IABU Headquarters
Delta Electronics, Inc.
Taoyuan3
No.18, Xinglong Rd., Taoyuan City,
Taoyuan County 330, Taiwan, R.O.C.
TEL: 886-3-362-6301 / FAX: 886-3-371-6301

Asia
Delta Electronics (Jiangsu) Ltd.
Wujiang Plant3
1688 Jiangxing East Road,
Wujiang Economic Development Zone
Wujiang City, Jiang Su Province,
People's Republic of China (Post code: 215200)
TEL: 86-512-6340-3008 / FAX: 86-769-6340-7290

Delta Greentech (China) Co., Ltd.
238 Min-Xia Road, Cao-Lu Industry Zone,Pudong, Shanghai,
People's Republic of China
Post code : 201209
TEL: 021-58635678 / FAX: 021-58630003

Delta Electronics (Japan), Inc.
Tokyo Office
2-1-14 Minato-ku Shibadaimon,
Tokyo 105-0012, Japan
TEL: 81-3-5733-1111 / FAX: 81-3-5733-1211

Delta Electronics (Korea), Inc.
234-9, Duck Soo Building 7F, Nonhyun-Dong,
Kangnam-Gu, Seoul, Korea 135-010
TEL: 82-2-515-5305 / FAX: 82-2-515-5302

Delta Electronics Int'l (S) Pte Ltd
4 Kaki Bukit Ave 1, #05-05, Singapore 417939
TEL: 65-6747-5155 / FAX: 65-6744-9228

Delta Electronics (India) Pvt. Ltd.
Plot No. 43, Sector – 35, HSIIDC,
Gurgaon122001, Haryana, India
TEL: 1-919-767-3800 / FAX: 91-124-403-6045

Americas
Delta Products Corporation (USA)
Raleigh Office
P.O. Box 12173,5101 Davis Drive,
Research Triangle Park, NC 27709, U.S.A.
TEL: 1-919-767-3813 / FAX: 1-919-767-3969

Delta Greentech (Brasil) S.A
Sao Paulo Office
Rua Itapeva, 26-30 Andar Edificio Itapeva One-Bela Vista
01332-000-Sao Paulo-SP-Brazil
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 Netherlands
TEL: 31-40-2592850 / FAX: 31-40-2592851

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C2000 Series User Manual

Classical Field Oriented Control AC Motor Drive

C2000 Series User Manual

www.delta.com.tw/industrialautomation

PLEASE READ PRIOR TO INSTALLATION FOR SAFETY.

DANGER

☑ AC input power must be disconnected before any wiring to the AC motor drive is made.

☑ 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.

☑ 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.

☑ 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.

CAUTION

☑ Never connect the AC motor drive output terminals U/T1, V/T2 and W/T3 directly to the AC mains circuit power supply.

☑ Only qualified persons are allowed to install, wire and maintain the AC motor drives.

☑ 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.

☑ 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.

☑ 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.

☑ 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℃ 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

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

Table of Contents

Application	**Control BD V1.03;** **Keypad V1.03;**

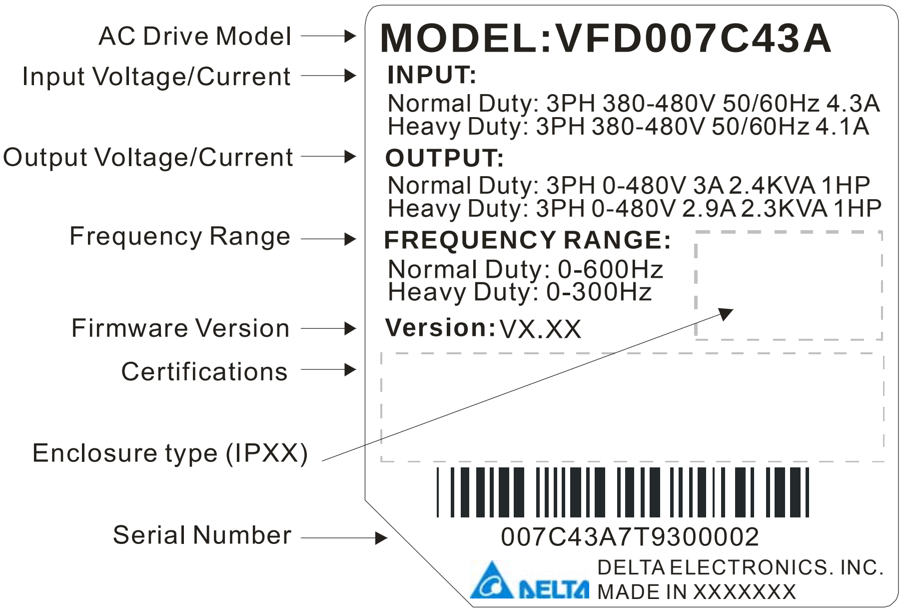
Chapter 1 Introduction

1-1 Receiving and Inspection

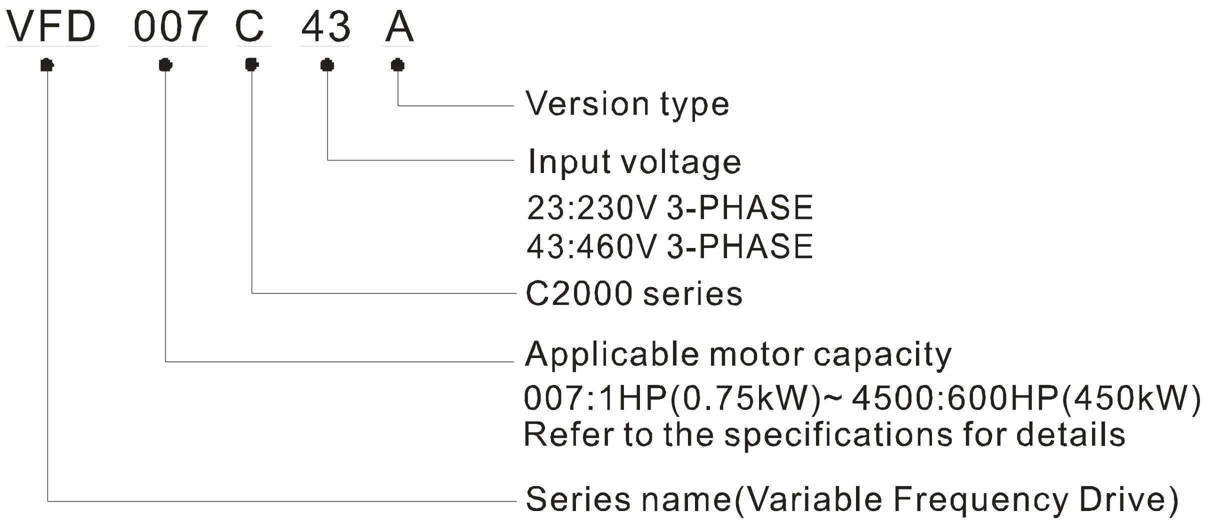
After receiving the AC motor drive, please check for the following:

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 AC motor drive, please make sure that the wiring of input terminals “R/L1, S/L2, T/L3” and output terminals”U/T1, V/T2, W/T3” 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.

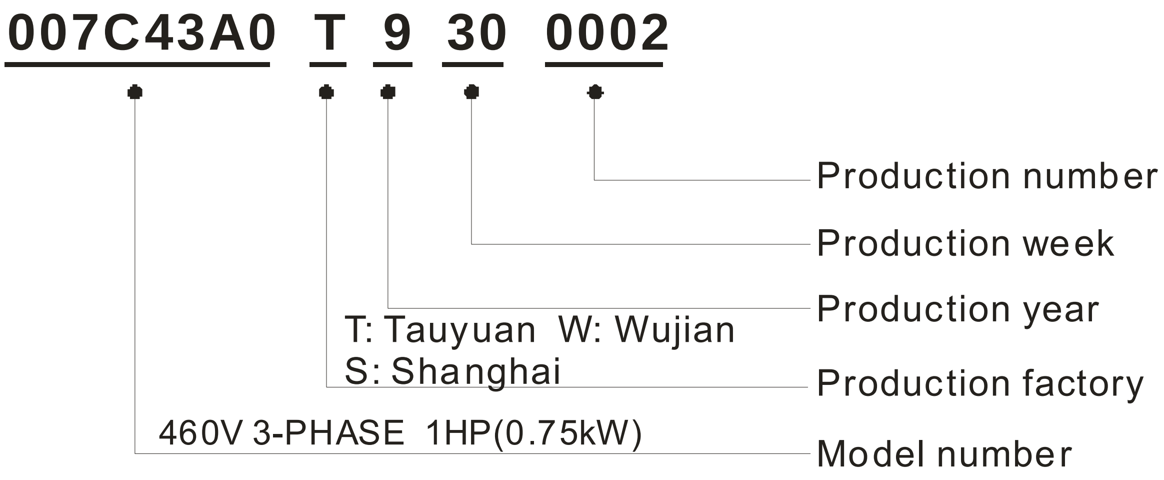
1-2 Nameplate Information



1-3 Model Name



1-4 Serial Number



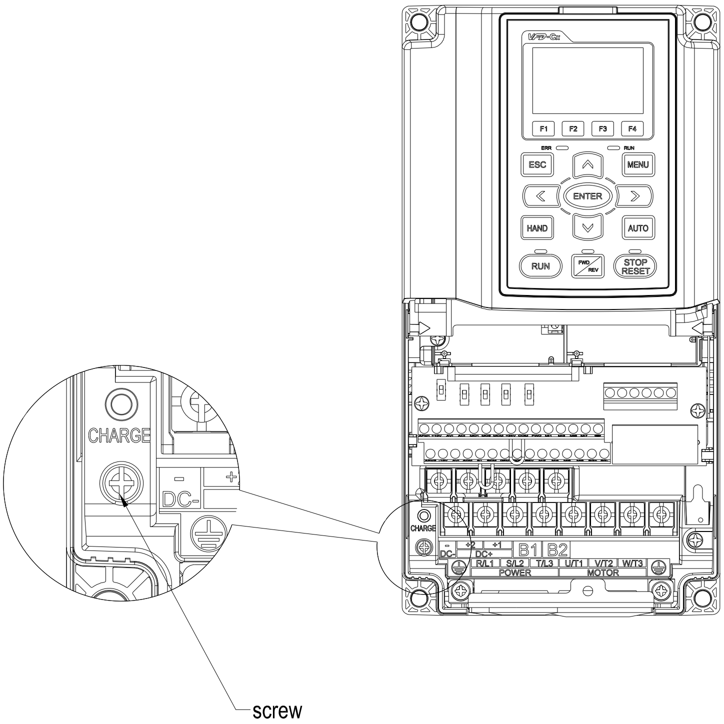
1-5 RFI Jumper

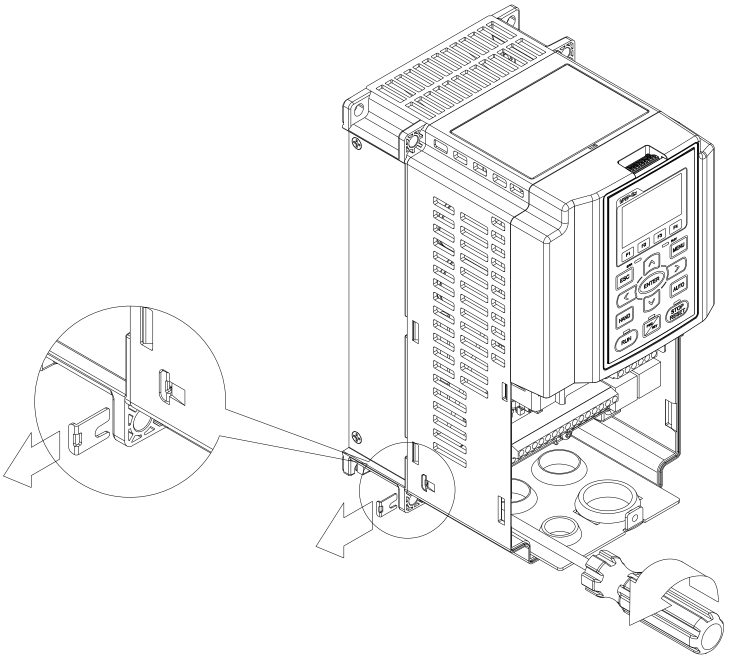
RFI Jumper: The AC motor drive may emit the electrical noise. The RFI jumper is used to suppress the interference (Radio Frequency Interference) on the power line.

Frame A~C

Screw Torque: 8~10kg-cm(6.9-8.7 lb -in.)

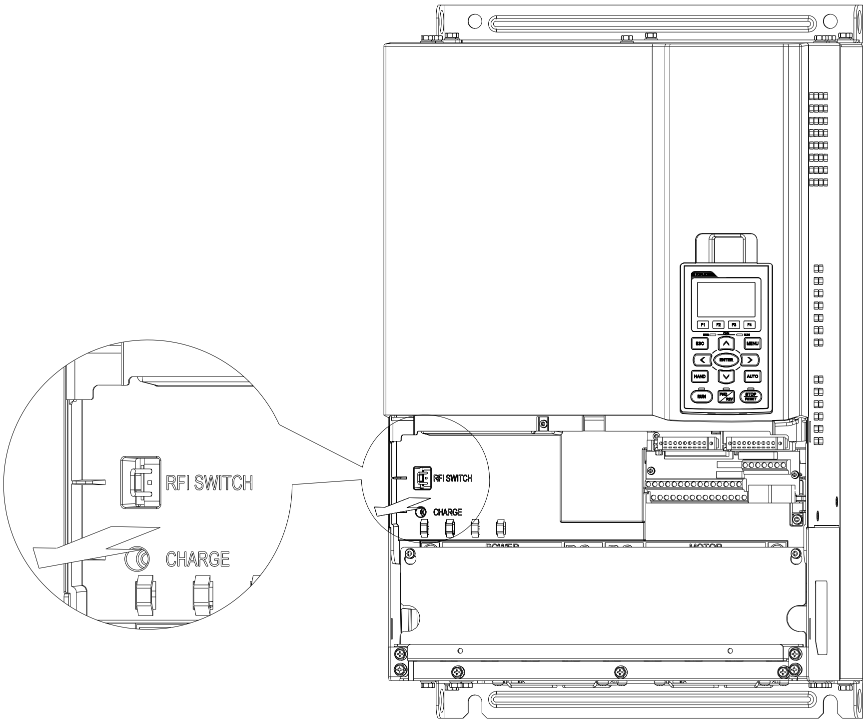
Loosen the screws and remove the RFI-jumper. Fasten the screws back to the original position after RFI-jumper is removed.





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.

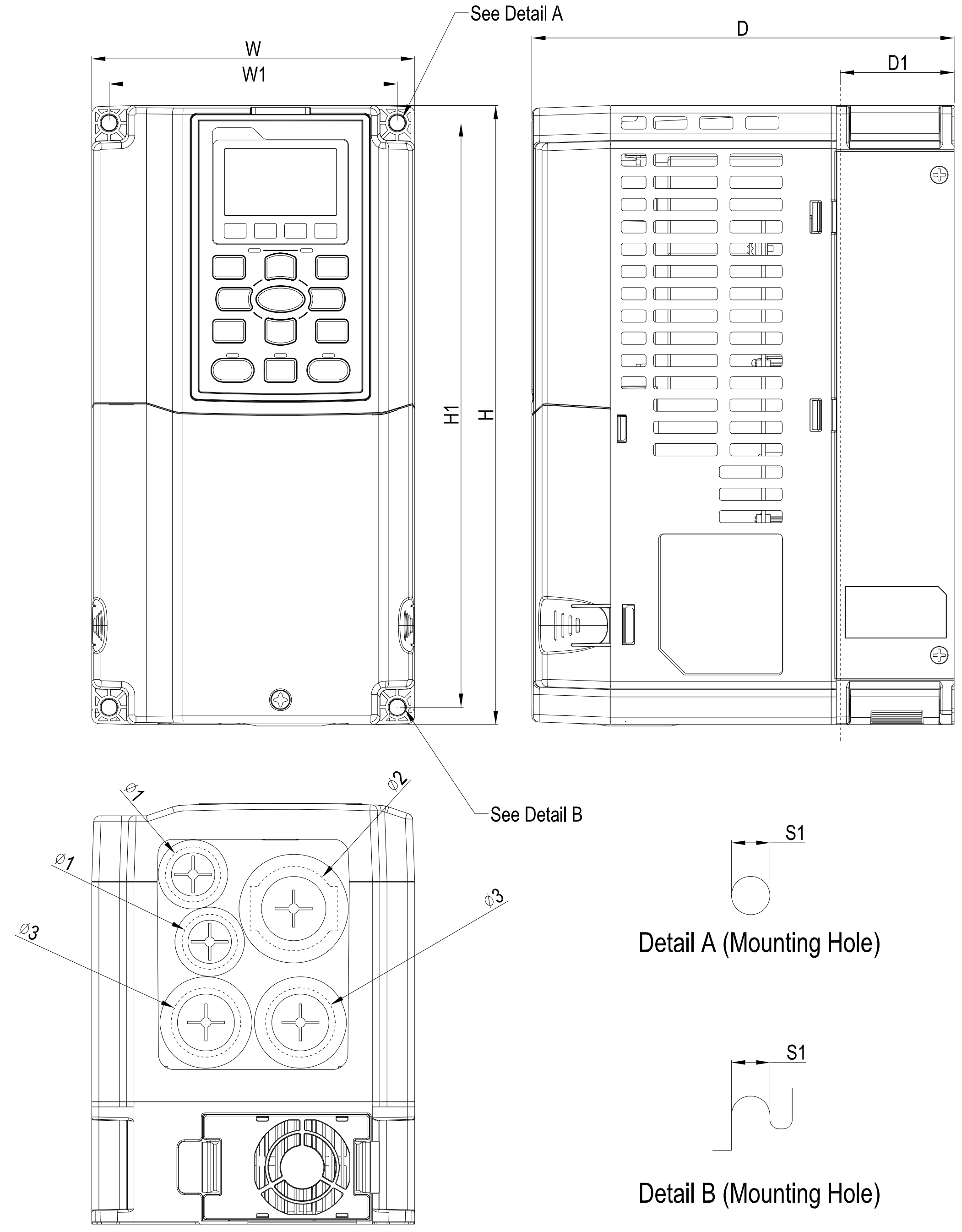
CAUTION!

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 1,000V. 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



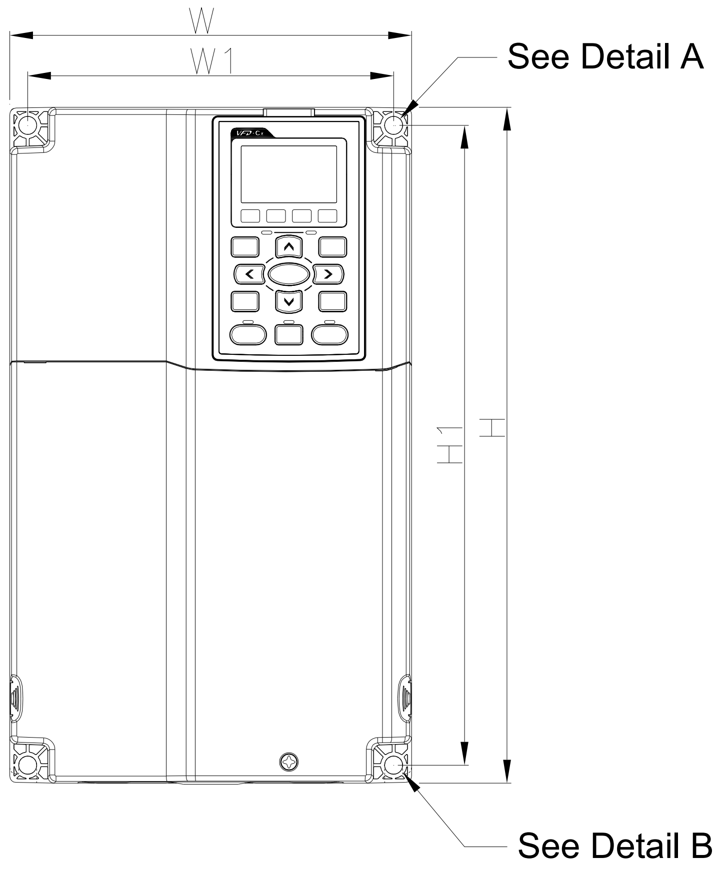
Unit: mm [inch]

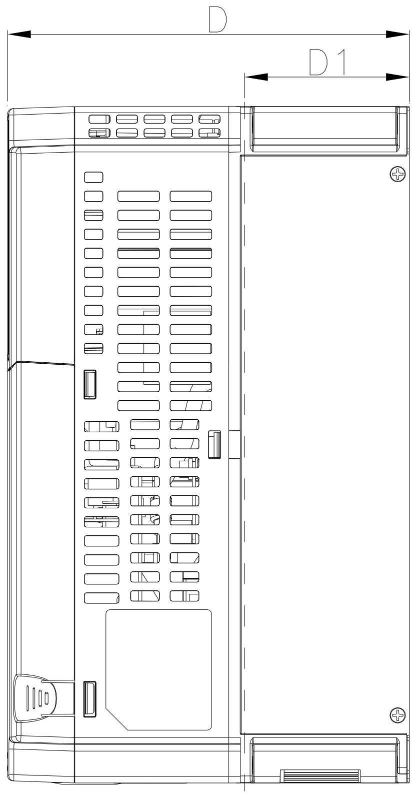
Frame	W	H	D	W1	H1	D1*	S1	Φ1	Φ2	Φ3
A1	130.0 [5.12]	250.0 [9.84]	170.0 [6.69]	116.0 [4.57]	236.0 [9.29]	45.8 [1.80]	6.2 [0.24]	22.2 [0.87]	34.0 [1.34]	28.0 [1.10]

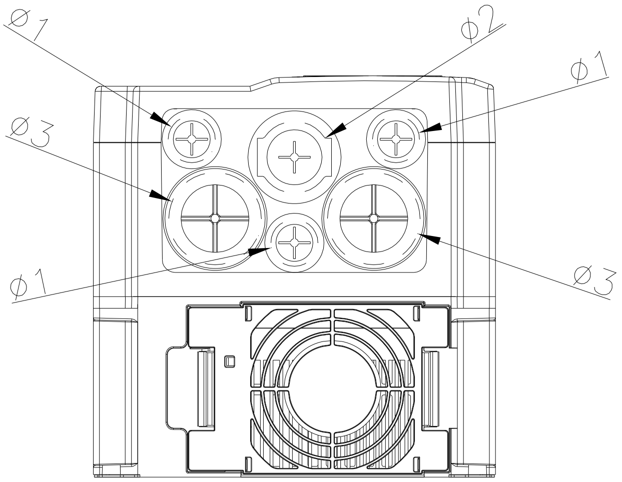
D1*: Flange mounting

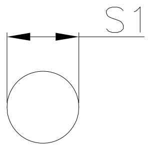
Frame B

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

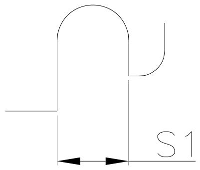








Detail A (Mounting Hole)



Detail B (Mounting Hole)

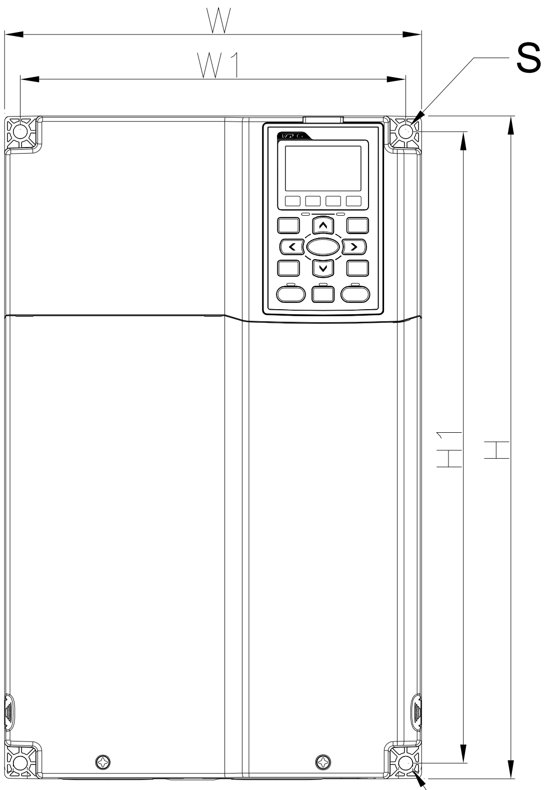
Unit: mm [inch]

Frame	W	H	D	W1	H1	D1*	S1	Φ1	Φ2	Φ3
B1	190.0 [7.48]	320.0 [12.60]	190.0 [7.48]	173.0 [6.81]	303.0 [11.93]	77.9 [3.07]	8.5 [0.33]	22.2 [0.87]	34.0 [1.34]	28.0 [1.10]

D1*: Flange mounting

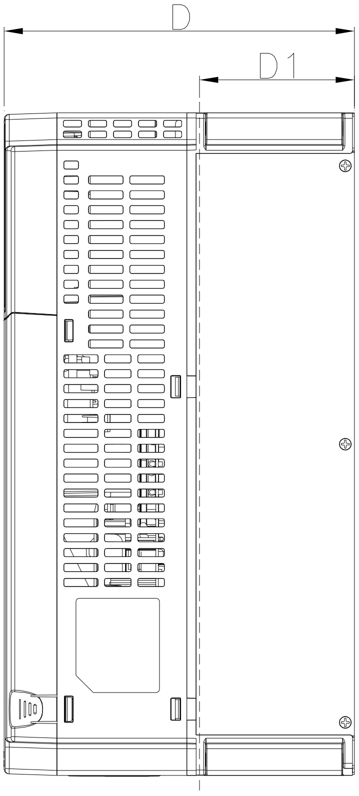
Frame C

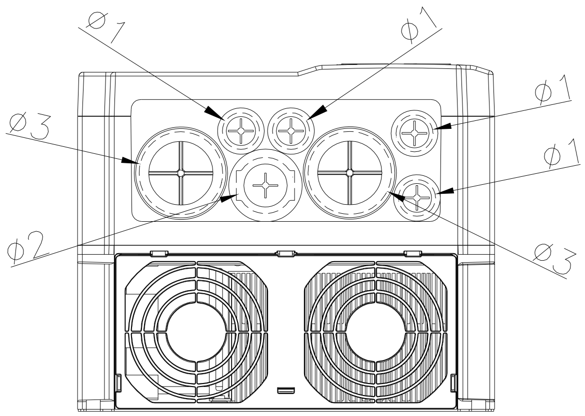
VFD150C23A; VFD185C23A; VFD185C43A/E; VFD220C23A; VFD220C43A/E; VFD300C43A/E

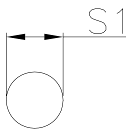


See Detail A

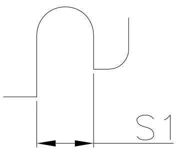
See Detail B







Detail A (Mounting Hole)



Detail B (Mounting Hole)

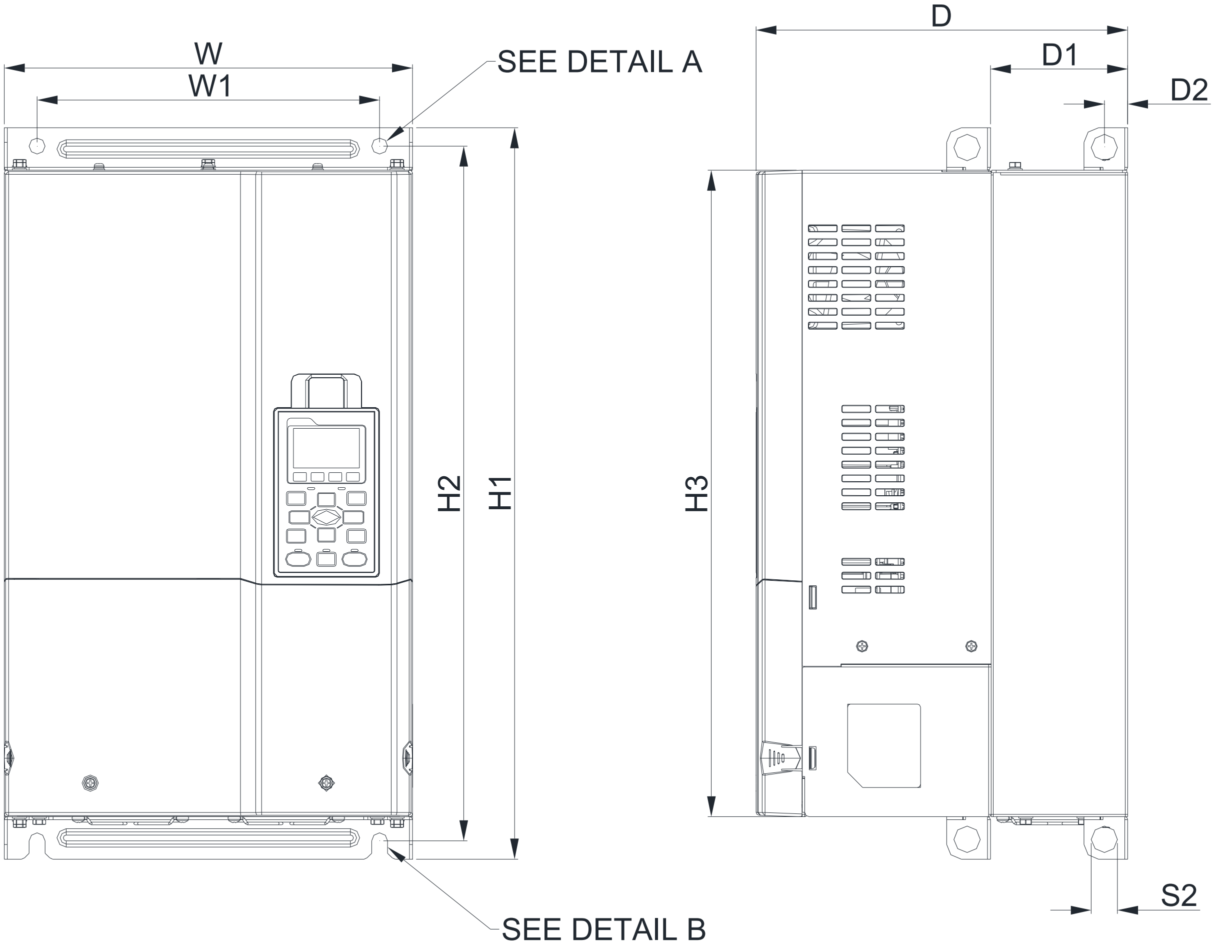
Unit: mm [inch]

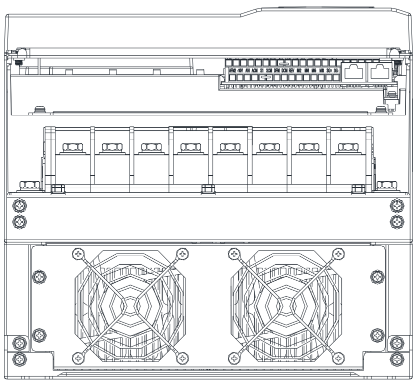
Frame	W	H	D	W1	H1	D1*	S1	Φ1	Φ2	Φ3
C1	250.0 [9.84]	400.0 [15.75]	210.0 [8.27]	231.0 [9.09]	381.0 [15.00]	92.9 [3.66]	8.5 [0.33]	22.2 [0.87]	34.0 [1.34]	50.0 [1.97]

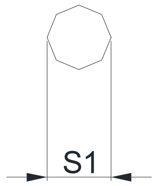
D1*: Flange mounting

Frame D0:

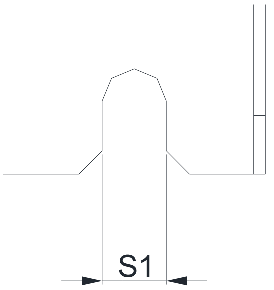
D0-1: VFD370C43S, VFD450C43S







DETAIL A
(MOUNTING HOLE)



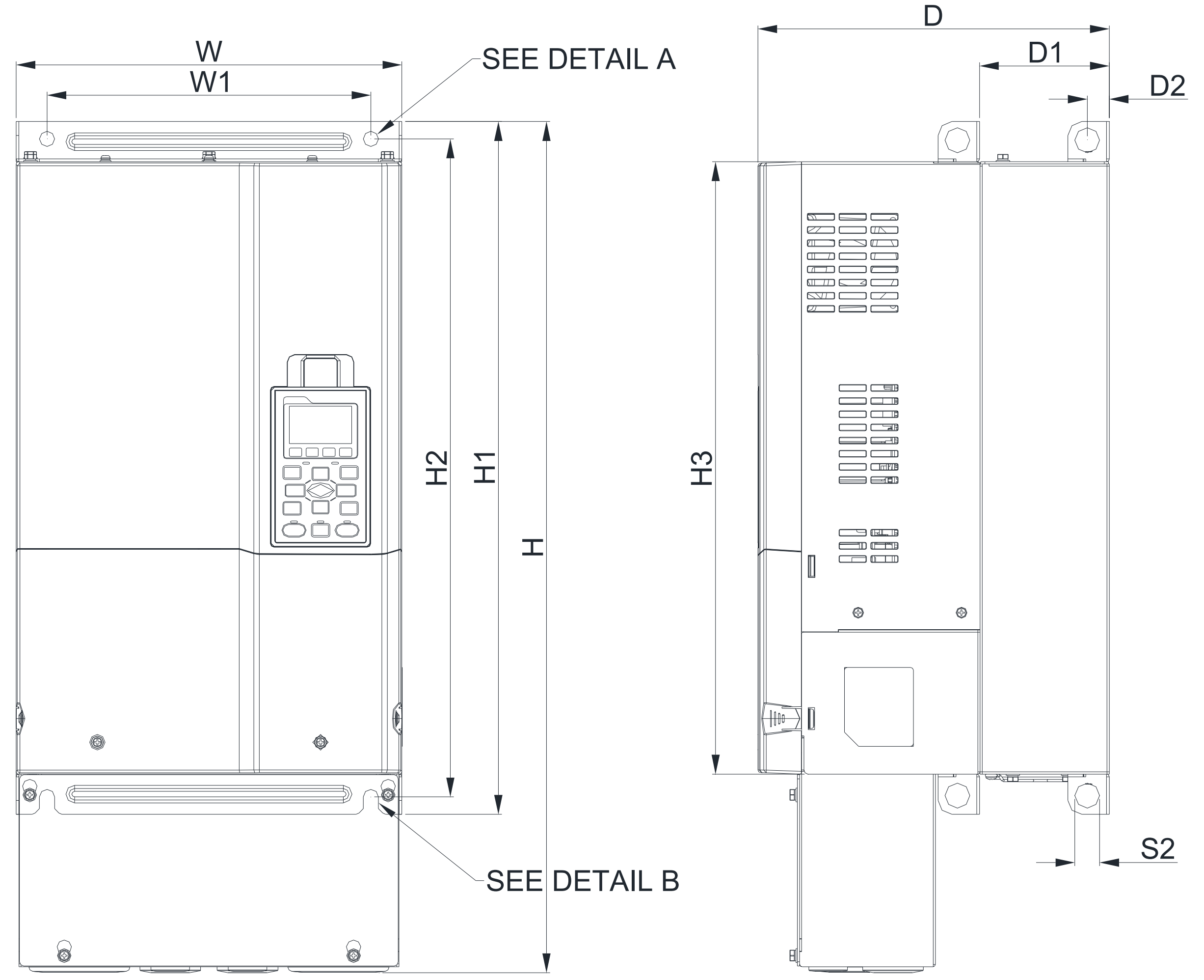
DETAIL B
(MOUNTING HOLE)

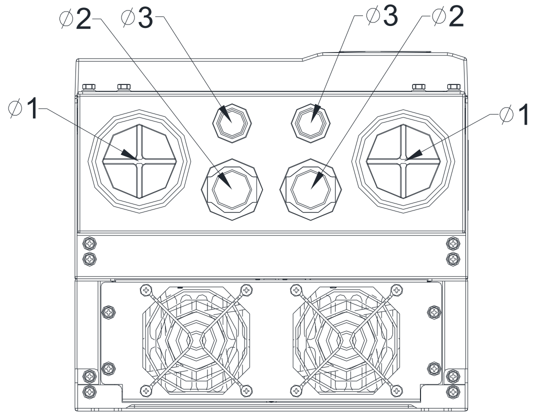
Frame	W	H1	D	W1	H2	H3	D1*	D2	S1	S2
D0-1	280.0 [11.02]	500.0 [19.69]	255.0 [10.04]	235.0 [9.25]	475.0 [18.70]	442.0 [17.40]	94.2 [3.71]	16.0 [0.63]	11.0 [0.43]	18.0 [0.71]

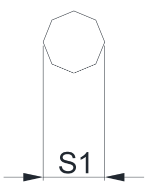
D1*：Flange Mounting

Frame D0

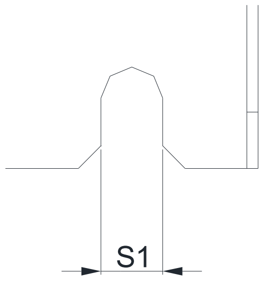
D0-2: VFD370C43U; VFD450C43U







DETAIL A
(MOUNTING HOLE)



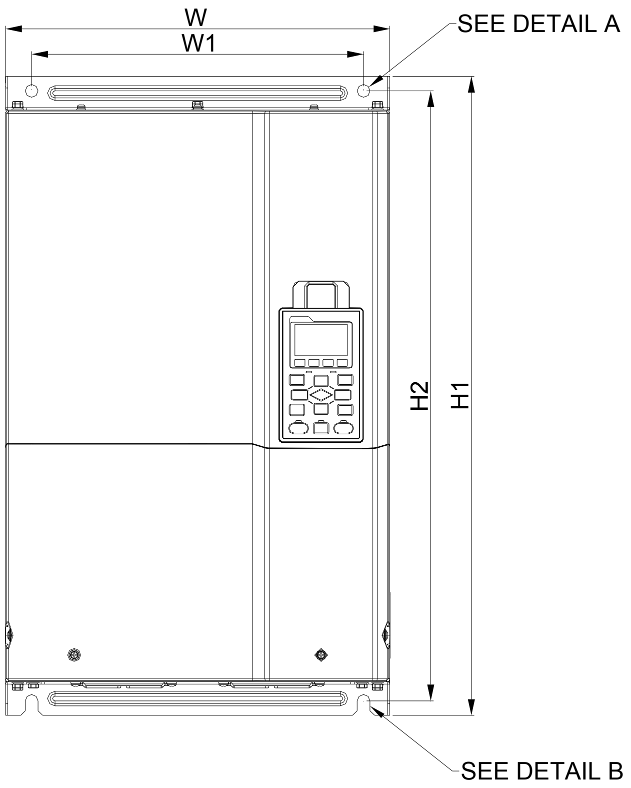
DETAIL B
(MOUNTING HOLE)

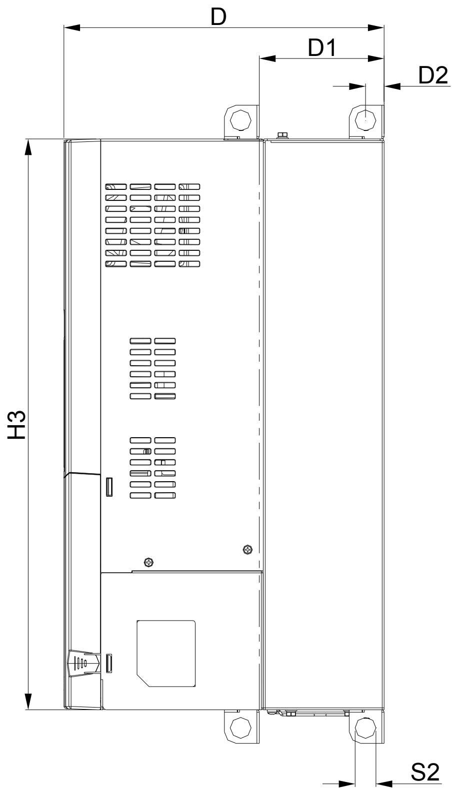
Frame	W	H	D	W1	H1	H2	H3	D1*	D2	S1	S2	Φ1	Φ2	Φ3
D0-2	280.0 [11.02]	614.4 [24.19]	255.0 [10.04]	235.0 [9.25]	500.0 [19.69]	475.0 [18.70]	442.0 [17.40]	94.2 [3.71]	16.0 [0.63]	11.0 [0.43]	18.0 [0.71]	62.7 [2.47]	34.0 [1.34]	22.0 [0.87]

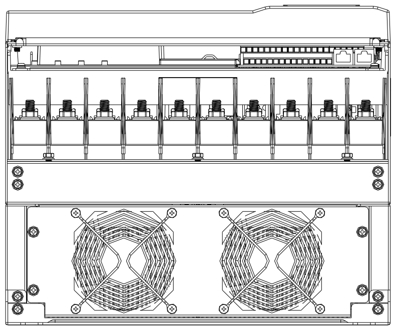
D1*：Flange Mounting

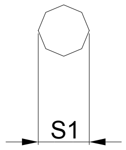
Frame D

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

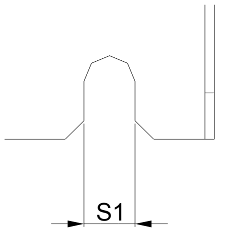








DETAIL A
(MOUNTING HOLE)



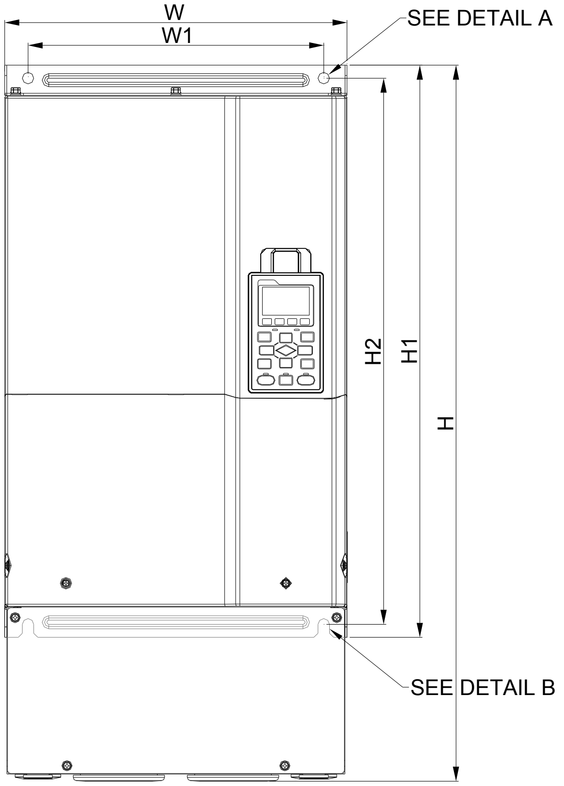
DETAIL B
(MOUNTING HOLE)

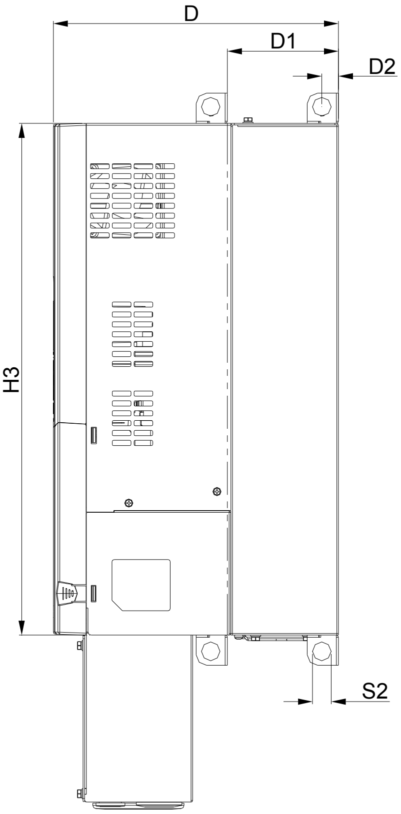
Unit: mm [inch]

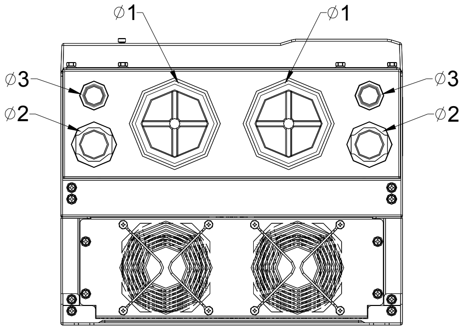
Frame	W	H	D	W1	H1	H2	H3	D1*	D2	S1	S2	Φ1	Φ2	Φ3
D1	330.0 [12.99]	-	275.0 [10.83]	285.0 [11.22]	550.0 [21.65]	525.0 [20.67]	492.0 [19.37]	107.2 [4.22]	16.0 [0.63]	11.0 [0.43]	18.0 [0.71]	-	-	-

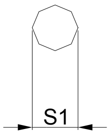
D1*: Flange mounting

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

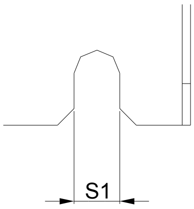








DETAIL A
(MOUNTING HOLE)



DETAIL B
(MOUNTING HOLE)

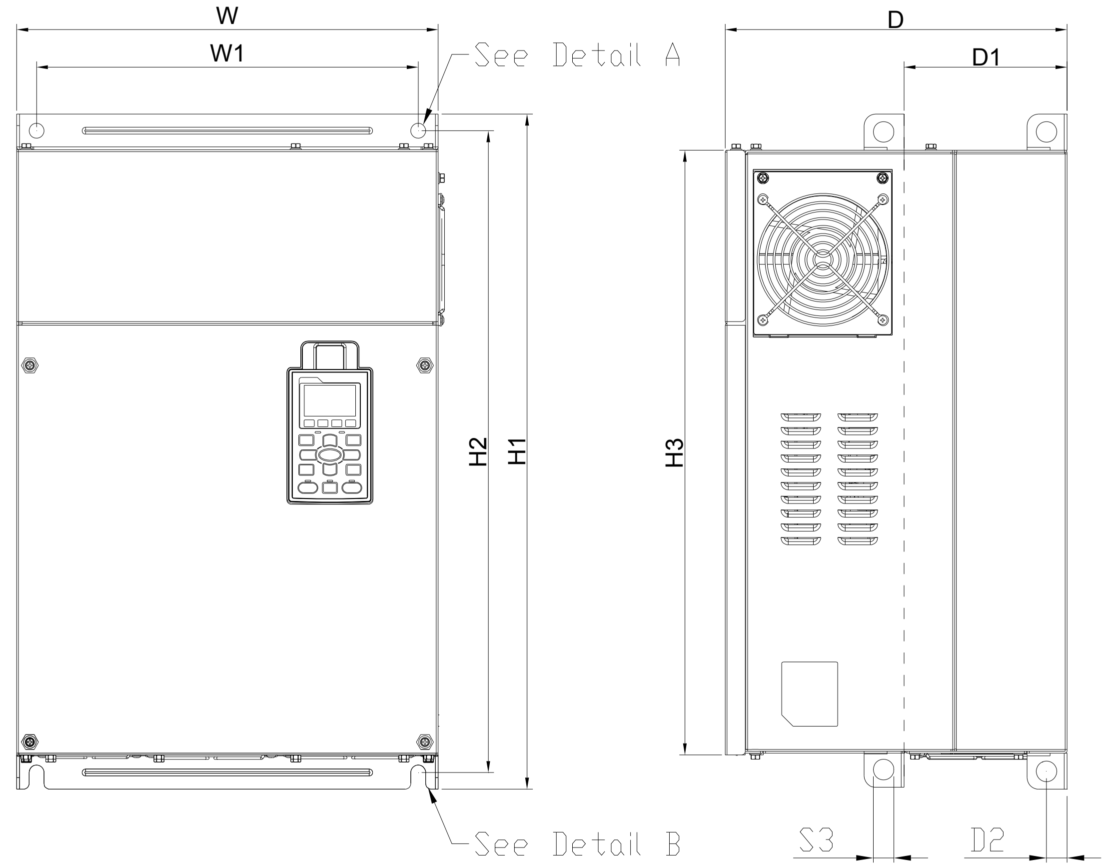
Unit: mm [inch]

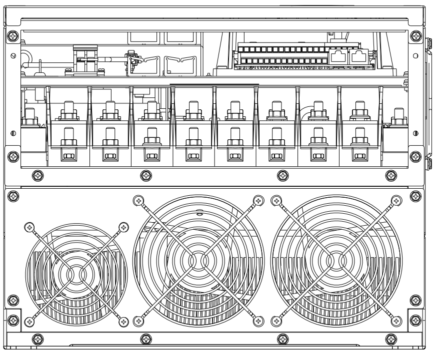
Frame	W	H	D	W1	H1	H2	H3	D1*	D2	S1	S2	Φ1	Φ2	Φ3
D2	330.0 [12.99]	688.3 [27.10]	275.0 [10.83]	285.0 [11.22]	550.0 [21.65]	525.0 [20.67]	492.0 [19.37]	107.2 [4.22]	16.0 [0.63]	11.0 [0.43]	18.0 [0.71]	76.2 [3.00]	34.0 [1.34]	22.0 [0.87]

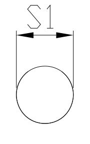
D1*: Flange mounting

Frame E

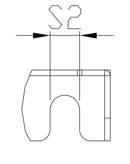
E1: VFD450C23A; VFD550C23A; VFD750C23A; VFD900C43A; VFD1100C43A







Detail A (Mounting Hole)



Detail B (Mounting Hole)

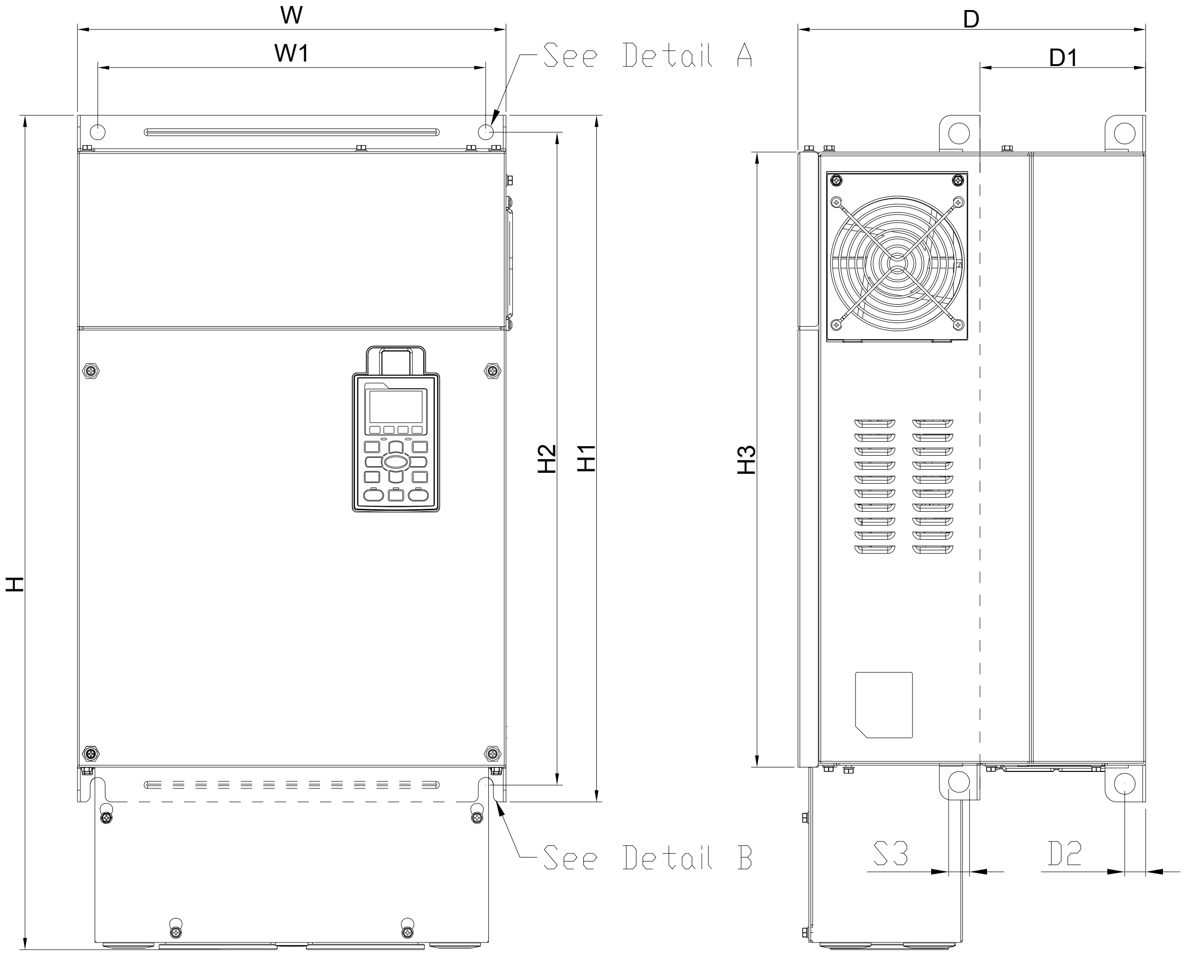
Unit: mm [inch]

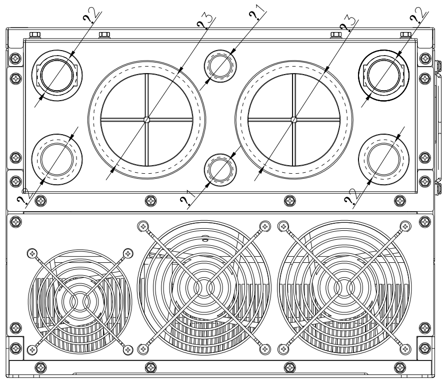
Frame	W	H	D	W1	H1	H2	H3	D1*	D2	S1, S2	S3	ψ1	ψ2	ψ3
E1	370.0 [14.57]	-	300.0 [11.81]	335.0 [13.19	589 [23.19]	560.0 [22.05]	528.0 [20.80]	143.0 [5.63]	18.0 [0.71]	13.0 [0.51]	18.0 [0.71]	-	-	-

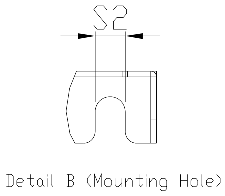
D1*: Flange mounting

Frame E

E2: VFD450C23E; VFD550C23E; VFD750C23E; VFD900C43E; VFD1100C43E







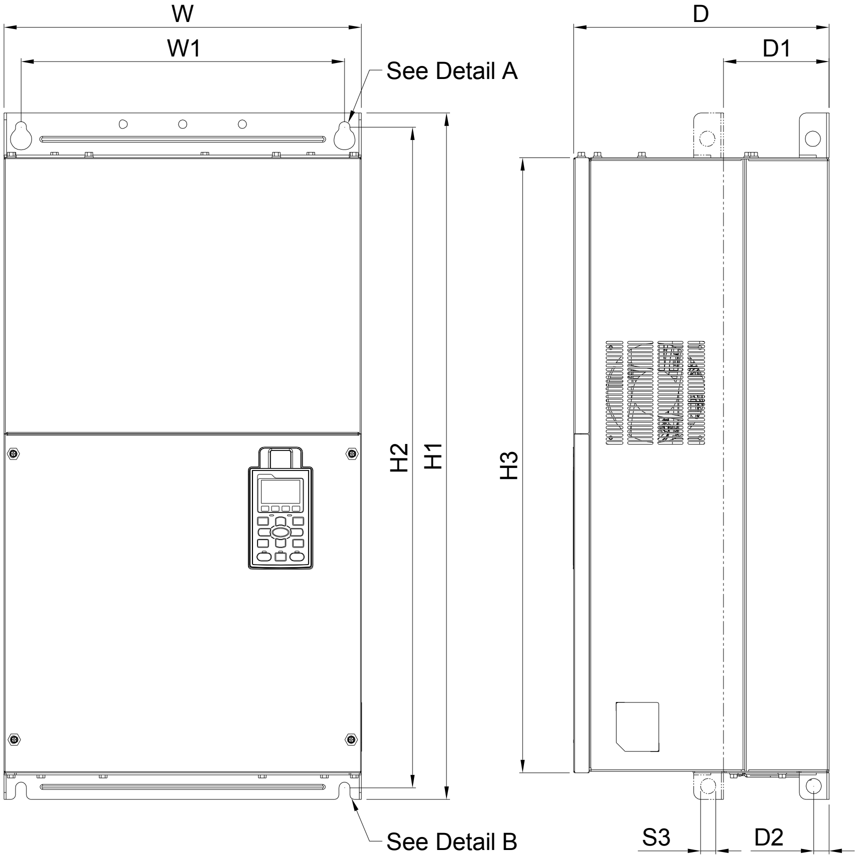
Unit: mm [inch]

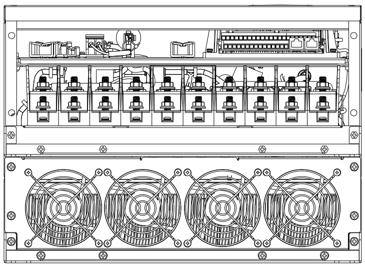
Frame	W	H	D	W1	H1	H2	H3	D1*	D2	S1, S2	S3	ψ1	ψ2	ψ3
E2	370.0 [14.57]	715.8 [28.18]	300.0 [11.81]	335.0 [13.19	589 [23.19]	560.0 [22.05]	528.0 [20.80]	143.0 [5.63]	18.0 [0.71]	13.0 [0.51]	18.0 [0.71]	22.0 [0.87]	34.0 [1.34]	92.0 [3.62]

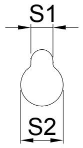
D1*: Flange mounting

Frame F

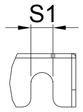
F1: VFD900C23A; VFD1320C43A; VFD1600C43A







Detail A (Mounting Hole)



Detail B (Mounting Hole)

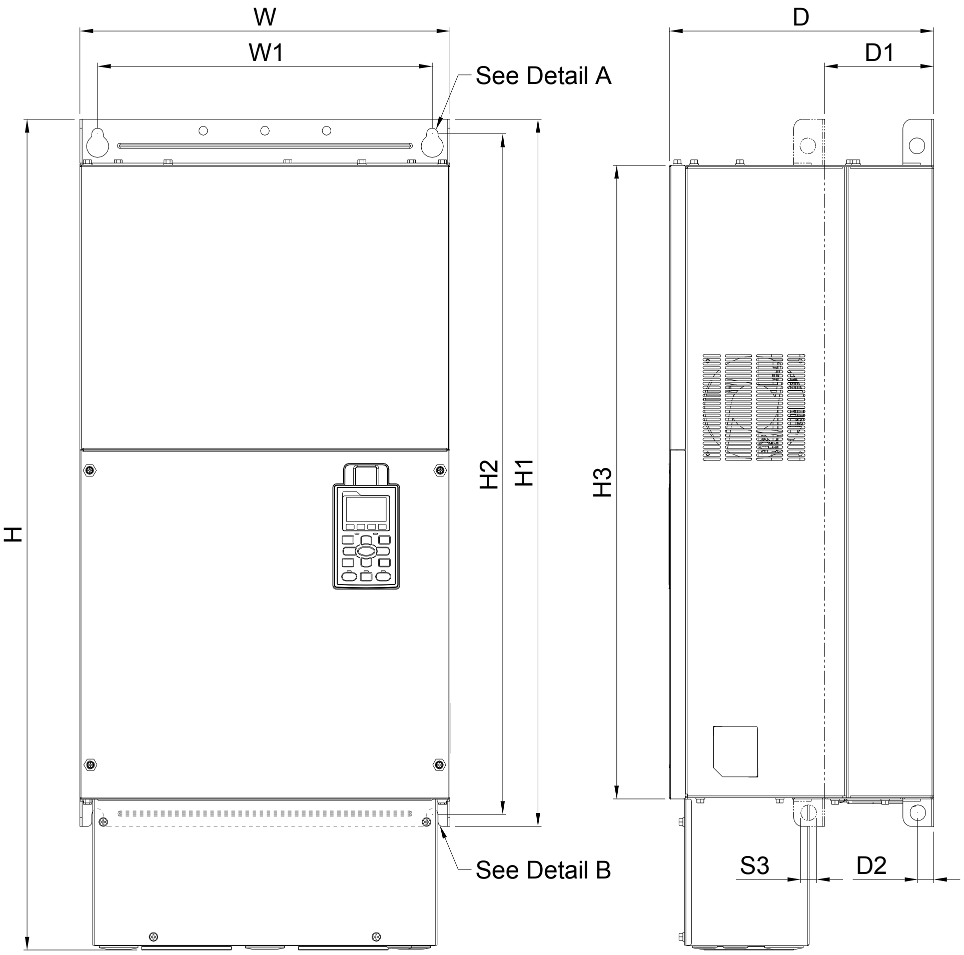
Unit: mm [inch]

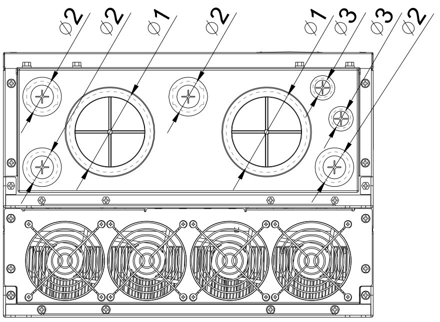
Frame	W	H	D	W1	H1	H2	H3	D1*	D2	S1	S2	S3
F1	420.0 [16.54]	-	300.0 [11.81]	380.0 [14.96]	800.0 [31.50]	770.0 [30.32]	717.0 [28.23]	124.0 [4.88]	18.0 [0.71]	13.0 [0.51]	25.0 [0.98]	18.0 [0.71]

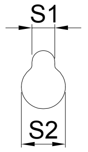
D1*: Flange mounting

Frame F

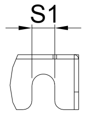
F2: VFD900C23E; VFD1320C43E; VFD1600C43E







Detail A (Mounting Hole)



Detail B (Mounting Hole)

Unit: mm [inch]

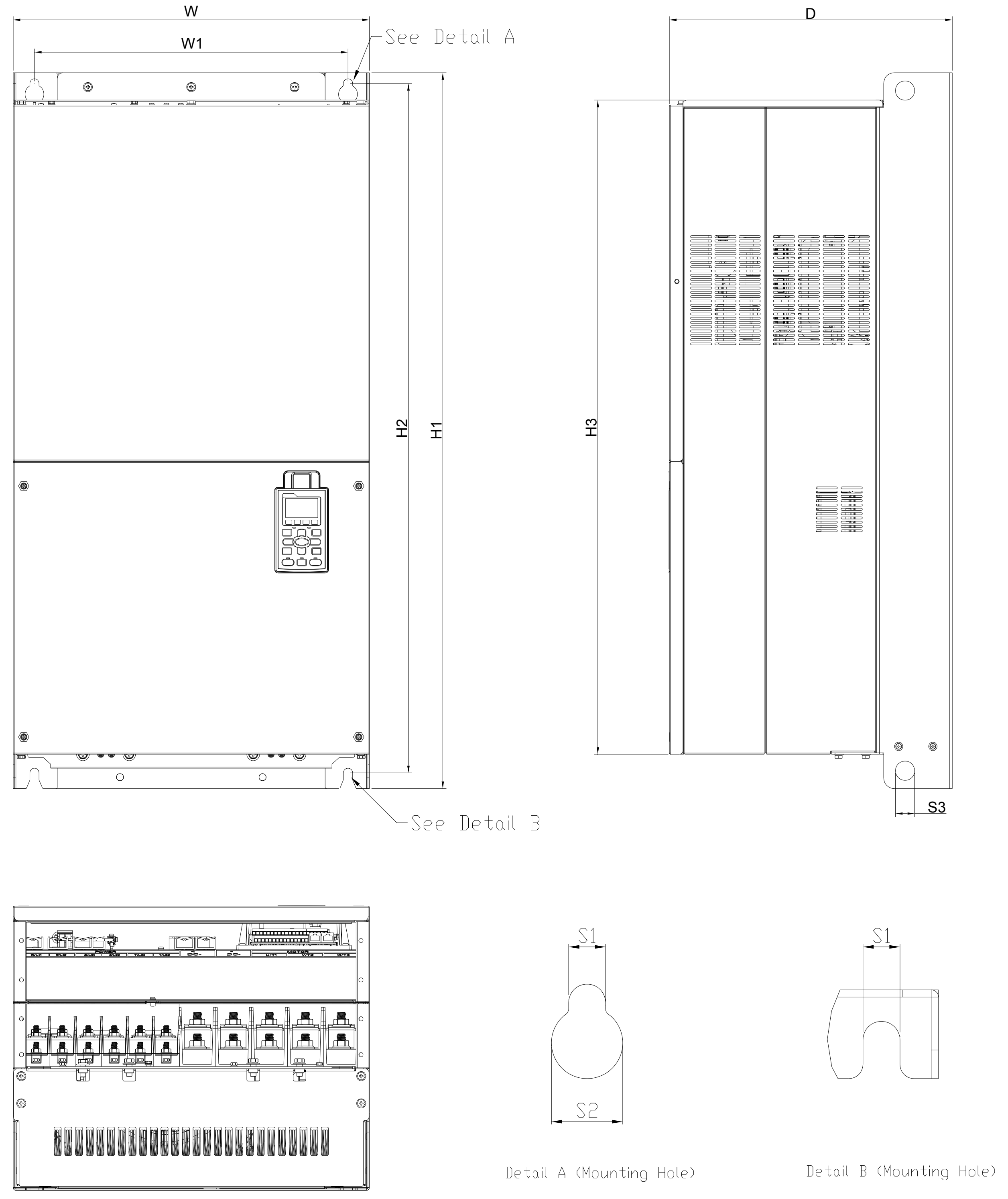
Frame	W	H	D	W1	H1	H2	H3	D1*	D2	S1	S2	S3
F2	420.0 [16.54]	940.0 [37.00]	300.0 [11.81]	380.0 [14.96]	800.0 [31.50]	770.0 [30.32]	717.0 [28.23]	124.0 [4.88]	18.0 [0.71]	13.0 [0.51]	25.0 [0.98]	18.0 [0.71]

Frame	ψ1	ψ2	ψ3
F2	92.0 [3.62]	35.0 [1.38]	22.0 [0.87]

D1*: Flange mounting

Frame G

G1: VFD1850C43A; VFD2200C43A

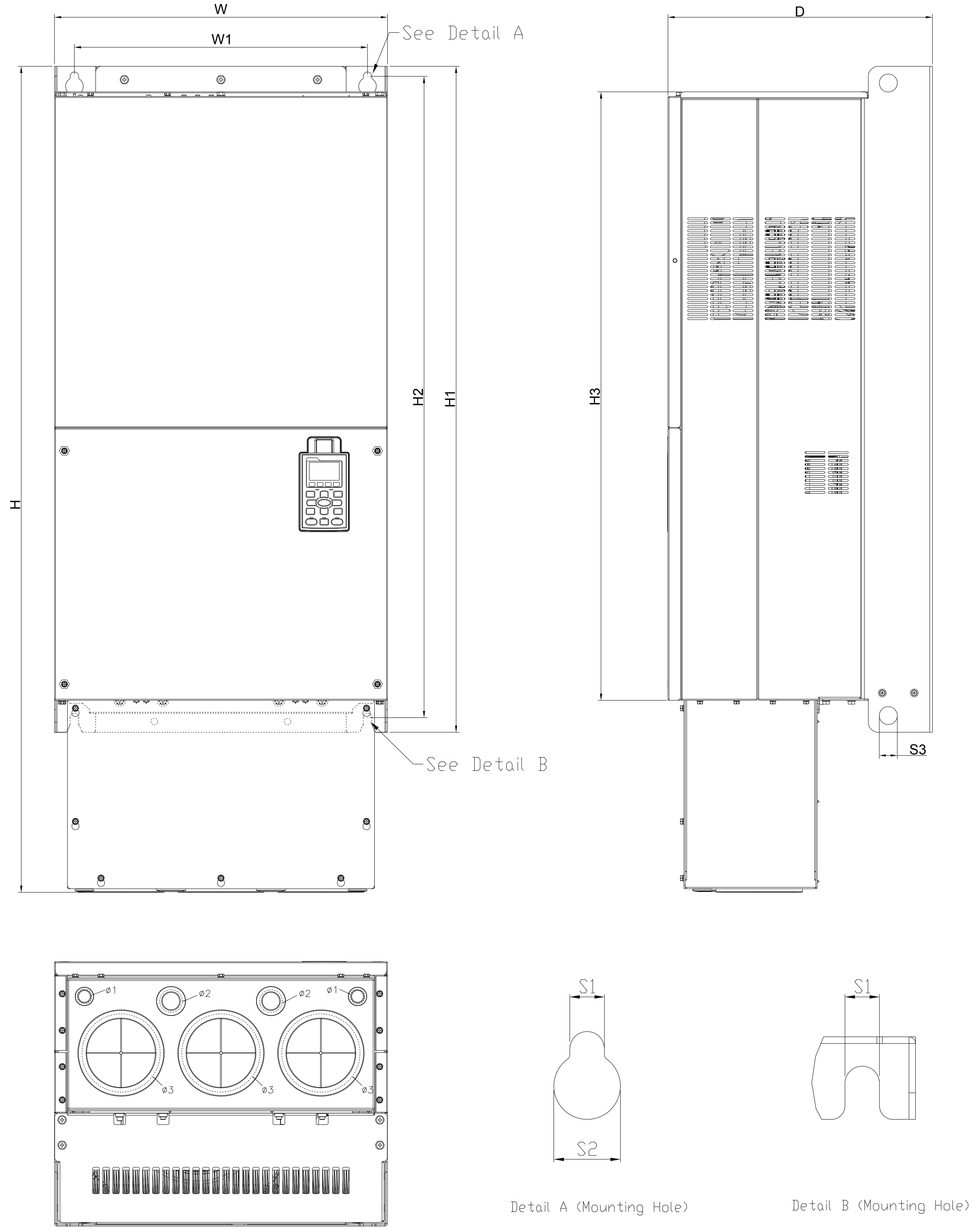


Unit: mm [inch]

Frame	W	H	D	W1	H1	H2	H3	S1	S2	S3	ψ1	ψ2	ψ3
G1	500.0 [19.69]	-	397.0 [15.63]	440.0 [217.32]	1000.0 [39.37]	963.0 [37.91]	913.6 [35.97]	13.0 [0.51]	26.5 [1.04]	27.0 [1.06]	-	-	-

Frame G

G2: VFD1850C43E; VFD2200C43E

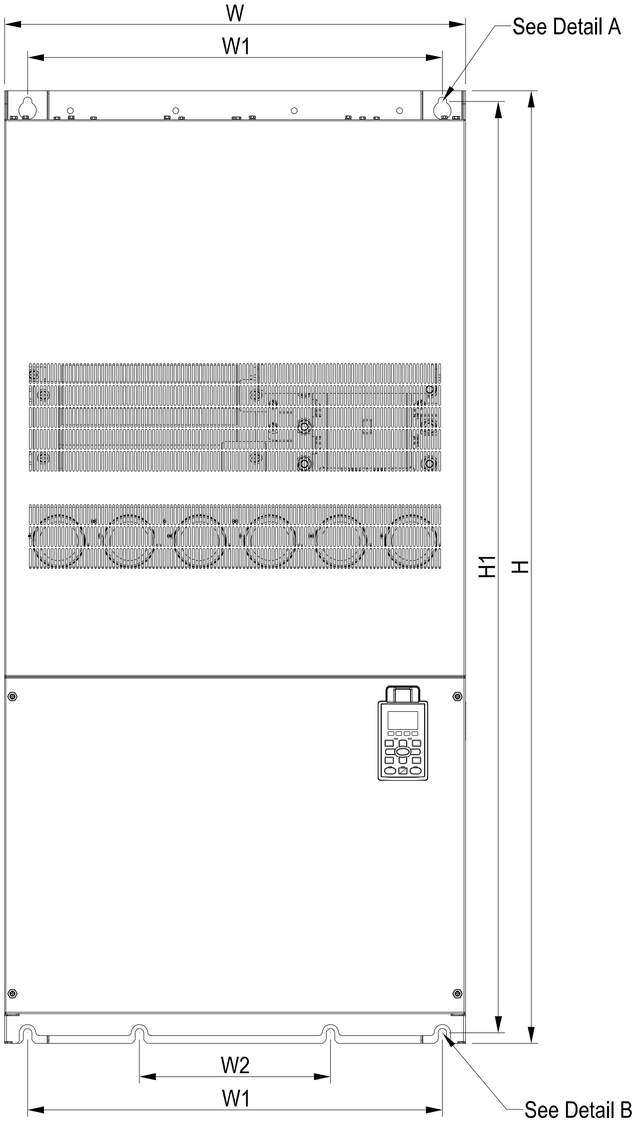


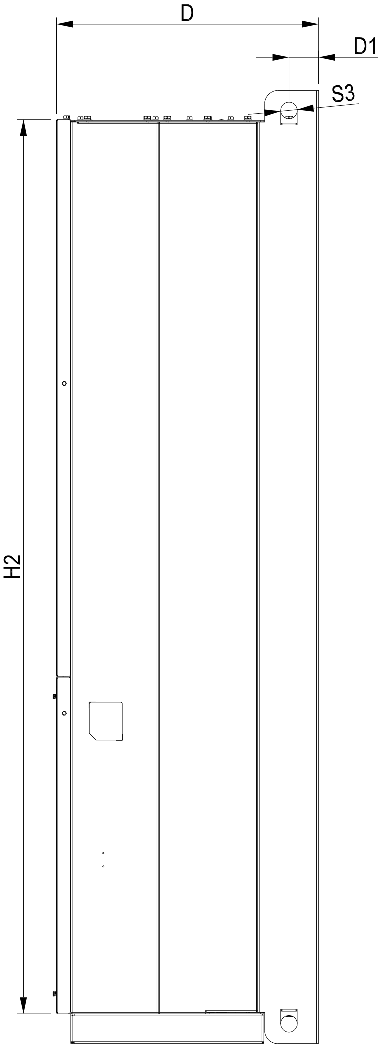
Unit: mm [inch]

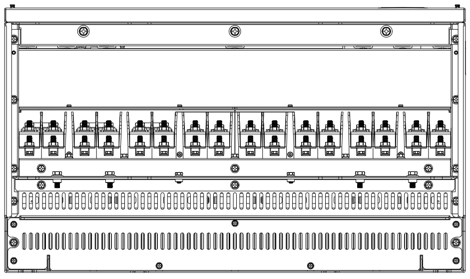
Frame	W	H	D	W1	H1	H2	H3	S1	S2	S3	ψ1	ψ2	ψ3
G2	500.0 [19.69]	1240.2 [48.83]	397.0 [15.63]	440.0 [217.32]	1000.0 [39.37]	963.0 [37.91]	913.6 [35.97]	13.0 [0.51]	26.5 [1.04]	27.0 [1.06]	22.0 [0.87]	34.0 [1.34]	117.5 [4.63]

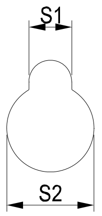
Frame H

H1: VFD2800C43A; VFD3150C43A; VFD3550C43A; VFD4500C43A

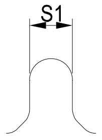








See Detail A(Mounting Hole)



See Detail B(Mounting Hole)

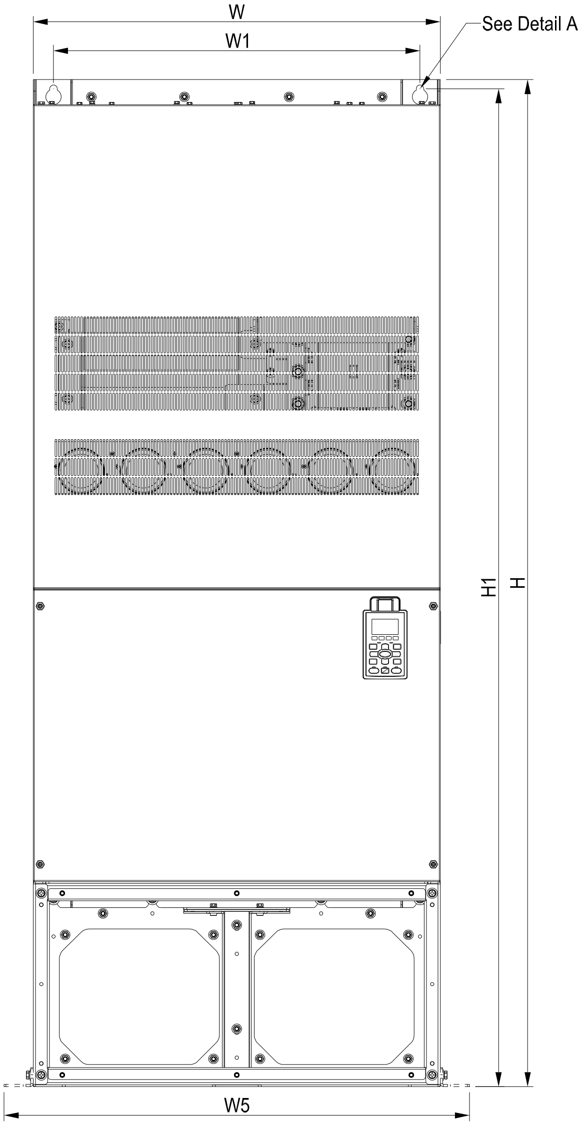
Unit: mm [inch]

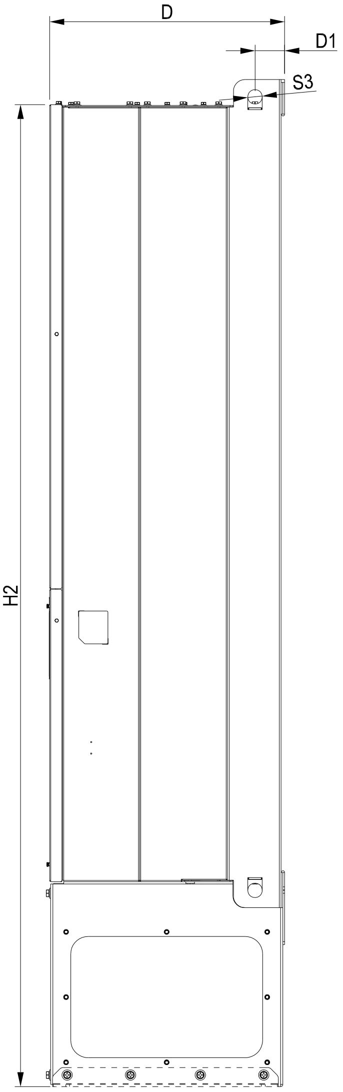
Frame	W	H	D	W1	W2	W3	W4	W5	W6	H1	H2	H3	H4
H1	700.0 [27.56]	1435.0 [56.5]	398.0 [15.67]	630.0 [24.8]	290.0 [11.42]	-	-	-	-	1403.0 [55.24]	1346.6 [53.02]	-	-

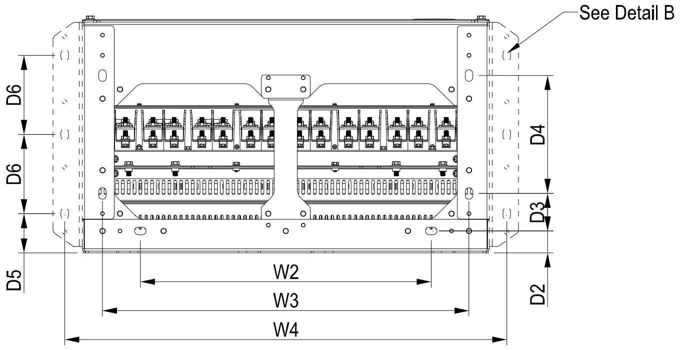
Frame	H5	D1	D2	D3	D4	D5	D6	S1	S2	S3	ψ1	ψ2	ψ3
H1	-	45.0 [1.77]	-	-	-	-	-	13.0 [0.51]	26.5 [1.04]	25.0 [0.98]	-	-	-

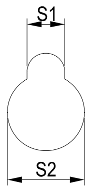
Frame H

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

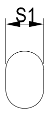








See Detail A(Mounting Hole)



See Detail B(Mounting Hole)

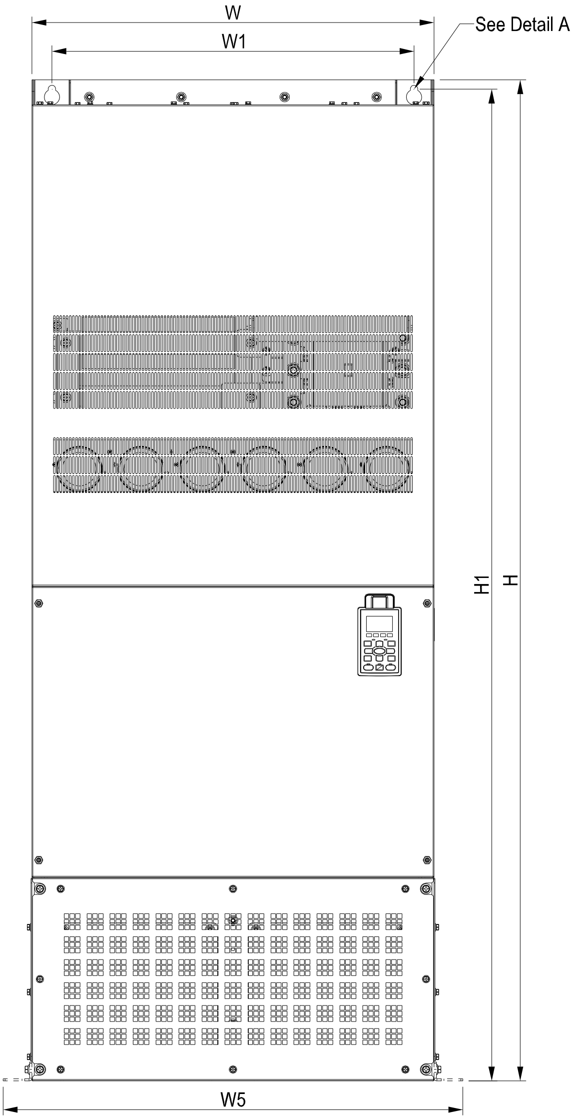
Unit: mm [inch]

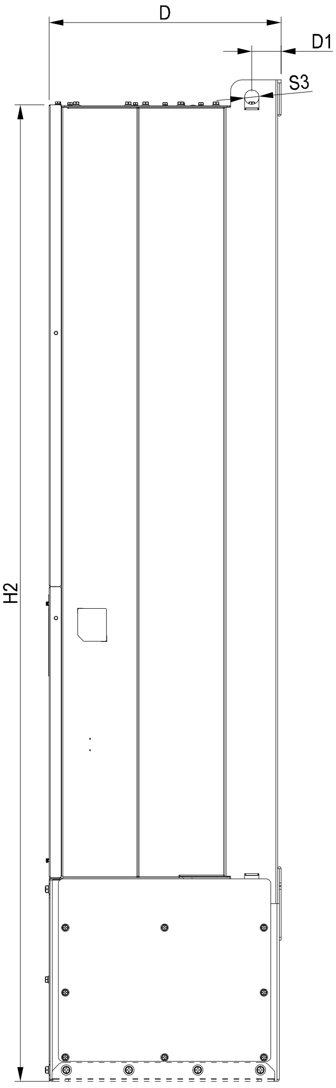
Frame	W	H	D	W1	W2	W3	W4	W5	W6	H1	H2	H3	H4
H2	700.0 [27.56]	1745.0 [68.70]	404.0 [15.91]	630.0 [24.8]	500.0 [19.69]	630.0 [24.8]	760.0 [29.92]	800.0 [31.5]	-	1729.0 [68.07]	1701.6 [66.99]	-	-

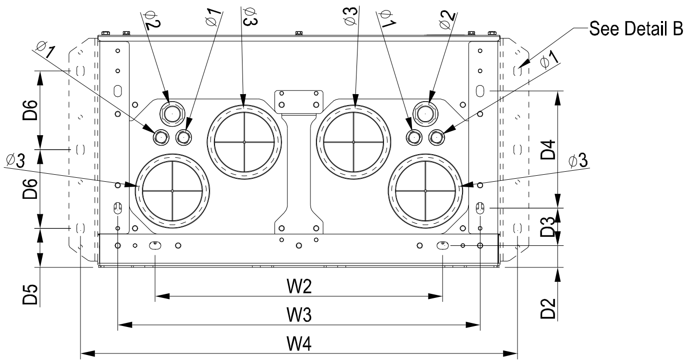
Frame	H5	D1	D2	D3	D4	D5	D6	S1	S2	S3	Φ1	Φ2	Φ3
H2	-	51.0 [2.01]	38.0 [1.50]	65.0 [2.56]	204.0 [8.03]	68.0 [2.68]	137.0 [5.39]	13.0 [0.51]	26.5 [1.04]	25.0 [0.98]	-	-	-

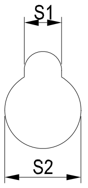
Frame H

H3: VFD2800C43E; VFD3150C43E; VFD3550C43E; VFD4500C43E

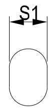








See Detail A(Mounting Hole)



See Detail B(Mounting Hole)

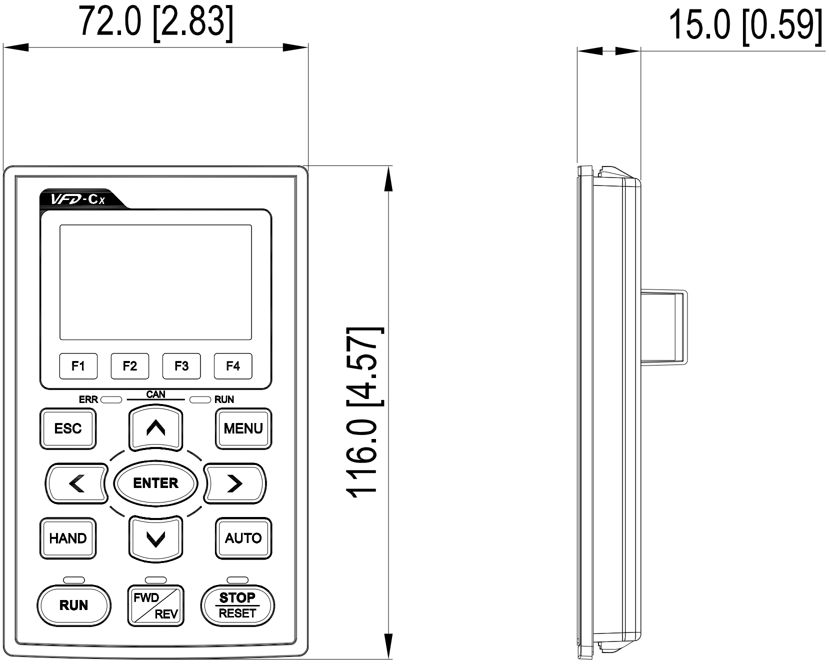
Unit: mm [inch]

Frame	W	H	D	W1	W2	W3	W4	W5	W6	H1	H2	H3	H4
H3	700.0 [27.56]	1745.0 [68.70]	404.0 [15.91]	630.0 [24.8]	500.0 [19.69]	630.0 [24.8]	760.0 [29.92]	800.0 [31.5]	-	1729.0 [68.07]	1701.6 [66.99]	-	-

Frame	H5	D1	D2	D3	D4	D5	D6	S1	S2	S3	Φ1	Φ2	Φ3
H3	-	51.0 [2.01]	38.0 [1.50]	65.0 [2.56]	204.0 [8.03]	68.0 [2.68]	137.0 [5.39]	13.0 [0.51]	26.5 [1.04]	25.0 [0.98]	22.0 [0.87]	34.0 [1.34]	117.5 [4.63]

Digital Keypad

KPC-CC01



Chapter 2 Installation

2-1 Minimum Mounting Clearance and Installation

NOTE

☑ Prevent fiber particles, scraps of paper, shredded wood saw dust, metal particles, etc. from adhereing to the heat sink

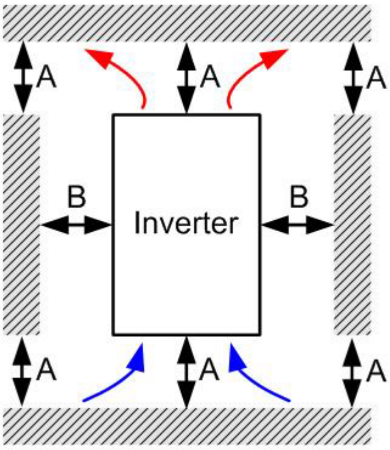
☑ Install the AC motor drive in a metal cabinet. When installing one drive below another one, use a metal separation between the AC motor drives to prevent mutual heating and to prevent the risk of fire accident.

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

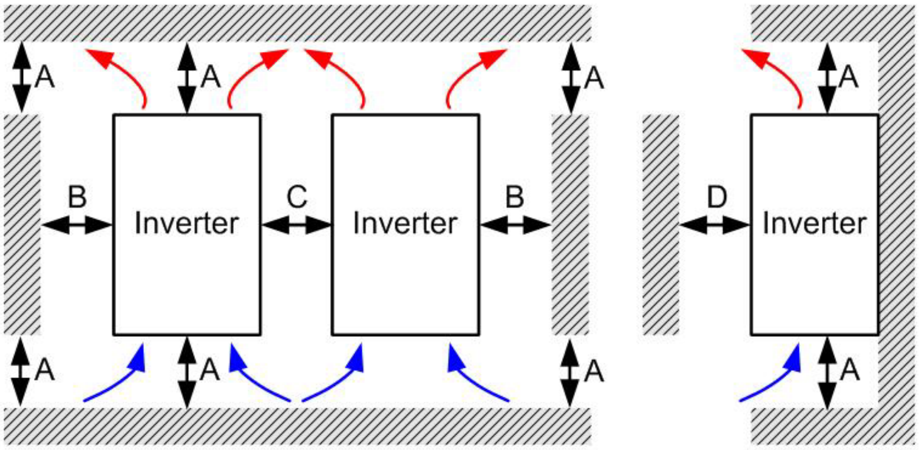
The appearances shown in the following figures are for reference only.

Airflow direction: ← (Blue arrow) inflow ← (Red arrow) outflow

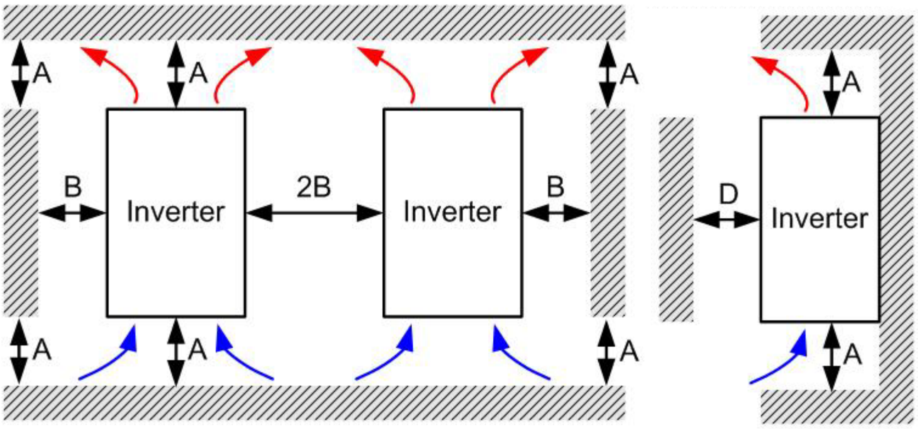
Single drive installation
(Frame A-H)

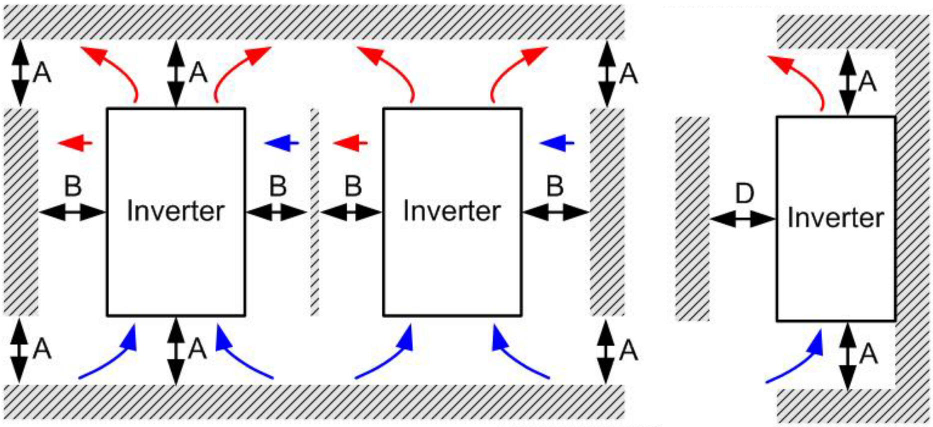
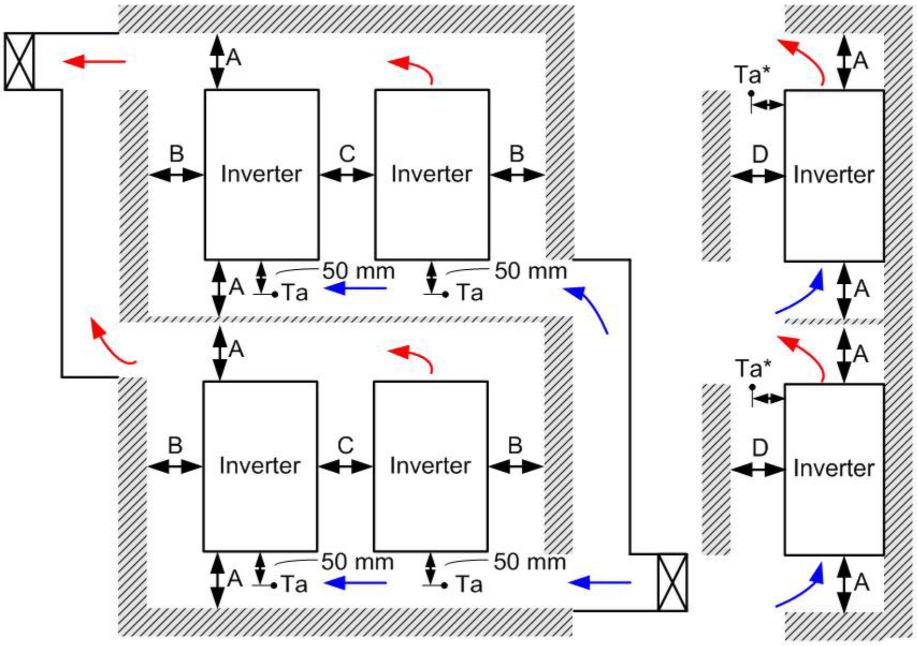


Side-by-side installation(Frame A-C)



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 50mm away from the fan's inflow side. (As shown in the figure below)


2-2 Minimum mounting clearance

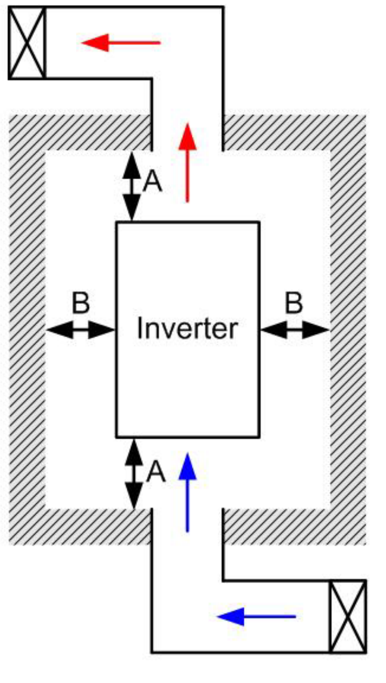
Frame	A (mm)	B (mm)	C (mm)	D (mm)
A~C	60	30	10	0
D0, D, E, F	100	50	-	0
G	200	100	-	0
H	350	0	0	200 (100, Ta=40℃)

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 D0	VFD370C43S, VFD450C43S, VFD370C43U, VFD450C43U

Frame D	VFD300C23A/E; VFD370C23A/E; VFD370C43A/E; VFD450C43A/E; VFD550C43A/E; VFD750C43A/E
Frame E	VFD450C23A/E; VFD550C23A/E; VFD750C23A/E; VFD900C43A/E; VFD1100C43A/E
Frame F	VFD900C23A/E; VFD1320C43A/E; VFD1600C43A/E
Frame G	VFD1850C43A; VFD2200C43A; VFD1850C43E; VFD2200C43E
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 AC 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.



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

※ Refer to the chart (Air flow rate for cooling) for ventilation equipment design and selection.

※ Refer to the chart (Power dissipation) for air conditioner design and selection.

Air flow rate for cooling							Power dissipation of AC motor drive		
Model No.	Flow Rate (cfm)			Flow Rate (m^3/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

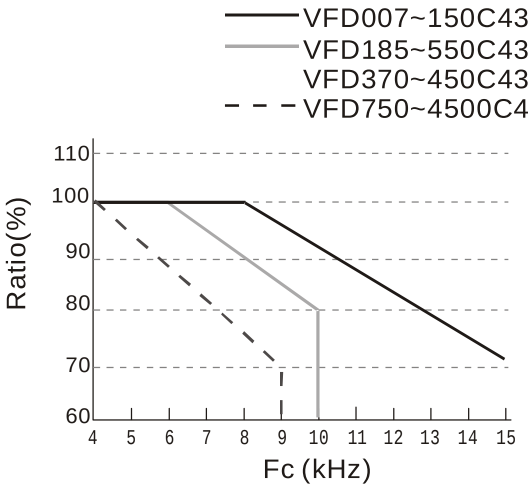
	Air flow rate for cooling						Power dissipation of AC motor drive		
Model No.	Flow Rate (cfm)			Flow Rate (m^3/hr)			Power Dissipation		
	External	Internal	Total	External	Internal	Total	Loss External (Heat sink)	Internal	Total
VFD022C43A/E	14	-	14	24	-	24	71	33	104
VFD037C43A/E	10	-	10	17	-	17	103	38	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. ※ 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. ※ When installing the multiple drives, volume of heat dissipation should be the heat dissipated for single drive X the number of the drives. ※ Heat dissipation for each model is calculated by rated voltage, current and default carrier.		

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

- Set Pr.06-55 = 1
- Set Pr.06-55 = 0 or 2

(50℃: UL open-type)
(40℃:UL type1 or open type_size by size)

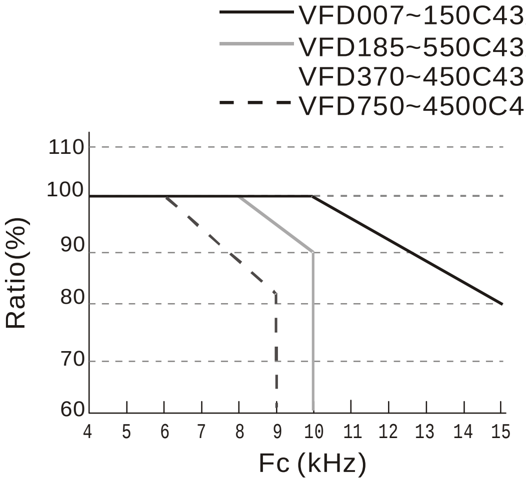
460V



- Set Pr.06-55 = 0 or 2

(40℃: UL open-type)
(30℃: UL type1 or open type_size by size)

460V

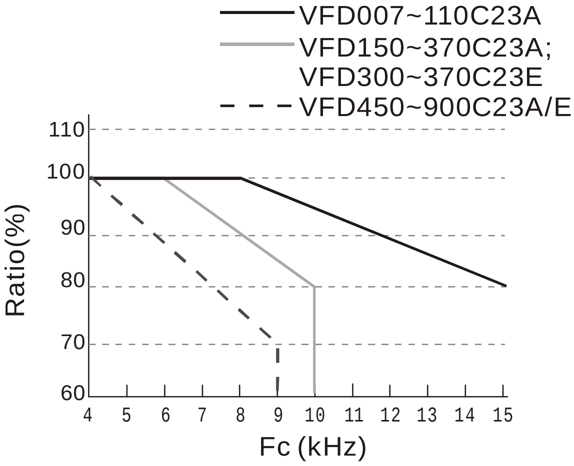


- Set Pr.06-55 = 1
- Set Pr.06-55 = 0 or 2

(50℃: UL open-type)

(40℃:UL type1 or open type_size by size)

230V

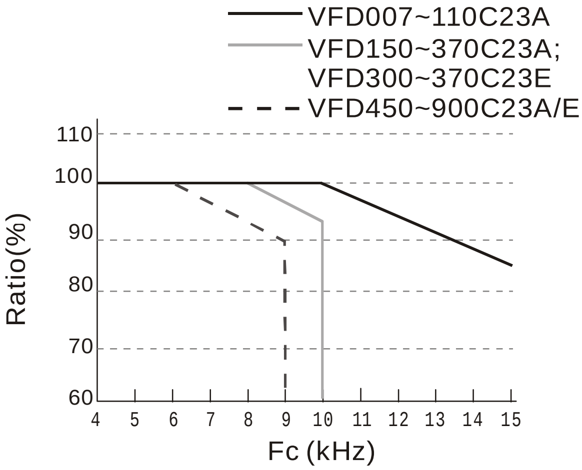


- Set Pr.06-55 = 0 or 2

(40℃: UL open-type)

(30℃: UL type1 or open type_size by size)

230V

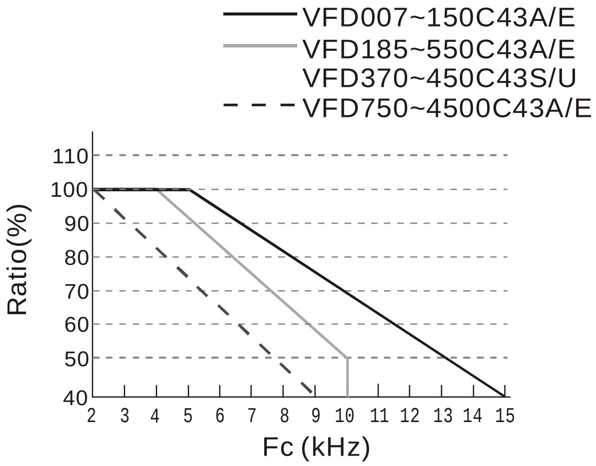


2-4 Derating Curve Diagram of Heavy Duty (Pr.00-16=1)

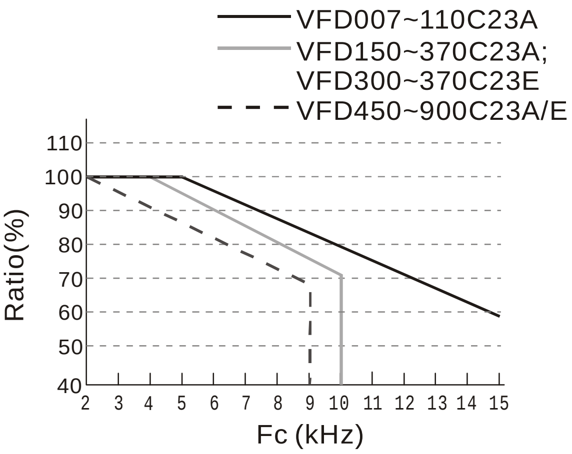
- Set Pr.06-55 = 1
- Set Pr.06-55 = 0 or 2

(50℃: UL open-type)
(40℃: UL type1 or open type_size by size)

460V



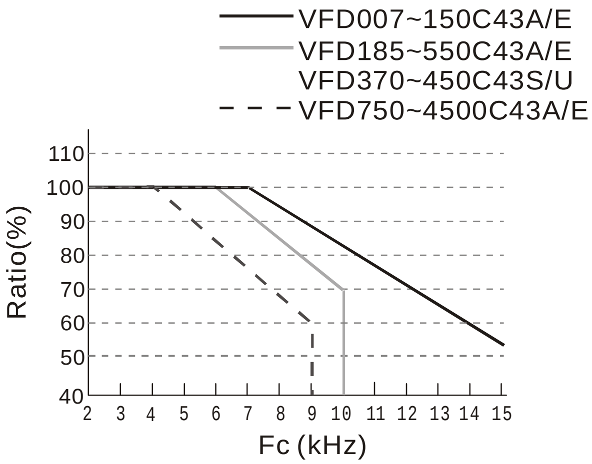
230V



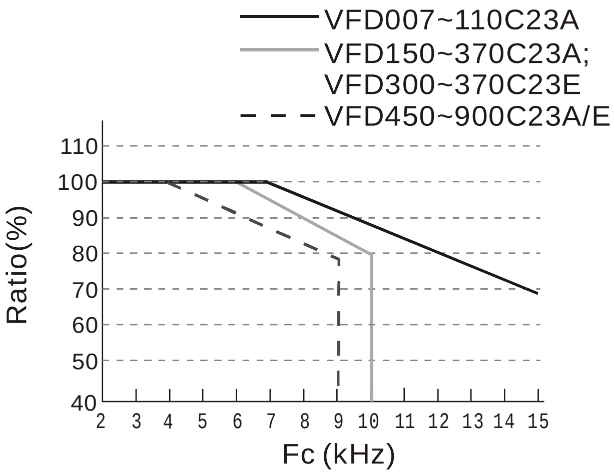
- Set Pr.06-55 = 0 or 2

(40℃: UL open-type)
(30℃: UL type1 or open type_size by size)

460V



230V



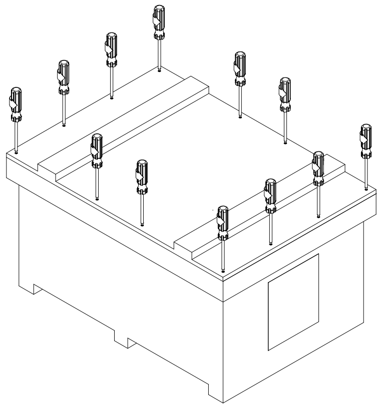
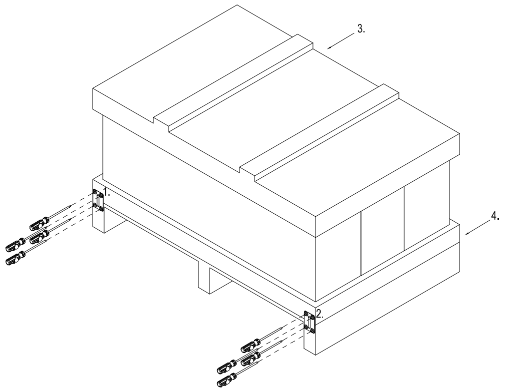
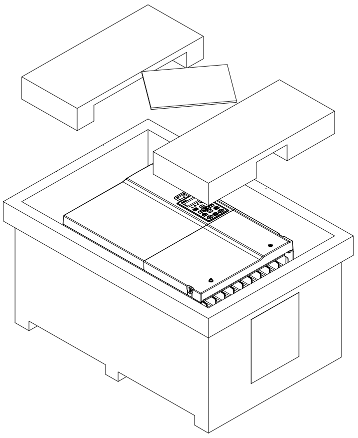
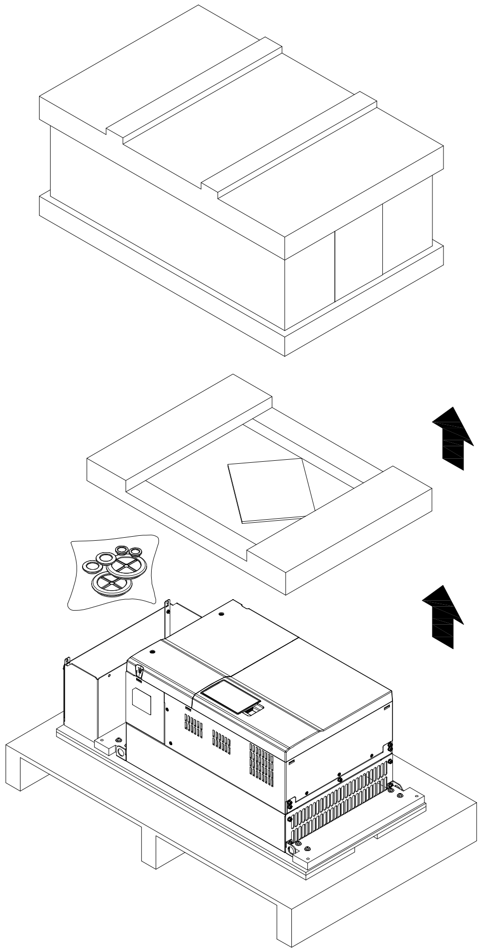
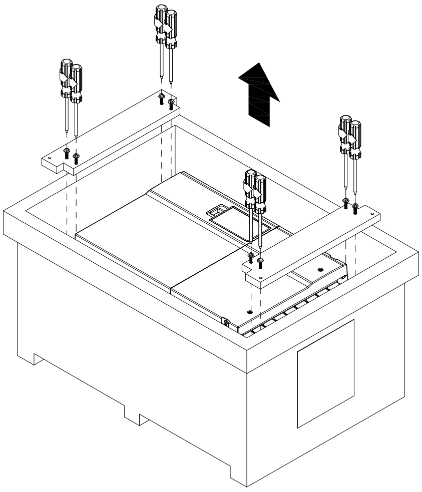
Chapter 3 Unpacking

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.

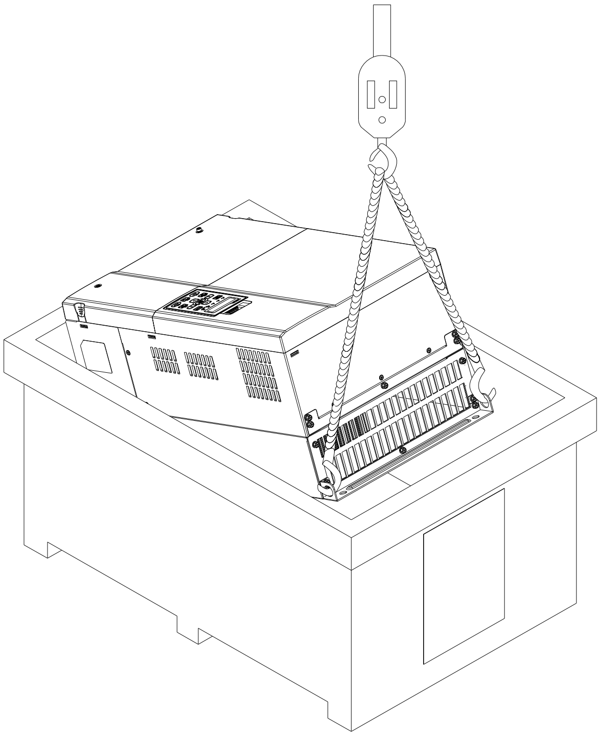
3-1 Unpacking

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

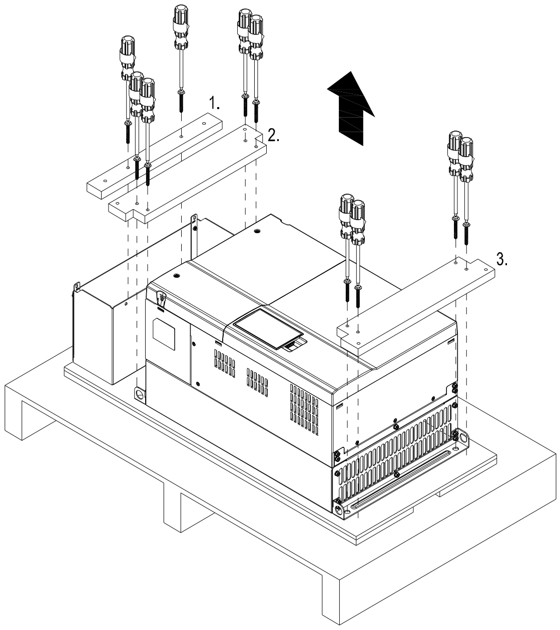
Frame D

Crate 1 (VFDXXXCXXA)	Crate 2 (VFDXXXCXXE)
Loosen the 12 cover screws to open the crate. 	Loosen the 4 screws on the iron plates. There are 4 iron plates and in total of 16 screws. 
Remove the EPEs and manual. 	Remove the crate cover, EPEs, rubber and manual. 
Loosen the 8 screws that fastened on the pallet and remove the wooden plate. 	

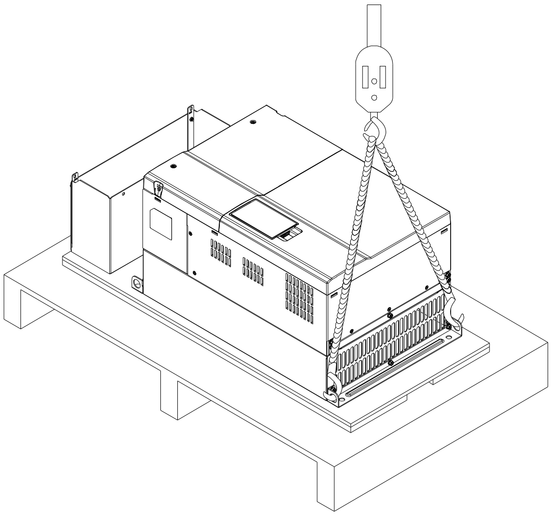
Lift the drive by hooking the lifting hole. It is now ready for installation.



Loosen the 10 screws on the pallet, remove the wooden plate.



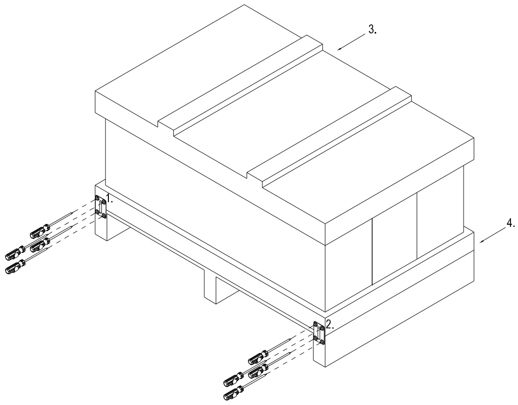
Lift the drive by hooking the lifting hole. It is now ready for installation.



Frame E

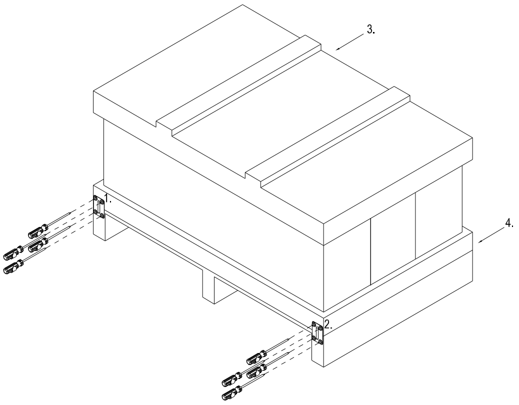
Crate 1 (VFDXXXCXXA)

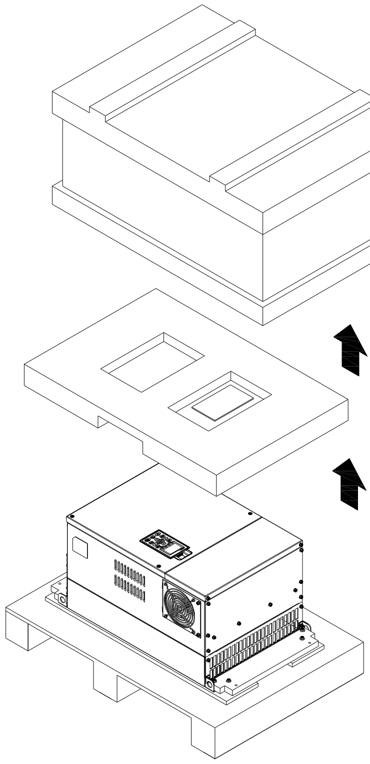
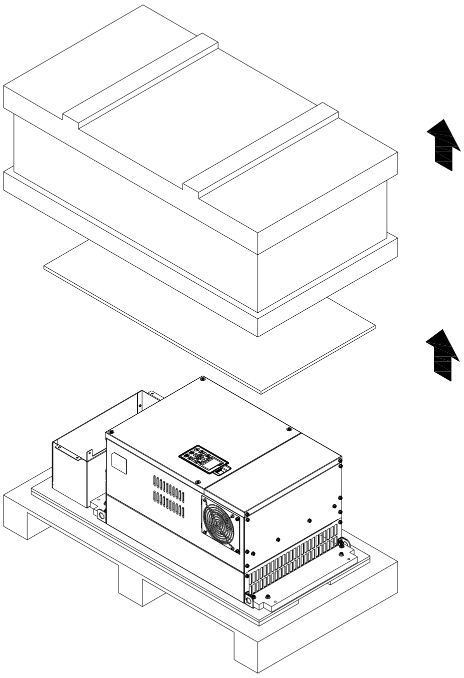
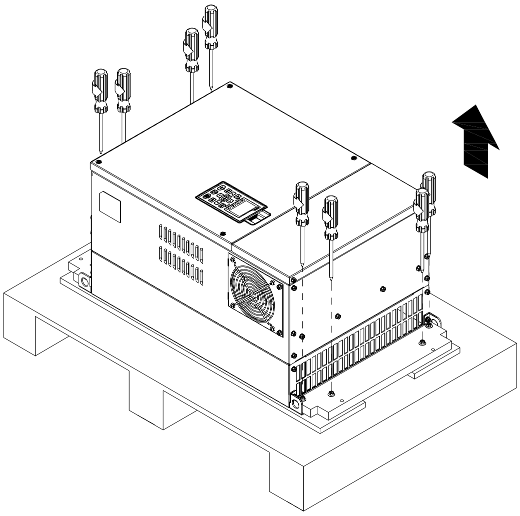
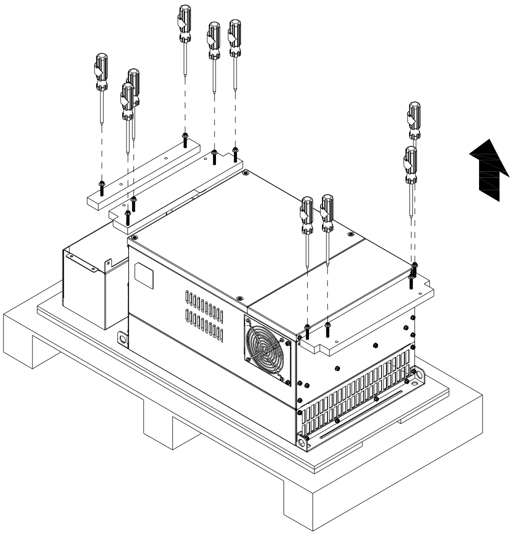
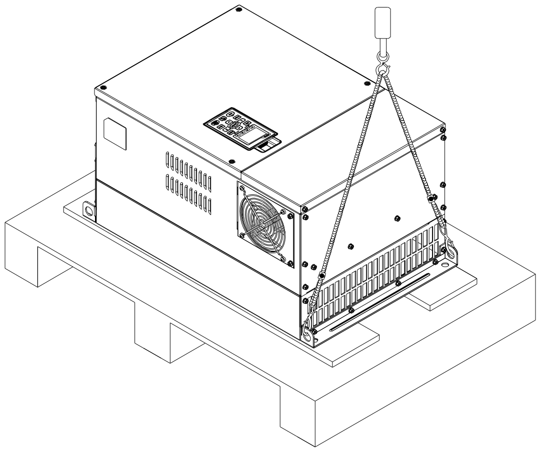
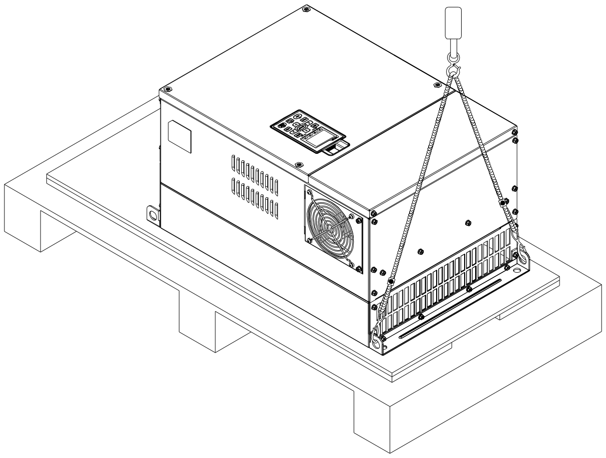
Loosen the 4 screws on the iron plates. There are 4 iron plates and in total of 16 screws.

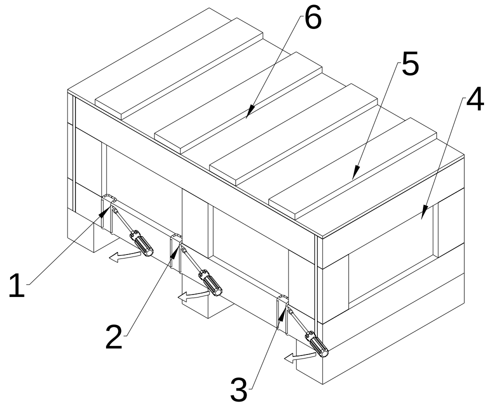
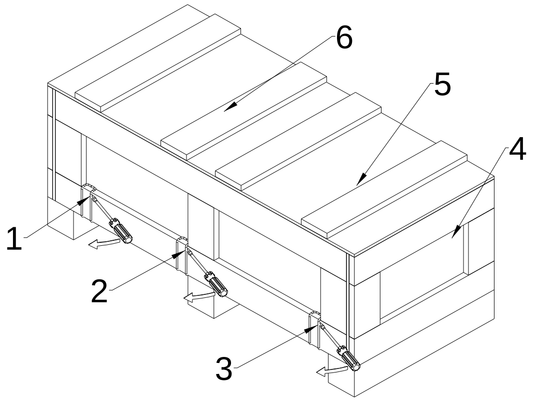
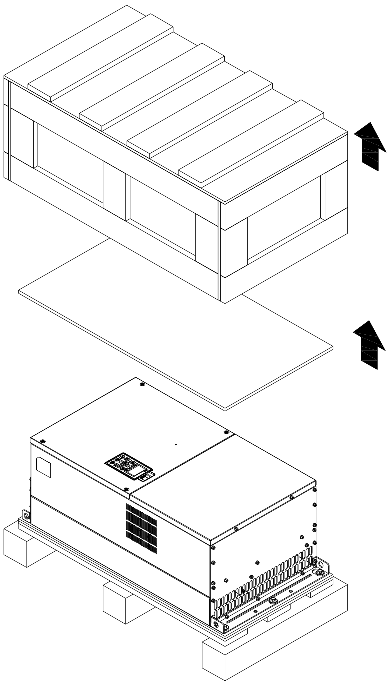
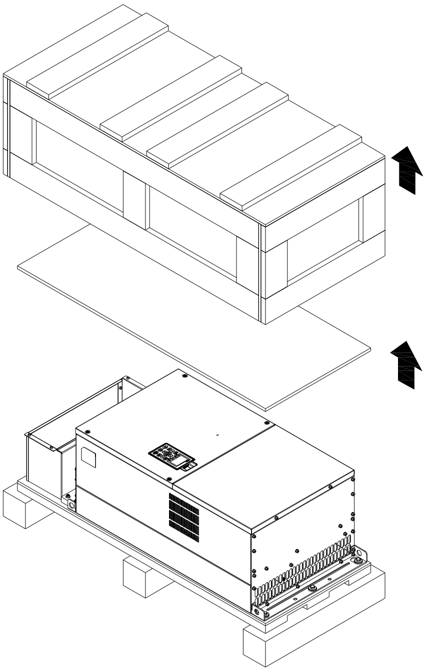
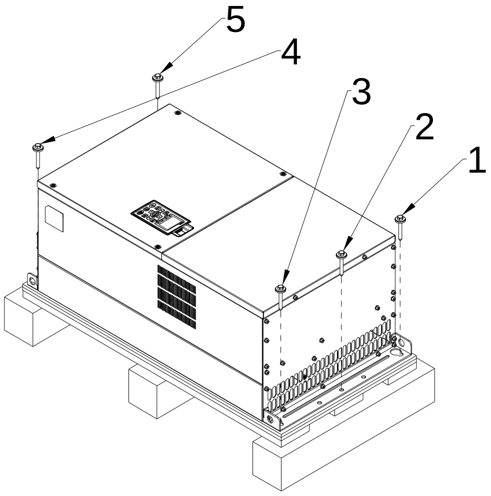
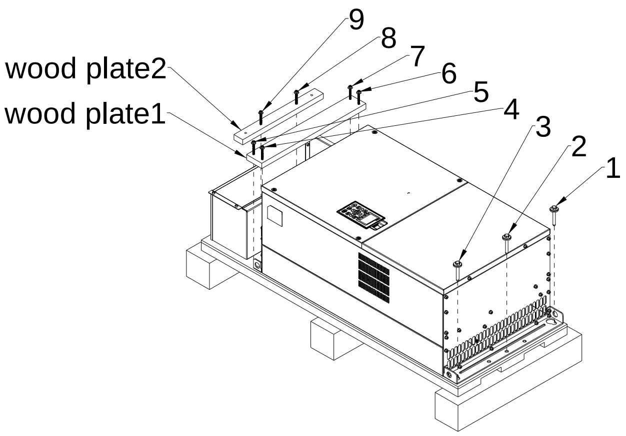


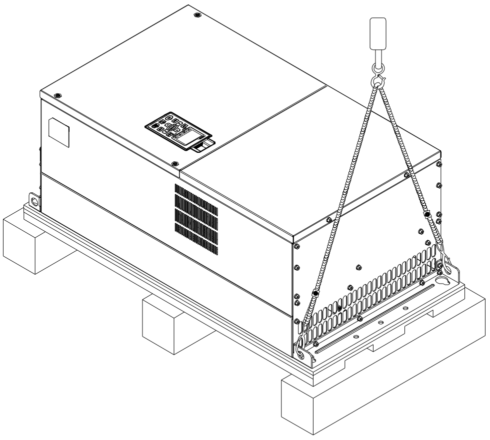
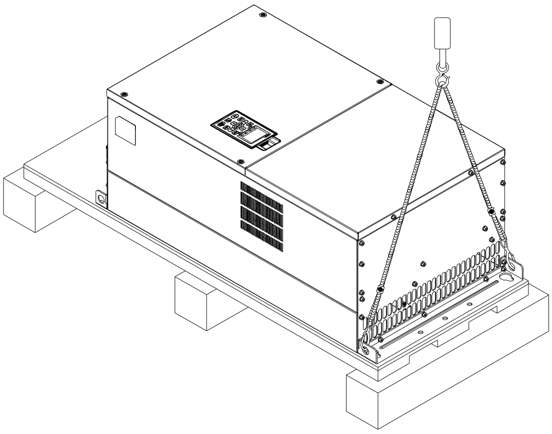
Crate 2 (VFDXXXCXXE)

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

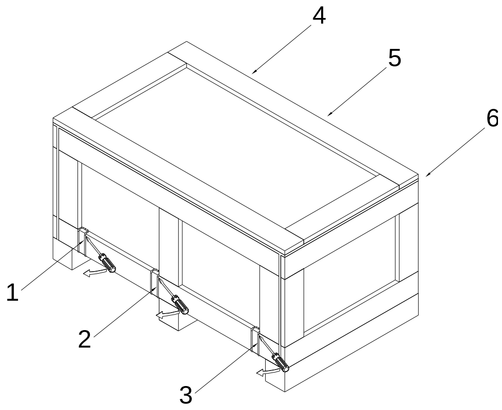
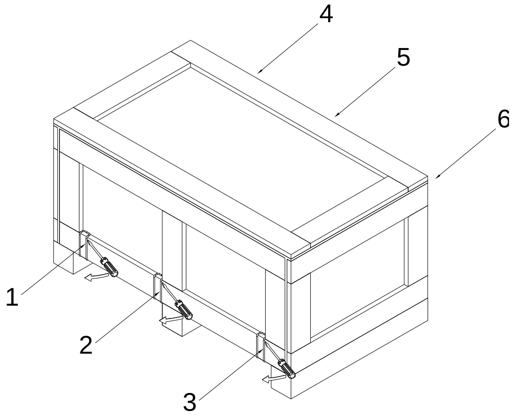
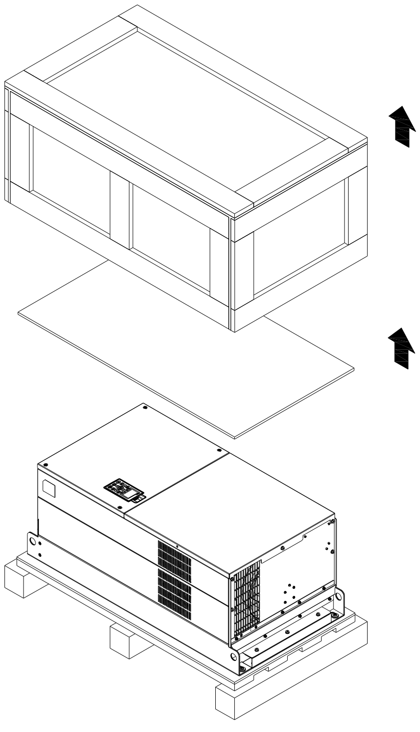
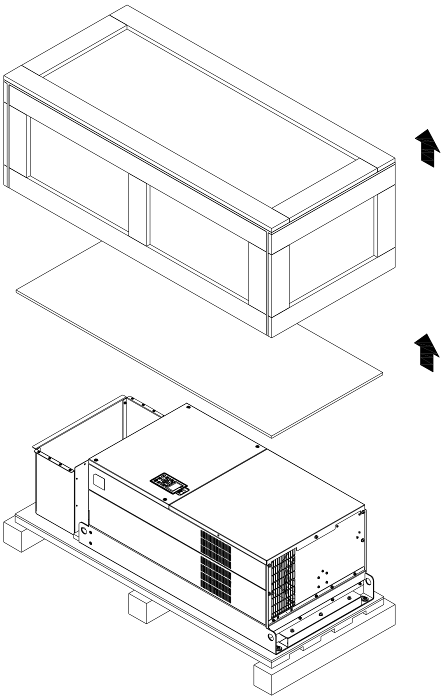


Remove the crate cover, EPEs and manual. 	Remove the crate cover, EPEs, rubbers and manual. 
Loosen the 8 screws on the pallet as shown in the following figure. 	Loosen the 10 screws on the pallet and remove the wooden plate. 
Lift the drive by hooking the lifting hole. It is now ready for installation. 	Lift the drive by hooking the lifting hole. It is now ready for installation. 

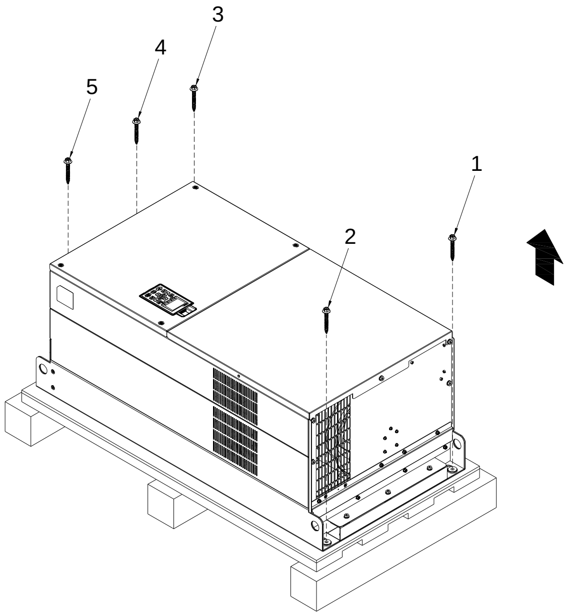
Frame F	
Crate 1 (VFDXXXCXXA) Remove the 6 clips on the side of the crate with a flat-head screwdriver. (As shown in figure below.)  	Crate 2 (VFDXXXCXXE) Remove the 6 clips on the side of the crate with a flat-head screwdriver. (As shown in figure below.) 
Remove the crate cover, EPEs and manual. 	Remove the crate cover, EPEs, rubbers and manual. 
Loosen the 5 screws on the pallet as shown in the following figure.  	Loosen the 9 screws on the pallet and remove the wooden plate. 

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. 

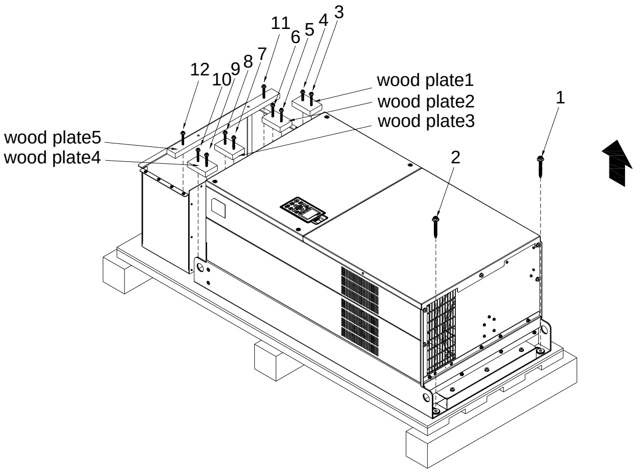
Frame G

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

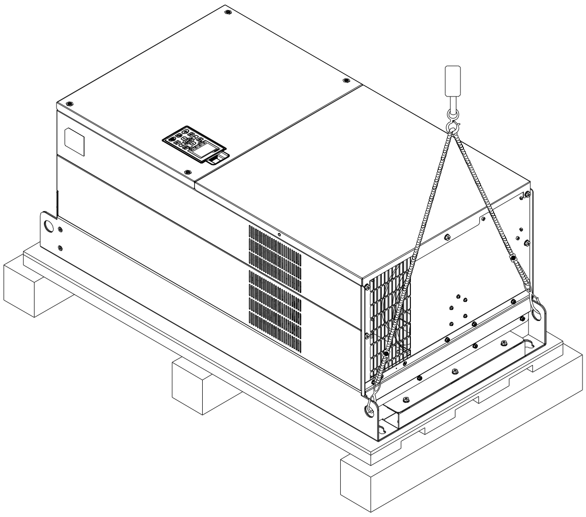
Loosen the 5 screws as shown in following figure:



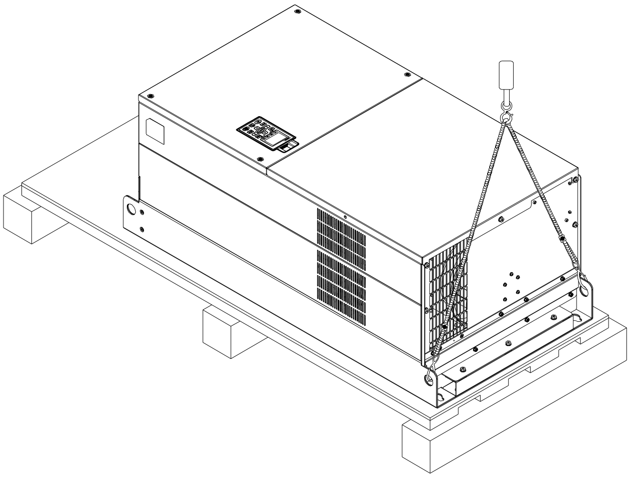
Loosen the 9 screws and remove the wooden plate.



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



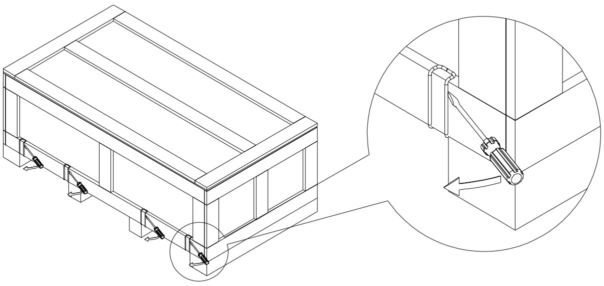
Lift the drive by hooking the lifting hole. It is now ready for installation.



Frame H

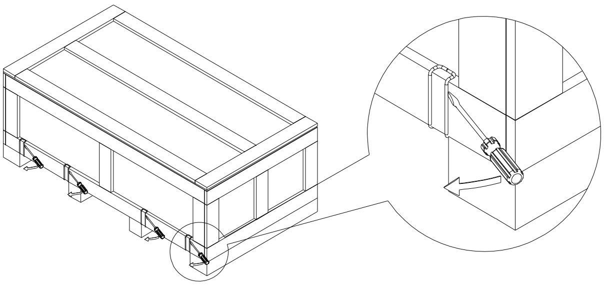
Crate 1 (VFDXXXC43A)

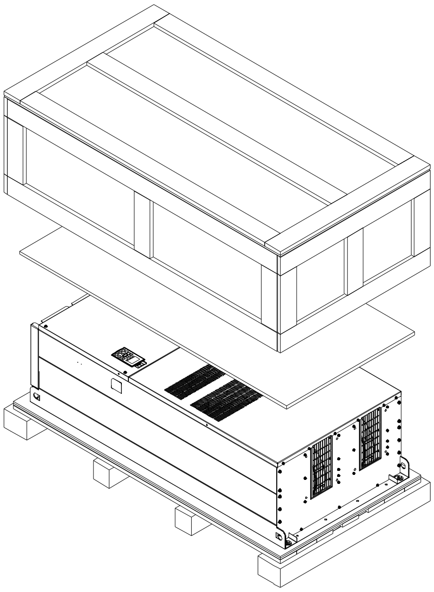
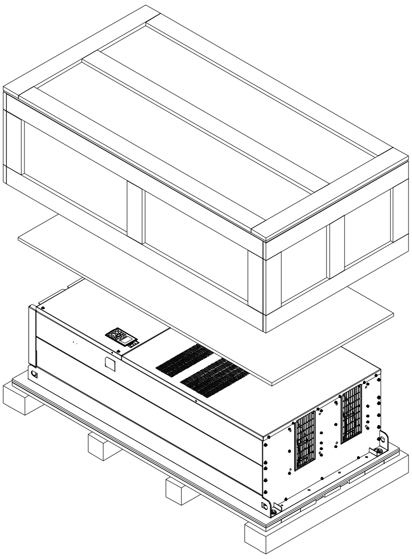
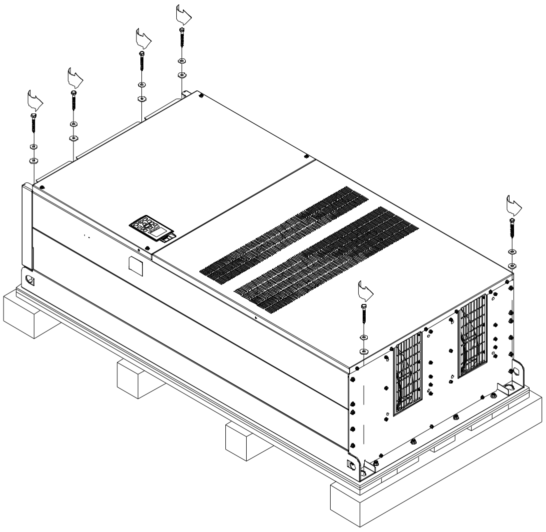
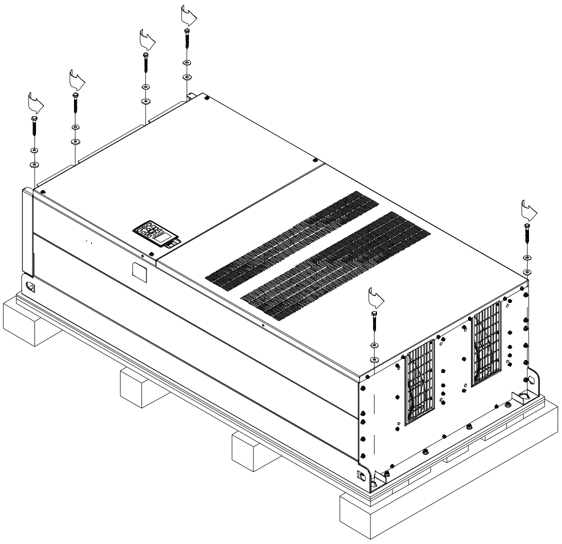
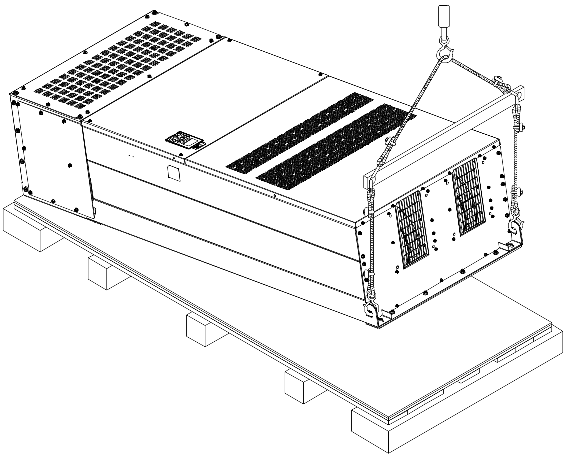
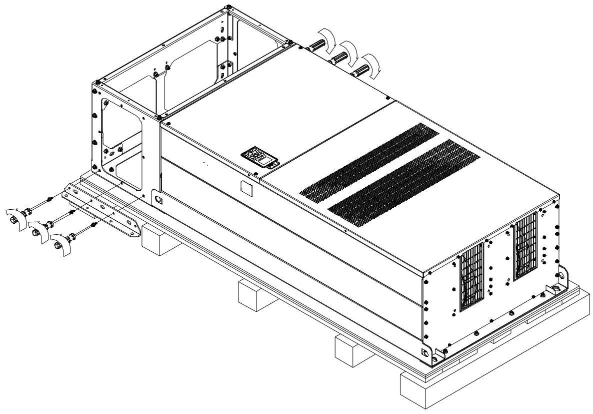
Remove the 8 clips on the side of the crate with a flathead screwdriver. (As shown in figure below.)



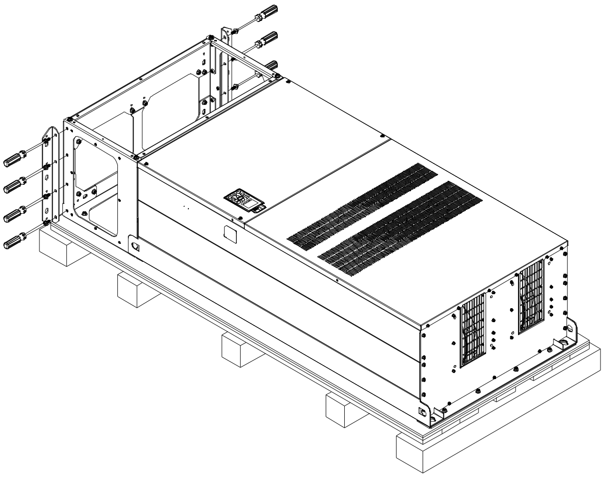
Crate 2 (VFDXXXC43E-1)

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

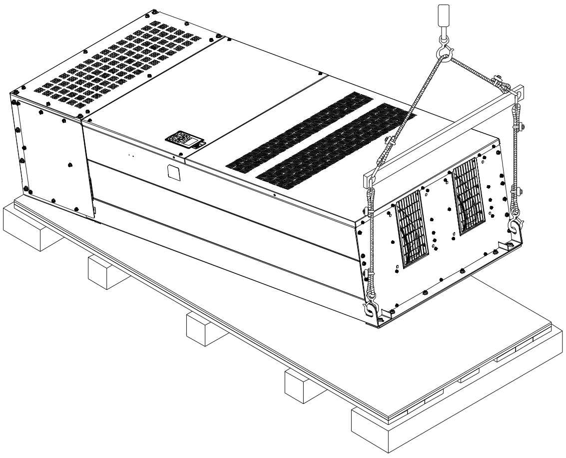


Remove the crate cover, EPEs and manual. 	Remove the crate cover, EPEs, rubbers and manual. 
Loosen the 6 screws on the top then remove 6 metal washers and 6 plastic washers as shown in figure below. 	Loosen the 6 screws on the top then remove 6 metal washers and 6 plastic washers as shown in figure below. 
Lift the drive by hooking the lifting hole. It is now ready for installation. 	Loosen 6 of the M6 screws on the side and remove the 2 plates, as shown in below. The removed screws and plates can be used to secure the AC motor drive from the external. 

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: 150~180kg-cm (130.20~156.24lb-in.)



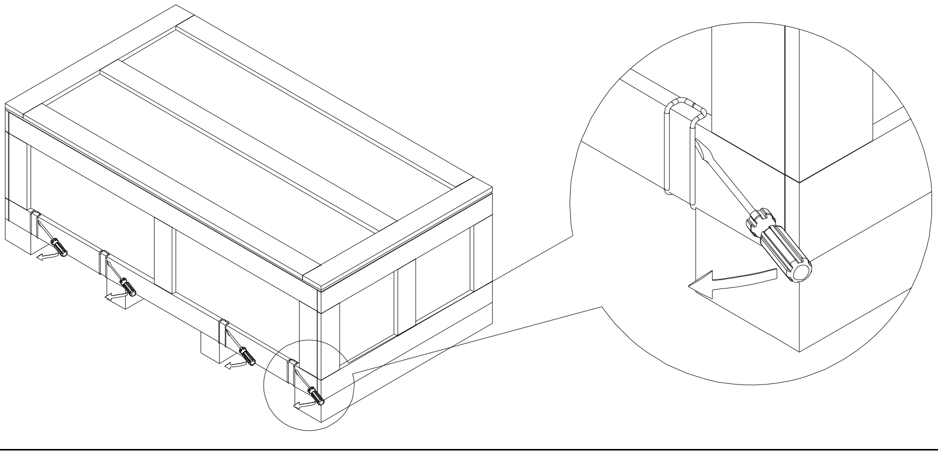
Lift the drive by hooking the lifting hole. It is now ready for installation.

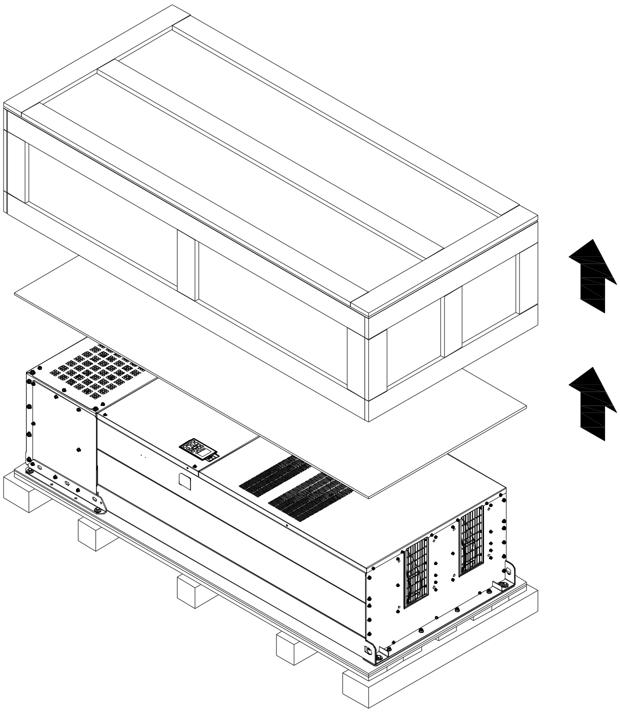
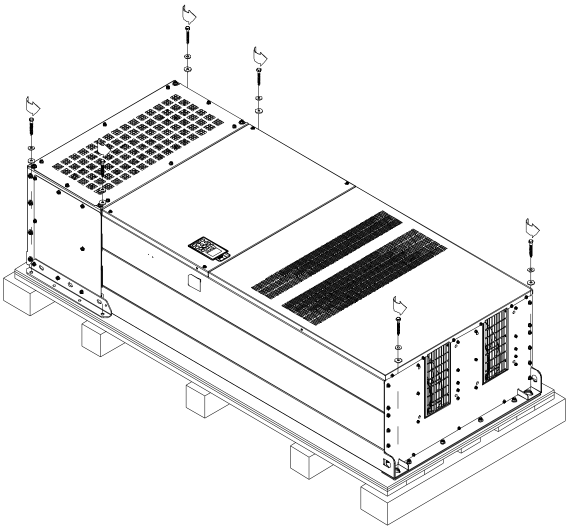
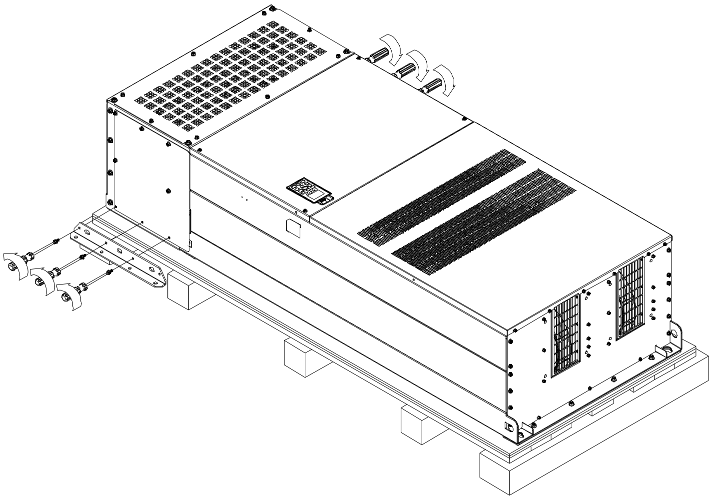


Frame H

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. 

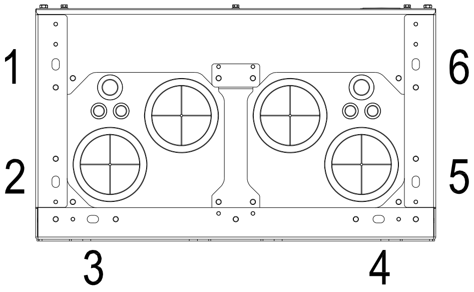
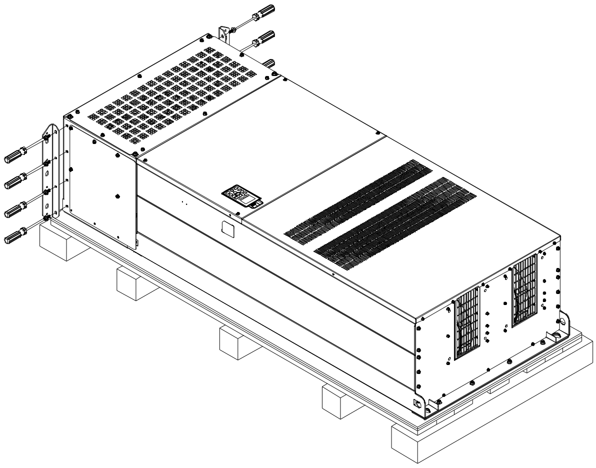
<table>
<tr>
<td>Secure the drive from the internal.
Loosen 18 of the M6 screws and remove the top cover as shown in figure 2. Mount the cover (figure 1) back to the drive by fasten the M6 screws to the two sides of the drive, as shown in figure 2.
Torque: 35~45kg-cm (30.38~39.06lb-in.)


Figure 1
Top cover (Use M12 screws)</td>
<td>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: 150~180kg-cm (130.20~156.24lb-in.)
</td>
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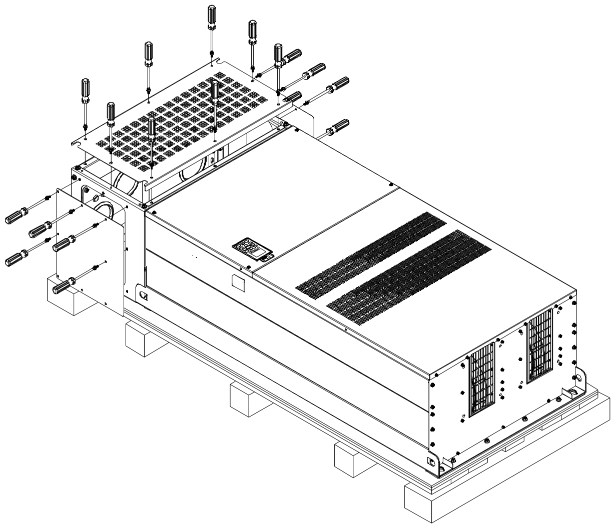
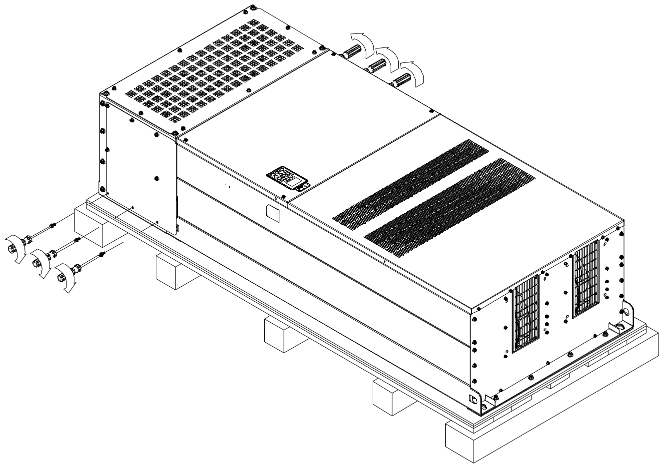
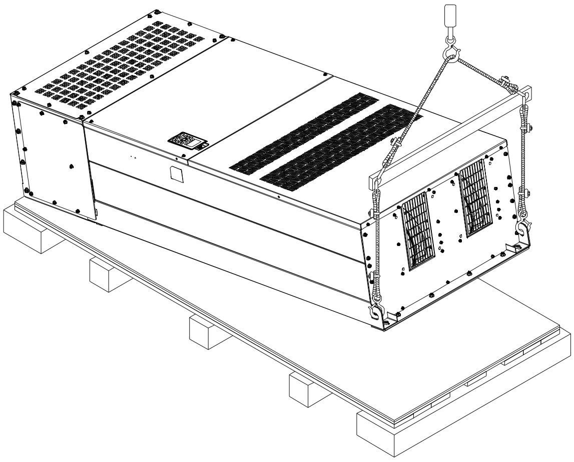
<tr>
<td>
Figure 2</td>
<td></td>
</tr>
<tr>
<td colspan="2">Fasten 6 of the M6 screws back to the original position where it was removed. As shown in the figure:
</td>
</tr>
</table>

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

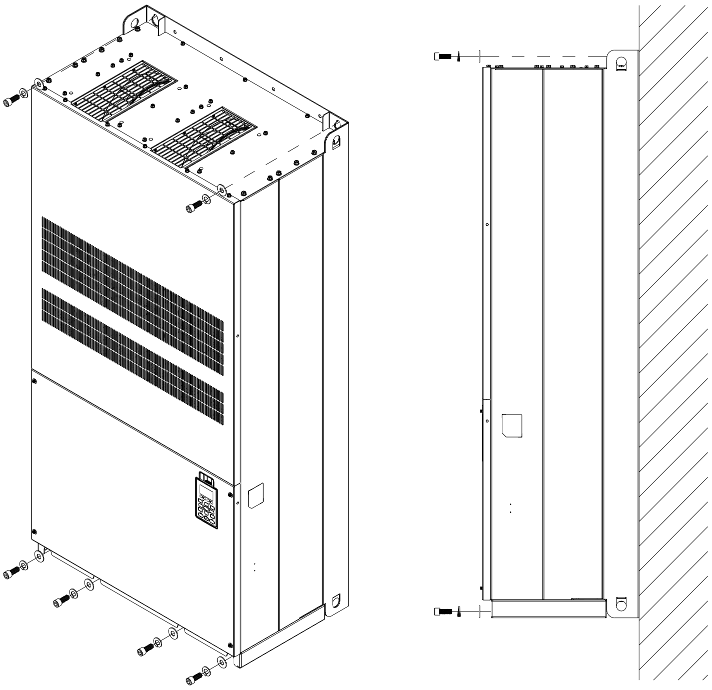


Frame H Secure the drive

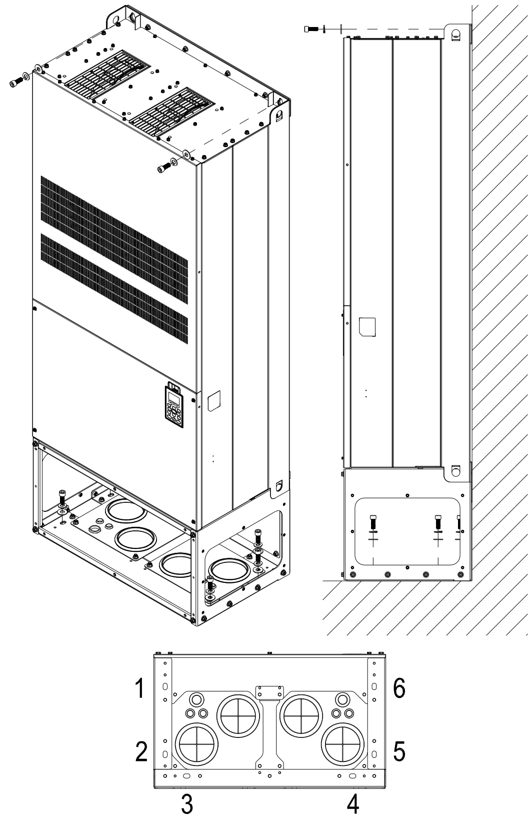
(VFDXXXC43A)

Screw: M12*6

Torque: 340-420kg-cm [295.1-364.6lb-in.]



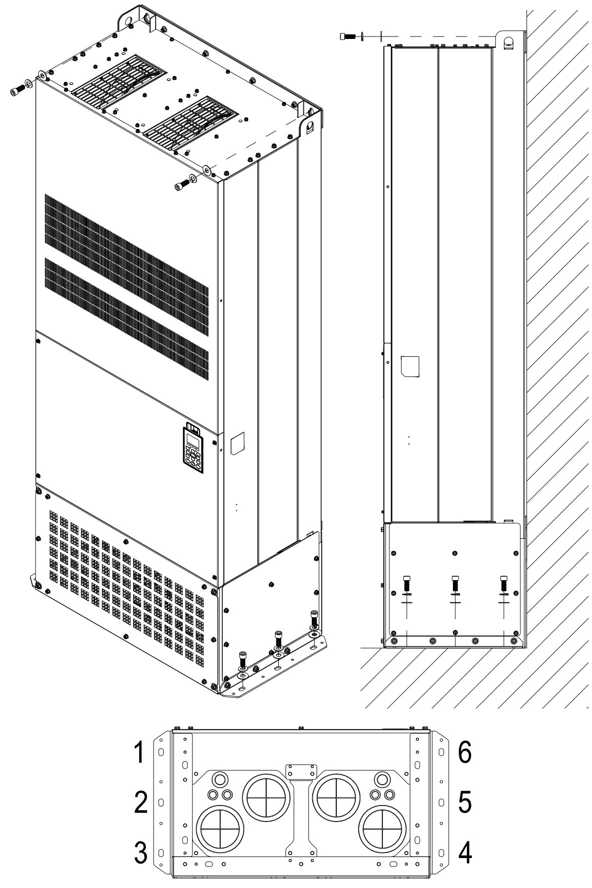
(VFDXXXC43E) & (VFDXXXC43E-1)



Secure the drive from the internal.

Screw: M12*8

Torque: 340-420kg-cm [295.1-364.6lb-in.]



Secure the drive from the external.

Screw: M12*8

Torque: 340-420kg-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:

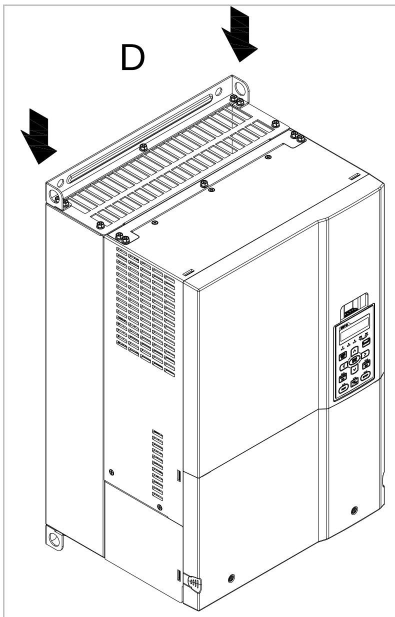


Figure 1

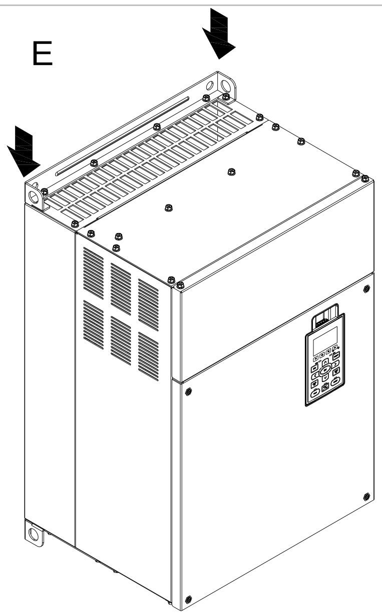


Figure 2

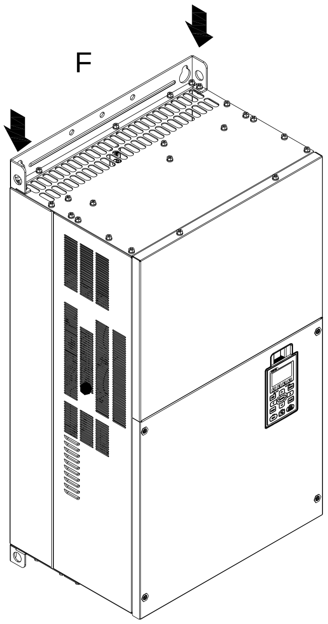


Figure 3

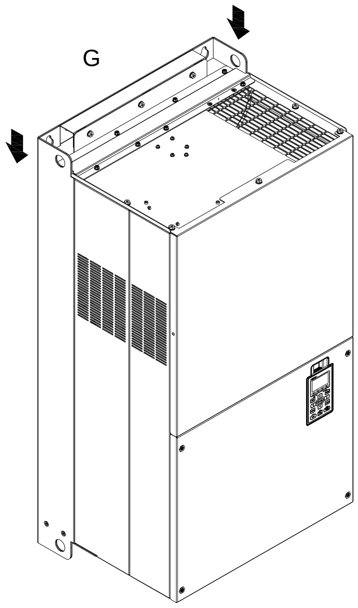


Figure 4

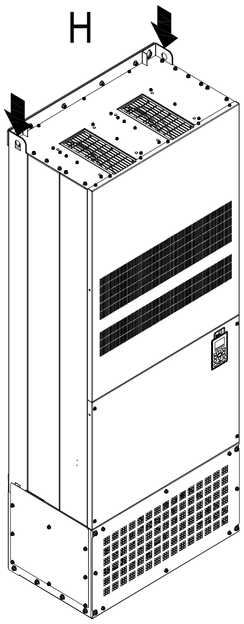
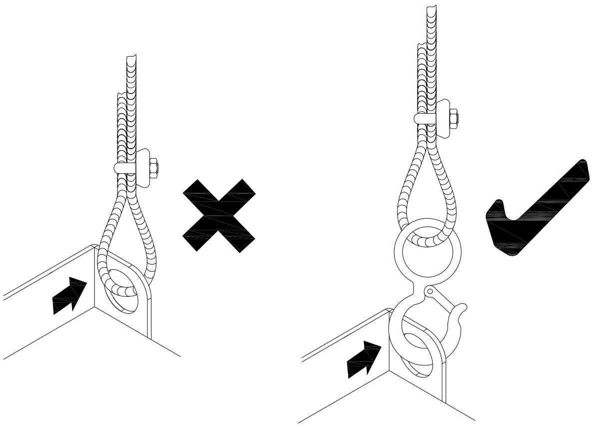
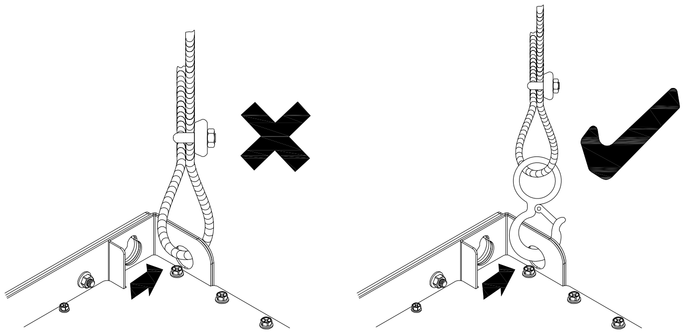


Figure 5

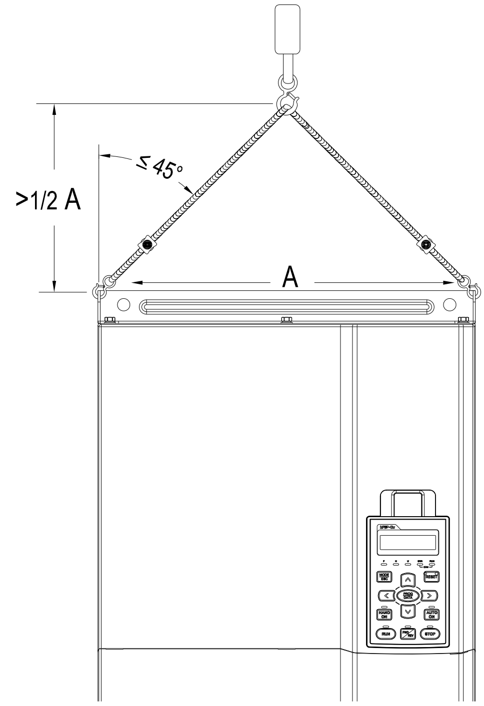
Ensure the lifting hook properly goes through the lifting hole, as shown in the following diagram. (Applicable to Frame D~E)

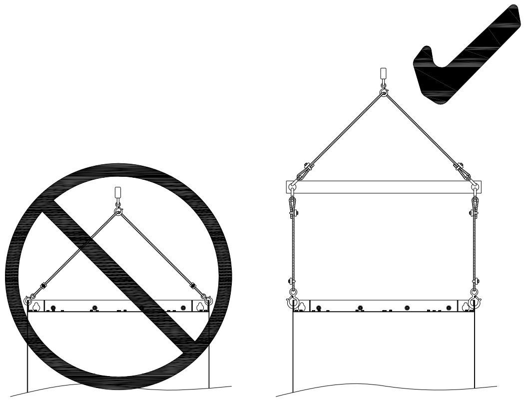


(Applicable to Frame F~H)

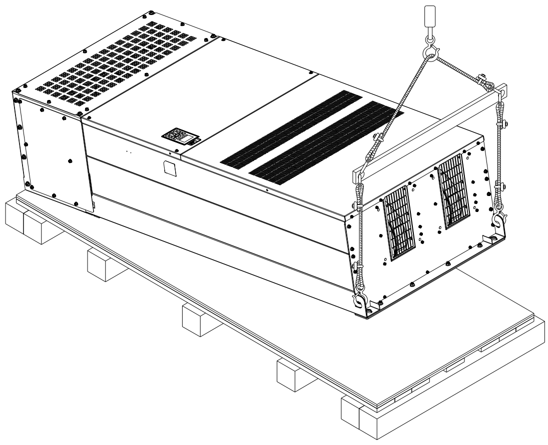


Ensure the angle between the lifting holes and the lifting device is within the specification, as shown in the following figure. (Applicable to Frame D~E)



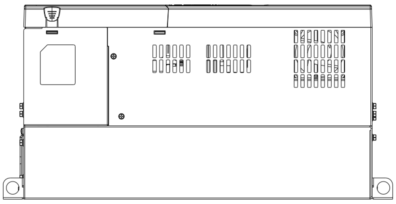


(Applicable to Frame F~H)

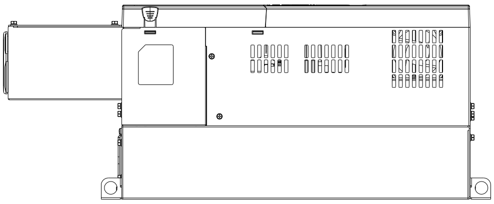


Weight

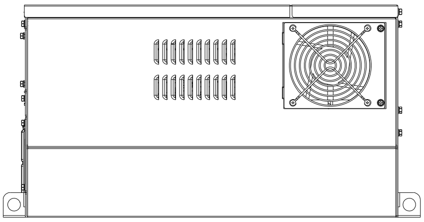
VFDXXXXCXXA D 37.6 kg(82.9 lbs.)



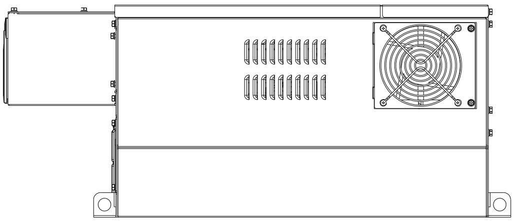
VFDXXXXCXXE D 40 kg(88.2 lbs.)



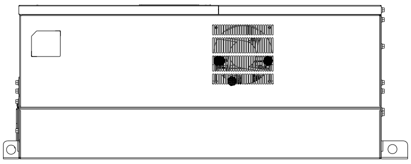
VFDXXXXCXXA E 63.6 kg(140.2 lbs.)



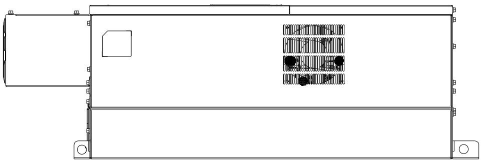
VFDXXXXCXXE E 66 kg(145.5 lbs.)



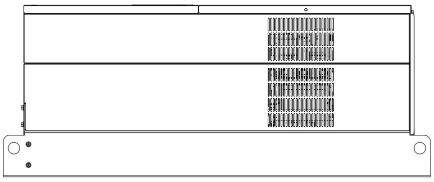
VFDXXXXCXXA F 85kg(187.2 lbs.)



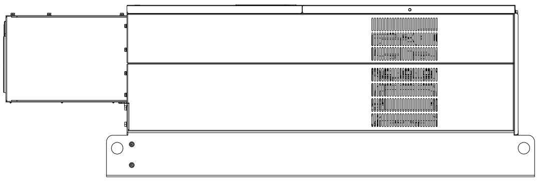
VFDXXXXCXXE F 88kg(193.8 lbs.)



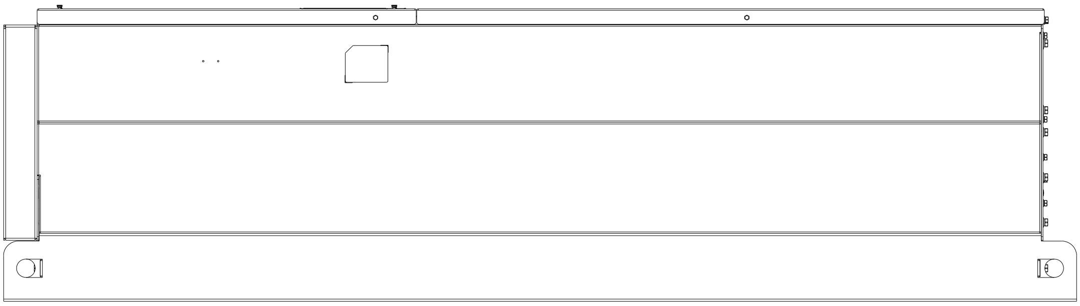
VFDXXXXCXXA G 130kg(286.5 lbs.)



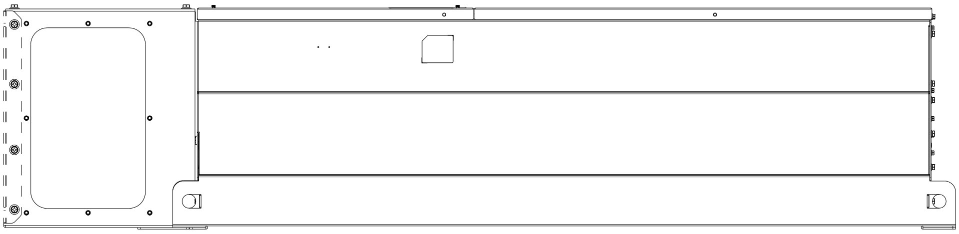
VFDXXXXCXXE G 138kg(303.9 lbs)



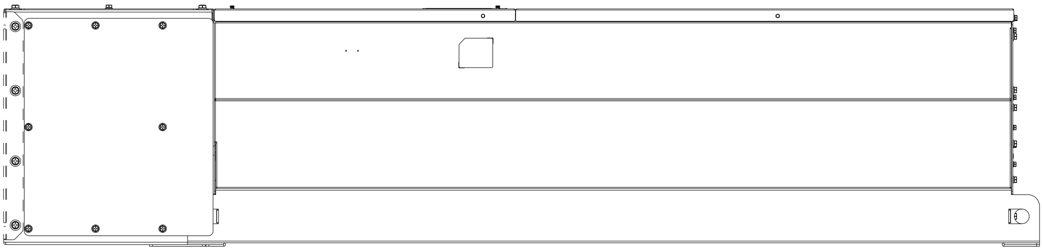
H1: VFD2800C43A; VFD3150C43A; VFD3550C43A; VFD4500C43A 235kg (518.1lbs)



H2: VFD2800C43E-1; VFD3150C43E-1; VFD3550C43E-1; VFD4500C43E-1 257kg (566.6lbs)



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).

