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Delta Open-Loop Variable-Torque Standard Drive VP3000 Series User Manual

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READ PRIOR TO INSTALLATION FOR SAFETY.

DANGER

☑ Disconnect AC input power before connecting any wiring to the AC motor drive.

☑ Even if the power has been turned off, a charge may still remain in the DC-link capacitors with hazardous voltages before the POWER LED is OFF. Do NOT touch the internal circuits and components.

☑ There are highly sensitive MOS components on the printed circuit boards. These components are especially sensitive to static electricity. Take anti-static measure before touching these components or the circuit boards.

☑ Never modify the internal components or wiring.

☑ Ground the AC motor drive by using the ground terminal. The grounding method must comply with the laws of the country where the AC motor drive is to be installed.

☑ Do NOT install the AC motor drive in a location with high temperature, direct sunlight or inflammable materials or gases.

CAUTION

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

☑ After finishing the wiring of the AC motor drive, check if U/T1, V/T2, and W/T3 are short-circuited to ground with a multimeter. Do NOT power the drive if short circuits occur. Eliminate the short circuits before the drive is powered.

☑ The rated voltage of power system to install motor drives is listed below. Ensure that the installation voltage is in the correct range when installing a motor drive.

1. For 230V models, the range is between 170–264V.
2. For 460V models, the range is between 323–528V.

☑ Refer to the table below for short circuit rating:

460V Model (Power)	0.75–37 kW	45–132 kW	160–280 kW	315–400 kW	450–630 kW
Short Circuit Rating	5 kA	10 kA	18 kA	30 kA	42 kA

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

☑ Even if the three-phase AC motor is stopped, a charge with hazardous voltages may still remain in the main circuit terminals of the AC motor drive.

☑ The performance of electrolytic capacitor will degrade if it is not charged for a long time. It is recommended to charge the drive that is stored in no charge condition every 2 years for 3–4 hours to restore the performance of electrolytic capacitor in the motor drive. **NOTE:** When power up the motor drive, use adjustable AC power source (ex. AC autotransformer) to charge the drive at 70–80% of rated voltage for 30 minutes (do not run the motor drive). Then charge the drive at 100% of rated voltage for an hour (do not run the motor drive). By doing these, restore the performance of electrolytic capacitor before starting to run the motor drive. Do NOT run the motor drive at 100% rated voltage right away.

☑ Pay attention to the following precautions when transporting and installing this package (including wooden crate and wood stave)

1. If you need to deworm the wooden crate, do NOT use fumigation or you will damage the drive. Any damage to the drive caused by using fumigation voids the warranty.
2. Use other methods, such as heat treatment or any other non-fumigation treatment, to deworm the wood packaging material.
3. If you use heat treatment to deworm, leave the packaging materials in an environment of over 56°C for a minimum of thirty minutes.

☑ Connect the drive to a three-phase three-wire or three-phase four-wire Wye system to comply with UL standards.

	☑ If the motor drive generates leakage current over AC 3.5 mA or over DC 10 mA on a grounding conductor, compliance with local grounding regulations or IEC61800-5-1 standard is the minimum requirement for grounding. ☑ The VP3000 series drives are designed for Industrial application. The non-linear load generates harmonic current, when you use a VP3000 series drive in a public low-voltage distribution network (such as power supply in a residential building), install suppression devices (for example, one-to-one transformer or input AC reactor) to suppress the possible interferences caused by the harmonic current. Contact Delta for more information.

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

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Issued Edition: 00
Firmware Version: V1.01 (Refer to Pr.00-06 on the product for the firmware version.)
Issued Date: 2024/04

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Chapter 1 An Overview before Use

1-1 Confirm the Model of AC Motor Drive to Use

After receiving the AC motor drive, check the following to ensure safe use:

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

1-1-1 Nameplate Information

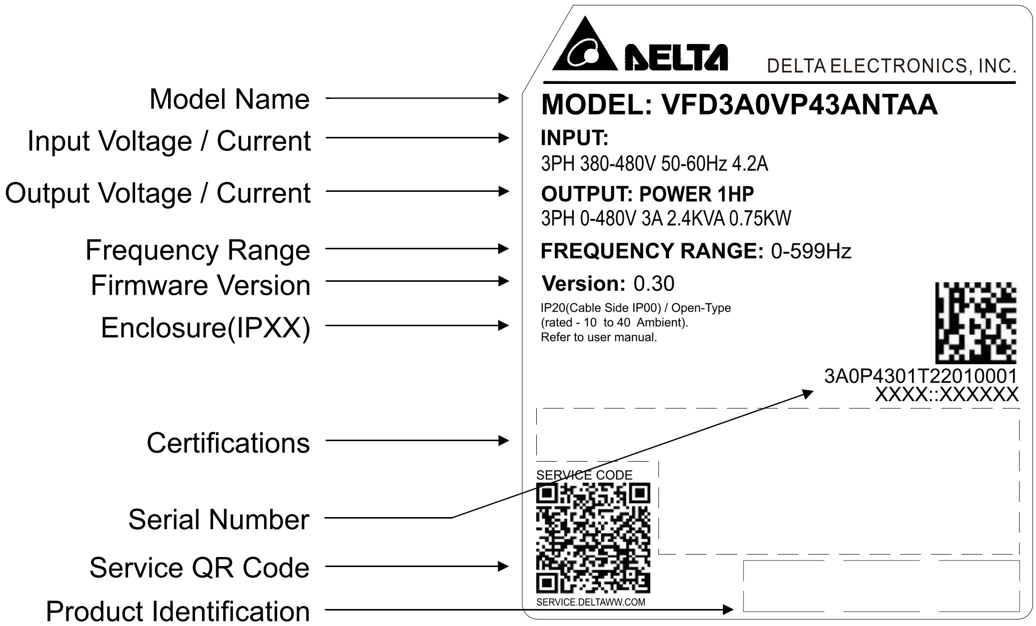


Figure 1-1

1-1-2 Model Name

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Example	VFD	3A0	VP	43	A	N	T	A	A

Definition		Description
[1]	Product name	VFD = Variable Frequency Device (AC Motor Drive)
[2]	Current specification	Continuous current (I_{CON}) **NOTE:** Refer to the Specifications in the user manual for more information.
[3]	Series	VP = VP3000
[4]	Input voltage	43 = 460V, three-phase
[5]	IP protection ratings	A = IP20 / UL Open Type / Wall-mount B = IP20 / Type 1 / Wall-mount S = IP00 / UL Open Type / Chassis
[6]	EMC filter	N = No built-in EMC filter F = EMC Category C3 S = EMC Category C2 H = EMC Category C3, Chassis
[7]	Safety function	T = Built-in STO (SIL3)
[8]	Special specification	A = No built-in DC choke C = Low harmonic (THDi 35%)
[9]	Version number	A = Version A **NOTE:** 1. For IP20 / UL Open Type models, accompanied with a LED digital keypad KPV-CE02 2. For IP20 / Type 1 models, accompanied with a LCD digital keypad KPV-CC01

Table 1-1

1-1-3 Serial Number

	[1]	[2]	[3]	[4]	[5]
Example	3A0P4301	T	22	01	0001

Definition		Description
[1]	Model name	VP3000 1HP (0.75 kW)
[2]	Production factory	T: Taoyuan W: Wujiang H: Hosur
[3]	Production year	2022
[4]	Production week	01
[5]	Production number	0001

Table 1-2

1-2 Part Names of the AC Motor Drive

Take frame A as an example.

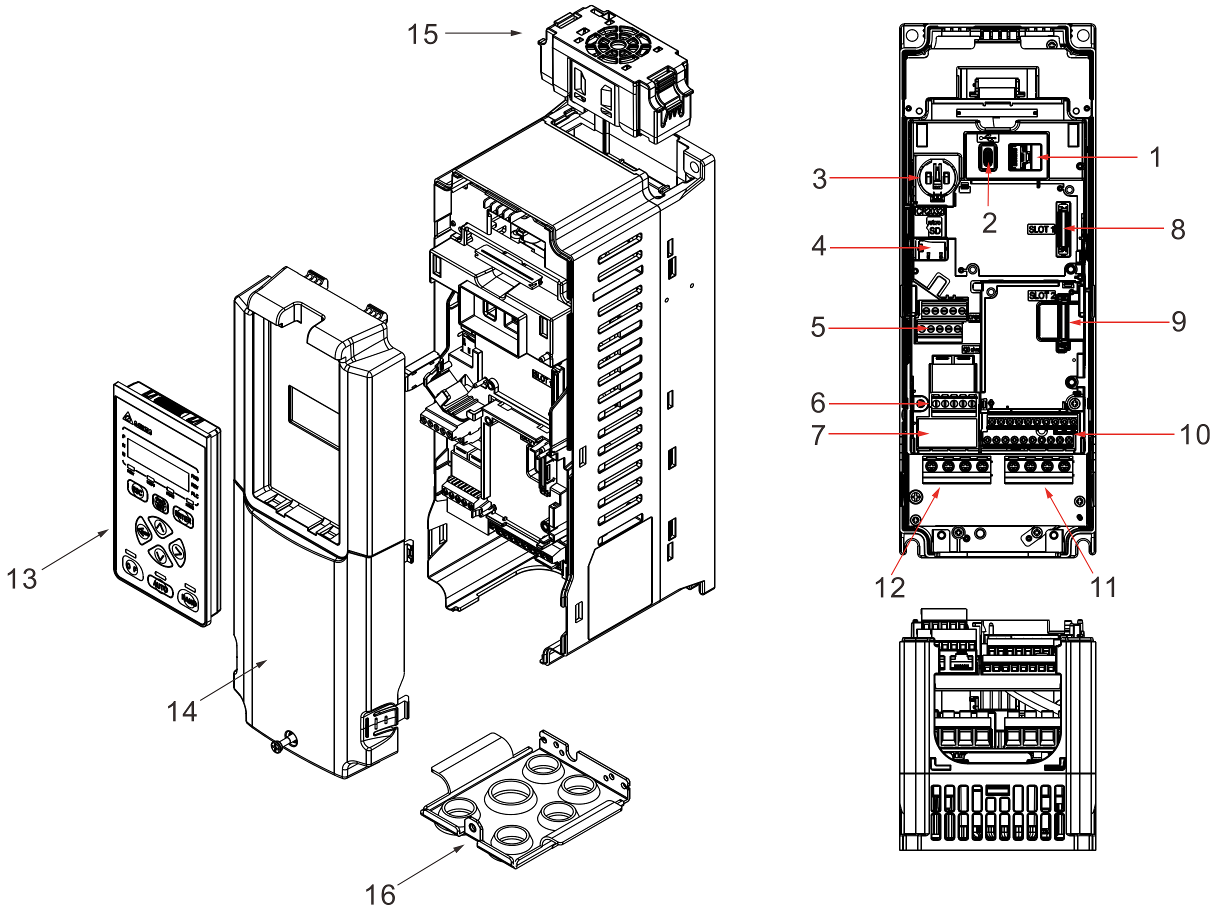


Figure 1-2

Number	Name	Description
1	Digital keypad connection port	To connect with digital keypad
2	USB-C port	To connect with operating software for monitoring the AC motor drive
3	CR2032 battery holder	Need to install the battery first for using RTC function
4	Micro SD slot	To install a memory card for storing historical records of the AC motor drive
5	Control circuit terminals A	Analog signal input / output terminals
6	Control circuit terminals B	Relay output terminals
7	RJ45 port	To connect with operating software for monitoring the AC motor drive
8	Extension card slot (SLOT 1)	A slot for digital input / digital output, analog input / analog output extension card
9	Extension card slot (SLOT 2)	A slot for communication extension card
10	Control circuit terminals C	Terminals of digital signals, communication and STO function
11	Motor output terminals	-
12	Main power input terminals	-
13	Digital keypad	To do the settings for the AC motor drive
14	Top cover	-
15	Cooling fan	-
16	Bottom cover	-

Table 1-3

Chapter 2 Mechanical Installation

2-1 Installation Environment

The product installation environment affects the product performance, durability and other service life. Follow the specifications in Section 11-2 Environment for Operation, Storage and Transportation for product installation.

2-2 Mounting Clearance

- ☑ Prevent fiber particles, scraps of paper, shredded wood, sawdust, metal particles, etc. from adhering to the heat sink.
- ☑ Install the AC motor drive in a metal cabinet. When installing one drive below another one, use a metal separator between the AC motor drives to prevent mutual heating and to prevent the risk of fire accident.
- ☑ Install the AC motor drive in a Pollution Degree 2 environment with clean and circulating air. A clean and circulating environment means air without polluting substances and dust.

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

Airflow direction: (Blue arrow) Inflow (Red arrow) Outflow (Black) Distance

Single drive installation (Frame A–K)

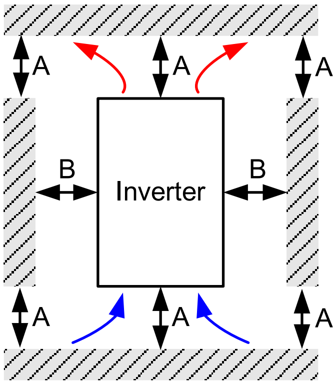


Figure 2-1

Multiple drives - Horizontal installation (Frame A–K)

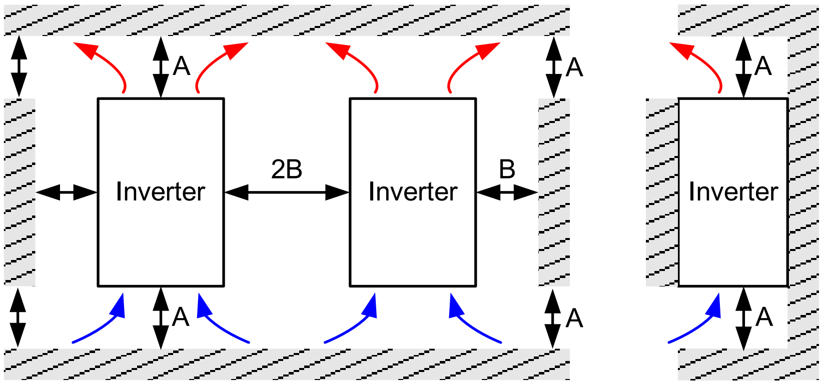


Figure 2-2

Single drive installation (Frame L–M)

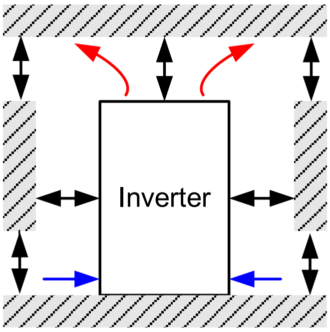


Figure 2-3

Multiple drives - Horizontal installation (Frame L–M)

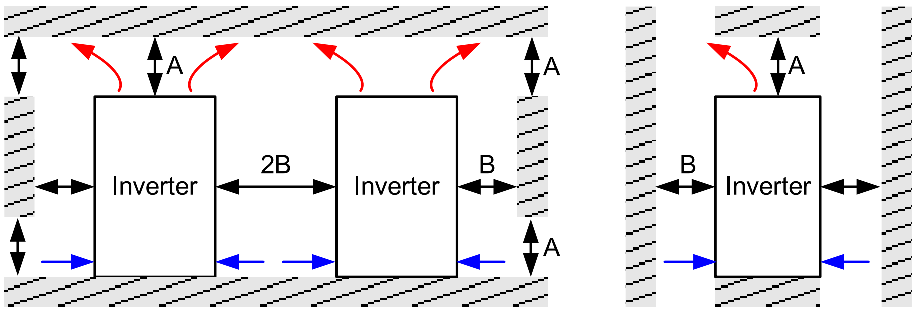


Figure 2-4

Multiple drives, side-by-side vertical installation

When installing one AC motor drive below another one (top-bottom installation), use a metal separator between the drives to prevent mutual heating. The temperature measured at the fan's inflow side must be lower than the temperature measured at the operation side. If the fan's inflow temperature is higher, use a thicker or larger size of metal separator. See diagram below. Operation temperature is the temperature measured at 50 mm away from the fan's inflow side.

(Frame A–K)

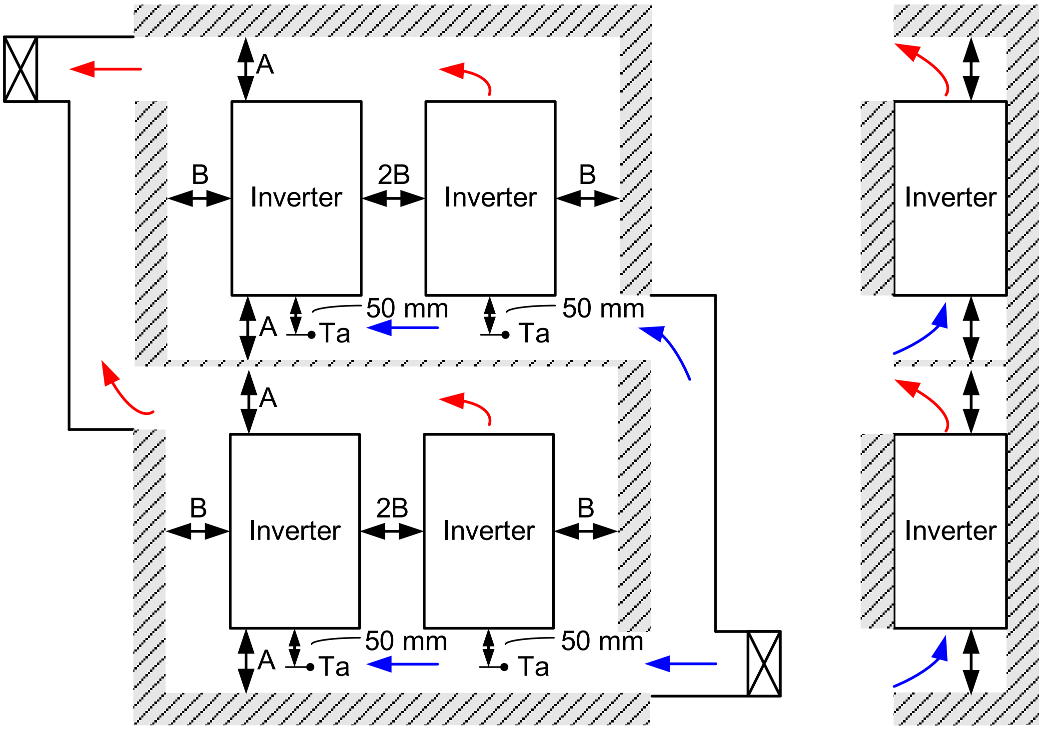


Diagram 2-5

(Frame L–M)

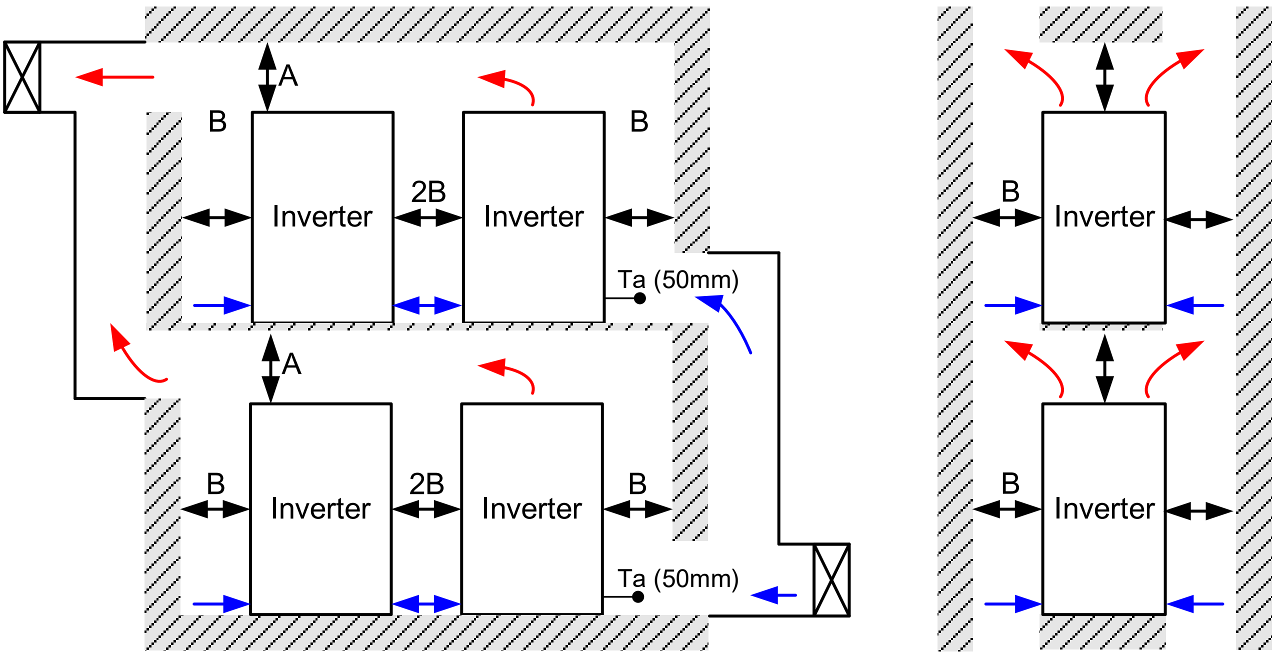


Diagram 2-6

Minimum mounting clearance

Frame	A (mm)	B (mm)
A–C	60	30
D–I	100	50
J	200	100
K	200	100
L	350	100
M	350	100

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

Table 2-1

Frame A	VFD3A0VP43ANTAA; VFD4A2VP43ANTAA; VFD5A6VP43ANTAA; VFD7A2VP43ANTAA; VFD011VP43ANTAA; VFD3A0VP43BFTAA; VFD4A2VP43BFTAA; VFD5A6VP43BFTAA; VFD7A2VP43BFTAA; VFD011VP43BFTAA
Frame B	VFD013VP43ANTAA; VFD018VP43ANTAA; VFD013VP43BFTAA; VFD018VP43BFTAA
Frame C	VFD025VP43ANTAA; VFD032VP43ANTAA; VFD038VP43ANTAA VFD025VP43BFTAA; VFD032VP43BFTAA; VFD038VP43BFTAA
Frame D	VFD045VP43ANTCA; VFD062VP43ANTCA; VFD045VP43BFTCA; VFD062VP43BFTCA; VFD045VP43BSTCA; VFD062VP43BSTCA
Frame E	VFD073VP43ANTCA; VFD090VP43ANTCA; VFD073VP43BFTCA; VFD090VP43BFTCA; VFD073VP43BSTCA; VFD090VP43BSTCA
Frame F	VFD110VP43AFTCA; VFD110VP43BFTCA; VFD110VP43BSTCA
Frame G	VFD150CP43AFTCA; VFD150VP43BFTCA; VFD150VP43BSTCA
Frame H	VFD180VP43AFTCA; VFD220VP43AFTCA; VFD180VP43BFTCA; VFD220VP43BFTCA; VFD180VP43BSTCA; VFD220VP43BSTCA
Frame I	VFD260VP43AFTCA; VFD310VP43AFTCA; VFD260VP43BFTCA; VFD310VP43BFTCA; VFD260VP43BSTCA; VFD310VP43BSTCA
Frame J	VFD370VP43AFTCA; VFD395VP43AFTCA; VFD370VP43BFTCA; VFD395VP43BFTCA; VFD370VP43BSTCA; VFD395VP43BSTCA
Frame K	VFD460VP43AFTCA; VFD485VP43AFTCA; VFD460VP43BFTCA; VFD485VP43BFTCA; VFD460VP43BSTCA; VFD485VP43BSTCA
Frame L	VFD530VP43SHTCA; VFD616VP43SHTCA; VFD683VP43SHTCA; VFD770VP43SHTCA
Frame M	VFD866VP43SHTCA; VFD930VP43SHTCA; VFD1K1VP43SHTCA; VFD1K2VP43SHTCA

Table 2-2

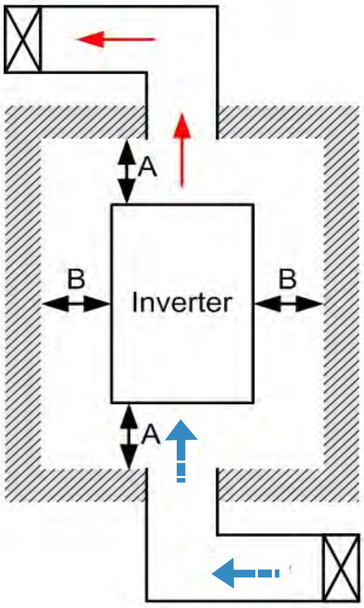


Figure 2-7

NOTE:

- The mounting clearances stated in the figure is for installing the drive in an open area (as shown in the figure on the left). To install the drive in a confined space (such as cabinet or electric box), follow the following rules: (1) Keep the minimum mounting clearances. (2) Install a ventilation equipment or an air conditioner to keep surrounding temperature lower than operation temperature. (3) Refer to parameter setting and set up Parameters A5-00 and H4-04.
- The table below lists the required air volume of each model for installing single drive in a confined space. When installing multiple drives, the required air volume shall be multiplied by the number of the drives.
- Refer to the chart (Airflow Rate for Cooling) for ventilation equipment design and selection.
- Refer to the chart (Power Dissipation for AC Motor Drive) for air conditioner design and selection.
- Different control mode affects the derating. See Pr.H4-04 for more information.
- Ambient temperature derating curve shows the derating status in different temperature in relation to different protection level.
- Refer to the ambient temperature derating curve and derating curves under different control modes in Chapter 11.
- If UL Type 1 models need side by side installation, remove the top cover for Frame A–C. Do NOT install the conduit box for Frame D and above.

2-3 Airflow and Power Dissipation

Airflow Rate for Cooling			Power Dissipation for AC Motor Drive		
Model	Flow Rate (cfm)	Flow Rate (m^3/hr)	Power Dissipation (watt)		
			Loss External (Heat sink)	Internal	Total
VFD3A0VP43ANTAA/-BFTAA	7.51	12.76	38	14	52
VFD4A2VP43ANTAA/-BFTAA	7.51	12.76	55	18	73
VFD5A6VP43ANTAA/-BFTAA	7.51	12.76	72	24	96
VFD7A2VP43ANTAA/-BFTAA	7.51	12.76	97	28	125
VFD011VP43ANTAA/-BFTAA	7.51	12.76	144	46	190
VFD013VP43ANTAA/-BFTAA	19.61	33.32	178	49	227
VFD018VP43ANTAA/-BFTAA	19.61	33.32	256	56	312
VFD025VP43ANTAA/-BFTAA	56.46	95.92	361	60	421
VFD032VP43ANTAA/-BFTAA	56.46	95.92	449	67	516
VFD038VP43ANTAA/-BFTAA	56.46	95.92	546	70	616
VFD045VP43ANTCA/-BFTCA/-BSTCA	95.56	162.36	458	120	578
VFD062VP43ANTCA/-BFTCA/-BSTCA	95.56	162.36	698	133	831
VFD073VP43ANTCA/-BFTCA/-BSTCA	93.23	158.4	786	137	923
VFD090VP43ANTCA/-BFTCA/-BSTCA	93.23	158.4	964	13	1101
VFD110VP43AFTCA/-BFTCA/-BSTCA	112.3	190.9	1287.9	157.9	1445.8
VFD150VP43AFTCA/-BFTCA/-BSTCA	150.6	255.8	1533.6	160.8	1694.4
VFD180VP43AFTCA/-BFTCA/-BSTCA	280.4	476.4	1876.1	203.2	2079.3
VFD220VP43AFTCA/-BFTCA/-BSTCA	280.4	476.4	2232.6	233.4	2466.0
VFD260VP43AFTCA/-BFTCA/-BSTCA	290.9	494.2	2422.9	248.6	2671.5
VFD310VP43AFTCA/-BFTCA/-BSTCA	290.9	494.2	2840.8	284.2	3125.1
VFD370VP43AFTCA/-BFTCA/-BSTCA	666.7	1132.7	3466.3	374.4	3840.7
VFD395VP43AFTCA/-BFTCA/-BSTCA	666.7	1132.7	3730.8	392.7	4123.5
VFD460VP43AFTCA/-BFTCA/-BSTCA	699.8	1189.0	1532.4	457.7	1990.2
VFD485VP43AFTCA/-BFTCA/-BSTCA	699.8	1189.0	4565.9	481.7	5047.6
VFD530VP43SHTCA	1105.3	1877.8	4722.5	946.4	5668.9
VFD616VP43SHTCA	1105.3	1877.8	5380.2	1016.7	6396.8
VFD683VP43SHTCA	1105.3	1877.8	5592.3	1134.0	6726.3
VFD770VP43SHTCA	1105.3	1877.8	6411.7	1249.4	7661.1
VFD866VP43SHTCA	1015.4	1725.1	8279.9	1268.5	9548.4
VFD930VP43SHTCA	1015.4	1725.1	9037.7	1363.2	10401.0
VFD1K1VP43SHTCA	1015.4	1725.1	10117.5	1647.8	11765.3
VFD1K2VP43SHTCA	1015.4	1725.1	11384.9	1861.3	13246.2
● The required airflow shown in the table is for installing single drive in a confined space. ● When installing multiple drives, the required air volume should be the required air volume for single drive × the number of the drives.			● The heat dissipation shown in the table is for installing single drive in a confined space. ● When installing multiple drives, volume of heat dissipation should be the heat dissipated for single drive × the number of the drives. ● Heat dissipation for each model is calculated by rated voltage, current and default carrier.		

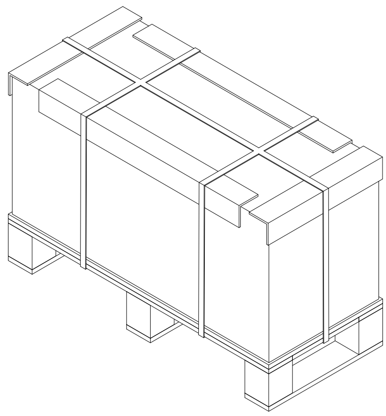
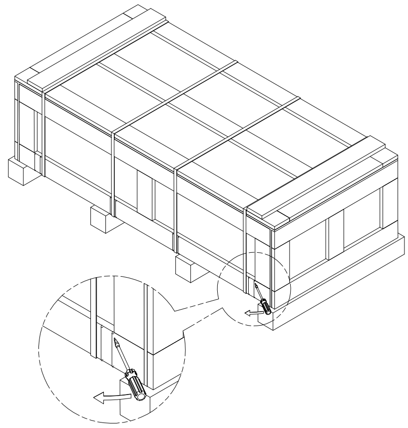
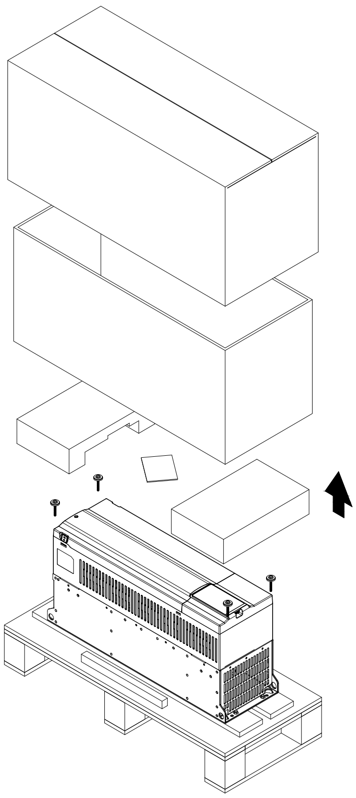
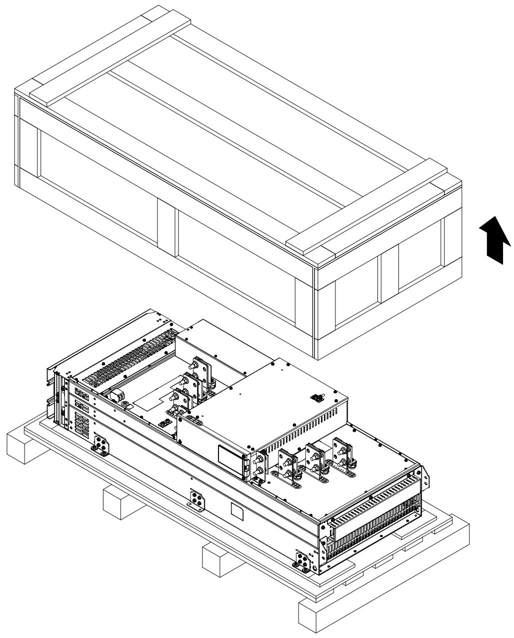
Table 2-3

2-4 Transportation and Installation

In order to ensure that the AC motor drive functions normally without risk of damage before installation, it should be kept in the original packaging during transportation or storage, and make sure the surrounding environmental conditions meet the specifications provided in this manual.

2-4-1 Unpacking

Follows the following steps for unpacking:

Frame G (Carton, applied for Frame A–G)	Frame L & M (Crate)
Step 1: Cut off all the packaging straps.  Figure 2-8	Step 1: Cut off all the packaging straps, and use a flathead screwdriver to pry open all fasteners on both sides of the crate.  Figure 2-9
Step 2: Remove the top cover, take out the EPEs and the manual, and then loosen the screws.  Figure 2-10	Step 2: Remove the top cover and take out the manual.  Figure 2-11

<table>
<tr><th>Frame G (Carton, applied for Frame A–G)</th><th>Frame L & M (Crate)</th></tr>
<tr><td rowspan="2">Step 3: Unpacking is completed.

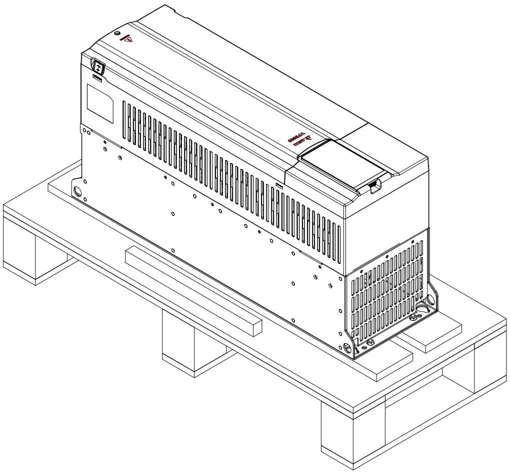



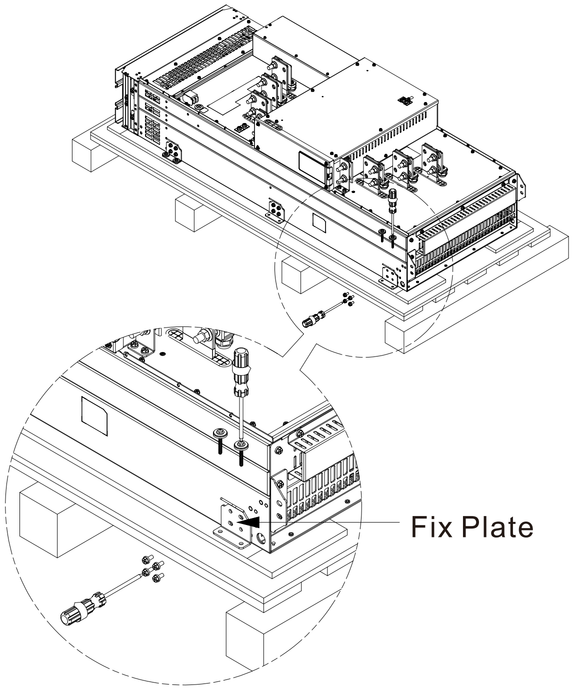
Figure 2-12</td><td>Step 3: Loosen the screws and fix plates on both sides of the drive.


Figure 2-13</td></tr>
<tr><td>Step 4: Unpacking is completed.

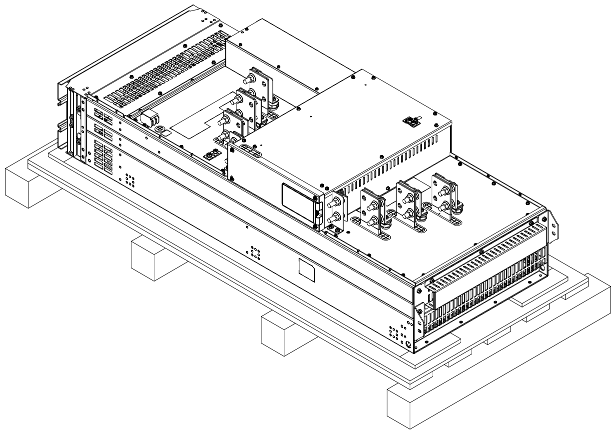



Figure 2-14</td></tr>
</table>

2-4-2 The Lifting Hook

The arrows indicate the location of the lifting holes of Frame E–M, as shown in the figures below:

Frame E1

Applicable models:
VFD073VP43ANTCA; VFD090VP43ANTCA

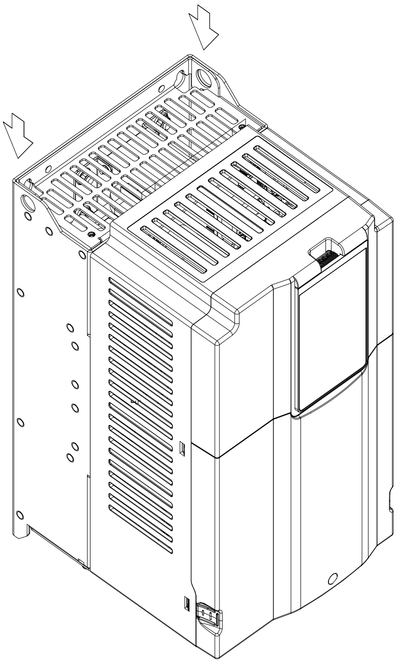


Figure 2-15

Frame E2

Applicable models:
VFD073VP43BFTCA; VFD090VP43BFTCA;
VFD073VP43BSTCA; VFD090VP43BSTCA

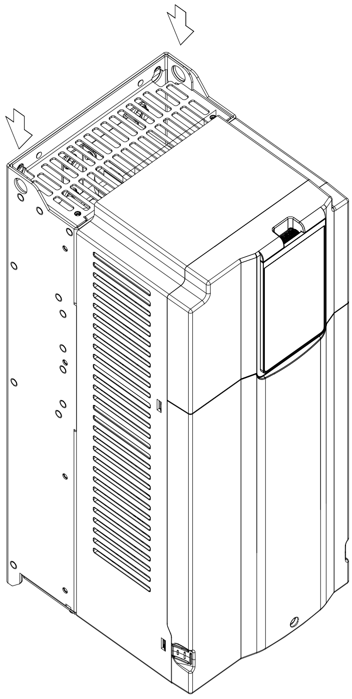


Figure 2-16

Frame F1

Applicable models:
VFD110VP43AFTCA

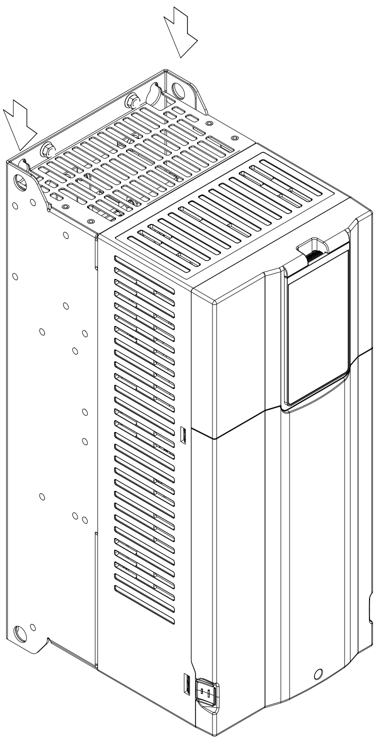


Figure 2-17

Frame F2

Applicable models:
VFD110VP43BFTCA; VFD110VP43BSTCA

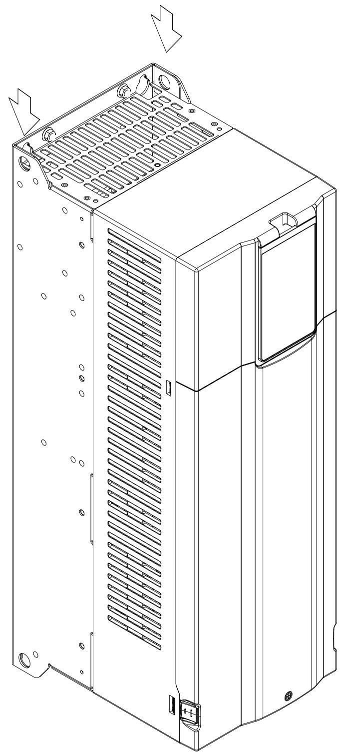


Figure 2-18

Frame G1

Applicable models:
VFD150VP43AFTCA

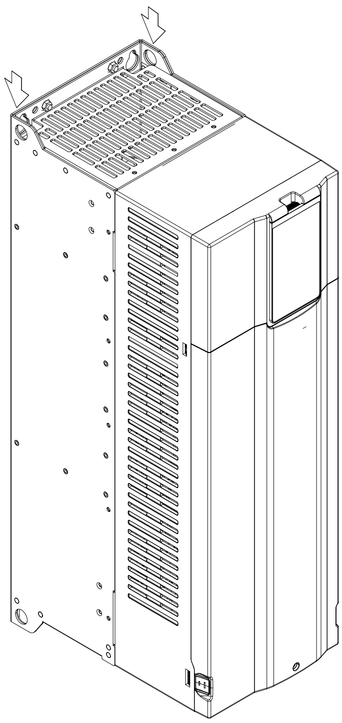


Figure 2-19

Frame G2

Applicable models:
VFD150VP43BSTCA; VFD150VP43BFTCA

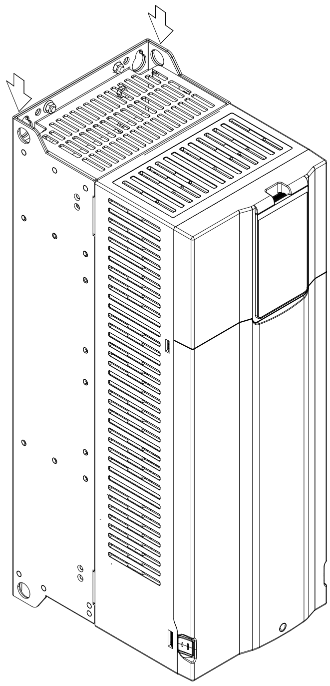


Figure 2-20

Frame H1

Applicable models:
VFD180VP43AFTCA; VFD220VP43AFTCA

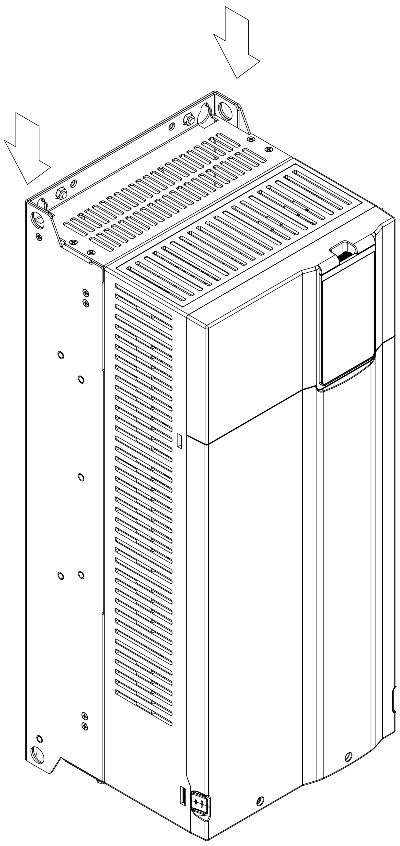


Figure 2-21

Frame H2

Applicable models:
VFD180VP43BFTCA; VFD180VP43BSTCA;
VFD220VP43BFTCA

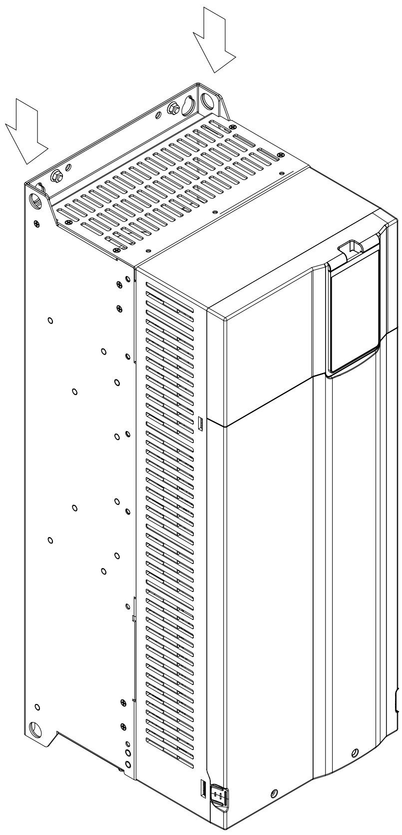


Figure 2-22

Frame I1

Applicable models:
VFD260VP43AFTCA; VFD310VP43AFTCA

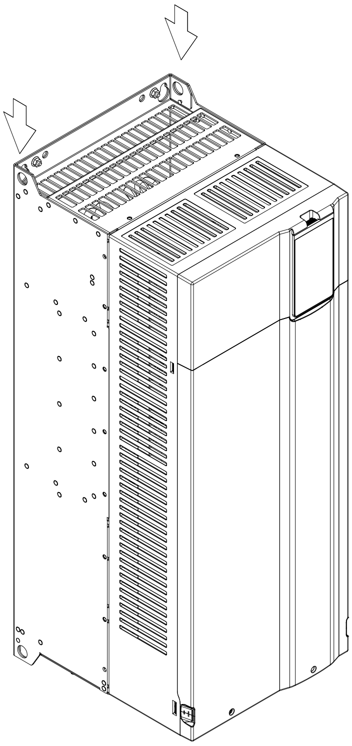


Figure 2-23

Frame I2

Applicable models:
VFD260VP43BFTCA; VFD260VP43BSTCA
VFD310VP43BFTCA; VFD310VP43BSTCA

