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MAHER

AFE2000

Active Front End Unit

User Manual

2011-02-15
5012604300-AFE0

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User Manual

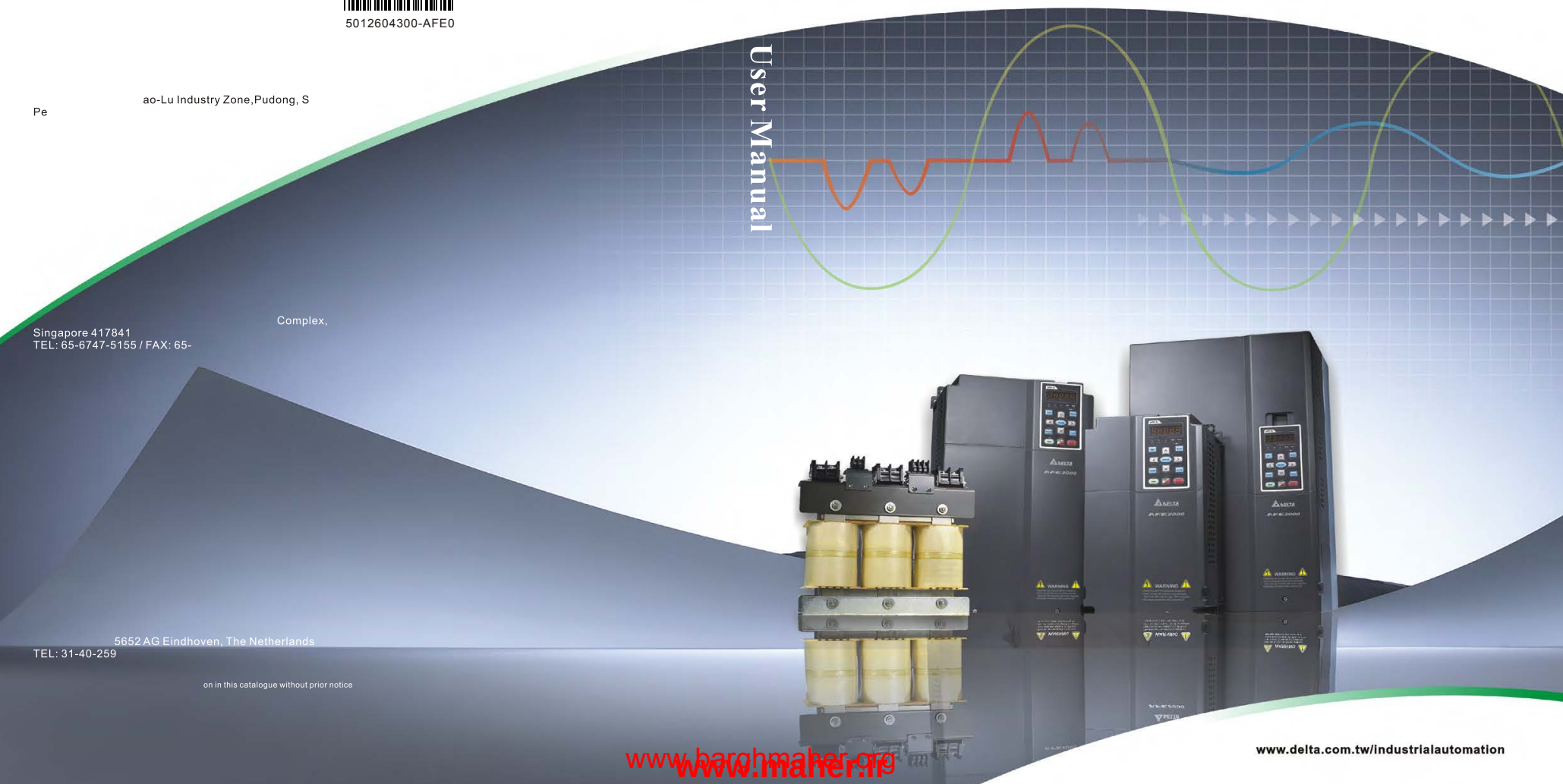


Table of Content

PLEASE READ THE FOLLOWING INFORMATION PRIOR TO INSTALLATION FOR SAFETY.

DANGER	☑ AC input power must be disconnected before any wiring or connection is made to the AFE2000. ☑ A charge may still remain in the DC-link capacitors with hazardous voltages after the power has been turned off. DO NOT touch the internal circuit and any other components before the Power LED indicator is off. ☑ There are highly sensitive MOS components on AFE2000 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 the internal components or wires. ☑ Ground AFE2000 using the ground terminal. The grounding method must comply with the laws of the country. ☑ Keep AFE2000 and the installation away from fire and inflammables.
CAUTION	☑ Only the qualified personnel are allowed to install, wiring, and repair the drive. ☑ A hazardous voltage may still remain in the AFE2000 main circuit terminals even when the three-phase DC motor is at stop status. ☑ If AFE2000 is not charged for more than 3 months, keep the ambient temperature lower than 30 °C. It should be avoided keeping AFE2000 in storage for over a year; it could cause degradation of electrolytic capacitors.

NOTE

- The content of this manual may be revised without prior notice. Please consult our distributors or download the recent version at (http://www.delta.com.tw/industrialautomation/)

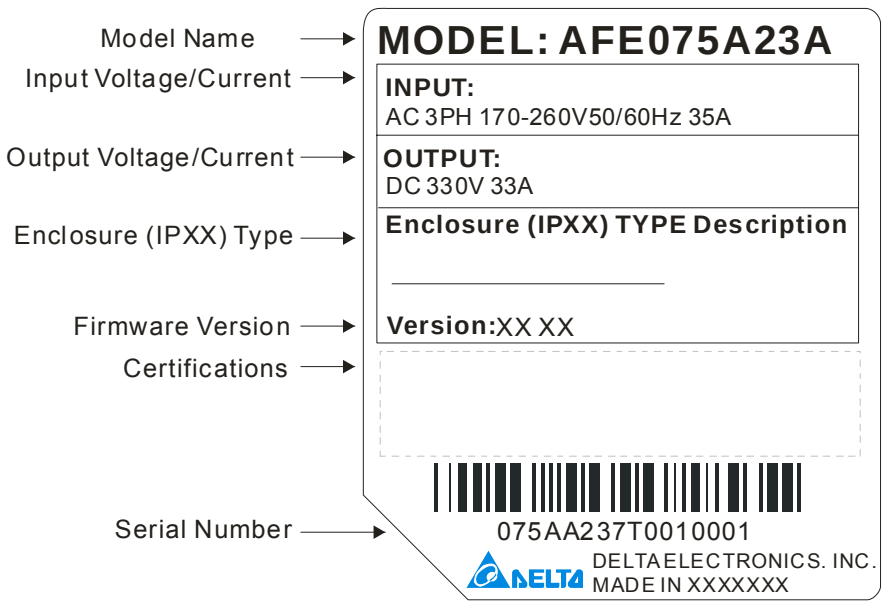
Chapter 1 Introduction

1.1 Receiving and Inspection

For usage safety of the AC motor drive, please check for the followings:

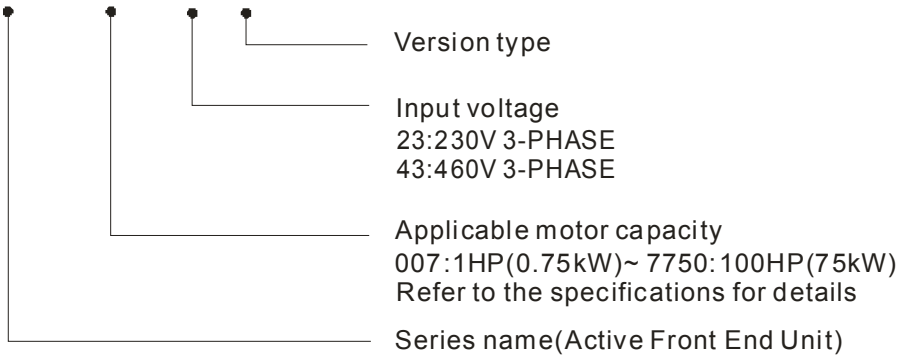
1. Please inspect the unit after unpacking to assure it was not damaged during shipment.
2. Make sure that the part number printed on the package corresponds with the part number indicated on the nameplate.
3. Make sure that the voltage for the wiring lie within the range as indicated on the nameplate.
4. Please install the AC motor drive according to this manual.
5. Before applying the power, please make sure that all the devices, including power, motor, control board and digital keypad, are connected correctly.
6. 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.

Nameplate



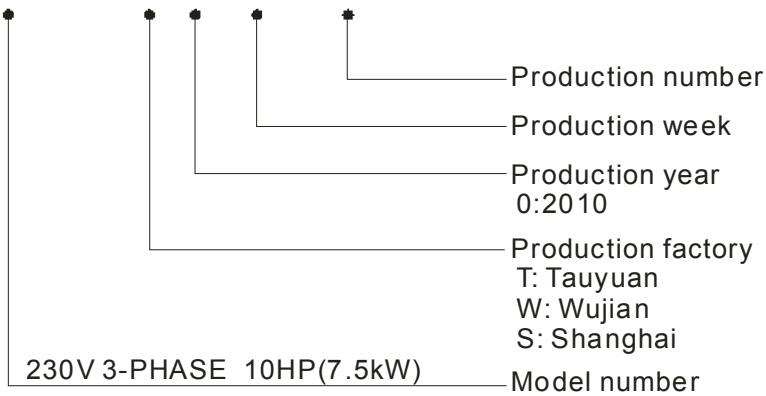
Model Name

AFE 075A 23 A



Serial Number

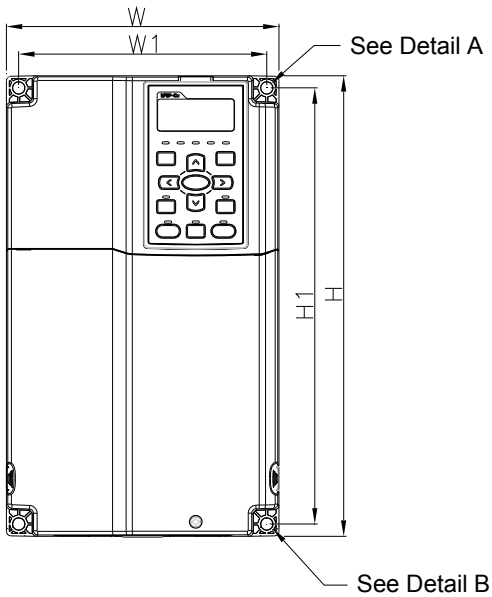
075AA237 T 0 01 0001

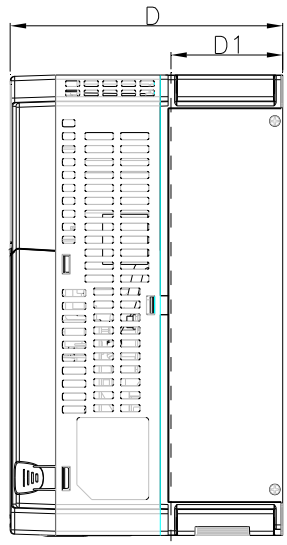


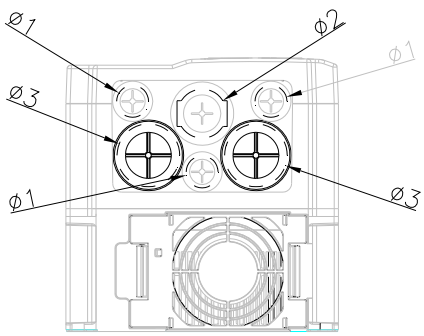
1.2 Dimensions

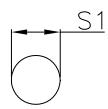
Frame B

AFE075A23A; AFE075A43A; AFE150A43A

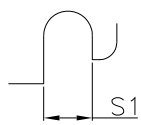








Detail A (Mounting Hole)



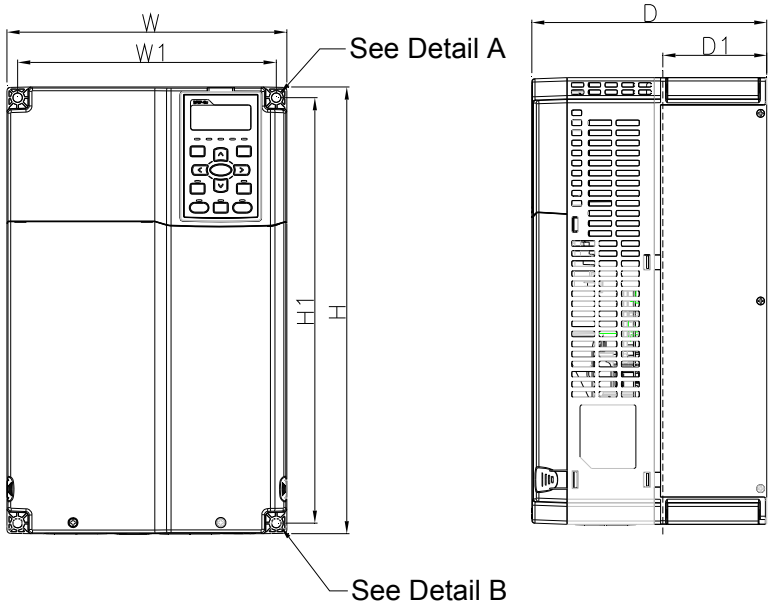
Detail B (Mounting Hole)

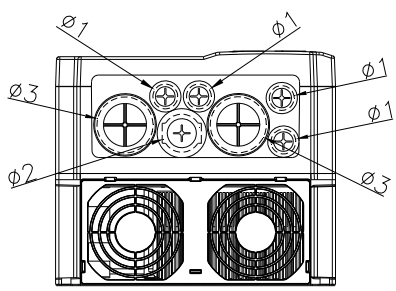
Unit:mm [inch]

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]

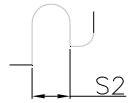
D1*: Flange mounting

Frame C
AFE150A23A; AFE220A23A; AFE220A43A





Detail A (Mounting Hole)



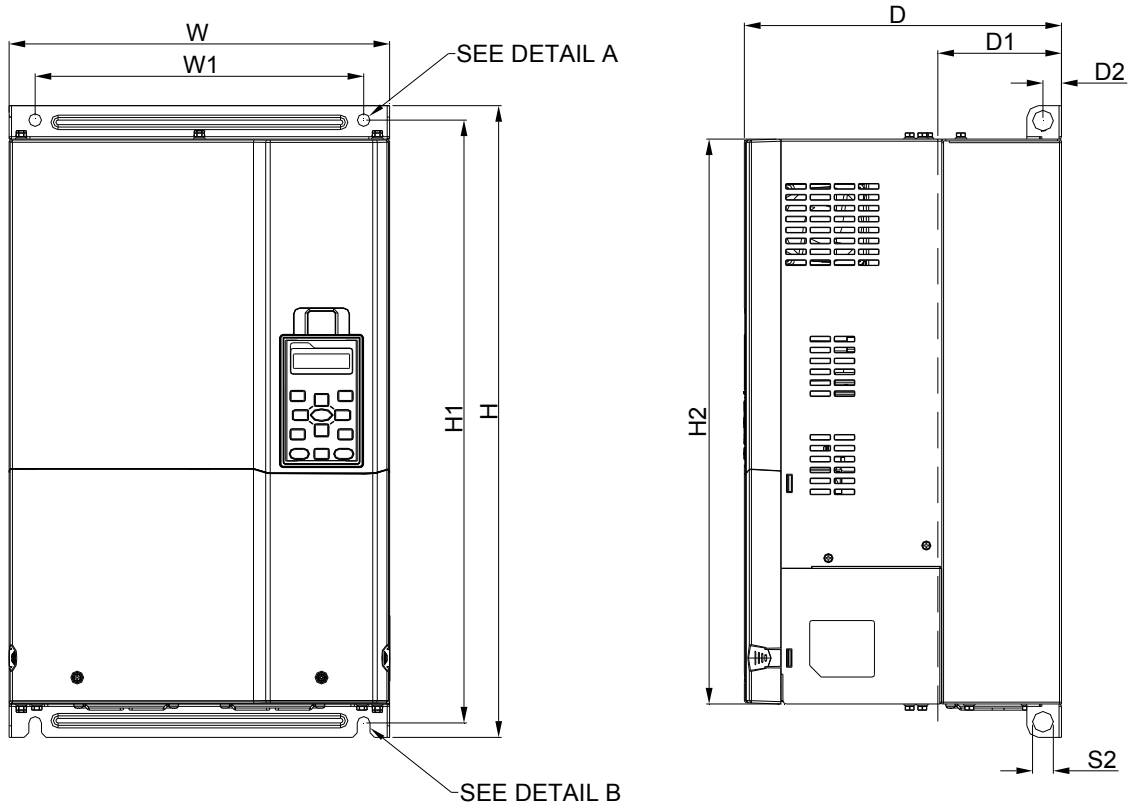
Detail B (Mounting Hole)

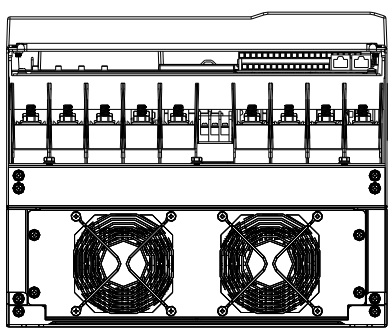
Unit:mm [inch]

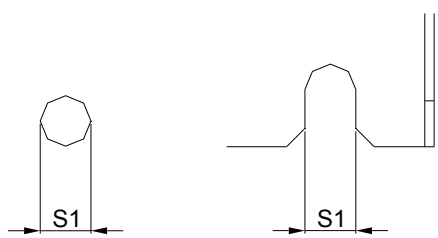
Frame	W	H	D	W1	H1	D1*	S1	Φ1	Φ2	Φ3
C1	250.0 [9.84]	400.0 [15.75]	210.0 [8.27]	231.0 [9.09]	381.0 [15.00]	92.9 [3.66]	8.5 [0.33]	22.2 [0.87]	34.0 [1.34]	50.0 [1.97]

D1*: Flange mounting

Frame D
D1: AFE370A23A; AFE370A43A; AFE450A43A; AFE750A43A;







DETAIL A
(MOUNTING HOLE)

DETAIL B
(MOUNTING HOLE)

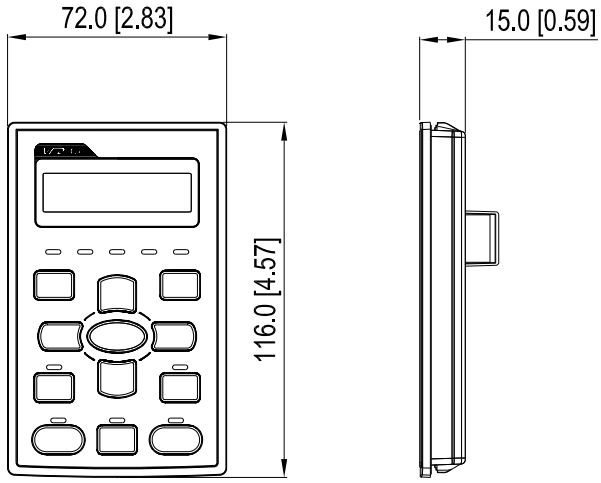
Unit:mm[inch]

Frame	W	H	D	W1	H1	H2	D1*	D2	S1	S2
D1	330.0 [12.99]	550.0 [21.65]	275.0 [10.83]	285.0 [11.22]	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

Digital Keypad

KPC-CE01

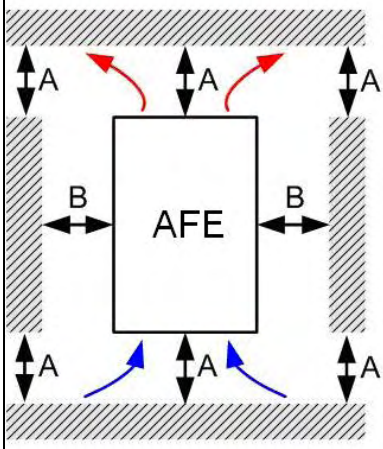


Chapter 2 Installation

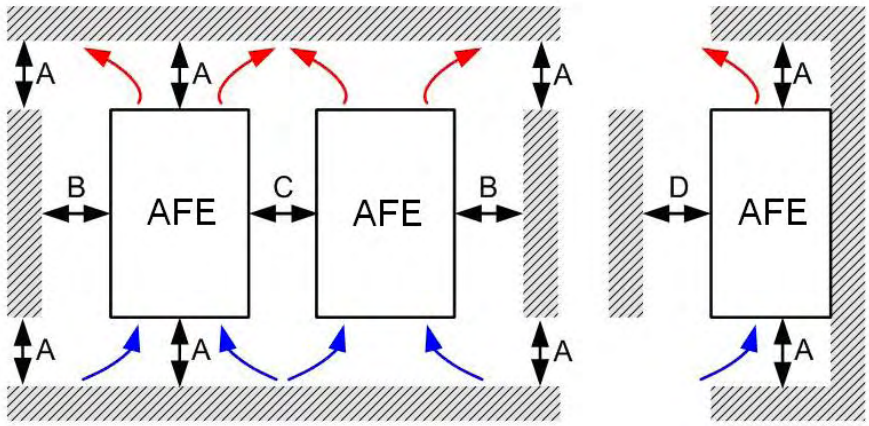
The appearances shown in the following figures are for reference only.

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

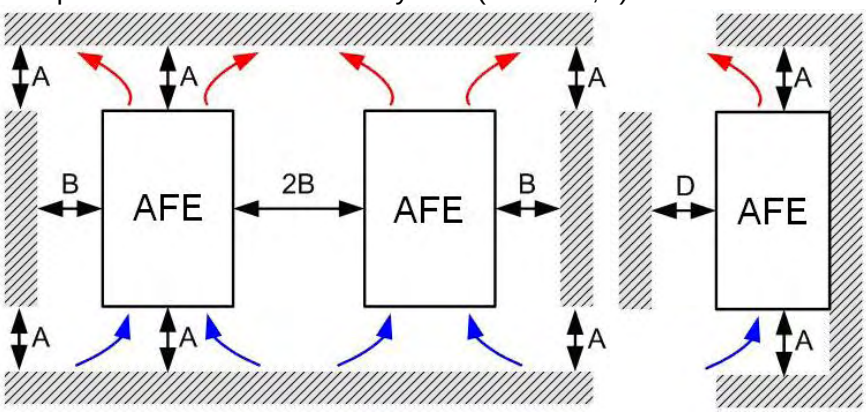
Single driv installation (Frame B-D)



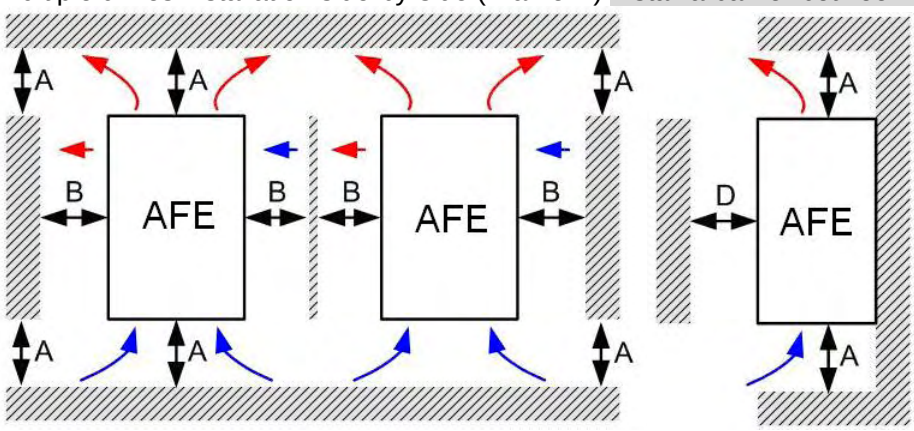
Side-by-side installation (Frame B-C)



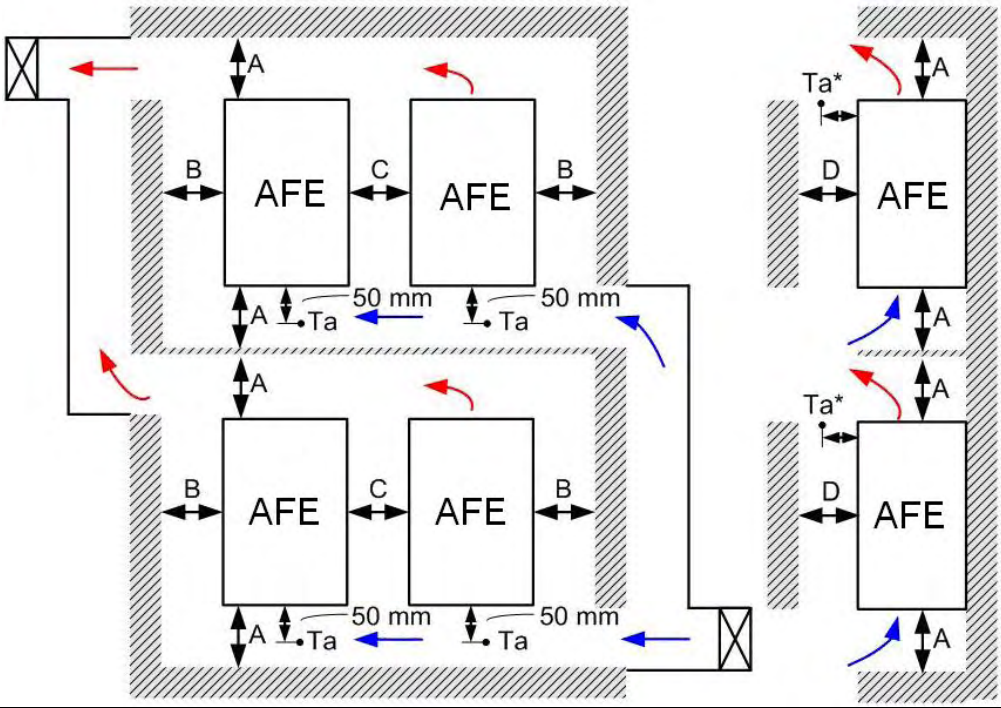
Multiple drives installation side-by-side (Frame B,C)



Multiple drives installation side-by-side (Frame D) Install a barrier between the drives



Multiple drives installation side-by-side in rows (Frame B,C) Ta: Frame B~D
For installation in rows, it is recommend to install a barrier between the drives. Adjust the size of the barrier till the temperature measured at the fan's inflow side is lower than the operation temperature. Operation temperature is the defined as the temperature measured 50mm away from the fan's inflow side. (As shown in the figure below)



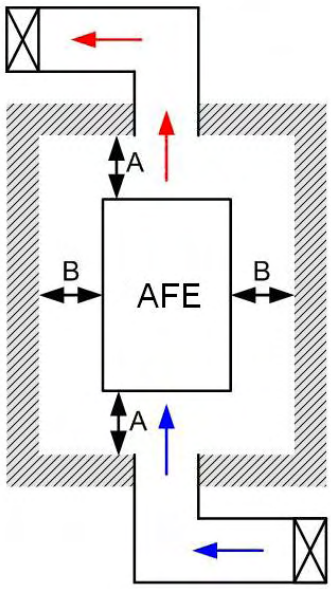
Minimum Mounting Clearances

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

Frame B	AFE075A23A; AFE075A43A; AFE150A43A;
Frame C	AFE150A23A; AFE220A23A; AFE220A43A;
Frame D	AFE370A23A; AFE370A43A; AFE450A43A; AFE750A43A;

NOTE

1. It is the minimum distance required for Frame B~D. If drives are installed closer than the minimum mounting clearance, the fan would not be able to function properly.



NOTE

※ The mounting clearances shown in the left figure are **NOT** for installing the drive in a confined space (such as cabinet or electric box). When installing in a confined space, besides the same minimum mounting clearances, it needs to have the ventilation equipment or air conditioner to keep the surrounding temperature lower than the operation temperature.

※ 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.

Air flow rate for cooling							Power Dissipation		
Model No.	Flow Rate (cfm)			Flow Rate (m^3/hr)			Power Dissipation		
	External	Internal	Total	External	Internal	Total	Loss External (Heat sink)	Internal	Total
AFE075A23A	66	14	80	112	24	136	249	86	335
AFE150A23A	166	12	178	282	20	302	455	161	616
AFE220A23A	146	12	158	248	20	268	649	216	865
AFE370A23A	179	30	209	304	51	355	1091	220	1311
AFE075A43A	40	14	54	68	24	92	216	76	292
AFE150A43A	58	14	73	99	24	124	396	122	518
AFE220A43A	99	21	120	168	36	204	476	158	635
AFE370A43A	179	30	209	304	51	355	809	184	993
AFE450A43A	179	30	209	304	51	355	929	218	1147
AFE750A43A	186	30	216	316	51	367	1408	334	1742

※ 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.