☑ All the units must be grounded directly to a common ground terminal to prevent lightning strike or electric shock.

☑ Please make sure to fasten the screw of the main circuit terminals to prevent sparks which is made by the loose screws due to vibration

DANGER

☑ 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.

☑ 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.

CAUTION

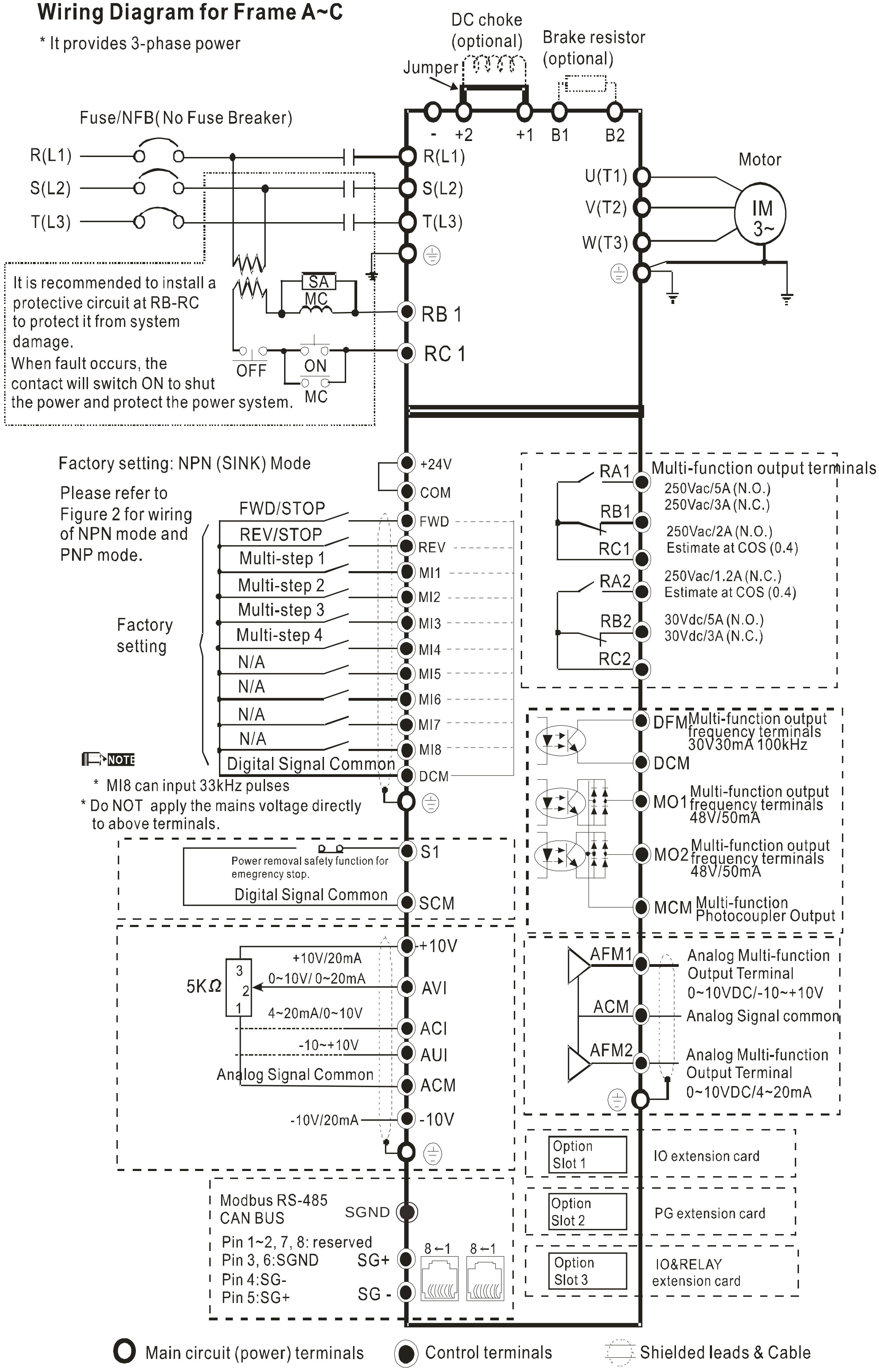
☑ When wiring, please choose the wires with specification that complys with local regulation for your personnel safety.

☑ Check following items after finishing the wiring:

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

Wiring Diagram for Frame A~C

* It provides 3-phase power



Wiring Diagram for Frame D and Frames Above

* It provides 3-phase power

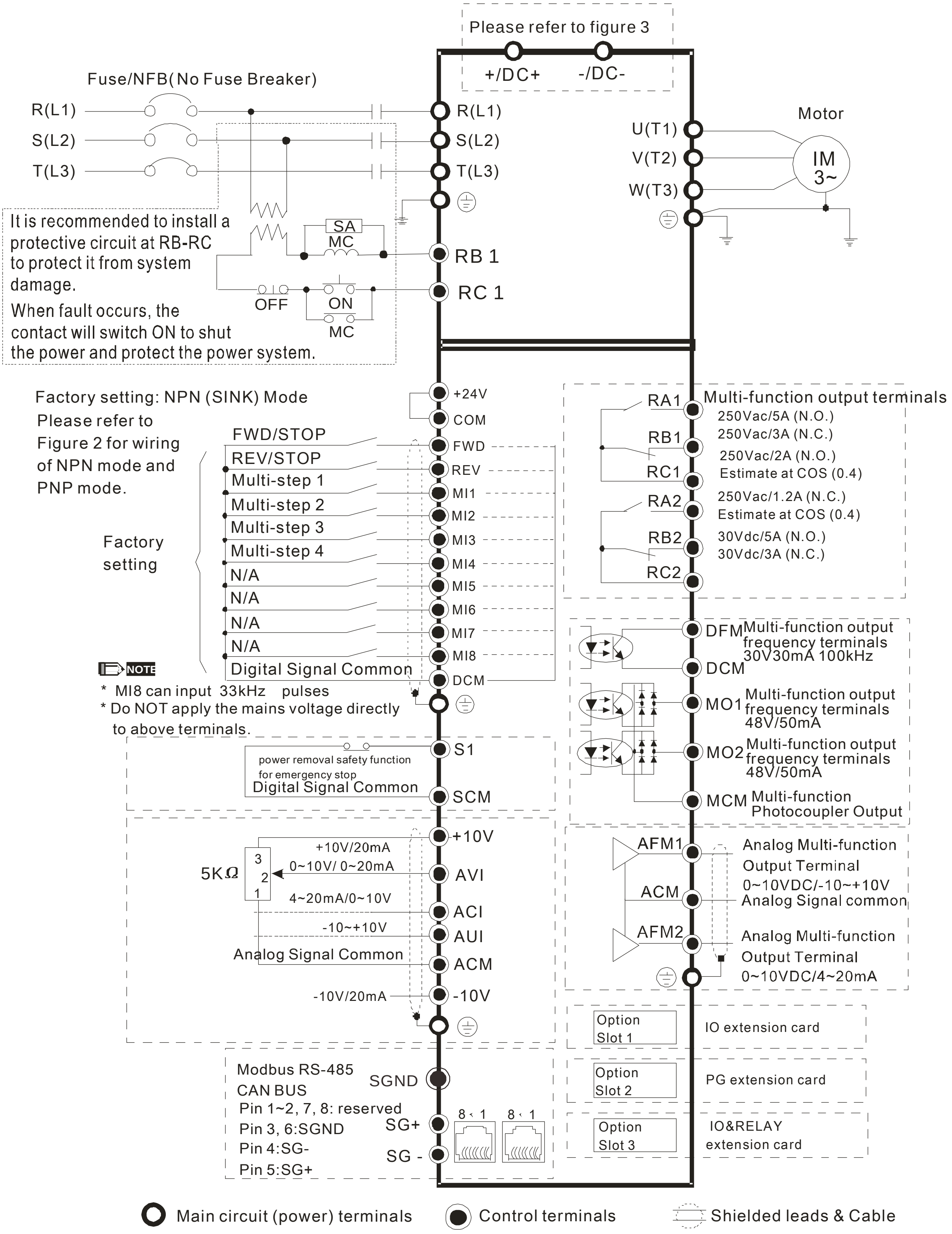


Figure 1

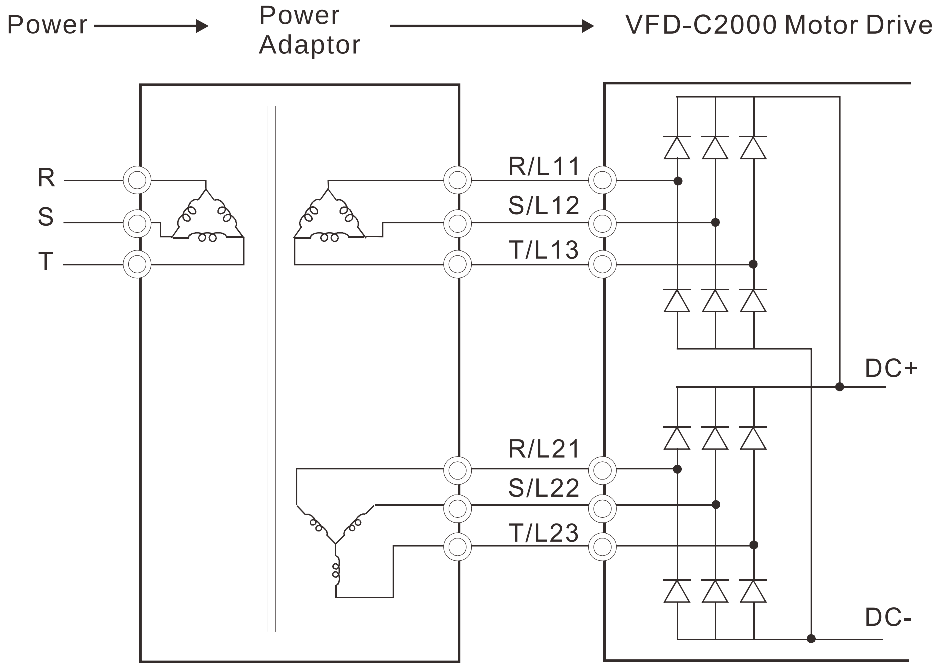


Figure 2

SINK（NPN）/SOURCE（PNP）Mode

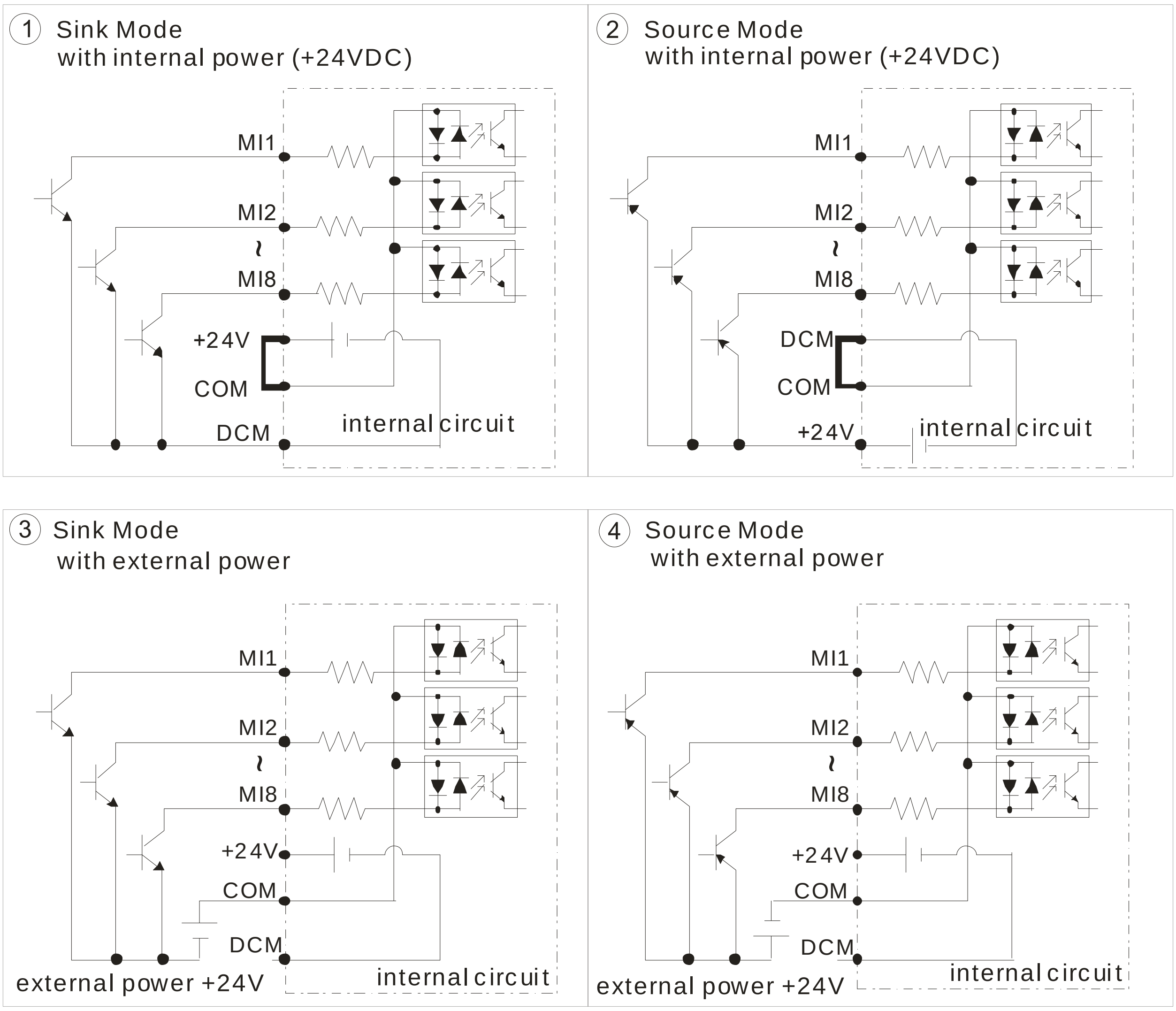


Figure 3

Function of DC Link

☑ Applicable to Frame E~H

☑ Operation Instruction

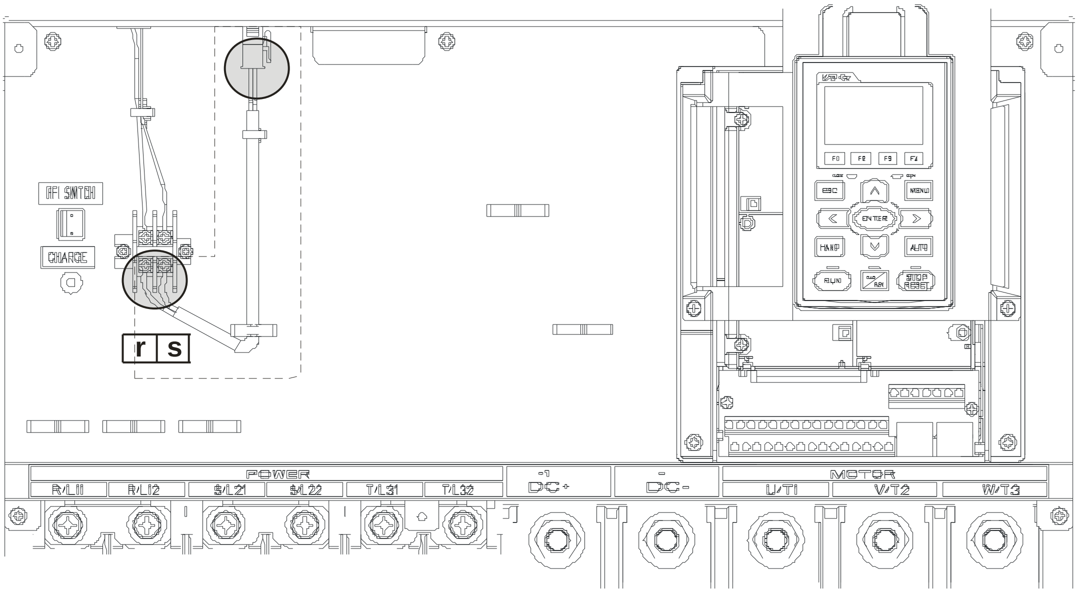
1. When RST power is off, please disconnect terminal r and terminal s. (As circled in dotted line, uninstall the gray section and properly store cable r and cable s. Cable r and cable s are not available in optional accessories, do not dispose them.)

   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 220V model and 440 Vac for 440V model.

   When the drive power is on, if terminal r and terminal s are not connected to new power source (220 Vac for 220V model and 440Vac 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

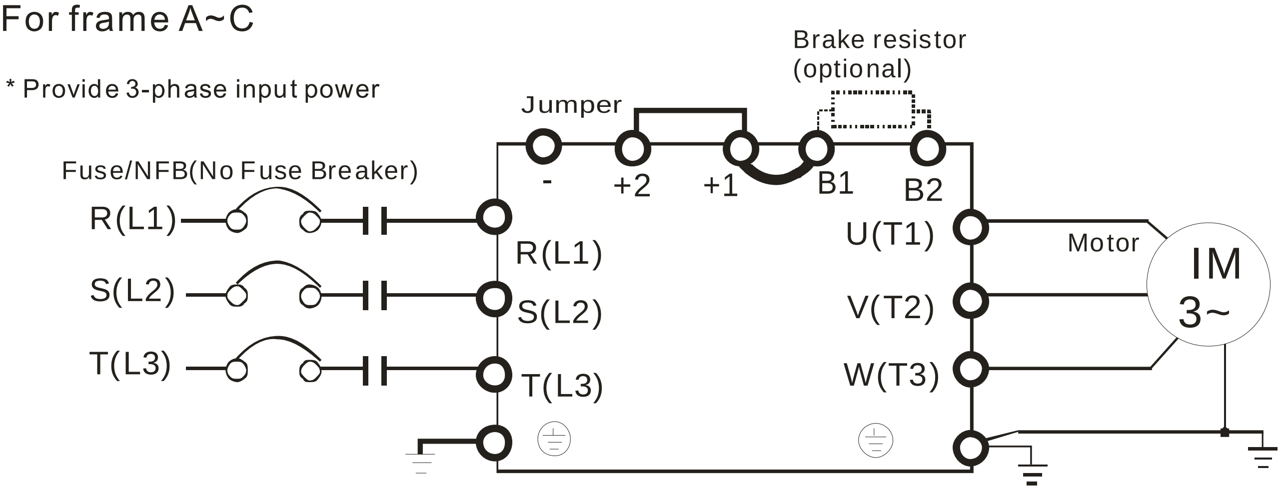
Common DC Bus can only be applied to the drives with same power range. If in your case the drives are in different power range, please contact with us (Delta Industrial Automation Business Unit).



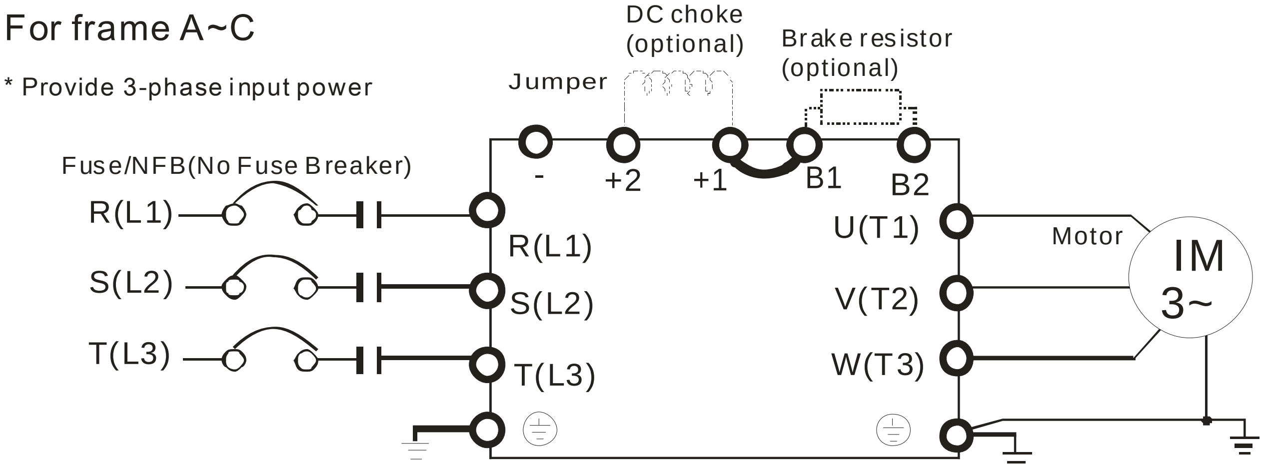
Chapter 5 Main Circuit Terminals

5-1 Main Circuit Diagram

For frame A~C

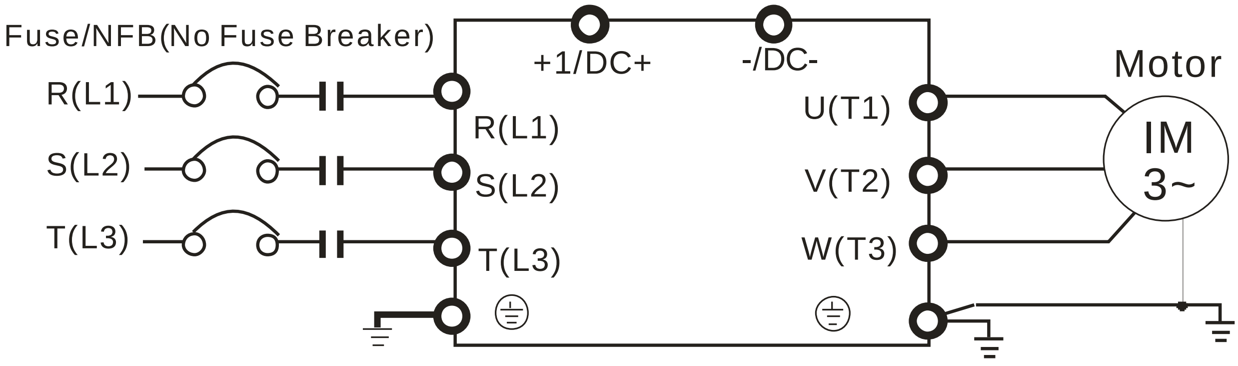


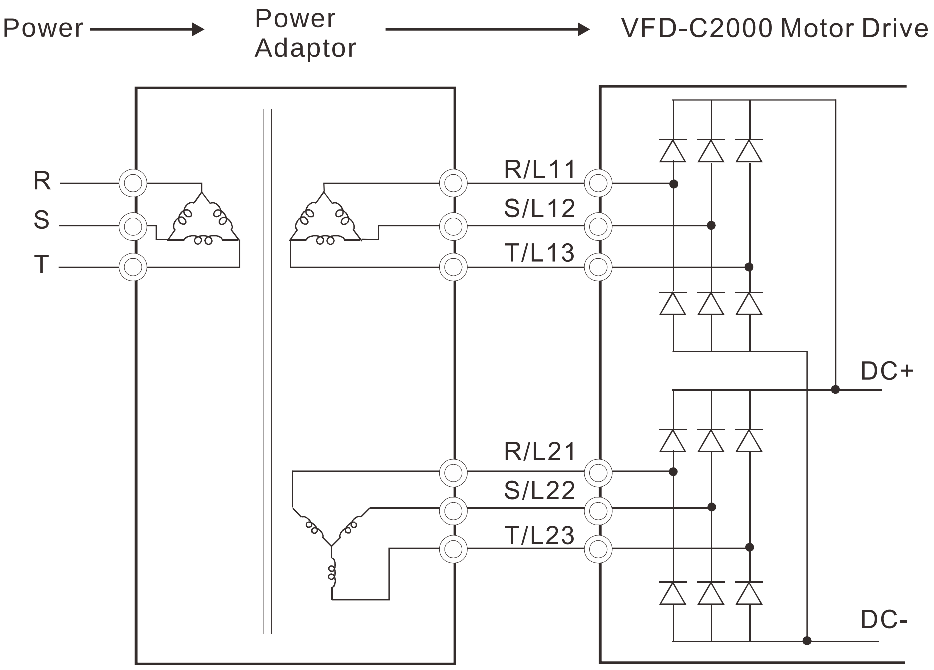
For frame A~C



For frame D and above D

* Provide 3-phase input power





Terminals	Descriptions
R/L1, S/L2, T/L3	AC line input terminals 3-phase
U/T1, V/T2, W/T3	AC drive output terminals for connecting 3-phase induction motor
+1, +2	Applicable to frame A~C Connections for DC reactor to improve the power factor. It needs to remove the jumper for installation.
+1/DC+, -/DC-	Connections for brake unit (VFDB series) (for 230V models: ≦22kW, built-in brake unit) (for 460V models: ≦30kW, built-in brake unit) Common DC Bus
B1, B2	Connections for brake resistor (optional)
⏚	Earth connection, please comply with local regulations.

CAUTION

Main power terminals

- ☑ 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.
- ☑ 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 R-C surge absorber.
- ☑ Fasten the screws in the main circuit terminal to prevent sparks condition made by the loose screws due to vibration.
- ☑ Please use voltage and current within the specification.
- ☑ When using a general GFCI (Ground Fault Circuit Interrupter), select a current sensor with sensitivity of 200mA or above and not less than 0.1-second operation time to avoid nuisance tripping.

☑ Please use the shield wire or tube for the power wiring and ground the two ends of the shield wire or tube.

☑ Do NOT run/stop AC motor drives by turning the power ON/OFF. Run/stop AC motor drives by RUN/STOP command via control terminals or keypad. If you still need to run/stop AC motor drives by turning power ON/OFF, it is recommended to do so only ONCE per hour.

Output terminals for main circuit

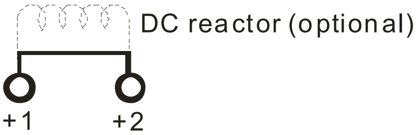
☑ When it needs to install the filter at the output side of terminals U/T1, V/T2, W/T3 on the AC motor drive. Please use inductance filter. Do not use phase-compensation capacitors or L-C (Inductance-Capacitance) or R-C (Resistance-Capacitance), unless approved by Delta.

☑ DO NOT connect phase-compensation capacitors or surge absorbers at the output terminals of AC motor drives.

☑ Use well-insulated motor, suitable for inverter operation.

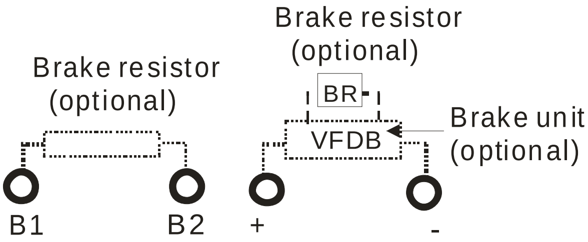
Terminals for connecting DC reactor, external brake resistor, external brake resistor and DC circuit

☑ 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.



☑ 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.

☑ 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.

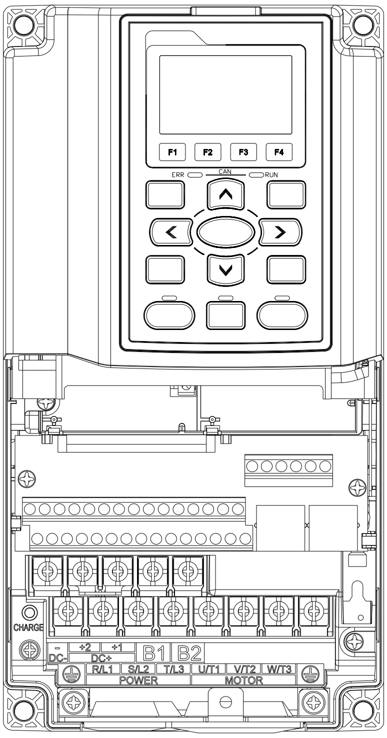


☑ For Frame A~C, the external brake resistor should connect to the terminals (B1, B2) of AC motor drives.

	☑ 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. ☑ When the terminals +1, +2 and - are not used, please leave the terminals open. ☑ DO NOT connect [+1, -], [+2, -], [+1/DC+, -/DC-] or brake resistor directly to prevent drive damage. ☑ 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. ☑ 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 (±10%)
VFD007C23A	8 AWG (8.4mm^2)	14 AWG (2.1mm^2)	M4 20kg-cm (17.4 lb-in.) (1.962Nm)
VFD015C23A		12 AWG (3.3mm^2)	
VFD022C23A		10 AWG (5.3mm^2)	
VFD037C23A		8 AWG (8.4mm^2)	
VFD007C43A		14 AWG (2.1mm^2)	
VFD007C43E		14 AWG (2.1mm^2)	
VFD015C43A		14 AWG (2.1mm^2)	
VFD015C43E		14 AWG (2.1mm^2)	
VFD022C43A		14 AWG (2.1mm^2)	
VFD022C43E		14 AWG (2.1mm^2)	
VFD037C43A		10 AWG (5.3mm^2)	
VFD037C43E		10 AWG (5.3mm^2)	
VFD040C43A		10 AWG (5.3mm^2)	
VFD040C43E		10 AWG (5.3mm^2)	
VFD055C43A		10 AWG (5.3mm^2)	
VFD055C43E		10 AWG (5.3mm^2)	
UL installations must use 600V, 75℃ or 90℃ 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

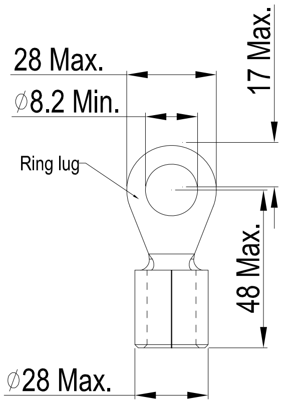
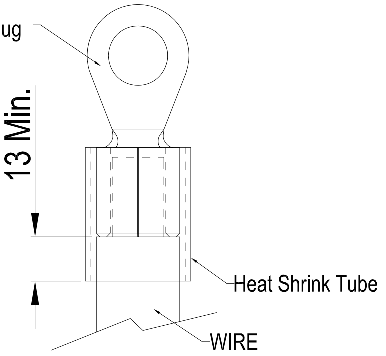
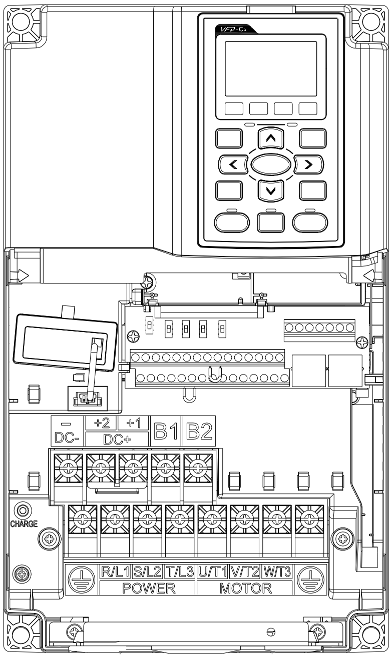


Figure 2



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 (±10%)
VFD055C23A	4 AWG (21.2mm^2)	8 AWG (8.4mm^2)	M5 35kg-cm (30.4 lb-in.) (3.434Nm)
VFD075C23A		6 AWG (13.3mm^2)	
VFD110C23A		4 AWG (21.2mm^2)	
VFD075C43A		8 AWG (8.4mm^2)	
VFD075C43E		10 AWG (5.3mm^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 600V, 75℃ or 90℃ wire. Use copper wire only.			

NOTE

Terminal D+ [+2 & +1]: Torque: 45 kg-cm [39.0lb-in.] (4.415Nm) (±10%)

1. VFD110C23A must use 600V, 90℃ wire when surrounding temperature exceeds 45℃.
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

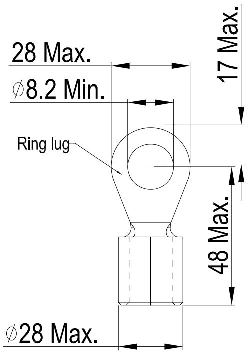
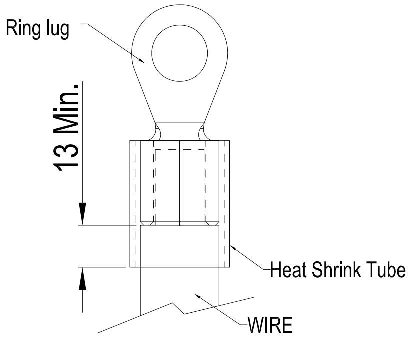
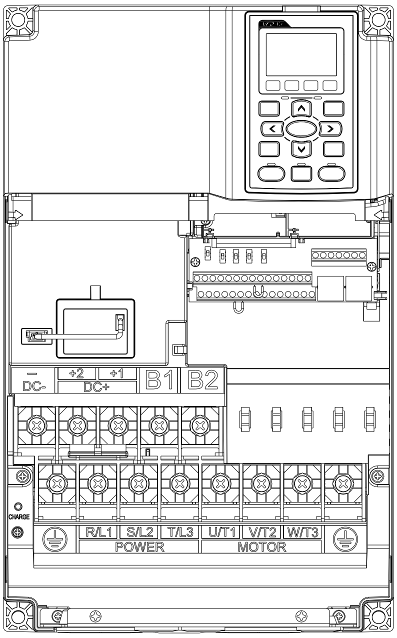


Figure 2



Frame C



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 (±10%)
VFD150C23A	1/0 AWG (53.5mm^2)	1 AWG (42.4mm^2)	M8 80kg-cm (69.4 lb-in.) (7.85Nm)
VFD185C23A		1/0 AWG (53.5mm^2)	
VFD220C23A		1/0 AWG (53.5mm^2)	
VFD185C43A		4 AWG (21.2mm^2)	
VFD185C43E		6 AWG (13.3mm^2)	
VFD220C43A		4 AWG (21.2mm^2)	
VFD220C43E		4 AWG (21.2mm^2)	
VFD300C43A		2 AWG (33.6mm^2)	
VFD300C43E		3 AWG (26.7mm^2)	
UL installations must use 600V, 75℃ or 90℃ wire. Use copper wire only.			

NOTE

Terminal D+ [+2 & +1]: Torque: 90 kg-cm [78.2lb-in.] (8.83Nm) (±10%)

1. VFD220C23A must use 600V, 90℃ wire when surrounding temperature exceeds 40℃.
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

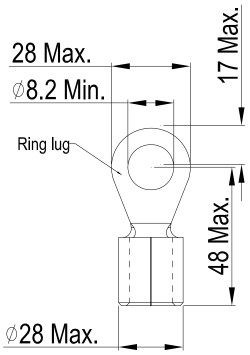
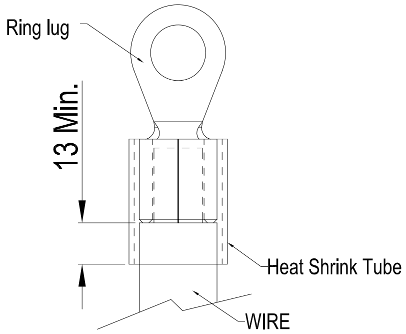
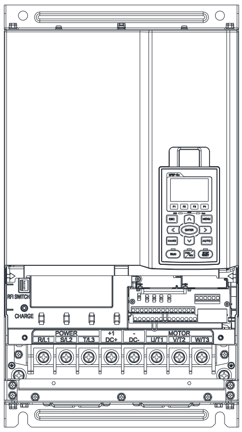


Figure 2



Frame D0



Main circuit terminals：

R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, ⏚, +1/DC+, -/DC-

Models	Max. Wire Gauge	Min. Wire Gauge	Torque (±10%)
VFD370C43S	2/0 AWG (67.4mm^2)	1/0 AWG (53.5mm^2)	M8 80kg-cm (70 lb-in.) (7.85Nm)
VFD450C43S		2/0 AWG (67.4mm^2)	
VFD370C43U		1/0 AWG (53.5mm^2)	
VFD450C43U		2/0 AWG (67.4mm^2)	

UL installations must use 600V, 75℃ or 90℃ wire. Use copper wire only.

Specification of grounding wire: 2AWG*2(33.6mm^2*2)

Figure 1 shows the terminal specification.

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

Figure 1

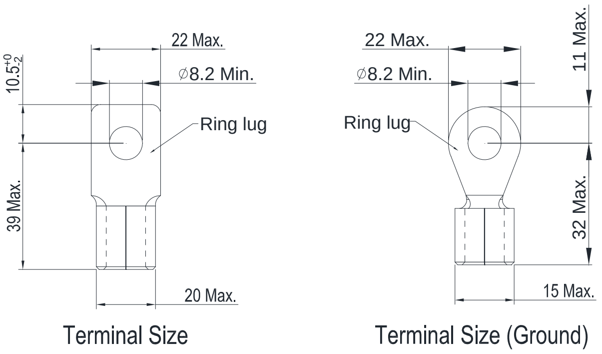
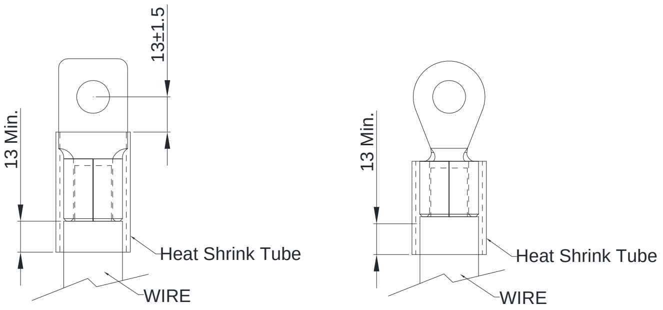
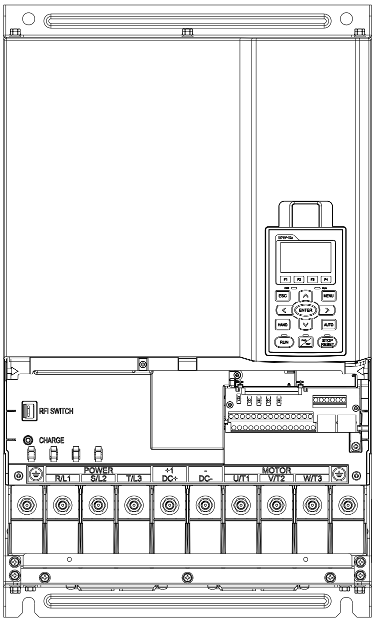


Figure 2



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 (±10%)
VFD300C23A	300MCM (152mm^2)	4/0 AWG (107mm^2)	M8 200kg-cm (173 lb-in.) (19.62Nm)
VFD370C23A		250MCM (127mm^2)	
VFD370C43A		1/0 AWG (53.5mm^2)	
VFD450C43A		2/0 AWG (67.4mm^2)	
VFD550C43A		3/0 AWG (85mm^2)	
VFD750C43A		300MCM (152mm^2)	
VFD300C23E	4/0 AWG. (107mm^2)	3/0 AWG (85mm^2)	
VFD370C23E		4/0 AWG (107mm^2)	
VFD370C43E		1/0 AWG (53.5mm^2)	
VFD450C43E		1/0 AWG (53.5mm^2)	
VFD550C43E		2/0 AWG (67.4mm^2)	
VFD750C43E		4/0 AWG (107mm^2)	

1. UL installations must use 600V, 75°C or 90 °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

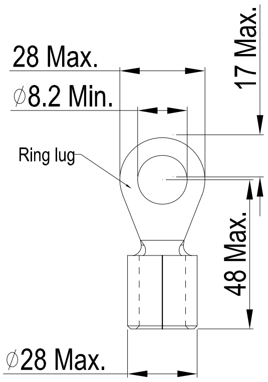
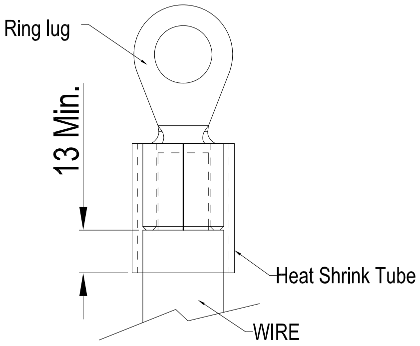
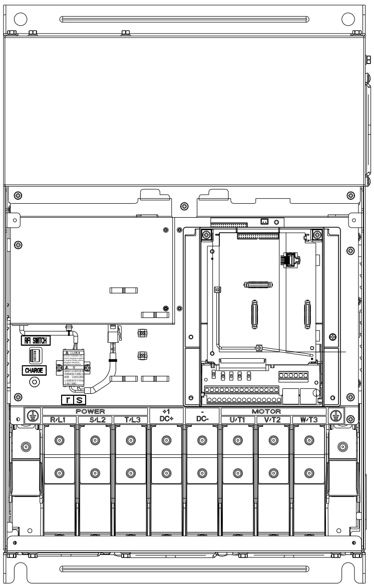


Figure 2



Frame E



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

Models	Max. Wire Gauge	Min. Wire Gauge	Torque (±10%)
VFD450C23A	300MCM*2 (152mm^2*2)	1/0AWG*2 (53.5mm^2*2)	M8 200kg-cm (173 lb-in.) (19.62Nm)
VFD550C23A		3/0AWG*2 (85mm^2*2)	
VFD750C23A		4/0 AWG*2 (107mm^2*2)	
VFD900C43A		1/0AWG*2 (53.5mm^2*2)	
VFD1100C43A		3/0AWG*2 (85mm^2*2)	
VFD450C23E	4/0 AWG*2 (107mm^2*2)	1/0AWG*2 (53.5mm^2*2)	
VFD550C23E		2/0AWG*2 (67.4mm^2*2)	
VFD750C23E		3/0AWG*2 (85mm^2*2)	
VFD900C43E		1/0AWG*2 (53.5mm^2*2)	
VFD1100C43E		2/0AWG*2 (67.4mm^2*2)	

1. UL installations must use 600V, 75°C or 90 °C wires. Use copper wire only.
2. Specification of grounding wire⏚: 300MCM [152 mm^2]
   Torque: M8 180kg-cm (156 lb-in.) (17.64Nm) (±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

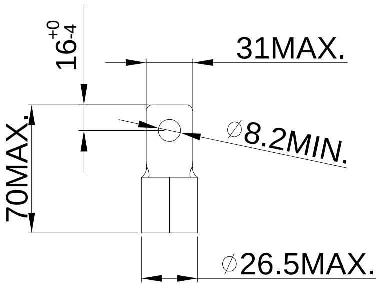


Figure 2⏚ E

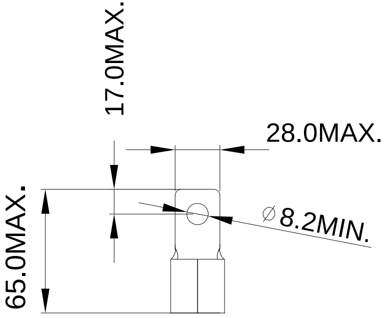
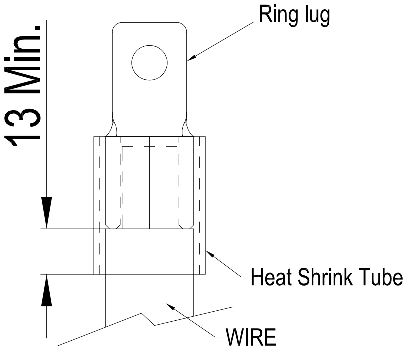
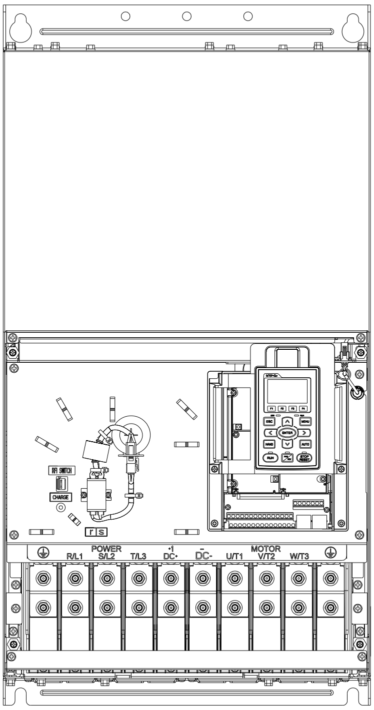


Figure 3



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 (±10%)
VFD900C23A	300MCM*2 (152mm^2*2)	300MCM*2 (152mm^2*2)	M8 200kg-cm (173 lb-in.) (19.62Nm)
VFD1320C43A		4/0 AWG*2 (107mm^2*2)	
VFD1600C43A		300MCM*2 (152mm^2)	
VFD900C23E	4/0 AWG*2 (107mm^2*2)	4/0 AWG*2 (107mm^2*2)	
VFD1320C43E		3/0AWG*2 (85mm^2*2)	
VFD1600C43E		4/0 AWG*2 (107mm^2*2)	

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

Figure 1

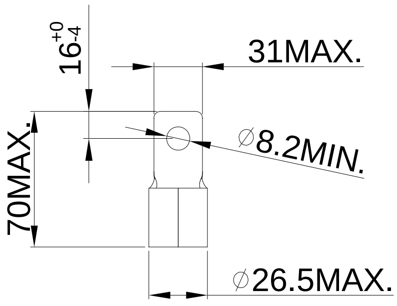
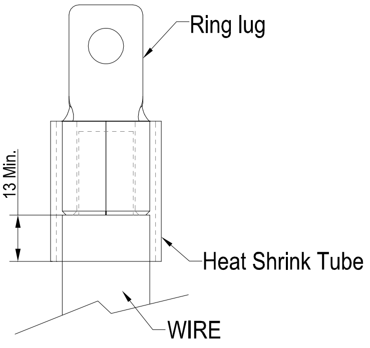
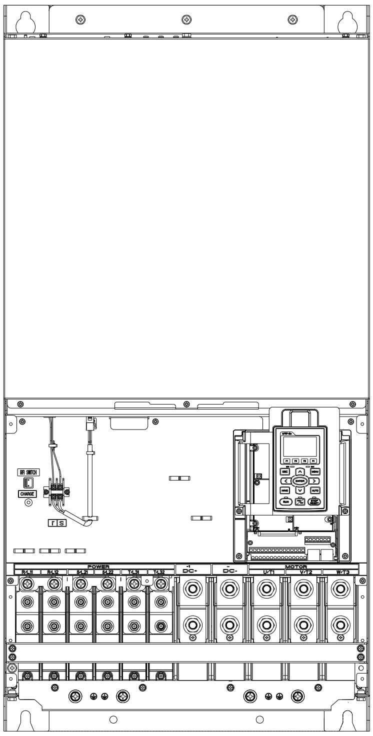


Figure 2



Frame G



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

Models	Max. Wire Gauge	Min. Wire Gauge	Torque (±10%)
VFD1850C43A	300MCM*4 (152mm^2*4)	2/0AWG*4 (67.4mm^2*4)	M8 200kg-cm (173 Ib-in.) (19.62Nm)
VFD2200C43A		3/0AWG*4 (85mm^2*4)	
VFD1850C43E		1/0AWG*4 (53.5mm^2*4)	
VFD2200C43E		2/0AWG*4 (67.4mm^2*4)	

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

Models	Max. Wire Gauge	Min. Wire Gauge	Torque (±10%)
VFD1850C43A	500MCM*2 (253mm^2*2)	400MCM*2 (203mm^2*2)	M12 408kg-cm (354lb-in.) (40Nm)
VFD2200C43A		500MCM*2 (253mm^2*2)	
VFD1850C43E		300MCM*2 (152mm^2*2)	
VFD2200C43E		400MCM*2 (203mm^2*2)	

1. UL installations must use 600V, 75℃ or 90℃ wire. Use copper wire only.
2. Use 600V, 90℃wire for VFD2200C43A when the surrounding temperature is over 45℃.
3. Figure 1 and Figure 2 show the specification for using ring lug.
4. Specification for grounding wire ⏚: 300MCM*4 [152 mm^2*2] Torque: M8 180kg-cm (156 Ib-in.) (17.64Nm) (±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,

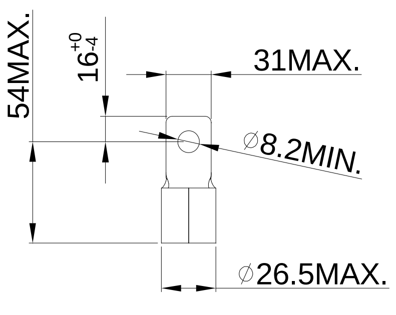


Figure2
U/T1, V/T2, W/T3, +1/DC+, -/DC-

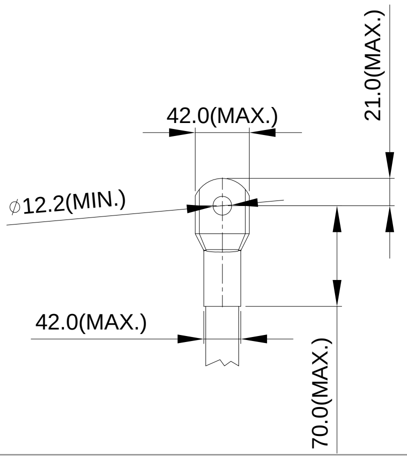


Figure 3

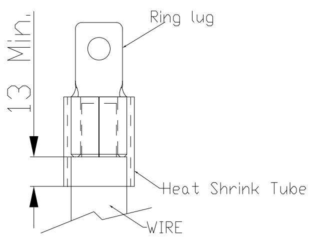
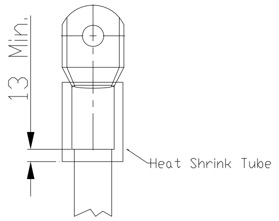
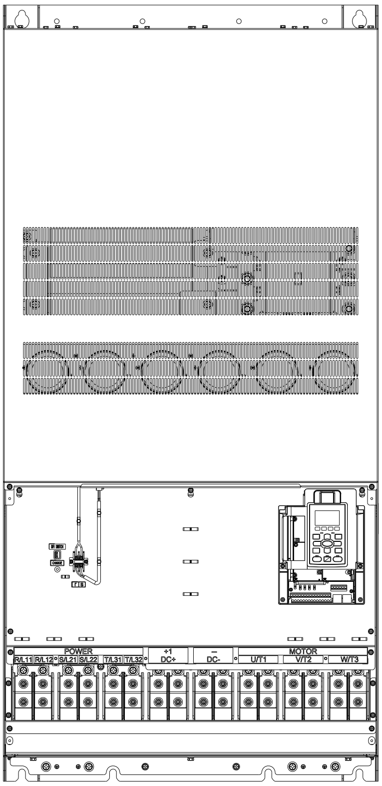


Figure 4



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	Torque (±10%)
VFD2800C43A	300MCM*4 (152mm^2*4)	4/0 AWG*4 (107mm^2*4)	M8 200kg-cm (173 lb-in.) (19.62Nm)
VFD3150C43A		300MCM*4 (152mm^2*4)	
VFD3550C43A		300MCM*4 (152mm^2*4)	
VFD4500C43A		300MCM*4 (152mm^2*4)	
VFD2800C43E-1		3/0 AWG*4 (85mm^2*4)	
VFD3150C43E-1		4/0 AWG*4 (107mm^2*4)	
VFD3550C43E-1		250MCM*4 (127mm^2*4)	
VFD4500C43E-1		250MCM*4 (127mm^2*4)	
VFD2800C43E		3/0 AWG*4 (85mm^2*4)	
VFD3150C43E		4/0 AWG*4 (107mm^2*4)	
VFD3550C43E		250MCM*4 (127mm^2*4)	
VFD4500C43E		250MCM*4 (127mm^2*4)	

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

Figure 1

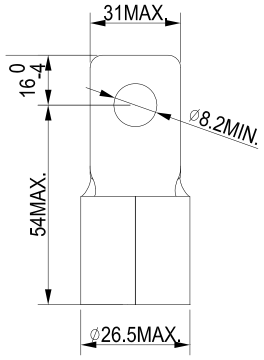
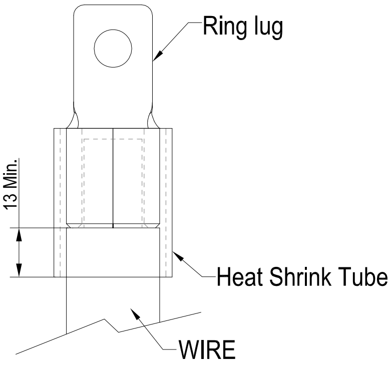


Figure 2



Chapter 6 Control Terminals

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

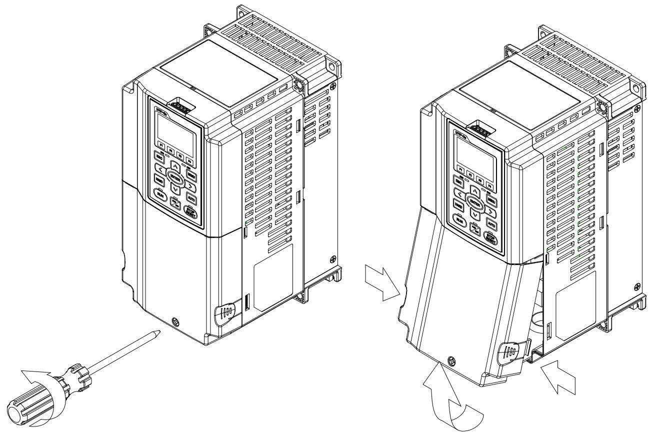
The drive appearances shown in the figures are for reference only, a real drive may look different.

Remove the cover for wiring. Frame A~H

Frame A&B

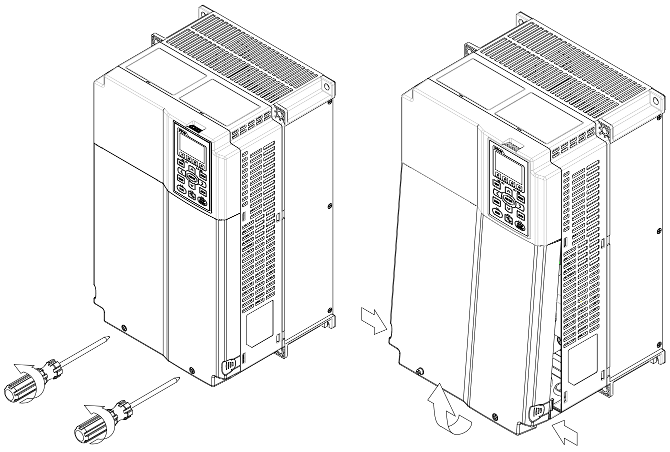
Loosen the screws and press the tabs on both sides to remove the cover.

Screw torque: 12~15Kg-cm [10.4~13Ib-in.]



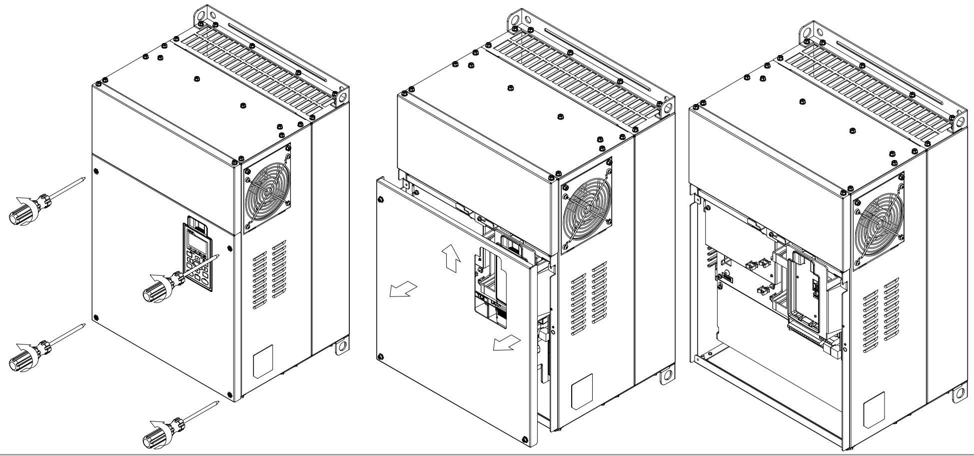
Frame C&D

Screw torque: 12~15Kg-cm [10.4~13Ib-in.]



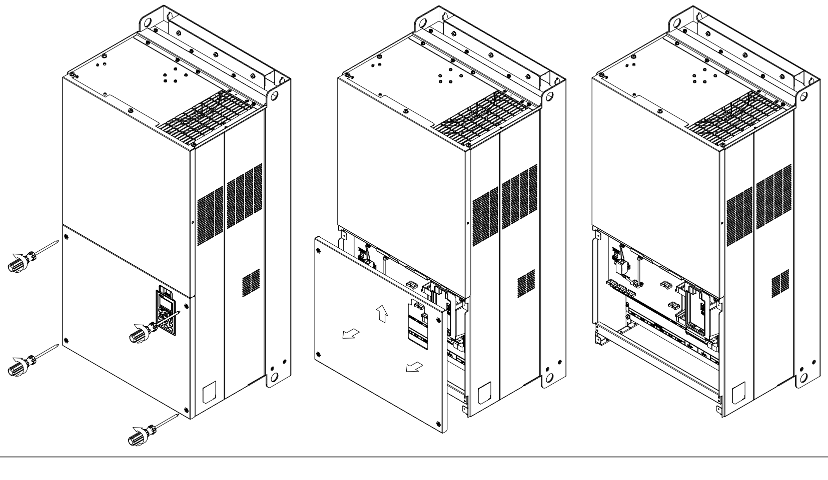
Frame E

Screw torque: 12~15Kg-cm [10.4~13Ib-in.] To remove the cover, lift it slightly and pull outward.



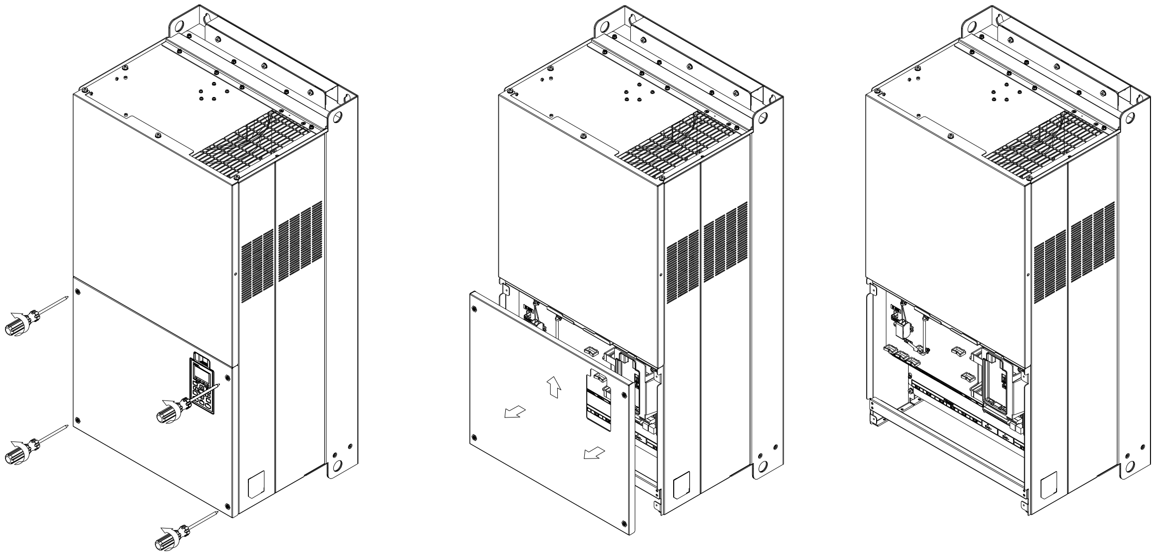
Frame F

Screw torque: 12~15Kg-cm [10.4~13Ib-in.] To remove the cover, lift it slightly and pull outward



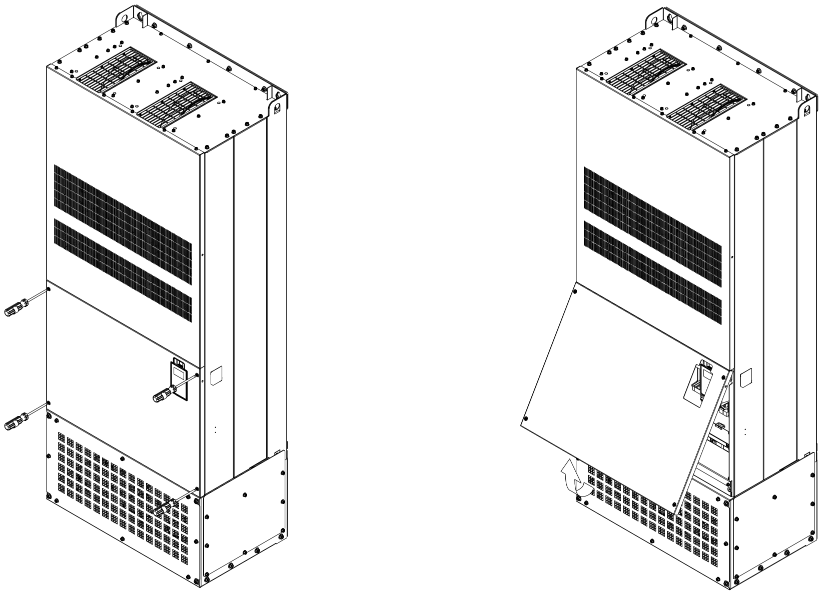
Frame G

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

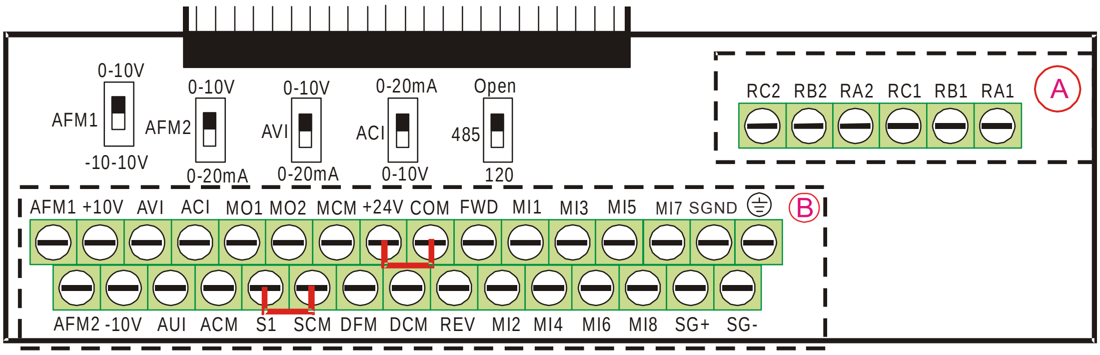


Frame H

Screw torque: 14~16Kg-cm [12.15~13.89lb-in.] To remove the cover, lift it slightly and pull outward



6-1 Specifications of Control Terminal



Removable Terminal Block

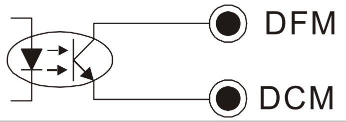
Wire Gauge: 26~16AWG（0.1281-1.318mm^2）,

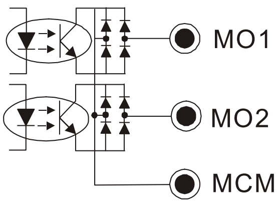
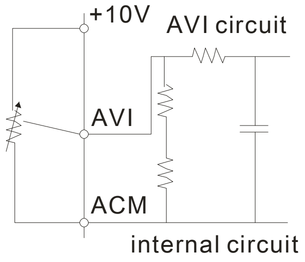
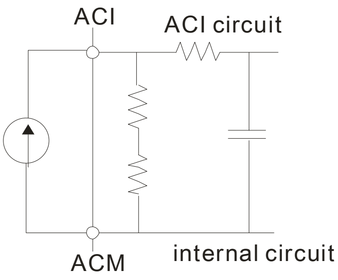
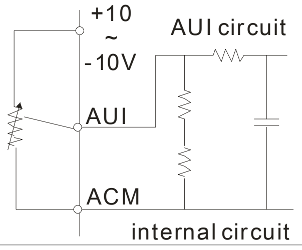
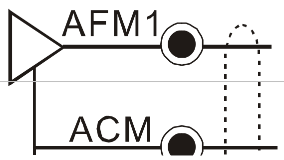
Torque: (A) 5kg-cm [4.31Ib-in.] (0.49Nm) (As shown in figure above)

(B) 8kg-cm [6.94Ib-in.] (0.78Nm) (As shown in figure above)

Wiring precautions:

- Reserves 5mm 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 3.5mm, tip thickness 0.6mm
- In the figure above, the factory setting for S1-SCM is short circuit. The factory setting for +24V-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±5% 200mA
COM	Digital control signal common (Sink)	Common for multi-function input terminals
FWD	Forward-Stop command	FWD-DCM: ON➔ forward running OFF➔ deceleration to stop
REV	Reverse-Stop command	REV-DCM: ON➔ reverse running OFF➔ deceleration to stop
MI1 ~ MI8	Multi-function input 1~8	Refer to parameters 02-01~02-08 to program the multi-function inputs MI1~MI8. ON: the activation current is 6.5mA≧11Vdc OFF: leakage current tolerance is 10μA≦11Vdc
DFM	Digital frequency meter 	Regard the pulse voltage as the output monitor signal Duty-cycle: 50% Min. load impedance: 1kΩ/100pf Max. current: 30mA Max. voltage: 30Vdc
DCM	Digital frequency signal common	
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 5A(N.O.)/3A(N.C.) 30VDC Inductive Load (COS 0.4): 2.0A(N.O.)/1.2A(N.C.) 250VAC 2.0A(N.O.)/1.2A(N.C.) 30VDC These terminals are to output monitoring signals, such as drive in operation, frequency attained or overload indication. Note: RA1 and RA2 have N.O. and N.C..
RB1	Multi-function relay output 1 (N.C.) b	
RC1	Multi-function relay common	
RA2	Multi-function relay output 2 (N.O.) a	
RB2	Multi-function relay output 2 (N.C.) b	
RC2	Multi-function relay common	
+10V	Potentiometer power supply	Analog frequency setting: +10Vdc 20mA
-10V	Potentiometer power supply	Analog frequency setting: -10Vdc 20mA
AVI	Analog voltage input 	Impedance: 20kΩ Range: 0~20mA/4~20mA/0~10V =0~Max. Output Frequency (Pr.01-00) AVI switch, factory setting is 0~10V
ACI	Analog current input 	Impedance: 250Ω Range: 0~20mA/4~20mA/0~10V= 0 ~ Max. Output Frequency (Pr.01-00) ACI Switch, factory setting is 4~20mA
AUI	Auxiliary analog voltage input 	Impedance: 20kΩ Range: -10~+10VDC=0 ~ Max. Output Frequency(Pr.01-00)
AFM1		0~10V Max. output current 2mA, Max. load 5kΩ -10~10V maximum output current 2mA, maximum load 5kΩ Output current: 2mA max Resolution: 0~10V corresponds to Max. operation

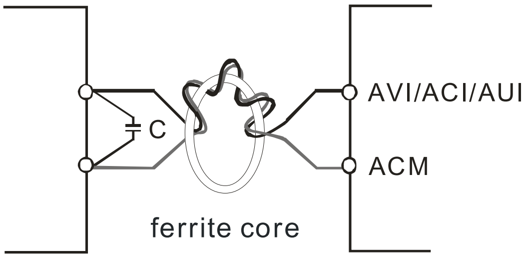
Terminals	Terminal Function	Factory Setting (NPN mode)
		frequency Range: 0~10V → -10~+10V AFM 1 Switch, factory setting is 0~10V
AFM2		0~10V Max. output current 2mA, Max. load 5kΩ 0~20mA Max. load 500Ω Output current: 20mA max Resolution: 0~10V corresponds to Max. operation frequency Range: 0~10V → 0/4~20mA AFM 2 Switch, factory setting is 0~10V
ACM	Analog Signal Common	Common for analog terminals
S1	Power removal safety function for EN954-1 and IEC/EN61508	
SCM		
SG+	Modbus RS-485	
SG-		
SGND		
RJ-45	PIN 1,2,7,8 :Reserved PIN 3, 6: SGND PIN 4: SG- PIN 5: SG+	

NOTE: Wire size of analog control signals: 18 AWG (0.75 mm^2) with shielded wire

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

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

☑ 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)

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

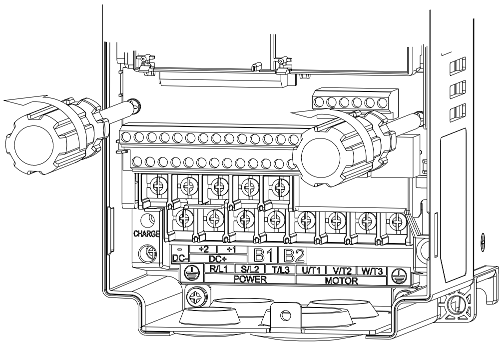
Transistor outputs (MO1, MO2, MCM)

☑ Make sure to connect the digital outputs to the right polarity.

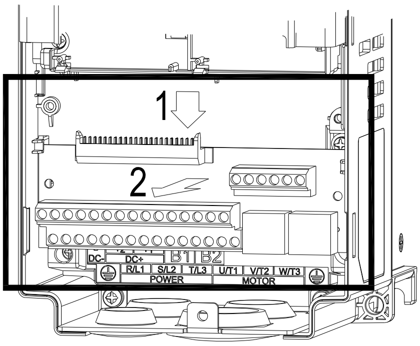
☑ When connecting a relay to the digital outputs connect a surge absorber across the coil and check the polarity.

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 6~8 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

Applicable Motor		*^{1} 125%Braking Torque 10%ED						*^{2} Max. Brake Torque		
HP	kW	Braking Torque (kg-m)	Brake Unit *^{4}VFDB	*^{3}Braking Resistor series for each Brake Unit		Resistor value spec. for each AC motor Drive	Total Braking Current (A)	Min. Resistor Value (Ω)	Max. Total Braking Current (A)	Peak Power (kW)
1	0.7	0.5	-	BR080W200*1		80W200Ω	1.9	63.3	6	2.3
2	1.5	1.0	-	BR200W091*1		200W91Ω	4.2	47.5	8	3.0
3	2.2	1.5	-	BR300W070*1		300W70Ω	5.4	38.0	10	3.8
5	3.7	2.5	-	BR400W040*1		400W40Ω	9.5	19.0	20	7.6
7.5	5.5	3.7	-	BR1K0W020*1		1000W20Ω	19	14.6	26	9.9
10	7.5	5.1	-	BR1K0W020*1		1000W20Ω	19	14.6	26	9.9
15	11	7.5	-	BR1K5W013*1		1500W13Ω	29	13.6	28	10.6
20	15	10.2	-	BR1K0W4P3*2	2 series	2000W8.6Ω	44	8.3	46	17.5
25	18	12.2	-	BR1K0W4P3*2	2 series	2000W8.6Ω	44	8.3	46	17.5
30	22	14.9	-	BR1K5W3P3*2	2 series	3000W6.6Ω	58	5.8	66	25.1
40	30	20.3	2015*2	BR1K0W5P1*2	2 series	4000W5.1Ω	75	4.8	80	30.4
50	37	25.1	2022*2	BR1K2W3P9*2	2 series	4800W3.9Ω	97	3.2	120	45.6
60	45	30.5	2022*2	BR1K5W3P3*2	2 series	6000W3.3Ω	118	3.2	120	45.6
75	55	37.2	2022*3	BR1K2W3P9*2	2 series	7200W2.6Ω	145	2.1	180	68.4
100	75	50.8	2022*4	BR1K2W3P9*2	2 series	9600W2Ω	190	1.6	240	91.2
125	90	60.9	2022*4	BR1K5W3P3*2	2 series	12000W1.65Ω	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 *^{4}VFDB	*^{3}Braking Resistor series for each Brake Unit		Resistor value spec. for each AC motor Drive	Total Braking Currnet (A)	Min. Resistor Value (Ω)	Max. Total Braking Current (A)	Peak Power (kW)
1	0.7	0.5	-	BR080W750*1		80W750Ω	1	190.0	4	3.0
2	1.5	1.0	-	BR200W360*1		200W360Ω	2.1	126.7	6	4.6
3	2.2	1.5	-	BR300W250*1		300W250Ω	3	108.6	7	5.3
5	3.7	2.5	-	BR400W150*1		400W150Ω	5.1	84.4	9	6.8
5.5 7.5	4.0 5.5	2.7 3.7	-	BR1K0W075*1		1000W75Ω	10.2	54.3	14	10.6
10	7.5	5.1	-	BR1K0W075*1		1000W75Ω	10.2	47.5	16	12.2
15	11	7.5	-	BR1K5W043*1		1500W43Ω	17.6	42.2	18	13.7
20	15	10.2	-	BR1K0W016*2	2 series	2000W32Ω	24	26.2	29	22.0
25	18	12.2	-	BR1K0W016*2	2 series	2000W32Ω	24	23.0	33	25.1
30	22	14.9	-	BR1K5W013*2	2 series	3000W26Ω	29	23.0	33	25.1
40	30	20.3	-	BR1K0W016*4	2 parallel, 2 series	4000W16Ω	47.5	14.1	54	41.0
50	40	25.1	4045*1	BR1K2W015*4	2 parallel, 2 series	4800W15Ω	50	12.7	60	45.6
60	45	30.5	4045*1	BR1K5W013*4	2 parallel, 2 series	6000W13Ω	59	12.7	60	45.6
75	55	37.2	4030*2	BR1K0W5P1*4	4 parallel	8000W10.2Ω	76	9.5	80	60.8
100	75	50.8	4045*2	BR1K2W015*4	2 parallel, 2 series	9600W7.5Ω	100	6.3	120	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 Curret (A)	Min. Resistor Value (Ω)	Max. Total Braking Current (A)	Peak Power (kW)
125	90	60.9	4045*2	BR1K5W013*4	2 parallel, 2 series	12000W6.5Ω	117	6.3	120	91.2
150	110	74.5	4110*1	BR1K2W015*10	5 parallel, 2 series	12000W6Ω	126	6.0	126	95.8
175	132	89.4	4160*1	BR1K5W012*12	6 parallel, 2 series	18000W4Ω	190	4.0	190	144.4
215	160	108.3	4160*1	BR1K5W012*12	6 parallel, 2 series	18000W4Ω	190	4.0	190	144.4
250	185	125.3	4185*1	BR1K5W012*14	7 parallel, 2 series	21000W3.4Ω	225	3.4	225	172.1
300	220	148.9	4110*2	BR1K2W015*10	5 parallel, 2 series	24000W3Ω	252	3.0	252	190.5
375	280	189.6	4160*2	BR1K5W012*12	6 parallel, 2 series	36000W2Ω	380	2.0	380	288.8
425	315	213.3	4160*2	BR1K5W012*12	6 parallel, 2 series	36000W2Ω	380	2.0	380	288.8
475	355	240.3	4185*2	BR1K5W012*14	7 parallel, 2 series	42000W1.7Ω	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%ED is 10sec (on: 10sec/ off: 90sec).

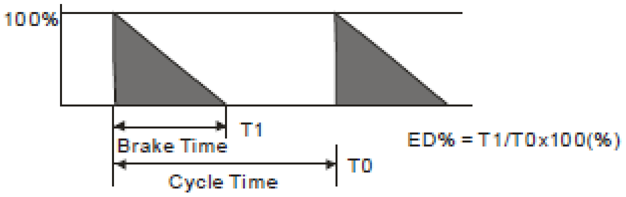
*[2] Please refer to the Brake Performance Curve for “Operation Duration & ED” vs. “Braking Current”.

*[3] For heat dissipation, a resistor of 400W or lower should be fixed to the frame and maintain the surface temperature below 50℃; a resistor of 1000W and above should maintain the surface temperature below 350℃.

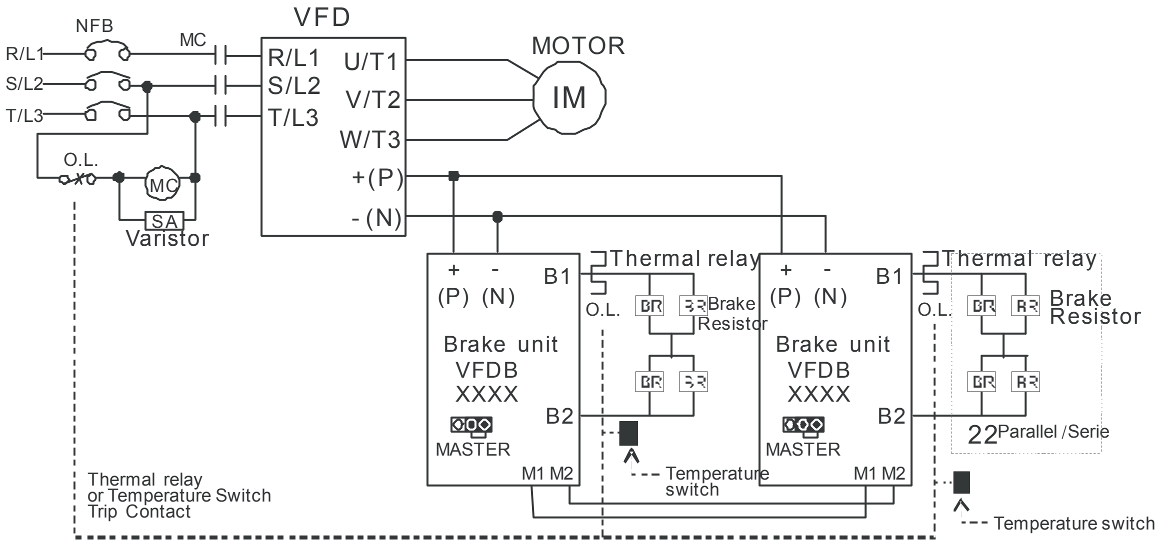
*[4] Please refer to VFDB series Braking Module Instruction for more detail on braking resistor.

NOTE

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.



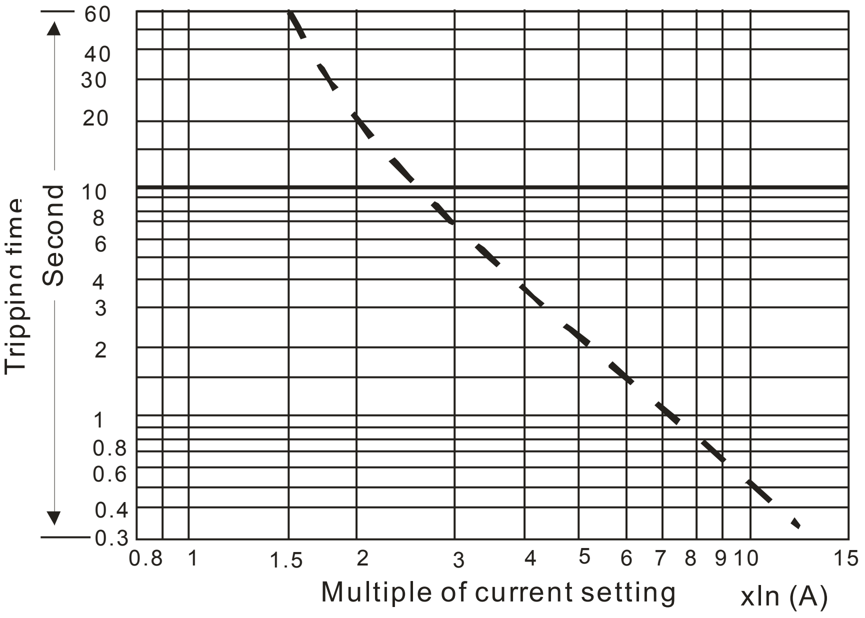
For safety concern, install an overload relay (O.L) between the brake unit and the brake resistor in conjunction with the magnetic contactor (MC) prior to the drive for abnormal protection. The purpose of installing the thermal overload relay is to protect the brake resistor from damage due to frequent 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.



- When AC Drive is equipped with a DC reactor, please read user manual to know th wiring method of input circuit of brake unit +(P).
- Do Not connect input circuit -(N) to the neutral point of the power system.

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 AC motor drive is applied for frequent braking, it is suggested to enlarge 2~3 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 406V, 110kw 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 non-fuse 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 non-fuse breaker(A)
VFD007C43A/E	5
VFD015C43A/E	10
VFD022C43A/E	15
VFD040C43A/E	20
VFD037C43A/E	20
VFD055C43A/E	30
VFD075C43A/E	40
VFD110C43A/E	50
VFD150C43A/E	60
VFD185C43A/E	75
VFD220C43A/E	100
VFD300C43A/E	125
VFD370C43A/E/S/U	150
VFD450C43A/E/S/U	175
VFD550C43A/E	250
VFD750C43A/E	300
VFD900C43A/E	300
VFD1100C43A/E	400
VFD1320C43A/E	500
VFD1600C43A/E	600
VFD1850C43A/E	600
VFD2200C43A/E	800
VFD2800C43A/E	1000
VFD3150C43A/E	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	I (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.

230V, 50/60Hz, 3-phase

kW	HP	Nominal Amps (rms)	Saturation Current (rms)	Inductance（mh）	
				3% impedance	5% impedance
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

460V, 50/60Hz, 3-phase

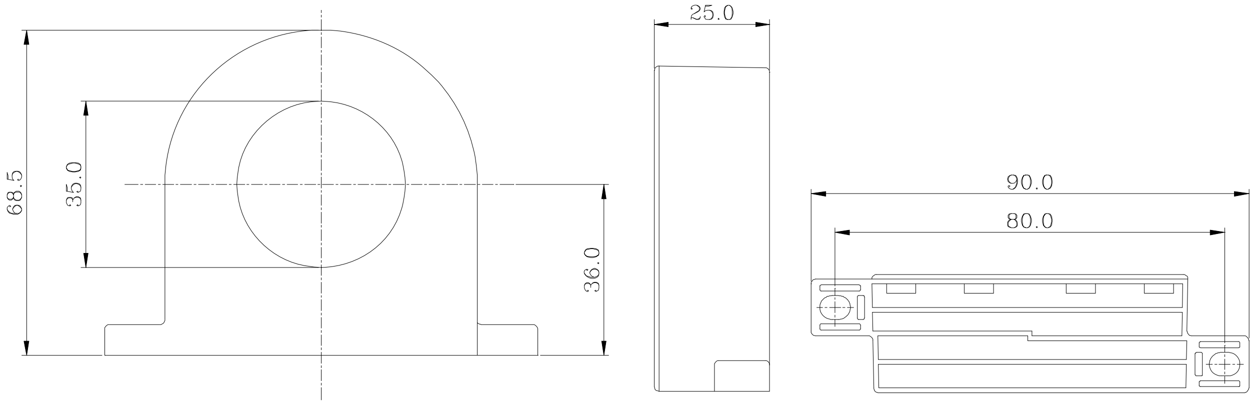
kW	HP	Nominal Amps (rms)	Saturation Current (rms)	Inductance（mh）	
				3% impedance	5% impedance
0.75	1	3	6	7.045	11.741
1.5	2	4	8	5.284	8.806
2.2	3	6	12	3.522	5.871
3.7	5	9	18	2.348	3.914
4	5	10.5	21	2.013	3.355
5.5	7.5	12	24	1.761	2.935
7.5	10	18	36	1.174	1.957
11	15	24	48	0.881	1.468
15	20	32	64	0.660	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	683	1366	0.031	0.052

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

7-5 Zero Phase Reactors (Chokes)

RF220X00A

UNIT: mm (inch)



Cable type (Note)	Recommended Wire Size (mm^2)			Qty.	Wiring Method
	AWG	mm^2	Nominal (mm^2)		
Single-core	≤10	≤5.3	≤5.5	1	Diagram A
	≤2	≤33.6	≤38	4	Diagram B
Three-core	≤12	≤3.3	≤3.5	1	Diagram A
	≤1	≤42.4	≤50	4	Diagram B

NOTE

600V 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.

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.

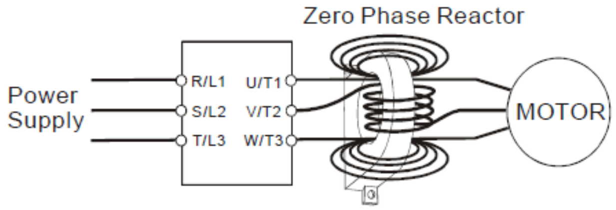
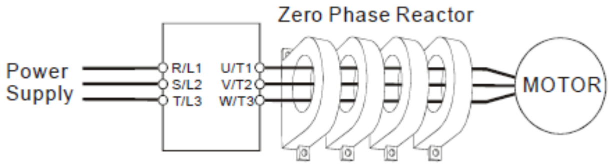


Diagram B

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）
230Vac 50/60Hz 3-Phase	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 50/60Hz 3-Phase	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
	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; VFD015C23A; VFD022C23A; VFD037C23A;	KMF325A	http://www.dem-uk.com/roxburgh/products/industrial_emc_filters/kmfa_three_phase_industrial_mains_filters_high_performance/ KMF325A Three Phase Industrial Mains Filters - High Performance 25 Amps
VFD055C23A; VFD075C23A; VFD110C23A;	KMF370A	http://www.dem-uk.com/roxburgh/products/industrial_emc_filters/kmfa_three_phase_industrial_mains_filters_high_performance/ 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_industrial_mains_filters_high_performance/ KMF3100A Three Phase Industrial Mains Filters - High Performance 100 Amps
VFD300C23A; VFD370C23A;	MIF3150	http://www.dem-uk.com/roxburgh/products/industrial_emc_filters/mif3_three_phase_industrial_multi_stage_drive_filters/ MIF3150 Three Phase Industrial Multi Stage Drive Filters - Very High Performance 150 Amps
VFD450C23A; VFD550C23A; VFD750C23A; VFD900C23A;	MIF3400B	http://www.dem-uk.com/roxburgh/products/industrial_emc_filters/mif3_three_phase_industrial_multi_stage_drive_filters/ 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_industrial_mains_filters_high_performance/ 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_industrial_mains_filters_high_performance/ 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_industrial_mains_filters_high_performance/ 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_industrial_multi_stage_drive_filters/ 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_industrial_multi_stage_drive_filters/ MIF3400B Three Phase Industrial Multi Stage Drive Filters - Very High Performance 400 Amps
VFD1850C43A/E; VFD2200C43A/E;	MIF3800 & Ring Cores *3	http://www.dem-uk.com/roxburgh/products/industrial_emc_filters/mif3_three_phase_industrial_multi_stage_drive_filters/ MIF3800 Three Phase Industrial Drive Filters - Very High Performance 800 Amps Ring Core Part No. : T102-15

Model	Applicable EMI Filter	Reference Website
VFD2800C43A/E; VFD3150C43A/E; VFD3550C43A/E;	MIF3800 & Ring Cores *2	http://www.dem-uk.com/roxburgh/products/industrial_emc_filters/mif3_three_phase_industrial_multi_stage_drive_filters/ MIF3800 Three Phase Industrial Drive Filters - Very High Performance 800 Amps 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 (1st 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.

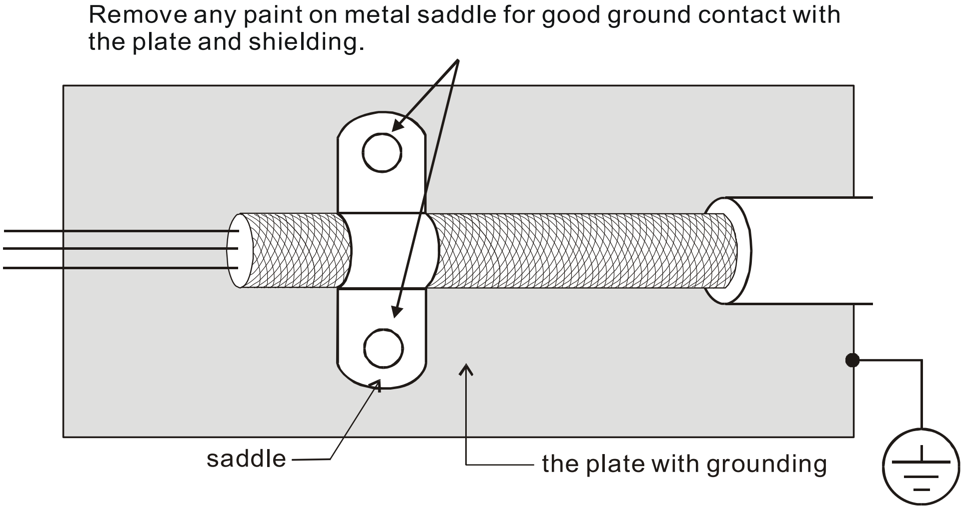
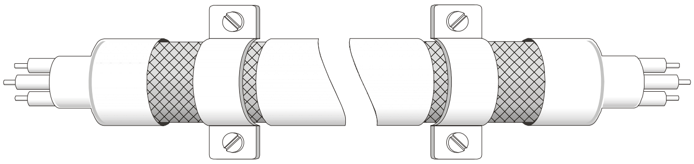
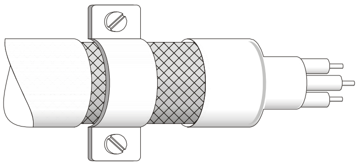


Figure 1



Saddle on both ends



Saddle on one end

Figure 2

The length of motor cable

1. Cable length suggestion for Drive in full load

a. Non-shielded cables:

For 5.5kW(7.5HP) model and below, max. cable length between the drive and motor is 328ft (100m). For 7.5kW(10HP) model and above is 656ft (200m).

b. Shielded cables:

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

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 460V 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≧7.5kW(10HP)

Motor Insulation level	1000V	1300V	1600V
Input 460VAC	66 ft (20m)	328 ft (100m)	1312 ft (400m)
Input 230VAC	1312 ft (400m)	1312 ft (400m)	1312 ft (400m)

For drive power range≦5.5kW(7.5HP)

Motor Insulation level	1000V	1300V	1600V
Input 460VAC	66 ft (20m)	165 ft (100m)	165 ft (400m)
Input 230VAC	328 ft (400m)	328 ft (400m)	328 ft (400m)

7-8 Digital Keypad

7-8-1 KPC-CE01

A: LED Display

Display frequency, current, voltage and error etc.

B: Status Indicator

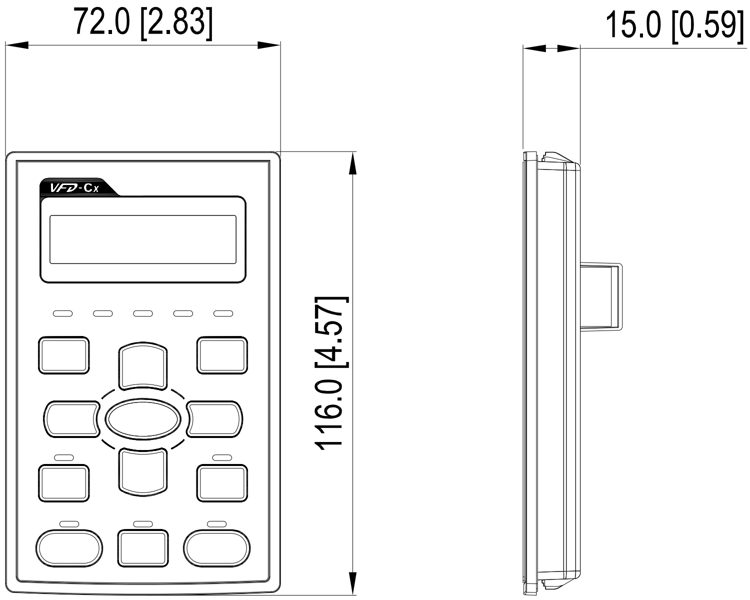
F: Frequency Command
H: Output Frequency
U: User Defined Units
ERR: CAN Error Indicator
RUN: CAN Run Indicator

C: Function

(Refer to the chart follows for detail description)

Key	Description
ESC	ESC Key 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 Press MENU key under any condition will return to the main MENU. Menu content: 1. Parameter Detail 3. Keypad locked 2. Copy Parameter 4. PLC Function
ENTER	ENTER Key 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 1. HAND key will operates according to the parameter settings when the source of HAND master frequency command and the source of HAND operation command is properly set,. The factory setting of the source command for frequency and operation are from the digital keypad . 2. Press HAND key in stop status, the drive setting switches to the parametr setting of HAND. Press HAND key in during operation, the drive will come to stop then switches to the parameter setting of HAND. 3. When process complete: H/A LED ON.
AUTO	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. 3. When process complete: H/A LED is OFF
FWD/REV	Operation Direction Key 1. FWD/REV key controls the operation direction but will NOT activate the drive. FWD: forward, REV: reverse. 2. The drive operates in the direction as shown by the LED light.
RUN	Start Key 1. It is only valid when the source of operation command is from the keypad. 2. Press the RUN key, the drive will according to the start-up setting and the RUN LED will be ON. 3. RUN key can be pressed for many times when the drive is in stop status. 4. “HAND” mode is enabled only when the source of operation command is by keypad.
STOP	Stop Key. 1. STOP key has the highest priority in command. 2. Press STOP key, the drive will come to stop under any condition. 3. The RESET key can be used to reset the drive when faults occur. If the RESET key is not responding, check MENU → Fault Records and checck the most recent fault.

7-8-2 **Dimension**



7-8-3 RJ45 Extension Lead for Digital Keypad

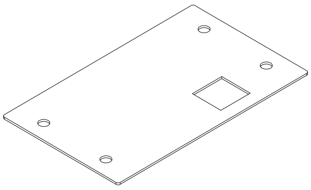
Part #	Description
CBC-K3FT	3 feet RJ45 extension lead (approximately 0.9m)
CBC-K5FT	5 feet RJ45 extension lead (approximately 1.5 m)
CBC-K7FT	7 feet RJ45 extension lead (approximately 2.1 m)
CBC-K10FT	10 feet RJ45 extension lead (approximately 3 m)
CBC-K16FT	16 feet RJ45 extension lead (approximately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

7-9 Panel Mounting (MKC-KPPK)

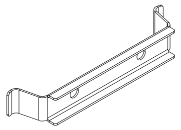
For MKC-KPPK model, user can choose wall mounting or embedded mounting, protection level is IP56.

Applicable to the digital keypads (KPC-CC01 & KPC-CE01).

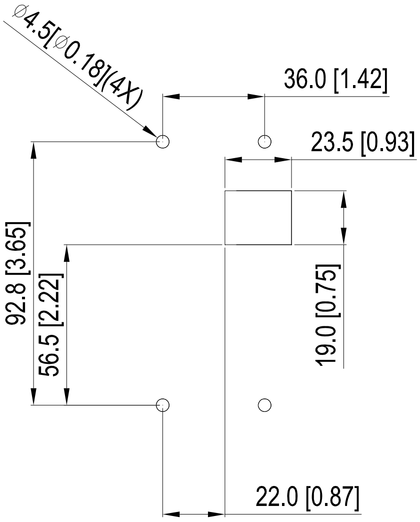
<table>
<tr><th>Wall Mounting</th><th>Embedded Mounting</th></tr>
<tr><td>accessories*1

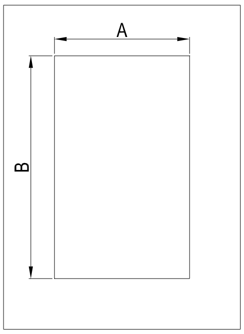


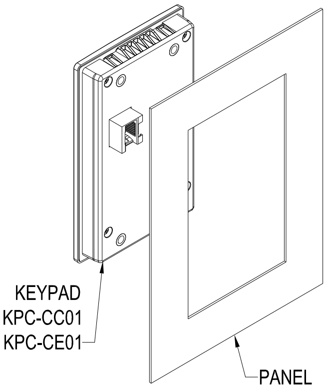
Screw *4 ~M4*p 0.7 *L8mm
Torque: 10-12kg-cm (8.7-10.4lb-in.)</td>
<td>accessories*2



Screw *4 ~M4*p 0.7 *L8mm
Torque: 10-12kg-cm (8.7-10.4lb-in.)</td></tr>
<tr><td>Panel cutout dimension Unit: mm [inch]


</td>
<td>Panel cutout dimension Unit: mm [inch]





Normal cutout dimension

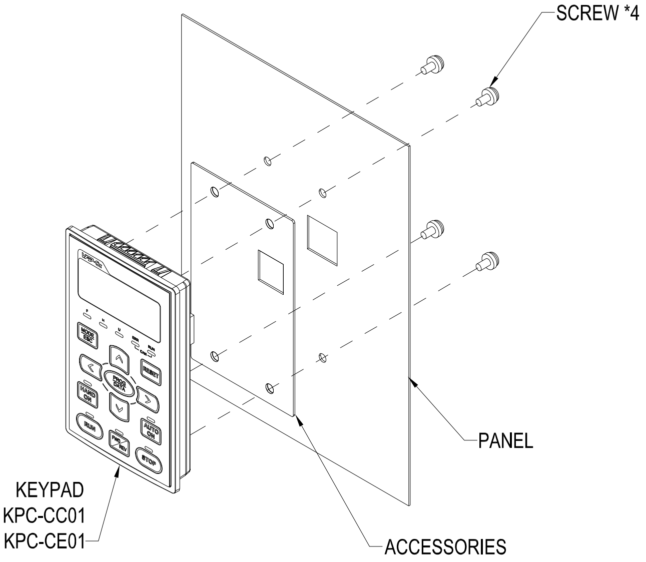
<table>
<tr><th>Panel thickness</th><th>1.2mm</th><th>1.6mm</th><th>2.0mm</th></tr>
<tr><td>A</td><td colspan="3">66.4 [2.614]</td></tr>
<tr><td>B</td><td>110.2 [4.339]</td><td>111.3 [4.382]</td><td>112.5 [4.429]</td></tr>
</table>

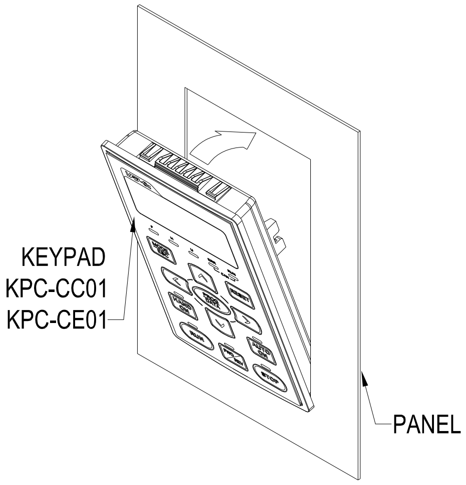
*Deviation: ±0.15mm /±0.0059inch

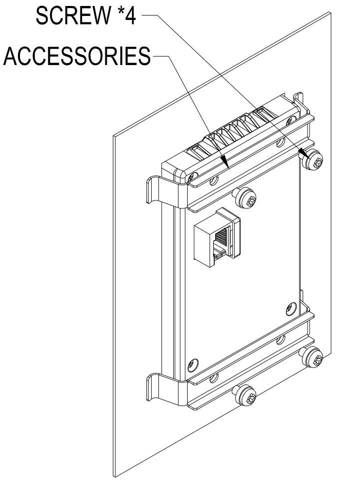
Cutout dimension (Waterproof level: IP56)

<table>
<tr><th>Panel thickness</th><th>1.2mm</th><th>1.6mm</th><th>2.0mm</th></tr>
<tr><td>A</td><td colspan="3">66.4 [2.614]</td></tr>
<tr><td>B</td><td colspan="3">110.8 [4.362]</td></tr>
</table>

*Deviation: ±0.15mm /±0.0059inch</td></tr>
</table>


SCREW *4
PANEL
KEYPAD
KPC-CC01
KPC-CE01
ACCESSORIES


KEYPAD
KPC-CC01
KPC-CE01
PANEL


SCREW *4
ACCESSORIES

7-10 Conduit Box Kit

■ Appearance

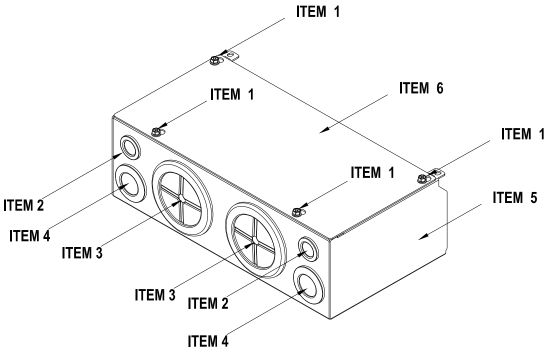
Frame D

Applicable models

VFD300C23A/23E; VFD370C23A/23E;VFD370C43A/43E; VFD450C43A/43E; VFD550C43A/43E; VFD750C43A/43E

Model number『MKC-DN1CB』

ITEM	Description	Qty.
1	Screw M5*0.8*10L	4
2	Rubber28	2
3	Rubber44	2
4	Rubber88	2
5	Conduit box cover	1
6	Conduit box base	1



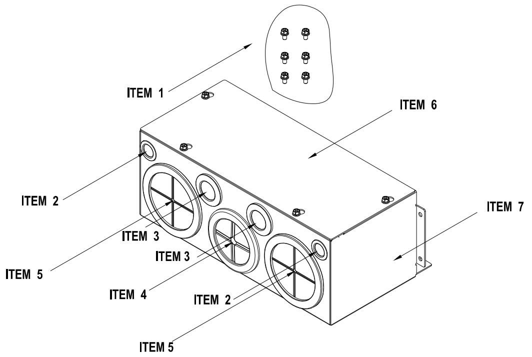
Frame E

Applicable models

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

Model number『MKC-EN1CB』

ITEM	Description	Qty.
1	Screw M5*0.8*10L	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



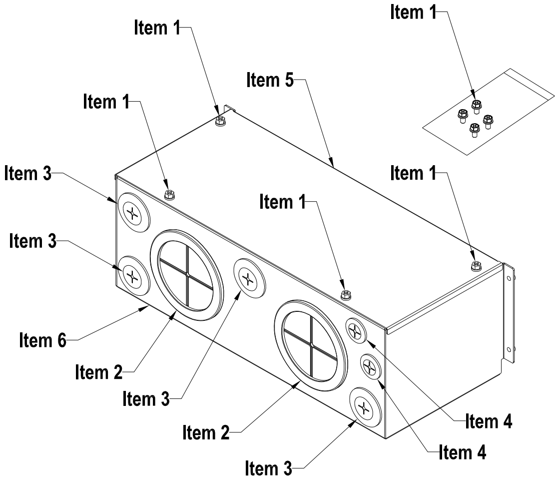
Frame F

Applicable models

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

Model number『MKC-FN1CB』

ITEM	Description	Qty.
1	Screw M5*0.8*10L	8
2	Bushing Rubber28	2
3	Bushing Rubber 44	4
4	Bushing Rubber 100	2
5	Conduit box cover	1
6	Conduit box base	1



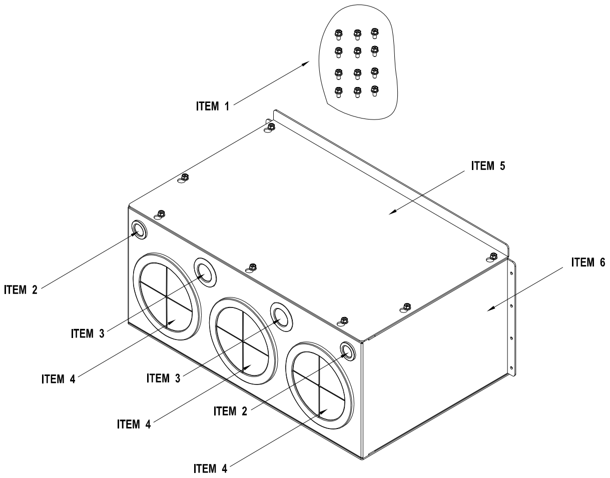
Frame G

Applicable models

VFD1850C43A/43E; VFD2200C43A/43E

Model number『MKC-GN1CB』

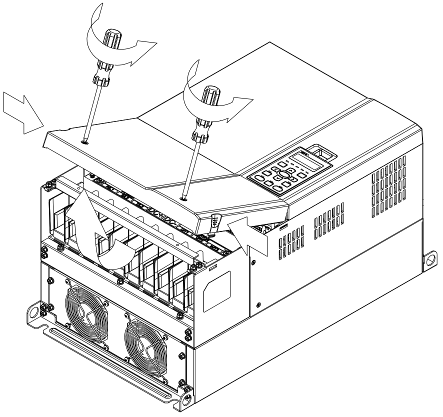
ITEM	Description	Qty.
1	Screw M5*0.8*10L	12
2	Bushing Rubber 28	2
3	Bushing Rubber 44	2
4	Bushing Rubber 130	3
5	Conduit box base	1
6	Conduit box cover	1



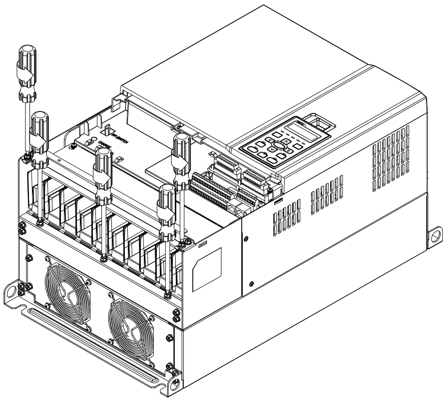
Conduit Box Installation

Frame D

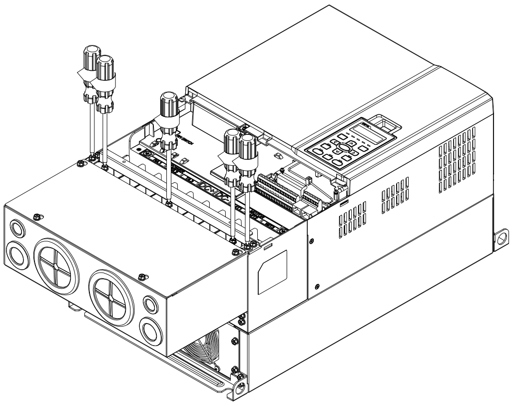
1. Loosen the cover screws and press the tabs on each side of the cover to remove the cover, as shown in the following figure. Screw torque: 10~12kg-cm (8.66~10.39Ib-in)



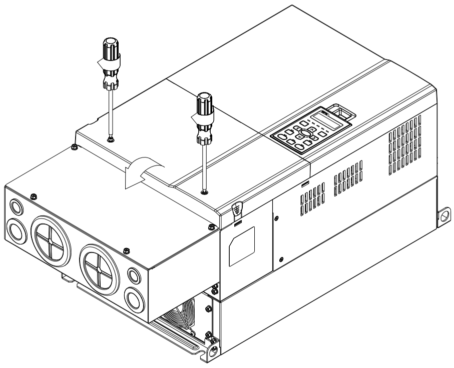
2. Remove the 5 screws shown in the following figure. Screw torque: 24~26kg-cm (20.8~22.6Ib-in).



3. Install the conduit box by fasten the 5 screws shown in the following figure.
Screw torque: 24~26kg-cm (20.8~22.6Ib-in).

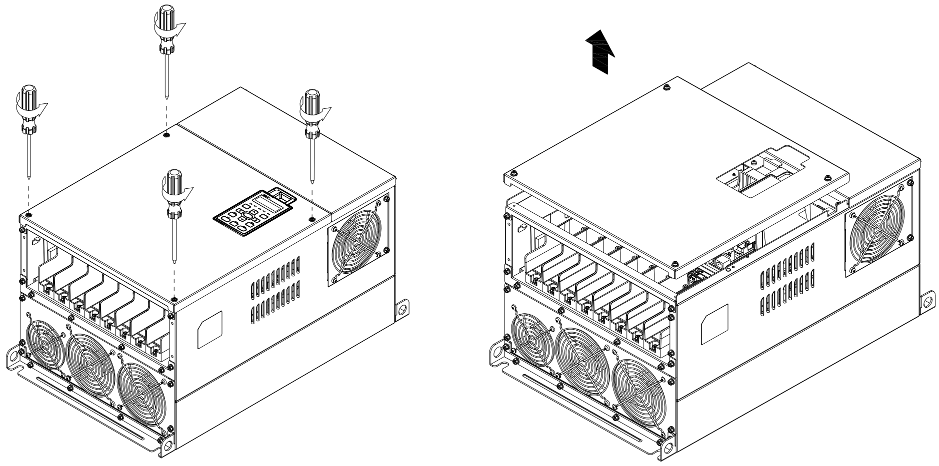


4. Fasten the 4 screws shown in the following figure. Screw torque: 10~12kg-cm (8.66~10.39Ib-in).

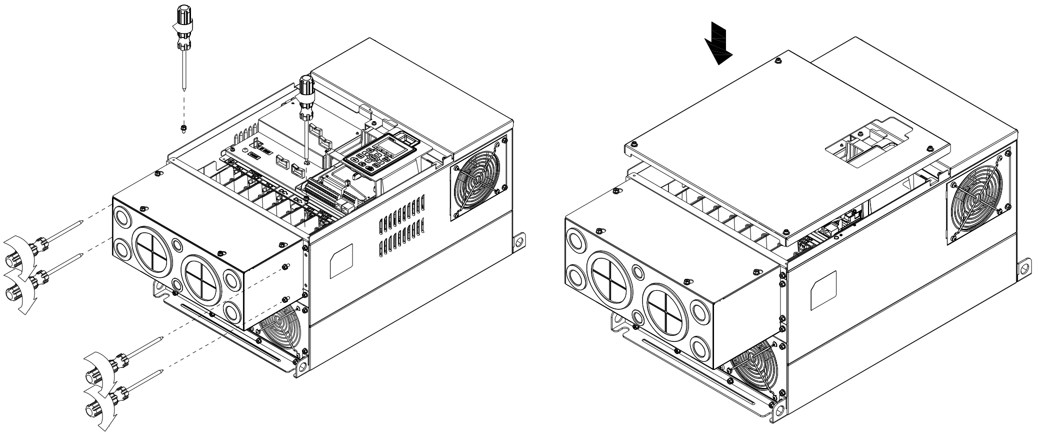


Frame E

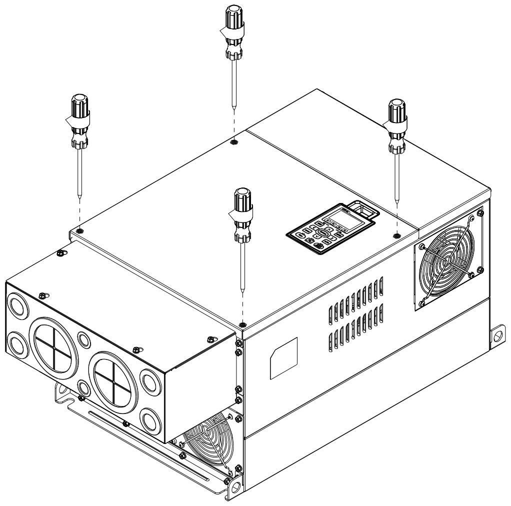
1. Loosen the 4 cover screws and lift the cover; Screw torque: 12~ 15 kg-cm (10.4~13Ib-in).



2. Fasten the 6 screws shown in the following figure and place the cover back to the original position. Screw torque: 24~26kg-cm (20.8~22.6Ib-in).

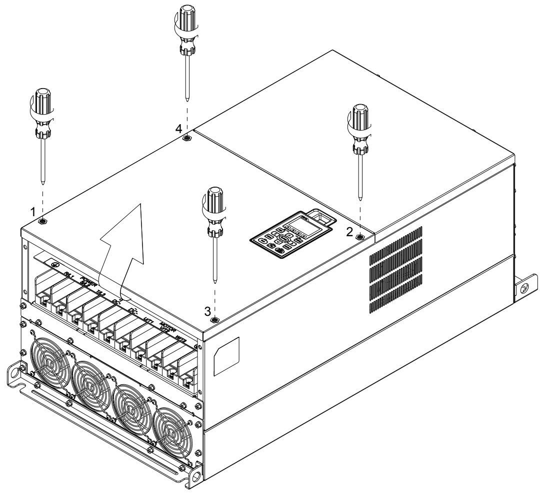


3. Fasten the 4 screws shown in the following figure. Screw torque:12~15kg-cm (10.4~13Ib-in)』

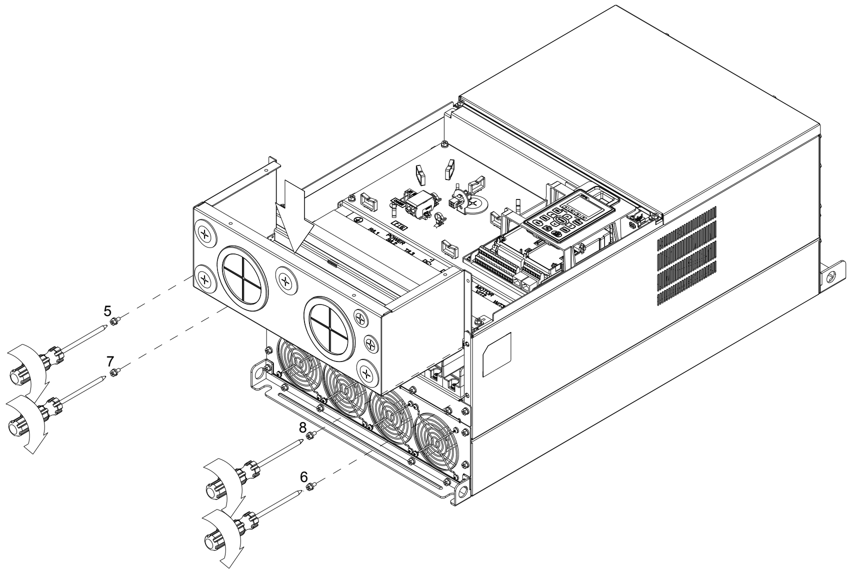


Frame F

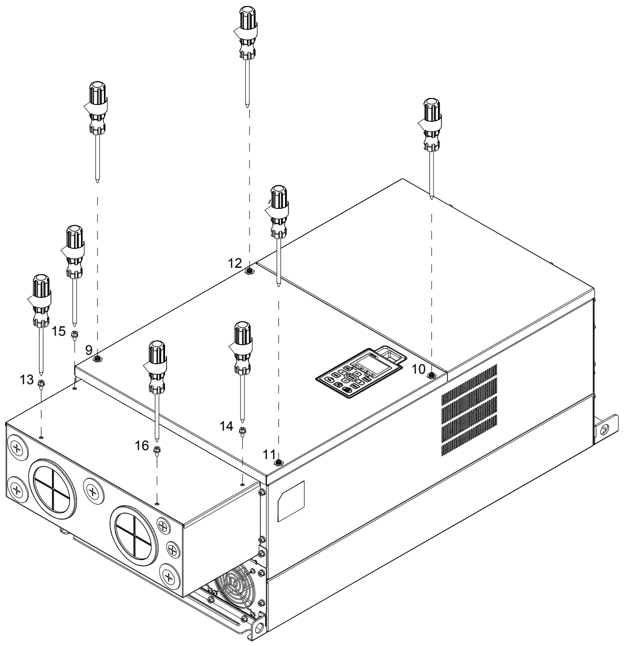
1. Loosen the cover screws and press the tabs on each side of the cover to remove the cover, as shown in the following figure. Screw torque: 14~16kg-cm (12.2~13.9Ib-in).



2. Install the conduit box by fastens the 4 screws, as shown in the following figure. Screw torque: 24~26kg-cm (20.8~22.6Ib-in).

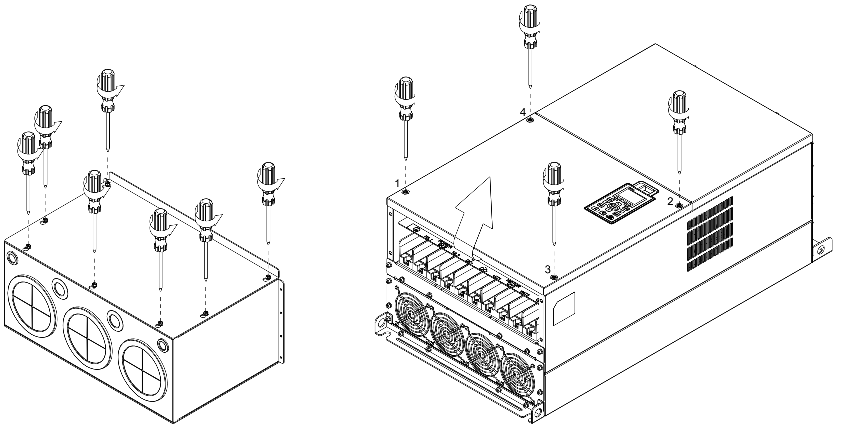


3. Install the conduit box by fasten all the screws shown in the following figure

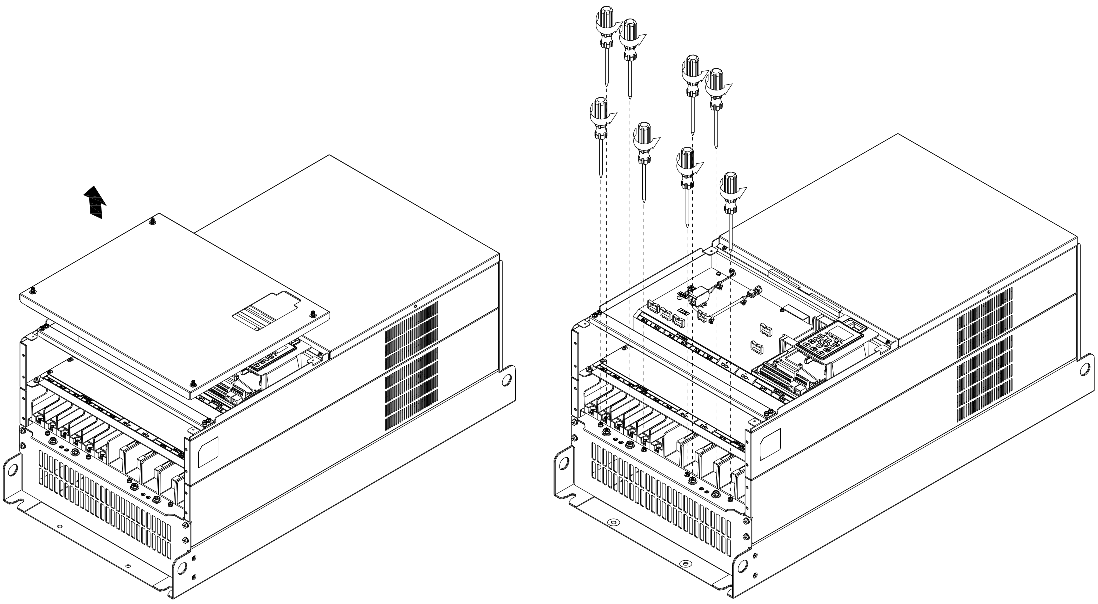


Frame G

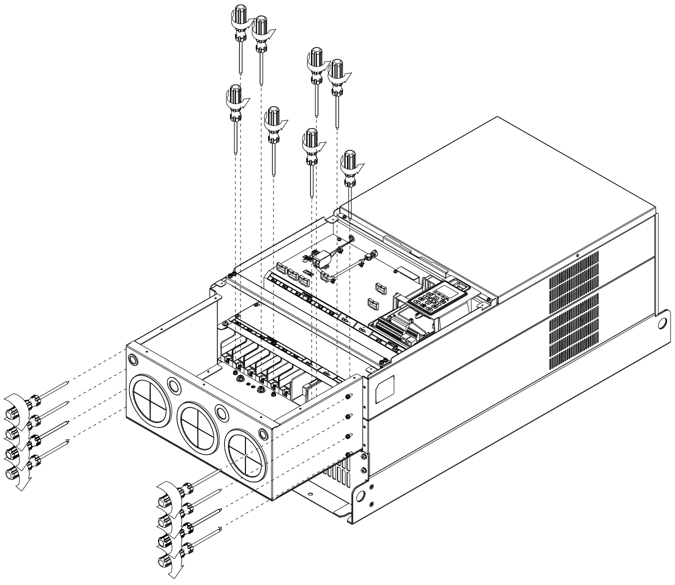
1. On the conduit box, loosen 7 of the cover screws and remove the cover. On the drive, loosen 4 of the cover screws and press the tabs on each side of the cover to remove the cover, as shown in the following figure. Screw torque: 12~15kg-cm (10.4~13Ib-in).



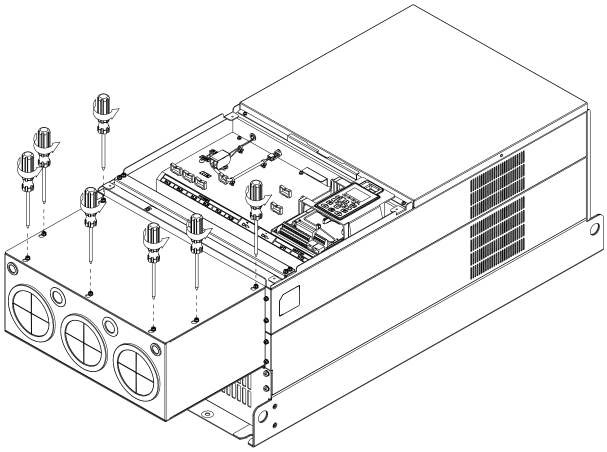
Remove the top cover and loosen the screws. Screw torque: 12~15kg-cm (10.4~13Ib-in).



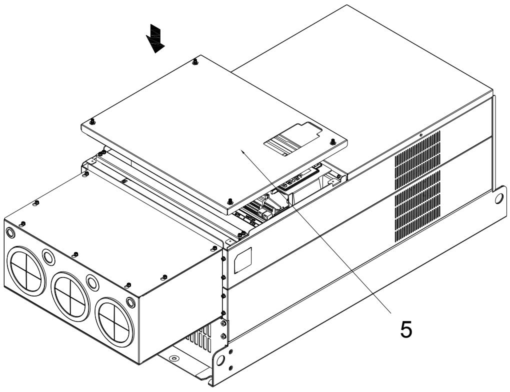
2. Install the conduit box by fastening all the screws shown in the following figure.
Screw torque: 25~30kg-cm (20.8~30Ib-in); Screw torque: 12~15kg-cm (10.4~13Ib-in)

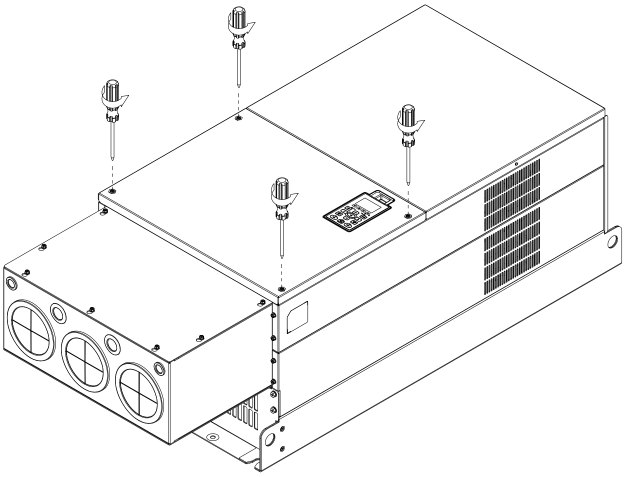


Fasten all the screws. Screw torque: 25~30kg-cm (20.8~30Ib-in).



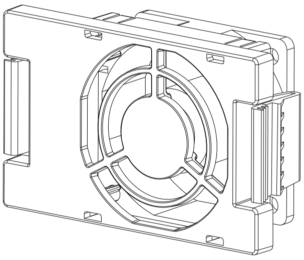
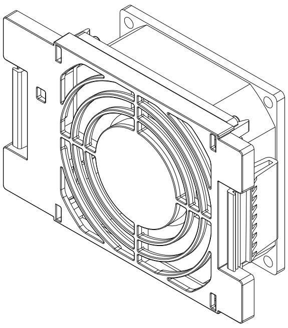
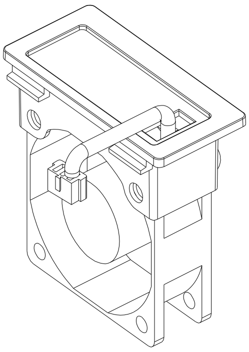
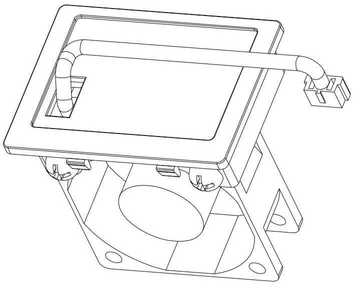
Place the cover back to the top and fasten the screws (as shown in the figure).
Screw torque: 12~15kg-cm (10.4~13Ib-in).

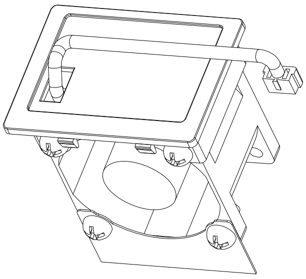
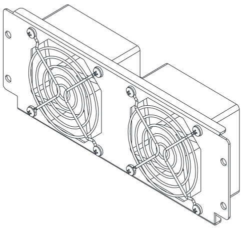
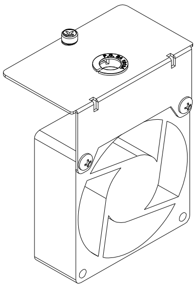
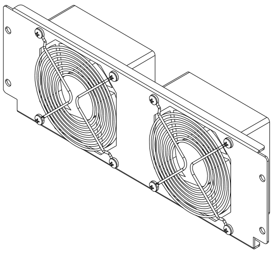
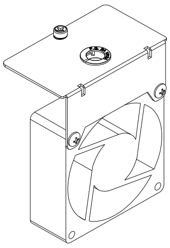
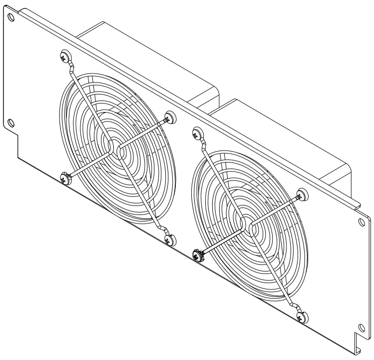
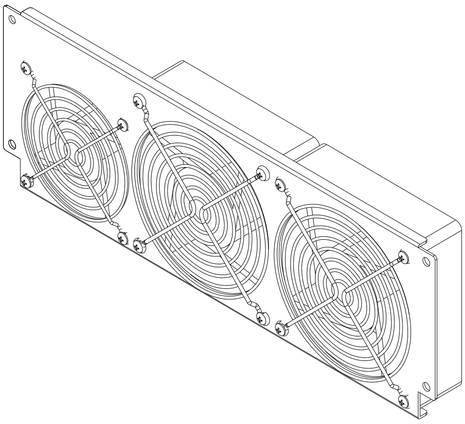


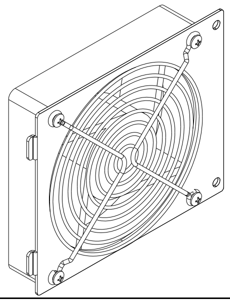


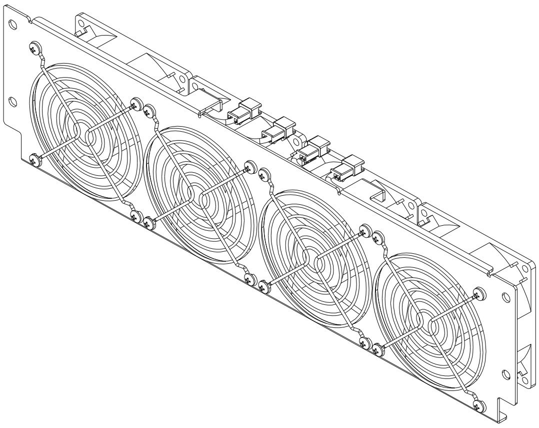
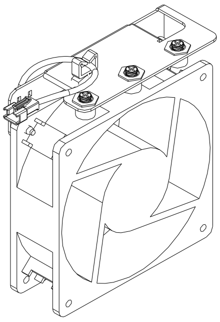
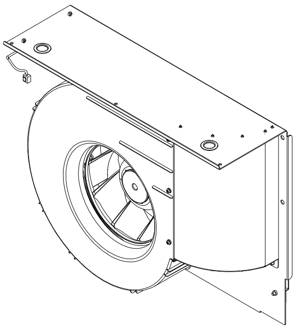
7-11 Fan Kit

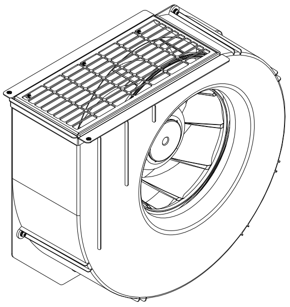
- Frames of the fan kit

Frame A Applicable Model VFD015C23A; VFD022C23A; VFD037C23A;VFD022C43A/43E; VFD037C43A/43E;VFD040C43A/43E; VFD055C43A/43E	Model『MKC-AFKM』 
Frame B Applicable Model VFD055C23A; VFD075C43A/43E	Model『MKC-BFKM1』 
Frame B Applicable Model VFD075C23A; VFD110C23A; VFD110C43A/43E; VFD150C43A/43E	Model 『MKC-BFKM2』
Frame B Applicable Model VFD055C23A; VFD075C23A; VFD110C23A;VFD075C43A/43E; VFD110C43A/43E;VFD150C43A/43E	Model 『MKC-BFKB』 
Frame C Applicable Model VFD150C23A; VFD185C23A; VFD220C23A	Model 『MKC-CFKB1』 

Frame C Applicable Model VFD185C43A/43E; VFD220C43A/43E;VFD300C43A/43E	Model 『MKC-CFKB2』 	
Frame D0 Applicable Model VFD370C43S/43U; VFD450C43S/43U;	Model『MKC-D0FKM』 	Model 『MKC-DFKB』 
Frame D Applicable Model VFD300C23A/23E; VFD370C23A/23E; VFD370C43A/43E; VFD450C43A/43E; VFD550C43A/43E; VFD750C43A/43E	Model 『MKC-DFKM』 	Model 『MKC-DFKB』 
Frame E Applicable Model VFD450C23A/23E; VFD550C23A/23E	Model 『MKC-EFKM1』 	
Frame E Applicable Model VFD750C23A/23E; VFD900C43A/43E; VFD1100C43A/43E	Model『MKC-EFKM2』 	

Frame E Applicable Model VFD450C23A/23E; VFD550C23A/23E; VFD750C23A/23E; VFD900C43A/43E; VFD1100C43A/43E	Model 『MKC-EFKB』 

Frame F Applicable Model VFD900C23A/23E; VFD1320C43A/43E; VFD1600C43A/43E;	Model 『MKC-FFKM』 
Frame F Applicable Model VFD900C23A/23E; VFD1320C43A/43E; VFD1600C43A/43E	Model 『MKC-FFKB』 
Frame G Applicable Model VFD1850C43A/43E; VFD2200C43A/43E	Model 『MKC-GFKM』 

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

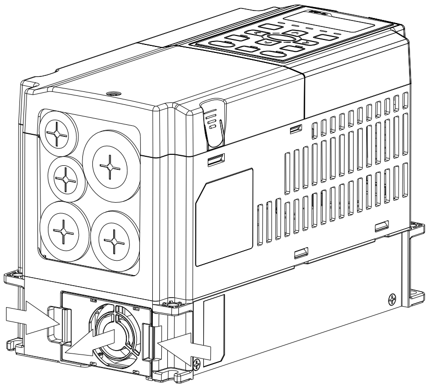
Fan Removal

Frame A

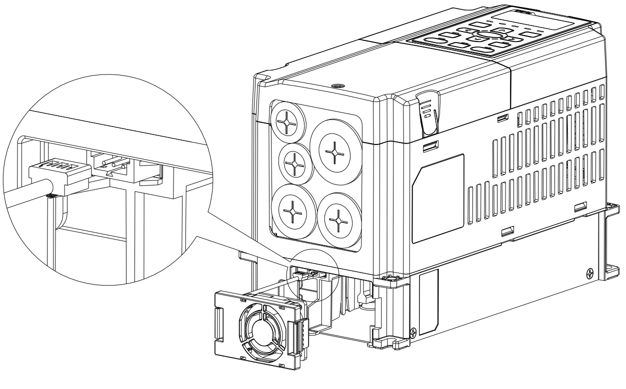
Applicable model

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.)

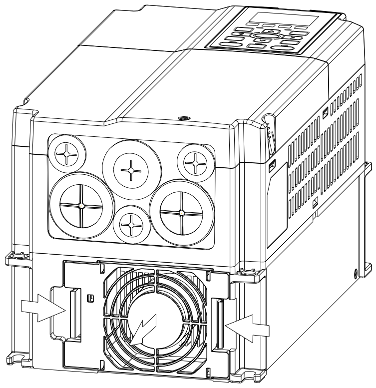


Frame B

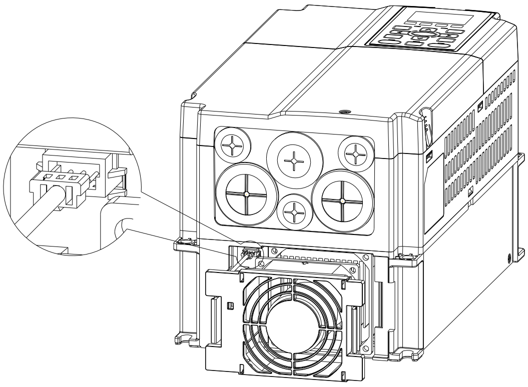
Applicable model

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.

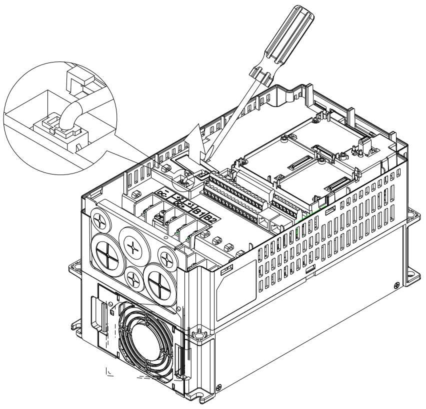


Frame B&C

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

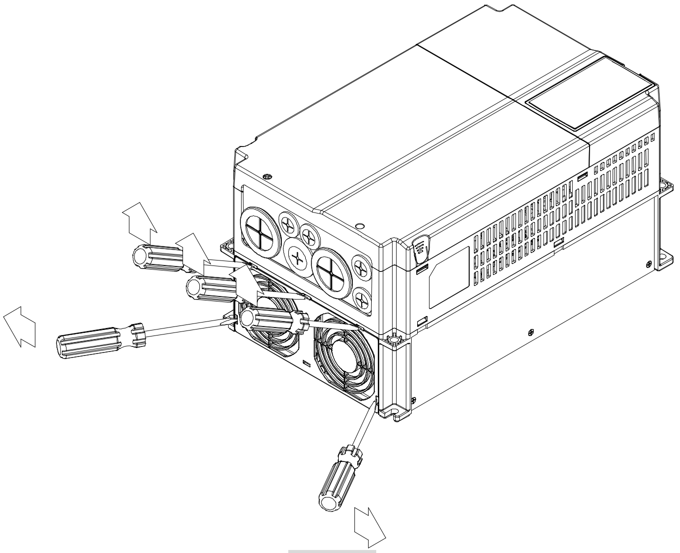


Figure 1

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)

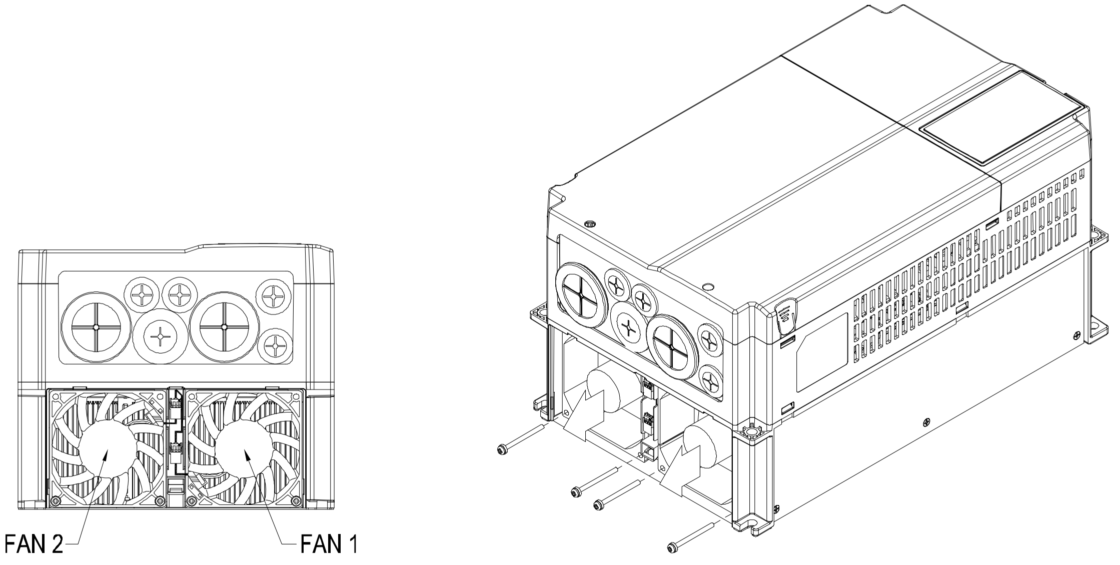


Figure 2

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: 10~12kg-cm (8.6~10.4in-lbf)』

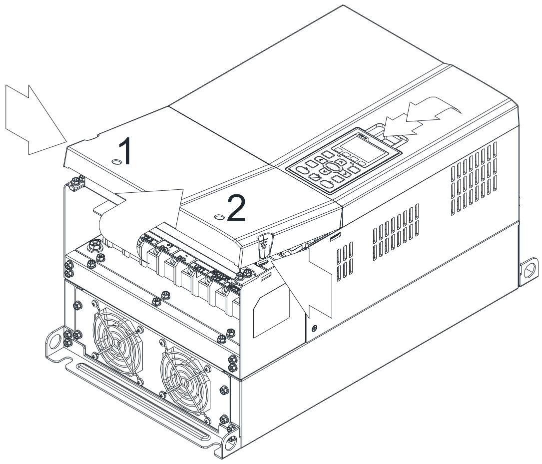


Figure 1

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

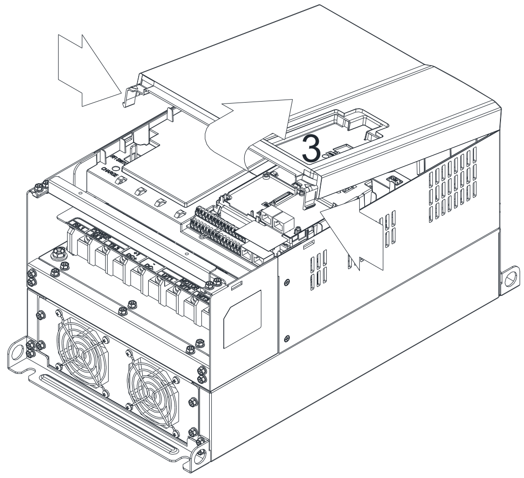


Figure 2

3. Loosen screw 4 and disconnect the fan power. Screw torque: 10~12kg-cm (8.6~10.4in-lbf).

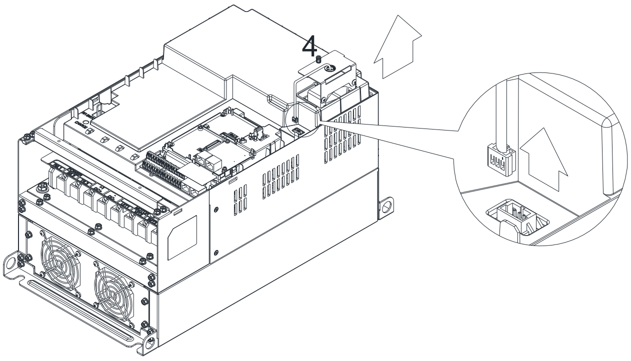


Figure 3

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)

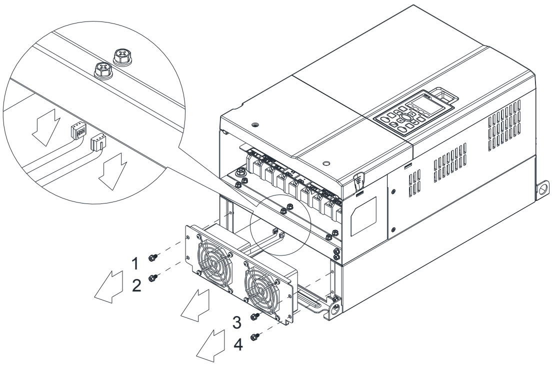


Figure 4

Frame 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).

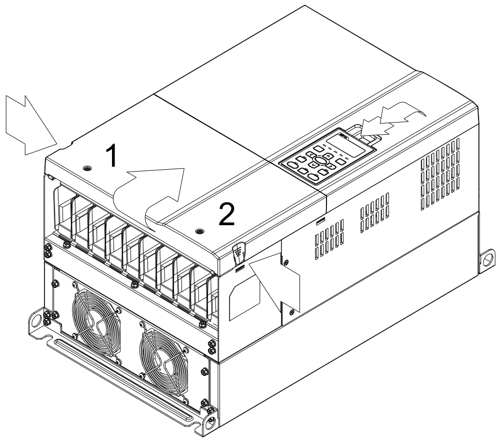


Figure 1

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

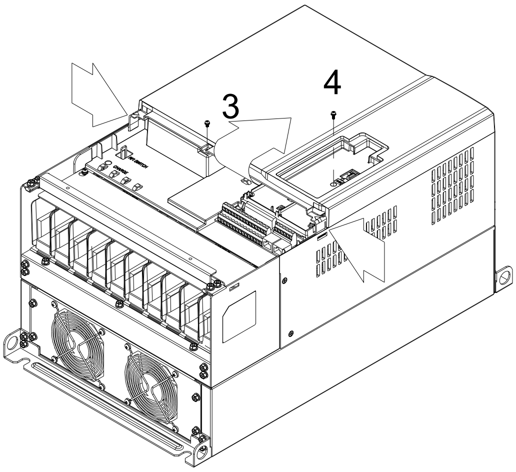


Figure 2

6. (Figure 3) Loosen screw 5 and disconnect the fan power. Screw torque: 10~12kg-cm (8.6~10.4in-lbf).

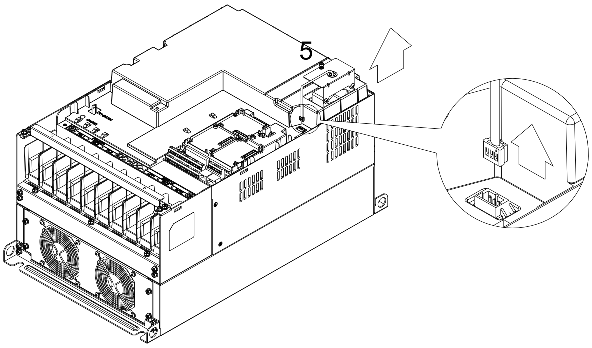


Figure 3

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)

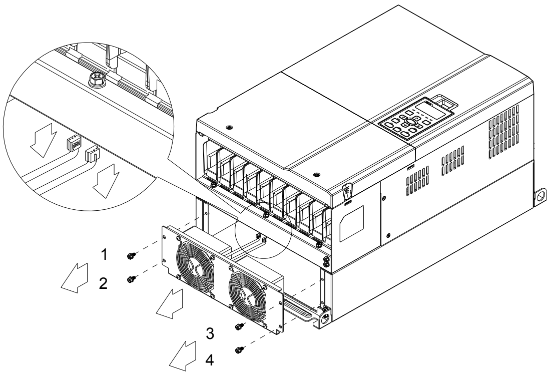


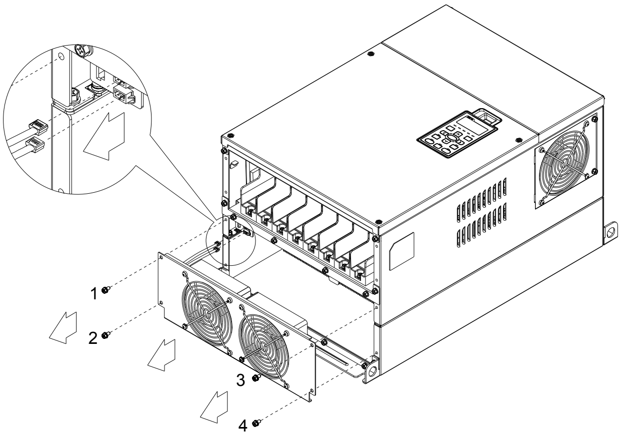
Figure 4

Frame E

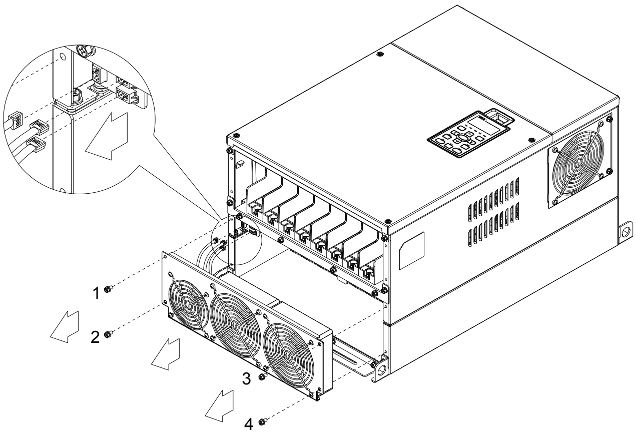
Applicable model:

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

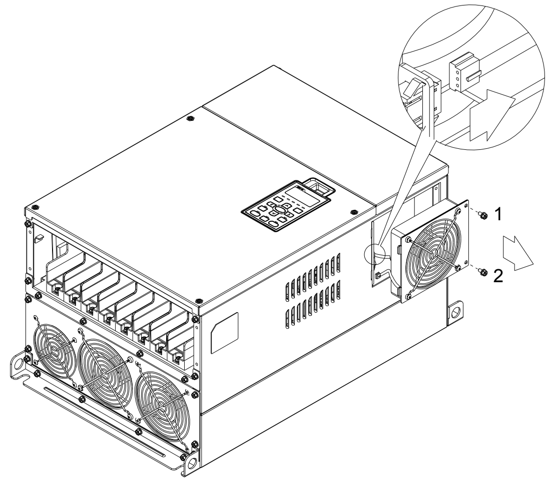
Loosen screw 1~4 (as shown in the figure below), and disconnect the fan power then remove the fan. Screw torque: 24~26kg-cm (20.8~25.6in-lbf).



Loosen screw 1~4(as shown in the figure below), and disconnect the fan power then remove the fan. Screw torque: 24~26kg-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).



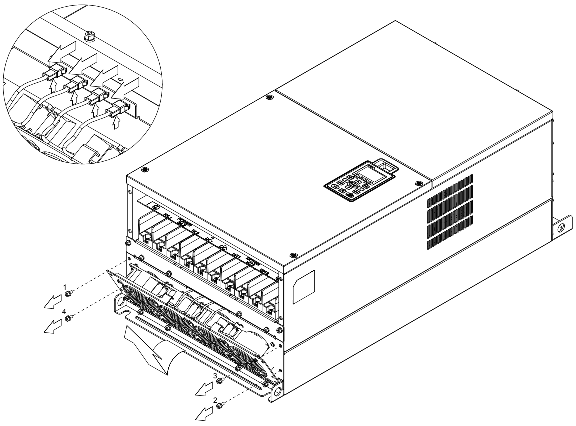
Frame F

Applicable model

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

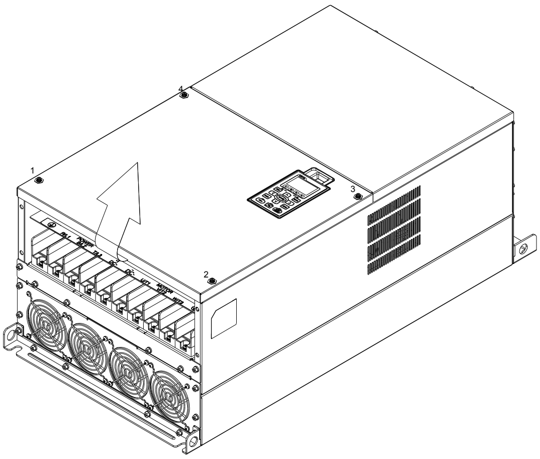
Fan model『MKC-FFKM』

Loosen the screws and removes the fan (as shown in figure below). Screw torque: 24~26kg-cm (20.8~22.6Ib-in』

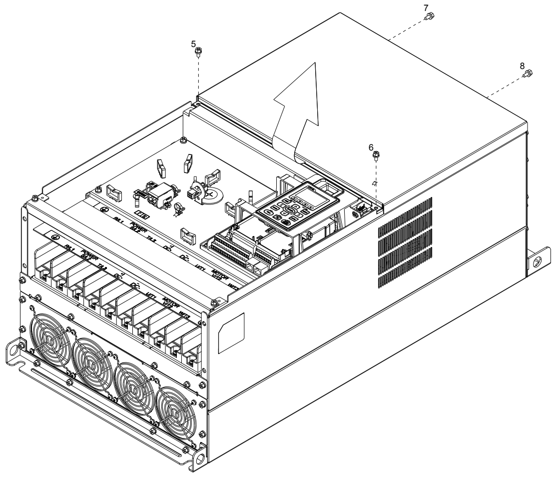


Fan model 『MKC-FFKB』

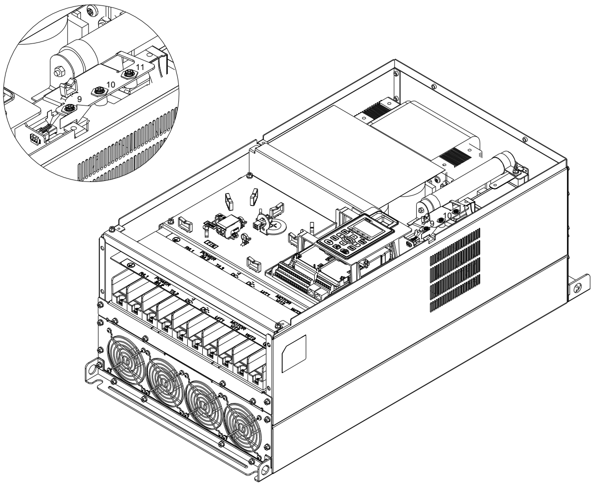
(1) Loosen the screw (as shown in figure below) and removes the cover. Screw torque: 14~16kg-cm (12.2~13.9Ib-in).

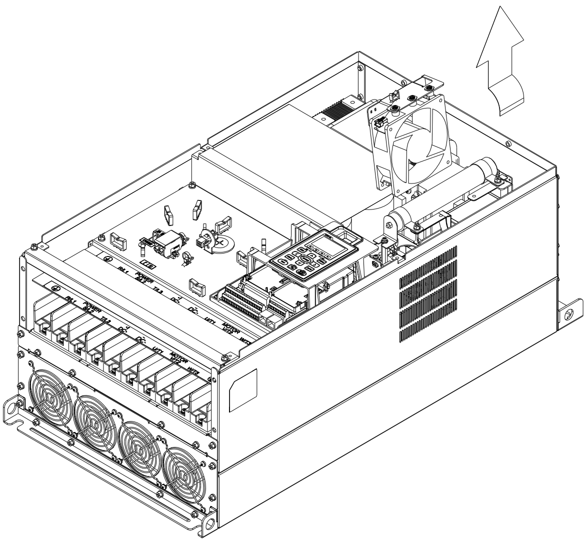


(2) Loosen the screw (as shown in figure below) and removes the cover. Screw torque: 24~26kg-cm (20.8~22.6Ib-in).



(3) Loosen the screws and remove the fan. (As shown in the figure below) Screw torque: 24~26kg-cm (20.8~22.6Ib-in).





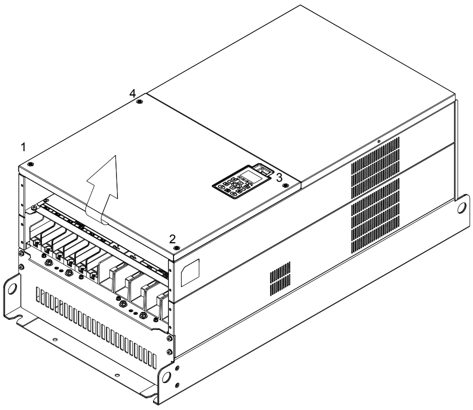
Frame G

Applicable model

VFD1800C43A/43E; VFD2200C43A/43E;

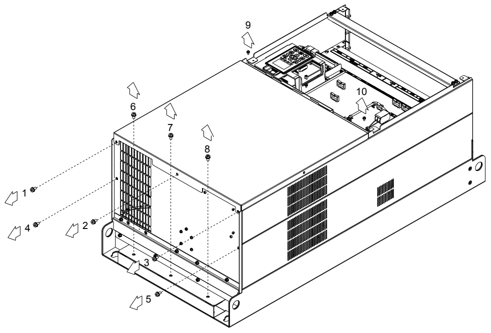
Fan model『MKC-GFKM』

(1) Loosen the screw (as shown in figure below) and remove the cover. Screw torque: 24~26kg-cm (20.8~22.6Ib-in).

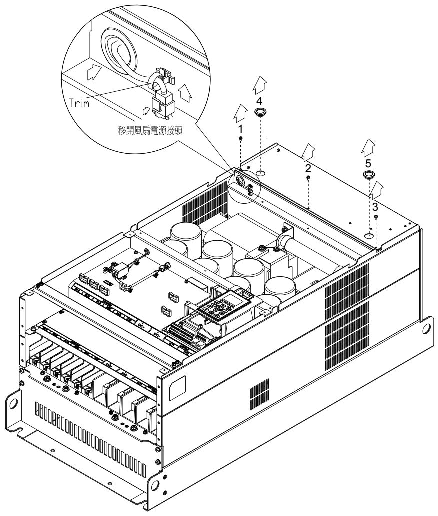


(2) For 1~8 shown in the figure: Loosen the screws
Screw torque:35~40kg-cm (30.4~34.7lb-in)

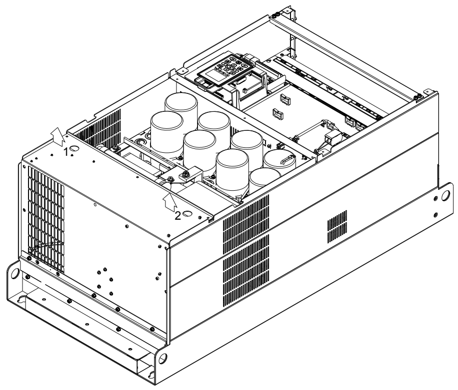
For 9~10 shown in the figure: Loosen the screws and removes the cover.
Screw torque: 24~26kg-cm (20.8~22.6Ib-in).



(3) Loosen screw 1,2,3 and remove the protective ring (as shown in figure below) Screw torque: 15~20kg-cm (12.2~13.9Ib-in).



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



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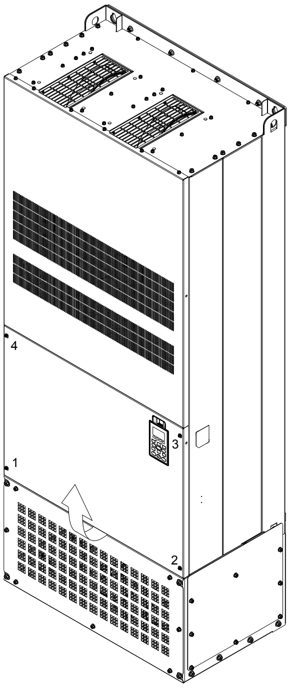
Frame H

Applicable model

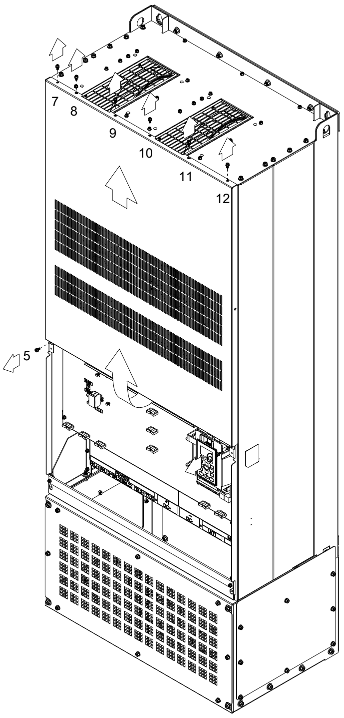
VFD2800C43A/43E; VFD3150C43A/43E; VFD3550C43A/43E; VFD4500C43A/43E

Fan model 『MKC-HFKM』

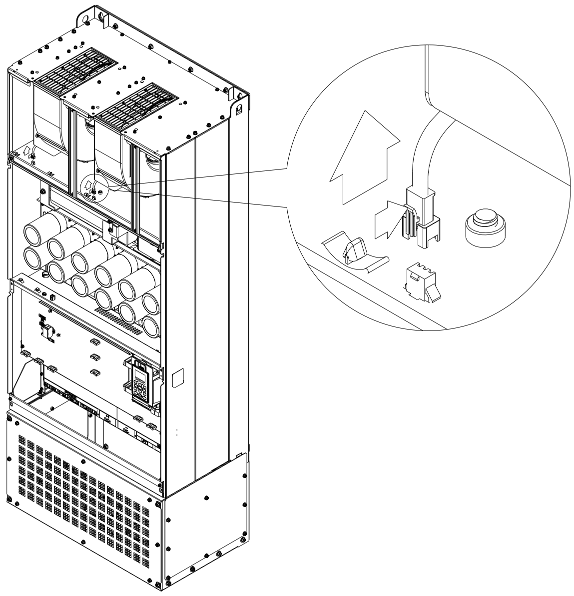
(1) Loosen the screw and remove the top cover.
Screw torque: 14~16kg-cm (12.2~13.9Ib-in)



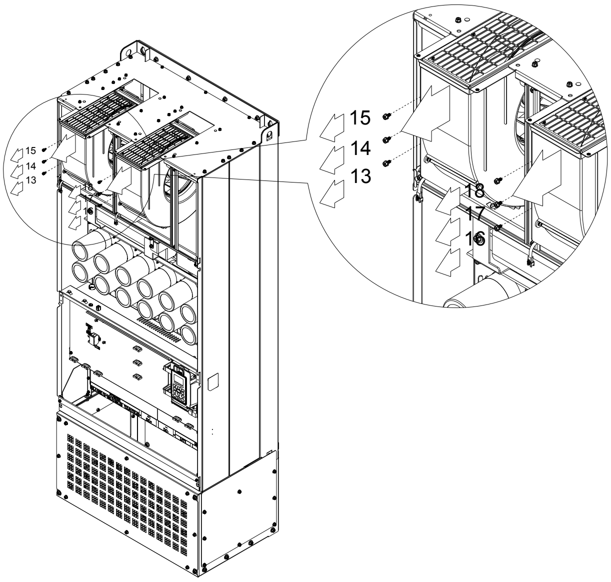
(2) Loosen the screw and remove the top cover.
Screw torque: 24~26kg-cm (20.8~22.6Ib-in).



(3) Disconnect the fan.



(4) Loosen the screw and remove the fan. Make sure fan power is properly disconnected before removal. Screw torque: 24~26kg-cm (20.8~22.6Ib-in).



7-12 Flange Mounting Kit

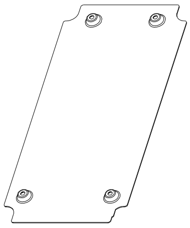
Applicable Models, Frame A~F

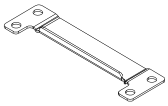
Frame A

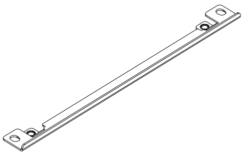
『MKC-AFM1』

Applicable model

VFD015C23A; VFD022C23A; VFD022C43A/43E


Accessories 1*1


Accessories 2*2


Accessories 3*2

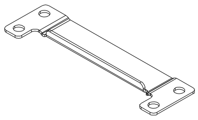
Screw 1 *4
M3*P 0.5; L=6mm

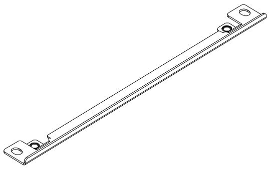
Screw 2*8
M6*P 1.0; L=16mm

『MKC-AFM』

Applicable model

VFD007C23A; VFD007C43A/43E; VFD015C43A/43E; VFD037C23A; VFD037C43A/43E; VFD040C43A/43E; VFD055C43A/43E

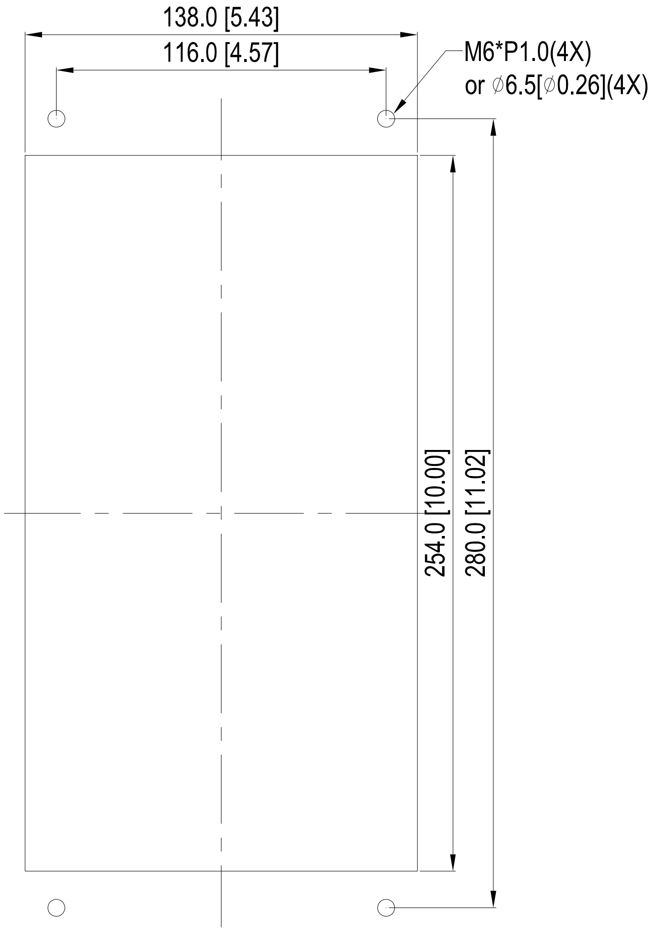

Accessories 2*2


Accessories t 3*2

Screw *8
M6*P 1.0; L=16mm

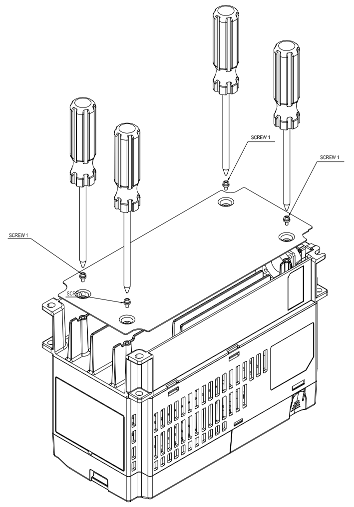
Cutout dimension

Unit: mm [inch]

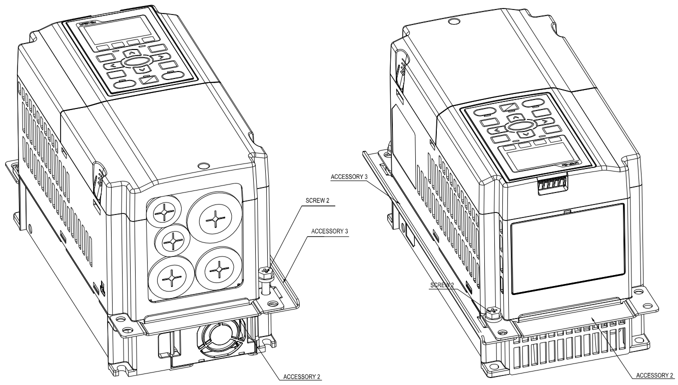


『MKC-AFM1』Installation

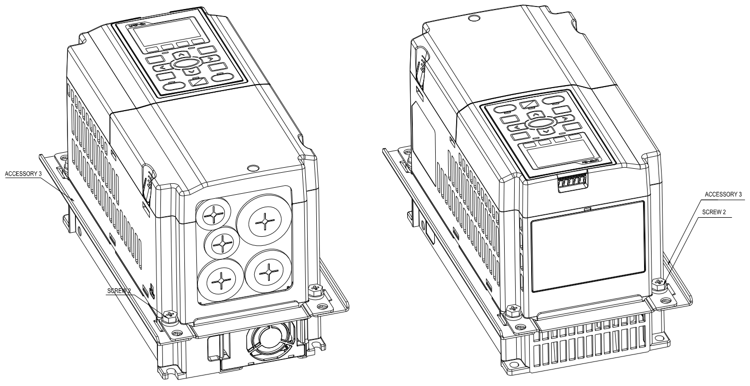
1. Install accessory 1 by fastening 4 of the screw 1(M3). Screw torque: 6~8kg-cm (5.21~6.94Ib-in).



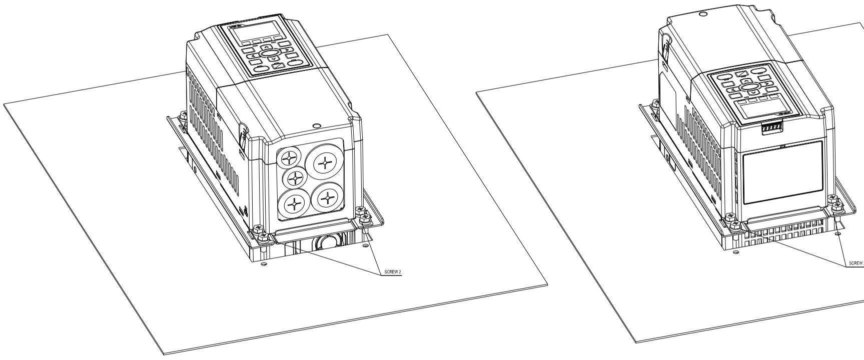
2. Install accessory 2&3 by fastening 2 of the screw 2(M6). Screw torque: 25~30kg-cm (5.21~6.94Ib-in).



3. Install accessory 2&3 by fastening 2 of the screw 2(M6). Screw torque: 25~30kg-cm (5.21~6.94Ib-in).

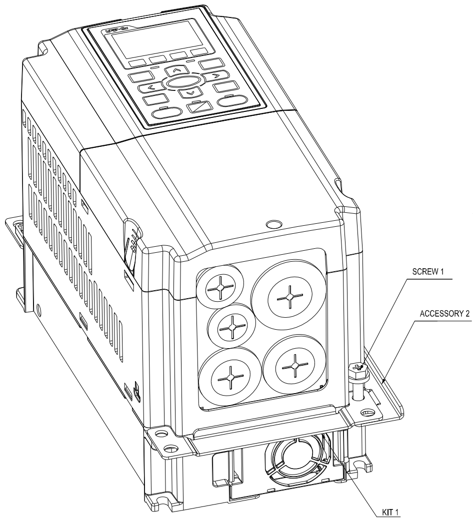


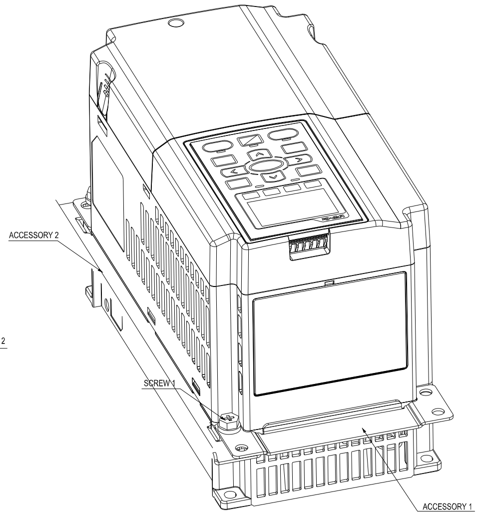
4. Plate installation, place 4 of the screw 2 (M6) through accessory 2&3 and the plate then fasten the screws. Screw torque: 25~30kg-cm (5.21~6.94Ib-in).