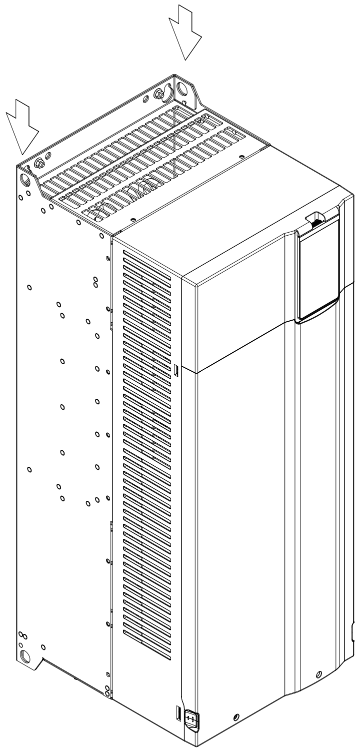


Figure 2-24

Frame J1

Applicable models:
VFD370VP43AFTCA; VFD395VP43AFTCA

Frame J2

Applicable models:
VFD370VP43BFTCA; VFD395VP43BFTCA;
VFD370VP43BSTCA; VFD395VP43BSTCA

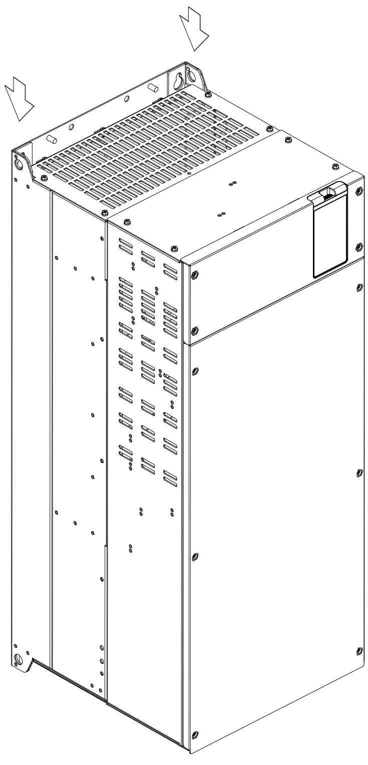


Figure 2-25

Frame K1

Applicable models:
VFD460VP43AFTCA; VFD485VP43AFTCA

Frame K2

Applicable models:
VFD460VP43BFTCA; VFD485VP43BFTCA;
VFD460VP43BSTCA; VFD485VP43BSTCA

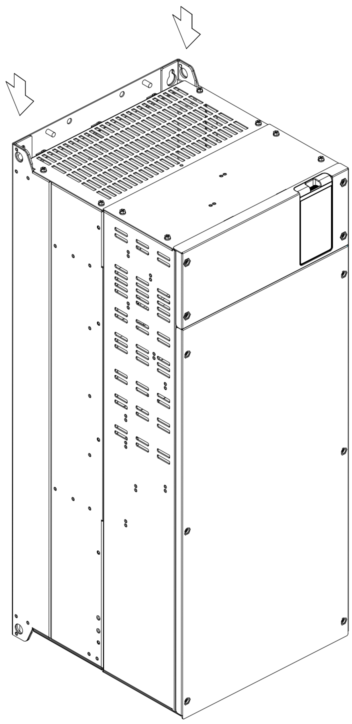


Figure 2-26

Frame L

Applicable models:
VFD530VP43SHTCA; VFD616VP43SHTCA;
VFD683VP43SHTCA; VFD770VP43SHTCA

Frame M

Applicable models:
VFD866VP43SHTCA; VFD930VP43SHTCA;
VFD1K1VP43SHTCA; VFD1K2VP43SHTCA

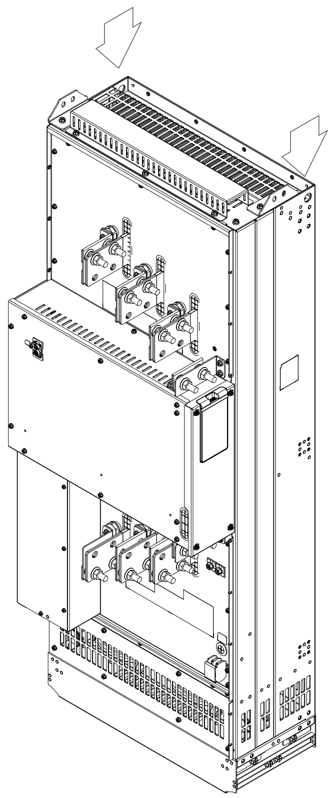


Figure 2-27

2-4-3 Weight

See Section 2-5 for the weight of each frame.

2-4-4 Lifting Indication

Frame E–K

1. Use the lifting hook to properly pass through the lifting hole, pay attention to the lifting method to prevent deformation of the drive lifting hole from improper installation.

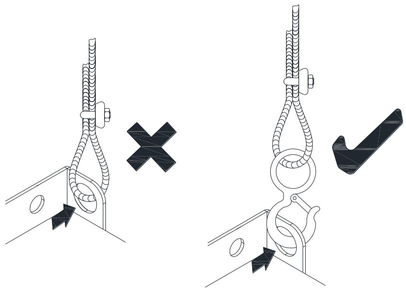


Figure 2-28

2. Make sure the two lifting hooks hook into the lifting holes, and then remove the screws and iron plates that fix the drive on the crate.

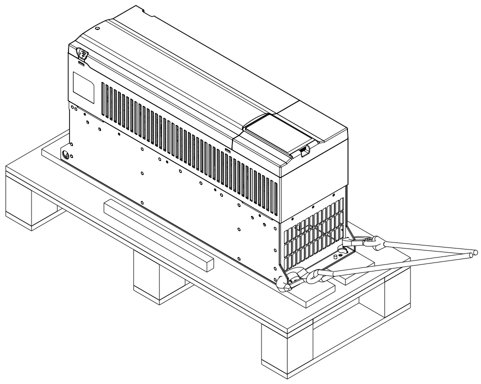


Figure 2-29

3. Note that the angle between the lifting hole of the drive and the hook device must be less than 30 degrees. The drive can be installed after being lifted.

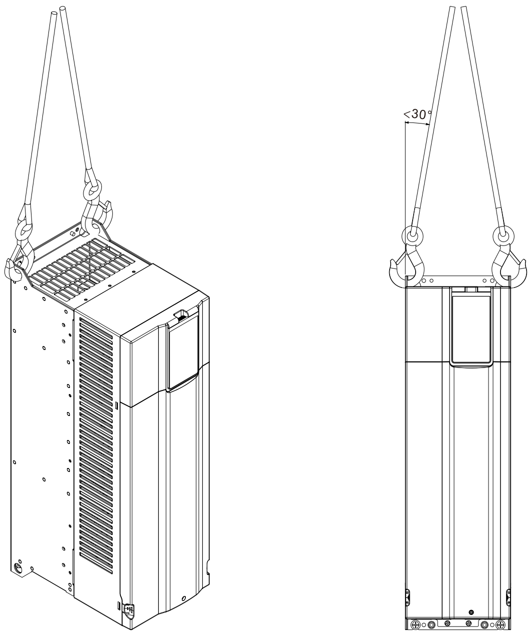


Figure 2-30

Frame L, M

Upright Lifting

1. Loosen the two screws and spare the track (refer to Section 2-4-5 Chassis Installation for track installation).

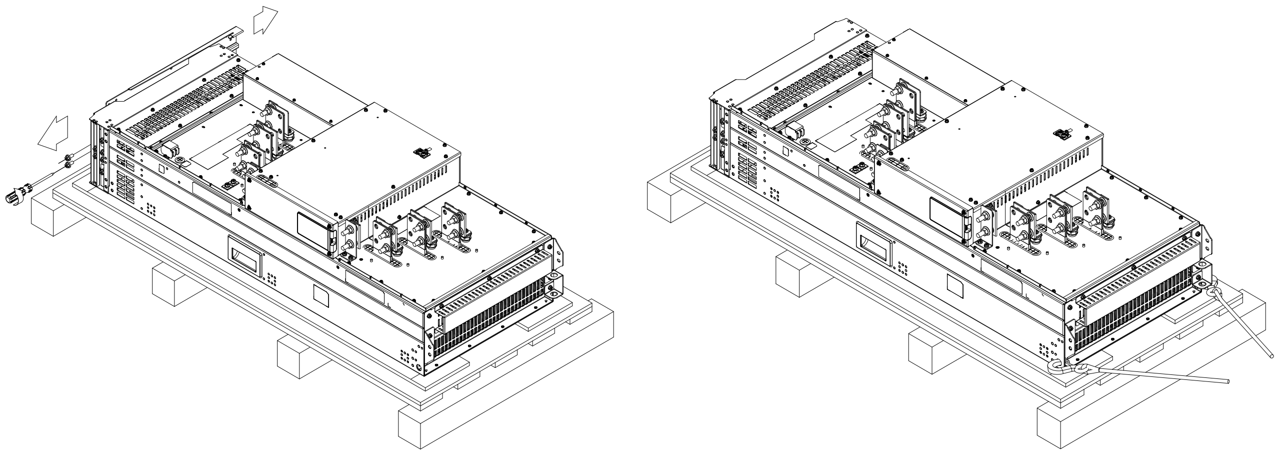


Figure 2-31

2. Note that the angle between the lifting hole of the drive and the hook device must be less than 30 degrees. The drive can be installed after being lifted.

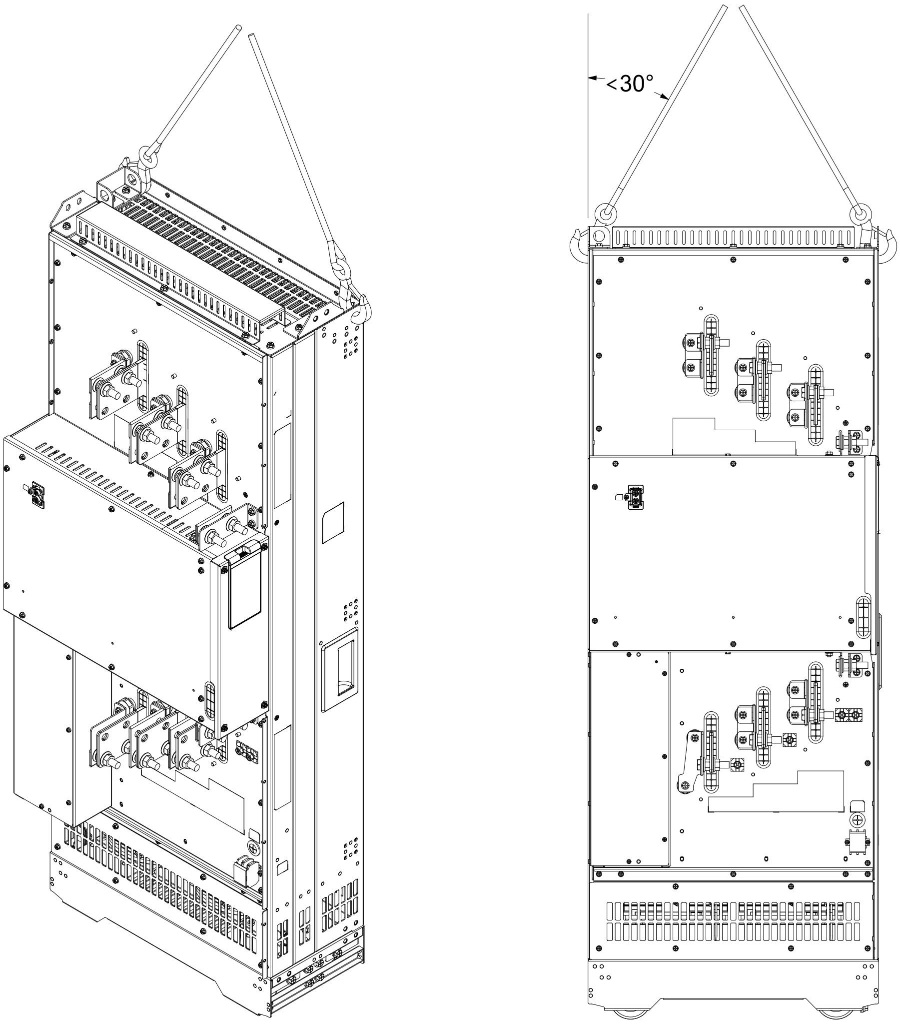


Figure 2-32

Horizontal Lifting

1. For the crate packaging, unscrew the fixed plate and the fixing two screws on the crate.

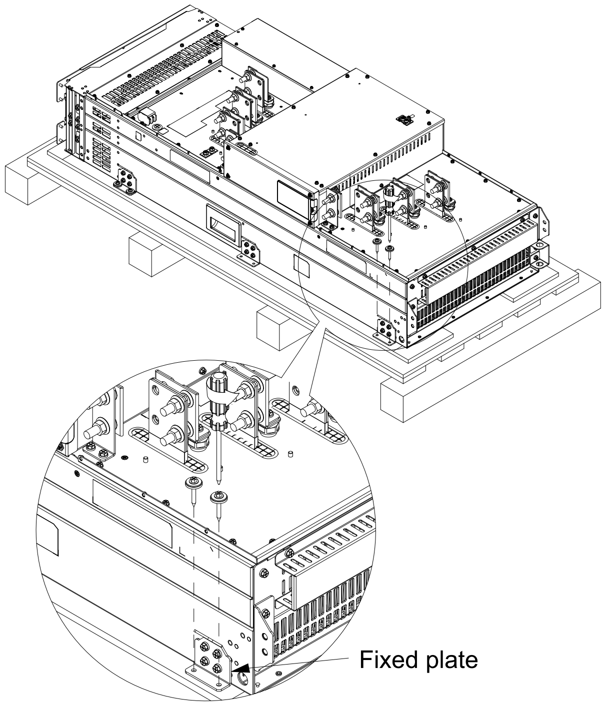


Figure 2-33

2. Lift the drive horizontally through the four fixed plate marking in the figure below. The angle between the lifting hole and the lifting hook is suggested to be 90 degrees.

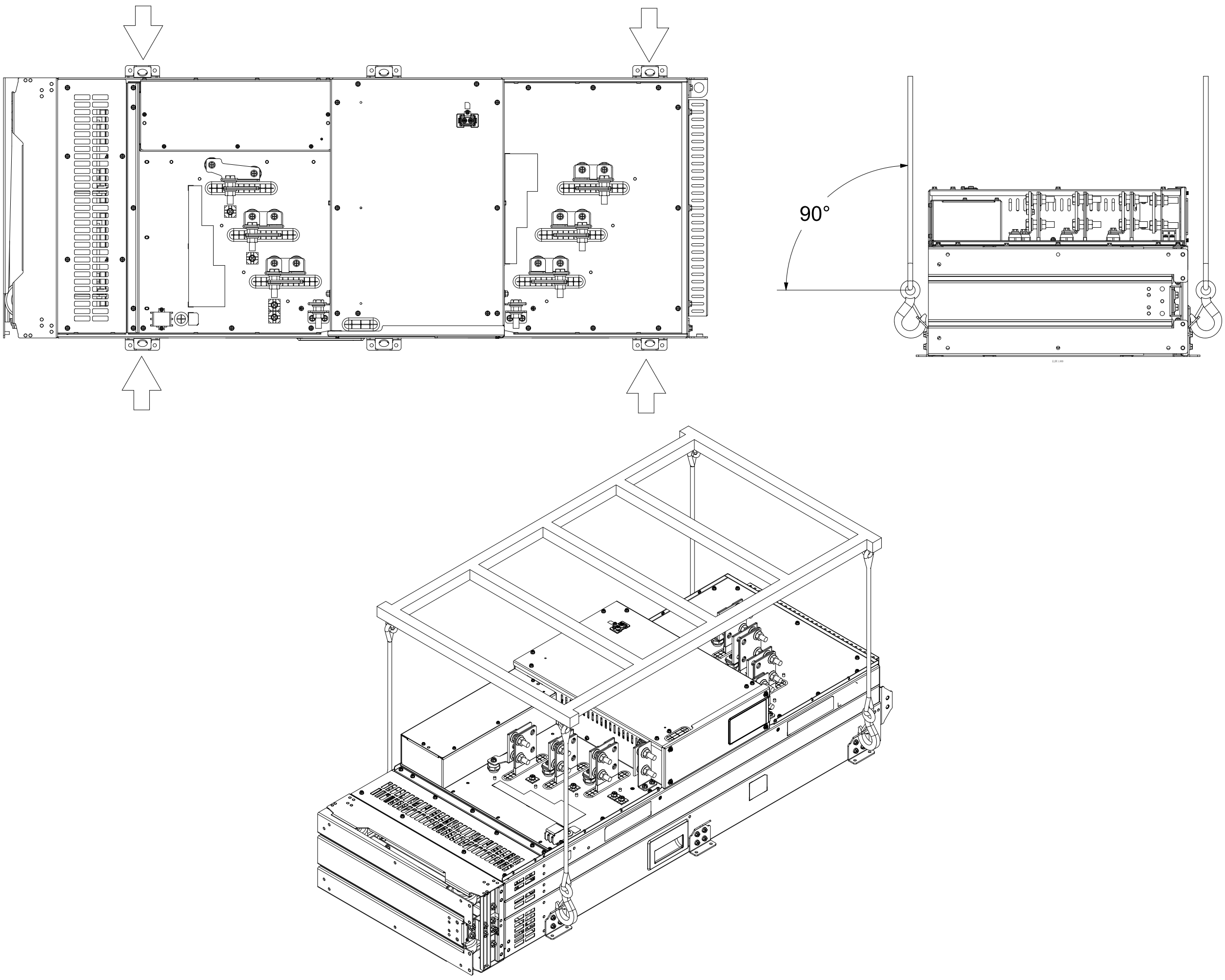


Figure 2-34

2-4-5 Chassis Installation

Follow the following steps for installation (applicable for Frame L & M):

1. Use 10 pcs of M6 and 2 pcs of M8 screws to lock the track to the cabinet.
   M6 Screw torque: 35–45 kg-cm / (30.4–39 lb-in.) / (3.43–4.41 Nm)
   M8 Screw torque: 100–110 kg-cm / (86.8–95.5 lb-in.) / (9.80–10.78 Nm)

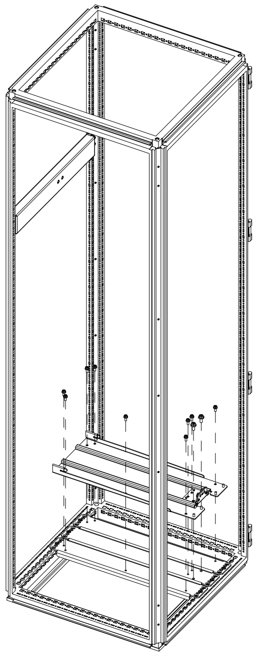


Figure 2-35

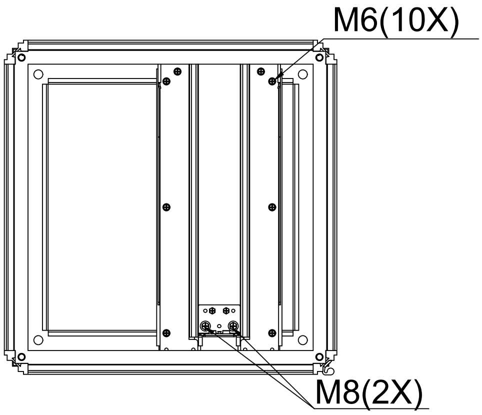


Figure 2-36

2. Lift the drive and place the front edge of the bottom against the end of the track, push the drive into the cabinet along the track and lean to the bottom. If you need auxiliary installation accessories, you can purchase the chassis rail (MKVP-CR01) as needed, refer to Section 10-3-7 for further information.
3. Use 4 pcs of M8 screws to lock the drive at the position indicated in the following figure.
   M8 Screw torque: 100–110 kg-cm / (86.8–95.5 lb-in.) / (9.80–10.78 Nm)

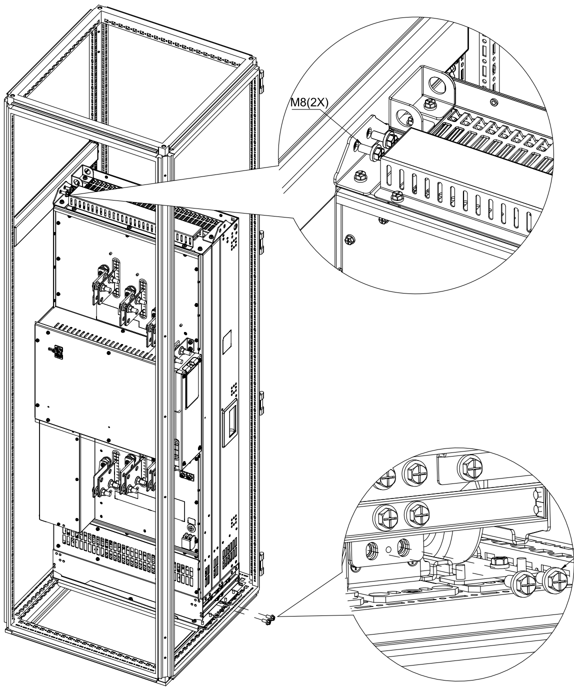


Figure 2-37

4. Install the front beam of the cabinet, and use 2 pcs of M8 screws to lock the drive at the position indicated in the following figure.
   M8 Screw torque: 100–110 kg-cm / (86.8–95.5 lb-in.) / (9.80–10.78 Nm)

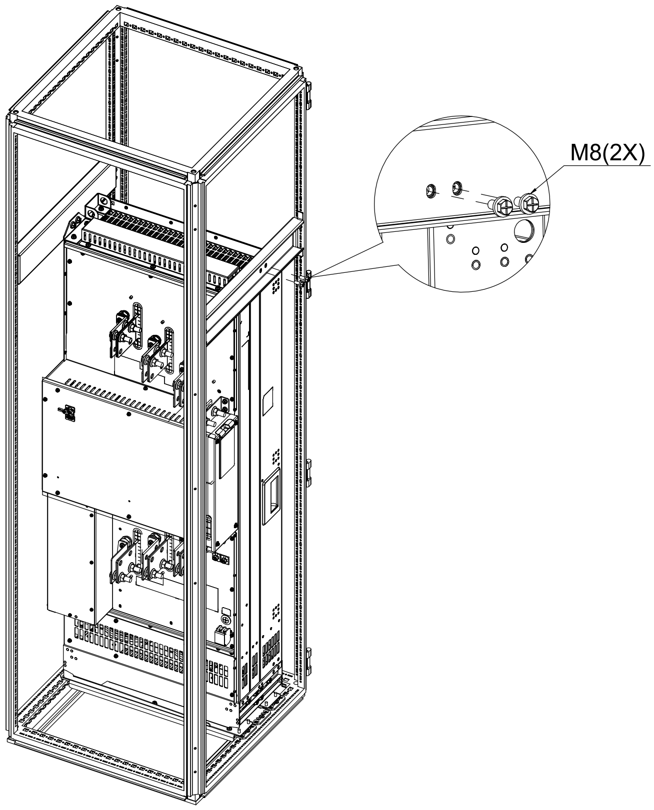


Figure 2-38

5. Loosen the 16 pcs of M12 screws and 4 pcs of M8 screws.

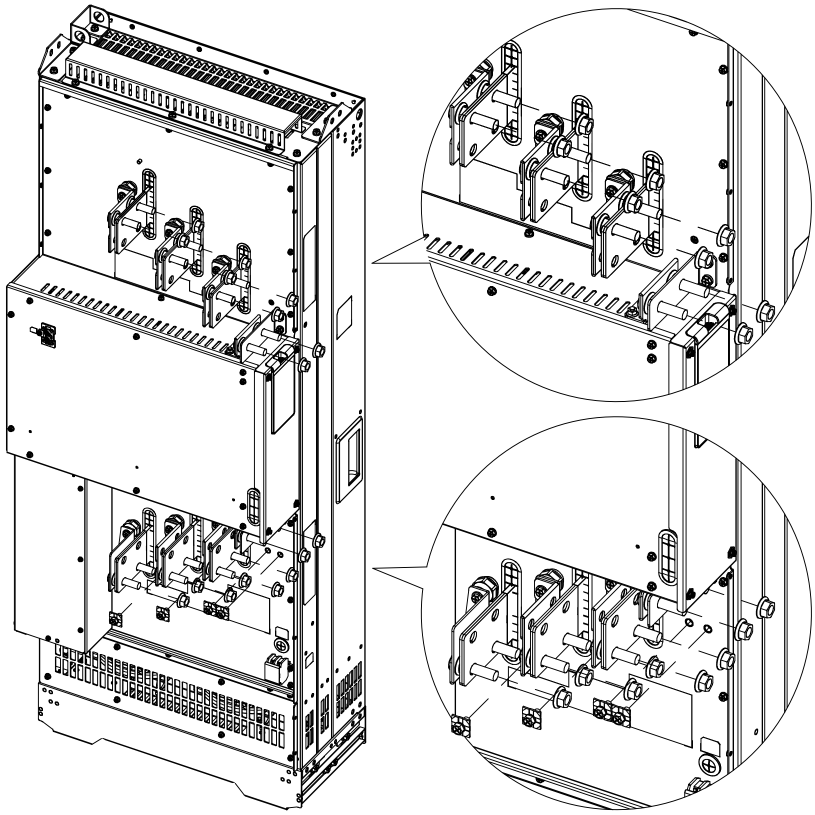


Figure 2-39

6. User the aforementioned 16 pcs of M12 nuts and 4pcs of M8 screws to secure the wire.
   M8 Screw torque: 100–110 kg-cm / (86.8–95.5 lb-in.) / (9.80–10.78 Nm)
   M12 Screw torque: 360 kg-cm / (312.5 lb-in.) / (35.28 Nm)

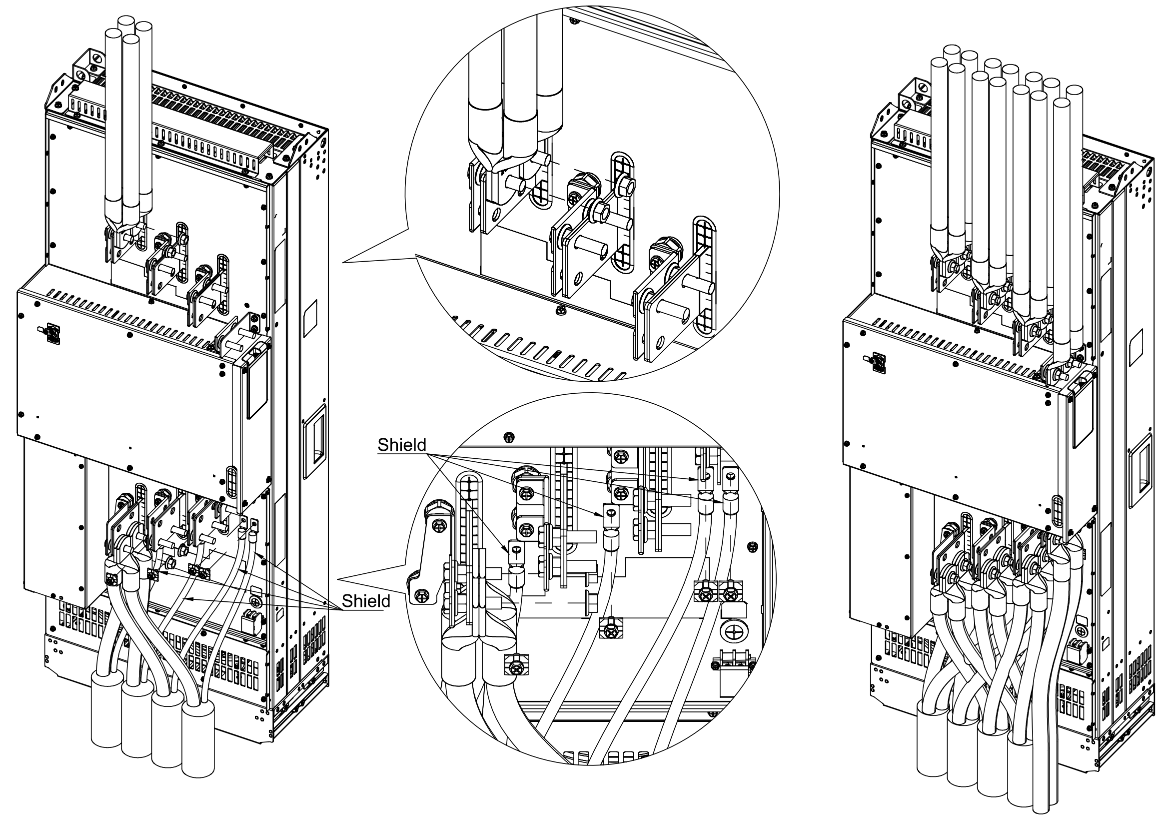


Figure 2-40

7. Installation completed.

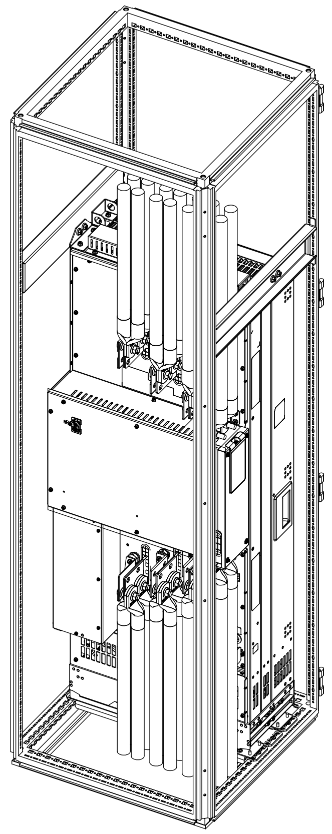


Figure 2-41

NOTE: The body of Frame L & M is relatively large. Pay attention to the placement of the drive and the safety of personnel during disassembly and assembly. Do not leave the drive randomly in the cabinet without being fully fixed and locked, or it may fall over.

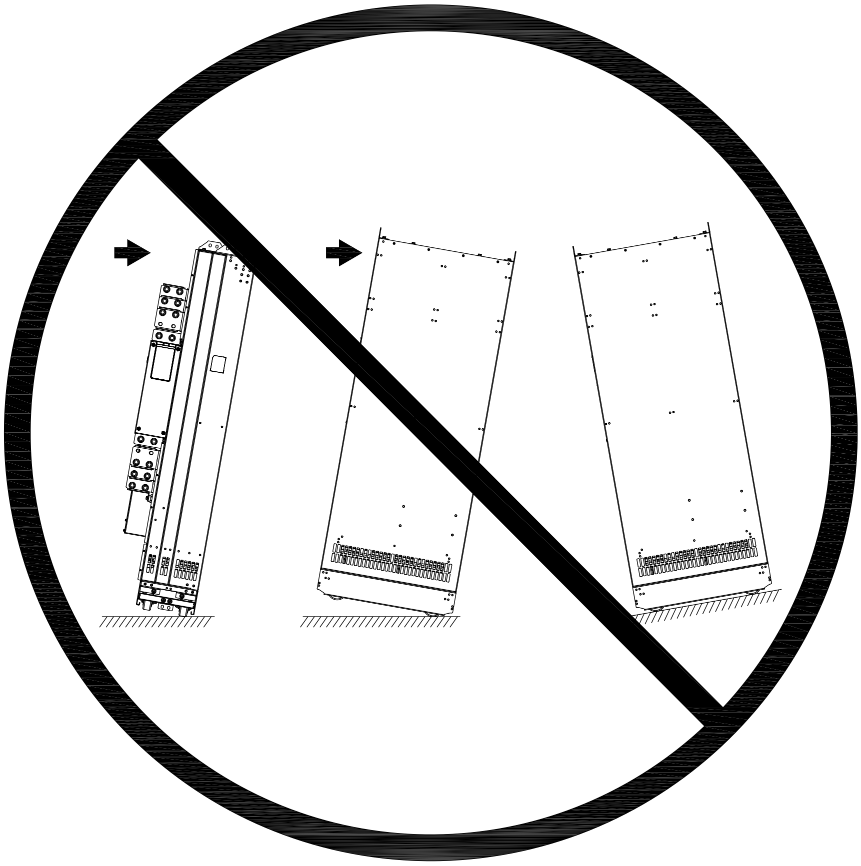


Figure 2-42

2-5 Appearance and Dimensions

Frame A1

Applicable models:

VFD3A0VP43ANTAA, VFD4A2VP43ANTAA, VFD5A6VP43ANTAA, VFD7A2VP43ANTAA, VFD011VP43ANTAA

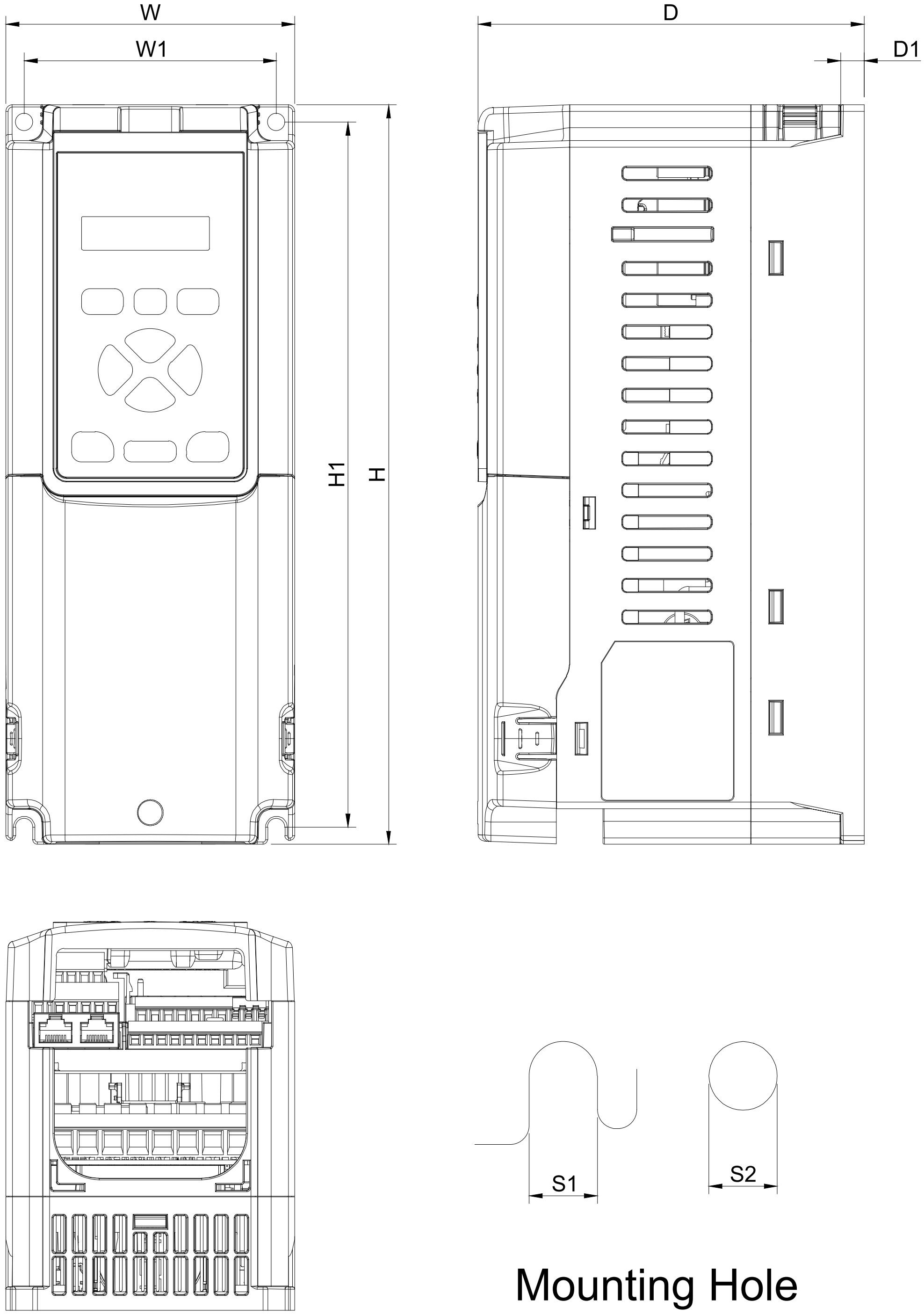


Figure 2-43

Unit: mm (inch)

Frame	W	W1	H	H1	D	D1	S1	S2
A1	110 (4.33)	96 (3.78)	280 (11.02)	267 (10.51)	147 (5.79)	9 (0.35)	6.5 (0.26)	6.5 (0.26)

Weight: 1.71 kg

Table 2-4

Frame A2

Applicable models:

VFD3A0VP43BFTAA, VFD4A2VP43BFTAA, VFD5A6VP43BFTAA, VFD7A2VP43BFTAA, VFD011VP43BFTAA

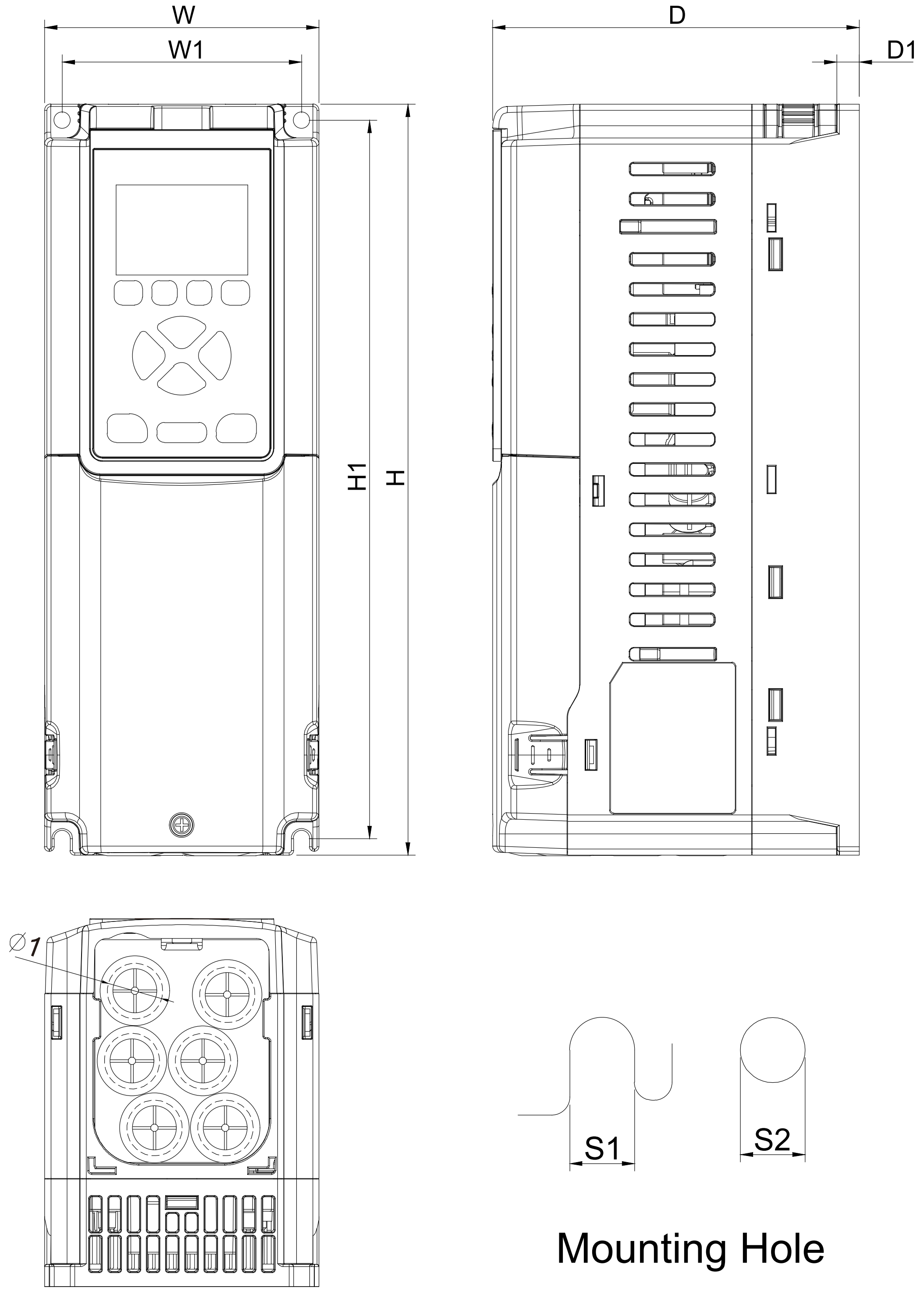


Figure 2-44

Unit: mm (inch)