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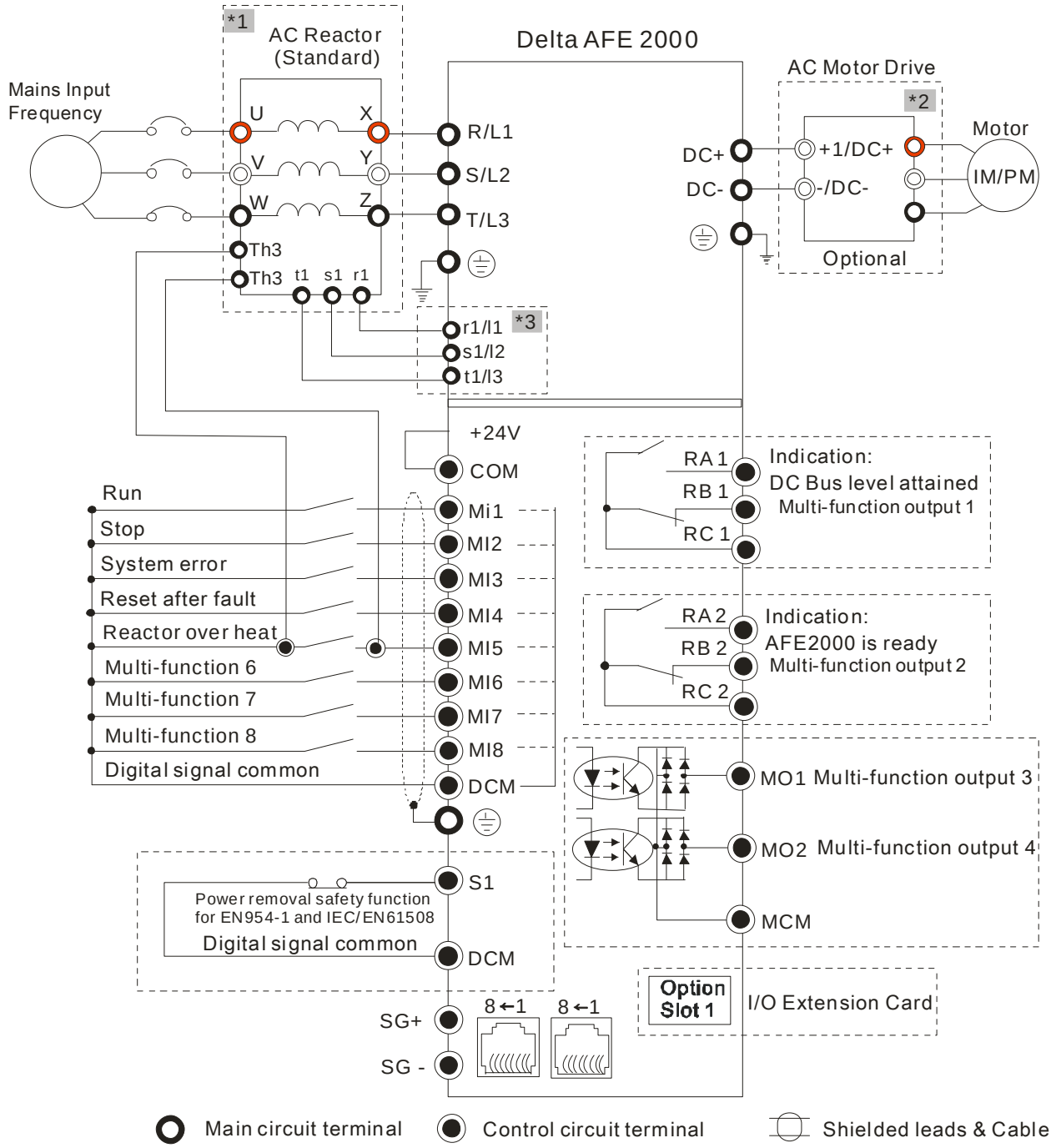
Chapter 3 Wiring

One-to-One Installation (One AFE unit + One AC motor drive)



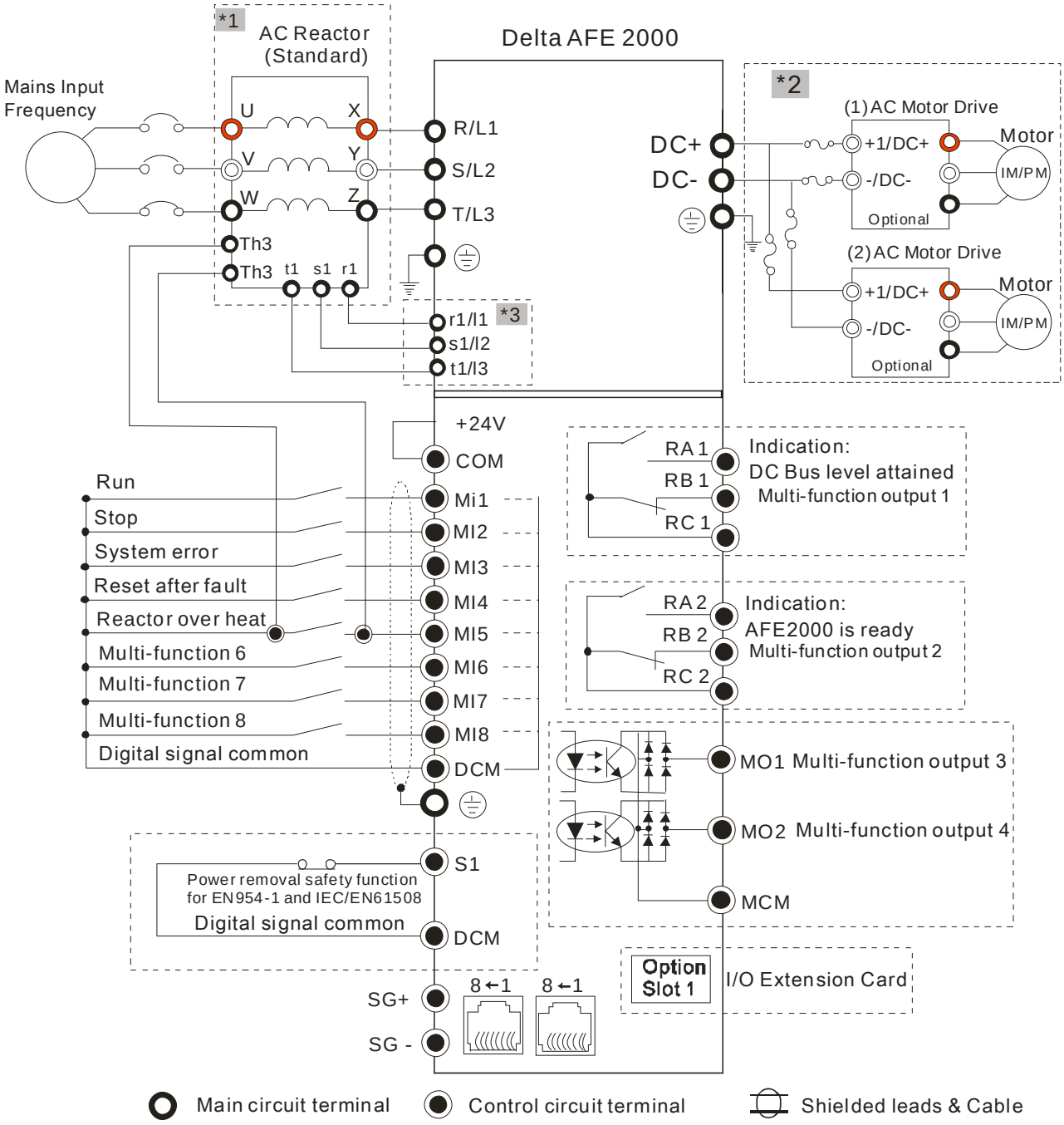
NOTE

*1 The Delta AC reactor (optional accessory) comes with a thermal protection function. When the reactor's temperature exceeds 120 ºC, the TH3 terminal will come ON and the AFE 2000 will receive a signal from the MI terminal to issue a warning message.

*2 For one-to-many installation, installing a fuse on the AC motor drive's input side is recommended. Please select a compatible fuse for your AC motor drive using the equation: Fuse specification= AC rated input current/ 0.78*1.5

*3 If the AC reactor installed on the system is not Delta's AC reactor, please connect the reactor's terminal to the power input terminal (R(L1), S(L2), T(L3)) for wiring.

One-to-Many Installation (One AFE unit + Many AC motor drives)



NOTE

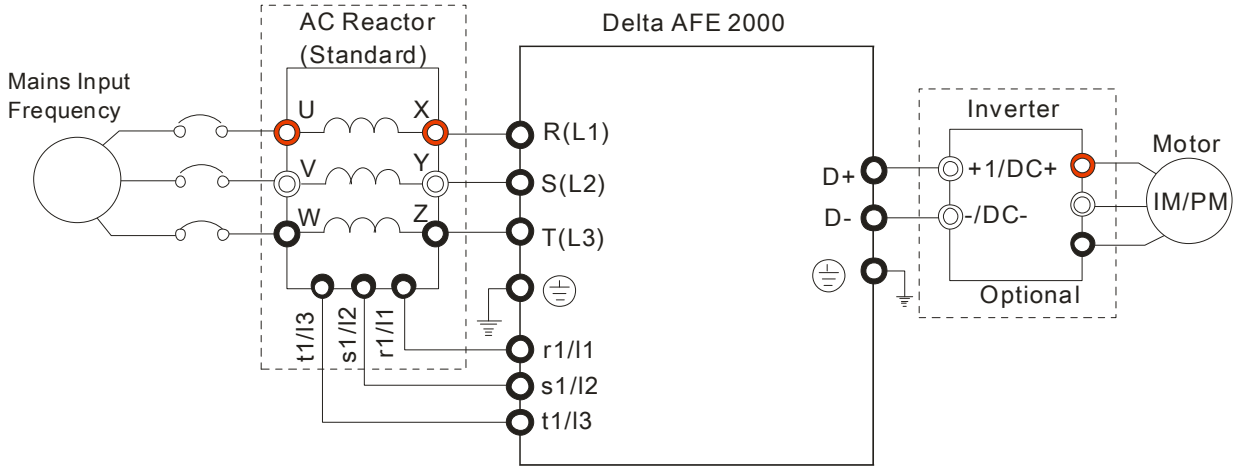
*1 The Delta AC reactor (optional accessory) comes with a thermal protection function. When the reactor's temperature exceeds 120 ºC, the TH3 terminal will come ON and the AFE 2000 will receive a signal from the MI terminal to issue a warning message.

*2 For one-to-many installation, installing a fuse on the AC motor drive's input side is recommended. Please select a compatible fuse for your AC motor drive using the equation: Fuse specification= AC rated input current/ 0.78*1.5

*3 If the AC reactor installed on the system is not Delta's AC reactor, please connect the reactor's terminal to the power input terminal (R(L1), S(L2), T(L3)) for wiring.

Chapter 4 Main Circuit Terminals

Terminal Diagram for AFE2000



Terminals	Description
R(L1), S(L2), T(L3)	AC line input terminals 3-phase
r1/l1, s1/l2, t1/l3	Phase lock input terminal 3-phase
DC+, DC-	AFE2000 output terminal connects to AC motor drive terminal +1/DC+ & -/DC-。
⏚	Protective grounding terminal, please ground according to the local regulations.

CAUTION

Main power terminal:

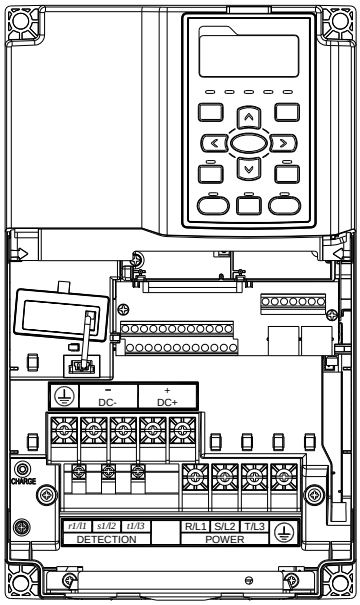
- ☑ Do not connect 3-phase model to one-phase power. It is unnecessary to consider phase-sequence for these terminals R/L1, S/L2 and T/L3.
- ☑ Please make sure to fasten the screw of the main circuit terminals to prevent sparks which is made by the loose screws due to vibration.
- ☑ Please use voltage and current within the specification.
- ☑ 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 or stop the AFE unit by turning the power ON or OFF. Please use the power control terminal MI-RUN, MI-STOP or the RUN/STOP key on the display board to control the AFE unit operation.

Output terminals for main circuit:

- ☑ Connects only the DC+(+1) and DC-(-) terminal of an AC motor drive to AFE unit output terminals.
- ☑ Please pay special attention to the AFE2000 output terminals (+) and (-) for connection, do not connect to the wrong output terminal.

Main Circuit Terminals

Frame B



Main circuit terminals:
R(L1), S(L2), T(L3), ⏚, DC+, DC-

Models	Max. Wire Gauge	Min. Wire Gauge	Torque (±10%)
AFE075A23A	4 AWG (21.2mm^2)	6 AWG (13.3mm^2)	M5 35kg-cm (30.4 lb-in.) (3.434Nm)
AFE075A43A		8 AWG (8.4mm^2)	
AFE150A43A		6 AWG (13.3mm^2)	
UL installations must use 600V, 75℃ or 90℃ wire. Use copper wire only. DC+ & DC-: must use 1kV Wire.			

NOTE

Terminal r1/l1, s1/l2, t1/l3：　Wire Gauge：20AWG [0.5mm²] ~ 14 AWG [2.1mm²]

Torque: 12 kg-cm [10.4 lb-in.] (1.18Nm) (±10%)

If additional terminal is needed when wiring, please refer to Figure 1 for additional terminal dimension.

After crimping the wire to the ring lug please apply the UL approved R/C (YDPU2) heat shrink tubing rate min 600Vac to the terminal. The insulation shall be all over the live part. Please refer to Figure 2.

Detection wire

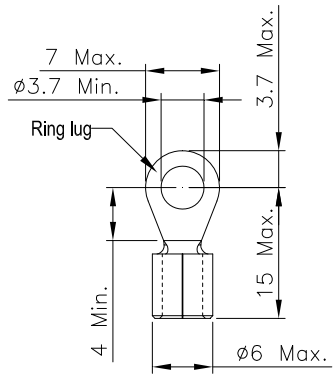


Figure 1

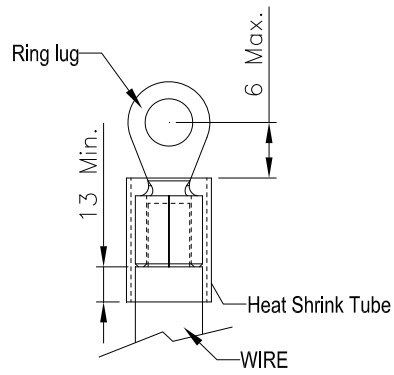


Figure 2

Power wire

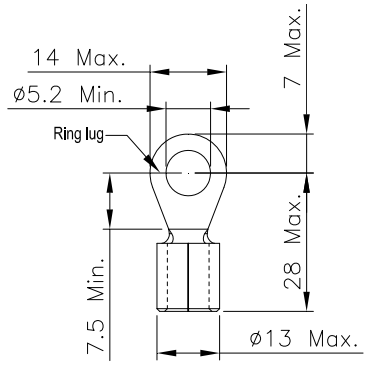


Figure 1

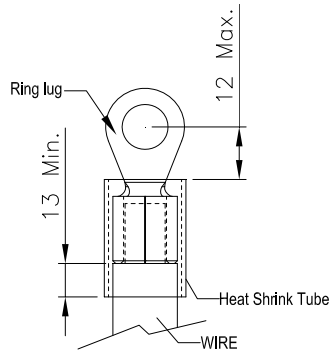
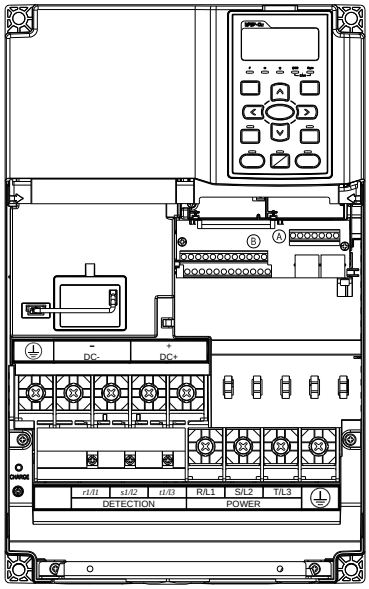


Figure 2

Frame C



Main circuit terminals:

R(L1), S(L2), T(L3), ⏚, DC+, DC-

Models	Max. Wire Gauge	Min. Wire Gauge	Torque (±10%)
AFE150A23A	1/0 AWG (53.5mm^2)	1 AWG (42.4mm^2)	M8 80kg-cm (69.4 lb-in.) (7.85Nm)
AFE220A23A		1/0 AWG (53.5mm^2)	
AFE220A43A		4 AWG (21.2mm^2)	
UL installations must use 600V, 75℃ or 90℃ wire. Use copper wire only. DC+ & DC-: must use 1kV Wire.			

NOTE

Terminal r1/l1, s1/l2, t1/l3：

Wire Gauge：20AWG [0.5mm²] ~ 14 AWG [2.1mm²]

Torque: 12 kg-cm [10.4 lb-in.] (1.18Nm) (±10%)

When surrounding temperature exceeds 45℃, please use 600V,90℃ wire for model AFE220A23A.

If additional terminal is needed when wiring, please refer to Figure 1 for additional terminal dimension.

After crimping the wire to the ring lug please apply the UL approved R/C (YDPU2) heat shrink tubing rate min 600Vac to the terminal. The insulation shall be all over the live part. Please refer to Figure 2.

Detection wire

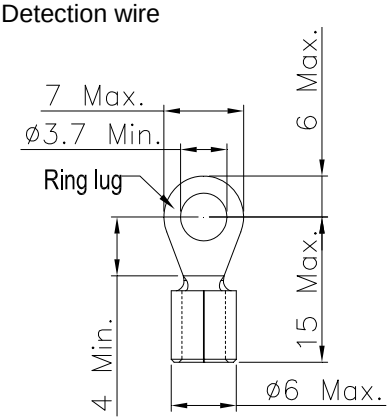


Figure 1

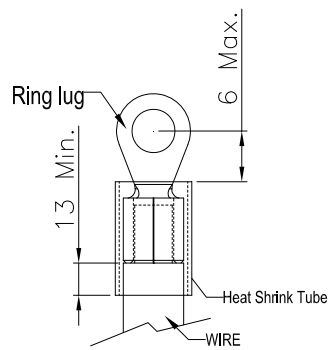


Figure 2

Power wire

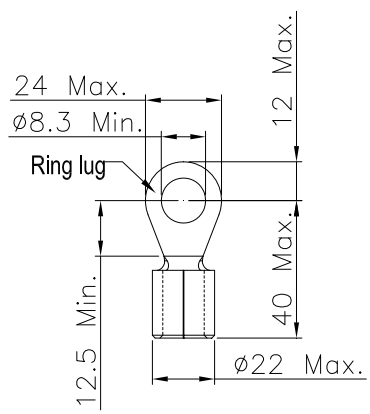


Figure 1

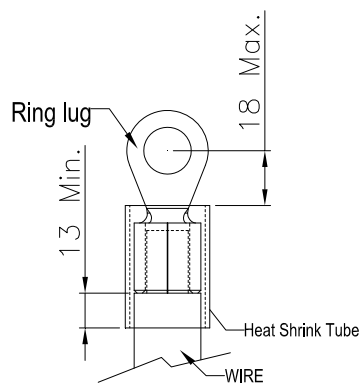
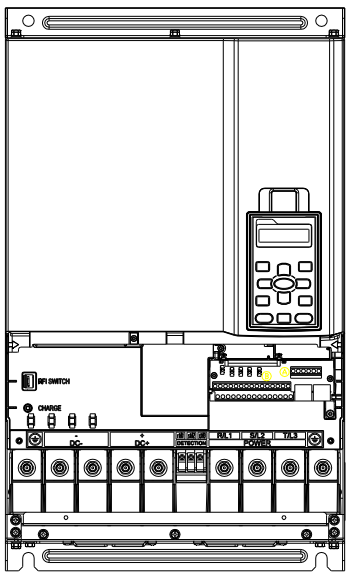


Figure 2

Frame D



Main circuit terminals:
R(L1), S(L2), T(L3) ⏚, DC+, DC-,

Models	Max. Wire Gauge	Min. Wire Gauge	Torque (±10%)
AFE370A23A	300MCM (152mm^2)	250MCM (127mm^2)	M8 200kg-cm (173 lb-in.) (19.62Nm)
AFE370A43A		1/0 AWG (53.5mm^2)	
AFE450A43A		2/0 AWG (67.4mm^2)	
AFE750A43A		300MCM (152mm^2)	
UL installations must use 600V, 75℃ or 90℃ wire. Use copper wire only. DC+ & DC-: must use 1kV Wire.			

NOTE

Terminal r1/l1, s1/l2, t1/l3：

Wire Gauge: 22AWG [0.3mm²] ~ 16 AWG [1.3mm²]

Torque: 5 kg-cm [4.3 lb-in.] (0.49 N.m)

If additional terminal is needed when wiring, please refer to Figure 1 for additional terminal dimension.

After crimping the wire to the ring lug please apply the UL approved R/C (YDPU2) heat shrink tubing rate min 600Vac to the terminal. The insulation shall be all over the live part. Please refer to Figure 2.

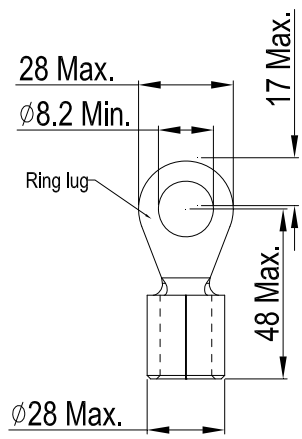


Figure 1

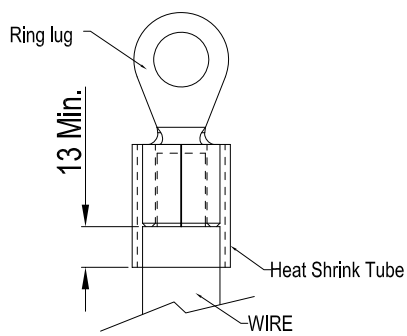


Figure 2

Chapter 5 Control Terminals

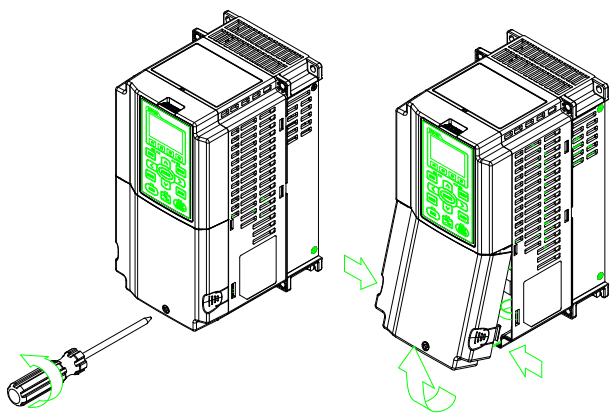
Please remove the cover before wiring multi-function input and output terminals.

The appearance of following figures are for reference only.

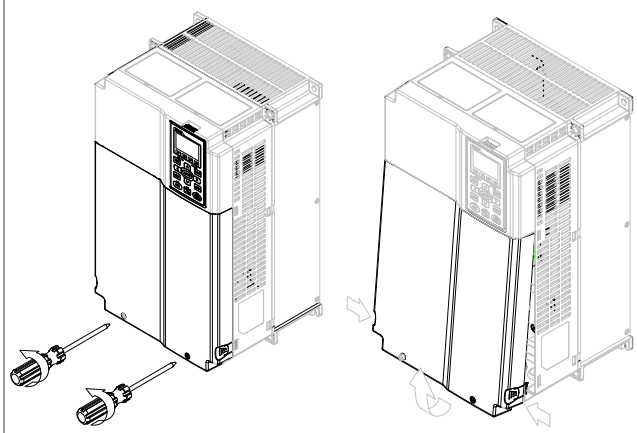
Removes the cover for wiring

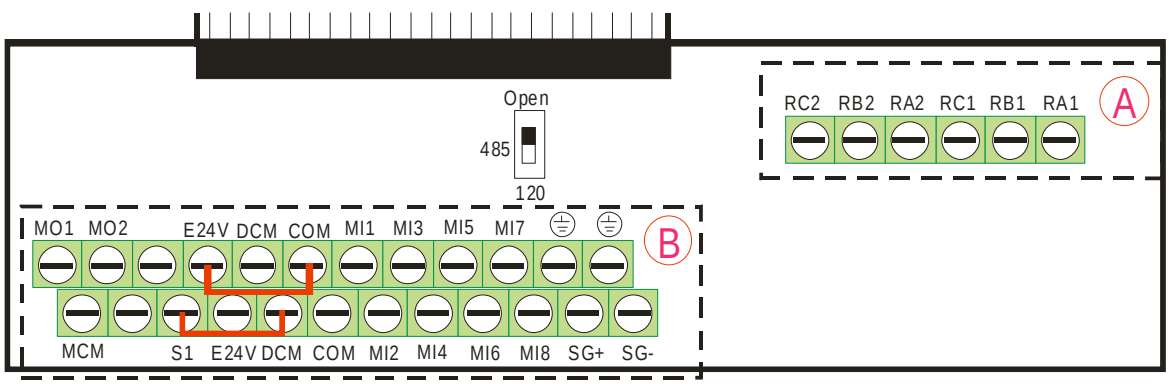
Frame B
Screw torque: 12~15Kg-cm [10.4~13lb-in.]

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



Frame C&D
Screw torque: 12~15Kg-cm [10.4~13lb-in.]





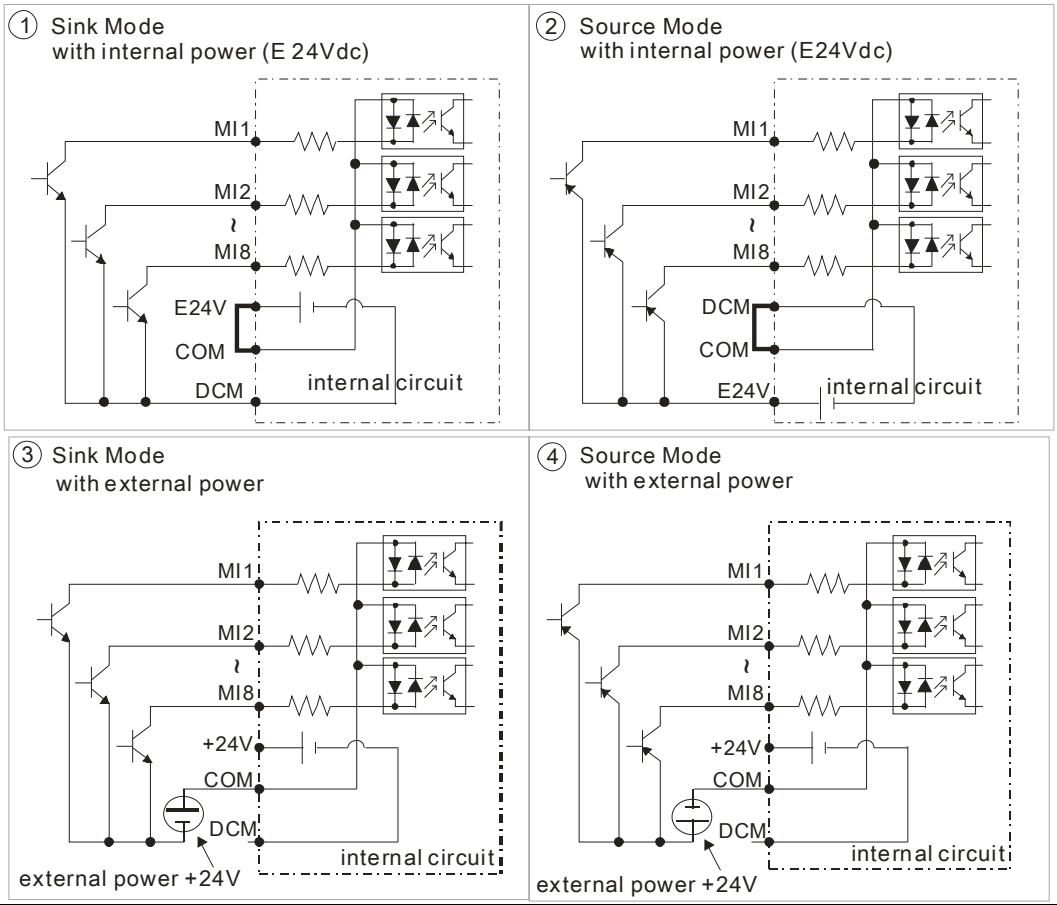
Removable Terminal Block

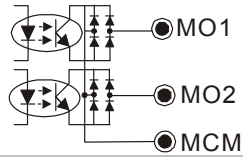
Specifications of Control Terminal

Wire Gauge: 26~16AWG（0.1281-1.318mm^2）;
Torque: (A) 5kg-cm [4.31lb-in.] (0.49Nm) (Refer to the Figure: Removable Terminal Block)
(B) 8kg-cm [6.94lb-in.] (0.78Nm) (Refer to the Figure: Removable Terminal Block)
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
- As shown in the figure above, S1-DCM is short circuit as the factory setting; and for E24V-COM is short circuit SINK mode (NPN), please refer to the following figures for more detail.

SINK（NPN）/SOURCE（PNP）Mode Switching Terminals.



Terminals	Terminal Function	Factory Setting (NPN mode)
E24V	Digital control signal common (Source)	+24V±5% 200mA Factory setting is short circuit status.
COM	Digital control signal common (Sink)	
MI1 ~ MI8	Multi-function input 1~8	The parameters used to set multi-function inputs MI1~MI8 are Pr.02-01~Pr.02-08. ON: the activation current is 6.5mA≧11Vdc OFF: leakage current tolerance is 10μA≦11Vdc
DCM	Digital frequency signal common	Common for multi-function input terminals.
MO1	Multi-function Output 1 (photocoupler)	The AFE2000 releases various monitor signals, such as drive in operation, frequency attained and overload indication, via transistor (open collector). 
MO2	Multi-function Output 2 (photocoupler)	
MCM	Multi-function Output Common (photocoupler)	Max 48Vdc 50mA
S1	The factory setting is short circuit.	
DCM	Power removal safety function for EN954-1 and IEC/EN61508	

Terminals	Terminal Function	Factory Setting (NPN mode)
SG+	PIN 1,2,7,8 :Reserved PIN 3, 6: GND	
SG-	PIN 4: SG- PIN 5: SG+	
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 It is used to output each monitor signal, such as drive is in operation, frequency attained or overload indication.
RB1	Multi-function relay output 1 (N.C.) b	
RC1	Multi-function relay common	
RA2	Multi-function relay output 2 (N.O.) a	
RB2	Multi-function relay output 2 (N.C.) b	
RC2	Multi-function relay common	

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

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.

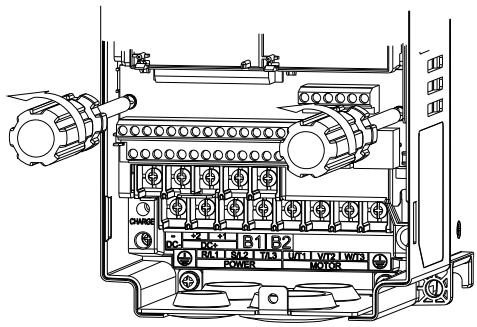
Transistor outputs (MO1, MO2, MCM)

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

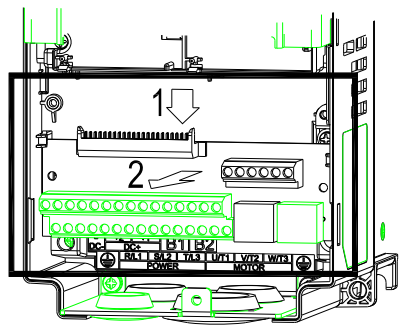
☑ When connecting a relay to the digital outputs, connect a surge absorber across the coil and check the polarity.

Removing the Terminal Block

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



2. Remove the control board by pulling it out in parallel direction for 6~8 cm (as indicated in the figure below : arrow **1**) then lift the control board (as indicated in the figure below: arrow **2**).



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Chapter 6 Optional Accessories

The accessories list in this chapter are sold separately and are available upon request. Please select applicable accessories for your AFE2000 unit or contact local distributor for suggestion on applicable model and specification. The optional accessories would significantly improves the AFE2000 efficiency.

- Non-fuse Circuit Breaker
- Fuse
- AC Reactor
- Zero Phase Reactor
- Digital Keypad
- Panel Mounting
- Conduit Box
- Fan Kit
- Flange Mounting Kit

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 the AFE unit.

3-phase 230V	
Model	Recommended Current (A)
AFE075A23A	60
AFE150A23A	125
AFE220A23A	200
AFE370A23A	250

3-phase 460V	
Model	Recommended Current (A)
AFE075A43A	40
AFE150A43A	60
AFE220A43A	100
AFE370A43A	150
AFE450A43A	175
AFE750A43A	300

Fuse Specification Chart

Fuses with specification smaller than the following table indicates are allowed.