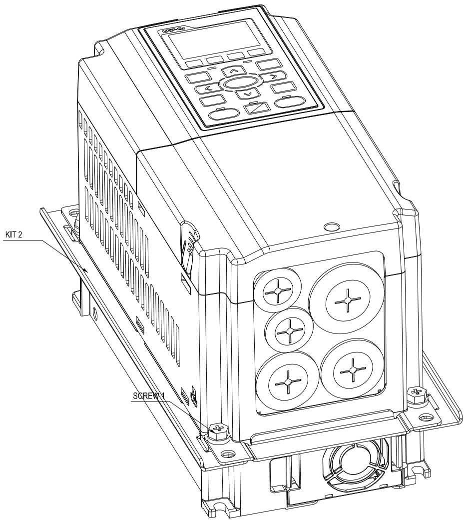
『MKC-AFM』 Installation

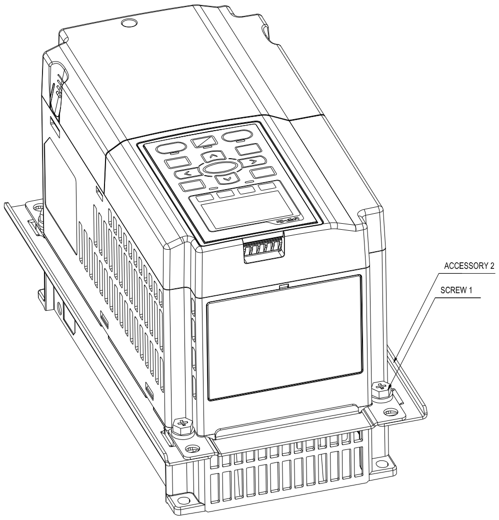
1. Install accessory 1& 2 by fastening 2 of the screw 1(M3). Screw torque: 25~30kg-cm (5.21~6.94Ib-in). (As shown in following figure)



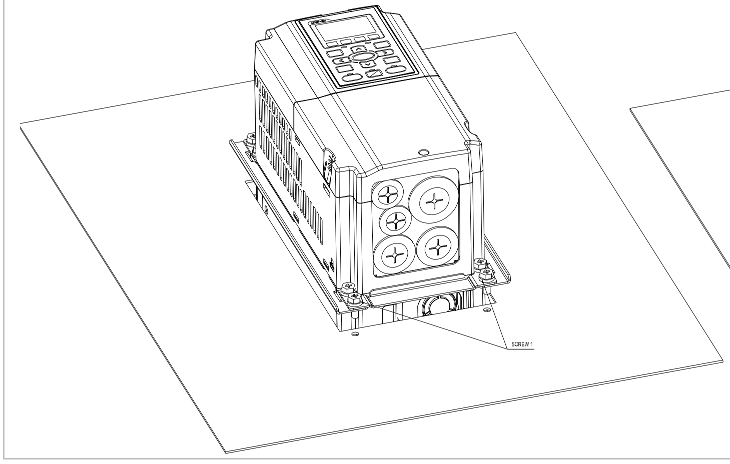


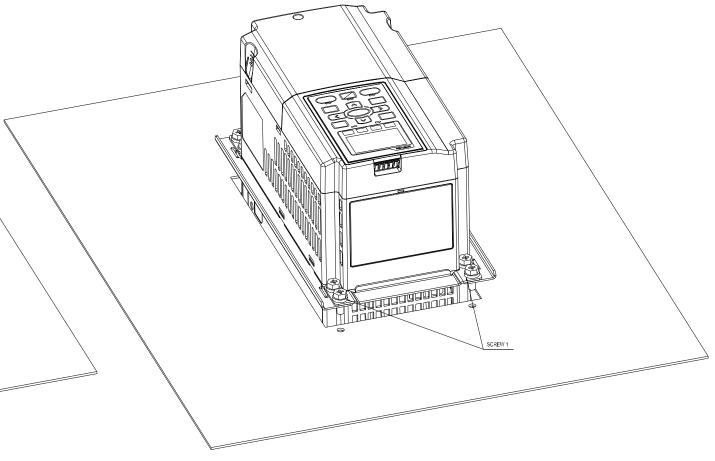
2. Install accessory 1& 2 by fastening 2 of the screw 1(M3). Screw torque: 25~30kg-cm (5.21~6.94Ib-in). (As shown in following figure)





3. Plate installation, place 4 of the screw 2 (M6) through accessory 1&2 and the plate then fasten the screws. Screw torque: 25~30kg-cm (5.21~6.94Ib-in). (As shown in following figure)



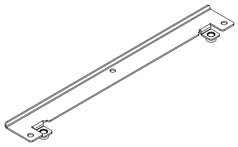


Frame B

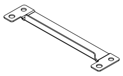
『MKC-BFM』

Applicable model

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



Accessories 1*2

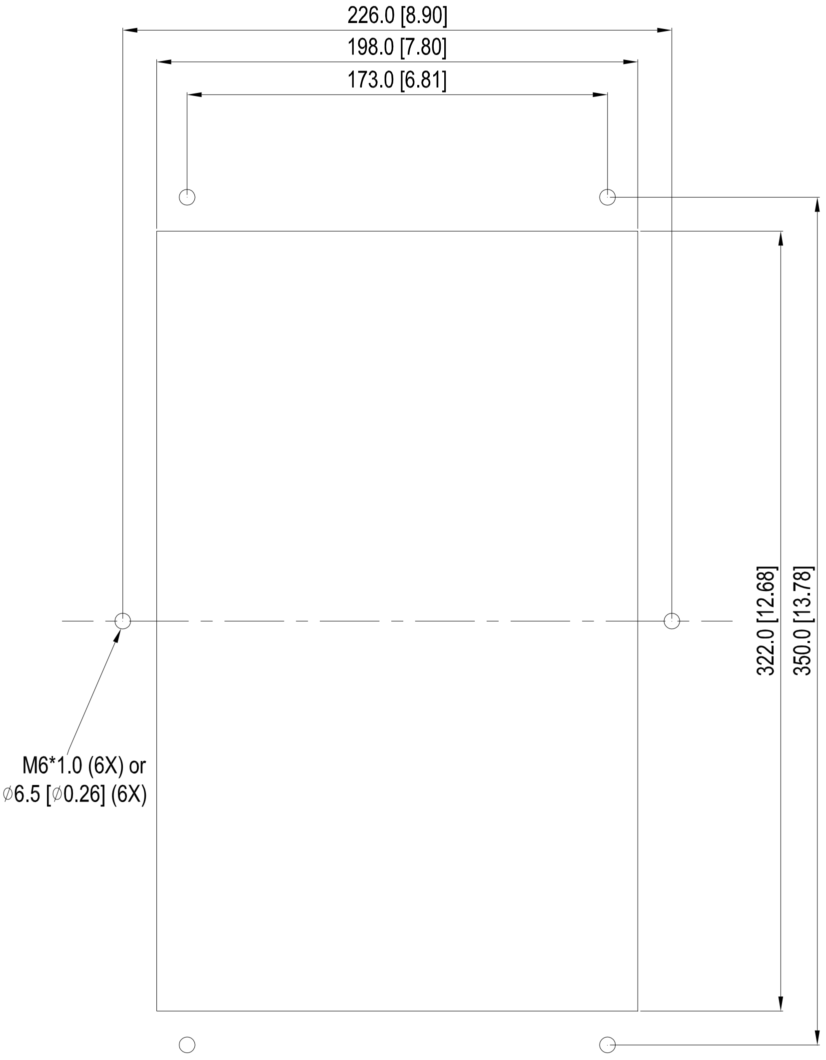


Accessories 2*2

Screw 1 *4 ~ M8*P 1.25;
Screw 2*6 ~ M6*P 1.0;

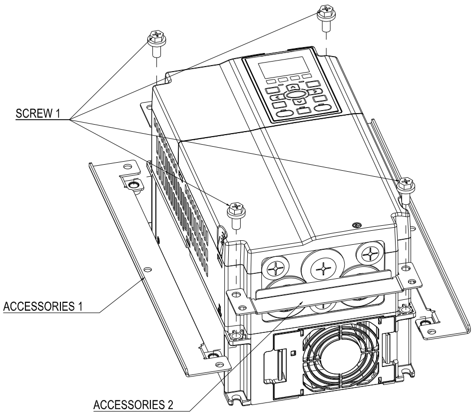
Cutout dimension

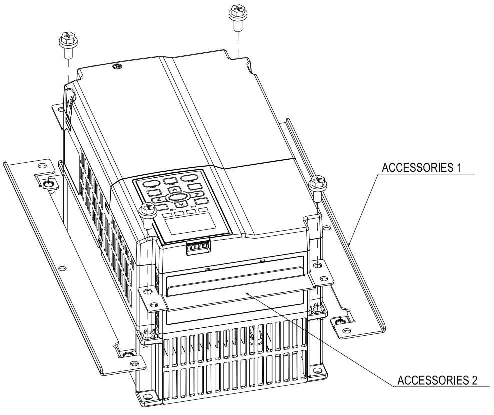
Unit: mm [inch]



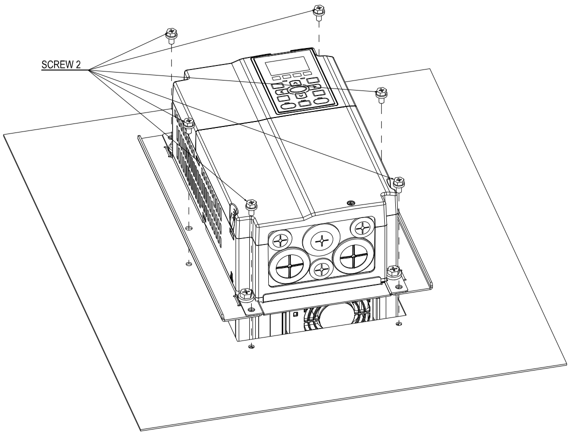
『MKC-BFM』Installation

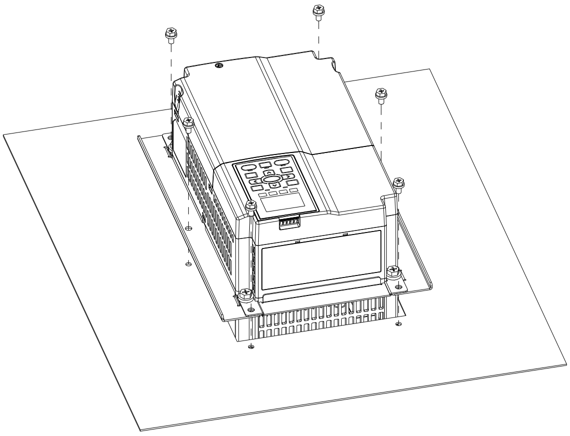
1. Install accessory 1& 2 by fastening 4 of the screw 1(M8). Screw torque: 40~45kg-cm (34.7~39.0Ib-in). (As shown in the following figure)





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



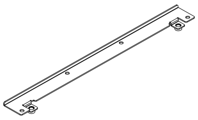


Frame C

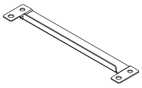
『MKC-CFM』

Applicable model

VFD150C23A; VFD185C23A; VFD220C23A; VFD185C43A/43E; VFD220C43A/43E; VFD300C43A/43E



Accessories 1*2

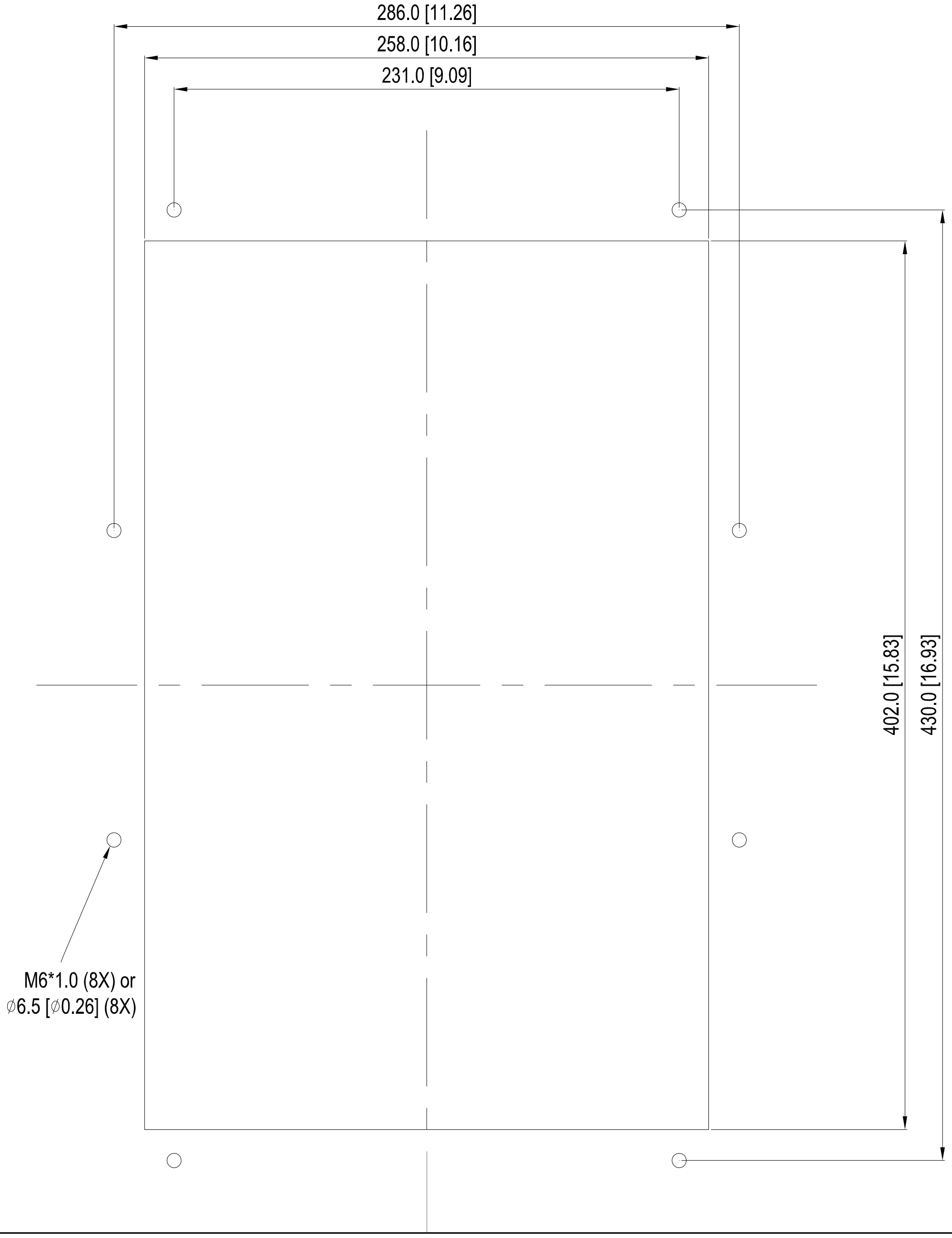


Accessories 2*2

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

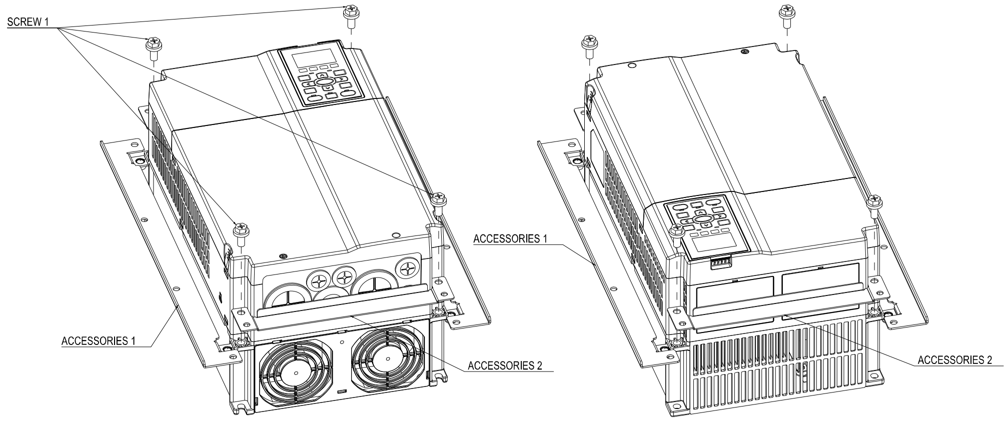
Cutout dimension

Unit: mm [inch]

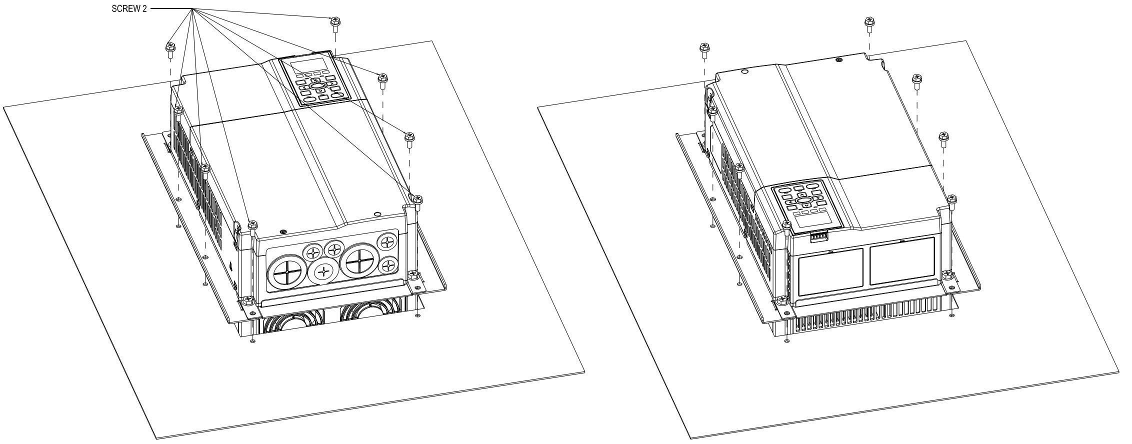


『MKC-CFM』Installation

1. Install accessory 1& 2 by fastening 4 of the screw 1(M8). Screw torque: 50~55kg-cm (43.4~47.7Ib-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: 25~30kg-cm (5.21~6.94Ib-in). (As shown in the following figure)



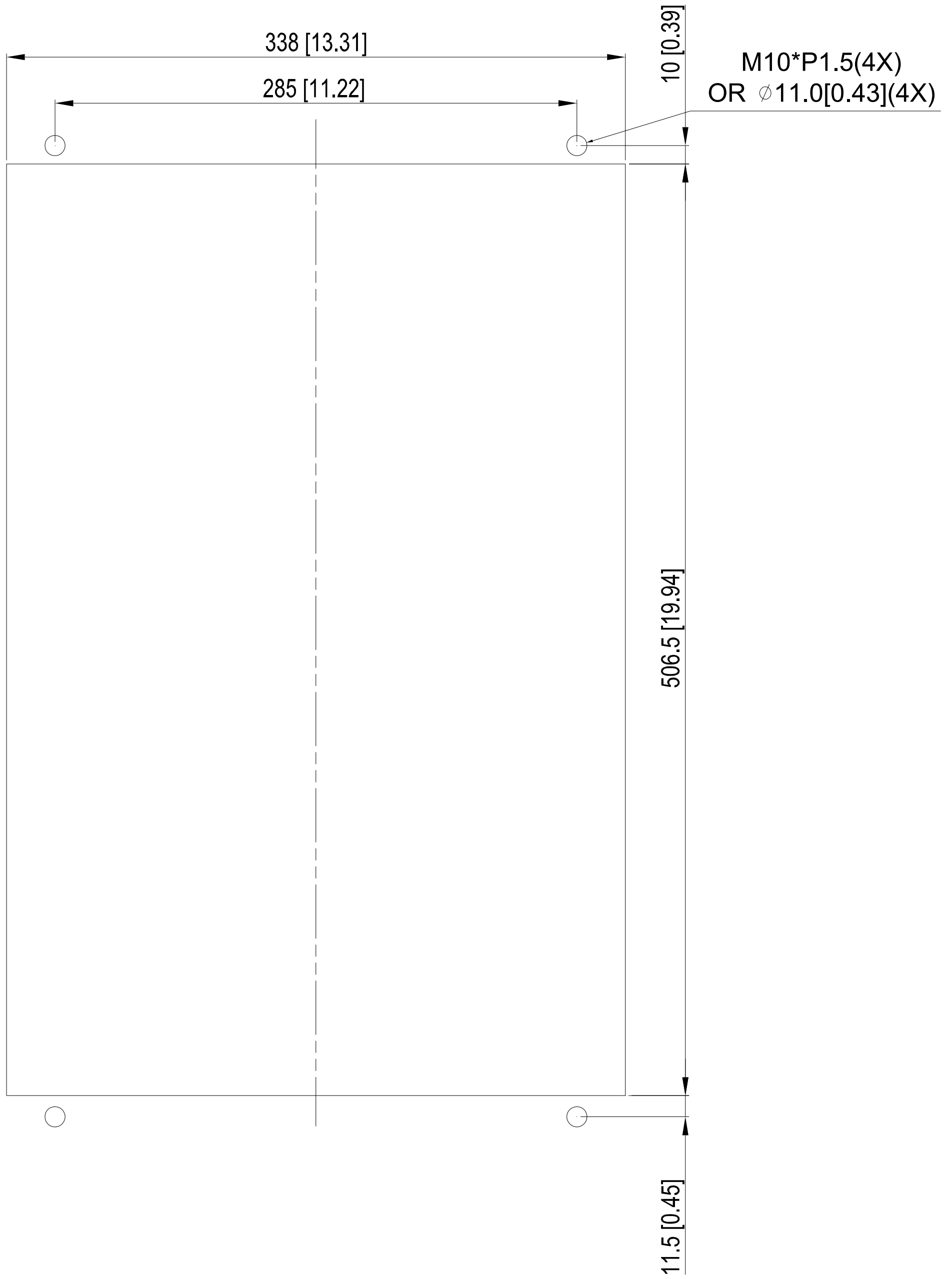
Frame D

Applicable model

VFD300C23A/23E; VFD370C23A/23E; VFD370C43A/43E; VFD450C43A/43E; VFD550C43A/43E; VFD750C43A/43E

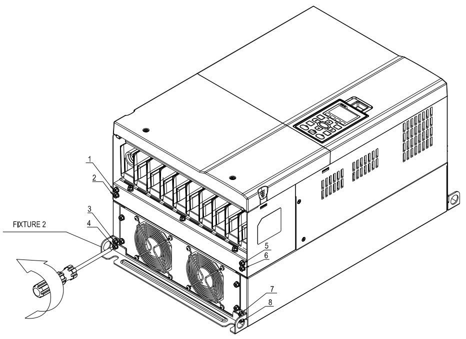
Cutout dimension

Unit: mm [inch]

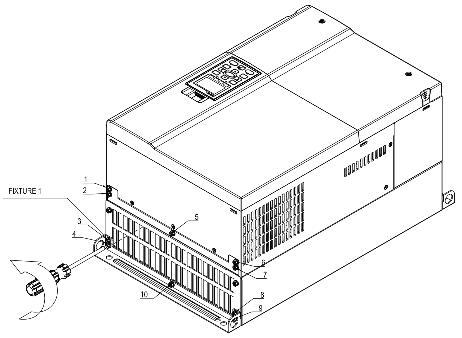


Frame D0&D&E

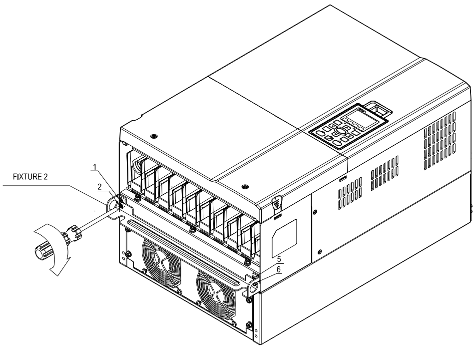
1. Loosen 8 screws and remove Fixture 2 (as shown in the following figure).



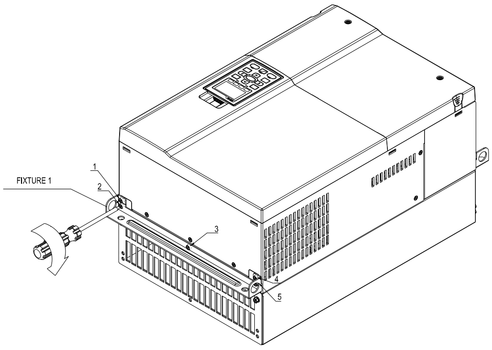
2. Loosen 10 screws and remove Fixture 1 (as shown in the following figure).



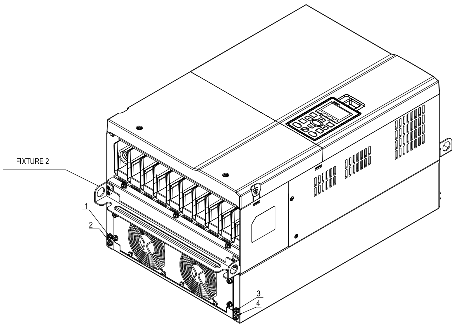
3. Fasten 4 screws (as shown in the following figure). Screw torque: 30~32kg-cm (26.0~27.8Ib-in).



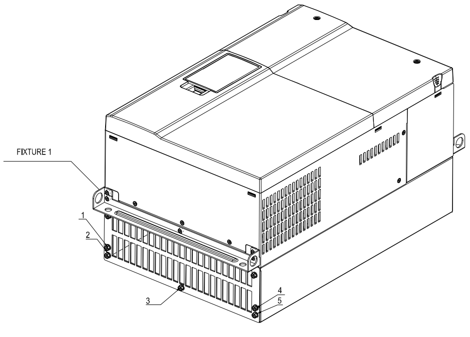
4. Fasten 5 screws (as shown in the following figure). Screw torque: 30~32kg-cm (26.0~27.8Ib-in).



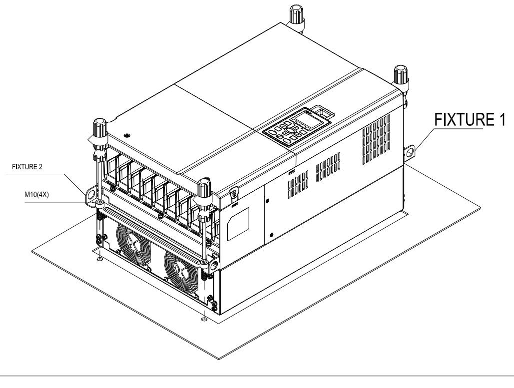
5. Fasten 4 screws (as shown in the following figure). Screw torque: 24~26kg-cm (20.8~22.6Ib-in).



6. Fasten 5 screws (as shown in the following figure). Screw torque: 24~26kg-cm (20.8~22.6Ib-in).



7. 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 (173.6~208.3Ib-in).

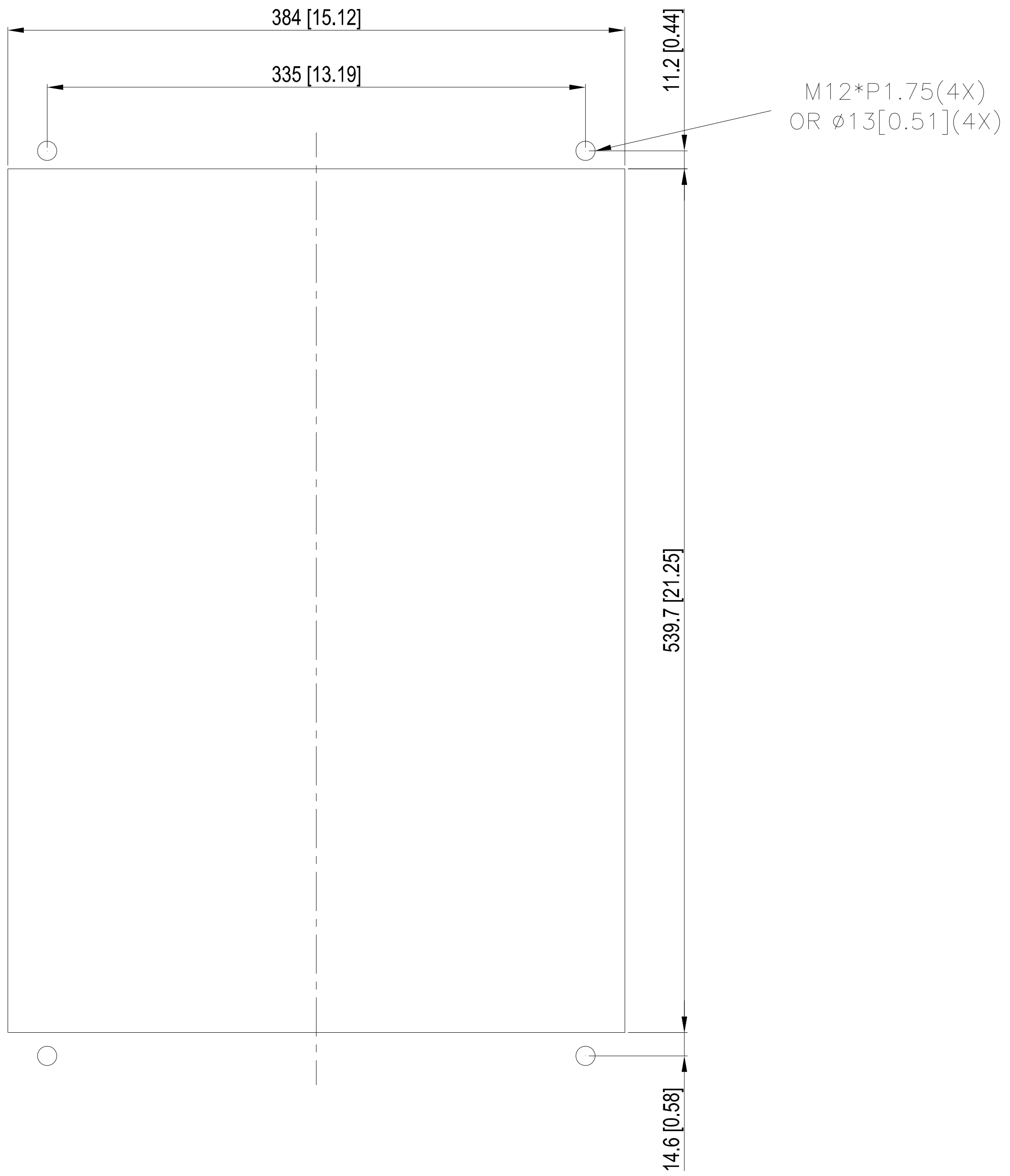


Frame E

Applicable model

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

Cutout dimension Unit: mm [inch]

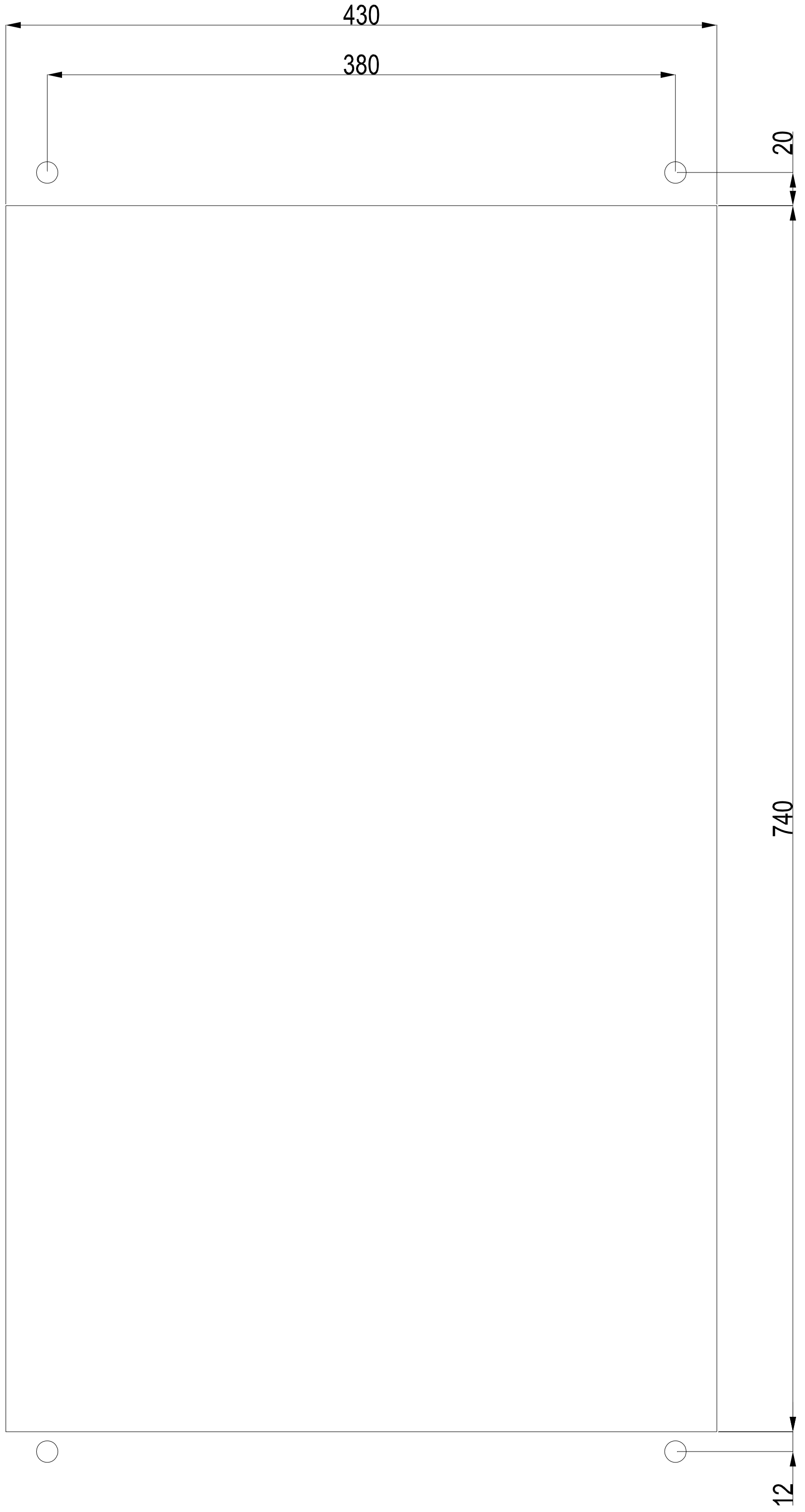


Frame F

Applicable model

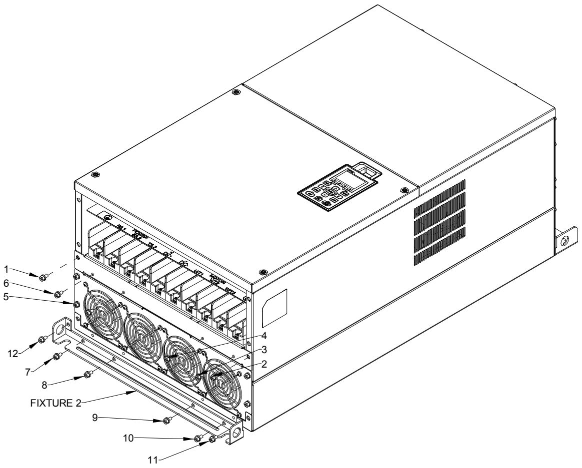
VFD900C23A/23E; VFD1320C43A/43E; VFD1600C43A/43E

Cutout dimension Unit: mm [inch]

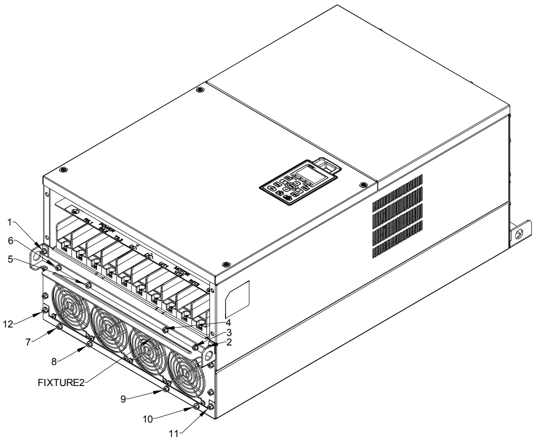


Frame F

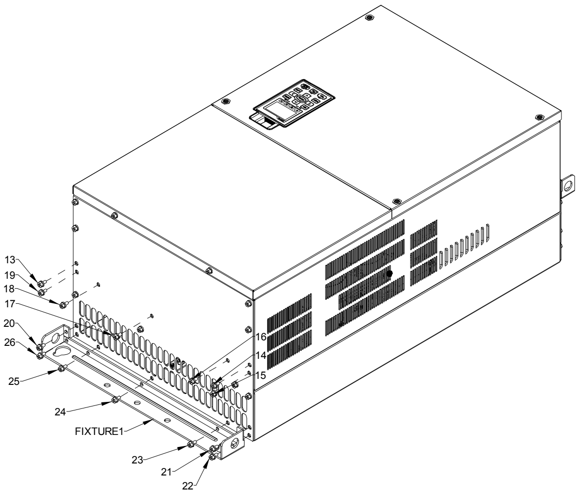
1. Loosen 12 screws and remove Fixture 2.



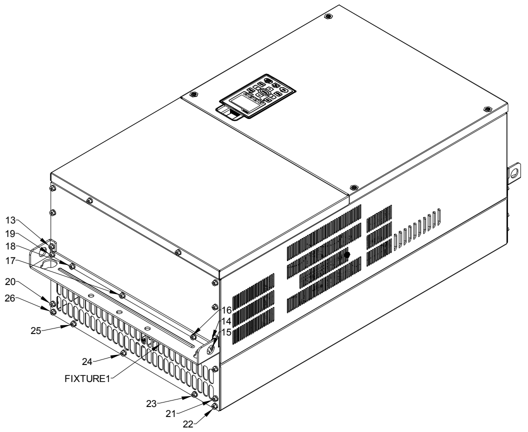
2. Loosen 12 screws and remove Fixture 2.
   Screw torque: 24~26kg-cm (20.8~22.6Ib-in).



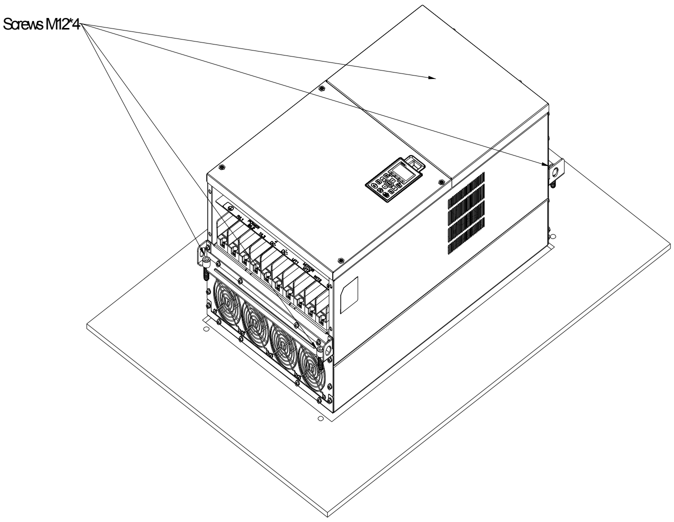
3. Loosen screw 13 ~26 and remove Fixture 1.



4. Install Fixture 1 by fasten screw 13 ~26
   Screw torque: 24~26kg-cm (20.8~22.6Ib-in).



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



7-13 USB/RS-485 Communication Interface IFD6530

⚠ Warning

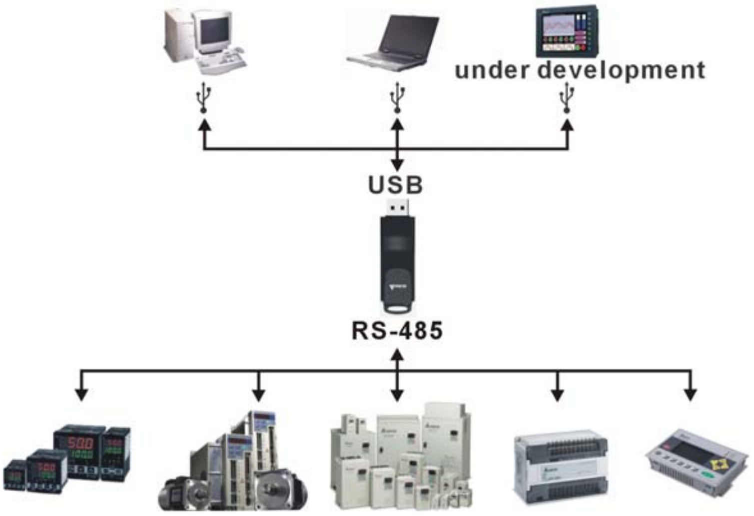
- ✓ *Please thoroughly read this instruction sheet before installation and putting it into use.*
- ✓ *The content of this instruction sheet and the driver file may be revised without prior notice. Please consult our distributors or download the most updated instruction/driver version at http://www.delta.com.tw/product/em/control/cm/control_cm_main.asp*

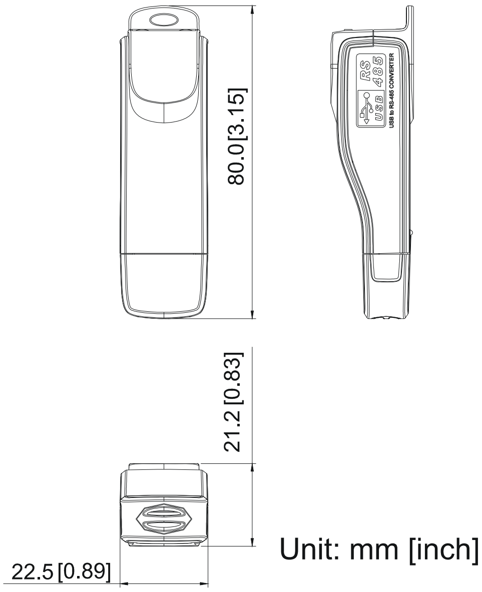
1. Introduction

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 115.2kbps 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)

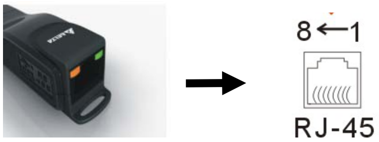




2. Specifications

Power supply	No external power is needed
Power consumption	1.5W
Isolated voltage	2,500VDC
Baud rate	75, 150, 300, 600, 1,200, 2,400, 4,800, 9,600, 19,200, 38,400, 57,600, 115,200 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
1	Reserved
2	Reserved
3	GND
4	SG-

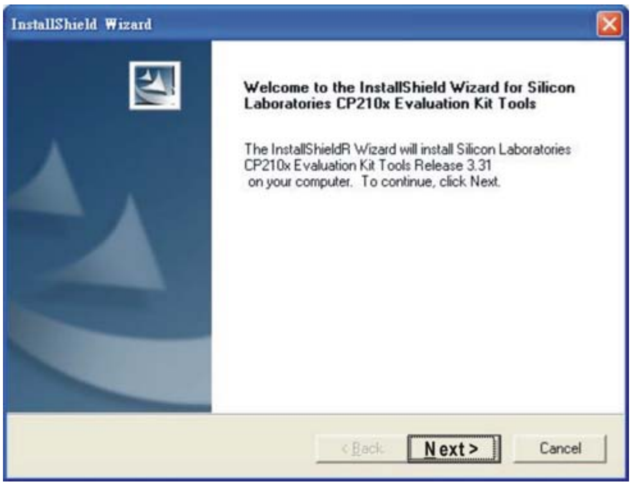
PIN	Description
5	SG+
6	GND
7	Reserved
8	+9V

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.

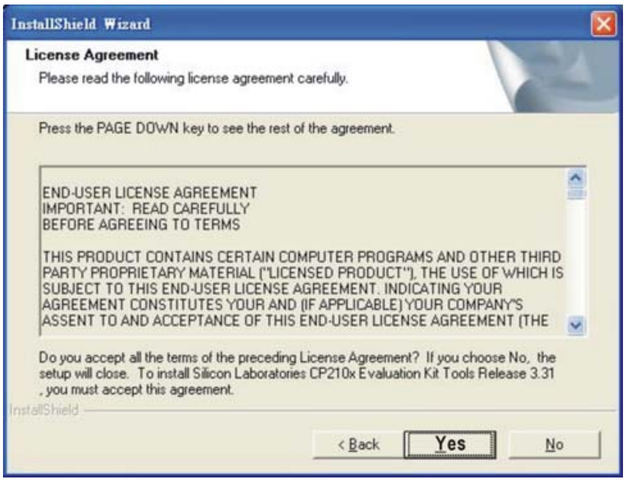
STEP 1



Welcome to the InstallShield Wizard for Silicon Laboratories CP210x Evaluation Kit Tools

The InstallShieldR Wizard will install Silicon Laboratories CP210x Evaluation Kit Tools Release 3.31 on your computer. To continue, click Next.

STEP 2



License Agreement

Please read the following license agreement carefully.

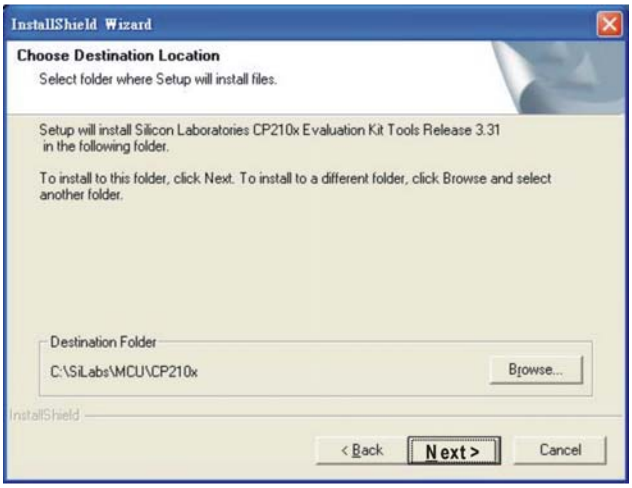
Press the PAGE DOWN key to see the rest of the agreement.

END-USER LICENSE AGREEMENT
IMPORTANT: READ CAREFULLY
BEFORE AGREEING TO TERMS

THIS PRODUCT CONTAINS CERTAIN COMPUTER PROGRAMS AND OTHER THIRD PARTY PROPRIETARY MATERIAL ("LICENSED PRODUCT"), THE USE OF WHICH IS SUBJECT TO THIS END-USER LICENSE AGREEMENT. INDICATING YOUR AGREEMENT CONSTITUTES YOUR AND (IF APPLICABLE) YOUR COMPANY'S ASSENT TO AND ACCEPTANCE OF THIS END-USER LICENSE AGREEMENT (THE

Do you accept all the terms of the preceding License Agreement? If you choose No, the setup will close. To install Silicon Laboratories CP210x Evaluation Kit Tools Release 3.31 , you must accept this agreement.

STEP 3



Choose Destination Location

Select folder where Setup will install files.

Setup will install Silicon Laboratories CP210x Evaluation Kit Tools Release 3.31 in the following folder.

To install to this folder, click Next. To install to a different folder, click Browse and select another folder.

Destination Folder: C:\SiLabs\MCU\CP210x

STEP 4

InstallShield Wizard Complete

Setup has finished installing Silicon Laboratories CP210x Evaluation Kit Tools Release 3.31 on your computer.

STEP 5

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

4. Driver Installation

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

STEP 1

Welcome to the Found New Hardware Wizard

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 permission).

Read our privacy policy

Can Windows connect to Windows Update to search for software?

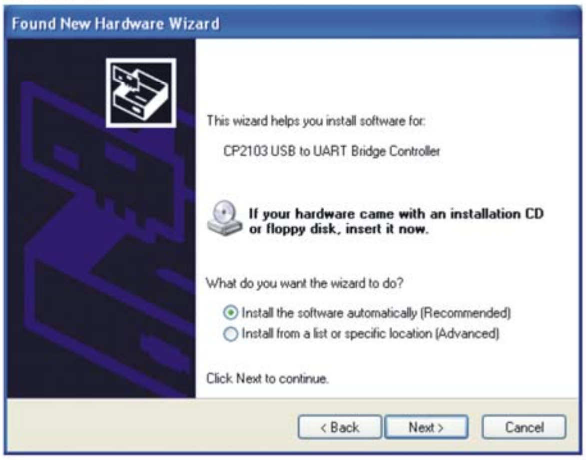
● Yes, this time only

○ Yes, now and every time I connect a device

○ No, not this time

Click Next to continue.

STEP 2



This wizard helps you install software for:

CP2103 USB to UART Bridge Controller

If your hardware came with an installation CD or floppy disk, insert it now.

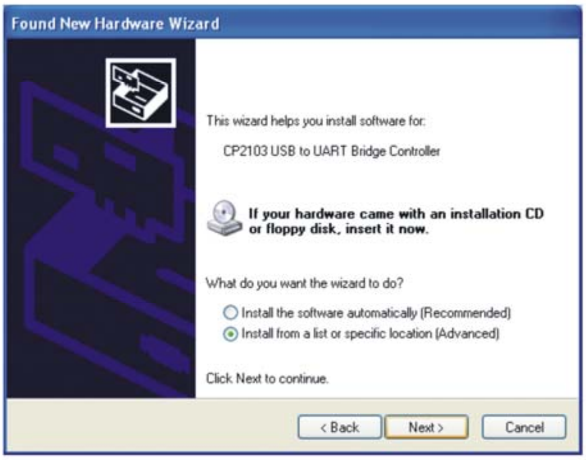
What do you want the wizard to do?

● Install the software automatically (Recommended)

○ Install from a list or specific location (Advanced)

Click Next to continue.

OR



This wizard helps you install software for:

CP2103 USB to UART Bridge Controller

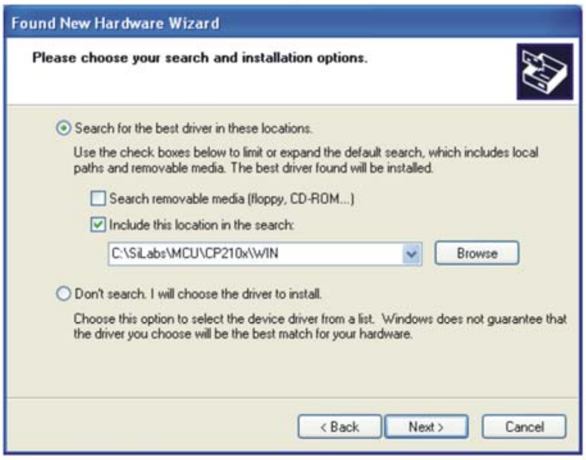
If your hardware came with an installation CD or floppy disk, insert it now.

What do you want the wizard to do?

○ Install the software automatically (Recommended)

● Install from a list or specific location (Advanced)

Click Next to continue.



Please choose your search and installation options.

● Search for the best driver in these locations.

Use the check boxes below to limit or expand the default search, which includes local paths and removable media. The best driver found will be installed.

☐ Search removable media (floppy, CD-ROM...)

☑ Include this location in the search:

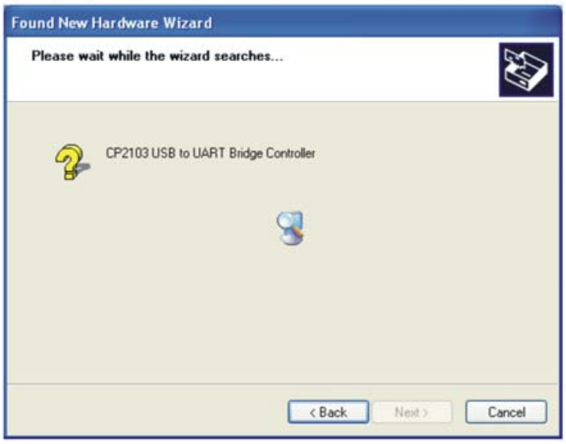
C:\SiLabs\MCU\CP210x\WIN

○ Don't search. I will choose the driver to install.

Choose this option to select the device driver from a list. Windows does not guarantee that the driver you choose will be the best match for your hardware.

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

STEP 3



Please wait while the wizard searches...

CP2103 USB to UART Bridge Controller

STEP 4

Completing the Found New Hardware Wizard

The wizard has finished installing the software for:

CP210x USB Composite Device

Click Finish to close the wizard.

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.

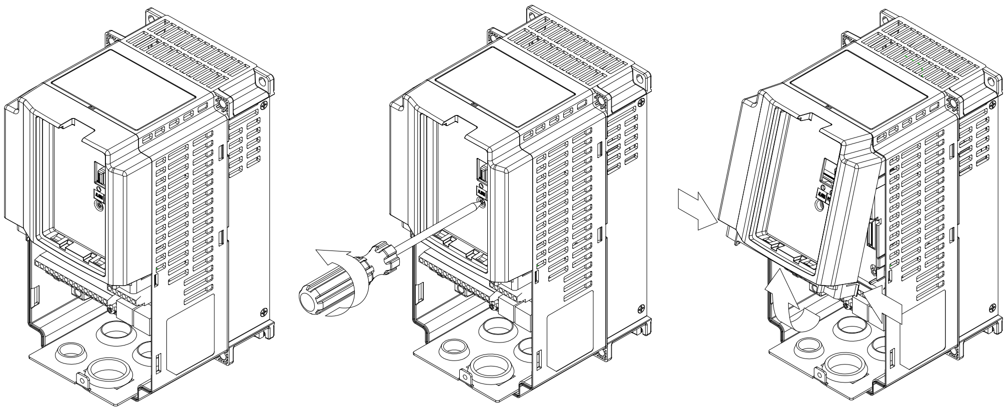
Chapter 8 Option Cards

Please select applicable option cards for your drive or contact local distributor for suggestion.

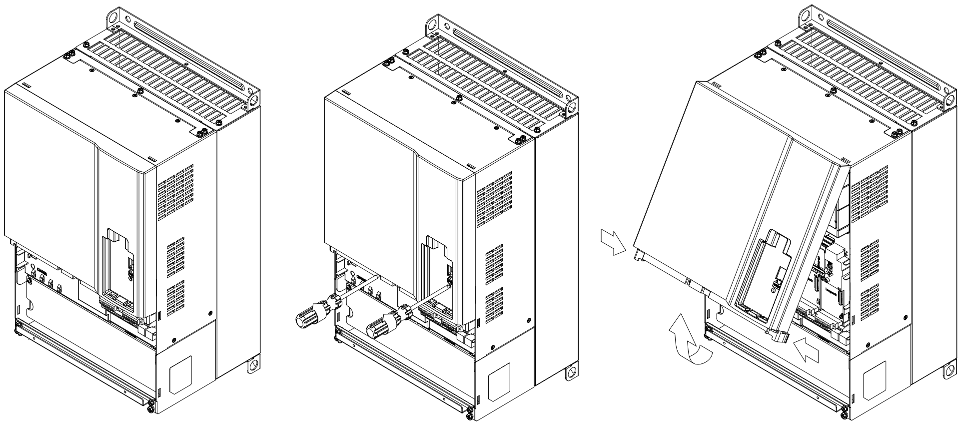
To prevent drive damage during installation, please removes the digital keypad and the cover before wiring. Refer to the following instruction.

8-1 Removed key cover

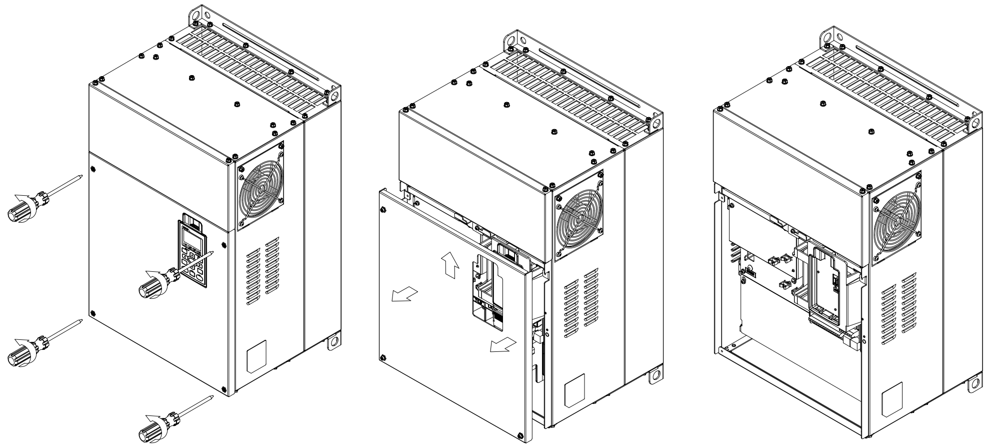
Frame A&B&C
Screw Torque: 8~10Kg-cm [6.9~8.7lb-in.]



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

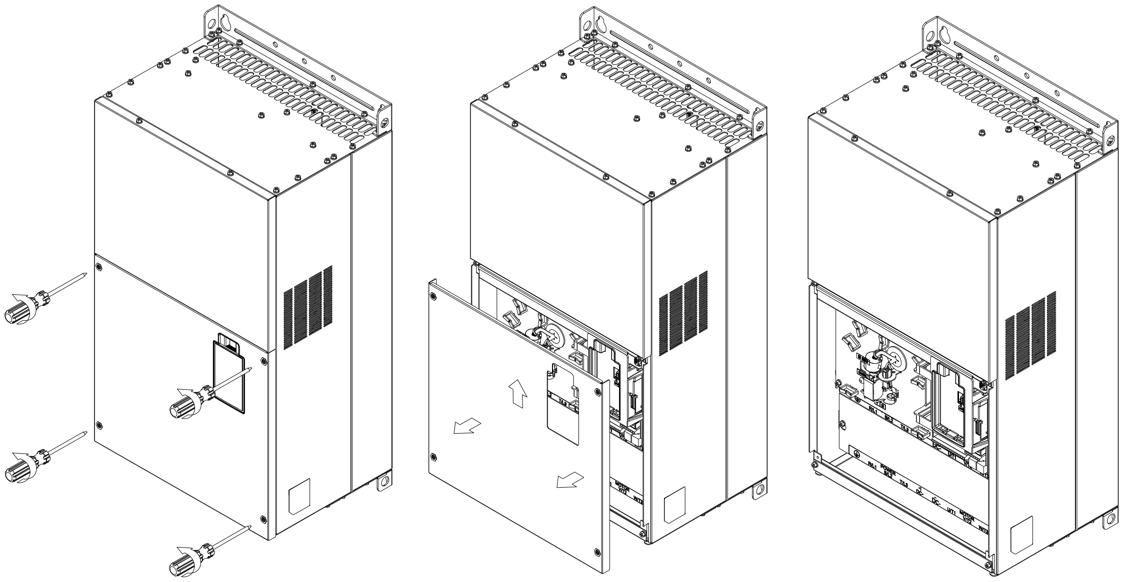


Frame E
Slightly lift the cover then pull to remove. Screw Torque: 12~15Kg-cm [10.4~13lb-in.]



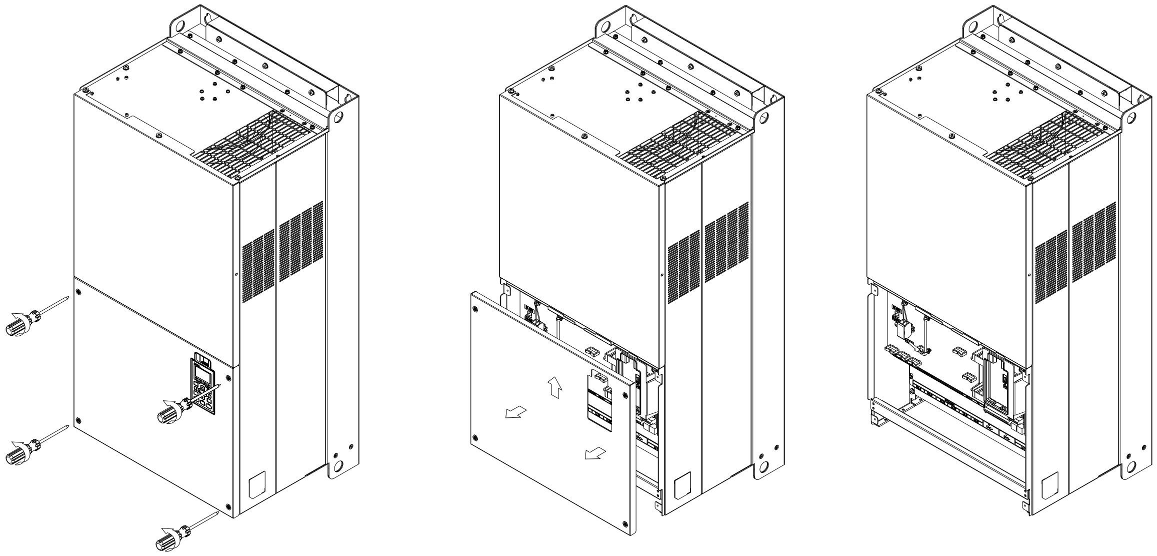
Frame F

Screw Torque: 12~ 15 Kg-cm [10.4~13lb-in.]



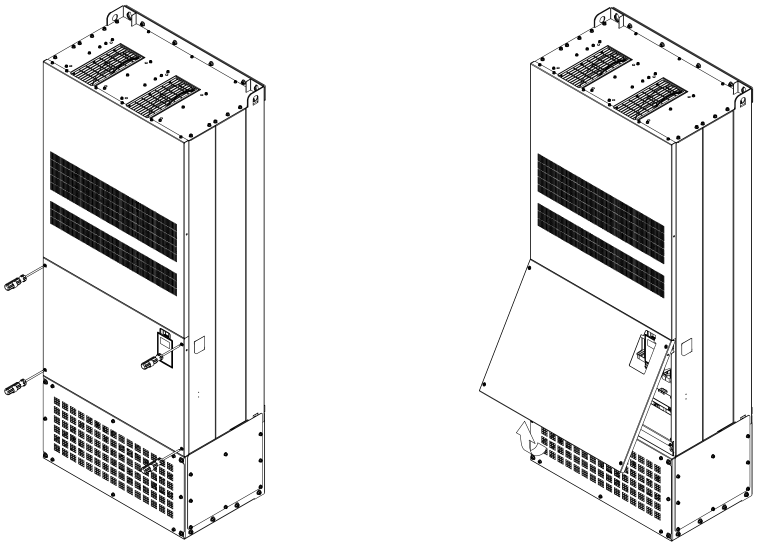
Frame G

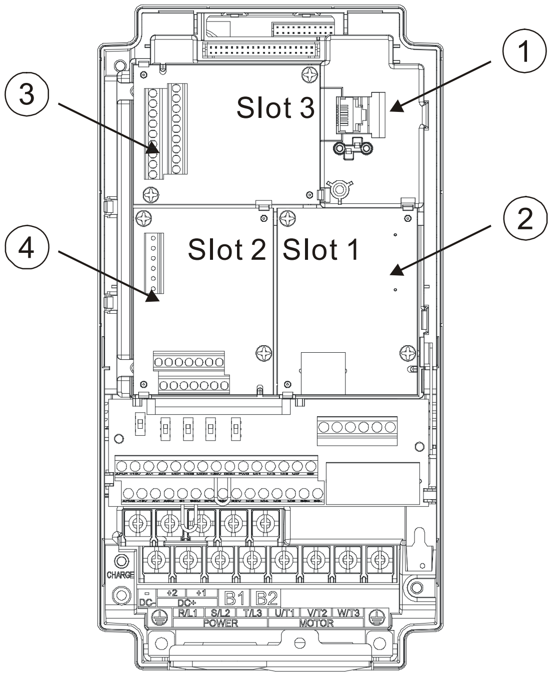
Screw Torque: 12~15Kg-cm [10.4~13lb-in.]



Frame H

Screw Torque: 14~16Kg-cm [12.15~13.89lb-in.]





1	RJ45 (Socket) for digital keypad KPC-CC01; KPC-CE01 Please refer to CH10 Digital Keypad for more details on KPC-CE01. Please refer to CH10 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-PG01O; EMC-PG01U; EMC-PG01R;

8-2 Screws Speciation for option card terminals:

EMC-D42A EMC-D611A EMC-BPS01	Wire gauge	24~12AWG（0.205~3.31mm^2）
	Torque	4Kg-cm [3.47Ib-in]
EMC-R6AA	Wire gauge	24~16AWG（0.205~1.31mm^2）
	Torque	6Kg-cm [5.21Ib-in]
EMC-PG01L EMC-PG01O EMC-PG01R EMC-PG01U	Wire gauge Torque	30~16AWG（0.0509~1.31mm^2） 2Kg-cm [1.74Ib-in]

8-3 EMC-D42A

I/O Extension Card	Terminals	Descriptions
	COM	Common for Multi-function input terminals 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. Internal power is applied from terminal E24: +24Vdc±5% 200mA, 5W External power +24VDC: max. voltage 30VDC, min. voltage 19VDC, 30W ON: the activation current is 6.5mA OFF: leakage current tolerance is 10μA
	MO10~MO11	Multi-function output terminals (photocoupler) Duty-cycle: 50% Max. output frequency: 100Hz Max. current: 50mA Max. voltage: 48Vdc
	MXM	Common for multi-function output terminals MO10, MO11(photocoupler) 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 Input frequency: 47~63Hz Input impedance: 27Kohm Terminal response time: ON: 10ms OFF: 20ms

8-5 EMC-R6AA

Relay Extension Card	Terminals	Descriptions
	RA10~RA15 RC10~RC15	Refer to Pr. 02.36~ Pr. 02.41 for multi-function input selection Resistive load: 5A(N.O.) /250Vac 5A(N.O.) /30Vdc Inductive load (COSPHI 0.4) 2.0A(N.O.) /250Vac 2.0A(N.O.) /30Vdc 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	24V GND	Input power: 24V±5% Maximum input current:0.5A Note: 1) Do not connect control terminal +24V (Digital control signal common: SOURCE) directly to the EMC-BPS01input terminal 24V. 2) Do not connect control terminal GND directly to the EMC-BPS01 input termina GND.

8-7 EMC-PG01L

■ Terminal description

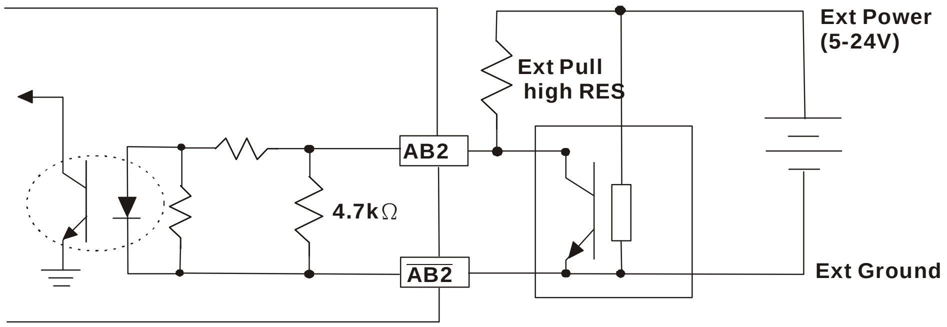
Set by Pr.10-00~10-02

Terminals		Descriptions
PG1	VP	Output voltage for power: +5V/+12V±5% (use FSW3 to switch +5V/+12V) 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: 300kP/sec
PG2	A2, /A2, B2, /B2	Pulse Input signal (Line Driver or Open Collector) Open Collector input voltage: +5~+24V (Note1) It can be 1-phase or 2-phase input. Max. output frequency: 300kP/sec.
PG OUT	AO, /AO, BO, /BO, ZO, /ZO, SG,	PG Card Output signals. It has division frequency function: 1~255 times Max. output voltage for Line driver: 5VDC Max. output current: 50mA Max. output frequency: 300kP/sec 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.

5V	Recommended pull-up resistor: above100~220Ω, 1/2W
12V	Recommended pull-up resistor: above 510~1.35kΩ, 1/2W
24V	Recommended pull-up resistor, above1.8k~3.3kΩ, 1/2W

PG2 Wiring Diagram

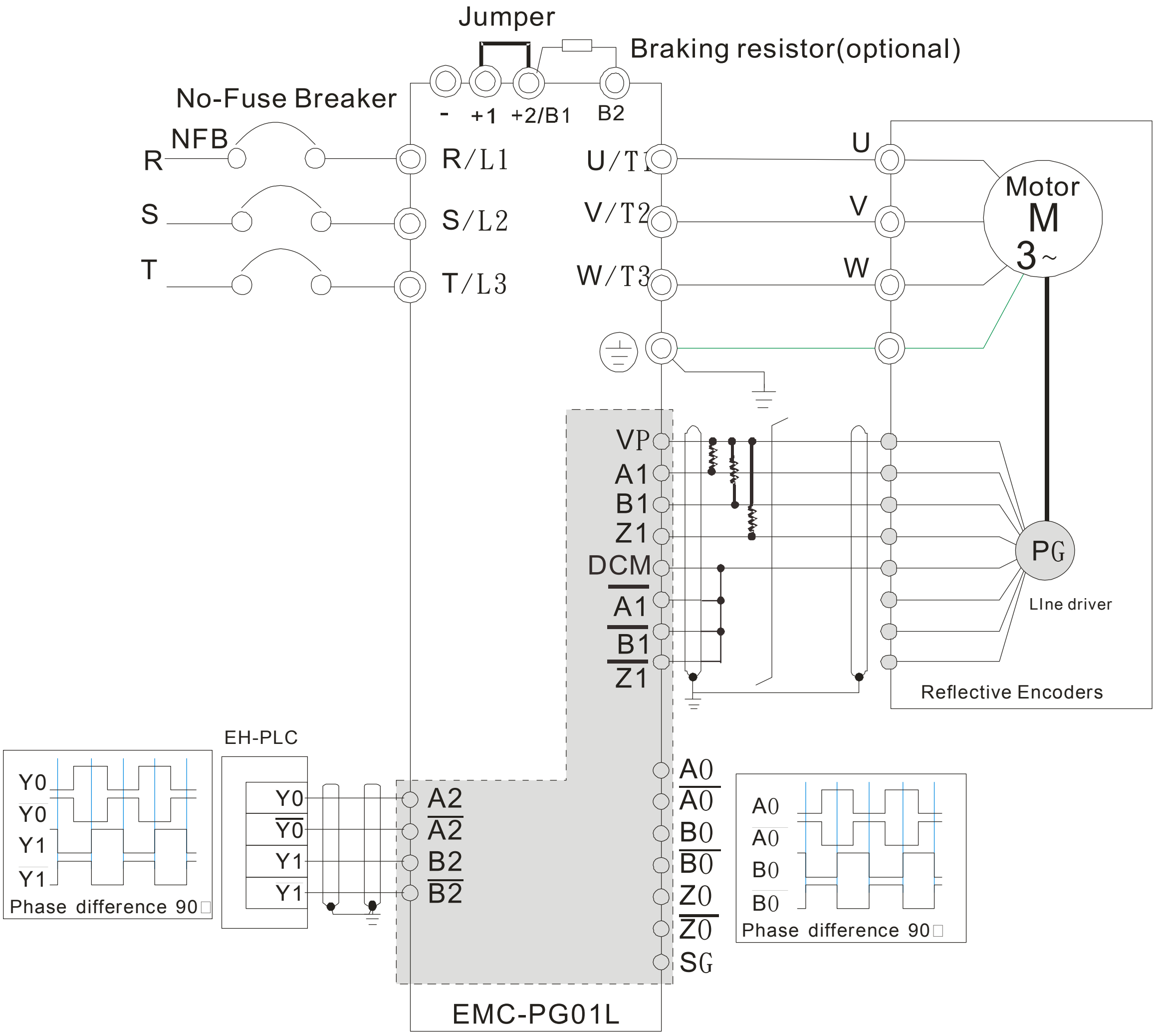


■ Wiring Diagram

☑ 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 0.81mm^2 (AWG24 to AWG18).

☑ Cable length: Less than 100m



8-8 EMC-PG01O

■ Terminal descriptions

Set by Pr.10-00~10-02

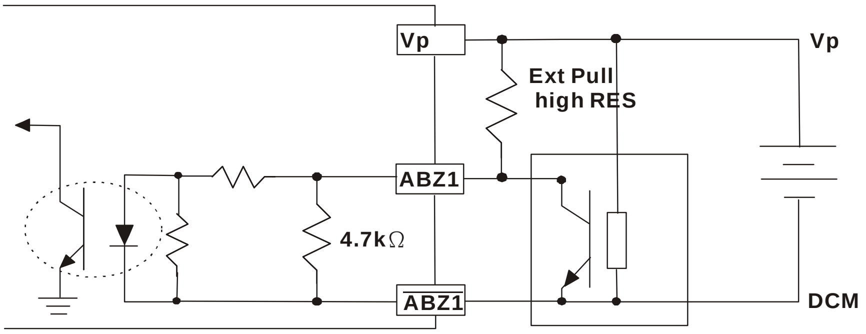
Terminals		Descriptions
PG1	VP	Output voltage for power: +5V/+12V±5% (use FSW3 to switch +5V/+12V) Max. output current: 200mA
	DCM	Common for power and signal
	A1, /A1, B1, /B1, Z1, /Z1	Encoder Input signal (Line Driver or Open Collector) Open Collector Input Voltage: +5V/+12V It can be 1-phase or 2-phase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

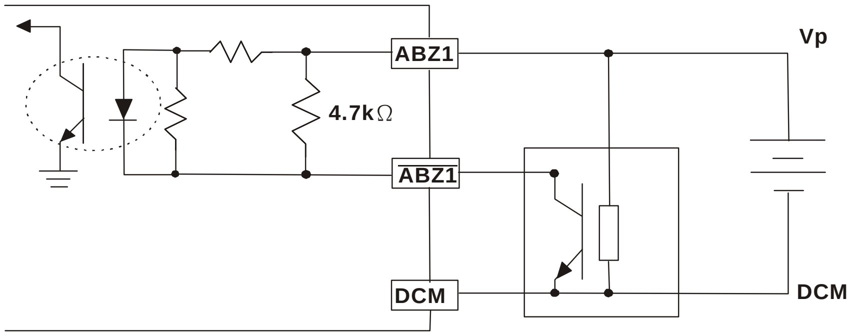
5V	Recommended pull-up resistor: above100~220Ω, 1/2W
12V	Recommended pull-up resistor: above 510~1.35kΩ, 1/2W
24V	Recommended pull-up resistor, above1.8k~3.3kΩ, 1/2W

PG1 Wiring Diagram

①



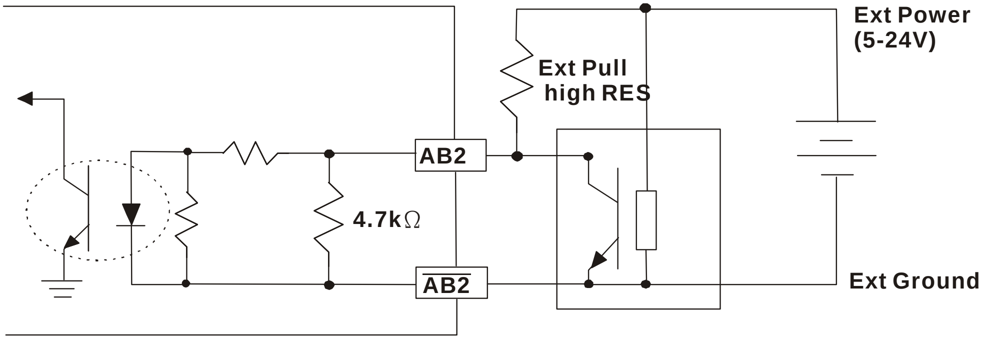
②



When wiring in this way, if there a signal on EMC-PG01's A1, B1 and Z1,LED lights is OFF.

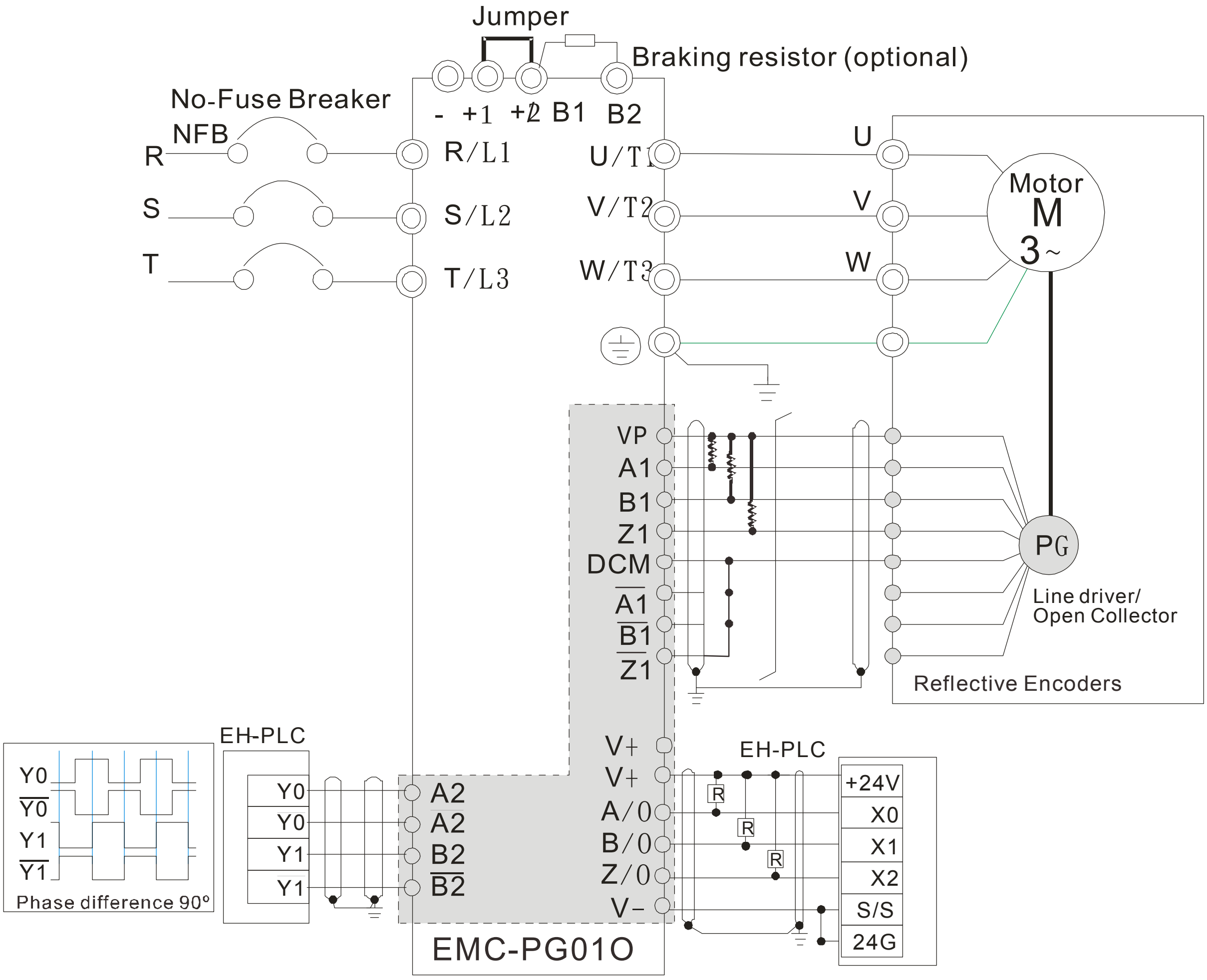
if A1, B1 and Z1 have no signals, LED lights is ON.

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 0.81mm^2 (AWG24 to AWG18).
- ☑ Cable length: Less than 100m



8-9 EMC-PG01U

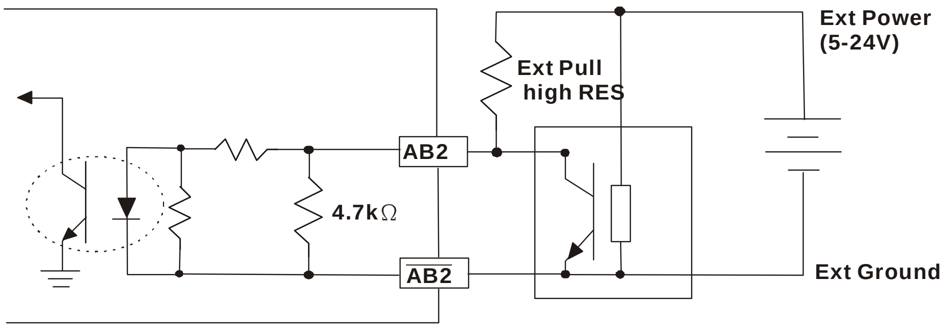
- FJMP1 S: Standard UVW Output Encoder; D: Delta Encoder
- Set by Pr.10-00~10-02

Terminals		Descriptions
PG1	VP	Output voltage for power: +5V/+12V±5% (use FSW3 to switch +5V/+12V) 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: 300kP/sec
	U1, /U1, V1, /V1, W1, /W1	Encoder input signal
PG2	A2, /A2, B2, /B2	Pulse Input signal (Line Driver or Open Collector) Open Collector Input Voltage: +5~+24V (Note1) It can be 1-phase or 2-phase input. Max. output frequency: 300kP/sec.
PG OUT	AO, /AO, BO, /BO, ZO, /ZO, SG	PG Card Output signals. It has division frequency function: 1~255 times Max. output voltage for Line driver: 5Vdc Max. output current: 50mA Max. output frequency: 300kP/sec 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.

5V	Recommended pull-up resistor: above100~220Ω, 1/2W
12V	Recommended pull-up resistor: above 510~1.35kΩ, 1/2W
24V	Recommended pull-up resistor, above1.8k~3.3kΩ, 1/2W

PG2 Wiring Diagram

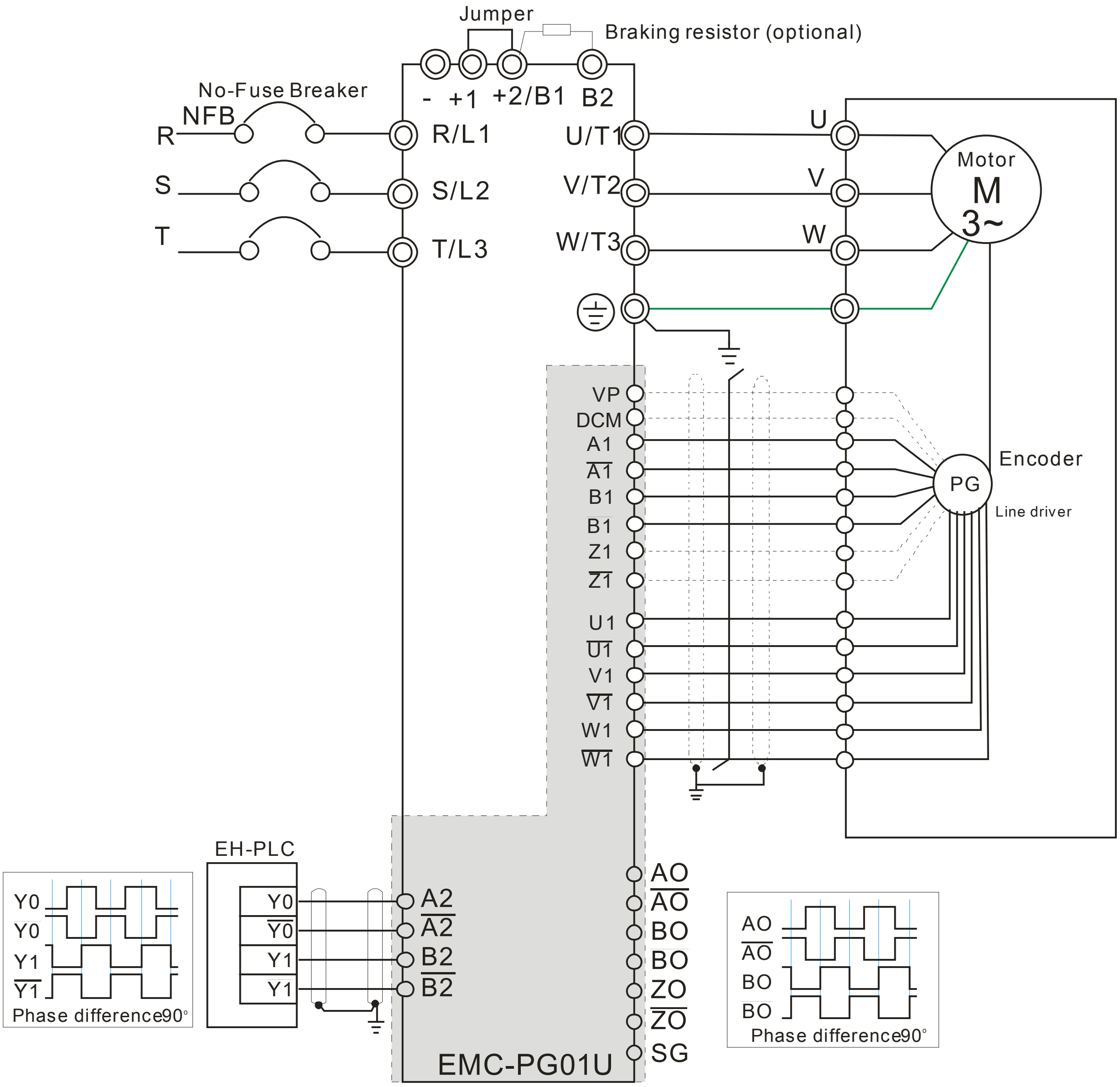


■ Wiring Diagram

☑ 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 0.81mm^2 (AWG24 to AWG18).

☑ Cable length: Less than 100m



8-10 EMC-PG01R

■ Terminal Descriptions

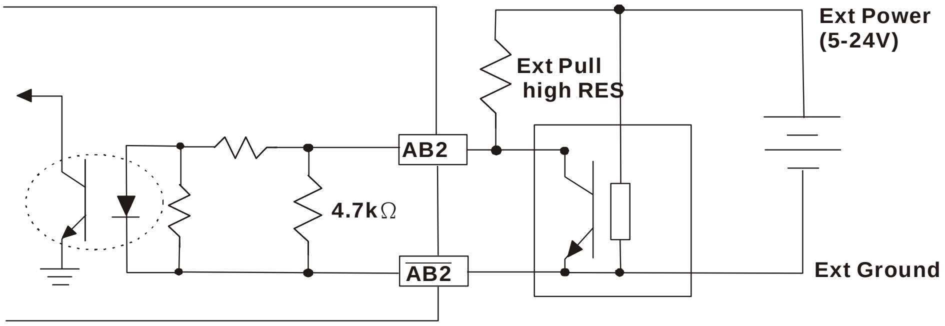
Set by Pr.10-00~10-02

Terminals		Descriptions
PG1	R1- R2	Resolver Output Power 7Vrms, 10kHz
	S1,S2, S3, S4,	Resolver Input Signal 3.5±0.175Vrms, 10kHz
PG2	A2, /A2, B2, /B2	Pulse Input signal (Line Driver or Open Collector) Open Collector Input Voltage: +5~+24V (Note1) It can be 1-phase or 2-phase input. Max. output frequency: 300kP/sec.
PG OUT	AO, /AO, BO, /BO, ZO, /ZO, SG,	PG Card Output signals. It has division frequency function: 1~255 times Max. output voltage for Line driver: 5VDC Max. output current: 50mA Max. output frequency: 300kP/sec 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.

5V	Recommended pull-up resistor: above100~220Ω, 1/2W
12V	Recommended pull-up resistor: above 510~1.35kΩ, 1/2W
24V	Recommended pull-up resistor, above1.8k~3.3kΩ, 1/2W

PG2 Wiring Diagram

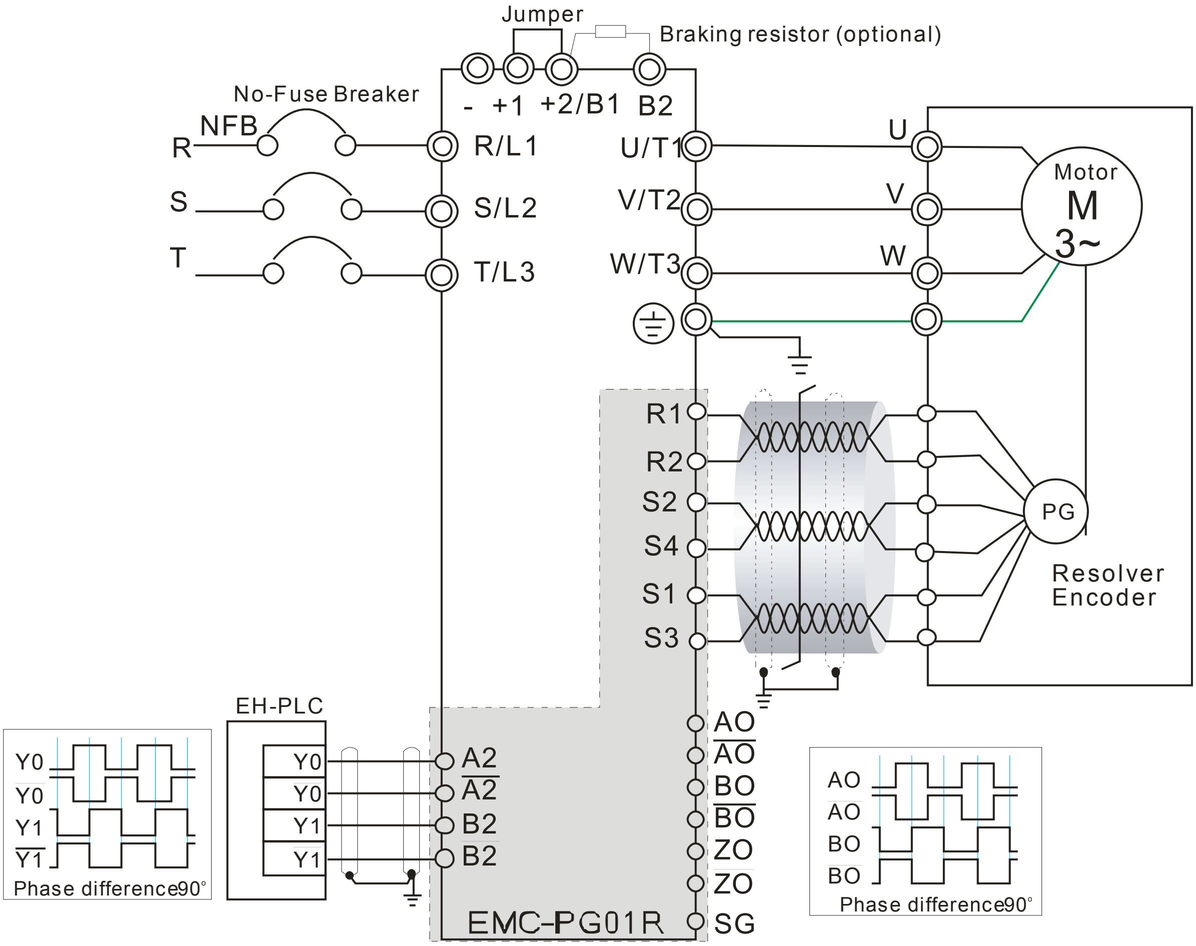


■ Wiring Diagram

☑ 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 0.81mm^2 (AWG24 to AWG18).

☑ Cable length: Less than 100m

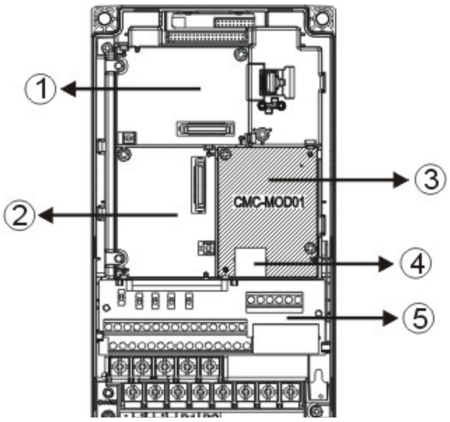


8-11 CMC-MOD01

■ Features

1. Supports Modbus TCP protocol
2. MDI/MDI-X auto-detect
3. Baud rate: 10/100Mbps 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, Delta Configuration

Electrical Specification

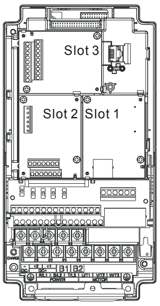
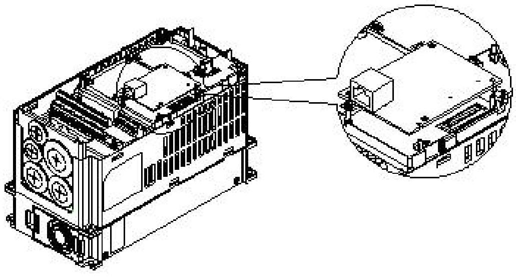
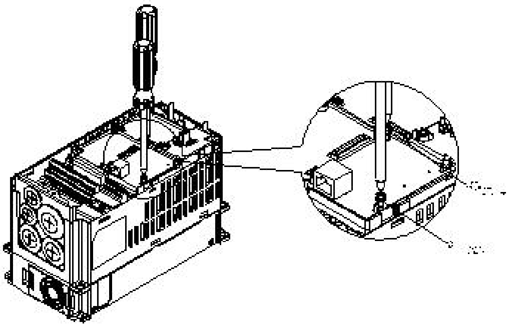
Power supply voltage	5VDC (supply by the AC motor drive)
Insulation voltage	2KV
Power consumption	0.8W
Weight	25g

Environment

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

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 ~ 8 kg-cm (5.21 ~ 6.94 in-lbs) after the PCB is clipped with the holes (shown in Figure 5).

 [Figure 3]	 [Figure 4]
 [Figure 5]	

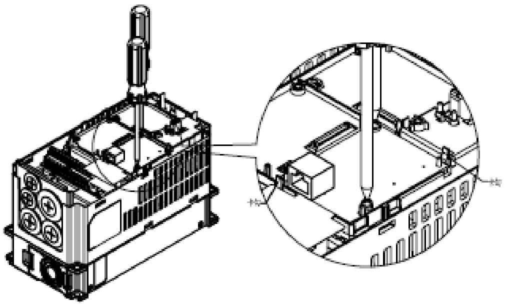
Communication Parameters for VFD-C2000 Connected to Ethernet

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.

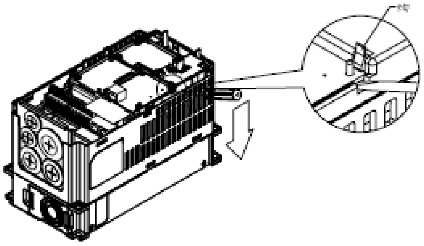
Parameter	Function	Set value (Dec)	Explanation
P00-20	Source of frequency command setting	8	The frequency command is controlled by communication card.
P00-21	Source of operation command setting	5	The operation command is controlled by communication card.
P09-30	Decoding method for communication	0	Decoding method for Delta AC motor 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

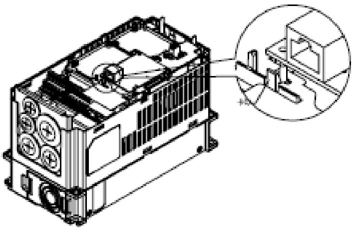
1. Switch off the power supply of VFD-C2000.
2. Remove the two screws (shown in Figure 6).
3. Twist opens the card clip and inserts the slot type screwdriver to the hollow to prize the PCB off the card clip (shown in Figure 7).
4. Twist opens the other card clip to remove the PCB (shown in Figure 8).



[Figure 6]



[Figure 7]



[Figure 8]

- **Basic Registers**

BR#	R/W	Content	Explanation
#0	R	Model name	Set up by the system; read only. The model code of CMC-MOD01=H'0203
#1	R	Firmware version	Displaying the current firmware version in hex, e.g. H'0100 indicates the firmware version V1.00.
#2	R	Release date of the version	Displaying the data in decimal form. 10,000s digit and 1,000s digit are for "month"; 100s digit and 10s digit are for "day". 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
LINK	Green	On	Network connection in normal status	--
		Flashes	Network in operation	--
		Off	Network not connected	Check if the network cable is connected

Troubleshooting

Abnormality	Cause	How to correct it?
POWER LED off	AC motor drive not powered	Check if AC motor drive is powered, and if the power supply is normal.
	CMC-MOD01 not connected to AC motor drive	Make sure CMC-MOD01 is connected to AC motor drive.
LINK LED off	CMC-MOD01 not connected to network	Make sure the network cable is correctly connected to network.
	Poor contact to RJ-45 connector	Make sure RJ-45 connector is connected to Ethernet port.
No module found	CMC-MOD01 not connected to network	Make sure CMC-MOD01 is connected to network.
	PC and CMC-MOD01 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-MOD01 setup page	CMC-MOD01 not connected to network	Make sure CMC-MOD01 is connected to the network.
	Incorrect communication setting in DCISoft	Make sure the communication setting in DCISoft is set to Ethernet.
	PC and CMC-MOD01 in different networks and blocked by network firewall.	Conduct the setup by AC motor drive keypad.
Able to open CMC-MOD01 setup page but fail to utilize webpage monitoring	Incorrect network setting in CMC-MOD01	Check if the network setting for CMC-MOD01 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.

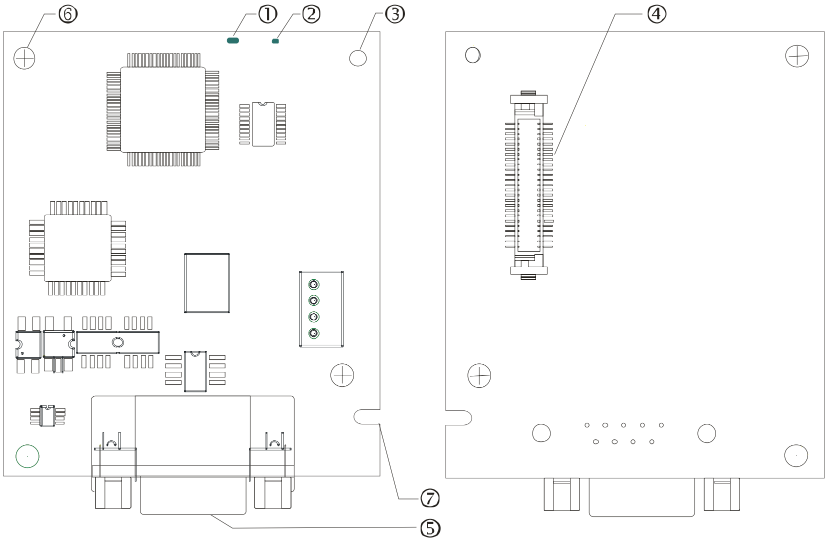
Abnormality	Cause	How to correct it?
Fail to send e-mail	Incorrect network setting in CMC-MOD01	Check if the network setting for CMC-MOD01 is correct.
	Incorrect mail server setting	Please confirm the IP address for SMTP-Server.

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. 12Mbps.

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 speed supported (auto-detection)	9.6kbps; 19.2kbps; 93.75kbps; 187.5kbps; 125kbps; 250kbps; 500kbps; 1.5Mbps; 3Mbps; 6Mbps; 12Mbps (bit per second)

Electrical Specification

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

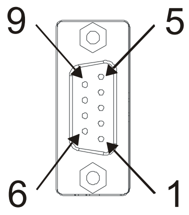
Environment

Noise immunity	ESD(IEC 61800-5-1,IEC 6100-4-2) EFT(IEC 61800-5-1,IEC 6100-4-4) Surge Teat(IEC 61800-5-1,IEC 6100-4-5) Conducted Susceptibility Test(IEC 61800-5-1,IEC 6100-4-6)
Operation /storage	Operation: -10ºC ~ 50ºC (temperature), 90% (humidity) Storage: -25ºC ~ 70ºC (temperature), 95% (humidity)
Shock / vibration resistance	International standards: IEC61131-2, IEC68-2-6 (TEST Fc)/IEC61131-2 & IEC 68-2-27 (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 motor drive is normal.

NET LED

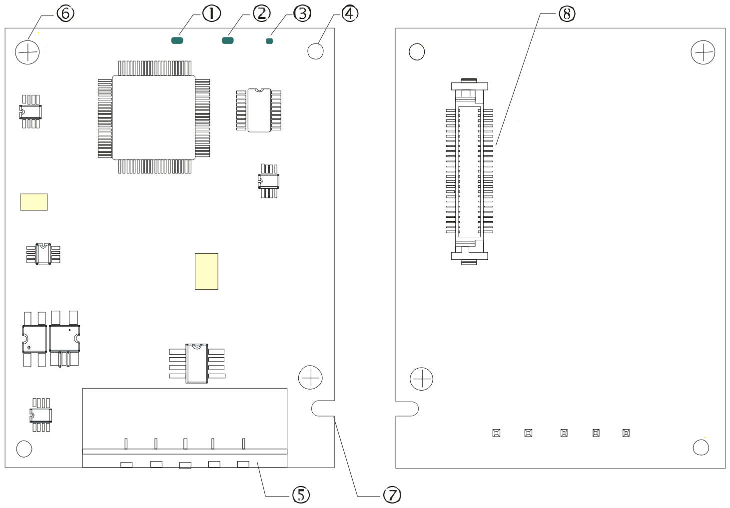
LED status	Indication	How to correct it?
Green light on	Normal status	--
Red light on	CMC-PD01 is not connected to PROFIBUS DP bus.	Connect CMC-PD01 to PROFIBUS DP bus.
Red light flashes	Invalid PROFIBUS communication address	Set the PROFIBUS address of CMC-PD01 between 1 ~ 125 (decimal)
Orange light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

8-13 CMC-DN01

■ 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: 125kbps, 250kbps, 500kbps 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



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

■ 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 2. Transmitting power supply from AC motor drive
Communication	Delta HSSP protocol

Electrical Specification

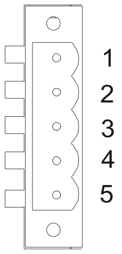
Power supply voltage	5VDC (supplied by AC motor drive)
Insulation voltage	500VDC
Communication wire power consumption	0.85W
Power consumption	1W
Weight	23g

Environment

Noise immunity	ESD (IEC 61800-5-1,IEC 6100-4-2) EFT (IEC 61800-5-1,IEC 6100-4-4) Surge Teat(IEC 61800-5-1,IEC 6100-4-5) Conducted Susceptibility Test (IEC 61800-5-1,IEC 6100-4-6)
Operation /storage	Operation: -10ºC ~ 50ºC (temperature), 90% (humidity) Storage: -25ºC ~ 70ºC (temperature), 95% (humidity)
Shock / vibration resistance	International standards: IEC61131-2, IEC68-2-6 (TEST Fc)/IEC61131-2 & 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	0V



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

MS LED

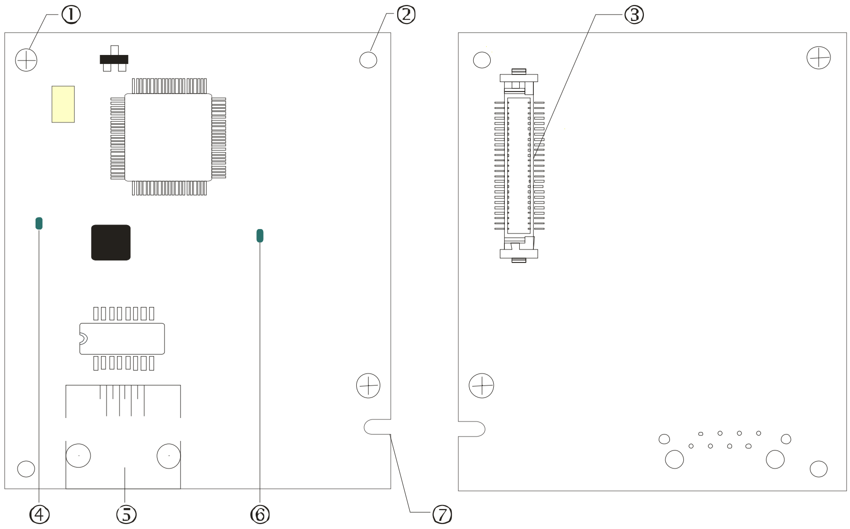
LED status	Indication	How to correct it?
Off	No power supply or being off-line	Check the power supply of CMC-DN01 and see of the connection is normal.
Green light flashes	Waiting for I/O data	Switch the master PLC to RUN status
Green light on	I/O data are normal	--
Red light flashes	Mapping error	1. Reconfigure CMC-DN01 2. Re-power AC motor drive
Red light on	Hardware error	1. See the error code displayed on AC motor drive. 2. Send back to the factory for repair if necessary.
Orange light flashes	CMC-DN01 is establishing connection with AC motor drive.	If the flashing lasts for a long time, check if CMC-DN01 and AC motor drive are correctly 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: 10/100Mbps auto-detect
4. AC motor drive keypad/Ethernet configuration
5. Virtual serial port

Product Profile



[Figure1]

1. Screw fixing hole
2. Positioning hole
3. AC motor drive connection port
4. LINK indicator
5. RJ-45 connection port
6. POWER indicator
7. Fool-proof groove

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 Configuration

Electrical Specification

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

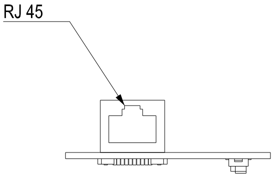
Environment

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

- **Installation**

Connecting CMC-EIP01 to Network

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

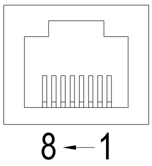


[Figure 2]

RJ-45 PIN Definition

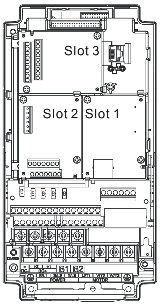
PIN	Signal	Definition
1	Tx+	Positive pole for data transmission
2	Tx-	Negative pole for data transmission
3	Rx+	Positive pole for data receiving
4	--	N/C

PIN	Signal	Definition
5	--	N/C
6	Rx-	Negative pole for data receiving
7	--	N/C
8	--	N/C

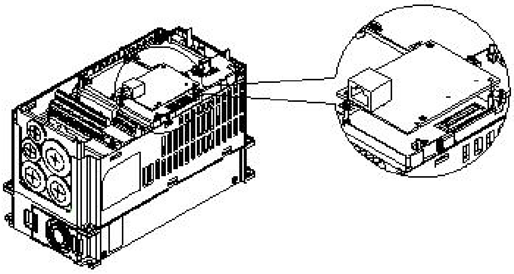


- **Connecting CMC-EIP01 to VFD-C2000**

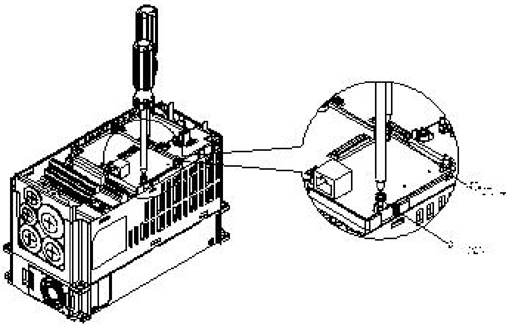
1. Switch off the power of AC motor drive.
2. Open the front cover of AC motor drive.
3. Place the insulation spacer into the positioning pin at Slot 1 (shown in Figure 3), and aim the two holes on the PCB at the positioning pin. Press the pin to clip the holes with the PCB (see Figure 4).
4. Screw up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



[Figure 3]



[Figure 4]



[Figure 5]

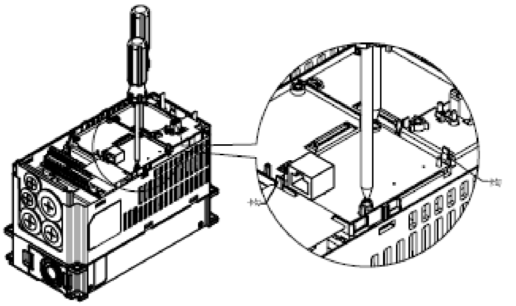
- **Communication Parameters for VFD-C2000 Connected to Ethernet**

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.

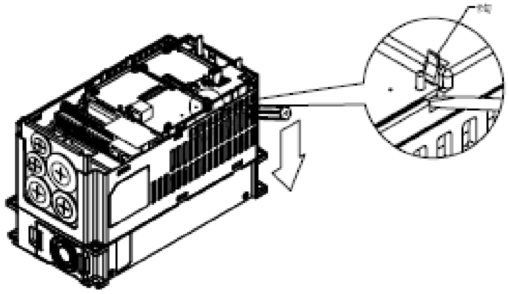
Parameter (Dec)	Function	Set value (Dec)	Explanation
P00-20	Source of frequency command setting	8	The frequency command is controlled by communication card.
P00-21	Source of operation command setting	5	The operation command is controlled by communication card.
P09-30	Decoding method for communication	0	The decoding method for Delta AC motor 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

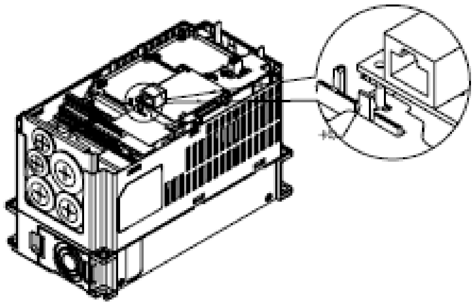
1. Switch off the power supply of VFD-C2000.
2. Remove the two screws (see Figure 6).
3. Twist opens the card clip and inserts the slot type screwdriver to the hollow to prize the PCB off the card clip (see Figure 7).
4. Twist opens the other card clip to remove the PCB (see Figure 8).



[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.
LINK	Green	On	Network connection in normal status	--
		Flashes	Network in operation	--
		Off	Network not connected	Check if the network cable is connected.

Troubleshooting

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

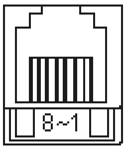
Abnormality	Cause	How to correct it?
	Poor contact to RJ-45 connector	Make sure RJ-45 connector is connected to Ethernet port.
No communication card found	CMC-EIP01 not connected to network	Make sure CMC-EIP01 is connected to network.
	PC and CMC-EIP01 in different networks and blocked by network firewall.	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

■



RS485 socket

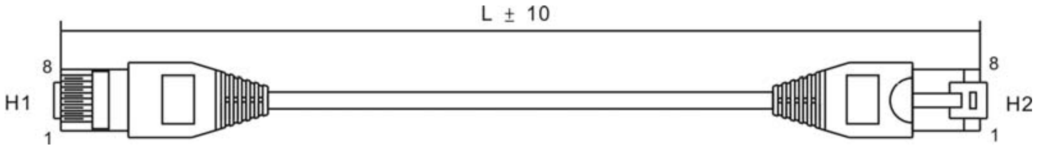
Pin	Pin name	Definition
1	CAN_H	CAN_H bus line (dominant high)
2	CAN_L	CAN_L bus line (dominant low)
3	CAN_GND	Ground/0V/V-
7	CAN_GND	Ground/0V/V-

- **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**

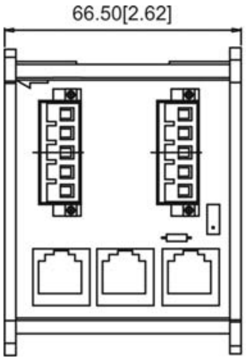
  Model: TAP-CB05, TAP-CB10

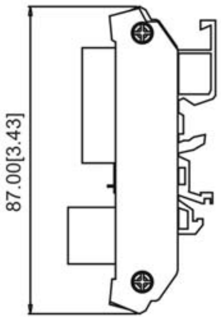


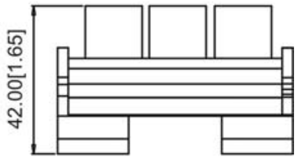
Title	Part No.	L	
		mm	inch
1	TAP-CB05	500 ± 10	19 ± 0.4
2	TAP-CB10	1000± 10	39 ± 0.4

- **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
Output Rating	HEAVY DUTY	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
		Carrier Frequency (kHz)	2~6kHz									
	NORMAL DUTY	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
		Carrier Frequency (kHz)	2~15kHz							2~10kHz		
Input Rating	Input Current (A) Heavy Duty		6.1	11	15	18.5	26	34	50	68	78	95
	Input Current (A) Normal Duty		6.4	12	16	20	28	36	52	72	83	99
	Rated Voltage/Frequency		3-phase AC 200V~240V (-15% ~ +10%), 50/60Hz									
	Operating Voltage Range		170~265Vac									
	Frequency Tolerance		47~63Hz									
AC Drive Weight			2.6± 0.3Kg			5.4± 1Kg				9.8± 1.5Kg		
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
Output Rating	HEAVY DUTY	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					
	NORMAL DUTY	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			
Input Rating	Input Current (A) Heavy Duty		118	136	162	196	233	315
	Input Current (A) Normal Duty		124	143	171	206	245	331
	Rated Voltage/Frequency		3-phase AC 200V~240V (-15% ~ +10%), 50/60Hz					
	Operating Voltage Range		170~265Vac					
	Frequency Tolerance		47~63Hz					
AC Drive Weight			38.5± 1.5Kg		64.8± 1.5Kg			86.5± 1.5Kg
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	Frame A to C (optional); Frame D and above (optional)
EMC-COP01	VFDXXC23A (optional); VFDXXXC23E (built-in)

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
Output Rating	HEAVY DUTY	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											
	NORMAL DUTY	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
		Carrier Frequency (kHz)	2~15kHz									2~10kHz		
Input Rating	Input Current (A) Heavy Duty		4.1	5.6	8.3	13	14.5	16	19	25	33	38	45	60
	Input Current (A) Normal 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											
	Operating Voltage Range		323~528Vac											
	Frequency Tolerance		47~63Hz											
AC Drive Weight			2.6± 0.3Kg						5.4± 1Kg			9.8± 1.5Kg		
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			VFDXXC43A (optional); VFDXXXC43E (built-in)											

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
Output Rating	HEAVY DUTY	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
		Carrier Frequency (kHz)	2~6kHz													
	NORMAL DUTY	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
		Carrier Frequency (kHz)	2~10kHz				2~9kHz									
Input Rating	Input Current (A) Heavy Duty		70	96	108	149	159	197	228	285	361	380	469	527	594	816
	Input Current (A) Normal Duty		74	101	114	157	167	207	240	300	380	400	494	555	625	866
	Rated Voltage/Frequency		3-Phase AC 380V~480V (-15%~+10%), 50/60Hz													
	Operating Voltage Range		323~528Vac													
	Frequency Tolerance		47~63Hz													
AC Drive Weight			38.5± 1.5Kg				64.8± 1.5Kg		86.5± 1.5Kg			134± 4Kg		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; VFDXXXC43E: Built-in EMI Filter VFDXXXC43A/43E Frame D and above: EMI Filter is optional
EMC-COP01	VFDXXC43A (optional); VFDXXXC43E (built-in)

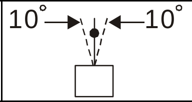
NOTE

- 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.

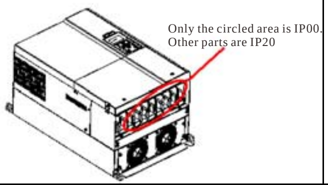
General Specifications

Control Characteristics	Control Method	1: V/F, 2: SVC, 3: VF+PG, 4: FOC+PG, 5: TQC+PG,
	Starting Torque	Reach up to 150% or above at 0.5Hz. Under FOC+PG mode, starting torque can reach 150% at 0Hz.
	V/F Curve	4 point adjustable V/F curve and square curve
	Speed Response Ability	5Hz (vector control can reach up to 40Hz)
	Torque Limit	Max. 200% torque current
	Torque Accuracy	±5%
	Max. Output Frequency (Hz)	Light duty and normal duty: 0.01~600.00Hz; Heavy duty: 0.00 ~ 300.00 Hz
	Frequency Output Accuracy	Digital command:±0.01%, -10℃~+40℃, Analog command: ±0.1%, 25±10℃
	Output Frequency Resolution	Digital command:0.01Hz, Analog command: 0.03 X max. output frequency/60 Hz (±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 VFD150C23A(include) and series above: PMW control; VFD150C23A and series below: on/off switch control 460V model VFD150C23A(include) and series above: PMW control; VFD150C23A and series below: on/off switch control
Protection Characteristics	Motor Protection	Electronic thermal relay protection
	Over-current Protection	For drive model 230V and 440V 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 410V 460: drive will stop when DC-BUS voltage exceeds 820V
	Over-temperature Protection	Built-in temperature sensor
	Stall Prevention	Stall prevention during acceleration, deceleration and running independently
	Restart After Instantaneous Power Failure	Parameter setting up to 20 seconds
	Grounding Leakage Current Protection	Leakage current is higher than 50% of rated current of the AC motor drive
Certifications		CE, cULus, GB/T12668-2, PCT (certification in progress)

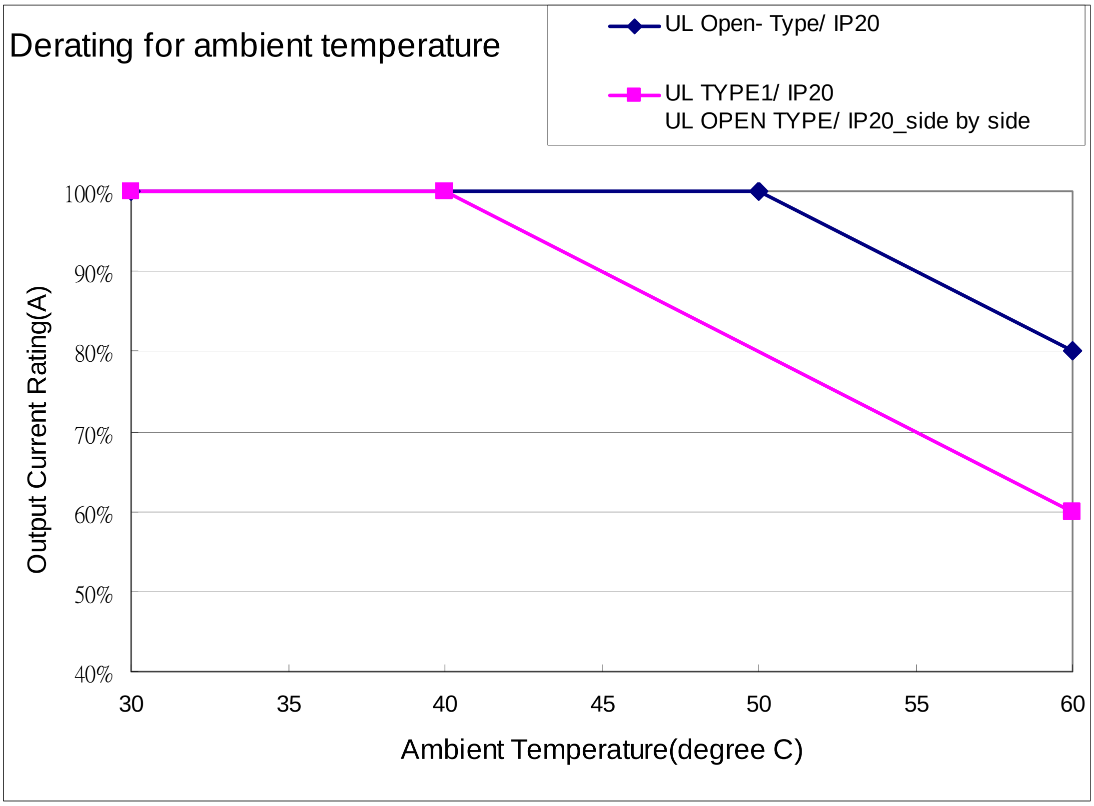
9-3 Environment for Operation, Storage and Transportation

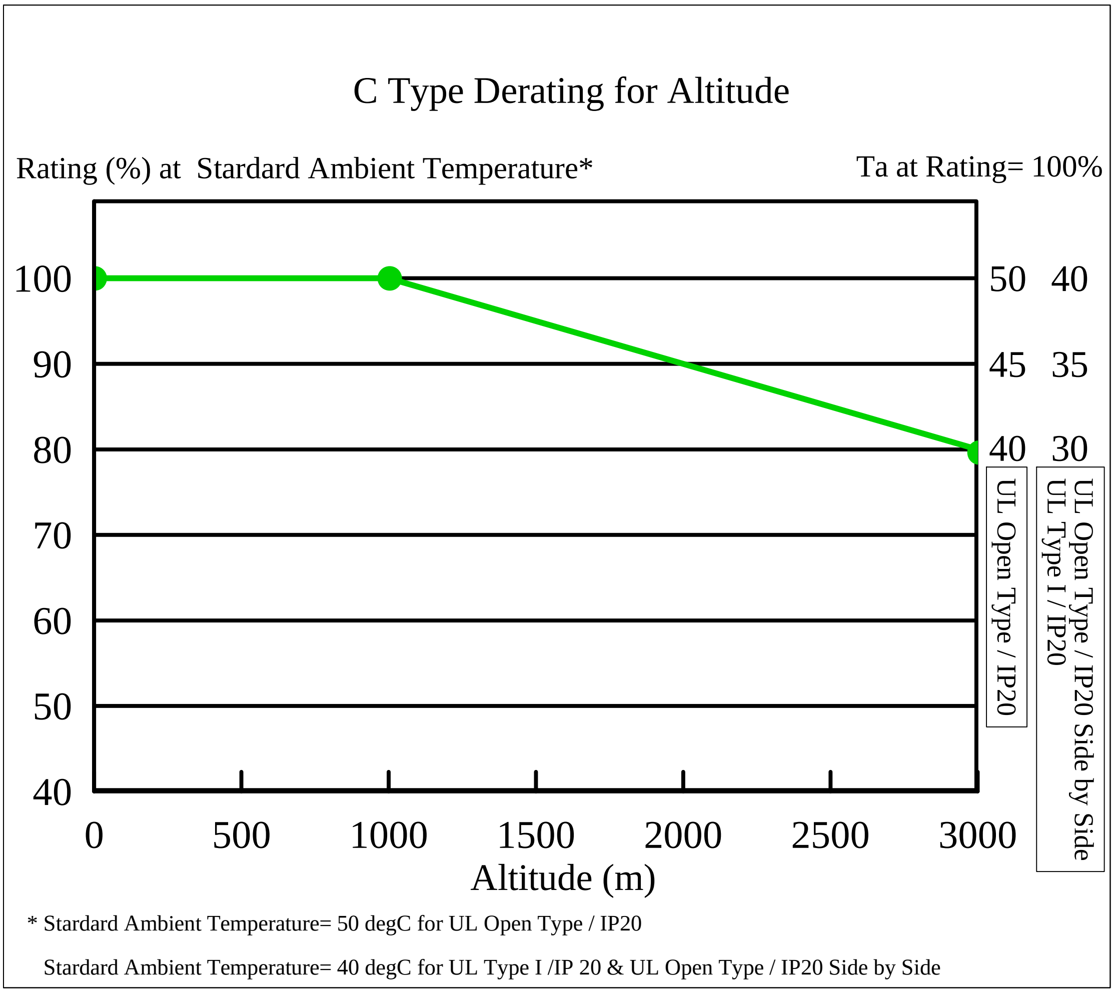
DO NOT expose the AC motor drive in the bad environment, such as dust, direct sunlight, corrosive/inflammable gasses, humidity, liquid and vibration environment. The salt in the air must be less than 0.01mg/cm^2 every year.			
Environment	Installation location	IEC60364-1/IEC60664-1 Pollution degree 2, Indoor use only	
	Surrounding Temperature	Storage	-25 °C ~ +70 °C
		Transportation	-25 °C ~ +70 °C
		Non-condensation, non-frozen	
	Rated Humidity	Operation	Max. 90%
		Storage/ Transportation	Max. 95%
		No condense water	
	Air Pressure	Operation/ Storage	86 to 106 kPa
		Transportation	70 to 106 kPa
	Pollution Level	IEC721-3-3	
		Operation	Class 3C2; Class 3S2
		Storage	Class 2C2; Class 2S2
		Transportation	Class 1C2; Class 1S2
		No concentrate	
	Altitude	Operation	If AC motor drive is installed at altitude 0~1000m, follow normal operation restriction. If it is install at altitude 1000~3000m, decrease 2% of rated current or lower 0.5℃ of temeperature for every 100m increase in altitude. Maximum altitude for Corner Grounded is 2000m.
Package Drop	Storage	ISTA procedure 1A(according to weight) IEC60068-2-31	
	Transportation		
Vibration	1.0mm, peak to peak value range from 2Hz to 13.2 Hz; 0.7G~1.0G range from 13.2Hz to 55Hz; 1.0G range from 55Hz to 512 Hz. Comply with IEC 60068-2-6		
Impact	IEC/EN 60068-2-27		
Operation Position	Max. allowed offset angle ±10° (under normal installation position)		

9-4 Specification for Operation Temperature and Protection Level

Model	Frame	Top cover	Conduit Box	Protection Level	Operation Temperature
VFDxxxCxxA	Frame A~C 230V: 0.75~22kW 460V: 0.75~30kW	Top cover Removed	Standard conduit plate	IP20/UL Open Type	-10~50℃
		Standard with top cover		IP20/UL Type1/NEMA1	-10~40℃
	Frame D~H 230V: >22kW 460V: >30kW	N/A	No conduit box	IP00/IP20/UL Open Type  	-10~50℃
VFDxxxCxxE	Frame A~C 460V: 0.75~30kW	Top cover Removed	Standard conduit plate	IP20/UL Open Type	-10~50℃
		Standard with top cover		IP20/UL Type1/NEMA1	-10~40℃
	Frame D~H 230V: >22kW 460V: >30kW	N/A	Standard conduit box	IP20/UL Type1/NEMA1	-10~40℃

Derating of ambient tempeture and altitude





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

Chapter 10 Digital Keypad

10-1 Descriptions of Digital Keypad

KPC-CC01

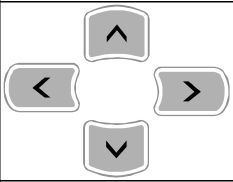
KPC-CE01(Option)

Communication Interface
RJ-45 (socket)、RS-485 interface;

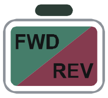
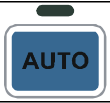
Installation Method
Embedded type and can be put flat on the surface of the control box. The front cover is water proof.

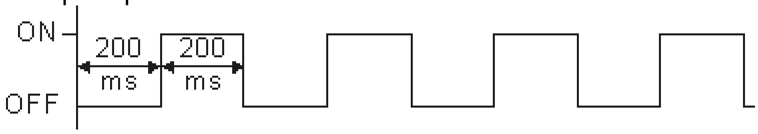
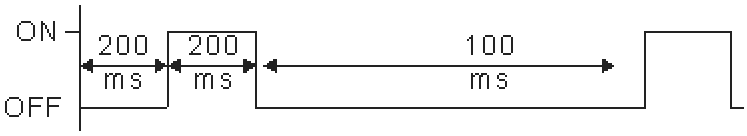
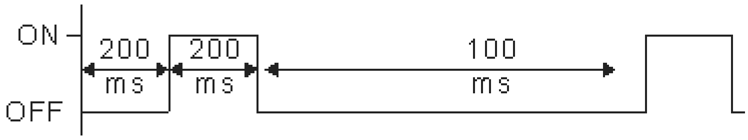
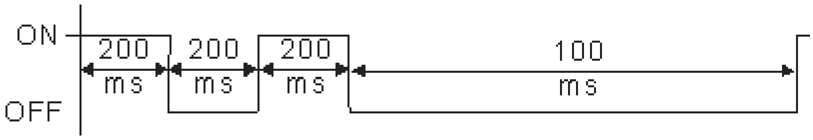
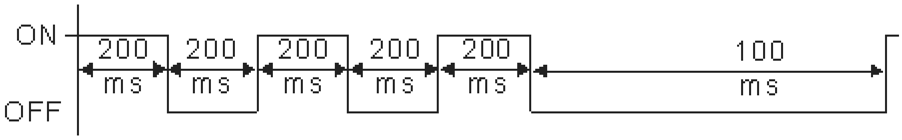
Descriptions of Keypad Functions

Key	Descriptions
RUN	Start Operation Key 1. It is only valid when the source of operation command is from the keypad. 2. It can operate the AC motor drive by the function setting and the RUN LED will be ON. 3. It can be pressed again and again at stop process. 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. 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. 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.
FWD REV	Operation Direction Key 1. This key is only control the operation direction NOT for activate the drive. FWD: forward, REV: reverse. 2. Refer to the LED descriptions for more details.
ENTER	ENTER Key Press ENTER and go to the next level. If it is the last level then press ENTER to execute the command.
ESC	ESC Key ESC key function is to leave current menu and return to the last menu. It is also functioned as a return key in the sub-menu.

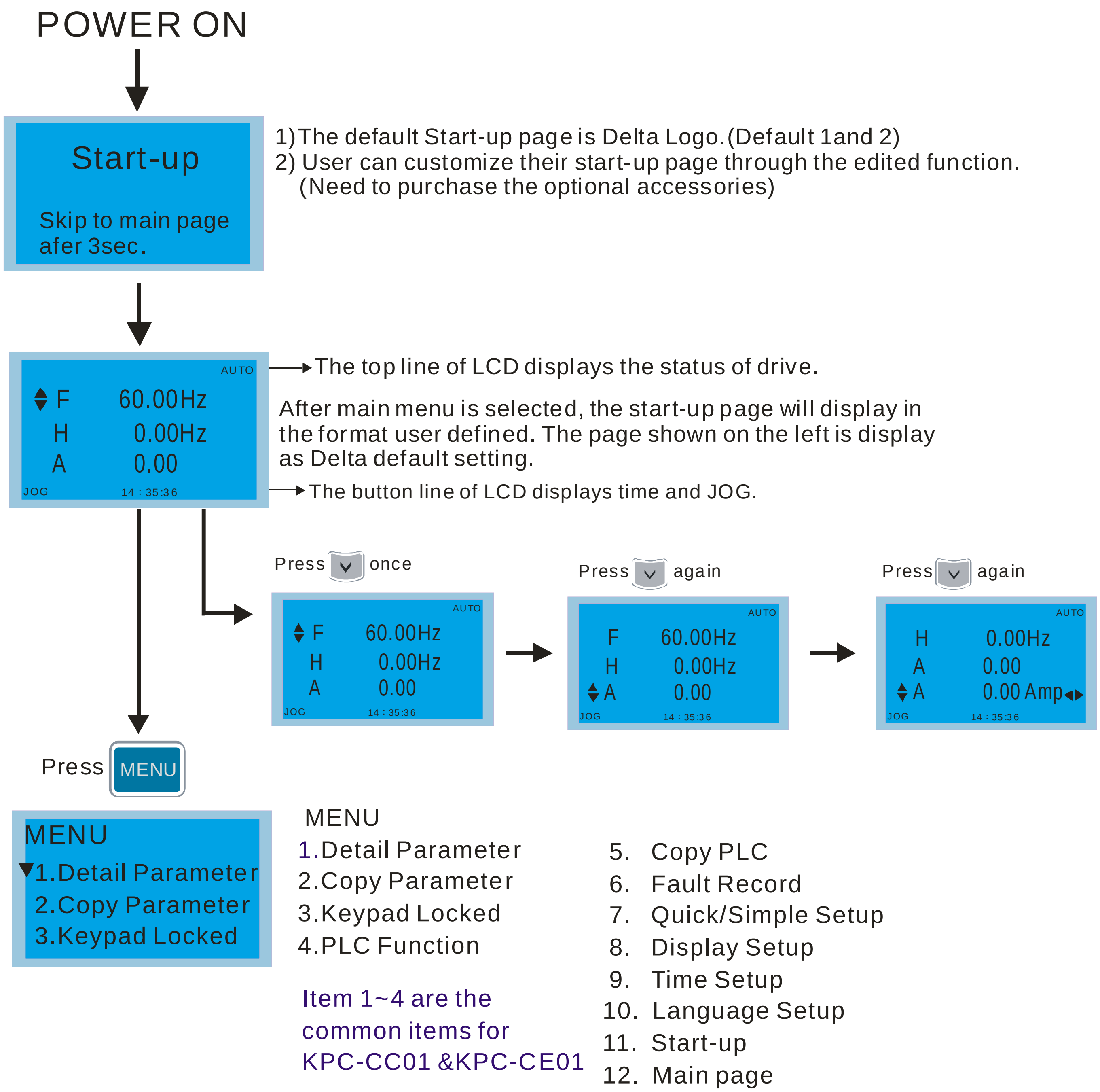
	Press menu to return to main menu. Menu content: KPC-CE01 does not support function 5 ~13. 1. Detail Parameter 2. Copy Parameter 3. Keypad Locked 4. PLC Function 5. Copy PLC 6. Fault Record 7. Quick/Simple Setup 8. Display Setup 9. Time Setup 10. Language Setup 11. Startup Menu 12. Main Page 13. PC Link
	Direction: Left/Right/Up/Down 1. In the numeric value setting mode, it is used to move the cursor and change the numeric value. 2. In the menu/text selection mode, it is used for item selection.
	Function Key 1. It has the factory setting function and the function can be set by the user. The present factory setting: F1 is JOG function. 2. Other functions must be defined by TPEditor first. TPEditor software V1.30.6 is available for download at: http://www.delta.com.tw/ch/product/em/download/download_main.asp?act=3&pid=1&cid=1&tpid=3 3. Installation Instruction for TPEditor is on page 10-15 of this chapter.
	HAND ON Key 1. This key is executed by the parameter settings of the source of Hand frequency and hand operation. The factory settings of both source of Hand frequency and hand operation are the digital keypad. 2. Press HAND 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. 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.
	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). 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. 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
	Steady ON: operation indicator of the AC motor drive, including DC brake, zero speed, standby, restart after fault and speed search. Blinking: drive is decelerating to stop or in the status of base block. Steady OFF: drive doesn’t execute the operation command
	Steady ON: stop indicator of the AC motor drive. Blinking: drive is in the standby status. Steady OFF: drive doesn’t execute “STOP” command.
	Operation Direction LED 1. Green light is on, the drive is running forward. 2. Red light is on, the drive is running backward. 3. Twinkling light: the drive is changing direction.
	(Only KPC-CE01 support this function) Setting can be done during operation. HAND LED: When HAND LED is on (HAND mode); when HAND LED is off (AUTO mode).
	(Only KPC-CE01Support this function) Setting can be done during operation. AUTO LED: when AUTO LED is on (AUTO mode); when AUTO LED is off (HAND mode).

<table>
<tr>
<td>CANopen ~"RUN"</td>
<td>
RUN LED:
<table>
<tr><th>LED status</th><th>Condition/State</th></tr>
<tr><td>OFF</td><td>CANopen at initial
No LED</td></tr>
<tr><td>Blinking</td><td>CANopen at pre-operation
 </td></tr>
<tr><td>Single flash</td><td>CANopen at stopped
 </td></tr>
<tr><td>ON</td><td>CANopen at operation status
No LED</td></tr>
</table>
</td>
</tr>
<tr>
<td>CANopen ~"ERR"</td>
<td>
ERR LED:
<table>
<tr><th>LED status</th><th>Condition/ State</th></tr>
<tr><td>OFF</td><td>No Error</td></tr>
<tr><td>Single flash</td><td>One message fail
 </td></tr>
<tr><td>Double flash</td><td>Guarding fail or heartbeat fail
 </td></tr>
<tr><td>Triple flash</td><td>SYNC fail
 </td></tr>
<tr><td>ON</td><td>Bus off</td></tr>
</table>
</td>
</tr>
</table>

10-2 Function of Digital Keypad KPC-CC01



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)

The top line of LCD displays the status of drive.

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.

The button line of LCD displays time and JOG.

MENU

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

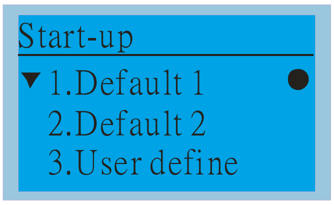
Item 1~4 are the common items for KPC-CC01 &KPC-CE01

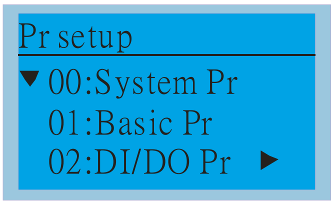
5. Copy PLC
6. Fault Record
7. Quick/Simple Setup
8. Display Setup
9. Time Setup
10. Language Setup
11. Start-up
12. Main page

NOTE

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





● : present setting

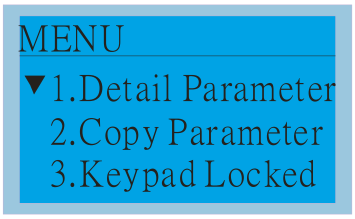
▼ : roll down the page for more options

Press ∧ ∨ for more options.

▶ : show complete sentence

Press < > for complete information

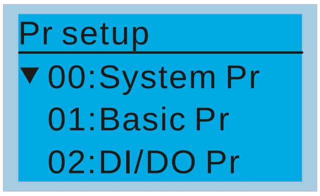
Display item



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

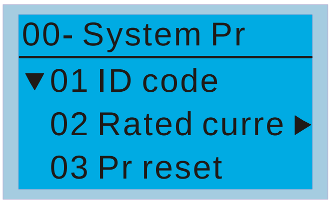
MENU
1.Detail Parameter
2.Copy Parameter
3.Keypad Locked
4.PLC Function
5. Copy PLC
6. Fault Record
7. Quick/Simple Setup
8. Display Setup
9. Time Setup
10. Language Setup
11. Start-up
12. Main page
13. PC Link

1. Detail Parameter

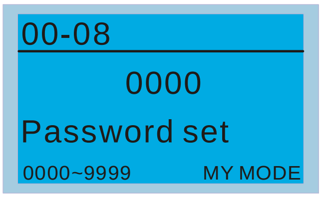


Press ENTER to select.

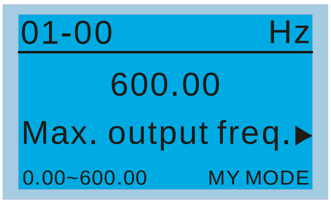
00 System Pr Content



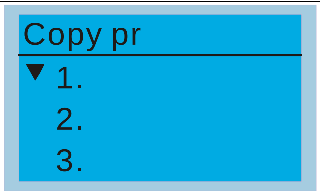
00-08 Password Set



01-00 The maximum output freq.



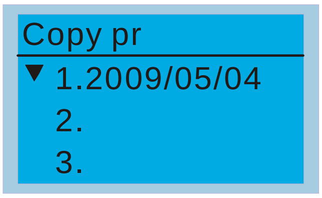
2. Copy Parameter



Copy pr
▼ 1.
2.
3.

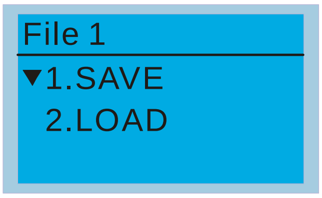
Copy parameters (Pr)

1. 4 sets of parameters duplication.
2. When the setting is complete, the date will be written to the copy parameters (Pr) page.



Copy pr
▼ 1.2009/05/04
2.
3.

Press ENTER

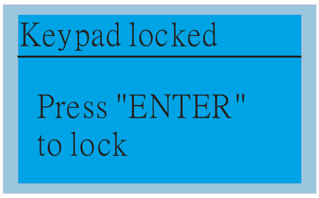


File 1
▼1.SAVE
2.LOAD

Press ▲ ▼ to save or load

After selecting save and pressing "ENTER", the parameter setting will be saved in the keypad.

3. Keypad locked



Keypad locked
Press "ENTER" to lock

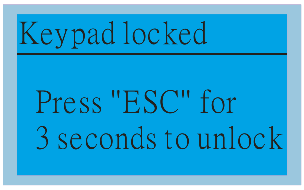
Press ENTER to lock

Keypad Locked

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

HAND
F 600.00Hz
H 600.00Hz
A 23.5A
JOG 14 : 35:56

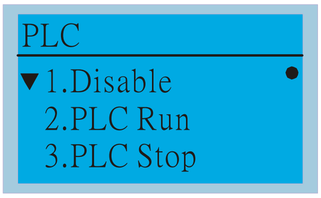
→



Keypad locked
Press "ESC" for 3 seconds to unlock

Press any key.

4. PLC Function

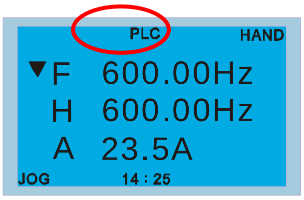


PLC
▼1.Disable ●
2.PLC Run
3.PLC Stop

PLC function

1. Disable
2. PLC run
3. PLC stop

When activate and stop PLC function, the PLC status will be displayed on main page of Delta default setting.

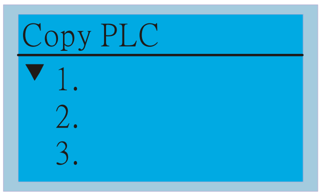


PLC HAND
▼F 600.00Hz
H 600.00Hz
A 23.5A
JOG 14 : 25

The PLC function of KPC-CE01 can only displays:

1. PLC0
2. PLC1
3. PLC2

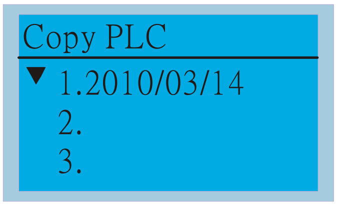
5. Copy PLC



Copy PLC
▼ 1.
2.
3.

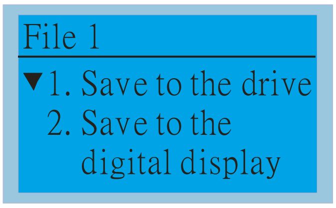
Copy PLC

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
2.
3.

Press ENTER to setting menu.



File 1
▼ 1. Save to the drive
2. Save to the digital display

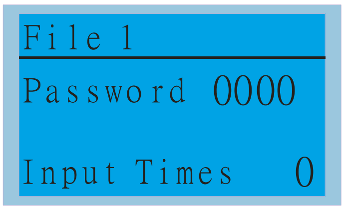
Press ∧ ∨ to select where to save the file

Press ENTER execute filesaving process.

If select save to the drive and press enter, the file will be saved to the drive.

NOTE

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.



File 1
Password 0000
Input Times 0

6. Fault record

Fault record
▼ 1:GFF
2:ocA
3:oH

Press ENTER to select.

KPC-CE01 does not support this function.

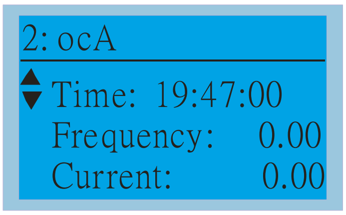
Fault Record

It can accumulate 6 sets of recent fault records with keypad V1.02 and below; 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..

Fault record
▼ 1:GFF
2:ocA
3:oH

Press ENTER to view the current and voltage of the fault

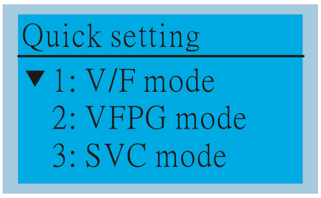


2: ocA
▲▼ Time: 19:47:00
Frequency: 0.00
Current: 0.00

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
2: VFPG mode
3: SVC mode

Press ENTER to select.

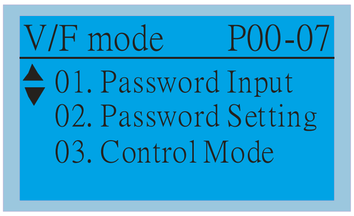
Quick Setting:

1. VF Mode
2. VFPG Mode
3. SVC Mode
4. FOCPG Mode
5. TQCPG Mode
6. My Mode

Quick Setting:

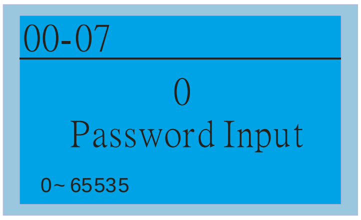
1. V/F Mode

01: Password Input (Decode)



V/F mode P00-07
▲▼ 01. Password Input
02. Password Setting
03. Control Mode

→



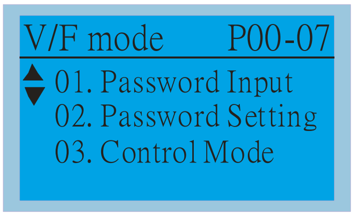
00-07
0
Password Input
0~65535

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 (P00-22)
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)

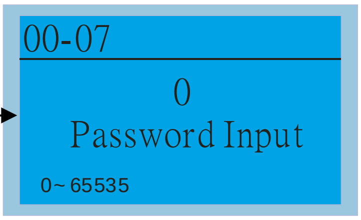
2. VFPG Mode

01: Password Input (Decode)



V/F mode P00-07
▲▼ 01. Password Input
02. Password Setting
03. Control Mode

→



00-07
0
Password Input
0~65535

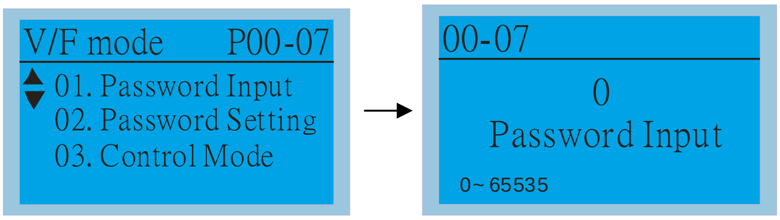
Items

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. Stop Method (P00-22)
9. Digital Keypad STOP function (P00-32)
10. Max. Operation Frequency (P01-00)
11. Base Frequency of Motor 1 (P01-01)
12. Max. Output Voltage Setting of Motor 1 (P01-02)
13. Min. Output Frequency of Motor 1 (P01-07)
14. Min. Output Voltage of Motor 1 (P01-08)
15. Output Frequency Upper Limit (P01-10)
16. Output Frequency Lower Limit (P01-11)
17. Accel. Time 1 (P01-12)
18. Decel Time 1 (P01-13)
19. Over-voltage Stall Prevention (P06-01)
20. Software Brake Level (P07-00)
21. Filter Time of Torque Command (P07-24)
22. Filter Time of Slip Compensation (P07-25)
23. Slip Compensation Gain (P07-27)
24. Encoder Type Selection (P10-00)
25. Encoder Pulse (P10-01)
26. Encoder Input Type Setting (P10-02)
27. ASR Control (P) 1 (P11-06)
28. ASR Control (I) 1 (P11-07)
29. ASR Control (P) 2 (P11-08)
30. ASR Control (I) 2 (P11-09)
31. P Gain of Zero Speed (P11-10)
32. I Gain of Zero Speed (P11-11)

3. SVCPG Mode

01: Password Input (Decode)



V/F mode P00-07
01. Password Input
02. Password Setting
03. Control Mode

00-07
0
Password Input
0~ 65535

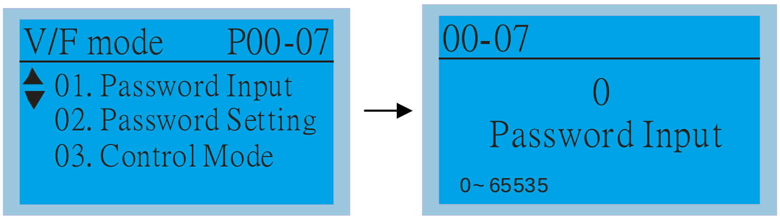
Items

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 (P00-22)
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. Min. Output Frequency of Motor 1 (P01-07)
15. Min. Output Voltage of Motor 1 (P01-08)
16. Output Frequency Upper Limit (P01-10)
17. Output Frequency Lower Limit (P01-11)
18. Accel. Time 1 (P01-12)
19. Decel Time 1 (P01-13)
20. Full-load Current of Induction Motor 1 (P05-01)
21. Rated Power of Induction Motor 1 (P05-02)
22. Rated Speed of Induction Motor 1 (P05-03)
23. Pole Number of Induction Motor 1 (P05-04)
24. No-load Current of Induction Motor 1 (P05-05)
25. Over-voltage Stall Prevention (P06-01)
26. Over-current Stall Prevention during Acceleration (P06-03)
27. Derating Protection (P06-55)
28. Software Brake Level (P07-00)

29. Emergency Stop (EF) & Force to Stop Selection (P07-20)
30. Filter Time of Torque Command (P07-24)
31. Filter Time of Slip Compensation (P07-25)
32. Slip Compensation Gain (P07-27)

4. FOCPG Mode

01: Password Input (Decode)

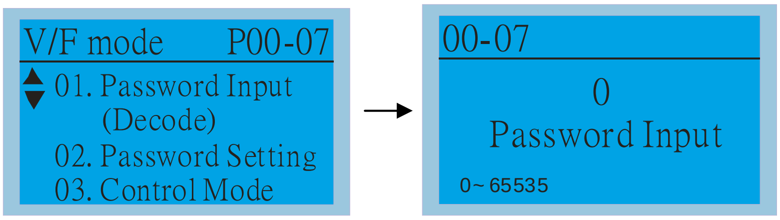


Items

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. Source of the Master Frequency Command (AUTO) (P00-20)
6. Source of the Operation Command (AUTO) (P00-21)
7. Stop Method (P00-22)
8. Max. Operation Frequency (P01-00)
9. Base Frequency of Motor 1 (P01-01)
10. Max. Output Voltage Setting of Motor 1 (P01-02)
11. Output Frequency Upper Limit (P01-10)
12. Output Frequency Lower Limit (P01-11)
13. Accel. Time 1 (P01-12)
14. Decel Time 1 (P01-13)
15. Full-load Current of Induction Motor 1 (P05-01)
16. Rated Power of Induction Motor 1 (P05-02)
17. Rated Speed of Induction Motor 1 (P05-03)
18. Pole Number of Induction Motor 1 (P05-04)
19. No-load Current of Induction Motor 1 (P05-05)
20. Over-voltage Stall Prevention (P06-01)
21. Over-current Stall Prevention during Acceleration (P06-03)
22. Derating Protection (P06-55)
23. Software Brake Level (P07-00)
24. Emergency Stop (EF) & Force to Stop Selection (P07-20)
25. Encoder Type Selection (P10-00)
26. Encoder Pulse (P10-01)
27. Encoder Input Type Setting (P10-02)
28. System Control (P11-00)
29. Per Unit of System Inertia (P11-01)
30. ASR1 Low-speed Bandwidth (P11-03)
31. ASR2 High-speed Bandwidth (P11-04)
32. Zero-speed Bandwidth (P11-05)

5. TQCPG Mode

01: Password Input (Decode)

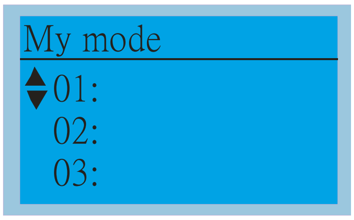


Items

1. Password Input (Decode) (P00-07)
2. Password Setting (P00-08)
3. Control Mode (P00-10)
4. Control of Speed Mode (P00-11)
5. Source of the Master Frequency Command (P00-20)

6. Source of the Operation Command (P00-21)
7. Max. Operation Frequency (P01-00)
8. Base Frequency of Motor 1 (P01-01)
9. Max. Output Voltage Setting of Motor 1 (P01-02)
10. Full-load Current of Induction Motor 1 (P05-01)
11. Rated Power of Induction Motor 1 (P05-02)
12. Rated Speed of Induction Motor 1 (P05-03)
13. Pole Number of Induction Motor 1 (P05-04)
14. No-load Current of Induction Motor 1 (P05-05)
15. Over-voltage Stall Prevention (P06-01)
16. Software Brake Level (P07-00)
17. Encoder Type Selection (P10-00)
18. Encoder Pulse (P10-01)
19. Encoder Input Type Setting (P10-02)
20. System Control (P11-00)
21. Per Unit of System Inertia (P11-01)
22. ASR1 Low-speed Bandwidth (P11-03)
23. ASR2 High-speed Bandwidth (P11-04)
24. Zero-speed Bandwidth (P11-05)
25. Max. Torque Command (P11-27)
26. Source of Torque Offset (P11-28)
27. Torque Offset Setting (P11-29)
28. Source of Torque Command (P11-33)
29. Torque Command (P11-34)
30. Speed Limit Selection (P11-36)
31. Forward Speed Limit (torque mode) (P11-37)
32. Reverse Speed Limit (torque mode) (P11-38)

6.My Mode



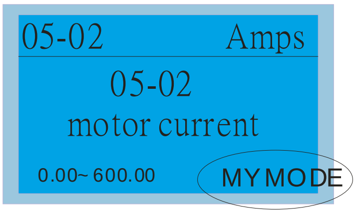
My mode
01:
02:
03:

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

My mode:

It can save 01~32 sets of parameters (Pr).

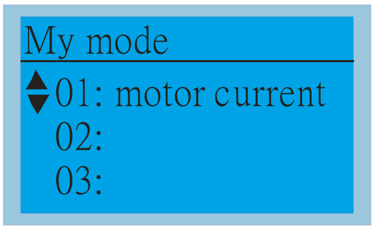
1



05-02 Amps
05-02
motor current
0.00~ 600.00 MY MODE

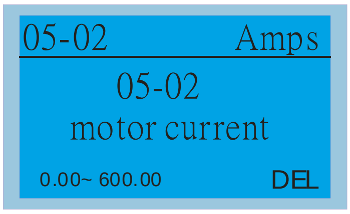
Press F4 and save to my mode.

2



My mode
01: motor current
02:
03:

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



05-02 Amps
05-02
motor current
0.00~ 600.00 DEL

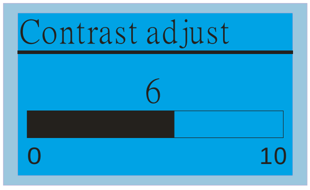
Press F4 to delete this Pr. setting in My Mode.

8. Display setup


Disp setup
▼1.Contrast Ad
2.BKLT time

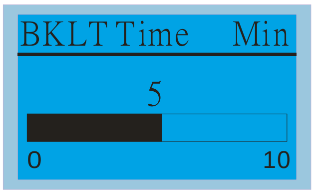
Press ENTER to enter the setting menu.

1. Contrast Adjustment


Contrast adjust
6
0 10

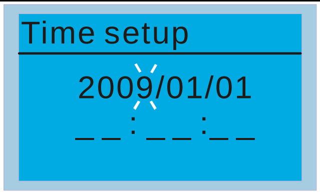
∧ ∨ Adjust setting value

2. Back-lighted Time


BKLT Time Min
5
0 10

∧ ∨ Adjust setting value

9. Time setting


Time setup
2009/01/01
__:__:__

Enter time setup page, "9" will continue to blink

< > move to left / right

∧ ∨ increase / decrease the value

Press ENTER to confirm.

NOTE

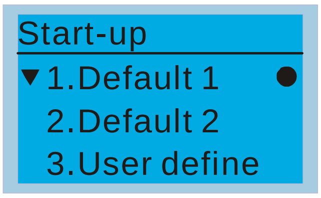
When the digital keypad is removed, the time setting will be in standby status for 7 days. After this period, the time needs to be reset.

10. Language setup


Language
1:English
▲▼2:繁體中文 ●
3:简体中文

Language selection.

11. Startup Page Setting


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

1. Default picture 1
   DELTA LOGO
2. Default picture 2
   DELTA Text
3. User defined: optional accessory is require (TPEditor & USB/RS-485 Communication Interface-IFD6530)
   Install an editing accessory would allow users to design their own start-up page.If editor accessory is not installed, "user defined" option will dispay a blank page.

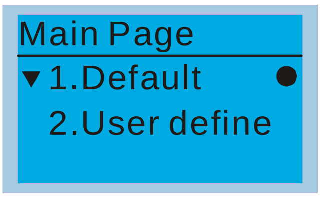
USB/RS-485 Communication Interface-IFD6530

Please refer to Chapter 07 Optional Accessories for more detail.

TPEditor

TPEditor Installation Instruction is on page 10-15 and TPEditor V1.03.6 is available for download at: http://www.delta.com.tw/ch/product/em/download/download_main.asp?act=3&pid=1&cid=1&tpid=3

12. Main page

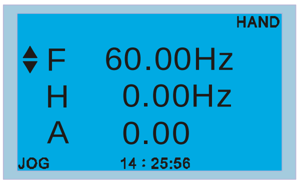


Main Page
▼1.Default ●
2.User define

Press ENTER to select.

1. Default page

Default picture and editable picture are available upon selection.



HAND
F 60.00Hz
H 0.00Hz
A 0.00
JOG 14 : 25:56

F 600.00Hz >>> H >>> A >>> U (circulate)

2. User defined: optional accessory is require (TPEditor & USB/RS-485 Communication Interface-IFD6530)

Install an editing accessory would allow users to design their own start-up page.If editor accessory is not installed, “user defined” option will dispay a blank page.

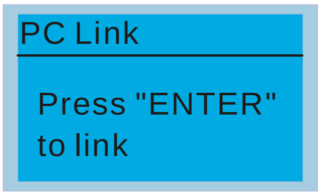
USB/RS-485 Communication Interface-IFD6530

Please refer to Chapter 07 Optional Acessories for more detail.

TPEditor

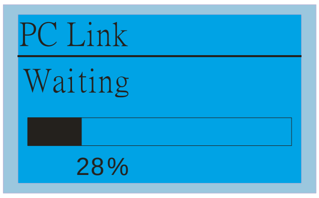
TPEditor Installation Instruction is on page 10-15 and TPEditor V1.30.6 is available for download at:
http://www.delta.com.tw/ch/product/em/download/download_main.asp?act=3&pid=1&cid=1&tpid=3

13. PC Link



PC Link
Press "ENTER" to link

Select 1 and press ENTER

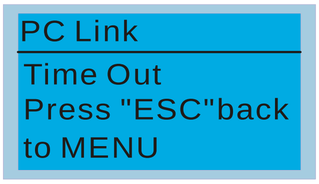


PC Link
Waiting
28%

Select 2 and press ENTER

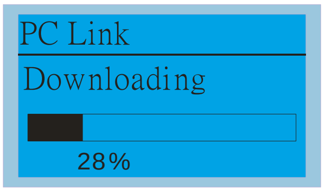
The function of PC Link is to establish a connection with computer to download the page for user defined editing. After enter to PC Link page, check if the connection of KPC-CC01 and computer is successfully establish, then press enter to go to next page and wait for communication response.

1. If the connection failed, the screen will show “Time Out”.



PC Link
Time Out
Press "ESC"back to MENU

2. If the connection succeeds, the screen page will show “Downloading”. When the download is done, it returns to MENU page.

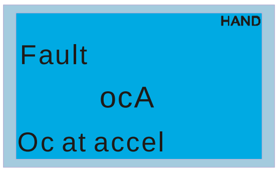


PC Link
Downloading
28%

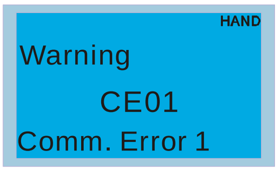
3. In order to set the start-up page and main page in the format user defined, user must check the user define option for start-up page and main page. If the user define page for editing has not yet downloaded to KPC-CC01, the start-up page and main page will display as blank.

Other display

When fault occur, the menu will display:



HAND
Fault
ocA
Oc at accel



HAND
Warning
CE01
Comm. Error 1

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”→“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 0.9m)
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)

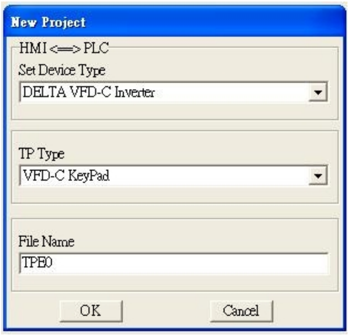
10-3 TPEditor Installation Instruction

TP functions can edit up to 256 pages (keypad), total capacity is 256KB. 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)→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.

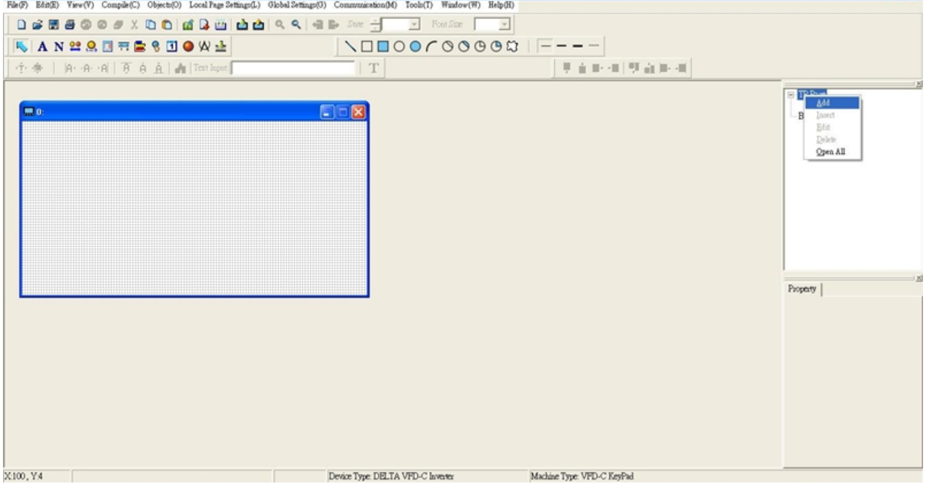


Set Device Type: DELTA VFD-C Inverter

TP Type: VFD-C KeyPad

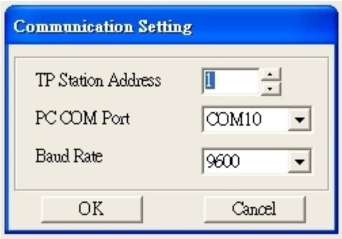
File Name: TPE0

3. You are now at the designing page. Go to Edit (E)→Click on Add a New Page (A) or go to the TP page on the upper right side, right click once on TP page and choose Add to increase one more page for editing. The current firmware of Keypad is version1.00 and can support up to 4 pages.



X100, Y4 | Device Type: DELTA VFD-C Inverter | Machine Type: VFD-C KeyPad

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



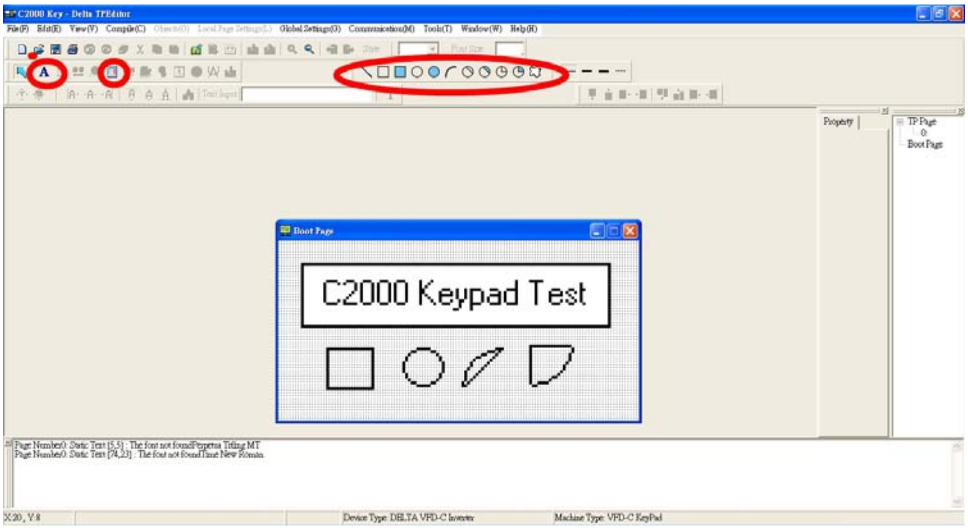
TP Station Address: 1

PC COM Port: COM10

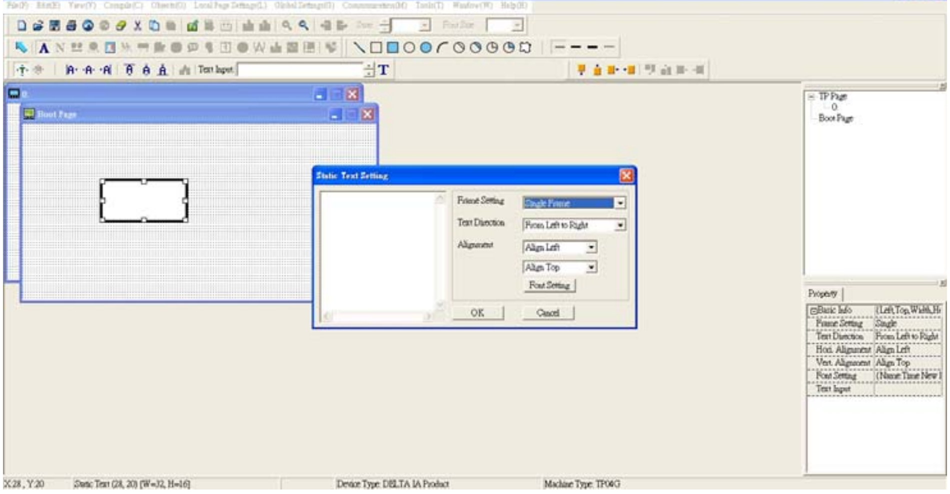
Baud Rate: 9600

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) →click on Boot Page (B). Then a blank Boot Page window will pop up. Use the circled items to design your Startup page.



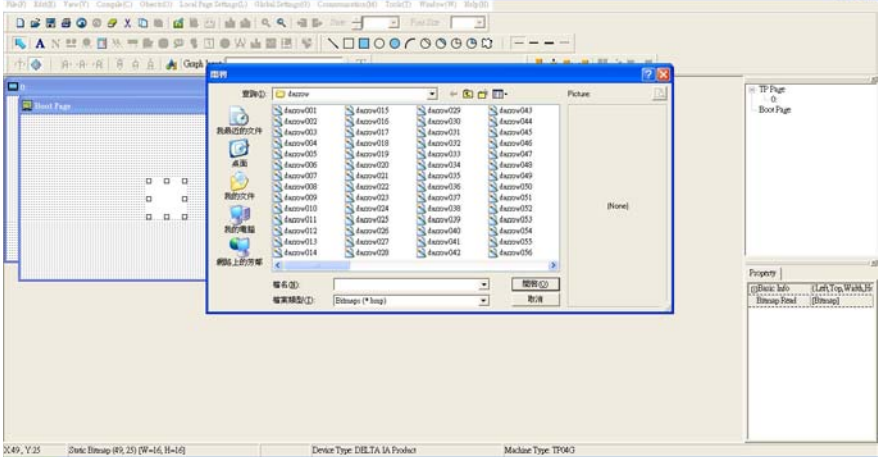
2. Static Text **A**. Open a blank page, click once on this button **A**, and then double click on that blank page. The following windows will pop up.



Frame Setting: Single Frame
Text Direction: From Left to Right
Alignment: Align Left, Align Top

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.

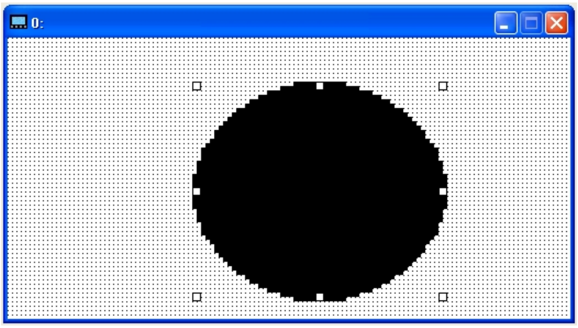
3. Static Bitmap →Open a blank page, then click once on this button and then double click on that blank page. The following window will pop up.



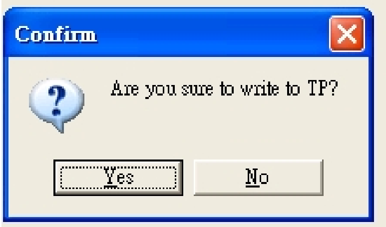
Please note that Static Bitmap setting support only images in BMP format. Now choose a image that you need and click open, then that image will appear in the Static Bitmap window.

4. Geometric Bitmap ╲ □ ■ ○ ● ◜ ⊘ ⊘ ◷ ◷ ⬠ → 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 icon ○ to a blank page, you will see the following window.

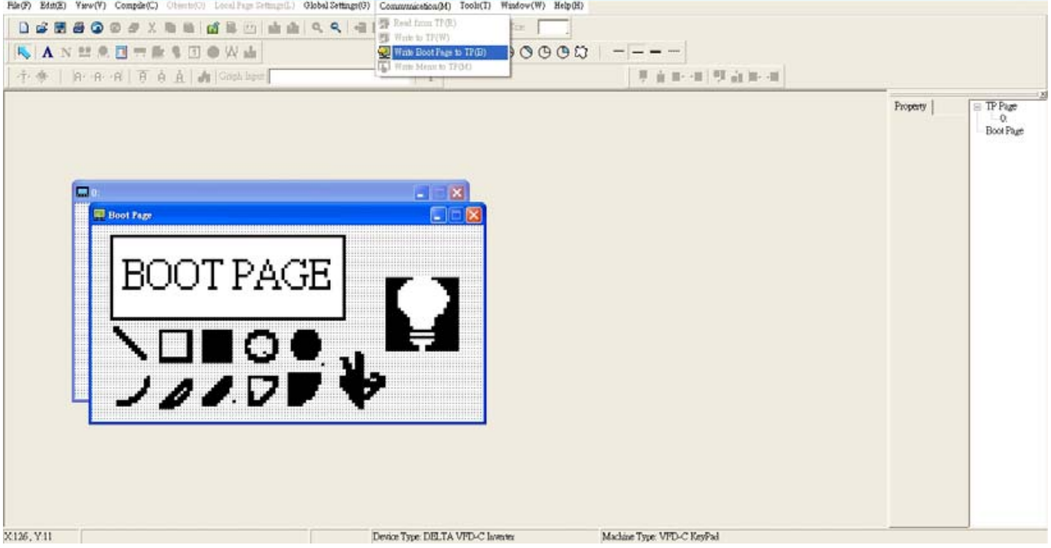


5. Download---Take the image below as an example. The sentence “Boot page” is static text, the 11 images below are geometric bitmaps. The image on the right hand side is a Static Bitmap. To upload a start up page, double click to activate “Boot page. Make sure that you have followed the instruction on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



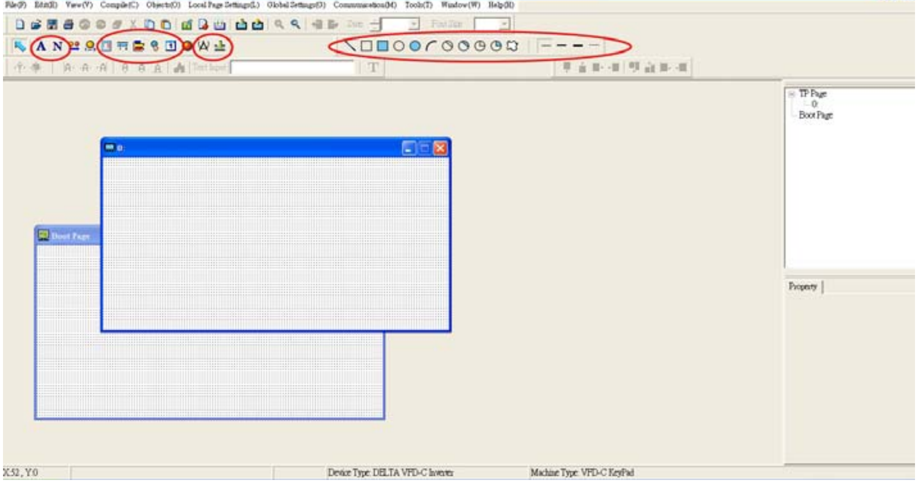
Are you sure to write to TP?

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.



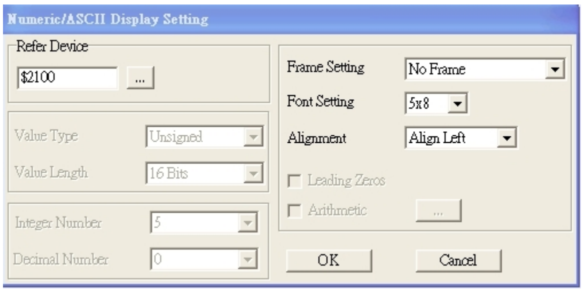
3) Edit Main Page

1. Click on a page under the TP Page to edit or go to View → 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 (O)→Click once on the Numeric/ASCII Display(A) **N** Numeric/ASCII Display(A) →Drag to enlarge to reach the size that you need to add objects in the screen where you want to create an object →Double click on the object to set up Related Devices, Frame Setting , Fonts and Alignment.



Numeric/ASCII Display Setting

Refer Device: $2100

Value Type: Unsigned

Value Length: 16 Bits

Integer Number: 5

Decimal Number: 0

Frame Setting: No Frame

Font Setting: 5x8

Alignment: Align Left

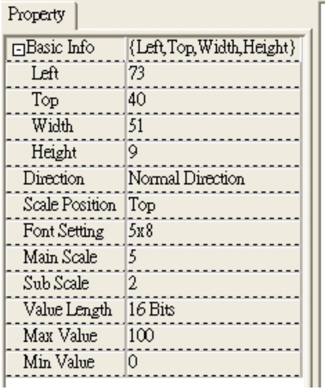
☐ Leading Zeros

☐ Arithmetic

OK Cancel

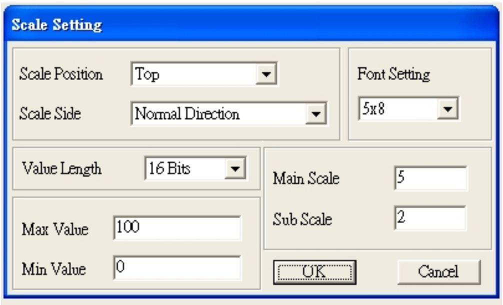
Related Device: Choose the VFD Communication Port that you need, if you want to read output frequency (H), set the VFD Communication Port to $2202. For other values, please refer to ACMD ModBus Comm Address List.

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



Property

⊟Basic Info	{Left,Top,Width,Height}
Left	73
Top	40
Width	51
Height	9
Direction	Normal Direction
Scale Position	Top
Font Setting	5x8
Main Scale	5
Sub Scale	2
Value Length	16 Bits
Max Value	100
Min Value	0



Scale Setting

Scale Position: Top

Scale Side: Normal Direction

Font Setting: 5x8

Value Length: 16 Bits

Main Scale: 5

Sub Scale: 2

Max Value: 100

Min Value: 0

OK Cancel

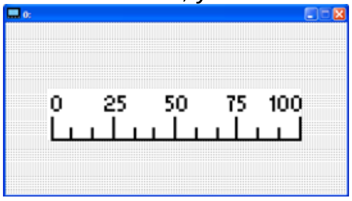
a. Scale Position: Click on the drop down list to choose which position that you need to place a scale.
b. Scale Side: Click on the drop down list to choose if you want to number your scale from smaller number to bigger number or from big to small. Click OK to accept this setting or click Cancel to abort.
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.

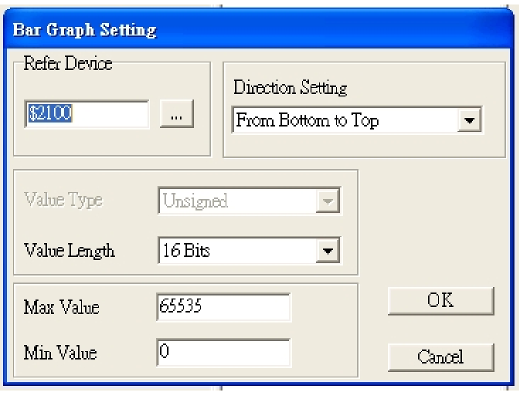
e. Main Scale & Sub Scale: In order to divide the whole scale into equal parts, key in the numbers of your choices for main scale and sub scale.