Frame	W	W1	H	H1	D	D1	S1	S2	Ø1
A2	110 (4.33)	96 (3.78)	300 (11.81)	287 (11.3)	147 (5.79)	9 (0.35)	6.5 (0.26)	6.5 (0.26)	22.2 (0.87)

Weight: 1.95 kg

Table 2-5

Frame B1

Applicable models:

VFD013VP43ANTAA, VFD018VP43ANTAA

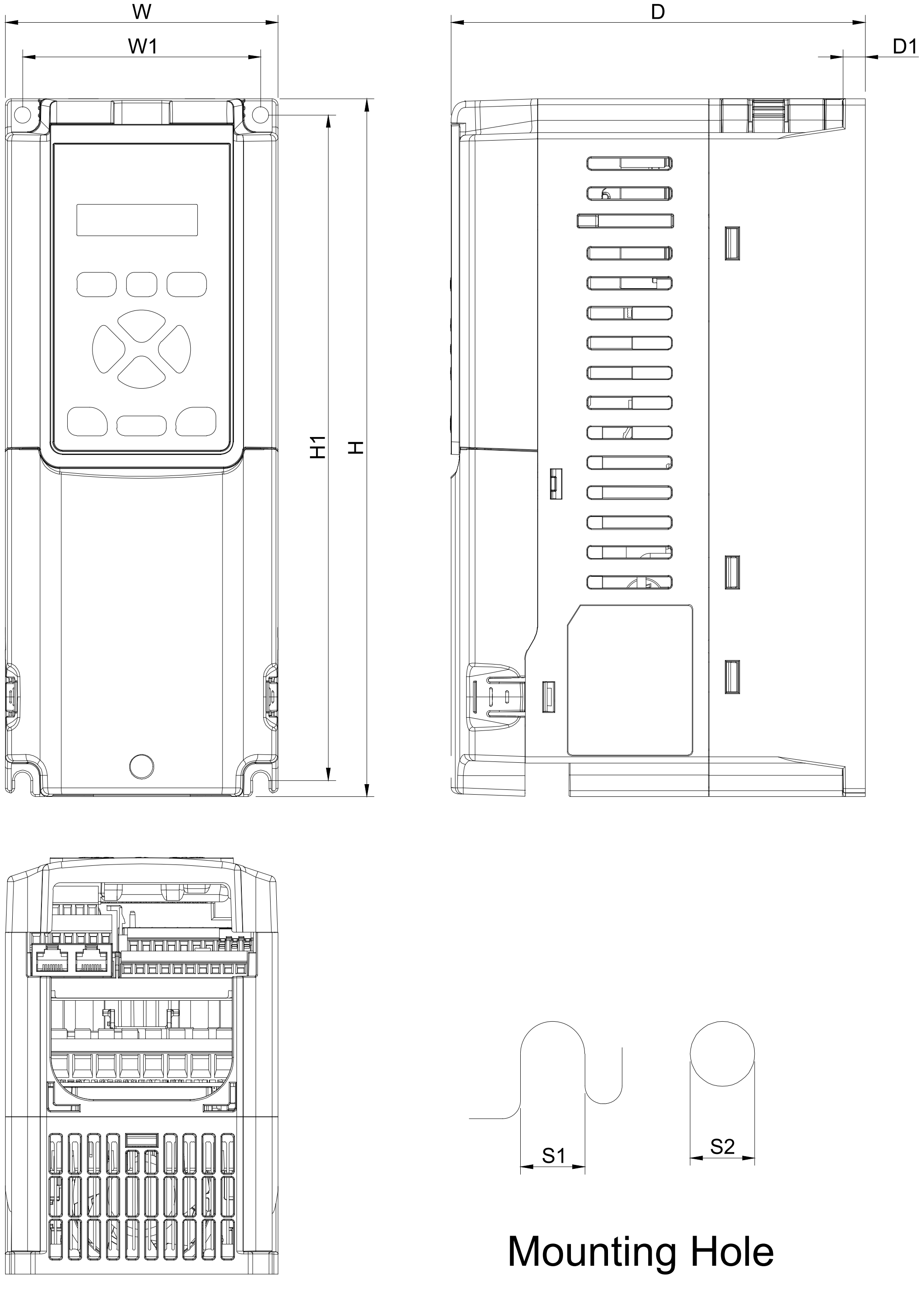


Figure 2-45

Unit: mm (inch)

Frame	W	W1	H	H1	D	D1	S1	S2
B1	110 (4.33)	96 (3.78)	280 (11.02)	267 (10.51)	167 (6.57)	9 (0.35)	6.5 (0.26)	6.5 (0.26)

Weight: 1.97 kg

Table 2-6

Frame B2

Applicable models:

VFD013VP43BFTAA, VFD018VP43BFTAA

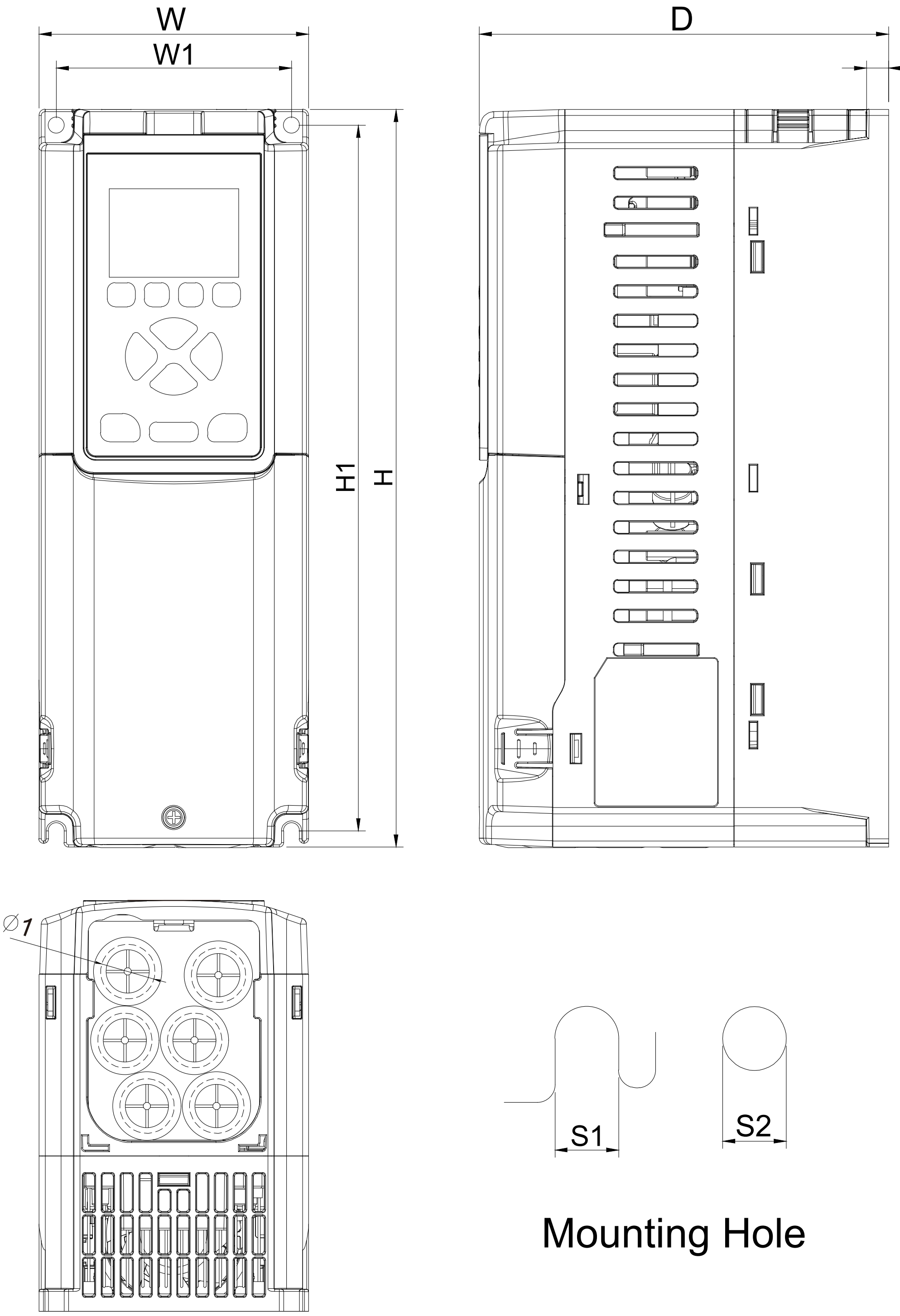


Figure 2-46

Unit: mm (inch)

Frame	W	W1	H	H1	D	D1	S1	S2	Ø1
B2	110 (4.33)	96 (3.78)	300 (11.81)	287 (11.3)	167 (6.57)	9 (0.35)	6.5 (0.26)	6.5 (0.26)	22.2 (0.87)

Weight: 2.47 kg

Table 2-7

Frame C1

Applicable models:

VFD025VP43ANTAA, VFD032VP43ANTAA, VFD038VP43ANTAA

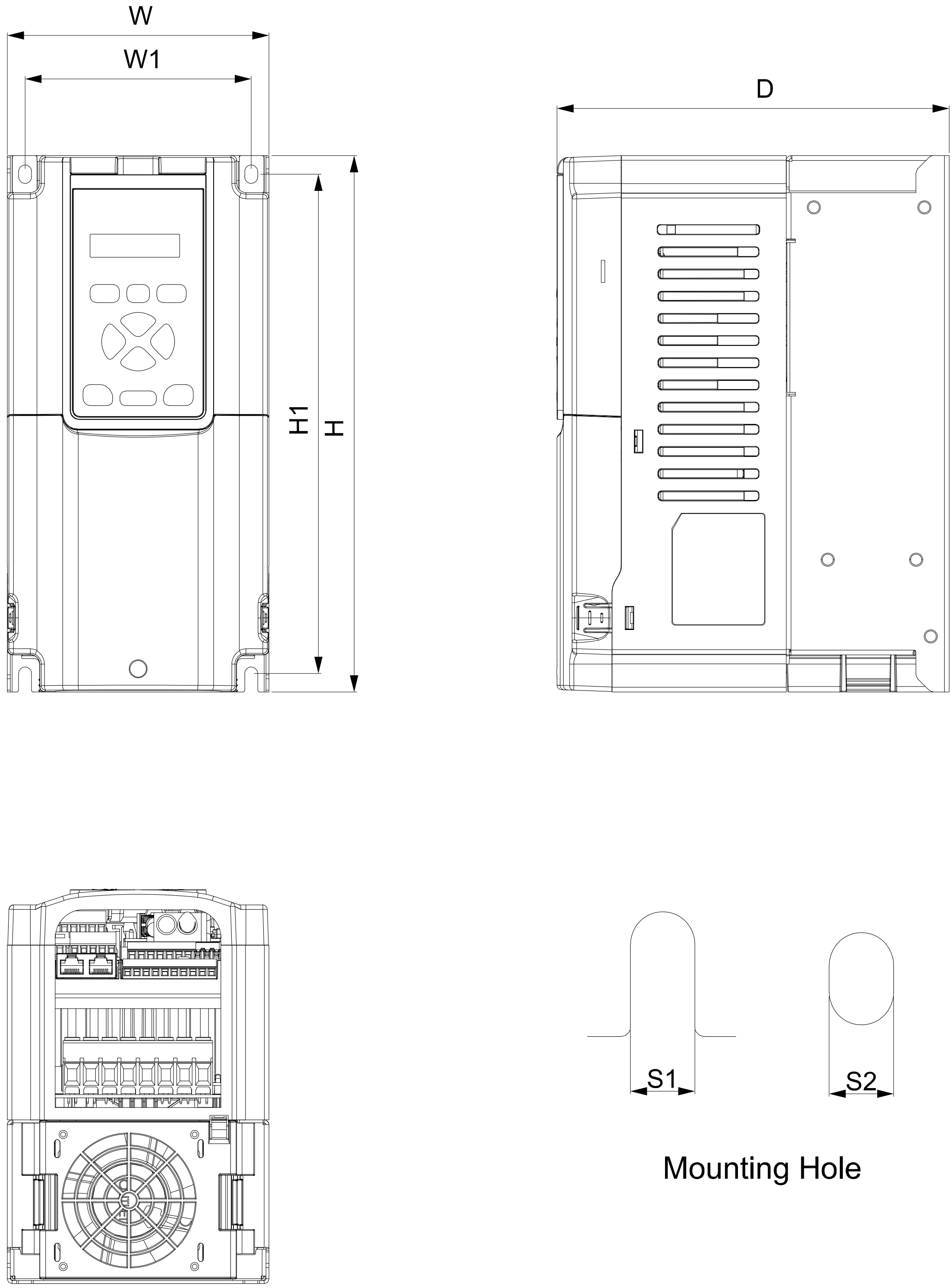


Figure 2-47

Unit: mm (inch)

Frame	W	W1	H	H1	D	S1	S2
C1	142 (5.59)	122.9 (4.84)	290 (11.42)	270 (10.63)	213 (8.39)	7 (0.28)	7 (0.28)

Weight: 5.6 kg

Table 2-8

Frame C2

Applicable models:

VFD025VP43BFTAA, VFD032VP43BFTAA, VFD038VP43BFTAA

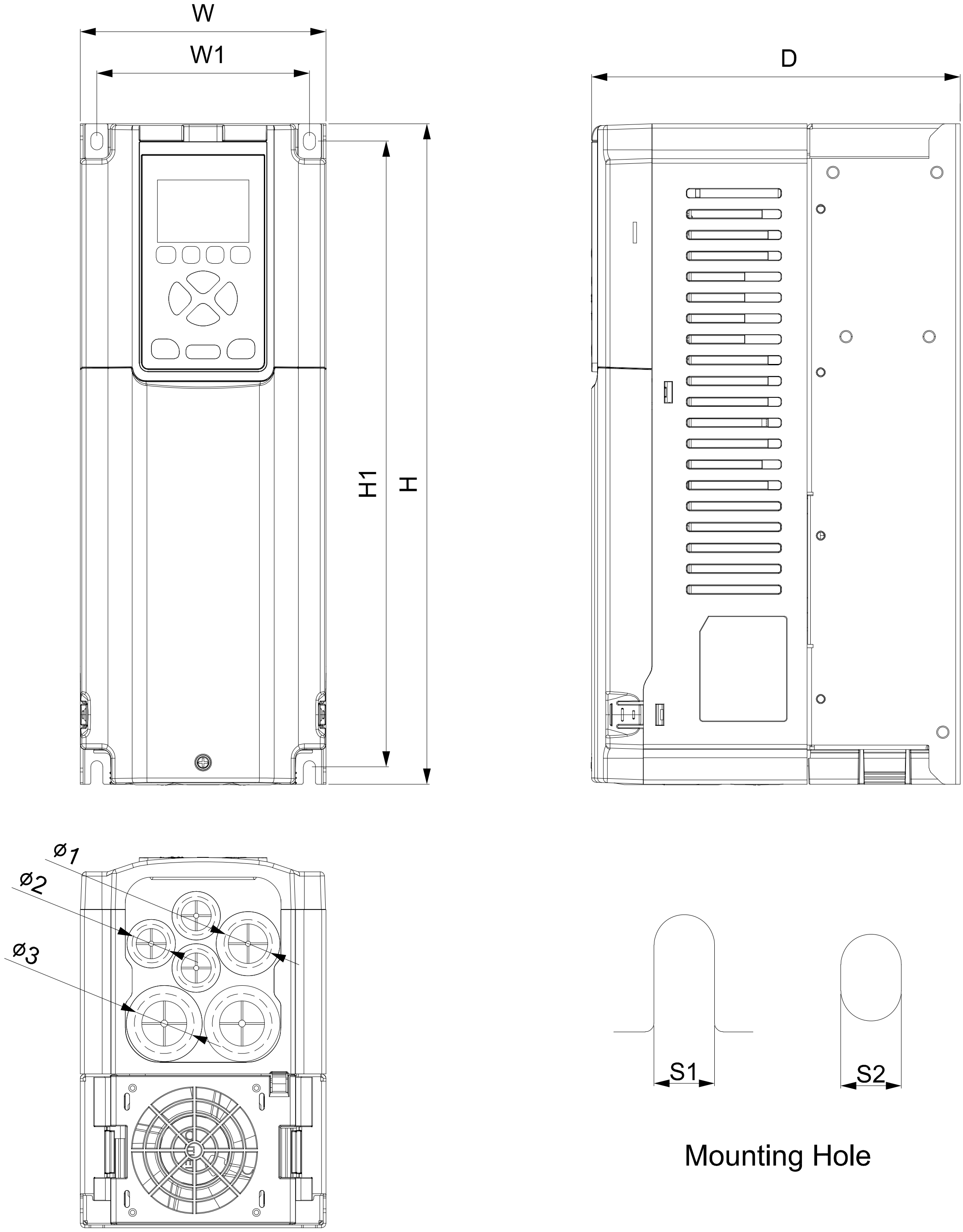


Figure 2-48

Unit: mm (inch)

Frame	W	W1	H	H1	D	S1	S2	Ø1	Ø2	Ø3
C2	142 (5.59)	122.9 (4.84)	380 (14.96)	360 (14.17)	213 (8.39)	7 (0.28)	7 (0.28)	27.8 (1.09)	22.2 (0.87)	34.5 (1.36)

Weight: 6 kg

Table 2-9

Frame D1

Applicable models:

VFD045VP43ANTCA, VFD062VP43ANTCA

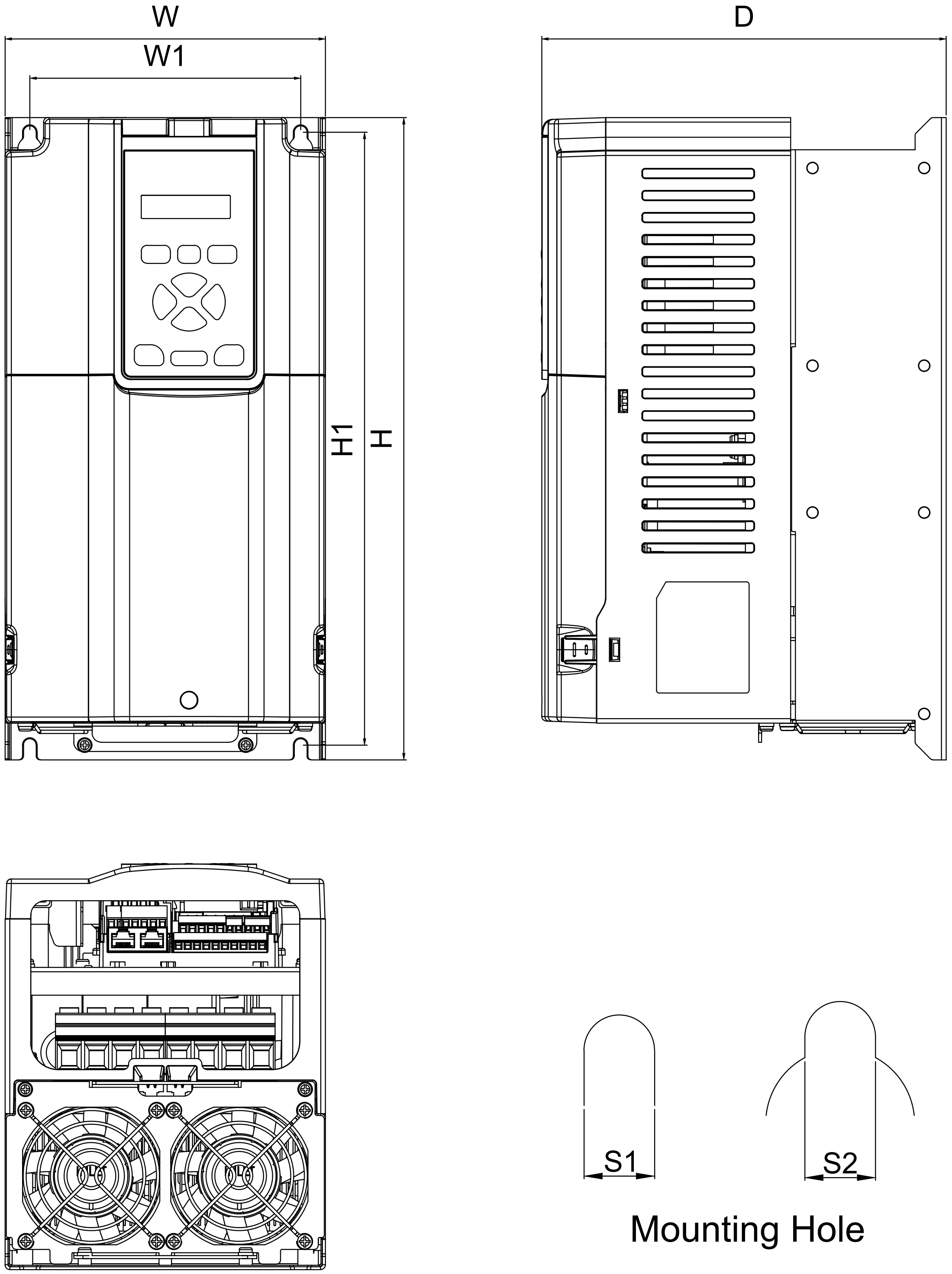


Figure 2-49

Unit: mm (inch)

Frame	W	W1	H	H1	D	S1	S2
D1	175 (6.89)	148 (5.83)	350 (13.78)	334 (13.15)	221 (8.7)	7 (0.28)	7 (0.28)

Weight: 8.5 kg

Table 2-10

Frame D2

Applicable models:

VFD045VP43BFTCA, VFD062VP43BFTCA, VFD045VP43BSTCA, VFD062VP43BSTCA

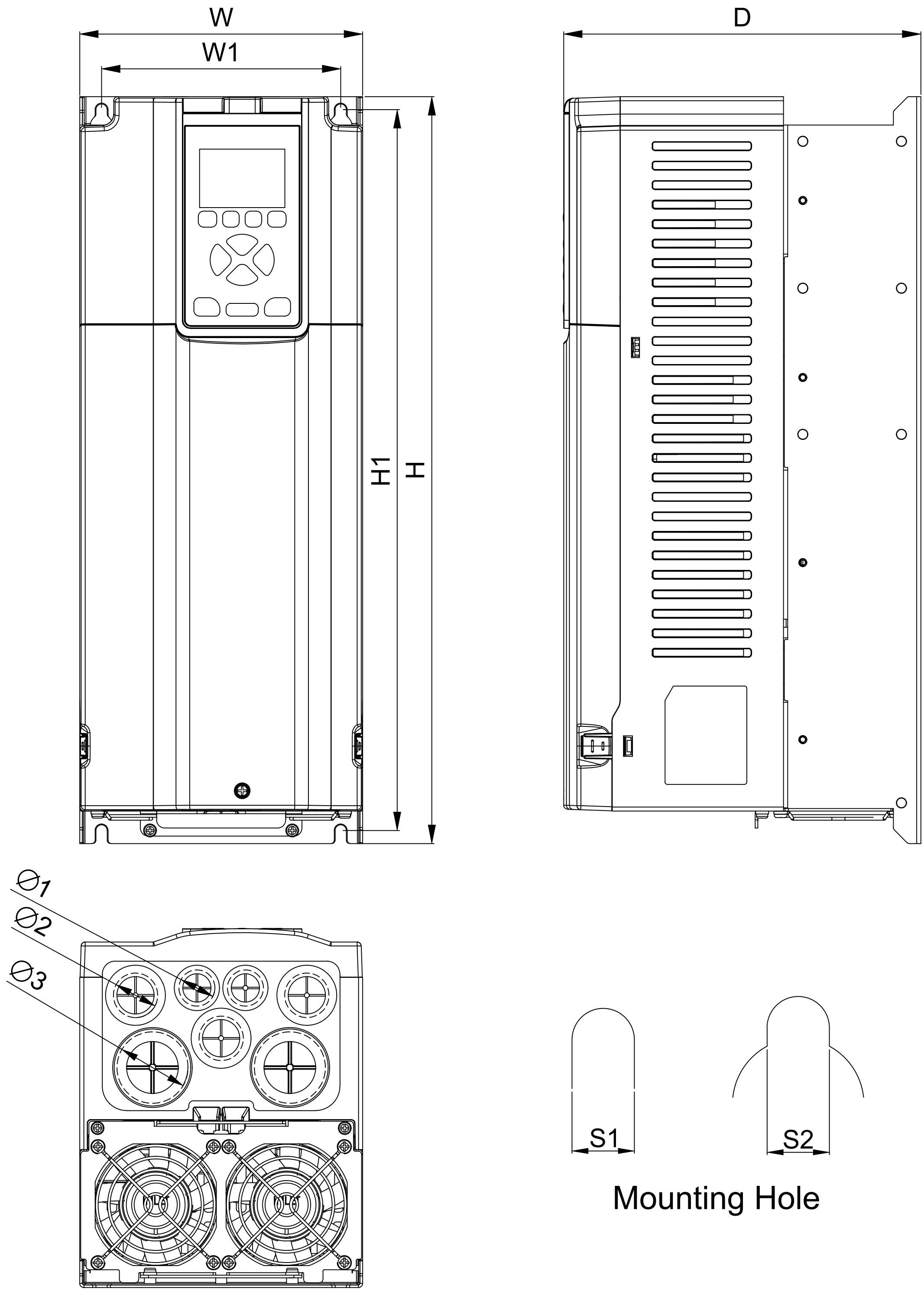


Figure 2-50

Unit: mm (inch)

Frame	W	W1	H	H1	D	S1	S2	Ø1	Ø2	Ø3
D2	175 (6.89)	148 (5.83)	460 (18.11)	444 (17.48)	221 (8.7)	7 (0.28)	7 (0.28)	22.3 (0.88)	27.4 (1.08)	44 (1.73)

Weight: 11 kg

Table 2-11

Frame E1

Applicable models:

VFD073VP43ANTCA, VFD090VP43ANTCA

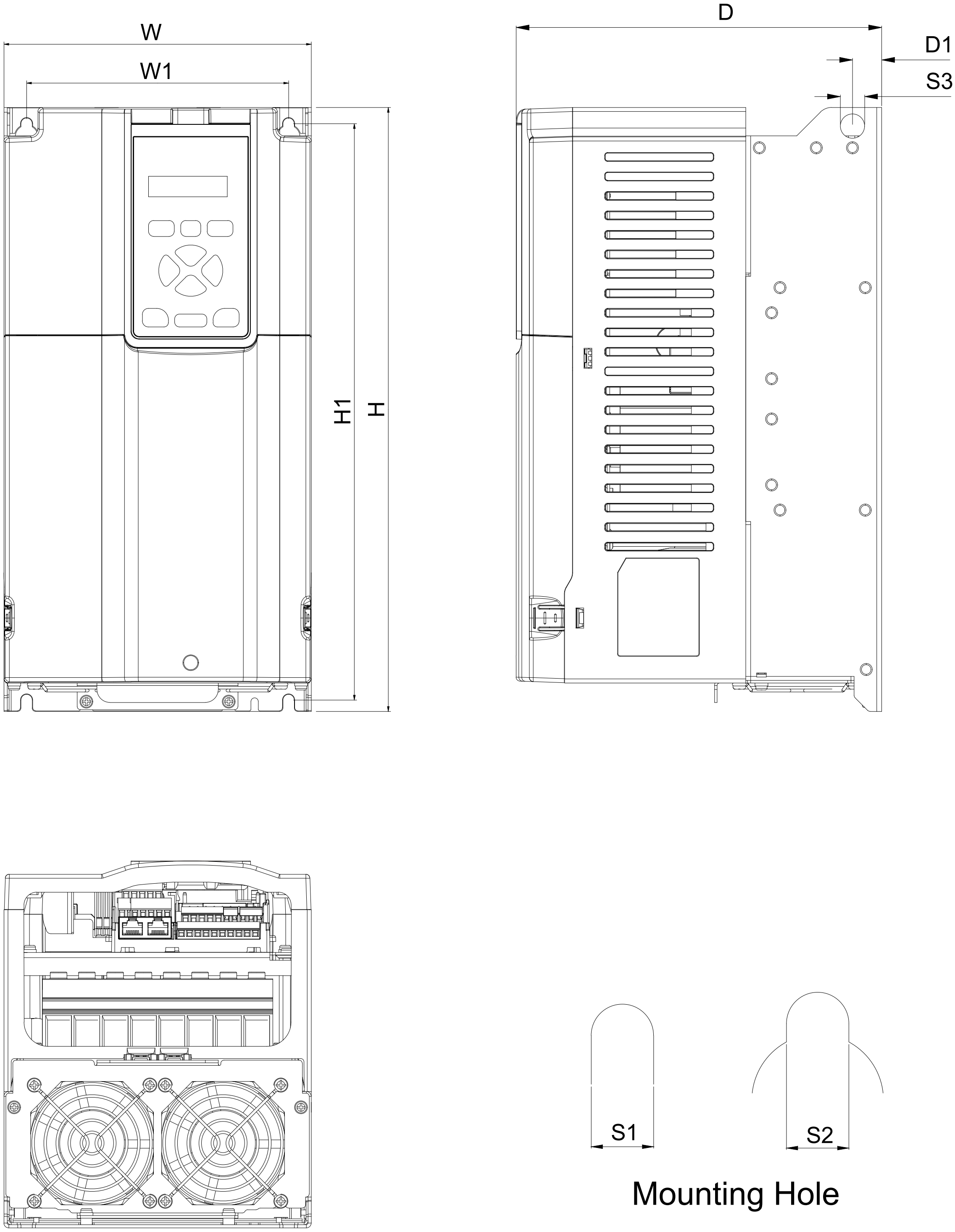


Figure 2-51

Unit: mm (inch)

Frame	W	W1	H	H1	D	D1	S1	S2	S3
E1	190 (7.48)	162 (6.38)	372 (14.65)	355 (13.98)	226 (8.90)	18 (0.71)	7 (0.28)	7 (0.28)	15 (0.59)

Weight: 10.5 kg

Table 2-12

Frame E2

Applicable models:

VFD073VP43BFTCA, VFD090VP43BFTCA, VFD073VP43BSTCA, VFD090VP43BSTCA

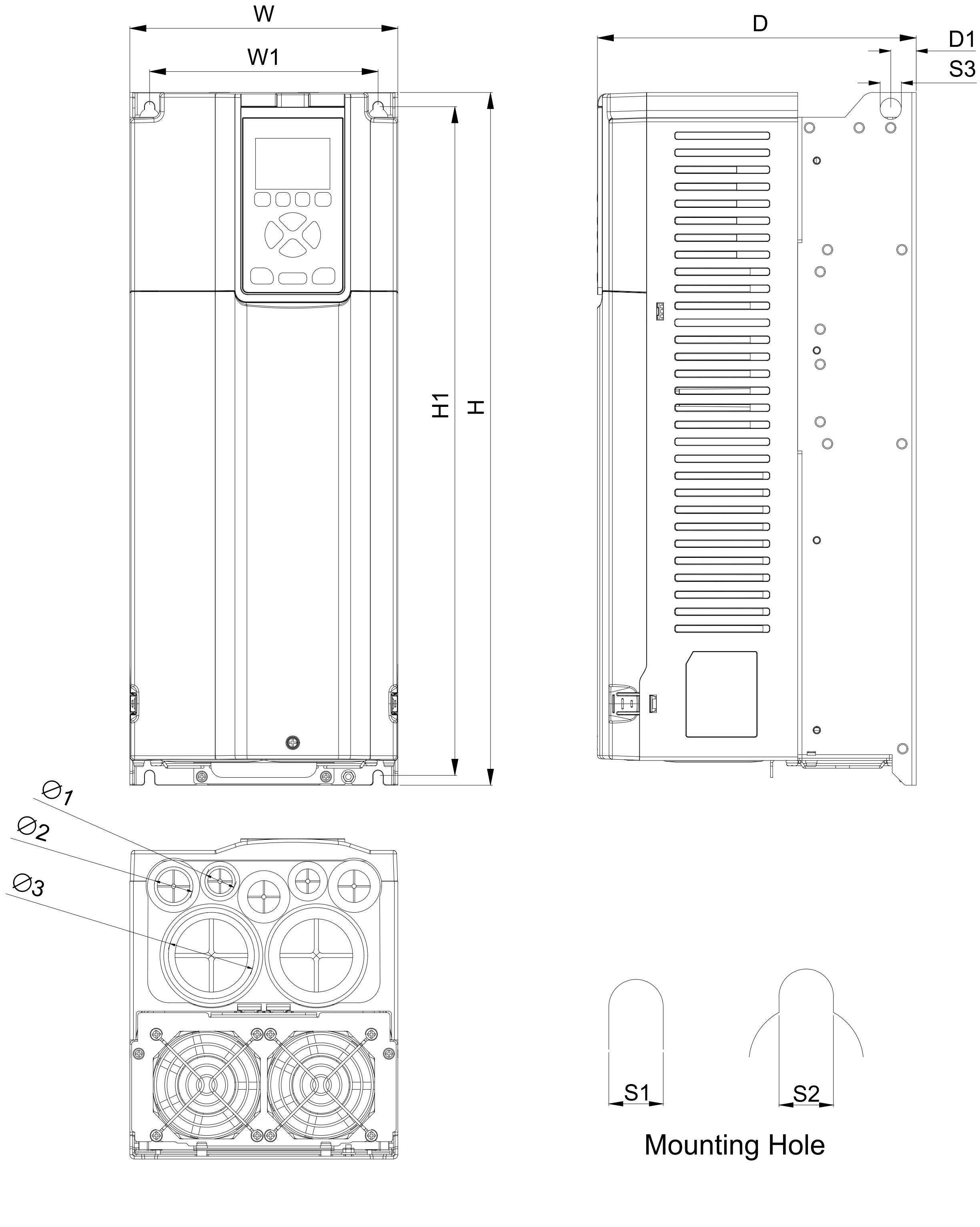


Figure 2-52

Unit: mm (inch)

Frame	W	W1	H	H1	D	D1	S1	S2	S3	Ø1	Ø2	Ø3
E2	190 (7.48)	162 (6.38)	489 (19.25)	472 (18.58)	226 (8.90)	18 (0.71)	7 (0.28)	7 (0.28)	15 (0.59)	21.5 (0.85)	27.5 (1.08)	61 (2.4)

Weight: 13 kg

Table 2-13

Frame F1

Applicable models:

VFD110VP43AFTCA

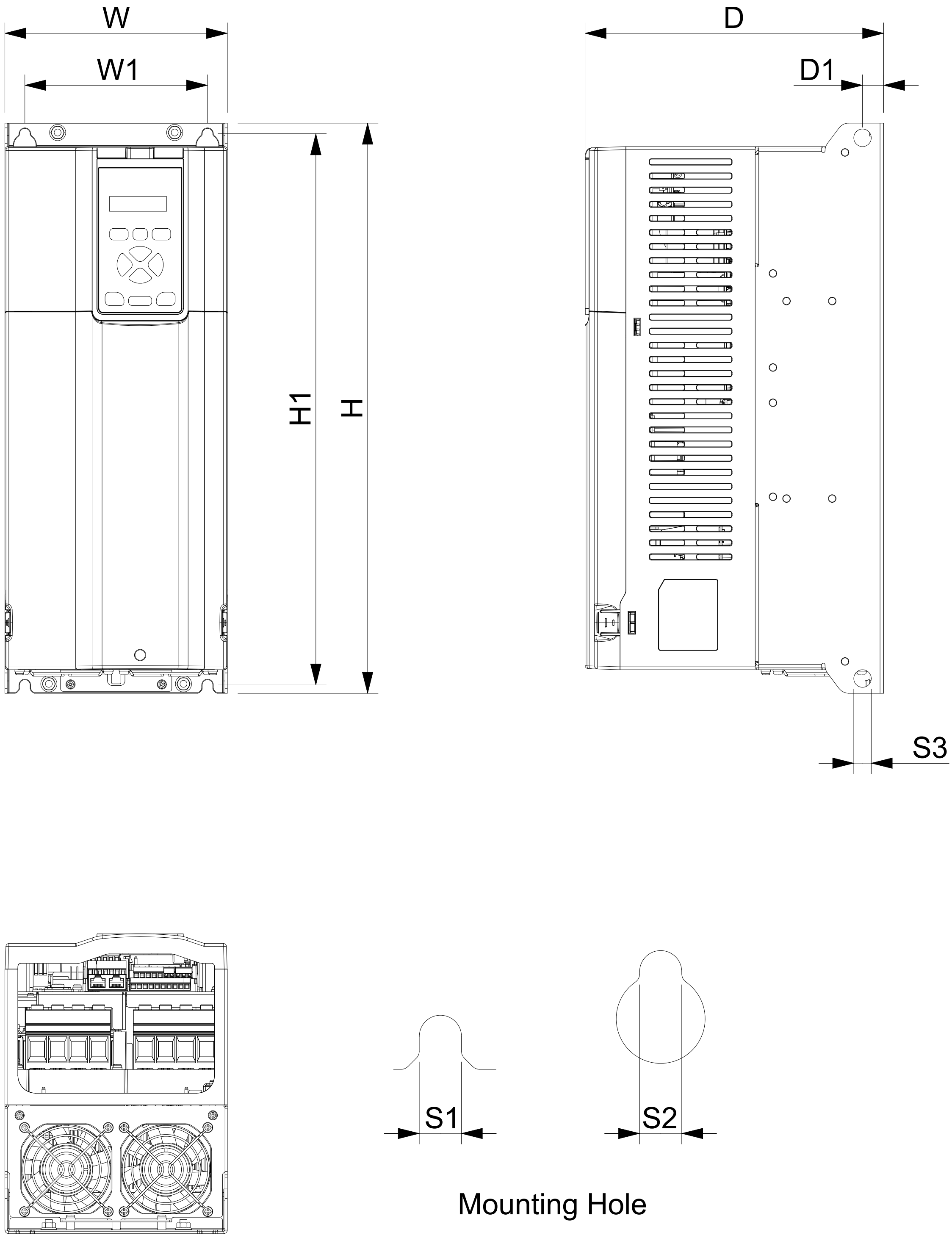


Figure 2-53

Unit: mm (inch)

Frame	W	W1	H	H1	D	D1	S1	S2	S3
F1	190 (7.48)	156 (6.14)	485 (19.09)	469 (18.46)	255 (10.04)	18 (0.71)	9 (0.35)	9 (0.35)	15 (0.59)

Weight: 14.4 kg

Table 2-14

Frame F2

Applicable models:

VFD110VP43BFTCA, VFD110VP43BSTCA

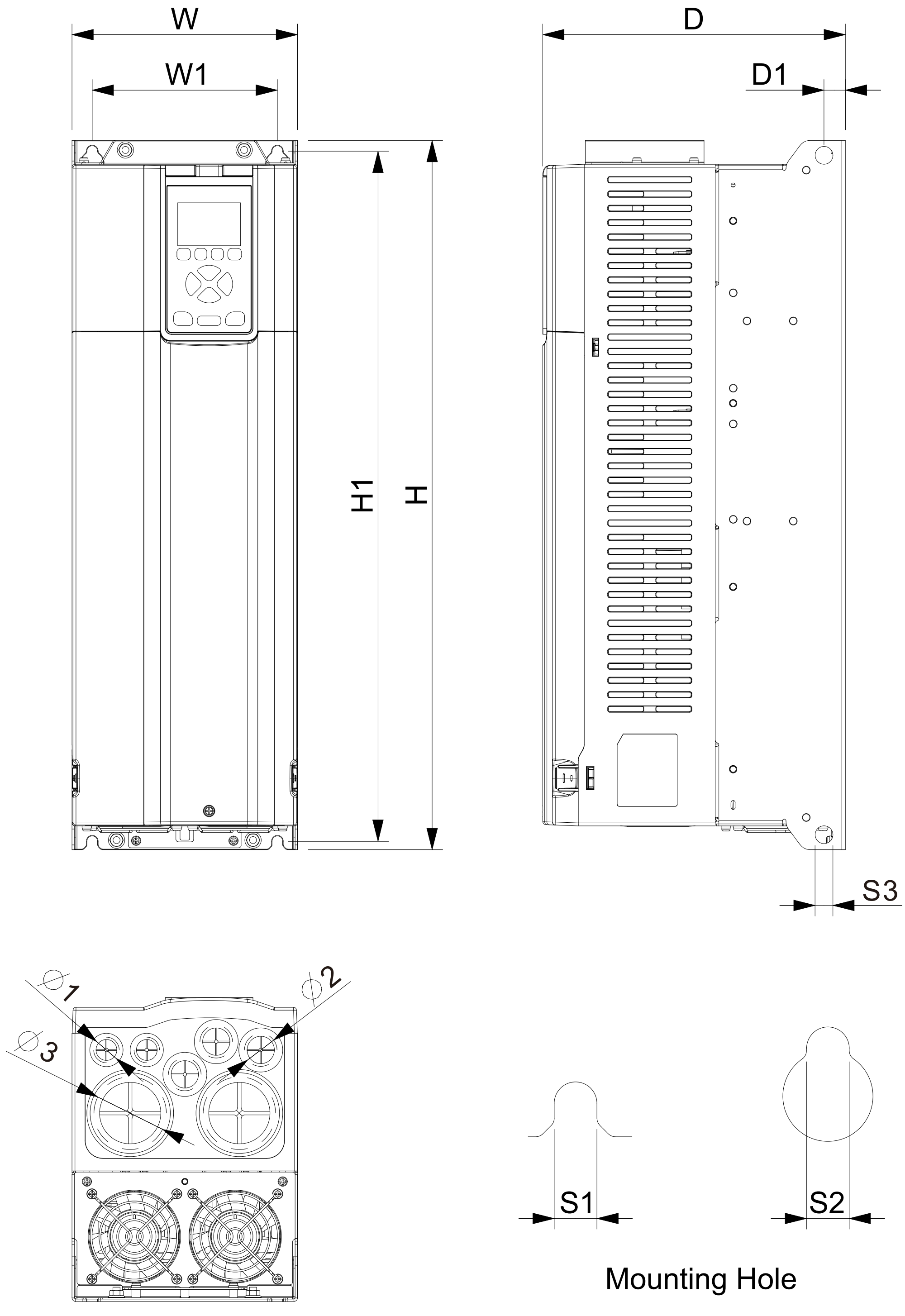


Figure 2-54

Unit: mm (inch)