NOTE

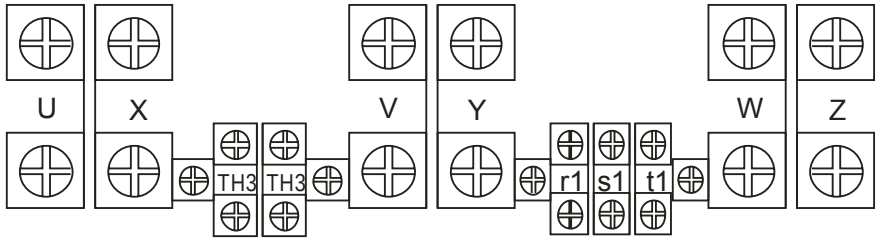
1. Use Copper Conductors Only, 75ºC for all field-wiring terminals located within the motor circuit.
2. "The drive is suitable for use in a circuit capable of delivering not more than 5000 rms symmetrical amperes, (480 or 240) ac maximum when used with listed Delta inverters." Or equivalent.
3. "The drive must be installed in a Pollution 2 environment with clean air according to enclosure classification. Cooling air must be clean, free from corrosive materials and electrically conductive dust."
4. All rubber grommets located on conduit box shall be removed and replaced with conduit hubs in the end use installation.
5. "For installation in the United States, branch circuit protection must be provided in accordance with the National Electrical Code (NEC) and any applicable local codes. To fulfill this requirement, use the UL classified fuses"
6. "For installation in Canada, branch circuit protection must be provided in accordance with Canadian Electrical Code and any applicable provincial codes. To fulfill this requirement, use the UL classified fuses"

230VModel	Manufacturer	Class / Catalog No	Rating
AFE075A23A	Cooper Bussmann Inc.	Class _T / JJS-60	600 Vac, 60A
AFE150A23A		Class _T / JJS-125	600 Vac, 125A
AFE220A23A		Class _T / JJS-175	600 Vac, 175A
AFE370A23A		Class _T / JJS-250	600 Vac, 250A

460V Model	Manufacturer	Class / Catalog No	Rating
AFE075A43A	Cooper Bussmann Inc.	Class _T / JJS-35	600 Vac, 35A
AFE150A43A		Class _T / JJS-60	600 Vac, 60A
AFE220A43A		Class _T / JJS-90	600 Vac, 90A
AFE370A43A		Class _T / JJS-125	600 Vac, 125A
AFE450A43A		Class _T / JJS-175	600 Vac, 175A
AFE750A43A		Class _T / JJS-300	600 Vac, 300A

AC Reactor

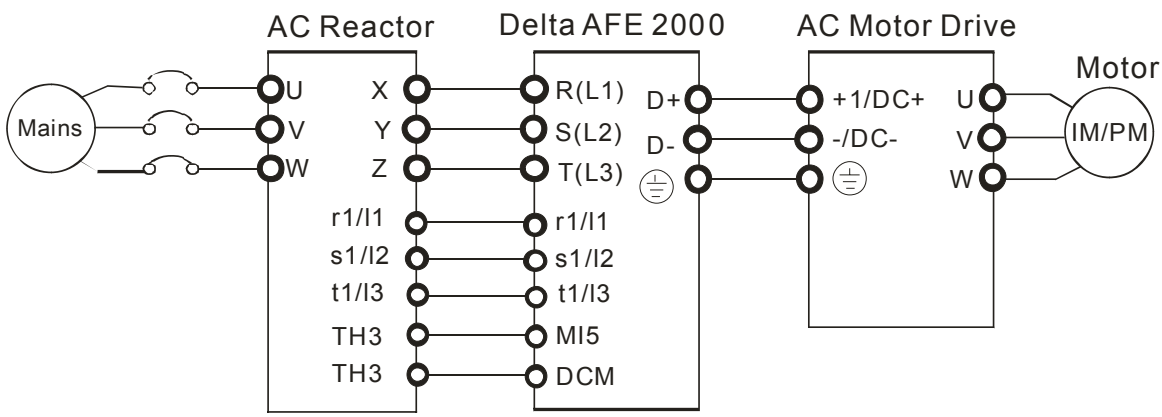
Terminal Specifications



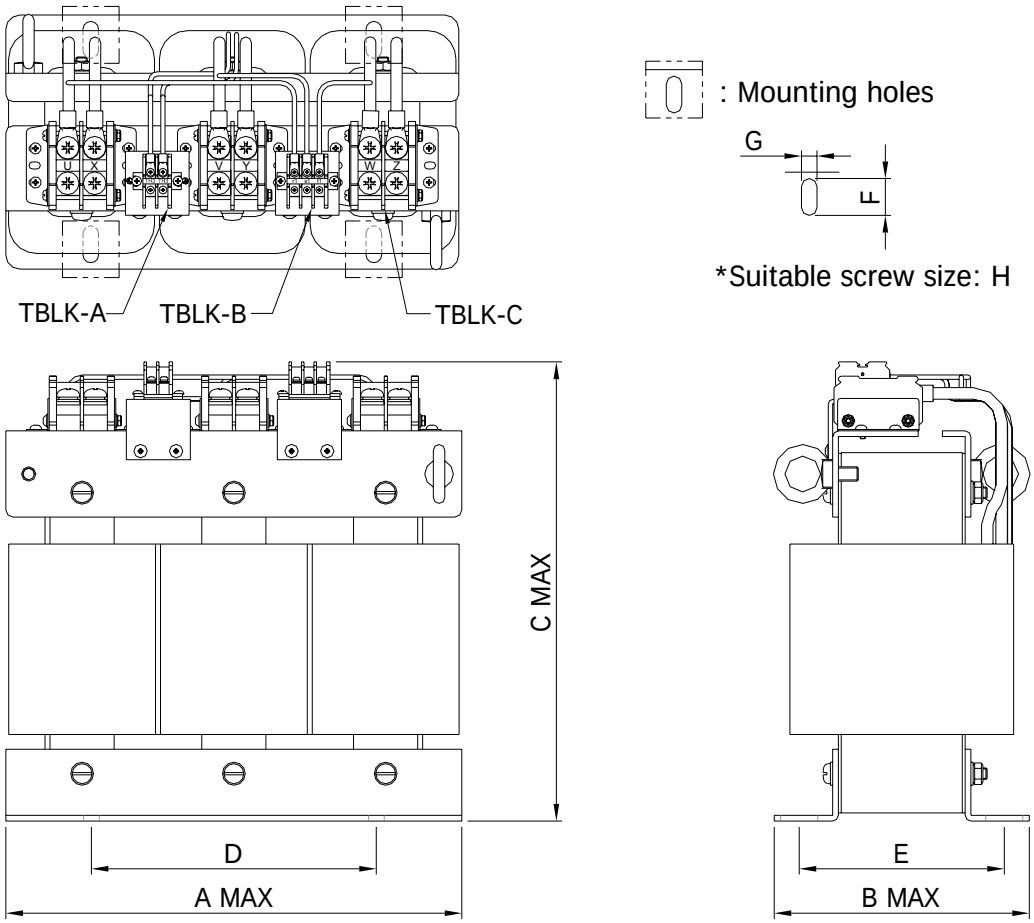
230 V Reactor Model	Frame	KW	Applicable Model AFE-___A23A	Inductance mH	Rated Current Arms	Torque: kg-cm / lb-in.. / Nm ±10%			Wieght
						Mounting	TBLK-A, B	TBLK-C	Net(Kg)
AF-RC075A2	B	7.5	075	2.1	35	40.0 /46.1 /3.92	3.8 /4.4 /0.37	23.0/ 26.5/ 2.25	28
AF-RC150A2	C	15	150	1.05	70	60.0 /69.2 /5.89	3.8 /4.4 /0.37	61.4/ 70.8/ 6.02	52
AF-RC220A2		22	220	0.77	95	80.0 /92.2 /7.85	3.8 /4.4 /0.37	61.4/ 70.8/ 6.02	62
AF-RC370A2	D	37	370	0.5	150	130.0 /149.9 /12.75	3.8 /4.4 /0.37	76.8/ 88.5/ 7.53	87

460 V Reactor Model	Frame	KW	Applicable Model AFE-___A43A	Inductance mH	Rated Current Arms	Torque: kg-cm / lb-in.. / Nm ±10%			Wieght
						Mounting	TBLK-A, B	TBLK-C	Net(Kg)
AF-RC075A4	B	7.5	075	7.32	20	40.0 /46.1 /3.92	3.8 /4.4 /0.37	23.0/ 26.5/ 2.25	28
AF-RC150A4		15	150	4.18	35	60.0 /69.2 /5.89	3.8 /4.4 /0.37	23.0/ 26.5/ 2.25	52
AF-RC220A4	C	22	220	2.92	50	80.0 /92.2 /7.85	3.8 /4.4 /0.37	61.4/ 70.8/ 6.02	62
AF-RC370A4	D	37	370	1.96	75	130.0 /149.9 /12.75	3.8 /4.4 /0.37	76.8/ 88.5/ 7.53	87
AF-RC450A4		45	450	1.54	95	160.0 /184.5 /15.70	3.8 /4.4 /0.37	76.8/ 88.5/ 7.53	105
AF-RC750A4		75	750	0.92	160	220.0 /253.7 /21.58	3.8 /4.4 /0.37	76.8/ 88.5/ 7.53	137

Wiring Diagram



Frame Structure



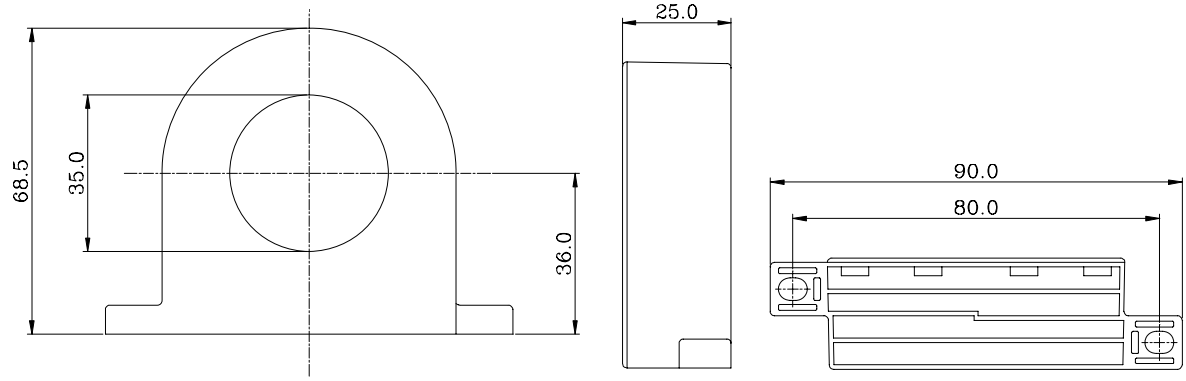
Model Specifications

Model	A mm [inch]	B mm [inch]	C mm [inch]	D mm [inch]	E mm [inch]	F mm [inch]	G mm [inch]	H Screw Type
AF-RC075A2	305 [12.01]	159 [6.26]	280 [11.02]	150 [5.91]	125 [4.92]	22 [0.87]	11 [0.43]	M10
AF-RC150A2	355 [13.98]	180 [7.09]	328 [12.91]	200 [7.87]	139 [5.47]	26 [1.02]	11 [0.43]	M10
AF-RC220A2	355 [13.98]	200 [7.87]	328 [12.91]	200 [7.87]	159 [6.26]	26 [1.02]	11 [0.43]	M10
AF-RC370A2	385 [15.16]	210 [8.27]	385 [15.16]	200 [7.87]	168 [6.26]	25 [1.02]	13 [0.51]	M12
AF-RC150A4	355 [13.98]	180 [7.09]	328 [12.91]	200 [7.87]	139 [5.47]	26 [1.02]	11 [0.43]	M10
AF-RC220A4	355 [13.98]	200 [7.87]	328 [12.91]	200 [7.87]	159 [6.26]	26 [1.02]	11 [0.43]	M10
AF-RC370A4	385 [15.16]	210 [8.27]	385 [15.16]	200 [7.87]	168 [6.26]	25 [1.02]	13 [0.51]	M12
AF-RC450A4	385 [15.16]	230 [9.06]	385 [15.16]	200 [7.87]	188 [7.40]	25 [1.02]	13 [0.51]	M12
AF-RC750A4	420 [16.54]	240 [9.45]	440 [17.32]	250 [9.84]	200 [7.87]	25 [1.02]	13 [0.51]	M12
AF-RC075A4	305 [12.01]	159 [6.26]	280 [11.02]	150 [5.91]	125 [4.92]	22 [0.87]	11 [0.43]	M10

Zero Phase Reactor

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.

Diagram A

Please wind each wire around the core for 4 times. The reactor must be placed at AFE2000 side as close as possible.

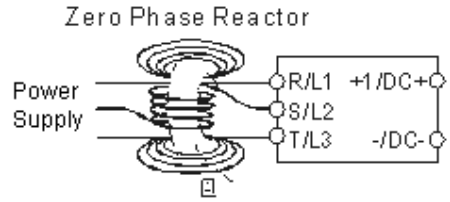
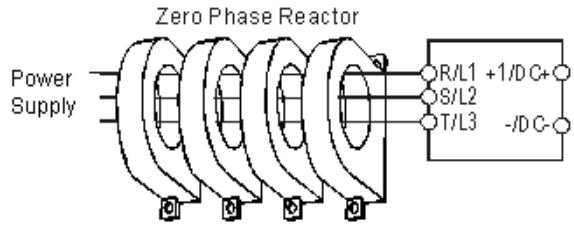


Diagram B

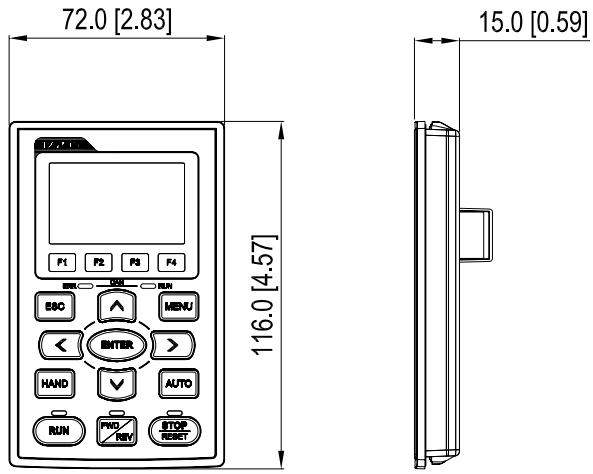
Please put wires through 4 cores in series without winding.



Digital Keypad

KPC-CC01

Frame size



Descriptions to the function key

Key	Description
RUN	START OPERATION 1. It is only valid when the source of operation command is from the keypad. 2. The RUN key starts AFE2000 to operate as the function setting and the RUN LED will be ON 3. It can be pressed again and again during stop.
STOP RESET	STOP OPERATION (When Stop key is pressed, all operation will stop in all condition.) This key has the highest priority in all condition. 1. When i STOP command is given, the AFE2000's operation will stop under any condition. 2. The RESET key can be used to reset the drive when faults occur. If the RESET key is not responsing, check MENU → Fault Records search for the most recent fault.
FWD REV	OPERATION DIRECTION (This function will be available soon)
ENTER	ENTER Press ENTER and go to the next level. If it is the last level then press ENTERnter to execute the command.
ESC	ESC Press ESC to return to the last page. If there is a sub-menu, press ESC will return to the previous category.
MENU	MENU, press MENU key at any time would return to the main menu. List of function: KPC-CE01does not support function 4~112. KPC-CC01does not support function 4, 5 and 7. 1. Detail Parameter 5. Copy PLC 9. Time Setting 2. Copy Parameter 6. Fault Record 10. Language Setting 3. Keypad Locked 7. Simple/ Quick Setting 11. Startup Menu Setting 4. PLC Function 8. Display Setting 12. Main Page Setting
↑ ← → ↓	1. "up", "down", "left" and "right". 2. When setting the number, use "left" and "right" key to increase and decrease the value. 3. When selecting the options, use "up" and "down" key to move the selection.
F1 F2 F3 F4	Function key (This function will be available soon.)

	(This function will be available soon.)
	(This function will be available soon.)

Panel Mounting (MKC-KPPK)

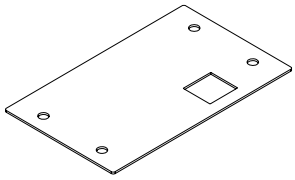
Panel Mounting (MKC-KPPK)

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

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

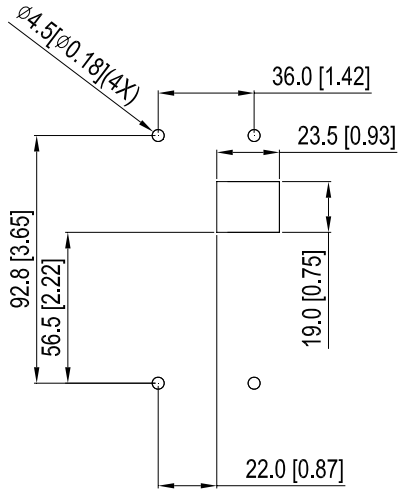
Wall Mounting

accessories*1



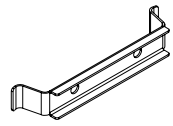
Screw *4 ~M4*p 0.7 *L8mm
Torque: 10-12kg-cm (8.7-10.4lb-in.)

Panel cutout dimension Unit: mm [inch]



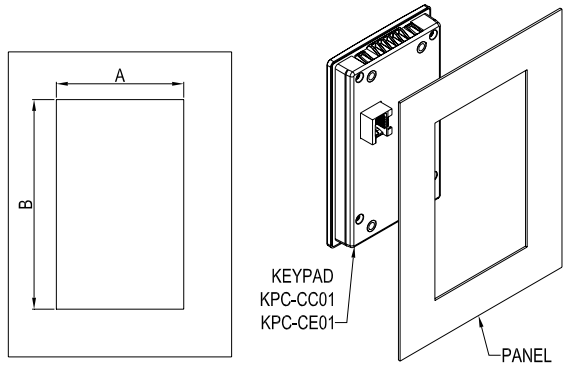
Embedded Mounting

accessories*2



Screw *4 ~M4*p 0.7 *L8mm
Torque: 10-12kg-cm (8.7-10.4lb-in.)

Panel cutout dimension Unit: mm [inch]



Normal cutout dimension

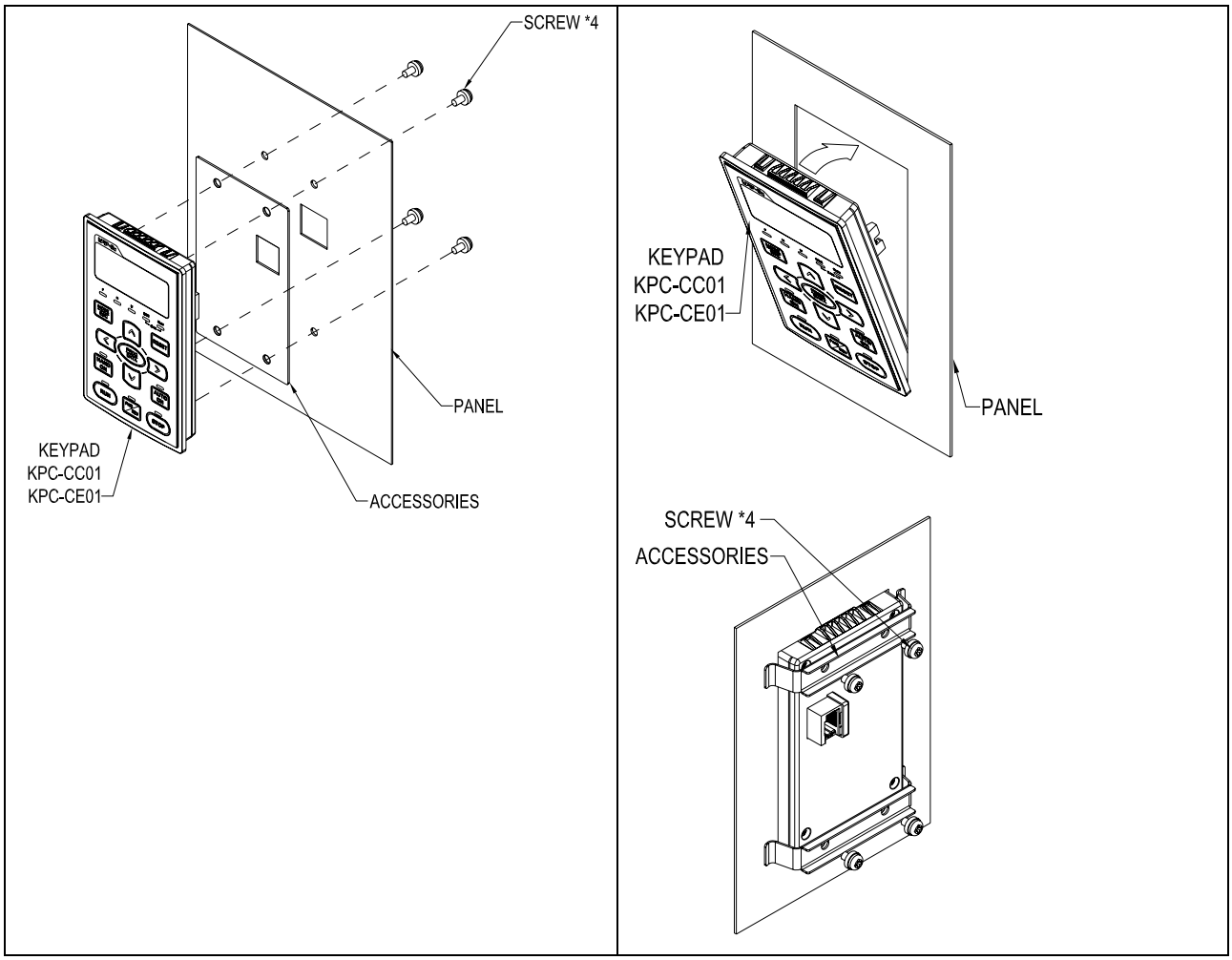
Panel thickness	1.2mm	1.6mm	2.0mm
A	66.4 [2.614]		
B	110.2 [4.339]	111.3 [4.382]	112.5 [4.429]

*Deviation: ±0.15mm /±0.0059inch

Cutout dimension (Waterproof level: IP56)

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

*Deviation: ±0.15mm /±0.0059inch


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

Conduit Box Kit

■ Appearance

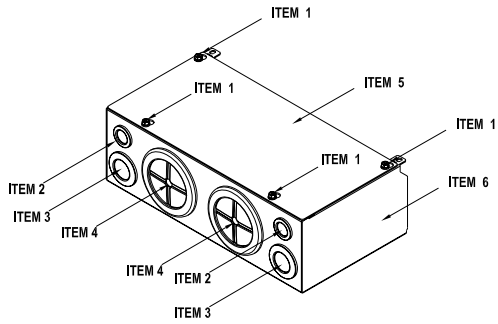
Frame D

Applicable modle

AFE370A23A; AFE370A43A; AFE450A43A; AFE750A43A;

Model number『MKC-DN1CB』

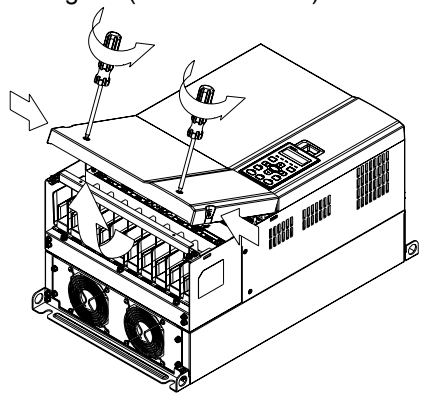
ITEM	Description	Qty.
1	Screw M5*0.8*10L	4
2	Rubber 28	2
3	Rubber 44	2
4	Rubber 88	2
5	Conduit box cover	1
6	Conduit box base	1



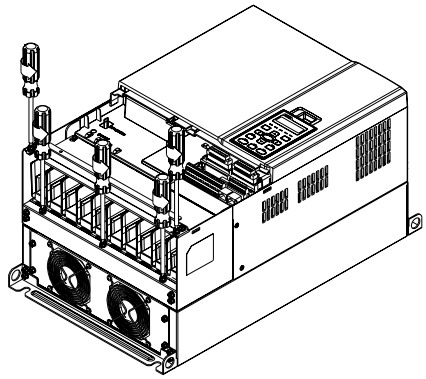
■ Installation

Frame D

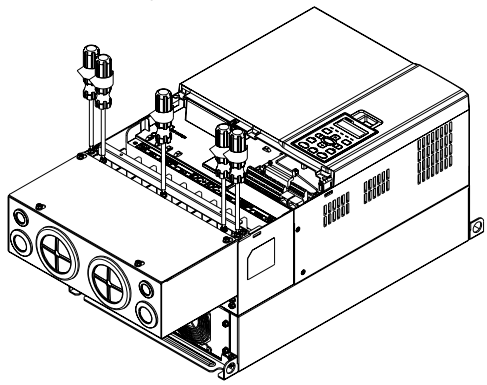
1. Loosen the cover screws and press the tabs on each side of the cover to remove the cover, as shown in the following figure. Screw torque: 10~12kg-cm (8.66~10.39lb-in)



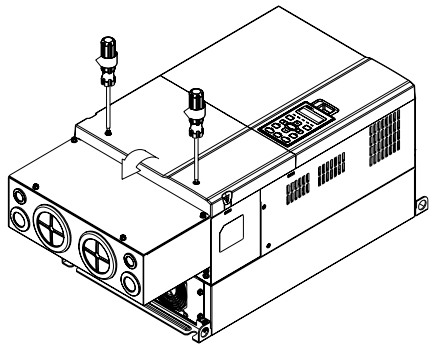
2. Remove the 5 screws shown in the following figure. Screw torque: 24~26kg-cm (20.8~22.6lb-in).



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



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

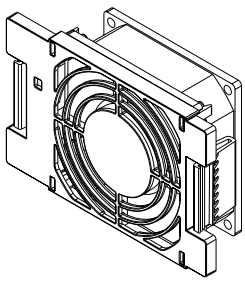


Fan Kit

■ Frames

Frame B

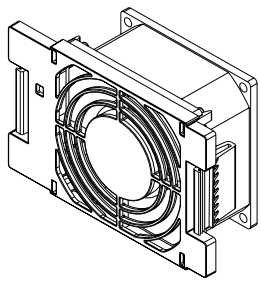
Applicable mode: AFE075A43A ; AFE075A23A;



Fan Model『MKC-BFKM1』

Frame B

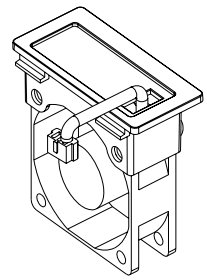
Applicable mode: AFE150A43A;



Fan Model 『MKC-BFKM2』

Frame B

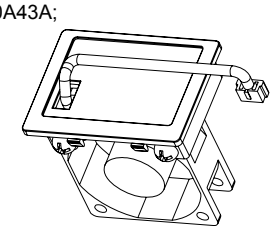
Applicable mode: AFE075A23A; AFE075A43A; AFE150A43A;



Fan Model 『MKC-BFKB』

Frame C

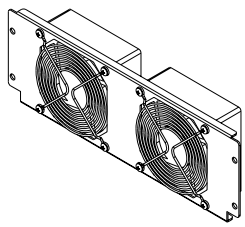
Applicable mode: AFE150A23A; AFE220A23A; AFE220A43A;



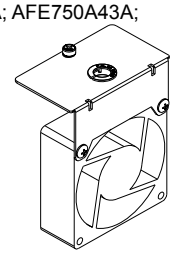
Fan Model 『MKC-CFKB1』

Frame D

Applicable mode: AFE370A23A; AFE370A43A; AFE450A43A; AFE750A43A;



Fan Model 『MKC-DFKM』

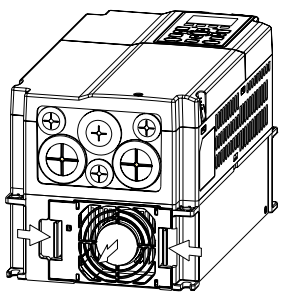


Fan Model 『MKC-DFKB』

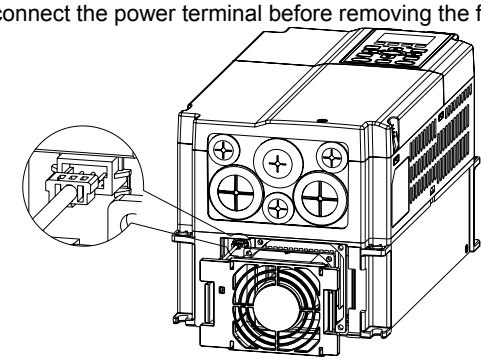
■ Fan Removal

Frame B Applicable mode: AFE075A43A;AFE075A23A; AFE150A43A

1. Press the tab on both side of the fan to successfully remove the fan.



2. Disconnect the power terminal before removing the fan.

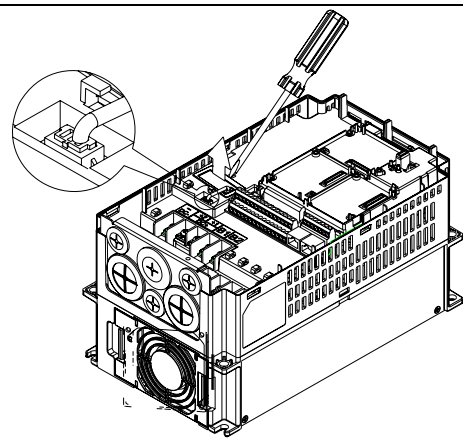


Frame B&C

Applicable model

AFE075A23A; AFE075A43A; AFE150A43A; AFE150A23A; AFE220A23A; AFE220A43A

Disconnect the power terminal and use a slotted screwdriver to remove the fan cover.



Frame D

Applicable model

AFE370A23A; AFE370A43A; AFE450A43A; AFE750A43A;

1. (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).

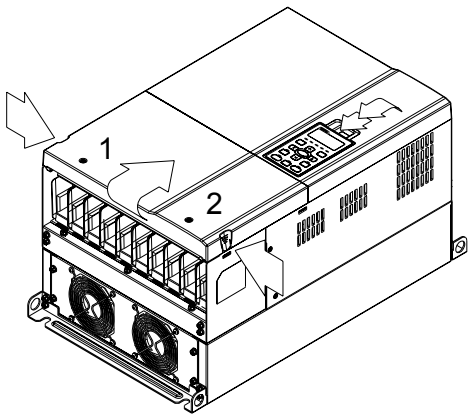


Figure 1

2. (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).