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 :



Bar Graph Setting

Refer Device: $2100

Direction Setting: From Bottom to Top

Value Type: Unsigned

Value Length: 16 Bits

Max Value: 65535

Min Value: 0

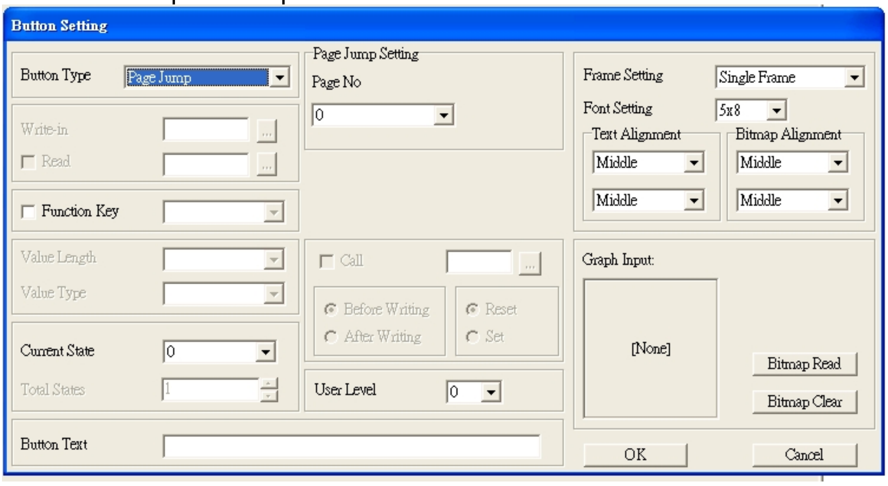
a. Related Device: Choose the VFD Communication Port that you need.

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 to open set up window.



Button Setting

Button Type: Page Jump

Page Jump Setting: Page No: 0

Frame Setting: Single Frame

Font Setting: 5x8

Text Alignment: Middle, Middle

Bitmap Alignment: Middle, Middle

Write-in

☐ Read

☐ Function Key

Value Length

Value Type

☐ Call

○ Before Writing ○ After Writing

○ Reset ○ Set

Current State: 0

Total States: 1

User Level: 0

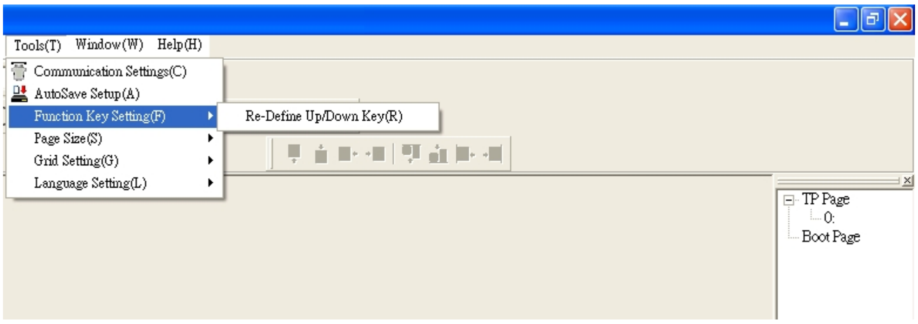
Graph Input: [None]

Button Text

a. <Button Type> allows you set up buttons' functions. But Page Jump is the only supported function currently.

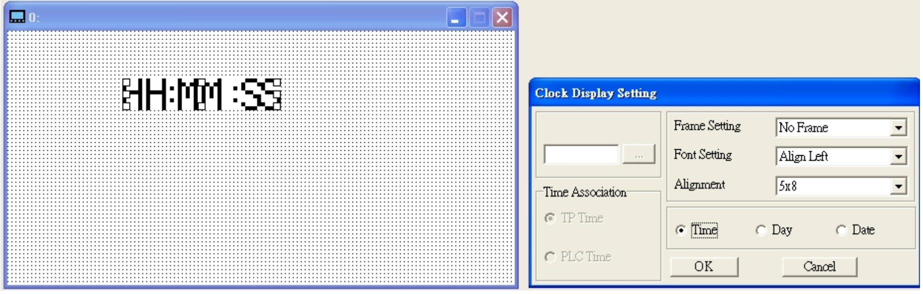
b. Page Jump setting: After you choose the Page Jump function in the drop down list, you will see this Page Jump Setting Menu

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→Function Key Settings (F)→Re-Define Up/Down Key(R).



d. There are no supported functions other than the setting mentioned above.

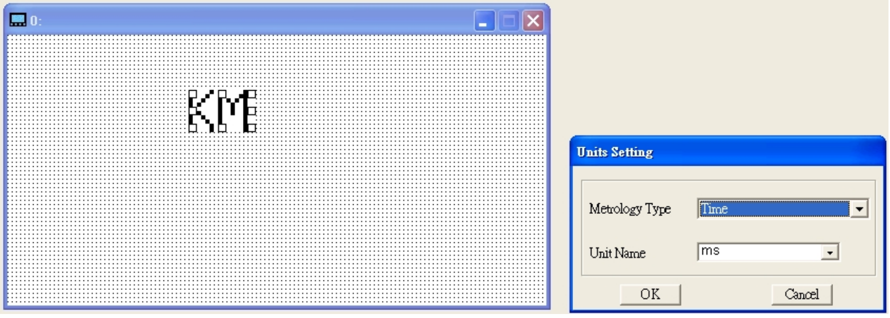
6. Clock Display Setting : Click once on this button .
Open a new file and click once in that window, you will see the following



Frame Setting: No Frame
Font Setting: Align Left
Alignment: 5x8
● Time ○ Day ○ Date

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



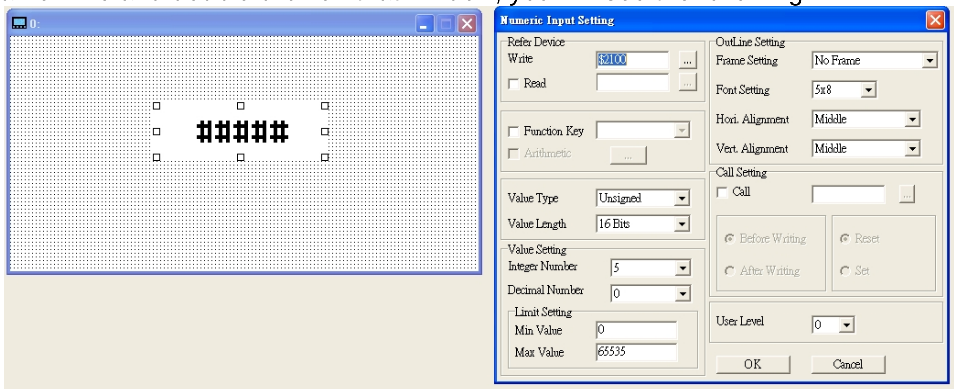
Metrology Type: Time
Unit Name: ms

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 :

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

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



Write: $2100
☐ Read
☐ Function Key
☐ Arithmetic
Value Type: Unsigned
Value Length: 16 Bits
Integer Number: 5
Decimal Number: 0
Min Value: 0
Max Value: 65535
Frame Setting: No Frame
Font Setting: 5x8
Hori. Alignment: Middle
Vert. Alignment: Middle
☐ Call
User Level: 0

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.

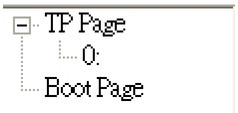
c. Function key: The setting here allows you to program keys on the keypad. Press the key on the menu then the corresponding key on the keypad will start to blink, then press Enter to confirm the setting.

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 C2000 have to be 16bits. The 32bits values are not supported.

e. Value Setting: This part is set automatically by the keypad itself.

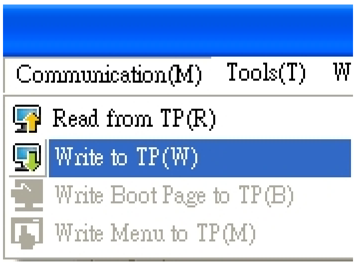
f. Limit Setting: Input the range the security setting here.

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.



9. Download TP Page : Press Up or Down key on the keypad until you reach #13 PC Link.

Then press Enter on the keypad and you will see the word “Waiting” on keypad’s screen. Now choose a page that you have created then go to Communication (M)→Write to TP(W) to start downloading the page to the keypad



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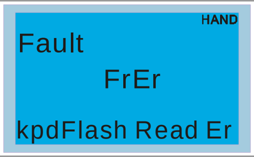
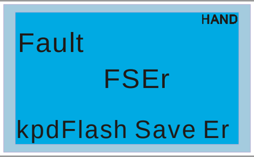
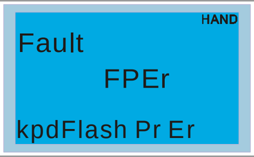
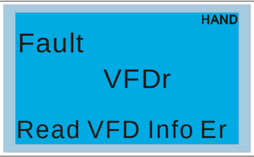
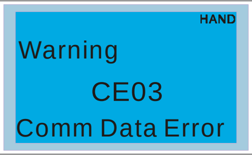
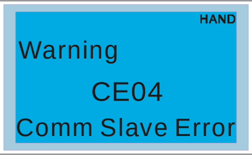
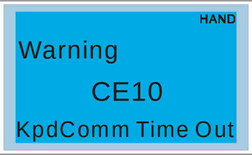
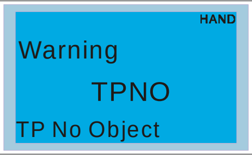
When you see the word Completed on the keypad’s screen, that means the download is done. Then you can press ESC on the keypad to go back to the menu of the keypad.

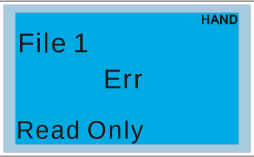
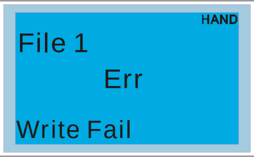
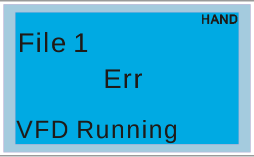
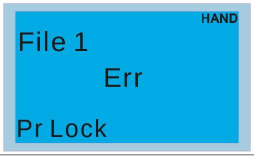
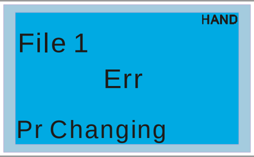
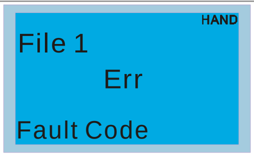
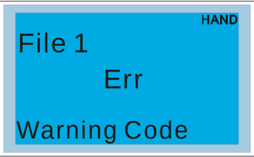
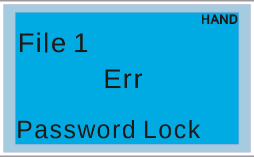
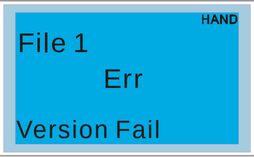
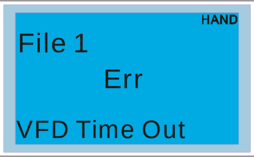
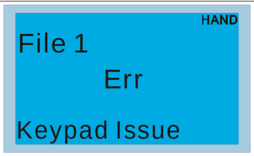
10-4 Digital Keypad KPC-CC01 Fault Codes and Descriptions

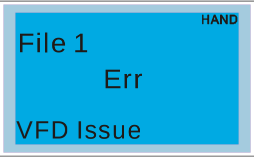
Following fault codes and description are for digital keypad KPC-CC01 with version V1.01 and version higher.

LCM Display	Description
HAND Fault FrEr kpdFlash Read Er	Keypad flash memory read error
HAND Fault FSEr kpdFlash Save Er	Keypad flash memory save error
HAND Fault FPEr kpdFlash Pr Er	Keypad flash memory parameter error
HAND Fault VFDr Read VFD Info Er	Keypad flash memory when read AC drive data error

LCM Display	Description
HAND Warning CE01 Comm Command Er	Modbus function code error
HAND Warning CE02 Comm Address Er	Modbus data address error
HAND Warning CE03 Comm Data Error	Modbus data value error
HAND Warning CE04 Comm Slave Error	Modbus slave drive error
HAND Warning CE10 KpdComm Time Out	Modbus transmission time-Out
HAND Warning TPNO TP No Object	Object not supported by TP Editor

Fault Descriptoin of File Copy and Setting Errors

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

LCM Display	Description
 HAND File 1 Err 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.

NOTE

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

00 Drive Parameters

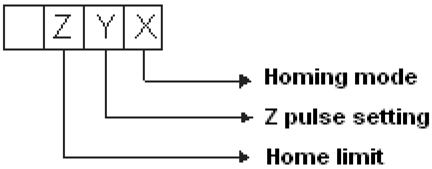
NOTE IM: Induction Motor; PM: Permanent Magnet Motor

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

Pr.	Explanation	Settings	Factory Setting
			only
00-02	Parameter Reset	0: No function 1: Read only 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 50Hz) 10: All parameters are reset to factory settings (base frequency is 60Hz)	0
✎ 00-03	Start-up Display Selection	0: F (frequency command) 1: H (output frequency) 2: U (multi-function display, see Pr.00-04) 3: A (output current)	0
✎ 00-04	Content of Multi-function Display	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) 8: Display estimate output torque % (t) 9: Display PG feedback (G) (refer to Pr.10-00,10-01) 10: Display PID feedback in % (b) 11: Display AVI in % (1.) 12: Display ACI in % (2.) 13: Display AUI in % (3.) 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) (i) 17: The status of digital output (ON/OFF) (o) 18: Multi-step speed (S) 19: The corresponding CPU pin status of digital input (d.) 20: The corresponding CPU pin status of digital output (0.) 21: Actual motor position (PG1 of PG card) (P.) 22: Pulse input frequency (PG2 of PG card) (S.) 23: Pulse input position (PG2 of PG card) (q.) 24: Position command tracing error (E.) 25: Overload count (0.00~100.00%) (h.) 26: Ground Fault GFF (Unit :%)(G.) 27: DC Bus voltage ripple (Unit: Vdc) (r.) 28: Display PLC data D1043 (C) 29: Display PM motor pole section (EMC-PG01U application) (4.) 30: Display output of user defined (U) 31: Display Pr.00-05 user Gain(K) 32: Number of actual motor revolution during operation (PG card plug in and Z phase signal input) (Z.) 33: Motor actual position during operation (when PG card is connected)(q) 34: Operation speed of fan(%) (F.) 35: Control Mode display: 0= Speed control mode (SPD), 1= torque control mode (TQR) (t.)	3

<table>
<tr><th></th><th>Pr.</th><th>Explanation</th><th>Settings</th><th>Factory Setting</th></tr>
<tr><td></td><td></td><td></td><td>36: Present operating carrier frequency of drive (Hz) (J.)
37: Reserved
38: Display drive status (6.)
39: Display estimated output torque, postitive and negative, using Nt-m as unit (t 0.0: postitive torque; -0.0: negative torque (C.)
40: Torqe Command, unit %(L.)
41: KWH, unit KWH(J)
42: PID Reference, unit % (h.)
43: PID offset (%) (h.)
44: PID Output Fcmd(Hz) (b.)</td><td></td></tr>
<tr><td></td><td>00-05</td><td>Coefficient Gain in Actual Output Frequency</td><td>0~160.00</td><td>1</td></tr>
<tr><td></td><td>00-06</td><td>Software Version</td><td>Read-only</td><td>#.#</td></tr>
<tr><td>⌁</td><td>00-07</td><td>Parameter Protection Password Input</td><td>0～65535
0~3: the times of password attempts</td><td>0</td></tr>
<tr><td>⌁</td><td>00-08</td><td>Parameter Protection Password Setting</td><td>0 ~ 65535
0: No password protection / password is entered correctly (Pr00-07)
1: Parameter is locked</td><td>0</td></tr>
<tr><td>⌁</td><td>00-09</td><td colspan="3">Reserved</td></tr>
<tr><td></td><td>00-10</td><td>Control Mode</td><td>0: Speed mode
1: Point-to-Point position control
2: Torque mode
3: Home mode</td><td>0</td></tr>
<tr><td></td><td>00-11</td><td>Control of Speed Mode</td><td>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)</td><td>0</td></tr>
<tr><td></td><td>00-12</td><td>Point-to-Point Position mode</td><td>0: Relative position
1: Absolute position</td><td></td></tr>
<tr><td></td><td>00-13</td><td>Torque Mode Control</td><td>0: TQCPG（IM Torque control + Encoder）
1: TQCPG (PM Torque control + Encoder)
2: TQC Sensorless (IM Sensorless torque control)</td><td>0</td></tr>
<tr><td></td><td>00-14</td><td colspan="3">Reserved</td></tr>
<tr><td></td><td>00-15</td><td colspan="3">Reserved</td></tr>
<tr><td>⌁</td><td>00-16</td><td>Load Selection</td><td>0: Normal load
1: Heavy load</td><td>0</td></tr>
<tr><td></td><td rowspan="2">00-17</td><td rowspan="2">Carrier Frequency</td><td>Normal load<table><tr><th>230V</th><th>460V</th><th>Carrier Frequency</th></tr><tr><td>1-15HP</td><td>1-20HP</td><td>2~15KHz</td></tr><tr><td>20-50HP</td><td>25-75HP</td><td>2~10KHz</td></tr><tr><td>60-125HP</td><td>100-475HP</td><td>2~09KHz</td></tr></table></td><td>8
6
4</td></tr>
<tr><td></td><td>Heavy load<table><tr><th>230V</th><th>460V</th><th>Carrier Frequency</th></tr><tr><td>1-15HP</td><td>1-20HP</td><td>2~15KHz</td></tr><tr><td>20-50HP</td><td>25-75HP</td><td>2~10KHz</td></tr><tr><td>60-125HP</td><td>100-475HP</td><td>2~09KHz</td></tr></table></td><td>2</td></tr>
<tr><td></td><td>00-18</td><td colspan="3">Reserved</td></tr>
<tr><td></td><td>00-19</td><td>PLC Command Mask</td><td>Bit 0: Control command by PLC force control</td><td>Read</td></tr>
</table>

	Pr.	Explanation	Settings	Factory Setting
			Bit 1: Frequency command by PLC force control Bit 2: Position command by PLC force control Bit 3: Torque command by PLC force control	only
ϟ	00-20	Source of Master Frequency Command（AUTO）	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)	0
ϟ	00-21	Source of the Operation Command（AUTO）	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 (no CANopen card)	0
ϟ	00-22	Stop Method	0: Ramp to stop 1: Coast to stop	0
ϟ	00-23	Control of Motor Direction	0: Enable forward/reverse 1: Reverse disable 2: Forward disable	0
	00-24	Memory of Frequency Command	Read only	Read only
	00-25	User Defined Characteristics	Bit 0~3: user define on 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: ℓ/m 009xh: kg/s 00Axh: kg/m 00Bxh: kg/h 00Cxh: lb/s 00Dxh: lb/m 00Exh: lb/h 00Fxh: ft/s 010xh: ft/m 011xh: M 012xh: ft 013xh: degC 014xh: degF 015xh: mbar 016xh: bar 017xh: Pa 018xh: kPa 019xh: mWG 01Axh: inWG 01Bxh: ftWG	0

	Pr.	Explanation	Settings	Factory Setting
			01Cxh: Psi 01Dxh: Atm 01Exh: L/s 01Fxh: L/m 020xh: L/h 021xh: m3/s 022xh: m3/h 023xh: GPM 024xh: CFM	
	00-26	Max. User Defined Value	0: Disable 0~65535 (when Pr.00-25 set to no decimal place) 0.0~6553.5 (when Pr.00-25 set to 1 decimal place) 0.0~655.35 (when Pr.00-25 set to 2 decimal place) 0.0~65.535 (when Pr.00-25 set to 3 decimal place)	0
	00-27	User Defined Value	Read only	Read Only
	00-28	Reserved		
	00-29	LOCAL/REMOTE Selection	0: Standard HOA function 1: Switching Local/Remote, the drive stops 2: Swithcing Local/Remote, the drive runs as the REMOTE setting for frequency and operation status 3: Swithcing Local/Remote, the drive runs as the LOCAL setting for frequency and operation status 4: Swithcing 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.	0
✎	00-30	Source of the Master Frequency Command（HAND）	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)	0
✎	00-31	Source of the Operation Command（HAND）	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)	0
✎	00-32	Digital Keypad STOP Function	0: STOP key disable 1: STOP key enable	0
	00-33 ~ 00-39	Reserved		
	00-40	Homing mode	 X Note: Forward run = closckwise (CW) Reverse run = counterclockwise (CCW)	0000

	Pr.	Explanation	Settings		Factory Setting
				0: Forward run to home. Set PL forward limit as check point. 1: Reverse run (CCW) to home. Set NL reverse limit (CCWL) as check point. 2: Forward run to home. Set ORG : OFF→ON as check point. 3: Reverse to home. Set ORG : OFF→ON as check point. 4: Forward run and search for Z-pulse as check point. 5: Forward run and search for Z-pulse as check point. 6: Forward run to home. Set ORG: ON→OFF as check point. 7: Reverse run to home. Set ORG : ON→OFF as check point. 8: Define current position as home.	
			Y	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	
			Z	When home limit is reached, set X to 2, 3, 4, 5, 6, 7 first. 0: display the error 1: reverse the direction	
	00-41	Homing by frequency 1	0.00~600.00Hz		8.00
	00-42	Homing by frequency 2	0.00~600.00Hz		2.00
	00-43 ~ 00-47	Reserved			
⚡	00-48	Display Filter Time (Current)	0.001~65.535 sec		0.100
⚡	00-49	Display Filter Time (Keypad)	0.001~65.535 sec		0.100
	00-50	Software Version (date)	Read only		#####
	00-51 ~ 00-61	Reserve			

01 Basic Parameters

	Pr.	Explanation	Settings	Factory Setting
	01-00	Max. Operation Frequency	50.00~600.00Hz	60.00/ 50.00
	01-01	Output Frequency of Motor 1	0.00~600.00Hz	60.00/ 50.00
	01-02	Output Voltage of Motor 1	230V: 0.0V~255.0V 460V: 0.0V~510.0V	200.0 400.0
	01-03	Mid-point Frequency 1 of Motor 1	0.00~600.00Hz	3.00
✓	01-04	Mid-point Voltage 1 of Motor 1	230V: 0.0V~240.0V 460V: 0.0V~480.0V	11.0 22.0
	01-05	Mid-point Frequency 2 of Motor 1	0.00~600.00Hz	0.50
✓	01-06	Mid-point Voltage 2 of Motor 1	230V: 0.0V~240.0V 460V: 0.0V~480.0V	2.0 4.0
	01-07	Min. Output Frequency of Motor 1	0.00~600.00Hz	0.00
✓	01-08	Min. Output Voltage of Motor 1	230V: 0.0V~240.0V 460V: 0.0V~480.0V	0.0 0.0
	01-09	Start-Up Frequency	0.00~600.00Hz	0.50
✓	01-10	Output Frequency Upper Limit	0.00~600.00Hz	600.00
✓	01-11	Output Frequency Lower Limit	0.00~600.00Hz	0
✓	01-12	Accel. Time 1	Pr.01-45=0: 0.00~600.00 second Pr.01-45=1: 0.00~6000.0 second AC drive with power greater than 30HP: 60.00/60.0	10.00 10.0
✓	01-13	Decel Time 1	Pr.01-45=0: 0.00~600.00 second Pr.01-45=1: 0.00~6000.0 second AC drive with power greater than 30HP: 60.00/60.0	10.00 10.0
✓	01-14	Accel Time 2	Pr.01-45=0: 0.00~600.00 second Pr.01-45=1: 0.00~6000.0 second AC drive with power greater than 30HP: 60.00/60.0	10.00 10.0
✓	01-15	Decel Time 2	Pr.01-45=0: 0.00~600.00 second Pr.01-45=1: 0.00~6000.0 second AC drive with power greater than 30HP: 60.00/60.0	10.00 10.0
✓	01-16	Accel Time 3	Pr.01-45=0: 0.00~600.00 second Pr.01-45=1: 0.00~6000.0 second AC drive with power greater than 30HP: 60.00/60.0	10.00 10.0
✓	01-17	Decel Time 3	Pr.01-45=0: 0.00~600.00 second Pr.01-45=1: 0.00~6000.0 second AC drive with power greater than 30HP: 60.00/60.0	10.00 10.0
✓	01-18	Accel Time 4	Pr.01-45=0: 0.00~600.00 second Pr.01-45=1: 0.00~6000.0 second AC drive with power greater than 30HP: 60.00/60.0	10.00 10.0
✓	01-19	Decel Time 4	Pr.01-45=0: 0.00~600.00 second Pr.01-45=1: 0.00~6000.0 second AC drive with power greater than 30HP: 60.00/60.0	10.00 10.0
✓	01-20	JOG Acceleration Time	Pr.01-45=0: 0.00~600.00 second Pr.01-45=1: 0.00~6000.0 second AC drive with power greater than 30HP: 60.00/60.0	10.00 10.0
✓	01-21	JOG Deceleration Time	Pr.01-45=0: 0.00~600.00 second	10.00 10.0

	Pr.	Explanation	Settings	Factory Setting
			Pr.01-45=1: 0.00~6000.0 second AC drive with power greater than 30HP: 60.00/60.0	
✓	01-22	JOG Frequency	0.00~600.00Hz	6.00
✓	01-23	1st/4th Accel/decel Frequency	0.00~600.00Hz	0.00
✓	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	0.20 0.2
✓	01-25	S-curve Acceleration Arrival Time 2	Pr.01-45=0: 0.00~25.00 second Pr.01-45=1: 0.0~250.0 second	0.20 0.2
✓	01-26	S-curve Deceleration Begin Time 1	Pr.01-45=0: 0.00~25.00 second Pr.01-45=1: 0.0~250.0 second	0.20 0.2
✓	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	0.20 0.2
	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)	0.00~600.00Hz	0.00
	01-34	Zero-speed Mode	0: Output waiting 1: Zero-speed operation 2: Fmin (Refer to Pr.01-07, 01-41)	0
	01-35	Output Frequency of Motor 2	0.00~600.00Hz	60.00/ 50.00
	01-36	Output Voltage of Motor 2	230V: 0.0V~255.0V 460V: 0.0V~510.0V	200.0 400.0
	01-37	Mid-point Frequency 1 of Motor 2	0.00~600.00Hz	3.00
✓	01-38	Mid-point Voltage 1 of Motor 2	230V: 0.0V~240.0V 460V: 0.0V~480.0V	11.0 22.0
	01-39	Mid-point Frequency 2 of Motor 2	0.00~600.00Hz	0.50
✓	01-40	Mid-point Voltage 2 of Motor 2	230V: 0.0V~240.0V 460V: 0.0V~480.0V	2.0 4.0
	01-41	Min. Output Frequency of Motor 2	0.00~600.00Hz	0.00
✓	01-42	Min. Output Voltage of Motor 2	230V: 0.0V~240.0V 460V: 0.0V~480.0V	0.0 0.0
	01-43	V/f Curve Selection	0: V/f curve determined by Pr.01-00~01-08 1: Curve to the power of 1.5 2: Curve to the power of 2	0
✓	01-44	Optimal Acceleration/Deceleration Setting	0: Linear accel. /decel. 1: Auto accel.; linear decel. 2: Linear accel.; auto decel. 3: Auto accel./decel. 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 1: Unit: 0.1sec	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 1: 2-wire mode 2, power on for operation control 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 (MI4)	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 1st, 2nd acceleration/deceleration time selection	0
02-27	Input terminal of I/O extension card (MI11)	9: The 3rd, 4th 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 ∆-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	

	Pr.	Explanation	Settings	Factory Setting
			39: Torque command direction	
			40: Force coast to stop	
			41: HAND switch	
			42: AUTO switch	
			43: Enable resolution selection (Pr.02-48)	
			44: Reversed 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	
✎	02-09	UP/DOWN key mode	0: up/down by the accel. /decel. time 1: up/down constant speed (Pr.02-10)	0
✎	02-10	Constant speed. The Accel. /Decel. Speed of the UP/DOWN Key	0.01~1.00Hz/ms	0.01
✎	02-11	Digital Input Response Time	0.000~30.000 second	0.005
✎	02-12	Digital Input Mode Selection	0000h~FFFFh (0: N.O.; 1: N.C.）	0000
✎	02-13	Multi-function Output 1 RY1	0: No function	11
✎	02-14	Multi-function Output 2 RY2	1: Operation Indication	1
✎	02-16	Multi-function Output 3 (MO1)	2: Operation speed attained	0
✎	02-17	Multi-function Output 4 (MO2)	3: Desired frequency attained 1 (Pr.02-22)	0
✎	02-36	Output Terminal of I/O Extension Card (MO10) or (RA10)	4: Desired frequency attained 2 (Pr.02-24)	0
✎	02-37	Output Terminal of I/O Extension Card (MO11) or (RA11)	5: Zero speed (Frequency command)	0
✎	02-38	Output Terminal of I/O Extension Card (MO12) or (RA12)	6: Zero speed, include STOP(Frequency command)	0
✎	02-39	Output Terminal of I/O Extension Card (MO13) or (RA13)	7: Over torque 1(Pr.06-06~06-08)	0
✎	02-40	Output Terminal of I/O Extension Card (MO14) or (RA14)	8: Over torque 2(Pr.06-09~06-11)	0
✎	02-41	Output Terminal of I/O Extension Card (MO15) or (RA15)	9: Drive is ready	0
✎	02-42	Output Terminal of I/O Extension Card (MO16)	10: Low voltage warning（LV）(Pr.06-00)	0
✎	02-43	Output Terminal of I/O Extension Card (MO17)	11: Malfunction indication	0
✎	02-44	Output Terminal of I/O Extension Card (MO18)	12: Mechanical brake release(Pr.02-32)	0
✎	02-45	Output Terminal of I/O Extension Card (MO19)	13: Overheat warning (Pr.06-15)	0
✎	02-46	Output Terminal of I/O Extension Card (MO20)	14: Software brake signal indication(Pr.07-00)	0
			15: PID feedback error	
			16: Slip error (oSL)	
			17: Terminal count value attained, does not return to 0 (Pr.02-20)	

	Pr.	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: △-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	0.00～600.00Hz	60.00/ 50.00
✓	02-23	The Width of the Desired Frequency Attained 1	0.00～600.00Hz	2.00
✓	02-24	Desired Frequency Attained 2	0.00～600.00Hz	60.00/ 50.00
✓	02-25	The Width of the Desired Frequency Attained 2	0.00～600.00Hz	2.00
	02-32	Brake Delay Time	0.000~65.000 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）	3.00
✓	02-35	External Operation Control Selection after Reset and	0: Disable	0

	Pr.	Explanation	Settings	Factory Setting
		Activate	1: Drive runs if run command exists after reset	
ϟ	02-47	Zero-speed Level of Motor	0~65535 rpm	0
ϟ	02-48	Max. Frequency of Resolution Switch	0.01~600.00Hz	60.00
ϟ	02-49	Switch the delay time of Max. output frequency	0.000~65.000 sec.	0.000
ϟ	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 Multi-function output 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
✎	03-00	Analog Input Selection (AVI)	0: No function	1
✎	03-01	Analog Input Selection (ACI)	1: Frequency command (speed limit under torque control mode)	0
✎	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	
✎	03-03	Analog Input Bias (AVI)	-100.0~100.0%	0
✎	03-04	Analog Input Bias (ACI)	-100.0~100.0%	0
✎	03-05	Analog Positive Voltage Input Bias (AUI)	-100.0~100.0%	0
✎	03-06	Reserved		
✎	03-07	Positive/negative Bias Mode (AVI)	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	0
✎	03-08	Positive/negative Bias Mode (ACI)		
✎	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. 1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.	0
✎	03-11	Analog Input Gain (AVI)	-500.0~500.0%	100.0
✎	03-12	Analog Input Gain (ACI)	-500.0~500.0%	100.0
✎	03-13	Analog Positive Input Gain (AUI)	-500.0~500.0%	100.0
✎	03-14	Analog Negative Input Gain (AUI)	-500.0~500.0%	100.0
✎	03-15	Analog Input Filter Time (AVI)	0.00~20.00 sec.	0.01
✎	03-16	Analog Input Filter Time (ACI)	0.00~20.00 sec.	0.01
✎	03-17	Analog Input Filter Time (AUI)	0.00~20.00 sec.	0.01
✎	03-18	Addition Function of the Analog Input	0: Disable (AVI, ACI, AUI) 1: Enable	0
✎	03-19	ACI Signal Loss	0: Disable	0

	Pr.	Explanation	Settings	Factory Setting
			1: Continue operation at the last frequency 2: Decelerate to 0Hz 3: Stop immediately and display ACE	
✓	03-20	Multi-function Output 1 (AFM1)	0: Output frequency (Hz)	0
✓	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	
✓	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 1: Reverse output 0V; Positive output 0-10V 2: Reverse output 5-0V; Positive output 5-10V	0
✓	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 1: Output 0V in REV direction; output 0-10V in FWD direction 2: Output 5-0V in REV direction; output 5-10V in FWD direction	0
✓	03-26	Reserved		
✓	03-27	AFM2 Output Bias	-100.00~100.00%	0.00
✓	03-28	AVI Selection	0: 0-10V 1: 0-20mA 2: 4-20mA	0
✓	03-29	ACI Selection	0: 4-20mA 1: 0-10V 2: 0-20mA	0
✓	03-30	Status of PLC Output Terminal	Monitor the status of PLC output terminals	Read only
	03-31	AFM2 0-20mA Output Selection	0: 0-20mA Output 1: 4-20mA Output	0
	03-32	AFM1 DC output setting level	0.00~100.00%	0.00
	03-33	AFM2 DC Output Setting Level	0.00~100.00%	0.00
	03-34	Resrve		
	03-35	AFM1 filter output time	0.00 ~ 20.00 Seonds	0.01

Pr.	Explanation	Settings	Factory Setting
03-36	AFM2 filter output time	0.00 ~ 20.00 Seonds	0.01
03-37 ~ 03-49	Reserve		
03-50	Analog Input Curve Selection	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	0
03-51	AVI Low Point	Pr.03-28=0, 0.00~10.00V Pr.03-28≠0, 0.00~20.00mA	0.00
03-52	AVI Proportional Low Point	0.00~100.00%	0.00
03-53	AVI Mid Point	Pr.03-28=0, 0.00~10.00V Pr.03-28≠0, 0.00~20.00mA	5.00
03-54	AVI Proportional Mid Point	0.00~100.00%	50.00
03-55	AVI High Point	Pr.03-28=0, 0.00~10.00V Pr.03-28≠0, 0.00~20.00mA	10.00
03-56	AVI Proportional High Point	0.00~100.00%	100.00
03-57	ACI Low Point	Pr.03-29=1, 0.00~10.00V Pr.03-29≠1, 0.00~20.00mA	4.00
03-58	ACI Proportional Low Point	0.00~100.00%	0.00
03-59	ACI Mid Point	Pr.03-29=1, 0.00~10.00V Pr.03-29≠1, 0.00~20.00mA	12.00
03-60	ACI Proportional Mid Point	0.00~100.00%	50.00
03-61	ACI High Point	Pr.03-29=1, 0.00~10.00V Pr.03-29≠1, 0.00~20.00mA	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
✓	04-00	1st Step Speed Frequency	0.00~600.00Hz	0
✓	04-01	2nd Step Speed Frequency	0.00~600.00Hz	0
✓	04-02	3rd Step Speed Frequency	0.00~600.00Hz	0
✓	04-03	4th Step Speed Frequency	0.00~600.00Hz	0
✓	04-04	5th Step Speed Frequency	0.00~600.00Hz	0
✓	04-05	6th Step Speed Frequency	0.00~600.00Hz	0
✓	04-06	7th Step Speed Frequency	0.00~600.00Hz	0
✓	04-07	8th Step Speed Frequency	0.00~600.00Hz	0
✓	04-08	9th Step Speed Frequency	0.00~600.00Hz	0
✓	04-09	10th Step Speed Frequency	0.00~600.00Hz	0
✓	04-10	11th Step Speed Frequency	0.00~600.00Hz	0
✓	04-11	12th Step Speed Frequency	0.00~600.00Hz	0
✓	04-12	13th Step Speed Frequency	0.00~600.00Hz	0
✓	04-13	14th Step Speed Frequency	0.00~600.00Hz	0
✓	04-14	15th Step Speed Frequency	0.00~600.00Hz	0
	04-15	Position command 1 (revolution)	-30000~30000	0
✓	04-16	Position command 1 (pulse)	-32767~32767	0
	04-17	Position command 2 (revolution)	-30000~30000	0
✓	04-18	Position command 2 (pulse)	-32767~32767	0
	04-19	Position command 3 (revolution)	-30000~30000	0
✓	04-20	Position command 3 (pulse)	-32767~32767	0
	04-21	Position command 4 (revolution)	-30000~30000	0
✓	04-22	Position command 4 (pulse)	-32767~32767	0
	04-23	Position command 5 (revolution)	-30000~30000	0
✓	04-24	Position command 5 (pulse)	-32767~32767	0
	04-25	Position command 6 (revolution)	-30000~30000	0
✓	04-26	Position command 6 (pulse)	-32767~32767	0
	04-27	Position command 7 (revolution)	-30000~30000	0
✓	04-28	Position command 7 (pulse)	-32767~32767	0
	04-29	Position command 8 (revolution)	-30000~30000	0
✓	04-30	Position command 8 (pulse)	-32767~32767	0
	04-31	Position command 9 (revolution)	-30000~30000	0
✓	04-32	Position command 9 (pulse)	-32767~32767	0
	04-33	Position command 10 (revolution)	-30000~30000	0
✓	04-34	Position command 10 (pulse)	-32767~32767	0
	04-35	Position command 11 (revolution)	-30000~30000	0
✓	04-36	Position command 11 (pulse)	-32767~32767	0

	Pr.	Explanation	Settings	Factory Setting
	04-37	Position command 12 (revolution)	-30000~30000	0
⚡	04-38	Position command 12 (pulse)	-32767~32767	0
	04-39	Position command 13 (revolution)	-30000~30000	0
⚡	04-40	Position command 13 (pulse)	-32767~32767	0
	04-41	Position command 14 (revolution)	-30000~30000	0
⚡	04-42	Position command 14 (pulse)	-32767~32767	0
	04-43	Position command 15 (revolution)	-30000~30000	0
⚡	04-44	Position command 15 (pulse)	-32767~32767	0

05 Motor Parameters

	Pr.	Explanation	Settings	Factory Setting
	05-00	Motor Auto Tuning	0: No function 1: Rolling test for induction motor(IM) (Rs, Rr, Lm, Lx, no-load current) 2: Static test for induction motor(IM) 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	0
	05-01	Full-load Current of Induction Motor 1(A)	10~120% of drive's rated current	#.##
✎	05-02	Rated Power of Induction Motor 1(kW)	0~655.35kW	#.##
✎	05-03	Rated Speed of Induction Motor 1 (rpm)	0~65535 1710(60Hz 4poles) ; 1410(50Hz 4 poles)	1710
	05-04	Pole Number of Induction Motor 1	2~20	4
	05-05	No-load Current of Induction Motor 1 (A)	0~ Pr.05-01 factory setting	#.##
	05-06	Stator Resistance (Rs) of Induction Motor 1	0~65.535Ω	#.###
	05-07	Rotor Resistance (Rr) of Induction Motor 1	0~65.535Ω	#.###
	05-08	Magnetizing Inductance (Lm) of Induction Motor 1	0~6553.5mH	#.#
	05-09	Stator Inductance (Lx) of Induction Motor 1	0~6553.5mH	#.#
	05-10 ~ 05-12	Reserved		
	05-13	Full-load Current of Induction Motor 2 (A)	10~120%	#.##
✎	05-14	Rated Power of Induction Motor 2 (kW)	0~655.35kW	#.##
✎	05-15	Rated Speed of Induction Motor 2 (rpm)	0~65535 1710(60Hz 4 poles) ; 1410(50Hz 4 poles)	1710
	05-16	Pole Number of Induction Motor 2	2~20	4
	05-17	No-load Current of Induction Motor 2 (A)	0~ Pr.05-01 factory setting	#.##
	05-18	Stator Resistance (Rs) of Induction Motor 2	0~65.535Ω	#.###
	05-19	Rotor Resistance (Rr) of Induction Motor 2	0~65.535Ω	#.###
	05-20	Magnetizing Inductance (Lm) of Induction Motor 2	0~6553.5mH	#.#
	05-21	Stator Inductance (Lx) of Induction Motor 2	0~6553.5mH	#.#
✎	05-22	Induction Motor 1/ 2 Selection	1: motor 1 2: motor 2	1
✎	05-23	Frequency for Y-connection/△-connection Switch of Induction Motor	0.00~600.00Hz	60.00
✎	05-24	Y-connection/△-connection Switch of Induction Motor	0: Disable 1: Enable	0

	Pr.	Explanation	Settings	Factory Setting
⌿	05-25	Delay Time for Y-connection/△-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 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	0.0~6553.5 kg.cm^2	0.0
	05-39	Stator Resistance of PM Motor	0.000~65.535Ω	0.000
	05-40	Permanent Magnet Motor Ld	0.00~655.35mH	0.000
	05-41	Permanent Magnet Motor Lq	0.00~655.35mH	0.000
	05-42	PG Offset angle of PM Motor	0.0~360.0°	0.0
	05-43	Ke parameter of PM Motor	0~65535 (Unit: V/1000rpm)	0

06 Protection Parameters

	Pr.	Explanation	Settings	Factory Setting
✓	06-00	Low Voltage Level	230V: Frame A to D: 150.0~220.0Vdc Frame E and frames above E: 190.0~220.0V 460V: Frame A to D: 300.0~440.0Vdc Frame E and frames above E: 380.0~440.0V	180.0 200.0 360.0 400.0
✓	06-01	Over-voltage Stall Prevention	0: Disabled 230V: 0.0~450.0Vdc 460V: 0.0~900.0Vdc	380.0 760.0
✓	06-02	Selection for Over-voltage Stall Prevention	0: Traditional over-voltage stall prevention 1: Smart over-voltage prevention	0
✓	06-03	Over-current Stall Prevention during Acceleration	Normal Load: 0~160%(100%: drive's rated current) Heavy Load: 0~180%(100%: drive's rated current)	120 150
✓	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)	120 150
✓	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
✓	06-06	Over-torque Detection Selection (OT1)	0: No function 1: Over-torque detection during constant speed operation, continue to operate after detection 2: Over-torque detection during constant speed operation, stop operation after detection 3: Over-torque detection during operation, continue to operate after detection 4: Over-torque detection during operation, stop operation after detection	0
✓	06-07	Over-torque Detection Level (OT1)	10~250% (100%: drive's rated current)	120
✓	06-08	Over-torque Detection Time (OT1)	0.0~60.0 sec.	0.1
✓	06-09	Over-torque Detection Selection (OT2)	0: No function 1: Over-torque detection during constant speed operation, continue to operate after detection 2: Over-torque detection during constant speed operation, stop operation after detection 3: Over-torque detection during operation, continue to operation after detection 4: Over-torque detection during operation, stop operation after detection	0
✓	06-10	Over-torque Detection Level (OT2)	10~250% (100%: drive's rated current)	120
✓	06-11	Over-torque Detection Time (OT2)	0.0~60.0 sec.	0.1
✓	06-12	Current Limit	0~250% (100%: drive's rated current）	150
✓	06-13	Electronic Thermal Relay Selection (Motor 1)	0: Constant torque output motor 1: Variable torque output motor 2: Disable	2
✓	06-14	Electronic Thermal Characteristic for Motor 1	30.0~600.0 sec.	60.0
✓	06-15	Heat Sink Over-heat (OH) Warning	0.0~110.0℃	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 (oH2)	
		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)	

	Pr.	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/△-connection switch error (ydc)	
			62: Decel. Energy Backup Error (dEb)	
			63: Slip error (oSL)	
			64: Electromagnet switch error (ryF)	
			65 : PG Card Error (PGF5)	
			66-67: Reserved	
			68: Sensorless, estimated rotating direction is different from commanding direction.	
			69: Sensorless, estimated over speeding RPM	
			70: Sensorless, a big inaccuracy between estimated RPM and the command.	
			71~72: 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)	
ϟ	06-23	Fault Output Option 1	0~65535(refer to bit table for fault code)	0
ϟ	06-24	Fault Output Option 2	0~65535(refer to bit table for fault code)	0
ϟ	06-25	Fault Output Option 3	0~65535(refer to bit table for fault code)	0
ϟ	06-26	Fault Output Option 4	0~65535(refer to bit table for fault code)	0
ϟ	06-27	Electronic Thermal Relay Selection 2 (Motor 2)	0: Constant torque output motor 1: Variable torque output motor 2: Disable	2
ϟ	06-28	Electronic Thermal Characteristic for Motor 2	30.0~600.0 sec	60.0
ϟ	06-29	PTC Detection Selection	0: Warn and keep operation 1: Warn and ramp to stop 2: Warn and coast to stop 3: No warning	0
ϟ	06-30	PTC Level	0.0～100.0%	50.0

Pr.	Explanation	Settings	Factory Setting
✎ 06-31	Frequency Command for Malfunction	0.00~655.35 Hz	Read only
06-32	Output Frequency at Malfunction	0.00~655.35 Hz	Read only
06-33	Output Voltage at Malfunction	0.0~6553.5 V	Read only
06-34	DC Voltage at Malfunction	0.0~6553.5 V	Read only
06-35	Output Current at Malfunction	0.00~655.35 Amp	Read only
06-36	IGBT Temperature at Malfunction	0.0~6553.5 ℃	Read only
06-37	Capacitance Temperature at Malfunction	0.0~6553.5 ℃	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 1: Warn and ramp to stop 2: Warn and coast to stop 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 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 1: constant carrier frequency and limit load current by setting carrier wave 2: constant rated current(same as setting 0), but close current limit	0
06-56	PT100 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		

Pr.	Explanation	Settings	Factory Setting
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 460V series: 0.0~440.0 Vdc	180.0 /360.0
06-63	Fault Record 1 (Day)	0~65535 days	Read only
06-64	Fault Record 1 (Min)	0~1439 min	Read only
06-65	Fault Record 2 (Day)	0~65535 days	Read only
06-66	Fault Record 2 (Min)	0~64799 min	Read only
06-67	Fault Record 3 (Day)	0~65535 days	Read only
06-68	Fault Record 3 (Min)	0~1439 min	Read only
06-69	Fault Record 4 (Day)	0~65535 days	Read only
06-70	Fault Record 4 (Min)	0~1439 min	Read only
06-71	Low Current Setting Level	0.0 ~ 6553.5 %	0.0
06-72	Low Current Detection Time	0.00 ~ 655.35sec	0.00
06-73	Treatment for low current	0 : No function 1 : Warn and coast to stop 2 : Warn and ramp to stop by 2nd deceleration time 3 : Warn and operation continue	0

07 Special Parameters

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

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

08 High-function PID Parameters

	Pr.	Explanation	Settings	Factory Setting
⌁	08-00	Input Terminal for PID Feedback	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	0
⌁	08-01	Proportional Gain (P)	0.0~500.0%	1.0
⌁	08-02	Integral Time (I)	0.00~100.00sec	1.00
⌁	08-03	Derivative Control (D)	0.00~1.00sec	0.00
⌁	08-04	Upper Limit of Integral Control	0.0~100.0%	100.0
⌁	08-05	PID Output Frequency Limit	0.0~110.0%	100.0
	08-06	PID feedback value by communication protocol	0.00~200.00%	0.00
⌁	08-07	PID Delay Time	0.0~2.5 秒	0.0
⌁	08-08	Feedback Signal Detection Time	0.0~3600.0sec	0.0
⌁	08-09	Feedback Signal Fault Treatment	0: Warn and keep operation 1: Warn and ramp to stop 2: Warn and coast to stop 3: Warn and operate at last frequency	0
⌁	08-10	Sleep Reference	0.00 ~ 600.00Hz	0.00
⌁	08-11	Wake-up Reference	0.00 ~ 600.00Hz	0.00
⌁	08-12	Sleep Time	0.0 ~ 6000.0sec	0.0
⌁	08-13	PID Deviation Level	1.0 ~ 50.0%	10.0
⌁	08-14	PID Deviation Time	0.1~300.0sec	5.0
⌁	08-15	Filter Time for PID Feedback	0.1~300.0sec	5.0
⌁	08-16	PID Compensation Selection	0: Parameter setting 1: Reserved	0
⌁	08-17	PID Compensation	-100.0~+100.0%	0
	08-18	Setting of Sleep Mode Function	0: Follow PID output command 1: Follow PID feedback signal	0
	08-19	Wake-up Integral Limit	0.0~200.0%	50.0
	08-20	PID Mode Selection	0: Serial connection 1: Parallel connection	0
	08-21	Enable PID to Change Operation Direction	0: Operation direction can be changed 1: Operation direction can not be changed	0
	08-22	Wakeup Delay Time	0.00~600.00 Seconds	0.00
	08-23	PID Control Bit	Bit 0 = 1, PID reverse running must follow the setting of Pr00-23. Bit 0 = 0, PID reverse running follow PID's calculated value.	0.00

09 Communication Parameters

	Pr.	Explanation	Settings	Factory Setting
✎	09-00	COM1 Communication Address	1~254	1
✎	09-01	COM1 Transmission Speed	4.8～115.2Kbps	9.6
✎	09-02	COM1 Transmission Fault Treatment	0: Warn and continue operation 1: Warn and ramp to stop 2: Warn and coast to stop 3: No warning and continue operation	3
✎	09-03	COM1 Time-out Detection	0.0～100.0 sec.	0.0
✎	09-04	COM1 Communication Protocol	1: 7N2 (ASCII) 2: 7E1 (ASCII) 3: 7O1 (ASCII) 4: 7E2 (ASCII) 5: 7O2 (ASCII) 6: 8N1 (ASCII) 7: 8N2 (ASCII) 8: 8E1 (ASCII) 9: 8O1 (ASCII) 10: 8E2 (ASCII) 11: 8O2 (ASCII) 12: 8N1 (RTU) 13: 8N2 (RTU) 14: 8E1 (RTU) 15: 8O1 (RTU) 16: 8E2 (RTU) 17: 8O2 (RTU)	1
✎	09-05 ~ 09-08	Reserved		
✎	09-09	Response Delay Time	0.0~200.0ms	2.0
✎	09-10	Main Frequency of the Communication	0.00~600.00Hz	60.00
✎	09-11	Block Transfer 1	0~65535	0
✎	09-12	Block Transfer 2	0~65535	0
✎	09-13	Block Transfer 3	0~65535	0
✎	09-14	Block Transfer 4	0~65535	0
✎	09-15	Block Transfer 5	0~65535	0
✎	09-16	Block Transfer 6	0~65535	0
✎	09-17	Block Transfer 7	0~65535	0
✎	09-18	Block Transfer 8	0~65535	0
✎	09-19	Block Transfer 9	0~65535	0
✎	09-20	Block Transfer 10	0~65535	0
✎	09-21	Block Transfer 11	0~65535	0
✎	09-22	Block Transfer 12	0~65535	0
✎	09-23	Block Transfer 13	0~65535	0
✎	09-24	Block Transfer 14	0~65535	0
✎	09-25	Block Transfer 15	0~65535	0
✎	09-26	Block Transfer 16	0~65535	0

Pr.	Explanation	Settings	Factory Setting
09-27 ~ 09-29	Reserved		
09-30	Communication Decoding Method	0: Decoding Method 1 1: Decoding Methond 2	1
09-31	Internal Communication Protocol	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	0
09-32 ~ 09-34	Reserve		
09-35	PLC Address	1~254	2
09-36	CANopen Slave Address	0: Disable 1~127	0
09-37	CANopen Speed	0: 1M 1: 500k 2: 250k 3: 125k 4: 100k (Delta only) 5: 50k	0
09-38	Reserved		
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 1: CANopen DS402 Standard	1
09-41	CANopen Communication Status	0: Node Reset State 1: Com Reset State 2: Boot up State 3: Pre Operation State 4: Operation State 5: Stop State	Read Only
09-42	CANopen Control Status	0: Not ready for use state 1: Inhibit start state 2: Ready to switch on state 3: Switched on state 4: Enable operation state 7: Quick Stop Active state 13: Err Reaction Activation state 14: Error state	Read Only
09-43	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

Pr.	Explanation	Settings	Factory Setting
09-44	Reserved		
09-45	CANopen Master Function	0: Disable 1: Enable	0
09-46	CANopen Master Address	1~127	100
09-47 ~ 09-59	Reserved		
09-60	Identifications for Communication Card	0: No communication card 1: DeviceNet Slave 2: Profibus-DP Slave 3: CANopen Slave/Master 4: Modbus-TCP Slave 5: Ethernet/IP Slave 6~8: Reserved	##
09-61	Firmware Version of Communication Card	Read only	##
09-62	Product Code	Read only	##
09-63	Error Code	Read only	##
09-64 ~ 09-69	Reserved		
09-70	Address of Communication Card	DeviceNet: 0-63 Profibus-DP: 1-125	1
09-71	Setting of DeviceNet Speed	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	2
09-72	Other Setting of DeviceNet Speed	0: Disable In this mode, baud rate can only be 0,1,2,3 in standard DeviceNet speed 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 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 1: Reset, return to factory setting	0
09-91	Additional Setting for Communication Card	Bit0: Enable IP filter Bit1: Enable to write internet parameters (1bit). Bit 1: Enable to write internet parameters (1bit). This bit will change to disable when it finishes saving the internet parameter updates. 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 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

NOTE IM: Induction Motor; PM: Permanent Magnet Motor

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

Pr.	Explanation	Settings	Factory Setting
⚡ 10-19	Positioning for Encoder Position	0~65535pulse	0
⚡ 10-20	Range for Encoder Position Attained	0~65535pulse	10
⚡ 10-21	Filter Time (PG2)	0~65.535 sec	0.100
10-22	Speed Mode (PG2)	0: Electronic Frequency 1: Mechanical Frequency (base on pole pair)	0
10-23	Reserved		
10-24	FOC&TQC Function Control	0~65535	0
10-25	FOC Bandwidth of Speed Observer	1.0~100.0Hz	40.0
10-26	FOC Minimum Stator Frequency	0.0~2.0%fN	2.0
10-27	FOC Low-pass Filter Time Constant	1~1000ms	50
10-28	FOC Excitation Current Rise Time	33~100%Tr	100
10-29	Top Limit of Frequency Deviation	0.00~100.00Hz	20.00
10-30	Resolver Pole Pair	1~50	1
10-31	I/F Mode, current command	0~150%Irated (Rated current % of the drive)	40
10-32	PM Sensorless Obeserver Bandwith for High Speed Zone	0.00~600.00Hz	5.00
10-33	Reserved		
10-34	PM Sensorless Observer Low-pass Filter Gain	0.00~655.35 Hz	1.00
10-35	Reserved		
10-36	Reserved		
10-37	PM Sensorless Control Word	0000~FFFFh	0000
10-38	Reserved		
10-39	Frequency when switch from I/F Mode to PM sensorless mode.	0.00~600.00Hz	20.00
10-40	Frequency when switch from PM sensorless observer mode to V/F mode.	0.00~600.00Hz	20.00
10-41	I/F mode, low pass-filter time	0.0~6.0sec	0.2
10-42	Initial Angle Detection Time	0~20ms	5
10-43	PG card version	0~655.35	Read only

11 Advanced Parameters

NOTE IM: Induction Motor; PM: Permanent Magnet Motor

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

	Pr.	Explanation	Settings	Factory Setting
✓	11-29	Torque Offset Setting	0~100%	0.0
✓	11-30	High Torque Offset	0~100%	30.0
✓	11-31	Middle Torque Offset	0~100%	20.0
✓	11-32	Low Torque Offset	0~100%	10.0
✓	11-33	Source of Torque Command	0: Digital keypad 1: RS-485 communication (Pr.11-34) 2: Analog input (Pr.03-00) 3: CANopen 4: Reserved 5: Communication extension card	0
✓	11-34	Torque Command	-100.0~+100.0% (Pr.11-27*11-34)	0
✓	11-35	Filter Time of Torque Command	0.000~1.000sec	0.000
✓	11-36	Speed Limit Selection	0: Set by Pr.11-37 (Forward speed limit) and Pr.11-38 (Reverse speed limit) 1: Set by Pr.11-37,11-38 and Pr.00-20 (Source of Master Frequency Command) 2: Set by Pr.00-20 (Source of Master Frequency Command).	0
✓	11-37	Forward Speed Limit (torque mode)	0~120%	10
✓	11-38	Reverse Speed Limit (torque mode)	0~120%	10
	11-39	Zero Torque Command Mode	0: Torque mode 1: Speed mode	0
	11-40	Command Source of Point-to-Point Position Control	0: External terminal 1: Reserved 2: RS485 3: CAN 4: PLC 5: Communication card	0
	11-41	Reserved		
	11-42	System Control Flags	0000~FFFFh	0000
	11-43	Max. Frequency of Point-to-Point Position Control	0.00~327.67Hz	10.00
	11-44	Accel. Time of Point-to Point Position Control	0.00~655.35 sec	1.00
	11-45	Decel. Time of Point-to Point Position Control	0.00~655.35 sec	3.00

Chapter 12 Description of Parameter Settings

00 Drive Parameters

✎ This parameter can be set during operation.

00-00 Identity Code of the AC Motor Drive

Factory Setting: #.#

Settings Read Only

00-01 Display AC Motor Drive Rated Current

Factory Setting: #.#

Settings Read Only

📖 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.

📖 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	D		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	5.5	7. 5	11	15	18.5	22	30
HP	1	2	3	5	5	7.5	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	11	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

00-02 Parameter Reset

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 50Hz)
10: All parameters are reset to factory settings (base frequency is 60Hz)

🕮 When it is set to 1, all parameters are read only except Pr.00-02~00-08 and it can be used with password setting for password protection. It needs to set Pr.00-02 to 0 before changing other parameter settings.

🕮 When it is set to 9 or 10: all parameters are reset to factory settings. If password is set in Pr.00-08, input the password set in Pr.00-07 to reset to factory settings.

🕮 When it is set to 5, KWH display value can be reset to 0 even when the drive is operating. Pr. 05-26, 05-27, 05-28, 05-29, 05-30 reset to 0.

🕮 When it is set to 6: clear internal PLC program (includes the related settings of PLC internal CANopen master)

🕮 When it is set to 7: reset the related settings of CANopen slave.

✎ 00-03 Start-up Display Selection

Factory setting: 0

Settings 0: Display the frequency command (F)
1: Display the actual output frequency (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.

✎ 00-04 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 % (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.), 0~10V/4-20mA/0-20mA corresponds to 0~100% (Refer to Note 2)

12: Display ACI in % (2.), 4~20mA/0~10V/0-20mA 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: %(h.)

41: KWH display, unit: KWH(J)

42: PID reference, unit: %(L)

43: PID offset, unit: %(o.)

44: PID output frequency, unit: Hz(b.)

NOTE

1. When Pr.10-01 is set to 1000 and Pr.10-02 is set to 1/2, the display range for PG 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 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	MI15	MI14	MI13	MI12	MI11	MI10	MI8	MI7	MI6	MI5	MI4	MI3	MI2	MI1	REV	FWD
Status	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0

MI10~MI15 are the terminals for extension cards (Pr.02-26~02-31).
If REV, MI1 and MI6 are ON, the value is 0000 0000 1000 0110 in binary and 0086h in HEX. When Pr.00-04 is set to “16” or “19”, it will display “0086h” 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 “0001h” 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 x60/2π)/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.

00-05 Coefficient Gain in Actual Output Frequency

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).

00-06 Software Version

Factory Setting: #.#

Settings Read only

✎ 00-07 Parameter Protection Password Input

Factory Setting: 0

Settings 1~9998, 10000~65535

Display 0~3 (the times of password attempts)

🕮 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.

🕮 Pr.00-07 and Pr.00-08 are used to prevent the personal misoperation.

🕮 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.

✎ 00-08 Parameter Protection Password Setting

Factory Setting: 0

Settings 1~9998, 10000~65535

0: No password protection / password is entered correctly (Pr00-07)

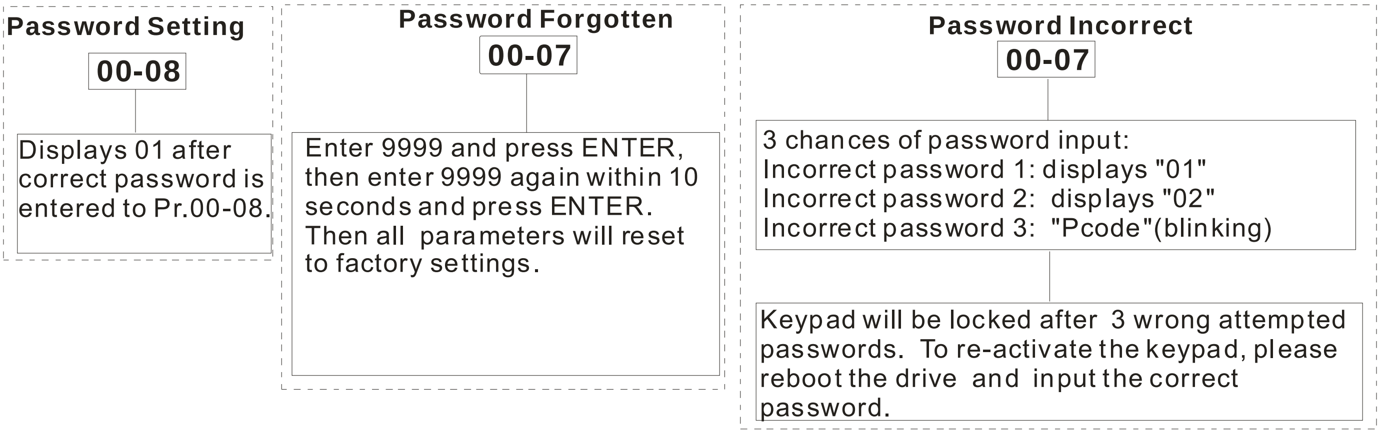
1: Password has been set

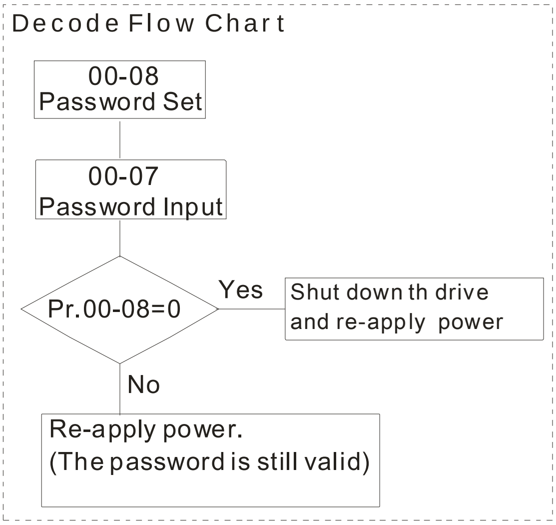
🕮 To set a password to protect your parameter settings. If the display shows 0, no password is set nor password has been correctly entered in Pr.00-07. All parameters can then be changed, including Pr.00-08. The first time you can set a password directly. After successful setting of password the display 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.

🕮 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





✎ **00-09** Reserved

00-10 Control Mode

Factory Setting: 0

Settings 0: Speed mode

1: Point-to-Point position control

2: Torque mode

3: Home mode

📖 This parameter determines the control mode of C2000 series AC motor drive.

00-11 Control of Speed Mode

Factory Setting: 0

Settings 0: VF (IM V/f control)

1: VFPG (IM V/f control+ Encoder)

2: SVC(IM sensorless vector control)

3: FOCPG (IM FOC vector control+ encoder)

4: FOCPG（PM FOC vector control + Encoder）

5: FOC Sensorless (IM field oriented sensorless vector control)

6 : PM Sensorless (PM field oriented sensorless vector control)

📖 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.

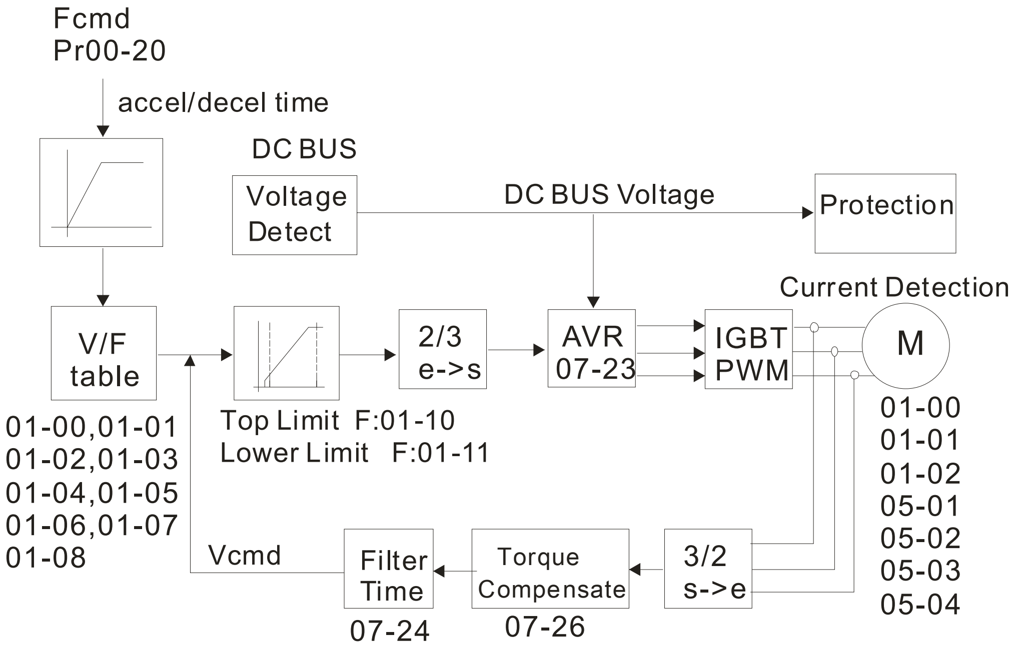
3: (IM FOC vector control+ encoder): besides torque increases, the speed control will be more accurate (1:1000).

4: (PM FOC vector control + Encoder): besides torque increases, the speed control will be more accurate (1:1000).

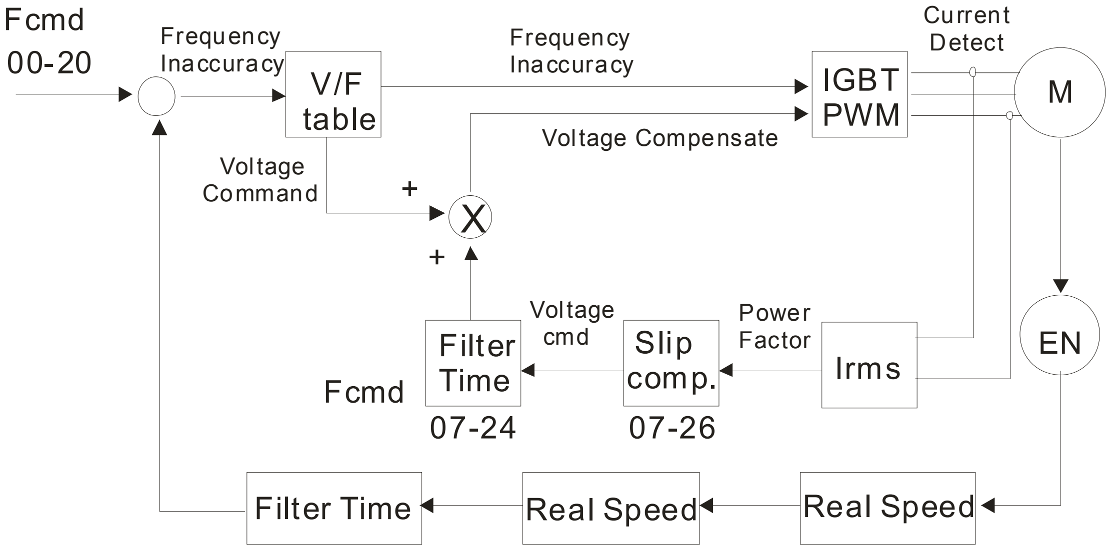
5: FOC Sensorless: IM field oriented sensorless vector control

6: PM Sensorless (PM field oriented sensorless vector control)

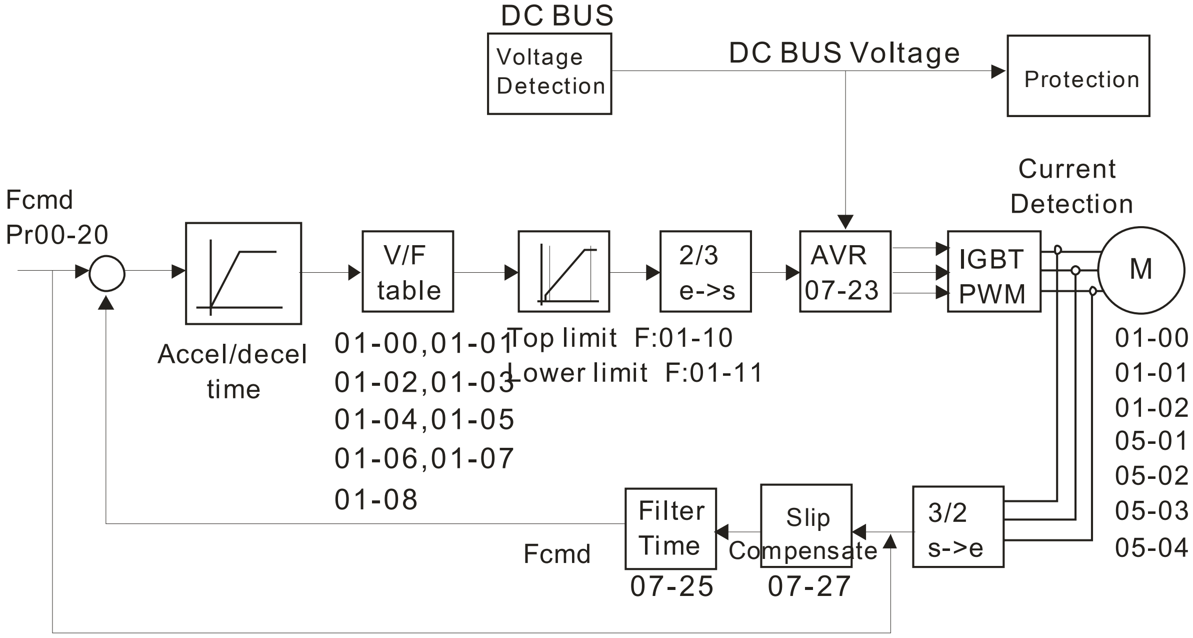
📖 When setting Pr.00-11 to 0, the V/F control diagram is shown as follows.



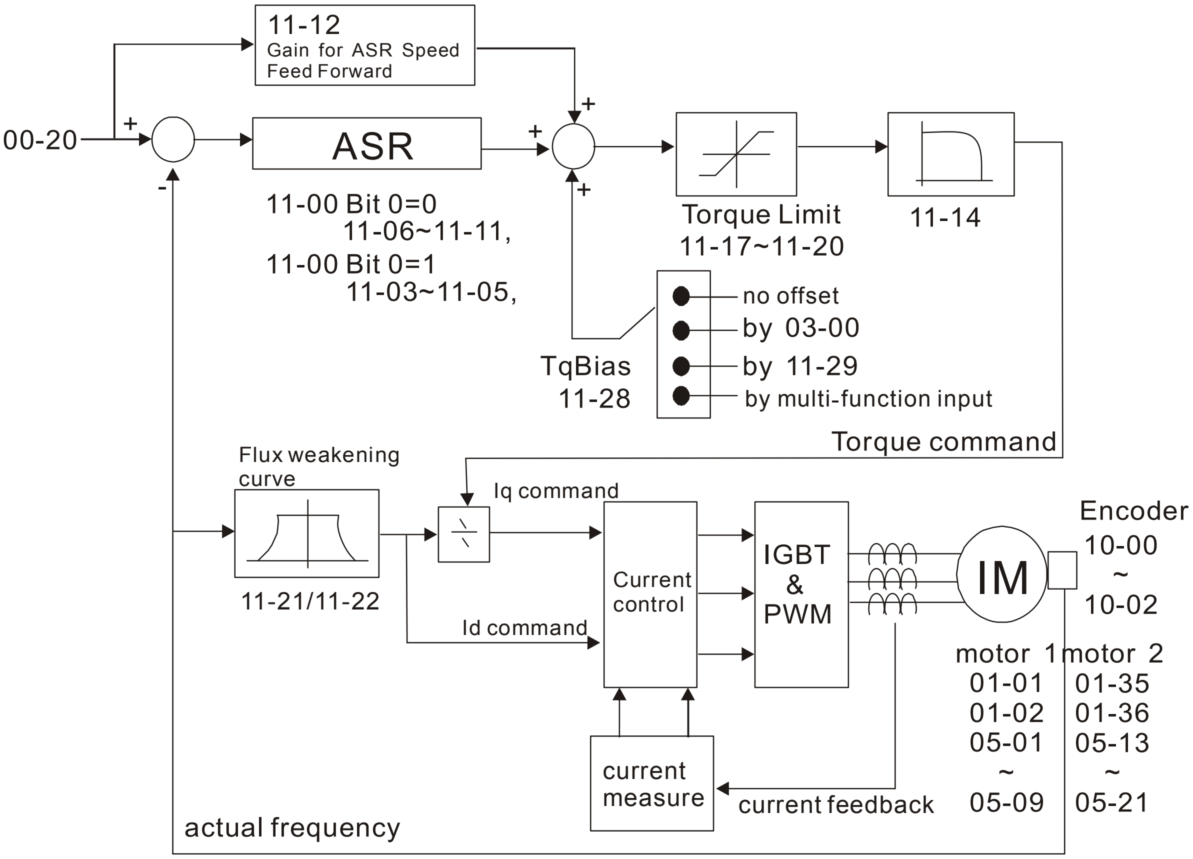
📖 When setting Pr.00-11 to 1, the V/F control + encoder diagram is shown as follows.



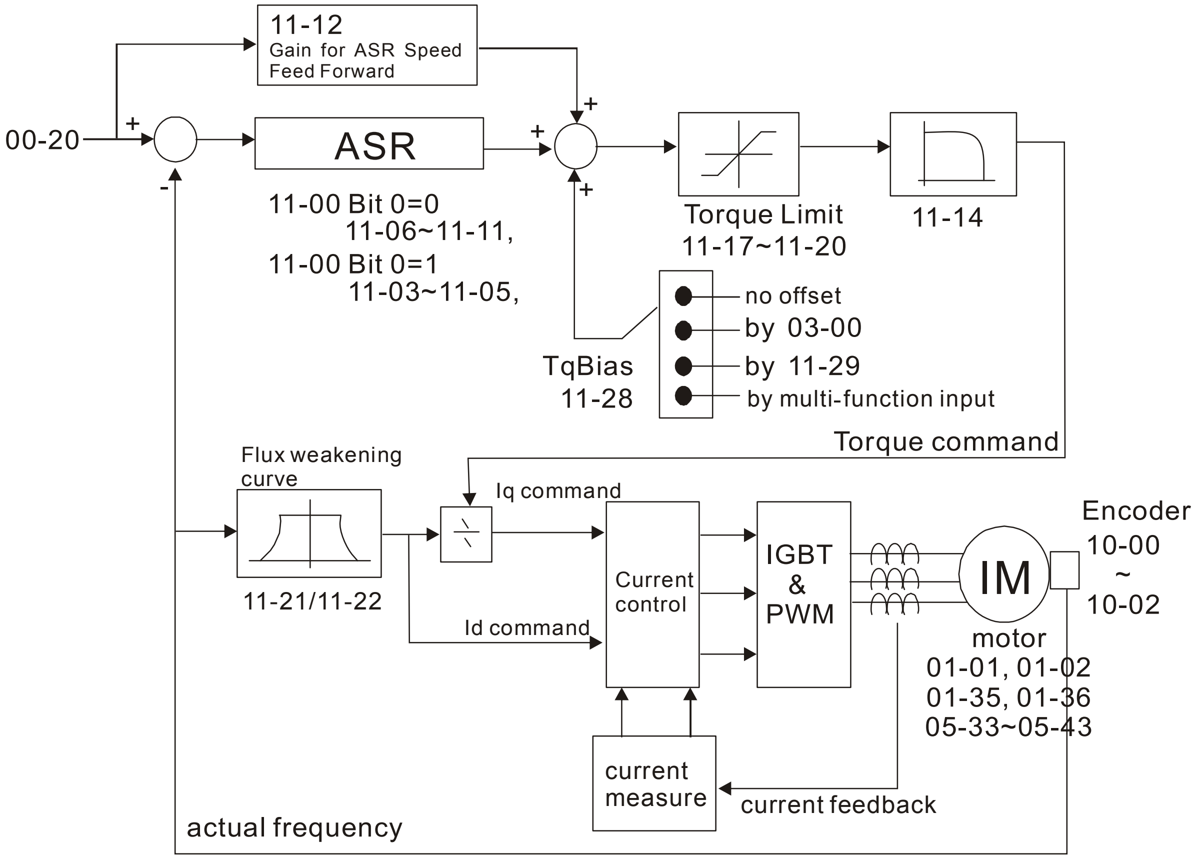
📖 When setting Pr.00-11 to 2, the sensorless vector control diagram is shown as follows.



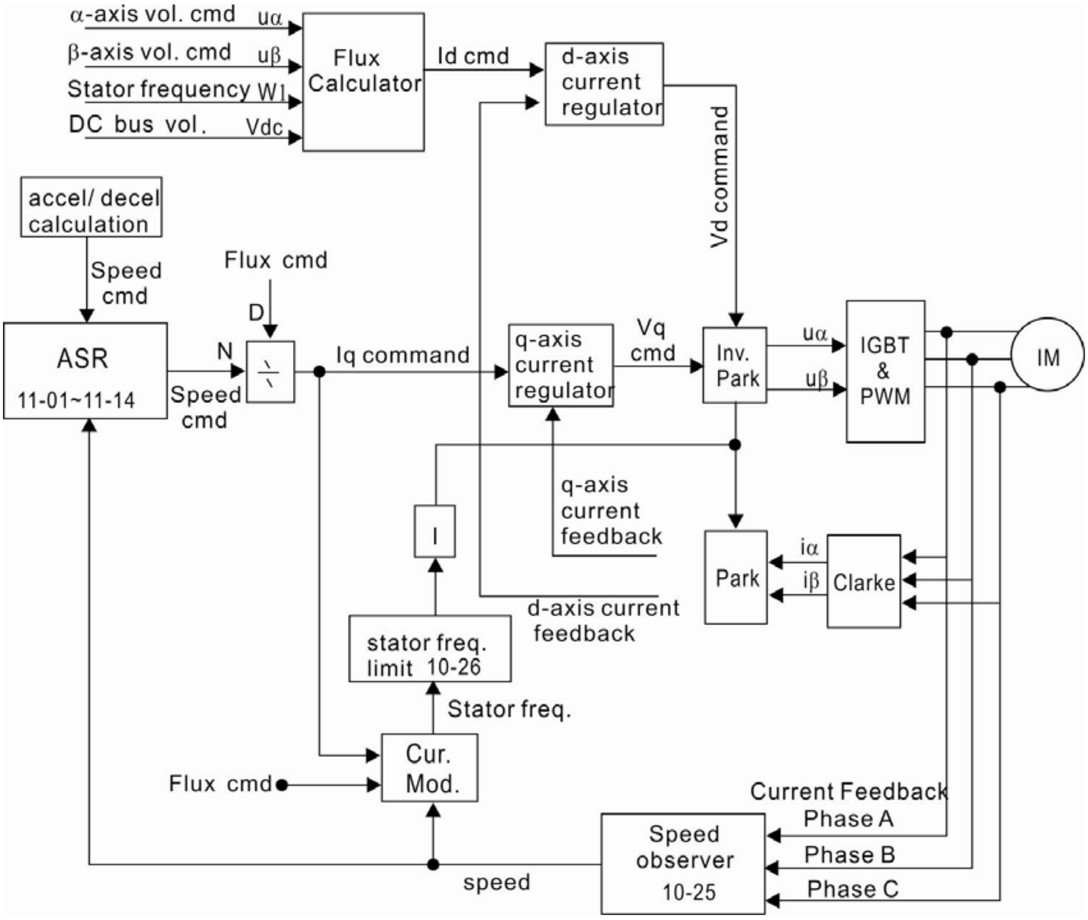
📖 When setting Pr.00-11 to 3, the FOCPG control diagram is shown as follows.



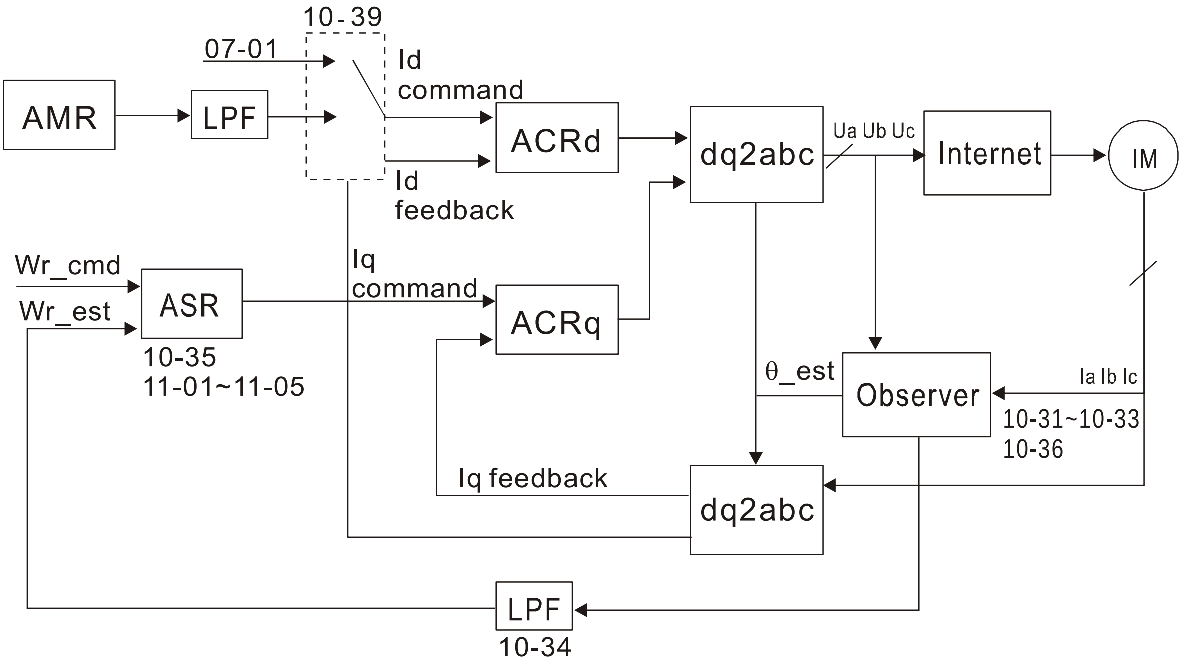
📖 When setting Pr.00-11 to 4, the FOCPG control diagram is shown as follows.



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



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



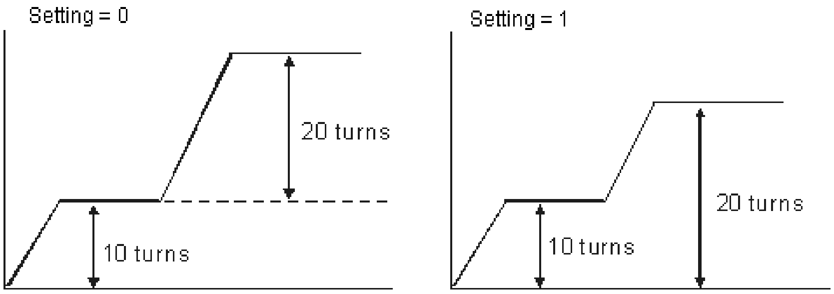
00-12 Point to Point Position control

Factory Settings: 0

Settings: 0: Incremental Type

1: Absolute Type

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



00-13 Control of Torque Mode

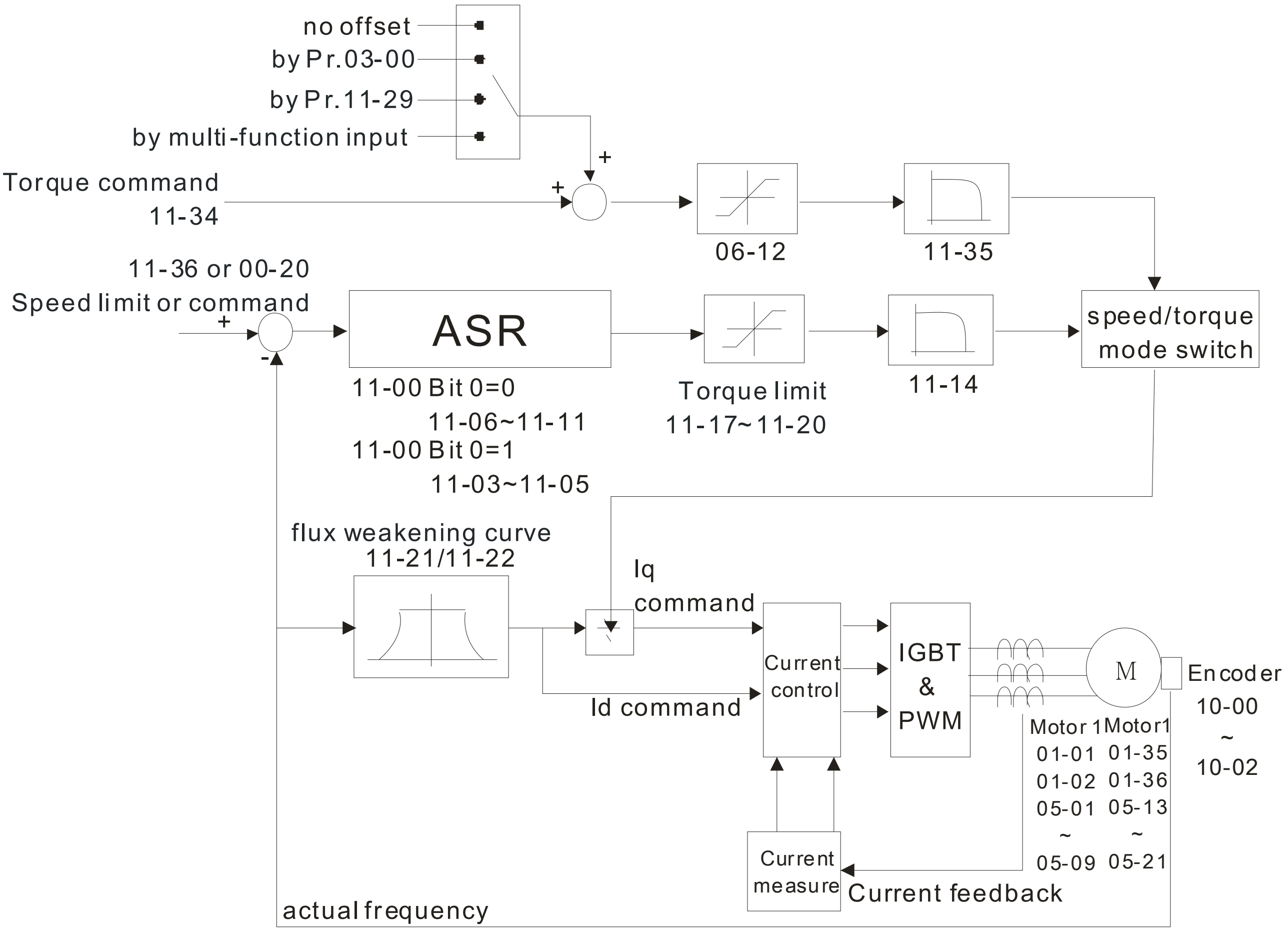
Factory Setting: 0

Settings 0: TQCPG（IM Torque control + Encoder）

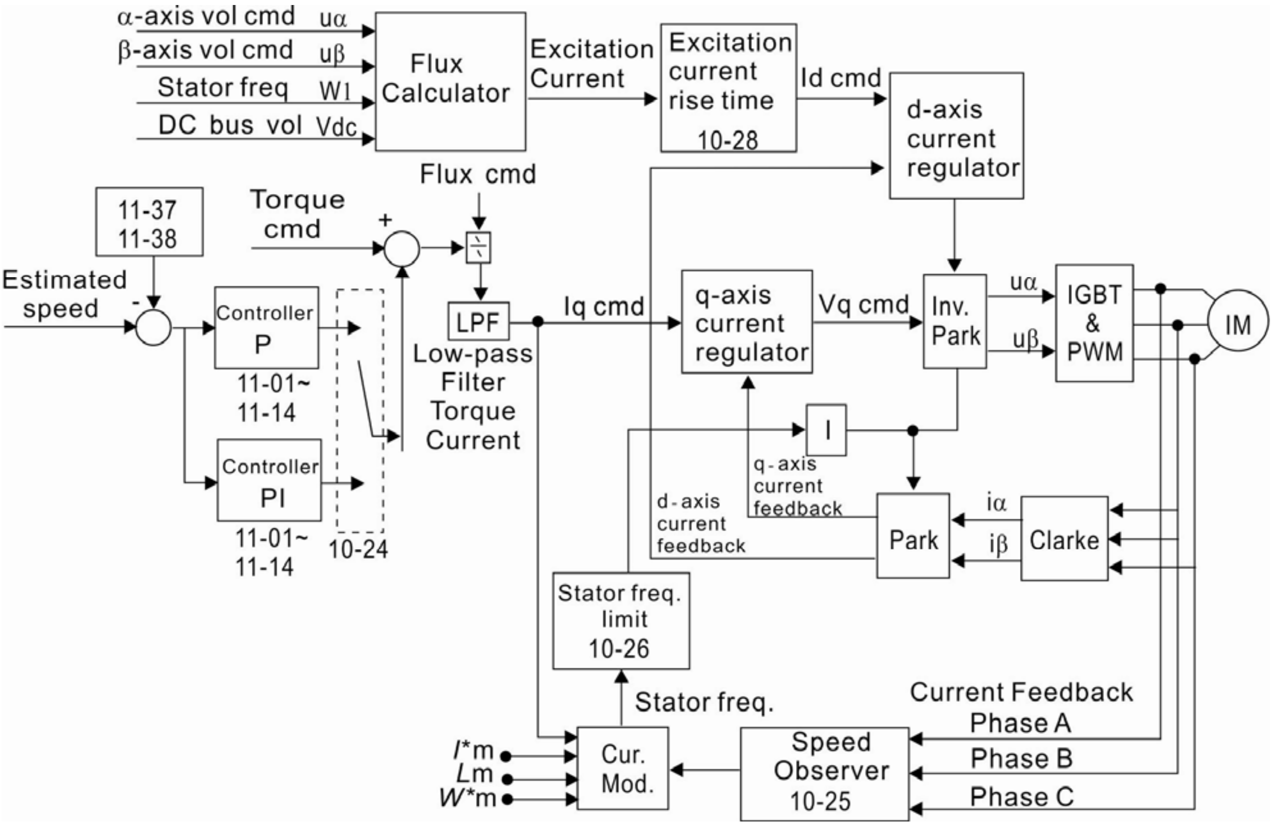
1: TQCPG (PM Torque control + Encoder)

2: TQC Sensorless (IM Sensorless torque control)

📖 TQCPG control diagram is shown in the following:


no offset
by Pr.03-00
by Pr.11-29
by multi-function input
Torque command
11-34
+
+
06-12
11-35
11-36 or 00-20
Speed limit or command
+
-
ASR
11-00 Bit 0=0
11-06~11-11
11-00 Bit 0=1
11-03~11-05
Torque limit
11-17~11-20
11-14
speed/torque
mode switch
flux weakening curve
11-21/11-22
Iq
command
Id command
Current
control
IGBT
&
PWM
M
Encoder
10-00
~
10-02
Motor 1
01-01
01-02
05-01
~
05-09
Motor1
01-35
01-36
05-13
~
05-21
Current
measure
Current feedback
actual frequency

📖 TQC Sensorless control diagram is shown in the following:



00-14 Reserved

00-15 Reserved

00-16 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.

📖 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.

📖 Pr.00-01 changes as the setting of Pr.00-16 changes.

00-17 Carrier Frequency

Factory setting: Table below

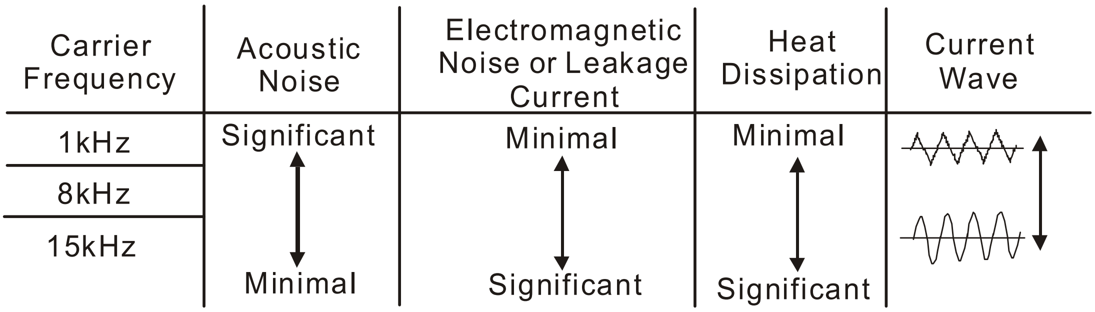
Settings 2～15kHz

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

230V Series			
Models	1-15HP [0.75-11kW]	20-50HP [15-37kW]	60-125HP [45-90kW]
Setting Range	02~15kHz	02~10kHz	02~09kHz
Normal Duty Factory Setting	8kHz	6kHz	4kHz

Heavy Duty Factory Setting	2kHz		

460V Series			
Models	1-20HP [0.75-15kW]	25-75HP [18.5-55kW]	100-475HP [75-355kW]
Setting Range	02~15kHz	02~10kHz	02~09kHz
Normal Duty Factory Setting	8kHz	6kHz	4kHz
Heavy Duty Factory Setting	2kHz		



📖 From the table, we see that the PWM carrier frequency has a significant influence on the electromagnetic noise, AC motor drive heat dissipation, and motor acoustic noise. Therefore, if the surrounding noise is greater than the motor noise, lower the carrier frequency is good to reduce the temperature rise. Although it is quiet operation in the higher carrier frequency, the entire wiring and interference resistance should be considerate.

📖 When the carrier frequency is higher than the factory setting, it needs to protect by decreasing the carrier frequency. See Pr.06-55 for the related setting and details.

00-18 Reserved

00-19 PLC Command Mask

Factory Setting: Read Only

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

📖 This parameter determines if frequency command or control command is occupied by PLC

00-20 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.

✎ 00-21 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)

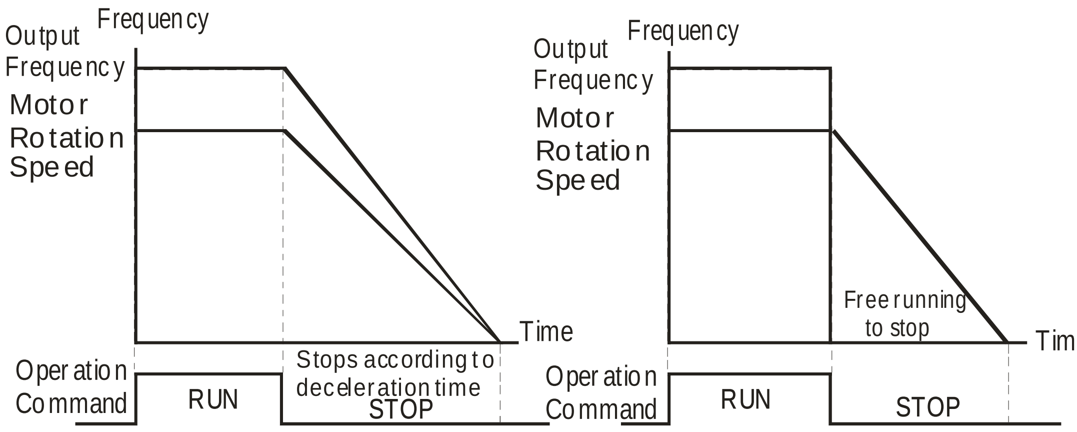
- It is used to set the source of the operation frequency in AUTO mode.
- When the operation command is controlled by the keypad KPC-CC01, keys RUN, STOP and JOG (F1) are valid.

✎ 00-22 Stop Method

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.



Ramp to 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).
- **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.

✎ 00-23 Control of Motor Direction

Factory Setting: 0

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

- 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.

00-24 Memory of Frequency Command

Factory Setting: Read Only

Settings Read only

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

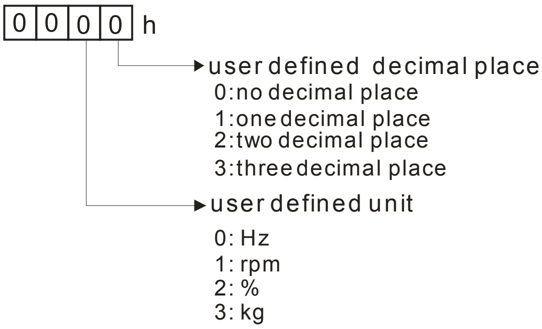
00-25 User Defined Characteristics

Factory Setting: 0

Settings 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 defined unit
000xh: Hz
001xh: rpm
002xh: %
003xh: kg

- 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.
- 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



00-26 Max. User Defined Value

Factory Setting: 0

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

- When Pr.00-26 is NOT set to 0. The user defined value is enabled. The 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 0021h 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.

00-27 User Defined Value

Factory Setting: Read only

Settings Read only

- Pr.00-27 will show user defined value when Pr.00-26 is not set to 0.
- 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

00-28 Reserved

00-29 LOCAL/REMOTE Selection

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.

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

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

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 HAND mode.

00-31 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

- It is used to set the source of the operation frequency in HAND 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 multi-function input terminal. When the external terminal is OFF, the drive won't receive any operation signal and can't execute JOG.

00-32 Digital Keypad STOP Function

Factory Setting: 0

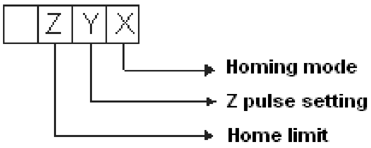
Settings 0: STOP key disable
1: STOP key enable

00-33 ~ 00-39 Reserved

00-40 Homing mode

Factory Setting: 0000h

Settings:



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

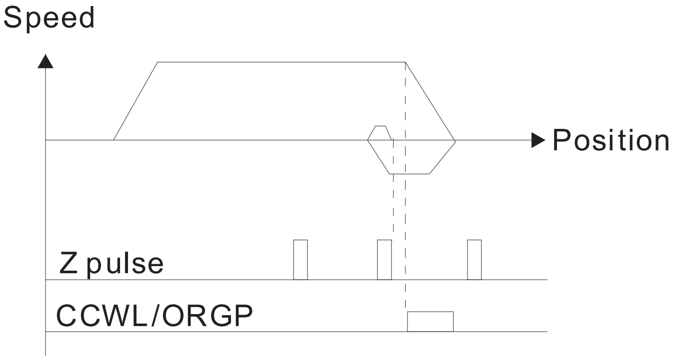
X 0: Forward run to home. Set PL forward limit as check point.
1: Reverse run (CCW) to home. Set NL reverse limit (CCWL) as check point.
2: Forward run to home. Set ORG : OFF→ON as check point.
3: Reverse to home. Set ORG : OFF→ON as check point.
4: Forward run and search for Z-pulse as check point.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

Y Set X to 0, 1, 2, 3, 6, 7 .
0: reverse run to Z pulse
1: continue forward run to Z pulse
2: Ignore Z pulse

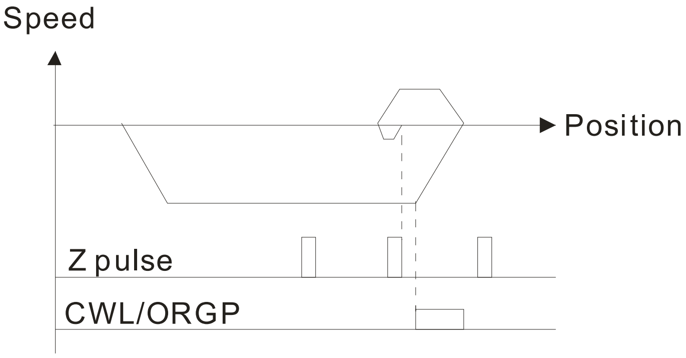
Z When home limit is reached, set X to 2, 3, 4, 5, 6, 7 first.
0: display error
1: reverse the direction

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

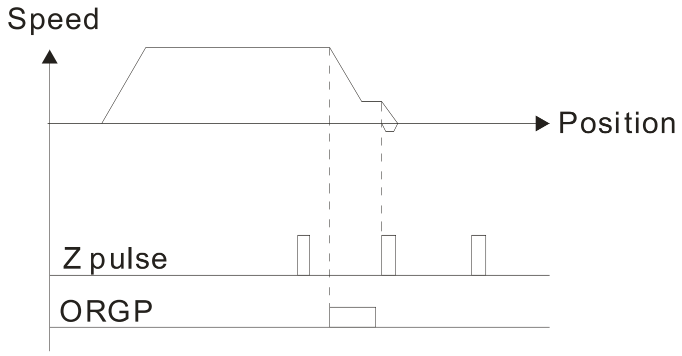
1. When Y=0, X=0 or Y=0, X=2



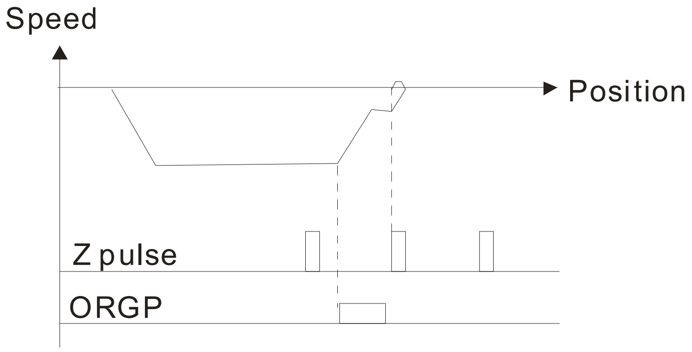
2. When Y=0, X=1 or Y=0, X=3



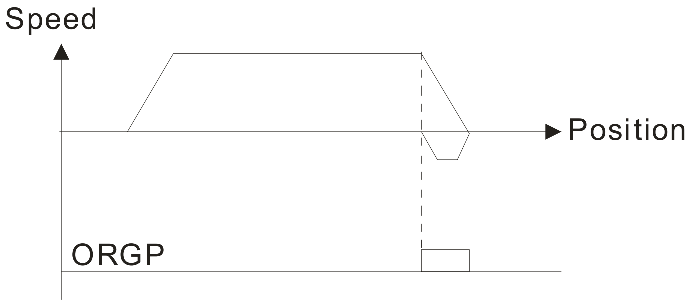
3. When Y=1, X=2



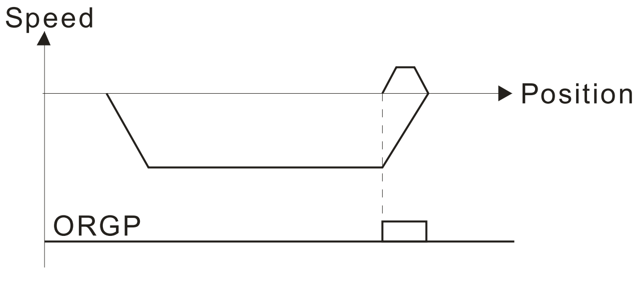
4. When Y=1, X=3



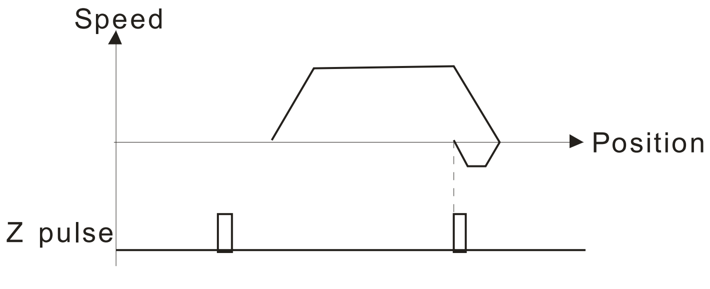
5. When Y=2, X=2



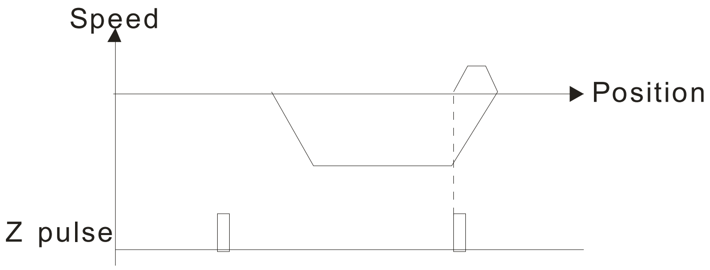
6. When Y=2, X=3



7. When Y=2, X=4



8. When Y=2, X=5



00-41 Homing by Frequency 1

Factory Setting: 8.00

Settings 0.00~600.00Hz

00-42 Homing by Frequency 2

Factory Setting: 2.00

Settings 0.00~600.00Hz

📖 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

📖 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.

📖 When Pr.00-10 is set to 3, after homing is complete, user must set control mode setting Pr.00-10 to 1 in order to perform P2P position control.

00-43 ~ 00-47 Reserved

✎ 00-48 Display Filter Time (Current)

Factory Settings: 0.100

Settings: 0.001~65.535 sec

📖 Set this parameter to minimize the current fluctuation displayed by digital keypad.

✎ 00-49 Display Filter Time (Keypad)

Factory Settings: 0.100

Settings: 0.001~65.535 sec

📖 Set this parameter to minimize the display value fluctuation displayed by digital keypad.

✎ 00-50 Software Version (date)

Factory Settings: ####

Settings: Read only

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

00-51 ~ 00-61 Reserve

Group 1 Basic Parameters

✎ This parameter can be set during operation.

01-00 Maximum Output Frequency

Factory Setting: 60.00/50.00

Settings 50.00~600.00Hz

🕮 This parameter determines the AC motor drive's Maximum Output Frequency. All the AC motor drive frequency command sources (analog inputs 0 to +10V, 4 to 20mA, 0 to 20mAand ±10V) are scaled to correspond to the output frequency range.

01-01 Output Frequency of Motor 1（base frequency and motor rated frequency）

01-35 Output Frequency of Motor 2（base frequency and motor rated frequency）

Factory Setting: 60.00/50.00

Settings 0.00~600.00Hz

🕮 This value should be set according to the rated frequency of the motor as indicated on the motor nameplate. If the motor is 60Hz, the setting should be 60Hz. If the motor is 50Hz, it should be set to 50Hz.

01-02 Output Voltage of Motor 1 (base frequency and motor rated frequency)

01-36 Output Voltage of Motor 2（base frequency and motor rated frequency）

Factory Setting: 200.0/400.0

Settings 230V series: 0.0~255.0V

460V series: 0.0~510.0V

🕮 This value should be set according to the rated voltage of the motor as indicated on the motor nameplate. If the motor is 220V, the setting should be 220.0. If the motor is 200V, it should be set to 200.0.

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

01-03 Mid-point Frequency 1 of Motor 1

Factory Setting: 3.00

Settings 0.00~600.00Hz

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

Factory Setting: 11.0/22.0

Settings 230V series: 0.0~240.0V

460V series: 0.0~480.0V

01-37 Mid-point Frequency 1 of Motor 2

Factory Setting: 3.00

Settings 0.00~600.00Hz

✎ **01-38** Mid-point Voltage 1 of Motor 2

Factory Setting: 11.0/22.0

Settings 230V series: 0.0~240.0V

460V series: 0.0~480.0V

01-05 Mid-point Frequency 2 of Motor 1

Factory Setting: 0.50

Settings 0.00~600.00Hz

✎ **01-06** Mid-point Voltage 2 of Motor 1

Factory Setting: 2.0/4.0

Settings 230V series: 0.0~240.0V

460V series: 0.0~480.0V

01-39 Mid-point Frequency 2 of Motor 2

Factory Setting: 0.50

Settings 0.00~600.00Hz

✎ **01-40** Mid-point Voltage 2 of Motor 2

Factory Setting: 2.0/4.0

Settings 230V series: 0.0~240.0V

460V series: 0.0~480.0V

01-07 Min. Output Frequency of Motor 1

Factory Setting: 0.00

Settings 0.00~600.00Hz

✎ **01-08** Min. Output Voltage of Motor 1

Factory Setting: 0.0/0.0

Settings 230V series: 0.0~240.0V

460V series: 0.0~480.0V

01-41 Min. Output Frequency of Motor 2

Factory Setting: 0.00

Settings 0.00~600.00Hz

✎ **01-42** Min. Output Voltage of Motor 2

Factory Setting: 0.0/0.0

Settings 230V series: 0.0~240.0V

460V series: 0.0~480.0V

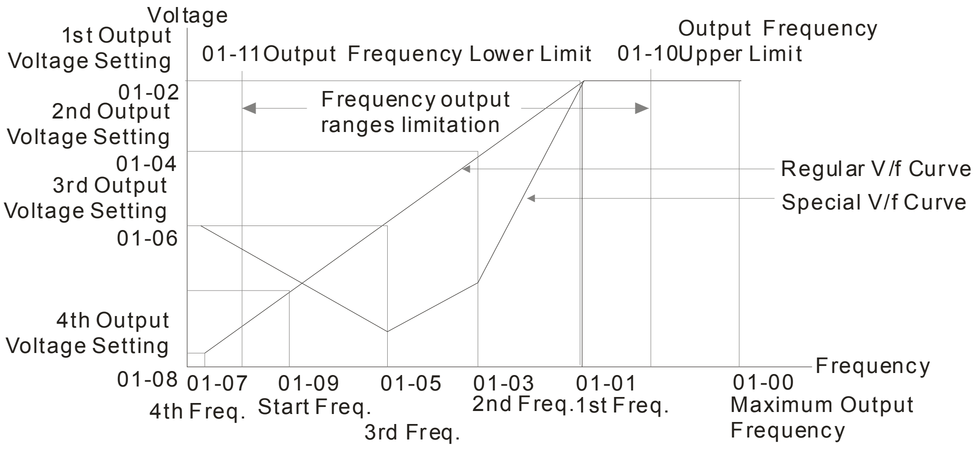
📖 V/f curve setting is usually set by the motor's allowable loading characteristics. Pay special attention to the motor's heat dissipation, dynamic balance, and bearing lubricity, if the loading characteristics exceed the loading limit of the motor.

📖 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.

📖 The V/f curve for the motor 1 is shown as follows. The V/f curve for the motor 2 can be deduced from it.

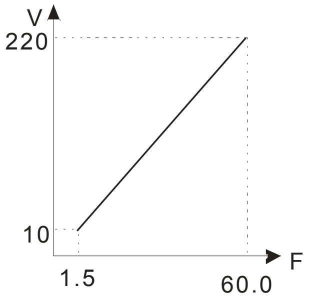


V/f Curve

Common settings of V/f curve:

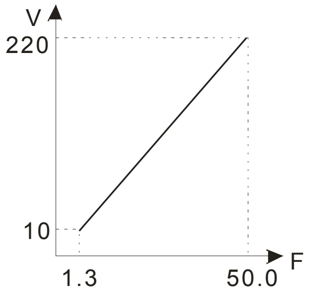
(1) General purpose

Motor spec. 60Hz



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

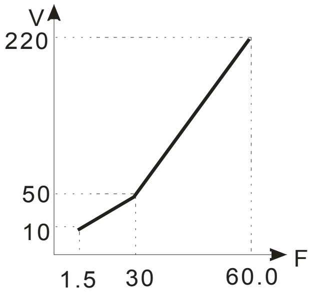
Motor spec. 50Hz



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

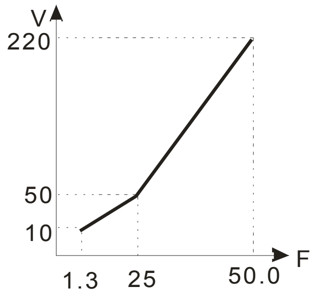
(2) Fan and hydraulic machinery

Motor spec. 60Hz



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

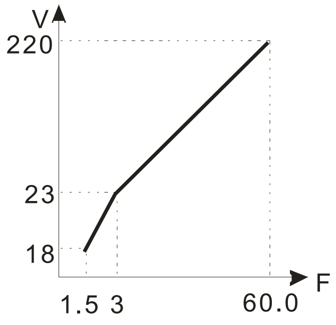
Motor spec. 50Hz



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

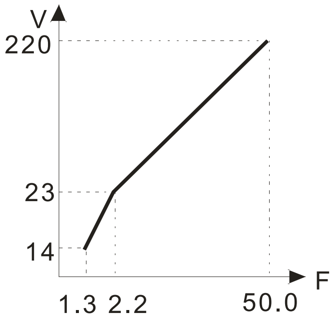
(3) High starting torque

Motor spec. 60Hz



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

Motor spec. 50Hz



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

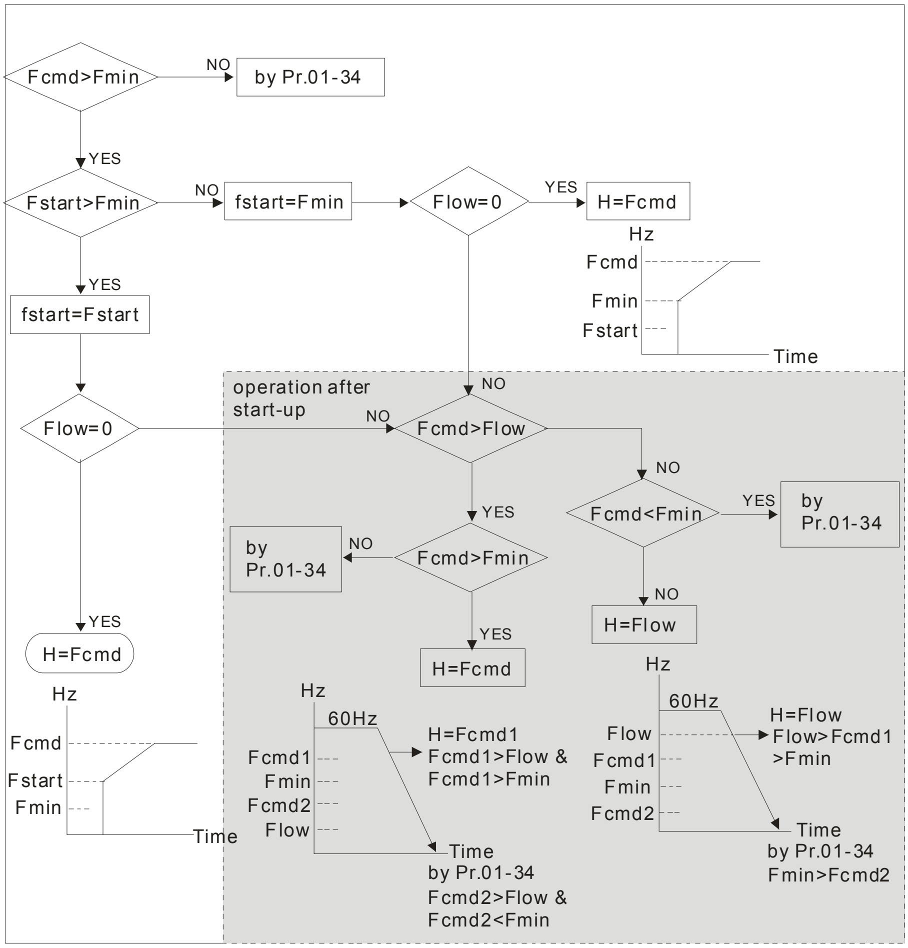
01-09 Start-Up Frequency

Factory Setting: 0.50

Settings 0.0~600.00Hz

- 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)

- Fcmd>Fmin and Fcmd<Fstart:
  - If Flow<Fcmd， drive will run with Fcmd directly.
  - If Flow>=Fcmd, drive will run with Fcmd firstly, then, accelerate to Flow according to acceleration time.
- The drive's output will stop immediately when output frequency has reach to Fmin during deceleration.



01-10 Output Frequency Upper Limit

Factory Setting: 600.00

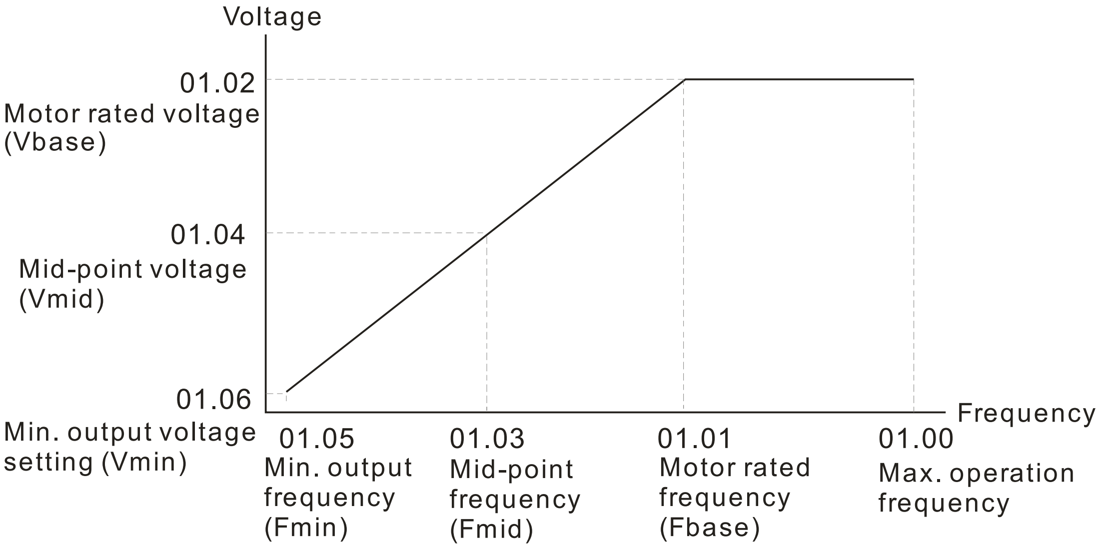
Settings 0.0~600.00Hz

01-11 Output Frequency Lower Limit

Factory Setting: 0.00

Settings 0.0~600.00Hz

- 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.
- Pr.01-10 setting must be ≥ 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.
- Related parameters: Pr.01-00 Max. Operation Frequency and Pr.01-11 Output Frequency Lower Limit



- 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.
- 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.
- 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 50Hz and frequency setting is 60Hz, max. output frequency will be 50Hz.
- If the output frequency lower limit setting is 10Hz and min. operation frequency setting (Pr.01-05) is 1.5Hz, it will operate by 10Hz when the frequency command is greater than Pr.01-05 and less than 10Hz. 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 60Hz and frequency setting is also 60Hz, it won't exceed 60Hz even after slip compensation. If the output frequency needs to exceed 60Hz, it can increase output

frequency upper limit or max. operation frequency.

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

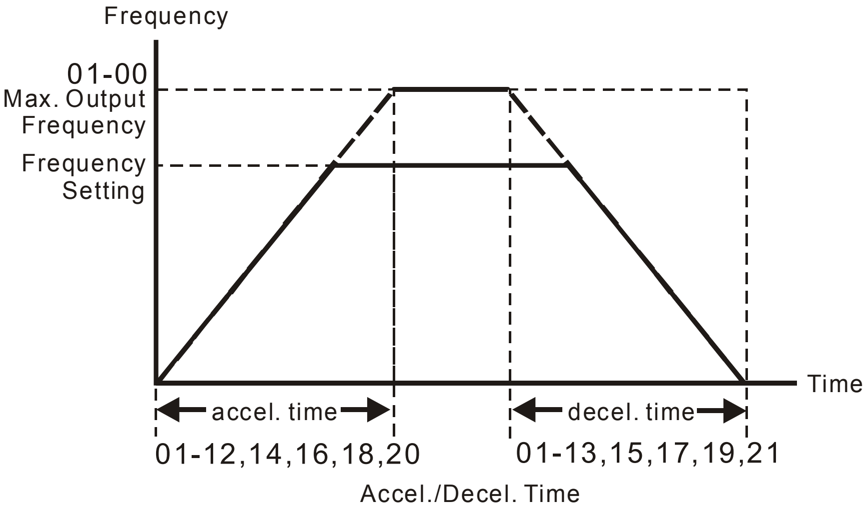
Factory Setting: 10.00/10.0

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

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

Pr.01-45=1: 0.00~6000.00 seconds

- 🕮 The Acceleration Time is used to determine the time required for the AC motor drive to ramp from 0Hz 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.
- 🕮 The Acceleration/Deceleration Time is invalid when using Pr.01-44 Optimal Acceleration/Deceleration Setting.
- 🕮 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.
- 🕮 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.
- 🕮 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.
- 🕮 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.
- 🕮 When enabling Pr.01-24~Pr.01-27, the actual accel./decel. time will be longer than the setting.



01-22 JOG Frequency

Factory Setting: 6.00

Settings 0.00~600.00Hz

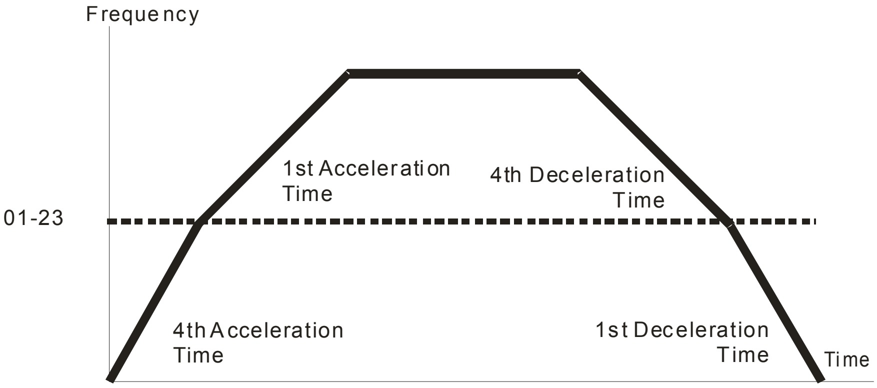
- Both external terminal JOG and key "F1" on the keypad KPC-CC01 can be used. When the jog command is ON, the AC motor drive will accelerate from 0Hz to jog frequency (Pr.01-22). When the jog command is OFF, the AC motor drive will decelerate from Jog Frequency to zero. The Jog Accel./Decel. time (Pr.01-20, 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.

01-23 1st/4th Accel./decel. Frequency

Factory Setting: 0.00

Settings 0.00~600.00Hz

- 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 4th acceleration time is set too short.



1st/4th Acceleration/Deceleration Frequency Switching

01-24 S-curve Acceleration Begin Time 1

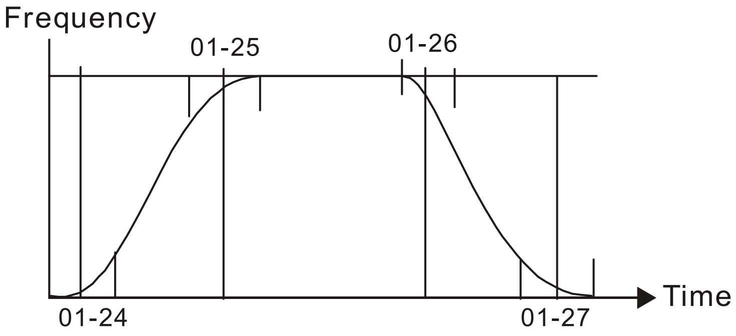
✓	01-25	S-curve Acceleration Arrival Time 2
✓	01-26	S-curve Deceleration Begin Time 1
✓	01-27	S-curve Deceleration Arrival Time 2

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.
- The S-curve function is disabled when accel./decel. time is set to 0.
- When Pr.01-12, 01-14, 01-16, 01-18 ≥ 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)/2
- When Pr.01-13, 01-15, 01-17, 01-19 ≥ 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

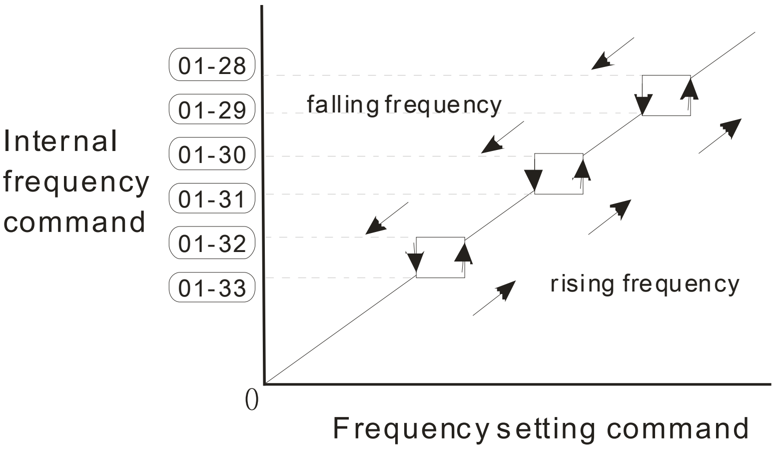


01-28	Skip Frequency 1 (upper limit)
01-29	Skip Frequency 1 (lower limit)
01-30	Skip Frequency 2 (upper limit)
01-31	Skip Frequency 2 (lower limit)
01-32	Skip Frequency 3 (upper limit)
01-33	Skip Frequency 3 (lower limit)

Factory Setting: 0.00

Settings 0.00~600.00Hz

- 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.
- 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.
- 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≥01-29≥01-30≥01-31≥01-32≥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.
- When accelerating/decelerating, the output frequency will still pass the range of skip frequencies.



01-34 Zero-speed Mode

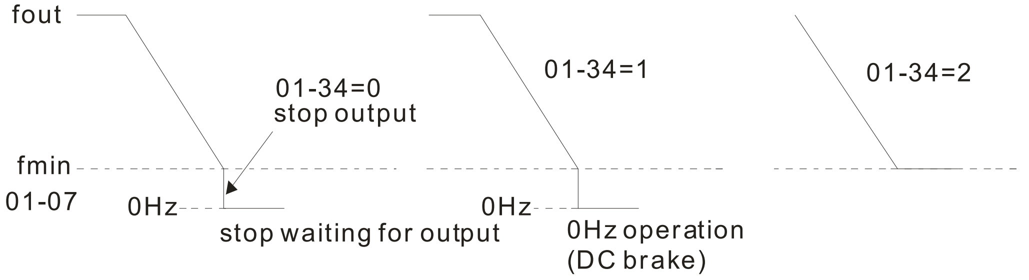
Factory Setting: 0

Settings 0: Output waiting

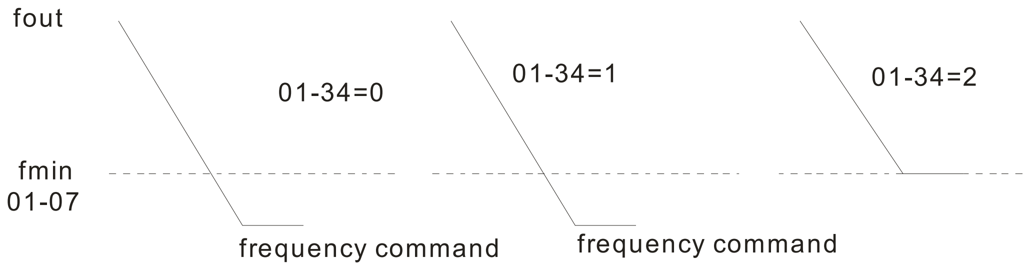
1: Zero-speed operation

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

- 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



- In FOCPG mode, when Pr.01-34 is set to 2, it will act according Pr.01-34 setting.



01-43 V/f Curve Selection

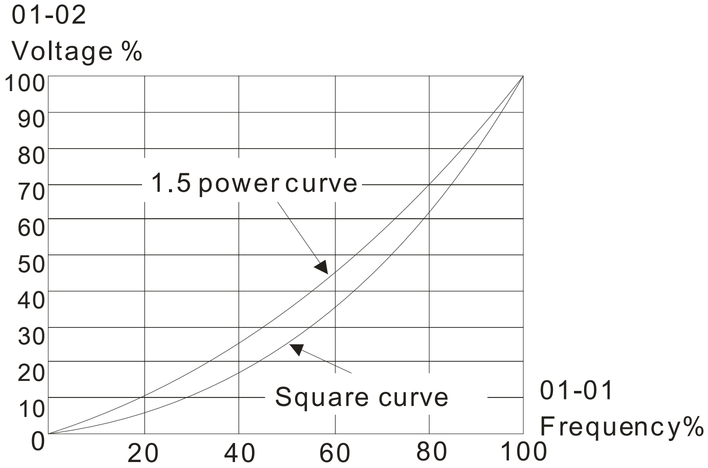
Factory Setting: 0

Settings 0: V/f curve determined by group 01

1: 1.5 power curve

2: Square curve

- 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, 2nd and 3rd voltage frequency setting are invalid.
- 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.

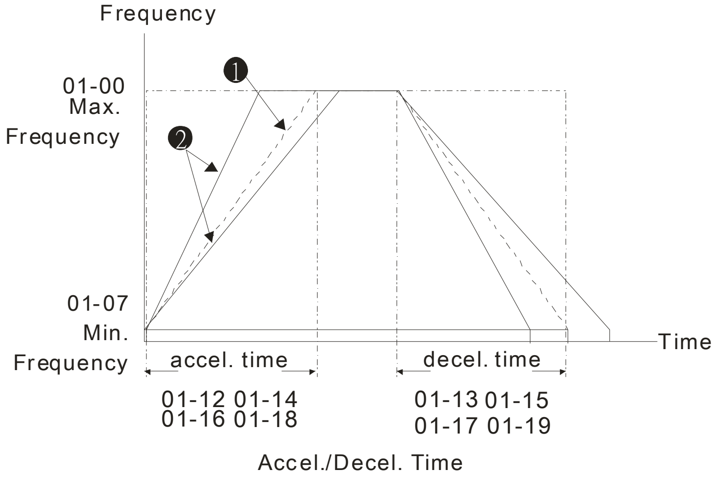


✎ 01-44 Optimal Acceleration/Deceleration Setting

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.



❶ When Pr.01-44 is set to 0.

❷ When Pr.01-44 is set to 3.

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

Factory Setting: 0

Settings 0: Unit 0.01 sec

1: Unit 0.1 sec

01-46 Time for CANopen Quick Stop

Factory Setting: 1.00

Settings Pr. 01-45=0: 0.00~600.00 sec

Pr. 01-45=1: 0.0~6000.0 sec

📖 It is used to set the time that decelerates from the max. operation frequency (Pr.01-00) to 0.00Hz in CANopen control

02 Digital Input/Output Parameter

✎ This parameter can be set during operation.

02-00 2-wire/3-wire Operation Control

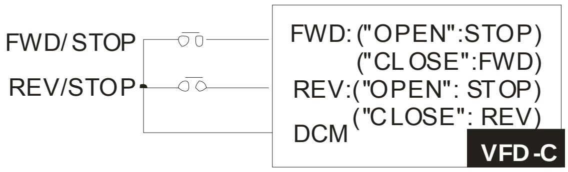
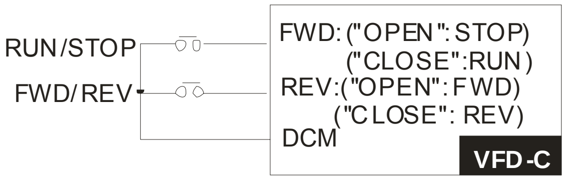
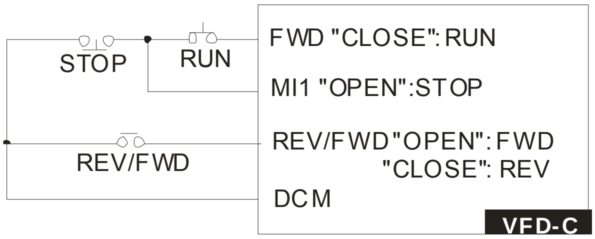
Factory Setting: 0

Settings 0: 2 wire mode 1

1: 2 wire mode 2

2: 3 wire mode

🕮 It is used to set the operation control method:

Pr.02-00	Control Circuits of the External Terminal
0 2-wire mode 1 FWD/STOP REV/STOP	
1 2-wire mode 2 RUN/STOP REV/FWD	
2 3-wire operation control	

02-01 Multi-function Input Command 1 (MI1) (MI1= STOP command when in 3-wire operation control)

Factory Setting: 1

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

Factory Setting: 2

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

Factory Setting: 3

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

Factory Setting: 4

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

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

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

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

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

02-27 Input terminal of I/O extension card (MI11)

02-28 Input terminal of I/O extension card (MI12)

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

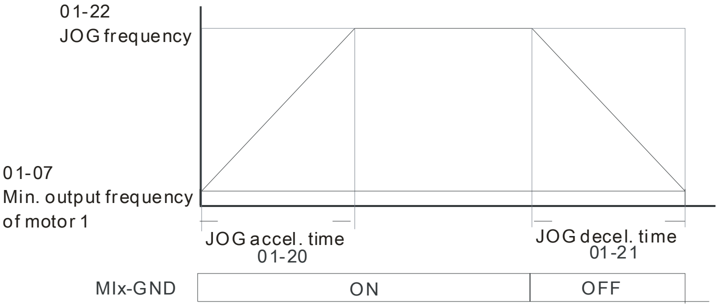
Factory Setting: 0

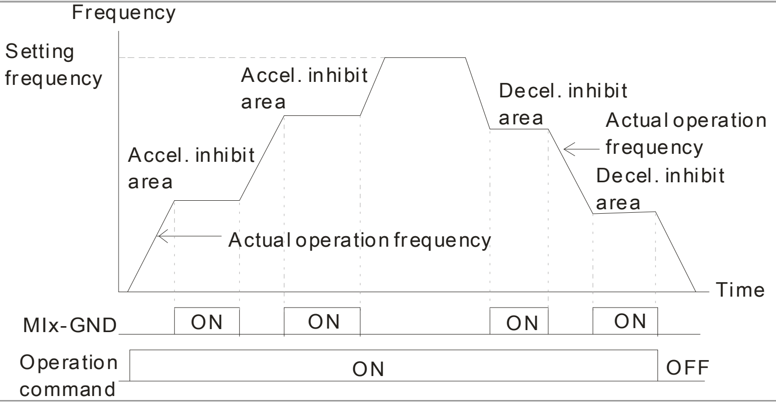
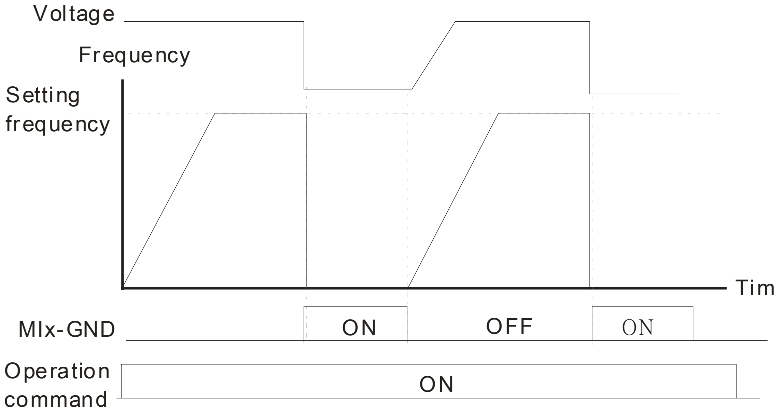
Settings

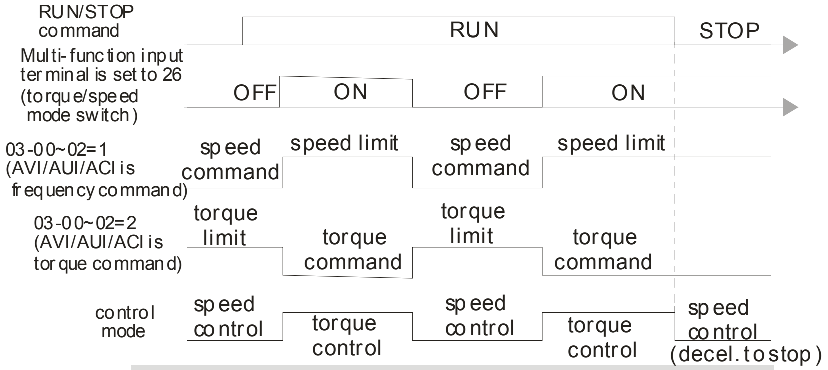
0: no function
1: multi-step speed command 1/multi-step position command 1
2: multi-step speed command 2/multi-step position command 2
3: multi-step speed command 3/multi-step position command 3
4: multi-step speed command 4/multi-step position command 4
5: Reset
6: JOG command（By KPC-CC01 or external control）
7: acceleration/deceleration speed not allow
8: the 1st, 2nd acceleration/deceleration time selection
9: the 3rd, 4th 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 ∆-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

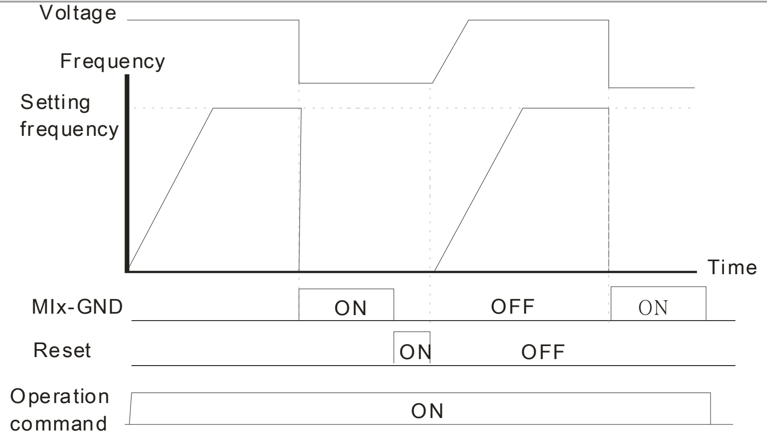
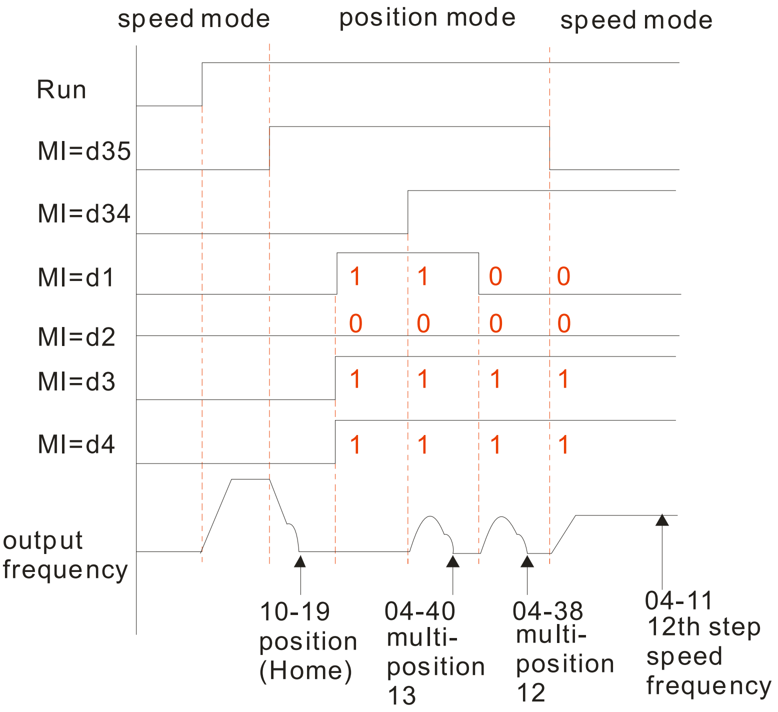
52: Selection for PLC mode bit1
53: Trigger CANopen quick stop
54~55: Reserve
56: Local/Remote Selection
57~70: Reserve

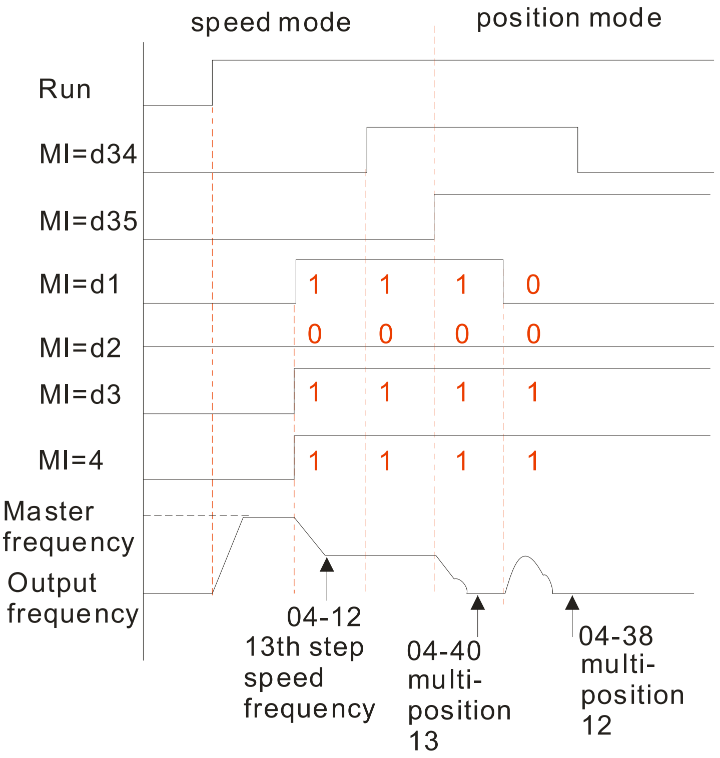
- This parameter selects the functions for each multi-function terminal.
- The terminals of Pr.02-26~Pr.02-29 are virtual and set as MI10~MI13 when using with optional card EMC-D42A. Pr.02-30~02-31 are virtual terminals.
- When being used as a virtual terminal, it needs to change the status (0/1: ON/OFF) 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.
- 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	Multi-step speed command 1/multi-step position command 1	15 step speeds could be conducted through the digital status of the 4 terminals, and 16 in total if the master speed is included. (Refer to Parameter set 4)
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	After the error of the drive is eliminated, use this terminal to reset the drive.
6	JOG Command	This function is valid when the source of operation command is external terminals. Before executing this function, it needs to wait for the drive stop completely. During running, it can change the operation direction and STOP key on the keypad is valid. Once the external terminal receives OFF command, the motor will stop by the JOG deceleration time. Refer to Pr.01-20~01-22 for details. 
7	Acceleration/deceleration Speed Inhibit	When this function is enabled, acceleration and deceleration is stopped. After this function is disabled, the AC motor drive starts to accel./decel. from the inhibit point.

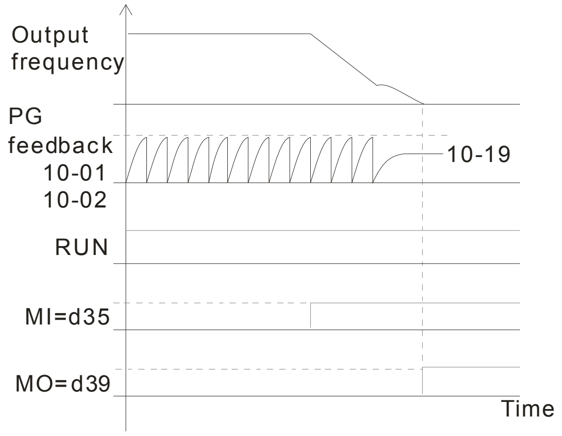
Settings	Functions	Descriptions
		
8	The 1st, 2nd acceleration or deceleration time selection	The acceleration/deceleration time of the drive could be selected from this function or the digital status of the terminals; there are 4 acceleration/deceleration speeds in total for selection.
9	The 3rd, 4th acceleration or deceleration time selection	
10	EF Input (EF: External fault)	For external fault input..Motor drive will decelerate by Pr.07-20 setting, keypad will show EF. (it will have fault record when external fault occurs). Until the causes of fault is eliminated, the drive can keep running after resetting.
11	External B.B. Input (Base Block)	When this contact is ON, output of the drive will be cut off immediately, and the motor will be free run and keypad will display B.B. signal. Refer to Pr.07-08 for details.
12	Output Stop (Output pause)	If this contact is ON, output of the drive will be cut off immediately, and the motor will then be free run. And once it is turned to OFF, the drive will accelerate to the setting frequency. 
13	Cancel the setting of the optimal accel./decel. time	Before using this function, Pr.01-44 should be set to 01/02/03/04 first. When this function is enabled, OFF is for auto mode and ON is for linear accel./decel.
14	Switch between drive settings 1 and 2	When the contact is ON: use motor 2 parameters. OFF: use motor 1 parameters.
15	Operation speed command form AVI	When the contact is ON, the source of the frequency will force to be AVI. (If the operation speed commands are set to AVI, ACI and AUI at the same time. The priority is AVI＞ACI＞AUI)
16	Operation speed command form ACI	When the contact is ON, the source of the frequency will force to be ACI. (If the operation speed commands are set to AVI, ACI and AUI at the same time. The priority is AVI＞ACI＞AUI)
17	Operation speed command form AUI	When this function is enabled, the source of the frequency will force to be AUI. (If the operation speed commands are set to AVI, ACI and AUI at the same time. The priority is AVI＞ACI＞AUI)
18	Emergency Stop (07-20)	When the contact is ON, the drive will ramp to stop by Pr.07-20 setting.

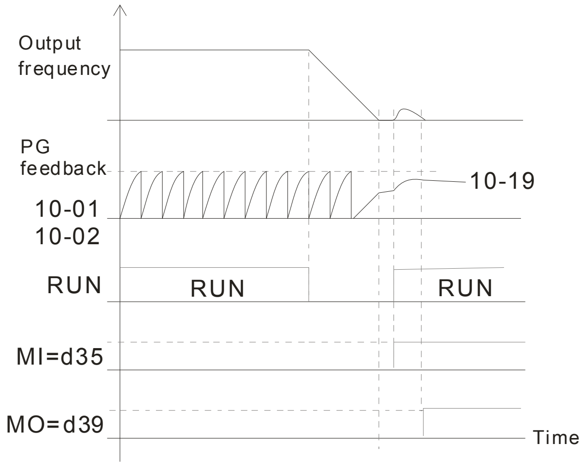
Settings	Functions	Descriptions
19	Digital Up command	When the contact is ON, the frequency will be increased and decreased. If this function is constantly ON, the frequency will be increased/decreased by Pr.02-09/Pr.02-10.
20	Digital Down command	
21	PID function disabled	When the contact is ON, the 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. When the contact is ON, the drive will execute forward Jog command. 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. When the contact is ON the drive will execute reverse Jog command. 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.
26	FOCPG/TQCPG mode selection	When the contact is ON: TQCPG mode. When the contact is OFF: FOCPG mode.  Switch timing for torque/speed control (00-10=0/4, multi-function input terminal 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
		
29	Signal confirmation for Y-connection	When is the contact is ON, the drive will operate by 1st V/f.
30	Signal confirmation for Δ-connection	When the contact is ON, the drive will operate by 2nd V/f.
31	High torque bias	Refer to Pr.11-30~11-32 for details.
32	Middle torque bias	
33	Low torque bias	
34	Switch between multi-step position and multi-speed control	When the contact is ON, the corresponding 15-step speed for the multi-function inputs 1-4 will be 15 positions. (Refer to Pr.04-16 to Pr.04-44) 

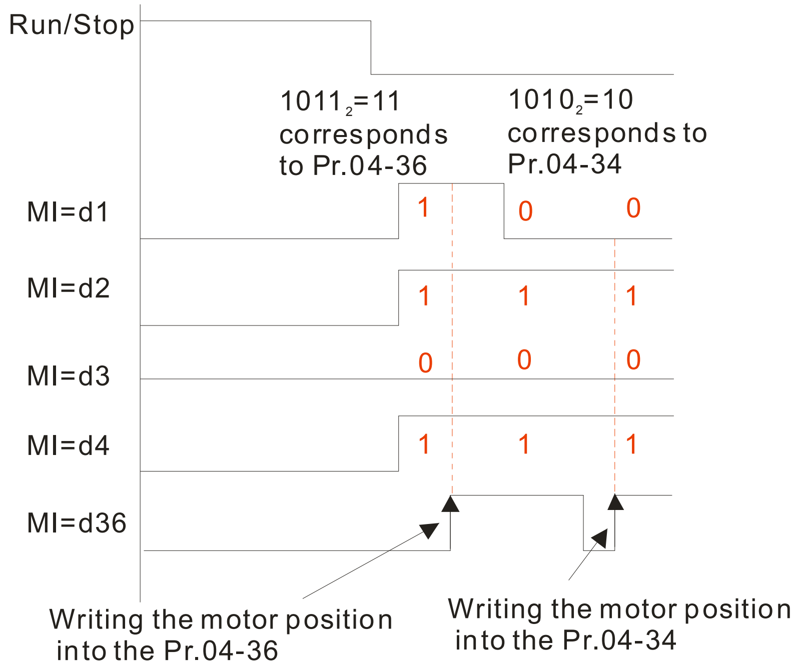
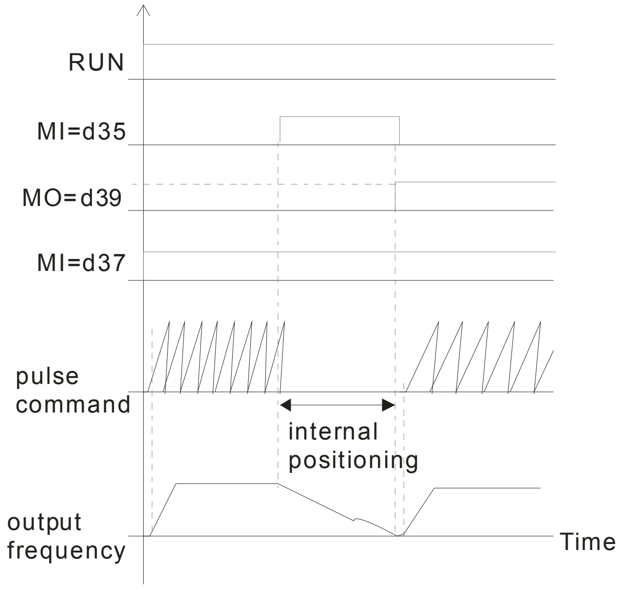
<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td></td><td></td><td>


</td></tr>
<tr><td>35</td><td>Enable single-point position control</td><td>
When the contact is ON, the AC motor drive will execute internal single-point position control according to the setting in Pr.10-19. This function is valid in FOCPG mode only.





</td></tr>
<tr><td>36</td><td>Enable multi-step position learning function</td><td>When the contact is ON/OFF, the drive will base the multi-function inputs 1-4 ON/OFF status to find the corresponding multi-step</td></tr>
</table>

Settings	Functions	Descriptions
	(valid at stop)	positions and write current motor position into such corresponding multi-step position. 
37	Full position control pulse command input enable	When Pr.00-20 is set to 4 or 5 and this contact is ON, the input pulse of PG card is position command. When using this function, it is recommended to set Pr.11-25 to 0. Example: please refer to the following diagram when using this faction with MI=d35 return to home position,. 
38	Disable EEPROM write function (Parameters written disable)	When this contact is ON, write to EEPROM is disabled. (Changed parameters will not be saved after power off)
39	Torque command direction	For torque control (Pr.00-10=2), when torque command is AVI or ACI, the contact is ON and it is negative torque.
40	Force coast to stop	When this contact is ON during the operation, the drive will free run to stop.

<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td>41</td><td>HAND switch</td><td rowspan="2">1. When MI is switched to off status, it executes a STOP command. , If MI is switched to off during operation, the drive will also stop.
2. Using keypad KPC-CC01 to switch between HAND/AUTO, the drive will stop first then switch to the HAND or AUTO status.
3. On the digital keypad KPC-CC01, it will display current drive status (HAND/OFF/AUTO).<table><tr><td></td><td>Bit 1</td><td>Bit 0</td></tr><tr><td>OFF</td><td>0</td><td>0</td></tr><tr><td>AUTO</td><td>0</td><td>1</td></tr><tr><td>HAND</td><td>1</td><td>0</td></tr><tr><td>OFF</td><td>1</td><td>1</td></tr></table></td></tr>
<tr><td>42</td><td>AUTO switch</td></tr>
<tr><td>43</td><td>Enable resolution selection</td><td>Refer to Pr.02-48 for details.</td></tr>
<tr><td>44</td><td>Reverse direction NLhoming</td><td>Signal input for reverse direction limit switch. When this terminal is ON, the drive will react to the setting in Pr.00-40, 00-41, 00-42 accordingly to execute homing in a reverse direction (counter clockwise).
Note: NL means input terminal detection is negative-edge triggered or be regarded as NO(Normal Open)</td></tr>
<tr><td>45</td><td>Forward direction PL homing</td><td>Signal input for forward direction limit switch. When this terminal is ON, the drive will react to the setting in Pr.00-40, 00-41, 00-42 accordingly to execute homing in a forward direction (clockwise).
Note: PL means input terminal detection is postive-edge triggered or be regarded as NC(Normal Close)</td></tr>
<tr><td>46</td><td>Homing ORG</td><td>ORG point input. When this terminal is ON, the drive will refer to the setting in Pr.00-40, 00-41, 00-42 accordingly to execute homing.</td></tr>
<tr><td>47</td><td>Homing function enable</td><td>Pr.00-10 = 3 (homing mode), if the external terminal MIx=47 is OFF, the drive will ignore the home command and execute Point to Point position control.</td></tr>
<tr><td>48</td><td>Mechanical gear ratio switch</td><td>When this contact is ON, the mechanical gear ratio switch will be the second group A2/B2 (refer to Pr.10-08 and Pr.10-09).</td></tr>
<tr><td>49</td><td>Drive enable</td><td>When drive=enable, RUN command is valid.
When drive= disable, RUN command is invalid.
When drive is in operation, motor coast to stop.
This function will interact with MO=51</td></tr>
<tr><td>50</td><td>Master dEb action input</td><td>Input the message setting in this parameter when dEb occurs to Master. This will ensure dEb also occurs to Slave, then Master and Slave will stop simultaneously.</td></tr>
<tr><td>51</td><td>Selection for PLC mode bit0</td><td rowspan="2"><table><tr><td>PLC status</td><td>Bit 1</td><td>Bit 0</td></tr><tr><td>Disable PLC function (PLC 0)</td><td>0</td><td>0</td></tr><tr><td>Trigger PLC to operation (PLC 1)</td><td>0</td><td>1</td></tr><tr><td>Trigger PLC to stop (PLC 2)</td><td>1</td><td>0</td></tr><tr><td>No function</td><td>1</td><td>1</td></tr></table></td></tr>
<tr><td>52</td><td>Selection for PLC mode bit1</td></tr>
<tr><td>53</td><td>Enable CANopen quick stop</td><td>When this function is enabled under CANopen control, it will change to quick stop. Refer to Chapter 15 for more details.</td></tr>
<tr><td>54~55</td><td colspan="2">Reserved</td></tr>
<tr><td>56</td><td>LOCAL/REMOTE Selection</td><td>Use Pr.00-29 to select for LOCAL/REMOTE mode(refer to Pr.00-29)
When Pr.00-29 is not set to 0, on the digital keypad KPC-CC01 it will display LOC/REM status. (It will display on the KPC-CC01 if the firmware version is above version 1.021).</td></tr>
</table>

<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td></td><td></td><td><table><tr><td></td><td>Bit 0</td></tr><tr><td>REM</td><td>0</td></tr><tr><td>LOC</td><td>1</td></tr></table></td></tr>
<tr><td>57~70</td><td colspan="2">Reserved</td></tr>
</table>

✎ 02-09 UP/DOWN Key Mode

Factory Setting: 0

Settings 0: Up/down by the accel/decel time

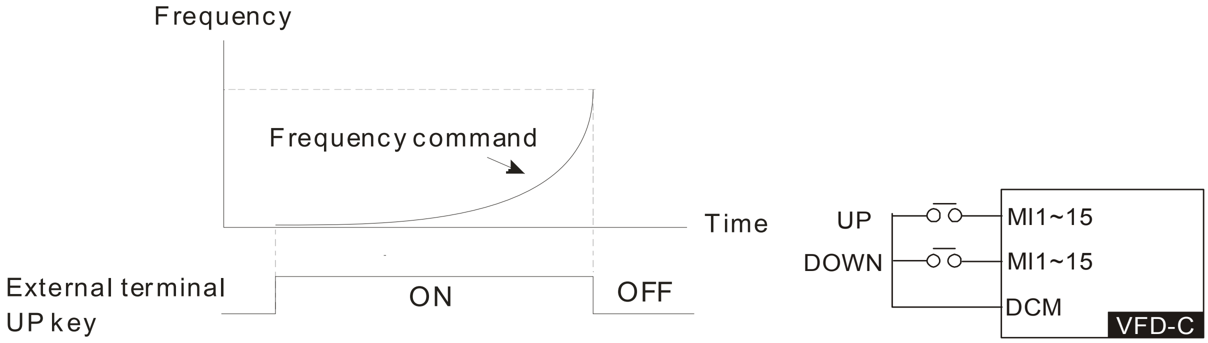
1: Up/down constant speed (Pr.02-10)

✎ 02-10 Constant speed. The Accel. /Decel. Speed of the UP/DOWN Key

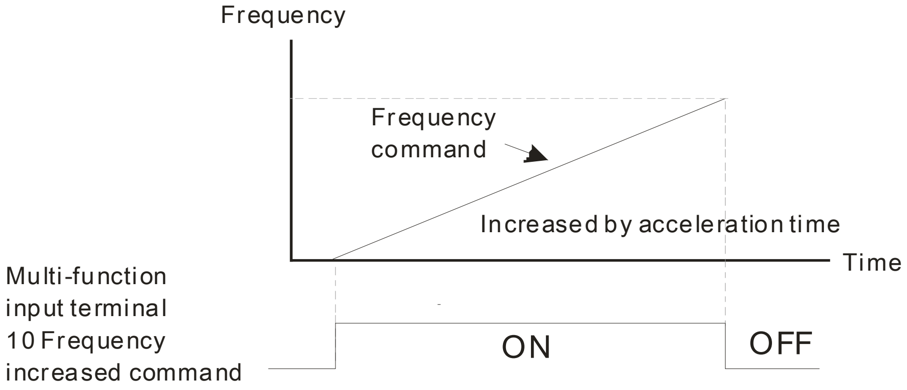
Factory Setting: 0.01

Settings 0.01~1.00Hz/ms

- 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.
- 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.



- 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.



✎ 02-11 Digital Input Response Time

Factory Setting: 0.005

Settings 0.000~30.000 sec

- 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.

- When using MI8 as encoder pulse feedback input, this parameter will not be refered

✓ **02-12** Digital Input Operation Setting

Factory Setting: 0000

Settings 0000h~FFFFh（0:N.O ; 1:N.C）

- The setting of this parameter is in hexadecimal.
- 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..
- Bit0 is for FWD terminal, bit1 is for REV terminal and bit2 to bit15 is for MI1 to MI14.
- 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 + 2nd step speed command=1001(binary)=9 (Decimal). Pr.02-12=9 needs to be set by communication to run forward with 2nd 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	bit0
MI14	MI13	MI12	MI11	MI10	MI9	MI8	MI7	MI6	MI5	MI4	MI3	MI2	MI1	╳	╳

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

Factory Setting: 11

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

Factory Setting: 1

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

✓ **02-17** Multi-function Output 4 (MO2)

✓ **02-36** Output terminal of I/O extension card (MO10) or (RA10)

✓ **02-37** Output terminal of I/O extension card (MO11) or (RA11)

✓ **02-38** Output terminal of I/O extension card (MO12) or (RA12)

✓ **02-39** Output terminal of I/O extension card (MO13) or (RA13)

✓ **02-40** Output terminal of I/O extension card (MO14) or (RA14)

✓ **02-41** Output terminal of I/O extension card (MO15) or (RA15)

✓ **02-42** Output terminal of I/O extension card (MO16)

✓ **02-43** Output terminal of I/O extension card (MO17)

✓ **02-44** Output terminal of I/O extension card (MO18)

✓ **02-45** Output terminal of I/O extension card (MO19)

✓ **02-46** Output terminal of the I/O extension card (MO20)

Factory Setting: 0

Settings

0: No function

1: Operation Indication

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 <= Pr.02-34 (<= 02-34)

31: Y-connection for the motor coil

32: △-connection for the motor coil

33: Zero speed (actual output frequency)

34: Zero speed include stop(actual output frequency)

35: Error output selection 1(Pr.06-23)

36: Error output selection 2(Pr.06-24)

37: Error output selection 3(Pr.06-25)

38: Error output selection 4(Pr.06-26)

39: Position attained (Pr.10-19)

40: Speed attained (including Stop)

41: Multi-position attained

42: Crane function

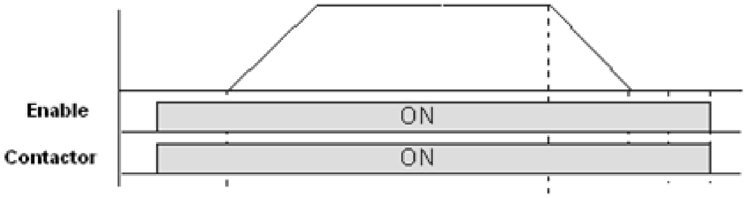
43: Actual motor speed slower than Pr.02-47

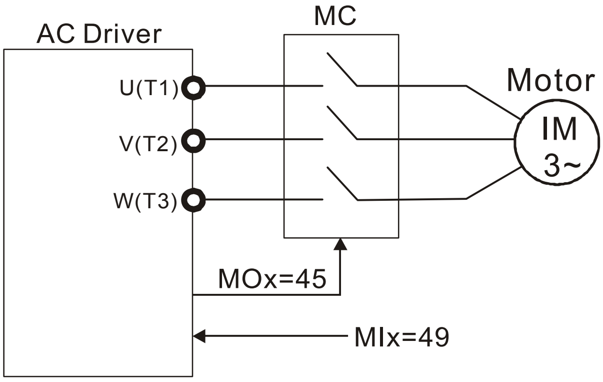
44: Low current output (Pr.06-71 to Pr.06-73)
45: UVW Output Electromagnetic valve On/Off Switch
46: Master dEb action output
47: Closed brake output
48: Reserved
49: Homing action complete
50: Output for CANopen control
51: Output for communication card
52: Output for RS485
53~62: Reserved

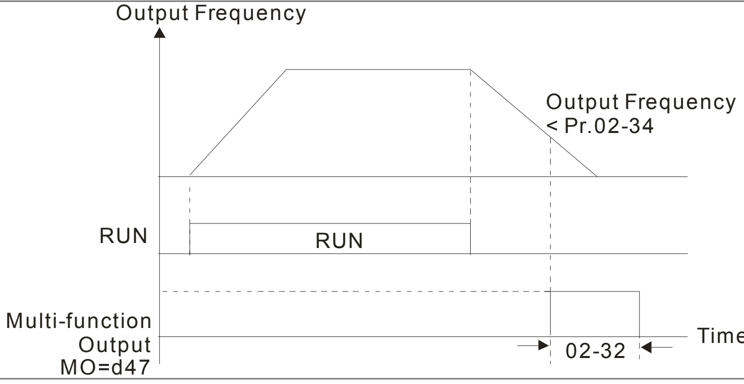
- This parameter is used for setting the function of multi-function terminals.
- Pr.02-36~Pr.02-41 requires additional extension cards to display the parameters, the choices of optional cards are EMC-D42A and EMC-R6AA.
- The optional card EMC-D42A provides 2 output terminals and can be used with Pr.02-36~02-37.
- The optional card EMC-R6AA provides 6 output terminals and can be used with Pr.02-36~02-41.
- 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 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 (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

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

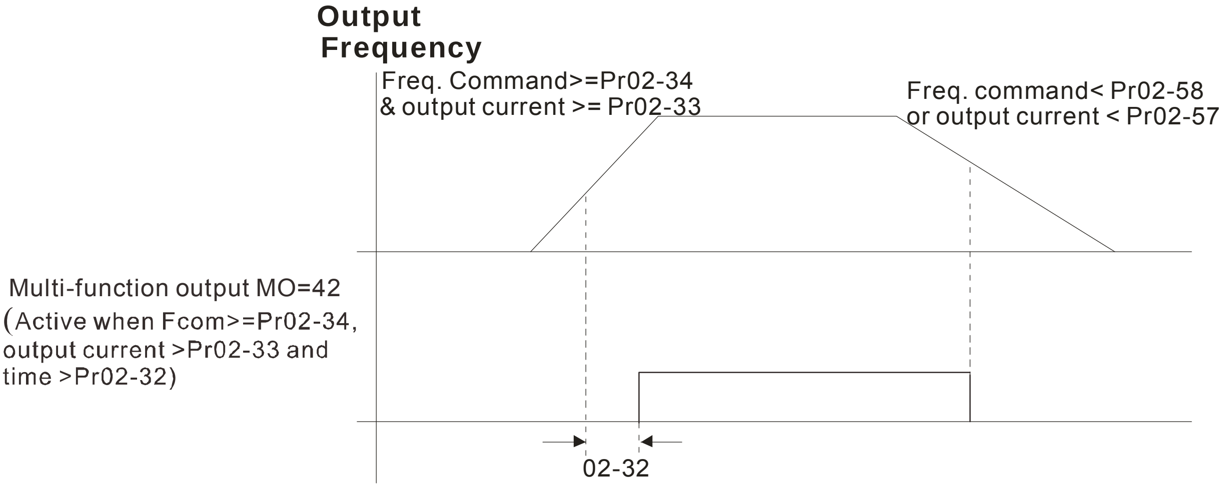
<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><td>Pr.04-26</td><td>0</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td>Pr.04-28</td><td>0</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Pr.04-30</td><td>1</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Pr.04-32</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pr.04-34</td><td>1</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td>Pr.04-36</td><td>1</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>Pr.04-38</td><td>1</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>Pr.04-40</td><td>1</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>Pr.04-42</td><td>1</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td>Pr.04-44</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
</table>
</td></tr>
<tr><td>42</td><td>Crane Function</td><td>This function should be used with Pr.02-32, Pr.02-33, Pr.02-34, Pr.02-57 and Pr.02-58.
Active when setting Pr.07-16=Pr.02-34 and Fcmd > Pr.02-34 and output current > Pr.02-33 and Time > Pr.02-32.
The example of the crane application is in the following for your reference.</td></tr>
<tr><td>43</td><td>Motor Zero-speed Output (Pr.02-47)</td><td>Active when motor actual speed is less than Pr.02-47.</td></tr>
<tr><td>44</td><td>Low Current Output</td><td>This function needs to be used with Pr.06-71 ~ Pr.06-73</td></tr>
<tr><td>45</td><td>UVW Phase Magnet Contractor ON/ OFF Switch</td><td>1. Under FOCPG control mode, set MI=49 (drive enable) and MO=45 (electromagnetic contractor On/Off switch), then the magnetic contactor will follow the drive status to be On or Off.
2. For brake control, set MO=12 (mechanical brake release), Pr.02-31=T1 sec (mechanical brake delay time); then enable/disable DC braking by set 07-01 (DC brake current) to any level except 0 and set Pr.07-02 = T2 (DC brake time at start up) and Pr.07-03 = T2 (DC brake current at stop). It is recommend to set T2 >T1 and try to activate brake control during zero-speed status.



 </td></tr>
<tr><td>46</td><td>Master dEb signal output</td><td>When dEb arise at Master, MO will send a dEb signal to Slave. Then Slave will follow Master’s command and decelerate to stop simultaneously.</td></tr>
<tr><td>47</td><td>Brake Release at Stop</td><td>When drive stops, the corresponding multi-function terminal will be ON if the frequency is less than Pr.02-34. After it is ON, it will be OFF when brake delay time exceeds Pr.02-32.</td></tr>
</table>

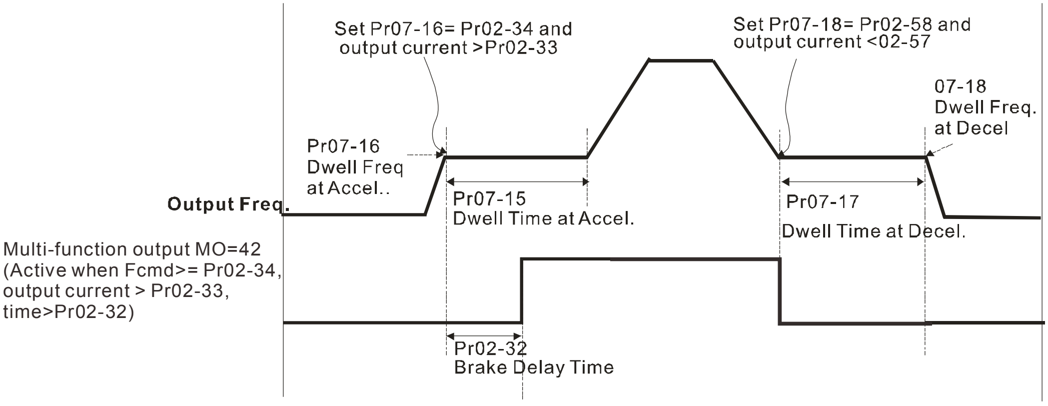
<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td></td><td></td><td>
</td></tr>
<tr><td>48</td><td colspan="2">Reserved</td></tr>
<tr><td>49</td><td>Homing Action Complete</td><td>Output when homing action complete.</td></tr>
<tr><td>50</td><td>Output for CANopen control</td><td>Controlled by CANopen multi-output terminal
For example, if to control RY2, then the Pr02-14 = 50.
The mapping table of the CANopen DO is below:
<table>
<tr><th>physical terminal</th><th>Setting of related parameters</th><th>Attribute</th><th>Corresponding Index</th></tr>
<tr><td>RY1</td><td>P2-13 = 50</td><td>RW</td><td>The bit 0 at 2026-41</td></tr>
<tr><td>RY2</td><td>P2-14 = 50</td><td>RW</td><td>The bit 1 at 2026-41</td></tr>
<tr><td>MO1</td><td>P2-16 = 50</td><td>RW</td><td>The bit 2 at 2026-41</td></tr>
<tr><td>MO2</td><td>P2-17 = 50</td><td>RW</td><td>The bit 3 at 2026-41</td></tr>
<tr><td>MO10</td><td rowspan="2">P2-36=50</td><td rowspan="2">RW</td><td>The bit 4 at 2026-41</td></tr>
<tr><td>RY10</td><td>The bit 5 at 2026-41</td></tr>
<tr><td>MO11</td><td rowspan="2">P2-37 = 50</td><td rowspan="2">RW</td><td>The bit 6 at 2026-41</td></tr>
<tr><td>RY11</td><td>The bit 7 at 2026-41</td></tr>
<tr><td>RY12</td><td>P2-38 = 50</td><td>RW</td><td>The bit 8 at 2026-41</td></tr>
<tr><td>RY13</td><td>P2-39 = 50</td><td>RW</td><td>The bit 9 at 2026-41</td></tr>
<tr><td>RY14</td><td>P2-40 = 50</td><td>RW</td><td>The bit 10 at 2026-41</td></tr>
<tr><td>RY15</td><td>P2-41= 50</td><td>RW</td><td>The bit 0 at 2026-41</td></tr>
</table>
Refer to Chapter 15-3-5 for more information</td></tr>
<tr><td>51</td><td>Output for communication card</td><td>For communication output of communication cards (CMC-MOD01, CMC-EIP01, CMC-PN01 and CMC-DN01)
<table>
<tr><th>physical terminal</th><th>Setting of related parameters</th><th>Attribute</th><th>Corresponding Address</th></tr>
<tr><td>RY1</td><td>P2-13 = 51</td><td>RW</td><td>The bit 0 2640</td></tr>
<tr><td>RY2</td><td>P2-14 = 51</td><td>RW</td><td>The bit 1 2640</td></tr>
<tr><td></td><td>P2-15 = 51</td><td>RW</td><td>The bit 2 2640</td></tr>
<tr><td>MO1</td><td>P2-16 = 51</td><td>RW</td><td>The bit 3 2640</td></tr>
<tr><td>MO2</td><td>P2-17 = 51</td><td>RW</td><td>The bit 4 2640</td></tr>
<tr><td>MO3</td><td>P2-18 = 51</td><td>RW</td><td>The bit 5 2640</td></tr>
<tr><td>MO4</td><td>P2-19 = 51</td><td>RW</td><td>The bit 6 2640</td></tr>
<tr><td>MO5</td><td>P2-20 = 51</td><td>RW</td><td>The bit 7 2640</td></tr>
</table></td></tr>
</table>

Settings	Functions	Descriptions			
		MO6	P2-21 = 51	RW	The bit 8 2640
		MO7	P2-22 = 51	RW	The bit 9 2640
		MO8	P2-23 = 51	RW	The bit 10 2640
52	Output for RS-485	For RS-485 output			
53~62	Reserved				

Example: Crane Application



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



02 - 18 Multi-function Output Setting

Factory Setting: 0000

Settings 0000h~FFFFh（0:N.O. ; 1:N.C.）

- 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 Pr02-13=1 and Pr02-18=0, Relay 1 is ON when the drive runs and is open when the drive is stopped.