Frame	W	W1	H	H1	D	D1	S1	S2	S3	Ø1	Ø2	Ø3
F2	190 (7.48)	156 (6.14)	595 (23.43)	579 (22.80)	255 (10.04)	18 (0.71)	9 (0.35)	9 (0.35)	15 (0.59)	21.5 (0.85)	27.5 (1.08)	61 (2.40)

Weight: 17.6 kg

Table 2-15

Frame G1

Applicable models:

VFD150VP43AFTCA

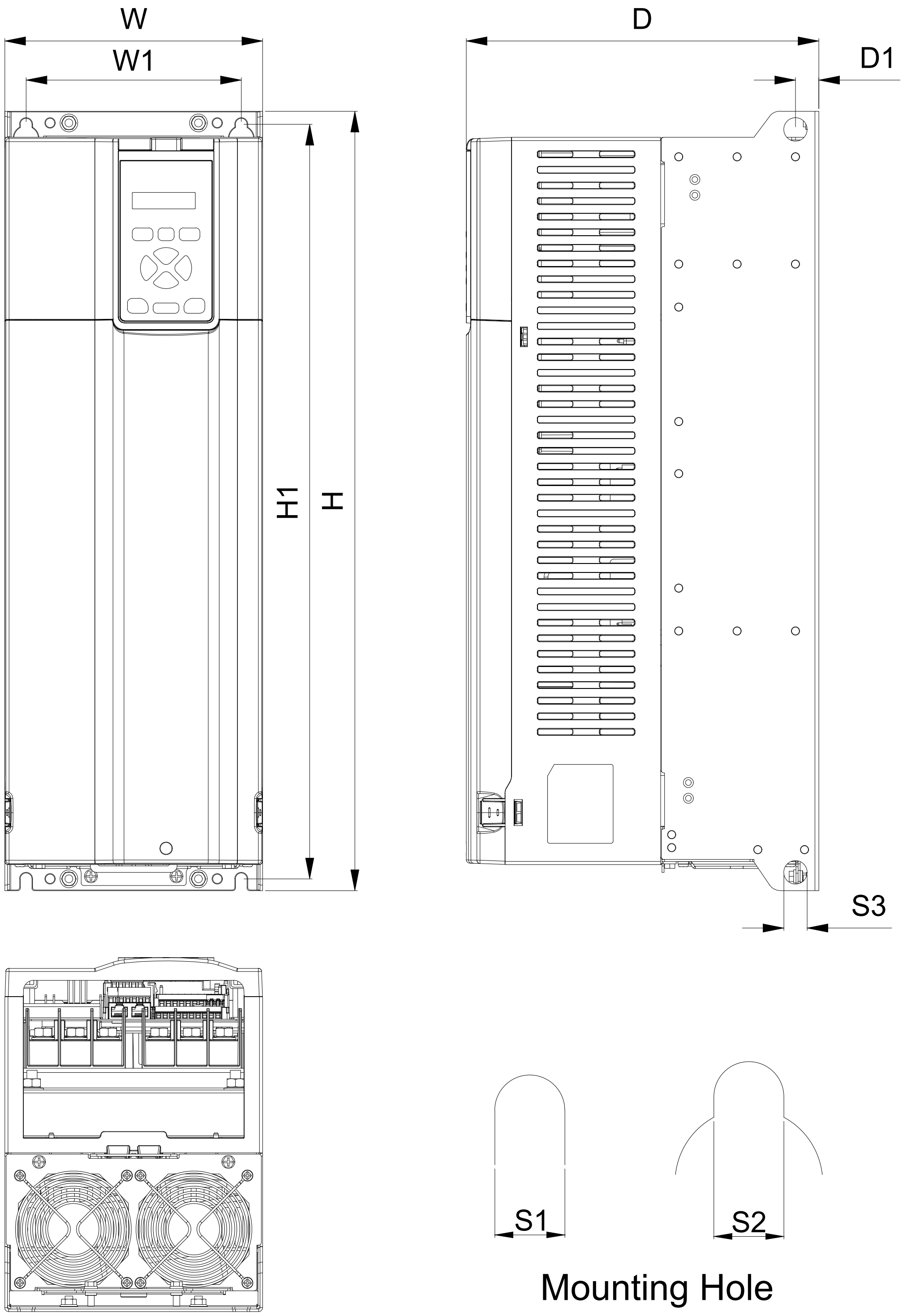


Figure 2-55

Unit: mm (inch)

Frame	W	W1	H	H1	D	D1	S1	S2	S3
G1	199 (7.83)	166 (6.54)	599 (23.58)	580 (22.83)	272 (10.71)	18 (0.71)	9 (0.35)	9 (0.35)	18 (0.71)

Weight: 23.8 kg

Table 2-16

Frame G2

Applicable models:

VFD150VP43BFTCA, VFD150VP43BSTCA

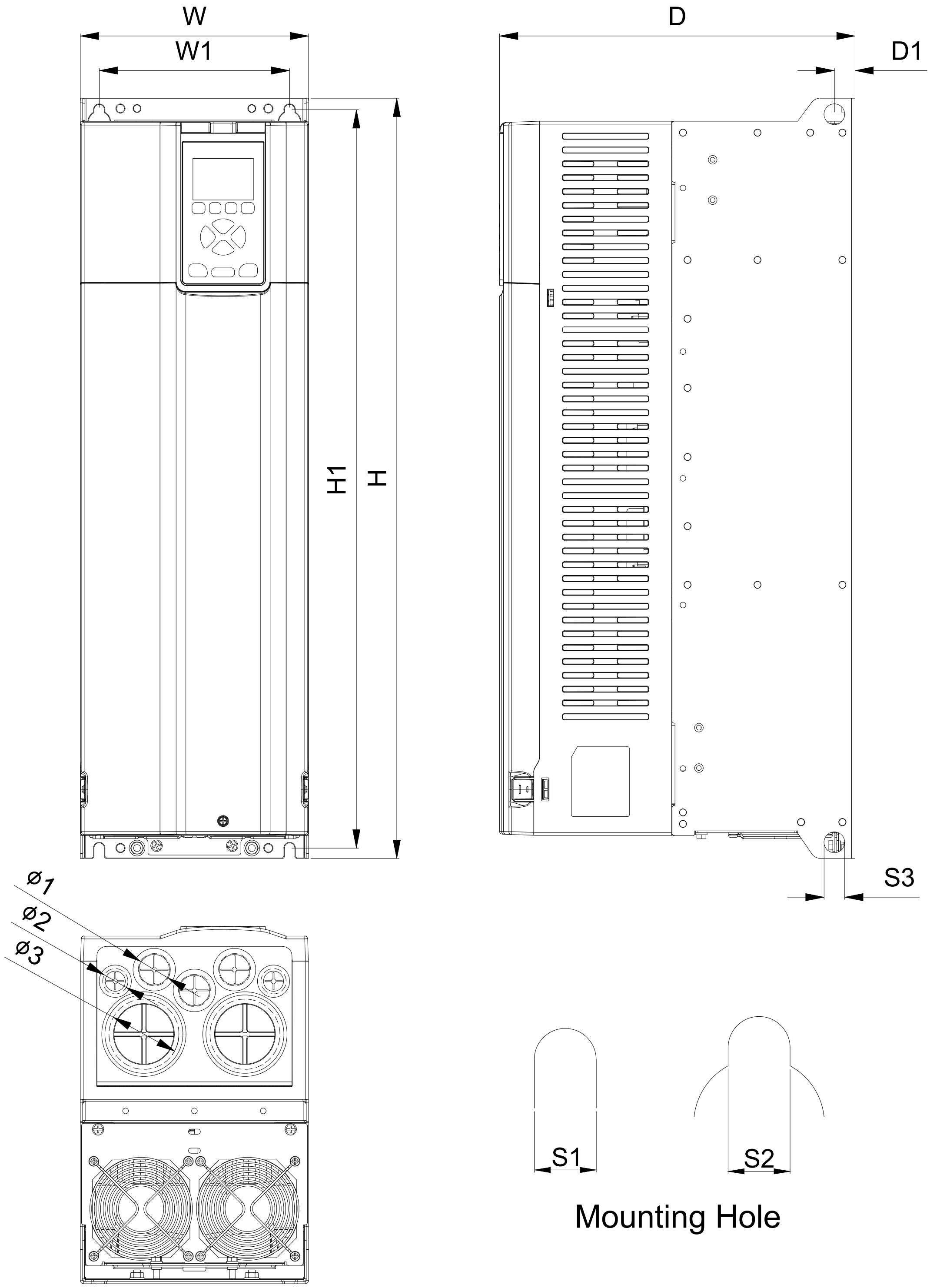


Figure 2-56

Unit: mm (inch)

Frame	W	W1	H	H1	D	D1	S1	S2	Ø1	Ø2	Ø3
G2	199 (7.83)	166 (6.54)	660 (25.98)	641 (25.24)	310 (12.2)	18 (0.71)	9 (0.35)	9 (0.35)	28 (1.1)	22 (0.87)	61 (2.4)

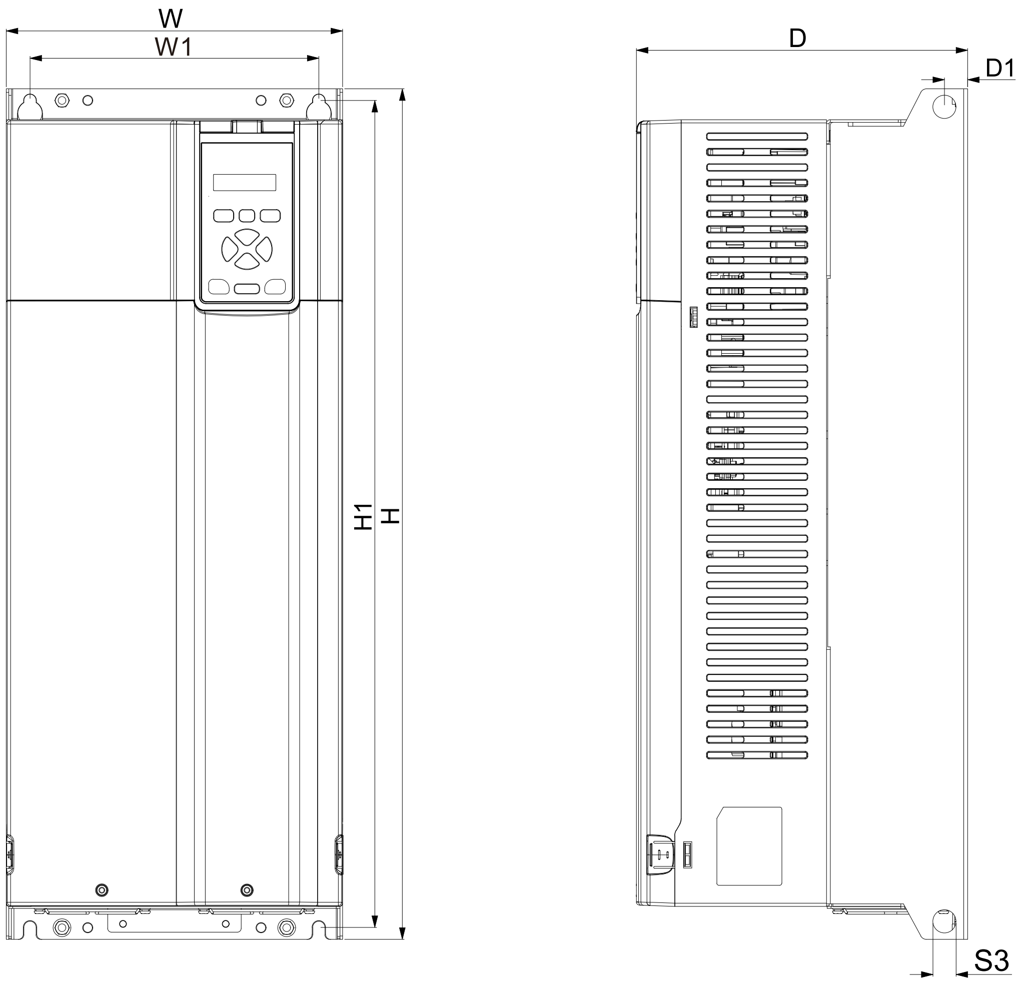
Weight: 28.7 kg

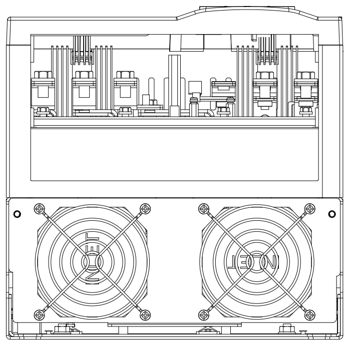
Table 2-17

Frame H1

Applicable models:

VFD180VP43AFTCA, VFD220VP43AFTCA





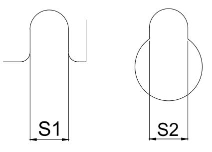


Figure 2-57

Unit: mm (inch)

Frame	W	W1	H	H1	D	D1	S1	S2	S3
H1	262 (10.31)	225 (8.89)	660 (25.98)	641.8 (25.27)	258 (10.16)	18 (0.71)	9.5 (0.37)	9.5 (0.37)	18 (0.71)

Weight: 34.2 kg

Table 2-18

Frame H2

Applicable models:

VFD180VP43BFTCA, VFD220VP43BFTCA, VFD180VP43BSTCA, VFD220VP43BSTCA

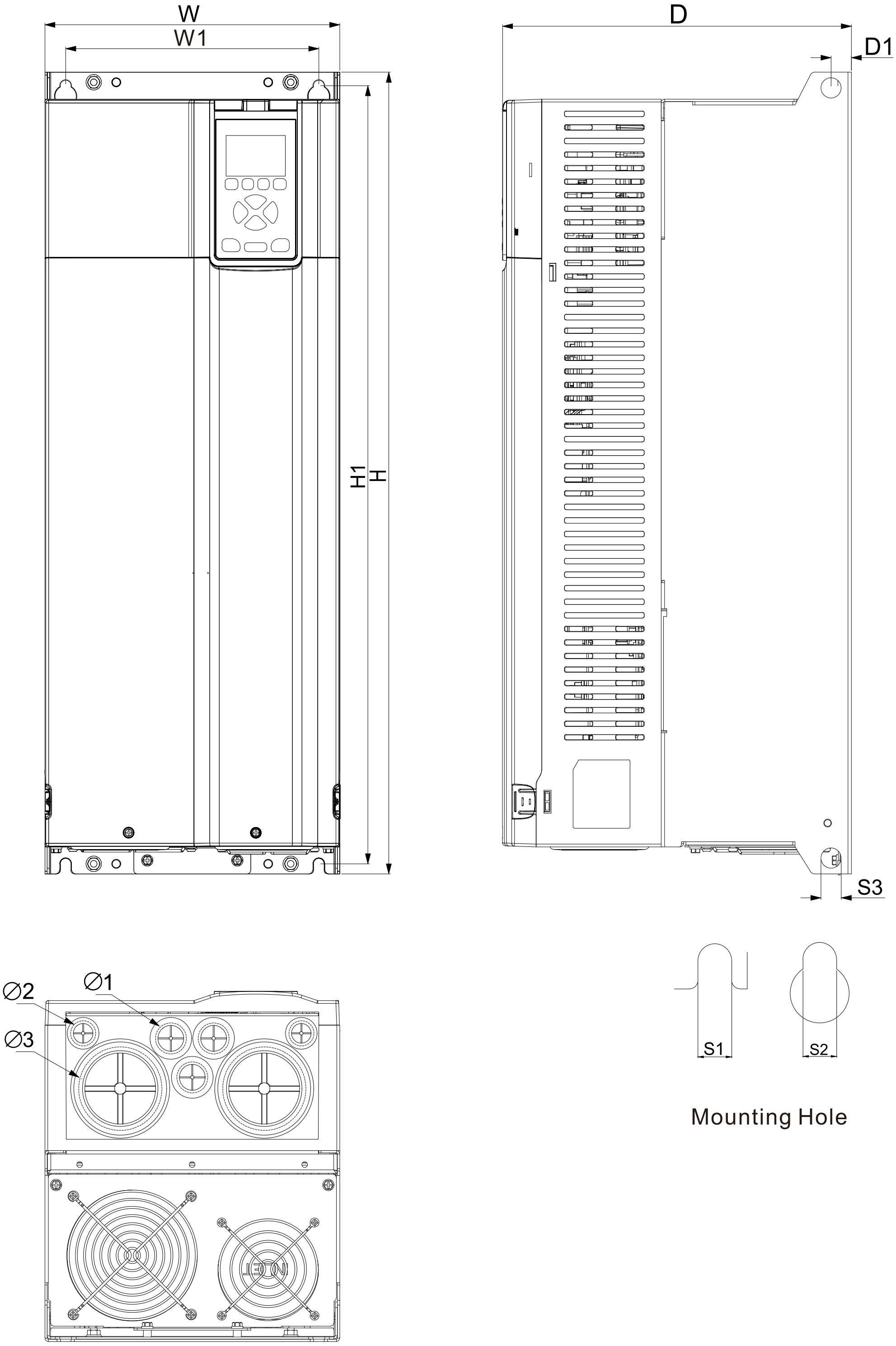


Figure 2-58

Unit: mm (inch)

Frame	W	W1	H	H1	D	D1	S1	S2	S3	Ø1	Ø2	Ø3
H2	262 (10.31)	225 (8.89)	710 (27.95)	689 (27.13)	310 (12.20)	18 (0.71)	9.5 (0.37)	9.5 (0.37)	18 (0.71)	27.5 (1.08)	22.3 (0.87)	74 (2.91)

Weight: 40.1 kg

Table 2-19

Frame I1

Applicable models:

VFD260VP43AFTCA, VFD310VP43AFTCA

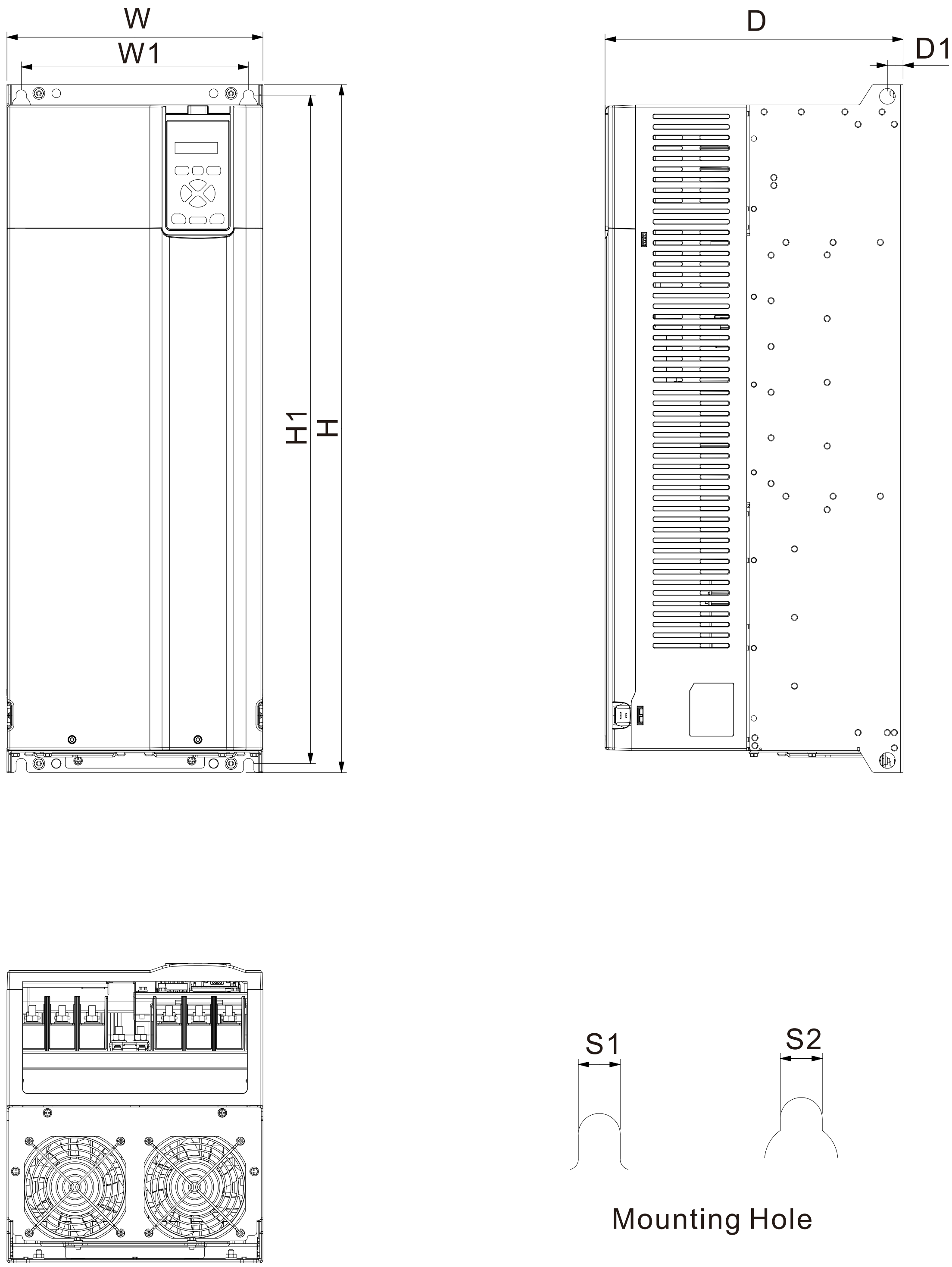


Figure 2-59

Unit: mm (inch)

Frame	W	W1	H	H1	D	D1	S1	S2
I1	293 (11.54)	260 (10.24)	783 (30.83)	761 (29.96)	341 (13.43)	18 (0.71)	12 (0.47)	12 (0.47)

Weight: 46.1 kg

Table 2-20

Frame I2

Applicable models:

VFD260VP43BFTCA, VFD310VP43BFTCA, VFD260VP43BSTCA, VFD310VP43BSTCA

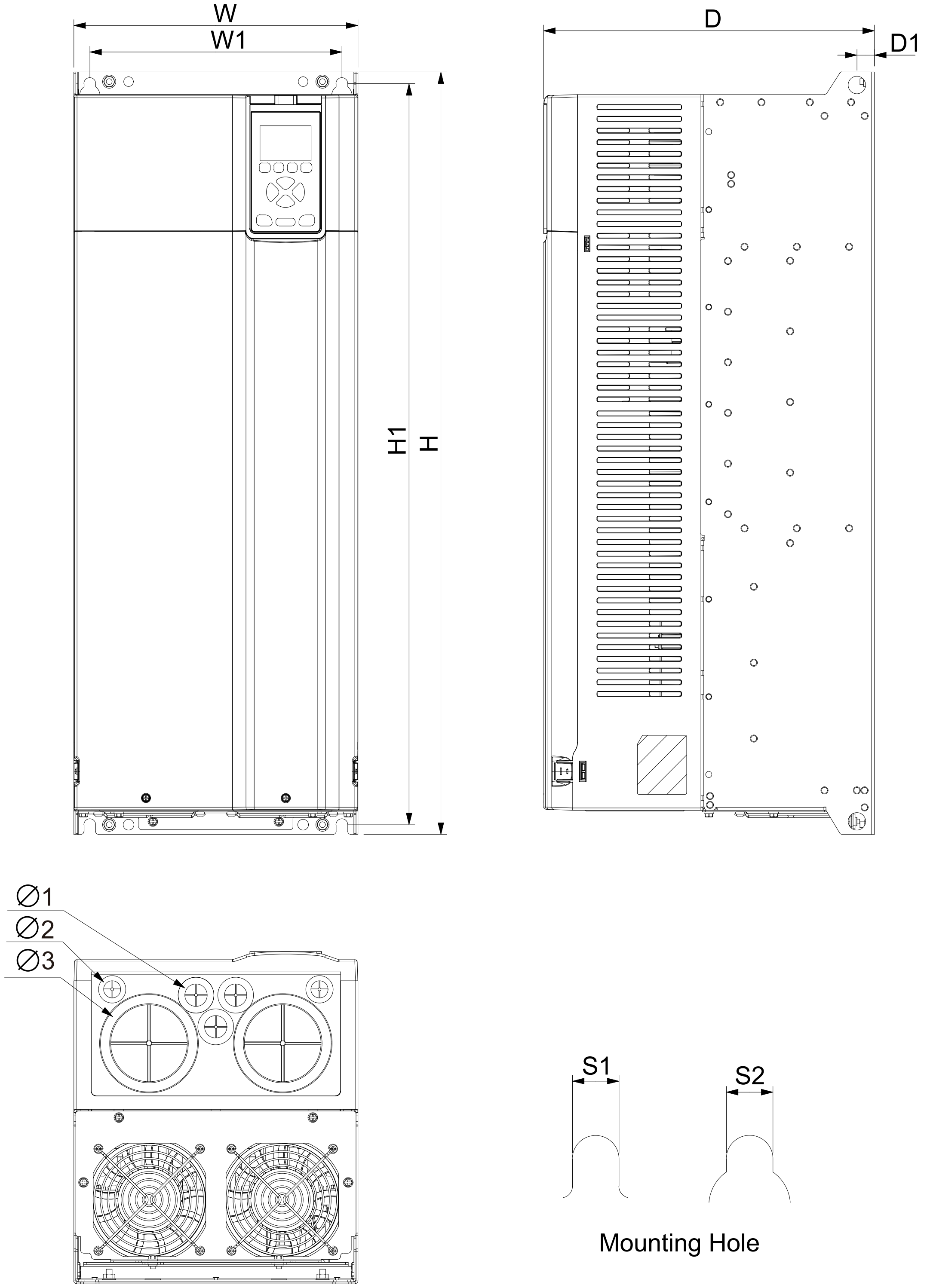


Figure 2-60

Unit: mm (inch)

Frame	W	W1	H	H1	D	D1	S1	S2	Ø1	Ø2	Ø3
I2	293 (11.54)	260 (10.24)	783 (30.83)	761 (29.96)	341 (13.43)	18 (0.71)	12 (0.47)	12 (0.47)	27.5 (1.08)	21.5 (0.85)	91 (3.58)

Weight: 48.6 kg

Table 2-21

Frame J1

Applicable models:

VFD370VP43AFTCA, VFD395VP43AFTCA

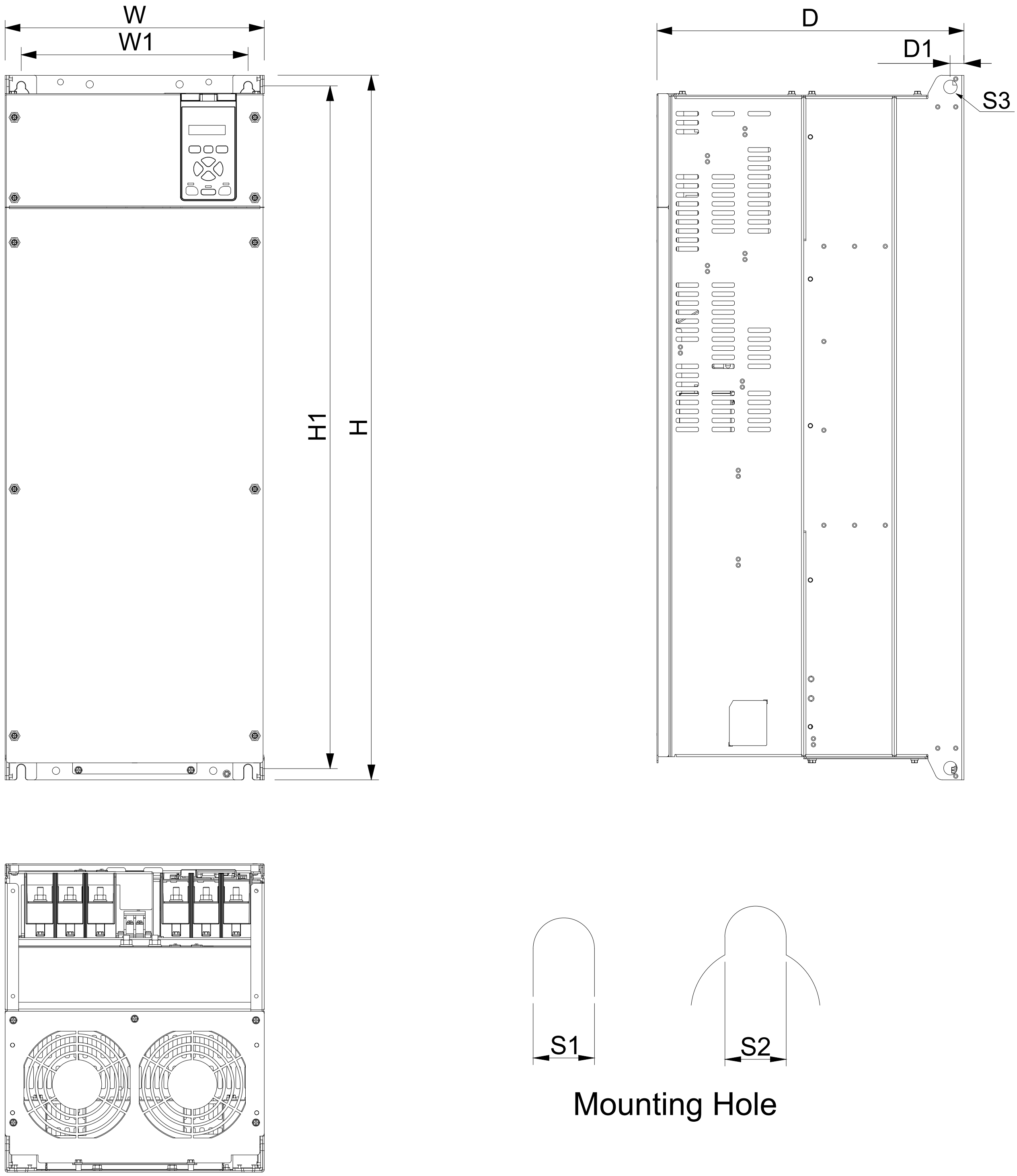


Figure 2-61

Unit: mm (inch)

Frame	W	W1	H	H1	D	D1	S1	S2	S3
J1	346 (13.62)	303 (11.93)	937 (36.89)	908 (35.75)	410 (16.14)	18 (0.71)	11 (0.43)	11 (0.43)	18 (0.71)

Weight: 74.2 kg

Table 2-22

Frame J2

Applicable models:

VFD370VP43BFTCA, VFD395VP43BFTCA , VFD370VP43BSTCA, VFD395VP43BSTCA

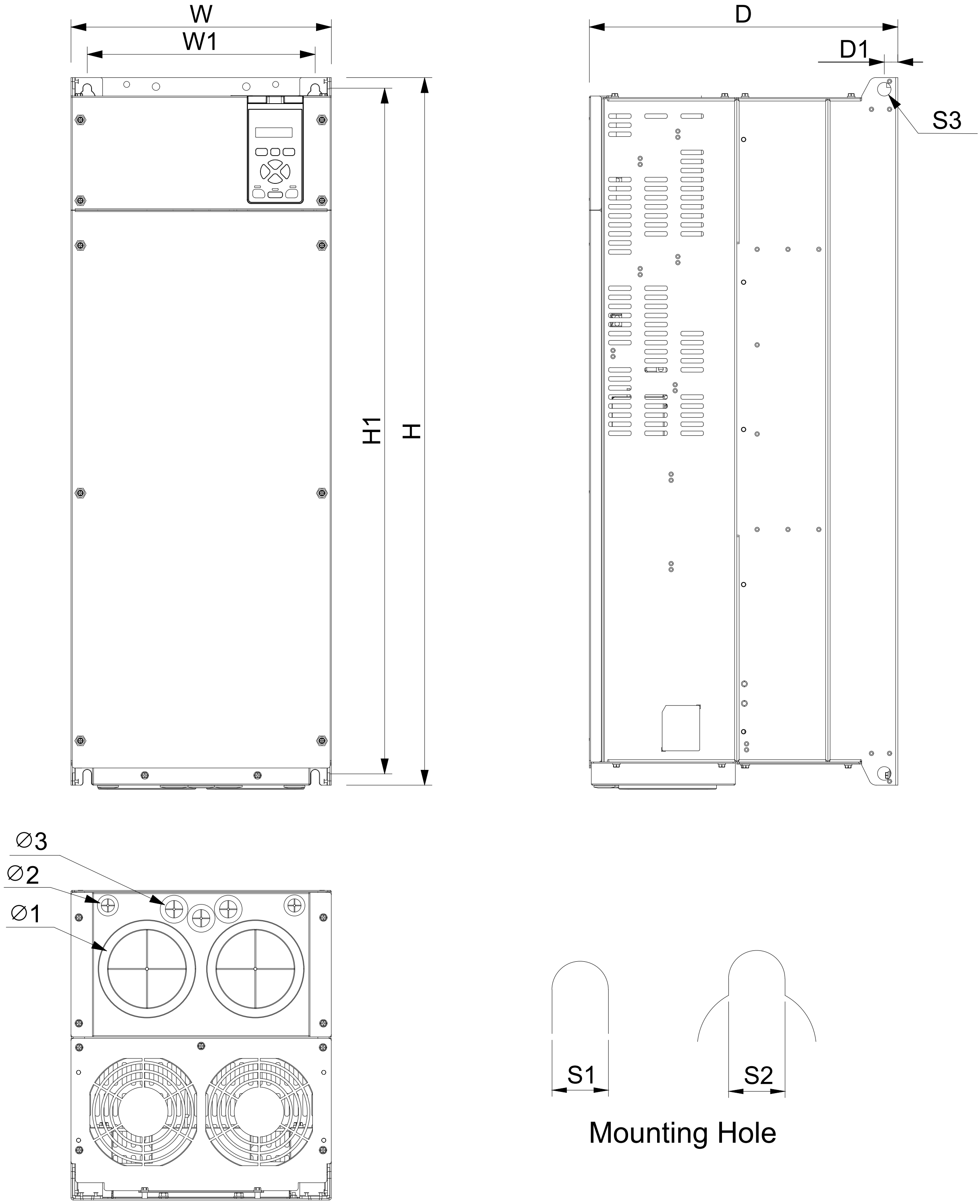


Figure 2-62

Unit: mm (inch)

Frame	W	W1	H	H1	D	D1	S1	S2	S3	Ø1	Ø2	Ø3
J2	346 (13.62)	303 (11.93)	937 (36.89)	908 (35.75)	410 (16.14)	18 (0.71)	11 (0.43)	11 (0.43)	18 (0.71)	117.3 (4.62)	21.5 (0.85)	27.5 (1.08)

Weight: 82.5 kg

Table 2-23

Frame K1

Applicable models:

VFD460VP43AFTCA, VFD485VP43AFTCA

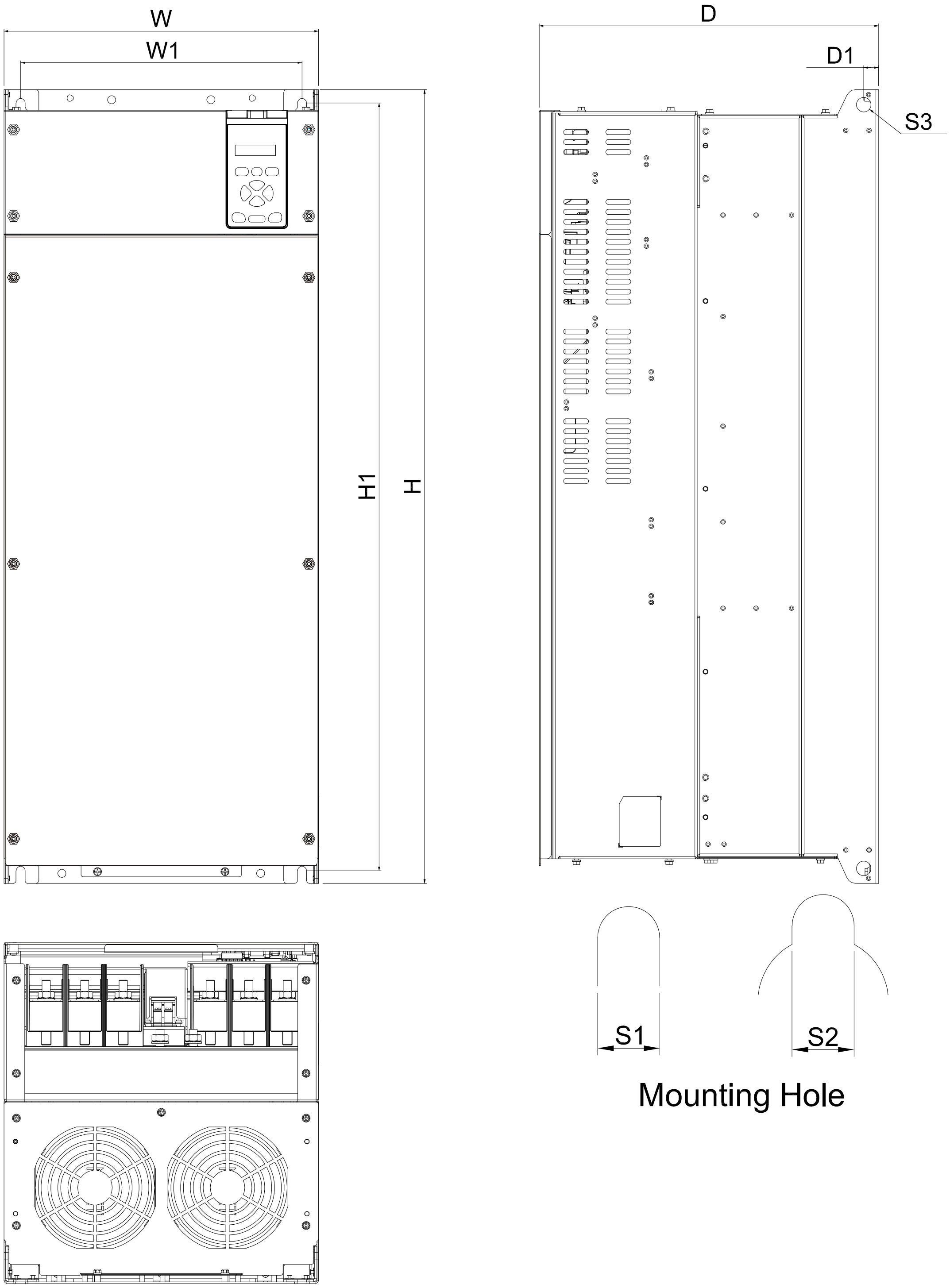


Figure 2-63

Unit: mm (inch)

Frame	W	W1	H	H1	D	D1	S1	S2	S3
K1	380 (14.96)	340 (13.39)	955 (37.60)	924 (36.38)	410 (16.14)	18 (0.71)	11 (0.43)	11 (0.43)	18 (0.71)

Weight: 90 kg

Table 2-24

Frame K2

Applicable models:

VFD460VP43BFTCA, VFD485VP43BFTCA, VFD460VP43BSTCA, VFD485VP43BSTCA

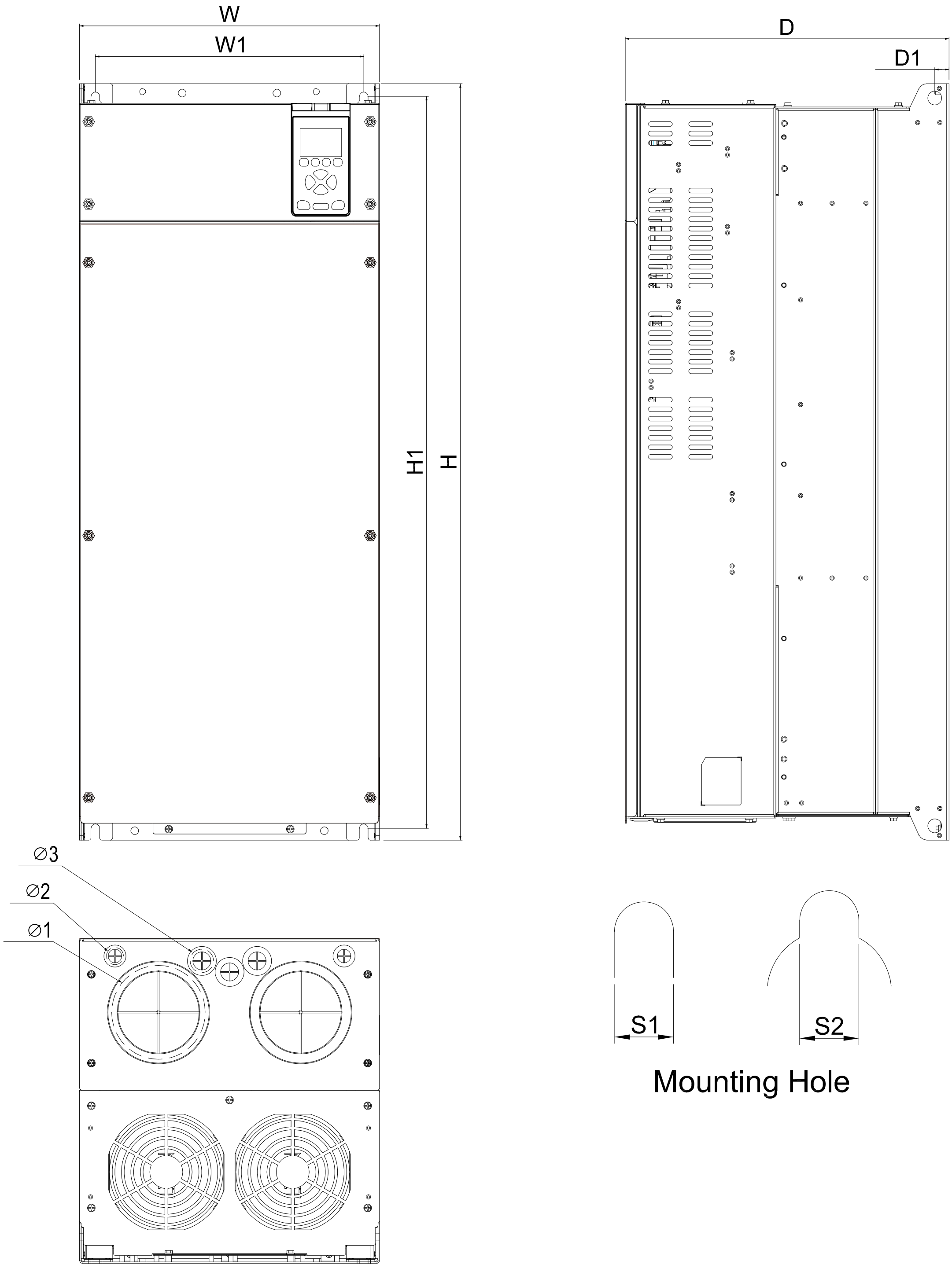


Figure 2-64

Unit: mm (inch)

Frame	W	W1	H	H1	D	D1	S1	S2	S3	Ø1	Ø2	Ø3
K2	380 (14.96)	340 (13.39)	955 (37.60)	924 (36.38)	410 (16.14)	18 (0.71)	11 (0.43)	11 (0.43)	18 (0.71)	117.3 (4.62)	21.5 (0.85)	27.5 (1.08)

Weight: 97 kg

Table 2-25

Frame L – Upright Installation

Applicable models:

VFD530VP43SHTCA, VFD616VP43SHTCA, VFD683VP43SHTCA, VFD770VP43SHTCA

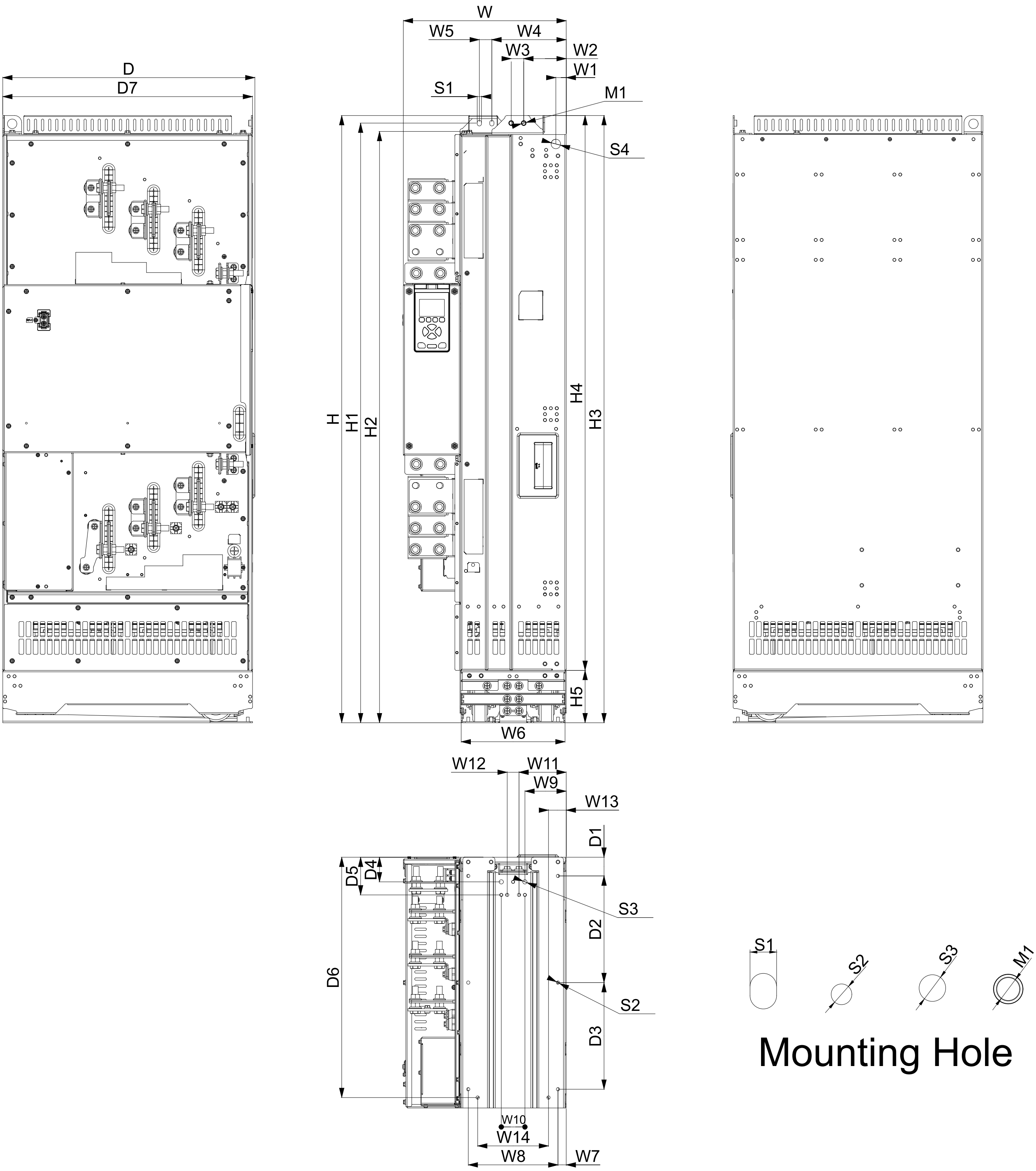


Figure 2-65

Unit: mm (inch)

Frame	W	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11
L	345 (13.58)	22 (0.87)	90 (3.54)	26.5 (1.04)	157.5 (6.2)	26.5 (1.04)	225 (8.86)	17.5 (0.69)	190 (7.48)	87.5 (3.44)	50 (1.97)	100 (3.94)

Frame	W12	W13	W14	H	H1	H2	H3	H4	H5	H6	H7	H8
L	25 (0.98)	37.5 (1.48)	150 (5.91)	1281 (50.43)	1265 (49.8)	1250 (49.21)	1278.5 (50.33)	1170.5 (46.08)	110.5 (4.35)	-	-	-

Frame	H9	D	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
L	-	534 (21.03)	39.5 (1.56)	225 (8.86)	225 (8.86)	52 (2.05)	79.5 (3.13)	507 (19.96)	529 (20.83)	-	-	-

Frame	S1	S2	S3	S4	M1
L	9 (0.35)	7 (0.28)	9 (0.35)	20 (0.79)	M8 P1.25

Weight: 128.4 kg

Table 2-26

Frame L – Upright Installation with IP20 Shielded Cover

Applicable models:

VFD530VP43SHTCA, VFD616VP43SHTCA, VFD683VP43SHTCA, VFD770VP43SHTCA

The following figure is the dimension after installing the IP20 shielded cover, refer to Section 10-3-8 IP20 Shielded Cover for further installation description.