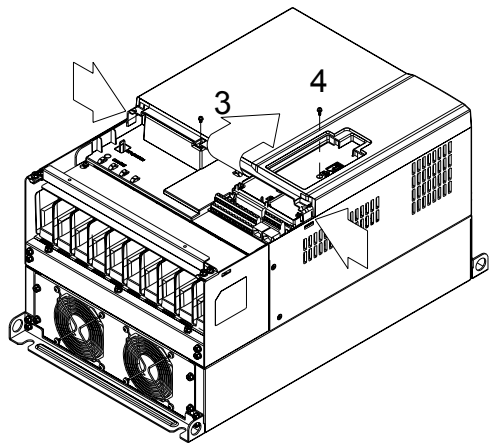


Figure 2

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

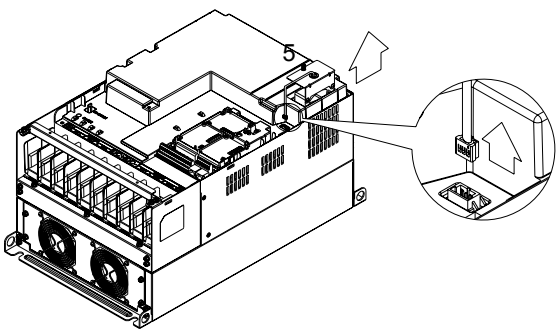


Figure 3

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

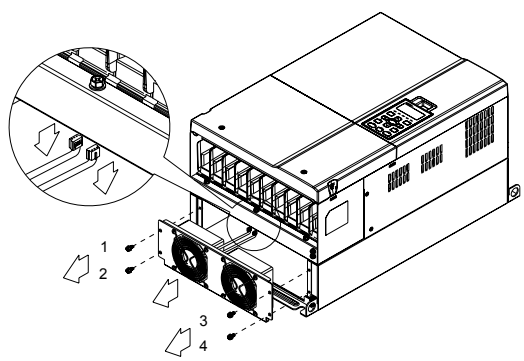


Figure 4

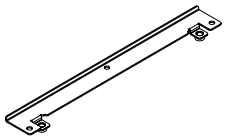
Flange Mounting Kit

Applicable Models, Frame B~D

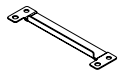
Frame B

『MKC-BFM』

Applicable model AFE075A23A; AFE075A43A; AFE150A43A;



Accessories 1*2

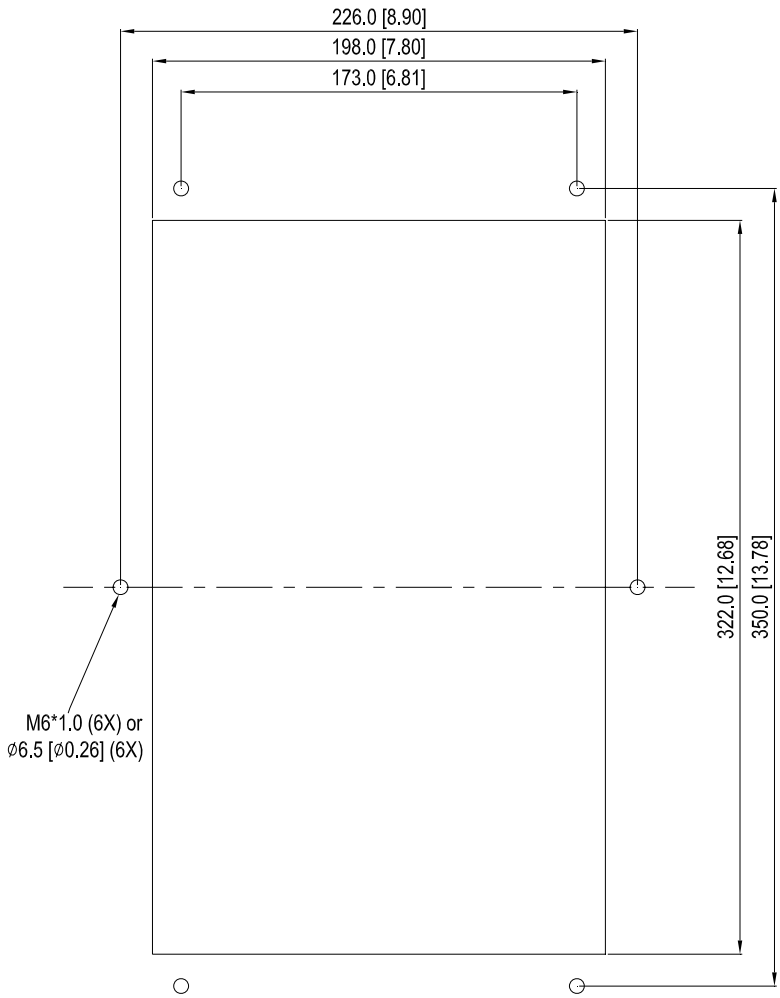


Accessories 2*2

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

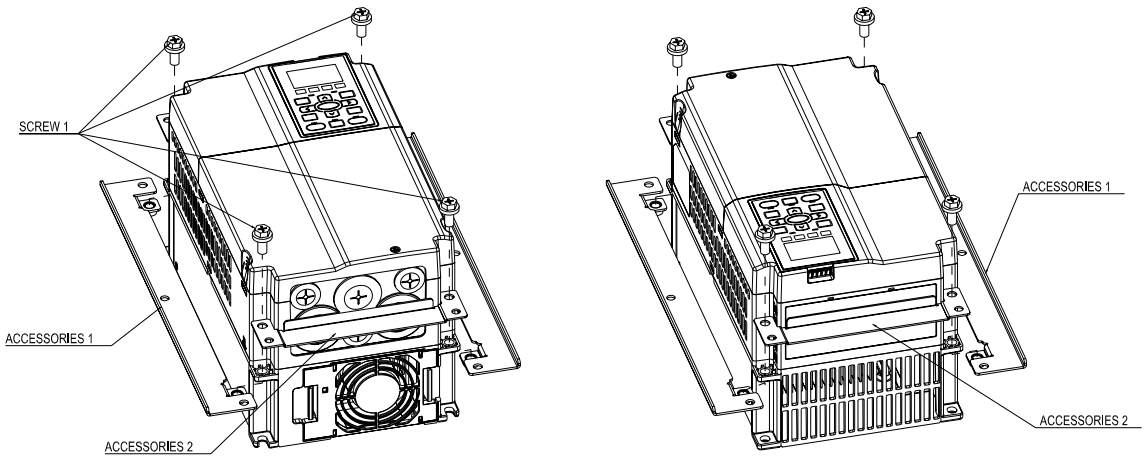
Cutout dimension

Unit: mm [inch]

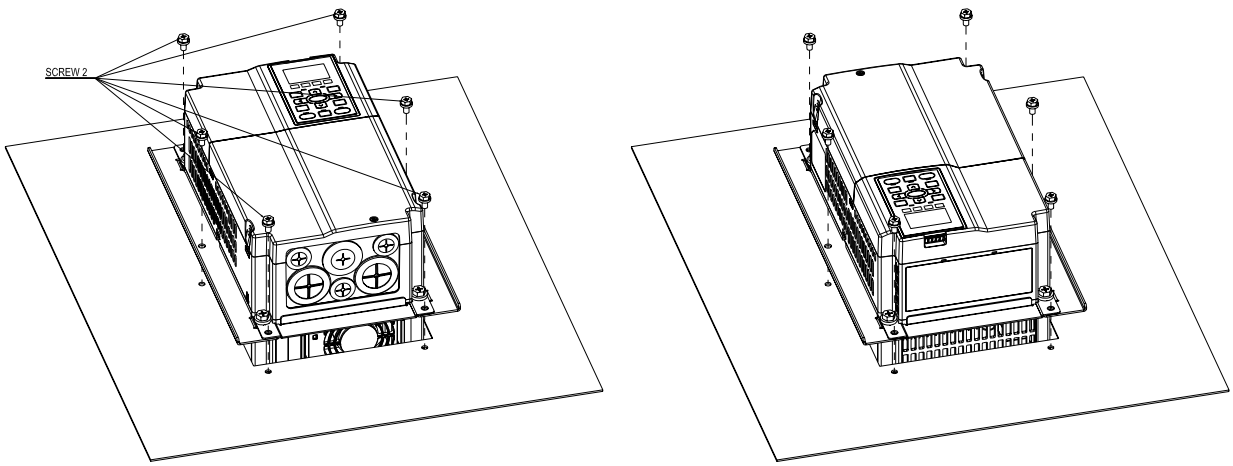


『MKC-BFM』Installation

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



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

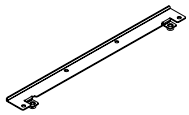


Frame C

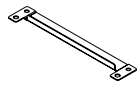
『MKC-CFM』

Applicable model

AFE150A23A; AFE220A23A; AFE220A43A;



Accessories 1*2

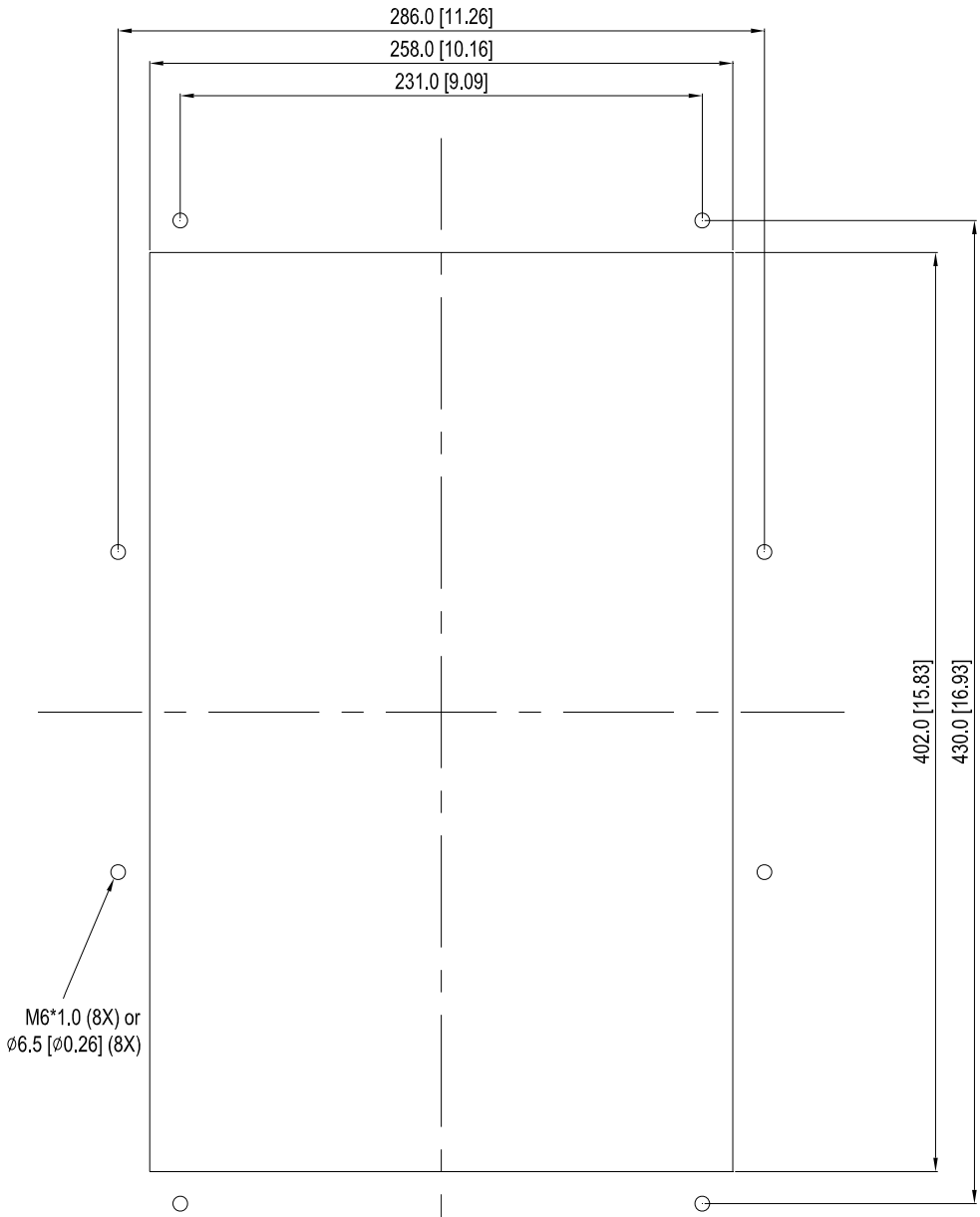


Accessories 2*2

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

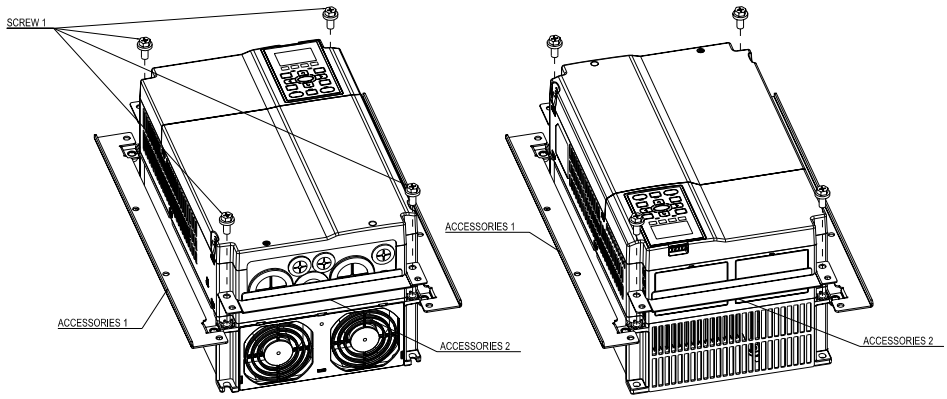
Cutout dimension

Unit:mm [inch]

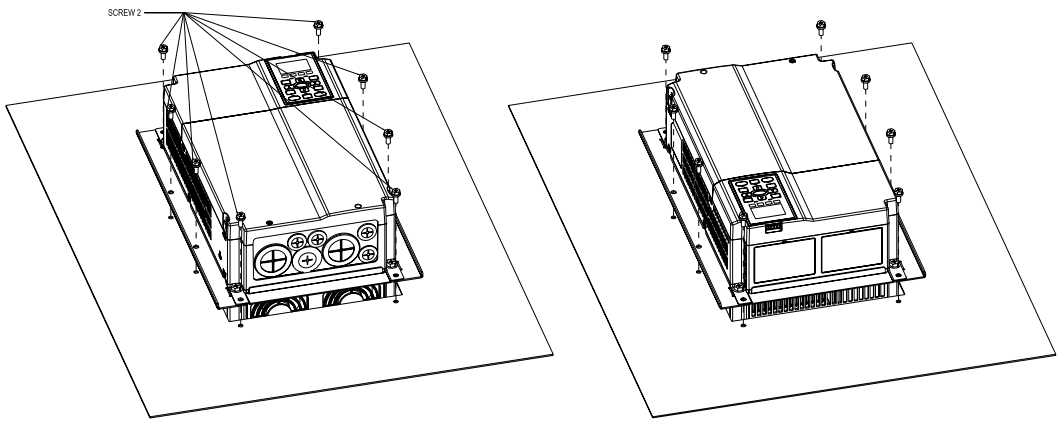


Installation『MKC-CFM』

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



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



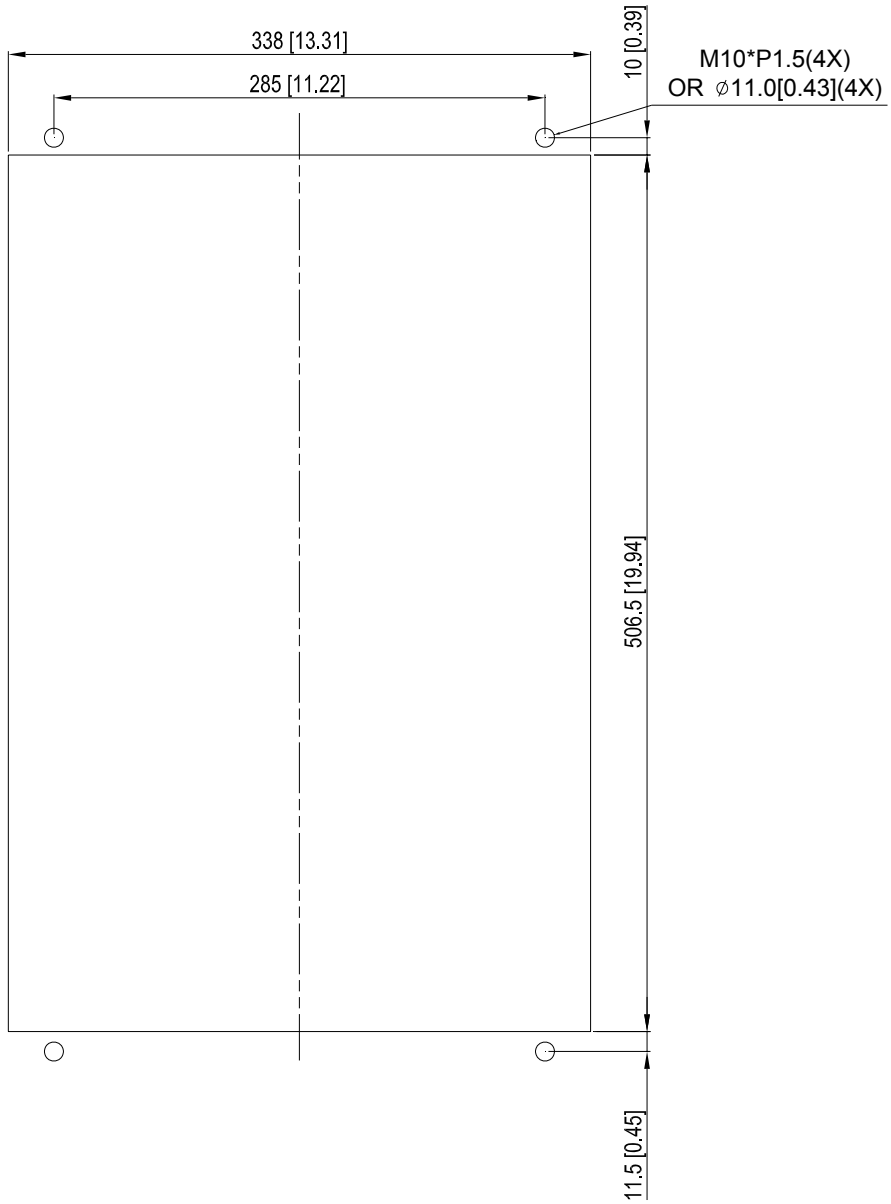
Frame D

Applicable model

AFE370A23A; AFE370A43A; AFE450A43A; AFE750A43A;

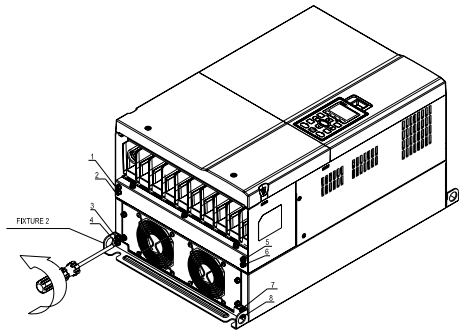
Cutout dimension

Unit:mm [inch]

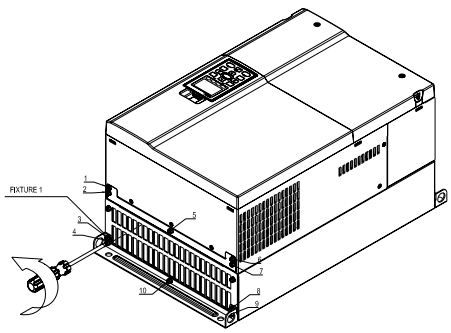


Installation for Frame D

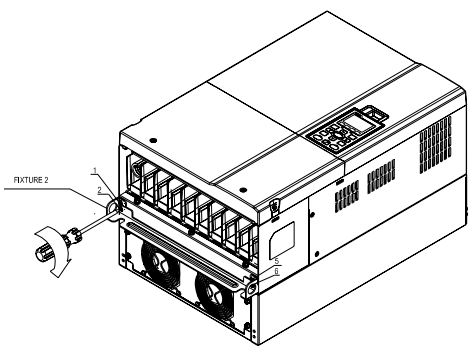
1. Loosen 8 screws and remove Fixture 2 (as shown in the following figure).



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

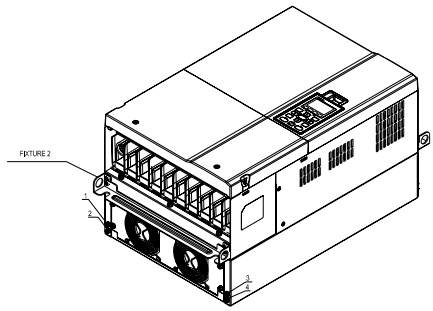


3. Fasten 4 screws (as shown in the following figure). Screw torque: 30~32kg-cm (26.0~27.8lb-in).

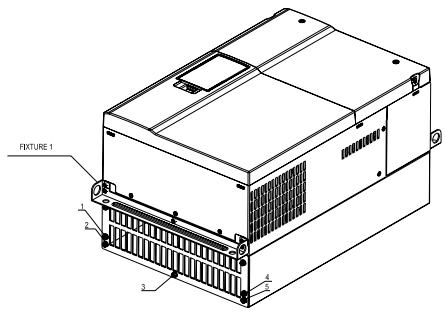


☑ Fasten 5 screws (as shown in the following figure). Screw torque: 30~32kg-cm (26.0~27.8lb-in).

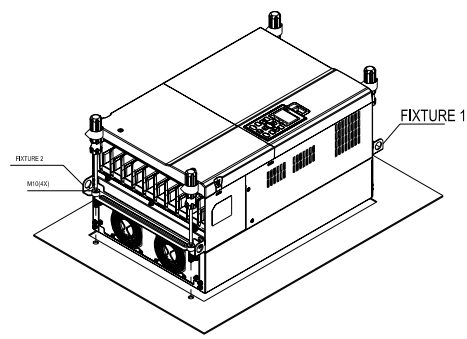
5. Fasten 4 screws (as shown in the following figure). Screw torque: 24~26kg-cm (20.8~22.6lb-in).

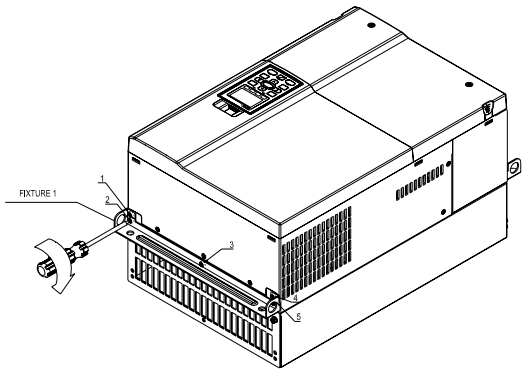


6. Fasten 5 screws (as shown in the following figure). Screw torque: 24~26kg-cm (20.8~22.6lb-in).



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 (173.6~208.3lb-in).





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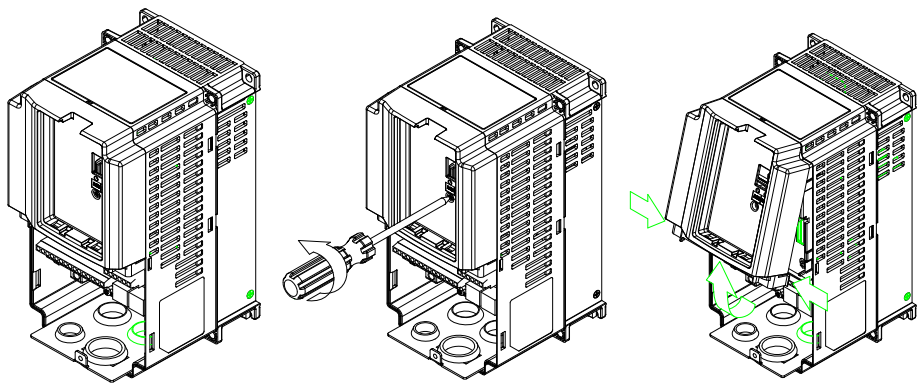
Chapter 7 Option Cards

The option cards listed in this chapter are sold separately and are available upon request. Please select applicable cards for your AFE2000 unit or contact local distributor for suggestion on applicable model and specification. The optional accessories would significantly improves the AFE2000 performance.

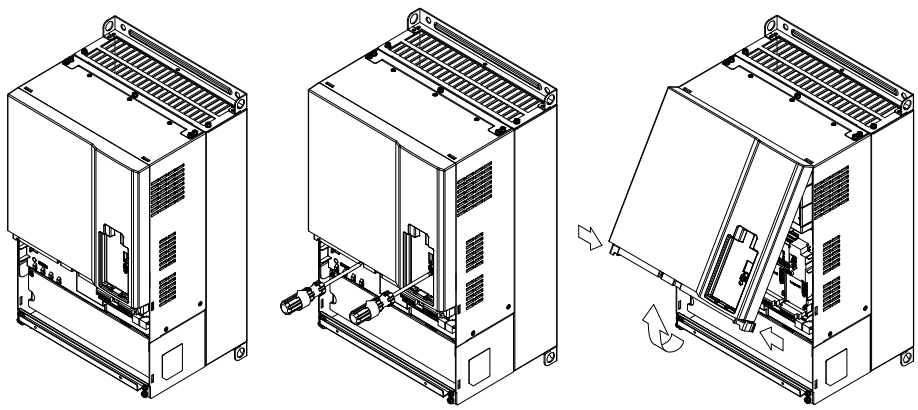
Please removes the digital keypad and the top cover before installation and install the option card according to the follows the following instruction or damage may result.

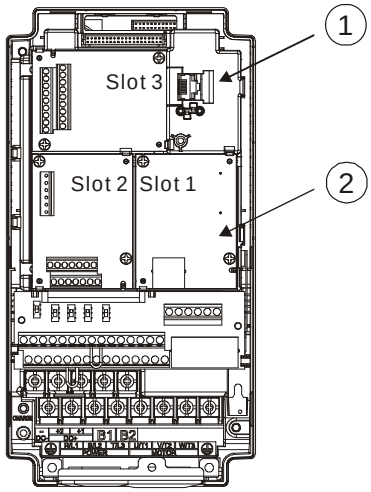
Remove key cover

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



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





1	RJ45(Socket) for digital keypad KPC-CC01; KPC-CE01 ☑ Please refer to CH09 Digital Keypad for more details on KPC-CE01 ☑ Please refer to CH09 Digital Keypad for more details on optional accessory RJ45 extension cable.
2	Communication extension cards(Slot 1) CMC-MOD01; CMC-PD01; CMC-DN01; CMC-EIP01; EMC-COP01;

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

■ 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, SMTP, MODBUS OVER TCP/IP, Delta Configuration

Electrical Specification

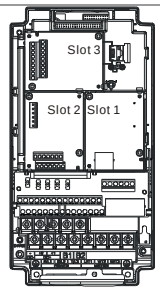
Power supply voltage	5VDC（suppliled by AFE2000）
Insulation voltage	2KV
Power consumption	0.8W
Weight	25g

Environment

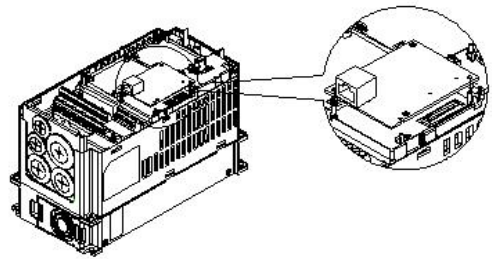
Noise immunity	ESD(IEC 61800-5-1,IEC 6100-4-2) EFT(IEC 61800-5-1,IEC 6100-4-4) Surge Teat(IEC 61800-5-1,IEC 6100-4-5) Conducted Susceptibility Test(IEC 61800-5-1,IEC 6100-4-6)
Operation/storage	Operation: -10°C ~ 50°C (temperature), 90% (humidity) Storage: -25°C ~ 70°C (temperature), 95% (humidity)
Vibration/shock immunity	International standard: IEC 61800-5-1, IEC 60068-2-6/IEC 61800-5-1, IEC 60068-2-27

- **Install CMC-MOD01 to AFE2000 unit**

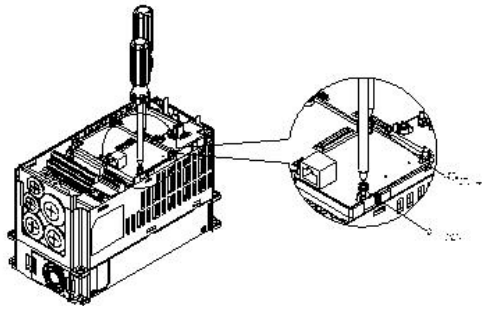
1. Turn off the AFE2000 power.
2. Open up AFE2000 cover.
3. Place the insulation spacer into the positioning pin at Slot 1 (shown in Figure 3), and aim the two holes on the PCB at the positioning pin. Press the pin to clip the holes with the PCB (see Figure 4)
4. Screw up at torque 6 ~ 8 kg-cm (5.21 ~ 6.94 in-lbs) after the PCB is clipped with the holes (see Figure 5).



[Figure 3]



[Figure 4]



[Figure 5]

- **Communication Parameters for AFE2000 Connected to Ethernet**

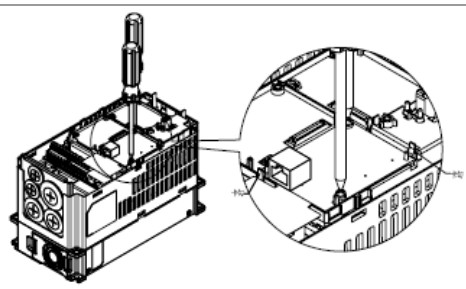
When AFE 2000 is link to Ethernet, please set up the communication parameters base on the table below. Ethernet master will be able to read/write the frequency word and control word of AFE C2000 after communication parameters setup

Parameter (Dec)	Function	Set value (Dec)	Explanation
01-04	Source of operation command setting	2	The operation command is controlled by communication card.
04-21	IP setting	0	Static IP(0) / Dynamic distribution IP(1)
04-22	IP address -1	192	IP address 192.168.1.5
04-23	IP address -2	168	IP address 192.168.1.5

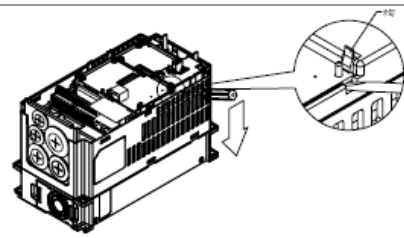
Parameter (Dec)	Function	Set value (Dec)	Explanation
04-24	IP address -3	1	IP address 192.168.1.5
04-25	IP address -4	5	IP address 192.168.1.5
04-26	Netmask -1	255	Netmask 255.255.255.0
04-27	Netmask -2	255	Netmask 255.255.255.0
04-28	Netmask -3	255	Netmask 255.255.255.0
04-29	Netmask -4	0	Netmask 255.255.255.0
04-30	Default gateway -1	192	Default gateway 192.168.1.1
04-31	Default gateway -2	168	Default gateway 192.168.1.1
04-32	Default gateway -3	1	Default gateway 192.168.1.1
04-33	Default gateway -4	1	Default gateway 192.168.1.1

- **Disconnecting CMC- MOD01 from AFE2000 unit**

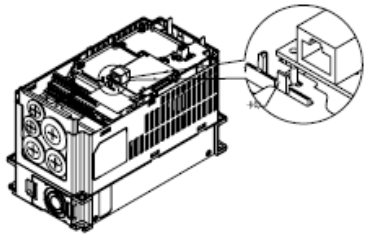
1. Turn off the AFE2000 power. .
2. Remove the two screws (see Figure 6).
3. Twist opens the card clip and inserts the slot type screwdriver to the hollow to prize the PCB off the card clip (see Figure 7).
4. Twist opens the other card clip to remove the PCB (see Figure 8)



[Figure 6]



[Figure 7]



[Figure 8]

- Basice 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	Status		Indication	Treatment
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

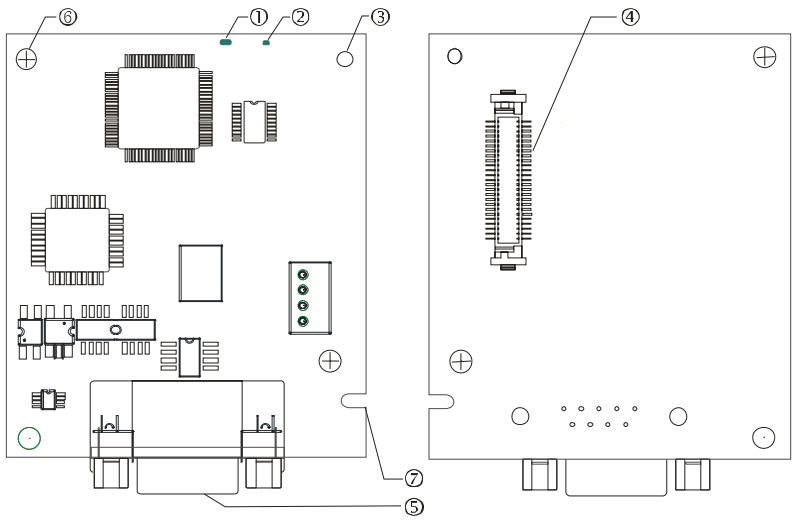
Abnormality	Cause	Treatment
POWER LED off	AC motor drive not powered	Check if AC motor drive is powered, and if the power supply is normal.
	CMC-MOD01 not connected to AC motor drive	Make sure CMC-MOD01 is connected to AC motor drive.
LINK LED off	CMC-MOD01 not connected to network	Make sure the network 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 AFE2000 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.
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.