  If Pr02-13=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
MO20	MO19	MO18	MO17	MO16	MO15	MO14	MO13	MO12	MO11	MO10	MO2	MO1	Reserved	RY2	RY1

✎ 02-19 Terminal Counting Value Attained (return to 0)

Factory Setting: 0

Settings 0~65535

🕮 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.

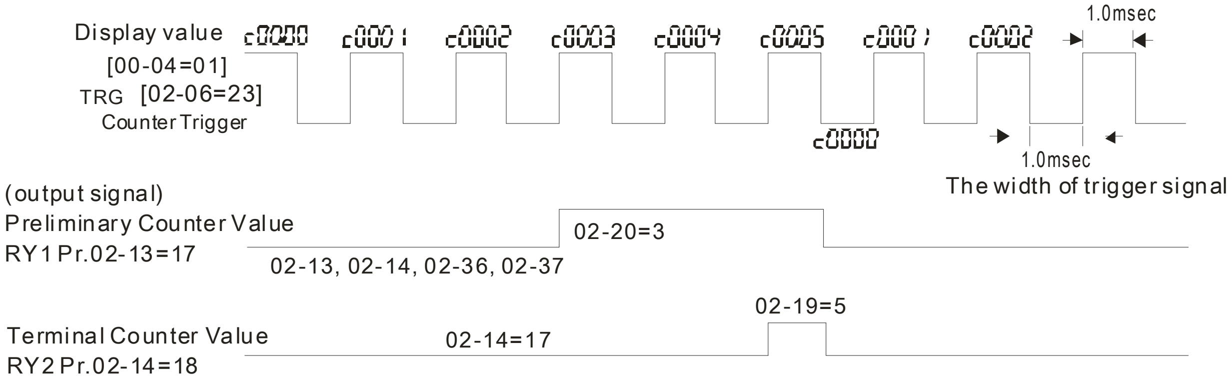
🕮 When the display shows c5555, the drive has counted 5,555 times. If display shows c5555•, it means that real counter value is between 55,550 to 55,559.

✎ 02-20 Preliminary Counting Value Attained (not return to 0)

Factory Setting: 0

Settings 0~65535

🕮 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.



✎ 02-21 Digital Output Gain（DFM）

Factory Setting: 1

Settings 1~166

🕮 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.

✎ 02-22 Desired Frequency Attained 1

Factory Setting: 60.00/50.00

Settings 0.00~600.00Hz

✎ 02-23 The Width of the Desired Frequency Attained 1

Factory Setting: 2.00

Settings 0.00~600.00Hz

✎ 02-24 Desired Frequency Attained 2

Factory Setting: 60.00/50.00

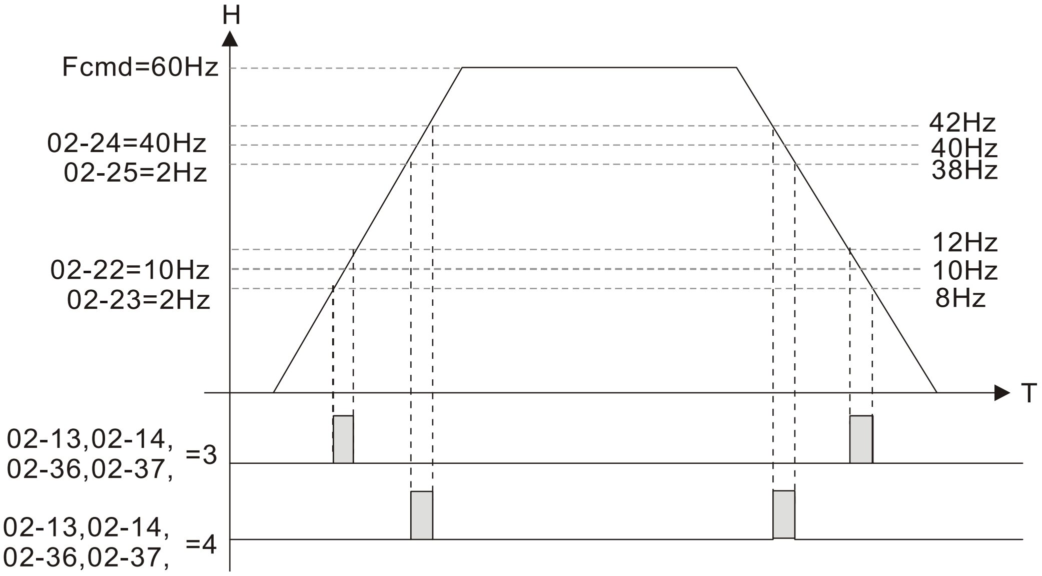
Settings 0.00~600.00Hz

✓ 02-25 The Width of the Desired Frequency Attained 2

Factory Setting: 2.00

Settings 0.00~600.00Hz

📖 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.

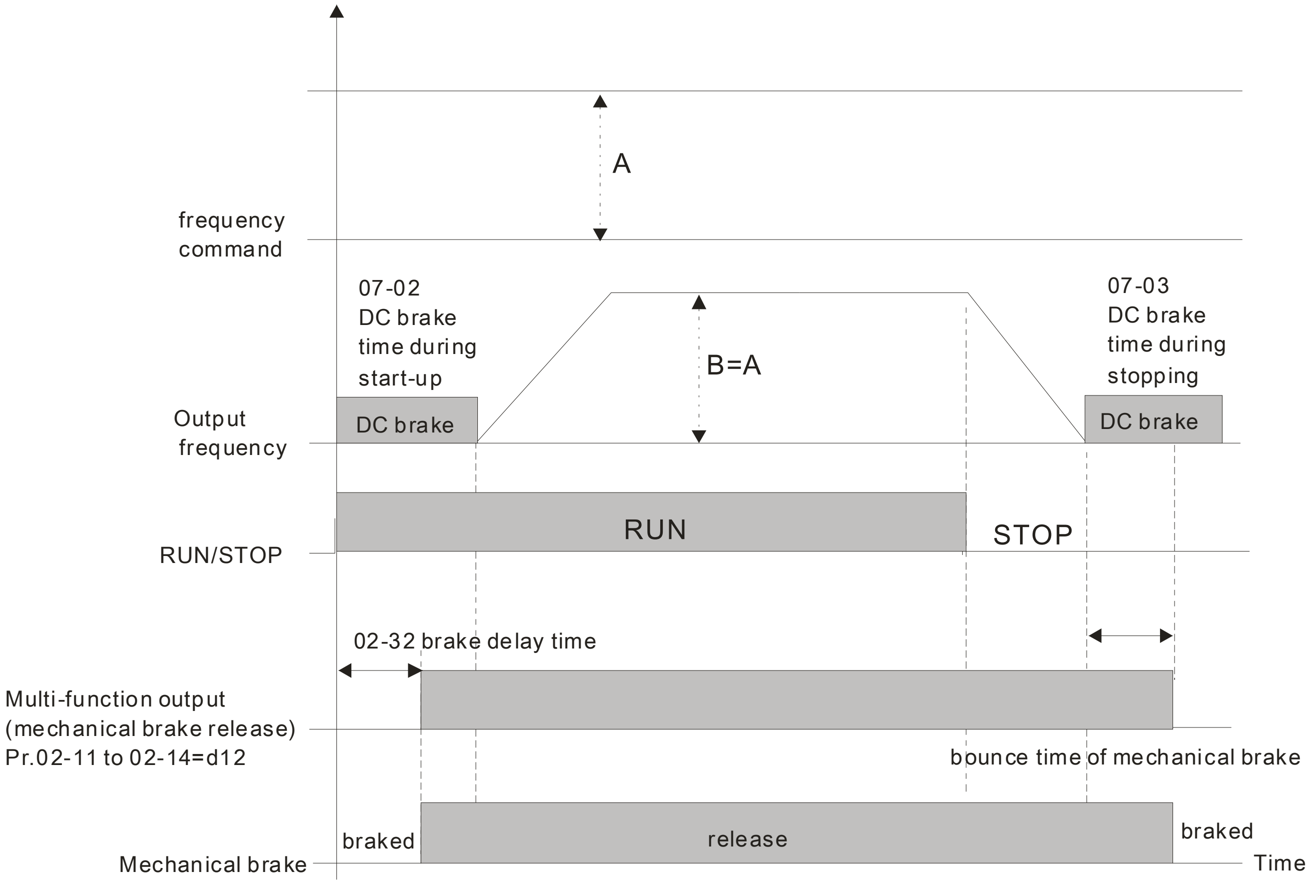


02-32 Brake Delay Time

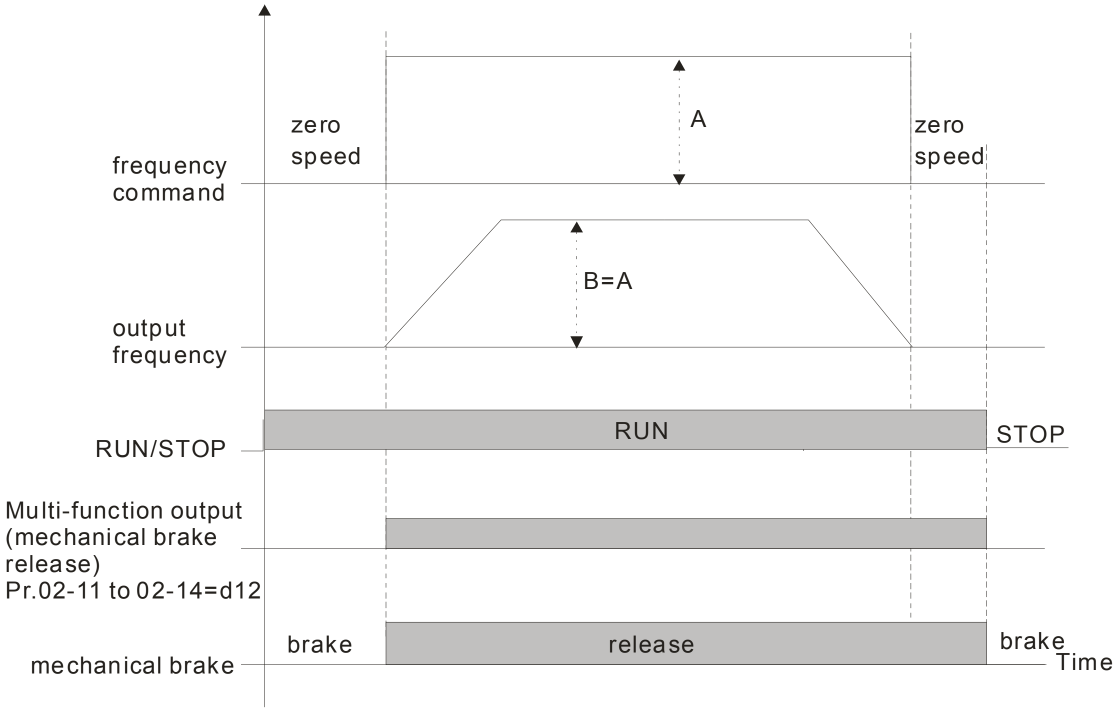
Factory Setting: 0.000

Settings 0.000~65.000 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.



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



✔ 02-33 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).

📖 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).

✎ 02-34 Output Boundary for Multi-function Output Terminals

Factory Setting: 3.00

Settings 0.00~600.00Hz

🕮 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).

✎ 02-35 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.

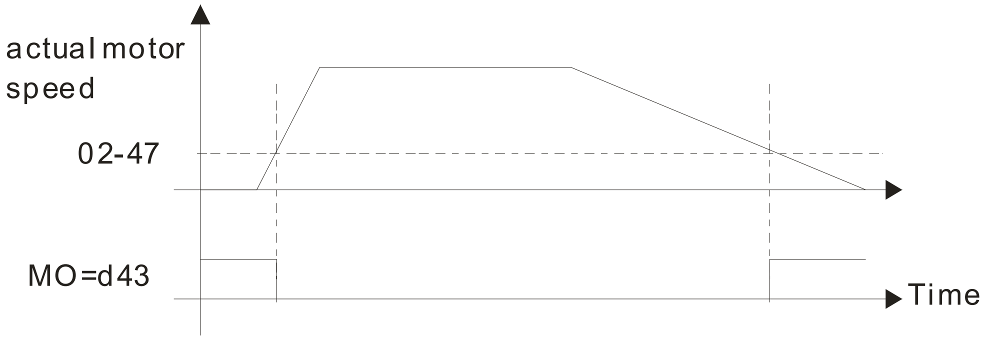
✎ 02-47 Zero-speed Level of Motor

Factory Setting: 0

Settings 0~65535 rpm

🕮 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.

🕮 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.



✎ 02-48 Max. Frequency of Resolution Switch

Factory Setting: 60.00

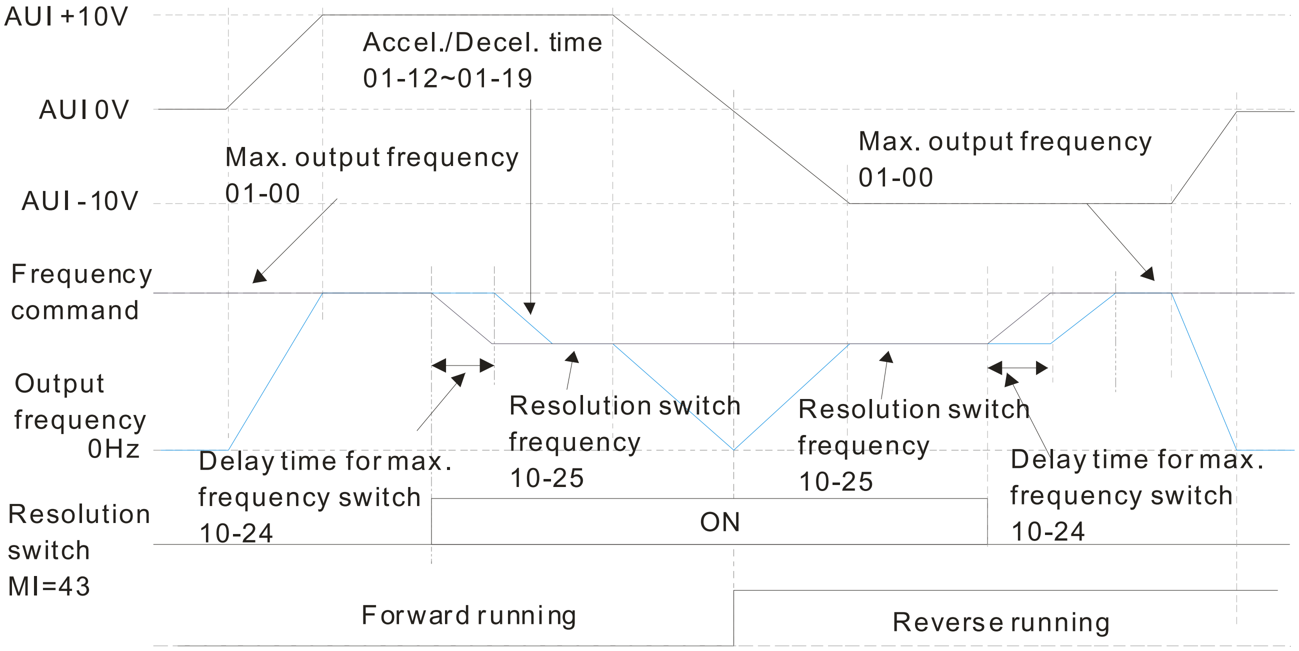
Settings 0.01~600.00Hz

✎ 02-49 Switch the delay time of Max. output frequency

Factory Setting: 0.000

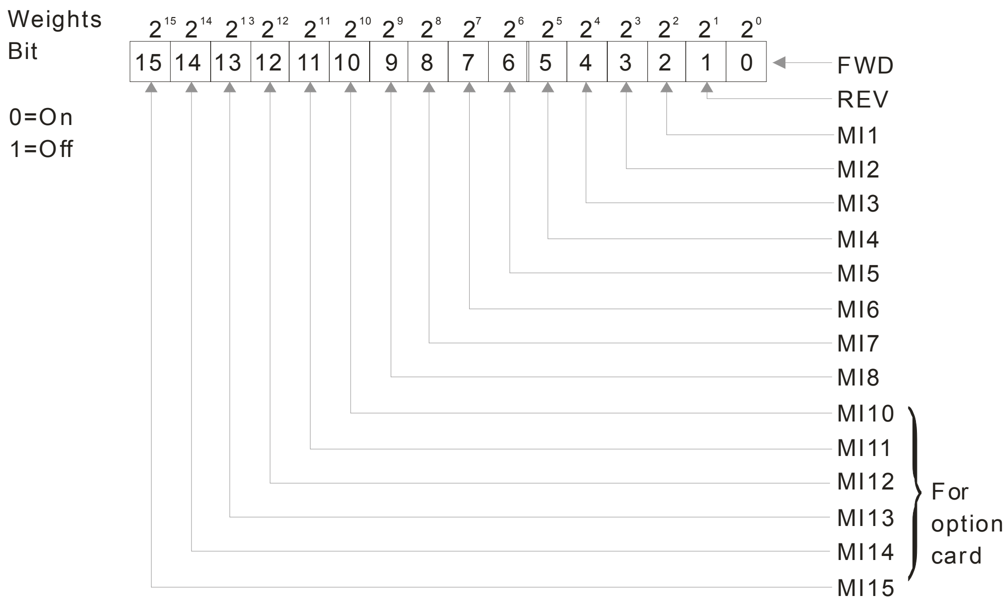
Settings 0.000~65.000 sec

🕮 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.



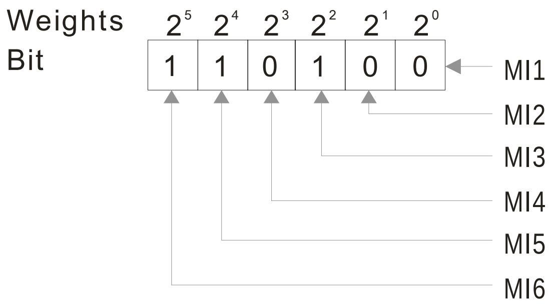
02-50 Display the Status of Multi-function Input Terminal

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.



0=ON
1=OFF

Settings
$= bit5x2^5+bit4x2^4+bit2x2^2$
$= 1x2^5+1x2^4+1x2^2$
$=32+16+4 =52$

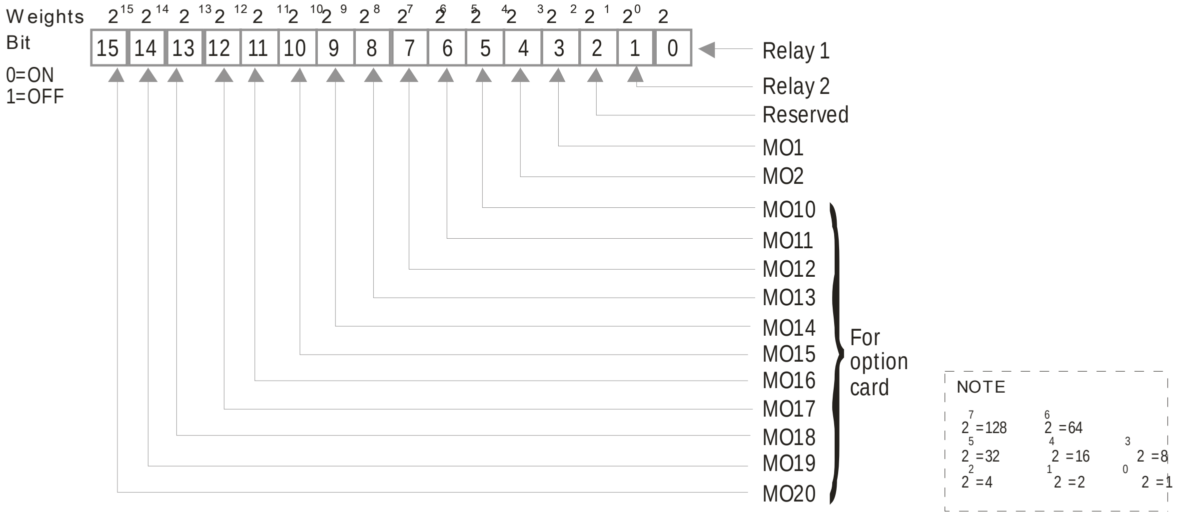
NOTE
$2^5=32$ $2^4=16$ $2^3=8$ $2^2=4$
$2^1=2$ $2^0=1$

02-51 Status of Multi-function Output Terminal

Factory Setting: Read only

📖 For Example:

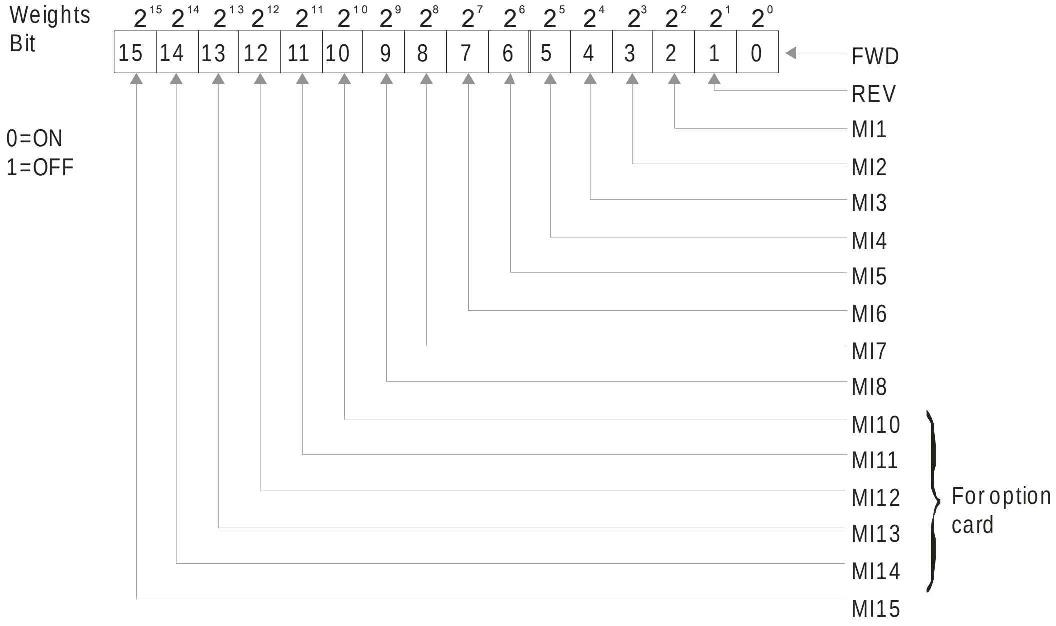
If Pr.02-51 displays 000Bh (Hex), i.e. the value is 11, and 1011 (binary). It means RY1, RY2 and MO1 are ON.



02-52 Display External Output terminal occupied by PLC

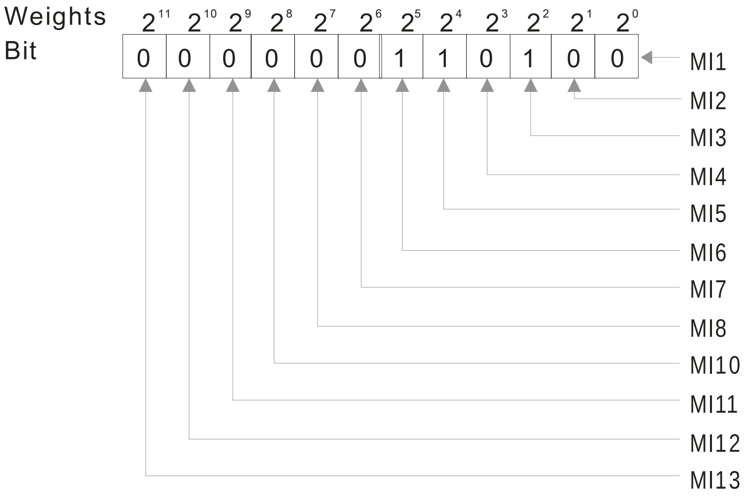
Factory Setting: Read only

📖 P.02-52 shows the external multi-function input terminal that used by PLC.



📖 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

$= bit5x2^{5}+bit4x2^{4}+bit2x2^{2}$

$= 1x2^{5}+1x2^{4}+1x2^{2}$

$=32+16+4 =52$

NOTE

$2^{14}=16384$ $2^{13}=8192$ $2^{12}=4096$

$2^{11}=2048$ $2^{10}=1024$ $2^{9}=512$

$2^{8}=256$ $2^{7}=128$ $2^{6}=64$

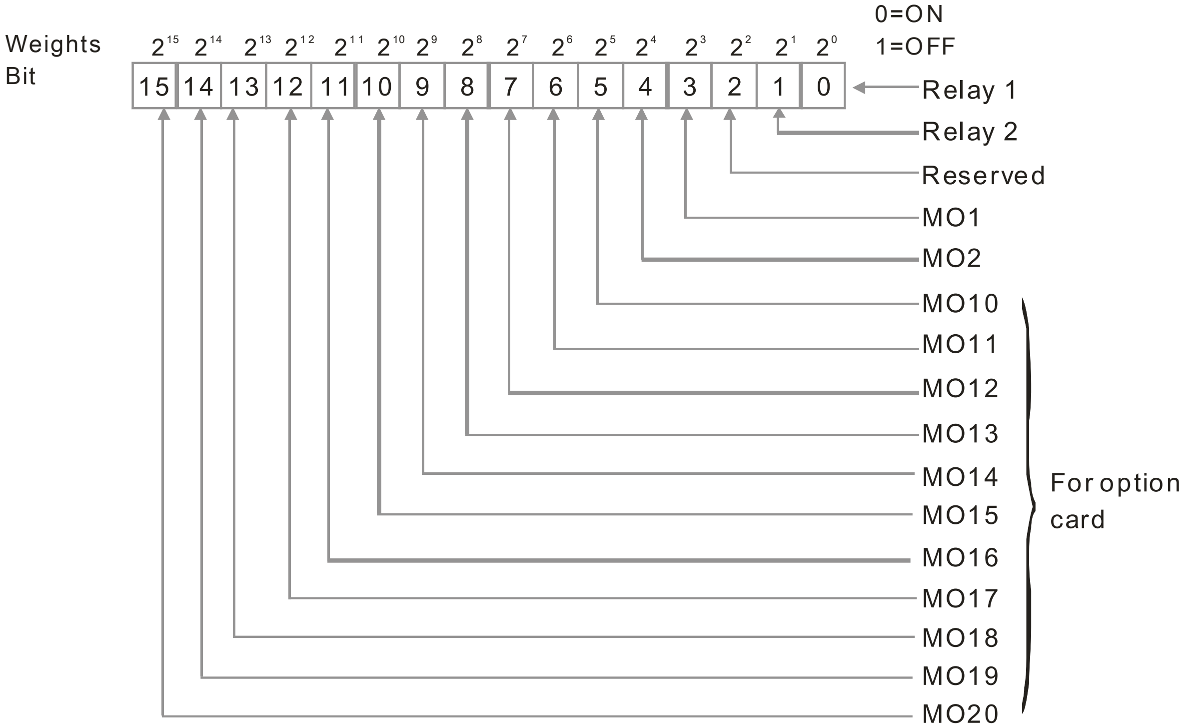
$2^{5}=32$ $2^{4}=16$ $2^{3}=8$ $2^{2}=4$

$2^{1}=2$ $2^{0}=1$

02-53 Display Multi-function Output Terminal occupied by PLC

Factory Setting: Read only

📖 P.02-53 shows the external multi-function output terminal that used by PLC.



NOTE

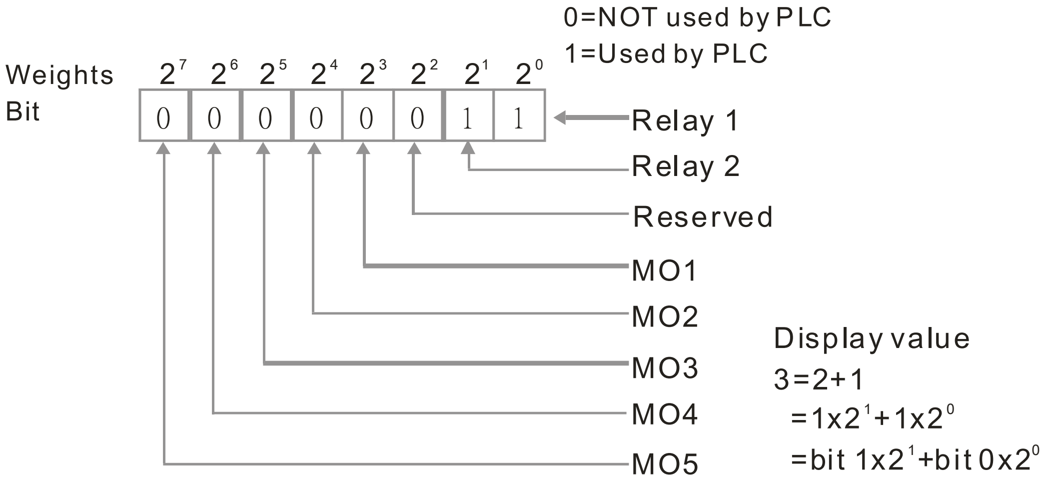
$2^{7}=128$ $2^{6}=64$

$2^{5}=32$ $2=16$ $2^{3}=8$

$2^{2}=4$ $2^{1}=2$ $2^{0}=1$

📖 For Example:

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



02-54 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.

02-55 Reserved

02-56 Reserved

✎ 02-57 Multi-function output terminal: Function 42: Brake Current Checking Point

Factory setting: 0

Settings 0~150%

✎ 02-58 Multi-function output terminal: Function 42: Brake Frequency Checking Point

Factory setting：0.00

Settings 0.00~655.35Hz

- 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)
- 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.
- 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 Pr02-58(<02-58), disable the setting of #42 of the multi-functional output Pr02-13, Pr02-14, Pr02-16, Pr02-17.

03 Analog Input/Output Parameter

ϰ This parameter can be set during operation.

ϰ **03-00** Analog Input Selection (AVI)

Factory Setting: 1

ϰ **03-01** Analog Input Selection (ACI)

Factory Setting: 0

ϰ **03-02** 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

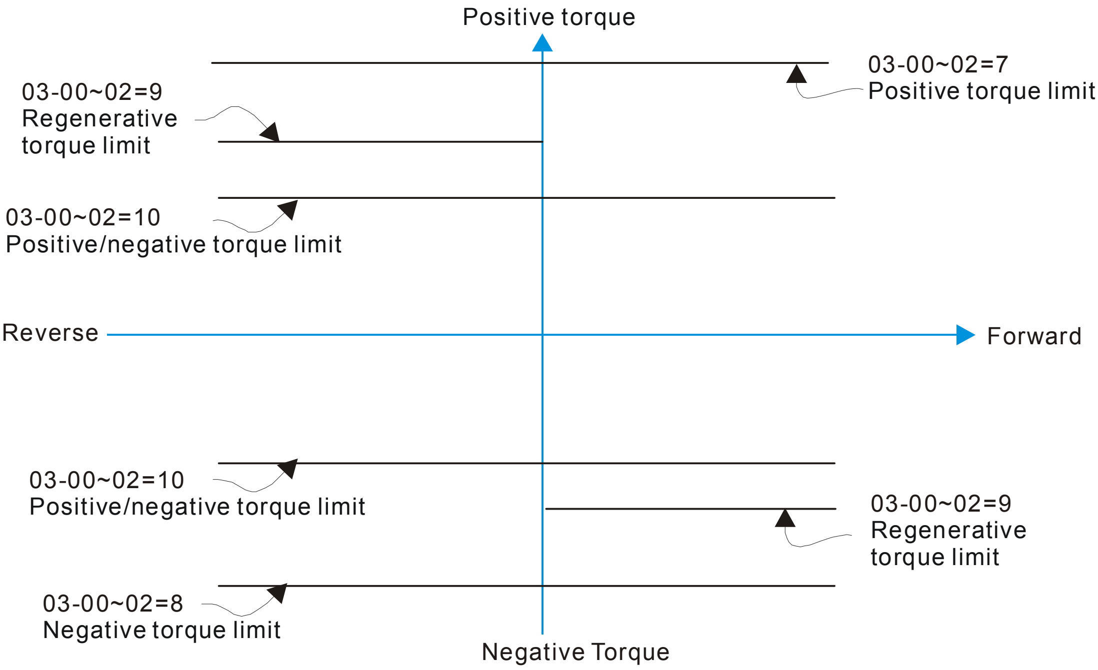
🕮 When use analog input as PID reference value, Pr00-20 must set 2(analog input).
Setting method 1: Pr03-00~03-02 set 1 as PID reference input
Setting method 2: Pr03-00~03-02 set 4 as PID reference input
If the setting value 1 and set value 4 existed at the same time, AVI input has highest priority to 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~±10V/4~20mA is 0 – max. output frequency(Pr.01-00)

🕮 When it is torque command or torque limit, the corresponding value for 0~±10V/4~20mA is 0 – max. output torque (Pr.11-27).

🕮 When it is torque compensation, the corresponding value for 0~±10V/4~20mA is 0 – rated torque.



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

ϟ **03-03** Analog Input Bias (AVI)

Factory Setting: 0

Settings -100.0~100.0%

📖 It is used to set the corresponding AVI voltage of the external analog input 0.

ϟ **03-04** Analog Input Bias (ACI)

Factory Setting: 0

Settings -100.0~100.0%

📖 It is used to set the corresponding ACI voltage of the external analog input 0.

ϟ **03-05** Analog Voltage Input Bias (AUI)

Factory Setting: 0

Settings -100.0~100.0%

📖 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 (4-20mA) corresponds to 0-60Hz.

ϟ **03-06** Reserved

ϟ **03-07** Positive/negative Bias Mode (AVI)

ϟ **03-08** Positive/negative Bias Mode (ACI)

ϟ **03-09** Positive/negative Bias Mode (AUI)

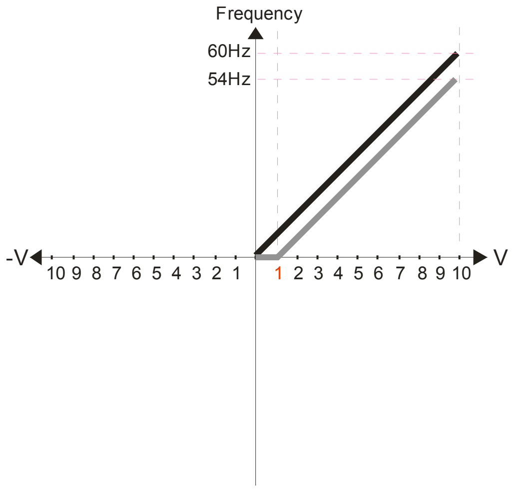
Factory Setting: 0

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

4: Serve bias 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

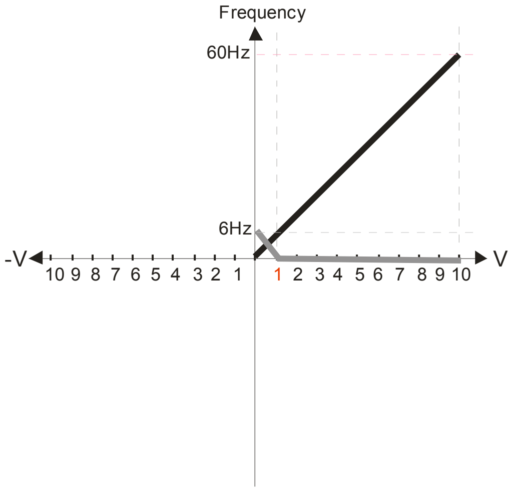


Pr.03-03=10%

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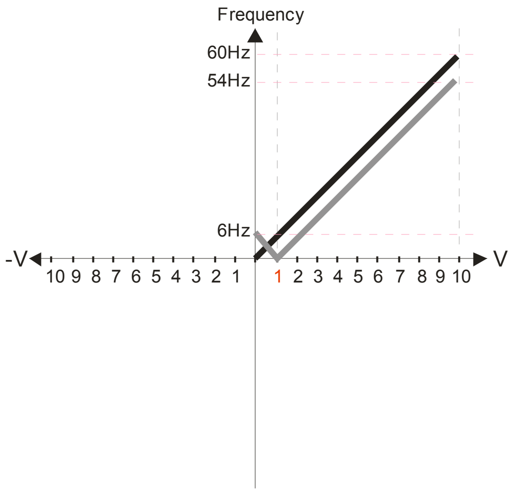
Pr.03-11Analog Input Gain (AVI)=100%

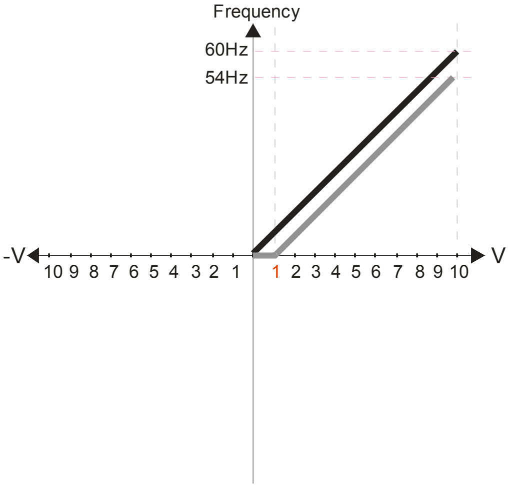


Pr.03-03=10%

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%

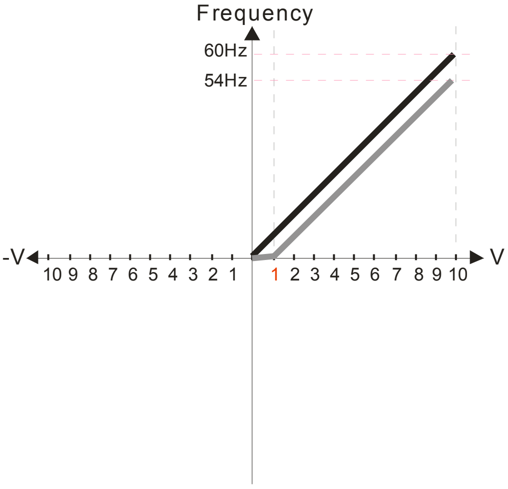
Pr.03-07~03-09 (Positive/Negative Bias Mode)

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 (AVI) = 100%



Pr.03-03=10%

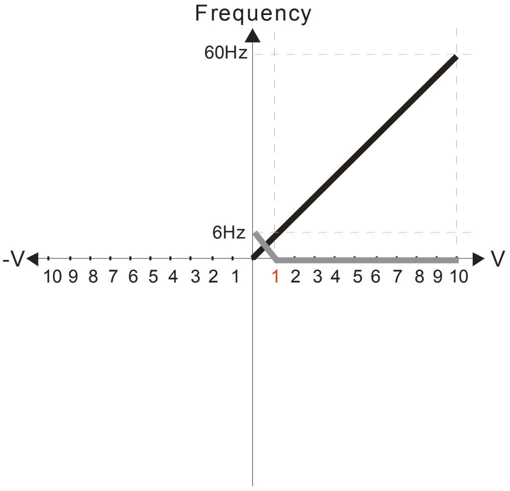
Pr.03-07~03-09 (Positive/Negative Bias Mode)

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%

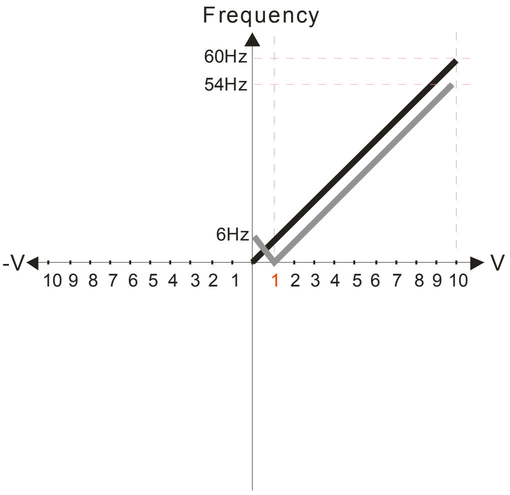
Pr.03-07~03-09 (Positive/Negative Bias Mode)

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



Pr.03-03=10%

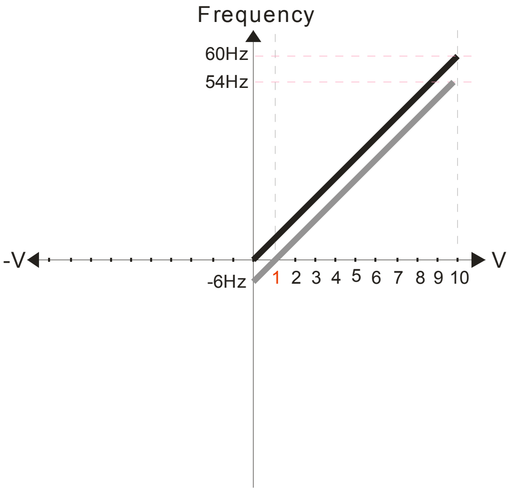
Pr.03-07~03-09 (Positive/Negative Bias Mode)

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%

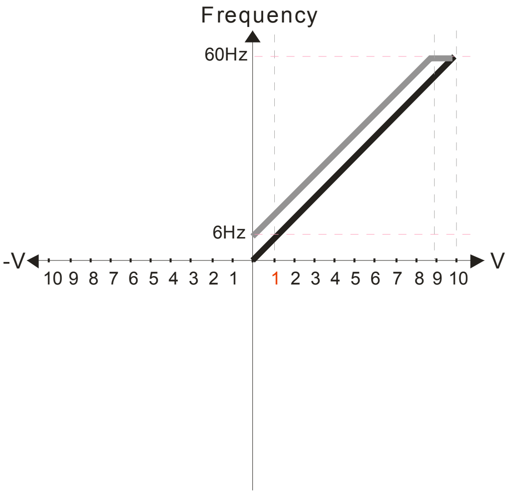
Pr.03-07~03-09 (Positive/Negative Bias Mode)

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 (AVI) = 100%



Pr.03-03=-10%

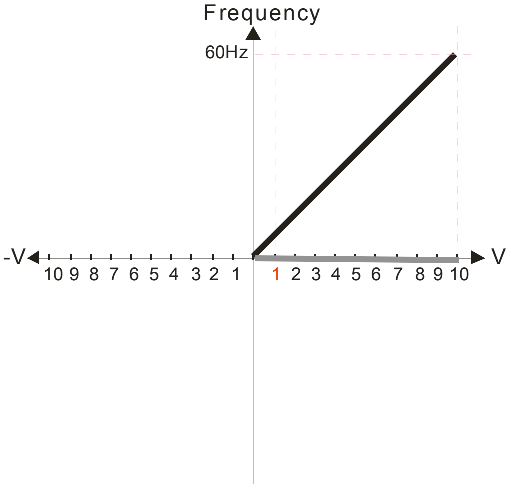
Pr.03-07~03-09 (Positive/Negative Bias Mode)

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%

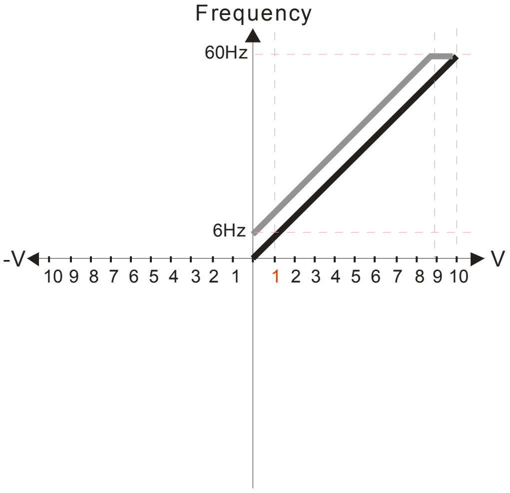
Pr.03-07~03-09 (Positive/Negative Bias Mode)

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 (AVI)= 100%



Pr.03-03=-10%

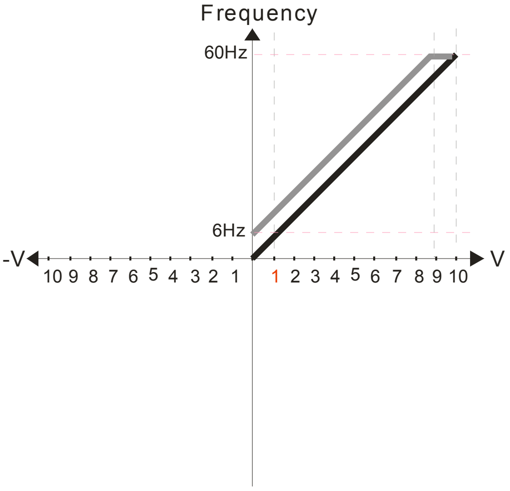
Pr.03-07~03-09 (Positive/Negative Bias Mode)

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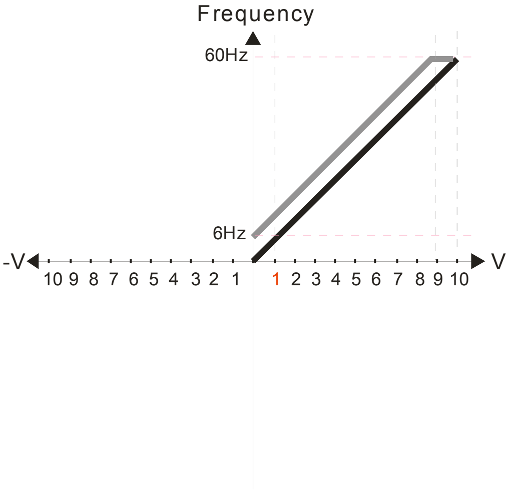
Pr.03-11 Analog Input Gain (AVI) = 100%



Pr.03-03=-10%

Pr.03-07~03-09 (Positive/Negative Bias Mode)

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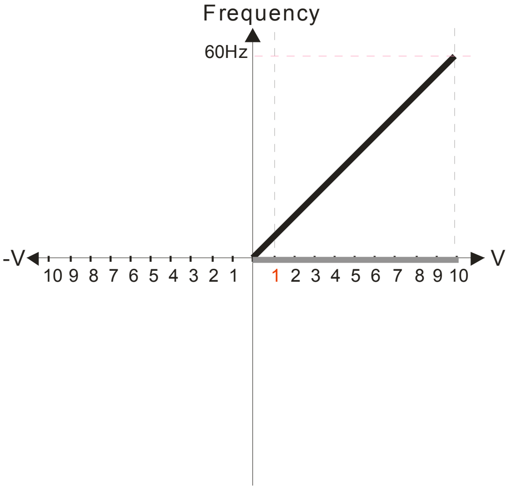

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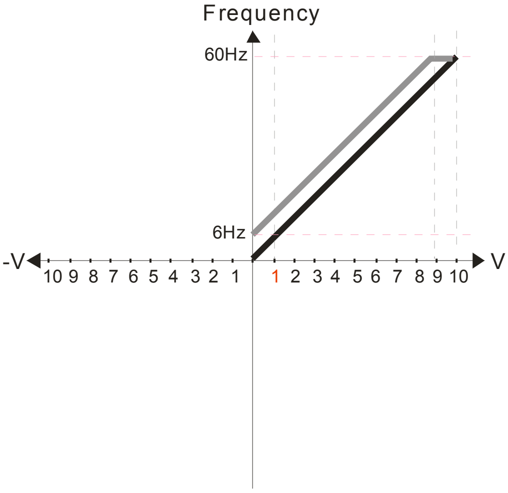

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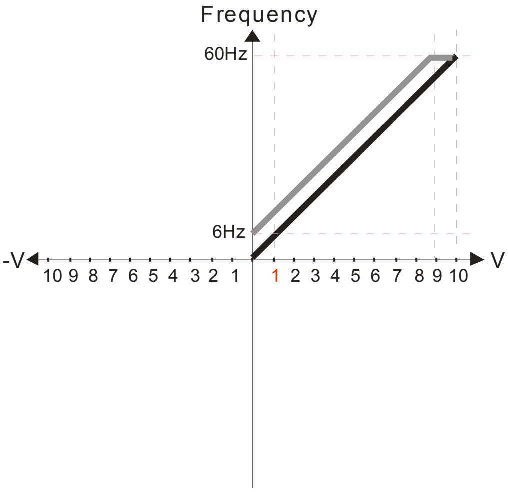

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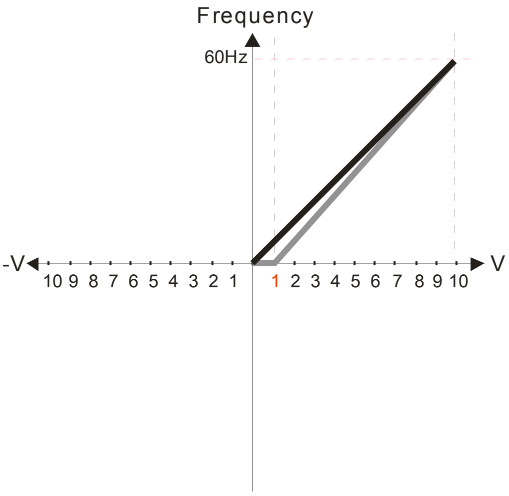

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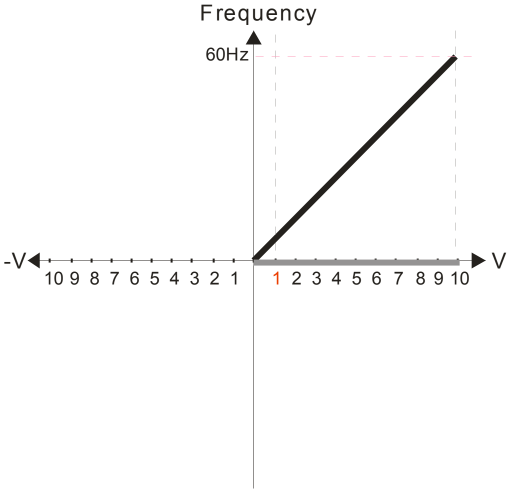
Pr.03-11 Analog Input Gain (AVI)= 1 11.1%
10/9=111.1%



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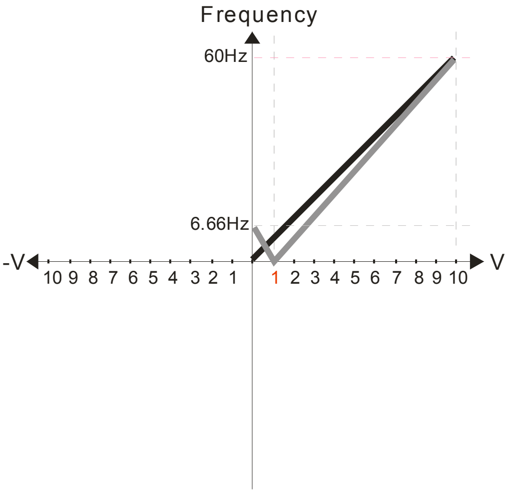

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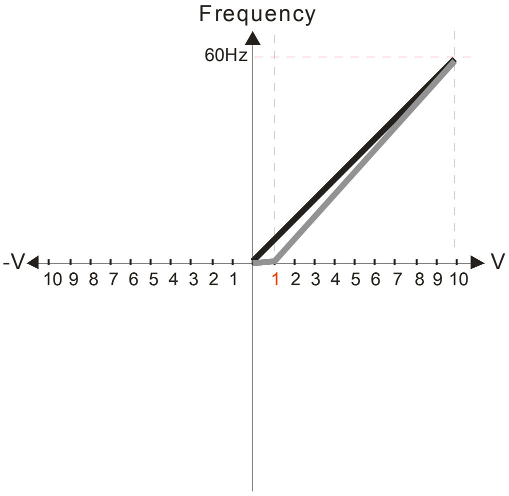

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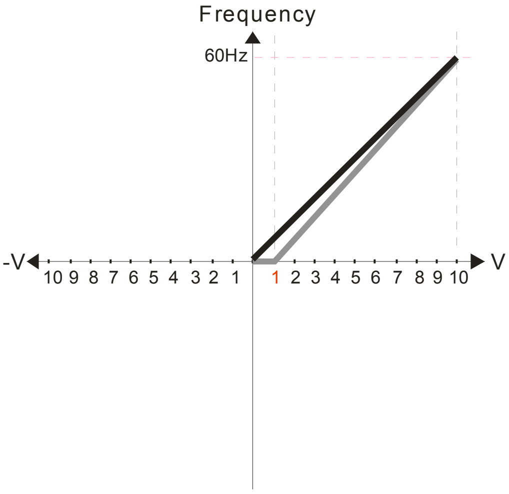

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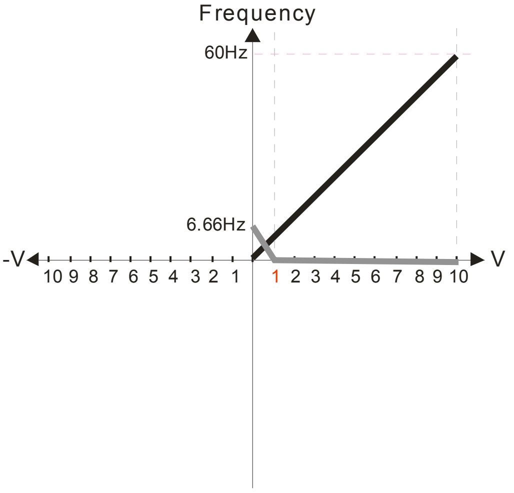

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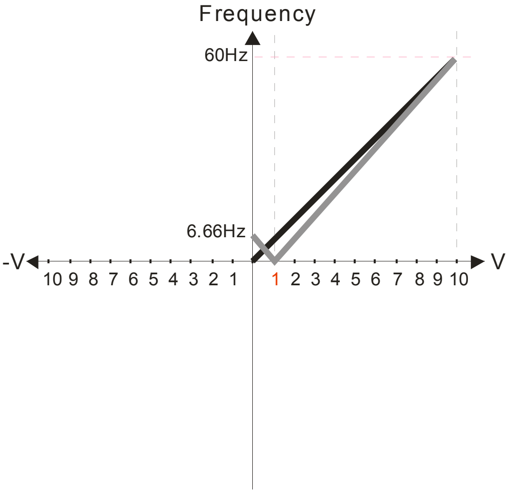

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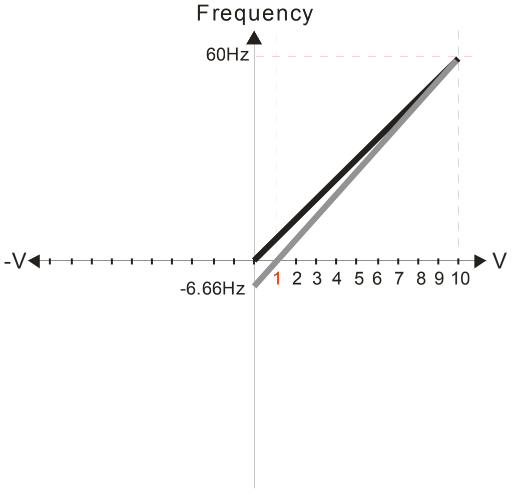

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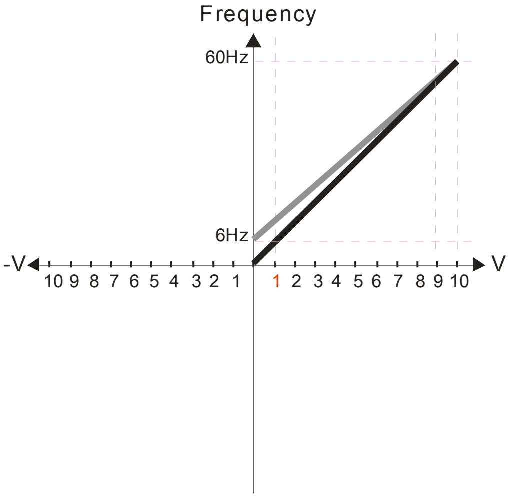

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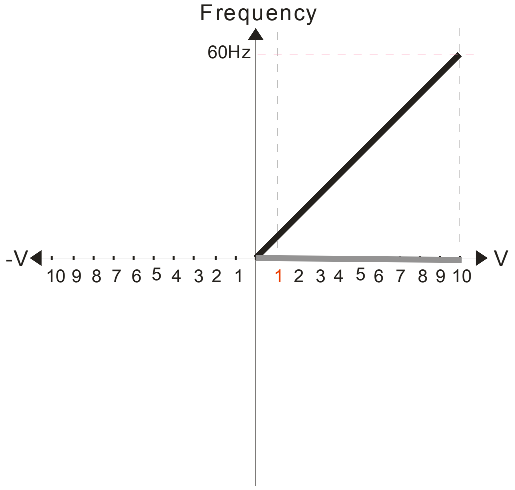
Calculate the bias: $\frac{60\text{-}6Hz}{10V} = \frac{6\text{-}0Hz}{XV}$ XV= $\frac{10}{9}$ =1.11V

∴Pr.03-03 = $\frac{1.11}{10}$ × 100%

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



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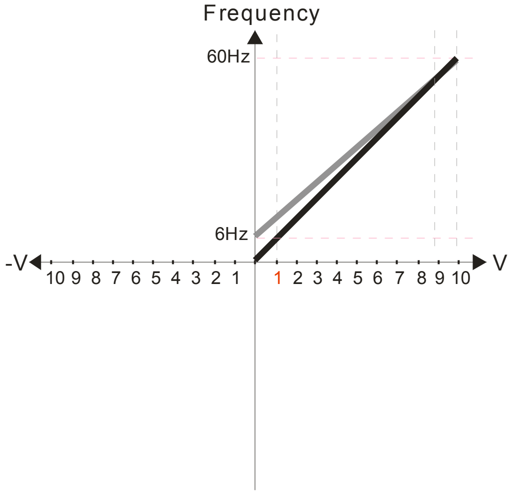

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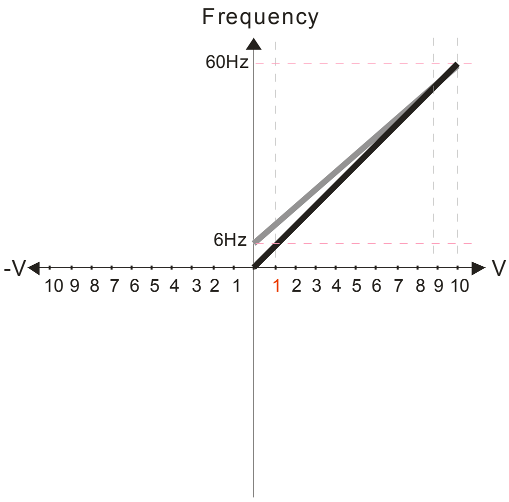

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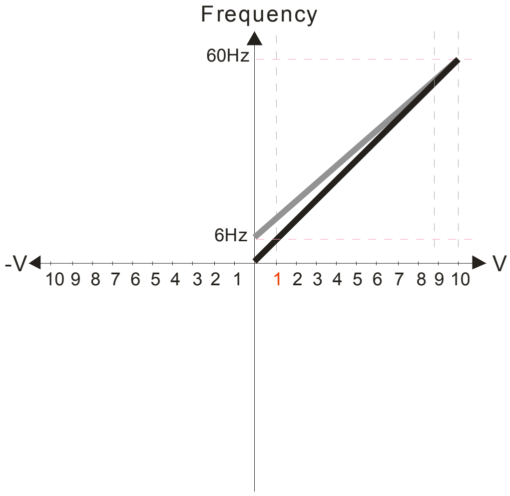

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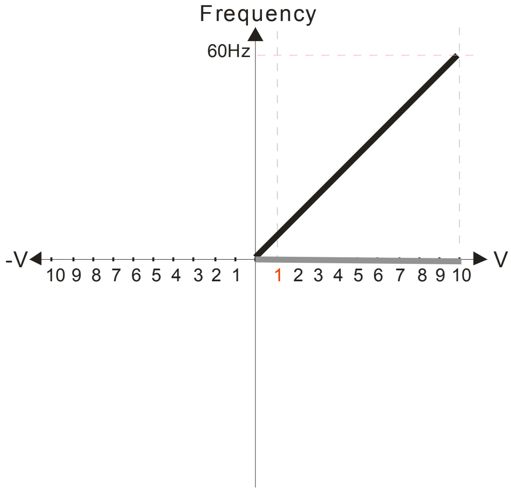

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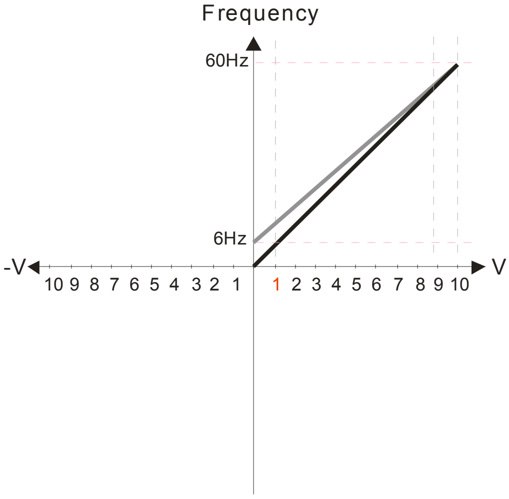

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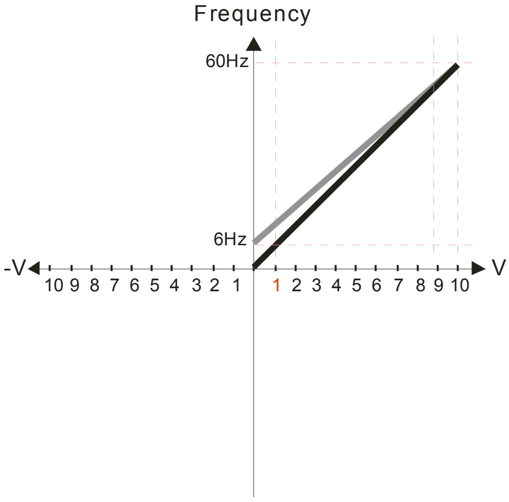

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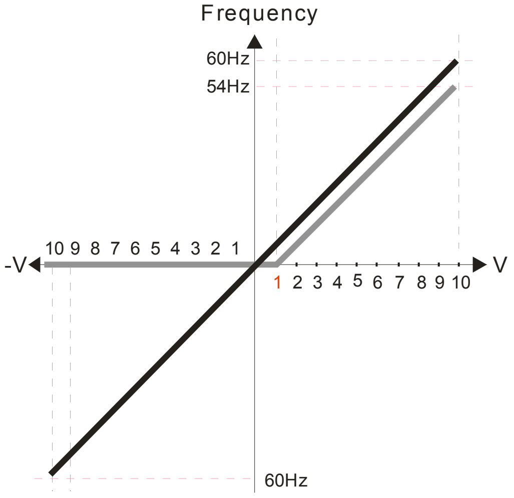

Pr.00-21=0 (Dgital keypad control and d run in FWD direction)
Pr.03-05 Analog Positive Voltage Input Bias (AUI) = 10%
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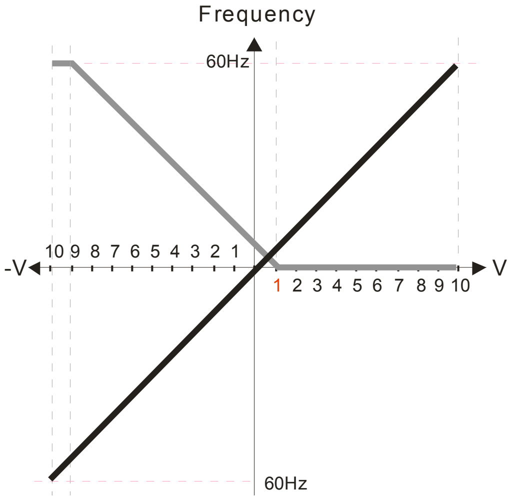
Pr.00-13 Analog Positive Input Gain (AUI)= 100%
Pr.03-14 Analog Negative Input Gain (AUI)= 100%



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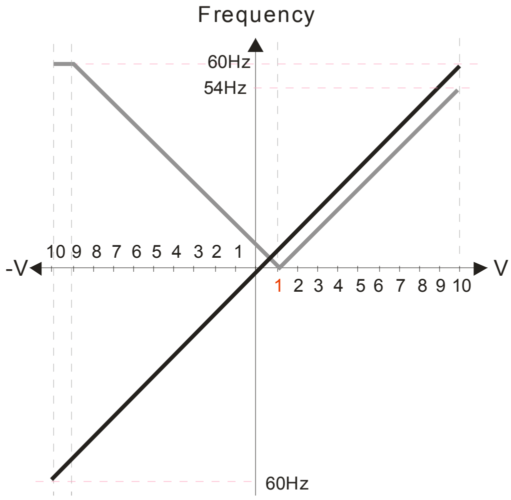

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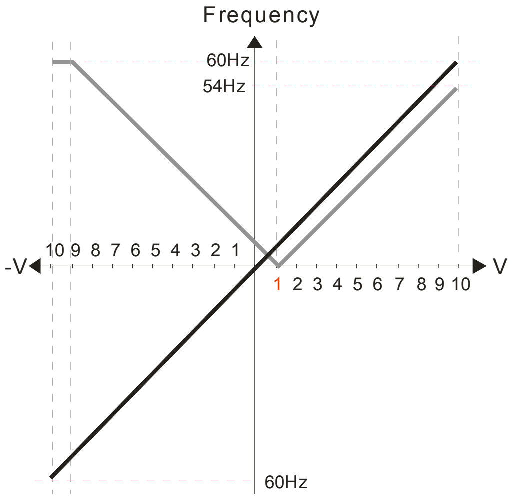

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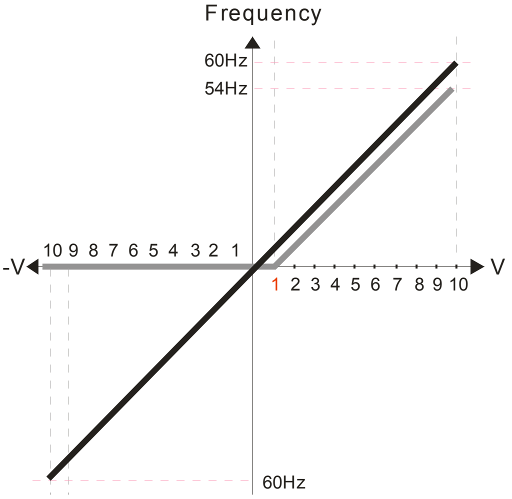

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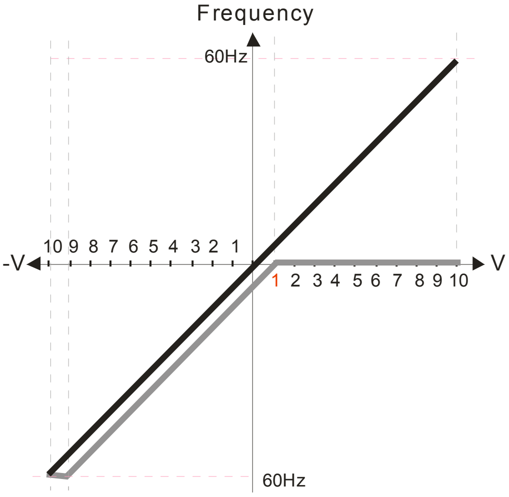
Pr.00-13 Analog Positive Input Gain (AUI)= 100%

Pr.03-14 Analog Negative Input Gain (AUI)= 100%



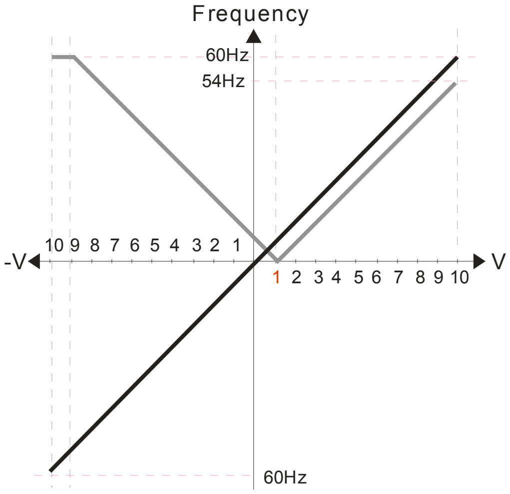
Pr.00-21=0 (Digital keypad control and run in FWD direction)
Pr.03-05 Analog Positive Voltage Input Bias (AUI) = 10%
Pr.03-07~03-09 (Positive/Negative Bias Mode)

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%



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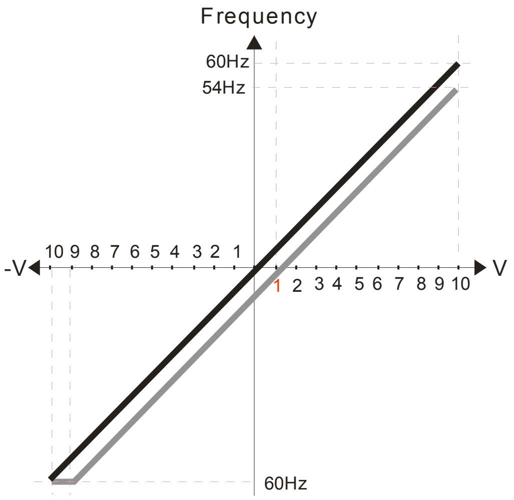
Pr.00-13 Analog Positive Input Gain (AUI)= 100%
Pr.03-14 Analog Negative Input Gain (AUI)= 100%



Pr.00-21=0 (Digital keypad control and run in FWD direction)
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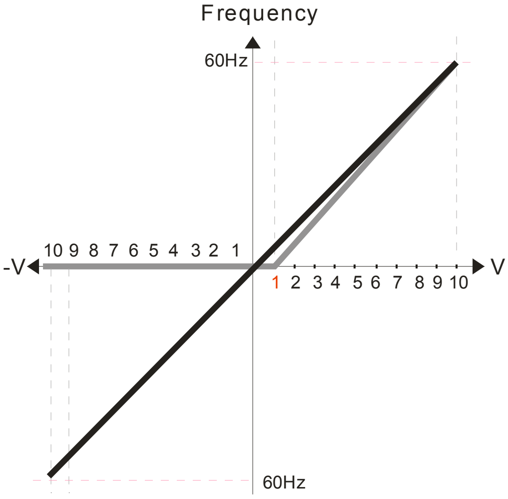

Pr.00-21=0 (Digital keypad control and run in FWD direction)
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Pr.03-07~03-09 (Positive/Negative Bias Mode)

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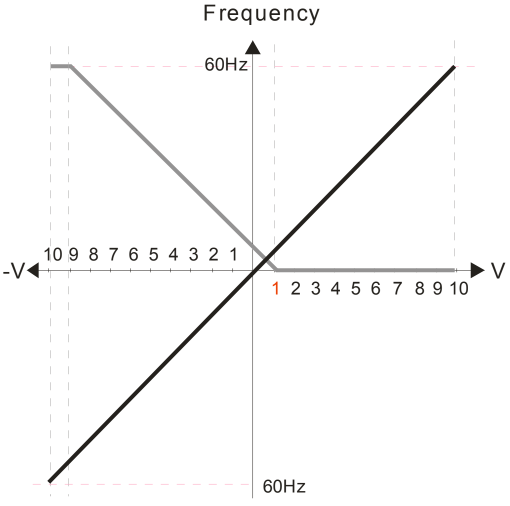
Pr.00-13 Analog Positive Input Gain (AUI)= 111.1%
(10/9) *100% = 111.1%
Pr.00-14 Analog Negative Input Gain (AUI) = 100%



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)

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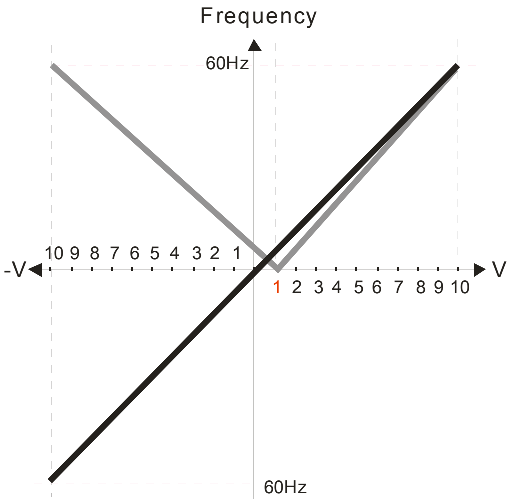

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Pr.03-07~03-09 (Positive/Negative Bias Mode)
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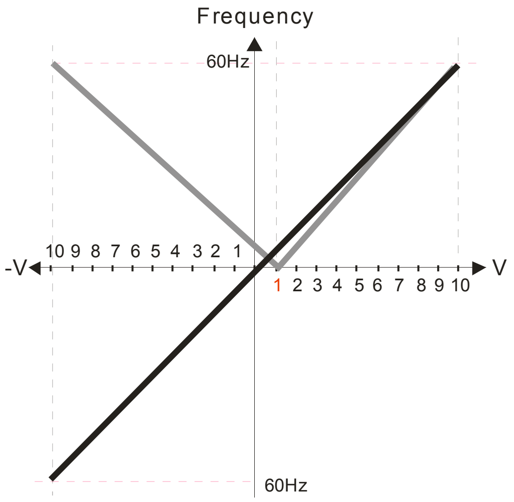
(10/9) *100% = 111.1%
Pr.00-14 Analog Negative Input Gain (AUI) = 100%



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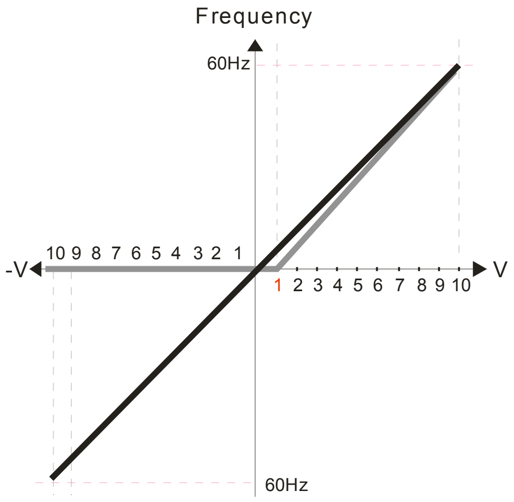
(10/9) *100% = 111.1%
Pr.00-14 Analog Negative Input Gain (AUI) = 100%



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)
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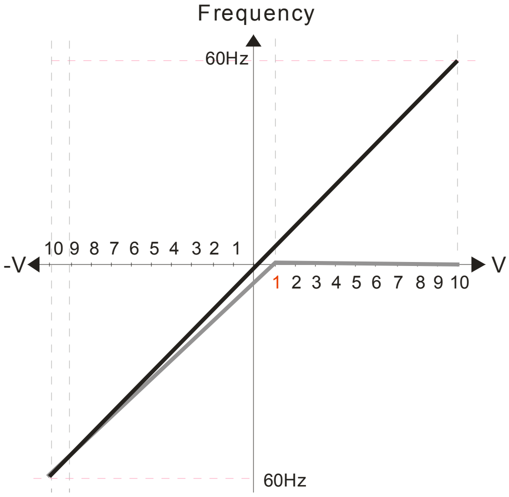
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

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)

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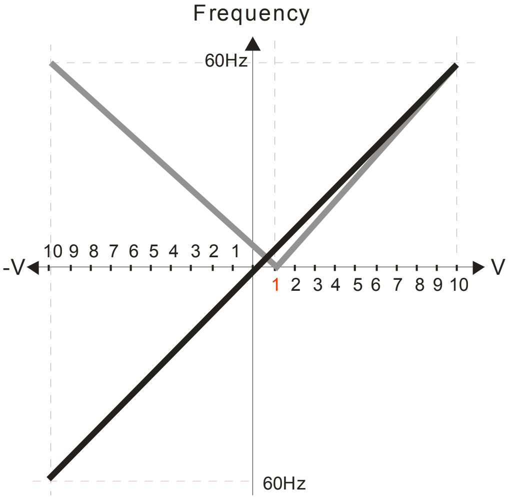
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.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)

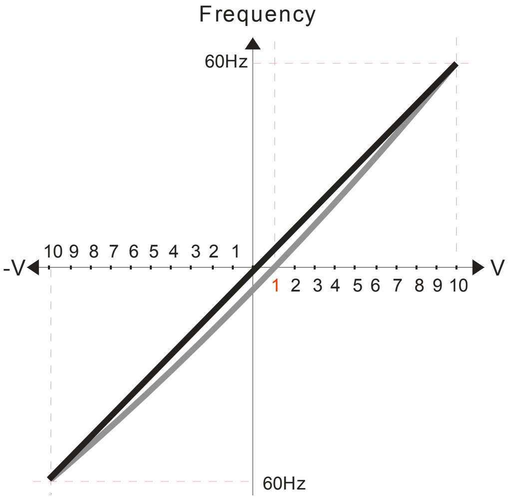
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

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%

03-10 Analog Frequency Command for Reverse Run

Factory Setting: 0

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.

🕮 Parameter 03-10 is used to enable reverse run command when a negative frequency (negative bias and gain) is input to AVI or ACI analog signal input.

03-11 Analog Input Gain (AVI)
03-12 Analog Input Gain (ACI)
03-13 Analog Positive Input Gain (AUI)
03-14 Analog Negative Input Gain (AUI)

Factory Setting: 100.0

Settings -500.0~500.0%

🕮 Parameters 03-03 to 03-14 are used when the source of frequency command is the analog voltage/current signal.

03-15 Analog Input Filter Time (AVI)
03-16 Analog Input Filter Time (ACI)
03-17 Analog Input Filter Time (AUI)

Factory Setting: 0.01

Settings 0.00~20.00 sec

🕮 These input delays can be used to filter noisy analog signal.

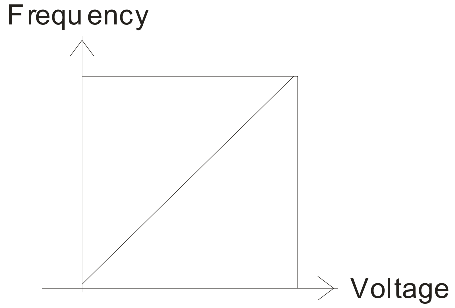
🕮 When the setting of the time constant is too large, the control will be stable but the control response will be slow. When the setting of time constant is too small, the control response will be faster but the control may be unstable. To find the optimal setting, please adjust the setting according to the control stable or response status.

✎ 03-18 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 AVI, ACI and AUI are AVI>ACI>AUI.



$$F command=[(ay \pm bias)*gain]*\frac{Fmax(01\text{-}00)}{10V \text{ or } 16mA}$$

Fcommand: the corresponding frequency for 10V or 20mA
ay : 10 or 16mA
bias : Pr.03-03,Pr. 03-04, Pr.03-05
gain : Pr.03-11, Pr.03-12, Pr.03-13, Pr.03-14

✎ 03-19 Treatment to 4-20mA 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

🕮 This parameter determines the behavior when 4~20mA signal is loss, when AVIc(Pr.03-28=2) or ACIc (03-29=0).

🕮 When Pr.03-28 is not set to 2, it means the voltage input to AVI terminal is 0-10V or 0-20mA. 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 0-10V. At this moment, Pr.03-19 will be invalid.

🕮 When setting is 1 or 2, it will display warning code “AnL” on the keypad. It will be blinking until the loss of the ACI signal is recovered or drive is stop.

✎ 03-20 Multi-function Output 1 (AFM1)

Factory Setting: 0

✎ 03-23 Multi-function Output 2 (AFM2)

Factory Setting: 0

Settings 0~23

Function Chart

Settings	Functions	Descriptions
0	Output frequency (Hz)	Max. frequency Pr.01-00 is regarded as 100%.
1	Frequency command (Hz)	Max. frequency Pr.01-00 is regarded as 100%.
2	Motor speed (Hz)	600Hz is regarded as 100%
3	Output current (rms)	(2.5 X rated current) is regarded as 100%
4	Output voltage	(2 X rated voltage) is regarded as 100%
5	DC Bus Voltage	450V (900V)=100%

6	Power factor	-1.000~1.000=100%
7	Power	Rated power is regarded as 100%
8	Output torque	Full-load torque is regarded as 100%
9	AVI	0~10V=0~100%
10	ACI	0~20mA=0~100%
11	AUI	-10~10V=0~100%
12	q-axis current (Iq)	(2.5 X rated current) is regarded as 100%
13	q-axis feedback value (Iq)	(2.5 X rated current) is regarded as 100%
14	d-axis current (Id)	(2.5 X rated current) is regarded as 100%
15	d-axis feedback value (Id)	(2.5 X rated current) is regarded as 100%
16	q-axis voltage (Vq)	250V (500V) =100%
17	d-axis voltage(Vd)	250V (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, CMC-PN01, CMC-DN01)
22	Analog output for communication card	For communication output (CMC-MOD01, CMC-EIP01, CMC-PN01, CMC-DN01)
23	Constant voltage/current output	Pr.03-32 and Pr.03-33 controls voltage/current output level 0~100% of Pr.03-32 corresponds to 0~10V of AFM1.

✎ **03-21** Gain of Analog Output 1 (AFM1)

Factory Setting: 100.0

✎ **03-24** Gain of Analog Output 2 (AFM2)

Factory Setting: 100.0

Settings 0~500.0%

🕮 It is used to adjust the analog voltage level (Pr.03-20) that terminal AFM outputs.

🕮 This parameter is set the corresponding voltage of the analog output 0.

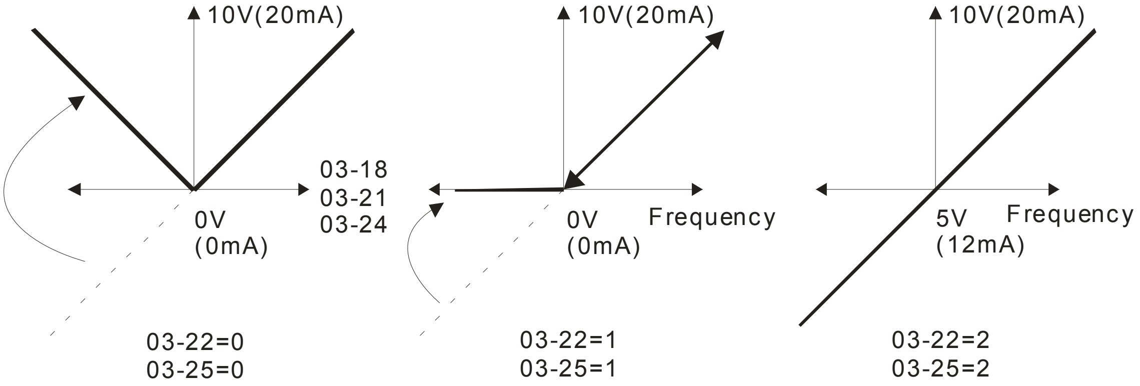
✎ **03-22** Analog Output 1 when in REV Direction (AFM1)

Factory Setting: 0

✎ **03-25** Analog Output 2 when in REV Direction (AFM2)

Factory Setting: 0

Settings 0: Absolute value in REV direction
1: Output 0V in REV direction; output 0-10V in FWD direction
2: Output 5-0V in REV direction; output 5-10V in FWD direction



Selections for the analog output direction

03-26 Reserve

✓ 03-27 AFM2 Output Bias

Factory Setting: 0.00

Settings -100.00~100.00%

📖 Example 1, AFM2 0-10V is set output frequency, the output equation is

$$10V \times (\frac{\text{Output Frequency}}{01-00}) \times 03-24 + 10V \times 03-27$$

📖 Example 2, AFM2 0-20mA is set output frequency, the output equation is

$$20mA \times (\frac{\text{Output Frequency}}{01-00}) \times 03-24 + 20mA \times 03-27$$

📖 Example 3, AFM2 4-20mA is set output frequency, the output equation is

$$4mA + 16mA \times (\frac{\text{Output Frequency}}{01-00}) \times 03-24 + 16mA \times 03-27$$

✓ 03-28 AVI Selection

Factory Setting: 0

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

✓ 03-29 ACI Selection

Factory Setting: 0

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

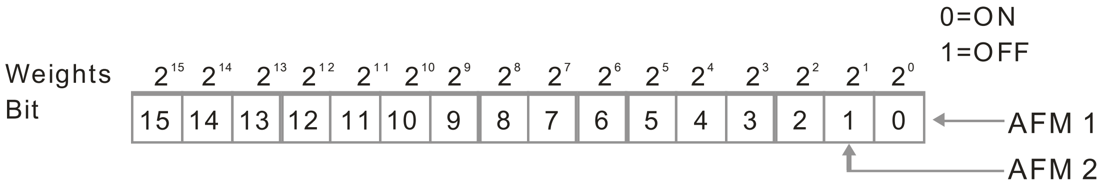
📖 When changing the input mode, please check if the switch of external terminal (SW3, SW4) corresponds to the setting of Pr.03-28~03-29.

⚡ 03-30 Status of PLC Output Terminal

Factory Setting: ##

Settings	0~65535
	Monitor the status of PLC analog output terminals

📖 P.03-30 shows the external multi-function output terminal that used by PLC.



NOTE

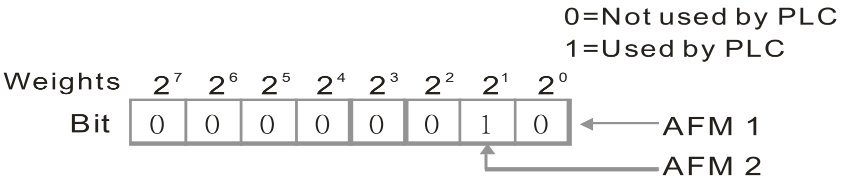
$2^7=128$ $2^6=64$

$2^5=32$ $2^4=16$ $2^3=8$

$2^2=4$ $2^1=2$ $2^0=1$

📖 For Example:

If the value of Pr.02-30 displays 0002h(Hex), it means AFM1and AFM2 are used by PLC.



Display value

$2=1x2^1+0x2^0$

$=bit\ 1x2^1+bit\ 0x2^0$

03-31 AFM2 0-20mA Output Selection

Factory Setting: 0

Settings	0: 0-20mA output
	1: 4-20mA output

03-32 AFM1 DC output setting level
03-33 AFM2 DC Output Setting Level

Factory Setting: 0.00

Settings 0.00~100.00%

03-34 Reserve

03-35 AFM1 Filter Output Time
03-36 AFM2 Filter Output Time

Factory Setting: 0.01

Settings 0.00~20.00 Seconds

03-37
~
03-49 Reserve

03-50 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

03-51 AVI Low Point

Factory Setting: 0.00

Settings 03-28=0, 0.00~10.00V
03-28≠0, 0.00~20.00mA

03-52 AVI Proportional Low Point

Factory Setting: 0.00

Settings 0.00~100.00%

03-53 AVI Mid Point

Factory Setting: 5.00

Settings 03-28=0, 0.00~10.00V
03-28≠0, 0.00~20.00mA

03-54 AVI Proportional Mid Point

Factory Setting: 50.00

Settings 0.00~100.00%

03-55 AVI High Point

Factory Setting: 10.00

Settings 03-28=0, 0.00~10.00V
03-28≠0, 0.00~20.00mA

03-56 AVI Proportional High Point

Factory Setting: 100.00

Settings 0.00~100.00%

🕮 When Pr.03-28 = 0, AVI setting is 0-10V and the unit is in voltage (V).

🕮 When Pr.03-28 ≠ 0, AVI setting is 0-20mA or 4-20mA 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.

🕮 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 1V. If the AVI input is swing between 1V and 1.1V, drive's output frequency will beats between 0% and 10%

03-57 ACI Low Point

Factory Setting: 4.00

Settings Pr.03-29=1, 0.00~10.00V
Pr.03-29≠1, 0.00~20.00mA

03-58 ACI Proportional Low Point

Factory Setting: 0.00

Settings 0.00~100.00%

03-59 ACI Mid Point

Factory Setting: 12.00

Settings 03-29=1, 0.00~10.00V
03-29≠1, 0.00~20.00mA

03-60 ACI Proportional Mid Point

Factory Setting: 50.00

Settings 0.00~100.00%

03-61 ACI High Point

Factory Setting: 20.00

Settings 03-29=1, 0.00~10.00V
03-29≠1, 0.00~20.00mA

03-62 ACI Proportional High Point

Factory Setting: 100.00

Settings 0.00~100.00%

- When Pr.03-29=1, ACI setting is 0-10V and the unit is in voltage (V).
- When Pr.03-29≠1, ACI setting is 0-20mA or 4-20mA 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).
- 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.
- 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 2mA. If the ACI input is swing between 2mA and 2.1mA, drive's output frequency will beats between 0% and 10%.

03-63 Positive AUI Voltage Low Point

Factory Setting: 0.00

Settings 0.00~10.00V

03-64 Positive AUI Voltage Proportional Low Point

Factory Setting: 0.00

Settings 0.00~100.00%

03-65 Positive AUI Voltage Mid Point

Factory Setting: 5.00

Settings 0.00~10.00V

03-66 Positive AUI Voltage Proportional Mid Point

Factory Setting: 50.00

Settings 0.00~100.00%

03-67 Positive AUI Voltage High Point

Factory Setting: 10.00

Settings 0.00~10.00V

03-68 Positive AUI Voltage Proportional High Point

Factory Setting: 100.00

Settings 0.00~100.00%

📖 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.

📖 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.

03-69 Negative AUI Voltage Low Point

Factory Setting: 0.00

Settings 0.00~-10.00V

03-70 Negative AUI Voltage Proportional Low Point

Factory Setting: 0.00

Settings 0.00~-100.00%

03-71 Negative AUI Voltage Mid Point

Factory Setting: -5.00

Settings 0.00~-10.00V

03-72 Negative AUI Voltage Proportional Mid Point

Factory Setting: -50.00

Settings 0.00~-100.00%

03-73 Negative AUI Voltage High Point

Factory Setting: -10.00

Settings 0.00~-10.00V

03-74 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.

📖 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.
- 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 -1V. If the AUI input is swing between -1V and -1.1V, drive’s output frequency will beats between 0% and 10%.

04 Multi-Step Speed Parameters

ϟ This parameter can be set during operation.

ϟ	04-00	1st Step Speed Frequency
ϟ	04-01	2nd Step Speed Frequency
ϟ	04-02	3rd Step Speed Frequency
ϟ	04-03	4th Step Speed Frequency
ϟ	04-04	5th Step Speed Frequency
ϟ	04-05	6th Step Speed Frequency
ϟ	04-06	7th Step Speed Frequency
ϟ	04-07	8th Step Speed Frequency
ϟ	04-08	9th Step Speed Frequency
ϟ	04-09	10th Step Speed Frequency
ϟ	04-10	11th Step Speed Frequency
ϟ	04-11	12th Step Speed Frequency
ϟ	04-12	13th Step Speed Frequency
ϟ	04-13	14th Step Speed Frequency
ϟ	04-14	15th Step Speed Frequency

Factory Setting: 0.00

Settings 0.00~600.00Hz

📖 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.

📖 The run/stop command can be controlled by the external terminal/digital keypad/communication via Pr.00-21.

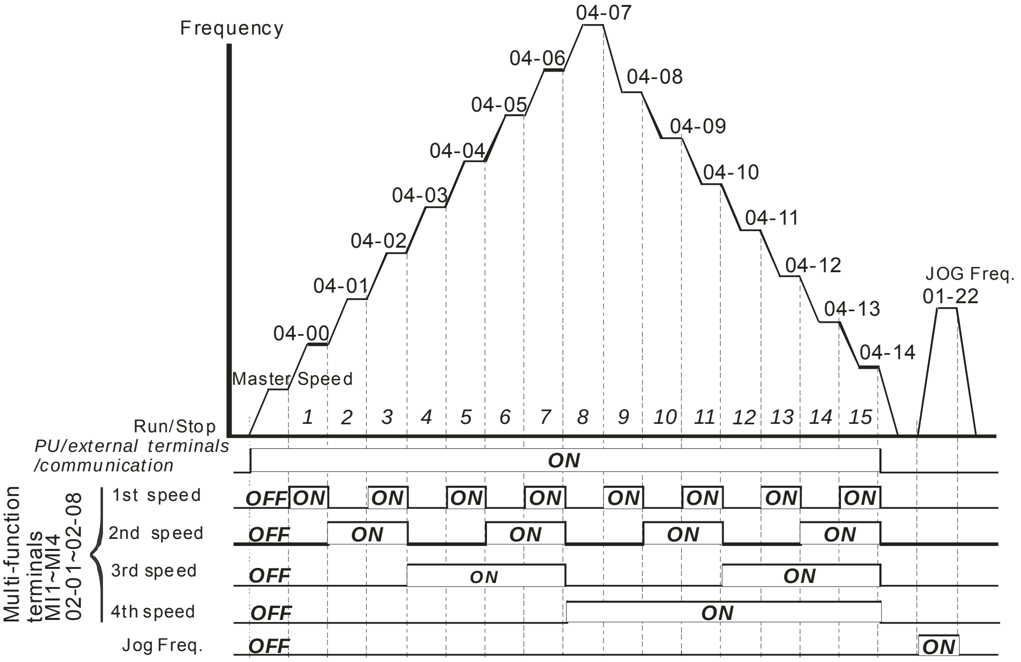
📖 Each one of multi-step speeds can be set within 0.0~600.0Hz during operation.

📖 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)



Multi-speed via External Terminals

✎ 04-16	Position command 1 (pulse)
✎ 04-18	Position command 2 (pulse)
✎ 04-20	Position command 3 (pulse)
✎ 04-22	Position command 4 (pulse)
✎ 04-24	Position command 5 (pulse)
✎ 04-26	Position command 6 (pulse)
✎ 04-28	Position command 7 (pulse)
✎ 04-30	Position command 8 (pulse)
✎ 04-32	Position command 9 (pulse)
✎ 04-34	Position command 10 (pulse)
✎ 04-36	Position command 11 (pulse)
✎ 04-38	Position command 12 (pulse)
✎ 04-40	Position command 13 (pulse)
✎ 04-42	Position command 14 (pulse)
✎ 04-44	Position command 15 (pulse)

Factory Setting: 0

Settings -32767~32767

📖 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	04-00 1st step speed frequency
04-18 Position command 2 (pulse)	0	0	1	0	04-01 2nd step speed frequency
04-20 Position command 3 (pulse)	0	0	1	1	04-02 3rd step speed frequency

04-22 Position command 4 (pulse)	0	1	0	0	04-03 4th step speed frequency
04-24 Position command 5 (pulse)	0	1	0	1	04-04 5th step speed frequency
04-26 Position command 6 (pulse)	0	1	1	0	04-05 6th step speed frequency
04-28 Position command 7 (pulse)	0	1	1	1	04-06 7th step speed frequency
04-30 Position command 8 (pulse)	1	0	0	0	04-07 8th step speed frequency
04-32 Position command 9 (pulse)	1	0	0	1	04-08 9th step speed frequency
04-34 Position command 10 (pulse)	1	0	1	0	04-09 10th step speed frequency
04-36 Position command 11 (pulse)	1	0	1	1	04-10 11th step speed frequency
04-38 Position command 12 (pulse)	1	1	0	0	04-11 12th step speed frequency
04-40 Position command 13 (pulse)	1	1	0	1	04-12 13th step speed frequency
04-42 Position command 14 (pulse)	1	1	1	0	04-13 14th step speed frequency
04-44 Position command 15 (pulse)	1	1	1	1	04-14 15th step speed frequency

04-15 Position command 1 (revolution)

04-17 Position command 2 (revolution)

04-19 Position command 3 (revolution)

04-21 Position command 4 (revolution)

04-23 Position command 5 (revolution)

04-25 Position command 6 (revolution)

04-27 Position command 7 (revolution)

04-29 Position command 8 (revolution)

04-31 Position command 9 (revolution)

04-33 Position command 10 (revolution)

04-35 Position command 11 (revolution)

04-37 Position command 12 (revolution)

04-39 Position command 13 (revolution)

04-41 Position command 14 (revolution)

04-43 Position command 15 (revolution)

📖 To switch the target position of the external terminal, set external terminal parameters to Pr.02-01=1, Pr.02-02=2, Pr.02-03=3, Pr.02-04= 4 by selecting the P2P target position via multi-step speed.

Setting: Target Position = 04-15 × (10-01*4) + 04-16

Multi-step Speed Status	Target Position of P2P			Maximum Speed 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 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		04-09
1011	Position 11	04-35	04-36		04-10
1100	Position 12	04-37	04-38		04-11
1101	Position 13	04-39	04-40		04-12
1110	Position 14	04-41	04-42		04-13
1111	Position 15	04-43	04-44		04-14

ϟ 04-50 PLC Buffer 1
ϟ 04-51 PLC Buffer 2
ϟ 04-52 PLC Buffer 3
ϟ 04-53 PLC Buffer 4
ϟ 04-54 PLC Buffer 5
ϟ 04-55 PLC Buffer 6
ϟ 04-56 PLC Buffer 7
ϟ 04-57 PLC Buffer 8
ϟ 04-58 PLC Buffer 9
ϟ 04-59 PLC Buffer 10

Factory Setting: 0

Settings 0~65535

📖 The 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.

05 Motor Parameters

✎ This parameter can be set during operation.

05-00 Motor Auto Tuning

Factory Setting: 0

Settings 0: No function

1: Rolling test for induction motor (Rs, Rr, Lm, Lx, no-load current)

2: Rolling test for induction motor

3: No function

4: Rolling test for PM motor magnetic pole

5: Rolling test for PM 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 Motor

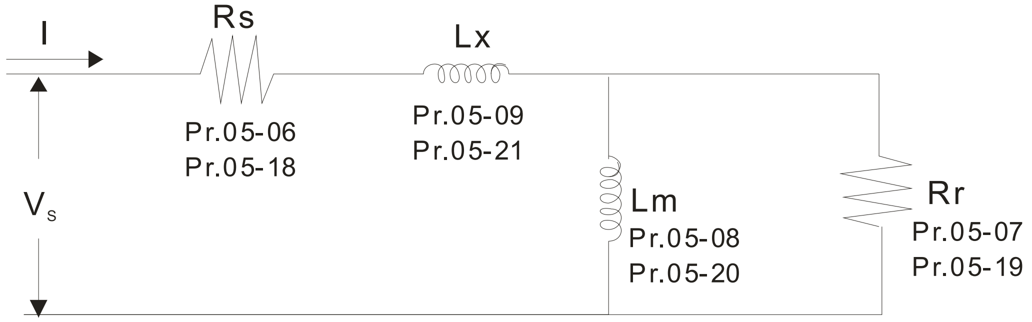
📖 Press 【Run】to beging auto tuning. The measured value will be written into motor 1 (Pr.05-05 ~05-09, Rs, Rr, Lm, Lx, no-load current) and motor 2 (Pr.05-17 to Pr.05-21) automatically.

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.

📖 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.

☑ Set up Pr.01-01, 01-02, 05-01~05-04 according to the motor nameplate information。

☑ 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.

☑ 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.

☑ It is not recommended to use torque/vector control mode if motor rated power exceeds the rated power of the AC motor drive.

☑ 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.

☑ The no-load current is usually 20~50% X rated current.

☑ The rated speed can not be greater than or equal to 120f/p (f = rated frequency Pr.01-01/01-35; P: number of motor poles Pr.05-04/05-16).

Permanent Magnet Motor (PM)

📖 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.

🕮 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.

☑ 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.

🕮 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.

05-01 Full-load Current of Induction Motor 1（A）

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% X rated current.

Example: The rated current for 7.5HP (5.5kW) is 25 and factory setting is 22.5A. The range for setting will be 10~30A.(25*40%=10A and 25*120%=30A)

✓ **05-02** Rated Power of Induction Motor 1(kW)

Factory Setting: #.##

Settings 0~655.35 kW

📖 It is used to set rated power of the motor 1. The factory setting is the power of the drive.

✓ **05-03** Rated Speed of Induction Motor 1 (rpm)

Factory Setting:
1710（60Hz 4 poles）
1410（50Hz 4 poles）

Settings 0~65535

📖 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.

05-04 Pole Number of Induction Motor 1

Factory Setting: 4

Settings 2~20

📖 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.

05-05 No-load Current of Induction Motor 1 (A)

Unit: Amper
Factory Setting: #.##

Settings 0 to the factory setting in Pr.05-01

📖 The factory setting is 40% X rated current.

05-06 Stator Resistance(Rs) of Induction Motor 1
05-07 Rotor Resistance(Rr) of Induction Motor 1

Factory Setting: #.###

Settings 0~65.535Ω

05-08 Magnetizing Inductance(Lm) of Induction Motor 1
05-09 Stator inductance(Lx) of Induction Motor 1

Factory Setting: #.#

Settings 0~6553.5mH

05-10
~
05-12 Reserved

05-13 Full-load Current of Induction Motor 2（A）

Unit: Amper
Factory Setting:#.##

Settings 10~120%

- This value should be set according to the rated frequency of the motor as indicated on the motor nameplate. The factory setting is 90% X rated current.
  Example: The rated current for 7.5HP (5.5kW) is 25A and factory setting is 22.5A. The range for setting will be 10~30A.(25*40%=10A and 25*120%=30A)

✎ **05-14** Rated Power of Induction Motor 2 (kW)

Factory Setting: #.##

Settings 0~655.35 kW

- It is used to set rated power of the motor 2. The factory setting is the power of the drive.

✎ **05-15** Rated Speed of Induction Motor 2 (rpm)

Factory Setting: 1710

Settings 0~65535

- It is used to set the rated speed of the motor and need to set according to the value indicated on the motor nameplate.

05-16 Pole Number of Induction Motor 2

Factory Setting: 4

Settings 2~20

- It is used to set the number of motor poles (must be an even number).

05-17 No-load Current of Induction Motor 2 (A)

Unit: Amper

Factory Setting: #.##

Settings 0 to the factory setting in Pr.05-13

- The factory setting is 40% X rated current.

05-18 Stator Resistance (Rs) of Induction Motor 2

05-19 Rotor Resistance (Rr) of Induction Motor 2

Factory Setting: #.###

Settings 0~65.535Ω

05-20 Magnetizing Inductance (Lm) of Induction Motor 2

05-21 Stator Inductance (Lx) of Induction Motor 2

Factory Setting: #.#

Settings 0~6553.5 mH

05-22 Induction Motor 1/ 2 Selection

Factory Setting: 1

Settings 1: Motor 1
2: Motor 2

- It is used to set the motor that driven by the AC motor drive.

⌁ 05-23 Frequency for Y-connection/△-connection Switch of Induction Motor

Factory Setting: 60.00

Settings 0.00~600.00Hz

05-24 Y-connection/△-connection Switch of Induction Motor IM

Factory Setting: 0

Settings 0: Disable

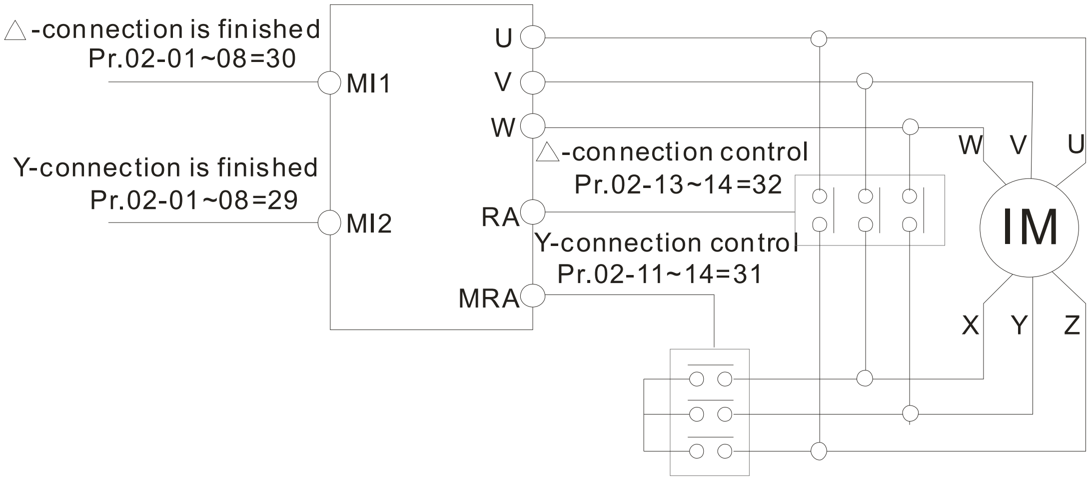
1: Enable

⌁ 05-25 Delay Time for Y-connection/△-connection Switch of Induction Motor

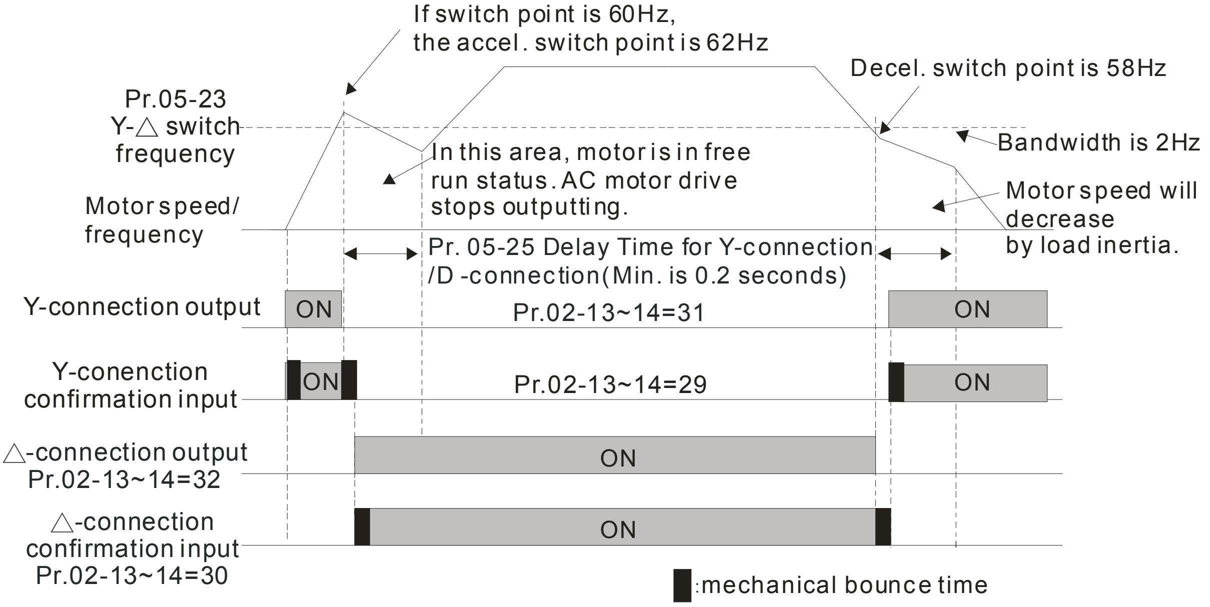
Factory Setting: 0.200

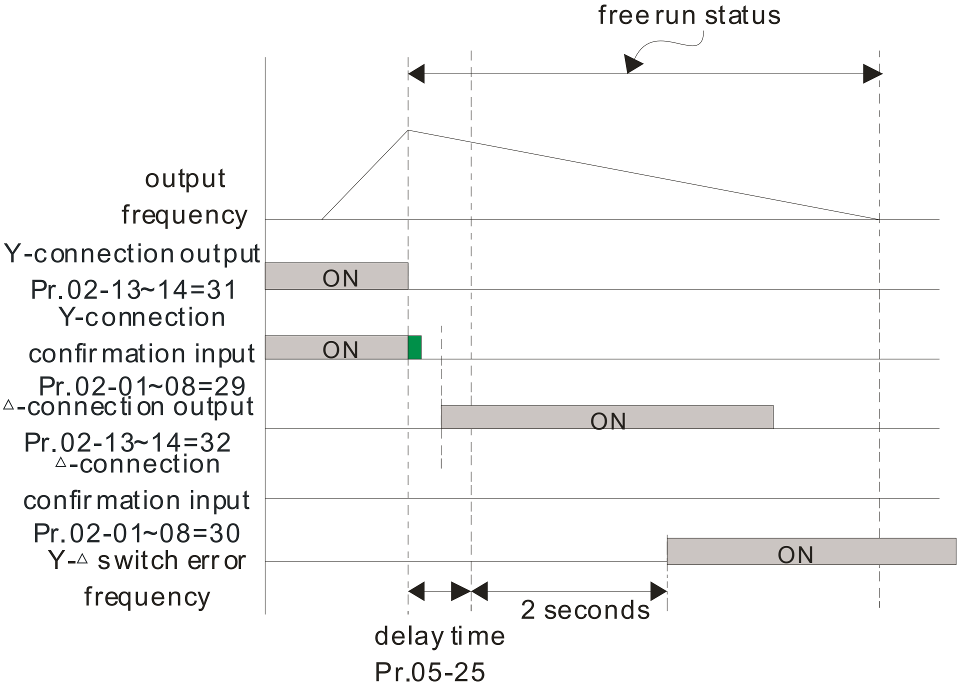
Settings 0.000~60.000 sec

- 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/Δ-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.
- Pr.05-24 is used to enable/disable Y-connection/Δ̃-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 Δ̃-connection. At the same time, it will also affect motor parameters.
- Pr.05-25 is used to set the switch delay time of Y-connection/Δ̃-connection.
- When output frequency reaches Y-connection/Δ-connection switch frequency, drive will delay by Pr.05-25 before multi-function output terminals are active.



Y- △ connection switch: can be used for wide range motor
Y -connection for low speed: higher torque can be used for rigid tapping
△-connection for high speed: higher torque can be used for high-speed drilling





05-26 Accumulative Watt Per Second of Motor in Low Word (W-sec)

Factory Setting: 0.0

Settings Read only

05-27 Accumulative Watt Per Second of Motor in High Word (W-sec)

Factory Setting: 0.0

Settings Read only

05-28 Accumulative Watt-hour of Motor (W-Hour)

Factory Setting: 0.0

Settings Read only

05-29 Accumulative Watt-hour of Motor in Low Word (KW-Hour)

Factory Setting: 0.0

Settings Read only

05-30 Accumulative Watt-hour of Motor in High Word (KW-Hour)

Factory Setting: 0.0

Settings Read only

🕮 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.

05-31 Accumulative Motor Operation Time (Min)

Factory Setting: 0

Settings 00~1439

05-32 Accumulative Motor Operation Time (day)

Factory Setting: 0

Settings 00~65535

🕮 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.

05-33 Induction Motor (IM) and Permanent Magnet Motor Selection

Factory Setting: 0

Settings 0: Induction Motor
1: Permanent Magnet Motor

05-34 Full-load current of Permanent Magnet Motor

Factory Setting: 0.00

Settings 0.00~655.35 Amps

05-35 Rated Power of Permanent Magnet Motor

Factory Setting: 0.00

Settings 0.00~655.35 kW

05-36 Rated speed of Permanent Magnet Motor

Factory Setting: 2000

Settings 0~65535 rpm

05-37 Pole number of Permanent Magnet Motor

Factory Setting: 10

Settings 0~65535

05-38 Inertia of Permanent Magnet Motor

Factory Setting: 0.0

Settings 0.0~6553.5 kg.cm^2 (0.0001kg.m^2)

🕮 This parameter setting is defined in **kg-cm^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)	3.70E-06	1.77E-05	2.77E-05	6.80E-05	1.13E-04	2.65E-04	4.45E-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)	8.17E-04	8.41E-04	1.12E-03	1.46E-03	3.47E-03	8.17E-04	8.41E-04	1.12E-03

※ For more information on motor inertia value, please refer to Pr.11-01.

05-39 Stator Resistance of PM Motor

Factory Setting: 0.000

Settings 0.000~65.535Ω

05-40 Permanent Magnet Motor Ld

Factory Setting: 0.00

Settings 0.00~655.35 mH

05-41 Permanent Magnet Motor Lq

Factory Setting: 0.00

Settings 0.00~655.35 mH

05-42 PG Offset angle of PM Motor

Factory Setting: 0

Settings 0.0~360.0°

🕮 When Pr.05-00 is set to 4, the drive will detect offset angle and write into Pr.05-42.

05-43 Ke parameter of PM Motor

Unit: V/1000rpm

Factory Setting: 0

Settings 0~65535

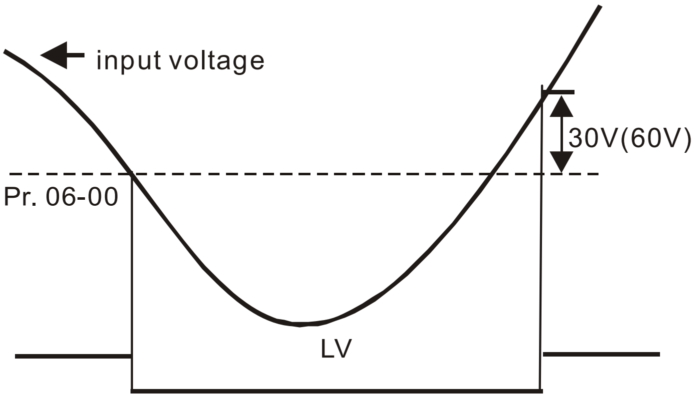
06 Protection Parameters

✐ This parameter can be set during operation.

✐ **06-00** Low Voltage Level

		Factory Setting:
Settings	230V Series:	
	Frame A to D: 150.o~ 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

- 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.



✐ **06-01** Over-voltage Stall Prevention

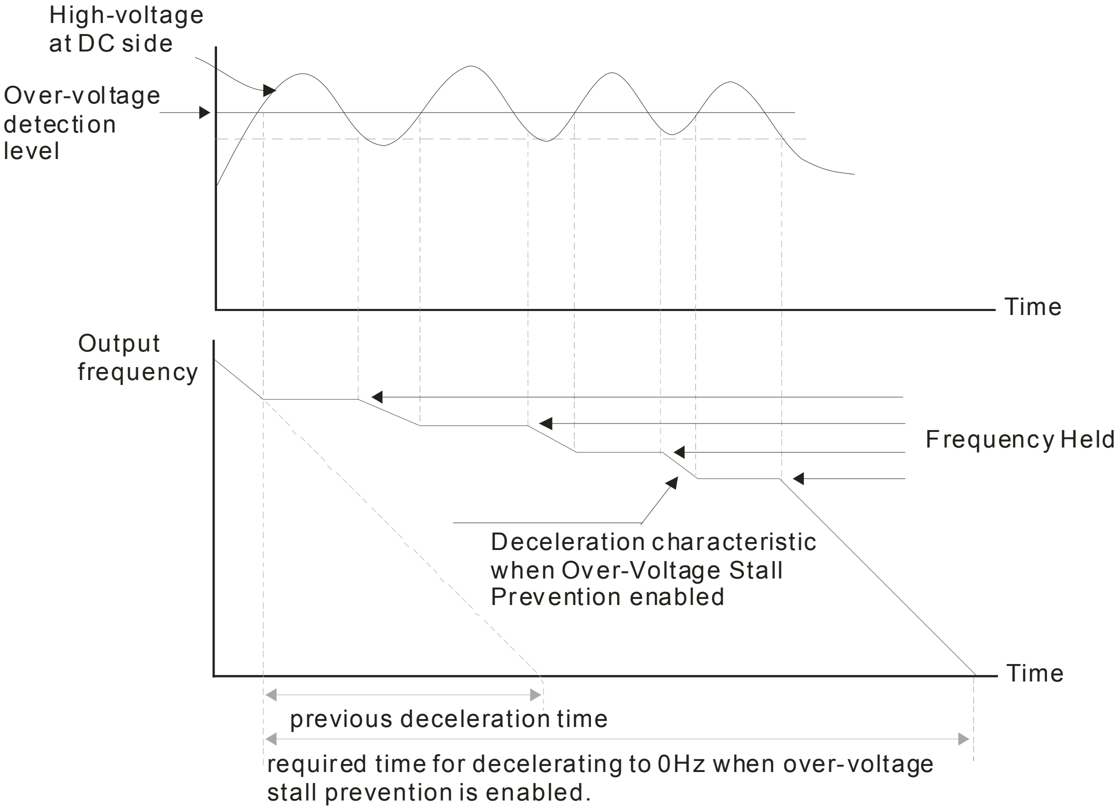
Factory Setting: 380.0/760.0

Settings	230V Series: 0.0~450.0V
	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.
- 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.
- 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.
- When the over-voltage stall prevention is enabled, drive deceleration time will be larger than the setting.
- 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)



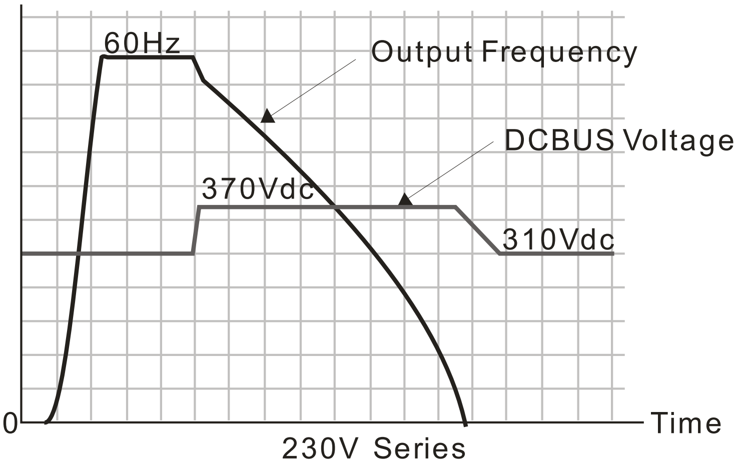
06-02 Selection for Over-voltage Stall Prevention

Factory Setting: 0

Settings 0: Traditional over-voltage stall prevention

1: Smart over-voltage prevention

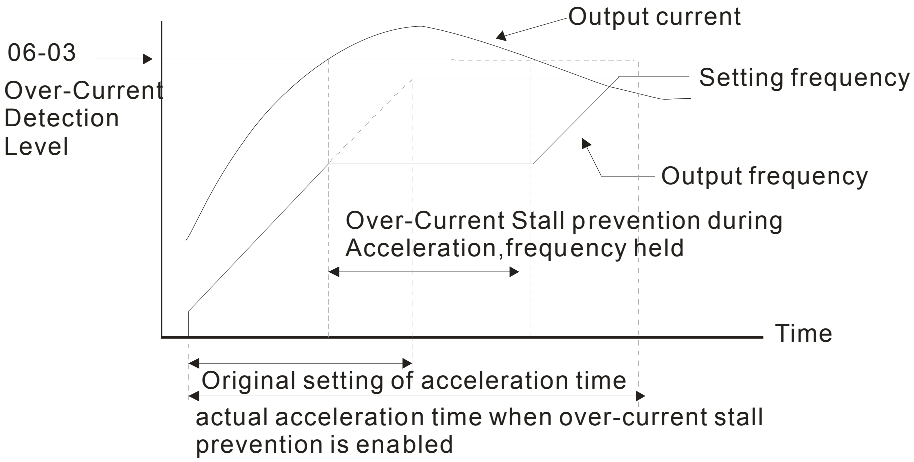
📖 When Pr.06-02 is set to 1, the drive will maintain DCbus voltage when decelerating and prevent OV.



06-03 Over-current Stall Prevention during Acceleration

Settings Normal duty: 0~160% (100%: drive's rated current) Factory Setting: 120
Heavy duty: 0~180% (100%: drive's rated current) Factory Setting: 150

- 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.
- 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.
- When the over-current stall prevention is enabled, drive acceleration time will be larger than the setting.
- When the Over-Current Stall Prevention occurs due to too small motor capacity or in the factory setting, please decrease Pr.06-03 setting.
- When there is any problem by using acceleration time, refer to the following items to solve it.
- 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.)
- 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)

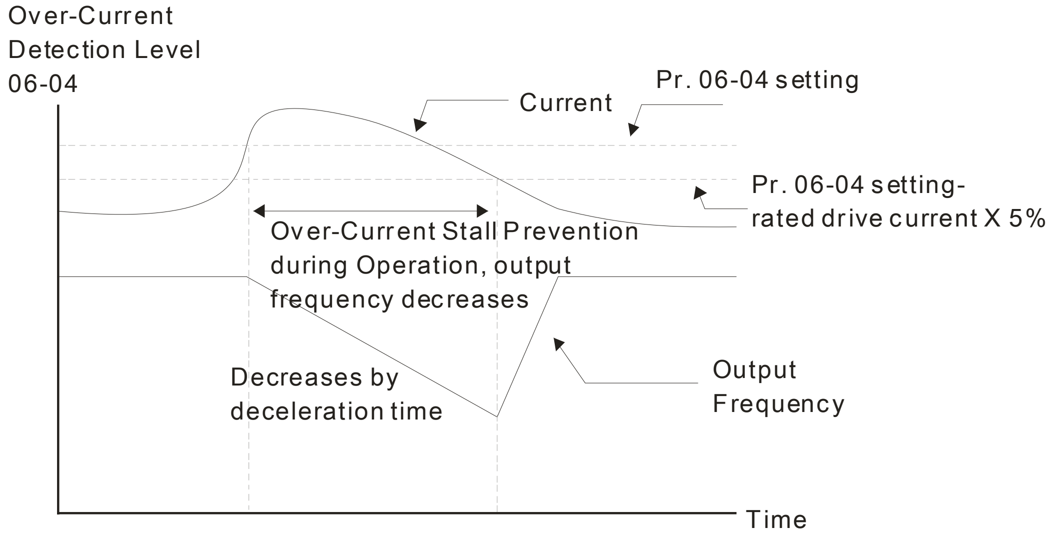


06-04 Over-current Stall Prevention during Operation

Settings Normal duty: 0~160% (100%: drive's rated current) Factory Setting: 120
Heavy duty: 0~180% (100%: drive's rated current) Factory Setting: 150

- It is a protection for drive to auto decrease output frequency when the motor is over-load abruptly during motor constant operation.
- 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 stall prevention during operation

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

Factory Setting: 0

Settings 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

📖 It is used to set the accel./decel. time selection when stall prevention occurs at constant speed.

⌁ 06-06 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

⌁ 06-09 Over-torque Detection Selection (OT2)

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

4: Over-torque detection during operation, stop 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.

🕮 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.

✎ 06-07 Over-torque Detection Level (OT1)

Factory Setting: 120

Settings 10 to 250% (100%: drive's rated current)

✎ 06-08 Over-torque Detection Level (OT1)

Factory Setting: 0.1

Settings 0.0~60.0 sec

✎ 06-10 Over-torque Detection Level (OT2)

Factory Setting: 120

Settings 10 to 250% (100%: drive's rated current)

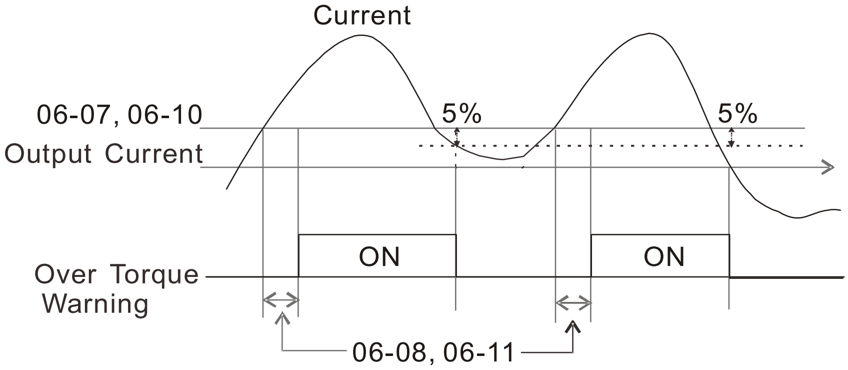
✎ 06-11 Over-torque Detection Time (OT2)

Factory Setting: 0.1

Settings 0.0~60.0 sec

🕮 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.

🕮 NOTE02: When Pr06-06 or Pr06-09 is set to 1 or 3, the motor drive will have the ot1/ot2 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.



🕮 NOTE03: When Pr06-06 or Pr06-09 is set to 2 or 4, the morot drive will have the ot1/ot2 fault after Over Torque Detection. Then the motor drive stop running until it is mnually reset.

✎ 06-12 Current Limit

Factory Setting: 170

Settings 0~250% (100%: drive's rated current)

🕮 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.

06-13 Electronic Thermal Relay Selection (Motor 1)

06-27 Electronic Thermal Relay Selection (Motor 2)

Factory Setting: 2

Settings 0: Constant torque output motor

1: Variable torque output motor

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.

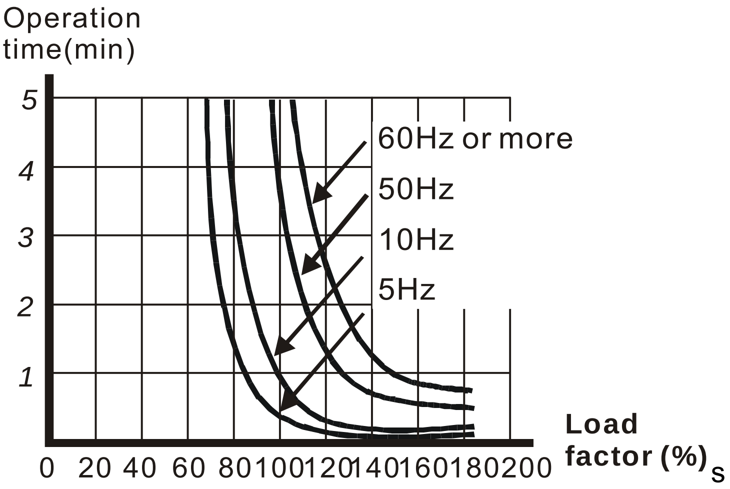
06-14 Electronic Thermal Characteristic for Motor 1

06-28 Electronic Thermal Characteristic for Motor 2

Factory Setting: 60.0

Settings 30.0~600.0 sec

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.



06-15 Heat Sink Over-heat (OH) Warning

Factory Setting: 85.0

Settings 0.0~110.0℃

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 (℃)		
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 (℃)		
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 (℃)		
VFD110C23A/E	100	75
VFD150C23A/E	95	70
VFD185C23A/E	95	70
VFD220C23A/E	95	70
VFD300C23A/E	95	60
VFD370C23A/E	95	60
VFD450C23A/E	100	60
VFD550C23A/E	100	60
VFD750C23A/E	100	60
VFD900C23A/E	100	60
VFD007C43A/E	100	90
VFD015C43A/E	100	90
VFD022C43A/E	100	95
VFD037C43A/E	100	100
VFD040C43A/E	100	95

Over-heating Level (℃)		
VFD300C43A/E	100	80
VFD370C43A/E	95	60
VFD450C43A/E	95	60
VFD550C43A/E	100	60
VFD750C43A/E	100	60
VFD900C43A/E	100	60
VFD1100C43A/E	100	60
VFD1320C43A/E	100	60
VFD1600C43A/E	100	60
VFD1850C43A/E	100	65
VFD2200C43A/E	100	65
VFD2800C43A/E	100	65
VFD3150C43A/E	100	65
VFD3550C43A/E	100	65

✓ **06-16** 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%.

06-17 Present Fault Record

06-18 Second Most Recent Fault Record

06-19 Third Most Recent Fault Record

06-20 Fourth Most Recent Fault Record

06-21 Fifth Most Recent Fault Record

06-22 Sixth Most Recent Fault Record

Settings	Can auto-reset after fault
0: No fault record	V (P07-10≠0 & P07-11≠0)
1: Over-current during acceleration (ocA)	V (P07-10≠0 & P07-11≠0)
2: Over-current during deceleration (ocd)	V (P07-10≠0 & P07-11≠0)
3: Over-current during constant speed(ocn)	V (P07-10≠0 & P07-11≠0)
4: Ground fault (GFF)	
5: IGBT short-circuit (occ)	V (P07-10≠0 & P07-11≠0)
6: Over-current at stop (ocS)	

7: Over-voltage during acceleration (ovA)	V (P07-10≠0 & P07-11≠0)
8: Over-voltage during deceleration (ovd)	V (P07-10≠0 & P07-11≠0)
9: Over-voltage during constant speed (ovn)	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 (Hd0)	
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) V (P07-10≠0)

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/△-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

- When the fault occurs and force stopping, it will record in this parameter.
- At stop with low voltage Lv (LvS warn, no record). During operation with mid-low voltage Lv (LvA, Lvd, Lvn error, will record).
- Setting 62: when dEb function is enabled, the drive will execute dEb and record to the Pr.06-17 to Pr.06-22 simultaneously.

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

Factory Setting: 0

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

- 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)	●						
2: Over-current during deceleration (ocd)	●						
3: Over-current during constant speed(ocn)	●						
4: Ground fault (GFF)	●						
5: IGBT short-circuit (occ)	●						
6: Over-current at stop (ocS)	●						
7: Over-voltage during acceleration (ovA)		●					
8: Over-voltage during deceleration (ovd)		●					
9: Over-voltage during constant speed (ovn)		●					
10: Over-voltage at stop (ovS)		●					
11: Low-voltage during acceleration (LvA)		●					
12: Low-voltage during deceleration (Lvd)		●					
13: Low-voltage during constant speed (Lvn)		●					
14: Stop mid-low voltage (LvS)		●					
15: Phase loss protection (OrP)		●					
16: IGBT over-heat (oH1)			●				
17: Capacitance over-heat (oH2)			●				
18: tH1o (TH1 open)			●				
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)			●				
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 (Hd0)				●			
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)						●	

Fault Code	Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6
	current	Volt.	OL	SYS	FBK	EXI	CE
61: Y-connection/△-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: 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							●

06-29 PTC (Positive Temperature Coefficient) Detection Selection

Factory Setting: 0

Settings 0: Warn and keep operating
1: Warn and ramp to stop
2: Warn and coast to stop
3: No warning

🕮 Pr.06-29 setting defines how the will drive operate after PTC detection. 再補充 03-00 d6

06-30 PTC Level

Factory Setting: 50.0

Settings 0.0~100.0%

🕮 It needs to set AVI/ACI/AUI analog input function Pr.03-00~03-02 to 6 (P.T.C. thermistor input value).

🕮 It is used to set the PTC level, and the corresponding value for 100% is max. analog input value.

⌁ 06-31 Frequency Command for Malfunction

Factory Setting: Read only

Settings 0.00~655.35Hz

🕮 When malfunction occurs, use can check the frequency command. If it happens again, it will overwrite the previous record.

06-32 Output Frequency at Malfunction

Factory Setting: Read only

Settings 0.00~655.35Hz

🕮 When malfunction occurs, use can check the current frequency command. If it happens again, it will overwrite the previous record.

06-33 Output Voltage at Malfunction

Factory Setting: Read only

Settings 0.0~6553.5V

🕮 When malfunction occurs, user can check current output voltage. If it happens again, it will overwrite the previous record.

06-34 DC Voltage at Malfunction

Factory Setting: Read only

Settings 0.0~6553.5V

🕮 When malfunction occurs, user can check the current DC voltage. If it happens again, it will overwrite the previous record.

06-35 Output Current at Malfunction

Factory Setting: Read only

Settings 0.00~655.35Amp

🕮 When malfunction occurs, user can check the current output current. If it happens again, it will overwrite the previous record.

06-36 IGBT Temperature at Malfunction

Factory Setting: Read only

Settings 0.0~6553.5℃

🕮 When malfunction occurs, user can check the current IGBT temperature. If it happens again, it will overwrite the previous record.

06-37 Capacitance Temperature at Malfunction

Factory Setting: Read only

Settings 0.0~6553.5℃

🕮 When malfunction occurs, user can check the current capacitance temperature. If it happens again, it will overwrite the previous record.

06-38 Motor Speed in rpm at Malfunction

Factory Setting: Read only

Settings 0.0~6553.5℃

🕮 When malfunction occurs, user can check the current motor speed in rpm. If it happens again, it will overwrite the previous record.

06-39 Torque Command at Malfunction

Factory Setting: Read only

Settings 0~65535

🕮 When malfunction occurs, user can check the current torque command. If it happens again, it will overwrite the previous record.

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

Factory Setting: Read only

Settings 0000h~FFFFh

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

Factory Setting: Read only

Settings 0000h~FFFFh

🕮 When malfunction occurs, user can check the status of multi-function input/output terminals. If it happens again, it will overwrite the previous record.

06-42 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.

06-43 Reserved

06-44 Reserved

06-45 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

🕮 Pr.06-45 defines how the drive will operates when output phase loss occur.

06-46 Deceleration Time of Output Phase Loss

Factory Setting:0.500

Settings 0.000~65.535 sec

06-47 Current detection level of output phase loss

Factory Setting:1.00

Settings 0.00~655.35%

06-48 Output phase loss detection function executing time before run

Factory Setting:0.000

Settings 0.000~65.535 sec

🕮 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.

06-49 Reserved

06-50 Reserved

06-51 Reserved

06-52 Reserved

06-53 Treatment for the detected Input Phase Loss （OrP）

Factory Setting: 0

Settings 0: warn, ramp to stop

1: warn, coast to stop

🕮 Over ripple protection

🕮 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.

06-54 Reserved

06-55 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

🕮 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 50oC with independent installation and UL open-type. When the carrier frequency is set to 15kHz, 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 12kHz. In addition, it will also decrease the carrier frequency when overload. When the carrier frequency is 15kHz and the current is 120%*72%=86% for a minute, the carrier frequency will decrease to the factory setting.

🕮 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 15kHz 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)

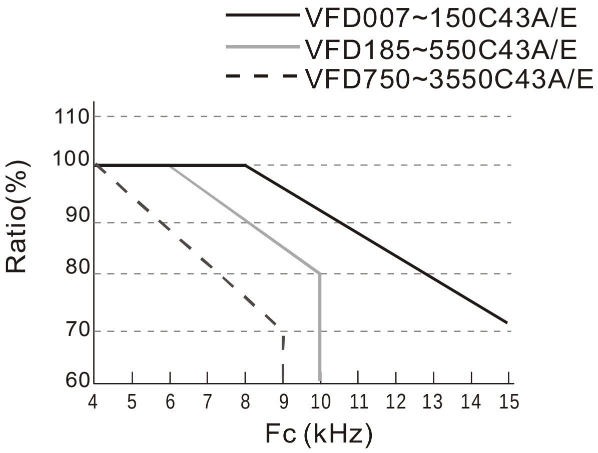
Pr.06-55=1

Pr.06-55=0 or 2

(50℃: UL open-type)

(40℃:UL type1 or open type_side by side)

460V

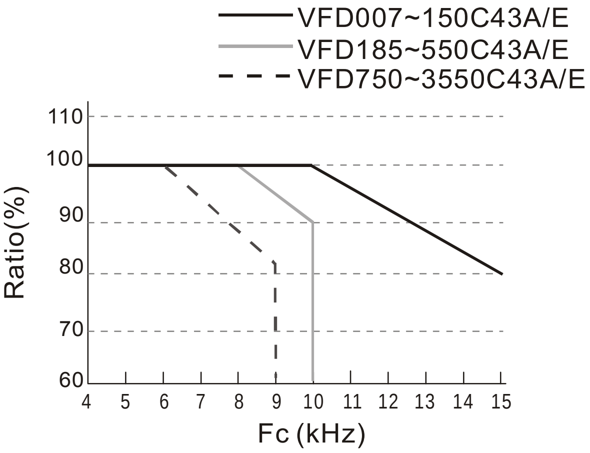


Pr.06-55=0 or 2

(40℃: UL open-type)

(30℃: UL type1 or open type_side by side)

460V



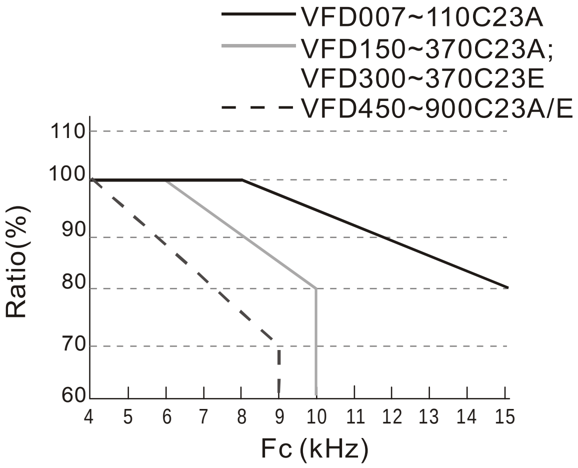
Setting=1

Setting=0 or 2

(50℃: UL open-type)

(40℃:UL type1 or open type_side by side)

230V

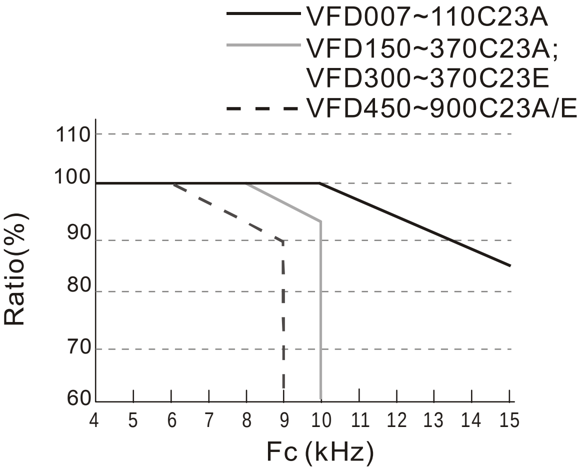


Setting=0 or 2

(40℃: UL open-type)

(30℃: UL type1 or open type_side by side)

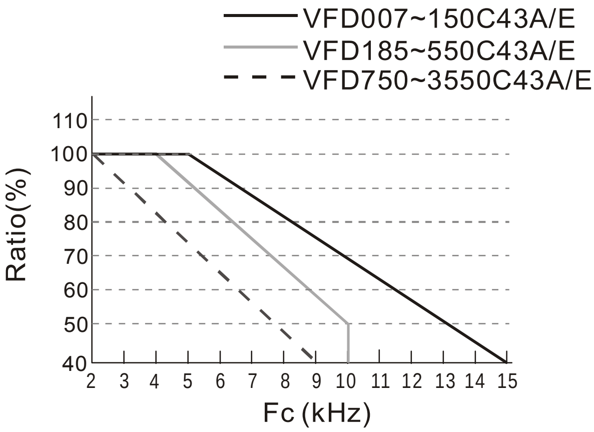
230V



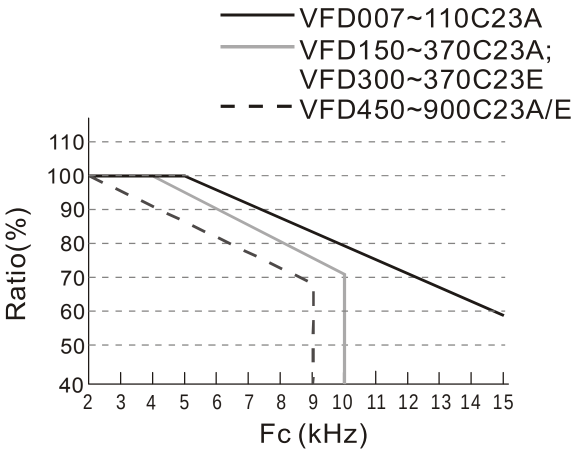
Derating curve diagram in the heavy duty (Pr.00-16=1)

Pr.06-55=1
Pr.06-55=0 or 2
(50℃: UL open-type)
(40℃: UL type1 or open type_side by side)

460V

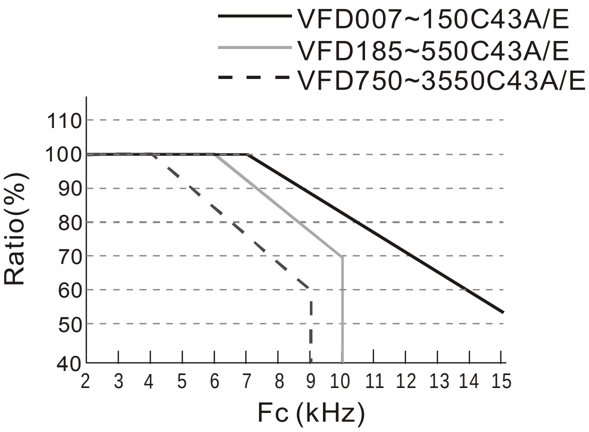


230V

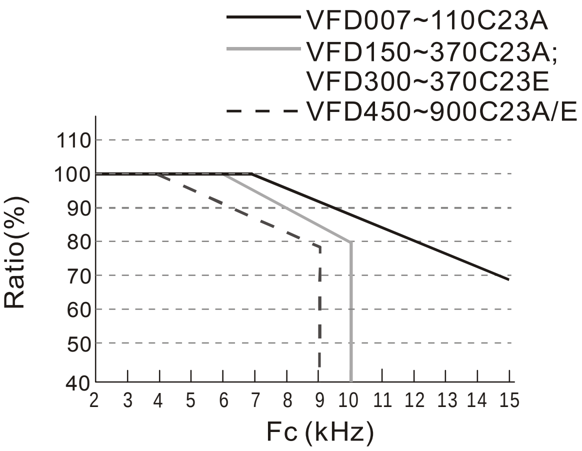


Pr.06-55=0 or 2
(40℃: UL open-type)
(30℃: UL type1 or open type_side by side)

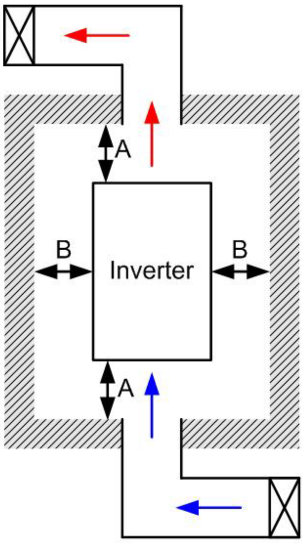
460V



230V



📖 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 (mm)	B (mm)	C (mm)	D (mm)
A~C	60	30	10	0
D~F	100	50	-	0
G	200	100	-	0
H	350	0	0	200 (100, Ta=40℃)

Air flow rate for cooling							Power dissipation of AC motor drive		
Model No.	Flow Rate (cfm)			Flow Rate (m^3/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.

※ 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.

※ When installing multiple drives, volume of heat dissipation should be the heat dissipated for single drive X the number of the drives.

※ Heat dissipation for each model is calculated by rated voltage, current and default carrier.

06-56 PT100 Detection Level 1

Factory Setting:5.000

Settings 0.000~10.000V

06-57 PT100 Detection Level 2

Factory Setting: 7.000

Settings 0.000~10.000V

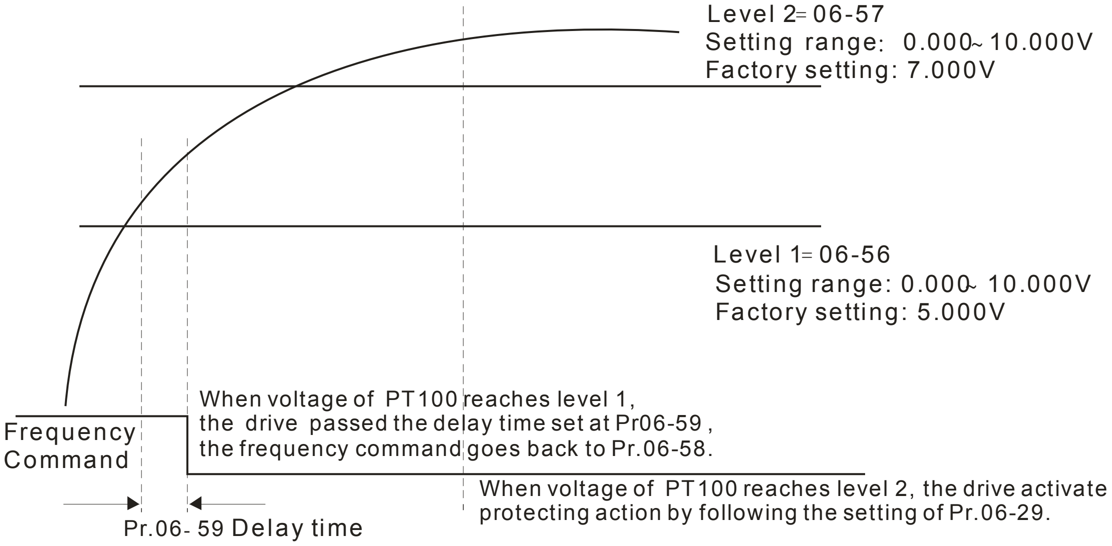
- Make sure Pr. 06-57 > Pr.06-56.

06-58 PT100 Level 1 Frequency Protection

Factory Setting: 0.00

Settings 0.00~600.00 Hz

- PT100 operation
  1. Use AVI, AUI or ACI(set to 0-10V) 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) ACI (Pr.03-01=11 and Pr.03-29=1).
  3. When using ACI as analog voltage input, set Pr.03-01=11 and Pr.03-29=1. Then switch SW2 to 0-10V on the I/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 9mA by setting Pr.03-33=45. The AFM2 constant output current is 20mA * 45% = 9mA.
  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:

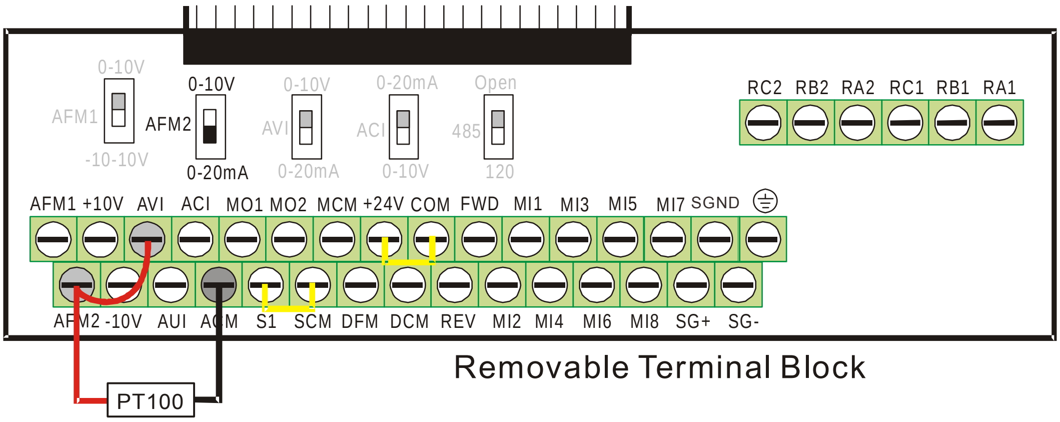


Figure 1

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

Example:
A PT100 is installed to the drive. If motor temperature reaches 135℃ (275°F) 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℃(275°F) or lower. If motor temperature exceeds 150℃(302°F), the motor will decelerate to stop and outputs an 'OH3' warning.

Set up process:

1. Switch AFM2 (SW2) to 0-20mA 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%(9mA)
4. Refer to RTD temperature and resistance comparison table
   Temperature=135℃, resistance=151.71Ω; Input current: 9mA, Voltage: approximately: 1.37Vdc
   Temperature=150℃, resistance=157.33Ω; Input current:9mA, Voltage: approximately: 1.42Vdc
5. Set Pr.06=56=1.37 and Pr.06-58=10Hz. When RTD temperature increases to 135℃ 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℃ or higher, the drive will decelerate to stop and outputs an 'OH3' warning.

06-59 Reserved

06-60 Software Detection GFF Current Level

Factory Setting: 60.0

Settings 0.0~6553.5 %

06-61 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.

🕮 When 3-phase current output unbalance value has exceeds Pr06-60 setting, drive will trip up GFF and stop output immediately.

06-62 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

06-63 Fault Record 1 (day)
06-65 Fault Record 2 (day)
06-67 Fault Record 3 (day)
06-69 Fault Record 4 (day)

Factory Setting: Read only

Settings 0~65535 days

06-64 Fault Record 1 (min)
06-66 Fault Record 2 (min)
06-68 Fault Record 3 (min)
06-70 Fault Record 4 (min)

Factory Setting: Read only

Settings 0~1439 min

🕮 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.

🕮 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 after operating.

Second fault	Pr.06-17	ovd
	Pr.06-18	ovA

Pr.06-63	3482	*3482-3000=482 min* ovd occurs at 482 min after last fault (ovA)
Pr.06-64	3000	

Third fault	Pr.06-17	ovA

Pr.06-63	4051	*4051-3482=569 min* ovA occurs at 569 min after last fault (ovd)

	Pr.06-18	ovd	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 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	

06-71 Low Current Setting Level

Factory Setting: 0.0

Settings 0.0 ~ 6553.5 %

06-72 Low Current Detection Time

Factory Setting: 0.00

Settings 0.00 ~ 655.35 sec

06-73 Treatment for low current

Factory Setting: 0

Settings
0 : No function
1 : warn and coast to stop
2 : warn and ramp to stop by 2nd deceleration time
3 : warn and operation continue

🕮 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.

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07 Special Parameters

✎ This parameter can be set during operation.

✎ **07-00** Software Brake Level

Factory Setting: 380.0/760.0

Settings 230V series: 350.0~450.0Vdc

460V series: 700.0~900.0Vdc

🕮 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.

🕮 It is only valid for the models below 30kW of 460 series and 22kW of 230 series.

✎ **07-01** DC Brake Current Level

Factory Setting: 0

Settings 0~100%

🕮 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.

🕮 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.

✎ **07-02** DC Brake Time at Start-up

Factory Setting: 0.0

Settings 0.00~60.0 sec

🕮 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.

✎ **07-03** DC Brake Time at Stop

Factory Setting: 0.00

Settings 0.00~60.00 sec

🕮 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.

🕮 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.

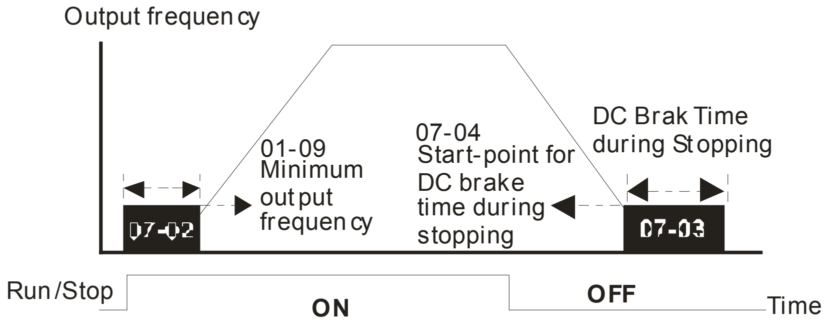
🕮 Related parameters: Pr.00-22 Stop Method, Pr.07-04 Start-point for DC Brake

✎ 07-04 Start-Point for DC Brake

Factory Setting: 0.00

Settings 0.00~600.00Hz

🕮 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.



DC Brake Time

🕮 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.

🕮 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.

07-05 Voltage 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.

✎ 07-06 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

🕮 This parameter determines the operation mode when the AC motor drive restarts from a momentary power loss.

🕮 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.

- 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.
- 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.
- 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.

✓ 07-07 Maximum Power Loss Duration

Factory Setting: 2.0

Settings 0.1~20.0 sec

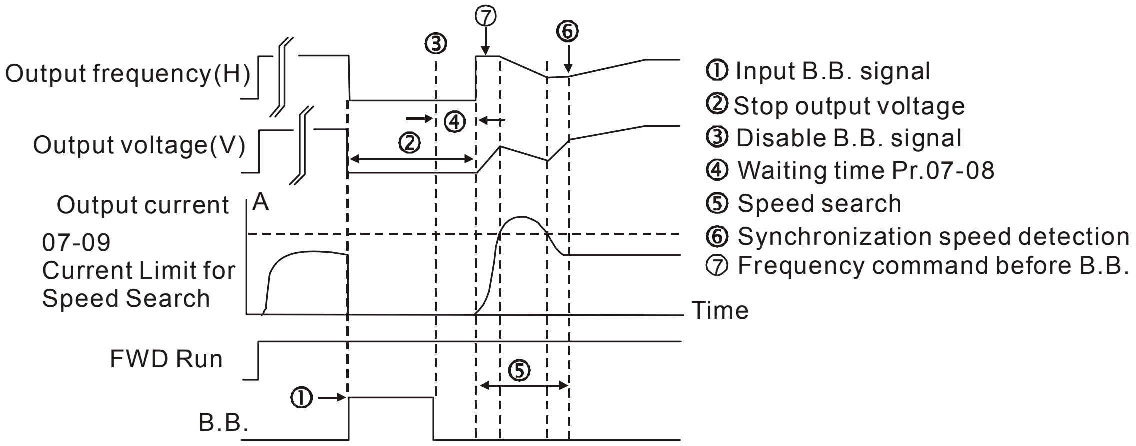
- If the duration of a power loss is less than this parameter setting, the AC motor drive will resume operation. If it exceeds the Maximum Allowable Power Loss Time, the AC motor drive output is then turned off (coast stop).
- The selected operation after power loss in Pr.07-06 is only executed when the maximum allowable power loss time is ≤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 ≤5 seconds, the operation mode as set in Pr.07-06 is not executed. In that case it starts up normally.

✓ 07-08 Base block Time

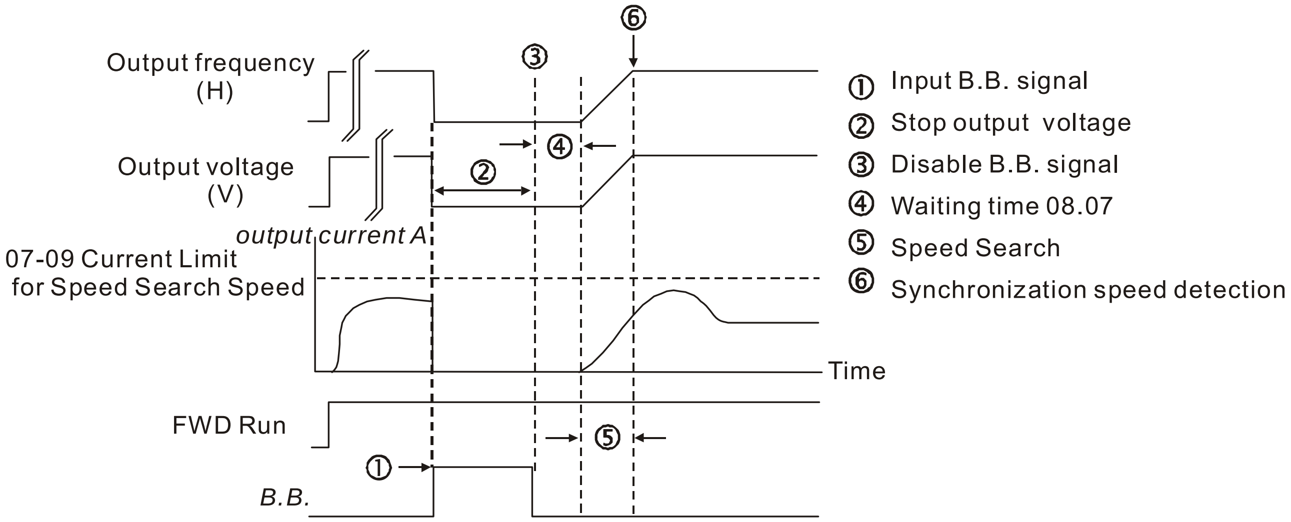
Factory Setting: 0.5

Settings 0.1~5.0 sec

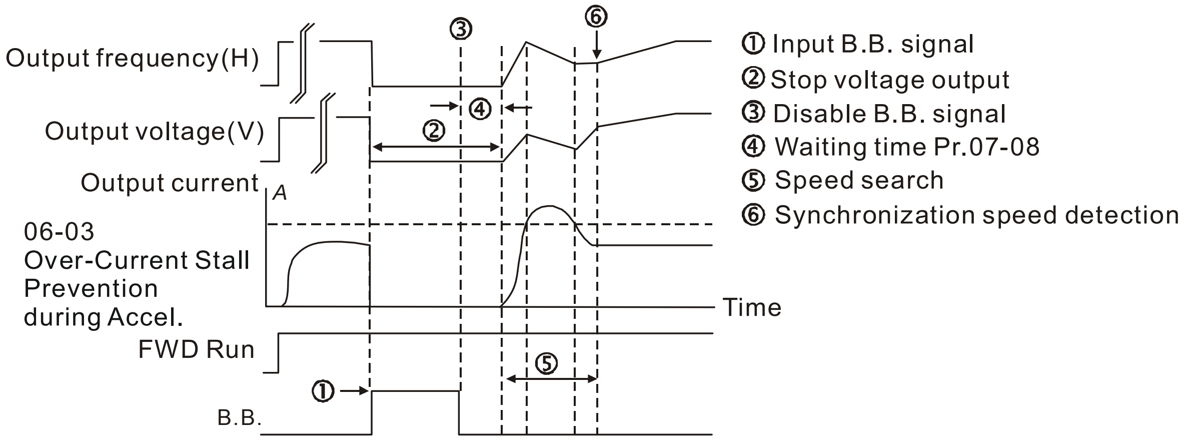
- When momentary power loss is detected, the AC drive will block its output and then wait for a specified period of time (determined by Pr.07-08, called Base-Block Time) before resuming operation. This parameter should be set at a value to ensure that any residual regeneration voltage from the motor on the output has disappeared before the drive is activated again.



B.B. Search with last output frequency downward timing chart



B.B. Search with minimum output frequency upward timing chart



B.B. Search with minimum output frequency upward timing chart

✎ 07-09 Current Limit for Speed Search

Factory Setting: 50

Settings 20~200%

- 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.
- 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.
- 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.

✎ 07-10 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

- 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.

- Fault includes: bb,oc,ov,occ. To restart after oc, ov, occ, Pr.07-11 can not be set to 0.

07-11 Auto Restart Time after Fault

Factory Setting: 0

Settings 0~10

- After fault (oc, ov, occ) occurs, the AC motor drive can be reset/restarted automatically up to 10 times.
- 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.
- 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.

07-12 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

- 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.
- 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.

07-13 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

- This parameter is used for the decel. time selection for momentary power loss.

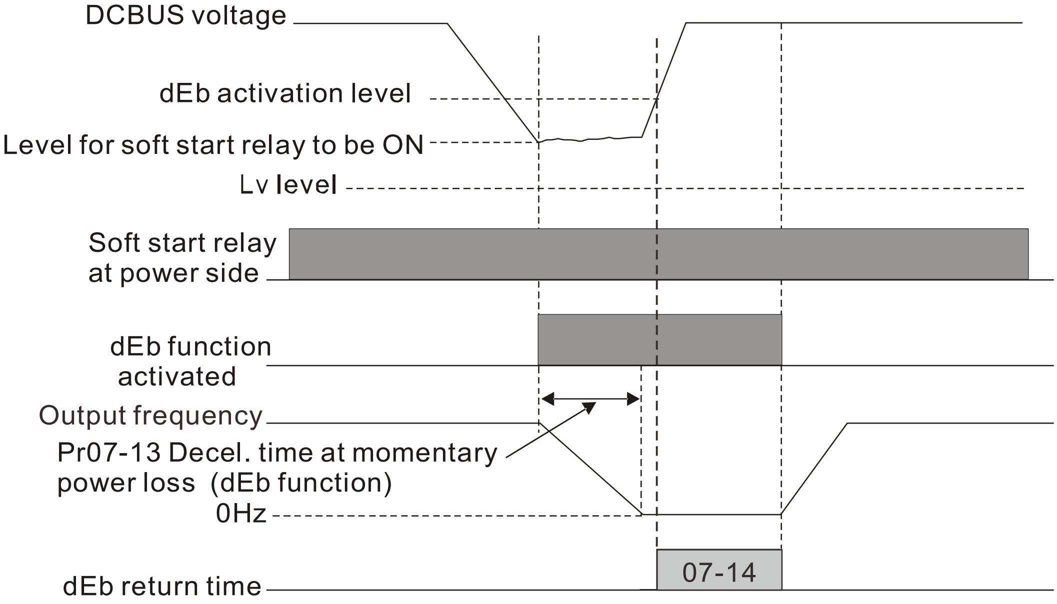
07-14 dEb Return Time

Factory Setting: 0.0

Settings 0.0~25.0 sec

📖 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

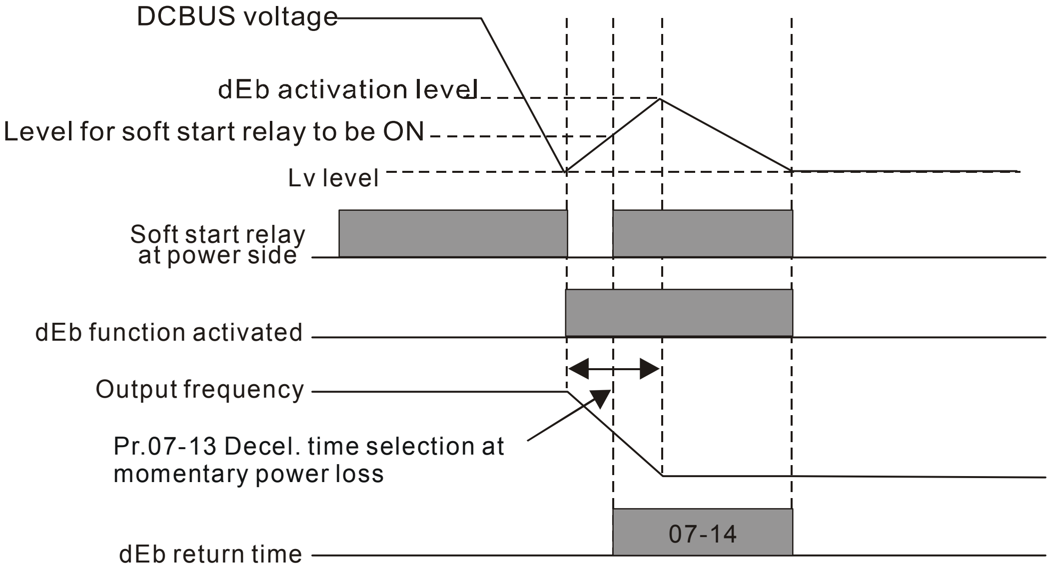


Note (1)When Pr07-14 is set to 0, the motor drive will stop and will not accelerate to the frequency before dEb even the power is on again. But when Pr07-14 is NOT set to 0, then a commad of zero speed will be sent to wait for power on.

Note (2) dEb activation level is when DCBUS voltage level is lower than (230V series : Lv level +20Vdc)

(460V series: Lv level +40Vdc)

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.

07-15 Dwell Time at Accel.

Factory Setting: 0.00

Settings 0.00~600.00 sec

07-16 Dwell Frequency at Accel.

Factory Setting: 0.00

Settings 0.00~600.00Hz

07-17 Dwell Time at Decel.

Factory Setting: 0.00

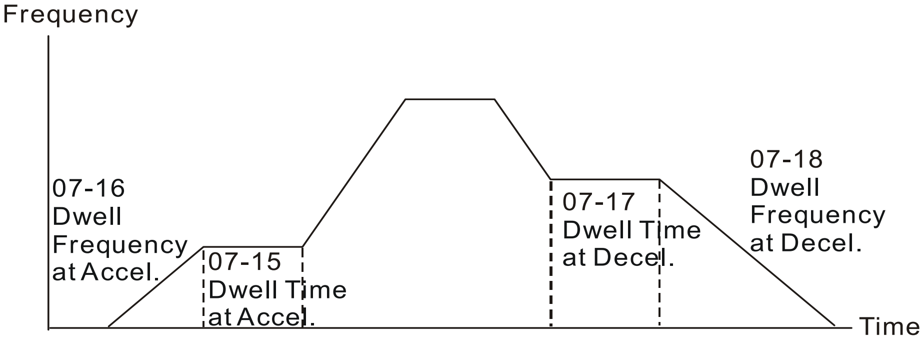
Settings 0.00~600.00 sec

07-18 Dwell Frequency at Decel.

Factory Setting: 0.00

Settings 0.00~600.00 Hz

- In the heavy load situation, Dwell can make stable output frequency temporarily, such as crane or elevator.
- Pr.07-15 to Pr.07-18 is for heavy load to prevent OV or OC occurs.



Dwell at accel./decel.

07-19 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°C) is attained.

4: Fan always OFF

- This parameter is used for the fan control.
- Setting 0: Fan will be ON as the drive's power is turned ON.
- Setting 1: 1 minute after AC motor drive stops, fan will be OFF
- Setting 2: AC motor drive runs and fan will be ON. AC motor drive stops and fan will be OFF.
- Setting 3: Fan run according to IGBT and capacitance temperature. Fan will be ON when preliminary capacitance temperature is higher than 60oC. Fan will be OFF, when capacitance temperature is lower than 40oC.
- Setting 4: Fan is always OFF

07-20 Emergency Stop (EF) & Force Stop

Factory Setting: 0

Settings 0: Coast to stop

1: Stop by 1st deceleration time

2: Stop by 2nd deceleration time

3: Stop by 3rd deceleration time

4: Stop by 4th deceleration time

5: System Deceleration (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.

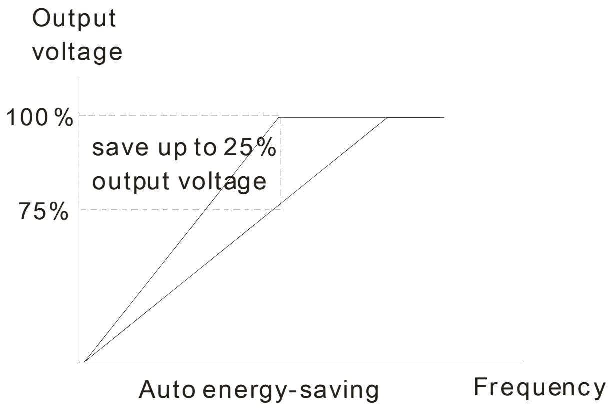
✎ 07-21 Auto Energy-saving Operation

Factory Setting: 0

Settings 0: Disable

1: Enable

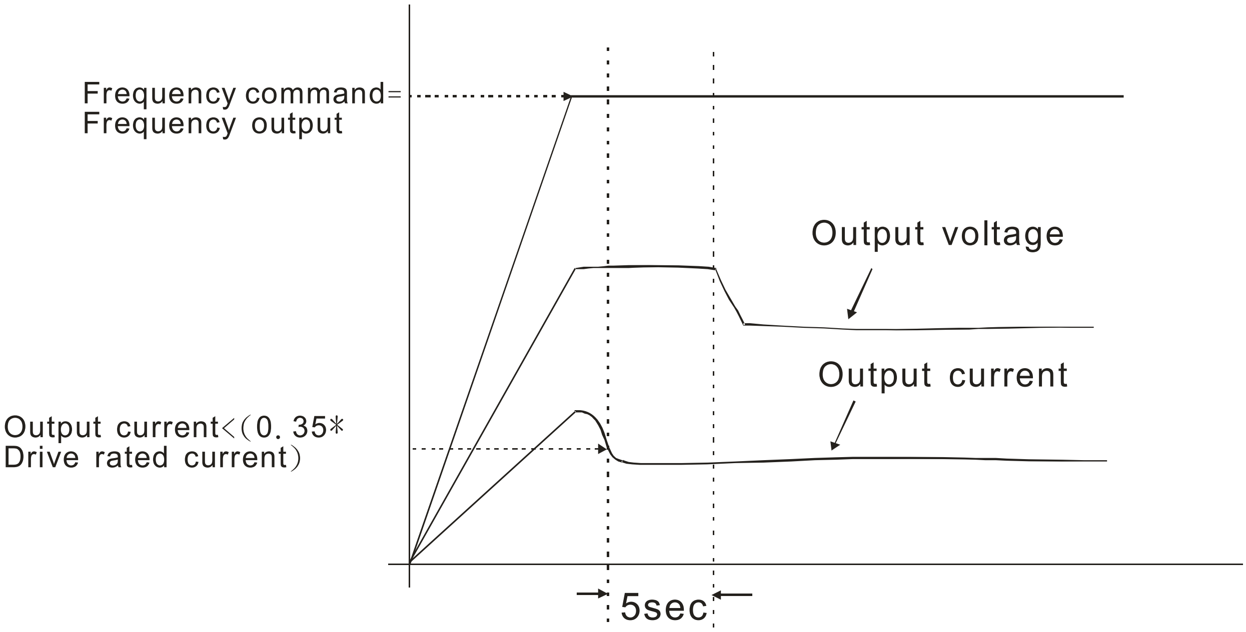
- When Pr.07-21 is set to 1, the acceleration and deceleration will operate with full voltage. During constant speed operation, it will auto calculate the best voltage value by the load power for the load. This function is not suitable for the ever-changing load or near full-load during operation.
- 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.



- 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.

- VF, VFPG, SVC control mode:
  When drive is running at constant speed and the U, V, W output power factor angle cos(phi)>=65.0° (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: (cos(phi)<60.0°) 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.



07-22 Energy-saving Gain

Factory Setting: 100

Settings 10~1000%

- When Pr. 07-21 is set to 1, this parameter can be used to adjust the gain of energy-saving. The factory setting is 100%. If the result is not good, it can adjust by decreasing the setting. If the motor oscillates, it should increase the setting value.
- 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.

07-23 Auto Voltage Regulation(AVR) Function

Factory Setting: 0

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

- The rated voltage of the motor is usually 220V/200VAC 60Hz/50Hz and the input voltage of the AC motor drive may vary between 180V to 264 VAC 50Hz/60Hz. Therefore, when the AC motor drive is used without AVR function, the output voltage will be the same as the input voltage. When the motor runs at voltages exceeding the rated voltage with 12% - 20%, its lifetime will be shorter and it can be damaged due to higher temperature, failing insulation and unstable torque output.
- AVR function automatically regulates the AC motor drive output voltage to the motor rated voltage. For instance, if V/f curve is set at 200 VAC/50Hz and the input voltage is at 200V to 264VAC, then the motor Output Voltage will automatically be reduced to a maximum of 200VAC/50Hz. If the input voltage is at 180V to 200VAC, output voltage to motor and input power will be in direct proportion.
- Setting 0: when AVR function is enabled, the drive will calculate the output voltage by actual

DC-bus voltage. The output voltage won't be changed by DC bus voltage.

- Setting 1: when AVR function is disabled, the drive will calculate the output voltage by DC-bus voltage. The output voltage will be changed by DC bus voltage. It may cause insufficient/over current.
- Setting 2: the drive will disable the AVR during deceleration, such as operated from high speed to low speed.
- When the motor ramps to stop, the deceleration time is longer. When setting this parameter to 2 with auto acceleration/deceleration, the deceleration will be quicker.
- When it is in FOCPG or TQCPG, it is recommended to set to 0 (enable AVR).

✓ **07-24** Filter Time of Torque Command (V/F and SVC control mode)

Factory Setting: 0.020

Settings 0.001~10.000 sec

- 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.

✓ **07-25** Filter Time of Slip Compensation (V/F and SVC control mode)

Factory Setting: 0.100

Settings 0.001~10.000 sec

- It can set Pr.05-22 and 05-23 to change the response time of compensation.
- 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.

✓ **07-26** Torque Compensation Gain (V/F and SVC control mode)

Factory Setting: 0

Settings 0~10

- 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.
- 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.
- 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.

✓ **07-27** Slip Compensation Gain (V/F and SVC control mode)

Factory Setting: 0.00

Settings 0.00~10.00

- 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.

- 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 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.
- 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.
- 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.

07-28 Reserved

✎ 07-29 Slip Deviation Level

Factory Setting: 0

Settings 0~100.0%

0: No detection

✎ 07-30 Detection Time of Slip Deviation

Factory Setting:1.0

Settings 0.0~10.0 sec

✎ 07-31 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

- The Pr.07-29 to Pr.07-31 are to set allowable slip level/time and over slip treatment when the drive is running.

✎ 07-32 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.05-29.)

✎ **07-33** Recovery Time to Pr.07-11 (# of automatic reboots after fault)

Factory Setting:60.0

Settings 00~6000.0 sec

🕮 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.

08 - 00 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

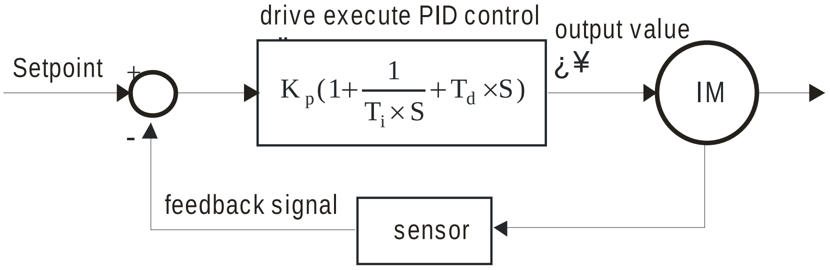
8: Positive PID feedback from communication protocol

- 🕮 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.
- 🕮 Positive feedback means: -target value + feedback. It is used for the detection value will be decreased by increasing the output frequency.
- 🕮 When Pr08-00≠7 neither ≠8, input value is disabled. The value of the setting remain the same after the derive is off.