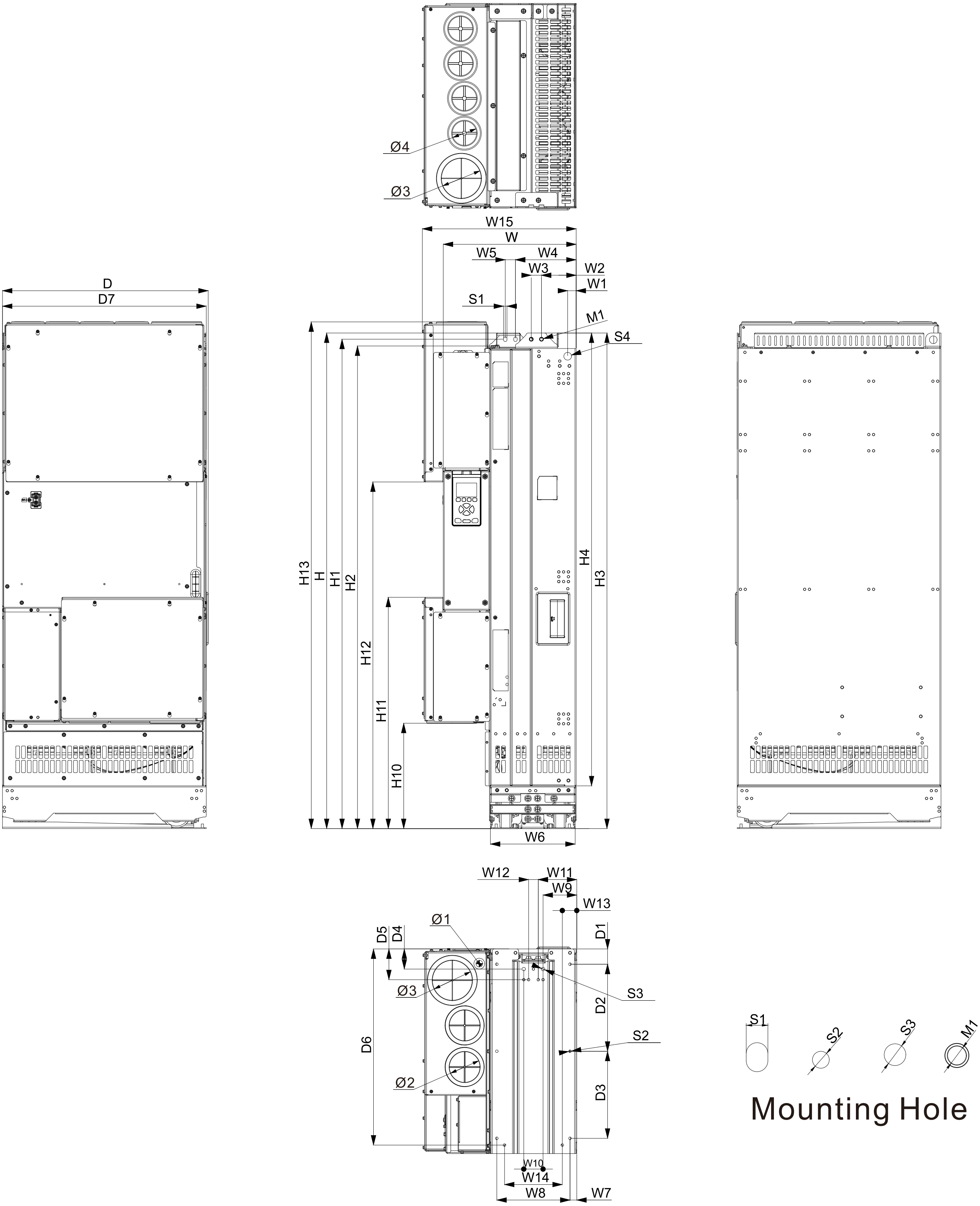


Figure 2-66

Unit: mm (inch)

Frame	W	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11
L	345 (13.58)	22 (0.87)	90 (3.54)	26.5 (1.04)	157.5 (6.2)	26.5 (1.04)	225 (8.86)	17.5 (0.69)	190 (7.48)	87.5 (3.44)	50 (1.97)	100 (3.94)
Frame	W12	W13	W14	H	H1	H2	H3	H4	H5	H6	H7	H8
L	25 (0.98)	37.5 (1.48)	150 (5.91)	1281 (50.43)	1265 (49.8)	1250 (49.21)	1278.5 (50.33)	1170.5 (46.08)	110.5 (4.35)	-	-	-
Frame	H9	H10	H11	H12	H13	D	D1	D2	D3	D4	D5	D6
L	-	272.3 (10.72)	598 (23.54)	896 (35.28)	1310.3 (51.59)	534 (21.03)	39.5 (1.56)	225 (8.86)	225 (8.86)	52 (2.05)	79.5 (3.13)	507 (19.96)
Frame	D7	D8	D9	D10	S1	S2	S3	S4	Ø1	Ø2	Ø3	Ø4
L	529 (20.83)	-	-	-	9 (0.35)	7 (0.28)	9 (0.35)	20 (0.79)	17.5 (0.69)	79 (3.11)	103 (4.05)	63 (2.48)
Frame	M1											
L	M8 P1.25											

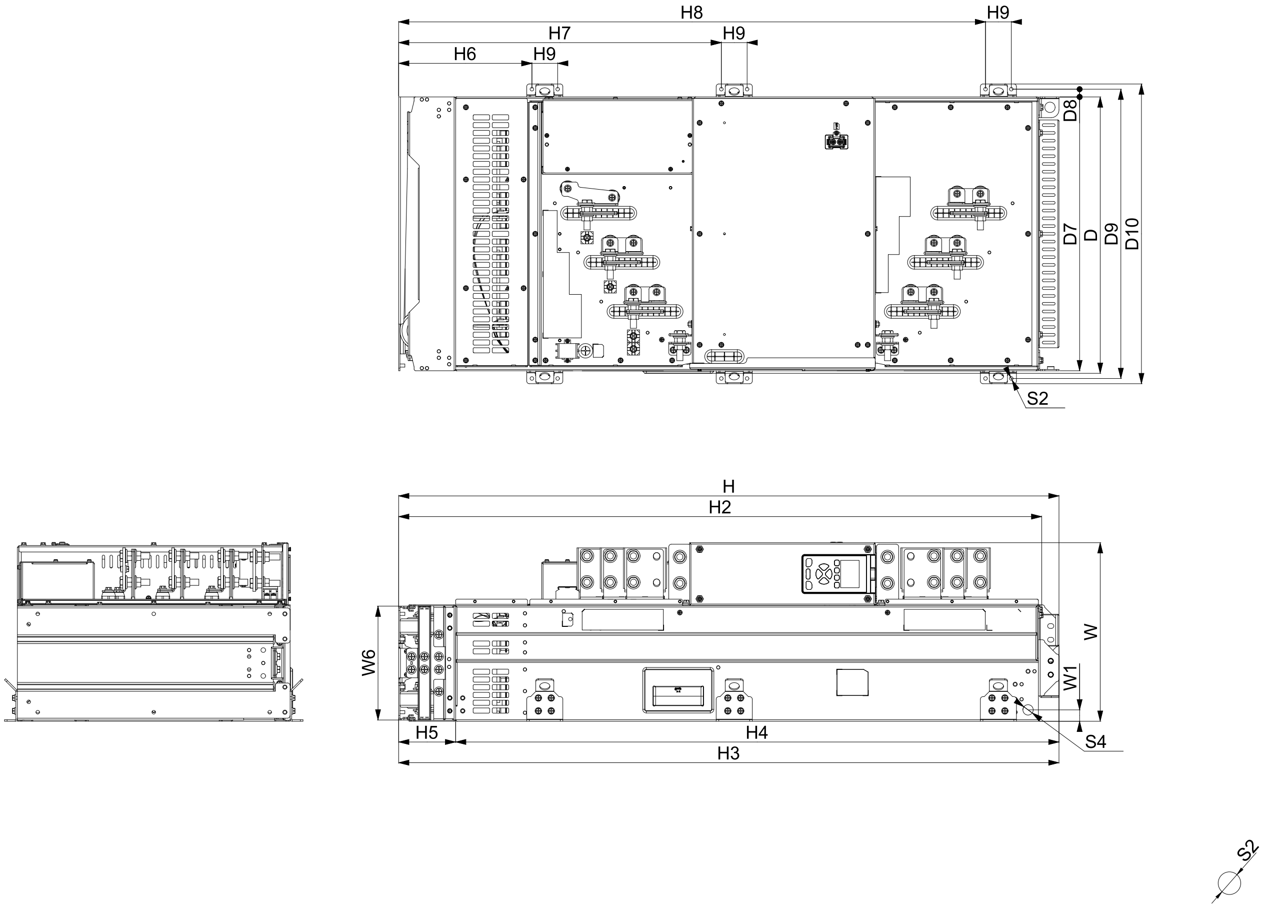
Weight: 139 kg

Table 2-27

Frame L – Horizontal Installation

Applicable models:

VFD530VP43SHTCA, VFD616VP43SHTCA, VFD683VP43SHTCA, VFD770VP43SHTCA



Mounting Hole

Figure 2-67

Unit: mm (inch)

Frame	W	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11
L	345 (13.58)	22 (0.87)	-	-	-	-	225 (8.86)	-	-	-	-	-

Frame	W12	W13	W14	H	H1	H2	H3	H4	H5	H6	H7	H8
L	-	-	-	1281 (50.43)	-	1250 (49.21)	1278.5 (50.33)	1170.5 (46.08)	110.5 (4.35)	258.5 (10.18)	626 (24.65)	1138.5 (44.82)

Frame	H9	D	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
L	50 (1.97)	534 (21.03)	-	-	-	-	-	-	529 (20.83)	15 (0.60)	559 (22.01)	579 (22.80)

Frame	S1	S2	S3	S4	M1
L	-	7 (0.28)	-	20 (0.79)	-

Weight: 128.4 kg

Table 2-28

Frame L – Horizontal Installation with IP20 Shielded Cover

Applicable models:

VFD530VP43SHTCA, VFD616VP43SHTCA, VFD683VP43SHTCA, VFD770VP43SHTCA

The following figure is the dimension after installing the IP20 shielded cover, refer to Section 10-3-8 IP20 Shielded Cover for further installation description.

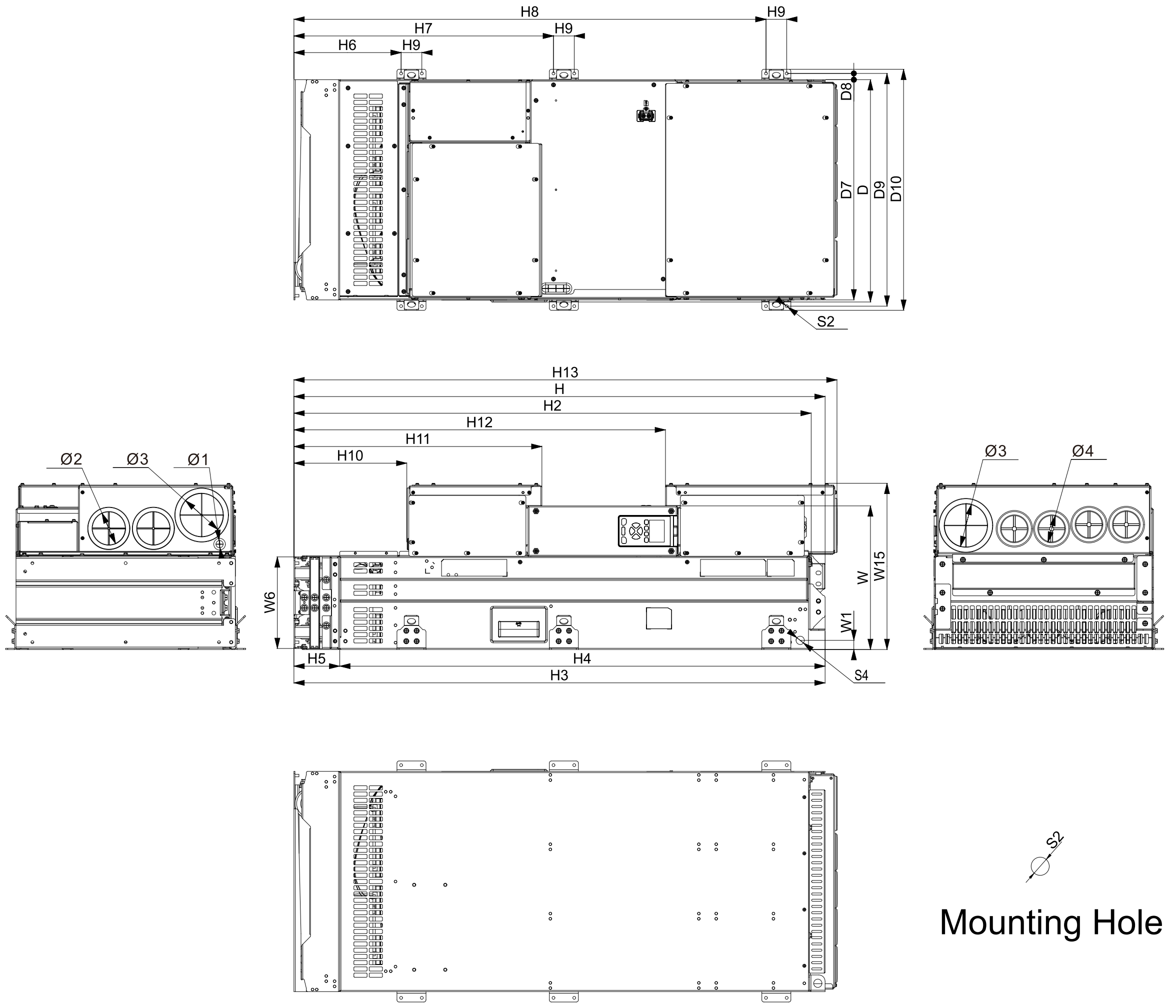


Figure 2-68

Unit: mm (inch)

Frame	W	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11
L	345 (13.58)	22 (0.87)	-	-	-	-	225 (8.86)	-	-	-	-	-

Frame	W12	W13	W14	W15	H	H1	H2	H3	H4	H5	H6	H7
L	-	-	-	399.3 (15.72)	1281 (50.43)	-	1250 (49.21)	1278.5 (50.33)	1170.5 (46.08)	110.5 (4.35)	258.5 (10.18)	626 (24.65)

Frame	H8	H9	H10	H11	H12	H13	D	D1	D2	D3	D4	D5
L	1138.5 (44.82)	50 (1.97)	272.3 (10.72)	598 (23.54)	896 (35.28)	1310.3 (51.59)	534 (21.03)	-	-	-	-	-

Frame	D6	D7	D8	D9	D10	S1	S2	S3	S4	Ø1	Ø2	Ø3
L	-	529 (20.83)	15 (0.60)	559 (22.01)	579 (22.80)	-	7 (0.28)	-	20 (0.79)	17.5 (0.69)	79 (3.11)	103 (4.05)

Frame	Ø4	M1
L	63 (2.48)	-

Weight: 139 kg

Table 2-29

Frame M – Upright Installation

Applicable models:

VFD866VP43SHTCA, VFD930VP43SHTCA, VFD1K1VP43SHTCA, VFD1K2VP43SHTCA

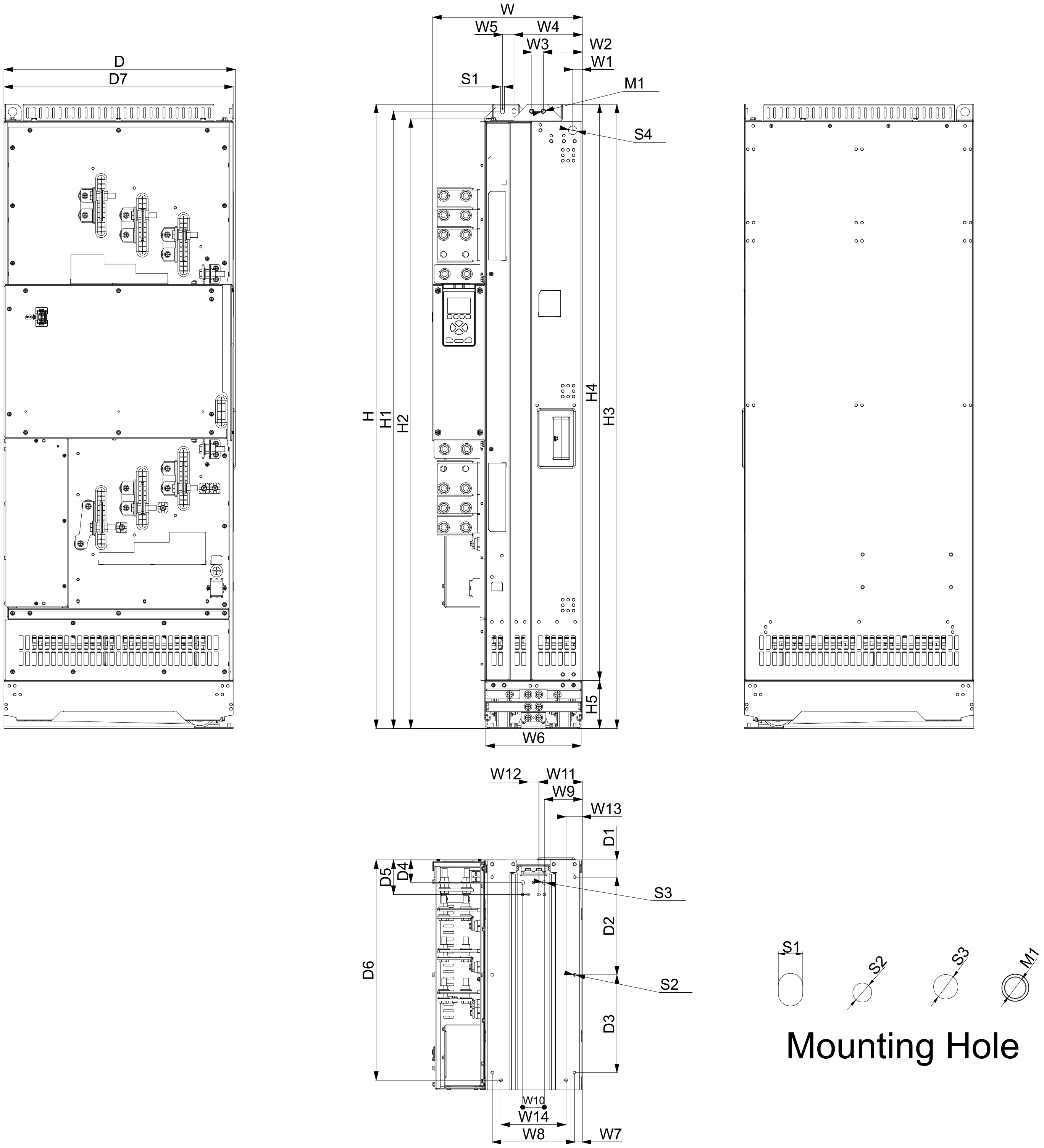


Figure 2-69

Unit: mm (inch)

Frame	W	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11
M	345 (13.58)	22 (0.87)	90 (3.54)	26.5 (1.04)	157.5 (6.2)	26.5 (1.04)	225 (8.86)	17.5 (0.69)	190 (7.48)	87.5 (3.44)	50 (1.97)	100 (3.94)
Frame	W12	W13	W14	H	H1	H2	H3	H4	H5	H6	H7	H8
M	25 (0.98)	37.5 (1.48)	150 (5.91)	1436 (56.54)	1420 (55.91)	1405 (55.31)	1433.5 (56.44)	1325.5 (52.19)	110.5 (4.35)	-	-	-
Frame	H9	D	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
M	-	534 (21.03)	39.5 (1.56)	225 (8.86)	225 (8.86)	52 (2.05)	79.5 (3.13)	507 (19.96)	529 (20.83)	-	-	-
Frame	S1	S2	S3	S4	M1							
M	9 (0.35)	7 (0.28)	9 (0.35)	20 (0.79)	M8 P1.25							

Weight: 173.0 kg

Table 2-30

Frame M – Upright Installation with IP20 Shielded Cover

Applicable models:

VFD866VP43SHTCA, VFD930VP43SHTCA, VFD1K1VP43SHTCA, VFD1K2VP43SHTCA

The following figure is the dimension after installing the IP20 shielded cover, refer to Section 10-3-8 IP20 Shielded Cover for further installation description.

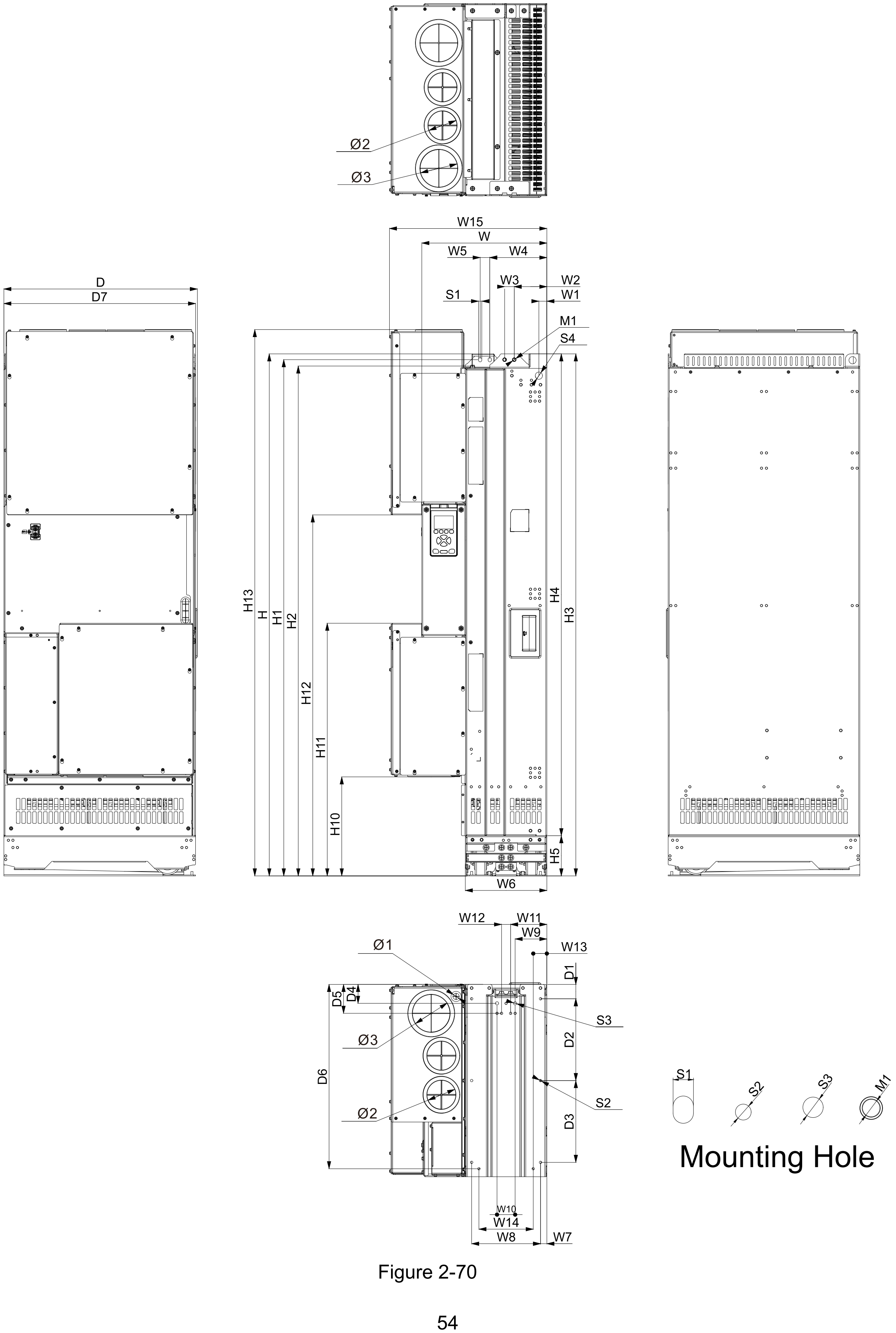


Figure 2-70

Unit: mm (inch)

Frame	W	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11
M	345 (13.58)	22 (0.87)	90 (3.54)	26.5 (1.04)	157.5 (6.2)	26.5 (1.04)	225 (8.86)	17.5 (0.69)	190 (7.48)	87.5 (3.44)	50 (1.97)	100 (3.94)
Frame	W12	W13	W14	H	H1	H2	H3	H4	H5	H6	H7	H8
M	25 (0.98)	37.5 (1.48)	150 (5.91)	1436 (56.54)	1420 (55.91)	1405 (55.31)	1433.5 (56.44)	1325.5 (52.19)	110.5 (4.35)	-	-	-
Frame	H9	H10	H11	H12	H13	D	D1	D2	D3	D4	D5	D6
M	-	272.3 (10.72)	695 (27.36)	993 (39.09)	1502.7 (59.16)	534 (21.03)	39.5 (1.56)	225 (8.86)	225 (8.86)	52 (2.05)	79.5 (3.13)	507 (19.96)
Frame	D7	D8	D9	D10	S1	S2	S3	S4	Ø1	Ø2	Ø3	M1
M	529 (20.83)	-	-	-	9 (0.35)	7 (0.28)	9 (0.35)	20 (0.79)	17.5 (0.69)	79 (3.11)	103 (4.05)	M8 P1.25

Weight: 186.3 kg

Table 2-31

Frame M – Horizontal Installation

Applicable models:

VFD866VP43SHTCA, VFD930VP43SHTCA, VFD1K1VP43SHTCA, VFD1K2VP43SHTCA

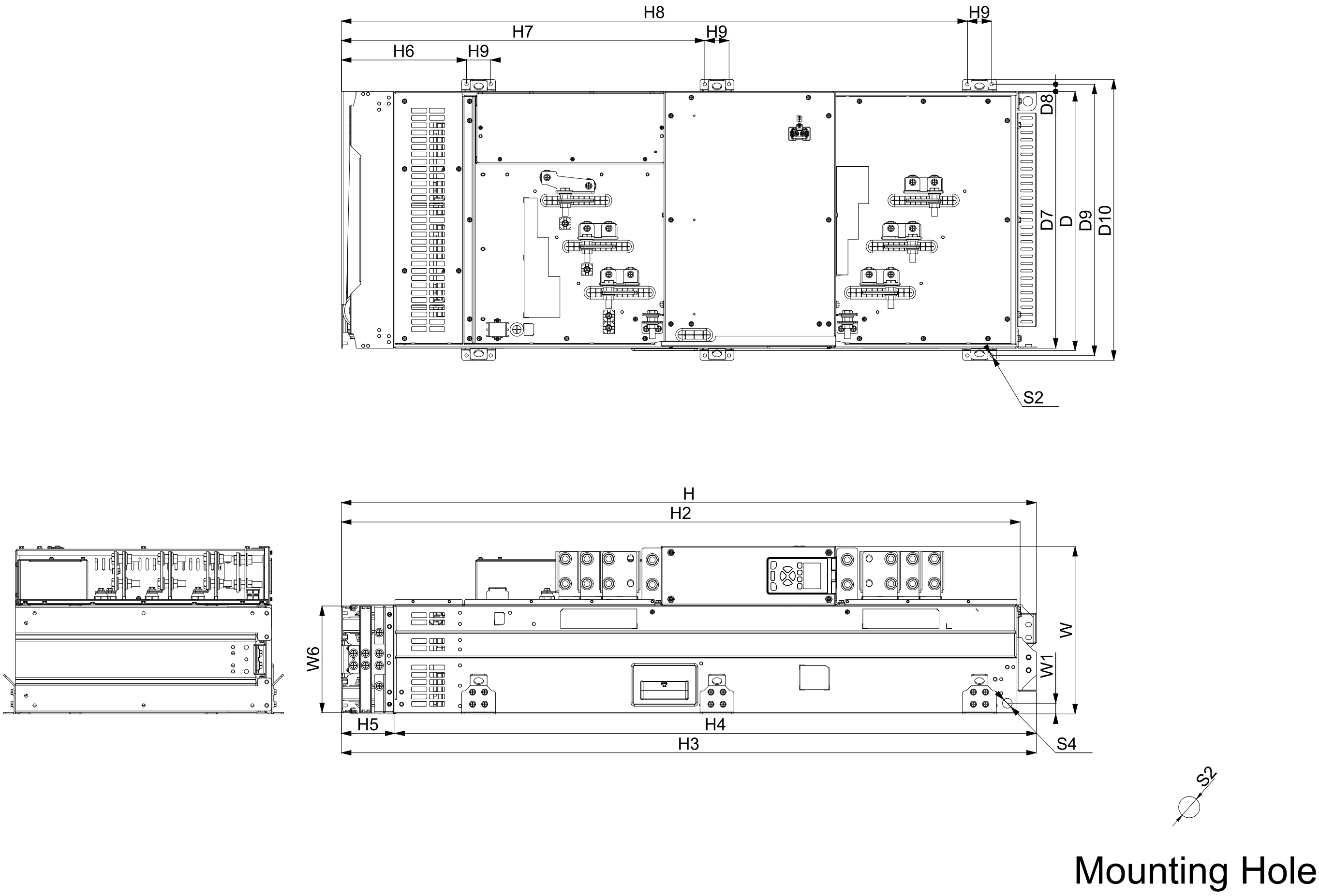


Figure 2-71

Unit: mm (inch)

Frame	W	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11
M	345 (13.58)	22 (0.87)	-	-	-	-	225 (8.86)	-	-	-	-	-

Frame	W12	W13	W14	H	H1	H2	H3	H4	H5	H6	H7	H8
M	-	-	-	1436 (56.54)	-	1405 (55.31)	1433.5 (56.44)	1325.5 (52.19)	110.5 (4.35)	258.5 (10.18)	751 (29.57)	1293.5 (50.93)

Frame	H9	D	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
M	50 (1.97)	-	-	-	-	-	-	-	529 (20.83)	15 (0.60)	559 (22.01)	579 (22.80)

Frame	S1	S2	S3	S4	M1
M	-	7 (0.28)	-	20 (0.79)	-

Weight: 173.0 kg

Table 2-32

Frame M – Horizontal Installation with IP20 Shielded Cover

Applicable models:

VFD866VP43SHTCA, VFD930VP43SHTCA, VFD1K1VP43SHTCA, VFD1K2VP43SHTCA

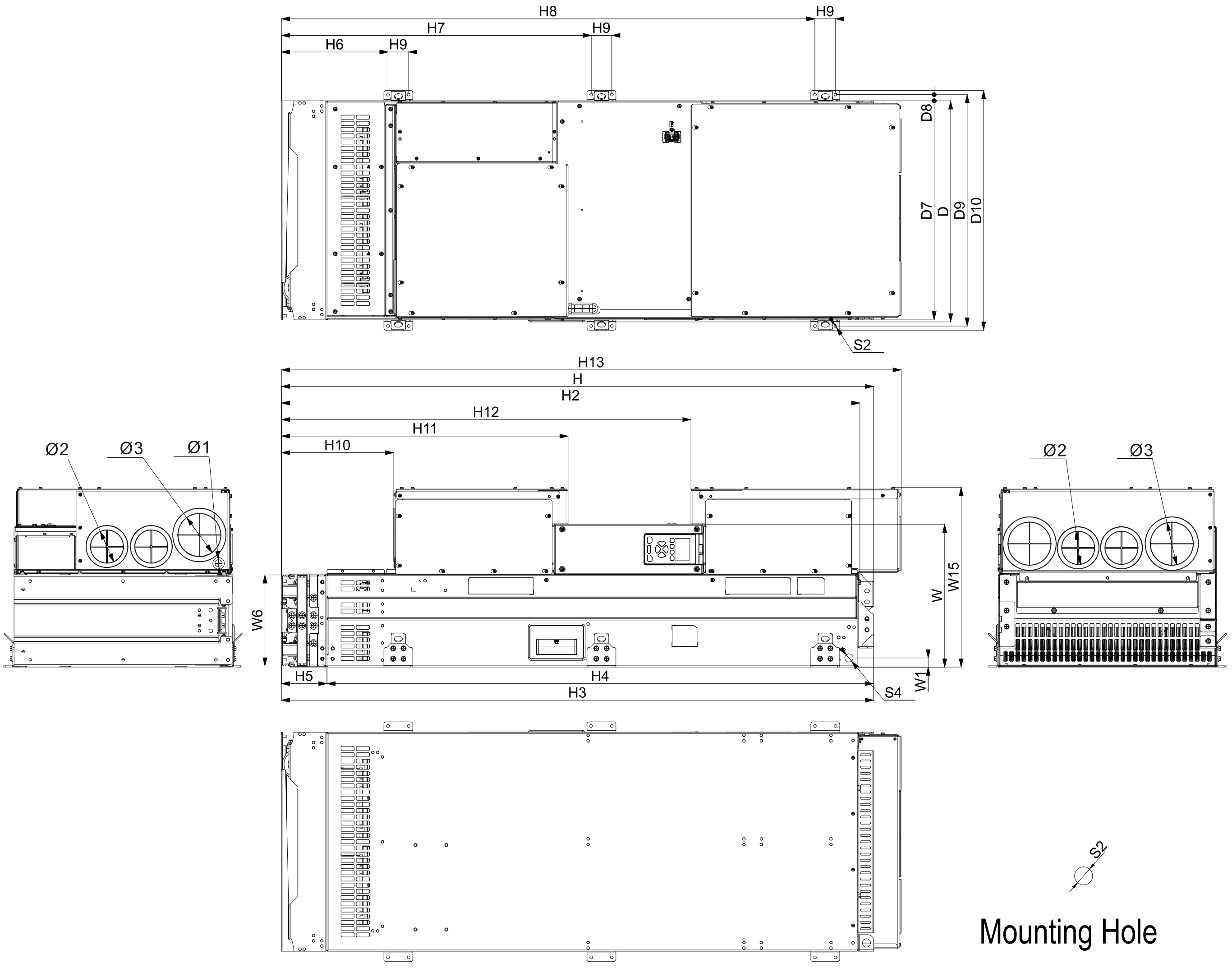


Figure 2-72

Unit: mm (inch)

Frame	W	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11
M	345 (13.58)	22 (0.87)	-	-	-	-	225 (8.86)	-	-	-	-	-

Frame	W12	W13	W14	W15	H	H1	H2	H3	H4	H5	H6	H7
M	-	-	-	434.3 (17.1)	1436 (56.54)	-	1405 (55.31)	1433.5 (56.44)	1325.5 (52.19)	110.5 (4.35)	258.5 (10.18)	751 (29.57)

Frame	H8	H9	H10	H11	H12	H13	D	D1	D2	D3	D4	D5
M	1293.5 (50.93)	50 (1.97)	272.3 (10.72)	695 (27.36)	993 (39.09)	1502.7 (59.16)	534 (21.03)	-	-	-	-	-

Frame	D6	D7	D8	D9	D10	S1	S2	S3	S4	Ø1	Ø2	Ø3
M	-	529 (20.83)	15 (0.6)	559 (22.01)	579 (22.8)	-	7 (0.28)	-	20 (0.79)	17.5 (0.69)	79 (3.11)	103 (4.05)

Frame	M1
M	-

Weight: 186.3 kg

Table 2-33

2-6 EMC Plate Installation

2-6-1 Installation Method

Frame A–C

Applicable models: VFD3A0–038VP43ANTAA

1. Fasten the metal plate on the AC motor drive, as shown in the figure below.

Frame	Screw Spec. and Torque
A–C	M3 6–8 kg-cm / (5.2–6.9 lb-in.) / (0.59–0.78 Nm)

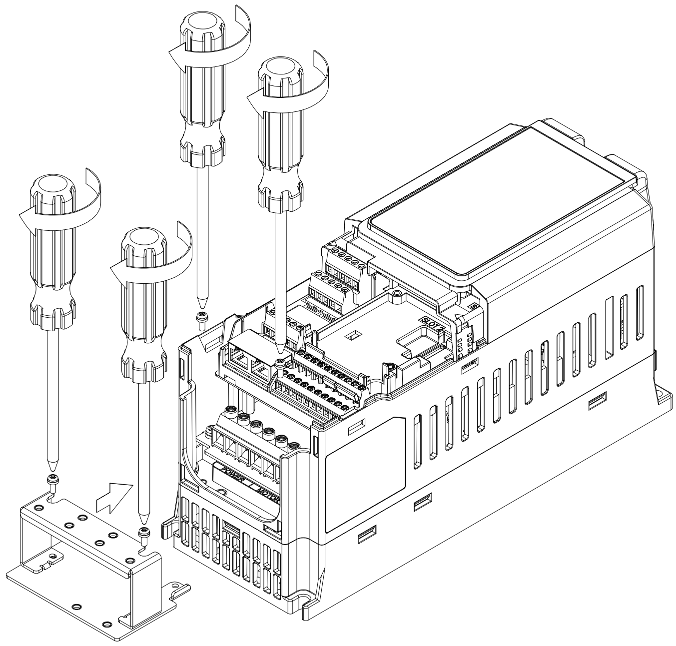


Figure 2-73

2. Choose the applicable Ohm clips according to the wire gauge and fasten it on the metal plate.

Frame	Screw Spec. and Torque
A–C	M4 14–16 kg-cm / (12.2–13.9 lb-in.) / (1.37–1.57 Nm)

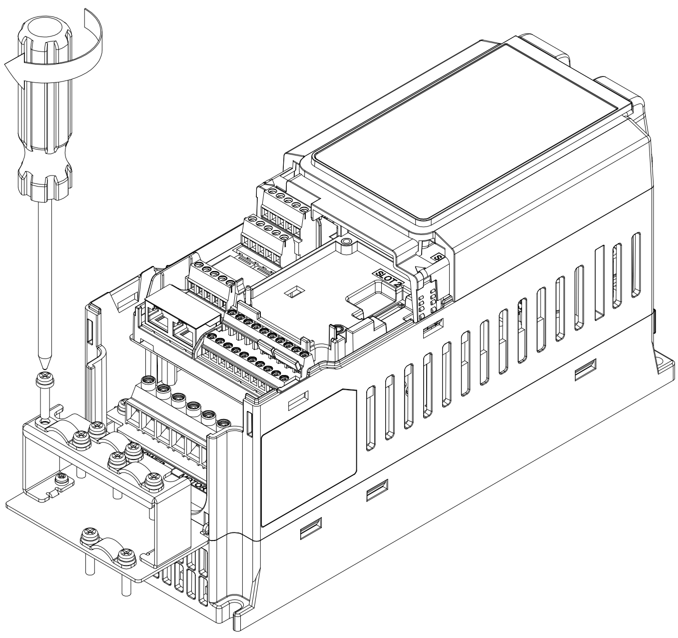


Figure 2-74

Frame D–E OPEN Type

Applicable models: VFD045–090VP43ANTCA

1. Fasten the metal plate on the AC motor drive, as shown in the figure below.

Frame	Screw Spec. and Torque
D–E	M4 14–16 kg-cm / (12.2–13.9 lb-in.) / (1.37–1.57 Nm)

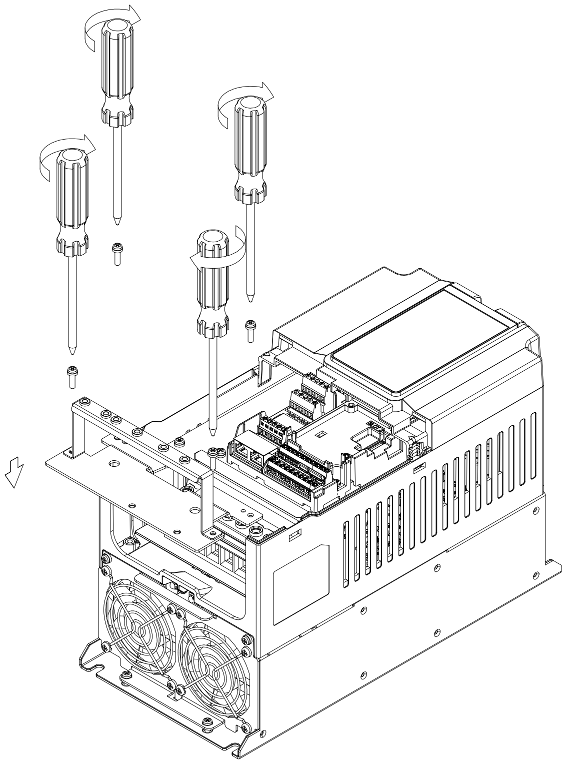


Figure 2-75

2. Choose the applicable Ohm clips according to the wire gauge and fasten it on the metal plate.

Frame	Screw Spec. and Torque
D–E	M4 14–16 kg-cm / (12.2–13.9 lb-in.) / (1.37–1.57 Nm)

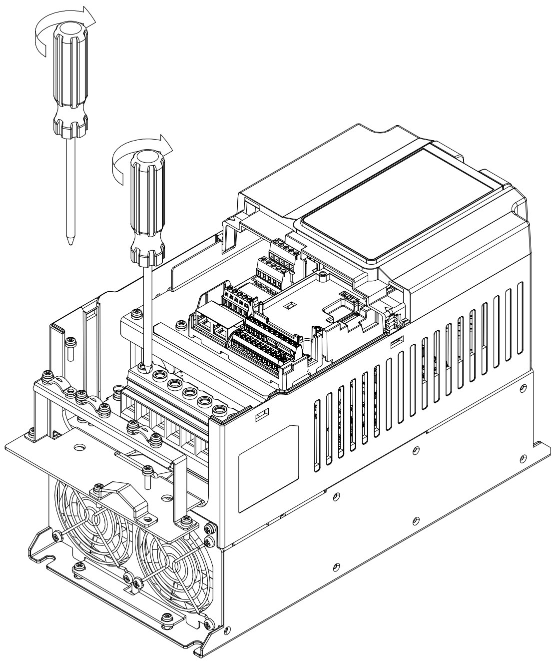


Figure 2-76

Frame D – Type 1

Applicable models: VFD045VP43BFTCA, VFD062VP43BFTCA, VFD045VP43BSTCA, VFD062VP43BSTCA

1. Refer to the following table for the assembling accessories, quantities and screw torque.

No.	Accessories	Qty (pcs)
1	Control clips	3
2	Screw M4xL15 (Screw torque: 14–16 kg-cm / 12.2–13.9 lb-in. / 1.37–1.57 Nm)	6
3	Output EMC clip	1
4	Screw M4xL15 (Screw torque: 14–16 kg-cm / 12.2–13.9 lb-in. / 1.37–1.57 Nm)	2

2. Fasten the accessories as shown in the figure below.

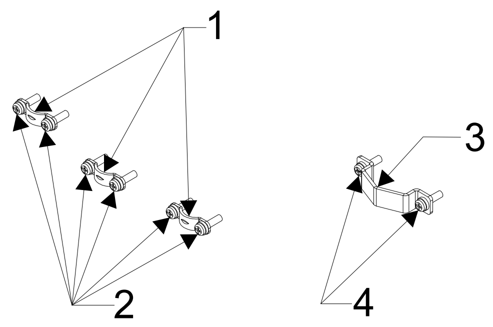


Figure 2-77

3. Install the above EMC plate and control clips onto the AC motor drive, refer to the installation location shown in the figure below.