CMC-PD01

■ Functions

1. Supports PZD control data exchange.
2. Supports PKW polling AFE2000 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. AFE2000 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 (bits per second)

Electrical Specification

Power supply voltage	5VDC (supplied by AFE2000)
Insulation voltage	500VDC
Power consumption	1W
Weight	28g

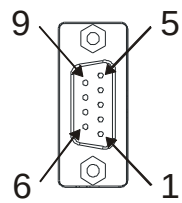
Environment

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	Treatment
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	Treatment
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.

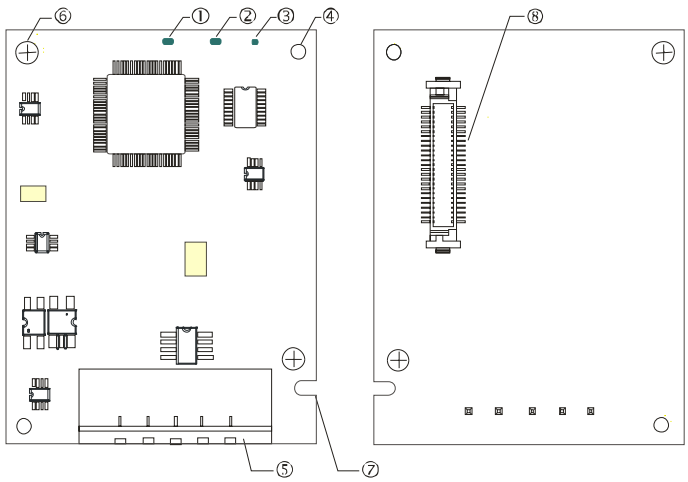
CMC-DN01

■ Functions

1. Based on the high-speed communication interface of Delta HSSP protocol, able to conduct immediate control to AFE2000 unit.
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 AFE2000 unit.

1. Power supplied from AFE2000 unit.

■ 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. AFE2000 connection port

■ Specifications

DeviceNet Connector

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

AFE2000 Connection Port

Interface	50 PIN communication terminal
Transmission method	SPI communication
Terminal function	1. Communicating with AFE2000 unit 2. Transmitting power supply from AFE2000 unit
Communication protocol	Delta HSSP protocol

Electrical Specification

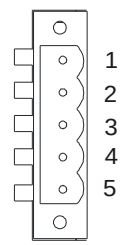
Power supply voltage	5VDC (supplied by AFE2000)
Insulation voltage	500VDC
Communication wire power consumption	0.85W
Power consumption	1W
Weight	23g

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 /IEC61131-2 & IEC 68-2-27

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	Treatment
On	Power supply in abnormal status.	Check the power supply of CMC-DN01.
Off	Power supply in normal status	--

NS LED

LED status	Indication	Treatment
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

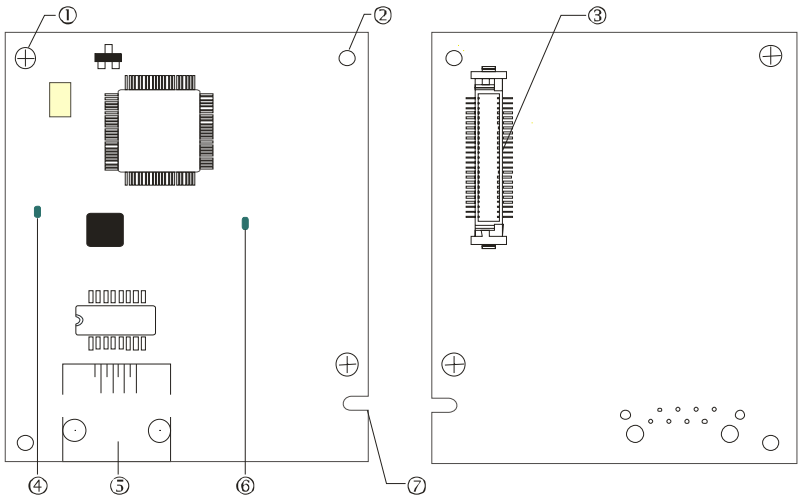
LED status	Indication	Treatment
Off	No power supply or being off-line	Check the power supply of CMC-DN01 and see of the connection is normal.
Green light flashes	Waiting for I/O data	Switch the master PLC to RUN status
Green light on	I/O data are normal	--
Red light flashes	Mapping error	1. Reconfigure CMC-DN01 2. Re-power AFE2000
Red light on	Hardware error	1. See the error code displayed on AFE2000. 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 AFE2000 are correctly installed and normally connected to each other.

CMC-EIP01

■ Functions

1. Supports Modbus TCP and Ethernet/IP protocol
2. MDI/MDI-X auto-detect
3. Baud rate: 10/100Mbps auto-detect
4. AFE2000 keypad/Ethernet configuration
5. Virtual serial port

■ Product Profile



[Figure1]

1. Screw fixing hole
2. Positioning hole
3. AFE2000 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

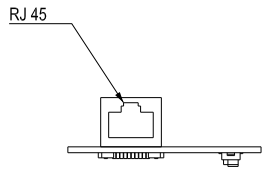
Environment

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 AFE2000 power.
2. Open up AFE2000 cover.
3. Connect CAT-5e network cable to RJ-45 port on CMC-EIP01 (See Figure 2).

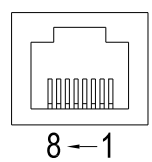


[Figure 2]

RJ-45 PIN Definition

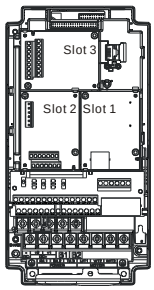
PIN	Signal	Definition
1	Tx+	Positive pole for data transmission
2	Tx-	Negative pole for data transmission
3	Rx+	Positive pole for data receiving
4	--	N/C

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

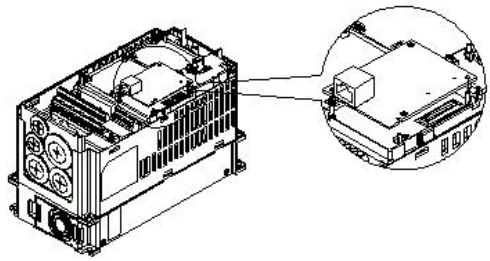


■ Connecting CMC-EIP01 to AFE2000

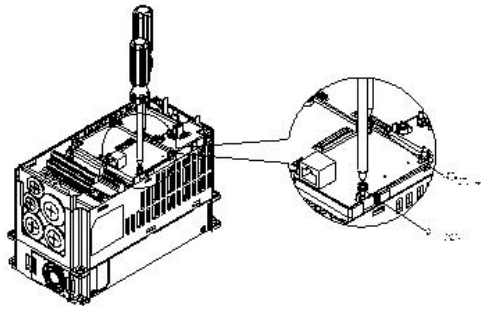
1. Turn off the AFE2000 power.
2. Open up AFE2000 cover.
3. Place the insulation spacer into the positioning pin at Slot 1 (shown in Figure 3), and aim the two holes on the PCB at the positioning pin. Press the pin to clip the holes with the PCB (see Figure 4).
4. Screw up at torque 6 ~ 8 kg-cm (5.21 ~ 6.94 in-lbs) after the PCB is clipped with the holes (see Figure 5).



[Figure 3]



[Figure 4]



[Figure 5]

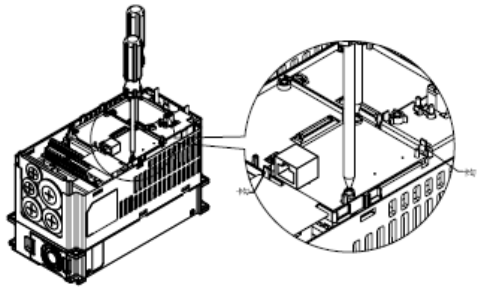
■ Communication Parameters for AFE2000 Connected to Ethernet

When AFE2000 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 AFE2000 after the communication parameters are set.

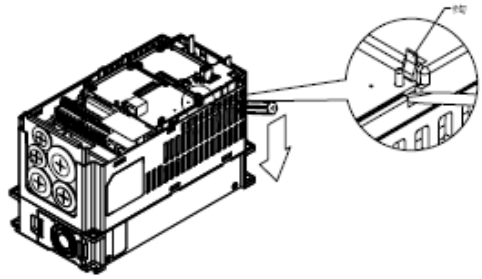
Parameter (Dec)	Function	Set value (Dec)	Explanation
01-04	Setting up source of operation command	5	The operation command is controlled by communication card.
04-21	IP setting	0	Static IP(0) / Dynamic distribution IP(1)
04-22	IP address -1	192	IP address 192.168.1.5
04-23	IP address -2	168	IP address 192.168.1.5
04-24	IP address -3	1	IP address 192.168.1.5
04-25	IP address -4	5	IP address 192.168.1.5
04-26	Netmask -1	255	Newmask 255.255.255.0
04-27	Netmask -2	255	Newmask 255.255.255.0
04-28	Netmask -3	255	Newmask 255.255.255.0
04-29	Netmask -4	0	Newmask 255.255.255.0
04-30	Default gateway -1	192	Default gateway 192.168.1.1
04-31	Default gateway -2	168	Default gateway192.168.1.1
04-32	Default gateway -3	1	Default gateway192.168.1.1
04-33	Default gateway -4	1	Default gateway192.168.1.1

■ Disconnecting CMC- EIP01 from AFEC2000

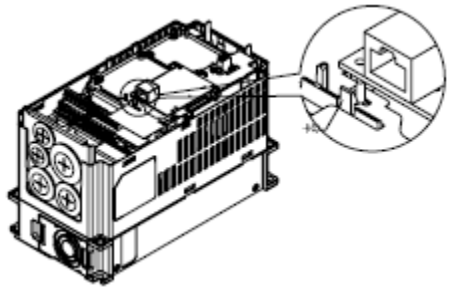
1. Turn off the AFEC2000 power.
2. Remove the two screws (see Figure 6).
3. Twist opens the card clip and inserts the slot type screwdriver to the hollow to prize the PCB off the card clip (see Figure 7).
4. Twist opens the other card clip to remove the PCB (see Figure 8).



[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	Treatment
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.

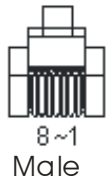
Troubleshooting

Abnormality	Cause	Treatment
POWER LED off	AFE2000 is not powered	Check if AFE2000 is connected to power supply, and if the power supply is normal.
	CMC-EIP01 not connected to AC motor drive	Make sure CMC-EIP01 is connected to AFE2000.

Abnormality	Cause	Treatment
LINK LED off	CMC-EIP01 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 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 the AFE2000 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.

EMC-COP01

■ RJ-45Pin definition



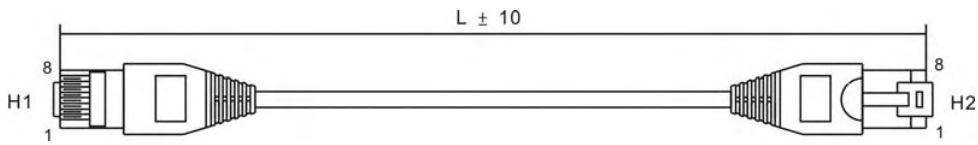
Pin	Pin name	Definition
1	CAN_H	CAN_H bus line (dominant high)
2	CAN_L	CAN_L bus line (dominant low)
3	CAN_GND	Ground/0V/V-
7	CAN_GND	Ground/0V/V-

■ Specification

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

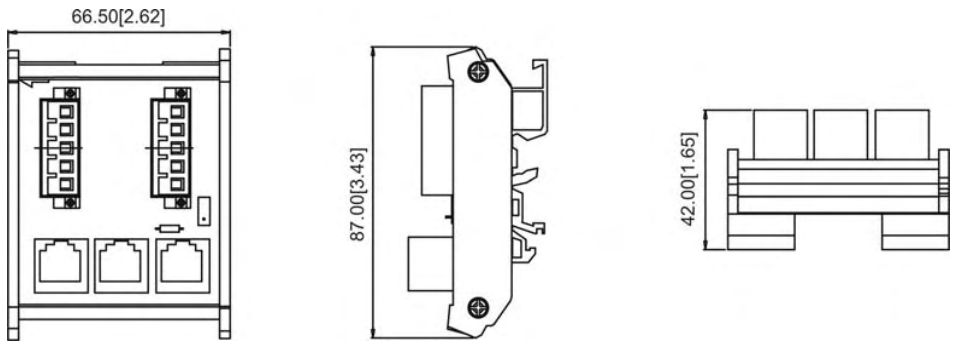
Model: TAP-CB03, TAP-CB04



Title	Part No.	L	
		mm	inch
1	TAP-CB03	500 ± 10	19 ± 0.4
2	TAP-CB04	1000± 10	39 ± 0.4

■ CANopen Dimension

Model: TAP-CN03



NOTE

■ Please refer to CANopen user manual for more details on CANopen operation. CANopen user manual is also available on Delta website: http://www.delta.com.tw/industrialautomation/.

Chapter 8 Specifications

	230V series				460V series					
Frame Size	B	C		D	B		C	D		
Model AFE-_ _ _A_ _A	075	150	220	370	075	150	220	370	450	750
Applicable power(kW)	7.5	15	22	37	7.5	15	22	37	45	75
Rate input voltage(V)	170~ 250Vac				325~ 500Vac					
Rated input current(A)	35	70	95	150	20	35	50	75	95	160
Voltage control	300~370Vdc				600~740Vdc					
Overload capacity	150% 60sec									
Frequency tolerance	±5%									
Power factor at input side	0.95 to above 0.99									
Harmonic (%)	Smaller than 5% (under rated current)									
Protection level	IP20/NEMA 1									
Cooling method	Fan cooling									
Installation environment	For indoor altitude 0~1000m(3280.60 feet) , keep it out of direct sunlight, corrosive gasses, liquid and dust. For altitude above 1000m(3280.60 feet), please decreases 3% of rated current for every 500m (1640.40 feet) increases. The maximum altitude is 2500m (8202.00 feet)									
Ambient temperature	-10~50℃									
Storage/transportation temperature	-25~+65℃									
Ambient humidity	Lower than 90%RH (non-condensing)									
Vibration	5.9m/ s²(0.6G) less than 10~55Hz (JIS C0040)									
Certifications	CE cULus GB/T12668-2 PCT (certification in progress)									

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Chapter 9 Digital Keypad

KPC-CC01(Optional)

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)

Communication interface：RJ-45 (socket), RS-485 interface

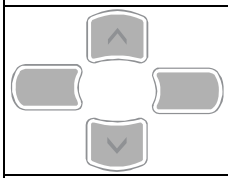
Installation Method:

☑ Embedded mounting. Flat installation to the control box surface and the front facet is water proof.

☑ Other optional accessories model: MKC-KPPK with protection level IP56 can be installed by flang mounting or embedded mounting.

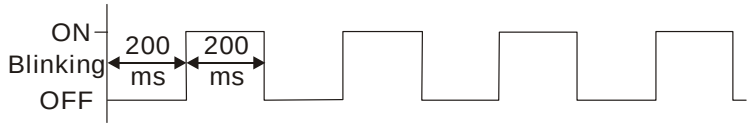
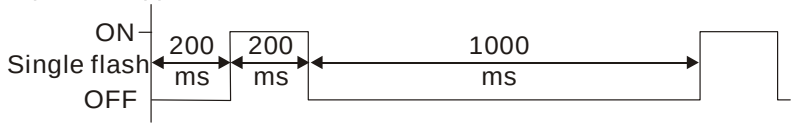
Descriptions of Keypad Functions

Key	Descriptions
RUN	Starts Operation 1. It is only valid when the source of operation command is from the keypad. 2. It can operate the AFE2000 by the function setting and the RUN LED will be ON. 3. It can be pressed again and again at stop process.
STOP RESET	Stop Command Key. This key has the highest 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	(This function is not supported.)
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.
MENU	Press MENU to return to the main menu page. MENU content: (KPC-CE01 does not support function 4~12; KPC-CC01 does not support function 4,5,7.) 1. Detail Parameter 5. Copy PLC 9. Time Setup 2. Copy Parameter 6. Fault Record 10. Language Setup 3. Keypad Locked 7. Quick/Simple Setup 11. Startup Menu

	4. PLC Function 8. Display Setup 12. Main Page
	1. Direction: Left/Right/Up/Down 2. In the numeric value setting mode, it is used to move the cursor and change the numeric value. 3. In the menu/text selection mode, it is used for item selection.
	Function (This function is not supported)
	(This function is not supported)
	(This function is not supported)

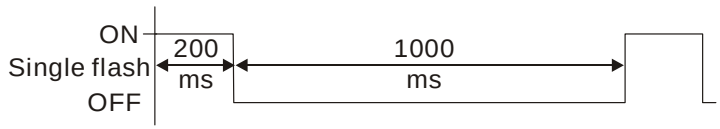
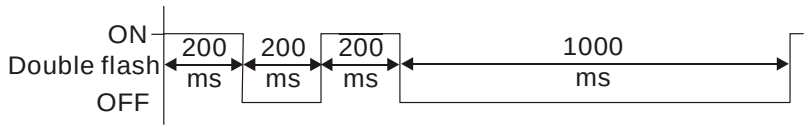
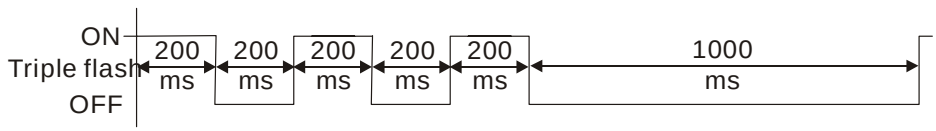
Descriptions of LED Functions

LED	Descriptions
	Steady ON: operation indicator of AFE2000. Steady OFF: AFE2000 does not perform the operation command
	Steady ON: stop indicator of the AC motor drive. The light ON represents the AFE2000 is in stop status. Steady OFF: AFE2000 does not perform “STOP” command.
	(This function is not supported)
	(This function is not supported)
	(This function is not supported)
CANopen ~”RUN”	RUN LED:

LED status	Condition/State
OFF	CANopen at initial No LED
Blinking	CANopen at pre-operation 
Single flash	CANopen at stopped 
ON	CANopen at operation status No LED

CANopen ~”ERR”	ERR LED:

LED status	Condition/ State
OFF	No Error

	Single flash	At lease one message fail 
	Double flash	Guarding fail or heartbeat fail 
	Triple flash	SYNC fail 
	ON	Bus off

Optional Accessory for Digital Keypad: RJ45 Extension Lead

Part No.	Description
CBC-K3FT	RJ45 Communication Cable 3 feet
CBC-K5FT	RJ45 Communication Cable 5 feet
CBC-K7FT	RJ45 Communication Cable 7 feet
CBC-K10FT	RJ45 Communication Cable 10 feet
CBC-K16FT	RJ45 Communication Cable 16 feet

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Chapter 10 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 Ch11 Description of Parameter Settings.

00 Display Parameters

Parameter	Explanation	Settings	Factory Setting
00-00	Identity Code of AFE2000	0: 230V, 7.5kW 1: 460V, 7.5Kw 2: 230V, 15kW 3: 460V, 15kW 4: 230V, 22kW 5: 460V, 22kW 6: 230V, 37kW 7: 460V, 37kW 9: 460V, 45kW 11: 460V, 75kW	Read only
00-01	Display AFE2000 Rated Current	0: 35A 1: 20A 2: 70A 3: 35A 4: 95A 5: 50A 6: 150A 7: 75A 9: 95A 11: 160A	Read only
00-02	Software version	Read only	Read only
00-03	Current of AFE Unit	Read only	Read only
00-04	Mains Input Frequency	Read only	Read only
00-05	DC-BUS voltage	Read only	Read only
00-06	Display the Input Power of AFE2000 (kW)	-300.0 ~300.0	Read only
00-07	Display the Amount of Power Consumed kWh (High Word)	0~9999	Read only
00-08	Display the Amount of Power Consumed kWh (Low Word)	0 ~ 9999	Read only
00-09	Display the Amount of Power Regenerated kWh (High Word)	0 ~ 9999	Read only
00-10	Display the Amount of Power Regenerated kWh (Low Word)	0 ~ 9999	Read only
00-11	Display Total Power kWh (High Word) * Total Power = Power Consumed + Power Regenerated	-9999 ~ 9999	Read only
00-12	Display Total Power AAA kWh (Low Word) *Total Power = Power Consumed+ Power	-9999 ~ 9999	Read only

Parameter	Explanation	Settings	Fault Retry	Fault Reset	Factory Setting
	Regenerated				
00-13	Display AFE2000 Internal Temperature (℃)	Read only			Read only
00-14	IGBT Temperature (℃)	Read only			Read only
00-15	Digital Input Status (ON/OFF)	Read only			Read only
00-16	Digital Output Status (ON/OFF)	Read only			Read only
00-17	DC Bus Voltage at Fault	Read only			Read only
00-18	Mains Input Frequency at Fault	Read only			Read only
00-19	Current value at Fault	Read only			Read only
00-20	1st Recent Fault Record		Fault Retry	Fault Reset	Read only
00-21	2nd Recent Fault Record	0: No Fault Record	O	O	Read only
00-22	3rd Recent Fault Record	3 : ocn			Read only
00-23	4th Recent Fault Record	4: GFF	O	O	Read only
00-24	5th Recent Fault Record	5 : occ (only for frame D)	O	O	Read only
00-25	6th Recent Fault Record	6: ocs	O	O	Read only
		9: oVn	O	O	
		10: oVs	O	O	
		13 : LVn			
		14: LVs	O	O	
		15: PHL (Input phase loss)	O	O	
		16: oH1 (IGBT over-heat)	O	O	
		17: oH2 (Capacitance over-heat)	O	O	
		18: ot1 (circuit error)			
		19: ot2 (circuit error)			
		20: oL (150% 1Min, AFE2000 over-load)	O	O	
		30: cF1 (Memory write-in error)			
		31: cF2 (Memory read error)			
		32: cd0 Isum current detection error			
		33: cd1 U-phase current detection error			
		34: cd2 V-phase current detection error			
		35: cd3 W-phase current detection error			
		36: Hd0 cc current detection error			
		37: Hd1 oc current detection error			
		38: Hd2 ov current detection error			
		47: S1 Enable Error		O	
		48: BST Voltage boosting error		O	
		49: EF1	O	O	
		52: PcodE Code error		O	
		54: cE1 communication error (warn)	O	O	
		55: cE2 communication error (warn)	O	O	
		56: cE3 communication error (warn)	O	O	
		57: cE4 communication error (warn)	O	O	

Parameter	Explanation	Settings			Factory Setting
		58: cE10 communication Time Out(warn)	O	O	
		59: cP10 PU Board Time out(warn)	O	O	
		65: PCE phase connection error		O	
		66: PLE Phase lock error	O	O	
		67: LDC control voltage is too low	O	O	
		68: RIP DC Bus ripple is too large	O	O	
00-26	Electricity cost (Low Word)	Read only			Read only
00-27	Electricity cost (High Word)	Read only			Read only
00-28	Input AC voltage	0~6553.5			Read only

01 Basic Parameter

Parameter	Explanation	Settings	Factory Setting
01-00	Parameter Reset	0: No function 1: Read only, write is disable 8: Keypad lock 10: All parameters are reset to the factory settings	0
01-01	Start-up Screen Display	0: Mains input frequency 1: DC BUS voltage 2: Output current	0
01-02	Password Input	1~9998, 10000~65535 0~2: times of wrong password input	0
01-03	Password Set	1~9998, 10000~65535 0: No password set or successful input in Pr.01-02 1: Password has been set, parameter is locked	0
01-04	Source of the Operation Command	1: External terminal 2: RS-485 serial communication or digital keypad (KPVL-CC01)	2
01-05	Control Mode Selection	0: AFE mode 1: Regenerate mode	0
01-06	Accel. Time	0.00~600.00 sec	2
01-07	Decel. Time	0.00~600.00sec	2
01-08	DC BUS Voltage Command	220V : 300~370V 440V : 600~740V	340 680
01-09	DC BUS Gain Ratio of P	0~100%	100
01-10	DC BUS Gain Ratio of I	0~100%	100
01-11	DC BUS Bandwidth Control	0~75 230V, 7.5kW 460V, 7.5kW 460V, 15kW 230V, 15kW 230V, 22kW 460V, 22kW 230V, 37kW 460V, 37kW 460V, 45kW 460V, 75kW	 18 18 18 22 22 22 22 22 22 22
01-12	Inductance Value of Reactor	0(230V, 7.5kW): 2.10 1(460V, 7.5Kw): 7.32 2(230V, 15kW): 1.32 3(460V, 15kW): 5.28 4(230V, 22kW): 0.88 5(460V, 22kW): 3.52 6(230V, 37kW): 0.50 7(460V, 37kW): 1.96 9(460V, 45kW): 1.76 11(460V, 75kW): 1.02	0.88

02 Digital Input/Output Parameters

Parameter	Explanation	Settings	Factory Setting
02-00	Multi-Function Input Command 1 (MI1)	0: Disable 1: RUN 2: STOP 3: EF1 4: RESET 5 : MASTER/SLAVE (will be available soon) 6 : ENABLE 7: EF2 8: EF3 9: oH3	1
02-01	Multi-Function Input Command 2 (MI2)		2
02-02	Multi-Function Input Command 3 (MI3)		3
02-03	Multi-Function Input Command 4 (MI4)		4
02-04	Multi-Function Input Command 5 (MI5)		0
02-05	Multi-Function Input Command 6 (MI6)		0
02-06	Multi-Function Input Command 7 (MI7)		0
02-07	Multi-Function Input Command 8 (MI8)		
02-08	Digital Input Response Time	0.001~ 30.000 sec	0.005
02-09	Digital Input Operation Direction	0～65535	0
02-10	Multi-Function Output 1 RA1, RB1, RC1（Relay1）	0: Disable 1: Operation indication 2: DCBUS command attained 3: AFE Ready (Phase lock complete) 4: Fault Indication 5: Overheat warning (03-05&03-06) 6: Output warning 7: Drive / Regenerate 8: Fault Reset	2
02-11	Multi-Function Output 2 RA2, RB2, RC2（Relay2）		3
02-12	Multi-Function Output 3 (MO1)		0
02-13	Multi-Function Output 4 (MO2)		0
02-14	Multi-Function Output Direction	0～65535	0

03 Special Protection Parameters

Parameter	Explanation	Settings	Factory Setting
03-00	Low Voltage Level	230V model: 160.0~220.0Vdc 460V model: 320.0~440.0Vdc	180 360
03-01	Current Limit (Drive)	0~250%	150
03-02	Current Limit (Regeneration)	0~250%	150
03-03	Phase Lock Frequency Deviation Level	0.00~10.00Hz	4.00
03-04	Phase Lock Frequency Deviation Time	0~1000ms	150
03-05	IGBT Temperature Warning Level	0.0~110.0 ℃	100.0
03-06	Ambient Temperature Warning Level	0.0~110.0 ℃	60.0
03-07	Numbers of Fault Retry	0~10	0
03-08	Fault Retry Reset Time	1~600 sec	600
03-09	Fan Control (only ON/OFF for Frame B)	0: Fan is always ON 1: As the drive stops, the fan will continue to run for 60 sec then stop. 2: Fan stops when the drive stops operation 3: Fan ON/OFF depends on the ambient temperature 4: Fan is always OFF	2
03-10	Voltage Boosting Error (Level Setting)	0.0V ~15.0V	5.0
03-11	Voltage Boosting Error (Time Setting)	200ms~1000ms	200
03-12	Work Delete	1: Delete (when deleting is completed, Pr.03-12 reset to 1)	0
03-13	Electricity cost	0~6553.5	3.0

04 通訊參數

Parameter	Explanation	Settings	Factory Setting
04-00	Communication Address	1~254	1
04-01	Transmission Speed (Keypad)	4.8～115.2Kbps	19.2
04-02	Transmission Fault Treatment (Keypad)	0: Warn and continue operation 1: Warn and ramp to stop 2: Reserved 3: No treatment and no warn	3
04-03	Time-out Detection (Keypad)	0.0～100.0 sec	0
04-04	Communication Protocol (Keypad)	0: 7N1 (ASCII) 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)	13
04-05	Response Delay Time	0.0~200.0ms	2
04-06	COM2Transmission Speed (Keypad)	4.8～115.2Kbps	19.2
04-07	COM2 Transmission Fault Treatment (Keypad)	0: Warning and continue to operate 1: Warn and ramp to stop 2: Warn and coast to stop 3: No warning and continue to operate	3
04-08	COM2 Time-out Detection (Keypad)	0.0～100.0 sec	0.0
04-09	COM2 Communication Protocol (Keypad)	0: 7N1 (ASCII) 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)	13
04-10	Communication Card Type	0: No communication card 1: DeviceNet Slave	0

Parameter	Explanation	Settings	Factory Setting
		2: Profibus-DP Slave 3: CANopen Slave/Master 4: Modbus-TCP Slave 5: EtherNet/IP Slave 6~8: Reserved	
04-11	CANopen Baud Rate	0: 1M 1: 500k 2: 250k 3: 125k 4: 100k (Delta only) 5: 50k	0
04-12	CANopen Slave Address	0: Disable 1~127	0
04-13	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	0
04-14	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
04-15	Communication Card Firmware Version	Read only	##
04-16	Product Code	Read only	##
04-17	Fault Code	Read only	##
04-18	Communication Card Address	DeviceNet: 0-63 Profibus-DP: 1-125	1
04-19	Setting of DeviceNet Speed	Standard DeviceNet: 0: 100Kbps 1: 125Kbps 2: 250Kbps 3: 1Mbps (Delta only) Non standard DeviceNet: (Delta only) 0: 10Kbps 1: 20Kbps 2: 50Kbps 3: 100Kbps 4: 125Kbps 5: 250Kbps 6: 500Kbps 7: 800Kbps 8: 1Mbps	2
04-20	Additional Setting of DeviceNet Speed	0: Disable In this mode, baud rate can only be 0,1,2,3 as a standard DeviceNet setting. 1: Enable In this mode, the baud rate of DeviceNet can be same as CANopen (0-8).	0
04-21	Communication Card IP Configuration	0: Static IP 1: Dynamic IP (DHCP)	0
04-22	Communication Card IP Address 1	0~255	0
04-23	Communication Card IP	0~255	0

Parameter	Explanation	Settings	Factory Setting
	Address 2		
04-24	Communication Card IP Address 3	0~255	0
04-25	Communication Card IP Address 4	0~255	0
04-26	Communication Card Address Mask 1	0~255	0
04-27	Communication Card Address Mask 2	0~255	0
04-28	Communication Card Address Mask 3	0~255	0
04-29	Communication Card Address Mask 4	0~255	0
04-30	Getway Address 1 of the Communication Card	0~255	0
04-31	Getway Address 2 of the Communication Card	0~255	0
04-32	Getway Address 3 of the Communication Card	0~255	0
04-33	Getway Address 4 of the Communication Card	0~255	0
04-34	Password for Communication Card (Low word)	0~255	0
04-35	Password for Communication Card (High word)	0~255	0
04-36	Communication Card Reset	0: No function 1: Reset (Returns to factory setting.)	0
04-37	Communication Card Additional Setting	Bit0: Enable IP filter 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 change to disable when it finishes saving the internet parameter updates.	0
04-38	Communication Card Status	Bit 0: password enable When the communication card is set with password, this bit is enabled. When the password is cleared, this bit is disabled.	0

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Chapter 11 Description of Parameter Settings

00 Display Parameters

✓ This parameter can be set during the operation.

00-00 Identity Code of AFE2000

Factory Setting: Read only

Settings Display is different for different models. Read only.