Common applications for PID control

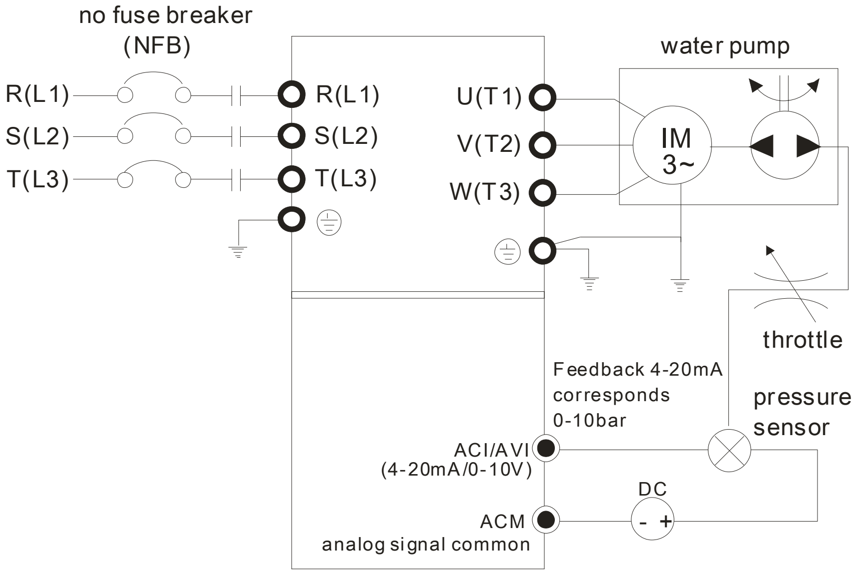
- ☑ Flow control: A flow sensor is used to feedback the flow data and performs accurate flow control.
- ☑ Pressure control: A pressure sensor is used to feedback the pressure data and performs precise pressure control.
- ☑ Air volume control: An air volume sensor is used to feedback the air volume data to have excellent air volume regulation.
- ☑ Temperature control: A thermocouple or thermistor is used to feedback temperature data for comfortable temperature control.
- ☑ 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:



K_p: Proportional gain(P) T_i: Integral time(I) T_d: Derivative control(D) S: Operator

- 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.
- 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 4-20mA signal corresponding to 0-10 bar as feedback to the drive.



1. Pr.00-04 is set to 10 (Display PID analog feedback signal value (b) (%))
2. Pr.01-12 Acceleration Time will be set as required
3. Pr.01-13 Deceleration Time will be set as required
4. Pr.00-21=0 to operate from the digital keypad
5. Pr.00-20=0, the set point is controlled by the digital keypad
6. Pr.08-00=1 (Negative PID feedback from analog input)
7. ACI analog input Pr. 03-01 set to 5, PID feedback signal.
8. 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))

📖 Refer to Pr.08-00 to 08-21 for PID parameters settings.

⚡ 08-01 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.

⚡ 08-02 Integral Time (I)

Factory Setting:1.00

Settings 0.00~100.00 sec
0.00: Disable

📖 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.

📖 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.

- When the integral time is too small, it may cause system oscillation.
- If the integral time is set as 0.00, Pr.08-02 will be disabled.

✎ 08-03 Derivative Control (D)

Factory Setting:0.00

Settings 0.00~1.00 sec

- 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.
- 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.
- 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.

✎ 08-04 Upper limit of Integral Control

Factory Setting:100.0

Settings 0.0~100.0%

- 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 %).
- 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.

✎ 08-05 PID Output Frequency Limit

Factory Setting:100.0

Settings 0.0~110.0%

- This parameter defines the percentage of output frequency limit during the PID control. The formula is Output Frequency Limit = Maximum Output Frequency (Pr.01-00) X Pr.08-05 %.

✎ 08-06 PID feedback value by communication protocol

Factory Setting: 0.00

Settings 0.00~200.00%

✎ 08-07 PID Delay Time

Factory Setting: 0.0

Settings 0.0~35.0 sec

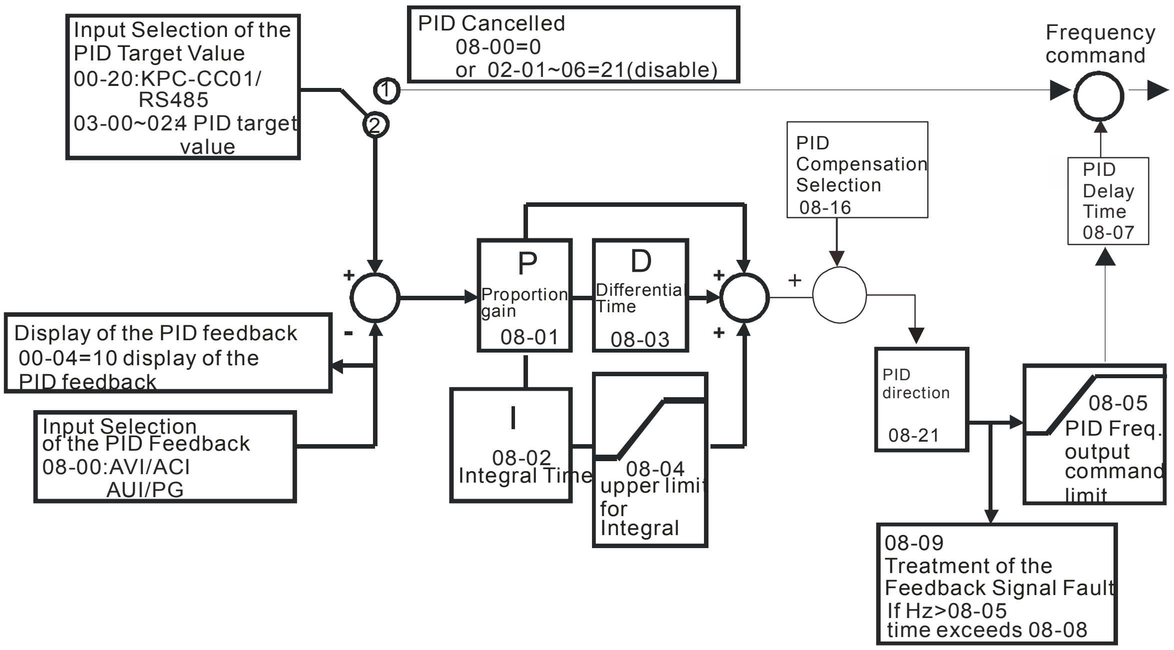
08-20 PID Mode Selection

Factory Setting: 0

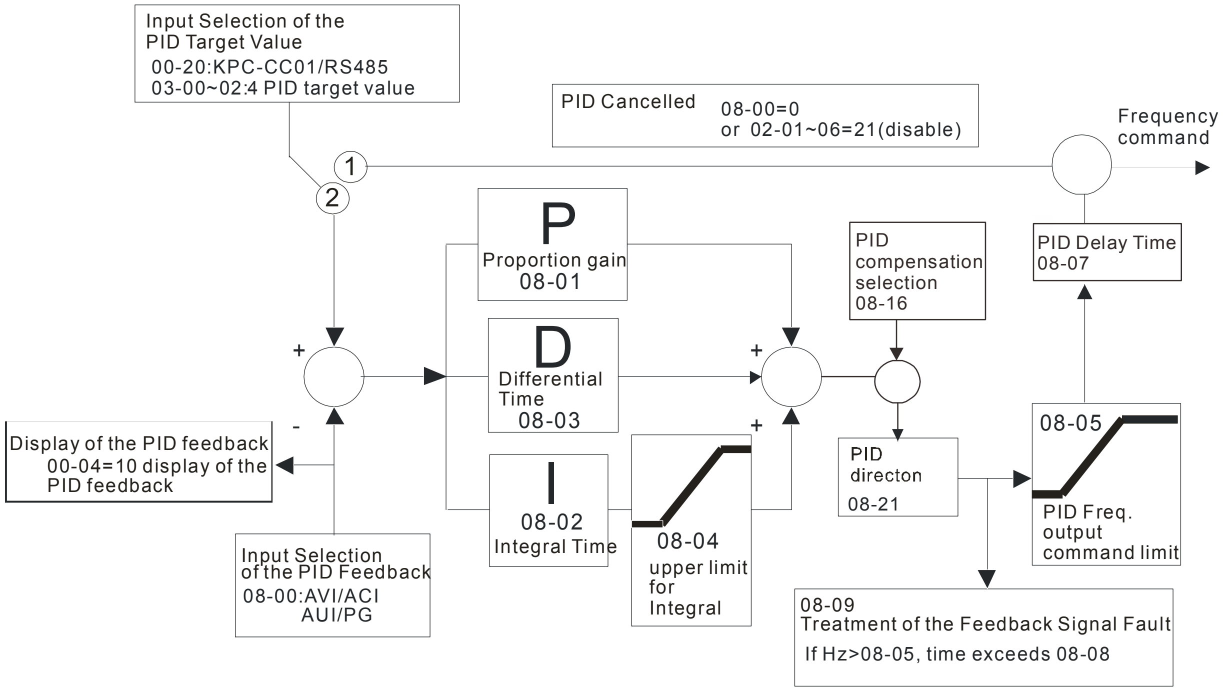
Settings 0: Serial connection
1: Parallel connection

- 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.
- 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.
- 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.
- Inappropriate setting of delay time may cause system error.
- PI Control: controlled by the P action only, and thus, the deviation cannot be eliminated entirely. To eliminate residual deviations, the P + 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.
- 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.
- 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



08-08 Feedback Signal Detection Time

Factory Setting: 0.0

Settings 0.0~3600.0 sec

- Pr.08-08 is valid only for ACI 4-20mA.
- This parameter sets the detection time of abnormal PID derative. If detection time is set to 0.0, detection function is disabled.

08-09 Feedback Signal Fault Treatment

Factory Setting: 0

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

📖 This parameter is valid only for ACI 4-20mA.

📖 AC motor drive acts when the feedback signals analog PID feedback is abnormal.

✓ 08-10 Sleep Reference

Factory Setting: 0.00

Settings 0.00~600.00Hz

📖 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.

✓ 08-11 Wake-up Reference

Factory Setting: 0.00

Settings 0.00~600.00Hz

📖 When Pr08-18 = 0, the unit of Pr08-10 and that of Pr08-11 become frequency. The settings then become 0 ~ 600.0 Hz.

📖 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%.

📖 And the percentage is based on the input command not maximum. E.g. If the maximum is 100 Kg, the command now is 30kg, if 08-11=40%, it is 12kg.

📖 The same to 08-10.

✓ 08-12 Sleep Time

Factory Setting: 0.0

Settings 0.00~6000.0 sec

📖 When the frequency command is smaller than the sleep frequency and less than the sleep time, the frequency command is equal to the sleep frequency. However the frequency command remains at 0.00Hz until the frequency command becomes equal to or bigger than the wake-up frequency.

✓ 08-13 PID Deviation Level

Factory Setting: 10.0

Settings 1.0~50.0%

✓ 08-14 PID Deviation Time

Factory Setting: 5.0

Settings 0.1~300.0 sec

✓ 08-15 Filter Time for PID Feedback

Factory Setting: 5.0

Settings 0.1~300.0 sec

📖 When the PID control function is normal, it should calculate within a period of time and close to the target value.

- Refer to the PID control diagram for details. When executing PID feedback control, if |PID reference target value – detection value| > Pr.08-13 PID Deviation Level and exceeds Pr.08-14 setting, the PID control fault occurs. The treatment will be done as Pr.08-09 setting.

⌁ 08-16 PID Compensation Selection

Factory Setting: 0

Settings 0: Parameter setting (Pr.08-17)

1: Reserved

- Pr08-16=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).

⌁ 08-17 PID Compensation

Factory Setting: 0

Settings -100.0~+100.0%

- The PID compensation value=Max. PID target value×Pr08-17. For example, the max. output frequency Pr01-00=60Hz, Pr08-17=10.0%, PID compensation value will increase output frequency 6.00Hz. 60.00Hz × 100.00% × 10.0% = 6.00Hz

08-18 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.
- 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%.

08-19 Wake-up Integral Limit

Factory Setting: 50.0

Settings 0.0~200.0%

- 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%)
- The Pr08-19 is used to reduce the reaction time from sleep to wake-up.

08-21 Enable PID to Change the Operation Direction

Factory Setting: 0

Settings 0: Disable change of direction

1: Enable change of direction

08-22 Wake-up delay time

Factory Setting: 0.00

Settings 0.00~600.00 sec.

Refer to Pr08-18 for more information.

08-23 PID Control Bit

Factory Setting: 0.00

Settings Bit0 =1, PID reverse running must follow the setting of Pr00-23

Bit0 = 0, PID reverse running follows PID’s calculated value

Bit0, When Pr08-21 = 1, PID reverse running is enable..

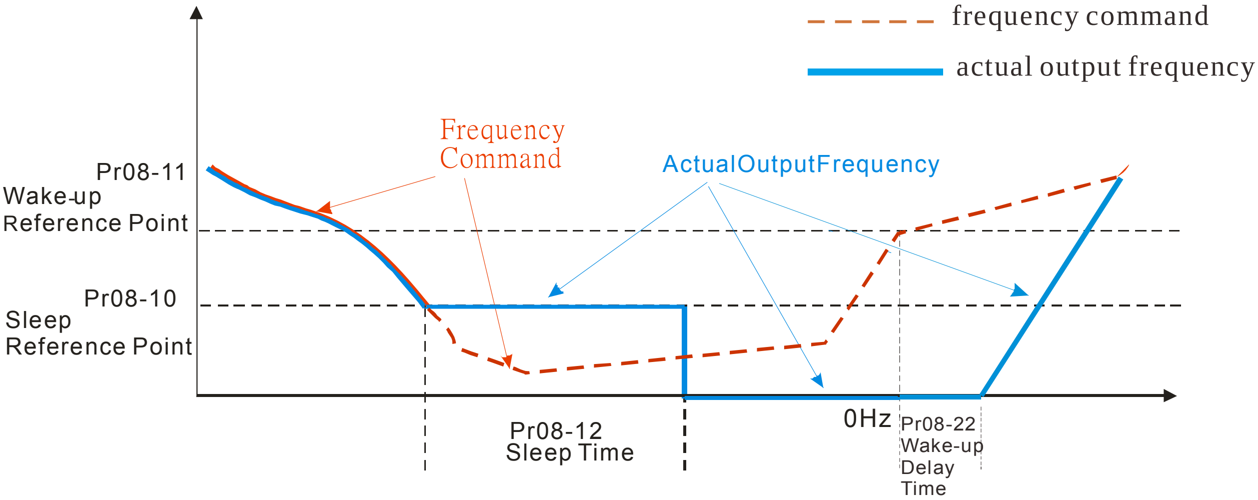
Bit0 = 0, if the PID calculated value is positive, it will be forward running. If the PID calculated value is negative, it will be reverse running.

There are three scenarios for sleep and wake-up frequency.

1) Frequency Command (PID is not in use, Pr08-=00

When the output frequency ≦ the sleep frequency, and the VFD reaches the preset sleep time, then the VFD will be at the sleep mode.

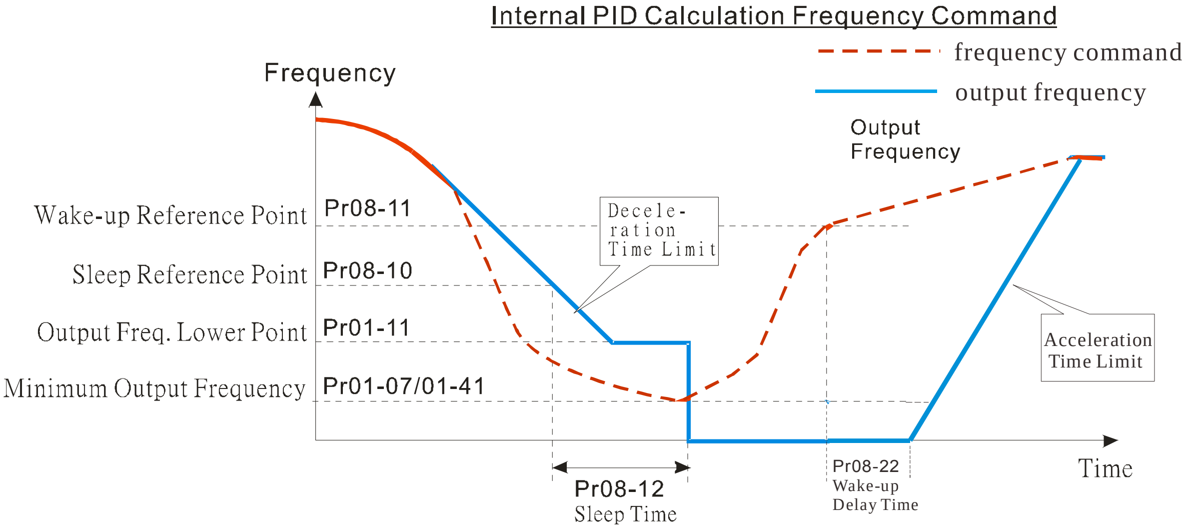
When the frequency command reaches the wake-up frequency, the VFD will start to count the wake-up delay time. Then when the VFD reaches the wake-up delay time, the VFD will begin acceleration time to reach the frequency command.



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 Hz).

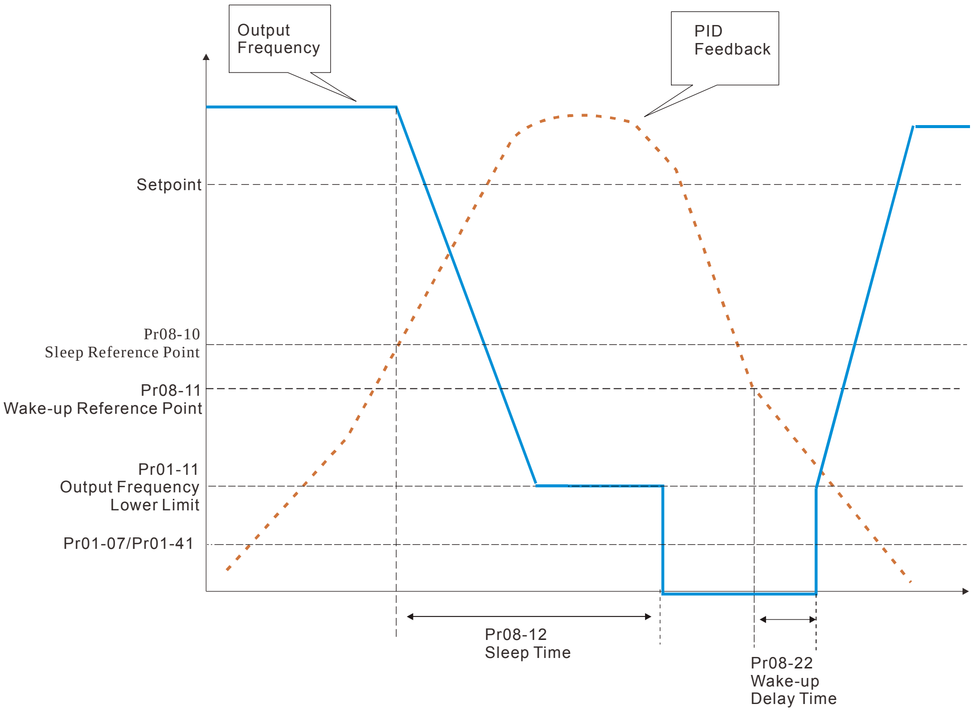
When the calculated frequency command reaches the wake-up frequency, the VFD will start to count the wake-up delay time. Once reaching the wake-up delay time, the VFD will start the acceleration time to reach the PID frequency command.



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 Hz).

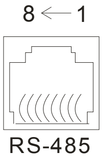
When PID feedback value reaches the wake up percentagethe motor drive will start to count the wake up delay time. Once reaches the wake up delay time, the motor drives starts the accelerating time to reach PID frequency command



09 Communication Parameters

✓ The parameter can be set during the operation.

When using communication devices, connects AC drive with PC by using Delta IFD6530 or IFD6500.



Modbus RS-485
Pin 1~2,7,8: Reserved
Pin 3, 6: GND
Pin 4: SG-
Pin 5: SG+

✓ 09 - 00 COM1 Communication Address

Factory Setting: 1

Settings 1~254

📖 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.

✓ 09 - 01 COM1 Transmission Speed

Factory Setting: 9.6

Settings 4.8~115.2Kbits/s

📖 This parameter is for set up the RS485 communication transmission speed.

✓ 09 - 02 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

📖 This parameter is set to how to react if transmission errors occur.

✓ 09 - 03 COM1 Time-out Detection

Factory Setting: 0.0

Settings 0.0~100.0 sec
0.0: Disable

📖 It is used to set the communication transmission time-out..

✓ 09 - 04 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

- Control by PC or PLC (Computer Link)
- 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.
- 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:

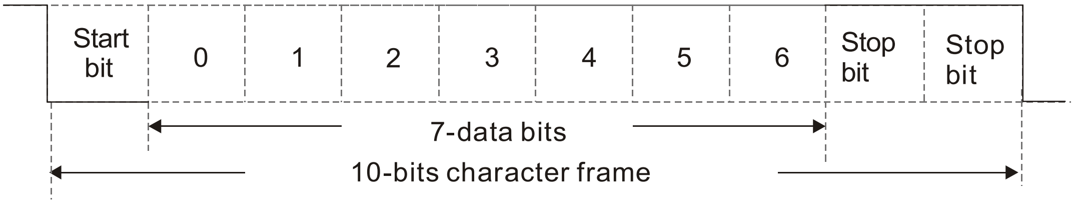
Character	‘0’	‘1’	‘2’	‘3’	‘4’	‘5’	‘6’	‘7’
ASCII code	30H	31H	32H	33H	34H	35H	36H	37H

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

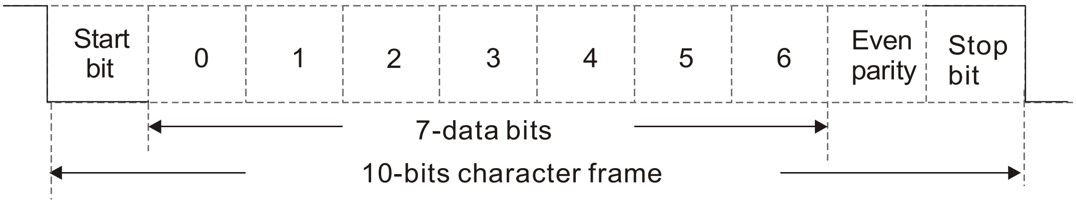
2. Data Format

10-bit character frame (For ASCII):

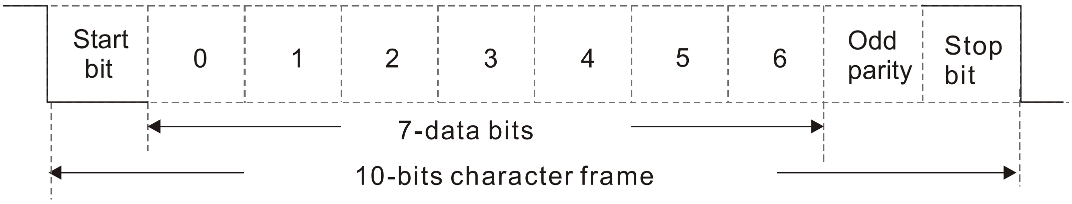
（7, N , 2）



（7 , E , 1）

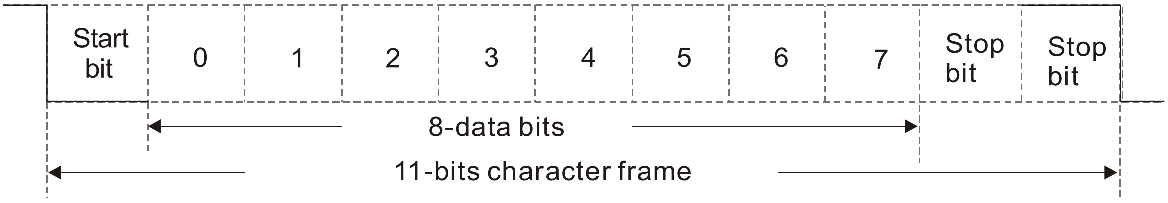


（7 , O , 1）

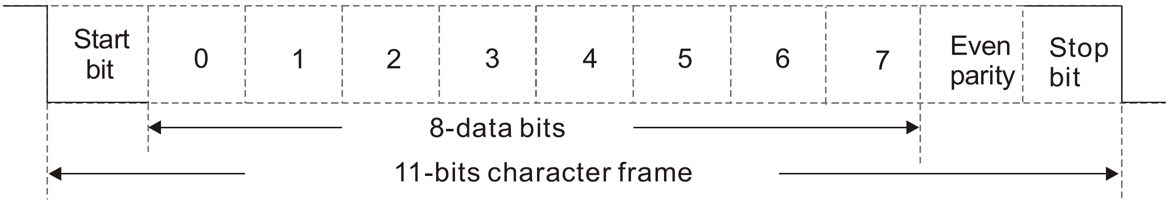


11-bit character frame (For RTU):

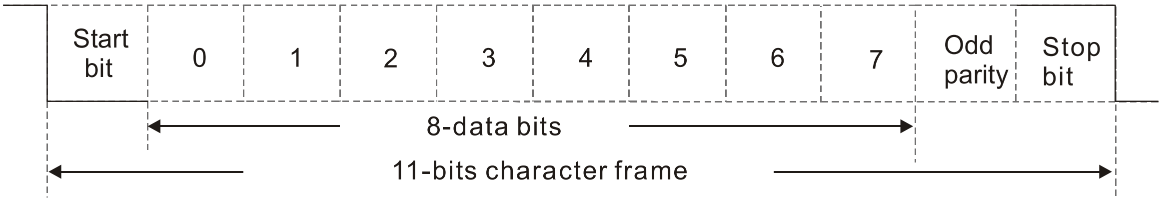
（8 , N , 2）



（8 , E , 1）



（8 , O , 1）



3. Communication Protocol

Communication Data Frame: **ASCII mode**

STX	Start character = ‘:’ (3AH)
Address Hi	Communication address: 8-bit address consists of 2 ASCII codes
Address Lo	
Function Hi	Command code: 8-bit command consists of 2 ASCII codes
Function Lo	
DATA (n-1)	Contents of data: Nx8-bit data consist of 2n ASCII codes n<=16, maximum of 32 ASCII codes
…….	
DATA 0	
LRC CHK Hi	LRC check sum: 8-bit check sum consists of 2 ASCII codes
LRC CHK Lo	
END Hi	End characters: END1= CR (0DH), END0= LF(0AH)
END Lo	

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 (n-1)	Contents of data: n×8-bit data, n<=16
…….	
DATA 0	
CRC CHK Low	CRC check sum: 16-bit check sum consists of 2 8-bit characters
CRC CHK High	
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
01H: AC drive of address 01
0FH: 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

06H: write single register

Example: reading continuous 2 data from register address 2102H, AMD address is 01H.

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	‘:’
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:

Address	01H
Function	03H
Starting data address	21H
	02H
Number of data (count by world)	00H
	02H

Response Message

Address	01H
Function	03H
Number of data (count by byte)	04H
Content of data address 2102H	17H
	70H

CRC CHK Low	6FH
CRC CHK High	F7H

Content of data address 2103H	00H
	00H
CRC CHK Low	FEH
CRC CHK High	5CH

06H: single write, write single data to register.

Example: writing data 6000(1770H) to register 0100H. AMD address is 01H.

ASCII mode:

Command Message:

STX	‘:’
Address	‘0’
	‘1’
Function	‘0’
	‘6’
Data address	‘0’
	‘1’
	‘0’
	‘0’
Data content	‘1’
	‘7’
	‘7’
	‘0’
LRC Check	‘7’
	‘1’
END	CR
	LF

Response Message

STX	‘:’
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	01H
Function	06H
Data address	01H
	00H
Data content	17H
	70H
CRC CHK Low	86H
CRC CHK High	22H

Response Message

Address	01H
Function	06H
Data address	01H
	00H
Data content	17H
	70H
CRC CHK Low	86H
CRC CHK High	22H

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 (1388H), Pr.04-01=40.00 (0FA0H). AC drive address is 01H.

ASCII Mode

Command Message:

STX	‘:’
ADR 1	‘0’
ADR 0	‘1’
CMD 1	‘1’
CMD 0	‘0’
Starting data address	‘0’
	‘5’
	‘0’
	‘0’
Number of data (count by word)	‘0’
	‘0’
	‘0’

Response Message

STX	‘:’
ADR 1	‘0’
ADR 0	‘1’
CMD 1	‘1’
CMD 0	‘0’
Starting data address	‘0’
	‘5’
	‘0’
	‘0’
Number of data (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:

ADR	01H
CMD	10H
Starting data address	05H 00H
Number of data (count by word)	00H 02H
Number of data (count by byte)	04
The first data content	13H 88H
The second data content	0FH A0H
CRC Check Low	'9'
CRC Check High	'A'

Response Message

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

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,

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

RTU mode:

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

Step 1:

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

Step 2:

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

Step 3:

Examine the LSB of CRC register.

Step 4:

If the LSB of CRC register is 0, shift the CRC register one bit to the right 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 CRC generation using C language. The function takes two arguments:

Unsigned char* data ← a pointer to the message buffer

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

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

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

return reg_crc;                              // return register CRC
```

4. Address list

Content	Address	Function	
AC drive parameters	GGnnH	GG means parameter group, nn means parameter number, for example, the address of Pr 4-01 is 0401H.	
Command write only	2000H	Bit1~0	00B：No function
			01B：Stop
			10B：Run
			11B：JOG+RUN
		Bit3~2	Reserved
		Bit5~4	00B：No function
			01B：FWD
			10B：REV
			11B：Change direction
		Bit7~6	00B：1st accel/decel.
			01B：2nd accel/decel
			10B：3rd accel/decel
			11B：4th accel/decel
		Bit11~8	000B: master speed
			0001B: 1st Step Speed Frequency
			0010B: 2nd Step Speed Frequency
			0011B: 3rd Step Speed Frequency
			0100B: 4th Step Speed Frequency
			0101B: 5th Step Speed Frequency
			0110B: 6th Step Speed Frequency
			0111B: 7th Step Speed Frequency
			1000B: 8th Step Speed Frequency
			1001B: 9th Step Speed Frequency
			1010B: 10th Step Speed Frequency
			1011B: 11th Step Speed Frequency
			1100B: 12th Step Speed Frequency
			1101B: 13th Step Speed Frequency
			1110B: 14th Step Speed Frequency
			1111B: 15th Step Speed Frequency
		Bit12	1: Enable bit06-11 function
		Bit14~13	00B：No function
			01B：Operated by digital keypad
			10B：Operated by Pr.00-21 setting
			11B：Change operation source
		Bit15	Reserved
	2001H	Frequency command	
	2002H	Bit0	1：EF (external fault) on
		Bit1	1：Reset
		Bit2	1：B.B ON
		Bit15~3	Reserved
Status monitor read only	2100H	Error code: refer to Pr.06-17 to Pr.06-22	
	2101H	Bit1~0	AC Drive Operation Status 00B: Drive stops 01B: Drive decelerating 10B: Drive standby 11B: Drive operating
		Bit2	1：JOG Command

Content	Address	Function	
		Bit4~3	Operation Direction 00B: FWD run 01B: From REV run to FWD run 10B: REV run 11B: From FWD run to REV run
		Bit8	1：Master frequency controlled by communication interface
		Bit9	1：Master frequency controlled by analog signal
		Bit10	1：Operation command controlled by communication interface
		Bit11	1：Parameter locked
		Bit12	1：Enable to copy parameters from keypad
		Bit15~13	Reserved
	2102H	Frequency command (F)	
	2103H	Output frequency (H)	
	2104H	Output current (AXX.X.X)	
	2105H	DC-BUS Voltage (UXXX.X)	
	2106H	Output voltage (EXXX.X)	
	2107H	Current step number of Multi-Step Speed Operation	
	2108H	Reserved	
	2109H	Counter value	
	210AH	Power Factor Angle (XXX.X)	
	210BH	Output Torque (%)	
	210CH	Actual motor speed (rpm)	
	210DH	Number of PG feed back pulses	
	210EH	Number of PG2 pulse commands	
	210FH	Power output (X.XXX)	
	2116H	Multi-function display (Pr.00-04)	
	211BH	Max. opeartion frequency (Pr.01-00) or Max. user defined value (Pr.00-26)	
	2200H	Display output current (A)	
	2201H	Display counter value (c)	
	2202H	Actual output frequency (H)	
	2203H	DC-BUS voltage (u)	
	2204H	Output voltage	
	2205H	Power angle	
	2206H	Display actual motor speed kW of U, V, W (P)	
	2207H	Display motor speed in rpm estimated by the drive or encoder feedback	
	2208H	Display positive/negative output torque in %, estimated by the drive (t0.0: positive torque, -0.0: negative torque)	
	2209H	Display PG feedback (as Pr. 00-04 NOTE 1)	
	220AH	PID feedback value after enabling PID function in % (b)	
	220BH	Display signal of AVI analog input terminal, 0-10V corresponds to 0-100% (1.) (as Pr. 00-04 NOTE 2)	
	220CH	Display signal of ACI analog input terminal, 4-V20mA/0-10V corresponds to 0-100% (2.) (as Pr. 00-04 NOTE 2)	
	220DH	Display signal of AUI analog input terminal, -10V~10V corresponds to -100~100% (3.) (as Pr. 00-04 NOTE 2)	
	220EH	IGBT temperature of drive power module in °C	
	220FH	The temperature of capacitance in °C	
	2210H	The status of digital input (ON/OFF), refer to Pr.02-12 (as Pr. 00-04 NOTE 3)	

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
	2220H	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 Pr 4-01 is 0401H.
	2225H	Carrier frequency of the drive
	2226H	Drive status
	2227H	Drive’s estimated output torque(positive or negative direction)
	2228H	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
	2230H	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:

STX	':'
Address	'0'
	'1'
Function	'8'
	'6'
Exception code	'0'
	'2'
LRC CHK	'7'
	'7'
END	CR
	LF

RTU mode:

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

The explanation of exception codes:

Exception code	Explanation
1	Illegal data value: The data value received in the command message is not available for the AC drive.
2	Illegal data address: The data address received in the command message is not available for the AC motor drive.
3	Parameters are locked: parameters can't be changed
4	Parameters can't be changed during operation
10	Communication time-out.

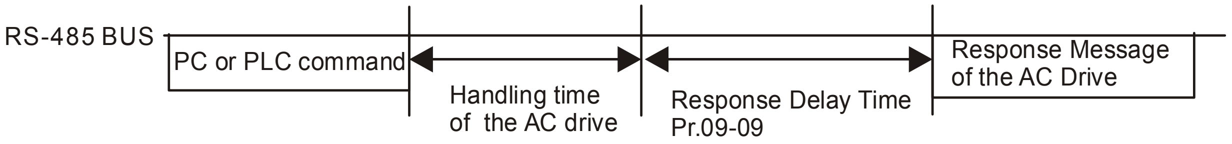
09-05 ~ 09-08 Reserved

09-09 Response Delay Time

Factory Setting: 2.0

Settings 0.0~200.0ms

🕮 This parameter is the response delay time after AC drive receives communication command as shown in the following.



09-10 Main Frequency of the Communication

Factory Setting: 60.00

Settings 0.00~600.00Hz

🕮 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.

⚡ **09-11** Block Transfer 1

⚡ **09-12** Block Transfer 2

⚡ **09-13** Block Transfer 3

⚡ **09-14** Block Transfer 4

⚡ **09-15** Block Transfer 5

⚡ **09-16** Block Transfer 6

⚡ **09-17** Block Transfer 7

⚡ **09-18** Block Transfer 8

⚡ **09-19** Block Transfer 9

⚡ **09-20** Block Transfer 10

⚡ **09-21** Block Transfer 11

⚡ **09-22** Block Transfer 12

⚡ **09-23** Block Transfer 13

⚡ **09-24** Block Transfer 14

⚡ **09-25** Block Transfer 15

⚡ **09-26** Block Transfer 16

Factory Setting: 0

Settings 0~65535

📖 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.

09-27 ~ **09-29** Reserved

09-30 Communication Decoding Method

Factory Setting: 1

Settings 0: Decoding Method 1
1: Decoding Method 2

		Decoding Method 1	Decoding Method 2
Source of Operation Control	Digital Keypd	Digital keypad controls the drive action regardless decoding method 1 or 2.	
	External Terminal	External terminal controls the drive action regardless decoding method 1 or 2.	
	RS-485	Refer to address: 2000h~20FFh	Refer to address: 6000h ~ 60FFh
	CANopen	Refer to index: 2020-01h~2020-FFh	Refer to index:2060-01h ~ 2060-FFh
	Communication Card	Refer to address: 2000h ~ 20FFh	Refer to address: 6000h ~ 60FFh
	PLC	PLC commands the drive action regardless decoding method 1 or 2.	

09-31 Internal Communication Protocol

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

🕮 When it is defined as internal communication, see CH16-10 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)

09-32 ~ 09-34 Reserved

09-35 PLC Address

Factory Setting: 2

Settings 1~254

09-36 CANopen Slave Address

Factory Setting: 0

Settings 0: Disable
1~127

09-37 CANopen Speed

Factory Setting: 0

Settings 0: 1M
1: 500k
2: 250k
3: 125k
4: 100k (Delta only)
5: 50k

09-38 Reserved

09-39 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 fail
bit 9: The setting value of CANopen address is fail
bit10: The checksum value of CANopen indexs is fail

09-40 CANopen Decoding Method

Factory Setting: 1

Settings 0: Delta defined decoding method
1: CANopen Standard DS402 protocol

09-41 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 State

09-42 CANopen Control Status

Factory Setting: Read Only

Settings 0: Not ready for use state
1: Inhibit start state
2: Ready to switch on state
3: Switched on state
4: Enable operation state
7: Quick stop active state
13: Err reaction activation state
14: Error state

09-43 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

09-44 Reserved

09-45 CANopen Master Function

Factory Setting: 0

Settings 0: Disable
1: Enable

09-46 CANopen Master Address

Factory Setting: 100

Settings 1~127

09-47 ~ 09-59 Reserved

09-60 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

09-61 Firmware Version of Communication Card

Factory Setting: ##

Settings Read only

09-62 Product Code

Factory Setting: ##

Settings Read only

🕮 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.

09-63 Fault Code

Factory Setting: ##

Settings Read only

📖 For more information about Fault codes, refer to Pr. 06-17~06-22 and Chapter 14.

09-64 ~ **09-69** Reserved

09-70 Address of Communication Card

Factory Setting: 1

Settings DeviceNet: 0-63
Profibus-DP: 1-125

09-71 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

09-72 Other Setting of DeviceNet Speed

Factory Setting: 0

Settings 0: Disable
1: Enable

📖 It needs to use with Pr.09-71.

📖 Setting 0: the baud rate can only be set to 0, 1, 2 or 3.

📖 Setting 1: setting of DeviceNet baud rate can be the same as CANopen (setting 0-8).

09-73 Reserved

09-74 Reserved

09-75 IP Configuration of the Communication Card

Factory Setting: 0

Settings 0: Static IP

1: DynamicIP (DHCP)

🕮 Setting 0: it needs to set IP address manually.

🕮 Setting 1: IP address will be auto set by host controller.

09-76 IP Address 1 of the Communication Card

09-77 IP Address 2 of the Communication Card

09-78 IP Address 3 of the Communication Card

09-79 IP Address 4 of the Communication Card

Factory Setting: 0

Settings 0~255

🕮 Pr.09-76~09-79 needs to use with communication card.

09-80 Address Mask 1 of the Communication Card

09-81 Address Mask 2 of the Communication Card

09-82 Address Mask 3 of the Communication Card

09-83 Address Mask 4 of the Communication Card

Factory Setting: 0

Settings 0~255

09-84 Getway Address 1 of the Communication Card

09-85 Getway Address 2 of the Communication Card

09-86 Getway Address 3 of the Communication Card

09-87 Getway Address 4 of the Communication Card

Factory Setting: 0

Settings 0~255

09-88 Password for Communication Card (Low word)

09-89 Password for Communication Card (High word)

Factory Setting: 0

Settings 0~255

09-90 Reset Communication Card

Factory Setting: 0

Settings 0: Disable
1: Reset, return to factory setting

09-91 Additional Setting for Communication Card

Factory Setting: 1

Settings 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 the parameters. This bit will change to disable when it finishes saving the update of internet parameters.

Bit 2: Login password enable(1bit)

Enable login password (1bit). This bit will be changed to disable when it finishes saving the update of internet parameters.

09-92 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

✓ 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.

10-00 Encoder Type Selection

Factory Setting: 0

Settings 0: Disable
1: ABZ
2: ABZ (Delta encoder for PM motor)
3: Resolver (Standard encoder for PM motor)
4: ABZ/UVW (Standard encoder for PM motor)

🕮 For PG extension card EMC-PG01L and EMC-PG01O, set Pr.10-00=1. These extension cards are for IM motor only.

🕮 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.

🕮 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.

🕮 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.

🕮 When using MI8 single phase pulse as speed feedback, the drive must at VFPG control mode only.

10-01 Encoder Pulse

Factory Setting: 600

Settings 1~20000

🕮 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.

🕮 This setting is also the encoder resolution. With the higher resolution, the speed control will be more accurate.

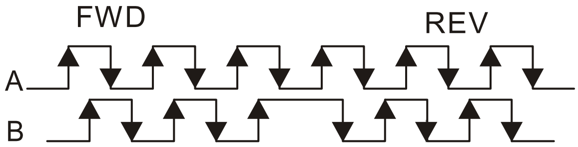
🕮 An incorrect input to Pr.10-00 may result drive over current, motor stall, PM motor magnetic pole origin detection error. If Pr.10-00 setting has changed, please trace the magnetic pole again, set Pr.05-00=4 (static test for PM motor magnetic pole and PG origin again).

10-02 Encoder Input Type Setting

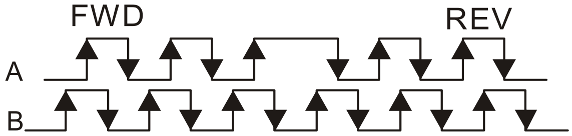
Factory Setting: 0

Settings 0: Disable

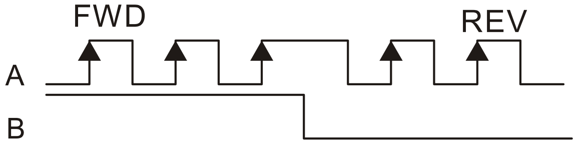
1: Phase A leads in a forward run command and phase B leads in a reverse run command



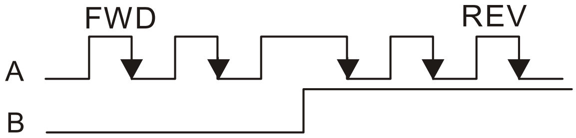
2: Phase B leads in a forward run command and phase A leads in a reverse run command



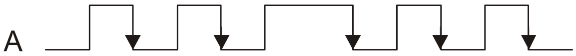
3: Phase A is a pulse input and phase B is a direction input. (L =reverse direction, H=forward direction)



4: Phase A is a pulse input and phase B is a direction input. (L=forward direction, H=reverse direction)



5: Single-phase input



✎ 10-03 Output Setting for Frequency Division (denominator)

Factory Setting: 1

Settings 1~255

📖 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.

✎ 10-04 Electrical Gear at Load Side A1

✎ 10-05 Electrical Gear at Motor Side B1

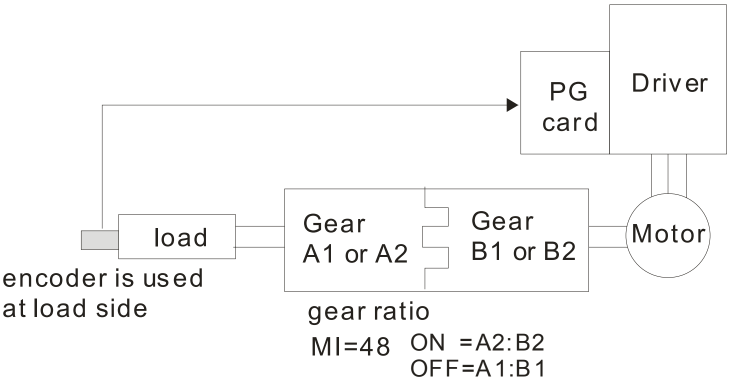
✎ 10-06 Electrical Gear at Load Side A2

✎ 10-07 Electrical Gear at Motor Side B2

Factory Setting: 100

Settings 1~65535

🕮 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



✎ 10-08 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

✎ 10-09 Detection Time of Encoder Feedback Fault

Factory Setting: 1.0

Settings 0.0~10.0 sec
0: No function

🕮 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.

✎ 10-10 Encoder Stall Level

Factory Setting: 115

Settings 0~120%
0: No function

🕮 This parameter determines the maximum encoder feedback signal allowed before a fault occurs. (Max. output frequency Pr.01-00 =100%)

✎ 10-11 Detection Time of Encoder Stall

Factory Setting: 0.1

Settings 0.0~2.0 sec

✎ 10-12 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.

10-13 Encoder Slip Range

Factory Setting: 50

Settings 0~50%

0: Disable

10-14 Detection Time of Encoder Slip

Factory Setting: 0.5

Settings 0.0~10.0 sec

10-15 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

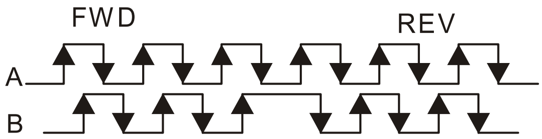
📖 When the value of (rotation speed – motor frequency) exceeds Pr.10-13 setting, detection time exceeds Pr.10-14; it will start to accumulate time. If detection time exceeds Pr.10-14, the encoder feedback signal error will occur. Refer to Pr.10-15 encoder stall and slip error treatment.

10-16 Pulse Input Type Setting (PG card: PG2)

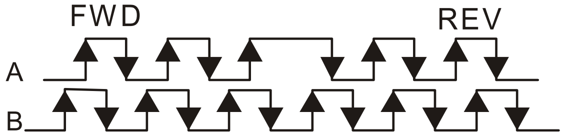
Factory Setting: 0

Settings 0: Disable

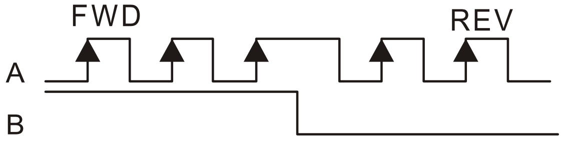
1: Phase A leads in a forward run command and phase B leads in a reverse run command



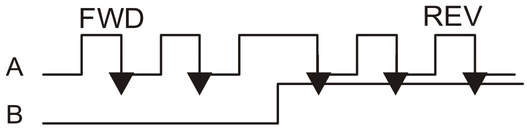
2: Phase B leads in a forward run command and phase A leads in a reverse run command



3: Phase A is a pulse input and phase B is a direction input. (L=reverse direction, H=forward direction)



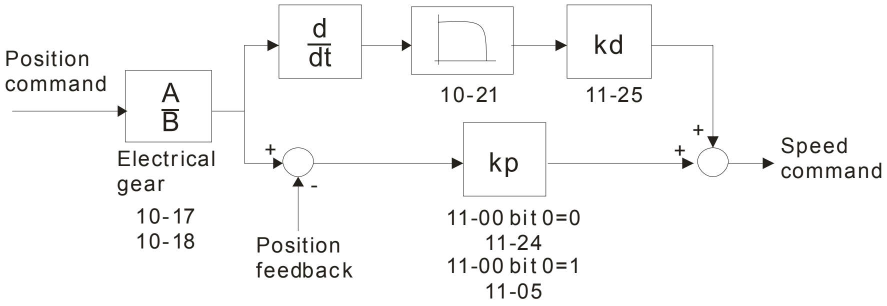
4: Phase A is a pulse input and phase B is a direction input. (L=forward direction, H=reverse direction)



📖 When this setting is different from Pr.10-02 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.

- Assume that Pr.10-01=1024, Pr.10-02=1, Pr.10-16=1, Pr.00-20=5, MI=37 and ON, it needs 1024 pulses to rotate the motor a revolution.
- Position control diagram



10-17 Electrical Gear A
10-18 Electrical Gear B

Factory Setting: 100

Settings 1~65535

- Rotation speed = pulse frequency/encoder pulse (Pr.10-01) * PG Electrical Gear A / PG Electrical Gear B.

10-19 Positioning for Encoder Position

Factory Setting: 0

Settings 0~65535 pulse

- This parameter determines the internal position in the position mode.
- It needs to be used with multi-function input terminal setting =35 (enable position control).
- When it is set to 0, it is the Z-phase position of encoder.

10-20 Range for Encoder Position Attained

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.

10-21 Filter Time (PG2)

Factory Setting: 0.100

Settings 0.000~65.535 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.

10-22 Speed Mode (PG2)

Factory Setting: 0

Settings 0: Electronic Frequency
1: Mechanical Frequency (base on pole pair)

10-23 Reserved

10-24 FOC&TQC Function Control

Factory Setting: 0

Settings 0~65535

Bit#	Description
0	ASR control at sensorless torque 0:use PI as ASR; 1:use P as ASR
1~10	NA
11	Activate DC braking when executing zero torque command 0:ON , 1:OFF
12	FOC Sensorless mode, cross zero means speed goes from negative to positive or positive to negative (forward to reverse direction or reverse to forward direction). 0: determine by stator frequency , 1: determine by speed command
13	NA
14	NA
15	Direction control at open loop status 0: Switch ON direction control 1: Switch OFF direction control

🕮 Except Bit=0 set to be used in closed loop, other Bit settings are for open loop.

10-25 FOC Bandwidth of Speed Observer

Factory Setting:40.0

Settings 20.0~100.0Hz

🕮 Setting speed observer to higher bandwidth could shorten the speed response time but will create greater noise interference during the speed observation. .

10-26 FOC Minimum Stator Frequency

Factory Setting:2.0

Settings 0.0~10.0%fN

🕮 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.

10-27 FOC Low-pass Filter Time Constant

Factory Setting:50

Settings 1~1000ms

🕮 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.

10-28 FOC Gain of Excitation Current Rise Time

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.

✎ 10-29 Top Limit of Frequency Deviation

Factory Setting: 20.00

Settings 0.00~100.00Hz

📖 Pr.10-29 is for setting the maximum of frequency deviation.

📖 When this parameter is set too large, resulting in abnormal PG feedback malfunction.

📖 If customer application require a large 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.

10-30 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.

10-33 Reserved
10-35 Reserved
10-36 Reserved
10-38 Reserved

10-31 I/F Mode, current command

Factory Setting: 40

Settings 0~150%Irated (Rated current % of the drive)

10-32 PM Sensorless Obeserver Bandwith for High Speed Zone

Factory Setting: 5.00

Settings 0.00~600.00Hz

10-34 PM Sensorless Observer Low-pass Filter Gain

Factory Setting: 1.00

Settings 0.00~655.35Hz

10-37 PM Sensorless Control Word

Factory Setting: 0000

Settings 0000~FFFFh

Bit No.	Function	Description
0	Reserved	
1	Reserved	
2	Choose a control mode to statrt.	0 :Start by IF mode 1: Start by VF mode
3	Choose a mode to stop .	0 :Stop by IF mode 1 :Stop by VF mode
4	Reserved	
5	Choose a control mode to stop	0 : When lower than Pr10-40, coast to stop If lower than Pr10-40, decelerate to stop by VF mode.
6	Reserved	
7	Reserved	

10-39 Frequency Point when switch from I/F mode to PM Sensorless mode

Factory Setting: 20.00

Settings 0.00~600.00Hz

10-40 Frequency Point when switch from PM Sensorless Observation mde to I/F mode

Factory Setting: 20.00

Settings 0.00~600.00Hz

10-41 I/F mode, low pass-filter time

Factory Setting: 0.2

Settings 0.0~6.0 sec

10-42 Initial Angle Detection Time

Factory Setting: 5

Settings 0~20 ms

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 (Pr00-10=0, Pr00-11=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 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

☑ Pr05-35 Rated Power of Permanent Magnet Motor

☑ Pr05-36 Rated speed of Permanent Magnet Motor

☑ Pr05-37 Pole number of Permanent Magnet Motor

☑ Pr05-38 Inertia of Permanent Magnet Motor

5. Set ASR Parameters

☑ Pr11-00 bit0=1: Auto tuning for ASR and APR

☑ Pr11-02：ASR1/ASR2 Switch Frequency, it is recommended to set Pr10-39 higher than 10Hz.

☑ 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.

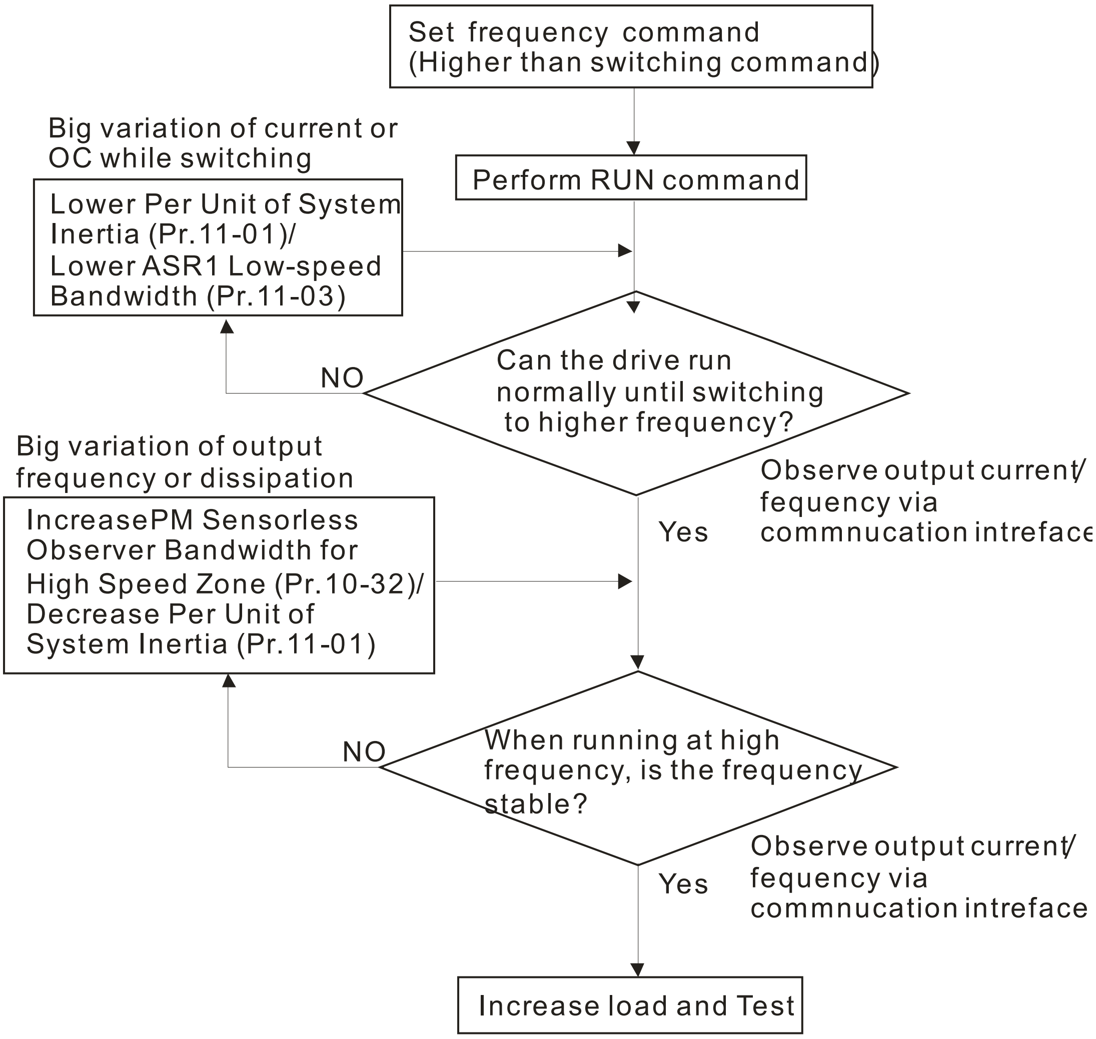
6. Set speed estimator and speed control's parameter.

☑ 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

☑ Refer to switch point prodcedure of I/F and FOC as shown in the image below.



Procedure for switching between I/F mode and FOC mode

11 Advanced Parameters

✎ This parameter can be set during operation.

In this parameter group, ASR is the abbreviation for Adjust Speed Regulator

11-00 System Control

Factory Setting: 0

Settings 0: Auto tuning for ASR and APR

1: Inertia estimate (only in FOCPG mode)

2: Zero servo

3: Dead time compensation closed

7: Selection to save or not save the 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.

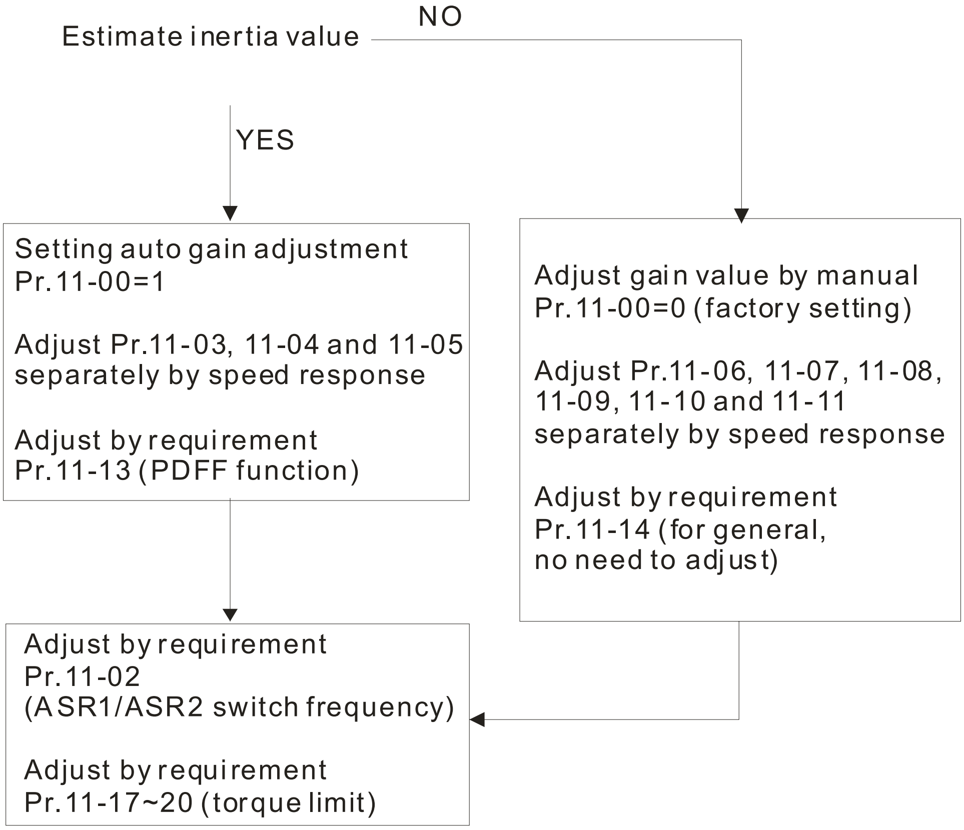
Bit 0=1: system will generate an ASR setting. At this moment, Pr.11-06~11-11 will be invalid and Pr.11-03~11-05 are valid.

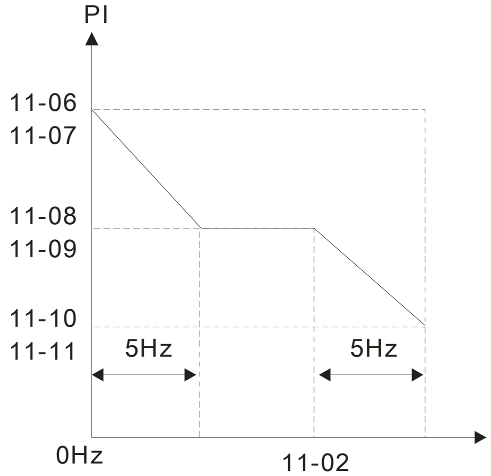
Bit 1=0: no function.

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)

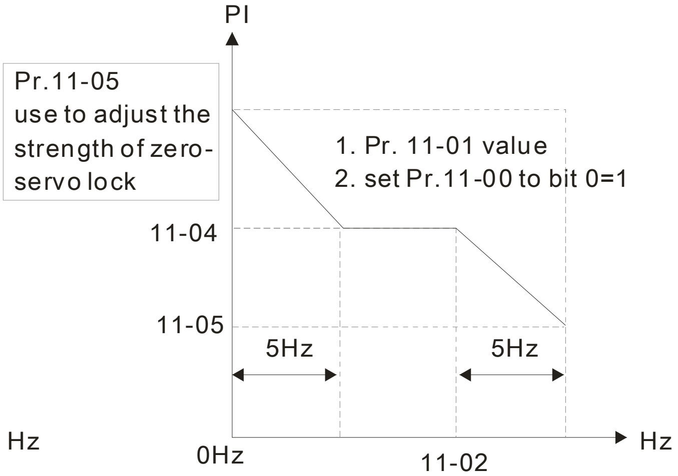
Bit 2=0: no function.

Bit 2=1: when frequency command is less than Fmin (Pr.01-07), it will use zero servo function.





PI adjustment-manual gain



PI adjustment-auto gain

📖 Bit 7=0: frequency is saved before power turns off. When power turns on again, the display frequency will be the memorized frequency.

Bit 7=1: frequency is not saved before power turns off. When power turns ON again, the display frequency will be 0.00Hz.

Bit 8=0: maximum speed for point-to-point position control is control by the setting of Pr.11-43.

Bit 8=1: maximum speed for point-to-point position control is control by the multi-step speed setting of the external terminal device. When multi-step speed of the external device is set to 0, the maximum operation speed will bet the setting of Pr.11-43.

✎ 11-01 Per Unit of System Inertia

Factory Setting: 400

Settings 1~65535（256=1PU）

📖 To get the system inertia from Pr.11-01, user needs to set Pr.11-00 to bit1=1 and execute continuous forward/reverse running.

Unit of induction motor system inertia is 0.001kg-m^2:

Power	Setting	Power	Setting	Power	Setting
1HP	2.3	20HP	95.3	100HP	1056.5
2HP	4.3	25HP	142.8	125HP	1275.3
3HP	8.3	30HP	176.5	150HP	1900.0
5HP	14.8	40HP	202.5	175HP	2150.0
7.5HP	26.0	50HP	355.5	215HP	2800.0
10HP	35.8	60HP	410.8	300HP	3550.0
15HP	74.3	75HP	494.8		

The base value for induction motor system inertia is set by Pr.05-38 and the unit is in 0.001kg-m^2.

✎ 11-02 ASR1/ASR2 Switch Frequency

Factory Setting: 7.00

Settings 5.00~600.00Hz

✎ 11-03 ASR1 Low-speed Bandwidth

Factory Setting: 10

Settings 1~40Hz (IM)/ 1~100Hz (PM)

11-04 ASR2 High-speed Bandwidth

Factory Setting: 10

Settings 1~40Hz (IM)/ 1~100Hz (PM)

11-05 Zero-speed Bandwidth

Factory Setting: 10

Settings 1~40Hz (IM)/ 1~100Hz (PM)

📖 After estimating inertia and set Pr.11-00 to bit 0=1 (auto tuning), user can adjust parameters Pr.11-03, 11-04 and 11-05 separately by speed response. The larger number you set, the faster response you will get. Pr.11-02 is the switch frequency for low-speed/high-speed bandwidth.

11-06 ASR (Auto Speed Regulation) control (P) 1

Factory Setting: 10

Settings 0~40 Hz (IM)/ 1~100Hz (PM)

11-07 ASR (Auto Speed Regulation) control (I) 1

Factory Setting: 0.100

Settings 0.000~10.000 sec

11-08 ASR (Auto Speed Regulation) control (PI) 2

Factory Setting: 10

Settings 0~40 Hz (IM)/ 0~100Hz (PM)

11-09 ASR (Auto Speed Regulation) control (I) 2

Factory Setting: 0.100

Settings 0.000~10.000 sec

11-10 ASR(Auto Speed Regulation) Control (P) of Zero Speed

Factory Setting: 10

Settings 0~40 Hz (IM)/ 0~100Hz (PM)

11-11 ASR(Auto Speed Regulation) Control (I) of Zero Speed

Factory Setting: 0.100

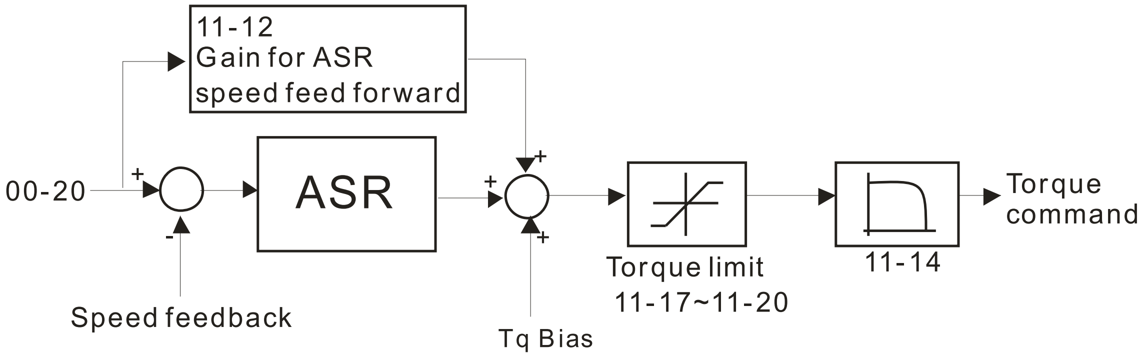
Settings 0.000~10.000 sec

11-12 Gain for ASR Speed Feed Forward

Factory Setting: 0

Settings 0~100%

📖 This parameter is used to improve speed response.



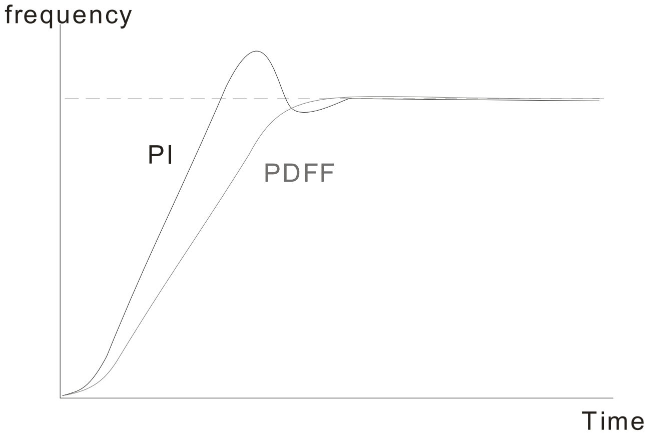
⚡ 11-13 PDFF Gain Value

Factory Setting: 30

Settings 0~200%

🕮 After finishing estimating and set Pr.11-00 to bit 0=1 (auto tuning), using Pr.11-13 to reduce overshoot. Please adjust PDFF gain value by actual situation.

🕮 This parameter will be invalid when Pr.05-24 is set to 1.



⚡ 11-14 Low-pass Filter Time of ASR Output

Factory Setting: 0.008

Settings 0.000~0.350 sec

🕮 It is used to set the filter time of ASR command.

⚡ 11-15 Notch Filter Depth

Factory Setting: 0

Settings 0~20db

⚡ 11-16 Notch Filter Frequency

Factory Setting: 0.00

Settings 0.00~200.00Hz

🕮 This parameter is used to set resonance frequency of mechanical system. It can be used to suppress the resonance of mechanical system.

🕮 The larger number you set Pr.11-15, the better suppression resonance function you will get.

🕮 The notch filter frequency is the resonance of mechanical frequency.

⚡ 11-17 Forward Motor Torque Limit

⚡ 11-18 Forward Regenerative Torque Limit

⚡ 11-19 Reverse Motor Torque Limit

⚡ 11-20 Reverse Regenerative Torque Limit

Factory Setting: 500

Settings 0~500%

🕮 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.

🕮 Calculation equation for motor rated torque:

Motor rated torque= $T(N.M)=\frac{P(W)}{\omega(rad/s)}$; P(W) value= Pr.05-02;

ω (rad/s) value= Pr.05-03 。 $\frac{RPM\times 2\pi}{60}=rad/s$

. FOCPG and FOC sensor-less control mode

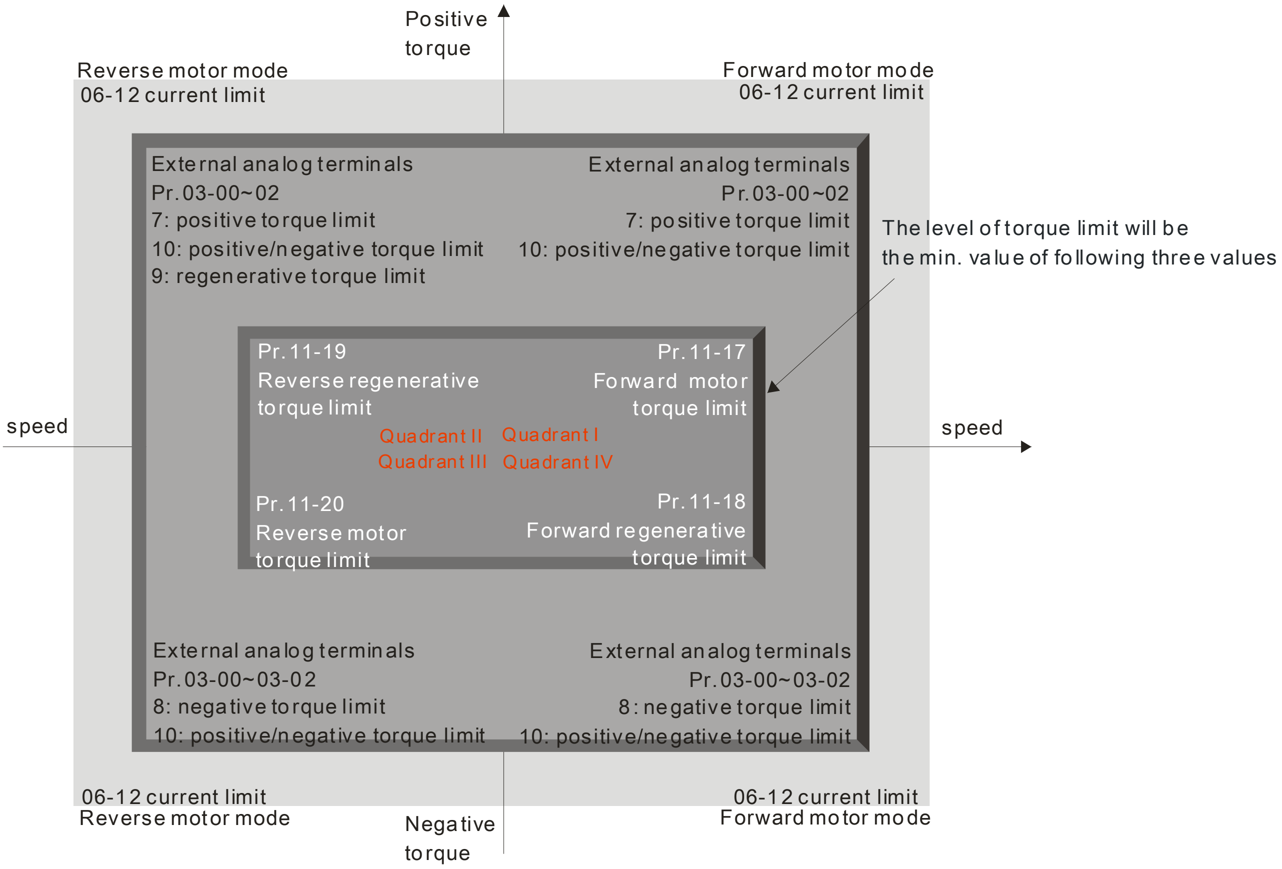
The drive rated current=100%. The setting value of parameters Pr11-17~Pr11-20 will compare to Pr03-00=7, 8, 9 and 10. The smallest value will become the torque limit value. Please refer to the torque limit diagram.

TQCPG and TQC Sensor-less control mode

The drive rated current=100%. The setting value of parameters Pr11-17~Pr11-20 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.



11-21 Gain Value of Flux Weakening Curve for Motor 1

Factory Setting: 90

Settings 0~200%

11-22 Gain Value of Flux Weakening Curve for Motor 2

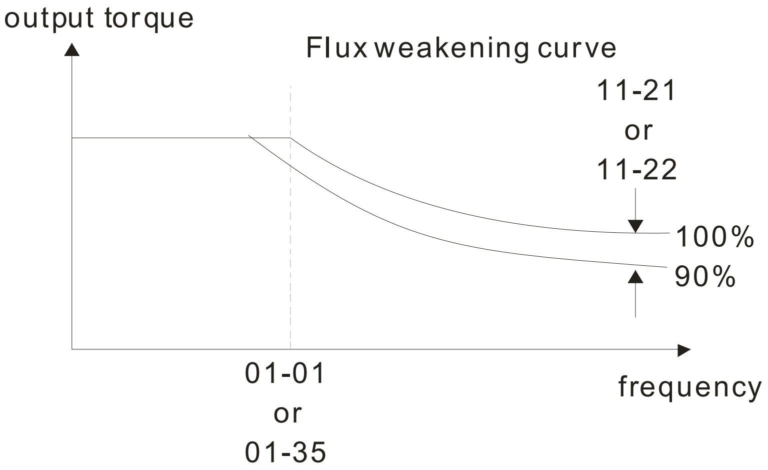
Factory Setting: 90

Settings 0~200%

Pr.11-21 and 11-22 are used to adjust the output voltage of flux weakening curve.

📖 For the spindle application, the adjustment method is

1. It is used to adjust the output voltage when exceeding rated frequency.
2. Monitor the output voltage
3. Adjust Pr.11-21 (motor 1) or Pr.11-22 (motor 2) setting to make the output voltage reach motor rated voltage.
4. The larger number it is set, the larger output voltage you will get.



✎ 11-23 Speed Response of Flux Weakening Area

Factory Setting: 65

Settings 0: Disable

0~150%

📖 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.

✎ 11-24 APR Gain

Factory Setting: 10.00

Settings 0.00~40.00 (IM)/ 0~100.00Hz (PM)

📖 Kip gain of internal position is determined by Pr.11-05.

✎ 11-25 Gain Value of APR Feed Forward

Factory Setting: 30

Settings 0~100

📖 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.

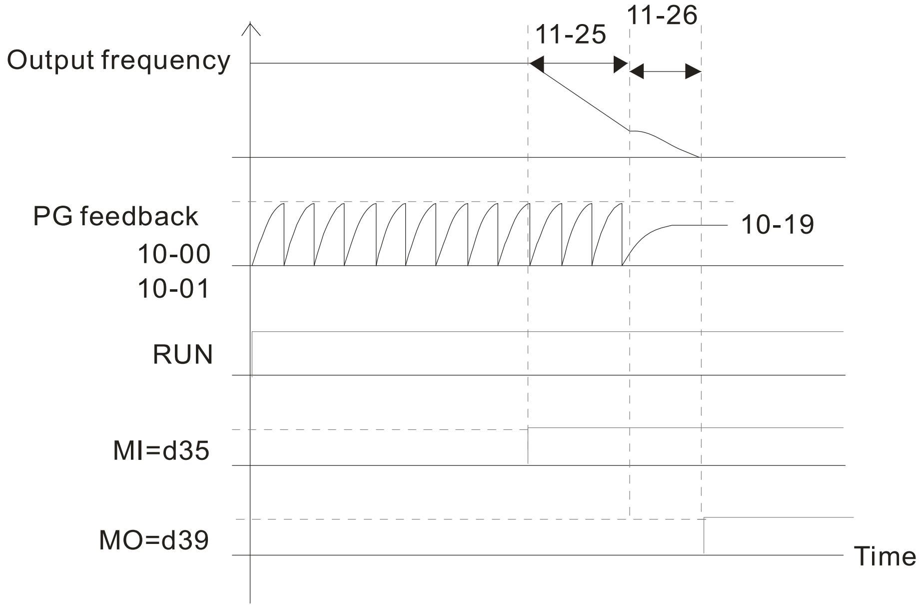
📖 When the multi-function input terminal is set to 37(ON), this parameter can be set as required. If this parameter is set to a non zero value and adjust Pr.10-21 (PG2 Filter Time) to reduce the position overshoot and pulse differential. If it is set to 0, it won't have overshoot problem in position control but the pulse differential is decided by Pr.11-05 (KP gain).

✎ 11-26 APR Curve Time

Factory Setting: 3.00

Settings 0.00~655.35 sec

📖 It is valid when the multi-function input terminal is set to 35(ON). The larger it is set, the longer the position time will be.



11-27 Max. Torque Command

Factory Setting: 100

Settings 0~500%

- The upper limit of torque command is 100%.
- Calculation equation for motor rated torque:

motor rated torque: $T(N.M)=\dfrac{P(W)}{\omega(rad/s)}$; P(W) value= Pr.05-02;

ω(rad/s) value= Pr.05-03 。 $\dfrac{RPM\times 2\pi}{60}=rad/s$

11-28 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)

- This parameter is the source of torque offset.
- 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

11-29 Torque Offset Setting

Factory Setting: 0.0

Settings 0.0~100.0%

- This parameter is torque offset. The motor rated torque is 100%.
- Calculation equation for motor rated torque:

motor rated torque: $T(N.M) = \frac{P(W)}{\omega(rad/s)}$; P(W) value= Pr.05-02;

ω(rad/s) value= Pr.05-03 ◦ $\frac{RPM \times 2\pi}{60} = rad/s$

11-30 High Torque Offset

Factory Setting: 30.0

Settings 0.0~100.0%

11-31 Middle Torque Offset

Factory Setting: 20.0

Settings 0.0~100.0%

11-32 Low Torque Offset

Factory Setting: 10.0

Settings 0.0~100.0%

- 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%.
- Calculation equation for motor rated torque:

motor rated torque: $T(N.M) = \frac{P(W)}{\omega(rad/s)}$; P(W) value= Pr.05-02;

ω(rad/s) value= Pr.05-03 ◦ $\frac{RPM \times 2\pi}{60} = rad/s$

11-33 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

- When Pr.11-33 is set to 0, torque command can be set in Pr.11-34.
- When Pr.11-33 is set to 1 or 2, Pr.11-34 would only display the torque command

11-34 Torque Command

Factory Setting: 0.0

Settings -100.0~100.0%(Pr.11-27=100%)

- 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.

✎ 11-35 Low-pass Filter Time of Torque Command

Factory Setting: 0.000

Settings 0.000~1.000 sec

- 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.

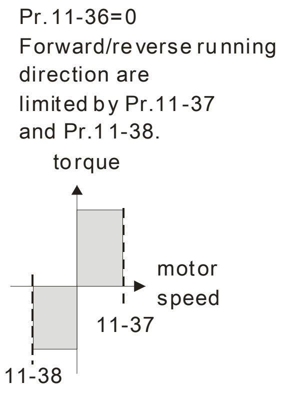
11-36 Speed Limit Selection

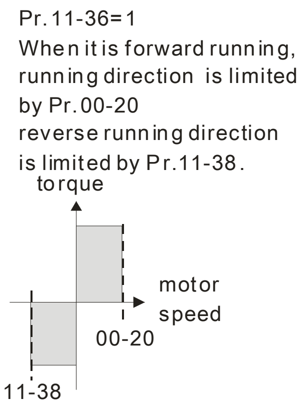
Factory Setting: 0

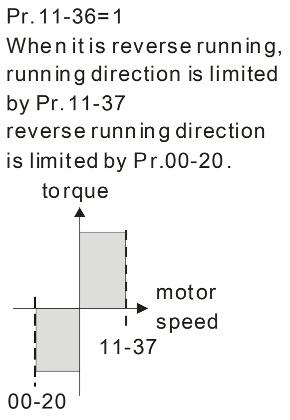
Settings 0: Set by Pr.11-37 (Forward speed limit) and Pr.11-38 (Reverse speed limit)
1: Set by Pr.11-37,11-38 and Pr.00-20 (Source of Master Frequency Command)
2: Set by Pr.00-20 (Source of Master Frequency Command).

- 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.
- Pr11-36=1:
  When the torque command is positive, the forward speed limit is Pr00-20 and reverse speed limit is Pr11-38.
  When the torque command is negative, the forward speed limit is Pr11-37 and reverse speed limit is Pr00-20.

- 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".







✎ 11-37 Forward Speed Limit (torque mode)

Factory Setting: 10

Settings 0~120%

✎ 11-38 Reverse Speed Limit (torque mode)

Factory Setting: 10

Settings 0~120%

- These parameters are used in the torque mode to limit the running direction and opposite direction. (Pr.01-00 max. output frequency=100%)

✎ 11-39 Zero Torque Command Mode

Factory Setting: 0

Settings 0: Torque mode
1: Speed mode

- 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 0Hz, 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.

11-40 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

11-41 Reserved

11-42 System control flag

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 limit is the torque command. 1: Speed control at torque mode, P06-12 the largest current limit is Pr06-12
1	FWD/REV direction control	0: FWD/REV cannot be controlled by 02-12 bit 0 & 1 1: FWD/REV can be controlled by 02-12 bit 0&1
2~15	Reserved	

11-43 Max. Frequency of Point- to-Point Position Control

Factory Settings:10.00

Settings 0.00~327.67Hz

11-44 Accel. Time of Point-to Point Position Control

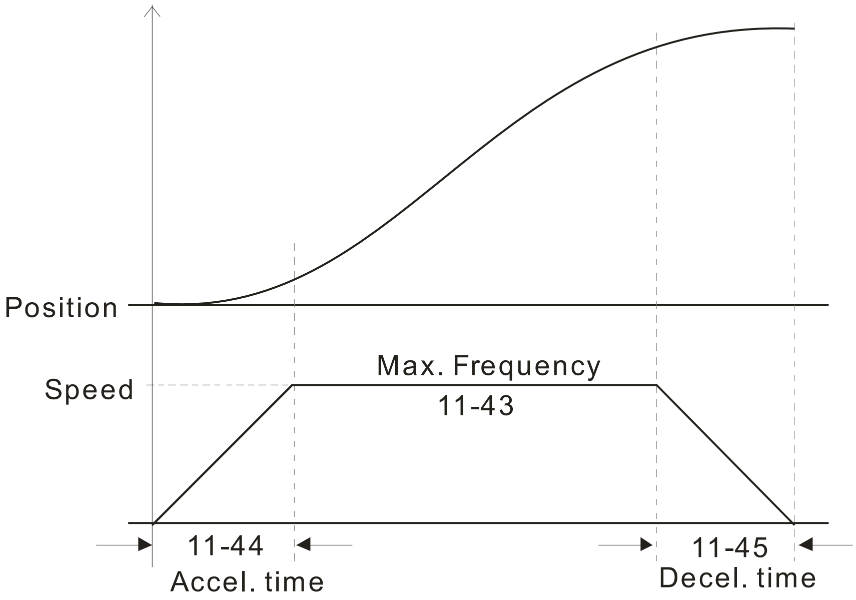
Factory Settings:1.00

Settings 0.00~655.35sec

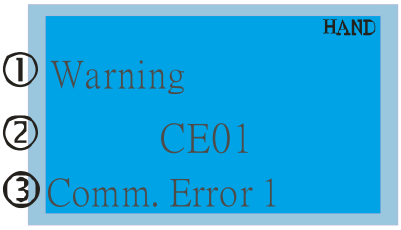
11-45 Decel. Time of Point-to Point Position Control

Factory Settings:3.00

Settings 0.00~655.35sec



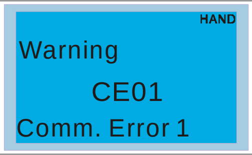
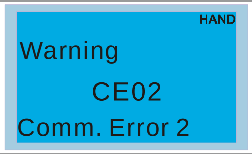
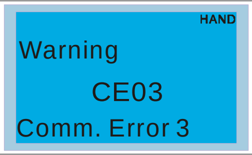
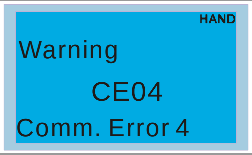
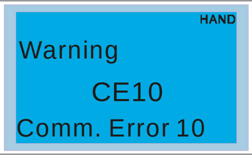
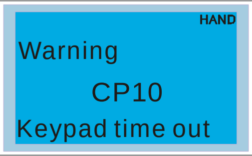
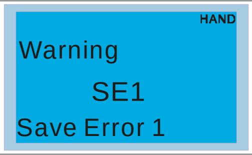
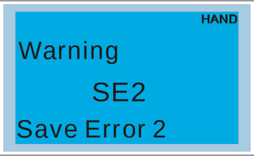
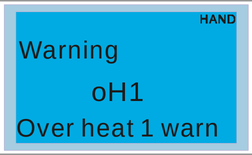
Chapter 13 Warning Codes

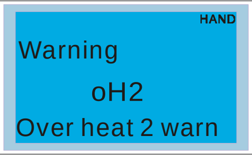
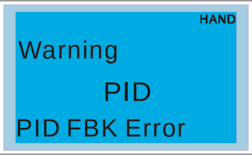
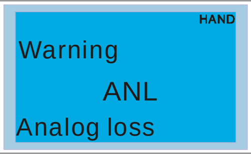
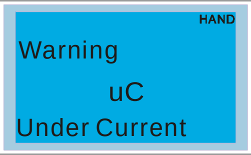
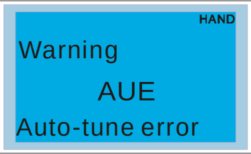
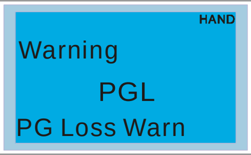
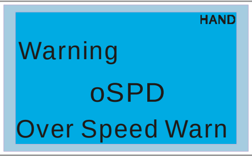
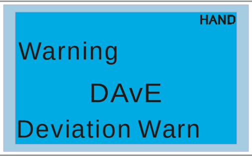
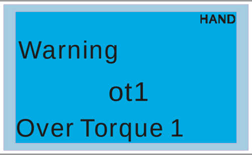
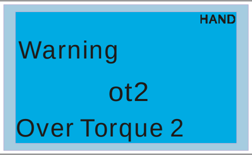


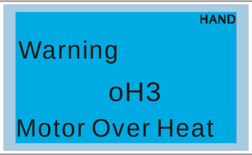
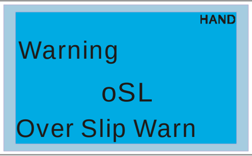
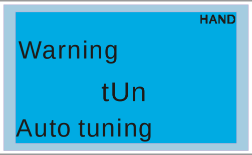
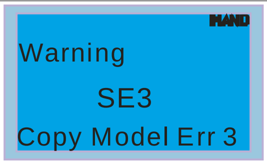
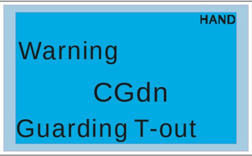
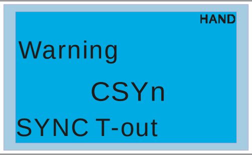
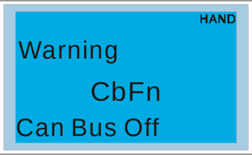
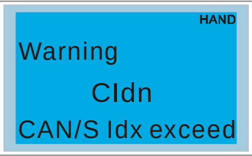
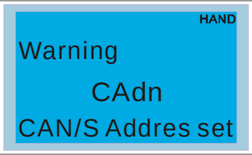
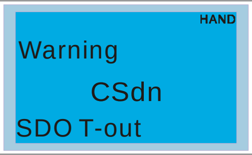
① Display error signal

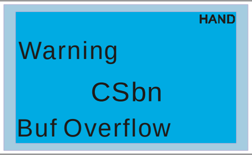
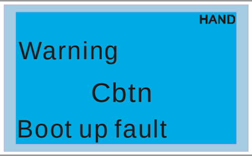
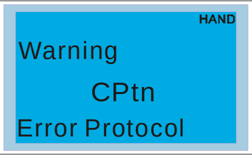
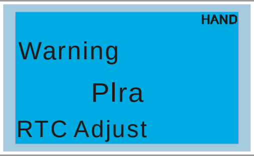
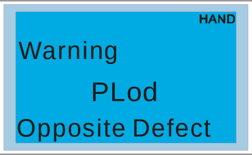
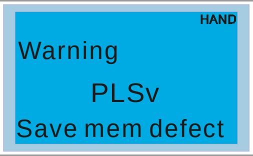
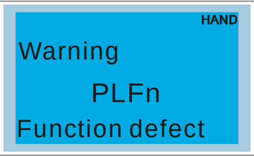
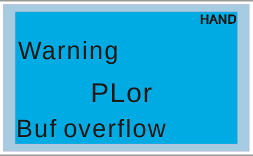
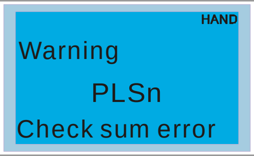
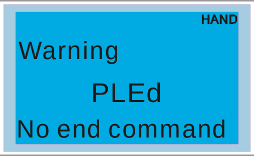
② Abbreviate error code
The code is displayed as shown on KPC-CE01.

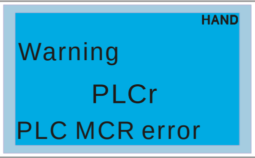
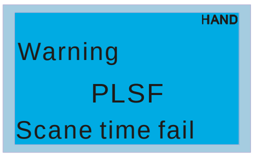
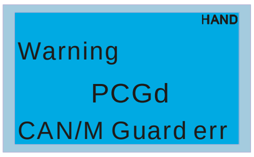
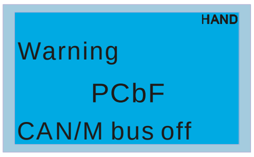
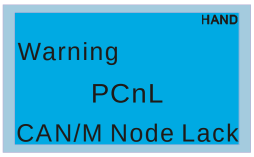
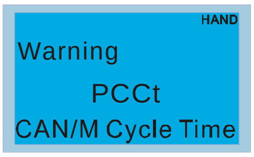
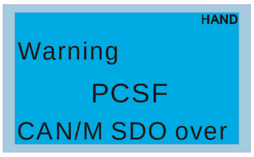
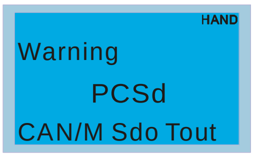
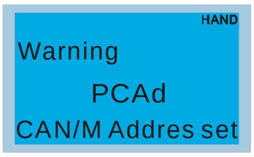
③ Display error description

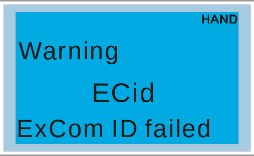
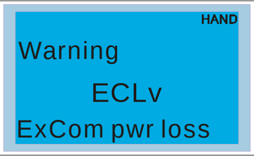
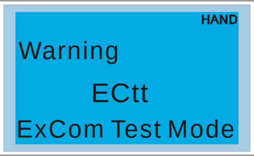
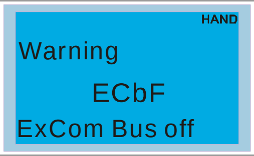
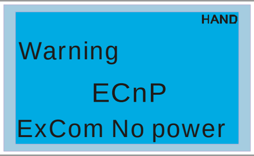
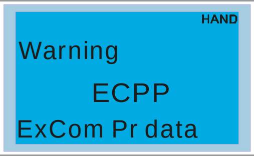
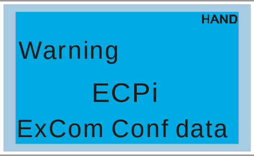
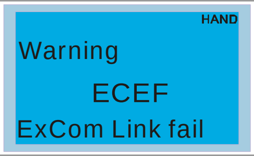
ID No.	Display on LCM Keypad	Descriptions
1	 HAND Warning CE01 Comm. Error 1	Modbus function code error
2	 HAND Warning CE02 Comm. Error 2	Address of Modbus data is error
3	 HAND Warning CE03 Comm. Error 3	Modbus data error
4	 HAND Warning CE04 Comm. Error 4	Modbus communication error
5	 HAND Warning CE10 Comm. Error 10	Modbus transmission time-out
6	 HAND Warning CP10 Keypad time out	Keypad transmission time-out
7	 HAND Warning SE1 Save Error 1	Keypad COPY error 1 Keypad simulation error, including communication delays, communication error (keypad recived error FF86) and parameter value error.
8	 HAND Warning SE2 Save Error 2	Keypad COPY error 2 Keypad simulation done, parameter write error
9	 HAND Warning oH1 Over heat 1 warn	IGBT over-heating warning

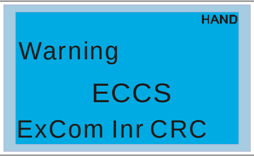
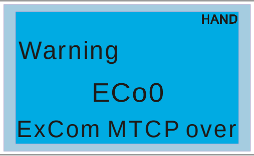
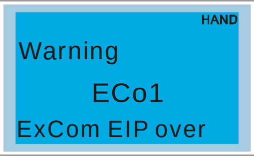
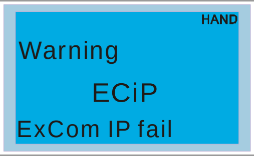
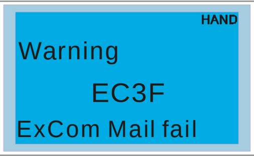
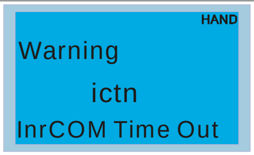
ID No.	Display on LCM Keypad	Descriptions
10	 HAND Warning oH2 Over heat 2 warn	Capacity over-heating warning
11	 HAND Warning PID PID FBK Error	PID feedback error
12	 HAND Warning ANL Analog loss	ACI signal error When Pr03-19 is set to 1 and 2.
13	 HAND Warning uC Under Current	Low current
14	 HAND Warning AUE Auto-tune error	Auto tuning error
15	 HAND Warning PGFB PG FBK Warn	PG feedback error
16	 HAND Warning PGL PG Loss Warn	PG feedback loss
17	 HAND Warning oSPD Over Speed Warn	Over-speed warning
18	 HAND Warning DAvE Deviation Warn	Over speed deviation warning
19	 HAND Warning PHL Phase Loss	Phase loss
20	 HAND Warning ot1 Over Torque 1	Over torque 1
21	 HAND Warning ot2 Over Torque 2	Over torque 2

ID No.	Display on LCM Keypad	Descriptions
22	 HAND Warning oH3 Motor Over Heat	Motor over-heating
24	 HAND Warning oSL Over Slip Warn	Over slip
25	 HAND Warning tUn Auto tuning	Auto tuning processing
30	 HAND Warning SE3 Copy Model Err 3	Keypad COPY error 3 Keypad copy between different power range drive
36	 HAND Warning CGdn Guarding T-out	CAN guarding time-out 1
37	 HAND Warning CHbn Heartbeat T-out	CAN heartbeat time-out 2
38	 HAND Warning CSYn SYNC T-out	CAN synchrony time-out
39	 HAND Warning CbFn Can Bus Off	CAN bus off
40	 HAND Warning CIdn CAN/S Idx exceed	CAN index error
41	 HAND Warning CAdn CAN/S Addres set	CAN station address error
42	 HAND Warning CFrn CAN/S FRAM fail	CAN memory error
43	 HAND Warning CSdn SDO T-out	CAN SDO transmission time-out

ID No.	Display on LCM Keypad	Descriptions
44	 HAND Warning CSbn Buf Overflow	CAN SDO received register overflow
45	 HAND Warning Cbtn Boot up fault	CAN boot up error
46	 HAND Warning CPtn Error Protocol	CAN format error
47	 HAND Warning Plra RTC Adjust	Adjust RTC
50	 HAND Warning PLod Opposite Defect	PLC download error
51	 HAND Warning PLSv Save mem defect	Save error of PLC download
52	 HAND Warning PLdA Data defect	Data error during PLC operation
53	 HAND Warning PLFn Function defect	Function code of PLC download error
54	 HAND Warning PLor Buf overflow	PLC register overflow
55	 HAND Warning PLFF Function defect	Function code of PLC operation error
56	 HAND Warning PLSn Check sum error	PLC checksum error
57	 HAND Warning PLEd No end command	PLC end command is missing

ID No.	Display on LCM Keypad	Descriptions
58	 HAND Warning PLCr PLC MCR error	PLC MCR command error
59	 HAND Warning PLdF Download fail	PLC download fail
60	 HAND Warning PLSF Scane time fail	PLC scan time exceed
61	 HAND Warning PCGd CAN/M Guard err	CAN Master guarding error
62	 HAND Warning PCbF CAN/M bus off	CAN Master bus off
63	 HAND Warning PCnL CAN/M Node Lack	CAN Master node error
64	 HAND Warning PCCt CAN/M Cycle Time	CAN/M cycle time-out
65	 HAND Warning PCSF CAN/M SDO over	CAN/M SDOover
66	 HAND Warning PCSd CAN/M Sdo Tout	CAN/M SDO time-out
67	 HAND Warning PCAd CAN/M Addres set	CAN/M station address error

ID No.	Display on LCM Keypad	Descriptions
70	 HAND Warning ECid ExCom ID failed	Duplicate MAC ID error Node address setting error
71	 HAND Warning ECLv ExCom pwr loss	Low voltage of communication card
72	 HAND Warning ECtt ExCom Test Mode	Communication card in test mode
73	 HAND Warning ECbF ExCom Bus off	DeviceNet bus-off
74	 HAND Warning ECnP ExCom No power	DeviceNet no power
75	 HAND Warning ECFF ExCom Facty def	Factory default setting error
76	 HAND Warning ECiF ExCom Inner err	Serious internal error
77	 HAND Warning ECio ExCom IONet brk	IO connection break off
78	 HAND Warning ECPP ExCom Pr data	Profibus parameter data error
79	 HAND Warning ECPi ExCom Conf data	Profibus configuration data error
80	 HAND Warning ECEF ExCom Link fail	Ethernet Link fail
81	 HAND Warning ECto ExCom Inr T-out	Communication time-out for communication card and drive

ID No.	Display on LCM Keypad	Descriptions
82	 HAND Warning ECCS ExCom Inr CRC	Check sum error for Communication card and drive
83	 HAND Warning ECrF ExCom Rtn def	Communication card returns to default setting
84	 HAND Warning ECo0 ExCom MTCP over	Modbus TCP exceed maximum communication value
85	 HAND Warning ECo1 ExCom EIP over	EtherNet/IP exceed maximum communication value
86	 HAND Warning ECiP ExCom IP fail	IP fail
87	 HAND Warning EC3F ExCom Mail fail	Mail fail
88	 HAND Warning Ecby ExCom Busy	Communication card busy
101	 HAND Warning ictn InrCOM Time Out	Internal communication is off

Chapter 14 Fault Codes and Descriptions

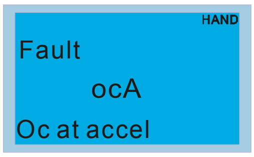
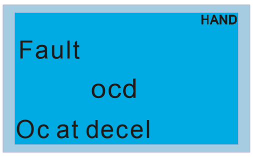
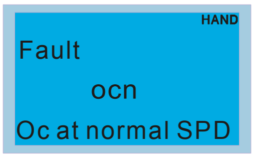
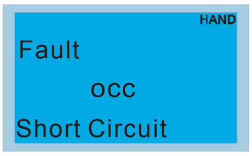
Warning
CE01
Comm. Error 1

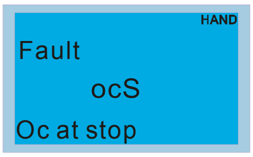
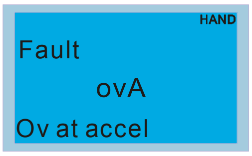
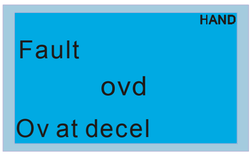
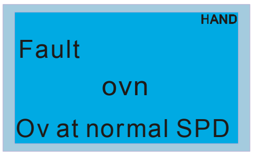
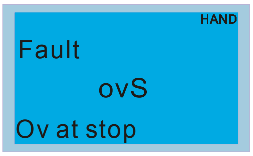
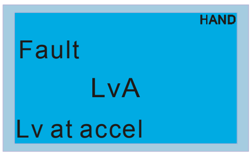
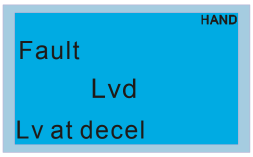
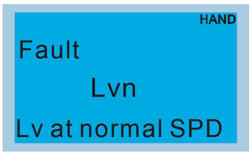
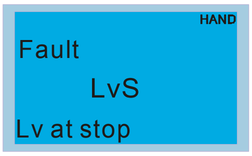
① Display error signal

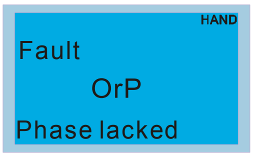
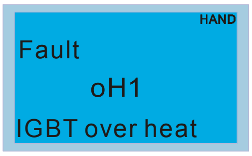
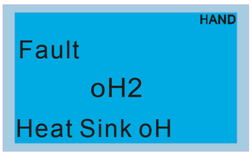
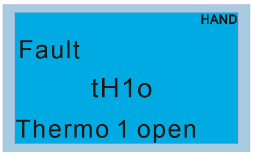
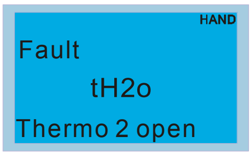
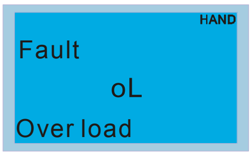
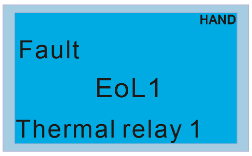
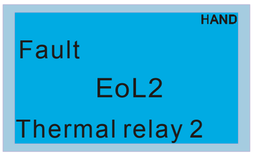
② Abbreviate error code
The code is displayed as shown on KPC-CE01.

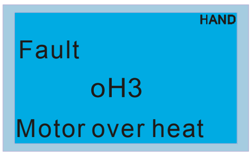
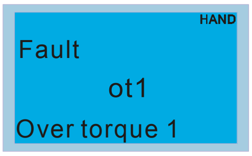
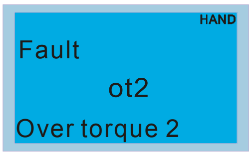
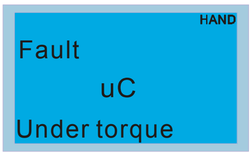
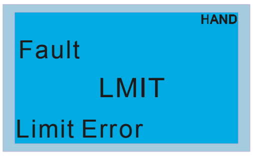
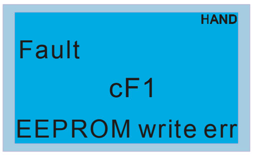
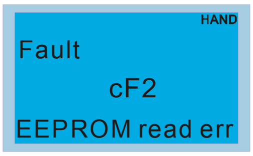
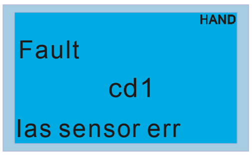
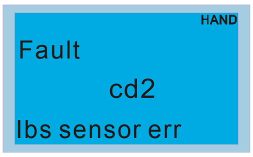
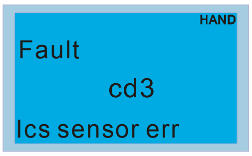
③ Display error description

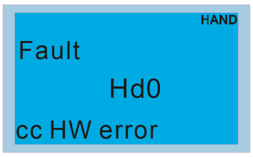
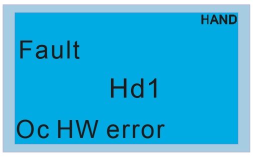
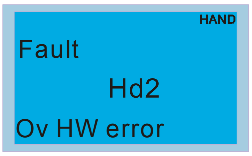
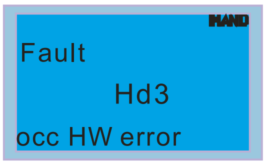
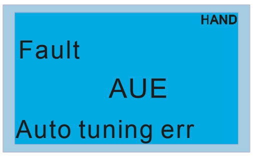
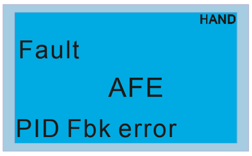
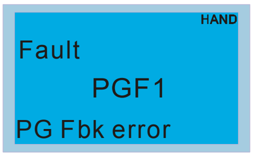
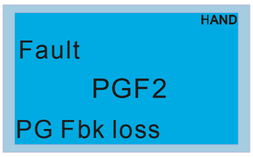
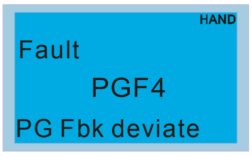
* Refer to setting of Pr06-17~Pr06~22.

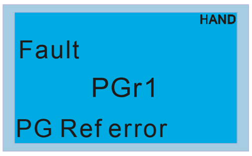
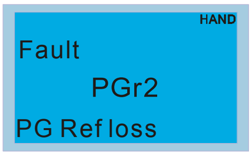
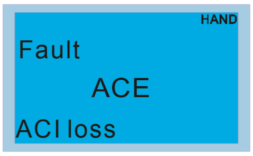
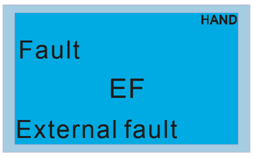
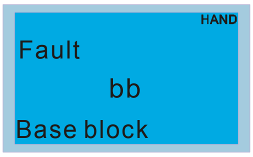
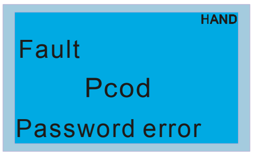
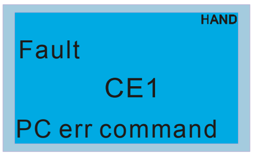
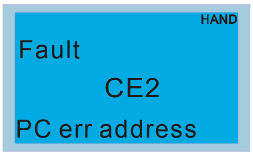
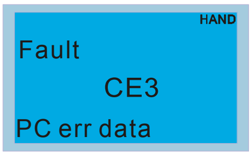
ID*	Fault Name	Fault Descriptions	Corrective Actions
1	 Fault ocA Oc at accel	Over-current during acceleration (Output current exceeds triple rated current during acceleration.)	1. Short-circuit at motor output: Check for possible poor insulation at the output. 2. Acceleration Time too short: Increase the Acceleration Time. 3. AC motor drive output power is too small: Replace the AC motor drive with the next higher power model.
2	 Fault ocd Oc at decel	Over-current during deceleration (Output current exceeds triple rated current during deceleration.)	1. Short-circuit at motor output: Check for possible poor insulation at the output. 2. Deceleration Time too short: Increase the Deceleration Time. 3. AC motor drive output power is too small: Replace the AC motor drive with the next higher power model.
3	 Fault ocn Oc at normal SPD	Over-current during steady state operation (Output current exceeds triple rated current during constant speed.)	1. Short-circuit at motor output: Check for possible poor insulation at the output. 2. Sudden increase in motor loading: Check for possible motor stall. 3. AC motor drive output power is too small: Replace the AC motor drive with the next higher power model.
4	 Fault GFF Ground fault	Ground fault	When (one of) the output terminal(s) is grounded, short circuit current is more than 50% of AC motor drive rated current, the AC motor drive power module may be damaged. NOTE: The short circuit protection is provided for AC motor drive protection, not for protecting the user. 1. Check the wiring connections between the AC motor drive and motor for possible short circuits, also to ground. 2. Check whether the IGBT power module is damaged. 3. Check for possible poor insulation at the output.
5	 Fault occ Short Circuit	Short-circuit is detected between upper bridge and lower bridge of the IGBT module	Return to the factory

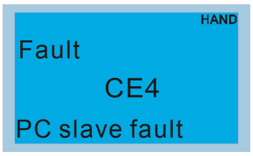
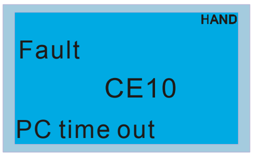
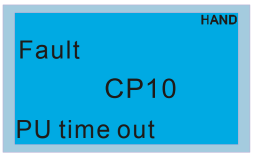
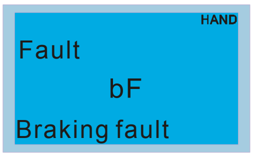
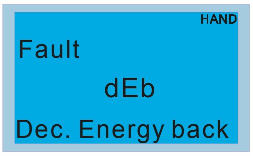
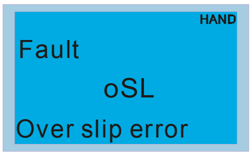
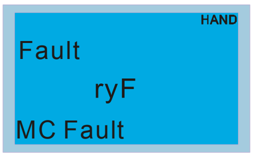
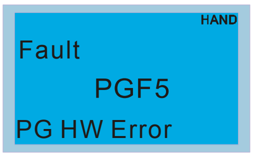
ID*	Fault Name	Fault Descriptions	Corrective Actions
6	 HAND Fault ocS Oc at stop	Hardware failure in current detection	Return to the factory
7	 HAND Fault ovA Ov at accel	DC BUS over-voltage during acceleration (230V: DC 450V; 460V: DC 900V)	1. Check if the input voltage falls within the rated AC motor drive input voltage range. 2. Check for possible voltage transients. 3. If DC BUS over-voltage due to regenerative voltage, please increase the acceleration time or add an optional brake resistor.
8	 HAND Fault ovd Ov at decel	DC BUS over-voltage during deceleration (230V: DC 450V; 460V: DC 900V)	1. Check if the input voltage falls within the rated AC motor drive input voltage range. 2. Check for possible voltage transients. 3. If DC BUS over-voltage due to regenerative voltage, please increase the Deceleration Time or add an optional brake resistor.
9	 HAND Fault ovn Ov at normal SPD	DC BUS over-voltage at constant speed (230V: DC 450V; 460V: DC 900V)	1. Check if the input voltage falls within the rated AC motor drive input voltage range. 2. Check for possible voltage transients. 3. If DC BUS over-voltage due to regenerative voltage, please increase the Deceleration Time or add an optional brake resistor.
10	 HAND Fault ovS Ov at stop	Hardware failure in voltage detection	1. Check if the input voltage falls within the rated AC motor drive input voltage range. 2. Check for possible voltage transients.
11	 HAND Fault LvA Lv at accel	DC BUS voltage is less than Pr.06-00 during acceleration	1. Check if the input voltage is normal 2. Check for possible sudden load
12	 HAND Fault Lvd Lv at decel	DC BUS voltage is less than Pr.06-00 during deceleration	1. Check if the input voltage is normal 2. Check for possible sudden load
13	 HAND Fault Lvn Lv at normal SPD	DC BUS voltage is less than Pr.06-00 in constant speed	1. Check if the input voltage is normal 2. Check for possible sudden load
14	 HAND Fault LvS Lv at stop	DC BUS voltage is less than Pr.06-00 at stop	1. Check if the input voltage is normal 2. Check for possible sudden load

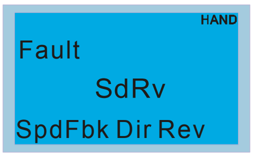
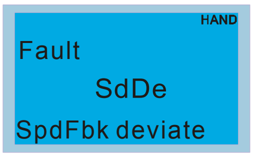
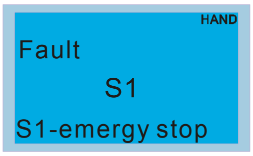
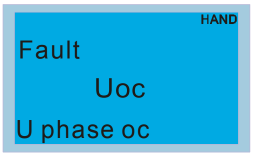
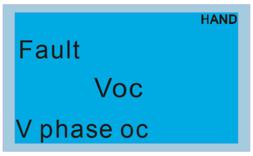
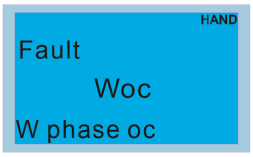
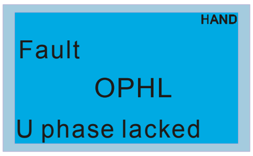
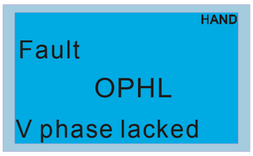
ID*	Fault Name	Fault Descriptions	Corrective Actions
15	 HAND Fault OrP Phase lacked	Phase Loss	Check Power Source Input if all 3 input phases are connected without loose contacts. For models 40hp and above, please check if the fuse for the AC input circuit is blown.
16	 HAND Fault oH1 IGBT over heat	IGBT overheating IGBT temperature exceeds protection level	1. Ensure that the ambient temperature falls within the specified temperature range. 2. Make sure that the ventilation holes are not obstructed. 3. Remove any foreign objects from the heatsinks and check for possible dirty heat sink fins. 4. Check the fan and clean it. 5. Provide enough spacing for adequate ventilation.
17	 HAND Fault oH2 Heat Sink oH	Heatsink overheating Capacitance temperature exceeds cause heatsink overheating.	1. Ensure that the ambient temperature falls within the specified temperature range. 2. Make sure heat sink is not obstructed. Check if the fan is operating 3. Check if there is enough ventilation clearance for AC motor drive.
18	 HAND Fault tH1o Thermo 1 open	IGBT Hardware Error	Return to the factory
19	 HAND Fault tH2o Thermo 2 open	Capacitor Hardware Error	Return to the factory
21	 HAND Fault oL Over load	Overload The AC motor drive detects excessive drive output current.	1. Check if the motor is overloaded. 2. Take the next higher power AC motor drive model.
22	 HAND Fault EoL1 Thermal relay 1	Electronics thermal relay 1 protection	1. Check the setting of electronics thermal relay (Pr.06-14) Take the next higher power AC motor drive model
23	 HAND Fault EoL2 Thermal relay 2	Electronics thermal relay 2 protection	1. Check the setting of electronics thermal relay (Pr.06-28) 2. Take the next higher power AC motor drive model

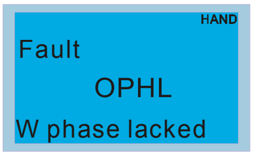
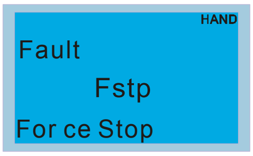
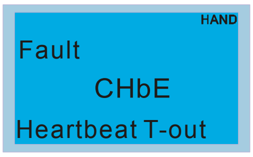
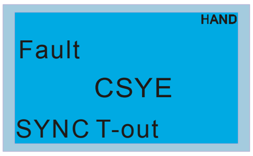
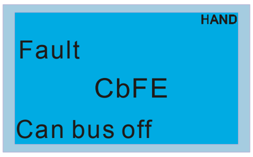
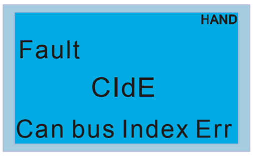
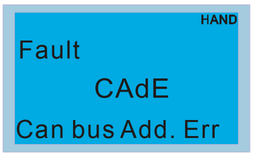
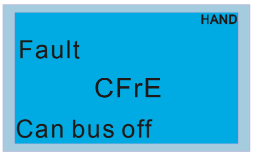
ID*	Fault Name	Fault Descriptions	Corrective Actions
24	 HAND Fault oH3 Motor over heat	Motor overheating The AC motor drive detecting internal temperature exceeds the setting of Pr.06-30 (PTC level) or Pr.06-57 (PT100 level 2).	1. Make sure that the motor is not obstructed. 2. Ensure that the ambient temperature falls within the specified temperature range. 3. Change to a higher power motor.
26	 HAND Fault ot1 Over torque 1	These two fault codes will be displayed when output current exceeds the over-torque detection level (Pr.06-07 or Pr.06-10) and exceeds over-torque detection (Pr.06-08 or Pr.06-11) and it is set to 2 or 4 in Pr.06-06 or Pr.06-09.	1. Check whether the motor is overloaded. 2. Check whether motor rated current setting (Pr.05-01) is suitable 3. Take the next higher power AC motor drive model.
27	 HAND Fault ot2 Over torque 2		
28	 HAND Fault uC Under torque	Low current detection	Check Pr.06-71, Pr.06-72, Pr.06-73.
29	 HAND Fault LMIT Limit Error	Limit error	
30	 HAND Fault cF1 EEPROM write err	Internal EEPROM can not be programmed.	1. Press “RESET” key to the factory setting 2. Return to the factory.
31	 HAND Fault cF2 EEPROM read err	Internal EEPROM can not be read.	1. Press “RESET” key to the factory setting 2. Return to the factory.
33	 HAND Fault cd1 Ias sensor err	U-phase error	Reboots the power. If fault code is still displayed on the keypad please return to the factory
34	 HAND Fault cd2 Ibs sensor err	V-phase error	Reboots the power. If fault code is still displayed on the keypad please return to the factory
35	 HAND Fault cd3 Ics sensor err	W-phase error	Reboots the power. If fault code is still displayed on the keypad please return to the factory

ID*	Fault Name	Fault Descriptions	Corrective Actions
36	 HAND Fault Hd0 cc HW error	CC (current clamp)	Reboots the power. If fault code is still displayed on the keypad please return to the factory
37	 HAND Fault Hd1 Oc HW error	OC hardware error	Reboots the power. If fault code is still displayed on the keypad please return to the factory
38	 HAND Fault Hd2 Ov HW error	OV hardware error	Reboots the power. If fault code is still displayed on the keypad please return to the factory
39	 HAND Fault Hd3 occ HW error	Occ hardware error	Reboots the power. If fault code is still displayed on the keypad please return to the factory
40	 HAND Fault AUE Auto tuning err	Auto tuning error	1. Check cabling between drive and motor 2. Try again.
41	 HAND Fault AFE PID Fbk error	PID loss (ACI)	1. Check the wiring of the PID feedback 2. Check the PID parameters settings
42	 HAND Fault PGF1 PG Fbk error	PG feedback error	Check if encoder parameter setting is accurate when it is PG feedback control.
43	 HAND Fault PGF2 PG Fbk loss	PG feedback loss	Check the wiring of the PG feedback
44	 HAND Fault PGF3 PG Fbk over SPD	PG feedback stall	1. Check the wiring of the PG feedback 2. Check if the setting of PI gain and deceleration is suitable 3. Return to the factory
45	 HAND Fault PGF4 PG Fbk deviate	PG slip error	1. Check the wiring of the PG feedback 2. Check if the setting of PI gain and deceleration is suitable 3. Return to the factory

ID*	Fault Name	Fault Descriptions	Corrective Actions
46	 HAND Fault PGr1 PG Ref error	Pulse input error	1. Check the pulse wiring 2. Return to the factory
47	 HAND Fault PGr2 PG Ref loss	Pulse input loss	1. Check the pulse wiring 2. Return to the factory
48	 HAND Fault ACE ACI loss	ACI loss	1. Check the ACI wiring 2. Check if the ACI signal is less than 4mA
49	 HAND Fault EF External fault	External Fault	1. Input EF (N.O.) on external terminal is closed to GND. Output U, V, W will be turned off. 2. Give RESET command after fault has been cleared.
50	 HAND Fault EF1 Emergency stop	Emergency stop	1. When the multi-function input terminals MI1 to MI6 are set to emergency stop, the AC motor drive stops output U, V, W and the motor coasts to stop. 2. Press RESET after fault has been cleared.
51	 HAND Fault bb Base block	External Base Block	1. When the external input terminal (B.B) is active, the AC motor drive output will be turned off. 2. Deactivate the external input terminal (B.B) to operate the AC motor drive again.
52	 HAND Fault Pcod Password error	Password is locked.	Keypad will be locked. Turn the power ON after power OFF to re-enter the correct password. See Pr.00-07 and 00-08.
54	 HAND Fault CE1 PC err command	Illegal function code	Check if the function code is correct (function code must be 03, 06, 10, 63)
55	 HAND Fault CE2 PC err address	Illegal data address (00H to 254H)	Check if the communication address is correct
56	 HAND Fault CE3 PC err data	Illegal data value	Check if the data value exceeds max./min. value

ID*	Fault Name	Fault Descriptions	Corrective Actions
67	 HAND Fault CE4 PC slave fault	Data is written to read-only address	Check if the communication address is correct
58	 HAND Fault CE10 PC time out	Modbus transmission time-out	
59	 HAND Fault CP10 PU time out	Keypad transmission time-out	
60	 HAND Fault bF Braking fault	Brake resistor fault	If the fault code is still displayed on the keypad after pressing "RESET" key, please return to the factory.
61	 HAND Fault ydc Y-delta connect	Y-connection/Δ-connection switch error	1. Check the wiring of the Y-connection/Δ-connection 2. Check the parameters settings
62	 HAND Fault dEb Dec. Energy back	When Pr.07-13 is not set to 0 and momentary power off or power cut, it will display dEb during accel./decel. stop.	1. Set Pr.07-13 to 0 2. Check if input power is stable
63	 HAND Fault oSL Over slip error	It will be displayed when slip exceeds Pr.05-26 setting and time exceeds Pr.05-27 setting.	1. Check if motor parameter is correct (please decrease the load if overload 2. Check the settings of Pr.05-26 and Pr.05-27
64	 HAND Fault ryF MC Fault	Electric valve switch error when executing Soft Start. (This warning is for frame E and higher frame of AC drives) Do not disconnect RST when drive is still operating.	
65	 HAND Fault PGF5 PG HW Error	Hardware error of PG Card Check if PG Card is insert to the right slot and parameter settings for encoder are accurate.	

ID*	Fault Name	Fault Descriptions	Corrective Actions
68	 HAND Fault SdRv SpdFbk Dir Rev	Rotaing direction is different from the commanding direction deteced by the sensorless. Solution Verify if the parameter setting of the motor drive is correct Increase the estimator's bandwidth and verify if parameters relating to the sensorless are correct.	
69	 HAND Fault SdOr SpdFbk over SPD	Overspeed rotation detected by the sensorless Solution Verify if the parameter setting of the motor drive is correct Increase the estimator's bandwidth and verify if parameters relating to the sensorless are correct. Verify if the gains of the speed circuit is reasonable.	
70	 HAND Fault SdDe SpdFbk deviate	Big difference between the rotating speed and the command deteced by the sensorless Solution Verify if the parameter setting of the motor drive is correct Increase the estimator's bandwidth and verify if parameters relating to the sensorless are correct. Verify if the gains of the speed circuit is reasonable.	
73	 HAND Fault S1 S1-emergy stop	Emergency stop for external safety	
79	 HAND Fault Uoc U phase oc	Phase U short circuit	
80	 HAND Fault Voc V phase oc	Phase V short circuit	
81	 HAND Fault Woc W phase oc	W phase short circuit	
82	 HAND Fault OPHL U phase lacked	Output phase loss (Phase U)	
83	 HAND Fault OPHL V phase lacked	Output phase loss (Phase V)	

ID*	Fault Name	Fault Descriptions	Corrective Actions
84	HAND Fault OPHL W phase lacked	Output phase loss (Phase W)	
90	HAND Fault Fstp For ce Stop	Internal PLC forced to stop Verify the setting of Pr.00-32	
101	HAND Fault CGdE Guarding T-out	CANopen guarding error	
102	HAND Fault CHbE Heartbeat T-out	CANopen heartbeat error	
103	HAND Fault CSYE SYNC T-out	CANopen synchronous error	
104	HAND Fault CbFE Can bus off	CANopen bus off error	
105	HAND Fault CIdE Can bus Index Err	CANopen index error	
106	HAND Fault CAdE Can bus Add. Err	CANopen station address error	
107	HAND Fault CFrE Can bus off	CANopen memory error	
111	HAND Fault ictE InrCom Time Out	Internal communication time-out	

Chapter 15 CANopen Overview

Newest version is available at http://www.delta.com.tw/industrialautomation/

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.

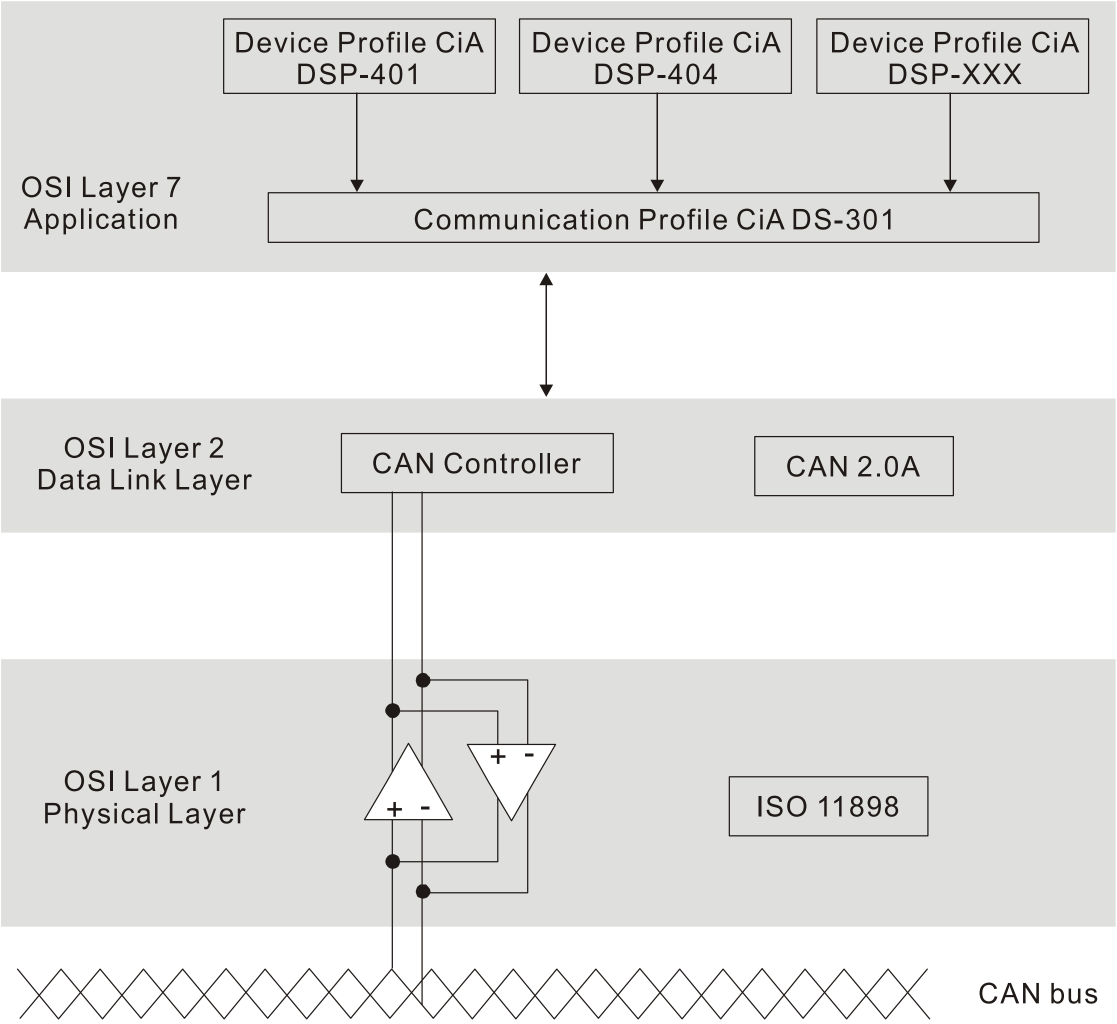
Delta CANopen not supporting service:

- Time Stamp service

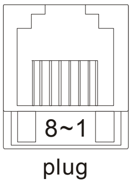
15.1 CANopen Overview

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 / 0V /V-
6	CAN_GND	Ground / 0V /V-

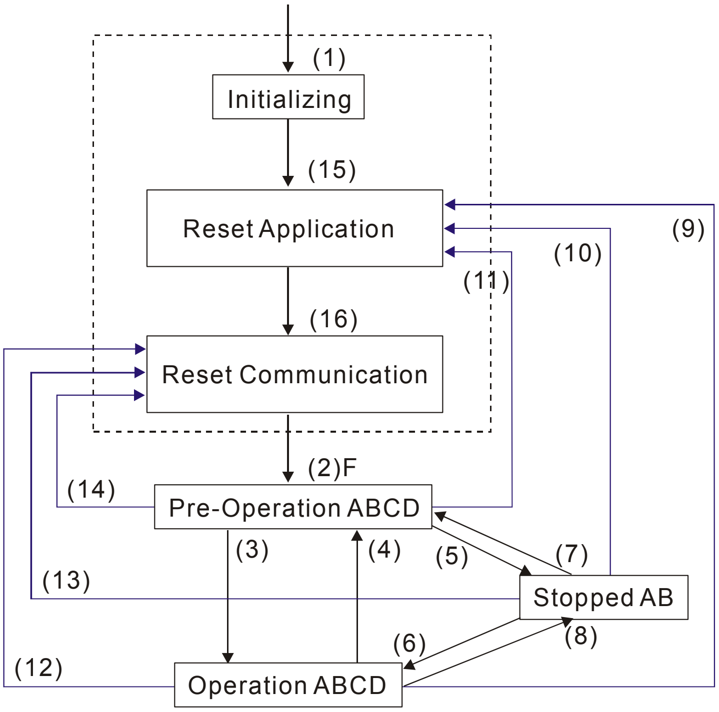
CANopen Communication Protocol

It has services as follows:

- NMT (Network Management Object)
- SDO (Service Data Objects)
- PDO (Process Data Object)
- EMCY (Emergency Object)

NMT (Network Management Object)

The Network Management (NMT) follows a Master/Slave structure for executing NMT service. Only one NMT master is in a network, and other nodes are regarded as slaves. All CANopen nodes have a present NMT state, and NMT master can control the state of the slave nodes. The state diagram of a node is shown as follows:



(1) After power is applied, it is auto in initialization state
(2) Enter pre-operational state automatically
(3) (6) Start remote node
(4) (7) Enter pre-operational state
(5) (8) Stop remote node
(9) (10) (11) Reset node
(12) (13) (14) Reset communication
(15) Enter reset application state automatically
(16) Enter reset communication state automatically

A: NMT
B: Node Guard
C: SDO
D: Emergency
E: PDO
F: Boot-up

	Initializing	Pre-Operational	Operational	Stopped
PDO			○	
SDO		○	○	
SYNC		○	○	
Time Stamp		○	○	
EMCY		○	○	
Boot-up	○			
NMT		○	○	○

SDO (Service Data Objects)

SDO is used to access the Object Dictionary in every CANopen node by Client/Server model. One SDO has two COB-ID (request SDO and response SDO) to upload or download data between two nodes. No data limit for SDOs to transfer data. But it needs to transfer by segment when data exceeds 4 bytes with an end signal in the last segment.

The Object Dictionary (OD) is a group of objects in CANopen node. Every node has an OD in the system, and OD contains all parameters describing the device and its network behavior. The access path of OD is the index and sub-index, each object has a unique index in OD, and has sub-index if necessary. The request and response frame structure of SDO communication is shown as follows:

PDO (Process Data Object)

PDO communication can be described by the producer/consumer model. Each node of the network will listen to the messages of the transmission node and distinguish if the message has to be processed or not after receiving the message. PDO can be transmitted from one device to one another device or to many other devices. Every PDO has two PDO services: a TxPDO and a RxPDO. PDOs are transmitted in a non-confirmed mode.

PDO Transmission type is defined in the PDO communication parameter index (1400h for the 1st RxPDO or 1800h for the 1st TxPDO), and all transmission types are listed in the following table:

Type Number	PDO				
	Cyclic	Acyclic	Synchronous	Asynchronous	RTR only
0		○	○		
1-240	○		○		
241-251	Reserved				
252			○		○
253				○	○
254				○	
255				○	

Type number 1-240 indicates the number of SYNC message between two PDO transmissions.

Type number 252 indicates the data is updated (but not sent) immediately after receiving SYNC.

Type number 253 indicates the data is updated immediately after receiving RTR.

Type number 254: Delta CANopen doesn’t support this transmission format.

Type number 255 indicates the data is asynchronous transmission.

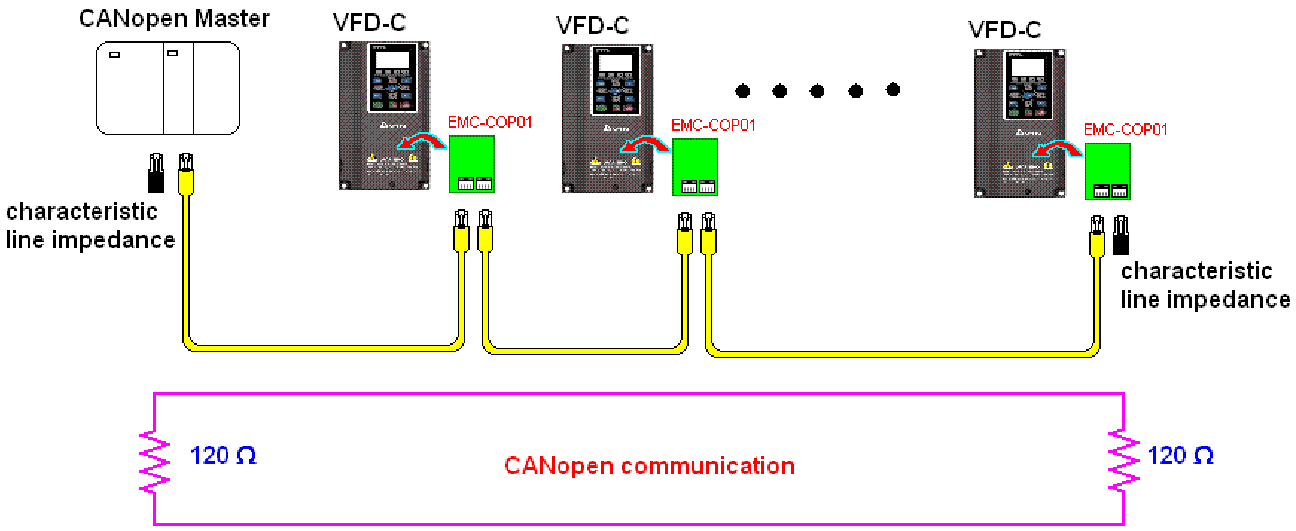
All PDO transmission data must be mapped to index via Object Dictionary.

EMCY (Emergency Object)

When errors occurred inside the hardware, an emergency object will be triggered an emergency object will only be sent when an error is occurred. As long as there is nothing wrong with the hardware, there will be no emergency object to be served as a warning of an error message.

15.2 Wiring for CANopen

An external adapter card: EMC-COP01 is used for CANopen wiring to connect CANopen to VFD C2000. The link is enabled by using RJ45 cable. The two farthest ends must be terminated with 120Ω terminating resistors.



15.3 CANopen Communication Interface Description

15.3.1 CANopen Control Mode Selection

There are two control modes for CANopen; Pr.09-40 set to 1 is the factory setting mode DS402 standard and Pr.09-40 set to 0 is Delta's standard setting mode.

Actually, there are two control modes according to Delta's standard, one is the old control mode (Pr09-30=0).
This control mode can only control the motor drive under frequency control. Another mode is a new standard (Pr09-30=1)
This new control mode allows the motor drive to be controlled under all sorts of mode.
Currently, C2000 support speed, torque, position and home mode.

The definition of relating control mode are:

CANopen Control Mode Selection	Control Mode							
	Speed		Torque		Position		Home	
	Index	Description	Index	Description	Index	Description	Index	Description
DS402 standard Pr. 09-40=1	6042-00	Target rotating speed (RPM)	6071-00	Target Torque (%)	607A-00	Target Position	-----	-----
	-----	-----	6072-00	Max. Torque Limit(%)	-----	-----	-----	-----
Delta Standard (Old definition) P09-40=1, P09-30=0	2020-02	Target rotating speed (Hz)	-----	-----	-----	-----	-----	-----
Delta Standard (New definition) P09-40=0, P09-30=1	2060-03	Target rotating speed (Hz)	2060-07	Target Torque (%)	2060-05	Target Position	-----	-----
	2060-04	Torque Limit (%)	2060-08	Speed Limit (Hz)	-----	-----	-----	-----

CANopen Control Mode Selection	Operation Control	
	Index	Description
DS402 standard Pr. 09-40=1	6040-00	Operation Command
	-----	-----
Delta Standard (Old definition) P09-40=1, P09-30=0	2020-01	Operation Command
Delta Standard (New definition) P09-40=0, P09-30=1	2060-01	Operation Command
	-----	-----

CANopen Control Mode Selection	Other	
	Index	Description
DS402 standard Pr. 09-40=1	605A-00	Quick stop processing mode
	605C-00	Disable operation processing mode
Delta Standard (Old definition) P09-40=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 1~127. 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.

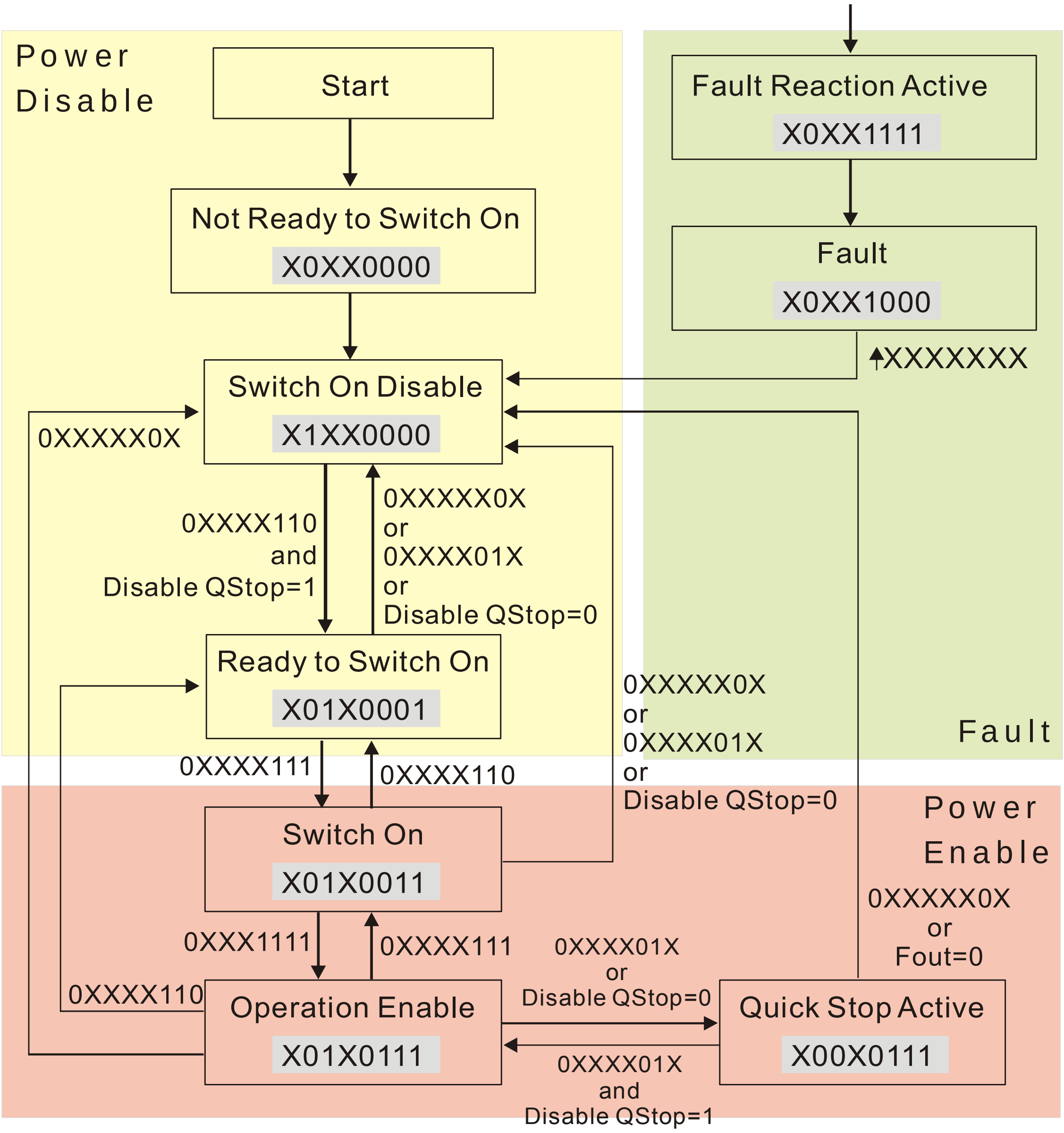
Therefore, when the motor drive is turned on and finishes the initiation, it will remain at Ready to Switch on status. To control the operation of the motor drive, you need to change this status to Operate Enable status. The way to change it is to commend the control word's bit0 ~ bit3 and bit7 of the Index 6040H and to pair with Index Status Word (Status Word 0X6041). The control steps and index definition are described as below:

Index 6040

15~9	8	7	6~4	3	2	1	0
Reserved	Halt	Fault Reset	Operation	Enable operation	Quick Stop	Enable Voltage	Switch On

Index 6041

15~14	13~12	11	10	9	8	7	6	5	4	3	2	1	0
Reserved	Operation	Internal limit active	Target reached	Remote	Reserved	Warning	Switch on disabled	Quick stop	Voltage enabled	Fault	Operation enable	Switch on	Ready to switch on



Set command 6040 =0xE, then set another command 6040 =0xF. Then the motor drive can be switched to Operation Enable. The Index 605A decides the dashed line of Operation Enable when the control mode changes from Quick Stop Active. (When the setting value is 1~3, this dashed line is active. But when the setting value of 605A is not 1~3, once he motor derive is switched to Quick Stop Active, it will not be able to switch back to Operation Enable.)

Index	Sub	Definition	Factory Setting	R/W	Size	Unit	PDO Map	Mode	note
605Ah	0	Quick stop option code	2	RW	S16		No		0 : disable drive function 1 :slow down on slow down ramp 2: slow down on quick stop ramp 5 slow down on slow down ramp and stay in QUICK STOP 6 slow down on quick stop ramp and stay in QUICK STOP 7 slow down on the current limit and stay in Quick stop

Besides, when the control section switches from Power Enable to Power Disable, use 605C to define parking method.

Index	Sub	Definition	Factory Setting	R/W	Size	Unit	PDO Map	Mode	note
605Ch	0	Disable operation option code	1	RW	S16		No		0: Disable drive function 1: Slow down with slow down ramp; disable of the drive function

15-3-2-3 Various mode control method (by following DS402 standard)

Control mode of C2000, supporting speed, torque, position and home control are described as below:

Speed mode

1. Let Ac Motor Drive be at the speed control mode: Set Index6060 to 2.
2. Switch to Operation Enable mode: Set 6040=0xE, then set 6040 = 0xF.
3. To set target frequency: Set target frequency of 6042, since the operation unit of 6042 is rpm, there is a transformation:

$n = f \times \frac{120}{p}$ n: rotation speed (rpm) (rounds/minute) P: motor’s pole number (Pole)

f: rotation frequency (Hz)

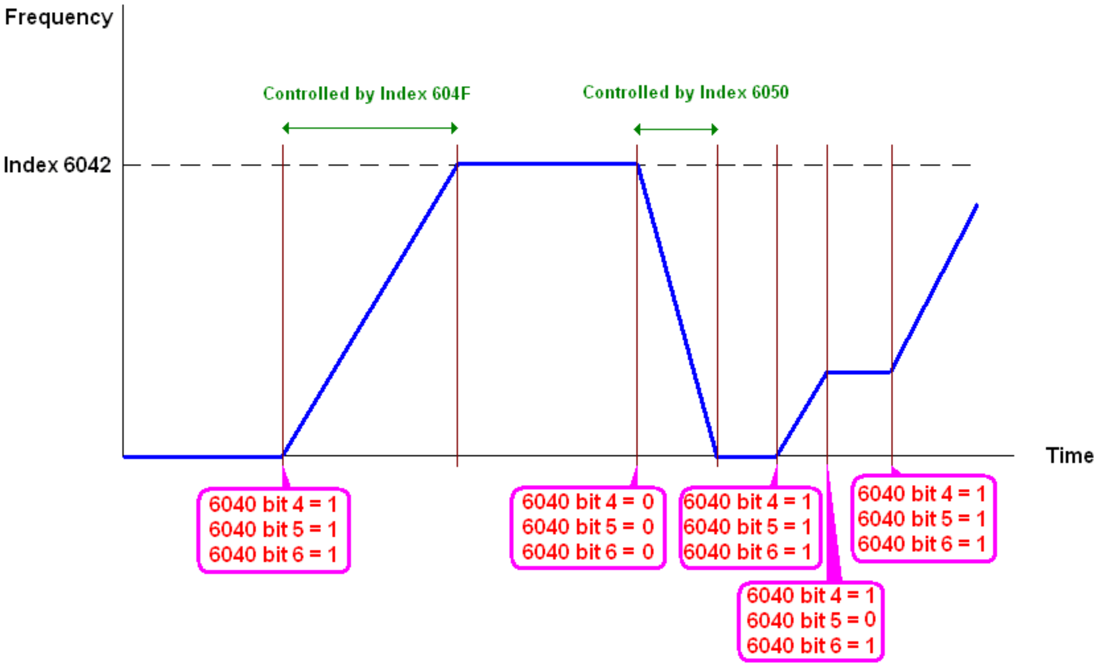
For example:

Set 6042H = 1500 (rpm), if the motor drive's pole number is 4 (Pr05-04 or Pr05-16), then the motor drive's operation frequency is 1500(120/4)=50Hz.

Besides, the 6042 is defined as a signed operation. The plus or minus sign means to rotate clockwise or counter clockwise

4. To set acceleration and deceleration: Use 604F(Acceleration) and 6050(Deceleration).
5. Trigger an ACK signal: In the speed control mode, the bit 6~4 of Index 6040 needs to be controlled. It is defined as below:

Speed mode (Index 6060=2)	Index 6040			SUM
	Bit 6	Bit 5	Bit 4	
	1	0	1	Locked at the current signal.
	1	1	1	Run to reach targeting signal.
	Other			Decelerate to 0Hz.



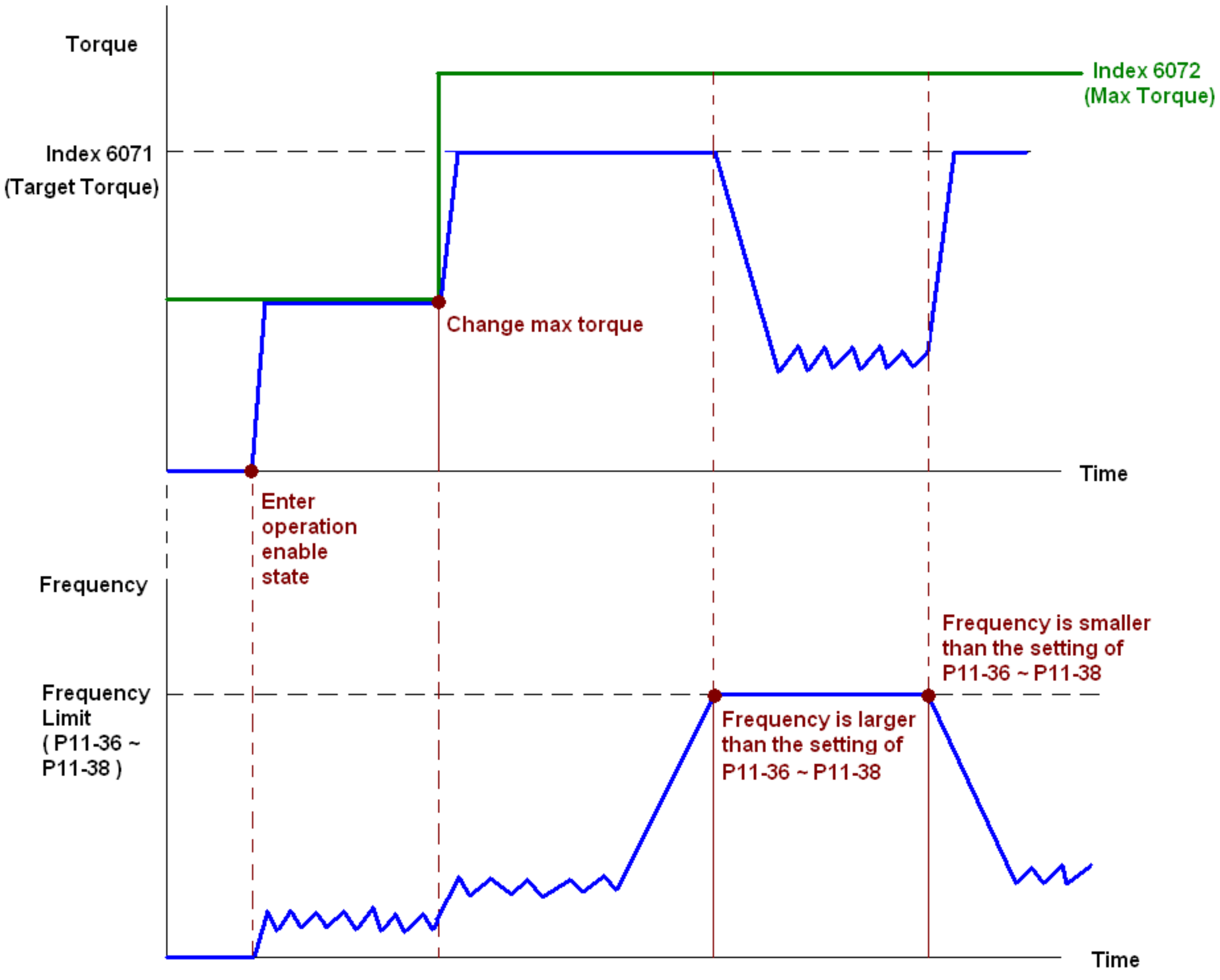
NOTE 01: To know the current rotation speed, read 6043. (unit: rpm)

NOTE 02: To know if the rotation speed can reach the targeting value; read bit 10 of 6041. (0: Not reached; 1: Reached)

Torque mode

1. Let Ac Motor Drive be at the torque control mode: Set Index6060 = 4.
2. Switch the current mode to Operation Enable, set 6040 = 0xE, then set 6040 = 0xF.
3. To set targeting torque: Set 6071 as targeting torque and 6072 as the largest output torque.

Torque mode (Index 6060=4)	Index 6040			SUM
	Bit 6	Bit 5	Bit 4	
	X	X	X	RUN to reach the targeting torque.



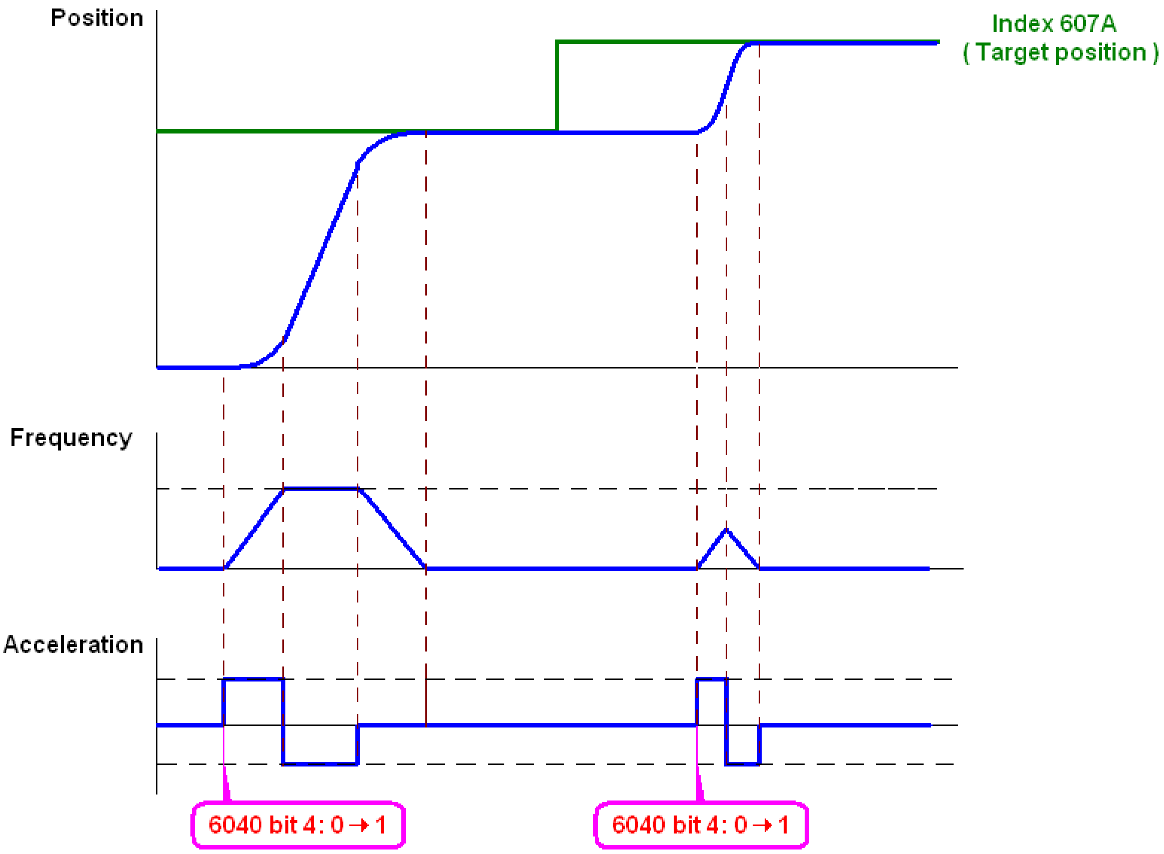
NOTE: The standard DS402 doesn't regulate the highest speed limit. Therefore if the motor drive defines the control mode of DS402, the highest speed will go with the setting of Pr11-36 to Pr11-38.

NOTE 01: To know the current torque, read 6077 (unit: 0.1%).

NOTE02: To know if reaching the targeting torque, read bit 10 of 6041. (0: Not reached; 1: Reached)

Position mode

1. Set the parameter of a trapezium curve to define position control (Pr11-43 Max. Frequency of Point- to-Point Position Control, Pr11-44 Accel. Time of Point-to Point Position Control and Pr11-45 Decel. Time of Point-to Point Position Control)
2. Let Ac Motor Drive be at the position control mode: Then set Index 6060 = 1.
3. Switch the current mode to Operation Enable, set 6040 = 0xE and then set 6040 = 0xF.
4. To set targeting position: set 607A as the targeting position.
5. Trigger an ACK signal: Set 6040 = 0x0F then set 6040 = 0x1F. (Bit4 changes from 0 to 1).



NOTE 01: To know the current position, read 6064.

NOTE 02: To know if the position reaches the targeting position, read bit 10 of 6041. (0: reached, 1: Not reached)

NOTE 03: To know if the position is over the limited area, read bit 11 of 6041 (0: in the limit, 1: over the limit)

Home mode

1. Set Pr00-12 to choose a home method.
2. Set the left and right limits correspond to the position of MI terminal.
3. To switch Ac Motor Drive control mode to Home mode: Set Index 6060 = 6.
4. To switch from current mode to Operation Enable: Set 6040 = 0xE, then set 6040 = 0xF.
5. To trigger an ACK signal: Set 6040 = 0x0F, then set 6040 = 0x1F (Bit4 changes from 0 to 1 and the motor drive will be back to home.)

Note 01: To know if the home mode is completed, read bit 12 of 6041. (0: reached, 1: Not reached)

15.3.3 By using Delta Standard (Old definition, only support speed mode)

15-3.3.1 Various mode control method (by following DS402 standard)

If you want to use DS402 standard to control the motor drive, please follow the steps below:

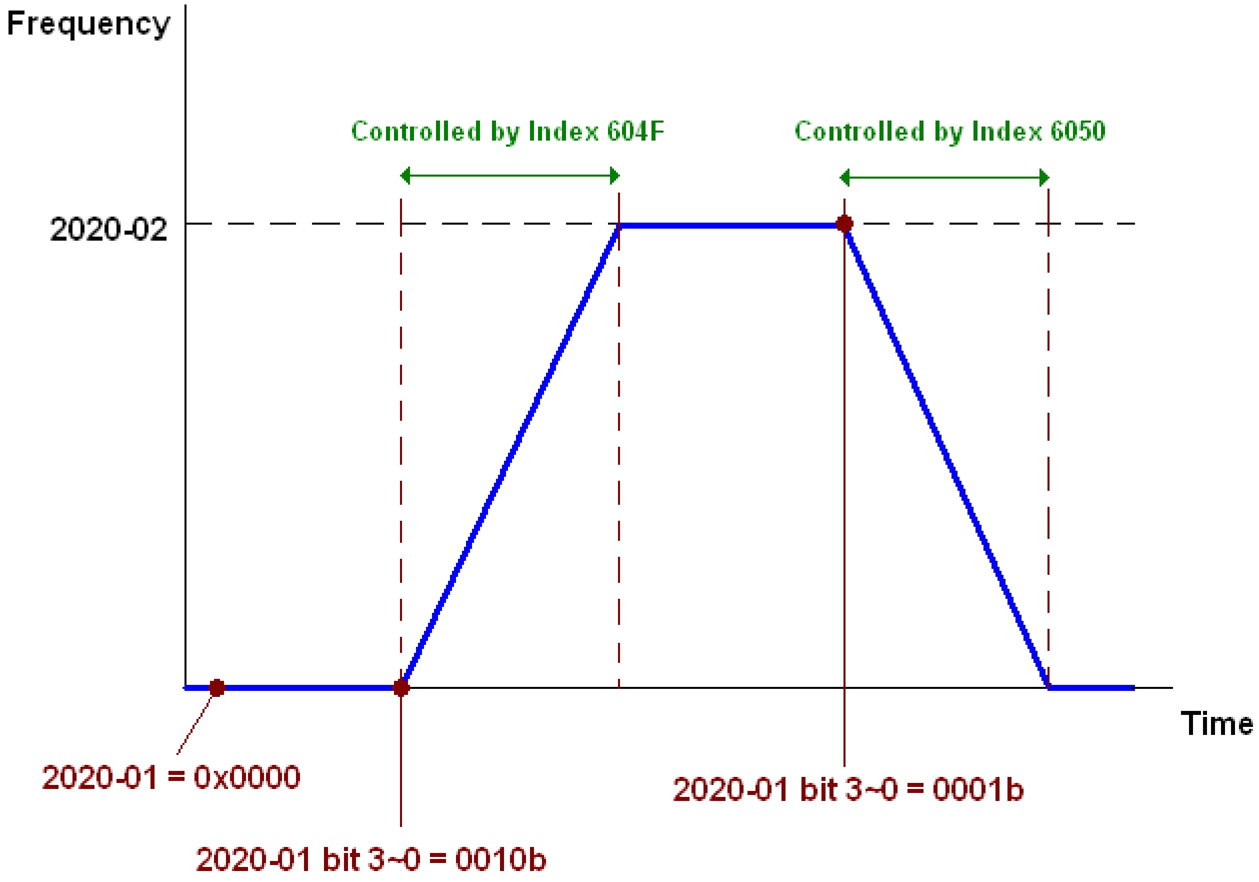
1. Wiring for hardware (Refer to chapter 15.2 Wiring for CANopen)
2. Operation source setting: set Pr.00-21 to 3 for CANopen communication card control.
3. Frequency source setting: set Pr.00.20 to 6. (Choose source of frequency commend from CANopen setting.)

4. Set Delta Standard (Old definition, only support speed mode) as control mode: Pr. 09-40 = 0 and 09-30 = 0.

   CANopen station setting: set Pr.09-36 (Range of setting is 1~127. When Pr.09-36=0, CANopen slave function is disabled.) (Note: If error arised (CAdE or CANopen memory error) as station setting is completed, press Pr.00-02=7 for reset.)
5. CANopen baud rate setting: set Pr.09.37 (CANBUS Baud Rate: 1M(0), 500K(1), 250K(2), 125K(3), 100K(4) and50K(5))

15-3-3-2 By speed mode

1. Set the target frequency: Set 2020-02, the unit is Hz, with a number of 2 decimal places. For example 1000 is 10.00.
2. Operation control: Set 2020-01 = 0002H for Running, and set 2020-01 = 0001H for Stopping.



15.3.4 By using Delta Standard (New definition)

15-3-4-1 Related set up of ac motor drive (Delta New Standard)

If you want to use DS402 standard to control the motor drive, please follow the steps below:

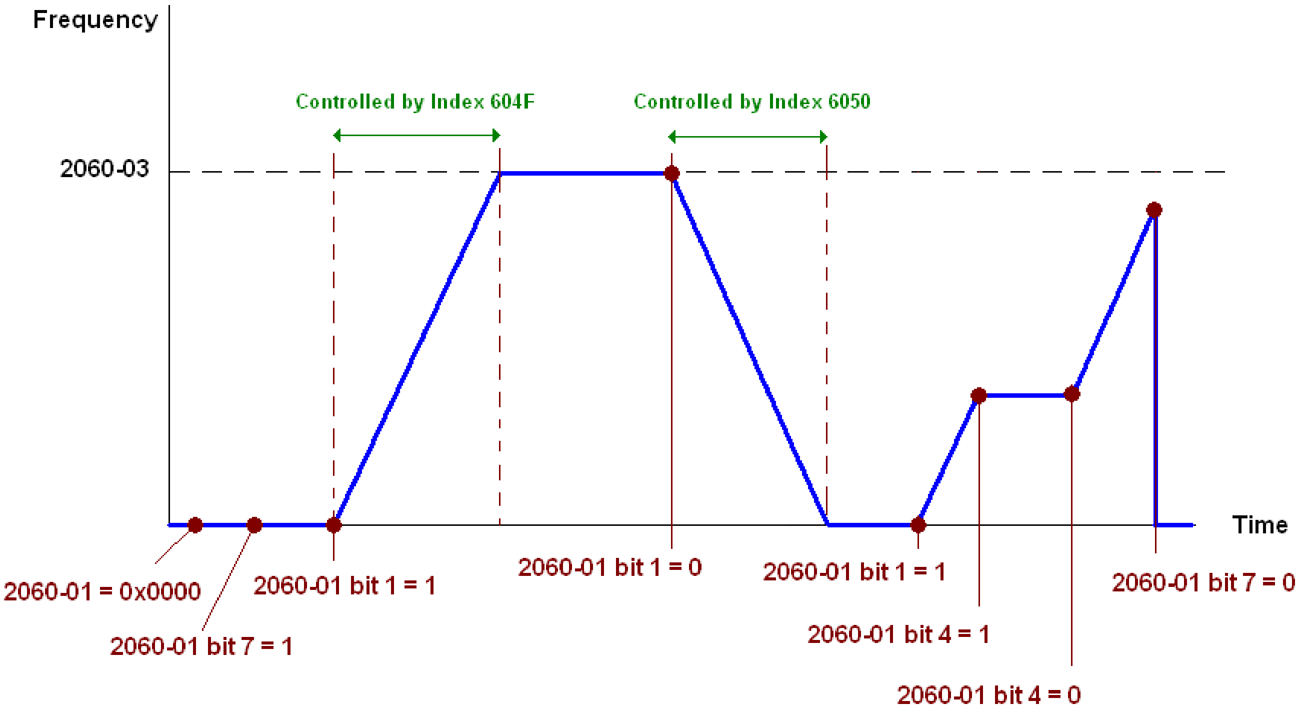
1. Wiring for hardware (Refer to chapter 15.2 Wiring for CANopen)
2. Operation source setting: set Pr.00-21 to 3 for CANopen communication card control.
3. Frequency source setting: set Pr.00.20 to 6. (Choose source of frequency commend from CANopen setting.)
4. Source of torque setting is set by Pr.11-33. (Choose source of torque commend from CANopen setting.)

5. CANopen station setting: set Pr.09-36 (Choose source of position commend from CANopen setting.)
6. Set Delta Standard (Old definition, only support speed mode) as control mode: Pr. 09-40 = 0 and 09-30 = 0.
7. CANopen station setting: set Pr.09-36 (Range of setting is 1~127. When Pr.09-36=0, CANopen slave function is disabled.) (Note: If error arised (CAdE or CANopen memory error) as station setting is completed, press Pr.00-02=7 for reset.)
8. CANopen baud rate setting: set Pr.09.37 (CANBUS Baud Rate: 1M(0), 500K(1), 250K(2), 125K(3), 100K(4) and50K(5))

15-3-4-2 Various mode control method (Delta New Standard)

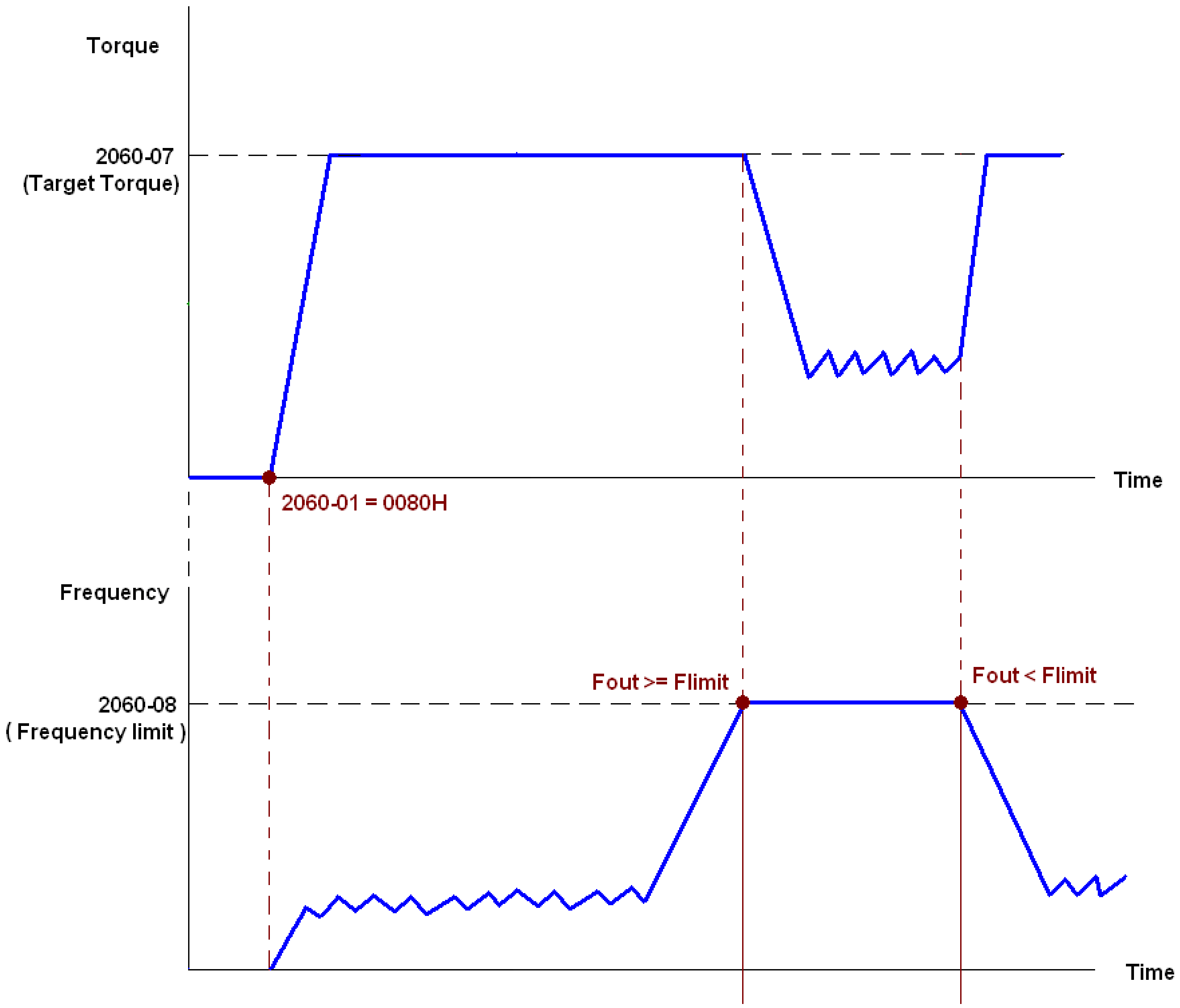
Speed Mode

1. Let Ac Motor Drive be at the speed control mode: Set Index6060 = 2.
2. Set the target frequency: set 2060-03, unit is Hz, with a number of 2 decimal places. For example 1000 is 10.00Hz.
3. Operation control: set 2060-01 = 008H for Server on, and set 2060-01 = 0081H for Running.



Torque Mode

1. Let Ac Motor Drive be at torque control mode: set Index 6060 = 4.
2. Set target torque: set 2060-07, unit is %, a number of 1 decimal place. For example 100 is 10.0%.
3. Operation control: Set 2060-01 = 0080H for Server on, then the motor drive will start to run to reach target torque.



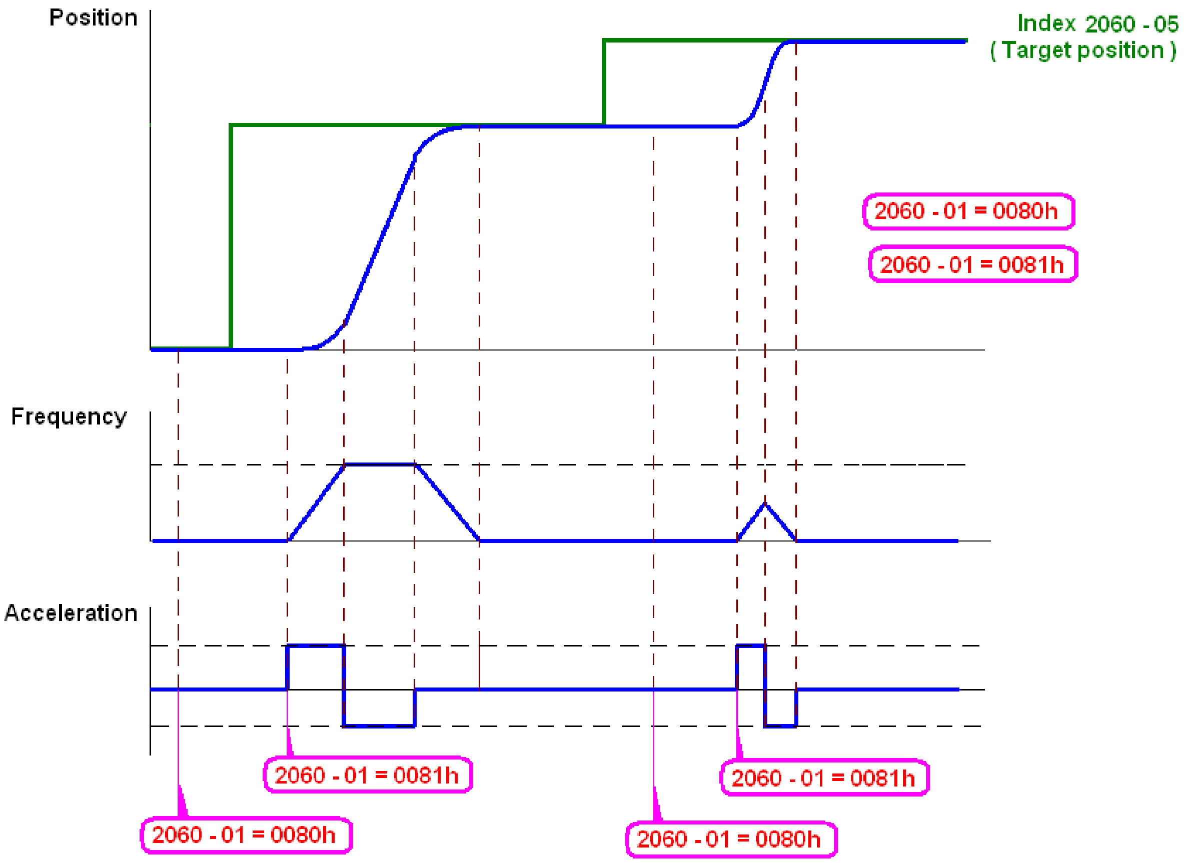
Note01 To know what the current torque is, read 2061-07 (unit is 0.1%).

Note02 To know if the torque can reach the setting value, read the bit 0 of 2061-01 (0: Not reached, 1: Reached).

Note 03: When doing torque output and if the motor drive's speed reaches the speed limit, the output torque will decrease to ensure the speed is under the limit.

Position Mode

1. Set the parameter of a trapezium curve to define position control (Pr11-43 Max. Position Control Frequency), Pr11-44 Accel. Time of Position Control, Pr11-45 Decel. Time of Position Control)
2. Let Ac motor drive be at the position control mode, set Index 6060 = 1.
3. Set 2060-01 = 0080h, then motor drive will have server on.
4. Set target position: set 2060-05 = target position.
5. Set 2060-01 =0081h to trigger the motor drive to run to the target position.
6. To move to another position, simply repeat step 3 to 5.



NOTE01: To know the current position, read 2061-05.

NOTE02: To know if reaching the target position, read bit 0 of 2061 (0: Not reached, 1: Reached).

Home Mode

1. Set Pr00-12 to choose how to return home.
2. Set the left and right limits correspond to the position of MI terminal.
3. To switch C2000 control mode to Home mode: Set Index 6060 = 6.
4. Set 2060-01 = 0080h, then motor drive will have server on.
5. Set the ACK signal: set 2060-01 = 0081h, then the motor drive will start to go back home.

NOTE 01: To know if returning home is completed, read bit12 of 6041 (0: Not reached, 1: Reached).

15-3-5 DI/DO AI AO are controlled via CANopen

To control the DO AO of the motor drive through CANopen, follow the steps below:

1. To set the DO to be controlled, define this DO to be controlled by CANopen. For example, set Pr02-14 to control RY2.
2. To set the DO to be controlled, define this AO to be controlled by CANopen. For example, set Pr03-23 to control AFM2.
3. To control the mapping index of CANopen. If you want to control DO, then you will need to control Index2026-41. If you want to control AO, then you will need to control 2026-AX. If you want to set RY2 as ON, set the bit 1 of Index 2026-41 =1, then RY2 will output 1. If you want to control AFM2 output = 50.00%, then you will need to set Index 2026-A2 =5000, then AFM2 will output 50%.

Mapping table of CANopen DI DO AI AO:

DI:

Terminal	Related Parameters	R/W	Mapping Index
FWD	==	RO	2026-01 bit 0
REV	==	RO	2026-01 bit 1
MI 1	==	RO	2026-01 bit 2
MI 2	==	RO	2026-01 bit 3
MI 3	==	RO	2026-01 bit 4
MI 4	==	RO	2026-01 bit 5
MI 5	==	RO	2026-01 bit 6
MI 6	==	RO	2026-01 bit 7
MI 7	==	RO	2026-01 bit 8
MI 8	==	RO	2026-01 bit 9
MI 10	==	RO	2026-01 bit 10
MI 11	==	RO	2026-01 bit 11
MI 12	==	RO	2026-01 bit 12
MI 13	==	RO	2026-01 bit 13
MI 14	==	RO	2026-01 bit 14
MI 15	==	RO	2026-01 bit 15

DO：

Terminal	Related Parameters	R/W	Mapping Index
RY1	P2-13 = 50	RW	2026-41 bit 0
RY2	P2-14 = 50	RW	2026-41 bit 1
	P2-15 = 50	RW	2026-41 bit 2
MO1	P2-16 = 50	RW	2026-41 bit 3
MO2	P2-17 = 50	RW	2026-41 bit 4
MO3	P2-18 = 50	RW	2026-41 bit 5
MO4	P2-19 = 50	RW	2026-41 bit 6

MO5	P2-20 = 50	RW	2026-41 bit 7
MO6	P2-21 = 50	RW	2026-41 bit 8
MO7	P2-22 = 50	RW	2026-41 bit 9
MO8	P2-23 = 50	RW	2026-41 bit 10

AI：

Terminal	Related Parameters	R/W	Mapping Index
AVI	==	RO	Value of 2026-61
ACI	==	RO	Value of 2026-62
AUI	==	RO	Value of 2026-63

AO：

Terminal	Related Parameters	R/W	Mapping Index
AFM1	P3-20 = 20	RW	Value of 2026-A1
AFM2	P3-23 = 20	RW	Value of 2026-A2

15.4 CANopen Supporting Index

C2000 Index:

Parameter index corresponds to each other as following:

Index	**sub-Index**
2000H + Group	member+1

For example:

Pr.10.15 (Encoder Slip Error Treatment)

Group		**member**
10(0$\overline{A}$H)	-	15(0FH)

Index = 2000H + 0AH = 200A

Sub Index = 0FH + 1H = 10H

C2000 Control Index:

Delta Standard Mode (Old definition)

Index	Sub	Definition	Factory Setting	R/W	Size	Note	
2020H	0	Number	3	R	U8		
	1	Control word	0	RW	U16	Bit 1~0	00B:disable
							01B:stop
							10B:disable
							11B: JOG Enable
						Bit3~2	Reserved
						Bit5~4	00B:disable
							01B: Direction forward
							10B: Reverse
							11B: Switch Direction
						Bit7~6	00B: 1st step Accel. /Decel.
							01B: 2nd step Accel. /Decel.
							10B: 3rd step Accel. /Decel.
							11B: 4th step Accel. /Decel.
						Bit11~8	0000B: Master speed
							0001B: 1st step speed
							0010B: 2nd step speed
							0011B: 3rd step speed
							0100B: 4th step speed
							0101B: 5th step speed
							0110B: 6th step speed
							0111B: 7th step speed
							1000B: 8th step speed
							1001B: 9th step speed
							1010B: 10th step speed
							1011B: 11th step speed
							1100B: 12th step speed
							1101B: 13th step speed
							1110B: 14th step speed
							1111B: 15th step speed
						Bit12	1: Enable the function of Bit6-11
						Bit14~13	00B: no function
							01B: Operation command by the digital keypad

Index	Sub	Definition	Factory Setting	R/W	Size	Note	
							10B: Operation command by Pr. 00-21 setting
							11B: Switch the source of operation command
						Bit 15	Reserved
	2	Freq. command (XXX.XXHz)	0	RW	U16		
	3	Other trigger	0	RW	U16	Bit0	1: E.F. ON
						Bit1	1: Reset
						Bit15~2	Reserved
2021H	0	Number	DH	R	U8		
	1	Error code	0	R	U16		
	2	AC motor drive status	0	R	U16	Bit 1~0	00B: stop
							01B: decelerate to stop
							10B: waiting for operation command
							11B: in operation
						Bit 2	1: JOG command
						Bit 4~3	00B: forward running
							01B: switch from reverse running to forward running
							10B: switch from forward running to reverse running
							11B: reverse running
						Bit 7~5	Reserved
						Bit 8	1: master frequency command controlled by communication interface
						Bit 9	1: master frequency command controlled by analog signal input
						Bit 10	1: operation command controlled by communication interface
						Bit 15~11	Reserved
	3	Freq. command (XXX.XXHz)	0	R	U16		
	4	Output freq. (XXX.XXHz)	0	R	U16		
	5	Output current (XX.XA)	0	R	U16		
	6	DC bus voltage (XXX.XV)	0	R	U16		
	7	Output voltage (XXX.XV)	0	R	U16		
	8	the current segment run by the multi-segment speed commend	0	R	U16		
	9	Reserved	0	R	U16		
	A	Display counter value（c）	0	R	U16		
	B	Display output power angle (XX.X°)	0	R	U16		
	C	Display output torque (XXX.X%)	0	R	U16		
	D	Display actual motor speed (rpm)	0	R	U16		
	E	Number of PG feed back pulses (0~65535)	0	R	U16		
	F	Number of PG2 pulse commands (0~65535)	0	R	U16		
	10	power output (X.XXXKWH)	0	R	U16		
2022H	0	Reserved	0	R	U16		
	1	Display output current	0	R	U16		

Index	Sub	Definition	Factory Setting	R/W	Size	Note	
	2	Display counter value	0	R	U16		
	3	Display actual output frequency (XXX.XXHz)	0	R	U16		
	4	Display DC-BUS voltage (XXX.XV)	0	R	U16		
	5	Display output voltage (XXX.XV)	0	R	U16		
	6	Display output power angle (XX.X°)	0	R	U16		
	7	Display output power in kW	0	R	U16		
	8	Display actual motor speed (rpm)	0	R	U16		
	9	Display estimate output torque (XXX.X%)	0	R	U16		
	A	Display PG feedback	0	R	U16		
	B	Display PID feedback value after enabling PID function in % (To 2 decimal places)	0	R	U16		
	C	Display signal of AVI analog input terminal, 0-10V corresponds to 0-100% (To 2 decimal places)	0	R	U16		
	D	Display signal of ACI analog input terminal, 4-V20mA/0-10V corresponds to 0-100% (To 2 decimal places)	0	R	U16		
	E	Display signal of AUI analog input terminal, -10V~10V corresponds to -100~100% (To 2 decimal places)	0	R	U16		
	F	Display the IGBT temperature of drive power module in ^{o}C	0	R	U16		
	10	Display the temperature of capacitance in ^{o}C	0	R	U16		
	11	The status of digital input (ON/OFF), refer to Pr.02-12	0	R	U16		
	12	The status of digital output (ON/OFF), refer to Pr.02-18	0	R	U16		
	13	Display the multi-step speed that is executing	0	R	U16		
	14	The corresponding CPU pin status of digital input	0	R	U16		
	15	The corresponding CPU pin status of digital output	0	R	U16		
	16	Number of actual motor revolution (PG1 of PG card). it will start from 9 when the actual operation direction is changed or keypad display at stop is 0. Max. is 65535	0	R	U16		
	17	Pulse input frequency (PG2 of PG card)	0	R	U16		
	18	Pulse input position (PG card PG2), maximum setting is 65535.	0	R	U16		
	19	Position command tracing error	0	R	U16		
	1A	Display times of counter overload (0.00~100.00%)	0	R	U16		

Index	Sub	Definition	Factory Setting	R/W	Size	Note	
	1B	Display GFF in %	0	R	U16		
	1C	Display DCbus voltage ripples (Unit: Vdc)	0	R	U16		
	1D	Display PLC register D1043 data	0	R	U16		
	1E	Display Pole of Permanent Magnet Motor	0	R	U16		
	1F	User page displays the value in physical measure	0	R	U16		
	20	Output Value of Pr.00-05	0	R	U16		
	21	Number of motor turns when drive operates	0	R	U16		
	22	Operation position of motor	0	R	U16		
	23	Fan speed of the drive	0	R	U16		
	24	Control mode of the drive 0: speed mode 1: torque mode	0	R	U16		
	25	Carrier frequency of the drive	0	R	U16		

CANopen Remote IO mapping

Index	Sub	R/W	Definition
2026H	01h	R	Each bit corresponds to the different input terminals
	02h	R	Each bit corresponds to the different input terminals
	03h~40h	R	Reserved
	41h	RW	Each bit corresponds to the different output terminals
	42h~60h	R	Reserved
	61h	R	AVI (%)
	62h	R	ACI (%)
	63h	R	AUI (%)
	64h~A0h	R	Reserved
	A1h	RW	AFM1 (%)
	A2h	RW	AFM2 (%)

Delta Standard Mode (New definition)

Index	sub	R/W	Size	Descriptions			Speed Mode	Position Mode	Home Mode	Torque Mode
				bit	Definition	Priority				
2060h	00h	R	U8							
	01h	RW	U16	0	Ack	4	0:fcmd =0 1:fcmd = Fset(Fpid)	Pulse 1: Position control	Pulse 1: Return to home	
				1	Dir	4	0: FWD run command 1: REV run command			
				2						
				3	Halt		0: drive run till target speed is attained 1: drive stop by declaration setting			
				4	Hold		0: drive run till target speed is attained 1: frequency stop at current frequency			
				5	JOG		0:JOG OFF Pulse 1:JOG RUN			
				6	QStop		Quick Stop			

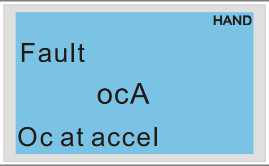
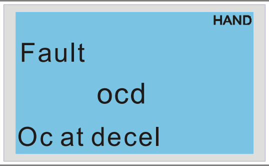
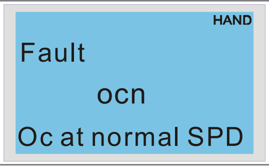
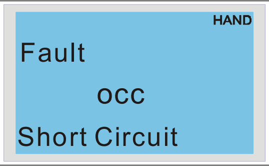
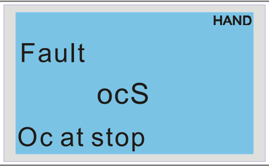
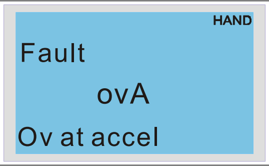
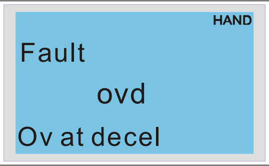
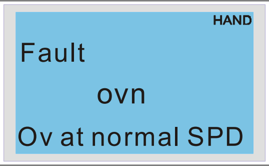
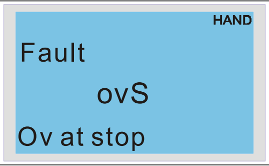
Index	sub	R/W	Size	Descriptions			Speed Mode	Position Mode	Home Mode	Torque Mode
				bit	Definition	Priority				
				7	Power		0:Power OFF 1:Power ON	0:Power OFF 1:Power ON	0:Power OFF 1:Power ON	0:Power OFF 1:Power ON
				14~8	Cmd SW		Multi-step frequency switching	Multi-step position switching		
				15			Pulse 1: Fault code cleared	Pulse 1: Fault code cleared	Pulse 1: Fault code cleared	Pulse 1: Fault code cleared
	02h	RW	U16							
	03h	RW	U16				Speed command (unsigned decimal)			
	04h	RW	U16							
	05h	RW	S32					Position command		
	06h	RW								
	07h	RW	U16							Torque command (signed decimal)
	08h	RW	U16							Speed limit (unsigned decimal)
2061h	01h	R	U16	0	Arrive		Frequency attained	Position attained	Homing complete	Torque attained
				1	Dir		0: Motor FWD run 1: Motor REV run	0: Motor FWD run 1: Motor REV run	0: Motor FWD run 1: Motor REV run	0: Motor FWD run 1: Motor REV run
				2	Warn		Warning	Warning	Warning	Warning
				3	Error		Error detected	Error detected	Error detected	Error detected
				4						
				5	JOG		JOG	JOG	JOG	JOG
				6	QStop		Quick stop	Quick stop	Quick stop	Quick stop
				7	Power On		Switch ON	Switch ON	Switch ON	Switch ON
				15~8						
	02h	R								
	03h	R	U16				Actual output frequency	Actual output frequency	Actual output frequency	Actual output frequency
	04h	R								
	05h	R	S32				Actual position (absolute)	Actual position (absolute)	Actual position (absolute)	Actual position (absolute)
	06h	R								
	07h	R	S16				Actual torque	Actual torque	Actual torque	Actual torque

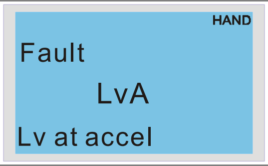
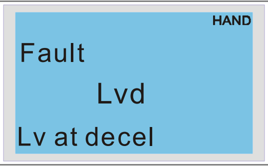
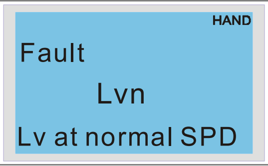
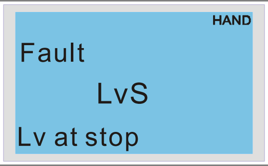
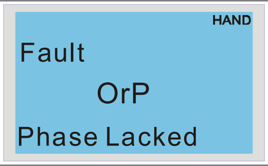
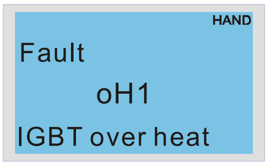
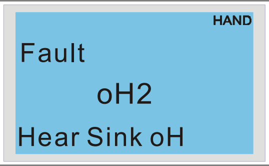
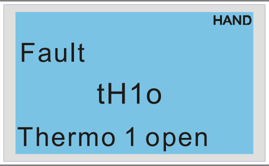
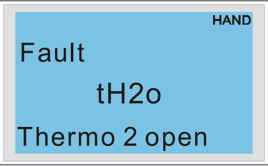
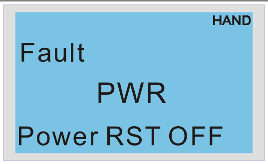
DS402 Standard

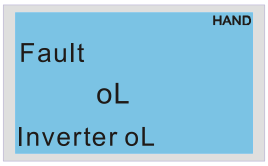
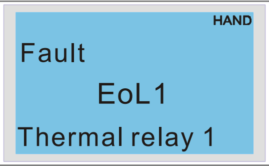
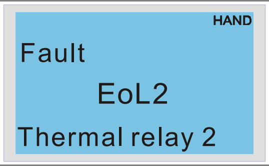
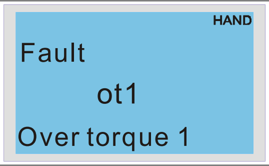
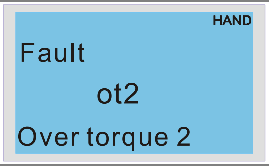
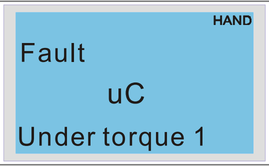
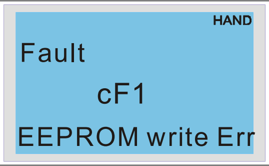
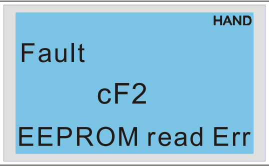
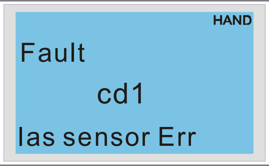
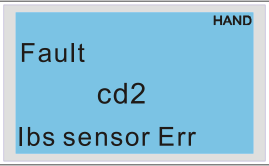
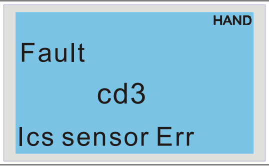
Index	Sub	Definition	Factory Setting	R/W	Size	Unit	PDO Map	Mode	Note
6007h	0	Abort connection option code	2	RW	S16		Yes		0: No action 2: Disable Voltage, 3: quick stop
603Fh	0	Error code	0	R0	U16		Yes		
6040h	0	Control word	0	RW	U16		Yes		
6041h	0	Status word	0	R0	U16		Yes		
6042h	0	vl target velocity	0	RW	S16	rpm	Yes	vl	
6043h	0	vl velocity demand	0	RO	S16	rpm	Yes	vl	
6044h	0	vl control effort	0	RO	S16	rpm	Yes	vl	
604Fh	0	vl ramp function time	10000	RW	U32	1ms	Yes	vl	Unit must be: 100ms, and check if the setting is set to 0.
6050h	0	vl slow down time	10000	RW	U32	1ms	Yes	vl	
6051h	0	vl quick stop time	1000	RW	U32	1ms	Yes	vl	
605Ah	0	Quick stop option code	2	RW	S16		No		0 : disable drive function 1 :slow down on slow down ramp 2: slow down on quick stop ramp

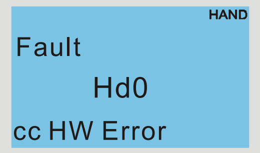
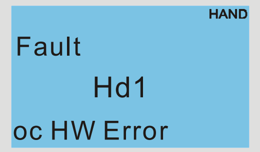
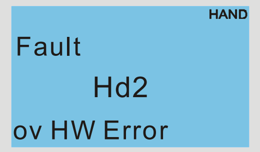
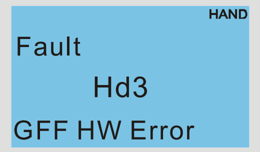
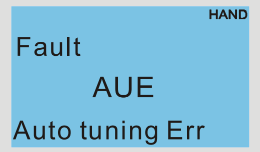
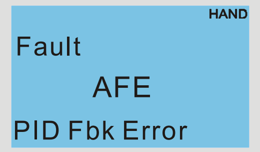
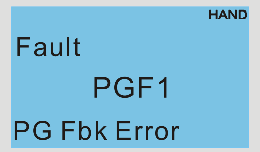
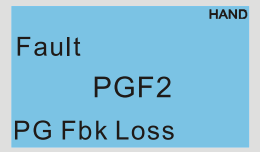
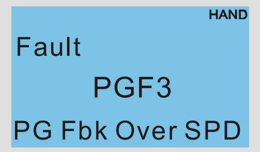
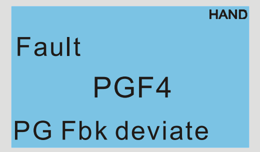
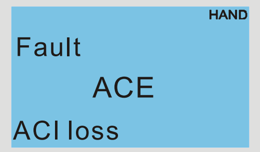
Index	Sub	Definition	Factory Setting	R/W	Size	Unit	PDO Map	Mode	Note
									5 slow down on slow down ramp and stay in QUICK STOP 6 slow down on quick stop ramp and stay in QUICK STOP
605Ch	0	Disable operation option code	1	RW	S16		No		0: Disable drive function 1: Slow down with slow down ramp; disable of the drive function
6060h	0	Mode of operation	2	RW	S8		Yes		1: Profile Position Mode 2: Velocity Mode 4: Torque Profile Mode 6: Homing Mode
6061h	0	Mode of operation display	2	RO	S8		Yes		Same as above
6064h	0	pp Position actual value	0	RO	S32		Yes	pp	
6071h	0	tq Target torque	0	RW	S16	0.1%	Yes	tq	Valid unit: 1%
6072h	0	tq Max torque	150	RW	U16	0.1%	No	tq	Valid unit: 1%
6075h	0	tq Motor rated current	0	RO	U32	mA	No	tq	
6077h	0	tq torque actual value	0	RO	S16	0.1%	Yes	tq	
6078h	0	tq current actual value	0	RO	S16	0.1%	Yes	tq	
6079h	0	tq DC link circuit voltage	0	RO	U32	mV	Yes	tq	
607Ah	0	pp Target position	0	RW	S32	1	Yes	pp	

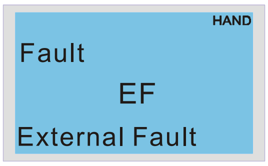
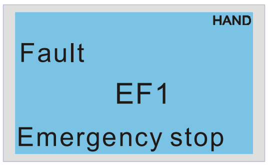
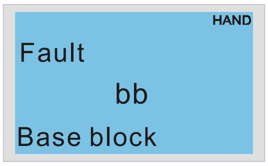
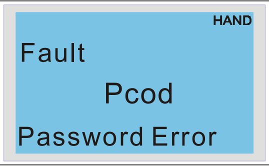
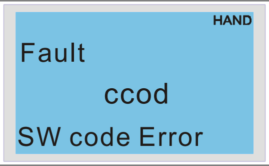
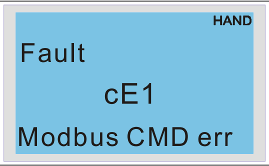
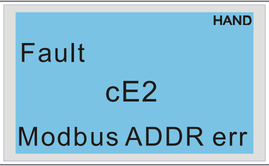
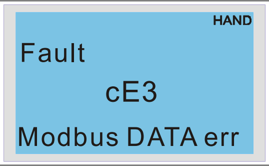
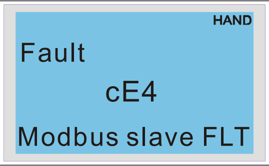
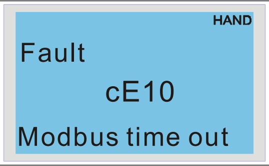
15.5 CANopen Fault Code

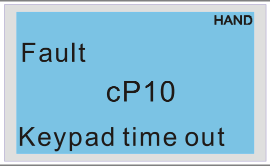
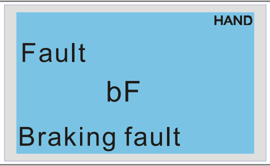
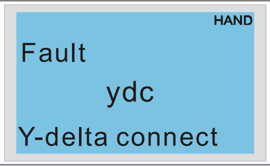
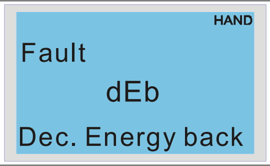
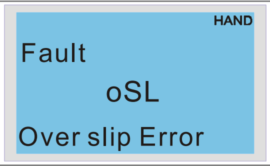
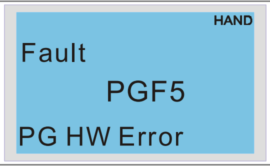
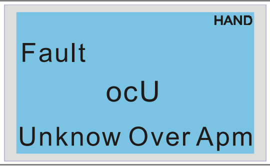
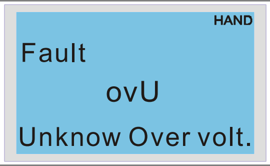
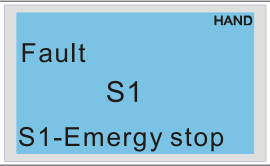
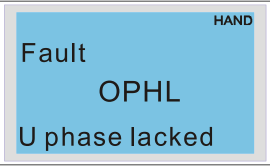
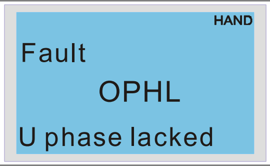
Display	Fault code	Description	CANopen fault code	CANopen fault register (bit 0~7)
 HAND Fault ocA Oc at accel	0001H	Over-current during acceleration	2213 H	1
 HAND Fault ocd Oc at decel	0002H	Over-current during deceleration	2213 H	1
 HAND Fault ocn Oc at normal SPD	0003H	Over-current during steady status operation	2214H	1
 HAND Fault GFF Ground fault	0004H	Ground fault. When (one of) the output terminal(s) is grounded, short circuit current is more than 50% of AC motor drive rated current. NOTE: The short circuit protection is provided for AC motor drive protection, not for protection of the user.	2240H	1
 HAND Fault occ Short Circuit	0005H	Short-circuit is detected between upper bridge and lower bridge of the IGBT module.	2250H	1
 HAND Fault ocS Oc at stop	0006H	Over-current at stop. Hardware failure in current detection	2314H	1
 HAND Fault ovA Ov at accel	0007H	Over-current during acceleration. Hardware failure in current detection	3210H	2
 HAND Fault ovd Ov at decel	0008H	Over-current during deceleration. Hardware failure in current detection.	3210H	2
 HAND Fault ovn Ov at normal SPD	0009H	Over-current during steady speed. Hardware failure in current detection.	3210H	2
 HAND Fault ovS Ov at stop	000AH	Over-voltage at stop. Hardware failure in current detection	3210H	2

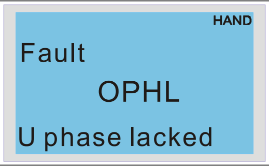
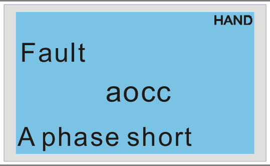
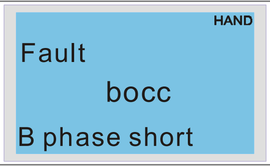
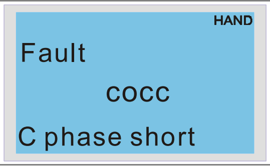
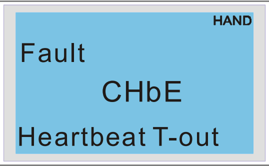
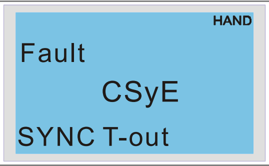
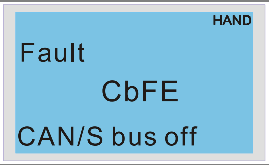
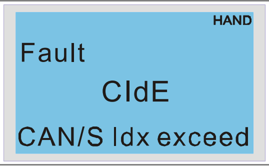
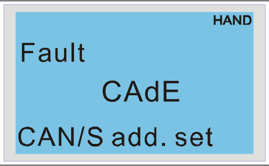
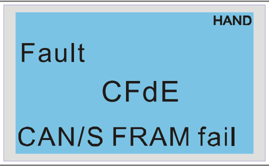
Display	Fault code	Description	CANopen fault code	CANopen fault register (bit 0~7)
 HAND Fault LvA Lv at accel	000BH	DC BUS voltage is less than Pr.06.00 during acceleration.	3220H	2
 HAND Fault Lvd Lv at decel	000CH	DC BUS voltage is less than Pr.06.00 during deceleration.	3220H	2
 HAND Fault Lvn Lv at normal SPD	000DH	DC BUS voltage is less than Pr.06.00 in constant speed.	3220H	2
 HAND Fault LvS Lv at stop	000EH	DC BUS voltage is less than Pr.06-00 at stop	3220H	2
 HAND Fault OrP Phase Lacked	000FH	Phase Loss Protection	3130H	2
 HAND Fault oH1 IGBT over heat	0010H	IGBT overheat IGBT temperature exceeds protection level. 1~15HP: 90℃ 20~100HP: 100℃	4310H	3
 HAND Fault oH2 Hear Sink oH	0011H	Heat sink overheat Heat sink temperature exceeds 90oC	4310H	3
 HAND Fault tH1o Thermo 1 open	0012H	Temperature detection circuit error (IGBT) IGBT NTC	FF00H	3
 HAND Fault tH2o Thermo 2 open	0013H	Temperature detection circuit error (capacity module) CAP NTC	FF01H	3
 HAND Fault PWR Power RST OFF	0014H	Power RST off	FF02H	2

Display	Fault code	Description	CANopen fault code	CANopen fault register (bit 0~7)
 HAND Fault oL Inverter oL	0015H	Overload. The AC motor drive detects excessive drive output current. NOTE: The AC motor drive can withstand up to 150% of the rated current for a maximum of 60 seconds.	2310H	1
 HAND Fault EoL1 Thermal relay 1	0016H	Electronics thermal relay 1 protection	2310H	1
 HAND Fault EoL2 Thermal relay 2	0017H	Electronics thermal relay 2 protection	2310H	1
 HAND Fault ot1 Over torque 1	001AH	These two fault codes will be displayed when output current exceeds the over-torque detection level (Pr.06.07 or Pr.06.10) and exceeds over-torque detection (Pr.06.08 or Pr.06.11) and it is set 2 or 4 in Pr.06-06 or Pr.06-09.	8311H	3
 HAND Fault ot2 Over torque 2	001BH		8311H	3
 HAND Fault uC Under torque 1	001CH	Low current	8321H	1
 HAND Fault cF1 EEPROM write Err	001EH	Internal EEPROM can not be programmed.	5530H	5
 HAND Fault cF2 EEPROM read Err	001FH	Internal EEPROM can not be read.	5530H	5
 HAND Fault cd1 Ias sensor Err	0021H	U-phase error	FF04H	1
 HAND Fault cd2 Ibs sensor Err	0022H	V-phase error	FF05H	1
 HAND Fault cd3 Ics sensor Err	0023H	W-phase error	FF06H	1

Display	Fault code	Description	CANopen fault code	CANopen fault register (bit 0~7)
 HAND Fault Hd0 cc HW Error	0024H	cc (current clamp) hardware error	FF07H	5
 HAND Fault Hd1 oc HW Error	0025H	oc hardware error	FF08H	5
 HAND Fault Hd2 ov HW Error	0026H	ov hardware error	FF09H	5
 HAND Fault Hd3 GFF HW Error	0027H	GFF hardware error	FF0AH	5
 HAND Fault AUE Auto tuning Err	0028H	Auto tuning error	FF21H	1
 HAND Fault AFE PID Fbk Error	0029H	PID loss (ACI)	FF22H	7
 HAND Fault PGF1 PG Fbk Error	002AH	PG feedback error	7301H	7
 HAND Fault PGF2 PG Fbk Loss	002BH	PG feedback loss	7301H	7
 HAND Fault PGF3 PG Fbk Over SPD	002BH	PG feedback stall	7301H	7
 HAND Fault PGF4 PG Fbk deviate	002CH	PG slip error	7301H	7
 HAND Fault ACE ACI loss	0030H	ACI loss	FF25H	1

Display	Fault code	Description	CANopen fault code	CANopen fault register (bit 0~7)
HAND Fault EF External Fault	0031H	External Fault When input EF (N.O.) on external terminal is closed to GND, AC motor drive stops output U, V, and W.	9000H	5
HAND Fault EF1 Emergency stop	0032H	Emergency stop When the multi-function input terminals MI1 to MI6 are set to emergency stop, the AC motor drive stops output U, V, W and the motor coasts to stop.	9000H	5
HAND Fault bb Base block	0033H	External Base Block When the external input terminals MI1 to MI16 are set as bb and active, the AC motor drive output will be turned off	9000H	5
HAND Fault Pcod Password Error	0034H	Password will be locked if three fault passwords are entered	FF26H	5
HAND Fault ccod SW code Error	0035H	Software error	6100H	5
HAND Fault cE1 Modbus CMD err	0036H	Illegal function code	7500H	4
HAND Fault cE2 Modbus ADDR err	0037H	Illegal data address (00H to 254H)	7500H	4
HAND Fault cE3 Modbus DATA err	0038H	Illegal data value	7500H	4
HAND Fault cE4 Modbus slave FLT	0039H	Data is written to read-only address	7500H	4
HAND Fault cE10 Modbus time out	003AH	Modbus transmission timeout.	7500H	5

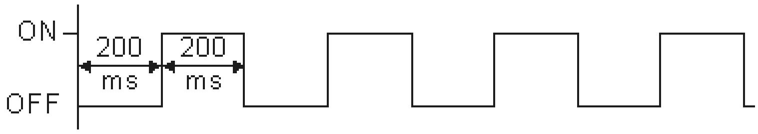
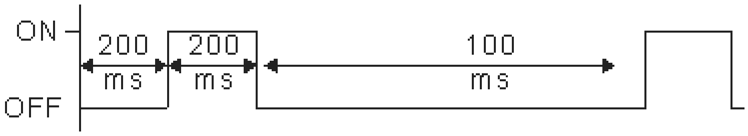
Display	Fault code	Description	CANopen fault code	CANopen fault register (bit 0~7)
 HAND Fault cP10 Keypad time out	003BH	Keypad transmission timeout.	7500H	4
 HAND Fault bF Braking fault	003CH	Brake resistor fault	7110H	4
 HAND Fault ydc Y-delta connect	003DH	Motor Y-Δ switch error	3330H	2
 HAND Fault dEb Dec. Energy back	003EH	Energy regeneration when decelerating	FF27H	2
 HAND Fault oSL Over slip Error	003FH	Over slip error. Slip exceeds Pr.05.26 limit and slip duration exceeds Pr.05.27 setting.	FF28H	7
 HAND Fault PGF5 PG HW Error	0041H	PG Card Error	FF29H	5
 HAND Fault ocU Unknow Over Apm	0042H	over current caused by unknown reason	2310H	1
 HAND Fault ovU Unknow Over volt.	0043H	over voltage caused by unknown reason	3210H	2
 HAND Fault S1 S1-Emergy stop	0049H	external safety emergency stop	FF2AH	5
 HAND Fault OPHL U phase lacked	0052H	U phase output phase loss	2331H	2
 HAND Fault OPHL U phase lacked	0053H	V phase output phase loss	2332H	2

Display	Fault code	Description	CANopen fault code	CANopen fault register (bit 0~7)
 HAND Fault OPHL U phase lacked	0054H	W phase output phase loss	2333H	2
 HAND Fault aocc A phase short	004FH	A phase short	FF2BH	1
 HAND Fault bocc B phase short	0050H	B phase short	FF2CH	1
 HAND Fault cocc C phase short	0051H	C phase short	FF2DH	1
 HAND Fault CGdE Guarding T-out	0065H	Guarding time-out 1	8130H	4
 HAND Fault CHbE Heartbeat T-out	0066H	Heartbeat time-out	8130H	4
 HAND Fault CSyE SYNC T-out	0067H	CAN synchrony error	8700H	4
 HAND Fault CbFE CAN/S bus off	0068H	CAN bus off	8140H	4
 HAND Fault CIdE CAN/S Idx exceed	0069H	Can index exceed	8110H	4
 HAND Fault CAdE CAN/S add. set	006AH	CAN address error	0x8100	4
 HAND Fault CFdE CAN/S FRAM fail	006BH	CAN frame fail	0x8100	4

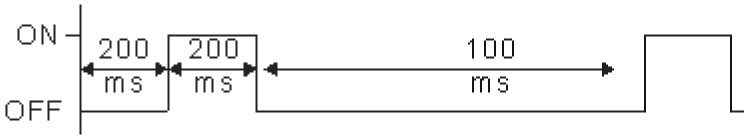
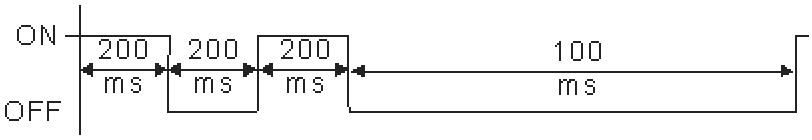
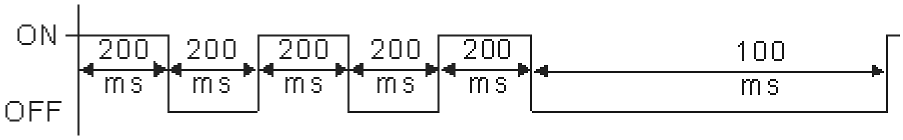
15.6 CANopen LED Function

There are two CANopen flash signs: RUN and ERR.

RUN LED:

LED status	Condition	CANopen State
OFF		Initial
Blinking		Pre-Operation
Single flash		Stopped
ON		Operation

ERR LED:

LED status	Condition/ State
OFF	No Error
Single flash	One Message fail 
Double flash	Guarding fail or heartbeat fail 
Triple flash	SYNC fail 
ON	Bus off

Chapter 16 PLC Function

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.

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

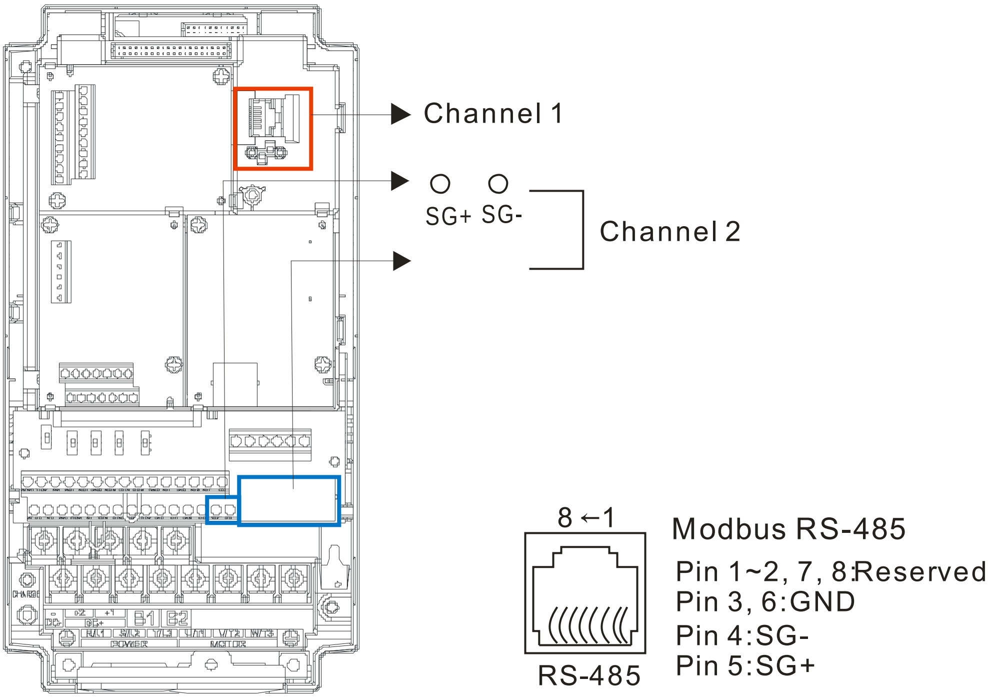
WPLSoft is a program editor of Delta DVP-PLC series and C2000 series for WINDOWS. Besides general PLC program planning and general WINDOWS editing functions, such as cut, paste, copy, multi-windows, WPLSoft also provides various Chinese/English comment editing and other special functions (e.g. register 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: 50MB and above CD-ROM (for installing WPLSoft)
Monitor	Resolution: 640×480, 16 colors and above, 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

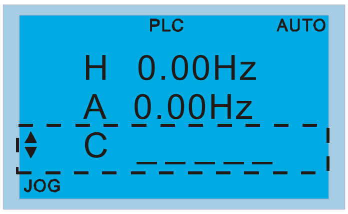
16-2 Precautions for Using PLC Functions

1. Default setting of PLC communication protocol is 7,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  Display for values exceed 9999 

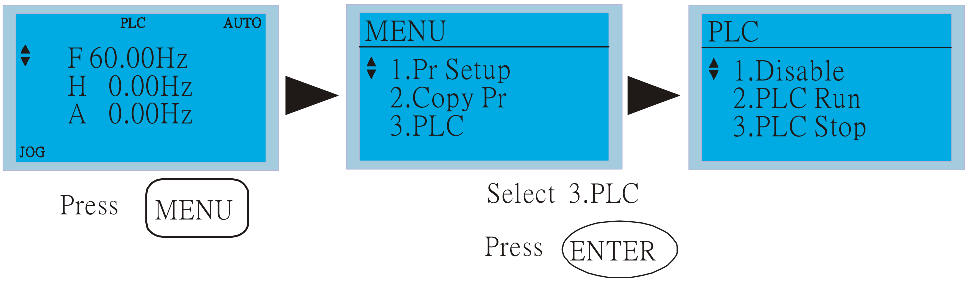
7. When PLC is in PLC Run or PLC Stop mode, Pr.00-02 (settings 9 and 10) are disabled.
8. When Pr.00-02 is set to 6, PLC function settings will return to factory settings.
9. When the Input Terminal X of PLC is programmed, the corresponding MI will be disabled (no function).
10. When AC motor drive operation 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 → select 3: PLC → ENTER.



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.

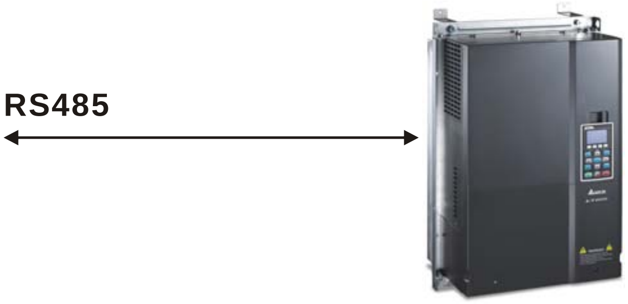
The PLC warning that is displayed before program downloaded to C2000 can be ignored, please continue the operation.

Disable

Run PLC

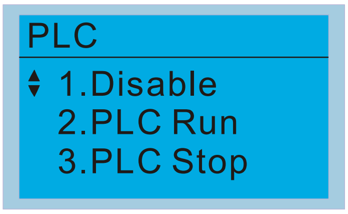
PLC Stop

2. Connection: Connect RJ-45 of AC motor drive to the computer by using RS485.



C2000

3. Run the program.



- PLC function, select function 2 (PLC Run).

  1: Disable (PLC0)

  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
1	FWD	REV	MI1	MI2	MI3	MI4	MI5	MI6	MI7	MI8						
2											MI10	MI11	MI12	MI13	MI14	MI15
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)

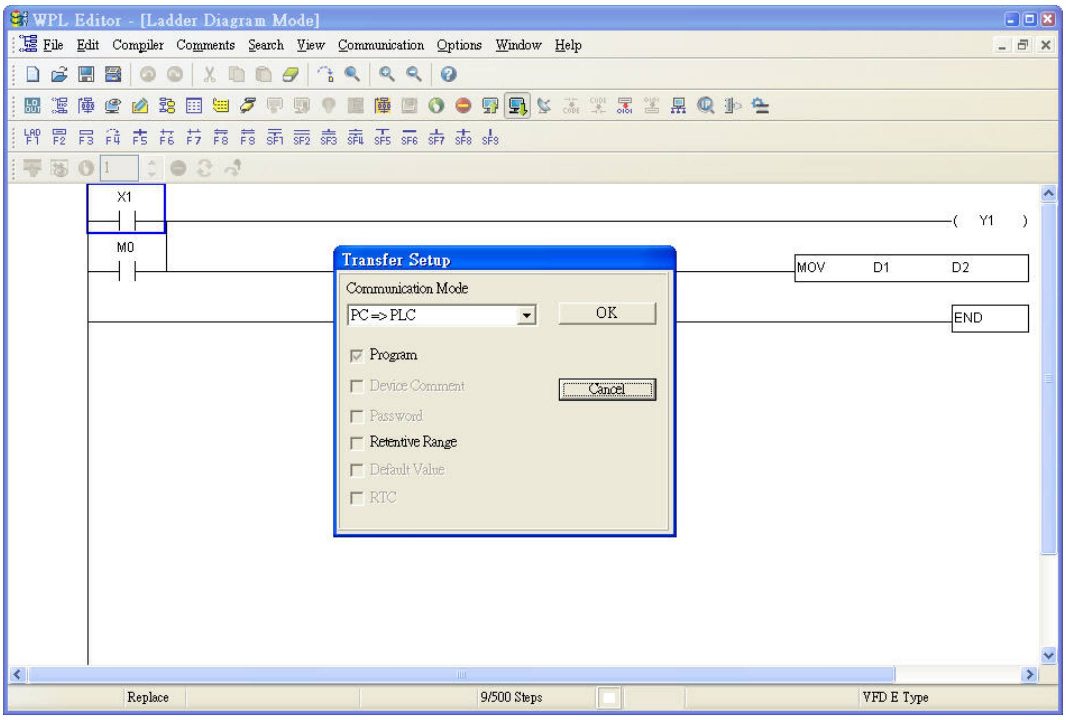
Output device:

Device	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17
1	RY1	RY2		MO1	MO2											
2						MO10	MO11									
3						RY10	RY11	RY12	RY13	RY14	RY15					

1: 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/



Transfer Setup

Communication Mode

PC => PLC

☑ Program

☐ Device Comment

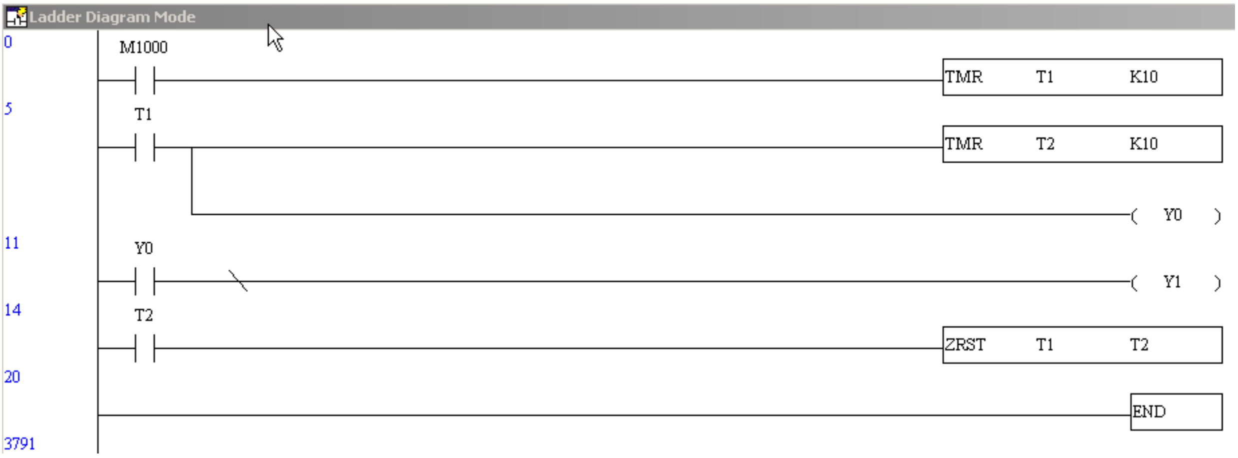
☐ Password

☐ Retentive Range

☐ Default Value

☐ RTC

16.3.4 Program Input



16.3.5 Program Download

Please download the program by following steps:

Step 1. Press CODE 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.

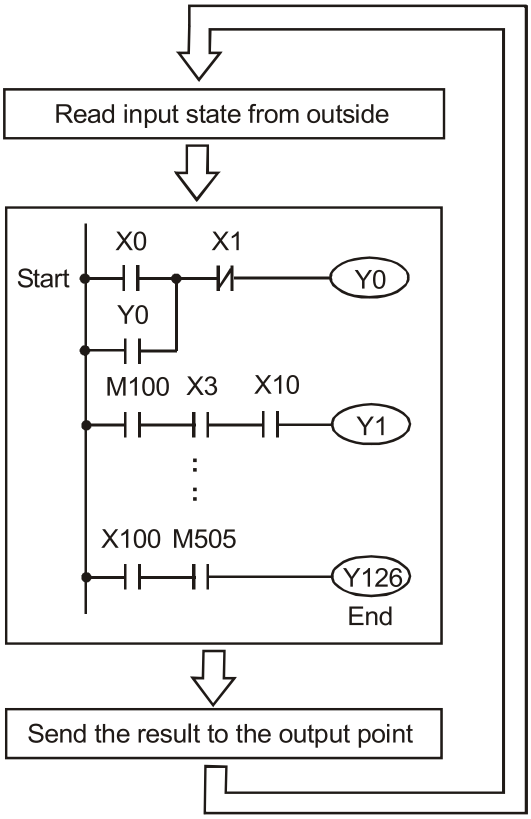
16.3.6 Program Monitor

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.

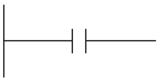
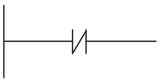
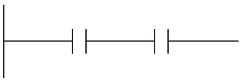
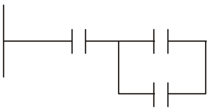
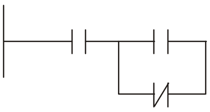
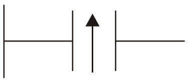
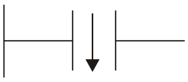
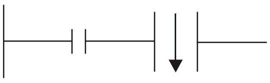
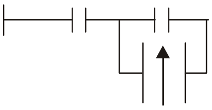
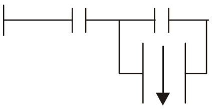
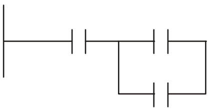
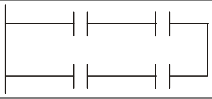
In conclusion, each internal storage unit occupies fixed storage unit. When using these equipments, the corresponding content will be read by bit, byte or word.

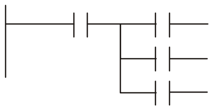
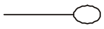
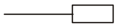
Brief introduction to the internal devices of PLC:

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. ☑ Equipment indication method: X0, X1…X7, X10, X11… 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. ☑ 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. ☑ 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. ☑ Equipment indication: C0, C1… C79. 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. ☑ 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.

Internal Device	Function
Data register	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.

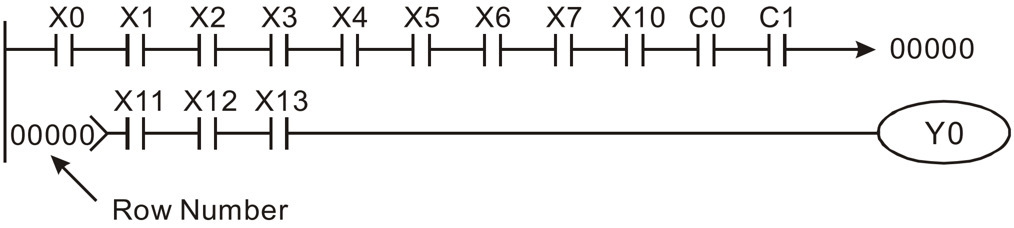
The structure of ladder diagram and information:

Ladder Diagram Structure	Explanation	Command	Device
	Normally open, contact a	LD	X, Y, M, T, C
	Normally closed, contact b	LDI	X, Y, M, T, C
	Serial normally open	AND	X, Y, M, T, C
	Parallel normally open	OR	X, Y, M, T, C
	Parallel normally closed	ORI	X, Y, M, T, C
	Rising-edge trigger switch	LDP	X, Y, M, T, C
	Falling-edge trigger switch	LDF	X, Y, M, T, C
	Rising-edge trigger in serial	ANDP	X, Y, M, T, C
	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
	Block in parallel	ORB	none

Ladder Diagram Structure	Explanation	Command	Device
	Multiple output	MPS MRD MPP	none
	Output command of coil drive	OUT	Y, M
	Basic command, Application command	Basic command/ Application command	
	Inverse logic	INV	none

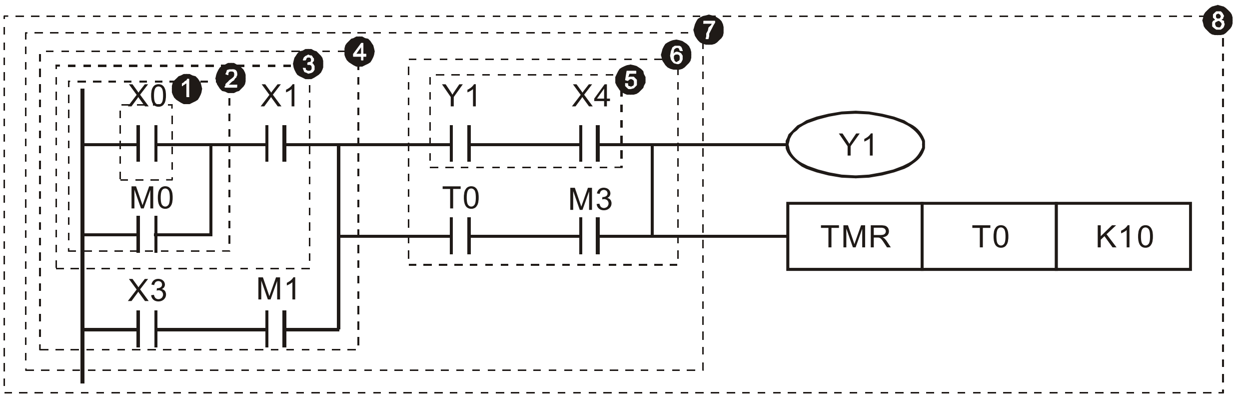
16.4.3 The Edition of PLC Ladder Diagram

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.

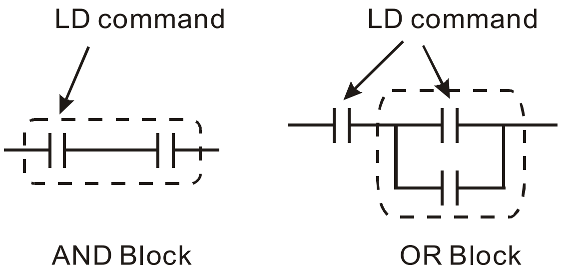


The explanation of command order:

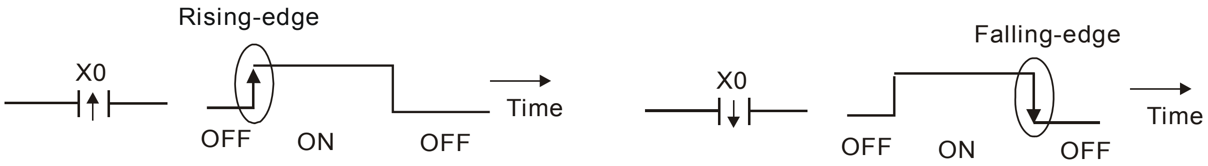
```
1     LD    X0
2     OR    M0
3     AND   X1
4     LD    X3
      AND   M1
      ORB
5     LD    Y1
      AND   X4
6     LD    T0
      AND   M3
      ORB
7     ANB
8     OUT   Y1
      TMR   T0    K10
```

The detail explanation of basic structure of ladder diagram

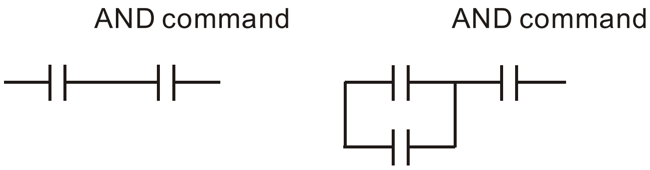
1. **LD (LDI) command:** give the command LD or LDI in the start of a block.



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.

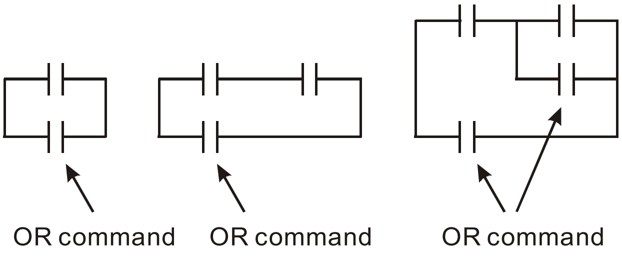


2. **AND (ANI) command:** single device connects to a device or a block in series.



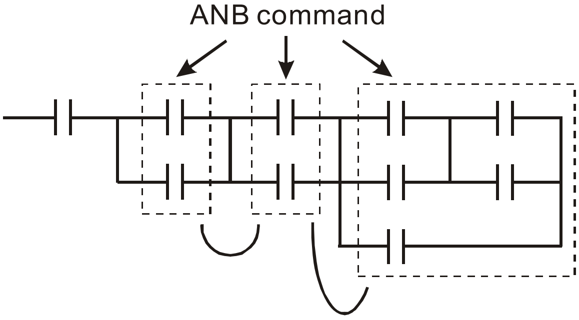
The structures of ANDP and ANDF are the same but the action is in rising-edge or falling-edge.

3. **OR (ORI) command:** single device connects to a device or a block.

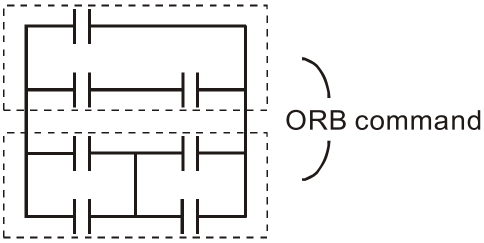


The structures of ORP and ORF are the same but the action is in rising-edge or falling-edge.

4. **ANB command:** a block connects to a device or a block in series.

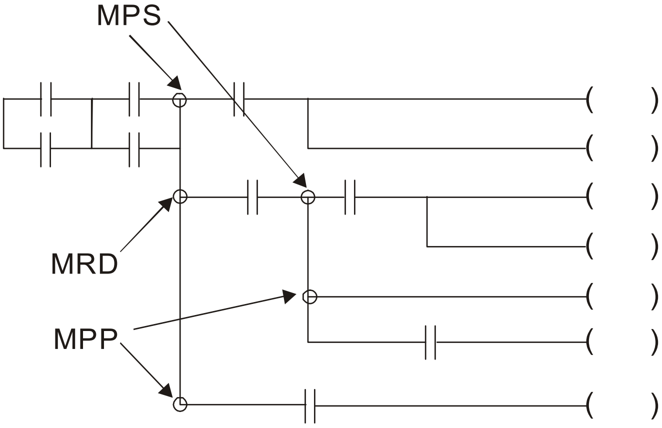


5. **ORB command:** a block connects to a device or a block in parallel.



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 "┬".
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 "├".
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.



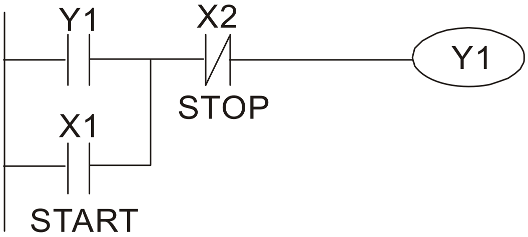
16.4.4 The Example for Designing Basic Program

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:

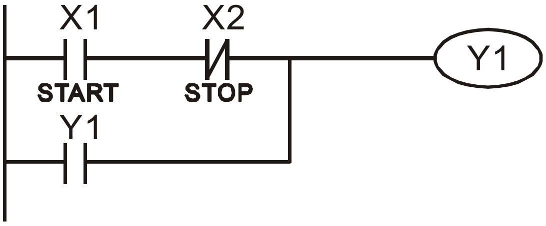
Example 1: the latching circuit for priority of stop

When start normally open contact X1=On, stop normally contact X2＝Off, and Y1=On are set at the same time, if X2=On, the coil Y1 will stop acting. Therefore, it calls priority of stop.



Example 2: the latching circuit for priority of start

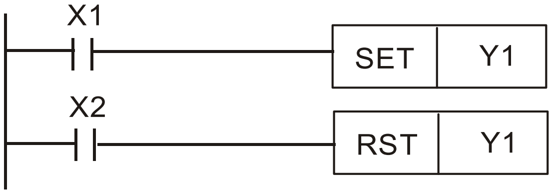
When start normally open contact X1=On, stop normally contact X2＝Off and Y1=On (coil Y1 will be active and latching) are valid at the same time, if X2=On, coil Y1 will be active due to latched contact. Therefore, it calls priority of start.



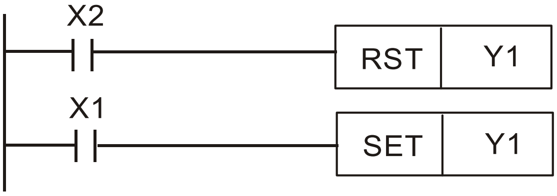
Example 3: the latching circuit of SET and RST commands

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 Y1 will be OFF when X1 and X2 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 X2 act at the same time, Y1 is ON so it calls top priority of start.

Top priority of stop



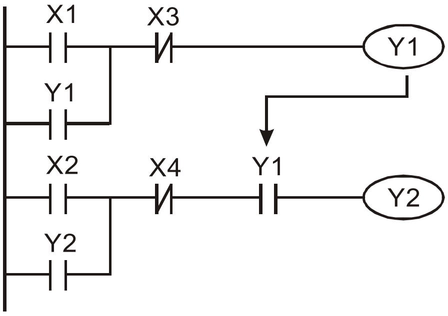
Top priority of start

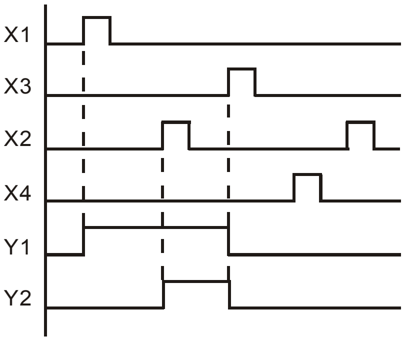


The common control circuit

Example 4: condition control

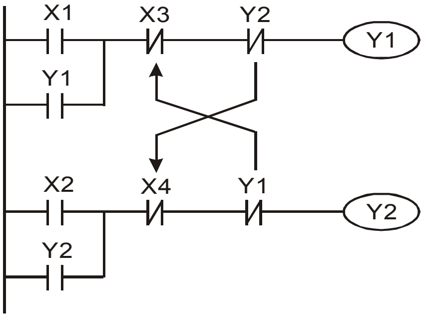
X1 and X3 can start/stop Y1 separately, X2 and X4 can start/stop Y2 separately and they are all self latched circuit. Y1 is an element for Y2 to do AND function due to the normally open contact connects to Y2 in series. Therefore, Y1 is the input of Y2 and Y2 is also the input of Y1.

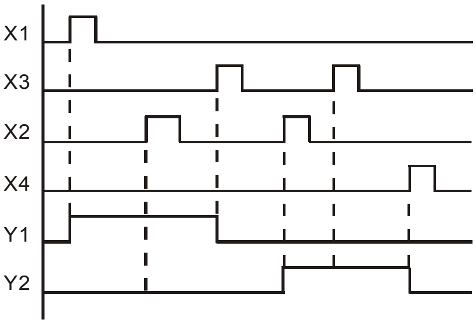




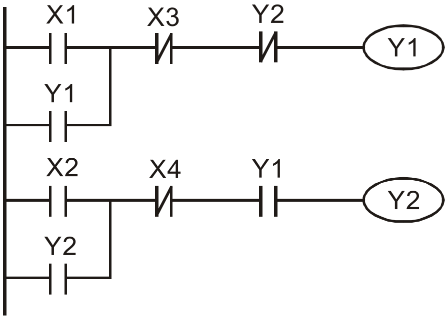
Example 5: Interlock control

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 X1 and X2 are valid at the same time, Y1 and Y2 won't act at the same time due to up-to-down scan of ladder diagram. For this ladder diagram, Y1 has higher priority than Y2.





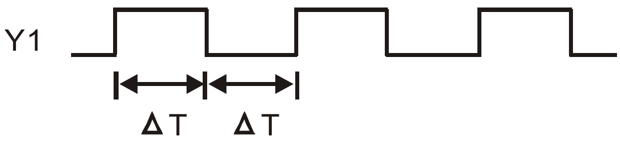
Example 6: Sequential Control



If add normally close contact Y2 into Y1 circuit to be an input for Y1 to do AND function. (as shown in the left side) Y1 is an input of Y2 and Y2 can stop Y1 after acting. In this way, Y1 and Y2 can execute in sequential.

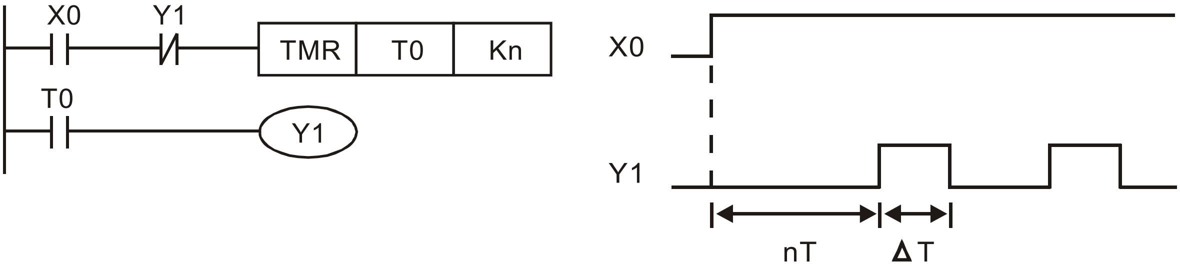
Example 7: Oscillating Circuit

The period of oscillating circuit is ΔT+ΔT



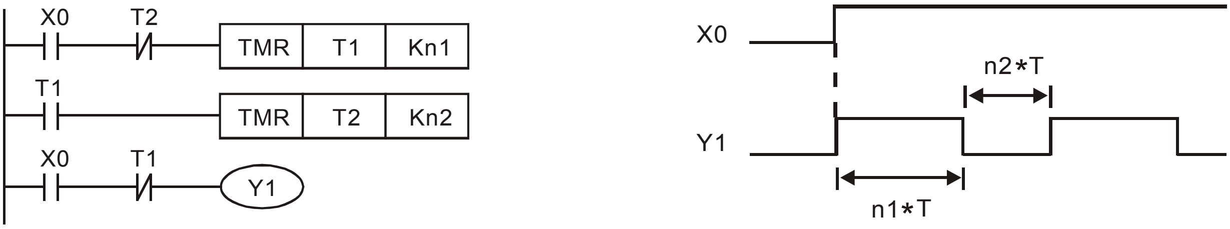
The figure above is a very simple ladder step diagram. When starting to scan Y1 normally close contact, Y1 normally close contact is close due to the coil Y1 is OFF. Then it will scan Y1 and the coil Y1 will be ON and output 1. In the next scan period to scan normally close contact Y1, Y1 normally close contact will be open due to Y1 is ON. Finally, coil Y1 will be OFF. The result of repeated scan, coil Y will output the vibrating pulse with cycle time ΔT (On) +ΔT (Off).

The vibrating circuitry of cycle time ΔT (On) +ΔT (Off):



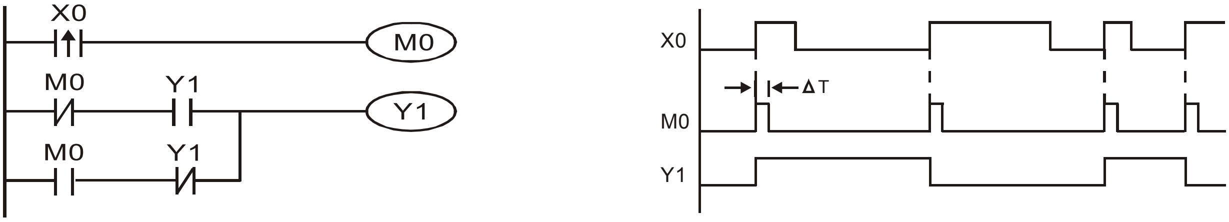
The figure above uses timer T0 to control coil Y1 to be ON. After Y1 is ON, timer T0 will be closed at the next scan period and output Y1. The oscillating circuit will be shown as above. (n is the setting of timer and it is decimal number. T is the base of timer. (clock period))

Example 8: Blinking Circuit



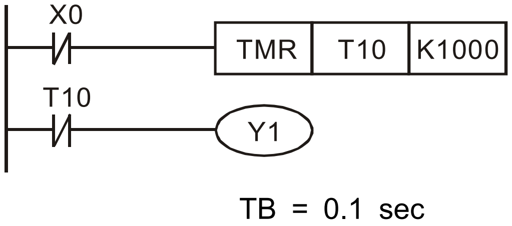
The figure above is common used oscillating circuit for indication light blinks or buzzer alarms. It uses two timers to control On/OFF time of Y1 coil. If figure, n1 and n2 are timer setting of T1 and T2. T is the base of timer (clock period)

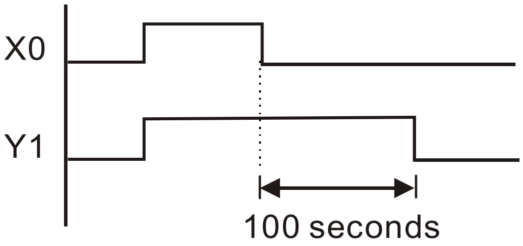
Example 9: Triggered Circuit



In figure above, the rising-edge differential command of X0 will make coil M0 to have a single pulse of ΔT (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 X0 and coil M0 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 X0 is a square wave of a period T, output coil Y1 is square wave of a period 2T.

Example 10: Delay Circuit

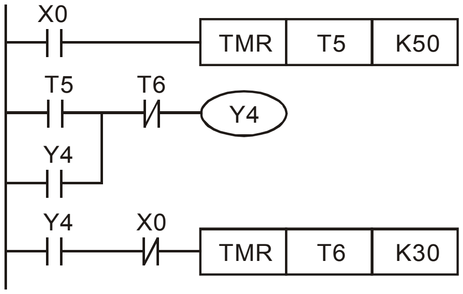


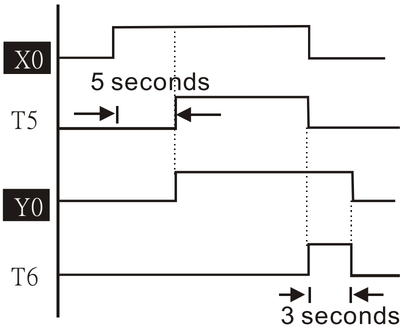


When input X0 is ON, output coil Y1 will be ON at the same time due to the corresponding normally close contact OFF makes timer T10 to be OFF. Output coil Y1 will be OFF after delaying 100 seconds (K1000*0.1 seconds =100 seconds) once input X0 is OFF and T10 is ON. Please refer to timing chart above.

Example 11: Output delay circuit, in the following example, the circuit is made up of two timers.

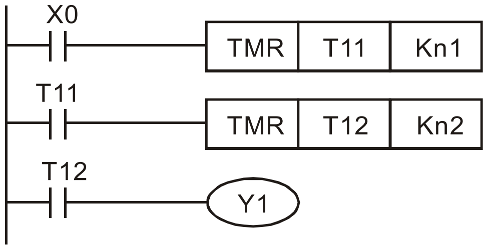
No matter input X0 is ON or OFF, output Y4 will be delay.

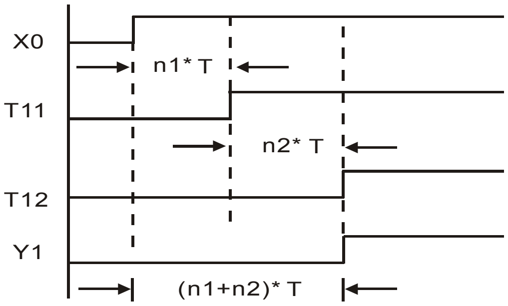




Example12: Extend Timer Circuit

In this circuit, the total delay time from input X0 is close and output Y1 is ON= (n1+n2)* T. where T is clock period. Timer: T11, T12; Timer cycle: T.





16.5 PLC Devices Function

Items	Specifications	Remarks
Control Method	Stored program, cyclic scan system	
I/O Processing Method	Batch processing (when END instruction is executed)	I/O refresh instruction is available
Execution Speed	Basic commands (minimum 0.24 us)	Application commands (1 ~ dozens us)
Program Language	Instruction, Ladder Logic, SFC	
Program Capacity	1000 STEPS	
Commands	80 commands	30 basic commands 50 application commands
Input/Output Contact	Input (X): 10, output (Y): 4	

	Device	**Item**		**Range**		**Function**
Relay bit mode	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	M1000~M1079, 80 points		
	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.
Register WORD data	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	D1000~D1099, 100 points		
			For special	D2000~D2799, 800 points		
Constant	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		

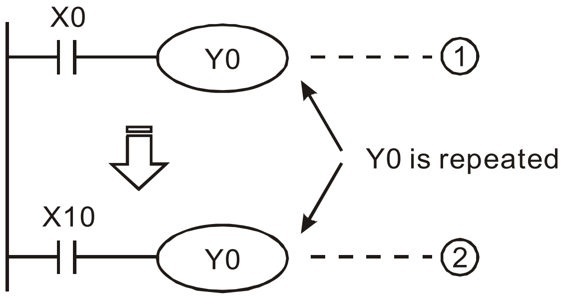
16.5.1 Devices Functions

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 Y0 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)

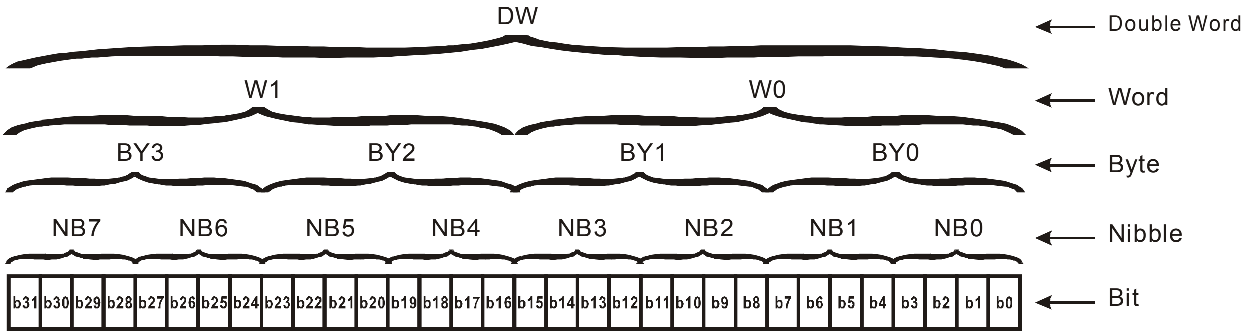
There are five value types for DVP-PLC to use by the different control destination. The following is the explanation of value types.

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 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 00~FF of hexadecimal system.
Word	It is made up of continuous 2 bytes, i.e. 16-bit, b15~b0. It can used to represent 0000~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 00000000~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: X0~X7, X10~X17… (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)

  ☑ 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.

  ☑ 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 X, Y, M, 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, H100 means 100 in hexadecimal number.

The Function of Auxiliary Relay

There are output coil and A, 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 1ms, 10ms and 100ms. 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	High speed
Count direction	Count up	Count up/down	
Settings	0~32,767	-2,147,483,648~+2,147,483,647	
Designate for constant	Constant K or data register D	Constant K or data register D (2 for designated)	
Present value change	Counter will stop when attaining settings	Counter will keep on counting when attaining settings	
Output contact	When count attains the settings value, contact will be On and latched.	When count up attains settings, contact will be On and latched. When count down attains settings, contact will reset to Off.	
Reset action	The present value will reset to 0 when RST command is executed and contact will reset to Off.		
Present register	16-bit	32-bit	
Contact action	After scanning, act together.	After scanning, act together. Act immediately when count attains. It has no 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:

☑ Setting range of 16-bit counter is K0~K32, 767. (K0 is the same as K1. output contact will be On immediately at the first count.

☑ 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.

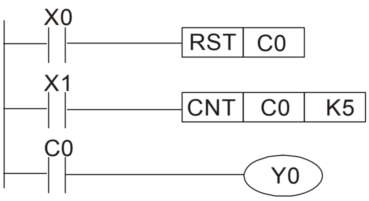
☑ If using MOV command, WPLSoft to send a value, which is large than setting to C0, register, at the next time that X1 is from Off to On, C0 counter contact will be On and present value will be set to the same as settings.

☑ The setting of counter can use constant K or register D (not includes special data register D1000~D1044) to be indirect setting.

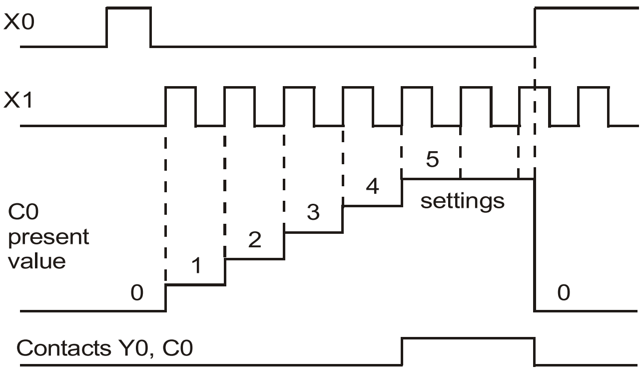
☑ If using constant K to be setting, it can only be positive number but if setting is data register D, it can be positive/negative number. The next number that counter counts up from 32,767 is -32,768.

Example:

```
LD      X0
RST     C0
LD      X1
CNT     C0  K5
LD      C0
OUT     Y0
```



1. When X0=On, RST command is executed, C0 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 C0 attains settings K5, C0 contact is On and C0 = setting =K5. C0 won't accept X1 trigger signal and C0 remains K5.



16.5.2 Special Auxiliary Relays

Special M	Function	Read(R)/ 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 ~ M1010	Reserved	-
M1011	10ms clock pulse, 5ms On/5ms Off	Read only
M1012	100ms clock pulse, 50ms On / 50ms Off	Read only
M1013	1s clock pulse, 0.5s On / 0.5s Off	Read only
M1014	1min clock pulse, 30s On / 30s Off	Read only

Special M	Function	Read(R)/ 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
M1036 ~ M1037	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 ~ 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)/ 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 ~ 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)/ Write(W)
D1000	Reserved	-
D1001	PLC firmware version	Read only
D1002	Program capacity	Read only
D1003	Checksum	Read only
D1004 ~ D1009	Reserved	-
D1010	Present scan time (Unit: 0.1ms)	Read only
D1011	Minimum scan time (Unit: 0.1ms)	Read only
D1012	Maximum scan time (Unit: 0.1ms)	Read only
D1013 ~ D1019	Reserved	-
D1020	Output frequency (0.000~600.00Hz)	Read only

Special D	Function	Read(R)/ Write(W)
D1021	Output current (####.#A)	Read only
D1022	The ID of the extension card: 0: no card 1: Relay Card(6 out) 2: I/O Card (4 in 2 out) 3~7: Reserved	Read only
D1023	The ID of the extension card: 0: no card 1: DeviceNet Slave 2: Profibus-DP Slave 3: CANopen Slave 4: Modbus-TCP Slave 5: EtherNet/IP Slave 6~8: Reserved	Read only
D1024 ~ D1026	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
D1031 ~ D1035	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
D1041 ~ D1042	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
D1046 ~ D1049	Reserved	-
D1050	Actual mode 0: Velocity mode 1: Position mode 2: Torque mode 3: Homing mode	Read only
D1051 ~ D1052	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)
D1056 ~ D1059	Reserved	Read only
D1060	Mode setting 0: Speed Mode 1: Position Mode 2: Torque Mode 3: Homing Mode	Read/Write
D1061 ~ D1069	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	Read(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)/ 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)

n = 0 ~ 7

Special D	Function	PDO Map	Power Failure Memory	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 0: no error 1: slave setting error 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	-	-		-
D1081 ~ D1086	Reserved	NO	NO		R
D1087 ~ D1089	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	1000ms	RW
D1094	Times of Break off detection	NO	YES	3	RW
D1095 ~ D1096	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 Map	Power Failure Memory	Factory Setting	R/W
D2000+100*n	Station number N of a salve station. Setting range: 0 ~127 0: CANopen function NOT available	NO	YES	0	RW

C2000 supports up to 8 CANopen protocol slaves; each slave occupies 100 of special D register and is numbered in 1~8. There are in total of 8 stations.

Slave No.	Slave No. 1	D2000	Station number
		D2001	Factory code(L)
		~	~
		D2099	Mapping address 4 (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(H) of receiving station 4
		⇩	
	Slave No. 8	D2700	Station number
		D2701	Factory code(L)
		~	~
		D2799	Mapping address 4(H)of receiving station 4

Slave No. 0~7

●: PDOTX, ▲: PDORX, ☐: To upate by a CANFLS command

Special D	Function	Pre-defined setting	R/W
D2000+100*n	Station number of slave No. n Setting range: 0~127 0: CANopen disable	0	RW
D2001+100*n	The category of slave No. n 192H: AC motor drive/ AC servo motor and drive 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-defined setting	CAN Index	PDO				R/W
				1	2	3	4	
D2006+100*n	Treatment for slave No. n communication disconnect	0	6007H-0010H	●		●	●	RW
D2007+100*n	Error code of slave No. n	0	603FH-0010H	●		●	●	R
D2008+100*n	Control word of slave No. n	0	6040H-0010H					RW
D2009+100*n	Status word of slave No. n	0	6041H-0010H					R
D2010+100*n	Control mode of slave No. n	2	6060H-0008H					RW
D2011+100*n	Actual mode of slave No. n	2	6061H-0008H					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	6042H-0010H	●				RW
D2013+100*n	Actual speed of slave No. n	0	6043H-0010H	●				R
D2014+100*n	Speed deviation of slave No. n	0	6044H-0010H					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	6077H-0010H				●	R
D2019+100*n	Actual current of slave No. n	0	6078H-0010H					R

Position control

Slave No. 0~7

Special D	Function	Pre-defined Setting	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	6081H-0020H					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	2026H-0110H		●			RW
D2027+100*n	MO setting of slave No. n	0	2026H-4110H		●			RW
D2028+100*n	AI1 status of slave No. n	0	2026H-6110H		●			RW
D2029+100*n	AI2 status of slave No. n	0	2026H-6210H		●			RW
D2030+100*n	AI3 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 Setting	R/W
D2034+100*n	Transmission setting of slave No. n	000AH	RW
D2067+100*n	Receiving setting of slave No. n	0000H	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
0F	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 0400H.

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	Program end	--

Other Command

Commands	Function	Operands
NOP	No function	--
INV	Inverse operation result	--
P	Indicator	P

16.6.2 Explanation for the Command

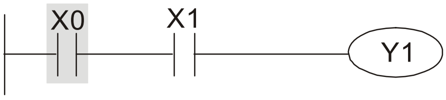
Mnemonic	**Function**					
LD	Load A contact					
Operand	X0~X17	Y0~Y17	M0~M799	T0~159	C0~C79	D0~D399
	✓	✓	✓	✓	✓	—

Explanation

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 save present contents, and at the same time, save the acquired contact status into the accumulative register.

Example

Ladder diagram



Command code		Operation
LD	**X0**	Load contact A of X0
AND	X1	Connect to contact A of X1 in series
OUT	Y1	Drive Y1 coil

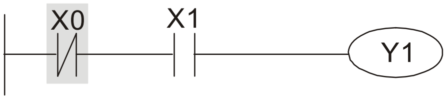
Mnemonic	**Function**					
LDI	Load B contact					
Operand	X0~X17	Y0~Y17	M0~M799	T0~159	C0~C79	D0~D399
	✓	✓	✓	✓	✓	—

Explanation

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 save present contents, and at the same time, save the acquired contact status into the accumulative register.

Example

Ladder diagram:

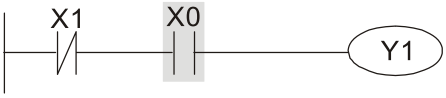


Command code:		Operation:
LDI	**X0**	Load contact B of X0
AND	X1	Connect to contact A of X1 in series
OUT	Y1	Drive Y1 coil

Mnemonic	**Function**					
AND	Series connection- A contact					
Operand	X0~X17	Y0~Y17	M0~M799	T0~159	C0~C79	D0~D399
	✓	✓	✓	✓	✓	—

Explanation The AND command is used in the series connection of A 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.

Example Ladder diagram:

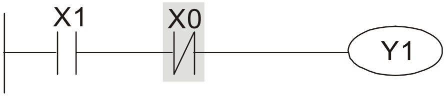


Command code:		Operation:
LDI	X1	Load contact B of X1
AND	**X0**	Connect to contact A of X0 in series
OUT	Y1	Drive Y1 coil

Mnemonic	**Function**					
ANI	Series connection- B contact					
Operand	X0~X17	Y0~Y17	M0~M799	T0~159	C0~C79	D0~D399
	✓	✓	✓	✓	✓	—

Explanation 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.

Example Ladder diagram:



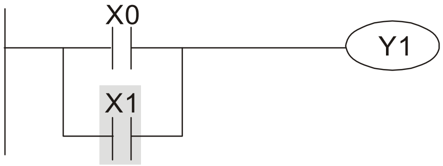
Command code:		Operation:
LD	X1	Load contact A of X1
ANI	**X0**	Connect to contact B of X0 in series
OUT	Y1	Drive Y1 coil

Mnemonic	**Function**					
OR	Parallel connection- A contact					
Operand	X0~X17	Y0~Y17	M0~M799	T0~159	C0~C79	D0~D399
	✓	✓	✓	✓	✓	—

Explanation The OR command is used in the parallel connection of A contact. The function of the 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.

Example

Ladder diagram:



Command code:		Operation:
LD	X0	Load contact A of X0
OR	**X1**	Connect to contact A of X1 in parallel
OUT	Y1	Drive Y1 coil

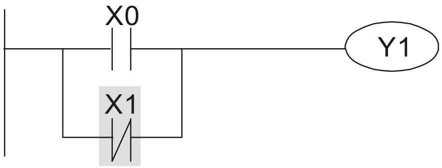
Mnemonic	Function					
ORI	Parallel connection- B contact					
Operand	X0~X17	Y0~Y17	M0~M799	T0~159	C0~C79	D0~D399
	✓	✓	✓	✓	✓	—

Explanation

The ORI command is used in the parallel connection of B contact. The function of the 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.

Example

Ladder diagram:



Command code:		Operation:
LD	X0	Load contact A of X0
ORI	**X1**	Connect to contact B of X1 in parallel
OUT	Y1	Drive Y1 coil

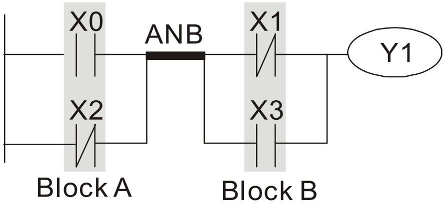
Mnemonic	Function
ANB	Series connection (Multiple Circuits)
Operand	None

Explanation

To perform the "ANB" calculation between the previous reserved logic results and contents of the accumulative register.

Example

Ladder diagram:



Command code:		Operation:
LD	X0	Load contact A of X0
ORI	X2	Connect to contact B of X2 in parallel
LDI	X1	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

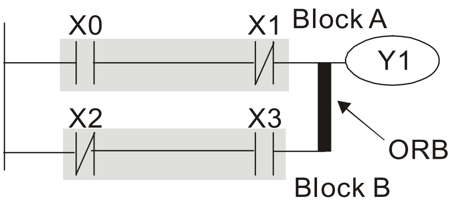
Mnemonic	Function
ORB	Parallel connection (Multiple circuits)
Operand	None

Explanation

ORB is to perform the "OR" calculation between the previous reserved logic results and contents of the accumulative register.

Example

Ladder diagram:



Command code:		Operation:
LD	X0	Load contact A of X0
ANI	X1	Connect to contact B of X1 in series
LDI	X2	Load contact B of X2
AND	X3	Connect to contact A of X3 in series
ORB		Connect circuit block in parallel
OUT	Y1	Drive Y1 coil

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 operation pointer pluses 1)

Mnemonic	**Function**
MRD	Reads the current result of the internal PLC operations
Operand	None

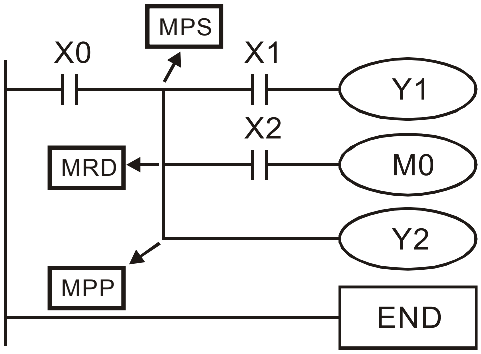
Explanation Reading content of the operation result to the accumulative register. (the pointer of operation result doesn't move)

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
MPS		Save in stack
AND	X1	Connect to contact A of X1 in series
OUT	Y1	Drive Y1 coil
MRD		Read from the stack (without moving pointer)
AND	X2	Connect to contact A of X2 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
	—	✓	✓	—	—	—

Explanation Output the logic calculation result before the OUT command to specific device.

Motion of coil contact:

Operation result	**OUT command**		
	Coil	**Contact**	
		A contact (normally open)	**B contact (normally closed)**
FALSE	Off	Non-continuity	Continuity
TRUE	On	Continuity	Non-continuity

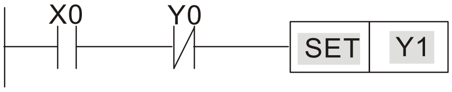
Example Ladder diagram:

Command code:		Operation:
LD	X0	Load contact B of X0
AND	X1	Connect to contact A of X1 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
	—	✓	✓	—	—	—

Explanation When the SET command is driven, its specific device is set to be “ON,” which will keep “ON” whether the SET command is still driven. You can use the RST command to set the device to “OFF”.

Example Ladder diagram:



Command code:		Operation:
LD	X0	Load contact A of X0
AN	Y0	Connect to contact B of 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
	—	✓	✓	✓	✓	✓

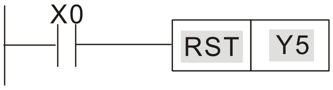
Explanation When the RST command is driven, motion of its specific device is as follows:

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**	Clear contact Y5

Mnemonic	Function	
TMR	16-bit timer	
Operand	T-K	T0~T159, K0~K32,767
	T-D	T0~T159, D0~D399

Explanation

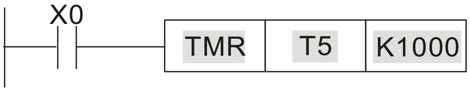
When TMR command is executed, the specific coil of timer is ON and timer will start to count. When the setting value of timer is attained (counting value >= setting value), the contact will be as following

NO(Normally Open) contact	Open collector
NC(Normally Closed) contact	Close 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 K1000	Setting of T5 counter is K1000.

Mnemonic	Function	
CNT	Clear contact or register	
Operand	C-K	C0~C79, K0~K32,767
	C-D	C0~C79, D0~D399

Explanation

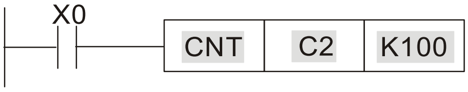
When the CNT command is executed from OFF→ON, which means that the counter coil is driven, and 1 should thus be added to the counter's value; when the counter achieved specific set value (value of counter = the setting value), motion of the contact is as follows:

NO(Normally Open) contact	Open collector
NC(Normally Close) contact	Close 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.

Example

Ladder diagram:



Command code:		Operation
LD	X0	Load contact A of
CNT	**C2 K100**	Setting of C2 counter is K100.

Mnemonic	**Function**
MC/MCR	Master control Start/Reset
Operand	N0~N7

Explanation

1. MC 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:

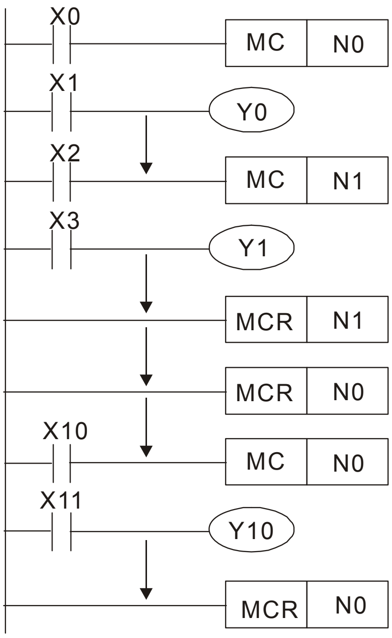
Command	Description
Timer	The counting value is set back to zero, the coil and the contact are both turned OFF
Accumulative timer	The coil is OFF, and the timer value and the contact stay at their present condition
Subroutine timer	The counting value is back to zero. Both coil and contact are turned OFF.
Counter	The coil is OFF, and the counting value and the contact stay at their present condition
Coils driven up by the OUT command	All turned OFF
Devices driven up by the SET and RST commands	Stay at present condition
Application commands	All of them are not acted , but the nest loop FOR-NEXT command will still be executed for times defined by users even though the MC-MCR 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:

Example

Ladder Diagram:



Command code:		Operation:
LD	X0	Load A contact of X0
MC	**N0**	Enable N0 common series connection contact
LD	X1	Load A contact of X1
OUT	Y0	Drive Y0 coil
:		
LD	X2	Load A contact of X2
MC	**N1**	Enable N1 common series connection contact
LD	X3	Load A contact of X3
OUT	Y1	Drive Y1 coil
:		
MCR	**N1**	Disable N1 common series connection contact
:		
MCR	**N0**	Disable N0 common series connection contact
:		
LD	X10	Load A contact of X10
MC	**N0**	Enable N0 common series connection contact
LD	X11	Load A contact of X0
OUT	Y10	Enable N0 common series connection contact
:		Load A contact of X1
MCR	**N0**	Drive Y0 coil

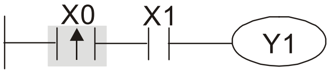
Mnemonic	**Function**					
LDP	Rising-edge detection operation					
Operand	X0~X17	Y0~Y17	M0~M799	T0~159	C0~C79	D0~D399
	✓	✓	✓	✓	✓	—

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 detection
AND	X1	Series connection A contact of X1
OUT	Y1	Drive Y1 coil

Remarks

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.

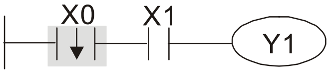
Mnemonic	**Function**					
LDF	Falling-edge detection operation					
Operand	X0~X17	Y0~Y17	M0~M799	T0~159	C0~C79	D0~D399
	✓	✓	✓	✓	✓	—

Explanation

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.

Example

Ladder diagram:



Command code:		Operation:
LDF	**X0**	Start X0 falling-edge detection
AND	X1	Series connection A contact of X1
OUT	Y1	Drive Y1 coil

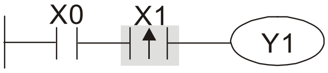
Mnemonic	**Function**					
ANDP	Rising-edge series connection					
Operand	X0~X17	Y0~Y17	M0~M799	T0~159	C0~C79	D0~D399
	✓	✓	✓	✓	✓	—

Explanation

ANDP command is used in the series connection of the contacts' rising-edge detection.

Example

Ladder diagram:

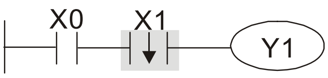


Command code:		Operation:
LD	X0	Load A contact of X0
ANDP	**X1**	X1 rising-edge detection in series connection
OUT	Y1	Drive Y1 coil

Mnemonic	**Function**					
ANDF	Falling-edge series connection					
Operand	X0~X17	Y0~Y17	M0~M799	T0~159	C0~C79	D0~D399
	✓	✓	✓	✓	✓	—

Explanation ANDF command is used in the series connection of the contacts' falling-edge detection.

Example Ladder diagram:

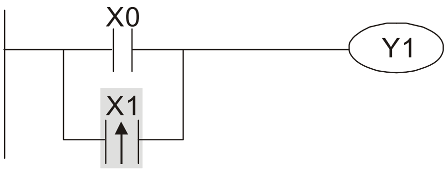


Command code:		Operation:
LD	X0	Load A contact of X0
ANDF	**X1**	X1 falling-edge detection in series connection
OUT	Y1	Drive Y1 coil

Mnemonic	**Function**					
ORP	Rising-edge parallel connection					
Operand	X0~X17	Y0~Y17	M0~M799	T0~159	C0~C79	D0~D399
	✓	✓	✓	✓	✓	—

Explanation The ORP commands are used in the parallel connection of the contact's rising-edge detection.

Example Ladder diagram:

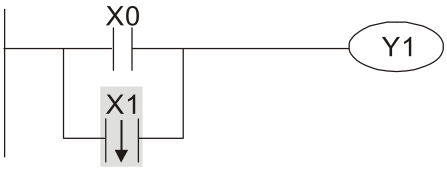


Command code:		Operation:
LD	X0	Load A contact of X0
ORP	**X1**	X1 rising-edge detection in parallel connection
OUT	Y1	Drive Y1 coil

Mnemonic	**Function**					
ORF	Falling-edge parallel connection					
Operand	X0~X17	Y0~Y17	M0~M799	T0~159	C0~C79	D0~D399
	✓	✓	✓	✓	✓	—

Explanation The ORP commands are used in the parallel connection of the contact's falling-edge detection.

Example Ladder diagram:



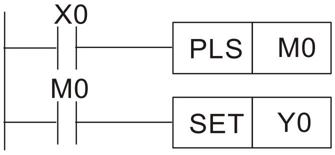
Command code:		Operation:
LD	X0	Load A contact of X0
ORF	**X1**	X1 falling-edge detection in parallel connection
OUT	Y1	Drive Y1 coil

Mnemonic	**Function**					
PLS	Rising-edge output					
Operand	X0~X17	Y0~Y17	M0~M799	T0~159	C0~C79	D0~D399
	—	✓	✓	—	—	—

Explanation When X0=OFF→ON (rising-edge trigger), PLS command will be executed and M0 will send the pulse of one time which the length is the time needed for one scan cycle.

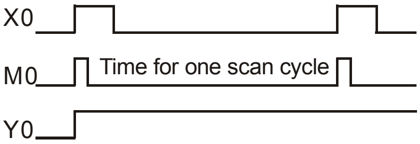
Example

Ladder diagram:



Command code:		Operation:
LD	X0	Load A contact of X0
PLS	**M0**	M0 rising-edge output
LD	M0	Load the contact A of M0
SET	Y0	Y0 latched (ON)

Timing diagram:

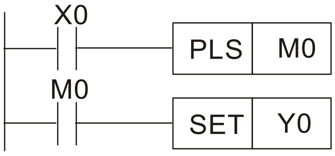


Mnemonic	**Function**					
PLF	Falling-edge output					
Operand	X0~X17	Y0~Y17	M0~M799	T0~159	C0~C79	D0~D399
	—	✓	✓	—	—	—

Explanation When X0= ON→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.

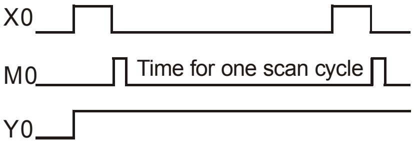
Example

Ladder diagram:



Command code:		Operation:
LD	X0	Load contact A of X0
PLF	**M0**	M0 falling-edge output
LD	M0	Load contact A of M0
SET	Y0	Y0 latched (ON)

Timing Diagram:



Mnemonic	**Function**
END	Program End
Operand	None

Explanation

It needs to add the END command at the end of ladder diagram program or command program. PLC will scan from address o to END command, after the execution it will return to address 0 and scan again.

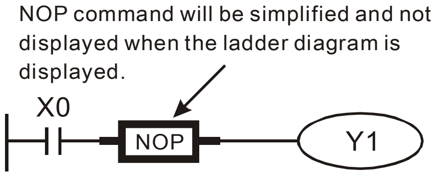
Mnemonic	**Function**
NOP	No action
Operand	None

Explanation

NOP command does no operation in the program; the result of executing this command will remain the logic operation. Use NOP command if user wants to delete certain command without changing the length of the program.

Example

Ladder diagram:


NOP command will be simplified and not displayed when the ladder diagram is displayed.

Command code:		Operation:
LD	X0	Load contact B of X0
NOP		No function
OUT	Y1	Drive Y1 coil

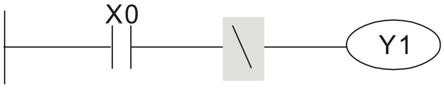
Mnemonic	**Function**
INV	Inverse operation result
Operand	None

Explanation

The operation result (before executing INV command) will be saved inversely into cumulative register.

Example

Ladder diagram:



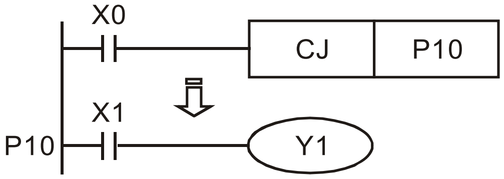
Command code:		Operation:
LD	X0	Load contact A of X0
INV		Operation result inversed
OUT	Y1	Drive Y1 coil

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:



Command code:		Operation:
LD	X0	Load contact A of X0
CJ	P10	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 Command	Function	STEPS	
		16-bit	32-bit			16bit	32bit
Loop control	01	CALL	-	✓	CALL subroutine	3	-
	02	SRET	-	-	The end of subroutine	1	-
	06	FEND	-	-	The end of main program	1	-
Transmission Comparison	10	CMP	DCMP	✓	Compare	7	13
	11	ZCP	DZCP	✓	Zone compare	9	17
	12	MOV	DMOV	✓	Data Move	5	9
	15	BMOV	DCMP	✓	Block move	7	–
Four Fundamental Operations of Arithmetic	20	ADD	–	✓	Perform the addition of BIN data	7	13
	21	SUB	DADD	✓	Perform the subtraction of BIN data	7	13
	22	MUL	DSUB	✓	Perform the multiplication of BIN data	7	13
	23	DIV	DMUL	✓	Perform the division of BIN data	7	13
	24	INC	DDIV	✓	Perform the addition of 1	3	5
	25	DEC	DINC	✓	Perform the subtraction of 1	3	5
Rotation and Displacement	30	ROR	DDEC	✓	Rotate to the right	5	–
	31	ROL	DROR	✓	Rotate to the left	5	–
Data Processing	40	ZRST	–	✓	Zero Reset	5	-
	49	FLT	DFLT	✓	Floating Point	5	9
Communication	150	MODRW	–	✓	MODBUS R/W	7	–
Floating Point	110	–	DECMP	✓	Floating Point Compare	–	13

	API	Mnemonic Codes		P Command	Function	STEPS	
		16-bit	32-bit			16bit	32bit
Operation	111	–	DEZCP	✓	Floating Point Zone Compare	–	17
	116	–	DRAD	✓	Degree → Radian	–	9
	117	–	DDEG	✓	Radian → Degree	–	9
	120	–	DEADD	✓	Floating Point Addition	–	13
	121	–	DESUB	✓	Floating Point Subtraction	–	13
	122	–	DEMUL	✓	Floating Point Multiplication	–	13
Floating Point Operation	123	–	DEDIV	✓	Floating Point Division	–	13
	124	–	DEXP	✓	Float Exponent Operation	–	9
	125	–	DLN	✓	Float Natural Logarithm Operation	–	9
	127	–	DESQR	✓	Floating Point Square Root	–	9
	129	–	DINT	✓	Float to Integer	–	9
	130	–	DSIN	✓	Sine	–	9
	131	–	DCOS	✓	Cosine	–	9
	132	–	DTAN	✓	Tangent	–	9
	133	–	DASIN	✓	Arc Sine	–	9
	134	–	DACOS	✓	Arc Cosine	–	9
	135	–	DATAN	✓	Art Tangent	–	9
	136	–	DSINH	✓	Hyperbolic Sine	–	9
	137	–	DCOSH	✓	Hyperbolic Cosine	–	9
	138	–	DTANH	✓	Hyperbolic Tangent	–	9
Calendar	160	TCMP	–	✓	Comaprison of calendar data	11	–
	161	TZCP	–	✓	Comparison of calendar data area	9	–
	162	TADD	–	✓	Calendar data addition	7	–
	163	TSUB	–	✓	Calendar data substraction	7	–
	166	TRD	–	✓	Read calendar data	3	–
Gray code	170	GRY	DGRY	✓	BIN→GRY code		
	171	GBIN	DGBIN	✓	GRY code →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

	API	Mnemonic Codes		P 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 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	OR＝	DOR＝	-	OR compare ※	5	9
	241	OR＞	DOR＞	-	OR compare ※	5	9
	242	OR＜	DOR＜	-	OR compare ※	5	9
	244	OR＜＞	DOR＜＞	-	OR compare ※	5	9
	245	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 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	–	✓	Read the parameters	5	–
	140	WPR	–	✓	Write the parameters	5	–
	141	FPID	–	✓	Drive PID control	9	–
	142	FREQ	–	✓	Control the drive frequency	7	–
	261	CANRX	–	✓	Read CANopen Slave data	9	-
	263	TORQ	–	✓	Set target torque	5	-
	264	CANTX	–	✓	Write CANopen Slave data	9	-
	265	CANFLS	–	✓	Update the mapping special D of CANopen	3	-

16.6.4 Explanation for the Application Commands

API					
01		**CALL**	**P**	S	Call Subroutine

	Bit Devices			Word Devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D

Operands:

S: Operand S can designate P.

Operand S of C2000 series can designate P0~P63.

16-bit command (3 STEPS)

CALL CALLP

32-bit command

— — — —

Flag signal: None

Explanation

1. **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					
06		**FEND**		—	The end of the main program (First End)

	Bit Devices			Word Devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D

Operands:

No operand

No contact to drive the instruction is required.

16-bit command (1 STEP)

FEND — —

32-bit command

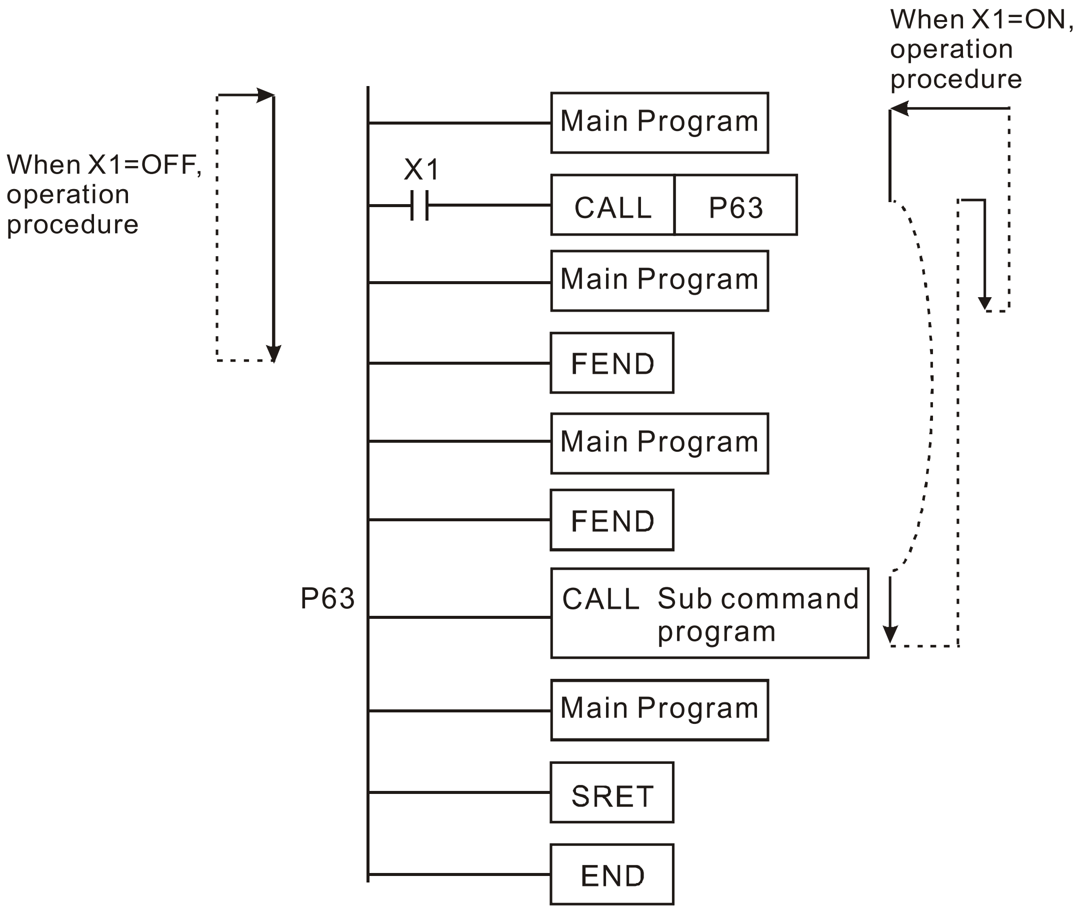
— — — —

Flag signal: None

Explanation

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



API					
10	**D**	**CMP**	**P**	(S1) (S2) (D)	Compare

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*
D		*	*								

Operand

Operand D occupies 3 consecutive devices.

16-bit command (7 STEPS)

CMP CMPP

32bits command (13 STEPS)

— — — —

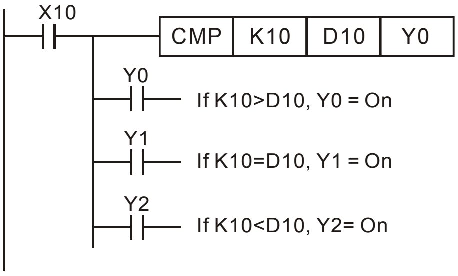
Flag signal: None

Explanation

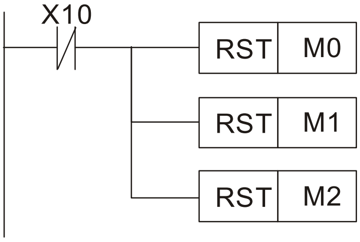
1. **S_1**: value comparsion 1, **S_2**: value comparsion 2 , **D**: result comparsion
2. The contents in **S_1** and **S_2** are compared and result is stored in **D**.
3. The two comparison values are compared algebraically and the two values are signed binary values. When b15 = 1 in 16-bit instruction, the comparison will regard the value as negative binary values.

Example

1. Designate device Y0, and operand D automatically occupies Y0, Y1, and Y2.
2. When X10 = On, CMP instruction will be executed and one of Y0, Y1, and Y2 will be On. When X10 = Off, CMP instruction will not be executed and Y0, Y1, and Y2 remain their status before X10 = Off.
3. If the user need to obtain a comparison result with ≥ ≤, and ≠, make a series parallel connection between Y0 ~ Y2.



4. To clear the comparison result, use RST or ZRST instruction.



API					
11	**D**	**ZCP**	**P**	(S1) (S2) (S) (D)	Zone Compare

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*
S				*	*	*	*	*	*	*	*
D		*	*								

Operands:

S_1: Lower bound of zone comparison **S_2**: Upper bound of zone comparison S: Comparison value

D: Comparison result

16-bit command (9 STEPS)

ZCP ZCPP

32-bit command (17 STEPS)

— — — —

Flag signal: none

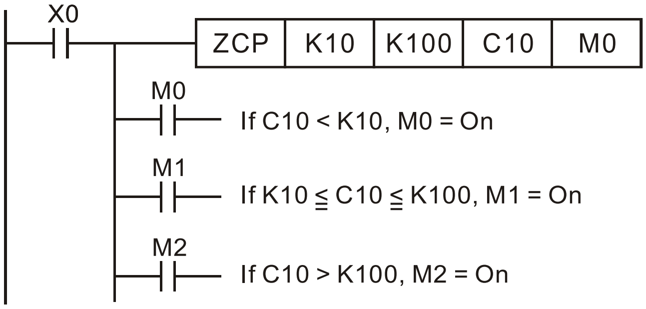
Explanation

1. **S_1**: Lower bound of zone comparison **S_2**: Upper bound of zone comparison S: Comparison value **D**: Comparison result
2. S is compared with its **S_1 S_2** and the result is stored in **D**.
3. When **S_1** > **S_2**, the instruction performs comparison by using **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.

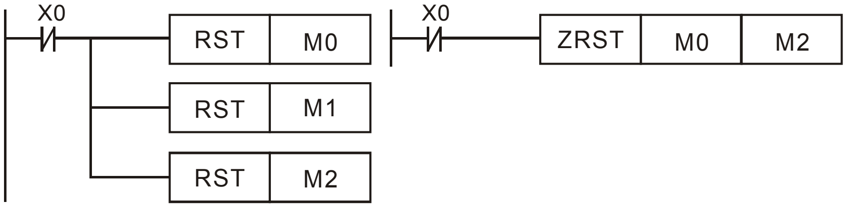
Example

1. Designate device M0, and operand D automatically occupies M0, M1 and M2.
2. When X0 = On, ZCP instruction will be executed and one of M0, M1, and M2 will be On. When X10 = Off, ZCP instruction will not be executed and M0, M1, and M2 remain their status before X0 = Off.
3. If the user need to obtain a comparison result with ≥ ≤, and ≠, make a series parallel connection between Y0 ~ Y2.

■



4. To clear the comparison result, use RST or ZRST instruction.



API					
12	**D**	**MOV**	**P**	S D	Moving the data

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Operand: None

16-bit command (5 STEPS)
MOV MOVP

32-bit command (9 STEPS)
— — — —

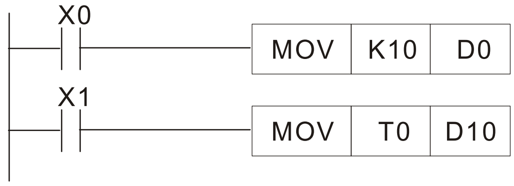
Flag signal: None

Explanation

1. 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.

Example

1. When X0 = Off, the content in D10 will remain unchanged. If X0 = On, the value K10 will be moved to D10 data register.
2. When X1 = Off, the content in D10 will remain unchanged. If X1 = On, the present value T0 will be moved to D10 data register.



API		**BMOV**		Ⓢ Ⓓ ⓝ	Block Move
15			**P**		

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S						*	*	*	*	*	*
D							*	*	*	*	*
n				*	*						

Operand:
Range of n ＝1~512

16-bit command (7 STEPS)
BMOV BMOVP

32-bit command
— — — —

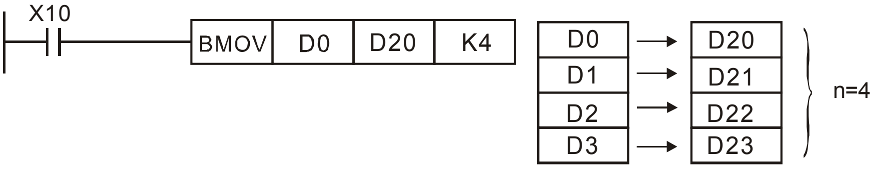
Flag signal: None

Explanation

1. S: Start of source devices D: Start of destination devices n: Number of data to be moved
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.

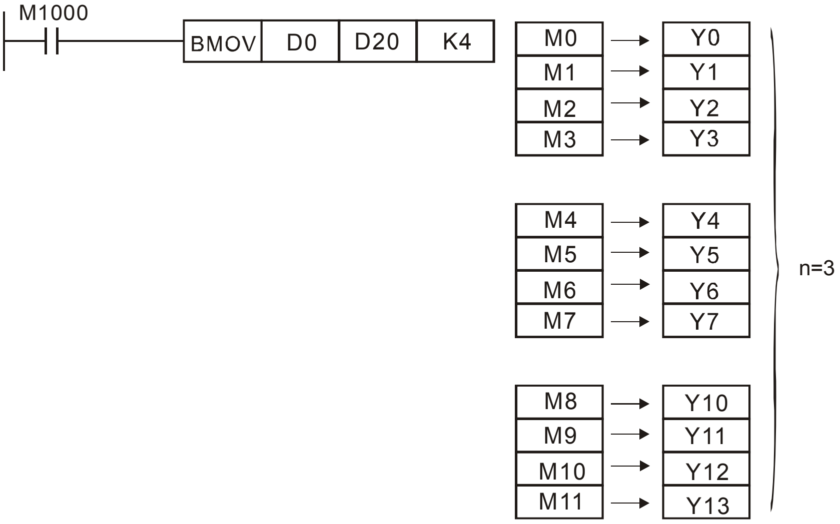
Example 1

When X10 = On, the contents in registers D0 ~ D3 will be moved to the 4 registers D20 ~ D23.



Example 2

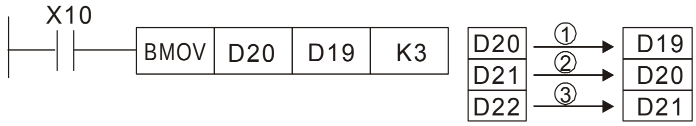
Assume the bit devices KnX, KnY, KnM and KnS are designated for moving, the number of digits of S and D has to be the same, i.e. their n has to be the same.



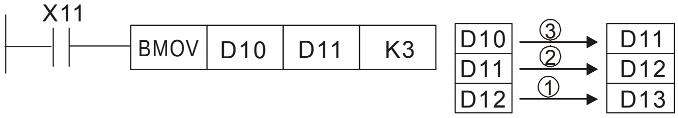
Example 3

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 designated device numbers.

When S > D, the BMOV command is processed in the order as ①→②→③



When S < D, the BMOV command is processed in the order as ③→②→①



API		ADD		(S1) (S2) (D)	BIN Addition
20	**D**		**P**		

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Operands: None

16-bit command (7 STEPS)
ADD ADDP

32-bit command (13 STEPS)
— — — —

Flag signal: M1020 Zero flag
M1021 Borrow flag
M1022 Carry flag

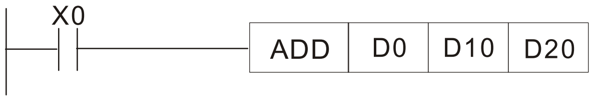
Explanation

1. **S_1**: Summand **S_2**: Addend **D**: Sum
2. This instruction adds **S_1** and **S_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.
   B. If the operation result < -32,768, borrow flag M1021 = On.
   C. If the operation result > 32,767, carry flag M1022 = On.

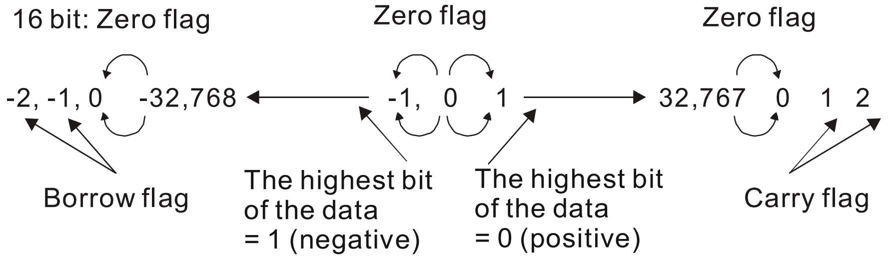
Example

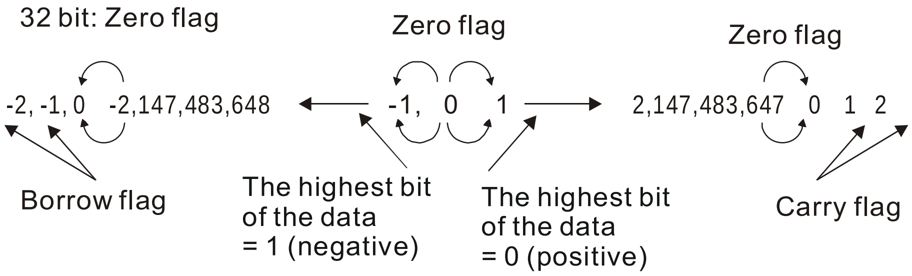
16-bit command:

When X0 = On, the content in D0 will plus the content in D10 and the sum will be stored in D20.



Remarks Flags and the positive/negative sign of the values:





API					
21	D	**SUB**	P	S1 S2 D	Subtraction

	Bit Devices			Word Devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Operands: None

16-bit command (7 STEPS)
SUB SUBP

32-bit command (13 STEPS)
— — — —

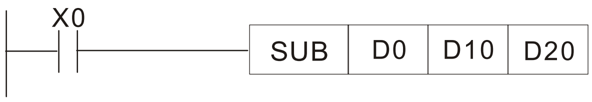
Flag signal: M1020 Zero flag
M1021 Borrow flag
M1022 Carry flag

Explanation

1. **S_1**: Minuend **S_2**: Subtrahend **D**: Remainder
2. This instruction subtracts **S_1** and **S_2** in BIN format and stores the result in **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 X0 = On, the content in D0 will minus the content in D10 and the remainder will be stored in D20.



API		**MUL**		(S1) (S2) (D)	BIN Multiplication
22	**D**		**P**		

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Operands:
In 16-bit instruction, D occupies 2 consecutive devices.

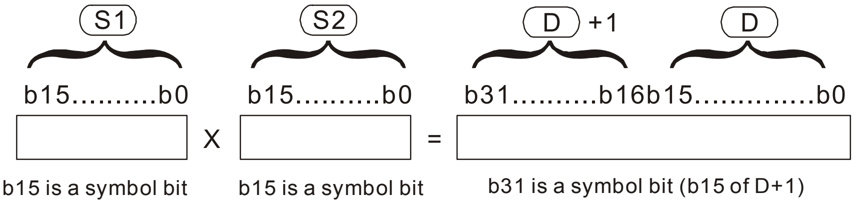
16-bit command (7 STEPS)
MUL MULP

32-bit command (13 STEPS)
— — — —

Flag signal: None

Explanation

1. **S_1**: Multiplicand **S_2**: Multiplication D: Product
2. This instruction multiplies **S_1** by **S_2** in BIN format and stores the result in D. Be careful with the positive/negative signs of **S_1**, **S_2** and D when doing 16-bit and 32-bit operations.
   16-bit command:

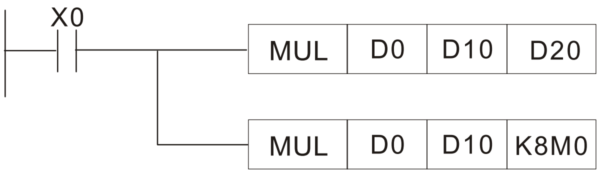


Symbol bit = 0 refers to a positive value.
Symbol bit = 1 refers to a negative value.

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.

Example

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					
23	**D**	**DIV**	**P**	S1 S2 D	BIN Division

	Bit Devices			Word Devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Operands:
In 16-bit instruction, **D** occupies 2 consecutive devices.

16-bit command (7 STEPS)
DIV DIVP

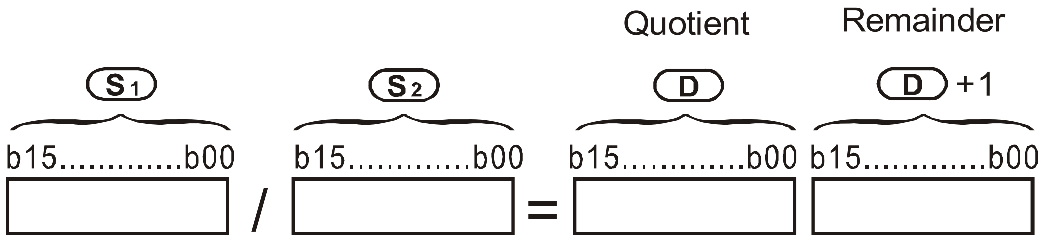
32-bit command (13 STEPS)
— — — —

Flag signal: none`

Explanation

1. **S_1**: Dividend **S_2**: Divisor **D**: Quotient and remainder
2. This instruction divides **S_1** and **S_2** in BIN format and stores the result in D. Be careful with the positive/negative signs of **S_1**, **S_2** and D when doing 16-bit and 32-bit operations.

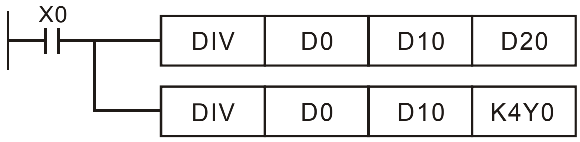
16-bit instruction:



If D is the bit device, it allocates K1~K14 to 16-bit and occupies 2 continuous sets of quotient and remainder.

Example

When X0 = 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.



API					
24	**D**	**INC**	**P**	(D)	Increment: BIN plus 1

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D							*	*	*	*	*

Operands: none

16-bit command (3 STEPS)
INC INCP

32-bit command (5 STEPS)
— — — —

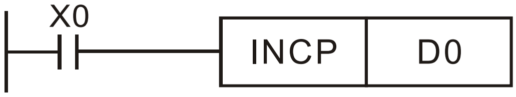
Flag signal: none

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 D0 pluses 1 automatically.



API 25	**D**	**DEC**	**P**	Ⓓ	Decrement: BIN minus 1

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D				*	*	*	*	*			

Operands: none

16-bit command (3 STEPS)

DEC DECP

32-bit command (5 STEPS)

— — — —

Flag signal: none

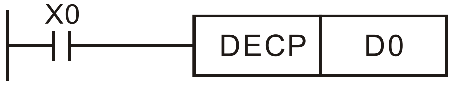
Explanation

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					
30		**ROR**	**P**	D n	Rotate to the Right

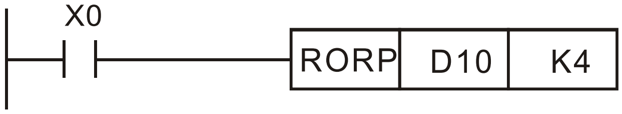
	Bit Devices			Word Devices								16 bit command (5 STEPS) ROR RORP
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D	
D							*	*	*	*	*	32-bit command — — — —
n				*	*							
Operands: D: if in KnY and KnM, only K4 (16-bit) is valid n: n=K1~K16 (16-bit)												Flag signal: M1022 Carry flag

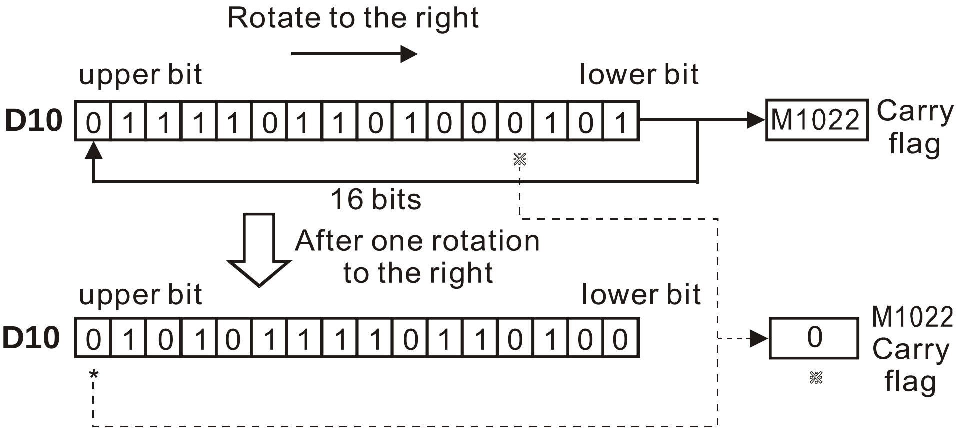
Explanation

1. **D**: Device to be rotated **n**: Number of bits to be rotated in 1 rotation
2. This instruction rotates the device content designated by **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		ROL		D n	Rotate to the Left
31			**P**		

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D							∗	∗	∗	∗	∗
n				∗	∗						

Operands:
D: if in KnY and KnM, only K4 (16-bit) is valid
n: n=K1~K16 (16-bit)

16-bit command (5 STEPS)
ROL ROLP

32-bit command
— — — —

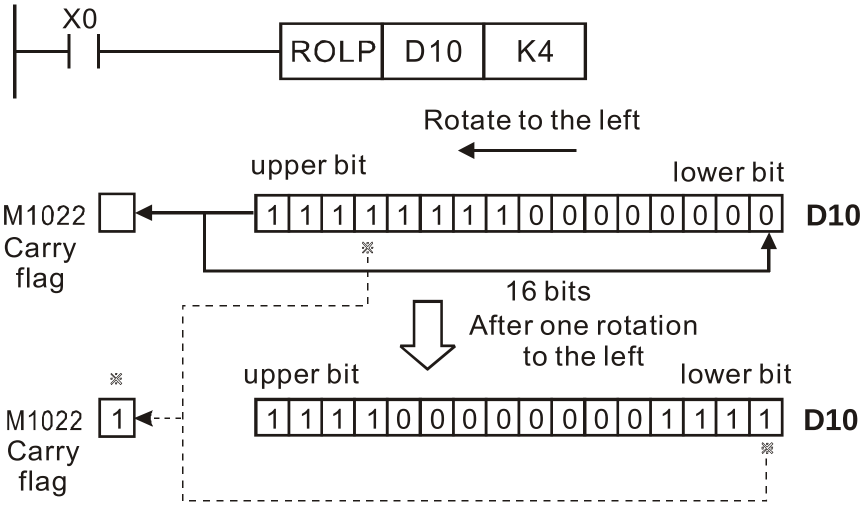
Flag signal: M1022 Carry flag

Explanation

1. **D**: Device to be rotated; **n**: Number of bits to be rotated in 1 rotation
2. This instruction rotates the device content designated by **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.



API				
40	**ZRST**	**P**	(D1) (D2)	Zero Reset

	Bit Devices			Word Devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D_1		*	*						*	*	*
D_2		*	*						*	*	*

Operands:
No of D_1 operand. ≦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.

16-bit command (5 STEPS)
ZRST ZRSTP

32-bit command
— — — —

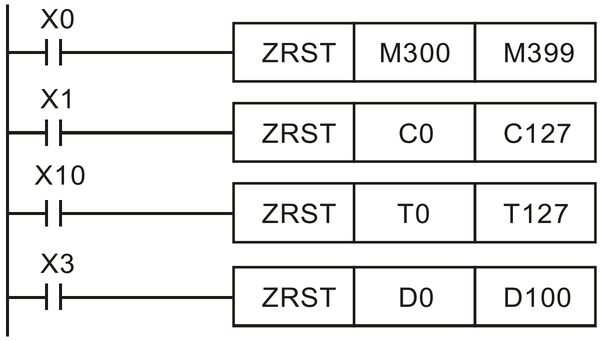
Flag signal: none

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.

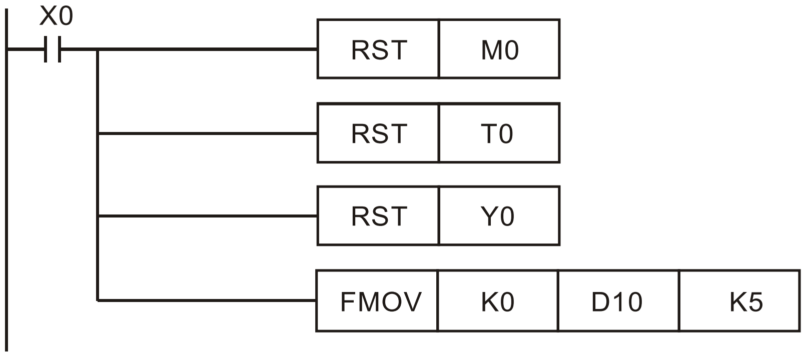
Example

1. When X0 = On, auxiliary relays M300 ~ M399 will be reset to Off.
2. When X1 = On, 16 counters C0 ~ C127 will all be reset (writing in 0; contact and coil being reset to Off).
3. When X10 = On, timers T0 ~ T127 will all be reset (writing in 0; contact and coil being reset to Off).
4. When X3 = On, data registers D0 ~ D100 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 KnY, KnM, KnS for reset.



API 49	**D**	**FLT**	**P**	S D	Floating Point

	Bit Devices			**Word Devices**						
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S		*	*						*	*	*
D		*	*						*	*	*

Operands:
No of D_1 operand. ≦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.

16-bit command (5 STEPS)
– – – –

32-bit command
DFLT DFLTP

Flag signal: none

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.

API		**MODRW**		S_1 S_2 S_3 S n	MODBUS R/W
150			**P**		

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D1				∗	∗				∗	∗	∗
D2									∗	∗	∗

Operands:
No of D_1 operand. ≦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.

16-bit command (5 STEPS)
MODRW MODRWP

32-bit command
– – – –

Flag signal:M1077 M1078 M1079

Explanation

- 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.
0F	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 #	Fucntion Code	Addr-ess	Register	Leng-th
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

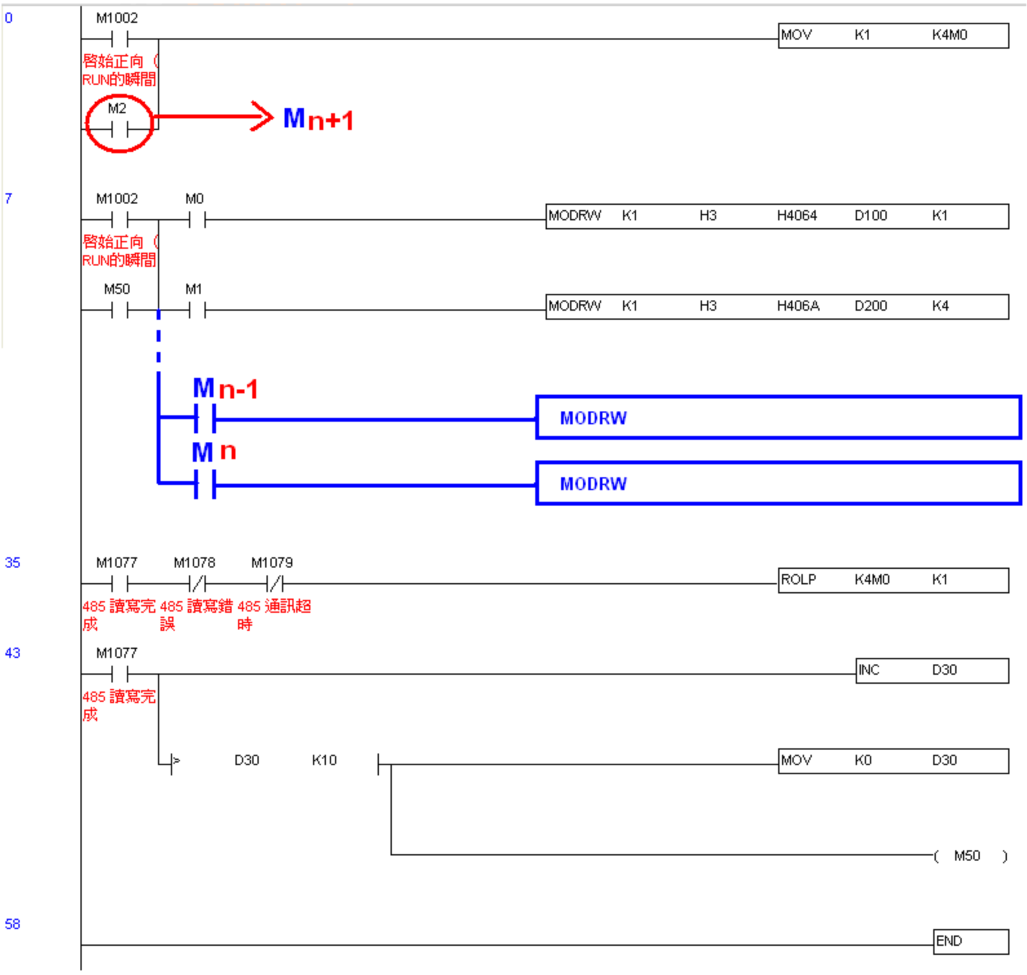
To control the slave PLC

No.	Example	MODRW COMMAND				
		S1	S2	S3	S4	n
		Station #	Function code	Add-ress	Register	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 T0~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 C0~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 T0~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

■

Example

- As the PLC starts to run, M0 = 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 M1 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 M0=1, this command will repeat itself.. If more commands need to be added, simply add blue color command and change repeat M to repeat Mn+1



API					
110	**D**	**DECMP**	**P**	S1 S2 D	Floating Point Compare

	Bit Devices			Word Devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
D				*	*						*

Operands:
D Operands occupy three continuous points.
Please refer to the specification of each model series for applicable range of the device.

16-bit command (5 STEPS)
_ _ _ _

32-bit command
DECMP DECMPP

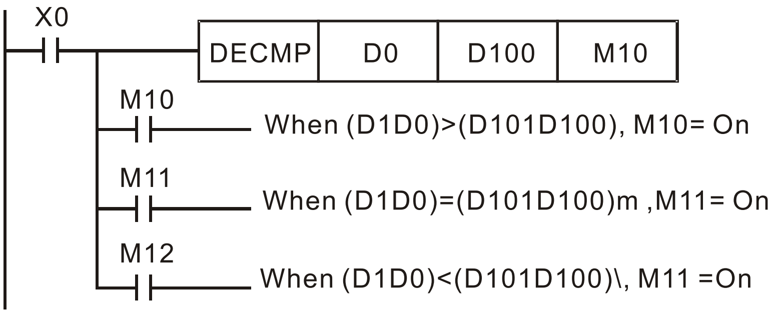
Flag signal: none

Explanation

- **S₁**：Binary floating point number comparison value 1. **S₂**：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 **S₁** or **S₂** 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 X0 = 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 X0 = Off.
- If you need to have results such as ≧, ≦ or ≠, make M10~ M12 paralllel connection.
- Use the RST or ZRST command to clean the results.



API 111	D	**DEZCP**	P	S1 S2 S D	Floating Point Zone Compare

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
S				*	*						*
D				*	*						*

Operands:

DOperands occupy three continuous points

Please refer to the specification of each model series for applicable range of the device.

16-bit command (5 STEPS)

– – – –

32-bit command

DEZCP DEZCPP

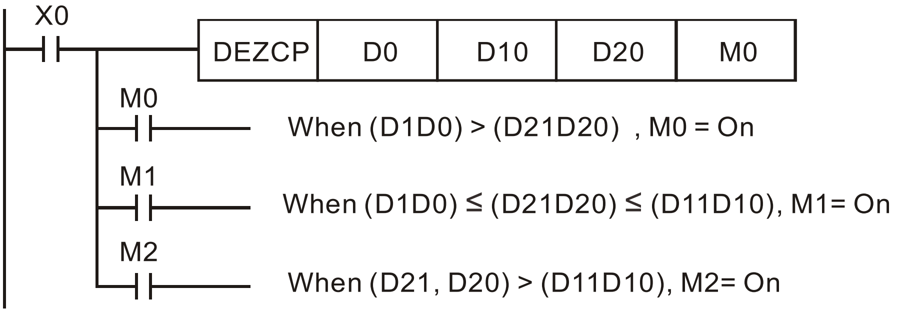
Flag signal: none

Explanation

- **S_1**：The lower limit of a binary floating poiont number of a zone comparison. **S_2**：The upper limit of a binary floating point number of a zone comparison. **D:** Comparison result,.three continuous points are occupied.
- **S_1**：Binary floating point number comparison value. Compare **S** to the **S_1** binary floating point number lower limit and to the **S_2** binary floating point number upper limit. Show the comparison result at **D.**
- If the source operands of **S_1** or **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 **S_1** is bigger than the binary floating point number upper limit **S_2**. Then a command uses the binary floating point number lower limit **S_1** as upper/lower limit to make comparison.

Example

- When assgined device is M0, then M10~M12 are automatically occupied.
- When X0 = 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 X0 = Off.
- Use the RST or ZRST command to clean the results



API					
116	**D**	**RAD**	**P**	S D	Degree → Radian

	Bit Devices			Word Devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				∗	∗						∗
D				∗	∗						∗

Operands:
Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)
– – – –

32-bit command
DRAD DRADP

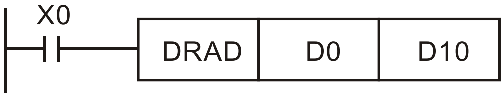
Flag signal: none

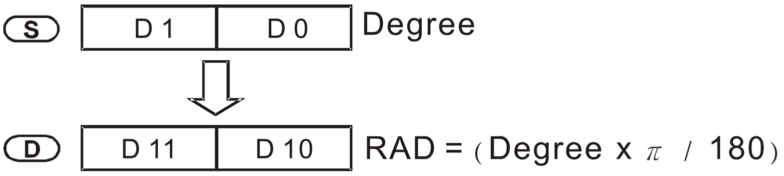
Explanation

- **S**：source of the data (degree). **D**：result of the changes (radian).
- Use the following formula to change degree to radian.
- Radian＝Degree × (π /180)

Example

- When X0 = 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.





API		**DEG**		(S) (D)	Radian → Degree
117	**D**		**P**		

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D				*	*						*

Operands:
Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)
– – – –

32-bit command
DDEG DDEGP

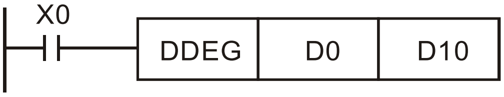
Flag signal: none

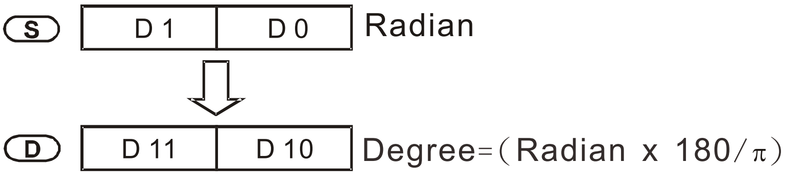
Explanation

- **S**：source of the data (Radian). **D**：result of the changes (Degree).
- Use the following formula to change radian to degree.
- Degree = Radian x (180/π)

Example

When X0 = 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 floating point number.





API					
120	**D**	**EADD**	**P**	S1 S2 D	Floating Point Addition

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
D				*	*						*

Operands:
Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)
— — — —

32-bit command
DEADD DEADDP

Flag signal: none

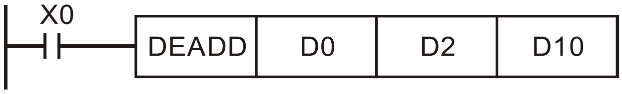
Explanation

- S_1 : augend, S_2 : addend, **D** : sum
- S_1 **S1** + **S2** = **D**. The floating point value in **S1** and **S2** are added and the result is stored in **D**. All calculation are done using binary floating poiont number.
- If the source operand **S1** or **S2** is specified as constant K or H, the constant will automatically be converted to binary floating point value for the addition operation.

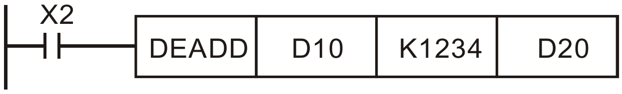
S1 and **S2** can designate the same register. In this case, if the instruction is specified as "continuous execution instruction" (generally DEADDP instruction) and the drive contact is ON,the register will be added once in every scan.

Example

- When X0 = On, the sum of binary floating point number (D1, D0) + binary floating point number (D3, D2) will be saved in (D11, D10).



- When X2 = On, the sum of binary floating point number



API		**ESUB**		S1 S2 D	Floating Point Subtraction
121	**D**		**P**		

	Bit Devices			Word Devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
D				*	*						*

Operands:
Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)
— — — —

32-bit command
DESUB DESUBP

Flag signal: none

Explanation

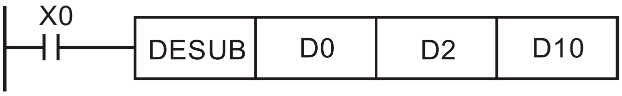
- **S1**: Minuend **S2**: Subtrahend **D**: Subtraction result

S1 − **S2** = **D**. The floating point value in **S2** is subtracted from the floating point value in **S1** and the result is stored in **D**. The subtraction is conducted in binary floating point format.

- If **S1** or **S2** is designated as constant K or H, the instruction will convert the constant into a binary floating point value before the operation.
- **S1** and **S2** 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 X0 = ON, binary floating point value (D1, D0) minuses binary floating point value (D3, D2) and the result is stored in (D11, 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).

API					
122	D	**EMUL**	P	S1 S2 D	Floating Point Multiplication

	Bit Devices			Word Devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
D				*	*						*

Operands:
Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)
— — — —

32-bit command
DEMUL DEMULP

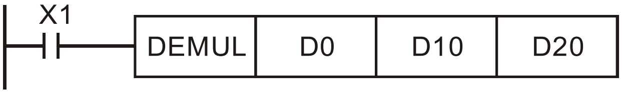
Flag signal: none

Explanation

- **S1**: Multiplicand **S2**: Multiplier **D**: Multiplication result
- **S1** x **S2** = **D**. The floating point value in **S1** is multiplied with the floating point value in **S2** and the result is **D**. The multiplication is conducted in binary floating point format
- If **S1** or **S2** is designated as constant K or H, the instruction will convert the constant into a binary floating point value before the operation
- **S1** and **S2** 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

Example

- When X1 = ON, binary floating point (D1, D0) multiplies binary floating point (D11, D10) and the result is stored in (D21, D20).



- When X2 = ON, K1234 (automatically converted into binary floating point value) multiplies binary floating point (D1, D0) and the result is stored in (D11, D10).

API		**EDIV**		S1 S2 D	Floating Point Division
123	**D**		**P**		

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				∗	∗						∗
S2				∗	∗						∗
D				∗	∗						∗

Operands:
Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)
– – – –

32-bit command
DEDIV DEDIVP

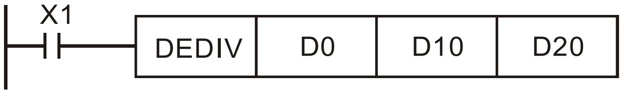
Flag signal: none

Explanation

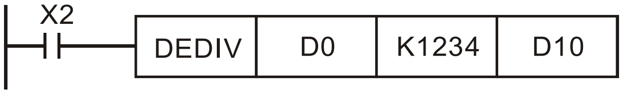
- **S1**: Dividend **S2**: Divisor **D**: Quotient and Remainder
- **S1**÷ **S2** = **D**. The floating point value in **S1** is divided by the floating point value in **S2** and the result is stored in **D**. The division is conducted in binary floating point
- If **S₁** or **S₂** is designated as constant K or H, the instruction will convert the constant into a binary floating point value before the operation.
- If **S2** = 0, operation error will occur, the instruction will not be executed

Example

- When X1 = 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).



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).



API		**EXP**		(S) (D)	Float Exponent Operation
124	**D**		**P**		

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D				*	*						*

Operands:
Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)
– – – –

32-bit command
DEXP DEXPP

Flag signal: none

Explanation

- **S**: Exponent **D**: Operation result
- The base is e = 2.71828 and exponent is **S**
- [**D** +1，**D**]=EXP[**S +1**，**S**]
- Both positive and negative values are valid for **S**. Register **D** has to be 32-bit format. Operation is conducted in floating point value, so the value in **S** needs to be converted into floating value before exponent operation.
- The content in **D** =e^{S} ; e=2.71828 and **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					
125	**D**	**LN**	**P**	S D	Float Natural Logarithm Operation

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D				*	*						*

Operands:
Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)
– – – –

32-bit command
DLN DLNP

Flag signal: none

Explanation

- **S**: Source device **D**: Operation result
- The base is e = 2.71828 and exponent is **S**
- [**D** +1，**D**]=EXP$^{[}$**S +1**，**S**$^{]}$
- Only a positive number is valid for **S**. Register **D** has to be 32-bit format. Operation is conducted in floating point value, so the value in **S** needs to be converted into floating value before exponent operation.
- The content in **D** =e^{S} ; e=2.71828 and **S** is the specified data source
- eD = **S**. The content of **D** = LN **S,** where the value in **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.

API		**ESQR**		Ⓢ Ⓓ	Floating Point Square Root
127	**D**		**P**		

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D				*	*						*

Operands:
Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)

– – – –

32-bit command

DESQR DESQR P

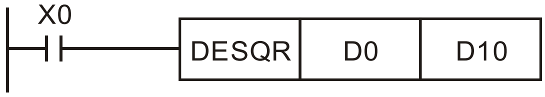
Flag signal: none

Explanation

- **S**: Source device **D**: Operation result
- This instruction performs a square root operation on the floating point value in **S** and stores the result in **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 **S** is specified as constant K or H, the integer value will automatically be converted to binary floating value.

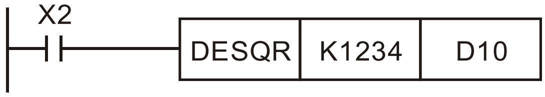
Example

- When X0 = ON, the square root of binary floating point (D1, D0) is stored in (D11, D10) after the operation of square root.



$$\underbrace{\sqrt{(D1, D0)}}_{\text{Binary floating point}} \longrightarrow \underbrace{(D11, D10)}_{\text{Binary floating point}}$$

- When X2 = ON, the square root of K1234 (automatically converted to binary floating value) is stored in (D11, D10).



API					
129	**D**	**INT**	**P**	S D	Float to Integer

	Bit Devices			Word Devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S											*
D											*

Operands:
Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)
— — — —

32-bit command
DINT DINTP

Flag signal: none

Explanation

- **S**: Source device **D**: Operation result
- The binary floating point value in the register **S** is converted to BIN integer and stored inregister **D**. The decimal of the operation result will be left out.
- This instruction is the opposite of the API 49 (FLT) instruction.

Example

- When X0 = 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 X1 = 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.

API					
130	**D**	**SIN**	**P**	Ⓢ Ⓓ	Sine

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Operands:
Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)
— — — —

32-bit command
DSIN DSINP

Flag signal: none

Explanation

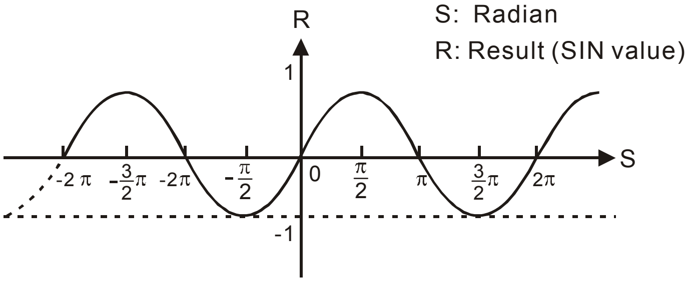
◆ **S**: Source device (0° ≦ **S** < 360°) **D**: Operation result

◆ The value in **S** can be set as radian.

◆ Radian mode. RAD = degree × π /180.

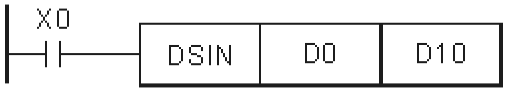
◆ SIN instruction performs sine operation on **S** and stores the result in **D**.

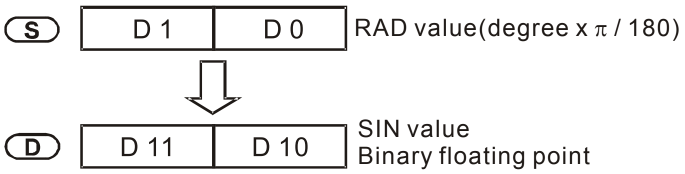
See the figure below for the relation between the radian and the operation result:



Example

◆ When X0 = 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.





API		**COS**		S D	Cosine
131	**D**		**P**		

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Operands:
Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)
— — — —

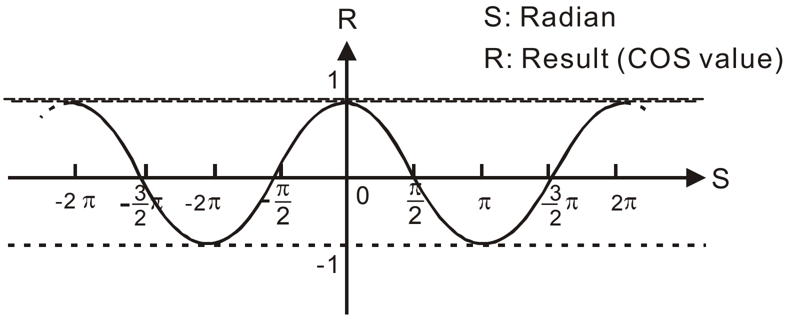
32-bit command
DCOS DCOSP

Flag signal: none

Explanation

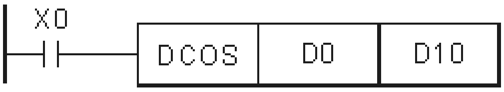
- **S**: Source device (0° ≦ **S** < 360°) **D**: Operation result
- The value in **S** can be set as radian or degree by flag M1018.
- M1018 = OFF, radian mode. RAD = degree ×π/180.
- M1018 = ON, degree mode. Degree range: 0° ≦ degree < 360°.
- If result to 0, M1020 = On.
- COS instruction performs cos operation on **S** and stores the result in **D**

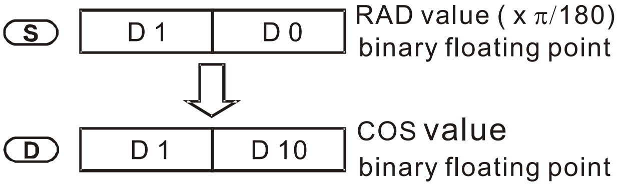
See the figure below for the relation between the radian and the operation result:



Example

- When X0 = ON, DCOS instruction conducts cosine operation on binary floating value in (D1, D0) and stores the COS value in (D11, D10) in binary floating format.





API					
132	D	**TAN**	P	Ⓢ Ⓓ	Tangent

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Operands:
Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)
– – – –

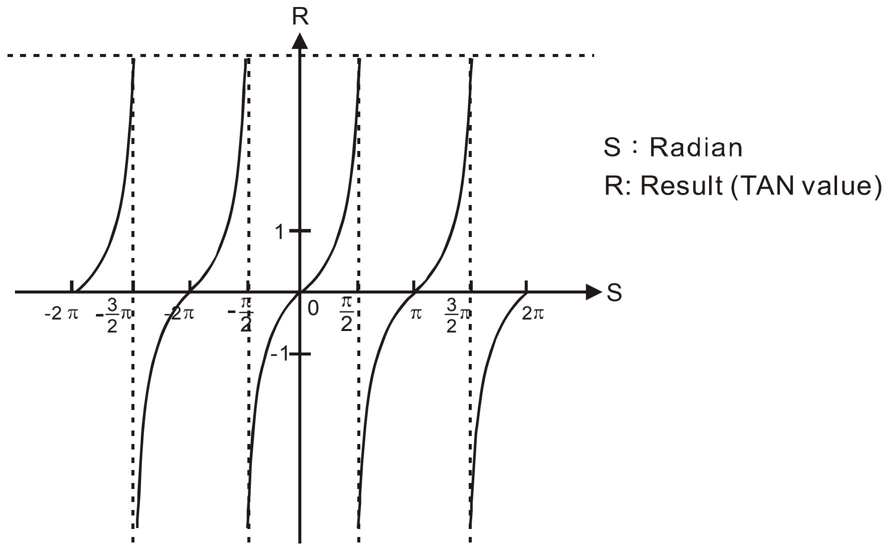
32-bit command
DTAN DTANP

Flag signal: none

Explanation

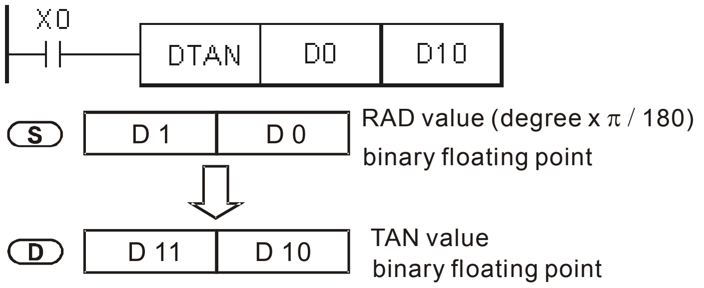
- **S**: Source device (0°≦**S**＜360°) **D**: Operation result
- The value in **S** can be set as radian or degree by flag M1018.
- M1018 = OFF, radian mode. RAD = degree ×π/180.
- M1018 = ON, degree mode. Degree range: 0°≦degree＜360°.
- When the operation result = 0, M1020 = On.
- TAN instruction performs tangent operation on **S** and stores the result in **D.**

See the figure below for the relation between the radian and the operation result



Example

When X0 = 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					
133	**D**	**ASIN**	**P**	Ⓢ Ⓓ	Arc Sine

	Bit Devices			Word Devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				＊	＊						＊
D											＊

Operands:
Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)
— — — —

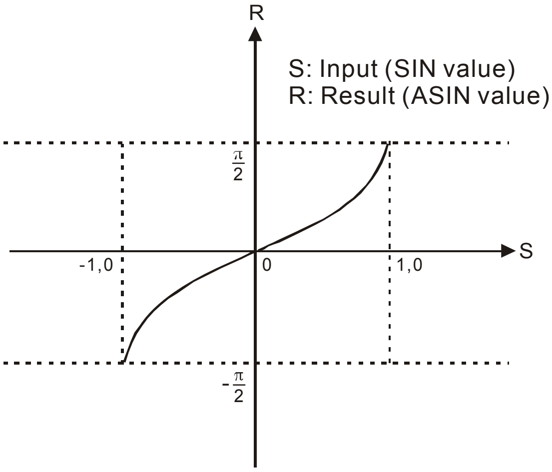
32-bit command
DASIN DASINP

Flag signal: none

Explanation

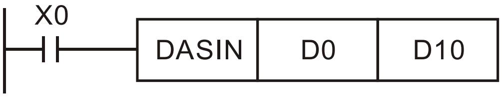
- **S**: Source device (binary floating value) **D**: Operation result
- ASIN value = $\sin^{-1}$

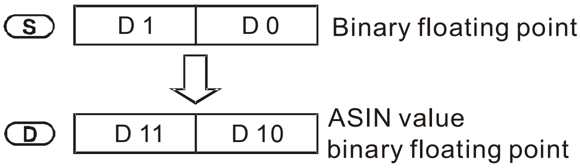
See the figure below for the relation between input **S** and the result:



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..





API					
134	**D**	**ACOS**	**P**	S D	Arc Cosine

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				∗	∗						∗
D											∗

Operands:
Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)
– – – –

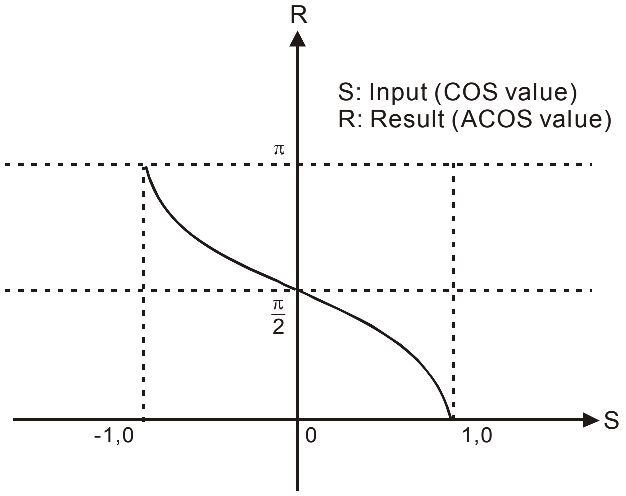
32-bit command
DACOS DACOS P

Flag signal: none

Explanation

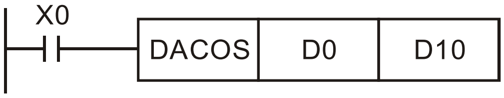
- **S**: Source device (binary floating value) **D**: Operation result
- ACOS value =cos^{-1}

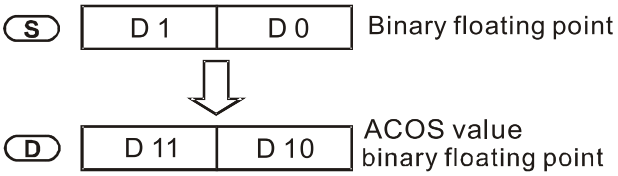
See the figure below for the relation between the input **S** and the result:



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.





API					
135	**D**	**ATAN**	**P**	(S) (D)	Art Tangent

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Operands:
Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)
— — — —

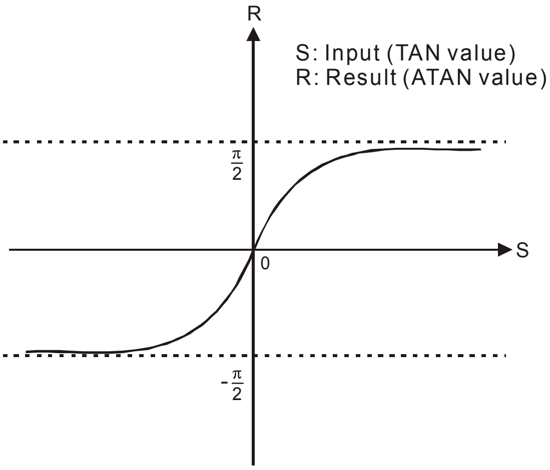
32-bit command
DATAN DATANP

Flag signal: none

Explanation

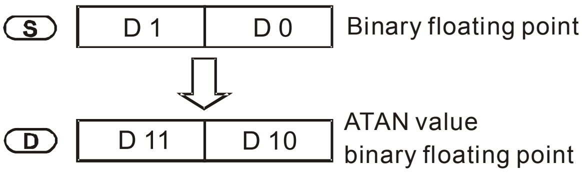
- **S**: Source device (binary floating value) **D**: Operation result
- ATAN value = $\tan^{-1}$

See the figure below for the relation between the input and the result:



Example

When X0 = 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 D	Hyperbolic Sine
136	**D**		**P**		

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Operands:
Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)
– – – –

32-bit command
DSINH DSINHP

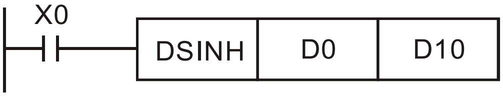
Flag signal: none

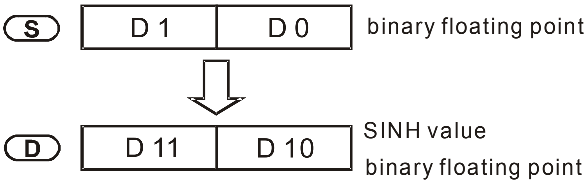
Explanation

- **S**: Specified source (binary floating point) **D**: Area where calculated result is stored
- Sinh value =$(e^{s}-e^{-s})/2$

Example

When X0=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.





API		**COSH**		Ⓢ Ⓓ	Hyperbolic Cosine
137	**D**		**P**		

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Operands:
Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)
– – – –

32-bit command
DCOSH DCOSHP

Flag signal: none

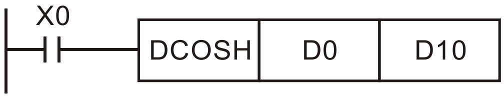
Explanation

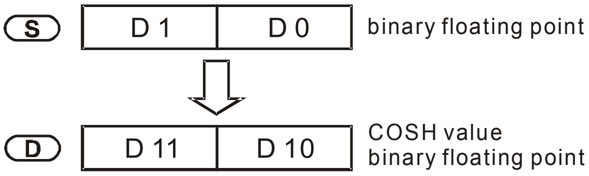
- **S**: Specified source (binary floating point) **D**: Area where calculated result is stored
- cosh value =$(e^{s}+e^{-s})/2$

Example

When X0=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	**D**	**TANH**	**P**	S D	Hyperbolic Tangent

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Operands:
Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)
– – – –

32-bit command
DTANH DTANHP

Flag signal: none

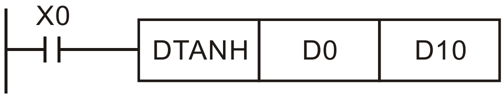
Explanation

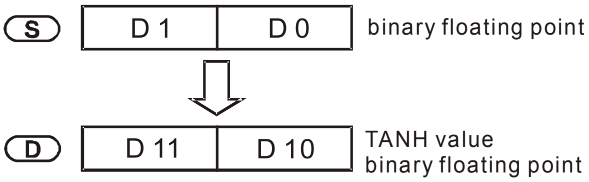
- **S**: Specified source (binary floating point) **D**: Area where calculated result is stored
- Tanh value =$(e^{s}-e^{-s})/(e^{s}+e^{-s})$

Example

When X0=On, specify binary floating point (D1, D0). Calculate ASIN value and save the result in (D11, D10). The

- The result stored in (D11, D10) is all in binary floating point format.





API 160		**TCMP**	**P**	S1 S2 S3 S D	Comaprison of calendar data

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*
S3				*	*	*	*	*	*	*	*
S									*	*	*
D		*	*								

Operands:
Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)
TCMP TCMPP

32-bit command
– – – –

Flag signal: none

Explanation

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)

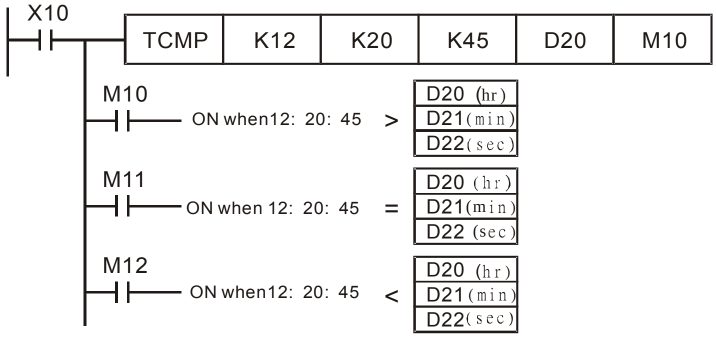
D: Comparison result (occupies 3 continuous devices)

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 **S** and save the comparsion result in **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 **S** is read by using TRD command previously and then compared by using TCMP command. If the content of **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 X10= 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 M10~M12. When X10 goes from On→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 ≧, ≦, ≠ are given.



API 161	**TZCP**	**P**	S1 S2 S D	Comparison of calendar data area

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*
S									*	*	*
D		*	*								

Operands:
Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)
TZCP TZCPP

32-bit command
— — — —

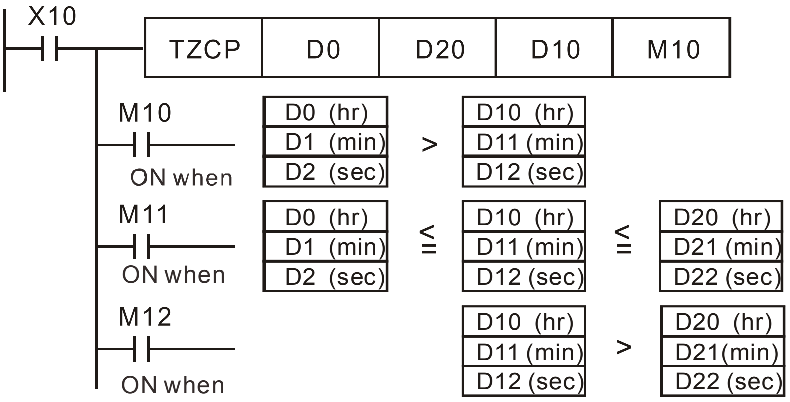
Flag signal: none

Explanation

- **S1**: Lower limit time data **S2**: Upper limit time data **S**: Current time of calendar **D**: Comparison result (occupies 3 continuous devices)
- **S** is compared to the time period of **S1~ S2** and the comparsion result is stored in **D**.
- **S1** , **S1** +1, **S1** +2: respectively represent “Hours”, “Minutes”, “Seconds” of the **lower limit** time data.
- **S2**, **S2** +1, **S2** +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 **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** < **S1**, and if **S** < **S2** , **D** is On. If **S** > $\mathbf{S_1}$ and if **S** > **S2**, **D** +2 is On. Besides these two situations, **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.



API		**TADD**		(S1) (S2) (D)	Calendar data addition
162			**P**		

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1									*	*	*
S2									*	*	*
D									*	*	*

16-bit command (5 STEPS)

TADD TADDP

32-bit command

– – – –

Operands:
Please refer to the specifications of each model for the range of operands.

- Flag signal: M1020 (Zero flag)
  M1022 (Carry flag)
  M1068 (calendar error)

Explanation

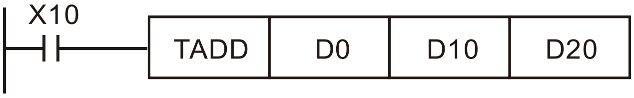
- **S1**: Time augend **S2**: Time addend **D**: Addition result

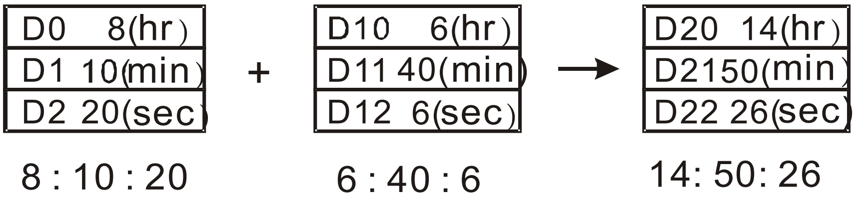
Operand **S1**, **S2**, **D** occupies 3 continuous devices

- **S1** + **S2** = **D**. The time data in the register specified by **S1** is added to the time data in the register specified by **S2** and the addition result is stored in the register specified by **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 addition result is in a value greater than 24 hours, the Carry flag M1022=On. The value of the result shows in **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 X10= 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.





API					
163		**TSUB**	**P**	(S1) (S2) (D)	Calendar data substraction

	Bit Devices			Word Devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1									*	*	*
S2									*	*	*
D									*	*	*

Operands:
Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)
TSUB TSUBP

32-bit command
– – – –

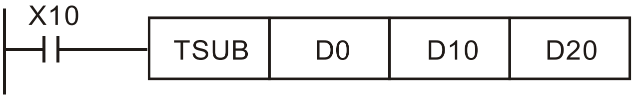
- Flag signal: M1020 (Zero flag)
  M1022 (Carry flag)
  M1068 (calendar error)

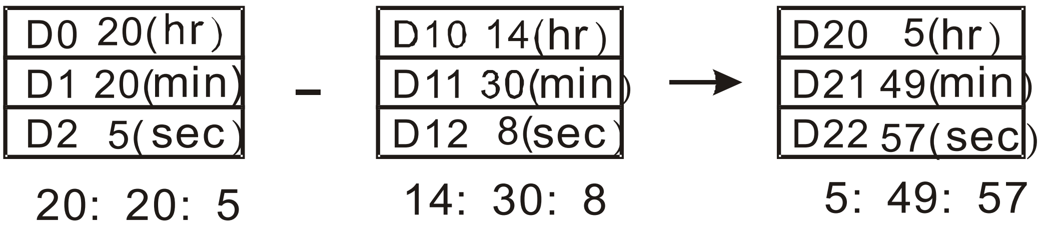
Explanation

- **S1**: Time Minuend **S2**: Time Subtrahend **D**: Subtraction result
Operand **S1**, **S2**, **D** occupies 3 continuous devices.
- 將 **S1** − **S2** = **D**. The time data in the register specified by **S2** is subtracted from the time data in the register specified by **S1** and the result is stored in the register specified by **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 **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.

Example

- When X10= 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.





API		**TRD**		D	Read calendar data
166			**P**		

	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 TSUBP

32-bit command
– – – –

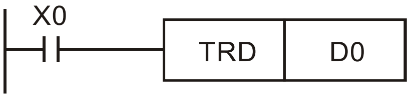
- Flag signal:

Explanation

- **S$_1$**: Time Minuend **S$_2$**: Time Addend **D**: Addition Result
- **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 **D**.
- D1063 reads only the last two digits of an year.

Example

- When X0=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.



special D	Item	content		normal D	Item
D1063	Year	00~99	→	D0	Year
D1064	week	1~7	→	D1	week
D1065	month	1~12	→	D2	month
D1066	day	1~31	→	D3	day