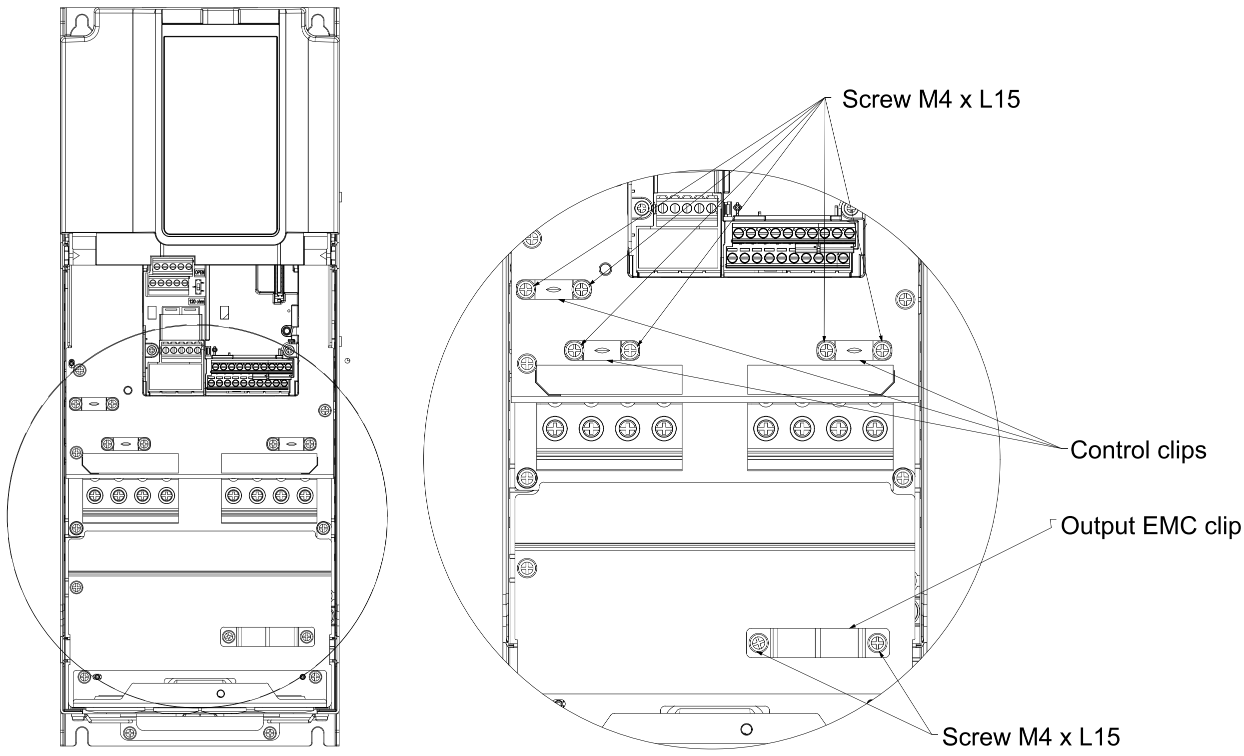


Figure 2-78

Frame E – Type 1

Applicable models: VFD073VP43BFTCA, VFD090VP43BFTCA, VFD073VP43BSTCA, VFD090VP43BSTCA

1. Refer to the following table for the assembling accessories, quantities and screw torque.

No.	Accessories	Qty (pcs)
1	Control clips	3
2	Screw M4xL15 (Screw torque: 14–16 kg-cm / 12.2–13.9 lb-in. / 1.37–1.57 Nm)	6
3	Output EMC clips	1
4	Screw M4xL15 (Screw torque: 14–16 kg-cm / 12.2–13.9 lb-in. / 1.37–1.57 Nm)	2

2. Fasten the accessories as shown in the figure below.

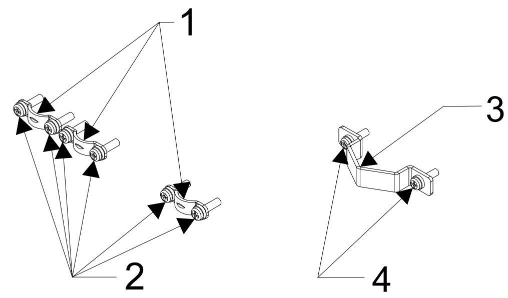


Figure 2-79

3. Install the above EMC plate and control clips onto the AC motor drive, refer to the installation location shown in the figure below.

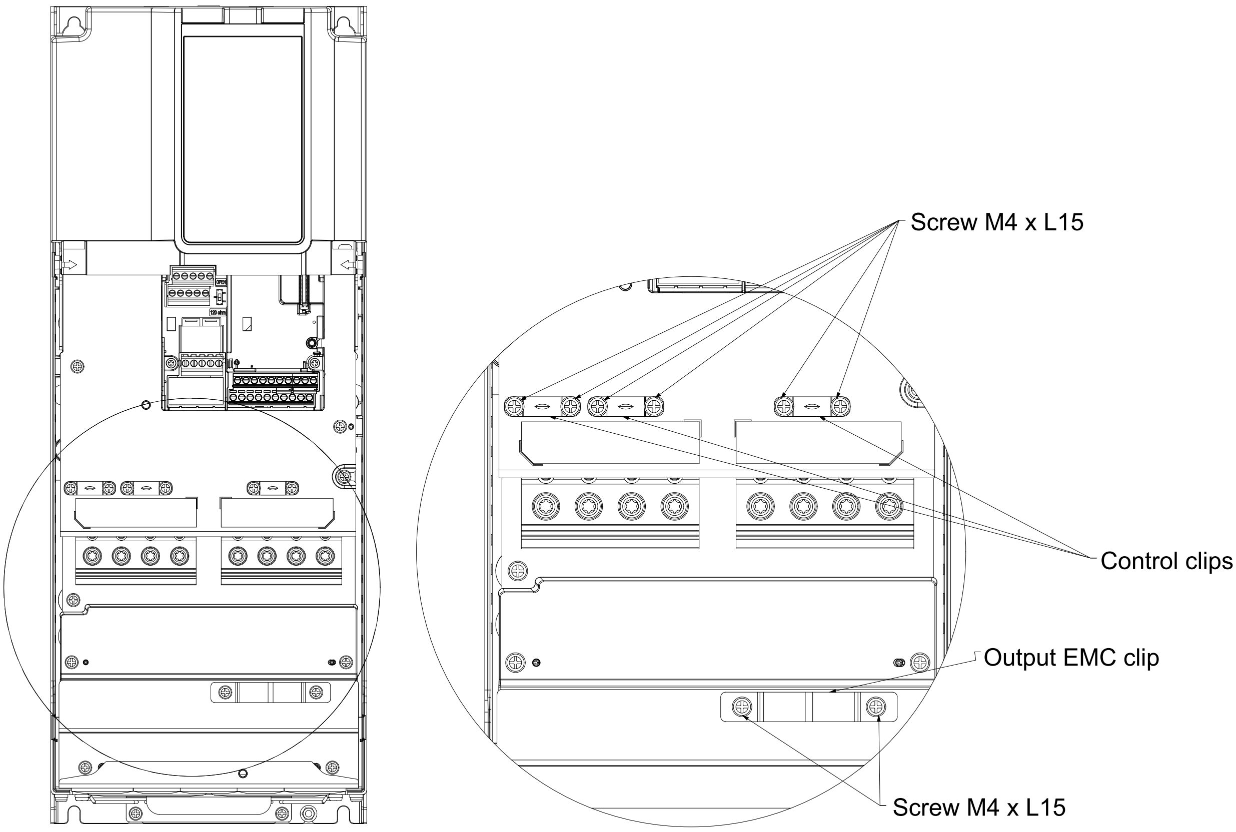


Figure 2-80

Frame F – Type 1

Applicable models: VFD110VP43AFTCA

1. Refer to the following table for the assembling accessories, quantities and screw torque.

No.	Accessories	Qty (pcs)
1	Screw M4xL8 (Screw torque: 14–16 kg-cm / 12.2–13.9 lb-in. / 1.37–1.57 Nm)	2
2	Control clips	3
3	Screw M4xL20 (Screw torque: 14–16 kg-cm / 12.2–13.9 lb-in. / 1.37–1.57 Nm)	6
4	Control EMC plate	1
5	Screw M5xL15 (Screw torque: 24–26 kg-cm / 20.8–22.6 lb-in. / 2.35–2.55 Nm)	2
6	Output EMC plate	1
7	Output EMC clip	1
8	Screw M4xL20 (Screw torque: 14–16 kg-cm / 12.2–13.9 lb-in. / 1.37–1.57 Nm)	2

2. Fasten the accessories as shown in the figure below.

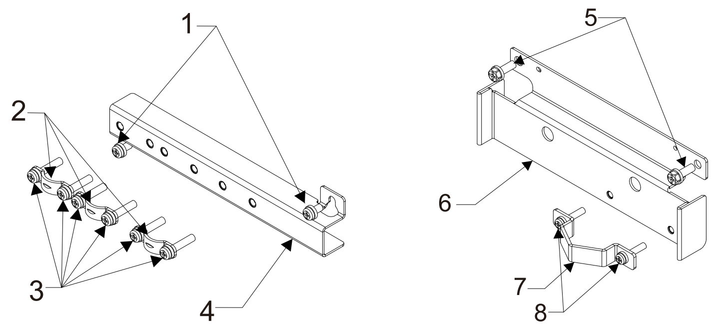


Figure 2-81

3. Install the above EMC plate and control clips onto the AC motor drive, refer to the installation location shown in the figure below.

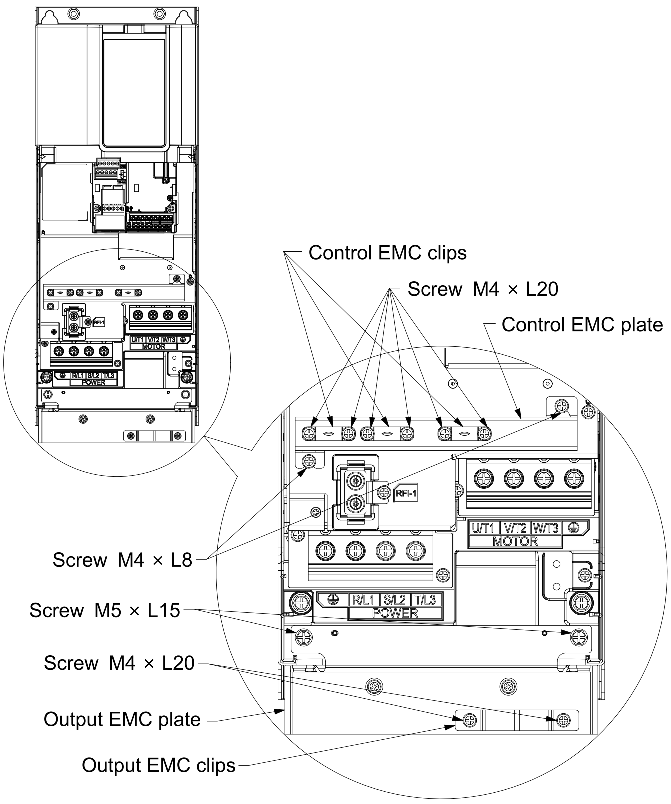


Figure 2-82

Frame G – Open Type

Applicable models: VFD150VP43AFTCA

1. Refer to the following table for the assembling accessories, quantities and screw torque.

No.	Accessories	Qty (pcs)
1	Control clips	3
2	Screw M4xL15 (Screw torque: 14–16 kg-cm / 12.2–13.9 lb-in. / 1.37–1.57 Nm)	6
3	EMC plate	1
4	Screw M4xL25 (Screw torque: 14–16 kg-cm / 12.2–13.9 lb-in. / 1.37–1.57 Nm)	4
5	Screw M5xL10 (Screw torque: 24–26 kg-cm / 20.8–22.6 lb-in. / 2.35–2.55 Nm)	2
6	Output EMC clips	2

2. Fasten the accessories as shown in the figure below.

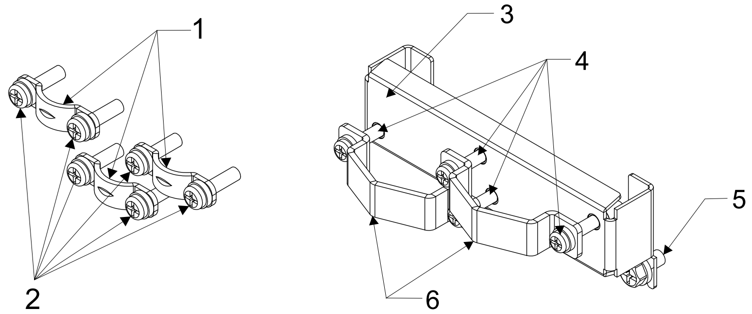


Figure 2-83

3. Install the above EMC plate and control clips onto the AC motor drive, refer to the installation location shown in the figure below.

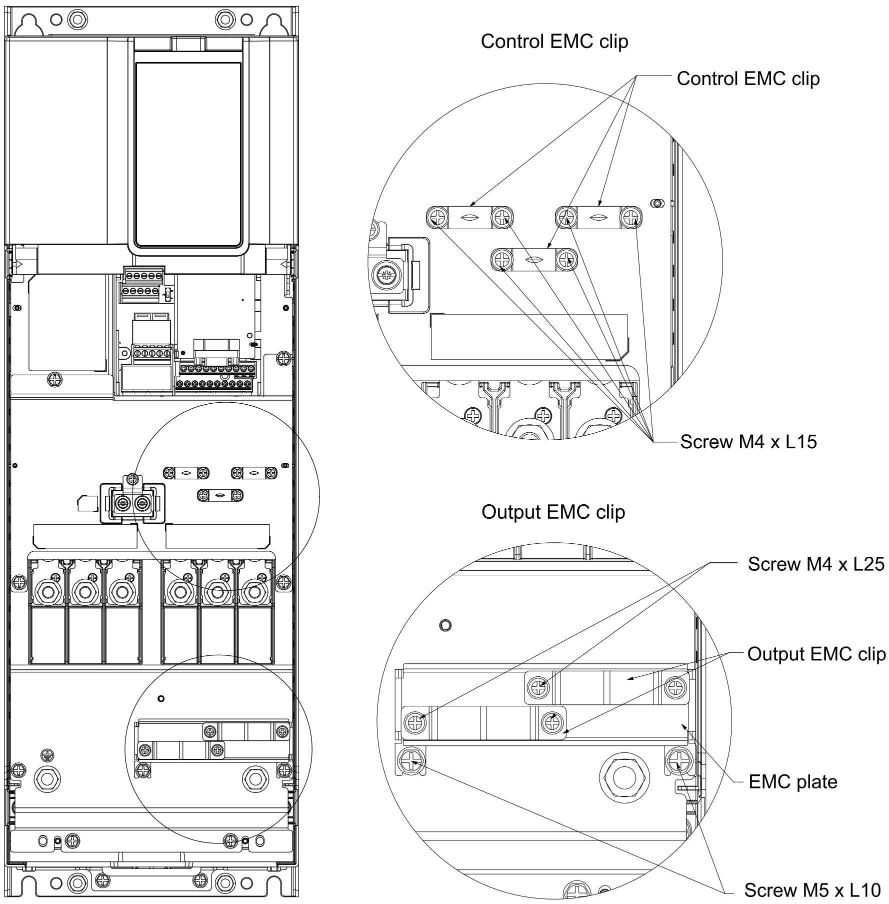


Figure 2-84

Frame G – Type1

Applicable models: VFD150VP43BFTCA, VFD150VP43BSTCA

1. Refer to the following table for the assembling accessories, quantities and screw torque.

No.	Accessories	Qty (pcs)
1	Control clips	3
2	Screw M4xL15 (Screw torque: 14–16 kg-cm / 12.2–13.9 lb-in. / 1.37–1.57 Nm)	6
3	EMC plate	1
4	Screw M5xL10 (Screw torque: 24–26 kg-cm / 20.8–22.6 lb-in. / 2.35–2.55 Nm)	2
5	Screw M4xL25 (Screw torque: 14–16 kg-cm / 12.2–13.9 lb-in. / 1.37–1.57 Nm)	4
6	Output EMC clips	2

2. Fasten the accessories as shown in the figure below.

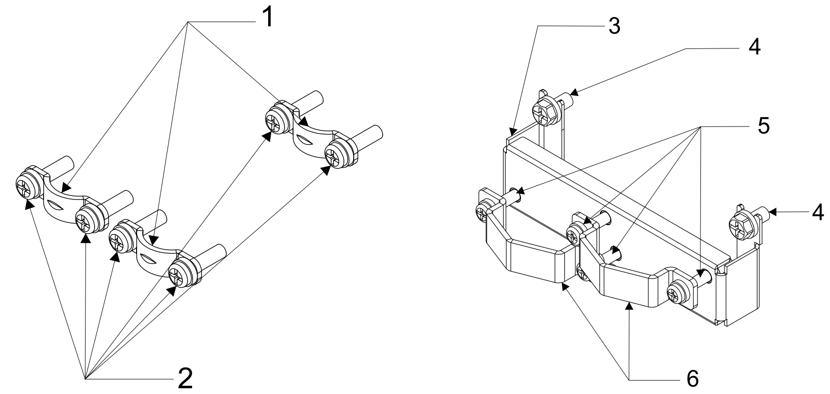


Figure 2-85

3. Install the above EMC plate and control clips onto the AC motor drive, refer to the installation location shown in the figure below.

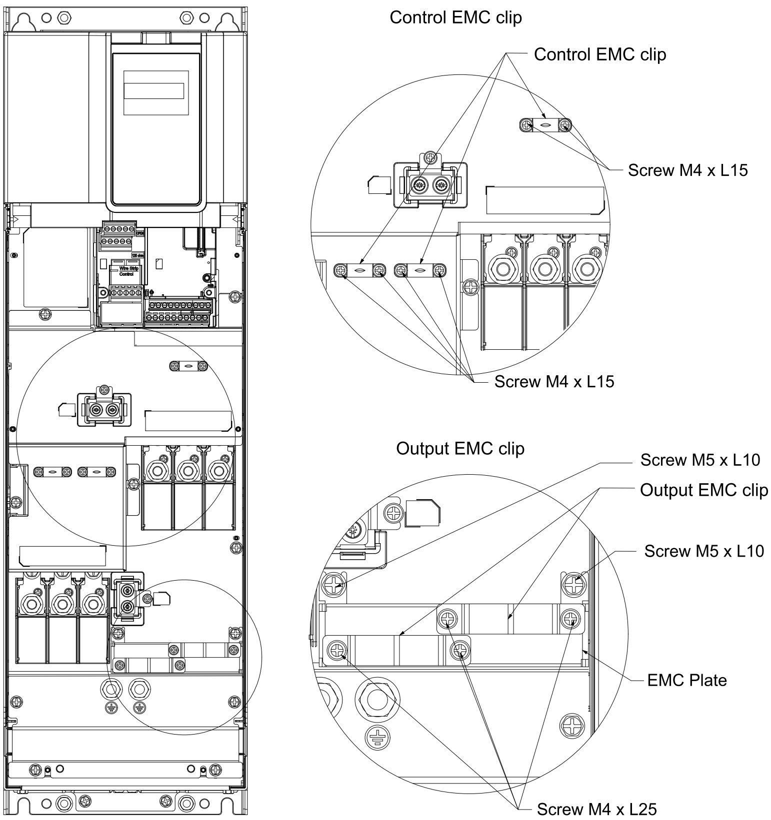


Figure 2-86

Frame H – Open Type

Applicable models: VFD180VP43AFTCA, VFD220VP43AFTCA

1. Refer to the following table for the assembling accessories, quantities and screw torque.

No.	Accessories	Qty (pcs)
1	Control clips	3
2	Screw M4xL20 (Screw torque: 14–16 kg-cm / 12.2–13.9 lb-in. / 1.37–1.57 Nm)	6
3	EMC plate	1
4	Screw M5xL10 (Screw torque: 24–26 kg-cm / 20.8–22.6 lb-in. / 2.35–2.55 Nm)	2
5	Screw M4xL30 (Screw torque: 14–16 kg-cm / 12.2–13.9 lb-in. / 1.37–1.57 Nm)	4
6	Output EMC clips	2

2. Fasten the accessories as shown in the figure below.

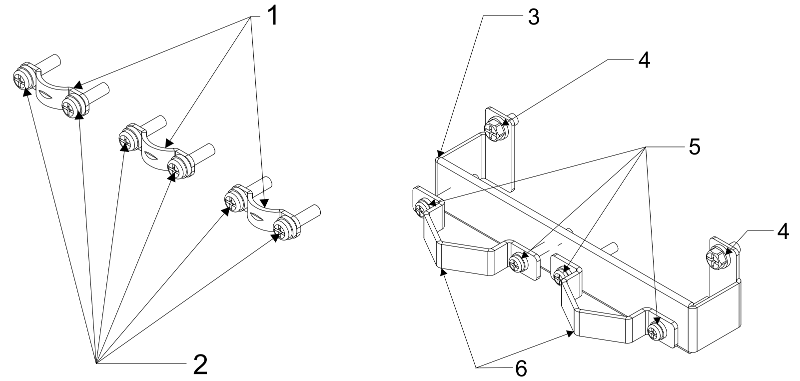


Figure 2-87

3. Install the above EMC plate and control clips onto the AC motor drive, refer to the installation location shown in the figure below.

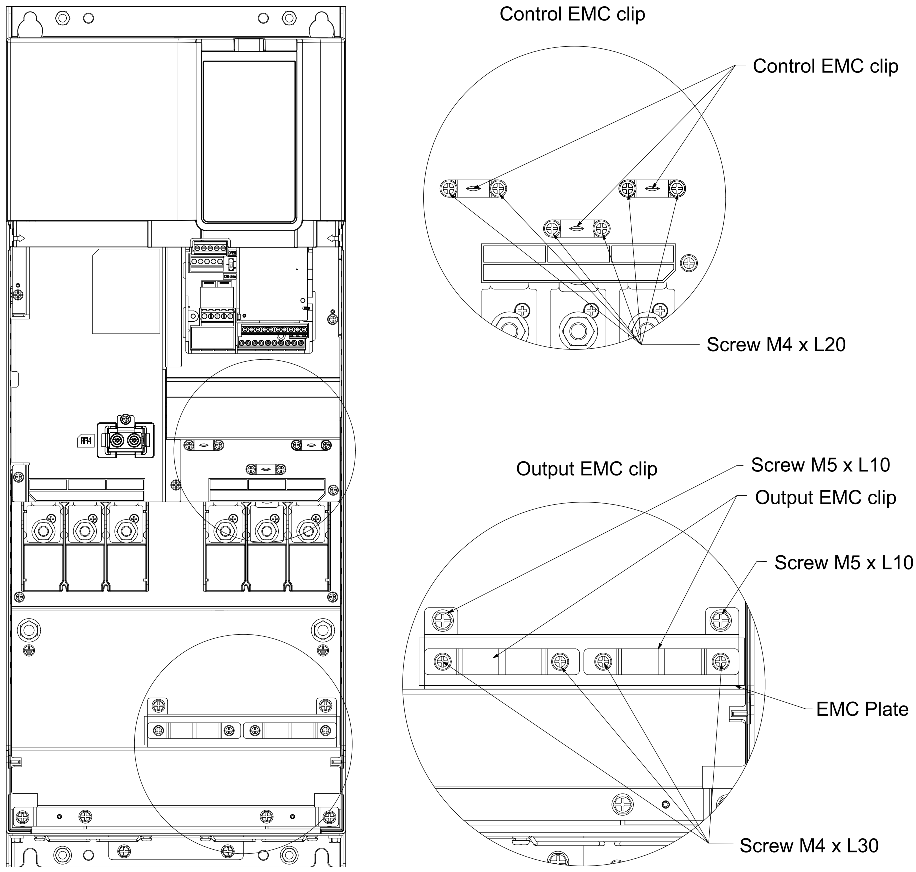


Figure 2-88

Frame I

Applicable models:

Open Type: VFD260VP43AFTCA, VFD310VP43AFTCA

Type 1: VFD260VP43BFTCA, VFD310VP43BFTCA, VFD260VP43BSTCA, VFD310VP43BSTCA

1. Refer to the following table for the assembling accessories, quantities and screw torque.

No.	Accessories	Qty (pcs)
1	Control clips	3
2	Screw M4xL20 (Screw torque: 14–16 kg-cm / 12.2–13.9 lb-in. / 1.37–1.57 Nm)	6
3	EMC plate	1
4	Screw M5xL10 (Screw torque: 24–26 kg-cm / 20.8–22.6 lb-in. / 2.35–2.55 Nm)	2
5	Screw M4xL33 (Screw torque: 14–16 kg-cm / 12.2–13.9 lb-in. / 1.37–1.57 Nm)	4
6	Output EMC clips	2

2. Fasten the accessories as shown in the figure below.

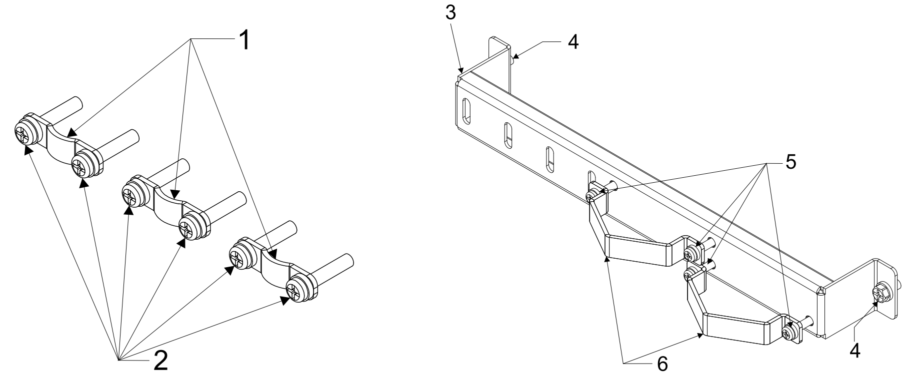


Figure 2-89

3. Install the above EMC plate and control clips onto the AC motor drive, refer to the installation location shown in the figure below.

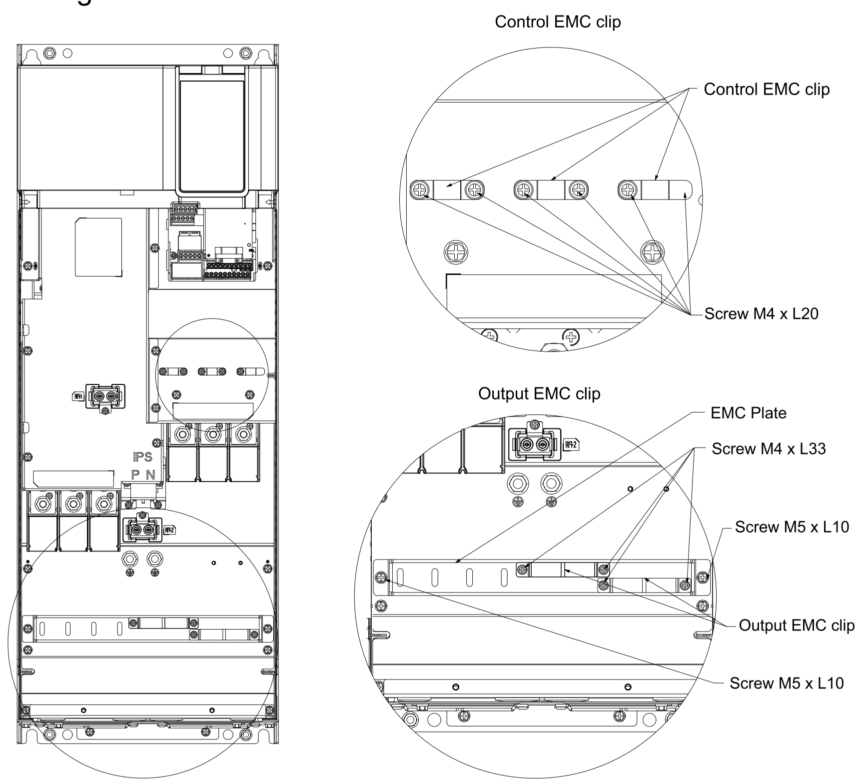


Figure 2-90

Frame J

Applicable models:

Open Type: VFD370VP43AFTCA, VFD395VP43AFTCA

Type 1: VFD370VP43BFTCA, VFD395VP43BFTCA, VFD370VP43BSTCA, VFD395VP43BSTCA

1. Refer to the following table for the assembling accessories, quantities and screw torque.

No.	Accessories	Qty (pcs)
1	Control clips	3
2	Screw M4xL20 (Screw torque: 14–16 kg-cm / 12.2–13.9 lb-in. / 1.37–1.57 Nm)	6
3	EMC plate	1
4	Screw M5xL10 (Screw torque: 24–26 kg-cm / 20.8–22.6 lb-in. / 2.35–2.55 Nm)	2
5	Output EMC clips	2
6	Screw M4xL33 (Screw torque: 14–16 kg-cm / 12.2–13.9 lb-in. / 1.37–1.57 Nm)	4

2. Fasten the accessories as shown in the figure below.

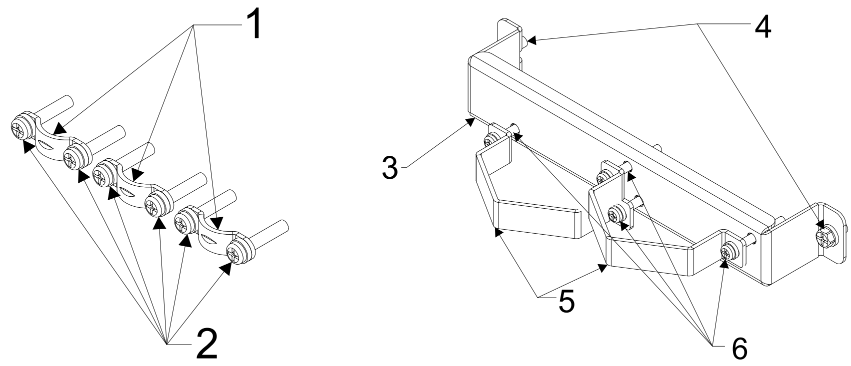


Figure 2-91

3. Install the above EMC plate and control clips onto the AC motor drive, refer to the installation location shown in the figure below.

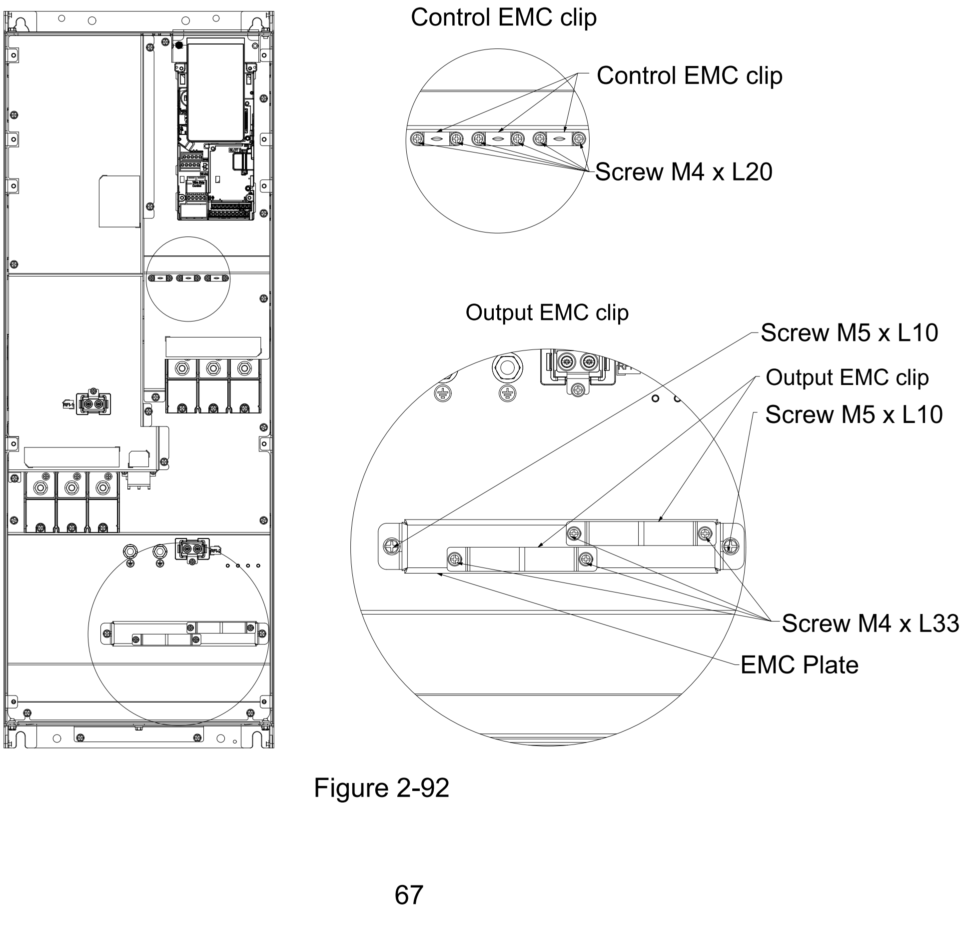


Figure 2-92

Frame K

Applicable models:

Open Type: VFD460VP43AFTCA, VFD485VP43AFTCA

Type 1: VFD460VP43BFTCA, VFD485VP43BFTCA, VFD460VP43BSTCA, VFD485VP43BSTCA

1. Refer to the following table for the assembling accessories, quantities and screw torque.

No.	Accessories	Qty (pcs)
1	Control clips	3
2	Screw M4xL20 (Screw torque: 14–16 kg-cm / 12.2–13.9 lb-in. / 1.37–1.57 Nm)	6
3	EMC plate	1
4	Screw M5xL10 (Screw torque: 24–26 kg-cm / 20.8–22.6 lb-in. / 2.35–2.55 Nm)	2
5	Output EMC clips	2
6	Screw M4xL33 (Screw torque: 14–16 kg-cm / 12.2–13.9 lb-in. / 1.37–1.57 Nm)	4

2. Fasten the accessories as shown in the figure below.

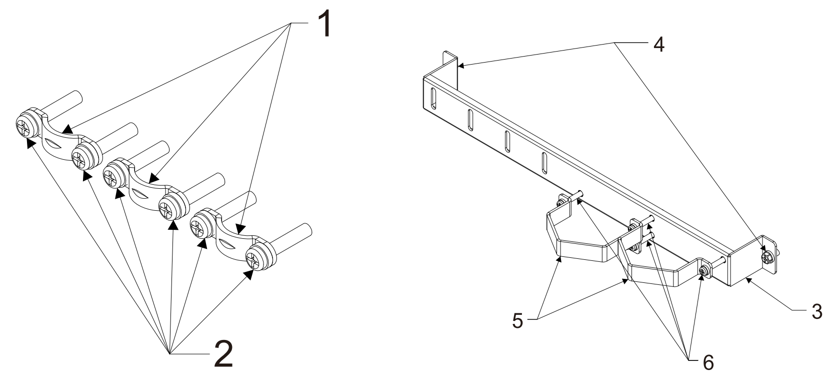


Figure 2-93

3. Install the above EMC plate and control clips onto the AC motor drive, refer to the installation location shown in the figure below.