00-01 Display AFE2000 Rated Current

Factory Setting: Read only

Settings Display is different for different models. 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.00-01.
- The factory setting is the rated current for normal duty.
- Pr.00-00 disaplays the identity code of AFE2000 and the code is set by the factory. Pr.00-01 is the rated current corresponds to its AFE2000 model (Pr.00-01). The corresponding current is shown at following:

AFE2000 Corresponding Chart										
Input voltage	230V				460V					
Pr.00-00	**0**	**2**	**4**	**6**	**1**	**3**	**5**	**7**	**9**	**11**
Applicable power range of AC motor drive (kW)	75	15	22	35	7.5	15	22	37	45	75
Rated input current	35	70	95	150	20	35	50	75	95	160

00-02 Software version

Factory Setting: #.##

Settings Read only (The display content is different by factory version.)

00-03 Current of AFE Unit

Factory Setting: #.##

Settings Read only (The display content is different by factory version.)

00-04 Mains Input Frequency (Line frequency)

Factory Setting: #.##

Settings Read only (The display content is different by factory version.)

00-05 DC-BUS voltage

Factory Setting: #.##

Settings Read only (The display content is different by factory version.)

00-06 Display the Input Power of AFE2000 (kW)

Factory Setting: #.##

Settings -300.0~300.0

00-07 Display the Amount of Power Consumed kWh (High Word)

Factory Setting: #.##

Settings 0~9999

00-08 Display the Amount of Power Consumed kWh (Low Word)

Factory Setting: #.##

Settings 0~9999

00-09 Display the Amount of Power Regenerated kWh (High Word)

Factory Setting: #.##

Settings 0~9999

00-10 Display the Amount of Power Regenerated kWh (Low Word)

Factory Setting: #.##

Settings 0~9999

00-11 Display Total Power kWh (High Word)

* Total Power = Power Consumed + Power Regenerated)

Factory Setting: #.##

Settings -9999~9999

00-12 Display Total Power AAA kWh (Low Word)

*Total Power = Power Consumed+ Power Regenerated

Factory Setting: #.##

Settings -9999~9999

When low word >10000 or low word < 10000, the high word adds 1 and the low word would return to 0. The maximum dislapy value for high word is 9999 and -9999, when high word > 9999, the display value will be 9999 and when high word < -9999, the display value will be -9999.

00-13 Display AFE2000 Internal Temperature (℃)

Factory Setting: #.##

Settings Read only

00-14 IGBT Temperature (℃)

Factory Setting: #.##

Settings Read only

00-15 Digital Input Status (ON/OFF)

Factory Setting: #.##

Settings Read only

00-16 Digital Output Status (ON/OFF)

Factory Setting: #.##

Settings Read only

00-17 DC Bus Voltage at Fault

Factory Setting: #.##

Settings Read only

00-18 Mains Input Frequency at Fault

Factory Setting: #.##

Settings Read only

00-19 Current value at Fault

Factory Setting: #.##

Settings Read only

00-20 1st Recent Fault Record
00-21 2nd Recent Fault Record
00-22 3rd Recent Fault Record
00-23 4th Recent Fault Record
00-24 5th Recent Fault Record
00-25 6th Recent Fault Record

Factory Setting: 0

Settings

Fault Code	Fault Retry	Fault Reset
0: No Fault Record	O	O
3 : ocn		
4: GFF	O	O

5 : occ (only for frame D)	O	O
6: ocs	O	O
9: oVn	O	O
10: oVs	O	O
13 : LVn	O	O
14: LVs	O	O
15: PHL (Input phase loss)	O	O
16: oH1 (IGBT over-heat)	O	O
17: oH2 (Capacitance over-heat)	O	O
18: ot1 (circuit error)		
19: ot2 (circuit error)		
20: oL (150% 1Min, AFE2000 over-load)	O	O
30: cF1 (Memory write-in error)		
31: cF2 (Memory read error)		
32: cd0 Isum current detection error		
33: cd1 U-phase current detection error		
34: cd2 V-phase current detection error		
35: cd3 W-phase current detection error		
36: Hd0 cc current detection error		
37: Hd1 oc current detection error		
38: Hd2 ov current detection error		
47: S1 Enable Error		O
48: BST Voltage boosting error		O
49: EF1	O	O
52: PcodE Code error		O
54: cE1 communication error (warn)	O	O
55: cE2 communication error (warn)	O	O
56: cE3 communication error (warn)	O	O
57: cE4 communication error (warn)	O	O
58: cE10 communication Time Out(warn)	O	O
59: cP10 PU Board Time out(warn)	O	O
65: PCE phase connection error		O
66: PLE Phase lock error		
67: LDC control voltage is too low		
68: RIP DC Bus ripple is too large		

00-26 Electricity cost (Low Word)

Factory Setting: #.##

Settings Read only

00-27 Electricity cost (High Word)

Factory Setting: #.##

Settings Read only

00-28 Input AC voltage

Factory Setting: #.##

Settings 0~6553.5

01 Basic Parameters

✓ This parameter can be set during the operation.

01-00 Parameter Reset

Factory Setting: 0

Settings 0: No function
1: Read only, write is disable
8: Keypad lock
10: All parameters are reset to the factory settings

- When it is set to 1, all parameters are read only except Pr.01-00 ~Pr.01-03. Password setting function can still be used to to prevent parameter setting changes when false operation.
- When it is set to 10, all parameters are reset to factory settings. If parameters are locked, please clear the password to return the parameters setting back to factory setting.
- When it is set to 8, digital keypad is disabled. All parameters are disabled except Pr. 01-00 and Pr.01-02.

01-01 Start-up Screen Display

Factory Setting: 0

Settings 0: Mains input frequency
1: DC BUS voltage
2: Output current

01-02 Password Input

Factory Setting: 0

Settings 1~9998，10000~65535
Display 0~2: times of wrong password input

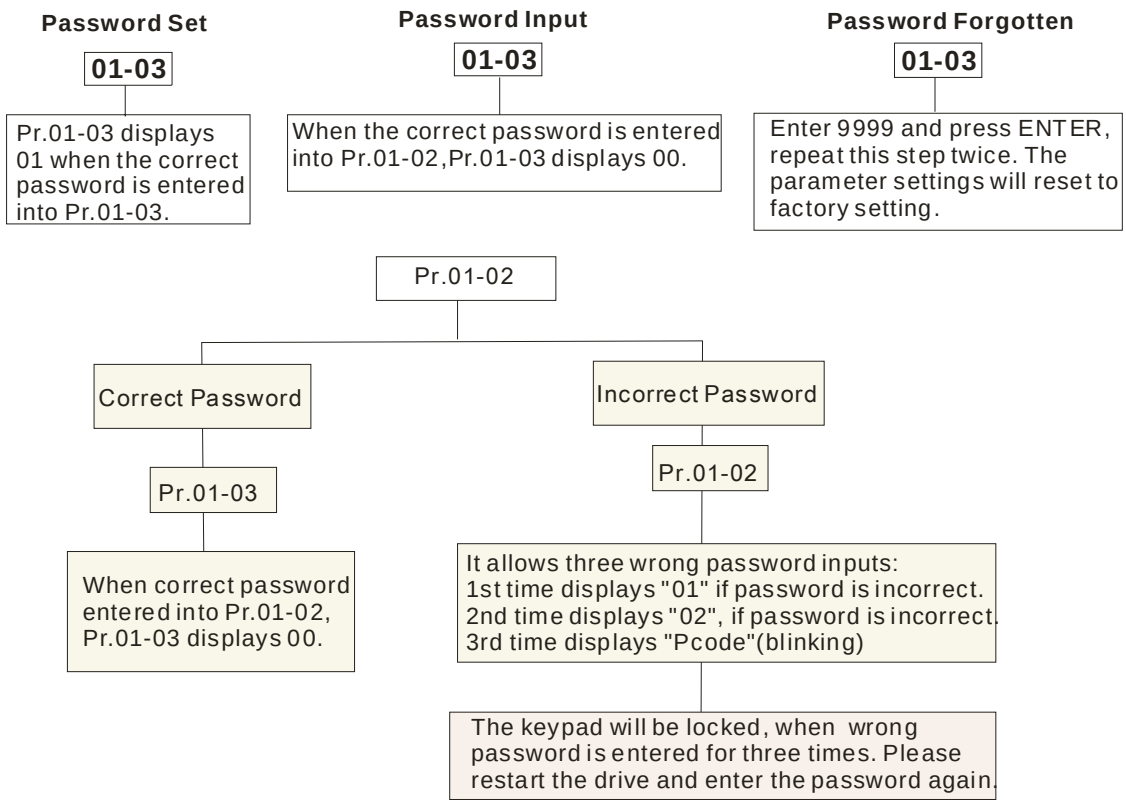
- Pr.01-02 is used to unlock the parameter only if Pr.01-03 password is set. Enter the same password as setted in Pr.01-03. The purpose of this parameter is to prevent the parameter changes caused by misoperation.
- When the user have forgotten the password, clear the setting by input 9999 and press ENTER key, then input 9999 again and press Enter within 10 seconds. After parameters are unlocked, all settings will return to factory setting.

01-03 Password Set

Factory Setting: 0

Settings 1~9998，10000~65535
Display 0: No password set or successful input in Pr.01-02
1: Password has been set, parameter is locked

- This parameter is used for password protection. Setting the password for first time, enter the password and if value display as 1, it means password setting is success. If display value is 0, it means no password has been set and password protection function is not yet activated, all parameters can be changed (Pr.01-03 setting can also be changed, please re-set your password).
- When the display value is 1, all parameters can be changed. In order to unlock the parameters, please go to Pr.01-02 and enter the right password, the display value will then be changed to 0 and all parameters can be changed. Note: If the display value is 0, it means the password is cleared, there will be no password protection when re-activating the AFE2000 unit. If display value is 1, it means the password is set (parameter locked) for everytime the AFE2000 unit is re-activated; in this case, enter the password to Pr.01-02 to unlock the parameters for change setting.
- How to make the password valid again after clearing the password:
  Method 1: Enter a new password to Pr.01-03.
  Method 2: Re-activate the unit and password protection setting will return to previous setting.
  Method 3: Enter a non-password digits to Pr.01-02.



01-04 Source of Operation Command

Factory Setting: 0

Settings 1: External terminal
2: RS-485 serial communication or digital keypad (KPVL-CC01)

- For the factory released AFE2000 unit, the digital keypad is not set as the source of operation command, user can perform operation control via the external terminal or the communication interface (RS485).
- When the PU led on the interface is lightened, the digital keypad can now perform the operation command. (For optional accessories selection, please refer to Ch 06 Optional Acessories- Digital keypad section.)

01-05 Control Mode Selection

Factory Setting: 0

Settings 0：AFE2000 mode
1：Regenerate mode

01-06 Accel. Time

Factory Setting: 2

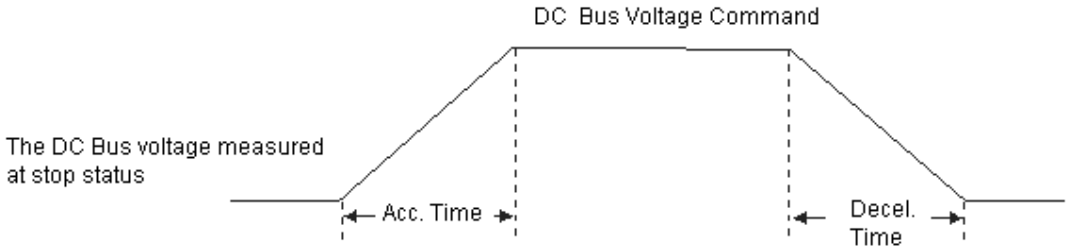
Settings 0.00~600.00 sec

01-07 Decel. Time

Factory Setting: 2

Settings 0.00~600.00 sec

- Acceleration: (The DC Bus voltage measured at stop – the maximum allowable voltage setting)/Acceleration Time
- Deceleration: (The DC Bus voltage measured at stop – the maximum allowable voltage setting)/Deceleration Time
- The maximum allowable voltage setting of the AFE2000 model.



01-08 DC BUS Voltage Command

Settings 230V: 300V~370V Factory Setting: 340
430V: 600V~740V Factory Setting: 680

01-09 DC BUS Gain Ratio of P

Factory Setting: 100

Settings 0~100%

01-10 DC BUS Gain Ratio of I

Factory Setting: 100

Settings 0~100%

01-11 DC BUS Bandwidth Control

Factory Setting:
Refer to the chart

Settings 0~75Hz

Pr.01-11 is to control the DC BUS Bandwidth:

AFE2000										
Input voltage	230V				460V					
Frame	B	C	D		B		C	D		
Applicable power range of AC motor drive (kW)	75	15	22	35	7.5	15	22	37	45	75
Factory setting (Hz)	18	22			18		22			

01-12 Inductance Value of Reactor

Factory Setting: 0.88

Settings 0(230V, 7.5kW): 2.10
1(460V, 7.5Kw): 7.32
2(230V, 15kW): 1.32
3(460V, 15kW): 5.28
4(230V, 22kW): 0.88
5(460V, 22kW): 3.52
6(230V, 37kW): 0.50
7(460V, 37kW): 1.96
9(460V, 45kW): 1.76
11(460V, 75kW): 1.02

02 Digital Input/Output Parameters

✓ This parameter can be set during the operation.

02-00 Multi-Function Input Command 1 (MI1)

Factory Setting: 1

02-01 Multi-Function Input Command 2 (MI2)

Factory Setting: 2

02-02 Multi-Function Input Command 3 (MI3)

Factory Setting: 3

02-03 Multi-Function Input Command 4 (MI4)

Factory Setting: 4

02-04 Multi-Function Input Command 5 (MI5)

Factory Setting: 5

02-05 Multi-Function Input Command 6 (MI6)

Factory Setting: 0

02-06 Multi-Function Input Command 7 (MI7)

Factory Setting: 0

02-07 Multi-Function Input Command 8 (MI8)

Factory Setting: 0

Settings
0: Disable
1: RUN
2: STOP
3: EF1
4: RESET
5: master/slave (will be available soon)
6: enable
7: EF2
8: EF3
9: oH3

📖 This parameter is user defined setting to select the functions for each multi-function terminal.
Summary of function settings:

Settings	Functions	Descriptions
0	No function	Output terminal has no function
1	RUN	This terminal is a latched contact. The terminal setting is valid when Pr.01-04=1 (control by external terminal).
2	STOP	This terminal is a latched contact The terminal setting is valid when Pr.01-04=1 (control by external terminal).
3	EF1	Emergency stop 1
4	RESET	When the fault is cleared, this terminal allows AFE2000 to perform the reset.
5	Master/Slave	(not supported)-
6	Enable	If this terminal is set, AFE2000 is enabled when the contact is triggered.
7	EF2	Emergency stop 2
8	EF3	Emergency stop 3
9	oH3	Reactor overheat warning When this terminal is triggered on, it will signal a reactor overheat warning.

02-08 Digital Input Response Time

Factory Setting: 0.005

Settings 0.001~30.000sec

🕮 It is used for digital input terminal signal delay and confirmation. The delay time is the confirmation time to prevent some uncertain interference that would cause error in the digital input terminals (M1~8). Under this condition, confirmation for this parameter would improve effectively, but the response time will be somewhat delayed.

02-09 Digital Input Operation Direction

Factory Setting: 0

Settings 0～65535

🕮 This function is for bit setting. Bit =1 indicate the multi-function output is in a reverse direction. For example: Pr.02-08 =1 (operating), when forward direction ouput bit is set to 0, Relay 1 will be ON when the drive is operating and Relay 1 will be OFF when the drive stops. Conversely, if reverse direction output bit is set to 1, Relay 1 will be OFF when the drive is operating and Relay 1 will be ON when the drive stops.

02-10 Multi-Function Output（Relay1）

Factory Setting: 2

02-11 Multi-Function Output（Relay2）

Factory Setting: 3

02-12 Multi-Function Output (MO1)

Factory Setting: 0

02-13 Multi-Function Output (MO2)

Factory Setting: 0

0: Disable
1: Operation indication
2: DCBUS command attained
3: AFE Ready (Phase lock complete)
4: Fault Indication
5: Overheat warning (Pr.03-05 & Pr.03-06)
6: Output warning
7: Drive / Regenerate
8: Fault Reset

🕮 This parameter is user defined setting to select the functions for each multi-function terminal. Summary of function settings:

Settings	Functions	Descriptions
0	Disable	Output terminal is disabled
1	Operation indication	When AFE2000 is at operation status, the contact is closed (NC).
2	DCBUS command attained	When DC Bus voltage level is attained, the contact is closed (NC).
3	AFE Ready (Phase lock complete)	When there's no fault occurs in AFE2000 and phase lock is complete, the contact is closed (NC).
4	Fault Indication	When the drive detects unusual faults, the contact is closed (NC).
5	Overheat warning (03-05&03-06)	When IGBT temperature or the ambient temperature is greater than Pr.03-05, it will release a warning before overheat causes AFE2000 shut down.
6	Output warning	When AFE2000 detects a warning, the contact is closed

		(NC).
7	Drive / Regenerate	When AFE2000 is at Drive status, the contact is closed (NC).
8	Fault Reset	When AFE2000 fault is cleared and receives a reset command, the contact will be closed (NC) for 100ms.

02-14 Multi-Function Output Direction

Factory Setting: 0

Settings 0~65535

This function is for bit setting. Bit =1 indicate the multi-function output is in a reverse direction. For example: Pr.02-11 =1 (operating indicator), when forward direction ouput bit is set to 0, Relay 1 will be ON when the drive is operating and Relay 1 will be OFF when the drive stops. Conversely, if reverse direction output bit is set to 1, Relay 1 will OFF when the drive is operating and Relay 1 will be ON when the drive stops.

Bit 3	Bit 2	Bit 1	Bit 0
MO2	MO1	MRA	RA

03 Protection Parameters

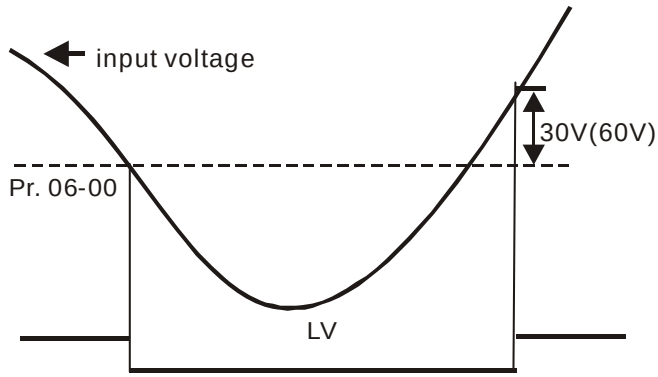
✓ This parameter can be set during the operation.

✓ 03-00 Low Voltage Level

Factory Setting: 180.0/360.0

Settings 230V model:160.0~220.0V
460Vmodel: 320.0~440.0V

🕮 This parameter is used to set the Low Voltage Level.



✓ 03-01 Current Limit (Drive)

Factory Setting: 150

Settings 0~250%

🕮 This parameter sets the maximum current limit for AFE2000 at drive status.

✓ 03-02 Current Limit (Regenerate)

Factory Setting: 150

Settings 0~250%

🕮 This parameter sets the maximum current limit for AFE2000 at energy regenerating status.

03-03 Phase Lock Frequency Deviation Level

Factory Setting: 4.00

Settings 0.00~10.00Hz

🕮 When AFE2000 detects phase lock frequency attain 47~63Hz and fluctuate within 1Hz for longer than 300 ms, AFE2000 phase lock is completed.

03-04 Phase Lock Frequency Deviation Time

Factory Setting: 150

Settings 0~1000ms

🕮 If the frequency detected is greater than the phaselock frequency and greater than the setting in Pr.03-03 for a time period longer than Pr.03-04, it will output a phase lock errorsignal (PLE).

03-05 IGBT Temperature Warning Level

Factory Setting: 100.0

Settings 0.0~11.0℃

03-06 Ambient Temperature Warning Level

Factory Setting: 60.0

Settings 0.0~11.0℃

03-07 Numbers of Fault Retry

Factory Setting: 0

Settings 0～10

After fault occurs (only for over-current OC or over-voltage OV fault occurs and occ), the AFE2000 unit can be reset/restarted automatically up to 10 times. Setting this parameter to 0 will disable to reset/restart the operation after any fault has occurred.

03-08 Fault Retry Reset Time

Factory Setting: 600

Settings 1~600 sec

03-09 Fan Control

Factory Setting: 0

Settings
0: Fan is always ON
1: As the drive stops, the fan will continue to run for 60 sec then stop.
2: Fan stops when the drive stops operation
3: Fan ON/OFF depends on the ambient temperature
4: Fan is always OFF

This parameter sets the fan control method for dissipating the heat. (For Frame B, only ON/OFF control is available.)

03-10 Voltage Boosting Error (Level)

Factory Setting: 5.0

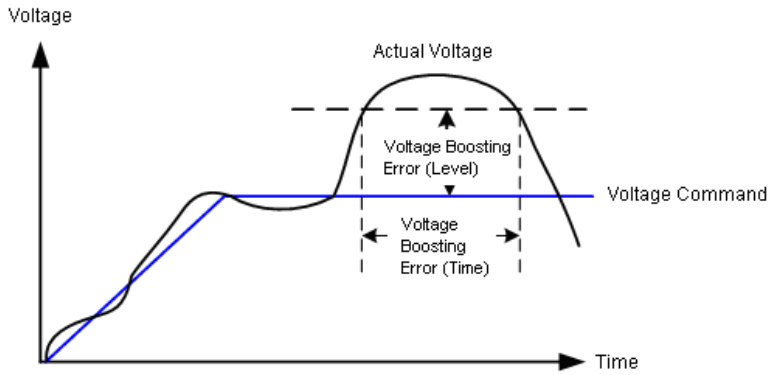
Settings 0.0～15.0V

03-11 Voltage Boosting Error (Time)

Factory Setting: 5.0

Settings 0.0~10.0sec

If the detected DC Bus feedback value minus the DC Bus command value is greater than the setting in Pr.03-08 and for a period longer than Pr.03-09, then Voltage Boosting Error (BST) would arise.



03-12 Work Delete

Factory Setting: 0

Settings 0: Parameter return to home setting
1: Delete (when deleting is completed, Pr.03-12 reset to 1)

📖 When Pr.03-12 is set to 1, Pr.00-07 to Pr.00-12 will be deleted and set to 0 and when this process is completed, Pr.03-12 return to 0.

03-13 Electricity cost

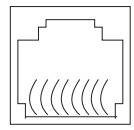
Factory Setting: 3.0

Settings 0~6553.5

04 Communication Parameters

This parameter can be set during the operation.

When controlling by communcation, it needs to connect the drive and PC by IFD6530 or IFD6500 converter.



RS-485

Serial communication
1:+EV
2:GND
3:SG-
4:SG+
5:NC
6:NC

04-00 Communication Address

Factory Setting: 1

Settings 1~254

🕮 If the AFE unitis controlled by RS-485 serial communication, the communication address for this AFE unit must be set via this parameter. And the communication address for each AC motor drive must be different and unique.

04-01 Transmission Speed

Factory Setting: 19.2

Settings 4.8~115.2kbits/s

🕮 This parameter is used to set the transmission speed between the RS485 master (PLC, PC, etc.) and AFE2000 unit.

04-02 Transmission Fault Treatment

Factory Setting: 3

Settings
0: Warn and continue operation
1: Warn and ramp to stop
2: Reserved
3: No treatment and no warn

🕮 This parameter is set to how to react if transmission errors occur.

04-03 Time-out Detection

Factory Setting: 0.0

Settings 0.0~100.0sec
0.0: No detection

🕮 It is used to set the transmission time between communication and keypad.

04-04 Communication Protocol

Factory Setting: 13

Settings
0：7，N，1 for ASCII
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)
- An AFE2000 unit 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 hexdecimal, ASCII: "0", "9", "A", "F", every 16 hexdecimal represent ASCII code. For example:

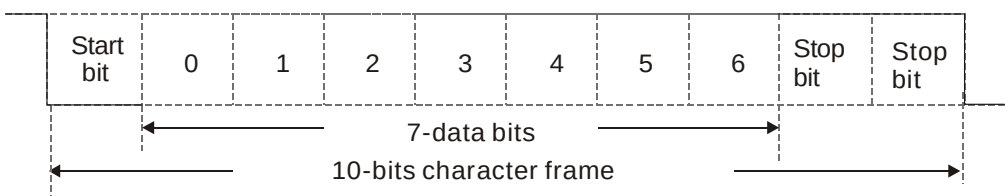
Character	'0'	'1'	'2'	'3'	'4'	'5'	'6'	'7'
ASCII code	30H	31H	32H	33H	34H	35H	36H	37H

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

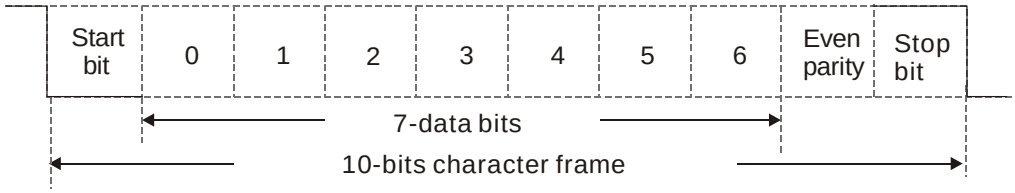
- Data Format

10-bit character frame (For ASCII):

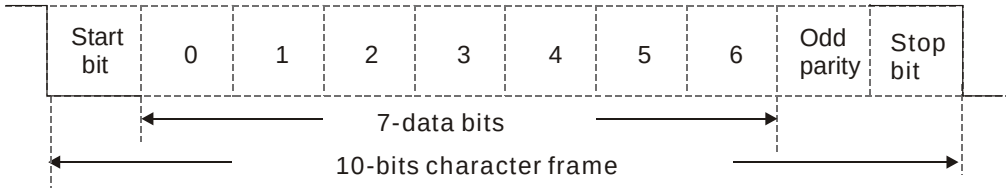
（7, N , 2）



（7 , E , 1）

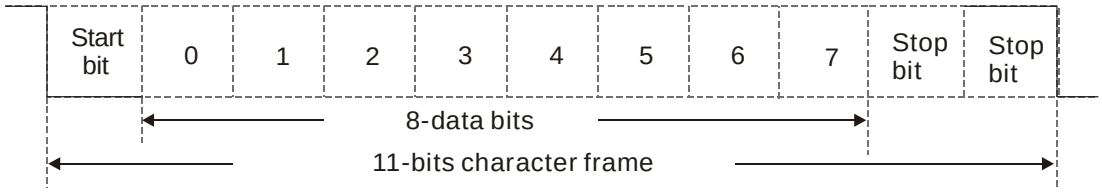


（7 , O , 1）

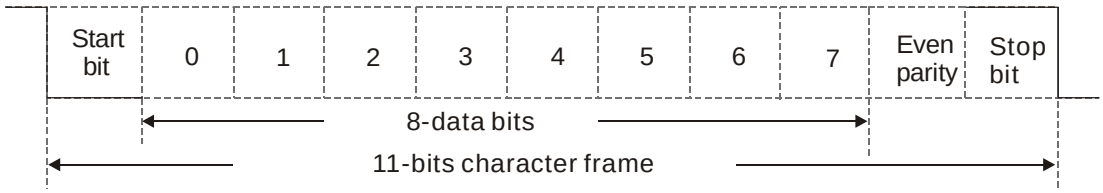


11-bit character frame (For RTU):

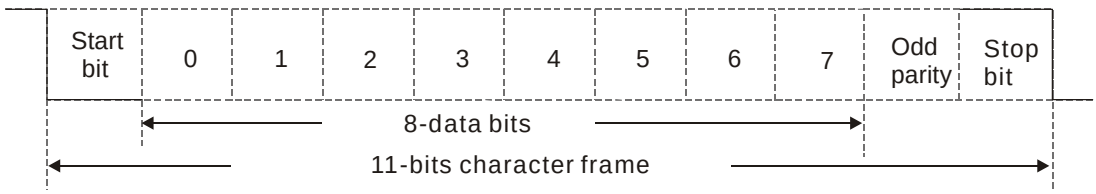
（8 , N , 2）



（8 , E , 1）



（8 , O , 1）



2. 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	

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 AFE unit. In this case, the AFE unit AFE UNIT will not reply any message to the master device.
00H: broadcast to all AFE units
01H: AFE unit of address 01
0FH: AFE unit of address 15
10H: AFE unit of address 16
:
FEH: AFE unit 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, AFE unit address is 01H.
ASCII mode:

Command Message:

STX	‘:’
Address	‘0’
	‘1’
Function	‘0’
	‘3’
Starting address	‘2’
	‘1’
	‘0’
	‘2’

Response Message

STX	‘:’
Address	‘0’
	‘1’
Function	‘0’
	‘3’
Number of data (count by byte)	‘0’
	‘4’
Content of starting address 2102H	‘1’
	‘7’

Number of data (count by word)	‘0’
	‘0’
	‘0’
	‘2’
LRC Check	‘D’
	‘7’
END	CR
	LF

	‘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
CRC CHK Low	6FH
CRC CHK High	F7H

Response Message

Address	01H
Function	03H
Number of data (count by byte)	04H
Content of data address 2102H	17H
	70H
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. AFE UNIT 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

Response Message

Address	01H
Function	06H
Data address	01H
	00H
Data content	17H
	70H
CRC CHK Low	86H

CRC CHK High	22H	CRC CHK High	22H

10H: write multiple registers (write multiple data to registers)