D1067	hour	0~23	→	D4	hour
D1068	minute	0~59	→	D5	minute
D1069	second	0~59	→	D6	second

API 170	GRY	P	(S) (D)	BIN→GRAY Code

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Operands:
Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)
GRY GRYP

32-bit command
DGRY DGRYP

- Flag signal: none

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 **D**.

- The range of **S** that can be converted to the GRAY CODE is shown as follows:

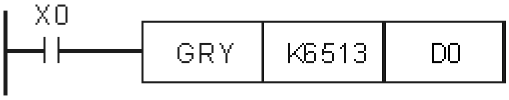
16-bit command：0~32,767

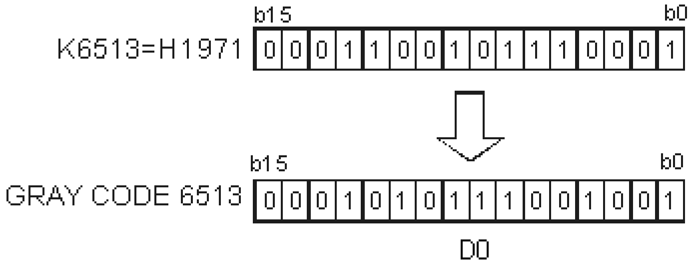
32-bit command：0~2,147,483,647

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

◆ When X0=On, constant K 6513 is converted to the GRAY CODE and stored in the D0.





	b15															b0
K6513=H1971	0	0	0	1	1	0	0	1	0	1	1	1	0	0	0	1
GRAY CODE 6513	0	0	0	1	0	1	0	1	1	1	0	0	1	0	0	1

API		GBIN		Ⓢ Ⓓ	GRAY Code→BIN
171			**P**		

	Bit Devices			Word Devices								16-bit command (5 STEPS) GBIN GBINP
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D	
S				*	*	*	*	*	*	*	*	32-bit command DGBIN DGBINP
D							*	*	*	*	*	
Operands: Please refer to the specifications of each model for the range of operands.												• Flag signal: none

Explanation

- **S**: Source GRAY CODE **D**: Destination which stores converted BIN result
- The GRAY CODE value in the specified device by **S** is converted to the BIN value equivalent and the converted result is stored in the area specified by **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 **S** that can be converted to the GRAY CODE is shown as follows:

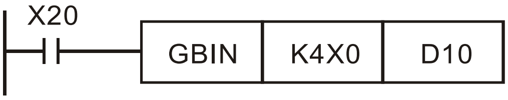
16-bit command：0~32,767

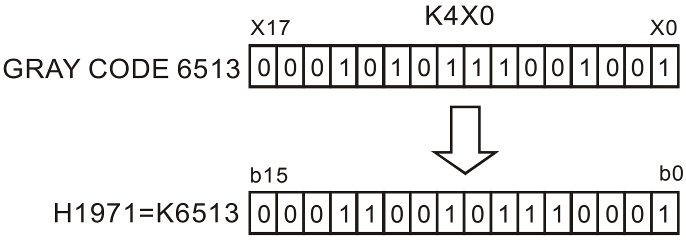
32-bit command：0~2,147,483,647

If the GRAY CODE value is outside the range shown above, it is determined as "Operation Error".

Example

◆ 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.





API					
215~ 217	**D**	**LD#**		(S1) (S2)	Contact Logical Operation LD#

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*

Operands: #: &, |, ^

Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)

LD# ZRSTP

32-bit command (9 STEPS)

DLD# — — —

Flag signal: none

Explanation

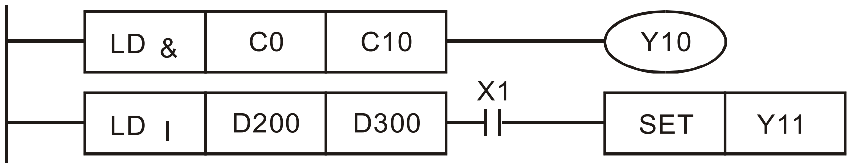
1. **S_1**: Data source device 1 **S_2**: Data source device 2
2. This instruction compares the content in **S_1** and **S_2**. If the result is not “0”, the continuity of the instruction is enabled. If the result is “0”, the continuity of the instruction is disabled.
3. LD# (**#:** &, |, ^) instruction is used for direct connection with BUS.

API No.	16 -bit instruction	32 -bit instruction	Continuity condition	No-continuity condition
215	LD&	**D**LD&	**S_1** & **S_2** $\neq 0$	**S_1** & **S_2** $= 0$
216	LD|	**D**LD|	**S_1** | **S_2** $\neq 0$	**S_1** | **S_2** $= 0$
217	LD^	**D**LD^	**S_1** ^ **S_2** $\neq 0$	**S_1** ^ **S_2** $= 0$

4. **&:** Logical “AND” operation
5. **|:** Logical “OR” operation
6. **^:** Logical “XOR” operation

Example

1. When the result of logical AND operation of C0 and C10 ≠ 0, Y10 = On.
2. When the result of logical OR operation of D200 and D300 ≠ 0 and X1 = On, Y11 = On will be retained.



API					
218~ 220	**D**	**AND#**		(S1) (S2)	Contact Logical Operation AND#

	Bit Devices			Word Devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*

Operands: #: &, |, ^

Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)

AND# ZRSTP

32-bit command (9 STEPS)

DAND# — — —

Flag signal: none

Explanation

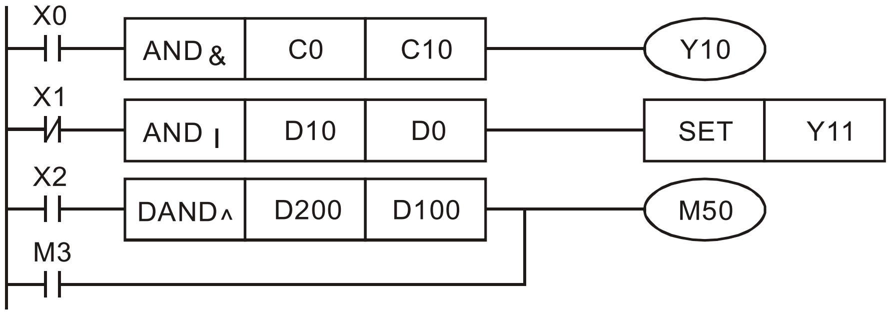
1. **S_1**: Data source device 1 **S_2**: Data source device 2
2. This instruction compares the content in **S_1** and **S_2**. If the result is not “0”, the continuity of the instruction is enabled. If the result is “0”, the continuity of the instruction is disabled.
3. AND# (**#:** &, |, ^) is an operation instruction used on series contacts.

API No.	16 -bit instruction	32 -bit instruction	Continuity condition	No-continuity condition
218	AND&	**D**AND&	**S_1** & **S_2** $\neq 0$	**S_1** & **S_2** $=0$
219	AND|	**D**AND|	**S_1** | **S_2** $\neq 0$	**S_1** | **S_2** $=0$
220	AND^	**D**AND^	**S_1** ^ **S_2** $\neq 0$	**S_1** ^ **S_2** $=0$

4. **&:** Logical “AND” operation
5. **|:** Logical “OR” operation
6. **^:** Logical “XOR” operation

Example

1. When X0 = On and the result of logical AND operation of C0 and C10 ≠ 0, Y10 = On.
2. When X1 = Off and the result of logical OR operation of D10 and D0 ≠ 0 and X1 = On, Y11 = On will be retained.
3. When X2 = On and the result of logical XOR operation of 32-bit register D200 (D201) and 32-bit register D100 (D101) ≠ 0 or M3 = On, M50 = On.



API					
221~ 223	**D**	**OR#**		(S1) (S2)	Contact Logical operation OR#

	Bit Devices			Word Devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*

Operand: #: &, |, ^

Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)

OR# ZRSTP

32-bit command (9 STEPS)

DOR# — — —

Flag signal: none

Explanation

1. S_1: Data source device 1 S_2: Data source device 2
2. This instruction compares the content in S_1 and 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. OR# (**#:** &, |, ^) is an operation instruction used on parallel contacts.

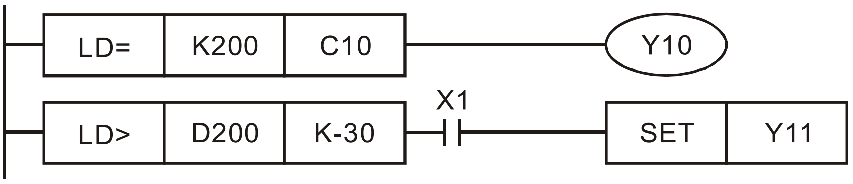
API No.	16 -bit instruction	32 -bit instruction	Continuity condition	No-continuity condition
221	OR&	**D**OR&	S_1 & S_2 $\neq 0$	S_1 & S_2 $=0$
222	OR|	**D**OR|	S_1 | S_2 $\neq 0$	S_1 | S_2 $=0$
223	OR^	**D**OR^	S_1 ^ S_2 $\neq 0$	S_1 ^ S_2 $=0$

4. **&:** Logical "AND" operation
5. **|:** Logical "OR" operation
6. **^:** Logical "XOR" operation

Example

When X1 = On and the result of logical AND operation of C0 and C10 ≠ 0, Y10 = On.

2. M60 will be On, if X2 and M30 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.



API					
224~ 230	**D**	**LD※**		S1 S2	Load Compare※

	Bit Devices			Word Devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*

Operands: ※: =, >, <, <>,≦,≧

Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)

LD※	ZRSTP

32 bits command (9 STEPS)

DLD※	—	—	—

Flag signal: none

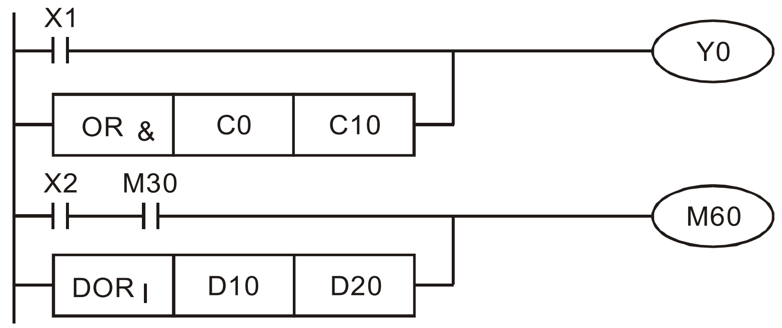
Explanation

1. **S_1**: Data source device 1 **S_2**: Data source device 2
2. This instruction compares the content in **S_1** and **S_2**. Take API224 (LD=) for example, if the result is "=", the continuity of the instruction is enabled. If the result is "≠", the continuity of the instruction is disabled.
3. LD※ (**※:** =, >, <, <>, ≤, ≥) instruction is used for direct connection with BUS.

API No.	16 -bit instruction	32 -bit instruction	Continuity condition	No-continuity condition
224	LD=	**D**LD=	$S_1 = S_2$	$S_1 \neq S_2$
225	LD>	**D**LD>	$S_1 > S_2$	$S_1 \leqq S_2$
226	LD<	**D**LD<	$S_1 < S_2$	$S_1 \geqq S_2$
228	LD<>	**D**LD<>	$S_1 \neq S_2$	$S_1 = S_2$
229	LD<=	**D**LD<=	$S_1 \leqq S_2$	$S_1 > S_2$
230	LD>=	**D**LD>=	$S_1 \geqq S_2$	$S_1 < S_2$

Example

1. When the content in C10 = K200, Y10 = On.
2. When the content in D200 > K-30 and X1 = On, Y11= On will be retained.



API					
232~ 238	**D**	**AND※**		(S1) (S2)	AND Compare※

	Bit Devices			Word Devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*

Operands: ※: =, >, <, <>,≦,≧

Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)

AND※ ZRSTP

32-bit command (9 STEPS)

DAND※ — — —

Flag signal: none

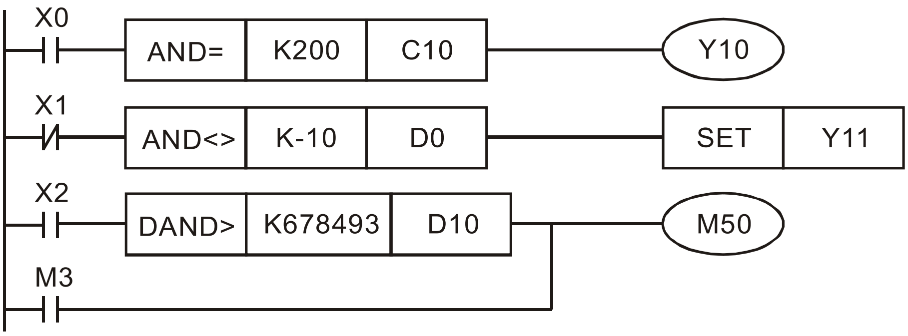
Explanation

1. **S_1**: Data source device 1 **S_2**: Data source device 2
2. This instruction compares the content in **S_1** and **S_2**. Take API232 (AND=) for example, if the result is "=", the continuity of the instruction is enabled. If the result is "≠", the continuity of the instruction is disabled.
3. AND※ (**※:** =, >, <, <>, ≤, ≥) is a comparison instruction is used on series contacts

API No.	16 –bit instruction	32 –bit instruction	Continuity condition	No-continuity condition
232	AND＝	**D**AND＝	**S_1 ＝ S_2**	**$S_1 \neq S_2$**
233	AND＞	**D**AND＞	**S_1 ＞ S_2**	**S_1 ≦ S_2**
234	AND＜	**D**AND＜	**S_1 ＜ S_2**	**S_1 ≧ S_2**
236	AND＜＞	**D**AND＜＞	**$S_1 \neq S_2$**	**S_1 ＝ S_2**
237	AND＜＝	**D**AND＜＝	**S_1 ≦ S_2**	**S_1 ＞ S_2**
238	AND＞＝	**D**AND＞＝	**S_1 ≧ S_2**	**S_1 ＜ S_2**

Example

1. When X0 = On and the content in C10 = K200, Y10 = On.
2. When X1 = Off and the content in D0 ≠ K-10, Y11= On will be retained.
3. When X2 = On and the content in 32-bit register D0 (D11) < 678,493 or M3 = On, M50 = On.



API					
240~ 246	D	**OR※**		(S1) (S2)	OR Compare※

	Bit Devices			Word Devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*

Operands: ※: =, >, <, <>, ≦, ≧

Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)

OR※ ZRSTP

32-bit command (9 STEPS)

DOR※ — — —

Flag signal: none

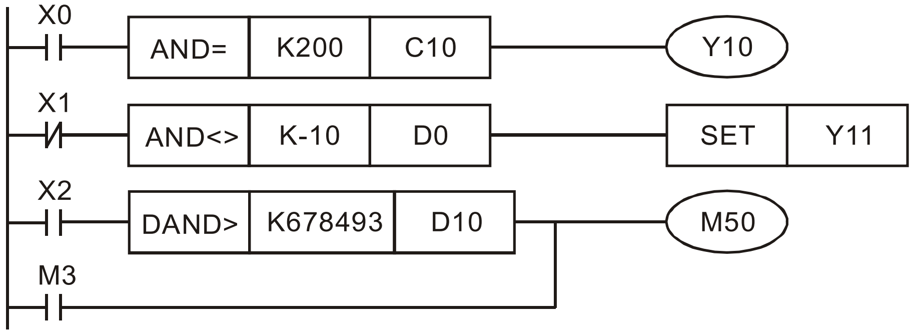
Explanation

1. **S_1**: Data source device 1 **S_2**: Data source device 2
2. This instruction compares the content in **S_1** and **S_2**. Take API240 (OR=) for example, if the result is "=", the continuity of the instruction is enabled. If the result is "≠", the continuity of the instruction is disabled.
3. OR※ (**※:** =, >, <, <>, ≤, ≥) is an comparison instruction used on parallel contacts.

API No.	16 -bit instruction	32 -bit instruction	Continuity condition	No-continuity condition
232	AND＝	**D**AND＝	**$S_1 = S_2$**	**$S_1 \neq S_2$**
233	AND＞	**D**AND＞	**$S_1 > S_2$**	**$S_1 \leqq S_2$**
234	AND＜	**D**AND＜	**$S_1 < S_2$**	**$S_1 \geqq S_2$**
236	AND＜＞	**D**AND＜＞	**$S_1 \neq S_2$**	**$S_1 = S_2$**
237	AND＜＝	**D**AND＜＝	**$S_1 \leqq S_2$**	**$S_1 > S_2$**
238	AND＞＝	**D**AND＞＝	**$S_1 \geqq S_2$**	**$S_1 < S_2$**

Example

1. When X1 = On and the present value of C10 = K200, Y0 = On.
2. When X1 = Off and the content in D0 ≠ K-10, Y11= On will be retained.
3. M50 will be On when X2=On and the content of 32-bit register D0(D11) <678,493 or M3= On.



API			
275~ 280	**FLD※**	S1 S2	Floating Point Contact Type Comparison LD※

	Bit Devices			Word Devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1									*	*	*
S2									*	*	*

Operand: ＃: &, |, ^

Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)

– – – –

32-bit command (9 STEPS)

FLD※ – – –

Flag signal: none

Explanation

◆ **S1**: Source device 1 **S2**: Source device 2

◆ This instruction compares the content in **S₁** and **S₂**. Take "FLD=" for example, if the result is "=",the continuity of the instruction is enabled. If the result is "≠", the continuity of the instruction is disabled.

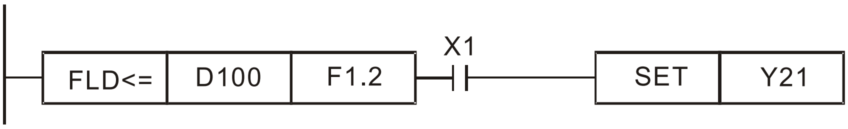
◆ The user can specify the floating point value directly into operands **S1** and **S2** (e.g. F1.2) or store the floating point value in D registers for further operation.

◆ FLD※ instruction is used for direct connection with left hand bus bar.

API No.	32-bit instruction	Continuity condition	Discontinuity condition
275	FLD＝	$S_1 = S_2$	$S_1 \neq S_2$
276	FLD＞	$S_1 > S_2$	$S_1 \leqq S_2$
277	FLD＜	$S_1 < S_2$	$S_1 \geqq S_2$
278	FLD＜＞	$S_1 \neq S_2$	$S_1 = S_2$
279	FLD＜＝	$S_1 \leqq S_2$	$S_1 > S_2$
280	FLD＞＝	$S_1 \geqq S_2$	$S_1 < S_2$

Example

◆ When the content in D100(D101) ≤ F1.2 and X1 is ON, Y21 = ON and latched.



API				
281~ 286	**FAND※**		(S1) (S2)	Floating Point Contact Type Comparison AND※

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1									∗	∗	∗
S2									∗	∗	∗

Operand: ＃: &, |, ^

Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)

– – – –

32-bit command (9 STEPS)

FAND※ – – –

Flag signal: none

Explanation

◆ **S1**: Source device 1 **S2**: Source device 2

◆ This instruction compares the content in **S1** and **S2**. Take "FAND =" for example, if the result is "=", the continuity of the instruction is enabled. If the result is "≠", the continuity of the instruction is disabled.

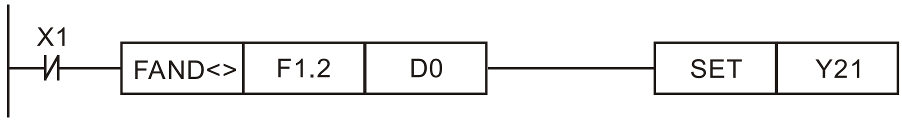
◆ The user can specify the floating point value directly into operands **S1** and **S2** (e.g. F1.2) or store the floating point value in D registers for further operation.

◆ FAND※ instruction is used for serial connection with contacts

API No.	32-bit instruction	Continuity condition	Discontinuity condition
281	FAND＝	$S_1 = S_2$	$S_1 \neq S_2$
282	FAND＞	$S_1 > S_2$	$S_1 \leqq S_2$
283	FAND＜	$S_1 < S_2$	$S_1 \geqq S_2$
284	FAND＜＞	$S_1 \neq S_2$	$S_1 = S_2$
285	FAND＜＝	$S_1 \leqq S_2$	$S_1 > S_2$
286	FAND＞＝	$S_1 \geqq S_2$	$S_1 < S_2$

Example

◆ When X1 is OFF and the content in D100(D101) is not equal to F1.2, Y21 = ON and latched.



API			
287~ 292	**FOR※**	(S1) (S2)	Floating Point Contact Type Comparison OR※

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1									*	*	*
S2									*	*	*

Operand: ＃: &, |, ^

Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)

– – – –

32-bit command (9 STEPS)

FOR※ – – –

Flag signal: none

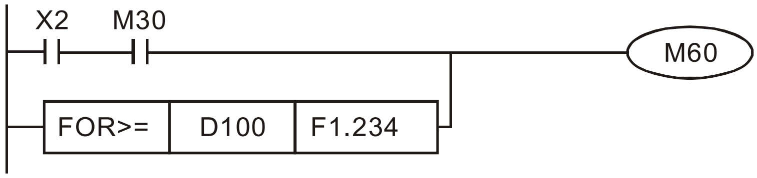
Explanation

- **S1**: Source device 1 **S2**: Source device 2
- This instruction compares the content in **S1** and **S2**. Take “FOR =” for example, if the result is “=”, the continuity of the instruction is enabled. If the result is “≠”, 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 condition
287	FOR＝	$S_1 = S_2$	$S_1 \neq S_2$
288	FOR＞	$S_1 > S_2$	$S_1 \leqq S_2$
289	FOR＜	$S_1 < S_2$	$S_1 \geqq S_2$
290	FOR＜＞	$S_1 \neq S_2$	$S_1 = S_2$
291	FOR＜＝	$S_1 \leqq S_2$	$S_1 > S_2$
292	FOR＞＝	$S_1 \geqq S_2$	$S_1 < S_2$

Example

- When both X2 and M30 are On and the content in D100(D101) ≥ F1.234, M60 = ON..



16.6.5 Description to drive's special commands

API					
139		**RPR**	**P**	(S1) (S2)	Read the AC motor drive's parameters

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				∗	∗						∗
S_2											∗

Operands: none

16-bit command (5 STEPS)
RPR RPRP

32-bit command
— — — —

Flag signal: none

Explanation **S_1**: Data address for reading **S_2**: The register that saves the read data

API					
140		**WPR**	**P**	(S1) (S2)	Write the AC motor drive's parameters

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				∗	∗						∗
S_2				∗	∗						∗

Operands: None

16-bit command (5 STEPS)
WPR WPRP

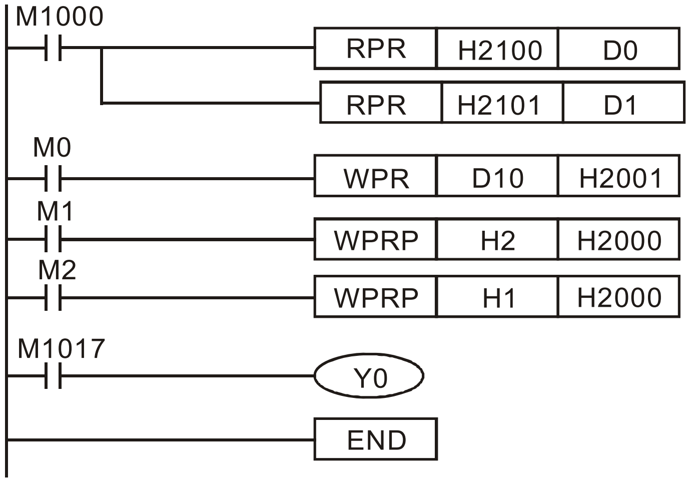
32-bit command
— — — —

Flag signal: none

Explanation **S_1**: The data for writing. **S_2**: The parameters address for the write data.

Example

1. It will read the data in parameter H2100 of the C2000 and write into D0; H2101 is read and write into D1.
2. When M0= ON data in D10 will be written into Pr. H2001 of C2000.
3. When M1=ON, data in H2 will be written into Pr. H2001 of C2000, which is to activate the AC motor drive.
4. When M2=ON, data in H1 will be written into H2000 of C2000, which is to stop the AC motor drive.
5. When data writing successfully, M1017 will be on.



API		**FPID**		(S1) (S2) (S3) (S4)	PID control for the AC motor drive
141			**P**		

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*						*
S_2				*	*						*
S_3				*	*						*
S_4				*	*						*

Operands: None

16-bit command (9 STEPS)

FPID FPIDP

32-bit command

— — — —

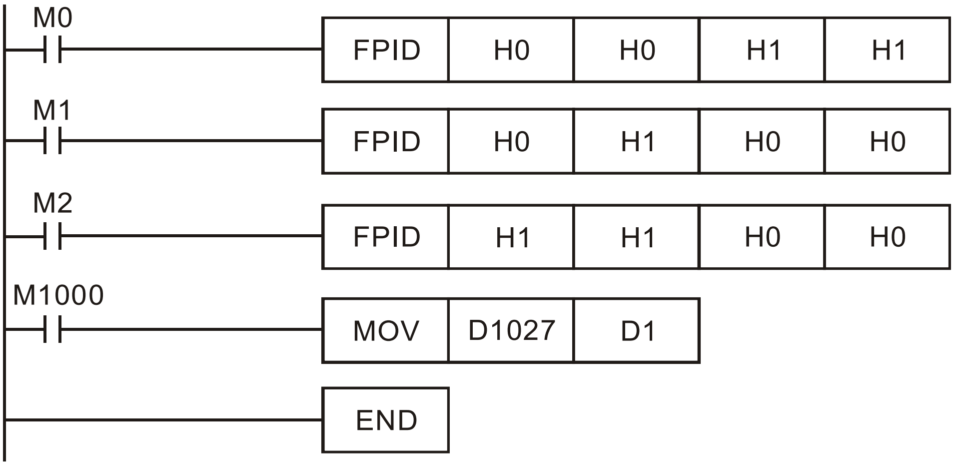
Flag signal: None

Explanation

1. **S_1**: PID Feedback Selection(0-6 acc.to Pr.08-00), **S_2**: Proportional Gain P, **S_3**: Integral Time I, **S_4**: 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)

Example

1. Assume that when M0=ON, **S_1** is set to 0 (PID function is disabled), **S_2**=0, **S_3**=1 (unit: 0.01 seconds) and **S_4**=1 (unit: 0.01 seconds).
2. Assume that when M1=ON, **S_1** is set to 0 (PID function is disabled), **S_2**=1 (unit: 0.01), **S_3**=0 and **S_4**=0.
3. Assume that when M2=ON, **S_1** is set to 1(frequency is inputted by digital keypad), **S_2**=1 (unit: 0.01), **S_3**=0 and **S_4**=0.
4. D1027: frequency command after PID calculation.



API		**FREQ**		(S1) (S2) (S3)	Operation control of the AC motor drive
142			**P**		

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S₁				*	*						*
S₂				*	*						*
S₃				*	*						*
Operands: None											

16-bit command (7 STEPS)
FREQ FREQP

32-bit command
— — — —

Flag signal: M1028

Explanation

1. **S_1**: frequency command, **S_2**: acceleration time, (Pr01-12) **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”

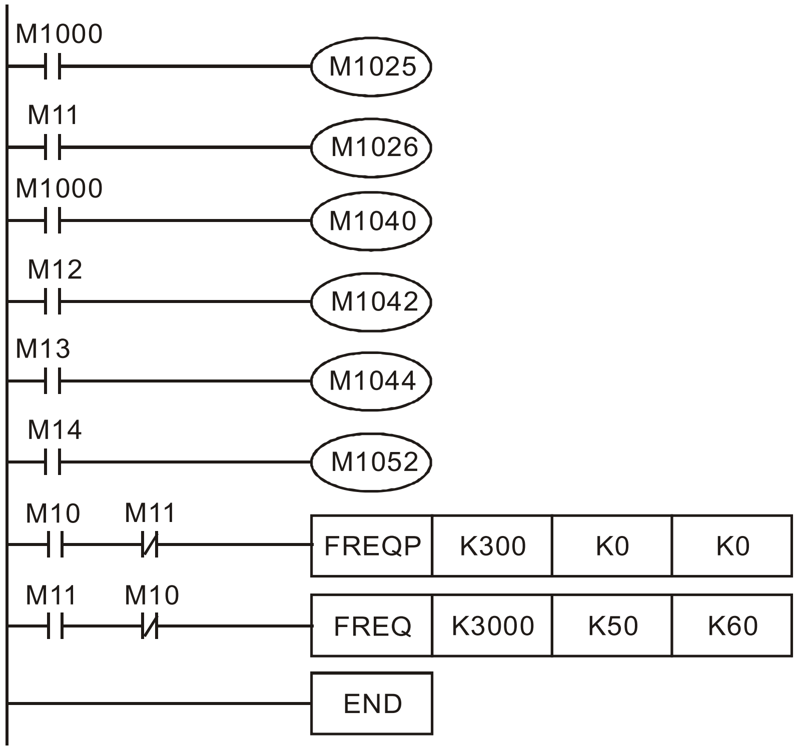
   The S2 of below Ladder diagram is set as 50 and it means acceleration is 0.5 second.

   The S3 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 0Hz.

Example

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 M10=ON, setting frequency command of the AC motor drive to K300(3.00Hz) and acceleration/deceleration time is 0.
3. When M11=ON, setting frequency command of the AC motor drive to K3000(30.00Hz), acceleration time is 50 and deceleration time is 60.



API 263	**TORQ**	**P**	(S1) (S2)	Torque Control of AC Motor Drive

	Bit Devices			Word Devices								16-bit command (7 STEPS)
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D	TORQ TORQ P
S_1				*	*						*	32-bit command
S_2				*	*						*	– – – –
Operands: None												Flag signal: M1063

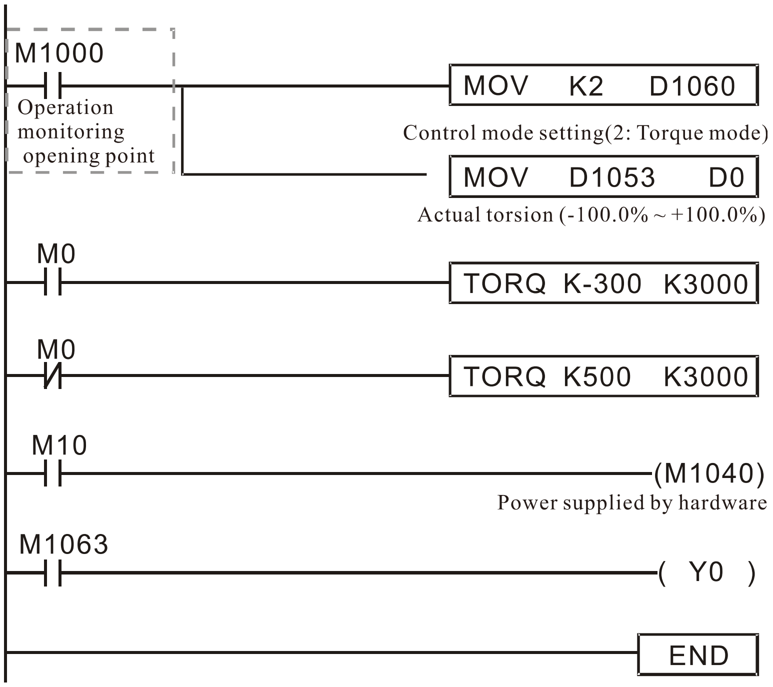
Explanation

1. **S_1**: torque command (display in signed decimal with one decimal place)
   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.

Example

1. M1040: control Servo On(On)/ Servo Off(Off). M1063: target torque attained. D1060: control mode setting. D1053: actual torque.
2. When M0=Off, setting torque command of the AC motor drive to K+300(+30.0%) and speed limit to 3000(30Hz).
3. When M0=On, setting torque command of AC motor drive to K-300(-30.0%) and speed limit to 3000(30Hz)。
4. When M10=On, AC motor drive begins to execute torque command.
5. When target torque is attained, M1063 will switch ON and flag signal will be blinking.



API 262	**DPOS**	**P**	(S1)	Point to Point Position Control of AC Motor Drive

	Bit Devices			**Word Devices**							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*						*

Operands: None

16-bit command (7 STEPS)
– – – –

32-bit command (5 steps)
DPOS DPOSP

Flag signal: M1064, M1070

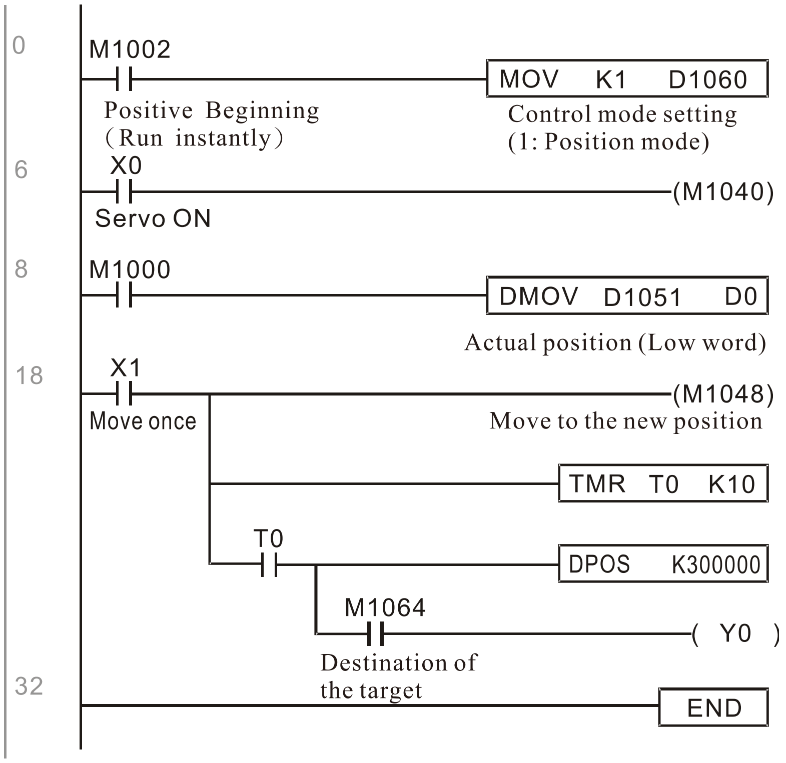
Explanation

- **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.

Example

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 X0=On, setting M1040 to ON (Servo On).
3. When X1=On, 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					
261		**CANRX**	**P**	(S1) (S2) (S3) (D)	Read CANopen slave data

	Bit Devices			Word Devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*						
S_2				*	*						
S_3				*	*						
D									*	*	*

Operand: none

16-bit command (7 STEPS)

FREQ FREQP

32-bit command

— — — —

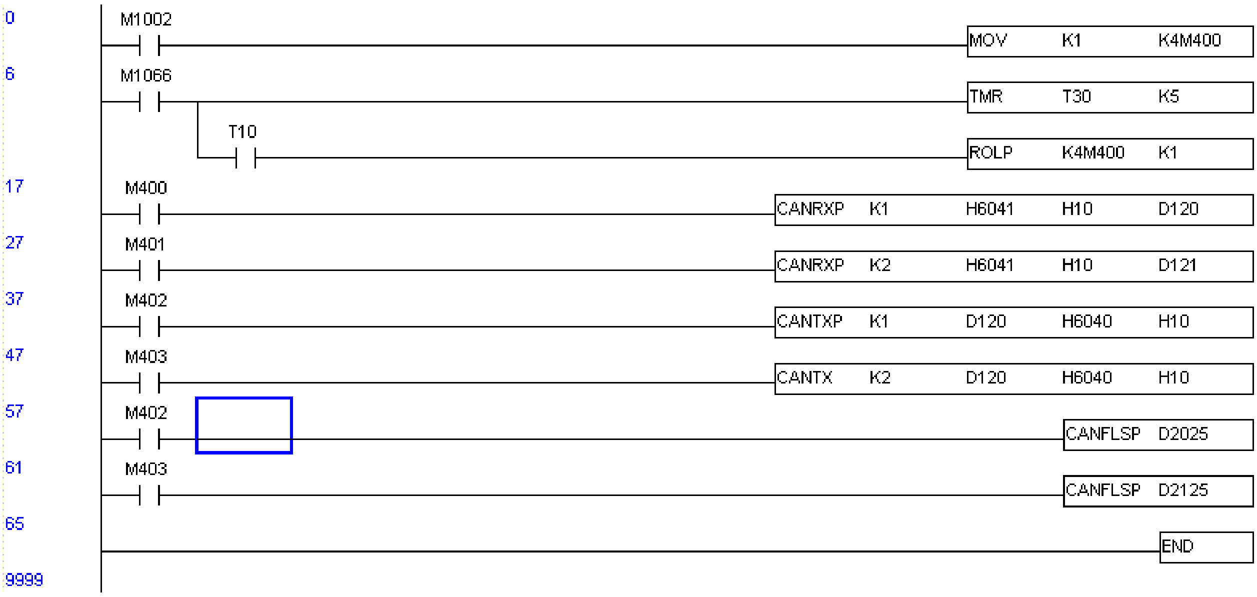
Flag signal: M1028

Explanation

1. **S_1**: Slave station number, **S_2**: main index, **S_3**: sub-index + bit length, **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		**CANTX**		(S1) (S2) (S3) (S4)	Write CANopen slave data
264			**P**		

	Bit Devices			**Word Devices**								16-bit command (7 STEPS) FREQ FREQP
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D	
S_1				∗	∗							
S_2				∗	∗				∗	∗	∗	32-bit command — — — —
S_3				∗	∗							
S_4				∗	∗							Flag signal: M1028
Operands: None												

Explanation

1. **S_1**: slave station number, **S_2**: the address to write, **S_3**: main index, **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 M1067 is now set to 1. However, if the slave replied an inaccurate response, this error message will be recorded in D1076~D1079.

API					
265		**CANFLS**	**P**	D	Update the mapping special D of CANopen

	Bit Devices			Word Devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D				*	*						

Operands: None

16-bit command (7 STEPS)

FREQ FREQP

32-bit command

— — — —

Flag signal: M1028

Explanation

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 M1067 will be 0 and this error message will be recorded to D1076~D1079.

API					
320	**D**	**ICOMR**	**P**	S1 S2 S3 D	Internal Communication Reader

	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

Explanation

S1 slave station number S2 : Device chosen (0: AC motor drive 1: Internal PLC) 。

S3: Reading address

D: Saving device

- The ICOMR command can read the register of the AC motor drive and that of internal PLC from slave station.

API					
321	**D**	**ICOMW**	**P**	(S1) (S2) (S3) (D)	Internal Communication Writer

	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 ICOMRP

32-bit command

DICOMR DICOMRP

Flag signal: M1077 M1078 M1079

Explanation

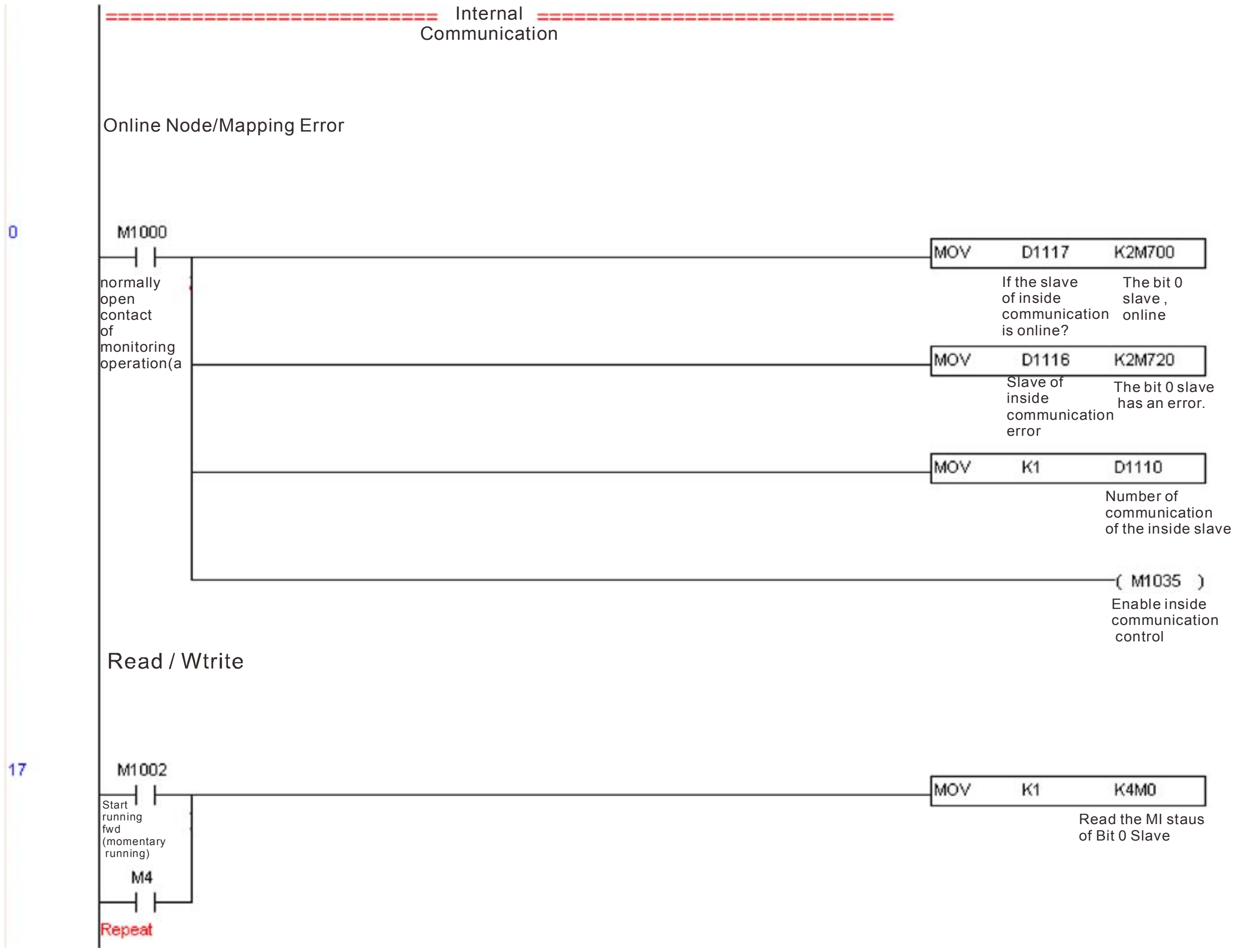
(S1): Slave station number (S2) Device chosen (0: AC motor drive., 1: Internal PLC)

(S3): Reading address

(D): Saving device

- 此指令 ICOMW 可以寫值到從站的變頻器和所內置 PLC 的暫存器值 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.)

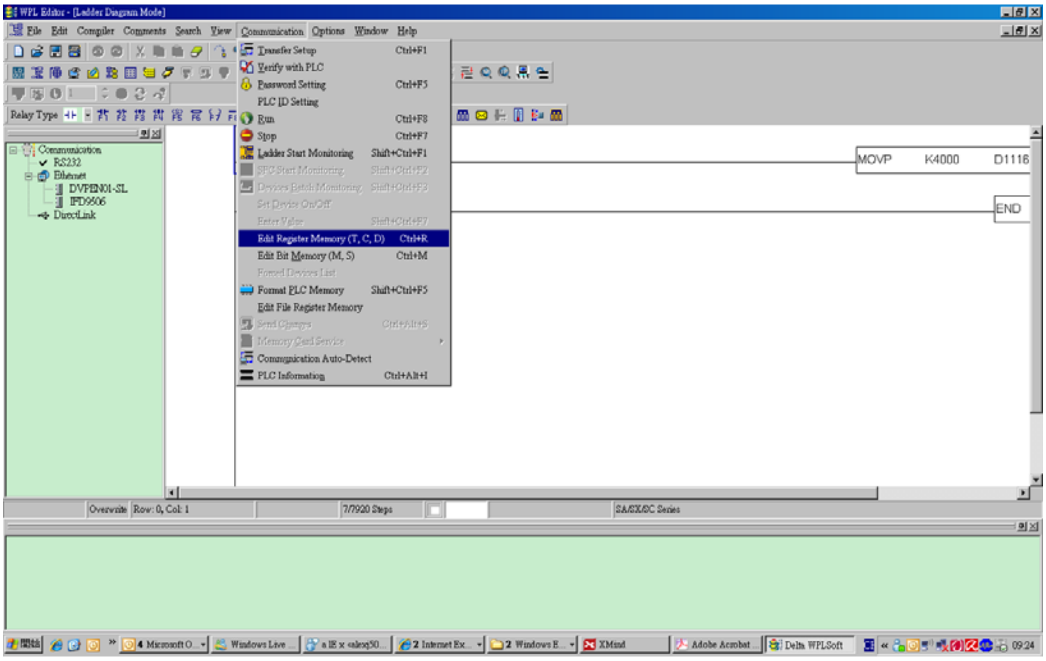
Step 2: Configuration of the Special D in Master

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.

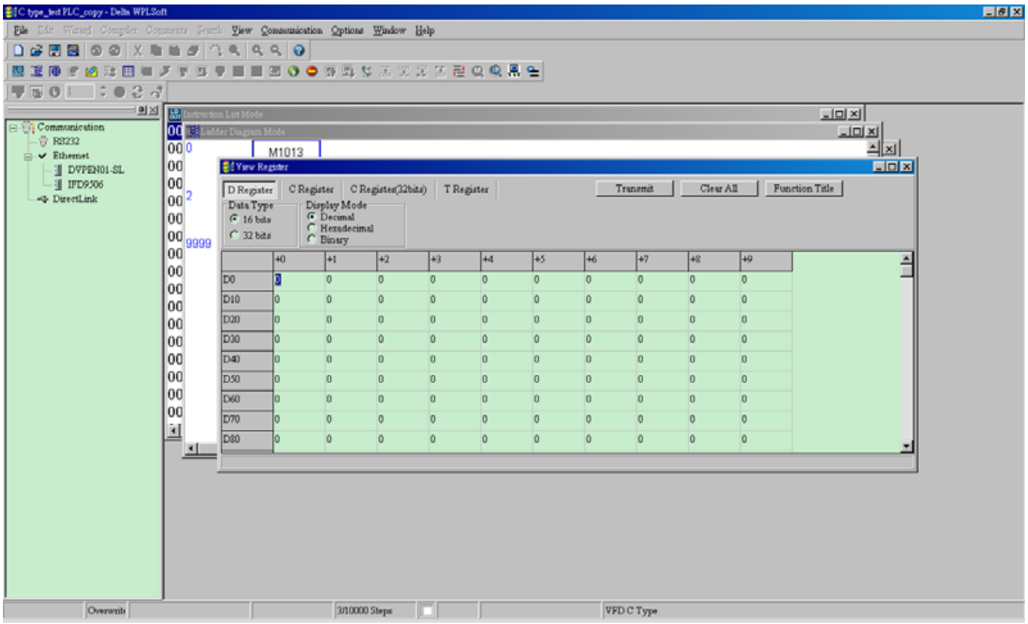
1. When communication cable 485 is connected, set PLC status to “stop” by WPL soft. (If PLC had already switched to “PLC Stop” mode then PLC status should be “stop” already.)

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”.



	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9
D0	0	0	0	0	0	0	0	0	0	0
D10	0	0	0	0	0	0	0	0	0	0
D20	0	0	0	0	0	0	0	0	0	0
D30	0	0	0	0	0	0	0	0	0	0
D40	0	0	0	0	0	0	0	0	0	0
D50	0	0	0	0	0	0	0	0	0	0
D60	0	0	0	0	0	0	0	0	0	0
D70	0	0	0	0	0	0	0	0	0	0
D80	0	0	0	0	0	0	0	0	0	0

- 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:

   ☑ **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 8~11 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 ~ 12	11	10 ~ 8	7	6 ~ 4	3	2 ~ 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 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 0x0A00.

- 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 ~ 12	11	10 ~ 8	7	6 ~ 4	3	2 ~ 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 0x0A00.

In same theory, to perform torque control, please enable the mapping function PDO4.

☑ The speed for 1 corresponding cycle is 8ms. (When shorten the cycle time to **<** 8ms, 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.

$\boxed{N = (1 \text{ cycle (ms)} * \text{rate (kbs)})/250}$

Example: 1 cycle is 2ms, speed= 1000k, max PDO value is 2*1000/250 = 8. If user wants to set the cycle time to 2ms, 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 ≤ 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.

☑ 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 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, 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.

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:

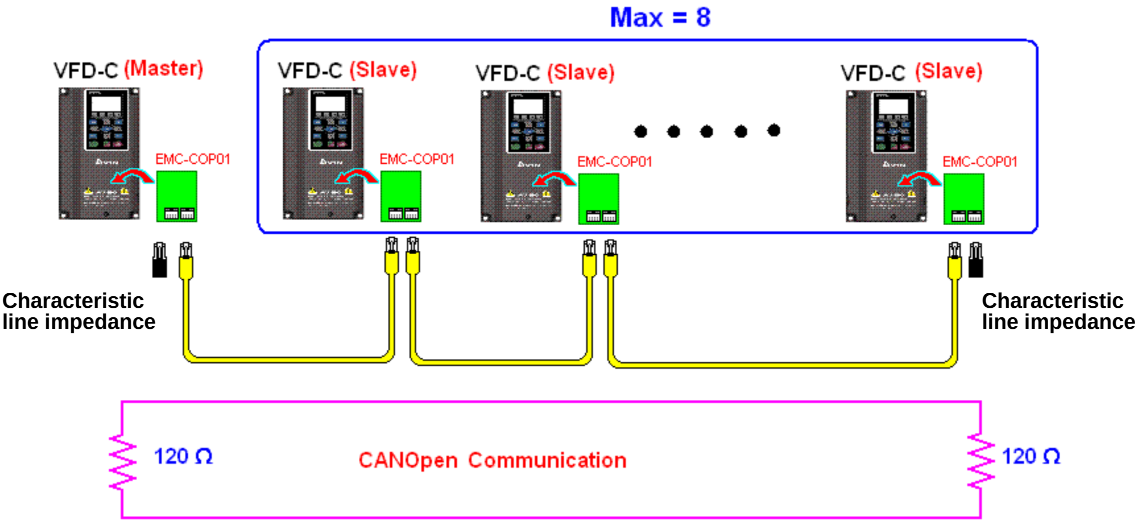
	Corresponding Parameter of Drive		Value	Definition
	C2000	E-C		
Slave address	09-36	09-20	0	Disable CANopen Hardware Interface
			1~127	CANopen communication address
CANopen speed	09-37	09-21	0	1M
			1	500K
			2	250K
			3	125K
			4	100K
			5	50K
Source of operation command	00-21		3	
		02-01	5	
Source 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 Parameter of Drive	Value	Definition
	A2		
Slave address	03-00	1~127	CANopen communication address
CANopen speed	bit8~11 of Pr.03-01 XRXX	R= 0	125K
		R= 1	250K
		R= 2	500K
		R= 3	750K
		R= 4	1M
Control/Command Source	01-01	B	

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.)

☑ 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

☑ Set D2100, 2200, 2300 2400 2500 2600 2700=0

☑ Download D2000~D2799 setting

Step 3: Set up Master station number and communication speed

☑ 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.

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**)**

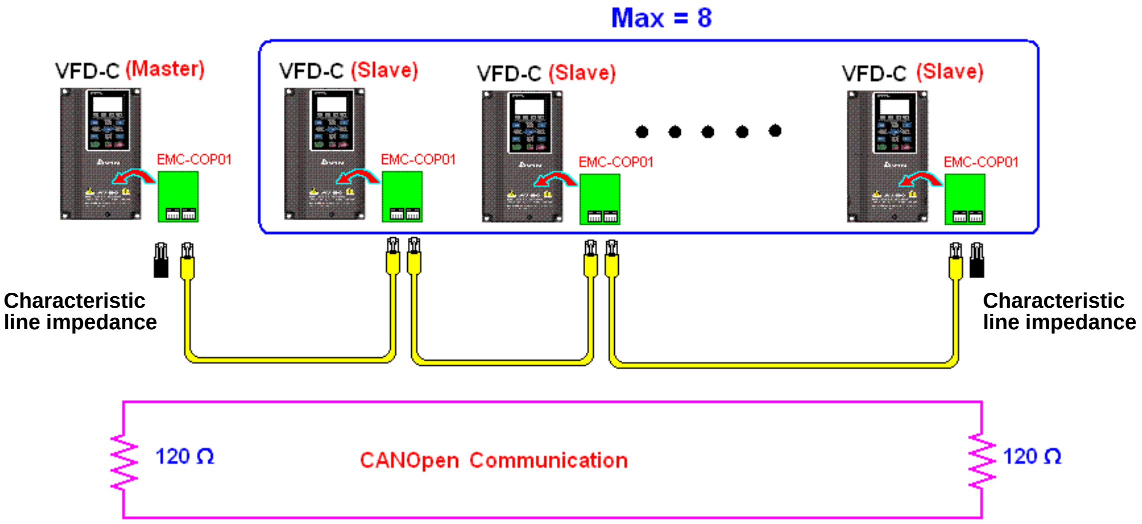
Step 5: Set Slave station number and communication speed.

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

(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	R/W
M1015	Target frequency attained	RO
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 (0.00~600.00)	RO

Special D	Descriptions	R/W
D1050	Actual mode (0:Speed, 1: Position, 2: Torque, 3: Homing)	RO

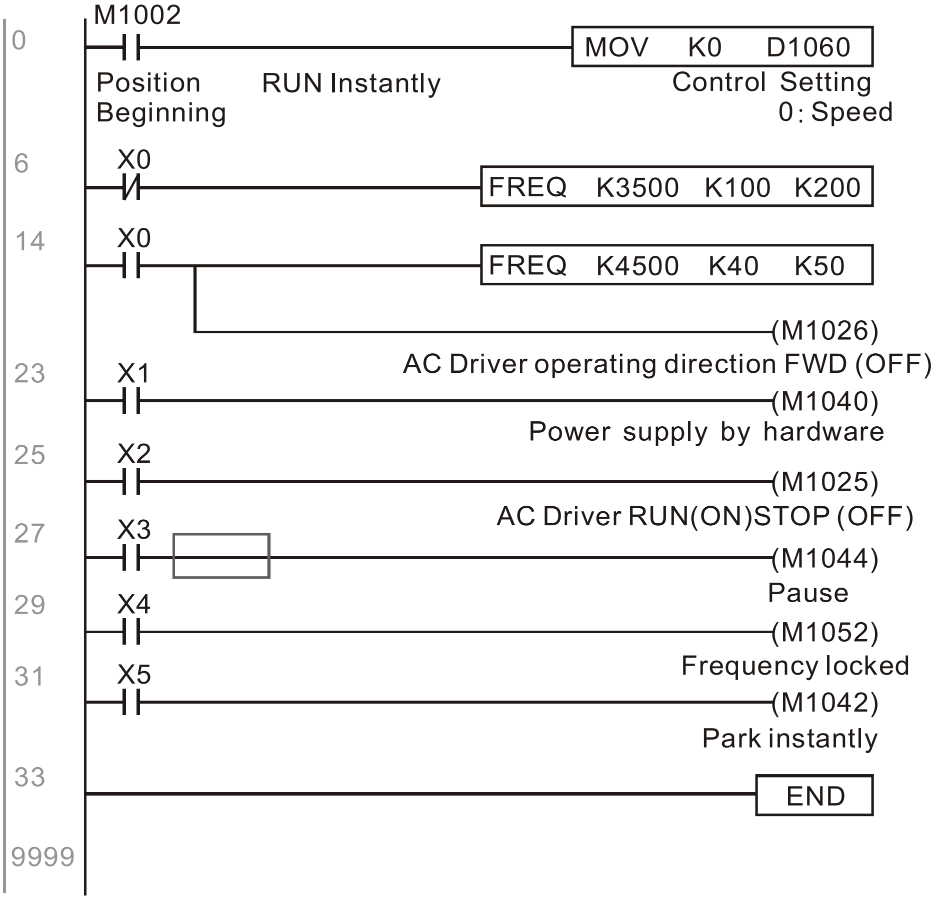
Control command for Speed Mode:

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 D1060 = 0, 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 M1040 = 1, 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

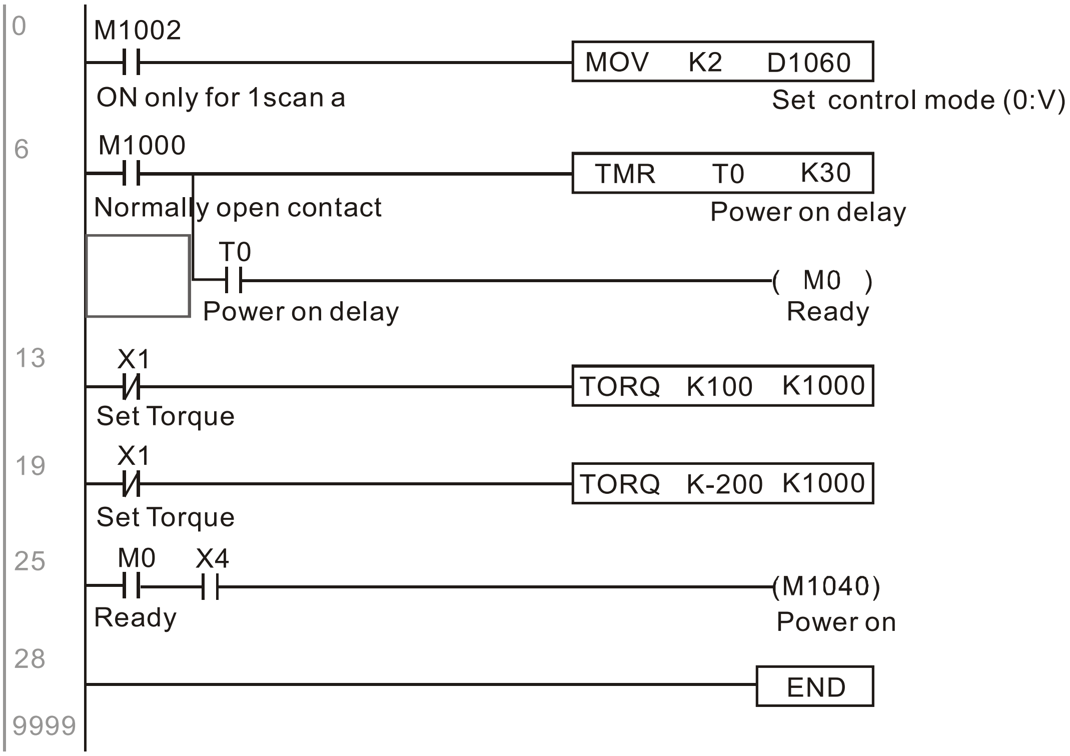
Control command for Torque Mode:

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 AC motor drive are completed.

1. When setting D1060 = 2, AC motor drive is in torque mode.
2. Write TORQ command to PLC program for torque and speed limit control.
3. When setting M1040 = 1, AC motor drive power turns ON and operate till target torque or speed limit is attained. Actual torque value can be read in D1053.


0
M1002
MOV K2 D1060
ON only for 1scan a
Set control mode (0:V)
6
M1000
TMR T0 K30
Normally open contact
Power on delay
T0
(M0)
Power on delay
Ready
13
X1
TORQ K100 K1000
Set Torque
19
X1
TORQ K-200 K1000
Set Torque
25
M0
X4
(M1040)
Ready
Power on
28
END
9999

Homing/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 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 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:

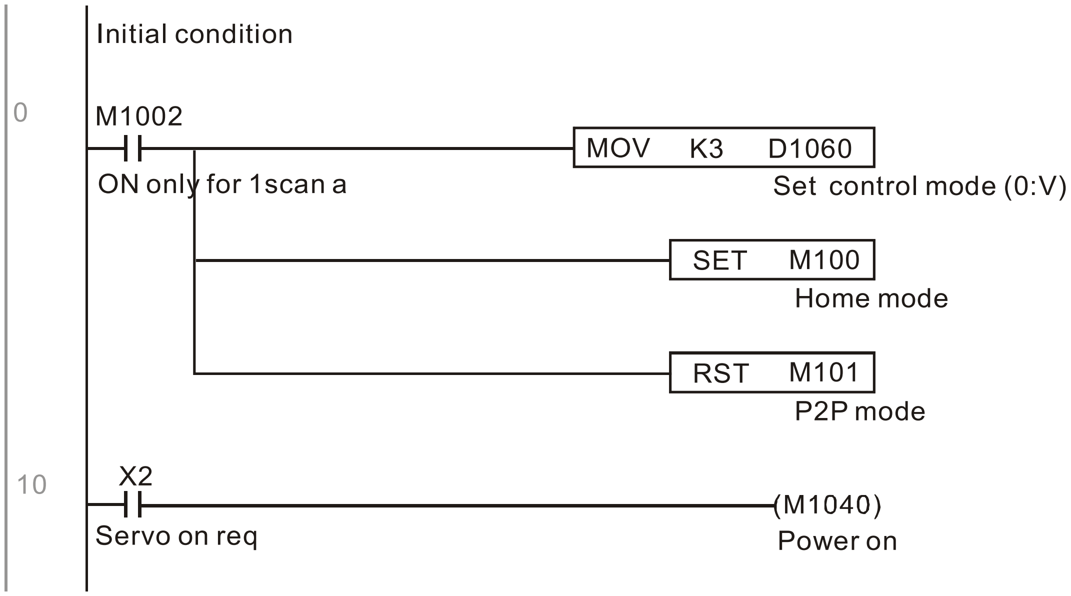
Before setting PLC program to homing mode or position mode, maker sure the motor parameter settings of the AC motor drive are completed.

1. Set Pr.00-40 to homing mode and set up corresponding limit sensor and origin point by MI (MI=44 is for reverse run limit, MI=45 is for forward run limit and 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.

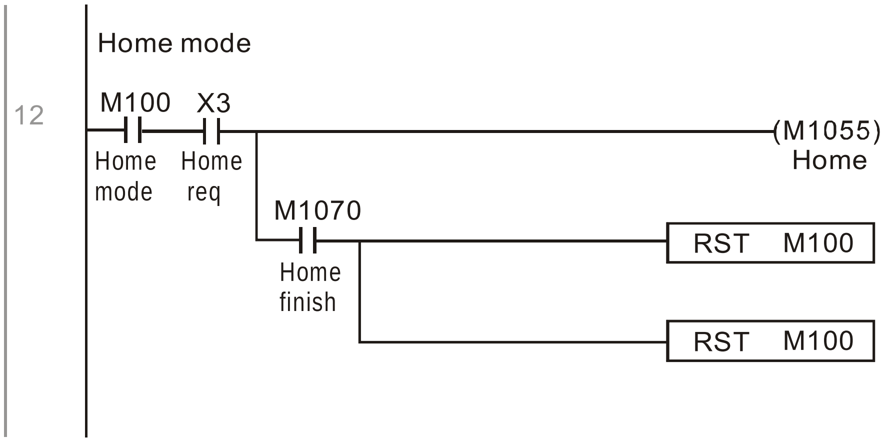
2. When setting D1060 = 3, AC motor drive is in homing mode.
3. When setting M1040 = 1, AC motor drive power turns ON.
4. When setting M1055=1, AC motor drive search for origin point.
5. When homing is complete, M1070 will be ON. Then set D1060=1 to switch control mode to position mode. (Ensure M1040 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 1ms, then AC motor drive will begin to operate till the target position is attained (only when M1040=1). Present motor position can be read from D1051 and D1052.

Step 1 ~ 7 can be categorized into three parts, please refer to the following example:

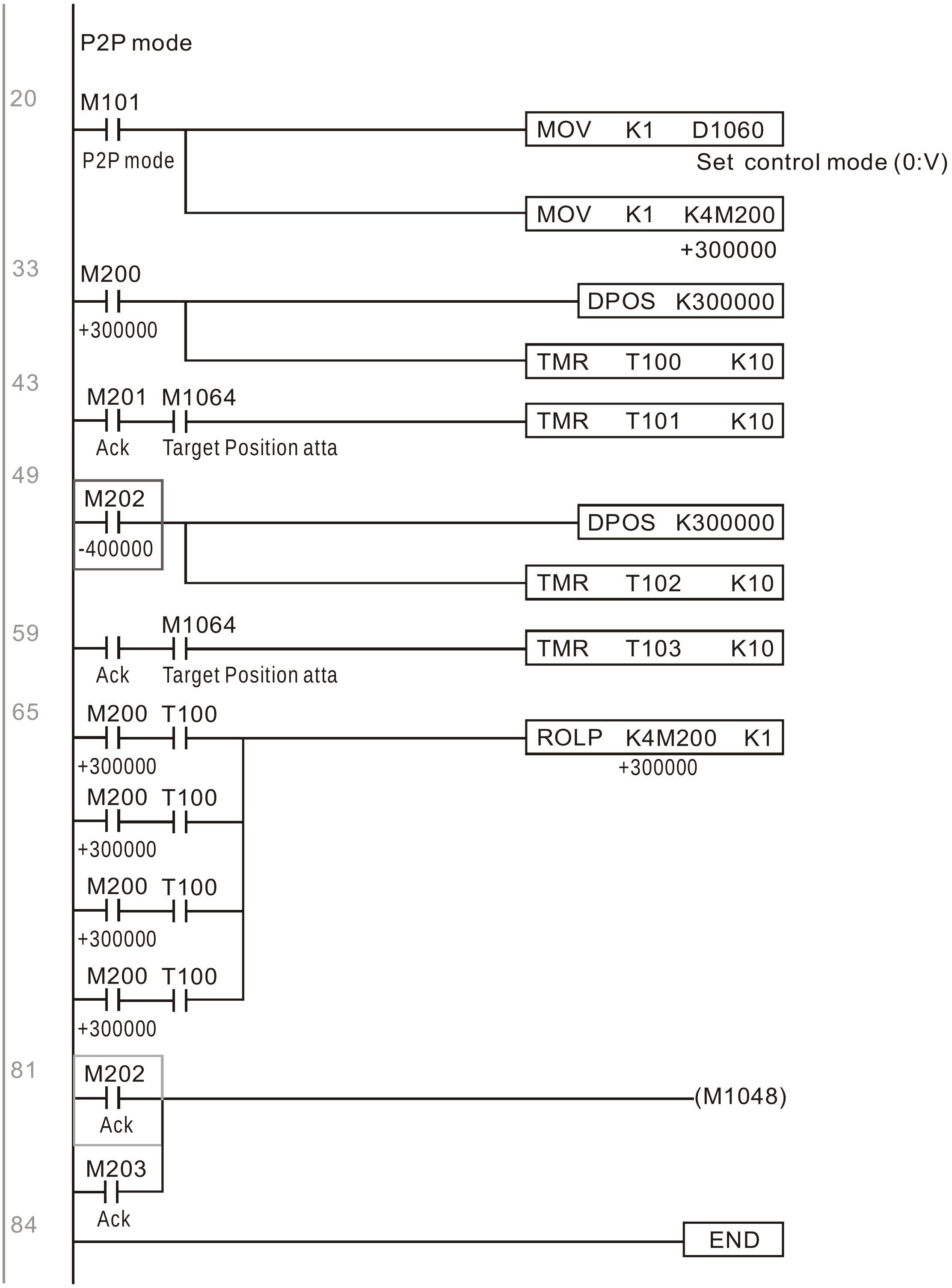
Part I: Set control mode to Homing Mode (D1060=3) and turn AC motor drive power ON by trigger X2.



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~-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.

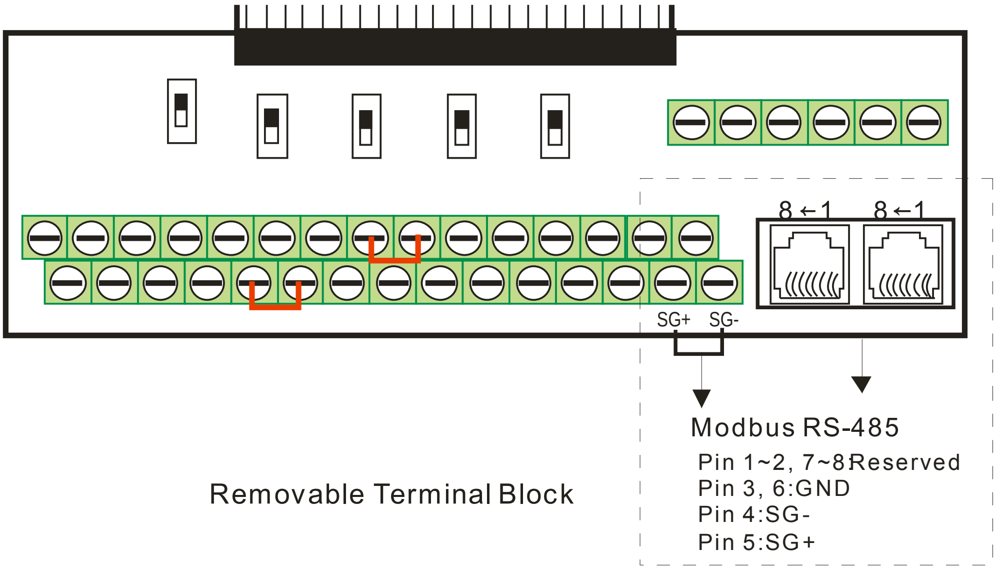
Master Drives Settings:

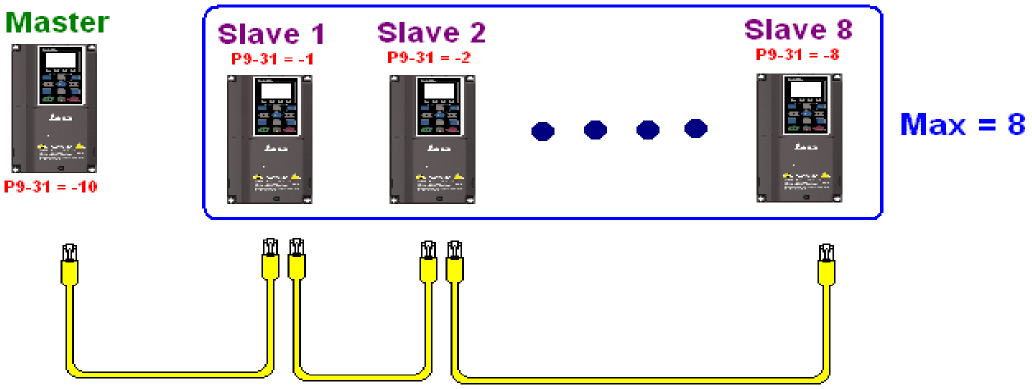
1. Set Pr.09-31= -10 and set PLC to Enable.

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)




Master
P9-31 = -10
Slave 1
P9-31 = -1
Slave 2
P9-31 = -2
Slave 8
P9-31 = -8
Max = 8

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							R/W
	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	Enable Bit 13 ~ 8	Enable Bit 13 ~ 8	-	-	
		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

※ N = 0 ~ 7

Special D Status

Special D	Description	R/W
D1115	Synchronous time cycle of internal communication(ms)	RO
D1116	Internal communication node error (bit0= Slave 1, bit1= Slave 2, …, bit7= Slave 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
	Definition	bit	Definition	bit	Definition	bit
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		-		-	-	

※ N = 0 ~ 7

Example: The PLC programming diagram below shows how to use 'Internal Communication' to control the frequency of Slave 1 and switches between 30.00Hz 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.

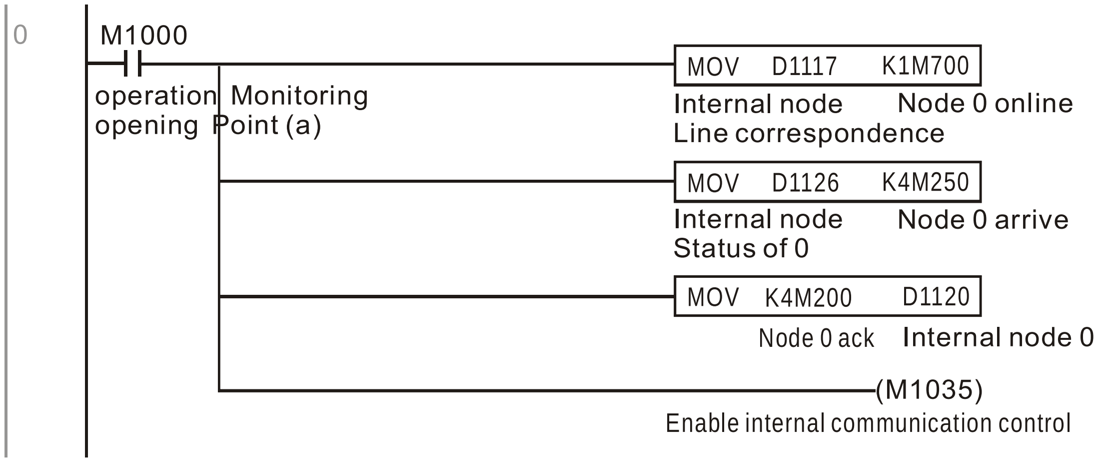


Diagram 2: When Slave 1 on-line status is detected, it will delay for 3 seconds before control command is enabled.

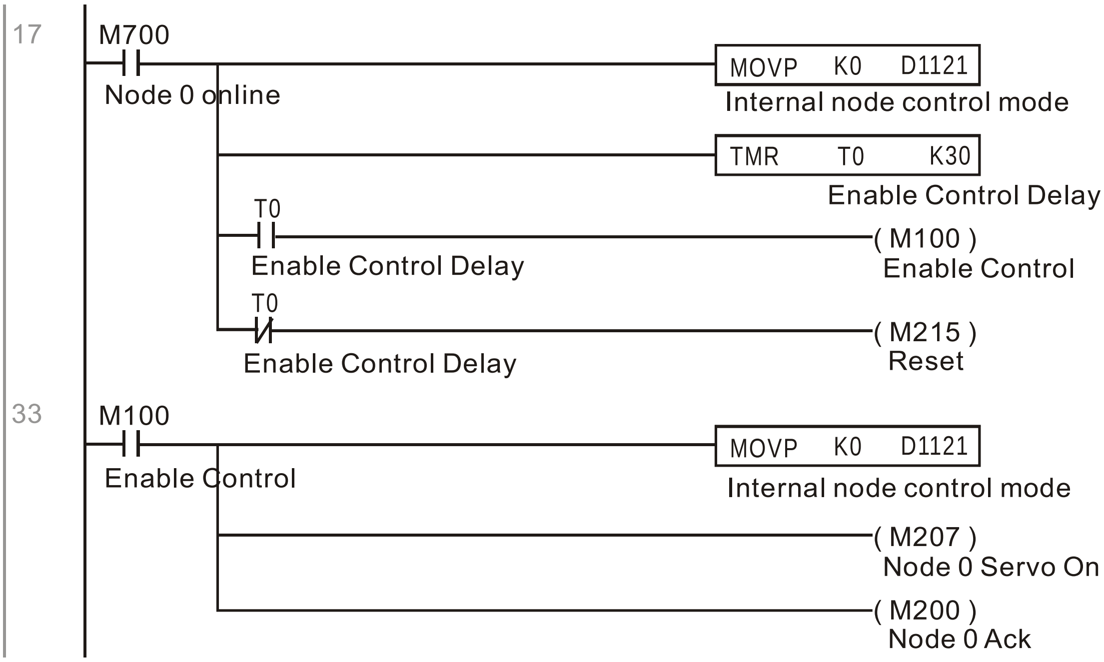
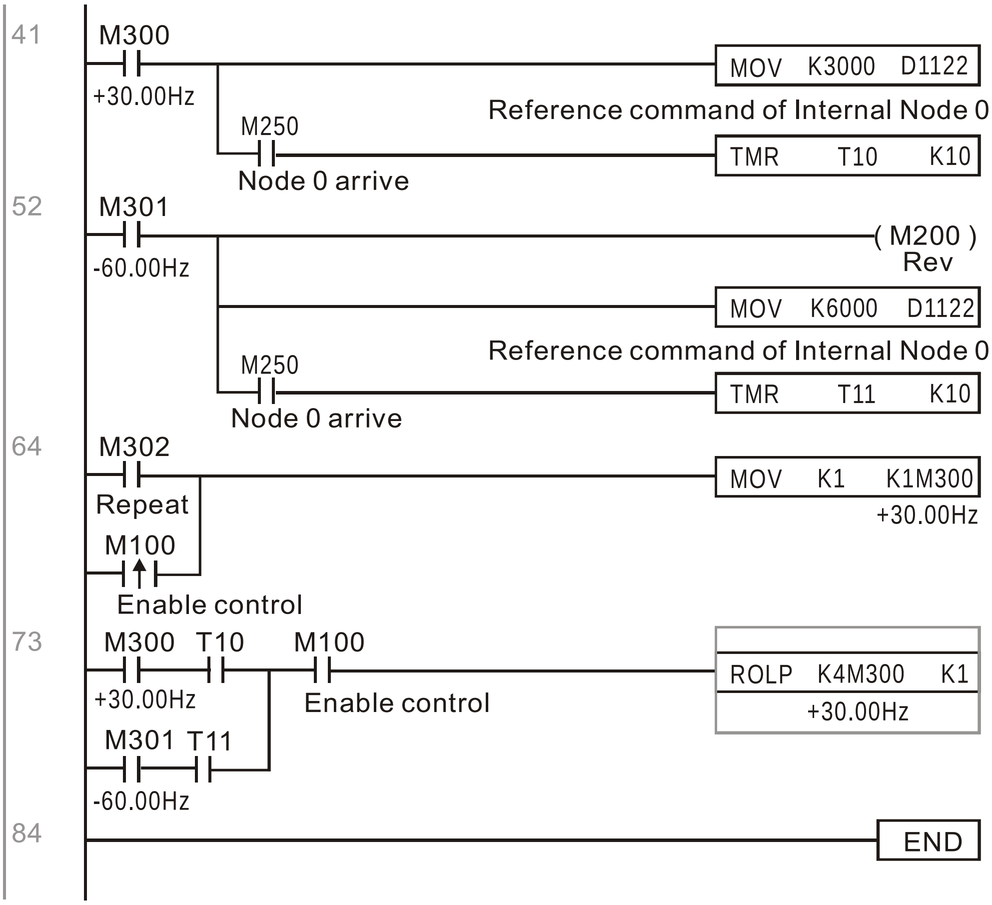
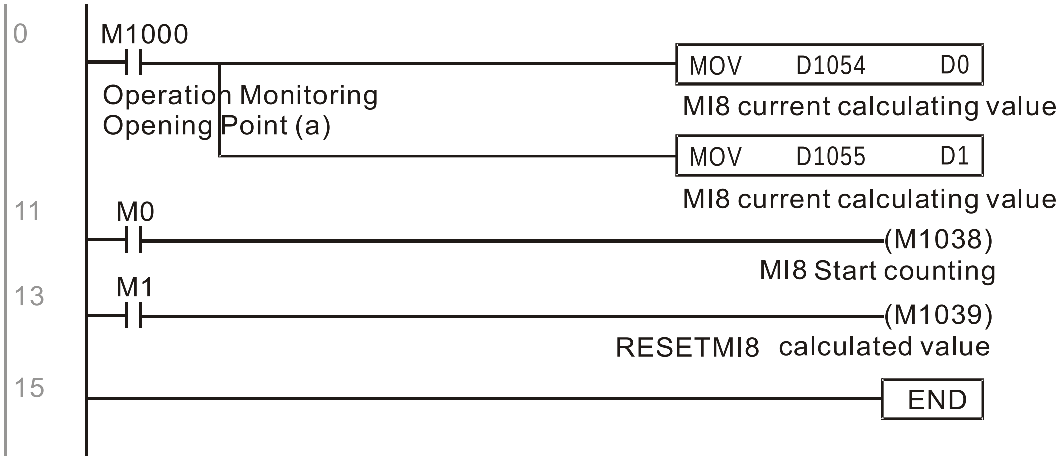


Diagram 3: Commanding Slave 1 to forward run in 30.00Hz for 1 second and reverse run in 60.00Hz for 1 second and repeats frequency switching.



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 (0x0F) and writing multiple Register (0x10). Explantion as below:

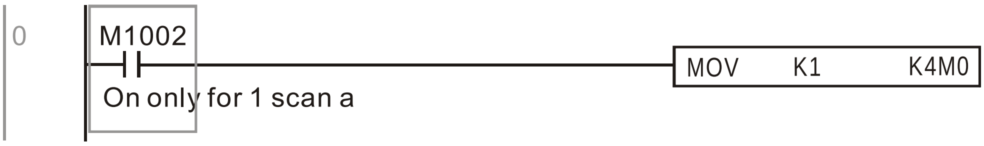
MODRW Command					Meaning	Slave is Delta PLC	Slave is Delta Motor Drive
S1	S2	S3	S4	S5			
Node	Comm.	Addr.	Cor. D register	Length			
K3	H01	H500	D0	K18	Read Coil (Bit)	Read slave 3 PLC 18 bits from Y0 ~ Y21, and save to master bit 0~ bit 15 of D0 and bit 0 ~ bit 3 of D1	Does not support this Function
K3	H02	H400	D10	K10	Read Input (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 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 Coil (Bit)	Write slave 3 PLC to Y11~Y12 frommaster bit 0~bit 9 of D40	Does not support this Function
K3	H10	H602	D50	K4	Read multiple 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

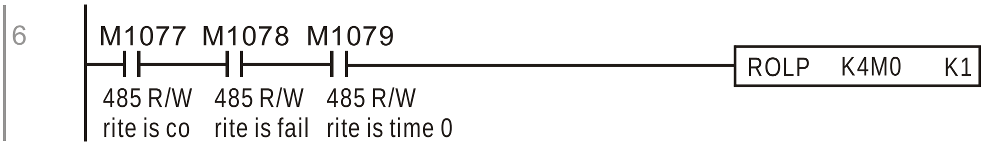
When executing MODRW，the status will be shown in M1077 (485 reading and writing complete), M1078(485 reading and writing error), and M1079 (485 reading and writing time out). The definition of M1077 will be cleared as 0 when commanding MODRW. When feedback is complete, error, or time out, M1099 will be set as On.

Example program：Each function testing

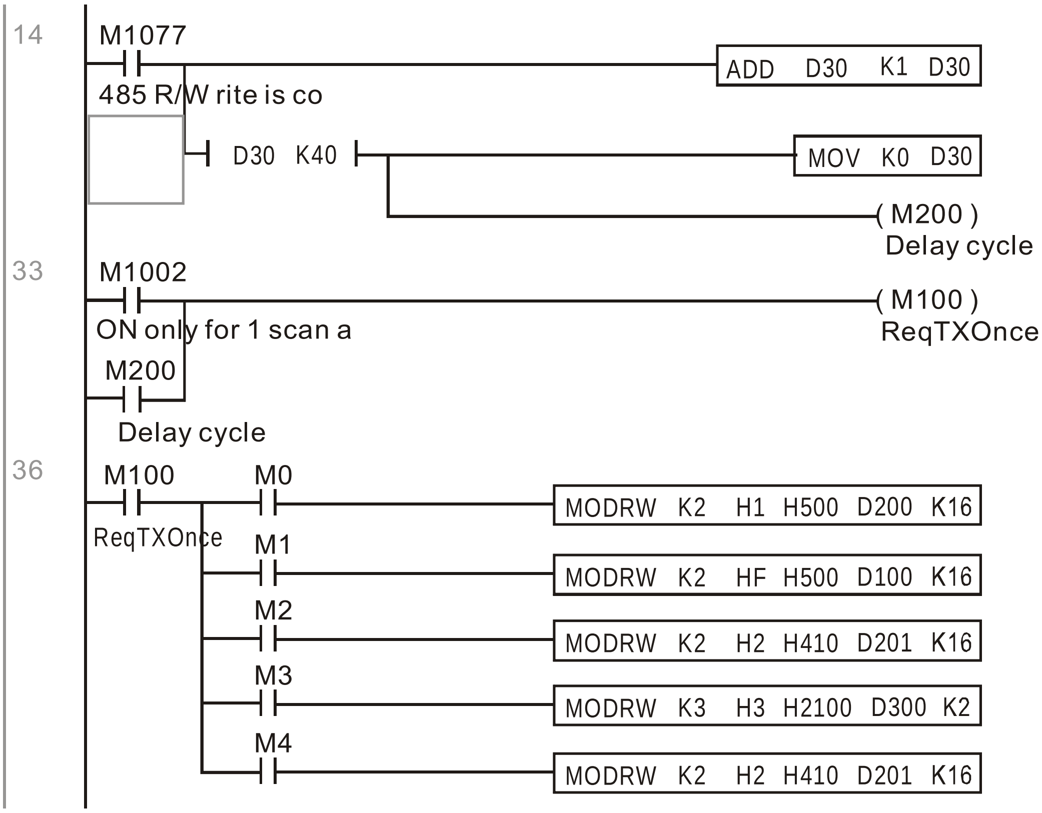
The first command will be transfer timing when turning on.



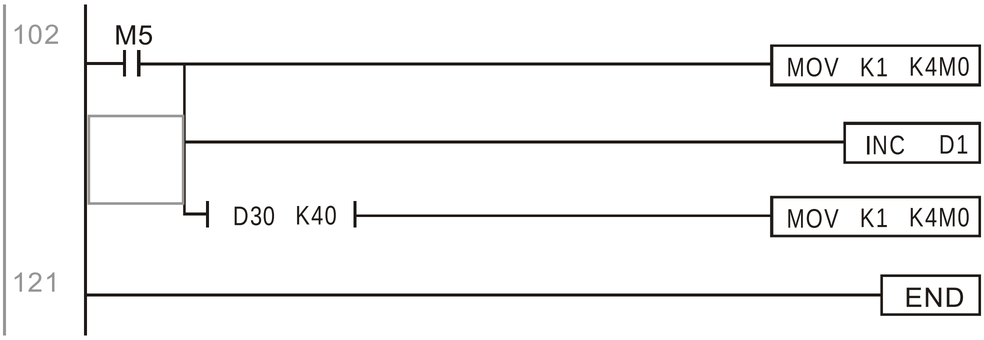
When feedback is finished without error, switch to next command



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：

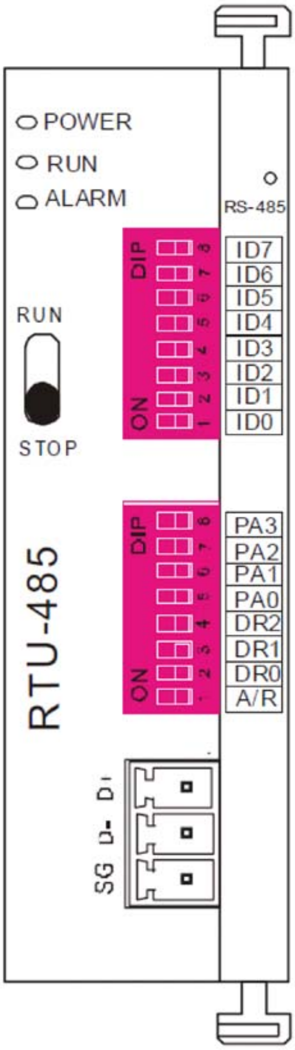
To control RTU-485.

Step 1：Set communication protocol, assuming communication protocol is 115200，8,N,2，RTU
C2000：PLC default node is 2 (9-35)
9-31=-12(COM1 controlled by PLC)，9-01=115.2 (communication speed is 115200)
9-04=13(protocol is 8,N,2，RTU)

RTU485：node = 8 (example)

ID7	ID6	ID5	ID4	ID3	ID2	ID1	ID0
0	0	0	0	1	0	0	0

PA3	PA2	PA1	PA0	DR2	DR1	DR0	A/R
1	0	0	0	1	1	1	0



Communication station #:
ID0~ ID7 are defined as 2^0, 2^1, 2^2…2^6, 2^7

Communication protocol

PA3	PA2	PA1	PA0	A/R	Communication Protocol
OFF	OFF	OFF	OFF	ON	7,E,1，ASCII
OFF	OFF	OFF	ON	ON	7,O,1，ASCII
OFF	OFF	ON	OFF	ON	7,E,2，ASCII
OFF	OFF	ON	ON	ON	7,O,2，ASCII
OFF	ON	OFF	OFF	ON	7,N,2，ASCII
OFF	ON	OFF	ON	ON	8,E,1，ASCII
OFF	ON	ON	OFF	ON	8,O,1，ASCII
OFF	ON	ON	ON	ON	8,N,1，ASCII
ON	OFF	OFF	OFF	ON	8,N,2，ASCII
OFF	ON	OFF	ON	OFF	8,E,1，RTU
OFF	ON	ON	OFF	OFF	8,O,1，RTU
OFF	ON	ON	ON	OFF	8,N,1，RTU
ON	OFF	OFF	OFF	OFF	8,N,2，RTU

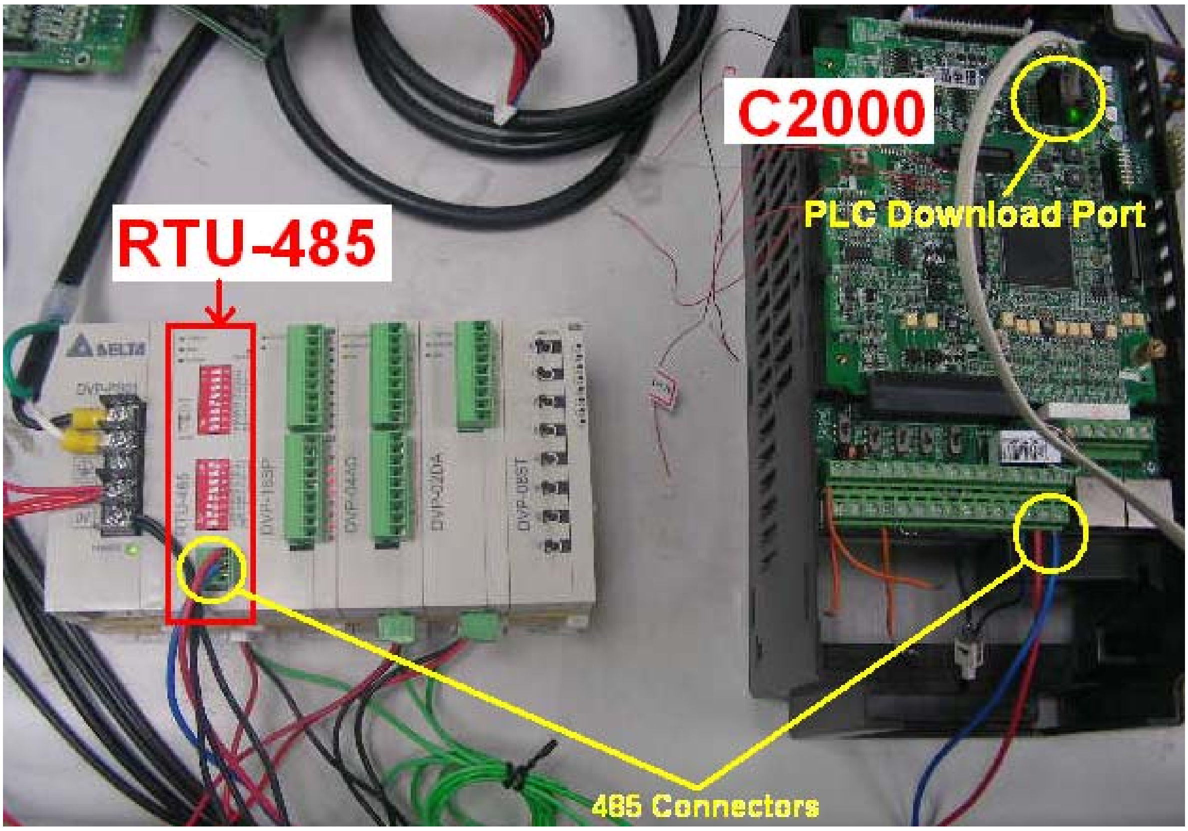
DR2	DR1	DR0	Communicaton Speed
OFF	OFF	OFF	1,200 bps
OFF	OFF	ON	2,400 bps
OFF	ON	OFF	4,800 bps
OFF	ON	ON	9,600 bps
ON	OFF	OFF	19,200 bps
ON	OFF	ON	38,400 bps
ON	ON	OFF	57,600 bps
ON	ON	ON	115,200 bps

Step 2: 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:

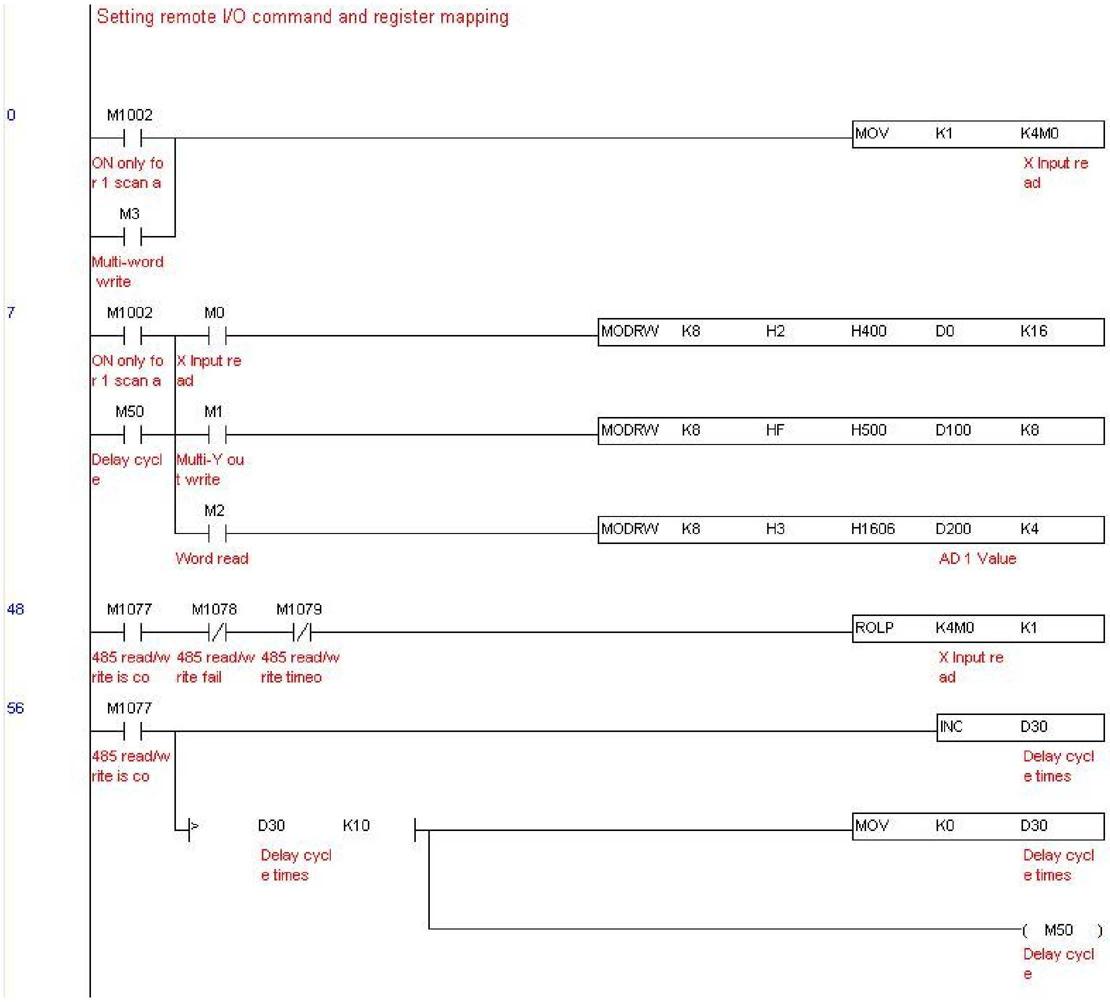
DVP-04AD(4 channels AD)、DVP02DA(2 channels DA) 和
DVP-08ST(8 switches)

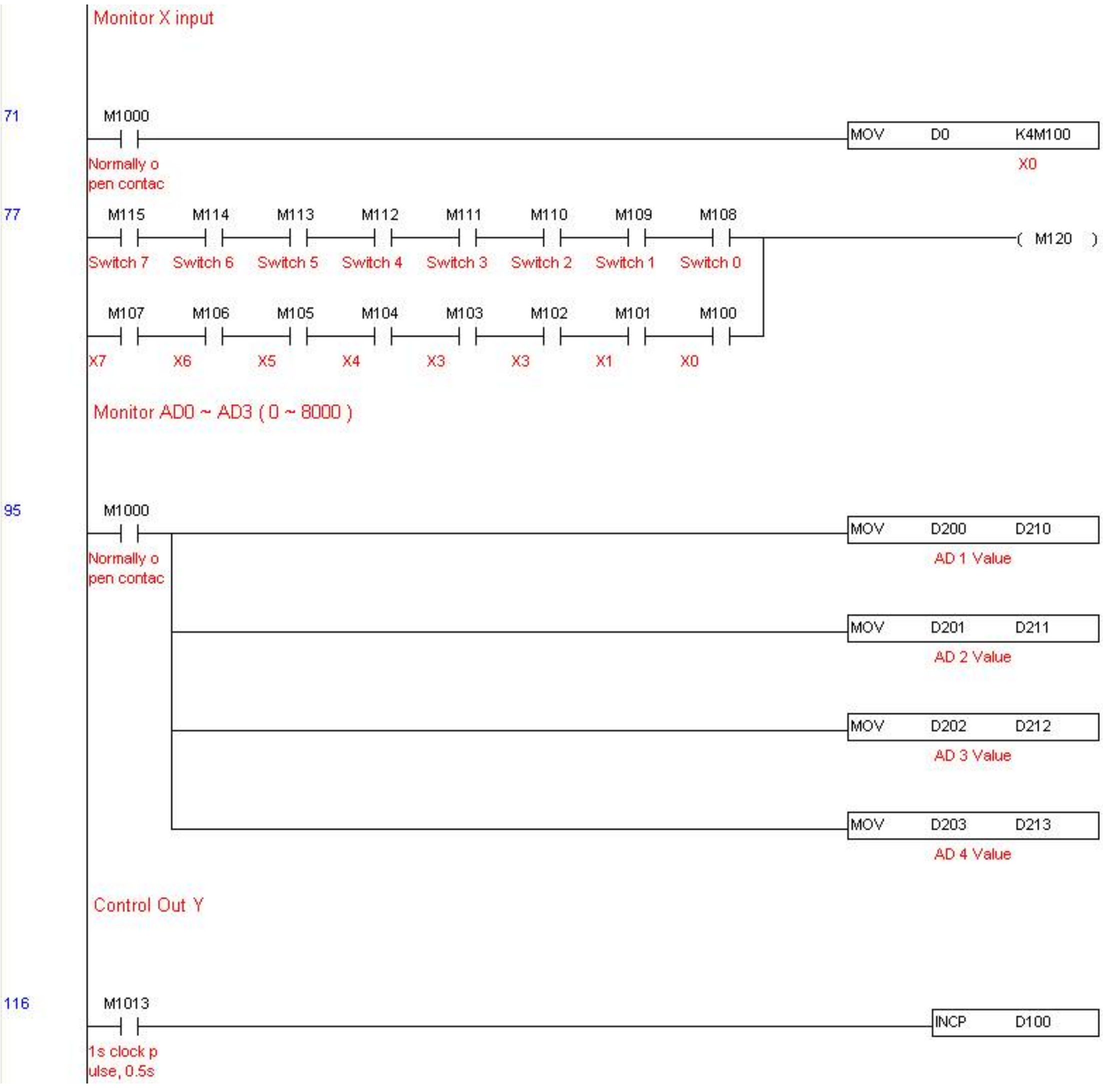
Module	Terminals	485 Address
DVP16-SP	X0 ~ X7	0400H ~ 0407H
	Y0 ~ Y7	0500H ~ 0507H
DVP-04AD	AD0 ~ AD3	1600H ~ 1603H
DVP02DA	DA0 ~ DA1	1640H ~ 1641H
DVP-08ST	Switch 0 ~ 7	0408H ~ 040FH

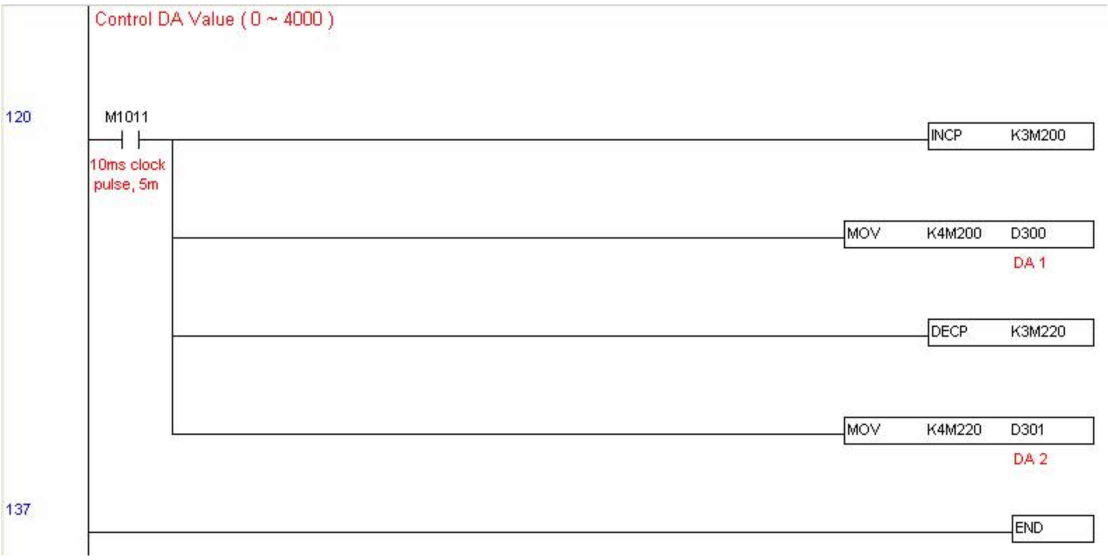
Step 3：Physical cinfiguration



Step 4：Programming PLC

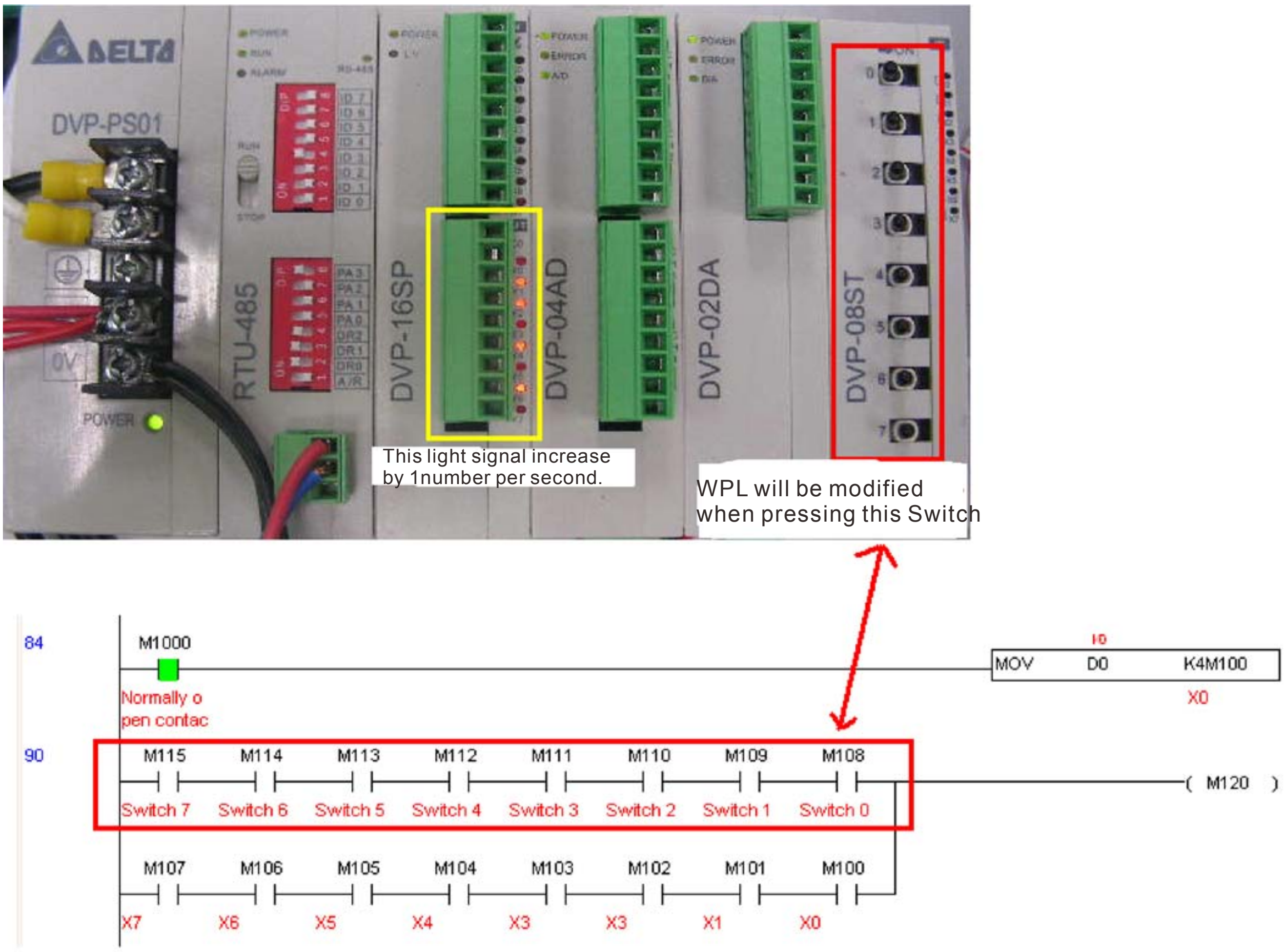



Monitor X input
71
M1000
Normally o
pen contac
MOV D0 K4M100
X0
77
M115 M114 M113 M112 M111 M110 M109 M108
Switch 7 Switch 6 Switch 5 Switch 4 Switch 3 Switch 2 Switch 1 Switch 0
(M120)
M107 M106 M105 M104 M103 M102 M101 M100
X7 X6 X5 X4 X3 X3 X1 X0
Monitor AD0 ~ AD3 (0 ~ 8000)
95
M1000
Normally o
pen contac
MOV D200 D210
AD 1 Value
MOV D201 D211
AD 2 Value
MOV D202 D212
AD 3 Value
MOV D203 D213
AD 4 Value
Control Out Y
116
M1013
1s clock p
ulse, 0.5s
INCP D100


Control DA Value (0 ~ 4000)
120
M1011
10ms clock
pulse, 5m
INCP K3M200
MOV K4M200 D300
DA 1
DECP K3M220
MOV K4M220 D301
DA 2
137
END

Step 5：Real action:

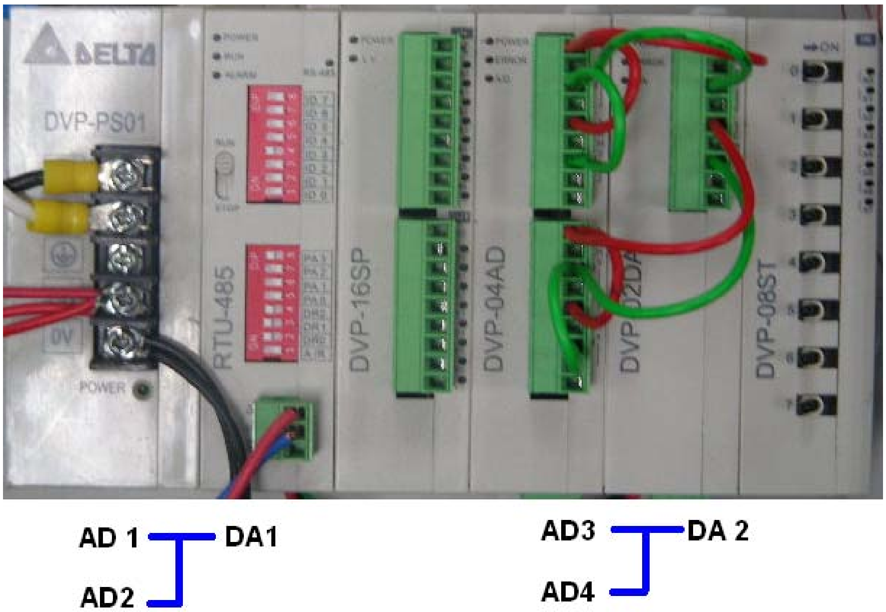
I/O testing：Toggling Switch, the corresponding reaction of M115 ~ M108 can be observed. In addition, the signals of output can be also observed (every one second add 1) (Binary display)

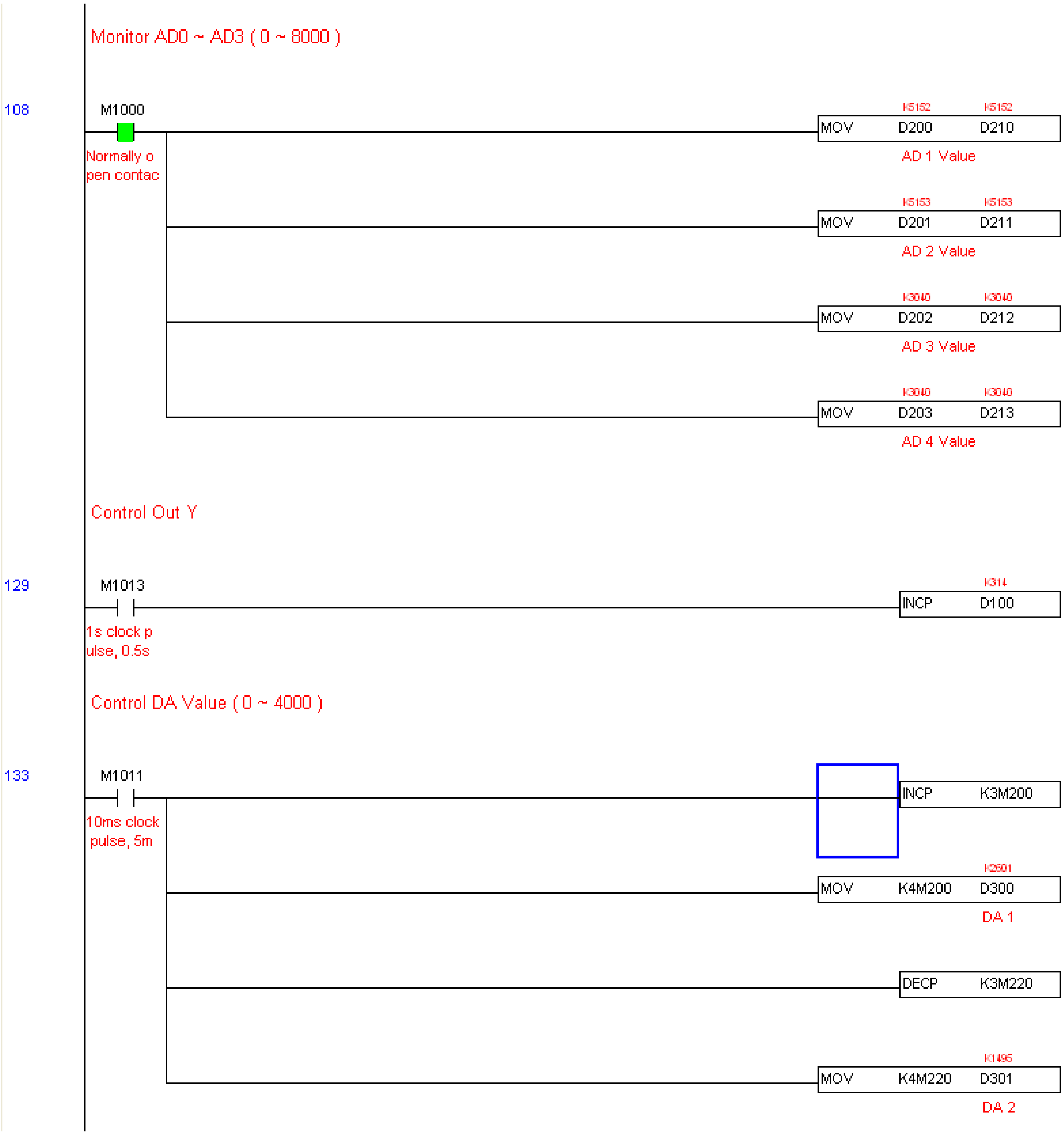


This light signal increase by 1number per second.

WPL will be modified when pressing this Switch

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.


DELTA
DVP-PS01
RTU-485
DVP-16SP
DVP-04AD
DVP-08ST
AD 1
DA1
AD2
AD3
DA 2
AD4


Monitor AD0 ~ AD3 (0 ~ 8000)
108
M1000
Normally o
pen contac
K5152
K5152
MOV
D200
D210
AD 1 Value
K5153
K5153
MOV
D201
D211
AD 2 Value
K3040
K3040
MOV
D202
D212
AD 3 Value
K3040
K3040
MOV
D203
D213
AD 4 Value
Control Out Y
129
M1013
1s clock p
ulse, 0.5s
K314
INCP
D100
Control DA Value (0 ~ 4000)
133
M1011
10ms clock
pulse, 5m
INCP
K3M200
K2601
MOV
K4M200
D300
DA 1
DECP
K3M220
K1495
MOV
K4M220
D301
DA 2

Chapter 17 How to Select the Right AC Motor Drive

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 Liquid (viscous) load Inertia load Load with power transmission	●			●
Load speed and torque characteristics	Constant torque Constant output Decreasing torque Decreasing output	●	●		
Load characteristics	Constant load Shock load Repetitive load High starting torque Low starting torque	●	●	●	●
Continuous operation, Short-time operation Long-time operation at medium/low speeds			●	●	
Maximum output current (instantaneous) Constant output current (continuous)		●		●	
Maximum frequency, Base frequency		●			
Power supply transformer capacity or percentage impedance Voltage fluctuations and unbalance Number of phases, single phase protection Frequency				●	●
Mechanical friction, losses in wiring				●	●
Duty cycle modification			●		

17-1 Capacity Formulas

1. **When one AC motor drive operates one motor**

   The starting capacity should be less than 1.5x rated capacity of AC motor drive

   The starting capacity=

$$\frac{k\times N}{973\times\eta\times\cos\varphi}\left(T_L+\frac{GD^2}{375}\times\frac{N}{t_A}\right)\le 1.5\times the\_capacity\_of\_AC\_motor\_drive(kVA)$$

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 ≦60 seconds

     The starting capacity=

$$\frac{k\times N}{\eta\times\cos\varphi}\left[n_T+n_s\left(k_s-1\right)\right]=P_{C1}\left[1+\frac{n_s}{n_T}\left(k_s-1\right)\right]\le 1.5\times the\_capacity\_of\_AC\_motor\_drive(kVA)$$

   - Acceleration time ≧60 seconds

     The starting capacity=

$$\frac{k\times N}{\eta\times\cos\varphi}\left[n_T+n_s\left(k_s-1\right)\right]=P_{C1}\left[1+\frac{n_s}{n_T}\left(k_s-1\right)\right]\le the\_capacity\_of\_AC\_motor\_drive(kVA)$$

   2.2 The current should be less than the rated current of AC motor drive(A)

   - Acceleration time ≦60 seconds

$$n_T+I_M\left[1+\frac{n_S}{n_T}\left(k_S-1\right)\right]\le 1.5\times the\_rated\_current\_of\_AC\_motor\_drive(A)$$

   - Acceleration time ≧60 seconds

$$n_T+I_M\left[1+\frac{n_S}{n_T}\left(k_S-1\right)\right]\le the\_rated\_current\_of\_AC\_motor\_drive(A)$$

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=

  $$\frac{k \times P_M}{\eta \times \cos\varphi} \leq the\_capacity\_of\_AC\_motor\_drive(kVA)$$

- The motor capacity should be less than the capacity of AC motor drive

  $$k \times \sqrt{3} \times V_M \times I_M \times 10^{-3} \leq the\_capacity\_of\_AC\_motor\_drive(kVA)$$

- The current should be less than the rated current of AC motor drive(A)

  $$k \times I_M \leq the\_rated\_current\_of\_AC\_motor\_drive(A)$$

Symbol explanation

P_M : Motor shaft output for load (kW)

η : Motor efficiency (normally, approx. 0.85)

$\cos\varphi$: Motor power factor (normally, approx. 0.75)

V_M : Motor rated voltage(V)

I_M : Motor rated current(A), for commercial power

k : Correction factor calculated from current distortion factor (1.05-1.1, depending on PWM method)

P_{C1} : Continuous motor capacity (kVA)

k_S : Starting current/rated current of motor

n_T : Number of motors in parallel

n_s : Number of simultaneously started motors

GD^2 : Total inertia (GD^2) calculated back to motor shaft (kg m^2)

T_L : 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 ≥1.25x(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

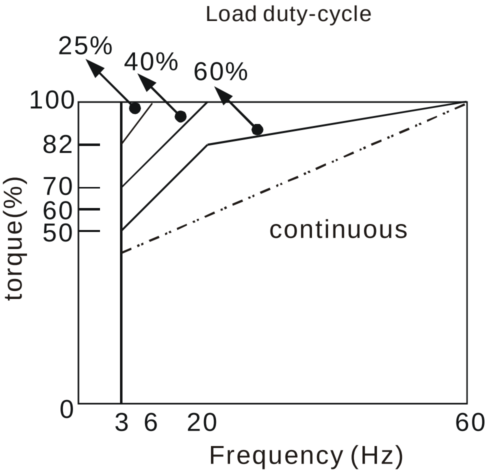
1. The AC Motor Drive can be driven at an output frequency up to 400Hz (less for some models) with the digital keypad. Setting errors may create a dangerous situation. For safety, the use of the upper limit frequency function is strongly recommended.
2. High DC brake operating voltages and long operation 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 (60Hz) 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 60Hz.

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 50/60Hz and above, lifetime reducing noises and vibrations may occur.

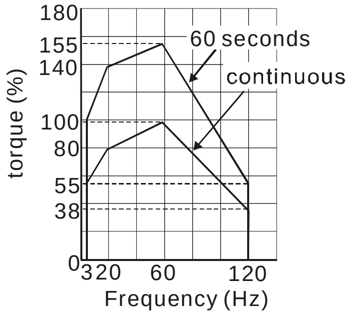
Motor torque

The torque characteristics of a motor operated by an AC motor drive and commercial mains power are different.

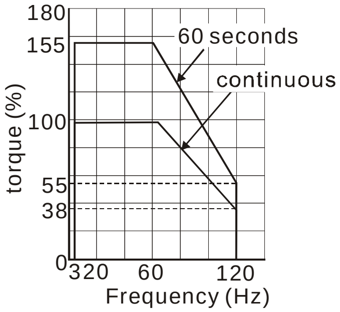
Below you'll find the torque-speed characteristics of a standard motor (4-pole, 15kW):

AC motor drive

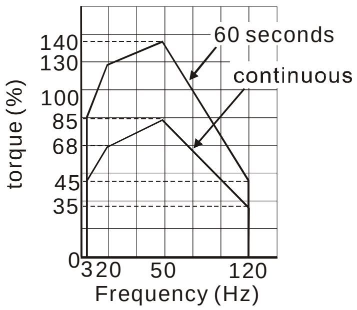
Motor



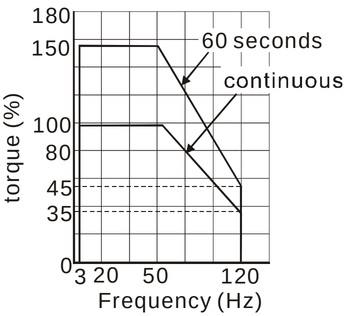
Base freq.: 60Hz
V/F for 220V/60Hz



Base freq.: 60Hz
V/F for 220V/60Hz



Base freq.: 50Hz
V/F for 220V/50Hz



Base freq.: 50Hz
V/F for 220V/50Hz

Chapter 18 Suggestions and Error Corrections for Standard AC Motor Drives

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

☑ Wait 5 seconds after a fault has been cleared before performing reset via keypad of input terminal.

☑ When the power is off after 5 minutes for ≦ 22kW models and 10 minutes for ≧ 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.

☑ 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.

☑ 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 Period**		
		Daily	Half Year	One Year
Check the ambient temperature, humidity, vibration and see if there are any dust, gas, oil or water drops	Visual inspection and measurement with equipment with standard specification	○		
If there are any dangerous objects	Visual inspection	○		

Voltage

Check Items	**Methods and Criterion**	**Maintenance Period**		
		Daily	Half Year	One Year
Check if the voltage of main circuit and control circuit is correct	Measure with multimeter with standard specification	○		

Digital Keypad Display

Check Items	**Methods and Criterion**	**Maintenance Period**		
		Daily	Half Year	One Year
Is the display clear for reading	Visual inspection	○		
Any missing characters	Visual inspection	○		

Mechanical parts

Check Items	**Methods and Criterion**	**Maintenance Period**		
		Daily	Half Year	One Year
If there is any abnormal sound or vibration	Visual and aural inspection		○	
If there are any loose screws	Tighten the screws		○	
If any part is deformed or damaged	Visual inspection		○	
If there is any color change by overheating	Visual inspection		○	
If there is any dust or dirt	Visual inspection		○	

Main circuit

Check Items	**Methods and Criterion**	**Maintenance Period**		
		Daily	Half Year	One Year
If there are any loose or missing screws	Tighten or replace the screw	○		
If machine or insulator is deformed, cracked, damaged or with color change due to overheating or ageing	Visual inspection **NOTE: Please ignore the color change of copper plate**		○	
If there is any dust or dirt	Visual inspection		○	

Terminals and wiring of main circuit

Check Items	**Methods and Criterion**	**Maintenance Period**		
		Daily	Half Year	One Year
If the terminal or the plate is color change or deformation due to overheat	Visual inspection		○	
If the insulator of wiring is damaged or color change	Visual inspection		○	
If there is any damage	Visual inspection	○		

DC capacity of main circuit

Check Items	**Methods and Criterion**	**Maintenance Period**		
		Daily	Half Year	One Year
If there is any leak of liquid, color change, crack or deformation	Visual inspection	○		
If the safety valve is not removed? If valve is inflated?	Visual inspection	○		
Measure static capacity when required		○		

Resistor of main circuit

Check Items	**Methods and Criterion**	**Maintenance Period**		
		Daily	Half Year	One Year
If there is any peculiar smell or insulator cracks due to overheat	Visual inspection, smell	○		
If there is any disconnection	Visual inspection	○		
If connection is damaged?	Measure with multimeter with standard specification	○		

Transformer and reactor of main circuit

Check Items	**Methods and Criterion**	**Maintenance Period**		
		Daily	Half Year	One Year
If there is any abnormal vibration or peculiar smell	Visual, aural inspection and smell	○		

Magnetic contactor and relay of main circuit

Check Items	**Methods and Criterion**	**Maintenance Period**		
		Daily	Half Year	One Year
If there are any loose screws	Visual and aural inspection	○		
If the contact works correctly	Visual inspection	○		

Printed circuit board and connector of main circuit

Check Items	**Methods and Criterion**	**Maintenance Period**		
		Daily	Half Year	One Year
If there are any loose screws and connectors	Tighten the screws and press the connectors firmly in place.		○	
If there is any peculiar smell and color change	Visual and smell inspection		○	
If there is any crack, damage, deformation or corrosion	Visual inspection		○	
If there is any liquid is leaked or deformation in capacity	Visual inspection		○	

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		○	
If there is any loose screw	Tighten the screw		○	
If there is any color change due to overheat	Change fan		○	

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		○	

NOTE

Please use the neutral cloth for clean and use dust cleaner to remove dust when necessary.

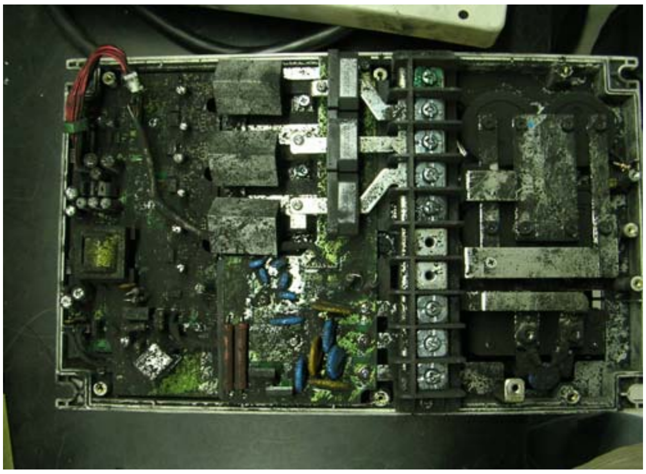
18-2 Greasy Dirt Problem

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.



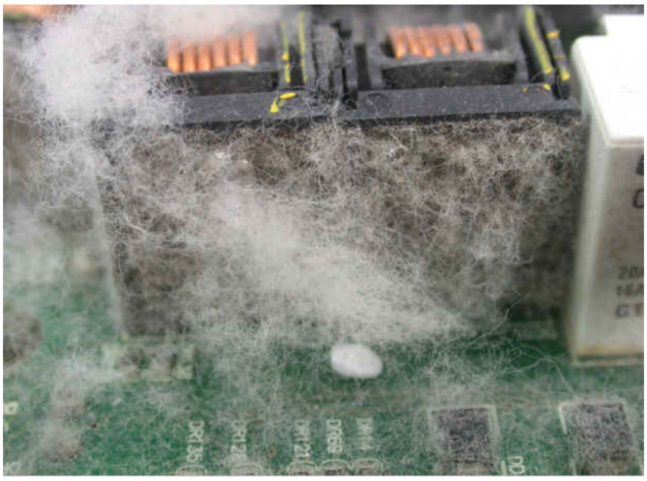
18-3 Fiber Dust Problem

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.



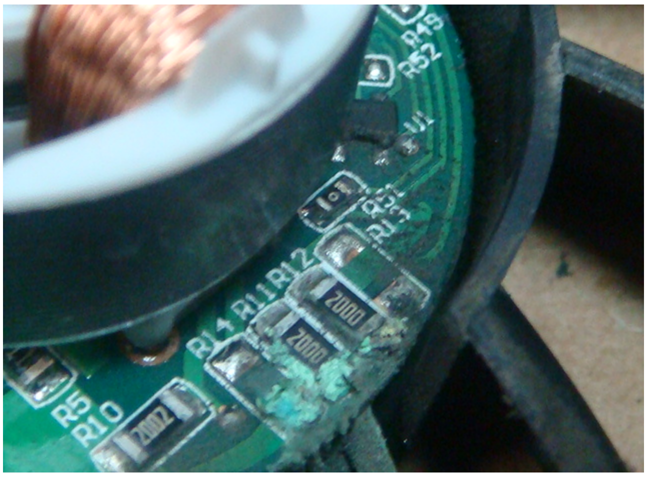
18-4 Erosion Problem

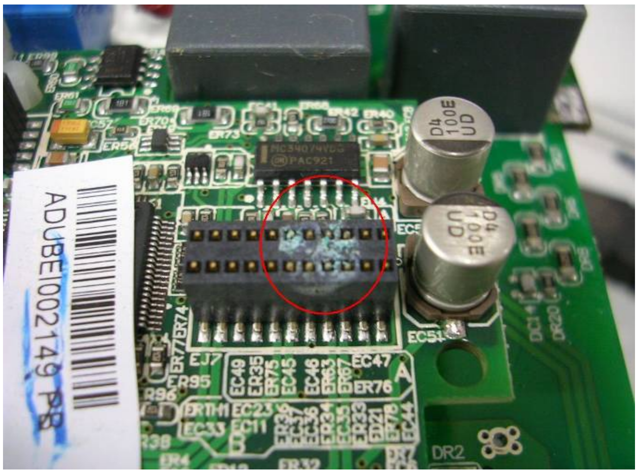
Erosion problems may occur if any fluids flow into the drives. Please be aware of the damages that erosion may cause to your drive.

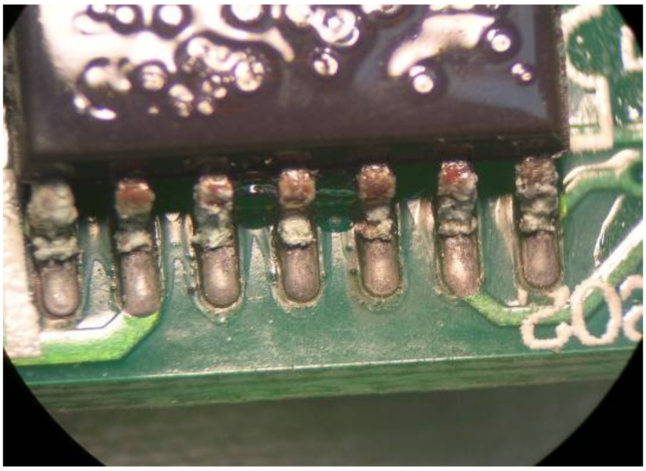
1. Erosion of internal components may cause the drive to malfunction and possibility to explode.

Solution:

Install the AC motor drive in a standard cabinet to keep it away from fluids. Clean the drive regularly to prevent erosion.







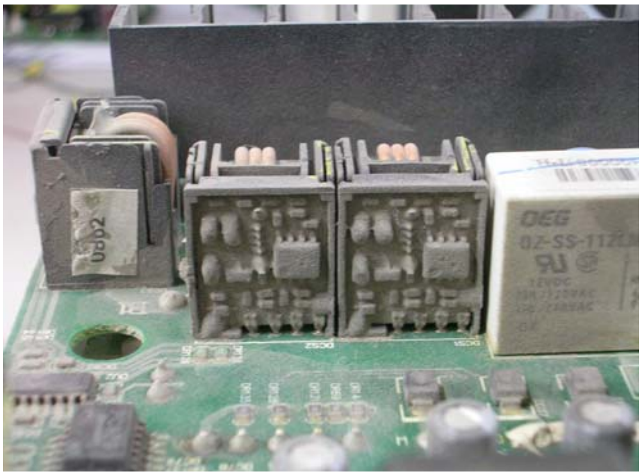
18-5 Industrial Dust Problem

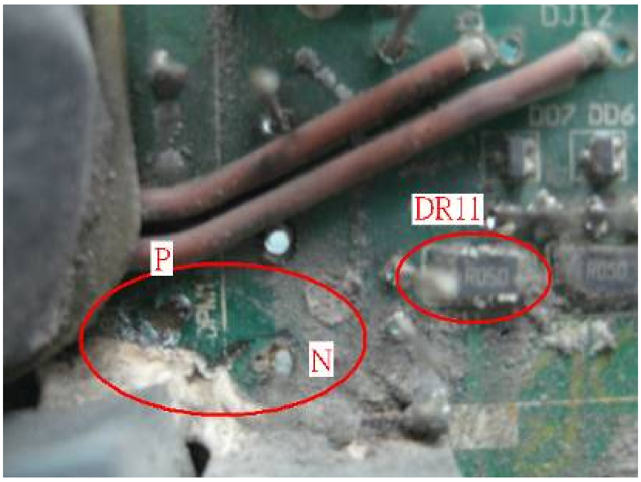
Serious industrial dust pollution frequently occurs in stone processing plants, flour mills, cement plants, and so on. Please be aware of the possible damage that industrial dust may cause to your drives:

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.





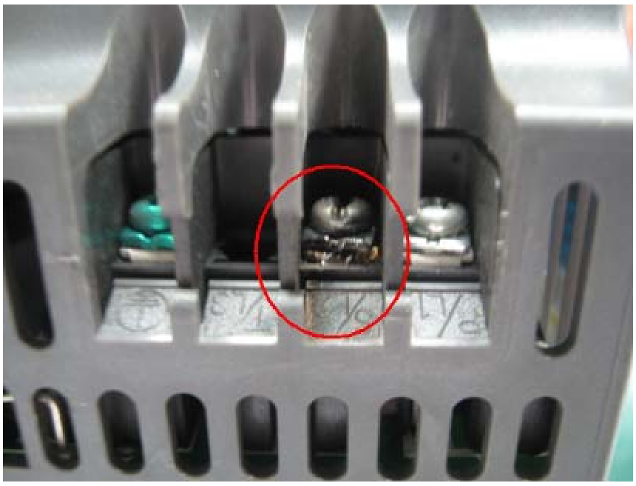
18-6 Wiring and Installation Problem

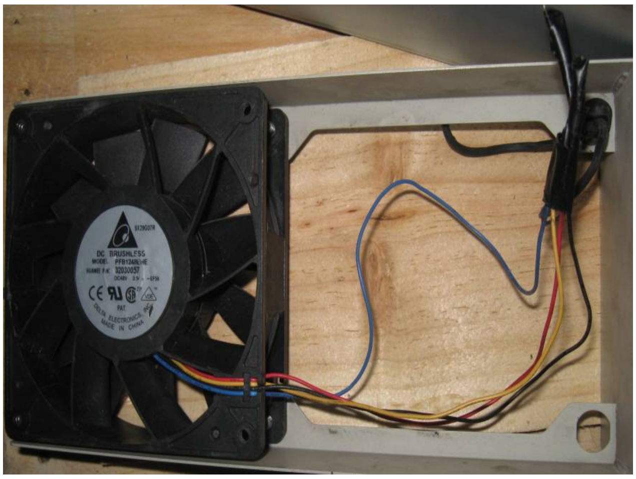
When wiring the drive, the most common problem is wrong wire installation or poor wiring. Please be aware of the possible damages that poor wiring may cause to your drives:

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.





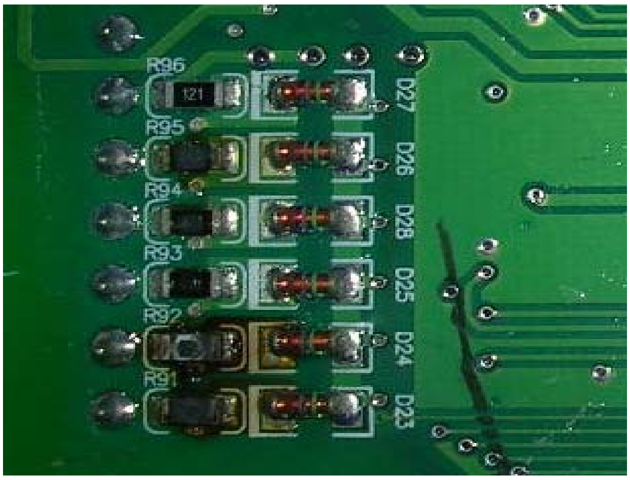
18-7 Multi-function Input/Output Terminals Problem

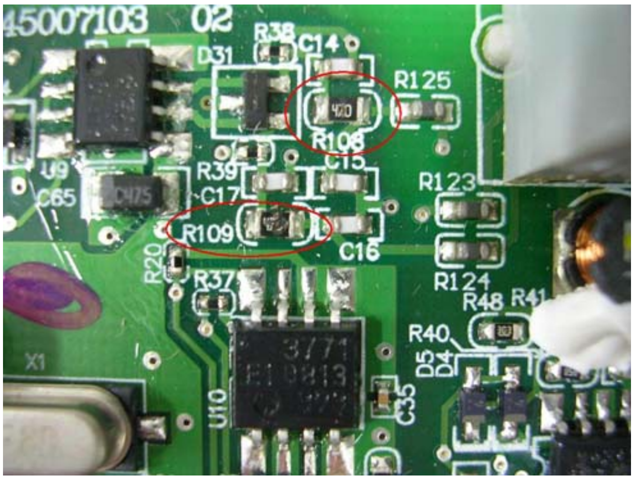
Multi-function input/output terminal errors are generally caused by over usage of terminals and not following specifications. Please be aware of the possible damages that errors on multi-function input/output terminals may cause to your drives:

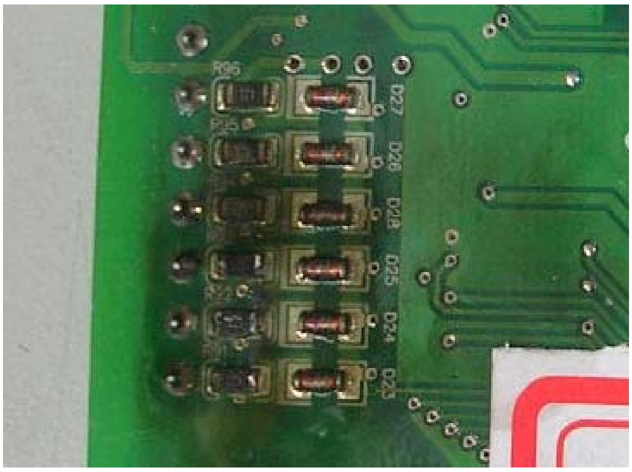
1. Input/output circuit may burns out when the terminal usage exceeds its limit.

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.







http://www.delta.com.tw/industrialautomation/

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

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 differential-mode noise. Differential-mode noise is caused by the stray capacitance between the conducting wires and common-mode noise is caused by the common-mode coupling current path created by the stray capacitance between the conducting wires and ground.
Basically, differential-mode noise has a greater impact to the AC motor drive and common-mode noise has a greater impact to high-sensitivity electronic devices. An excessive amount of differential-mode noise may trigger the circuit protection system of the AC motor drive. Common-mode noise affects peripheral electronic devices via the common ground connection.

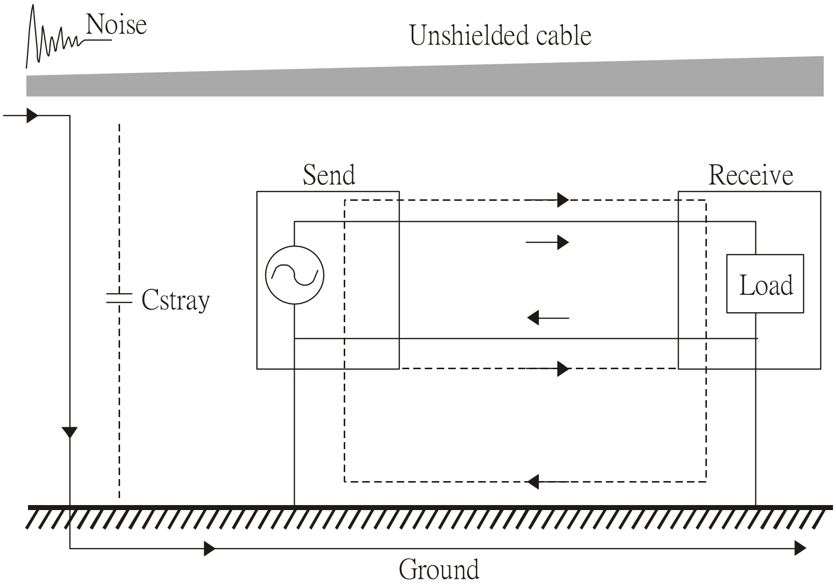
EMC problems can be more serious when the following conditions apply:

- When a large horsepower AC motor drive is connected to a large horsepower motor.
- The AC motor drive's operation voltage increases.
- Fast switching of the IGBTs.
- When a long cable is used to connect the motor to the AC motor drive.

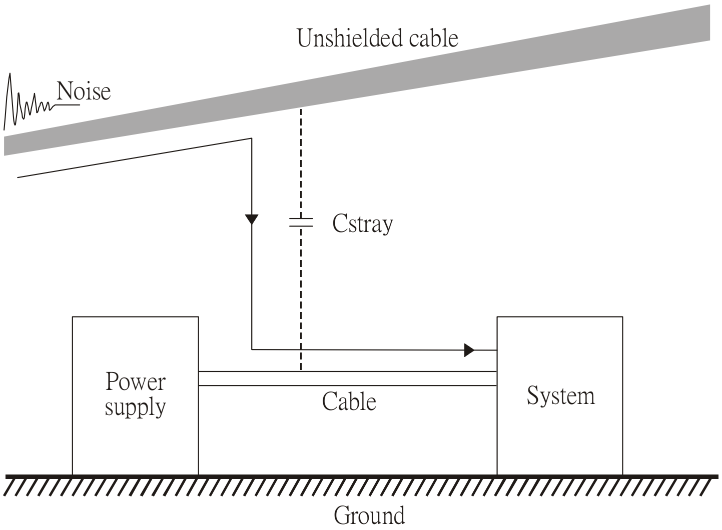
2.2 How does EMI transmit? (Noise transmission path)

Noise disturbs peripheral high-sensitivity electrical devices/systems via conduction and radiation, their transmission paths are shown hereafter:

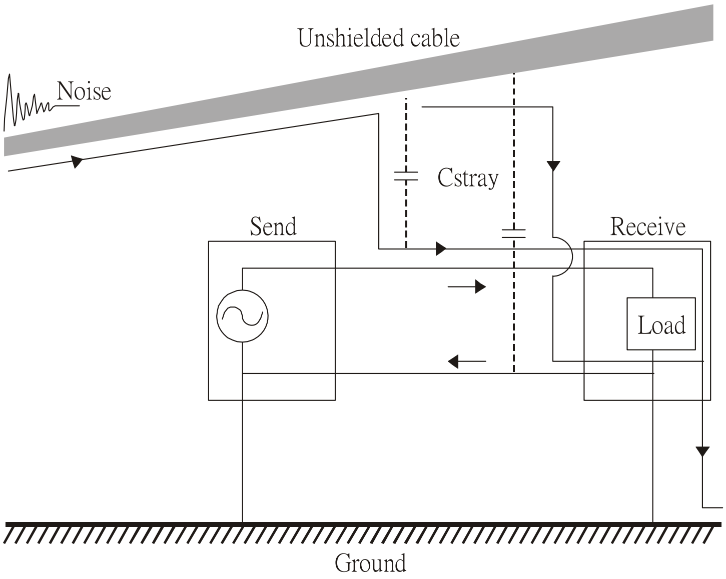
1. Noise current in the unshielded power cable is conducted to ground via stray capacitances into a common-mode voltage. Whether or not other modules are capable to resist this common-mode noise depends on their Common-Mode Rejection Ratio (CMRR), as shown in the following figure.



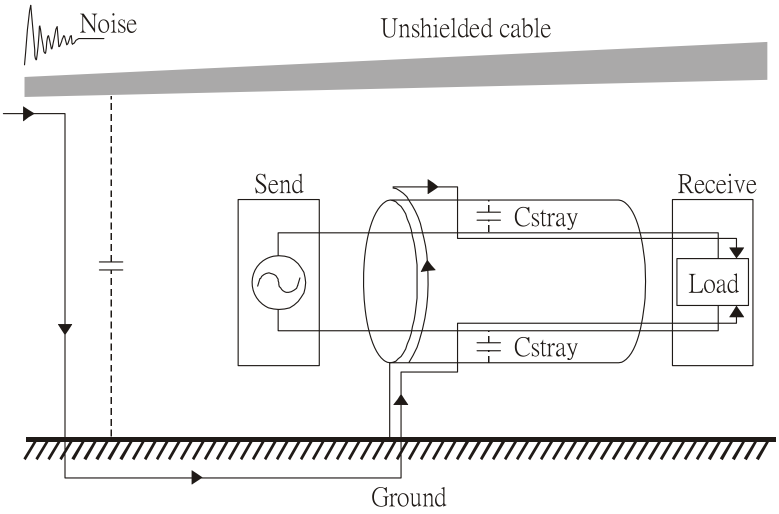
2. Common-mode noise in the power cable is transmitted through the stray capacitance and coupled into the adjacent signal cable, as shown in Figure 2. Several methods can be applied to reduce the effect of this common-mode noise; for example, shield the power cable and/or the signal cables, separate 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°, etc.



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.

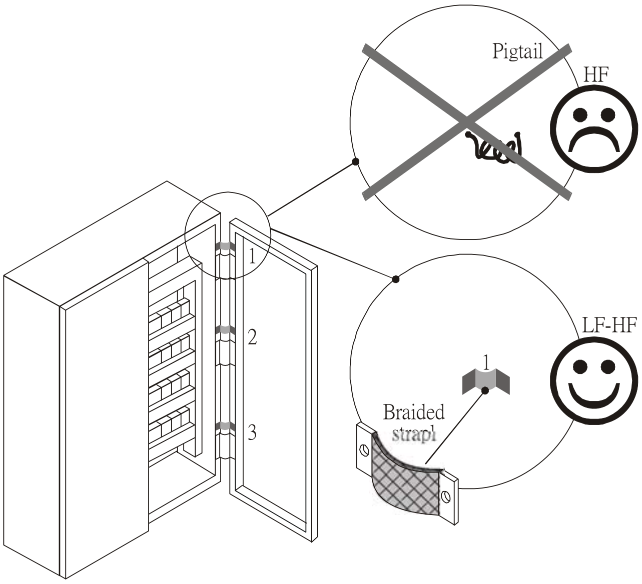
According to Ohm's law, the earth resistance for electrode and the ground are different, in this case potential differences may arise.

3.1 Protective Grounding & Functional Grounding

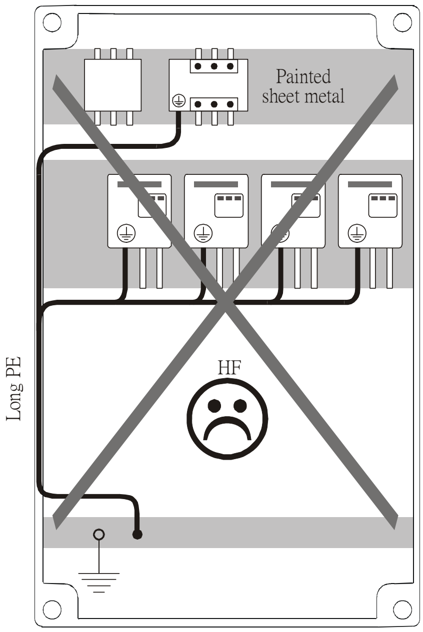
Please carefully read the following instruction if two types of grounding are applied at the same time. Protective grounding is applied outside buildings and must have low resistance. On the other hand, functional grounding can be applied inside buildings and must have low impedance.
The goal of EMC is to avoid any interference effects. Grounding for EMC can be distinguished by frequency. For frequencies lower than 10kHz, a *single-point ground* system should be used and for frequencies higher than 10 kHz, a *multiple point ground* system should be used.

- *Single Point Grounding*: all signal grounds of all IT equipment are connected in series to form a single reference point. This point can be grounded directly to earth; to the designated grounding point or to the safety point that is already grounded.
- *Multiple Point Grounding:* all signals of all IT equipment are grounded independently.
- *Hybrid Grounding:* this type of grounding behaves differently for low and high frequencies. When two pieces of IT equipment (A and B) are connected via a shielded cable, one end is connected directly to ground while the other end is connected to ground via a capacitor. This type of grounding system fulfils the criteria for high and low frequency grounding.
- *Floating grounding:* the signals of all IT equipment are isolated from each other and are not grounded.

DC current flows evenly throughout the conductor section. But AC current flows towards the conductor's surface as frequency increases; this is called the "skin effect". It causes the effective cross-section area to be reduced with increasing frequency. Therefore it is suggested to increase the effective ground cross-section area for high frequencies by replacing pigtail grounding by braided conductors or strip conductors. Refer to the following figure.



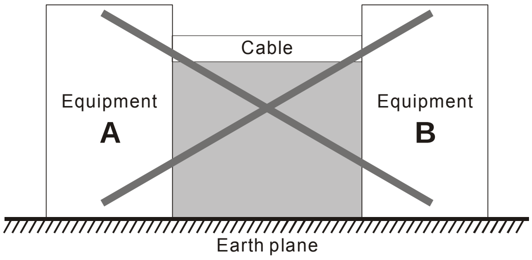
This is why a thick short ground wire must be implemented for connecting to the common grounding path or the ground busbar. Especially when a controller (e.g. PLC) is connected to an AC motor drive, it must be grounded by a short and thick conducting wire. It is suggested to use a flat braided conductor (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.

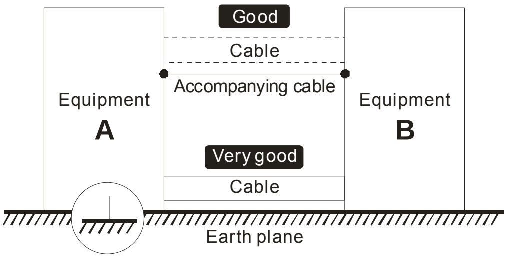


3.2 Ground Loops

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

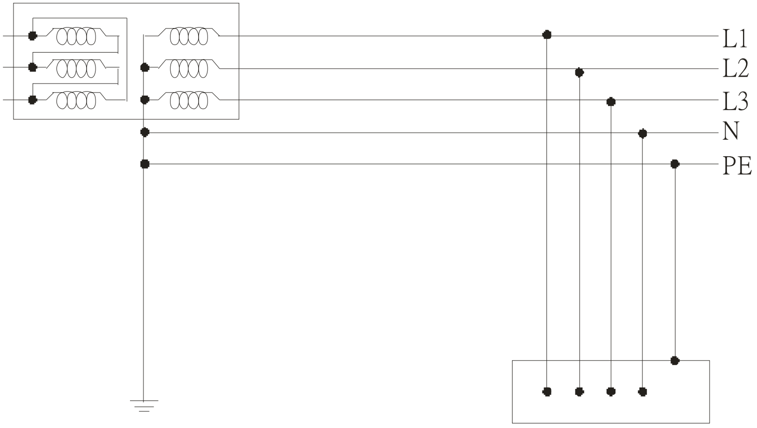
The international standard IEC60364 distinguishes three different earthing system categories, using the two-letter codes TN, TT, IT.

- 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.)
  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

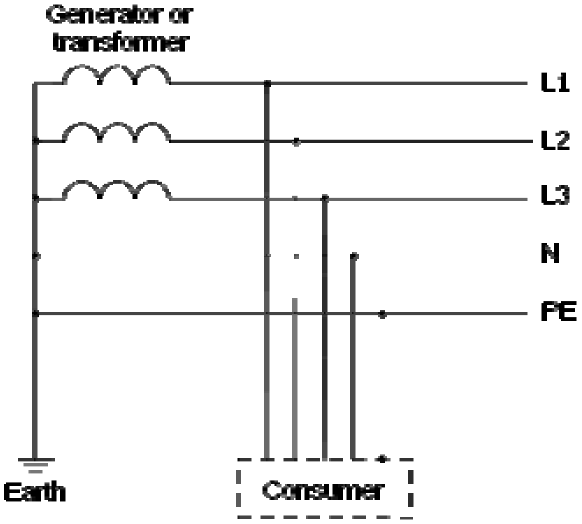
TN*:* The neutral point of the low voltage transformer or generator is earthed, usually the star point in a three-phase system. The body of the electrical device is connected to earth via this earth connection at the transformer.

protective earth (*PE*): 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.



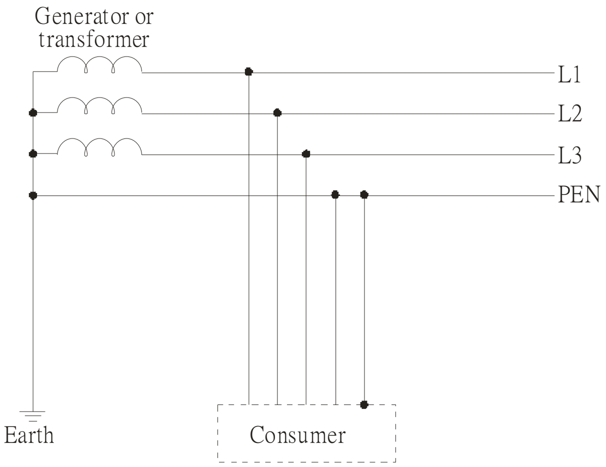
TN-S system

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.



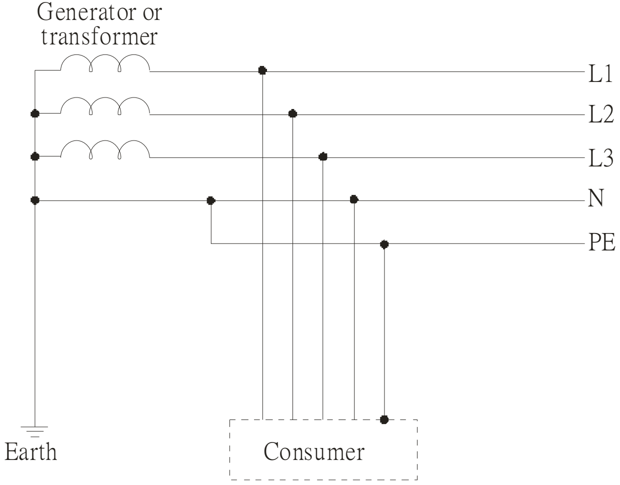
TN-C system

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.



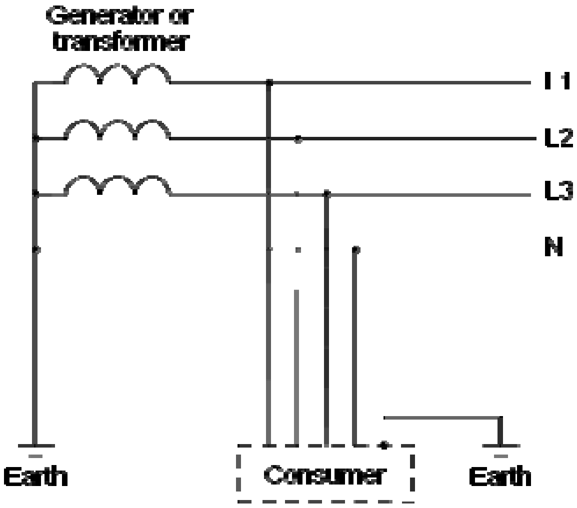
TN-C-S system

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



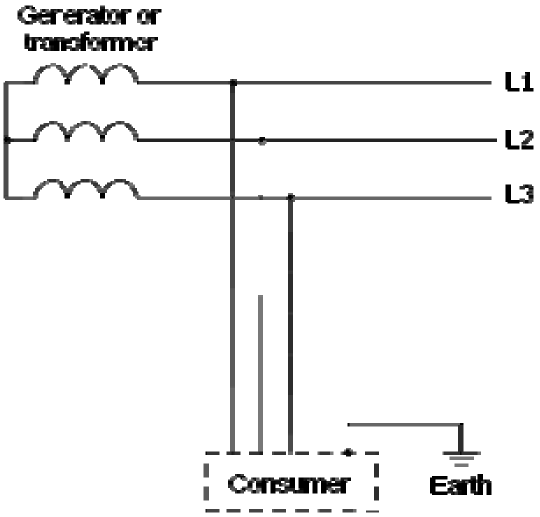
TT system

TT: The neutral point (N) of the low voltage transformer and the equipment frames (PE) are connected to a separate earthing point. The Neutral (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 Continuity of the PE conductor must be ensured throughout the installation	Good Continuity of the PE conductor must be ensured throughout the installation	Good RCD is mandatory	Good Continuity of the PE conductor must be ensured throughout the installation
Safety of property	Poor High fault current (around 1kA)	Poor High fault current (around 1kA)	Good Medium fault current (< a few dozen amperes)	Good Low current at the first fault (< a few dozen mA) but high current at the second fault
Availability of energy	Good	Good	Good	Excellent
EMC behavior	Excellent Few equipotential Problems: - Need to handle the high leaking currents problem of the device - High fault current (transient disturbances)	Poor (prohibited) - Neutral and PE are the same - Circulation of disturbance currents in exposed conductive parts (high magnetic-field radiation) - High fault currents (transient disturbances)	Good - Over-voltage risk - Equipotential Problems: - Need to handle the high leaking currents problem of the device - RCD (Residual-current device)	Poor (should be avoided) - Over-voltage risk - Common–mode filters and surge arrestors must handle the phase to phase voltage. - RCDs subject to nuisance tripping when common-mode capacitors are present - Equivalent to TN system for second fault

Chapter 4 Solution to EMI: Shielding

4.1 What is Shielding?

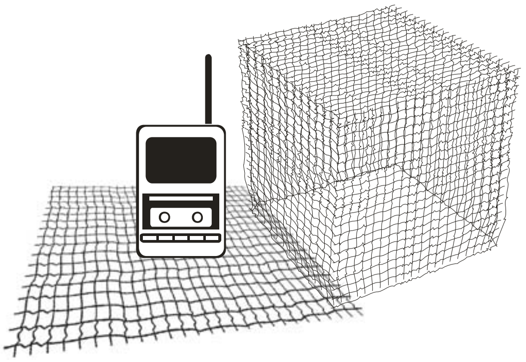
Electrostatic shielding is used to isolate equipment so that it will not create electromagnetic field interference or be influenced by an external electromagnetic field. A conductive material is used for electrostatic shielding to achieve this isolation.

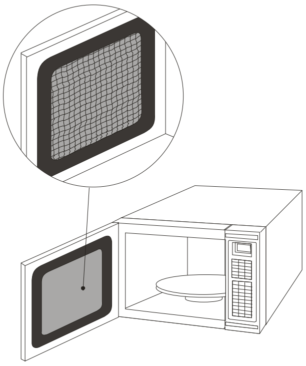
A *Faraday cage* can be made from a mesh of metal or a conductive material.
One characteristic of metal is that it is highly conductive and not electrostatic,, which offers shielding and prevents interference by external electrical fields. Metal with its high conductivity protects the internal devices 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:

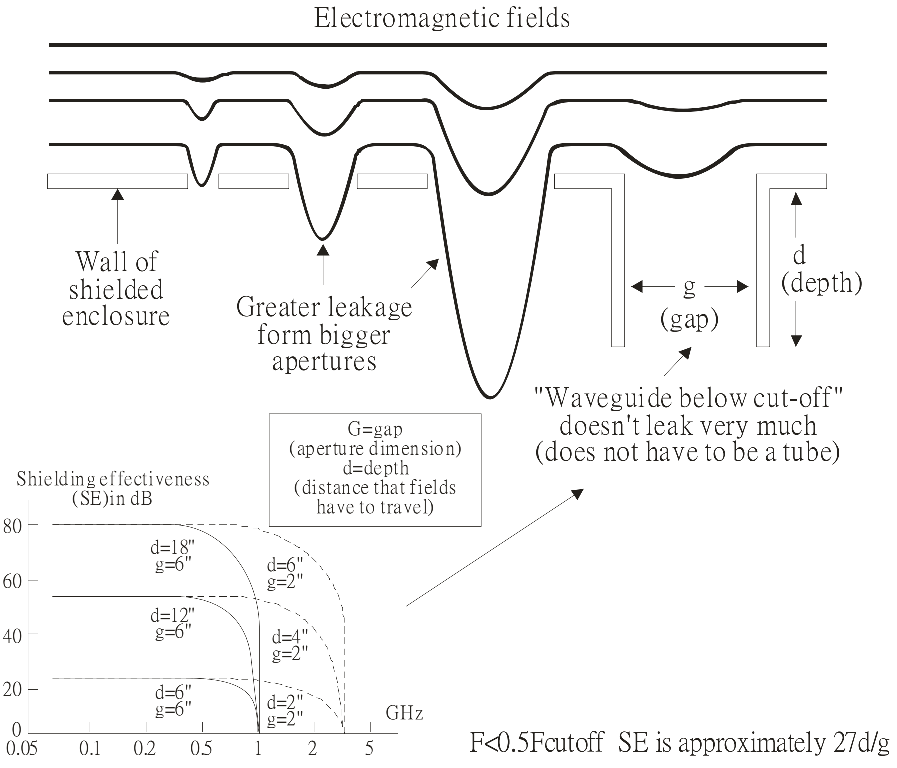
- earth high-voltage indoor equipment using a metal frame or a high-density metal mesh
- shielding a power transformer is achieved by wrapping a metal sheet between the primary and secondary windings or by adding an enamel wire to the winding wire which is then earthed.
- a shielding coating, which is 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.



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:

SEdB=A+R+B (Measures in dB) where A= Absorption loss (dB)
R= Reflection loss (dB)
B= Correction factor (dB) (for multiple reflections in thin shields)

The absorption loss refers to the amount of energy loss as the electromagnetic wave travels through the shield. The formula is:

AdB=1.314(fσμ)1/2t where f= frequency (MHz)
μ= permeability relative to copper
σ= conductivity relative to copper
t= thickness of the shield in centimetres

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

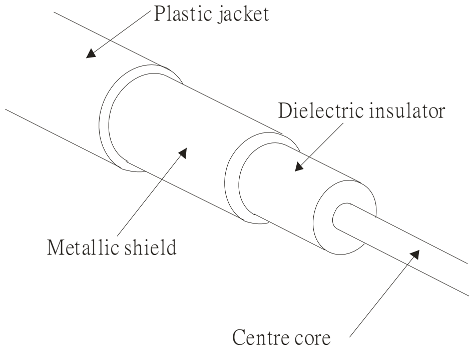
Shielded Twisted Pair (STP) is a type of cable where two insulated copper wires are twisted together with a metal mesh surrounding the twisted pair that forms the electromagnetic shielding and can also be used for grounding.

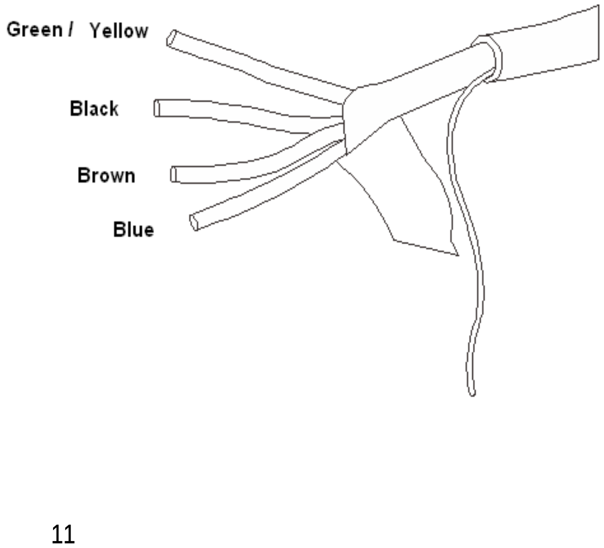
The individual electrical wires and complete cable are surrounded by (synthetic) rubber, that provides insulation and also protects against damage.

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.





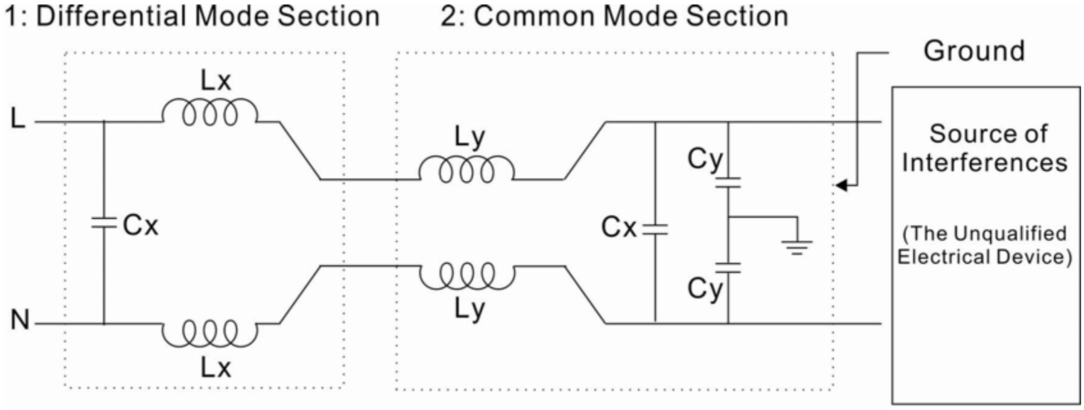
Chapter 5 Solution to EMI: Filter

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 (150kHz~300MHz) and low frequency (100Hz~3000Hz). High-frequency noise fades more over distance and has a shorter wave-length, while low-frequency noise fades less over distance and has a longer wave-length.. Both types of interference are transmitted through power cables and power leads, affecting the power supply side.

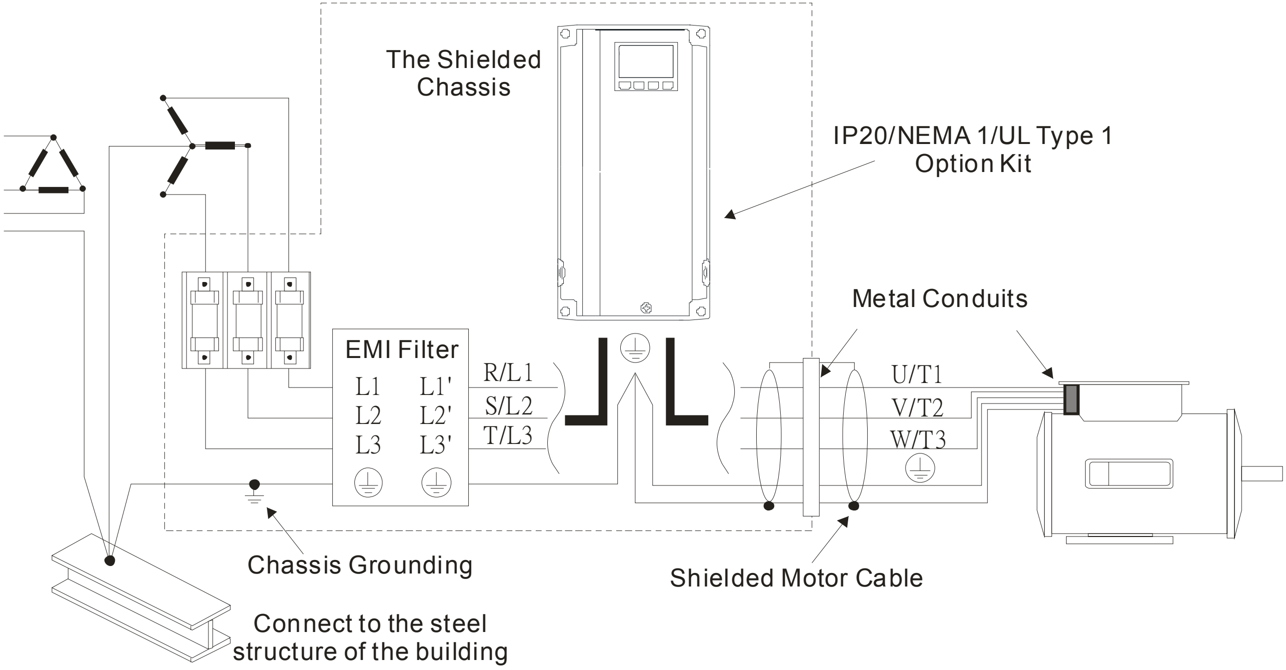
High-frequency interference at the power side can be eliminated or attenuated by mounting a filter. The filter consists of coils and capacitors. Some drives do not have a built-in filter, in which case the installation of an external option filter is required. The drawing below shows a standard filter diagram:



A filter is composed of a Differential Mode section (to eliminate noise below 150kHz) and a Common Mode section (to eliminate noise above 150kHz). 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

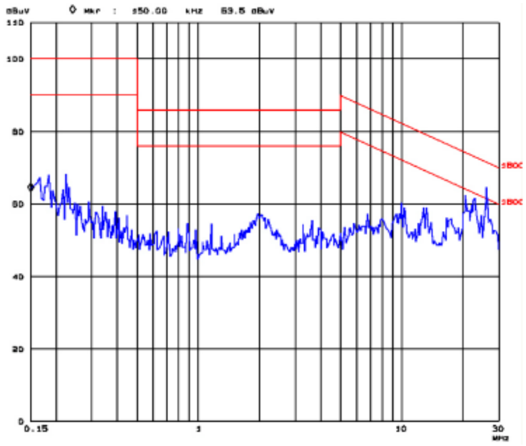
The filter and the AC drive should be installed in the control cabinet or on the mounting plate that is earthed to ground. The motor cable must be shielded and as short as possible. Please use the filters recommended by Delta to ensure compliance with EMC standards.



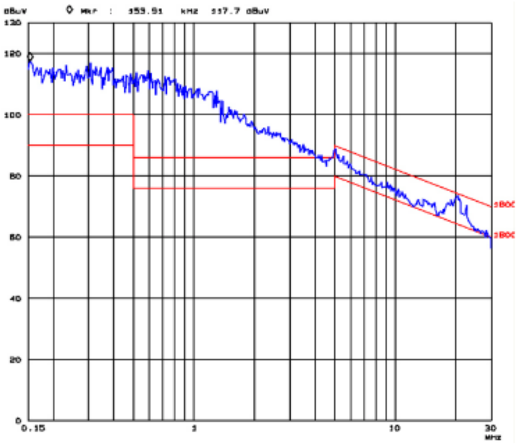
AC Motor Drives with Built-in Filter

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>

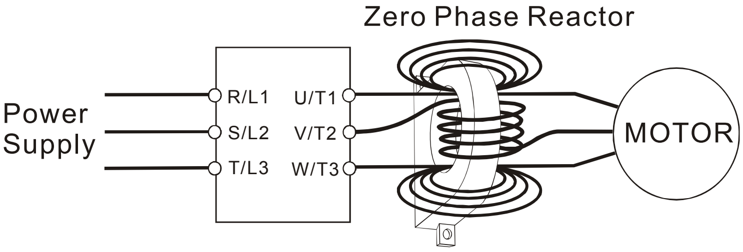
Zero Phase Reactor (Choke)

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.

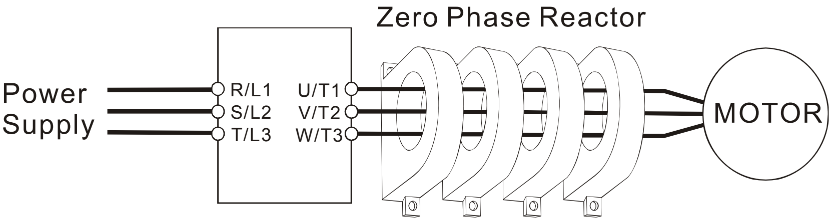
Zero Phase Reactor Installation

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.



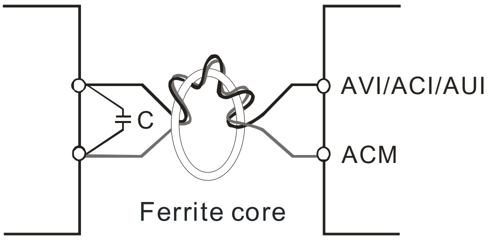
2. Place all wires through the middle of four zero-phase reactors without winding.



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.

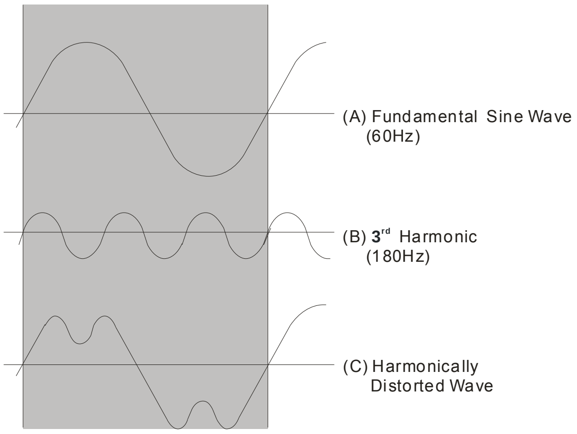
Wind the wires around the core in same direction for 3 times or more.

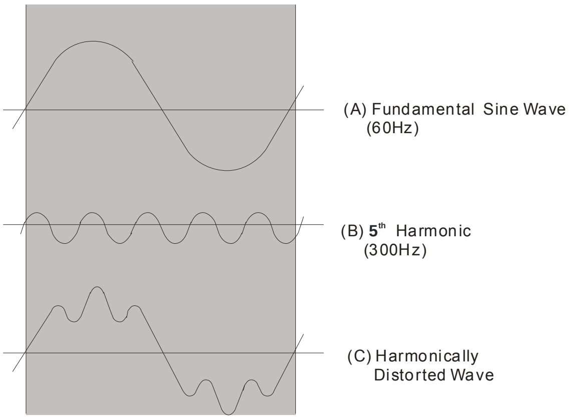


5.2 Harmonic Interference

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).

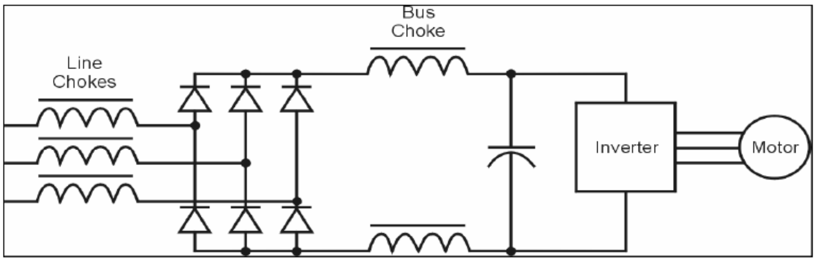
Harmonic Current at the Power Supply Side





Suppression of Harmonic Currents

When a large portion of lower order harmonic currents (5th, 7th, 11th ,etc) occur at the power input, surrounding devices will be disturbed and the power factor will be low as a result of reactive power. Installing a reactor at the AC Motor Drive’s input effectively suppresses lower order harmonic currents.



AC Reactor

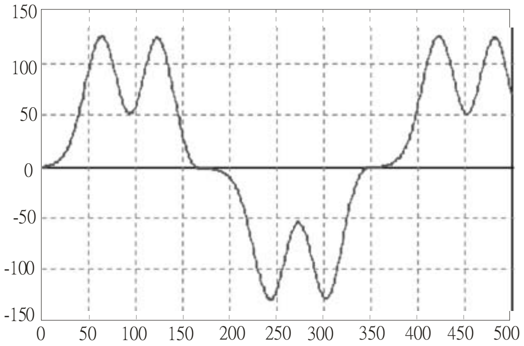
Installed in series with the power supply and is effective in reducing low order current harmonics. Features of an AC reactor include:

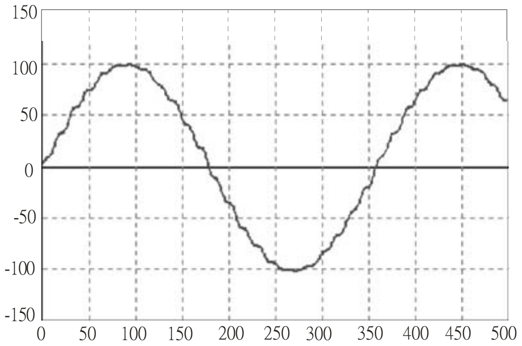
1. Reduces the harmonic currents to the AC Motor Drive and increases the impedance of the power supply.
2. Absorbs interferences generated by surrounding devices (such as surge voltages, currents, and mains surge voltages) and reduce their effect on the AC Motor Drive.
3. Increases the power factor.

DC Reactor

A DC-Reactor is installed between the rectifier and the DC-bus capacitor to suppress harmonic currents and to achieve a higher power factor.

Current Wave Diagrams


Without Reactor


With Reactor