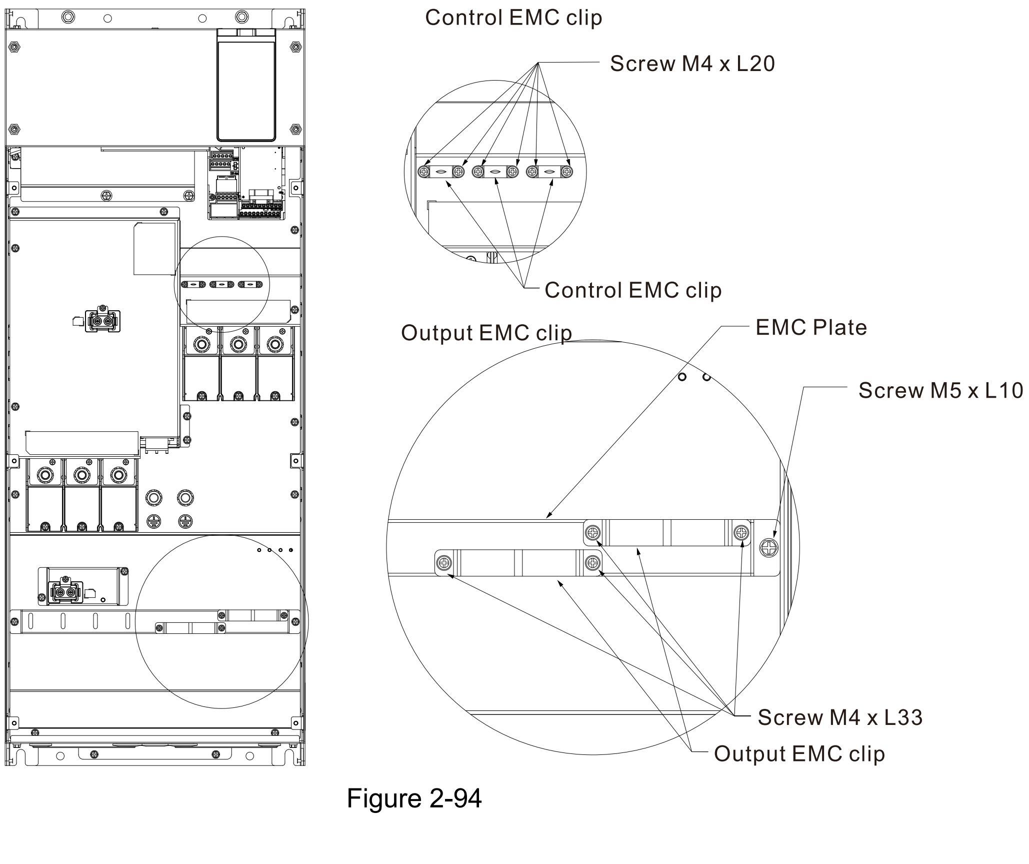
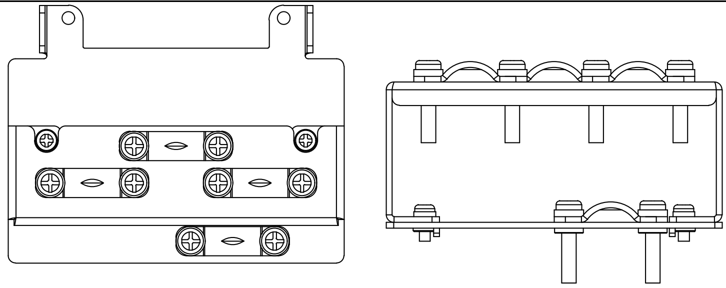
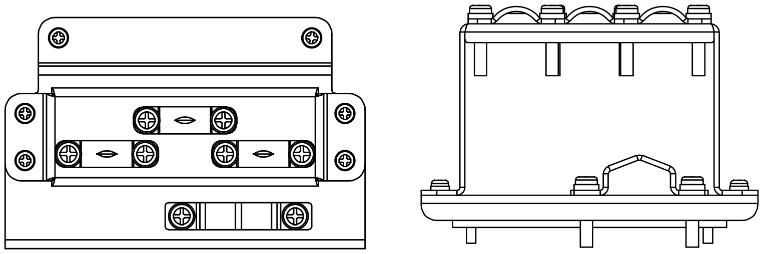
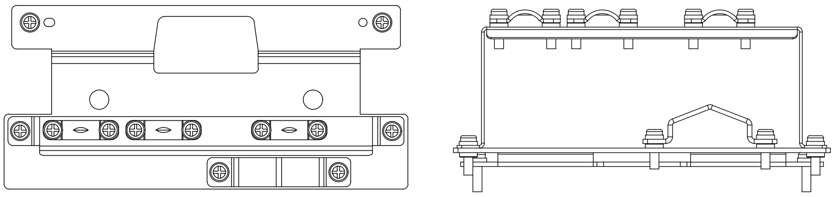
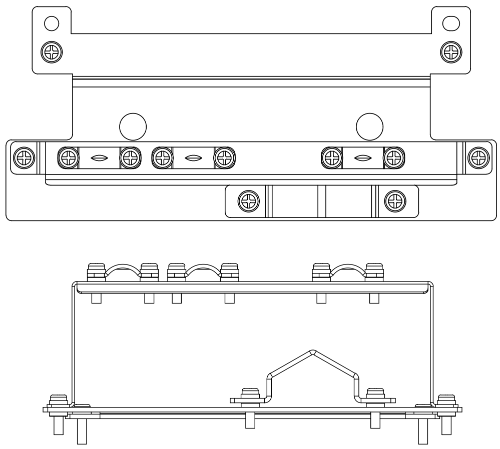


Figure 2-94

2-6-2 Suggested Wiring Method

EMC Plate Model	Diagram
MKVP-EPB	 Figure 2-95
MKVP-EPC	 Figure 2-96
MKVP-EPD	 Figure 2-97
MKVP-EPE	 Figure 2-98

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Chapter 3 Electrical Wiring

3-1 Safety Precautions

DANGER

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

CAUTION

Main Input Power Terminals

- ☑ Do not connect three-phase model to single-phase power. R/L1, S/L2 and T/L3 have no phase-sequence requirement, it can be connected in any sequence.
- ☑ The connection between the three-phase AC input power supply and the main circuit terminals (R/L1, S/L2, T/L3) must be connected with a non-fuse switch. Add a magnetic contactor (MC) to the power input wiring to cut off power quickly and reduce malfunction when the AC motor drive protection function activates. Both ends of the MC should have an R-C surge absorber.
- ☑ Use voltage and current within the specification in Chapter 11. Refer to Chapter 11 Specifications for details.
- ☑ When using a general GFCI (Ground Fault Circuit Interrupter), select a current sensor with sensitivity of 200 mA or above and not less than 0.1-second operation time to avoid nuisance tripping.
- ☑ Use shielded wire or conduit for the power wiring and ground the two ends of the shield wire or conduit.
- ☑ Do NOT run and stop AC motor drives by turning the power ON and OFF. Run and stop AC motor drives by sending RUN and STOP command through the control terminals or the keypad. If you still need to run and stop AC motor drives by turning power ON and OFF, do so no more often than ONCE per hour.
- ☑ To comply with UL standards, connect the drive to a three-phase three-wire or three-phase four-wire Wye system of mains power system.

Output terminals for main circuit

- ☑ Use well-insulated motor, suitable for inverter operation.
- ☑ When the AC drive output terminals U/T1, V/T2, and W/T3 are connected to the motor terminals U/T1, V/T2, and W/T3 respectively, the motor will rotate counterclockwise (as viewed on the shaft end of the motor, refer to the pointed direction in the figure below) upon a forward operation command is received To permanently reverse the direction of motor rotation, switch over any of the two motor leads.

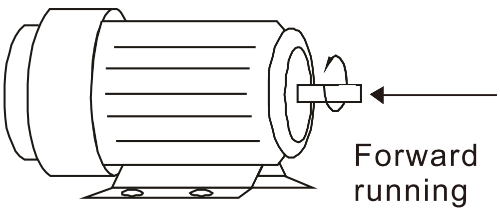


Figure 3-1

Analog Input Terminals (AI1, AI2, AI3 and ACM)

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

☑ Use twisted-pair wire for weak analog signals.

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

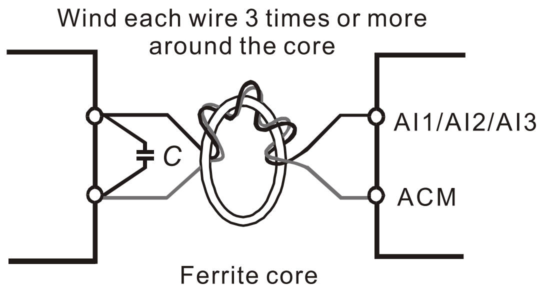


Figure 3-2

Digital Inputs (FWD, REV, MI1–MI6 and COM)

☑ The “COM” terminal is a common terminal of the photo-coupler in all the wiring methods.

☑ When the photo-coupler uses the internal power supply, the switch connection for Sink and Source modes are as below:
MI-DCM: Sink mode
MI-+24V: Source mode

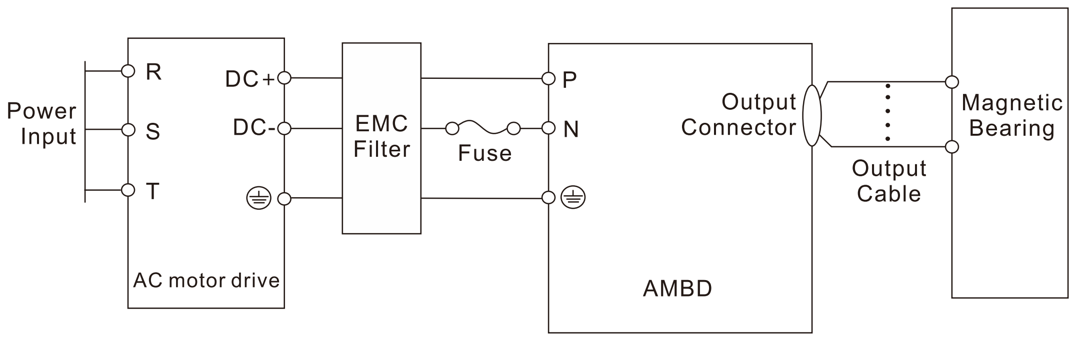
☑ When the photo-coupler uses the external power supply, remove the short-circuit cable between +24V and COM terminals. Connect the +/- terminal of the external power supply to the MI or COM terminal to determine the Sink or Source mode.

AMBD POWER Terminal

☑ The AMBD POWER Terminal is not a traditional PN terminal. It can only be used with a magnetic bearing controller and only provides 2.5A (around 1.5W) for external use. Exceeding the power will cause damage to the internal components.

☑ When used with a magnetic bearing controller, Fuse connection must be connected in series to avoid damage to the drive causes by external faults or short-circuits. The Fuse specification withstand voltage should be larger than 600 V_{AC} and the Fuse current is 8 A; it is recommended to use Bussman Fuse model FWC-8A10F.

☑ AMBD power terminal wiring diagram



3-2 System Wiring Diagram

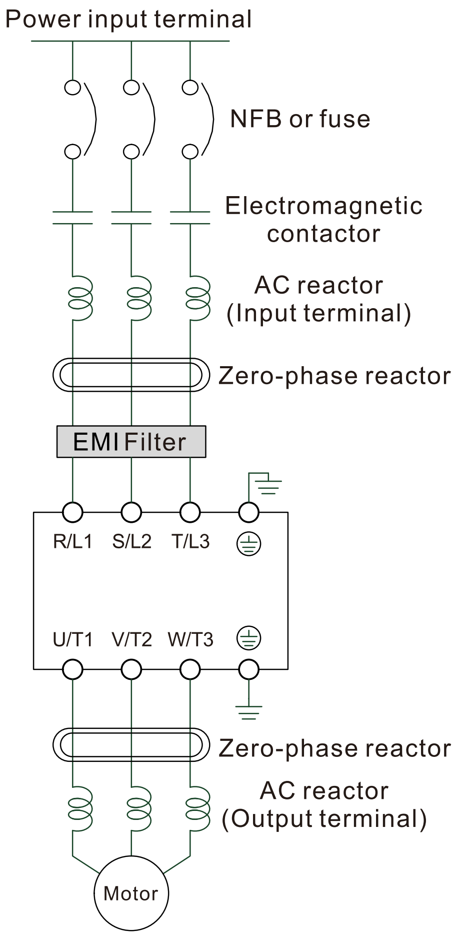


Figure 3-3

Power input terminal	Supply power according to the rated power specifications indicated in the manual
NFB or fuse	There may be a large inrush current during power on. Refer to Section 3-2-1 NFB to select a suitable NFB or Section 3-2-1 Fuse Specification Chart.
Electromagnetic contactor	Switching the power ON / OFF on the primary side of the electromagnetic contactor can turn the drive ON / OFF, but frequent switching may cause machine failure. Do not switch ON / OFF more than once an hour. Do not use the electromagnetic contactor as the power switch for the drive; doing so shortens the life of the drive.
AC reactor (Input terminal)	When the main power capacity is > 500 kVA, or when it switches into the phase capacitor, the instantaneous peak voltage and current generated may destroy the internal circuit of the drive. It is recommended that you install an input side AC reactor in the drive. This also improves the power factor and reduces power harmonics. The wiring distance should be within 10 m. Refer to Section 10-3-2 AC Reactor for details.
Zero phase reactor	Used to reduce radiated interference, especially in environments with audio devices, and reduce input and output side interference. The effective range is AM band to 10 MHz. Refer to Section 10-3-3 Zero Phase Reactor for details.
EMI filter	Can be used to reduce electromagnetic interference. Refer to Section 10-3-4 EMI Filter for details.
AC reactor (Output terminal)	The motor cable length affects the size of the reflected wave on the motor end. It is recommended that you install an AC output reactor when the motor wiring length exceeds 20m. Refer to Section 10-3-2 AC Reactor for details.

Table 3-1

3-2-1 Magnetic Contactor / Air Circuit Breaker and Non-fuse Circuit Breaker / Fuse Spec.

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

  It is recommended the surrounding temperature for MC should be ≥ 60°C and that for ACB should be ≥ 50°C. In the meanwhile, consider temperature derating for components with ON / OFF switch in accordance with the ambient temperature of the on-site distribution panel.

- Fuse Specification

  ☑ Fuse specifications lower than the table below are allowed.

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

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

Frame	Model	Rated Output Current (A)	Rated Input Current (A)	MC/ACB Selection (A)	NFB (A)	Fuse Selection	Fuse Current (A)	UL61800-5-1 SCCR (kA)
A	VFD3A0VP43ANTAA	3	4.2	9	9	JJS-10	10	5
A	VFD4A2VP43ANTAA	4.2	5.9	9	12	JJS-15	15	5
A	VFD5A6VP43ANTAA	5.6	7.8	12	18	JJS-15	15	5
A	VFD7A2VP43ANTAA	7.2	10.1	16	18	JJS-20	20	5
A	VFD011VP43ANTAA	11	15.4	22	32	JJS-30	30	5
B	VFD013VP43ANTAA	13	18.2	32	32	JJS-35	35	5
B	VFD018VP43ANTAA	18	25	40	50	JJS-50	50	5
C	VFD025VP43ANTAA	25	35	65	65	JJS-70	70	5
C	VFD032VP43ANTAA	32	45	80	85	JJS-90	90	5
C	VFD038VP43ANTAA	38	53	80	105	JJS-100	100	5
D	VFD045VP43ANTCA	45	45	80	85	JJS-80	80	5
D	VFD062VP43ANTCA	62	62	105	105	JJS-110	110	5
E	VFD073VP43ANTCA	73	73	125	130	JJS-150	150	10
E	VFD090VP43ANTCA	90	90	150	150	JJS-175	175	10
A	VFD3A0VP43BFTAA	3	4.2	9	9	JJS-10	10	5
A	VFD4A2VP43BFTAA	4.2	5.9	9	12	JJS-15	15	5
A	VFD5A6VP43BFTAA	5.6	7.8	12	12	JJS-15	15	5
A	VFD7A2VP43BFTAA	7.2	10.1	16	18	JJS-20	20	5
A	VFD011VP43BFTAA	11	15.4	22	32	JJS-30	30	5
B	VFD013VP43BFTAA	13	18.2	32	32	JJS-35	35	5
B	VFD018VP43BFTAA	18	25	40	40	JJS-50	50	5
C	VFD025VP43BFTAA	25	35	65	65	JJS-70	70	5
C	VFD032VP43BFTAA	32	45	80	85	JJS-90	90	5
C	VFD038VP43BFTAA	38	53	80	105	JJS-100	100	5
D	VFD045VP43BFTCA	45	45	80	85	JJS-80	80	5
D	VFD062VP43BFTCA	62	62	105	105	JJS-110	110	5

Frame	Model	Rated Output Current (A)	Rated Input Current (A)	MC/ACB Selection (A)	NFB (A)	Fuse Selection	Fuse Current (A)	UL61800-5-1 SCCR (kA)
E	VFD073VP43BFTCA	73	73	125	130	JJS-150	150	10
E	VFD090VP43BFTCA	90	90	150	150	JJS-175	175	10
D	VFD045VP43BSTCA	45	45	80	85	JJS-80	80	5
D	VFD062VP43BSTCA	62	62	105	105	JJS-110	110	5
E	VFD073VP43BSTCA	73	73	125	130	JJS-150	150	10
E	VFD090VP43BSTCA	90	90	150	150	JJS-175	175	10
F	VFD110VP43JSTCA	110	110	185	250	JJS-225	225	10
G	VFD150VP43JSTCA	150	150	265	300	JJS-300	300	10
H	VFD180VP43JSTCA	180	180	265	300	JJS-350	350	10
	VFD220VP43JSTCA	220	220	330	400	JJS-400	400	10
I	VFD260VP43JSTCA	260	260	400	500	JJS-500	500	10
	VFD310VP43JSTCA	310	310	500	600	JJS-600	600	18
J	VFD370VP43JSTCA	370	370	630	600	JJS-600	600	18
	VFD395VP43JSTCA	395	395	630	800	JJS-600	600	18
K	VFD460VP43JSTCA	460	460	800	800	KTU-800	800	18
	VFD485VP43JSTCA	481	481	800	1000	KTU-800	800	18
L	VFD530VP43SFTCA	530	530	800	1000	KTU-1100	1100	18
	VFD616VP43SFTCA	616	616	1000	1200	KTU-1200	1200	30
	VFD683VP43SFTCA	683	683	1000	1350	KTU-1400	1400	30
	VFD770VP43SFTCA	770	770	1250	1500	KTU-1600	1600	30
M	VFD866VP43SFTCA	866	866	1500	1500	KTU-1800	1800	42
	VFD930VP43SFTCA	930	930	1600	2000	KTU-1800	1800	42
	VFD1K1VP43SFTCA	1100	1100	2000	2000	KTU-2000	2000	42
	VFD1K2VP43SFTCA	1212	1212	2000	2000	KTU-2400	2400	42

Table 3-2

3-3 Main Circuit Terminals

3-3-1 Remove the Cover for Wiring

Remove the top cover before wiring the multi-function input and output terminals (except Frame L and M).

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

Frame A–G

Screw torque: 12–15 kg-cm / (10.4–13 Ib-in.) / (1.2–1.5 Nm)

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

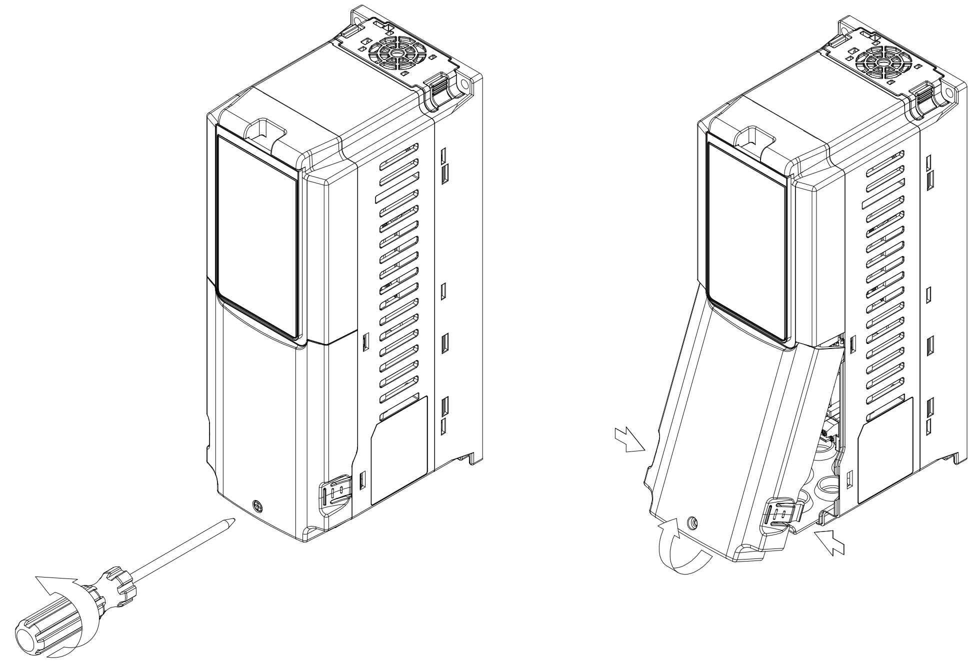


Figure 3-4

Frame H–I

Screw torque: 12–15 kg-cm / (10.4–13 Ib-in.) / (1.2–1.5 Nm)

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

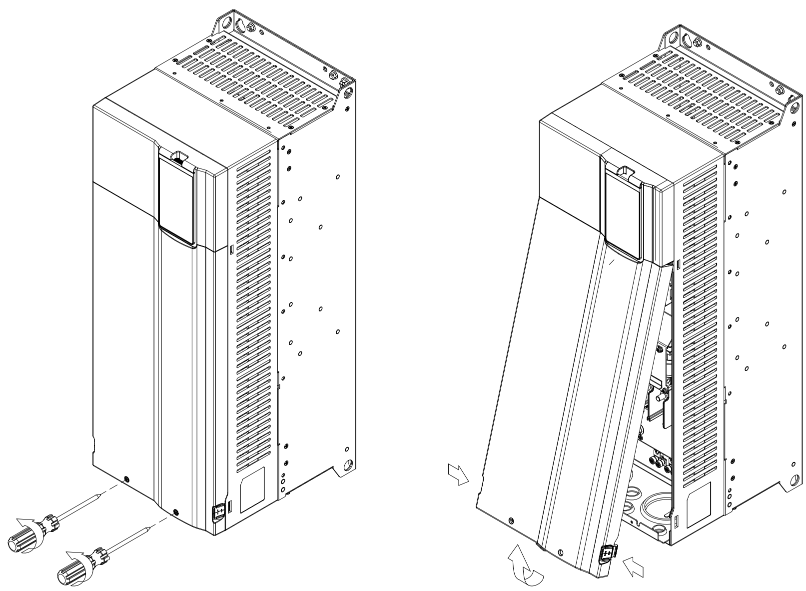


Figure 3-5

Frame J–K

Screw torque: 14–16 kg-cm / (12.15–13.89 lb-in.) / (1.4–1.6 Nm)

Loosen the screws and remove the top cover.

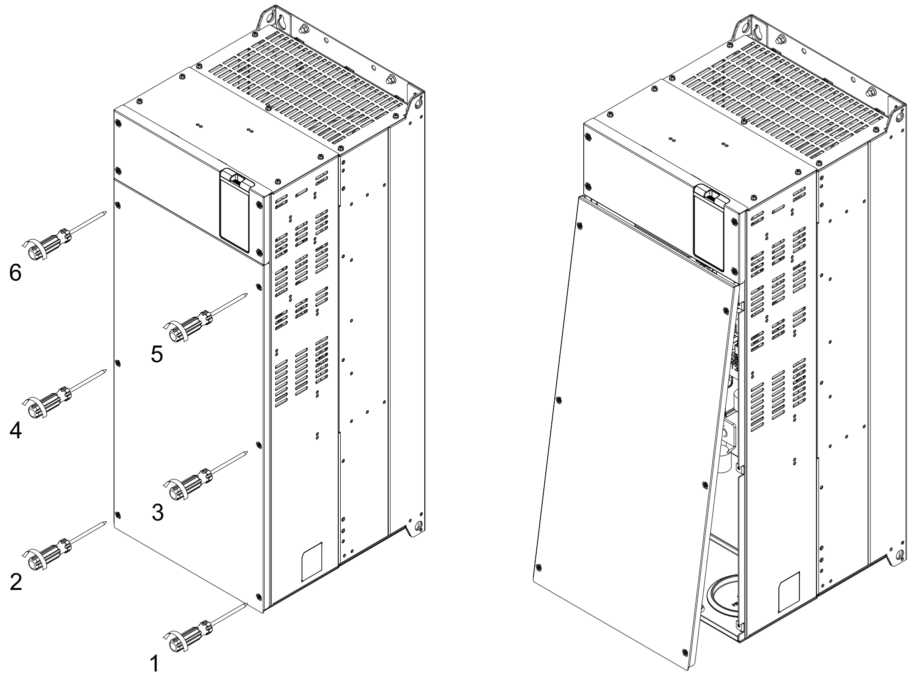


Figure 3-6

Frame L–M

You can wire the main circuit terminals without removing the top cover.

Screw torque: 14–16 kg-cm / (12.15–13.89 lb-in.) / (1.4–1.6 Nm)

Loosen the screws and remove the cover for wiring the control terminals.

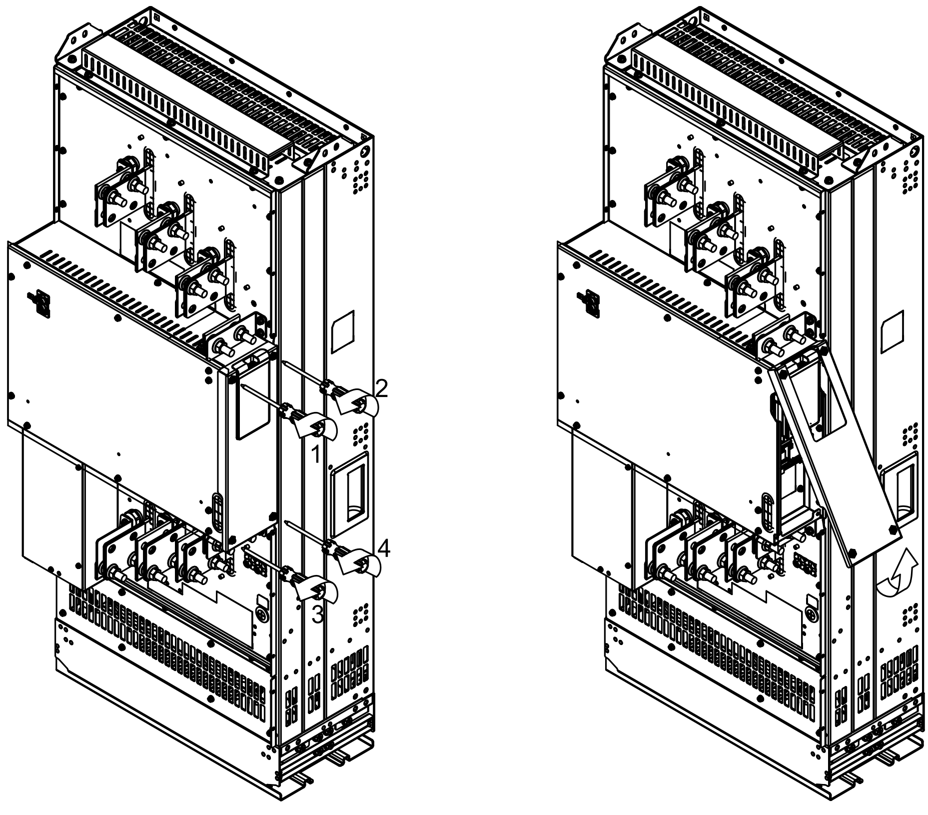


Figure 3-7

3-3-2 Wiring

Applicable for all frame models

Input: three-phase power

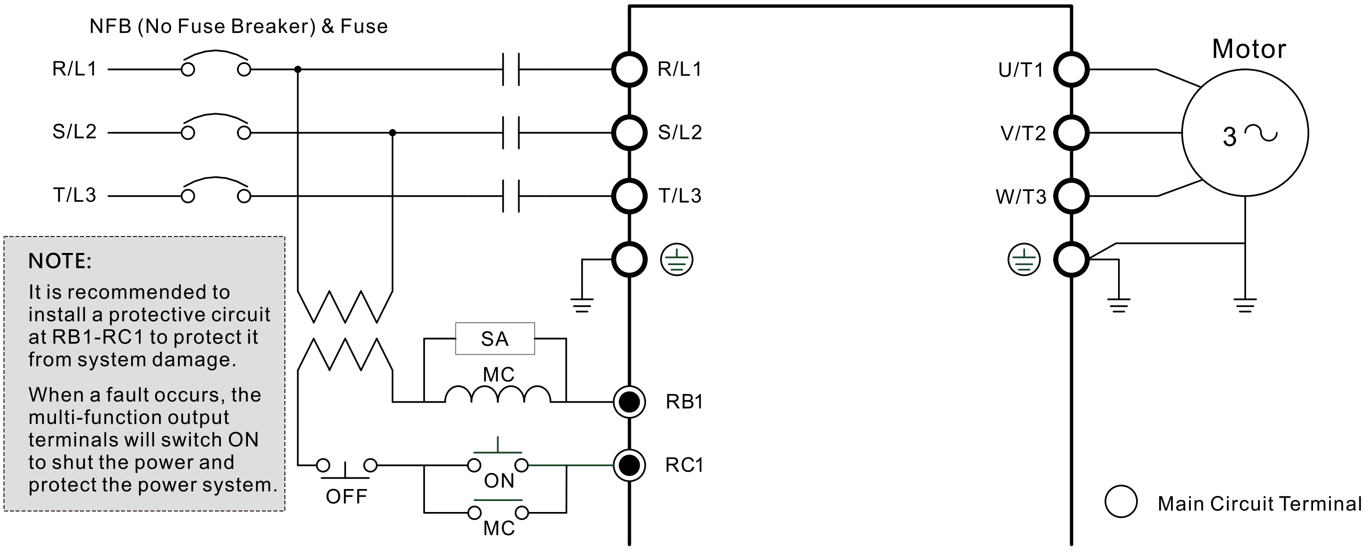


Figure 3-8

NOTE: When the wiring between the motor and the drive exceeds 75m, refer to Section 10-3-2 Motor Wiring Length for the cable length specification.

Terminal	Description
R/L1, S/L2, T/L3	Power input terminal (three-phase)
U/T1, V/T2, W/T3	AC motor drive output terminals for connecting three-phase induction motor
⏚	Ground connection, comply with local regulations.

Table 3-3

3-3-3 Terminal Specification

- Use the specified ring lug for main circuit terminal wiring. See Figure 3-9 and Figure 3-10 for ring lug specifications. For other types of wiring, use the wires that comply with the local regulations.
- After crimping the wire to the ring lug (must be UL approved), UL and CSA approved recognized component (YDPU2/8), install heat shrink tube rated at a minimum of 600 V_{AC} insulation over the live part. Refer to Figure 3-10.

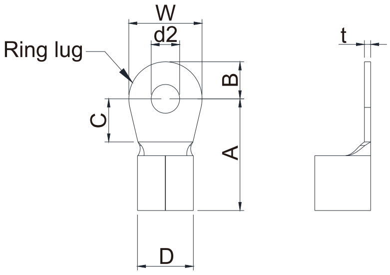


Figure 3-9

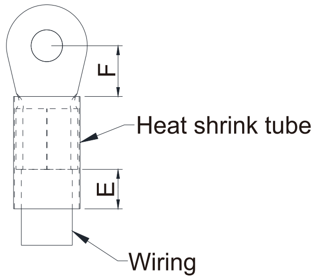


Figure 3-10

Ring Lug Terminal Specification

The part number of the ring lugs (produced by K.S. Terminals Inc.) in the table below are for reference only. You can buy the ring lugs of your choice to match with different frame sizes. Frame A–F are designed for European terminal blocks, and the specifications in the table below are not applicable.

Unit: mm

Frame	AWG/MCM	Kit P/N	A (MAX)	B (MAX)	C (MIN)	D (MAX)	d2 (MIN)	E (MIN)	F (MIN)	W (MAX)	t (MAX)
G	2 AWG	SQNBS38-8	39	11.5	12	22	8.4	15	12	22	1.3
H	1/0 AWG	SQNBS60-8	40	12	12.6	25.6	8.4	15	12.6	25.6	4
	2 AWG	SQNBS38-8									
I	3/0 AWG	SQNBS80-8	42	12	16	28	8.4	15	16	28	4.3
	4/0 AWG	SQNBS100-8									
	250 MCM	SQNBS125-8									
J	250 MCM	SQNBS125-8	53	12	16	36	8.4	15	16	36	4
	300 MCM	SQNBS150-8									
K	350 MCM	SQNBS180-10	70	19	16	39.6	10.5	15	16	44	4.8
	400 MCM	SQNBS250-10									
L	2/0 AWG	TLK70-12	58.5	30	13	31	13	15	13	31	5.5
	3/0 AWG	TLK95-12									
	4/0 AWG	TLK120-12									
	250 MCM	TLK150-12									
	300 MCM	TLK150-12									
M	300 MCM	TLK150-12	91.5	30	13	43	13	15	13	43	5.9
	350 MCM	TLK185-12									
	500 MCM	TLK300-12									

Table 3-4

NOTE:

*1. AWG: Refer to the tables below for wire specifications of each frame model.
*2. F(MAX.) = 16.5

AMBD POWER Terminal Specification

Frame	AWG/MCM	Kit P/N	A (MAX)	B (MAX)	C (MIN)	D (MAX)	d2 (MIN)	E (MIN)	F (MIN)	W (MAX)	t (MAX)
I~M	16~20 AWG	RNYBL1-4	18	3.8	7	6	4.3	11	7	8	0.75

Table 3-5

Frame A1

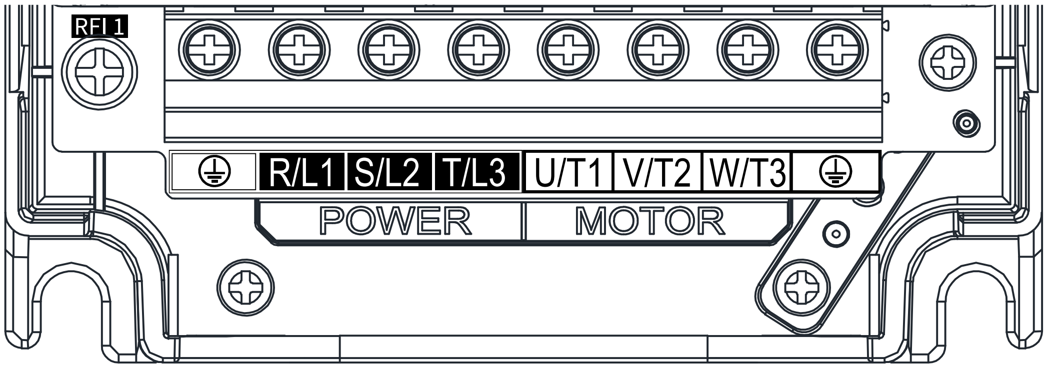


Figure 3-11

- If you install at Ta 50°C environment, use coper wires that have a voltage rating of 600V and are temperature resistance to 75°C or 90°C.
- If you install at Ta 50°C above environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 90°C or above.
- To be UL installation resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire.
- Stripping length: 7–8 mm

Model	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3			Terminal ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))
VFD3A0VP43ANTAA		0.75 mm^2 (18 AWG)			2.5 mm^2 (14 AWG)	
VFD4A2VP43ANTAA		1.5 mm^2 (16 AWG)			2.5 mm^2 (14 AWG)	
VFD5A6VP43ANTAA	6 mm^2 (10 AWG)	1.5 mm^2 (16 AWG)	6 kg-cm (5.2 lb-in.) (0.59 Nm)	6 mm^2 (10 AWG)	2.5 mm^2 (14 AWG)	6 kg-cm (5.2 lb-in.) (0.59 Nm)
VFD7A2VP43ANTAA		2.5 mm^2 (14 AWG)			2.5 mm^2 (14 AWG)	
VFD011VP43ANTAA		4.0 mm^2 (12 AWG)			4.0 mm^2 (12 AWG)	

Table 3-5

Frame A2

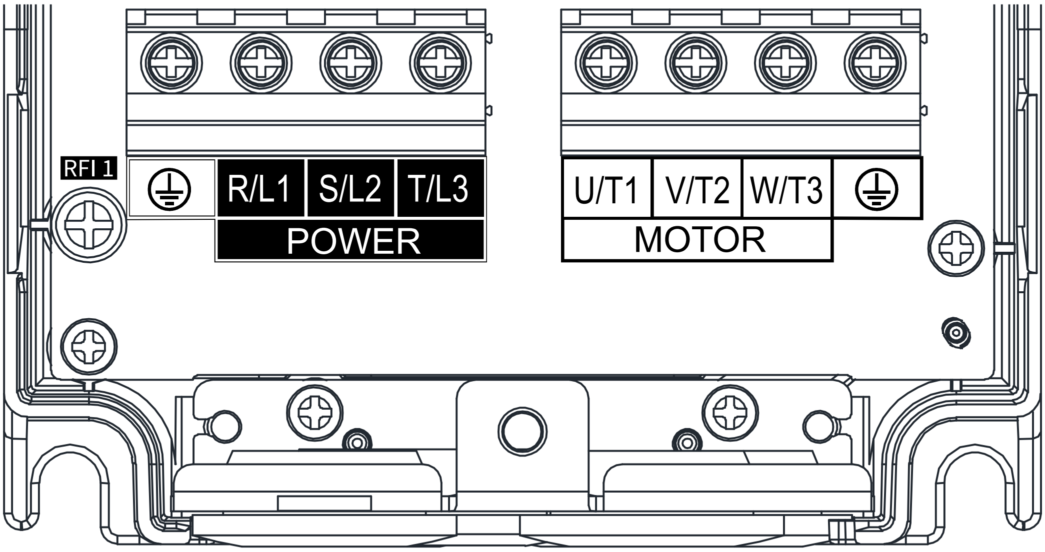


Figure 3-12

- If you install at Ta 50°C environment, use coper wires that have a voltage rating of 600V and are temperature resistance to 75°C or 90°C.
- If you install at Ta 50°C above environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 90°C or above.
- To be UL installation resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire.
- Stripping length: 7–8 mm

Model	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3			Terminal ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))
VFD3A0VP43BFTAA	6 mm^2 (10 AWG)	0.75 mm^2 (18 AWG)	6 kg-cm (5.2 lb-in.) (0.59 Nm)	6 mm^2 (10 AWG)	2.5 mm^2 (14 AWG)	6 kg-cm (5.2 lb-in.) (0.59 Nm)
VFD4A2VP43BFTAA		1.5 mm^2 (16 AWG)			2.5 mm^2 (14 AWG)	
VFD5A6VP43BFTAA		1.5 mm^2 (16 AWG)			2.5 mm^2 (14 AWG)	
VFD7A2VP43BFTAA		2.5 mm^2 (14 AWG)			2.5 mm^2 (14 AWG)	
VFD011VP43BFTAA		4.0 mm^2 (12 AWG)			4.0 mm^2 (12 AWG)	

Table 3-6

Frame B1

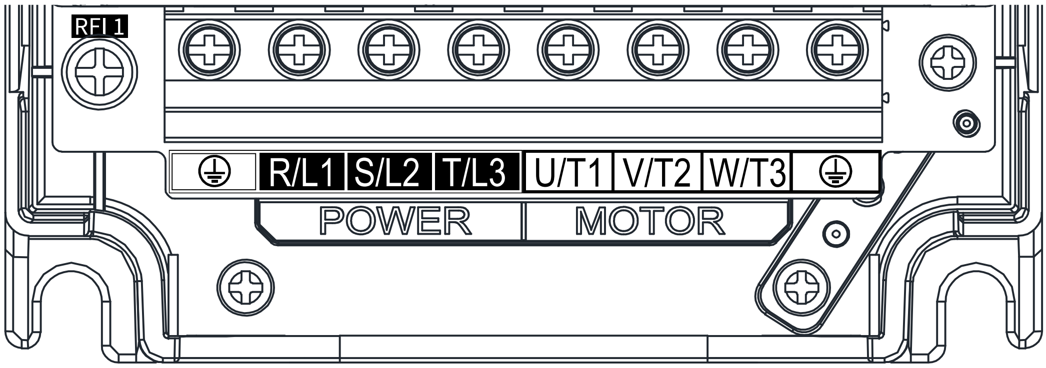


Figure 3-13

- If you install at Ta 50°C environment, use coper wires that have a voltage rating of 600V and are temperature resistance to 75°C or 90°C.
- If you install at Ta 50°C above environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 90°C or above.
- For VFD018VP43ANTAA models: if you install at Ta 40°C above environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 90°C or above.
- To be UL installation resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire.
- Stripping length: 7–8 mm

Model	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3			Terminal ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))
VFD013VP43ANTAA	6 mm^2 (10 AWG)	6 mm^2 (10 AWG)	6 kg-cm (5.2 lb-in.) (0.59 Nm)	6 mm^2 (10 AWG)	6 mm^2 (10 AWG)	6 kg-cm (5.2 lb-in.) (0.59 Nm)
VFD018VP43ANTAA		6 mm^2 (10 AWG)			6 mm^2 (10 AWG)	

Table 3-7

Frame B2

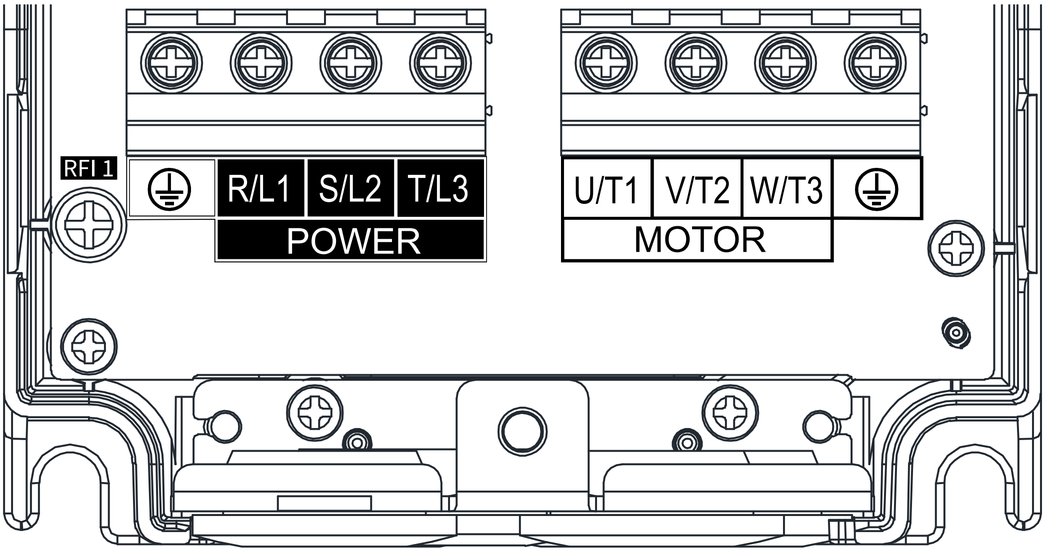


Figure 3-14

- If you install at Ta 50°C environment, use coper wires that have a voltage rating of 600V and are temperature resistance to 75°C or 90°C.
- If you install at Ta 50°C above environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 90°C or above.
- For VFD018VP43BFTAA models: if you install at Ta 40°C above environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 90°C or above.
- To be UL installation resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire.
- Stripping length: 7–8 mm