Example: Set the multi-step speed,

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

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'
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, 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
```

3. Address list

Content	Address	Function
AFE2000 Parameters	GGnnH	GG means parameter group, nn means parameter number, for example, the address of Pr 4-01 is 0401H.

Content	Address	Function	
Command to AFE2000	2000H	Bit 0-3	0: No function 1: Stop 2: Run 3: No function
		Bit 4-5	00B: No function 01B: No function 10B: No function 11B: No function
		Bit 6-7	00B: No function 01B: No function 10B: No function 11B: No function
		Bit 8-11	0000B: No function
			0001B: No function
			0010B: No function
			0011B: No function
			0100B: No function
			0101B: No function
			0110B: No function
			0111B: No function
			1000B: No function
			1001B: No function
			1010B: No function
			1011B: No function
			1100B: No function
			1101B: No function
			1110B: No function
			1111B: No function
		Bit 12	1: No function
		Bit 13~14	00B: No function
			01B: operated by digital keypad
			10B: operated by Pr.01-04 setting
			11B: change operation source
		Bit 15	Reserved
	2001H	Frequency command	
	2002H	Bit 0	1: EF (external fault) on
		Bit 1	1: Reset
		Bit 2	1: B.B. ON
		Bit 3-15	No function
Monitor AFE2000 status	2100H	Error code: No function	
	2119H	Bit 0	1: No function
		Bit 1	1: Operation status
		Bit 2	1: No function
		Bit 3	1: No function
		Bit 4	1: No function
		Bit 8	1: No function
		Bit 9	1: No function
		Bit 10	1: Operation command controlled by communication interface
		Bit 11	1: Parameters have been locked
		Bit 12	1: enable to copy parameter from keypad
		Bit 13-15	Reserved
	211AH	Phase Lock (PLL) Frequency(FXXXX)	
	2104H	Output current (AXXX.X)	

Content	Address	Function
	2105H	DC-BUS Voltage (UXXX.X)
	220EH	Display the IGBT temperature of AFE200 power module in °C
	220FH	Display the ambient temperature in °C
	2210H	Analog input status ON/OFF
	2211H	Analog output status ON/OFF
	2213H	The corresponding CPU pin status of digital input
	2214H	The corresponding CPU pin status of digital output

4. 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:

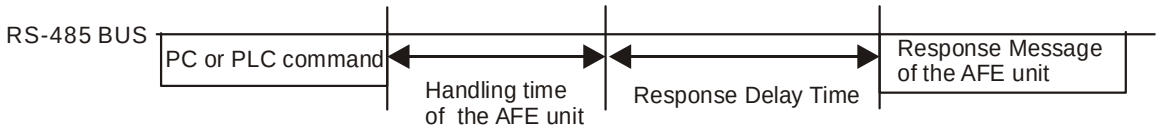
Exception code	Explanation
1	Illegal data value: The data value received in the command message is not available for the AFE unit.
2	Illegal data address: The data address received in the command message is not available for the AC motor drive.
3	Parameters are locked: parameters can’t be changed
4	Parameters can’t be changed during operation
10	Communication time-out.

04-05 Response Delay Time

Factory Setting: 2.0

Settings 0.0~200.0ms

🕮 This parameter is the response delay time after AFE unit receives communication command as shown in the following.



04-06 COM2Transmission Speed

Factory Setting: 19.2

Settings 4.8~115.2kbits/s

🕮 This parameter is used to set the transmission speed between the RS485 master (PLC, PC, etc.) and AFE2000 unit.

04-07 COM2 Transmission Fault Treatment

Factory Setting: 3

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

🕮 This parameter is set to how to react if transmission errors occur.

04-08 COM2 Time-out Detection

Factory Setting: 0.0

Settings 0.0~100.0sec
0.0: No detection

🕮 It is used to set the transmission time between communication and keypad.

04-09 COM2 Communication Protocol

Factory Setting: 13

Settings
0：7，N，1 for ASCII
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

04-10 Communication Card Type

Factory Setting: Read only

Settings
0：no communication card
1：DeviceNet Slave
2：Profibus-DP Slave
3：CANopen Slave/Master
4：Modbus-TCP Slave
5：EtherNet/IP Slave
6~8：Reserved

04-11 CANopen Baud Rate

Factory Setting: 0

Settings
0: 1M
1: 500k
2: 250k
3: 125k
4: 100k (Delta only)
5: 50k

04-12 CANopen Slave Address

Factory Setting: 0

Settings
0: Disable
1~127

04-13 CANopen Communication Status

Factory Setting: Read only

Settings
0: Node Reset State
1: Com Reset State
2: Boot up State
3: Pre Operation State
4: Operation State
5: Stop State

04-14 CANopen Warning Record

Factory Setting: Read only

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

04-15 Communication Card Firmware Version

Factory Setting: ##

Settings Read only

04-16 Product Code

Factory Setting: ##

Settings Read only

04-17 Fault Code

Factory Setting: ##

Settings Read only

04-18 Communication Card Address

Factory Setting: ##

Settings DeviceNet: 0-63
Profibus-DP: 1-125

04-19 Setting of DeviceNet Speed

Factory Setting: 2

Settings Standard DeviceNet:
0: 100Kbps
1: 125Kbps
2: 250Kbps
3: 1Mbps (Delta only)
Non standard DeviceNet: (Delta only)
0: 10Kbps
1: 20Kbps
2: 50Kbps
3: 100Kbps
4: 125Kbps

5: 250Kbps
6: 500Kbps
7: 800Kbps
8: 1Mbps

04-20 Additional Setting of DeviceNet Speed

Factory Setting: 1

Settings 0: Disable
1：Enable

- This parameter needs to work with Pr.09-71.
- Pr.04-20=0: in this mode, baud rate can only be 0,1,2,3 as the standard DeviceNet setting.
- Pr.04-20=1: with the additional setting, the baude rate of the Device Net can be (0-8), the same as the CANopen.

04-21 Communication Card IP Configuration

Factory Setting: 0

Settings 0：Static IP
1：Dynamic IP (DHCP)

- Pr.04-21=0: user needs input the IP address
- Pr.04-21=1: the controller set the IP address automatically.

04-22 Communication Card IP Address 1
04-23 Communication Card IP Address 2
04-24 Communication Card IP Address 3
04-25 Communication Card IP Address 4

Factory Setting: 0

Settings 0~255

04-26 Communication Card Address Mask 1
04-27 Communication Card Address Mask 2
04-28 Communication Card Address Mask 3
04-29 Communication Card Address Mask 4

Factory Setting: 0

Settings 0~255

04-30 Getway Address 1 of the Communication Card
04-31 Getway Address 2 of the Communication Card
04-32 Getway Address 3 of the Communication Card
04-33 Getway Address 4 of the Communication Card

Factory Setting: 0

Settings 0~255

04-34 Password for Communication Card (Low word)
04-35 Password for Communication Card (High word)

Factory Setting: 0

Settings 0~255

04-36 Communication Card Reset

Factory Setting: 0

Settings 0: No function

1: Reset (Returns to factory setting.)

04-37 Communication Card Additional Setting

Factory Setting: 1

Settings Bit0: Enable IP filter

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 change to disable when it finishes saving the internet parameter updates.

04-38 Communication Card Status

Factory Setting: 0

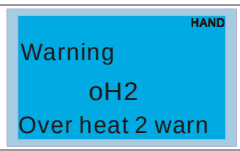
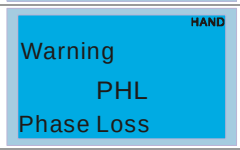
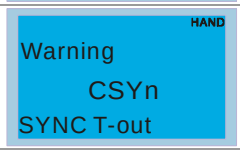
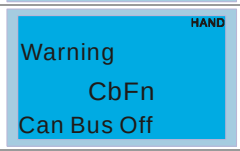
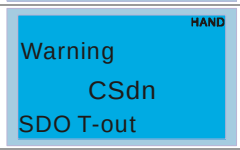
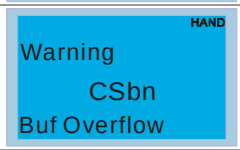
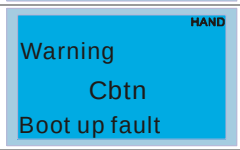
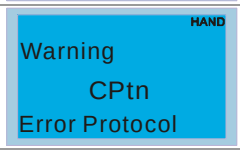
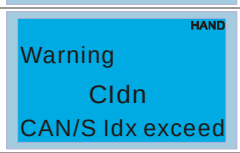
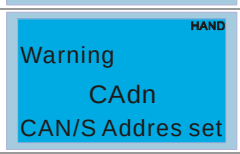
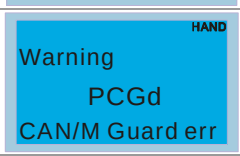
Settings Bit 0: password enable

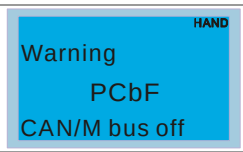
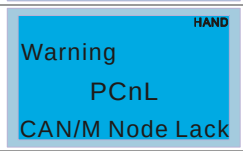
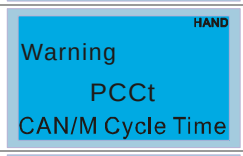
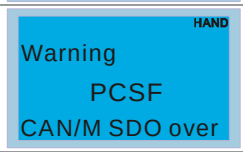
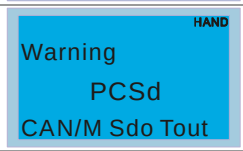
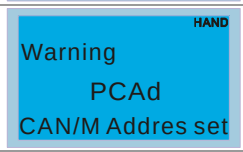
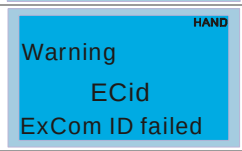
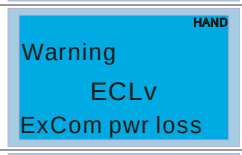
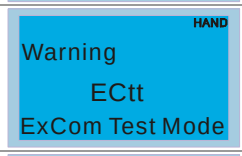
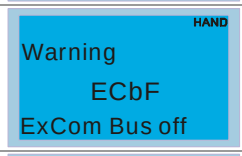
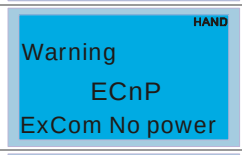
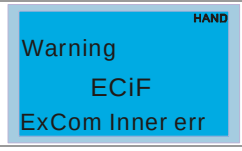
When the communication card is set with password, this bit is enabled. When the password is cleared, this bit is disabled.

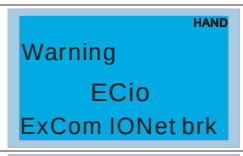
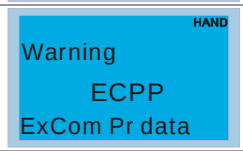
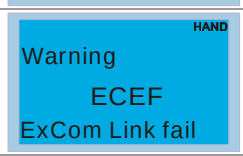
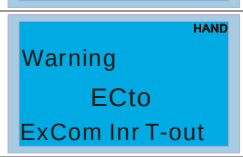
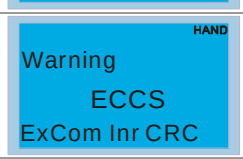
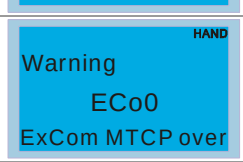
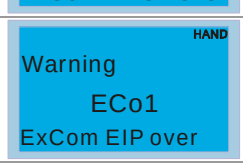
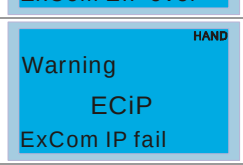
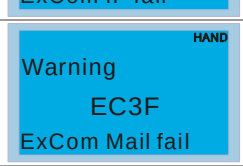
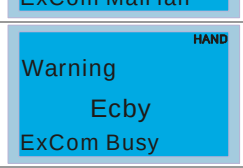
Chapter 12 Warning Codes

① Display error signal
② Abbreviate error code
The code is displayed as shown on KPC-CE01.
③ Display error description

Display on LCM Keypad	Descriptions
HAND Warning CE01 Comm. Error 1	Modbus function code error
HAND Warning CE02 Comm. Error 2	Address of Modbus data is error
HAND Warning CE03 Comm. Error 3	Modbus data error
HAND Warning CE04 Comm. Error 4	Modbus communication error
HAND Warning CE10 Comm. Error 10	Modbus transmission time-out
HAND Warning CP10 Keypad time out	Keypad transmission time-out
HAND Warning SE1 Save Error 1	Keypad COPY error 1
HAND Warning SE2 Save Error 2	Keypad COPY error 2
HAND Warning oH1 Over heat 1 warn	IGBT over-heating warning

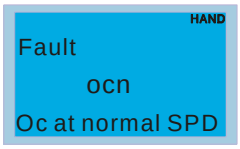
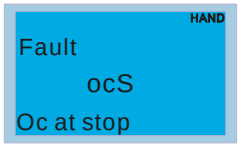
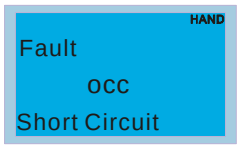
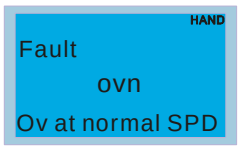
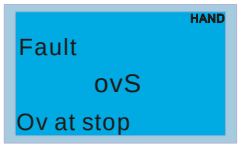
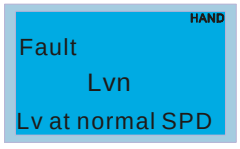
	Capacity over-heating warning
	Phase loss
	CAN guarding time-out 1
	CAN heartbeat time-out 2
	CAN synchrony time-out
	CAN bus off
	CAN SDO transmission time-out
	CAN SDO received register overflow
	CAN boot up error
	CAN format error
	CAN index error
	CAN station address error
	CAN Master guarding error

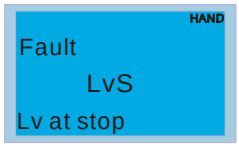
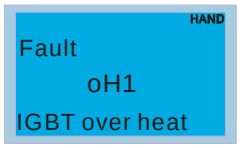
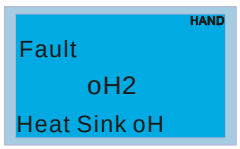
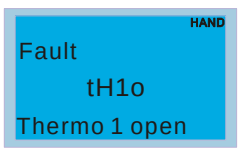
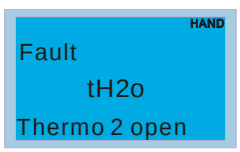
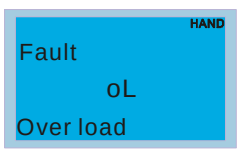
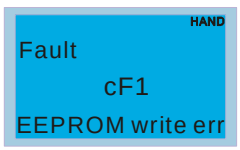
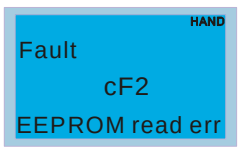
	CAN Master bus off
	CAN Master node error
	CAN Master cycle time-out
	CAN Master SDO over
	CAN Master SDO time-out
	CAN Master station address error
	Duplicate MAC ID error Node address setting error
	Low voltage of communication card
	Communication card in test mode
	DeviceNet bus-off
	DeviceNet no power
	Factory default setting error
	Serious internal error

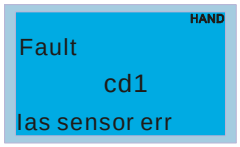
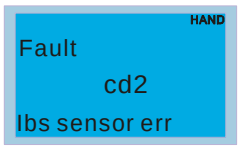
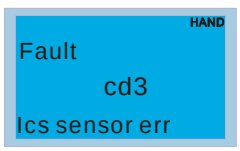
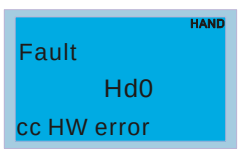
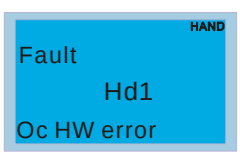
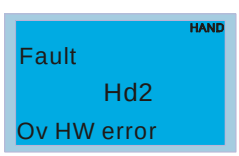
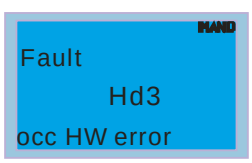
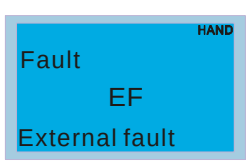
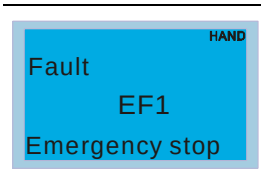
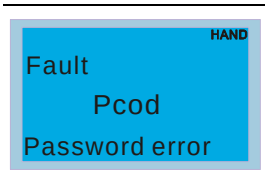
	IO connection break off
	Profibus parameter data error
	Profibus configuration data error
	Ethernet link fail
	Communication time-out for communication card and drive
	Check sum error for communication card and drive
	Communication card returns to default setting
	Modbus TCP exceed maximum communication value
	EtherNet/IP exceed maximum communication value
	IP fail
	Mail fail
	Communication card busy

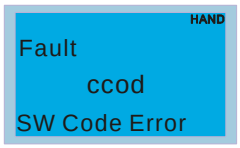
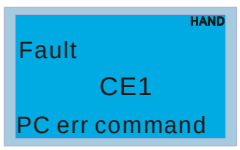
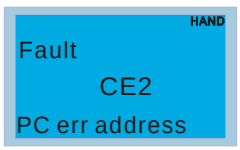
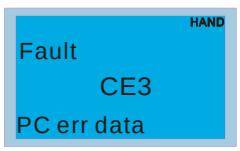
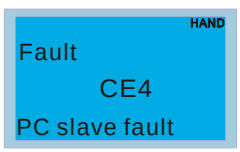
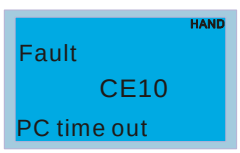
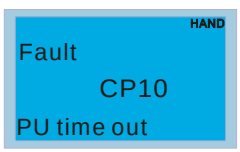
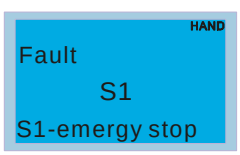
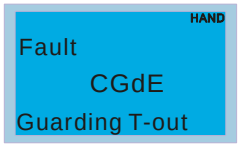
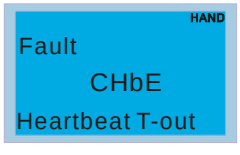
Chapter 13 Fault Codes and Descriptions

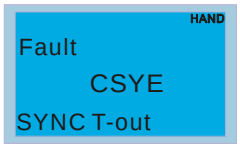
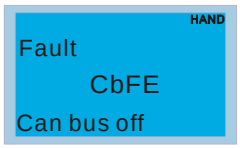
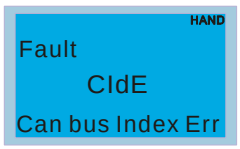
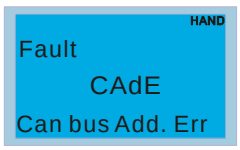
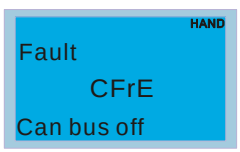
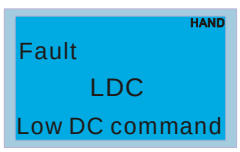
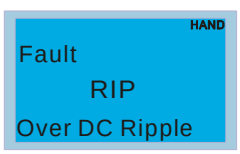
① Display error signal
② Abbreviate error code
The code is displayed as shown on KPC-CE01.
③ Display error description

Fault Name	Fault Descriptions	Corrective Actions
	Over-current during steady state operation (Output current exceeds 2.5 times of the rated current during constant speed.)	1. Check for possible poor insulation at the output. 2. Sudden increase in motor loading: Check for possible motor stall. 3. Replace the AFE2000 with the next higher power model.
	Hardware failure in current detection	Return to the factory
	Ground fault	When (one of) the output terminal(s) is grounded, short circuit current is more than 50% of AFE2000 rated current. NOTE: The short circuit protection is provided for AFE2000 protection, not for protecting the user. 1. Check whether the IGBT power module is damaged. 2. Check for possible poor insulation at the output .
	Short-circuit is detected between upper bridge and lower bridge of the IGBT module	Return to the factory
	DC BUS over-voltage at constant speed (230V: 425Vdc；460V: 850Vdc)	1. Check if the input voltage falls within the rated AFE2000 input voltage range. 2. Check for possible voltage transients.
	Hardware failure in voltage detection at stop status.	1. Check if the input voltage falls within the rated AFE2000 input voltage range. 2. Check for possible voltage transients.
	DC BUS voltage is less than Pr.03-00 at constant speed	1. Check if the input voltage is normal 2. Check for possible sudden load

Fault Name	Fault Descriptions	Corrective Actions
	DC BUS voltage is less than Pr.03-00 at stop	1. Check if the input voltage is normal 2. Check for possible sudden load
	IGBT overheating IGBT temperature exceeds protection level 1~50HP: 105℃; 60~100HP: 110℃	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.
	Heatsink overheating Capacitance temperature exceeds protection level. 1~50HP: 80℃; 60~100HP: 65℃	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.
	IGBT Hardware Error	Return to the factory
	Capacitor Hardware Error	Return to the factory
	Overload The AC motor drive detects excessive drive output current.	1. Increase AFE2000 output capacity. Replace with the next higher power AFE2000 unit.
	Internal EEPROM can not be programmed or Internal EEPROM can not be read.	1. Press “RESET” key to the factory setting 2. Return to the factory.
	Internal EEPROM can not be read.	1. Press “RESET” key to the factory setting 2. Return to the factory.

Fault Name	Fault Descriptions	Corrective Actions
	R-phase error	Reboots the power. If fault code is still appears on the keypad please return to the factory
	S-phase error T-phase error	Reboots the power. If fault code is still appears on the keypad please return to the factory
	W-phase error	Reboots the power. If fault code is still appears on the keypad please return to the factory
	cc (current clamp)	Reboots the power. If fault code is still appears on the keypad please return to the factory
	oc hardware error	Reboots the power. If fault code is still appears on the keypad please return to the factory
	ov hardware error	Reboots the power. If fault code is still displayed on the keypad please return to the factory
	occ hardware error	Reboots the power. If fault code is still displayed on the keypad please return to the factory
	External fault	1. When EF (N.O.) external terminal is ON. AC motor drive stop output. 2. Press RESET after fault has been cleared.
	Emergency stop	1. When the multi-function input terminals MI1 to MI6 are set to emergency stop, the AC motor drive stops output. 2. Press RESET after fault has been cleared.
	Wrong password input (3 times)	1. Refer to Pr.00-07 and 00-08. 2. Turn off the power then turn it on again and enter the correct password.

Fault Name	Fault Descriptions	Corrective Actions
	Software code error	
	Illegal function code	Check if the function code is correct (function code must be 03, 06, 10, 63)
	Illegal data address (00H to 254H)	Check if the communication data length is correct
	Illegal data value	Check if the data value exceeds max./min. value
	Data is written to read-only address	Check if the communication address is correct
	Modbus transmission time-out	
	Keypad transmission time-out	
	Emergency stop for external safety	
	CANopen guarding error	
	CANopen heartbeat error	

Fault Name	Fault Descriptions	Corrective Actions
	CANopen synchronous error	
	CANopen bus off error	
	CANopen index error	
	CANopen station address error	
	CANopen memory error	
	DC bus voltage command is too low.	
	DC bus voltage ripple is too large	

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Chapter 14 CANopen Slave

Newest version is available at http://www.delta.com.tw/industrialautomation/

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~ PDO2
- 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.

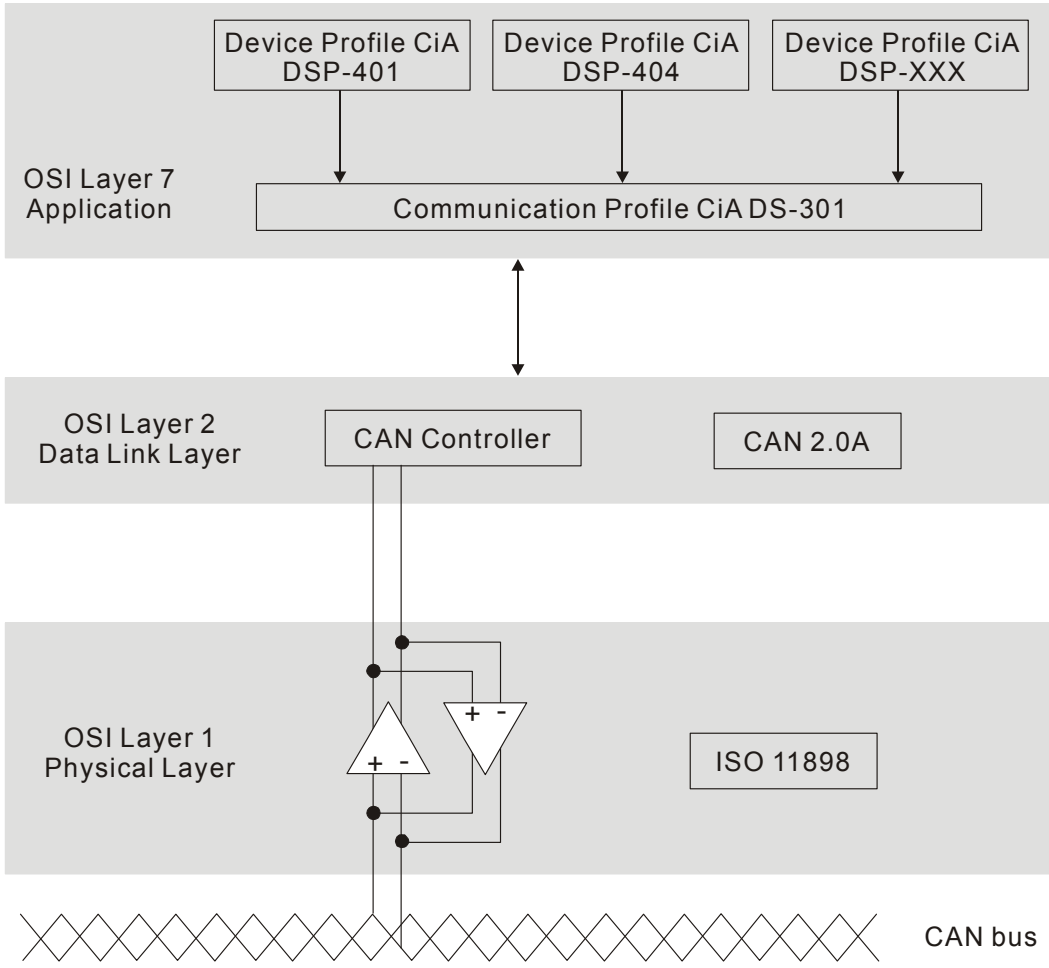
Delta CANopen not supporting service:

- Time Stamp service

14.1 CANopen Overview

CANopen Protocol

CANopen is a CAN-based higher layer protocol, and was designed for motion-oriented machine control networks, such as handling systems. Version 4 of CANopen (CiA DS301) is standardized as EN50325-4. The CANopen specifications cover application layer and communication profile (CiA DS301), as well as a framework for programmable devices (CiA 302), recommendations for cables and connectors (CiA 303-1) and SI units and prefix representations (CiA 303-2).



RJ-45 Pin Definition

PIN	Signal	Description
1	CAN_H	CAN_H bus line (dominant high)
2	CAN_L	CAN_L bus line (dominant low)
3	CAN_GND	Ground / 0V /V-
7	CAN_GND	Ground / 0V /V-

Pre-Defined Connection Set

To reduce configuration effort for simple networks, CANopen define a mandatory default identifier allocation scheme. The 11-bit identifier structure in predefined connection is set as follows:

COB Identifier (CAN Identifier)										
10	9	8	7	6	5	4	3	2	1	0
Function Code				Node Number						

Object	Function Code	Node Number	COB-ID	Object Dictionary Index
Broadcast messages				
NMT	0000	-	0	-
SYNC	0001	-	80H	1005H, 1006H, 1007H
TIME STAMP	0010	-	100H	1012H, 1013H
Point-to-point messages				
Emergency	0001	1-127	81H-FFH	1014H, 1015H
TPDO1	0011	1-127	181H-1FFH	1800H
RPDO1	0100	1-127	201H-27FH	1400H
TPDO2	0101	1-127	281H-2FFH	1801H
RPDO2	0110	1-127	301H-37FH	1401H
TPDO3	0111	1-127	381H-3FFH	1802H
RPDO3	1000	1-127	401H-47FH	1402H
TPDO4	1001	1-127	481H-4FFH	1803H
RPDO4	1010	1-127	501H-57FH	1403H
Default SDO (tx)	1011	1-127	581H-5FFH	1200H
Default SDO (rx)	1100	1-127	601H-67FH	1200H
NMT Error Control	1110	1-127	701H-77FH	1016H, 1017H

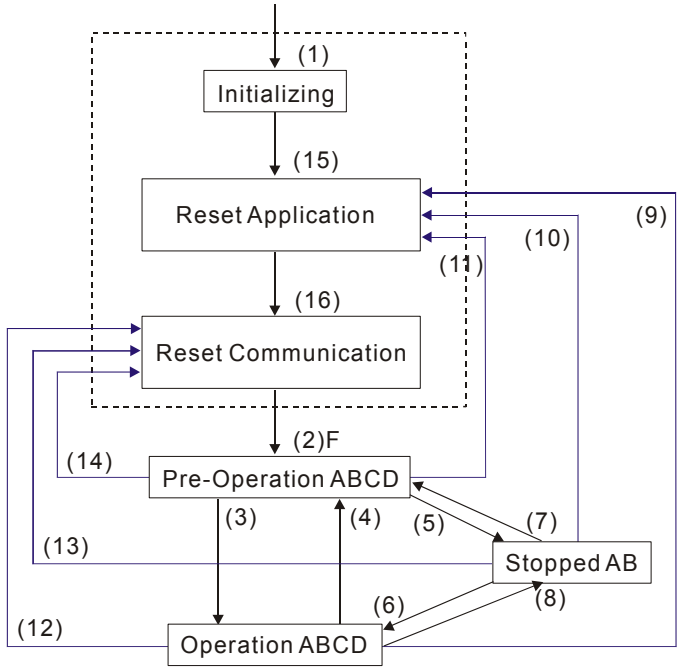
CANopen Communication Protocol

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:

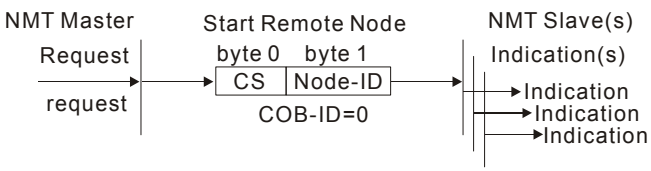


(1) After power is applied, it is auto in initialization state
(2) Enter pre-operational state automatically
(3) (6) Start remote node
(4) (7) Enter pre-operational state
(5) (8) Stop remote node
(9) (10) (11) Reset node
(12) (13) (14) Reset communication
(15) Enter reset application state automatically
(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		○	○	○

NMT Protocol is shown as follows:



Value	CS Definition
1	Start
2	Stop
128	Enter Pre-Operational
129	Reset Node
130	Reset Communication

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:

Type		Data 0								Data 1	Data 2	Data 3	Data 4	Data 5	Data 6	Data 7
		7	6	5	4	3	2	1	0	Index	Index	Index	Data	Data	Data	Data
		command								L	H	Sub	LL	LH	HL	HH
Initiate Domain Download	Client	0	0	1	-	N		E	S							
	Server	0	1	1	-	-	-	-	-							
Initiate Domain Upload	Client	0	1	0	-	-	-	-	-							
	Server	0	1	0	-	N		E	S							
Abort Domain Transfer	Client	1	0	0	-	-	-	-	-							
	Server	1	0	0	-	-	-	-	-							

N: Bytes not use
E: normal(0)/expedited(1)
S: size indicated

PDO (Process Data Object)

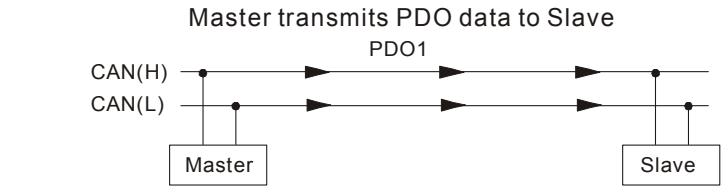
PDO communication can be described by the producer/consumer model. Each node of the network will listen to the messages of the transmission node and distinguish if the message has to be processed or not after receiving the message. PDO can be transmitted from one device to one another device or to many 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.

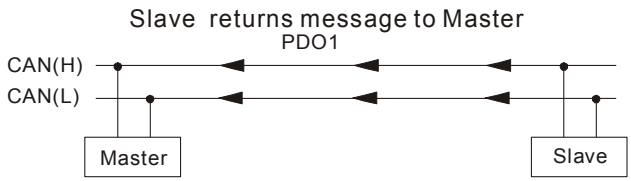
All PDO transmission data must be mapped to index via Object Dictionary.
Example:



PDO1 data value Data 0, Data 1, Data 2, Data 3, Data 4, Data 5, Data 6, Data 7,
0x11, 0x22, 0x33, 0x44, 0x55, 0x66, 0x77, 0x88,

PDO1 Map

Index	Sub	Definition	Value	R/W	Size
0x1600	0	0. Number	1	R/W	U8
0x1600	1	1. Mapped Object	0x60400010	R/W	U32
0x1600	2	2. Mapped Object	0	R/W	U32
0x1600	3	3. Mapped Object	0	R/W	U32
0x1600	4	4. Mapped Object	0	R/W	U32
0x60400010 → 0x6040	0	0. Control word	0x2211	R/W	U16 (2 Bytes)



PDO1 data value Data 0, Data 1, Data 2, Data 3, Data 4, Data 5, Data 6, Data 7,
0xF3, 0x00,

PDO1 Map

Index	Sub	Definition	Value	R/W	Size
0x1A00	0	0. Number	1	R/W	U8
0x1A00	1	1. Mapped Object	0x60410010	R/W	U32
0x1A00	2	2. Mapped Object	0	R/W	U32
0x1A00	3	3. Mapped Object	0	R/W	U32
0x1A00	4	4. Mapped Object	0	R/W	U32
0x6041	0	Status Word	0xF3	R/W	U16

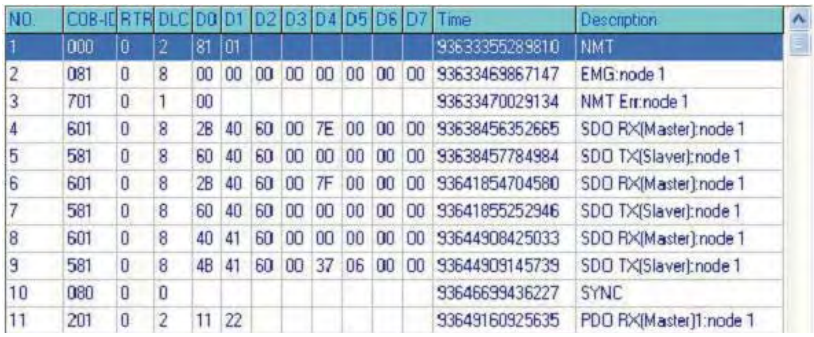
EMCY (Emergency Object)

Emergency objects are triggered when hardware failure occurs for a warning interrupt. The data format of a emergency object is a 8 bytes data as shown in the following:

Byte	0	1	2	3	4	5	6	7
Content	Emergency Error Code		Error register (Object 1001H)	Manufacturer specific Error Field				

Please refer to Chapter 5 CANopen error codes for emergency definition of C2000.

Example:

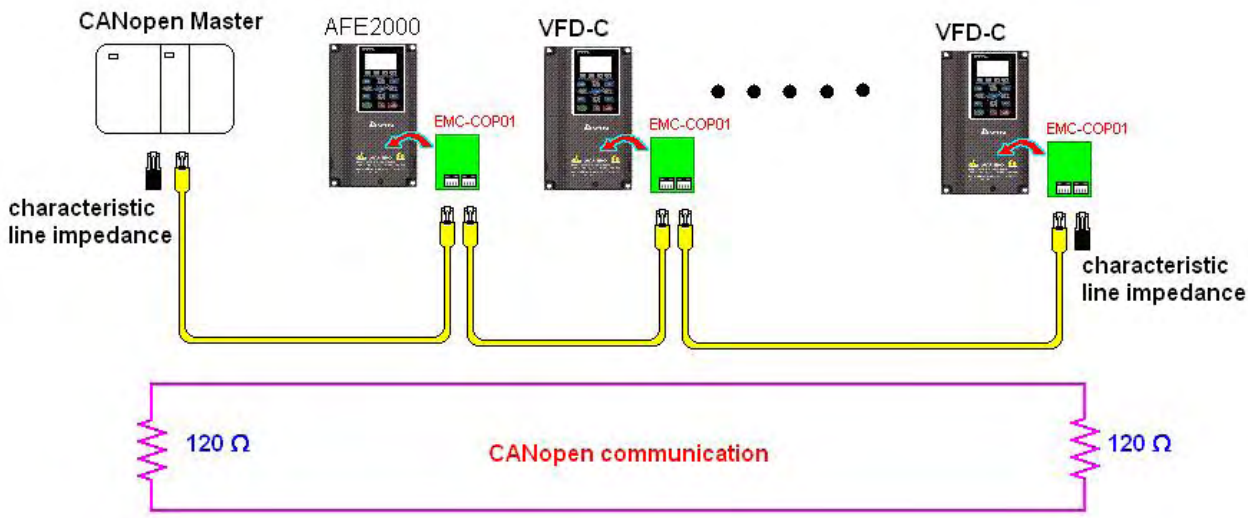


NO.	COB-ID	RTR	DLC	D0	D1	D2	D3	D4	D5	D6	D7	Time	Description
1	000	0	2	81	01							93633355289810	NMT
2	081	0	8	00	00	00	00	00	00	00	00	93633469867147	EMG:node 1
3	701	0	1	00								93633470029134	NMT Err:node 1
4	601	0	8	2B	40	60	00	7E	00	00	00	93638456352665	SDO RX[Master]:node 1
5	581	0	8	60	40	60	00	00	00	00	00	93638457784984	SDO TX[Slaver]:node 1
6	601	0	8	2B	40	60	00	7F	00	00	00	93641854704580	SDO RX[Master]:node 1
7	581	0	8	60	40	60	00	00	00	00	00	93641855252946	SDO TX[Slaver]:node 1
8	601	0	8	40	41	60	00	00	00	00	00	93644908425033	SDO RX[Master]:node 1
9	581	0	8	4B	41	60	00	37	06	00	00	93644909145739	SDO TX[Slaver]:node 1
10	080	0	0									93646699436227	SYNC
11	201	0	2	11	22							93649160925635	PDO RX[Master]1:node 1

Master send NM message to slave 1 for RESET request.
Slave 1 responds no error
Slave 1 responds a boot up message
Master enter Index6040 = 7EH in slave 1
Slave 1 responds OK
Master enter Index6040= 7FH in slave 1
Slave 1 responds OK
Master enter value for Index6041 to slave 1
Slave 1 responds 0640H
Master enter SYNC
Master enter PD01=2211H to slave 1

14.2 CANopen Wiring

An external adapter card: EMC-COP01 is used for CANopen wiring; establish CANopen to AFE2000 connection. The link is enabled by using RJ45 cable. The two farthest ends must be terminated with 120Ω terminating resistors.



14.3 CANopen Communication Control

Delta Standard Control Mode

1. Wiring (refer to Chapter 2 for CANopen Wiring).
2. Identity setting: set Pr.04-10 to 3. Select CANopen communication mode)
3. CANopen station can be set by Pr.04-12 (setting range is 1 to 127; 0 is Disable CANopen slave function). Note: If CANopen station address error (CAdE) or CANopen memory error arise, reset can by done by setting Pr.01-00 to 7.
4. CANopen baud rate setting: set Pr.04-11 (Baud rate options: 1M(0), 500K(1), 250K(2), 125K(3), 100K(4) and 50K(5).
5. CANopen decode method: set 20XX. Modbud address is mapped to CANopen address 2020. When using 20XX address (old): in index 2020.01 enter 0002H for motor to run; 0001H for motor to stop.

14.4 CANopen Supporting Index

Basic Index Support by AFE2000:

Index	Sub	Definition	Default Setting	R/W	Size	Note
1000H	0	Device type	00010192H	R	U32	
1001H	0	Error register	0	R	U8	
1005H	0	COB-ID SYNC message	80H	R	U32	
1006H	0	Communication cycle period	0	RW	U32	Unit: us The setting value should be in a multiple of 500us (integer) and within the range 500us to 16ms
1008H	0	Manufacturer device name	0	R	U32	
1009H	0	Manufacturer hardware version	0	R	U32	
100AH	0	Manufacturer software version	0	R	U32	
100CH	0	Guarding time	0	RW	U16	Unit: ms
100DH	0	Guarding factor	0	RW	U8	
1010H	0	Store Parameter	2	R	U8	
	1	Save all parameters	0	RW	U32	
	2	Save communication parameter	1	RW	U32	
1011H	0	Restore Parameter	2	R	U8	
	1	Restore all parameters	0	RW	U32	
	2	Restore communication parameter	1	RW	U32	
1014H	0	COB-ID emergency	0000080H+Node-ID	R	U32	
1015H	0	Inhibit time EMCY	0	RW	U16	Unit: 100us The setting value should be in a multiple of 10 (integer).
1016H	0	Consumer heartbeat time	1	R	U8	
	1	Consumer 1	0	RW	U32	Unit: 1ms Disable Guarding time to function properly,
1017H	0	Producer heartbeat time	0	RW	U16	Unit: 1ms Disable Guarding time to function properly.
1018H	0	Number	0	R	U8	
	1	Vender ID	000001DDH	R	U32	
	2	Product code	2A00+machine code	R	U32	
	3	Revision	00010000H	R	U32	
1200H	0	Server SDO Parameter	2	R	U8	
	1	COB-ID Client -> Server	0000600H+Node-ID	R	U32	
	2	COB-ID Client <- Server	0000580H+Node-ID	R	U32	
1400H	0	Number	2	R	U8	
	1	COB-ID used by PDO	00000200H+Node-ID	RW	U32	
	2	Transmission Type	5	RW	U8	00:Acyclic& Synchronous 01~240:Cyclic & Synchronous 255:Asynchronous
1401H	0	Number	2	R	U8	
	1	COB-ID used by PDO	80000300H+Node-ID	RW	U32	

Index	Sub	Definition	Default Setting	R/W	Size	Note
	2	Transmission Type	5	RW	U8	00: Acyclic & Synchronous 01~240:Cyclic & Synchronous 255:Asynchronous
1402H	0	Number	2	R	U8	
	1	COB-ID used by PDO	80000400H+Node-ID	RW	U32	
	2	Transmission Type	5	RW	U8	00: Acyclic & Synchronous 01~240:Cyclic & Synchronous 255:Asynchronous
1403H	0	Number	2	R	U8	
	1	COB-ID used by PDO	80000500H+Node-ID	RW	U32	
	2	Transmission Type	5H	RW	U8	00: Acyclic & Synchronous 01~240:Cyclic & Synchronous 255:Asynchronous
1600H	0	Number	2	RW	U8	
	1	1.Mapped Object	60400010H	RW	U32	
	2	2.Mapped Object	60420010H	RW	U32	
	3	3.Mapped Object	0	RW	U32	
	4	4.Mapped Object	0	RW	U32	
1601H	0	Number	3	RW	U8	
	1	1.Mapped Object	20264110H	RW	U32	
	2	2.Mapped Object	2026A110H	RW	U32	
	3	3.Mapped Object	2026A210H	RW	U32	
	4	4.Mapped Object	0	RW	U32	
1602H	0	Number	3	RW	U8	
	1	1.Mapped Object	60400010H	RW	U32	
	2	2.Mapped Object	607A0020H	RW	U32	
	3	3.Mapped Object	60600008H	RW	U32	
	4	4.Mapped Object	0	RW	U32	
1603H	0	Number	3	RW	U8	
	1	1.Mapped Object	60400010H	RW	U32	
	2	2.Mapped Object	60710010H	RW	U32	
	3	3.Mapped Object	60600008H	RW	U32	
	4	4.Mapped Object	0	RW	U32	
1800H	0	Number	5	R	U8	
	1	COB-ID used by PDO	00000180H+Node-ID	RW	U32	
	2	Transmission Type	5	RW	U8	00: Acyclic & Synchronous 01~240:Cyclic & Synchronous 255:Asynchronous
	3	Inhibit time	0	RW	U16	Unit: 100us The setting value should be in a multiple of 10 (integer).
	4	CMS-Priority Group	3	RW	U8	
	5	Event timer	0	RW	U16	Unit: 1ms

Index	Sub	Definition	Default Setting	R/W	Size	Note
1801H	0	Number	5	R	U8	
	1	COB-ID used by PDO	80000280H+Node-ID	RW	U32	
	2	Transmission Type	5	RW	U8	00: Acyclic & Synchronous 01~240:Cyclic & Synchronous 255:Asynchronous
	3	Inhibit time	0	RW	U16	Unit: 100us The setting value should be in a multiple of 10 (integer).
	4	CMS-Priority Group	3	RW	U8	
	5	Event timer	0	RW	U16	Unit: 1ms
1802H	0	Number	5	R	U8	
	1	COB-ID used by PDO	80000380H+Node-ID	RW	U32	
	2	Transmission Type	5	RW	U8	00: Acyclic & Synchronous 01~240:Cyclic & Synchronous 255:Asynchronous
	3	Inhibit time	0	RW	U16	Unit: 100us The setting value should be in a multiple of 10 (integer).
	4	CMS-Priority Group	3	RW	U8	
	5	Event timer	0	RW	U16	Unit: 1ms
1803H	0	Number	5	R	U8	
	1	COB-ID used by PDO	80000480H+Node-ID	RW	U32	
	2	Transmission Type	5	RW	U8	00: Acyclic & Synchronous 01~240:Cyclic & Synchronous 255:Asynchronous
	3	Inhibit time	0	RW	U16	Unit: 100us The setting value should be in a multiple of 10 (integer).
	4	CMS-Priority Group	3	RW	U8	
	5	Event timer	0	RW	U16	Unit: 1ms
1A00H	0	Number	2	RW	U8	
	1	1.Mapped Object	60410010H	RW	U32	
	2	2.Mapped Object	60430010H	RW	U32	
	3	3.Mapped Object	0	RW	U32	
	4	4.Mapped Object	0	RW	U32	
1A01H	0	Number	4	RW	U8	
	1	1.Mapped Object	20260110H	RW	U32	
	2	2.Mapped Object	20266110H	RW	U32	
	3	3.Mapped Object	20266210H	RW	U32	
	4	4.Mapped Object	20266310H	RW	U32	
1A02H	0	Number	3	RW	U8	
	1	1.Mapped Object	60410010H	RW	U32	
	2	2.Mapped Object	60640020H	RW	U32	
	3	3.Mapped Object	60610008H	RW	U32	
	4	4.Mapped Object	0	RW	U32	
1A03H	0	Number	3	RW	U8	

Index	Sub	Definition	Default Setting	R/W	Size	Note
	1	1.Mapped Object	60410010H	RW	U32	
	2	2.Mapped Object	60770010H	RW	U32	
	3	3.Mapped Object	60610008H	RW	U32	
	4	4.Mapped Object	0	RW	U32	

AFE2000 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)

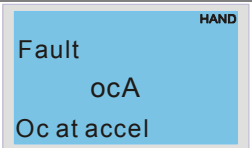
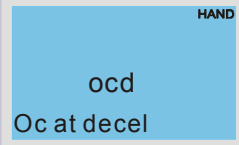
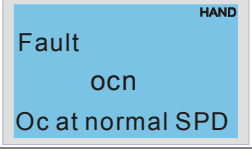
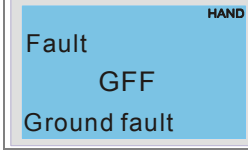
Index = 2000H + 0AH = 200A

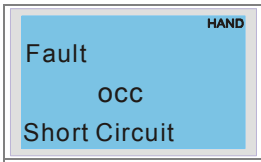
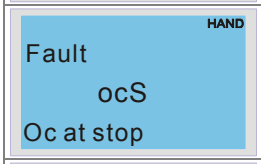
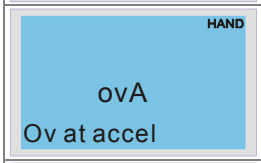
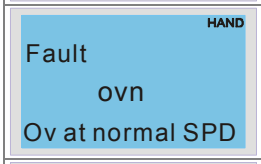
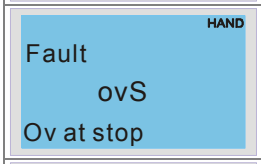
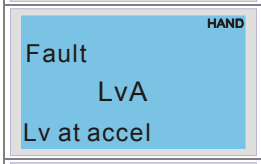
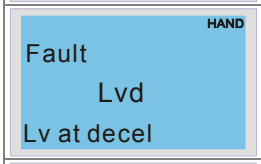
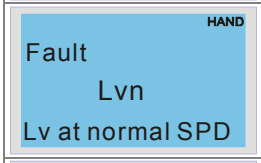
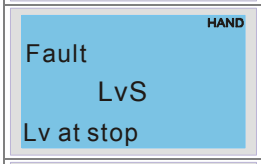
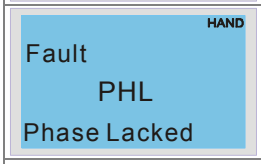
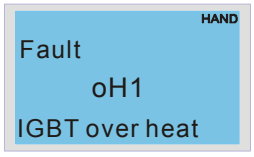
Sub Index = 0FH + 1H = 10H

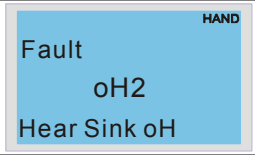
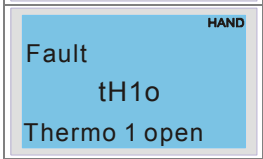
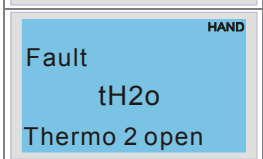
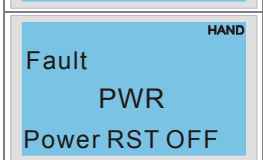
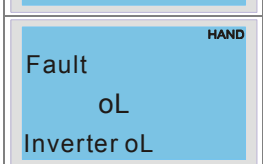
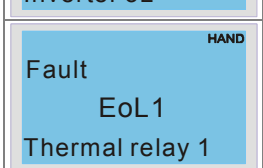
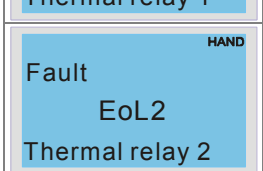
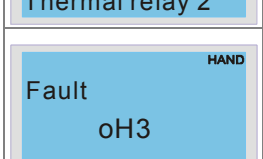
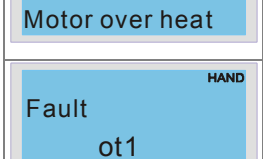
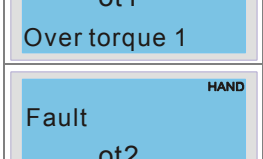
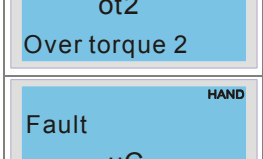
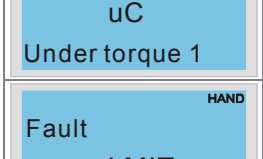
AFE2000 Control Index:

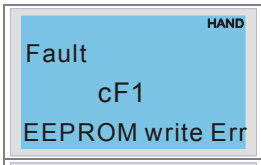
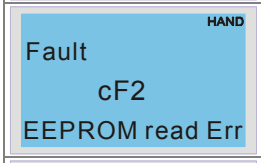
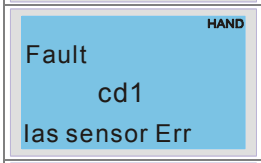
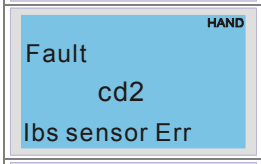
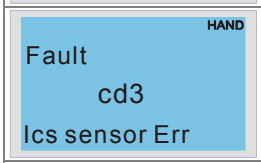
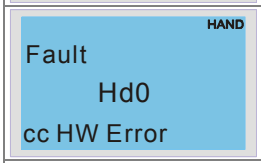
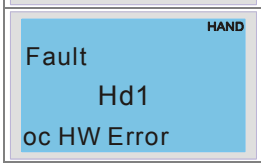
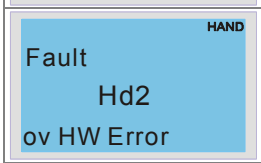
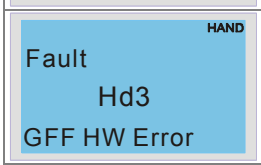
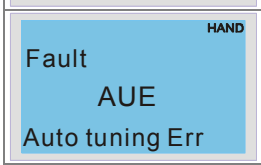
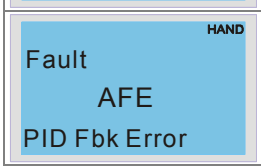
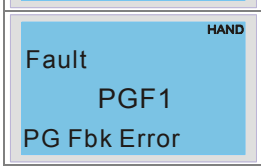
Please refer to Ch 11 Detailed Parameters- Pr.04-04 Communication Protocols.

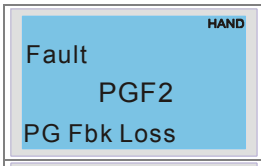
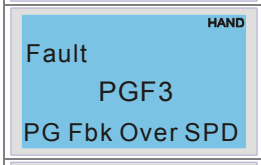
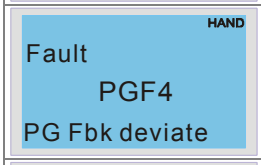
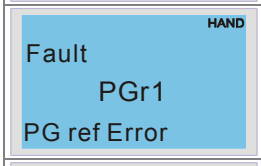
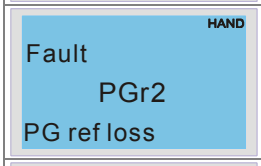
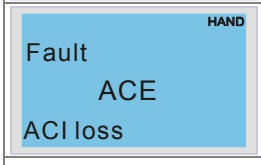
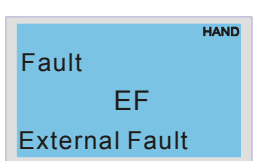
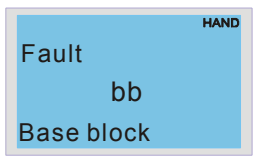
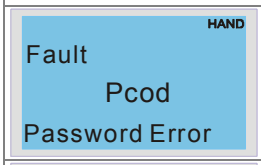
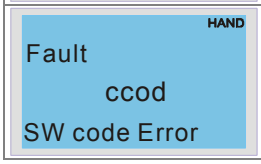
14.5 CANopen Fault Code

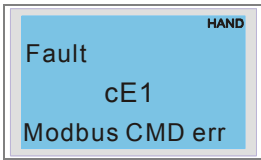
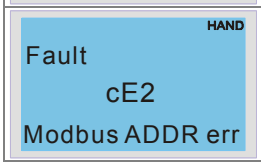
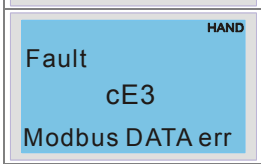
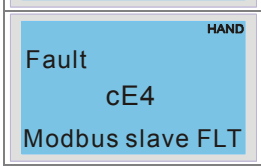
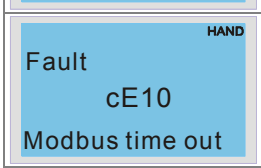
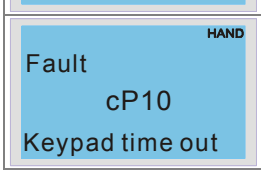
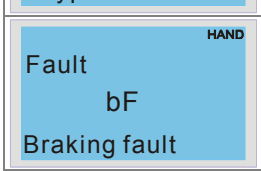
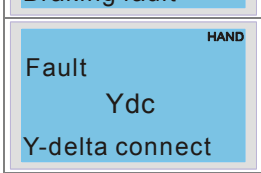
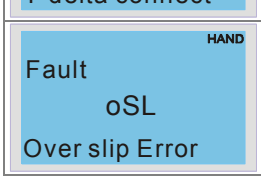
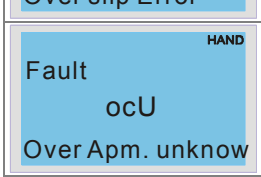
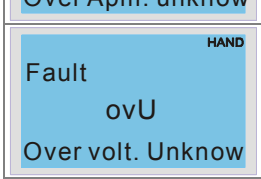
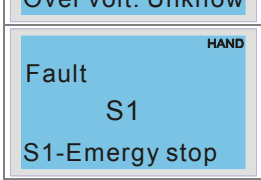
Display	Fault code	Description	CANopen fault code	CANopen fault register (bit 0~7)
	0009H	Over-current during acceleration	2310H	1
	000AH	Over-current during deceleration	2310H	1
	000BH	Over-current during steady status operation	2310H	1
	000CH	Ground fault Protection.	2240H	1

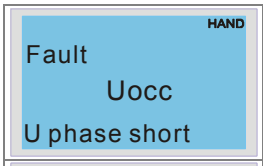
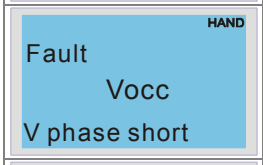
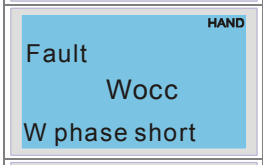
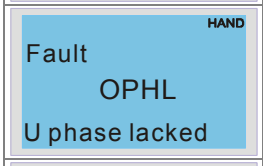
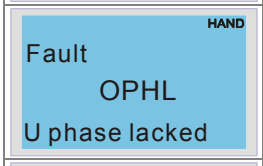
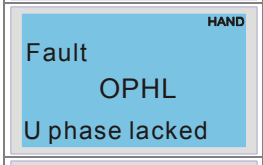
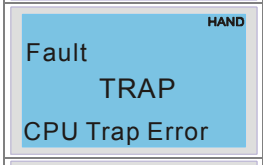
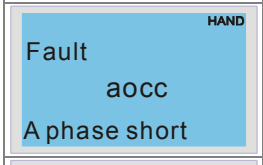
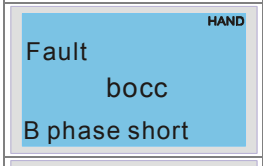
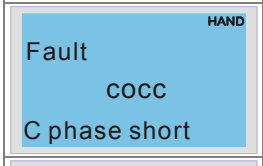
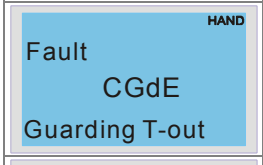
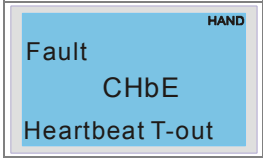
	000DH	Short-circuit is detected between upper bridge and lower bridge of the IGBT module.	2240H	1
	000EH	Over-current at stop. Hardware failure in current detection	2310H	1
	000FH	Over-current during acceleration. Hardware failure in current detection	3210H	2
	0010H	Over-current during steady speed. Hardware failure in current detection. 230V: 450Vdc; 460V: 900Vdc	3210H	2
	0011H	Over-voltage at stop. Hardware failure in current detection	3210H	2
	0012H	DC BUS voltage is less than Pr.06.00 during acceleration.	3220H	2
	0013H	DC BUS voltage is less than Pr.06.00 during deceleration.	3220H	2
	0014H	DC BUS voltage is less than Pr.06.00 in constant speed.	3220H	2
	0015H	DC BUS voltage is less than Pr.06-00 at stop	3220H	2
	0016H	Phase Loss.	3130H	2
	0017H	IGBT overheat IGBT temperature exceeds protection level. 1~15HP: 90℃ 20~100HP: 100℃	4310H	3

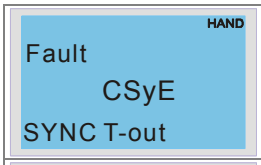
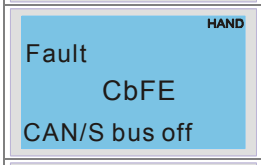
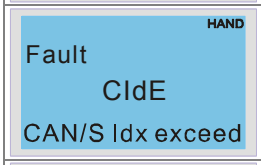
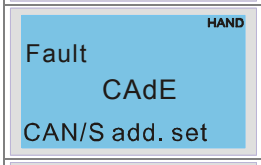
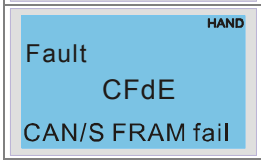
	0018H	Heatsink overheat Heat sink temperature exceeds 90℃	4310H	3
	0019H	Temperature detection circuit error (IGBT) IGBT NTC open	4300H	3
	001AH	Temperature detection circuit error (capacity module) CAP NTC open	4200H	3
	001BH	Power RST off	3120H	2
	001CH	Overload. The drive output current exceeds AC motor drive durability.	2310H	1
	001DH	Electronics thermal relay 1 protection	2310H	1
	001EH	Electronics thermal relay 2 protection	2310H	1
	001FH	Motor overheating The AC motor drive detects that the internal temperature exceeds Pr.06-30 (PTC level)	7120H	1
	0020H	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
	0021H		8311H	3
	0022H	Low current	8321H	1
	0023H	Limit Error	7320H	1

	0024H	Internal EEPROM can not be programmed.	5530H	5
	0025H	Internal EEPROM can not be read.	5530H	5
	0027H	U-phase error	2300H	1
	0028H	V-phase error	2300H	1
	0029H	W-phase error	2300H	1
	002AH	cc (current clamp) hardware error.	5000H	5
	002BH	oc hardware error.	5000H	5
	002CH	ov hardware error.	5000H	5
	002DH	GFF hardware error.	5000H	5
	002DH	Auto tuning error	7120H	1
	002EH	PID loss (ACI)	7300H	7
	002FH	PG feedback error	7300H	7

	0030H	PG feedback loss	7300H	7
	0031H	PG feedback stall	7300H	7
	0032H	PG slip error	7300H	7
	0033H	Pulse input error	7300H	7
	0034H	Pulse input loss	7300H	7
	0035H	ACI loss	FF00H	1
	0036H	External Fault When input EF (N.O.) on external terminal is closed to GND, AC motor drive stops output.	9000H	5
	0037H	Emergency stop When the multi-function input terminals MI1 to MI6 are set to emergency stop, the AC motor drive stops output and the motor coasts to stop	9000H	5
	0038H	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
	0039H	Password will be locked if three fault passwords are entered	6320H	5
	003AH	Software error	6320H	5

	0031H	Illegal function code	7500H	4
	0032H	Illegal data address (00H to 254H)	7500H	4
	0033H	Illegal data value	7500H	4
	0034H	Data is written to read-only address	7500H	4
	0035H	Modbus transmission timeout.	7500H	4
	0036H	Keypad transmission timeout.	7500H	4
	0037H	Brake resistor fault	7110H	4
	0038H	Y-connection/Δ-connection switch error	3330H	2
	0039H	Overslip error occurs when the slip exceeds Pr.05.26 limit and the time exceeds Pr.05.27 setting.	FF00H	7
	003AH	Unknown over current	2310H	1
	003BH	Unknown over voltage	3210H	2
	003CH	External emergency sto	9000H	5

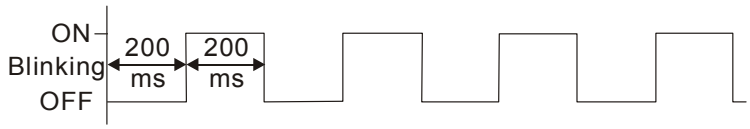
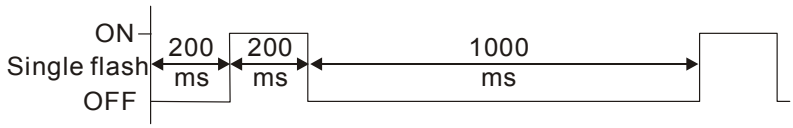
		U-phase short-circuit	2240H	1
		V-phase short-circuit	2240H	1
		W-phase short-circuit	2240H	1
		Phase loss (U phase)	3131H	2
		Phase loss (V phase)	3132H	2
		Phase loss (W phase)	3133H	2
		CPU command error	6000H	7
	003DH	A-phase short-circuit	2240H	1
	003EH	B-phase short-circuit	2240H	1
	003FH	C-phase short-circuit	2240H	1
	0040H	CANopen Guarding time-out 1	8130H	4
	0041H	CANopen Heartbeat time-out	8130H	4

	0042H	CAN synchrony error	8700H	4
	0043H	CAN bus off	8140H	4
	0044H	Can index error	8110H	4
	0045H	CAN address error	0x8100	4
	0046H	CAN memory error	0x8100	4

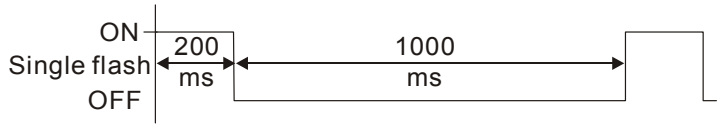
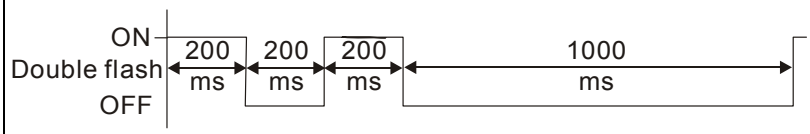
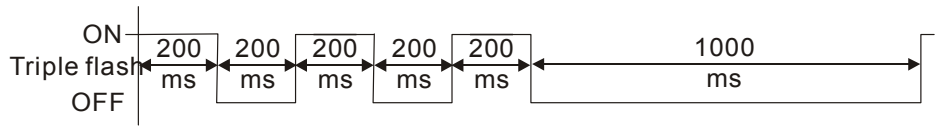
14.6 CANopen LED Function

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