<table>
<tr><th rowspan="2">Model</th><th colspan="3">Main Circuit Terminals
R/L1, S/L2, T/L3, U/T1, V/T2, W/T3</th><th colspan="3">Terminal ⏚</th></tr>
<tr><th>Max. Wire Gauge</th><th>Min. Wire Gauge</th><th>Screw Spec. and Torque (±10%))</th><th>Max. Wire Gauge</th><th>Min. Wire Gauge</th><th>Screw Spec. and Torque (±10%))</th></tr>
<tr><td>VFD013VP43BFTAA</td><td rowspan="2">6 mm^2
(10 AWG)</td><td>6 mm^2
(10 AWG)</td><td rowspan="2">6 kg-cm
(5.2 lb-in.)
(0.59 Nm)</td><td rowspan="2">6 mm^2
(10 AWG)</td><td>6 mm^2
(10 AWG)</td><td rowspan="2">6 kg-cm
(5.2 lb-in.)
(0.59 Nm)</td></tr>
<tr><td>VFD018VP43BFTAA</td><td>6 mm^2
(10 AWG)</td><td>6 mm^2
(10 AWG)</td></tr>
</table>

Table 3-8

Frame C1

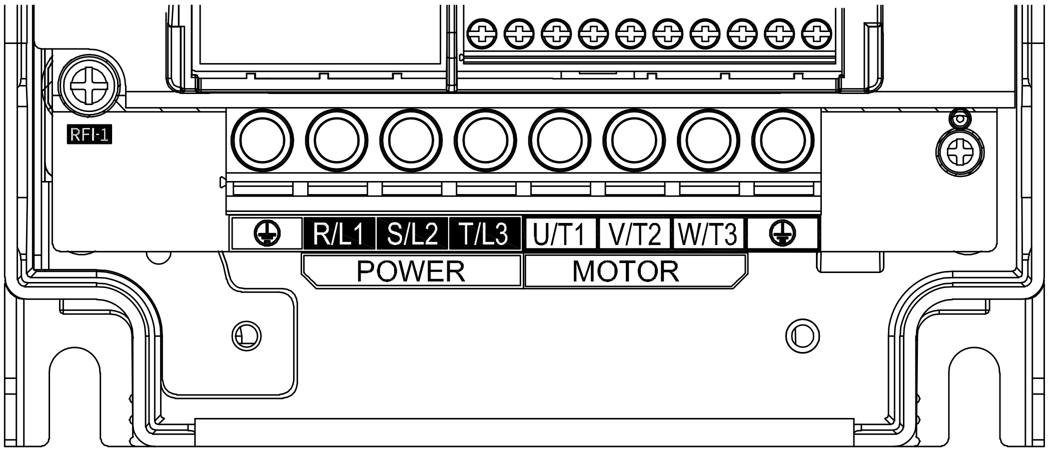


Figure 3-15

- If you install at Ta 50°C environment, use coper wires that have a voltage rating of 600V and are temperature resistance to 75°C or 90°C.
- If you install at Ta 50°C above environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 90°C or above.
- To be UL installation resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire.
- Stripping length: 11–12 mm

Model	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3			Terminal ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))
VFD025VP43ANTAA	16 mm^2 (6 AWG)	10 mm^2 (8 AWG)	12 kg-cm (10.4 lb-in.) (1.18 Nm)	16 mm^2 (6 AWG)	10 mm^2 (8 AWG)	12 kg-cm (10.4 lb-in.) (1.18 Nm)
VFD032VP43ANTAA		10 mm^2 (8 AWG)			10 mm^2 (8 AWG)	
VFD038VP43ANTAA		10 mm^2 (8 AWG)			10 mm^2 (8 AWG)	

Table 3-9

Frame C2

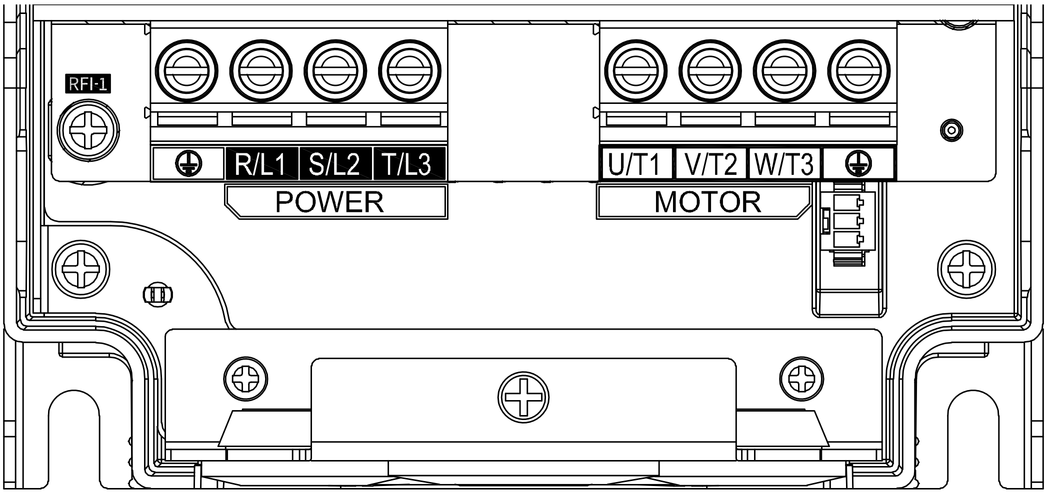


Figure 3-16

- If you install at Ta 50°C environment, use coper wires that have a voltage rating of 600V and are temperature resistance to 75°C or 90°C.
- If you install at Ta 50°C above environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 90°C or above.
- To be UL installation resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire.
- Stripping length: 11–12 mm

Model	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3			Terminal ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))
VFD025VP43BFTAA	16 mm^2 (6 AWG)	10 mm^2 (8 AWG)	12 kg-cm (10.4 lb-in.) (1.18 Nm)	16 mm^2 (6 AWG)	10 mm^2 (8 AWG)	12 kg-cm (10.4 lb-in.) (1.18 Nm)
VFD032VP43BFTAA		10 mm^2 (8 AWG)			10 mm^2 (8 AWG)	
VFD038VP43BFTAA		10 mm^2 (8 AWG)			10 mm^2 (8 AWG)	

Table 3-10

Frame D1

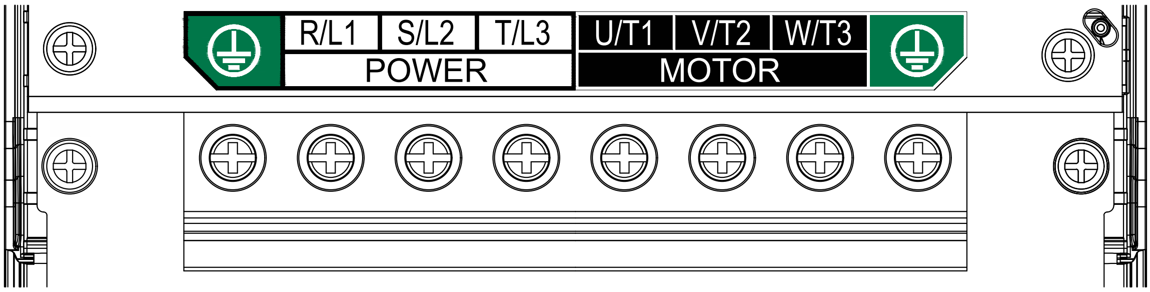


Figure 3-17

- If you install at Ta 50°C environment, use coper wires that have a voltage rating of 600V and are temperature resistance to 75°C or 90°C.
- If you install at Ta 50°C above environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 90°C or above.
- To be UL installation resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire.
- Stripping length: 18–19 mm

Model	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3			Terminal ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))
VFD045VP43ANTCA	25 mm^2 (4 AWG)	16 mm^2 (6 AWG)	39 kg-cm (33.9 lb-in.) (3.82 Nm)	25 mm^2 (4 AWG)	16 mm^2 (6 AWG)	39 kg-cm (33.9 lb-in.) (3.82 Nm)
VFD062VP43ANTCA		25 mm^2 (4 AWG)			16 mm^2 (6 AWG)	

Table 3-11

Frame D2

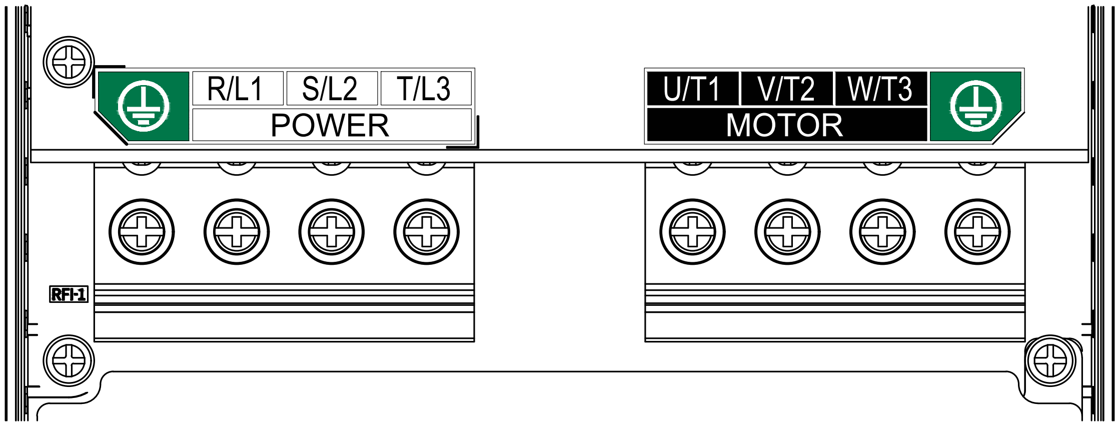


Figure 3-18

- If you install at Ta 50°C environment, use coper wires that have a voltage rating of 600V and are temperature resistance to 75°C or 90°C.
- If you install at Ta 50°C above environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 90°C or above.
- To be UL installation resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire.
- Stripping length: 18–19 mm

Model	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3			Terminal ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))
VFD045VP43BFTCA	25 mm^2 (4 AWG)	16 mm^2 (6 AWG)	39 kg-cm (33.9 lb-in.) (3.82 Nm)	25 mm^2 (4 AWG)	16mm^2 (6 AWG)	39 kg-cm (33.9 lb-in.) (3.82 Nm)
VFD062VP43BFTCA		25 mm^2 (4 AWG)			16mm^2 (6 AWG)	
VFD045VP43BSTCA		16 mm^2 (6 AWG)			16mm^2 (6 AWG)	
VFD062VP43BSTCA		25 mm^2 (4 AWG)			16mm^2 (6 AWG)	

Table 3-12

Frame E1

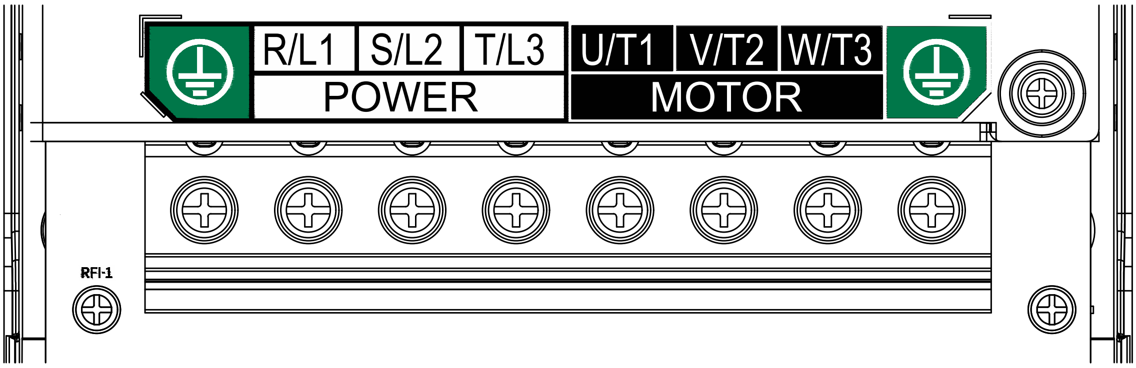


Figure 3-19

- If you install at Ta 50°C environment, use coper wires that have a voltage rating of 600V and are temperature resistance to 75°C or 90°C.
- If you install at Ta 50°C above environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 90°C or above.
- To be UL installation resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire.
- Stripping length: 19–21 mm

Model	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3			Terminal ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))
VFD073VP43ANTCA	50 mm^2 (1 AWG)	35 mm^2 (3 AWG)	56 kg-cm (48.7 lb-in.) (5.50 Nm)	50 mm^2 (1 AWG)	16 mm^2 (6 AWG)	56 kg-cm (48.7 lb-in.) (5.50 Nm)
VFD090VP43ANTCA		35 mm^2 (2 AWG)			16 mm^2 (6 AWG)	

Table 3-13

Frame E2

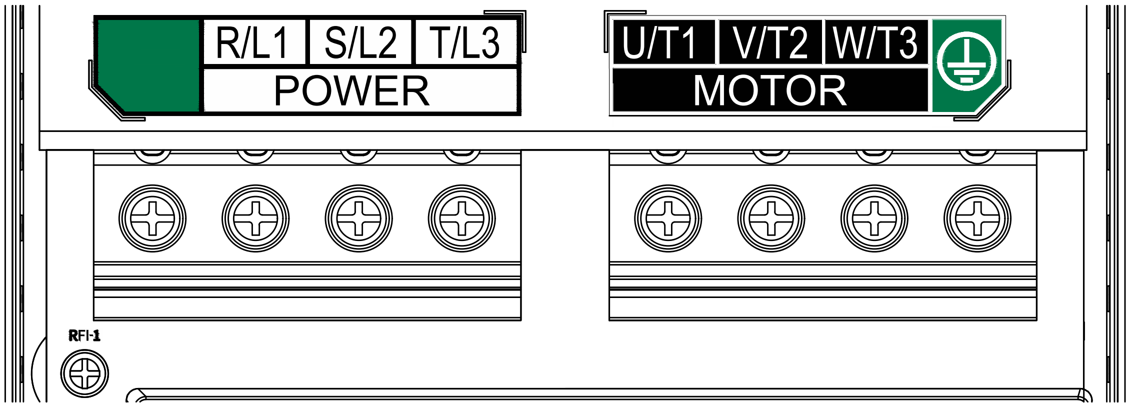


Figure 3-20

- If you install at Ta 50°C environment, use coper wires that have a voltage rating of 600V and are temperature resistance to 75°C or 90°C.
- If you install at Ta 50°C above environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 90°C or above.
- To be UL installation resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire.
- Stripping length: 19–21 mm

Model	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3			Terminal ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))
VFD073VP43BSTCA	50 mm^2 (1 AWG)	35 mm^2 (3 AWG)	56 kg-cm (48.7 lb-in.) (5.50 Nm)	50 mm^2 (1 AWG)	16 mm^2 (6 AWG)	56 kg-cm (48.7 lb-in.) (5.50 Nm)
VFD090VP43BSTCA		35 mm^2 (2 AWG)			16 mm^2 (6 AWG)	
VFD073VP43BFTCA		35 mm^2 (3 AWG)			16 mm^2 (6 AWG)	
VFD090VP43BFTCA		35 mm^2 (2 AWG)			16 mm^2 (6 AWG)	

Table 3-14

Frame F1

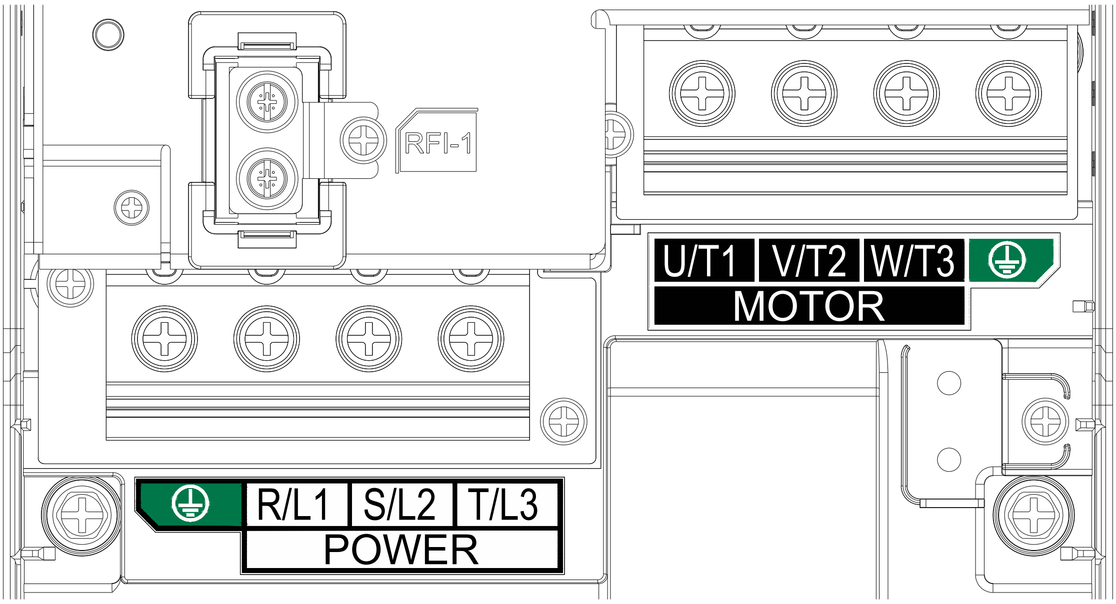


Figure 3-21

- If you install at Ta 50°C environment, use coper wires that have a voltage rating of 600V and are temperature resistance to 75°C or 90°C.
- If you install at Ta 50°C above environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 90°C or above.
- To be UL installation resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire.
- Stripping length: 19–21 mm

Model	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3			Terminal ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))
VFD110VP43AFTCA	50 mm^2 (1/0 AWG)	50 mm^2 (1/0 AWG)	56 kg-cm (48.7 lb-in.) (5.50 Nm)	50 mm^2 (1/0 AWG)	25 mm^2 (3 AWG)	56 kg-cm (48.7 lb-in.) (5.50 Nm)

Table 3-15

Frame F2

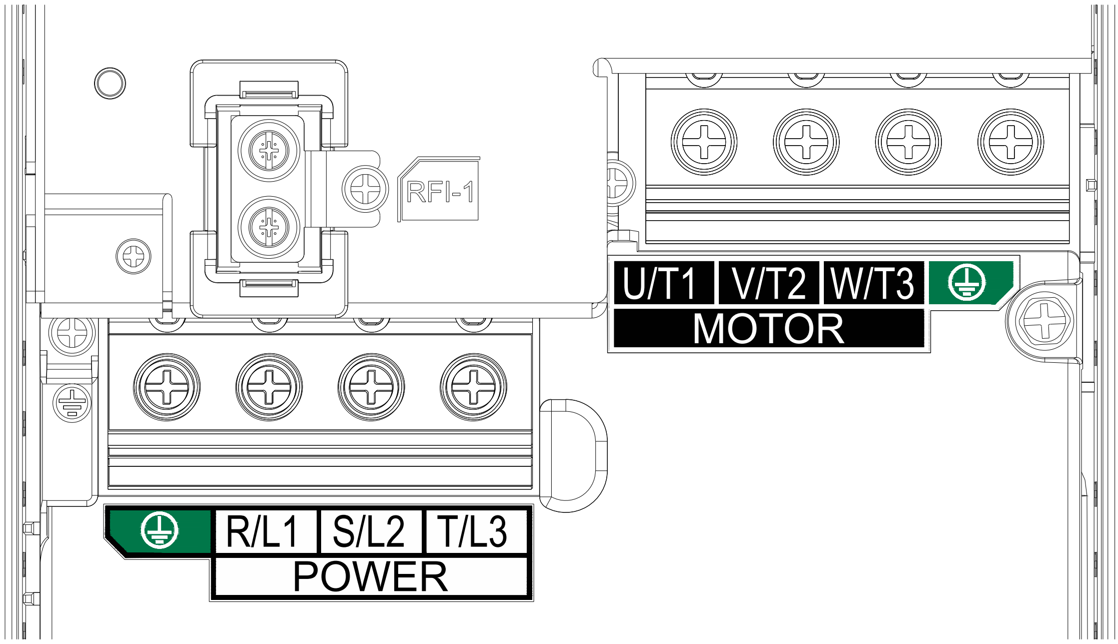


Figure 3-22

- If you install at Ta 50°C environment, use coper wires that have a voltage rating of 600V and are temperature resistance to 75°C or 90°C.
- If you install at Ta 50°C above environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 90°C or above.
- To be UL installation resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire.
- Stripping length: 19–21 mm

Model	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3			Terminal ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))
VFD110VP43BFTCA	50 mm^2 (1/0 AWG)	50 mm^2 (1/0 AWG)	56 kg-cm (48.7 lb-in.) (5.50 Nm)	50 mm^2 (1/0 AWG)	25 mm^2 (3 AWG)	56 kg-cm (48.7 lb-in.) (5.50 Nm)
VFD110VP43BSTCA		50 mm^2 (1/0 AWG)			25 mm^2 (3 AWG)	

Table 3-16

Frame G1

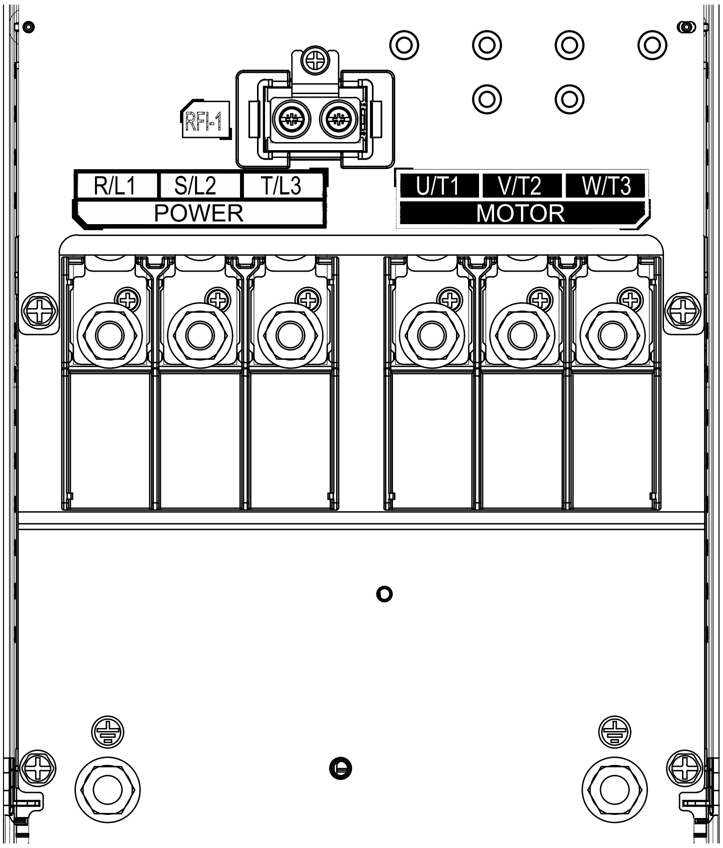


Figure 3-23

- If you install at Ta 50°C environment, use coper wires that have a voltage rating of 600V and are temperature resistance to 75°C or 90°C.
- If you install at Ta 50°C above environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 90°C or above.
- To be UL installation resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire.

Model	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3			Terminal ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))
VFD150VP43AFTCA	35 mm^2*2 (3 AWG*2)	35 mm^2*2 (3 AWG*2)	M8 92 kg-cm (79.9 lb-in.) (9.02 Nm)	35 mm^2 (3 AWG)	35 mm^2 (3 AWG)	M8 92 kg-cm (79.9 lb-in.) (9.02 Nm)

Table 3-17

Frame G2

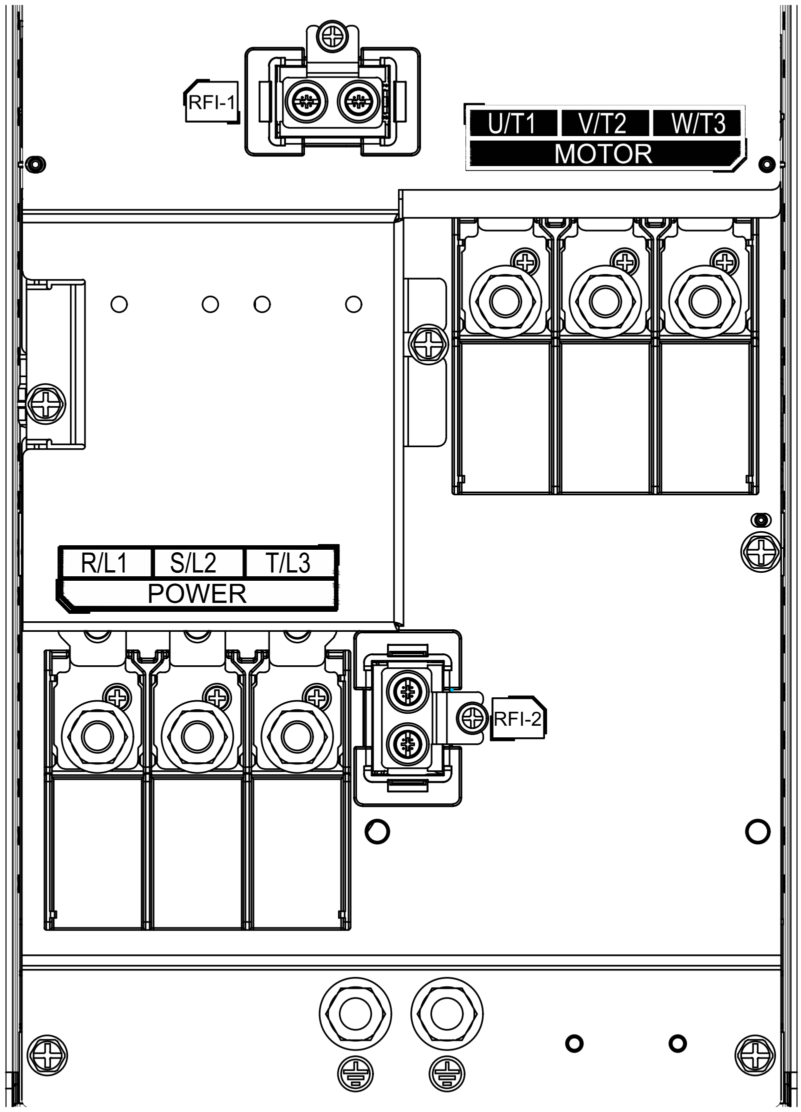


Figure 3-24

- If you install at Ta 50°C environment, use coper wires that have a voltage rating of 600V and are temperature resistance to 75°C or 90°C.
- If you install at Ta 50°C above environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 90°C or above.
- To be UL installation resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire.

Model	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3			Terminal ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))
VFD150VP43BFTCA	35 mm^2*2 (3 AWG*2)	35 mm^2*2 (3 AWG*2)	M8 92 kg-cm (79.9 lb-in.) (9.02 Nm)	35 mm^2 (3 AWG)	35 mm^2 (3 AWG)	M8 92 kg-cm (79.9 lb-in.) (9.02 Nm)
VFD150VP43BSTCA		35 mm^2*2 (3 AWG*2)		35 mm^2 (3 AWG)	35 mm^2 (3 AWG)	

Table 3-18

Frame H1

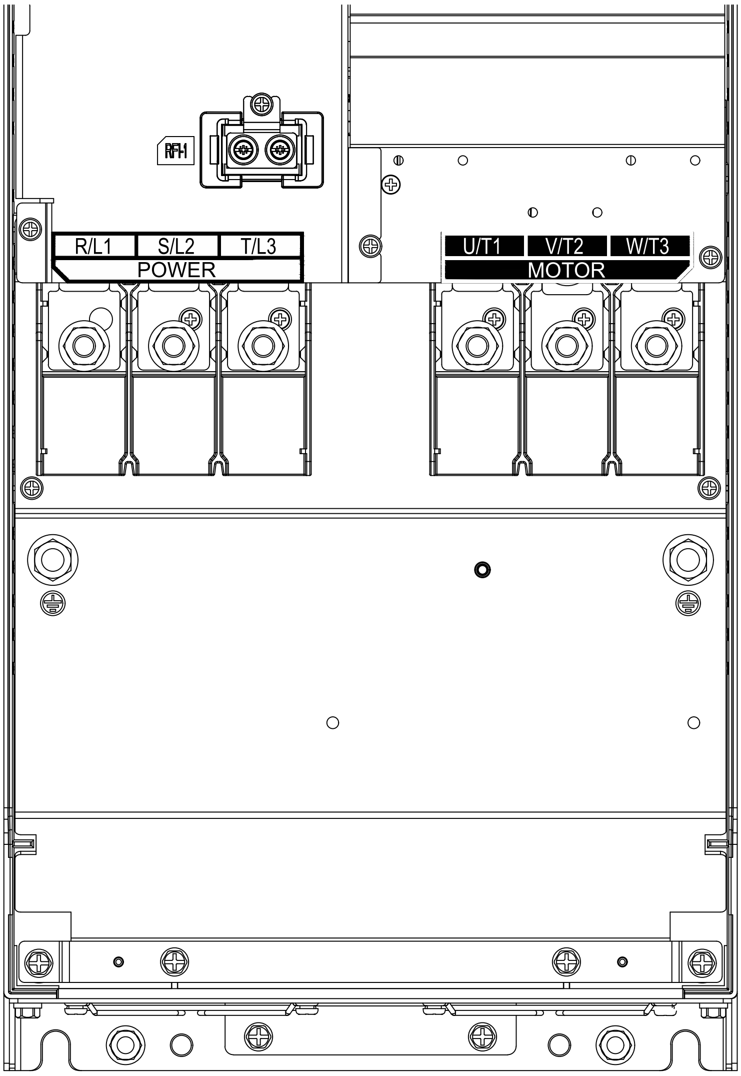


Figure 3-25

- If you install at Ta 50°C environment, use coper wires that have a voltage rating of 600V and are temperature resistance to 75°C or 90°C.
- If you install at Ta 50°C above environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 90°C or above.
- To be UL installation resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire.

Model	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3			Terminal ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))
VFD180VP43AFTCA	50 mm^2*2 (1/0 AWG*2)	35 mm^2*2 (2 AWG*2)	80 kg-cm (69.4 lb-in.) (7.84 Nm)	50 mm^2*2 (1/0 AWG*2)	35 mm^2*2 (2 AWG*2)	80 kg-cm (69.4 lb-in.) (7.84 Nm)
VFD220VP43AFTCA		50 mm^2*2 (1/0 AWG*2)			50 mm^2*2 (1/0 AWG*2)	

Table 3-19

Frame H2

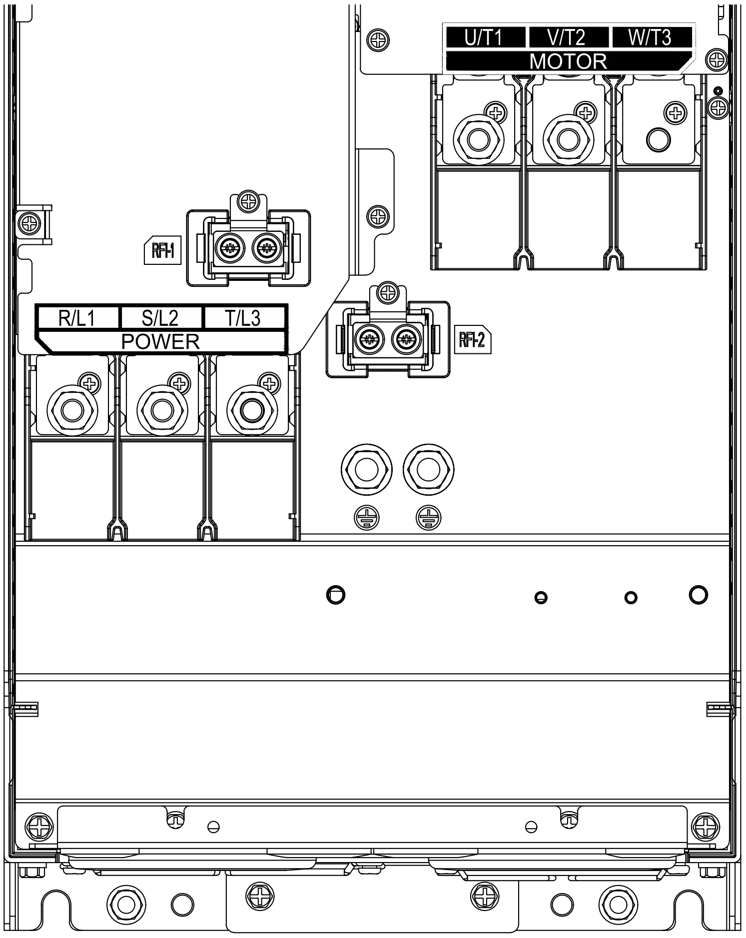


Figure 3-26

- If you install at Ta 50°C environment, use coper wires that have a voltage rating of 600V and are temperature resistance to 75°C or 90°C.
- If you install at Ta 50°C above environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 90°C or above.
- To be UL installation resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire.

Model	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3			Terminal ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))
VFD180VP43BSTCA	50 mm^2*2 (1/0 AWG*2)	35 mm^2*2 (2 AWG*2)	80 kg-cm (69.4 lb-in.) (7.84 Nm)	50 mm^2*2 (1/0 AWG*2)	35 mm^2*2 (2 AWG*2)	80 kg-cm (69.4 lb-in.) (7.84 Nm)
VFD220VP43BSTCA		50 mm^2*2 (1/0 AWG*2)			50 mm^2*2 (1/0 AWG*2)	
VFD180VP43BFTCA		35 mm^2*2 (2 AWG*2)			35 mm^2*2 (2 AWG*2)	
VFD220VP43BFTCA		50 mm^2*2 (1/0 AWG*2)			50 mm^2*2 (1/0 AWG*2)	

Table 3-20

Frame I

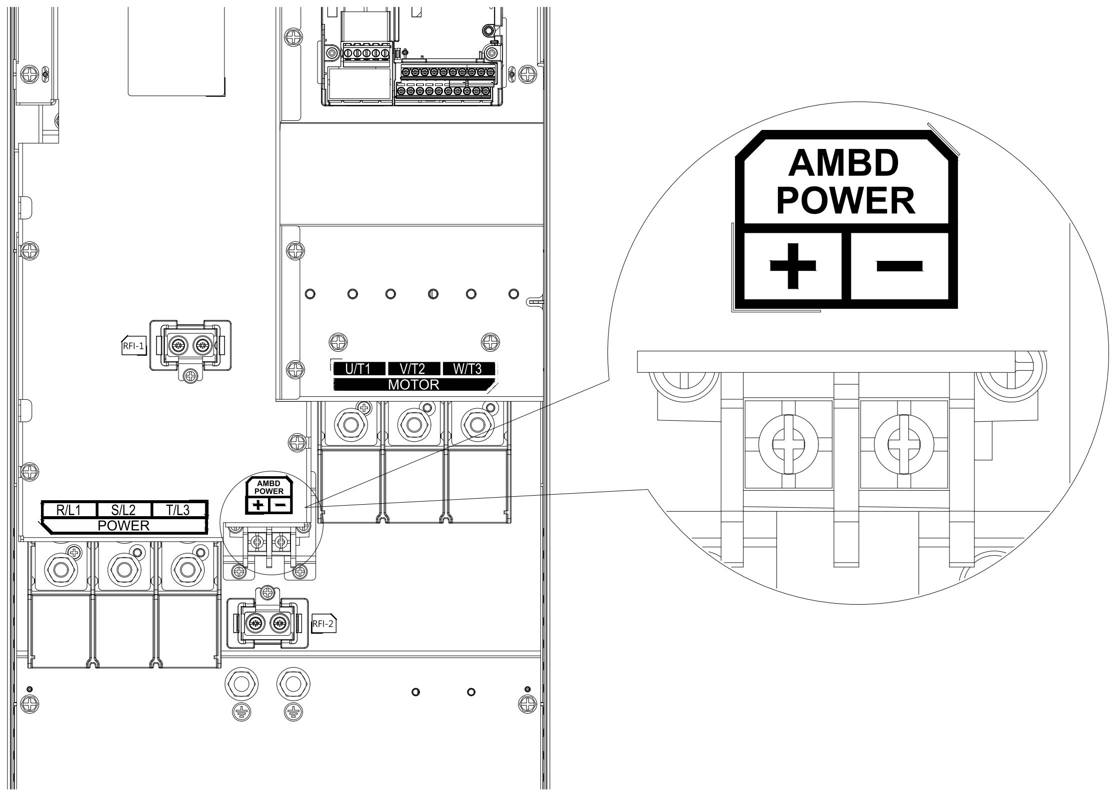


Figure 3-27

- If you install at Ta 50°C environment, use coper wires that have a voltage rating of 600V and are temperature resistance to 75°C or 90°C.
- If you install at Ta 50°C above environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 90°C or above.
- To be UL installation resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire.
- For AMBD Terminal, use wires that are recognized by UL or IEC with a voltage resistance of 600 V_{AC} or above, and are temperature resistance to 90°C or above.

Model	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3			Terminal ⏚			AMBD Terminal		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)
VFD260VP43AFTCA	120 mm^2*2 (4/0 AWG*2)	70 mm^2*2 (2/0 AWG*2)	M8 92 kg-cm (79.9 lb-in.) (9.02 Nm)	120 mm^2 (4/0 AWG)	70 mm^2 (2/0 AWG)	M8 92 kg-cm (79.9 lb-in.) (9.02 Nm)	1.5 mm^2 (16 AWG*1)	0.5 mm^2 (20 AWG*1)	M4 15 kg-cm (13.1 lb-in.) (1.47 Nm)
VFD310VP43AFTCA		95 mm^2*2 (3/0 AWG*2)			95 mm^2 (3/0 AWG)				
VFD260VP43BFTCA		70 mm^2*2 (2/0 AWG*2)			70 mm^2 (2/0 AWG)				
VFD310VP43BFTCA		95 mm^2*2 (3/0 AWG*2)			95 mm^2 (3/0 AWG)				
VFD260VP43BSTCA		70 mm^2*2 (2/0 AWG*2)			70 mm^2 (2/0 AWG)				
VFD310VP43BSTCA		95 mm^2*2 (3/0 AWG*2)			95 mm^2 (3/0 AWG)				

Table 3-21

Frame J

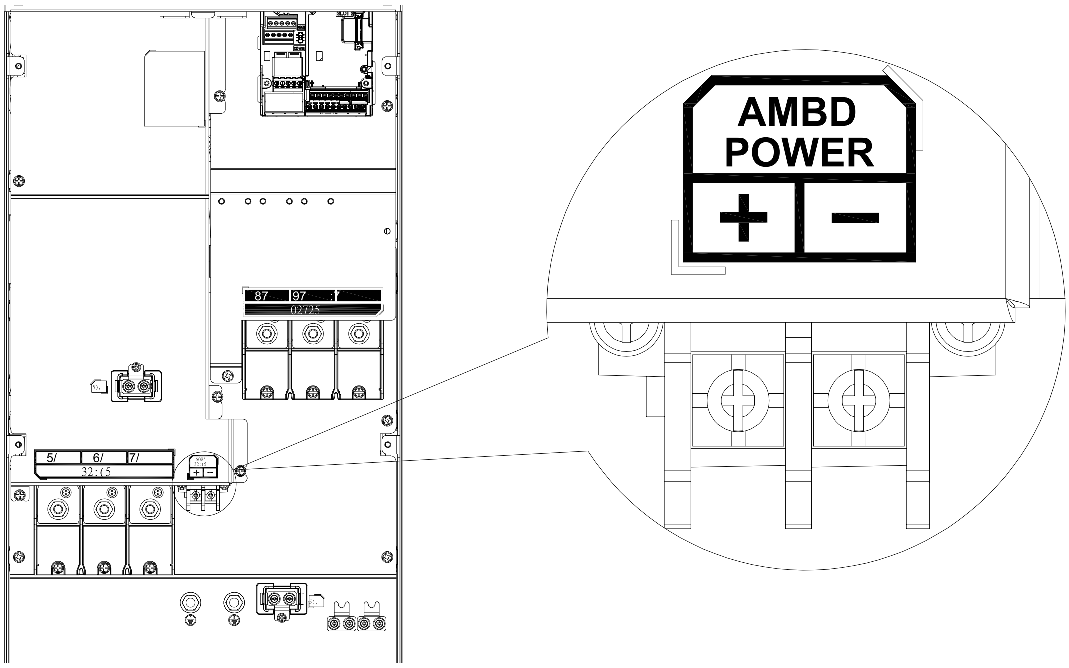


Figure 3-28

- If you install at Ta 45°C environment, use coper wires that have a voltage rating of 600V and are temperature resistance to 75°C or 90°C.
- For VFD395VP43xxTCA models: if you install at Ta 45°C above environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 90°C or above.
- To be UL installation resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire.
- For AMBD Terminal, use wires that are recognized by UL or IEC with a voltage resistance of 600 V_{AC} or above, and are temperature resistance to 90°C or above.

<table>
<tr><th rowspan="2">Model</th><th colspan="3">Main Circuit Terminals
R/L1, S/L2, T/L3, U/T1, V/T2, W/T3</th><th colspan="3">Terminal ⏚</th><th colspan="3">AMBD Terminal</th></tr>
<tr><th>Max. Wire Gauge</th><th>Min. Wire Gauge</th><th>Screw Spec. and Torque (±10%))</th><th>Max. Wire Gauge</th><th>Min. Wire Gauge</th><th>Screw Spec. and Torque (±10%))</th><th>Max. Wire Gauge</th><th>Min. Wire Gauge</th><th>Screw Spec. and Torque (±10%)</th></tr>
<tr><td>VFD370VP43AFTCA</td><td rowspan="6">150 mm²*2
(300 MCM*2)</td><td>120 mm²*2
(250 MCM*2)</td><td rowspan="6">M8
92 kg-cm
(79.9 lb-in.)
(9.02 Nm)</td><td>150 mm²
(300 MCM)</td><td>120 mm²
(250 MCM)</td><td rowspan="6">M8
92 kg-cm
(79.9 lb-in.)
(9.02 Nm)</td><td rowspan="6">1.5 mm²
(16 AWG*1)</td><td rowspan="6">0.5 mm²
(20 AWG*1)</td><td rowspan="6">M4
15 kg-cm
(13.1 lb-in.)
(1.47 Nm)</td></tr>
<tr><td>VFD395VP43AFTCA</td><td>120 mm²*2
(250 MCM*2)</td><td>150 mm²
(300 MCM)</td><td>120 mm²
(250 MCM)</td></tr>
<tr><td>VFD370VP43BFTCA</td><td>120 mm²*2
(250 MCM*2)</td><td>150 mm²
(300 MCM)</td><td>120 mm²
(250 MCM)</td></tr>
<tr><td>VFD395VP43BFTCA</td><td>120 mm²*2
(250 MCM*2)</td><td>150 mm²
(300 MCM)</td><td>120 mm²
(250 MCM)</td></tr>
<tr><td>VFD370VP43BSTCA</td><td>120 mm²*2
(250 MCM*2)</td><td>150 mm²
(300 MCM)</td><td>120 mm²
(250 MCM)</td></tr>
<tr><td>VFD395VP43BSTCA</td><td>120 mm²*2
(250 MCM*2)</td><td>150 mm²
(300 MCM)</td><td>120 mm²
(250 MCM)</td></tr>
</table>

Table 3-22

Frame K

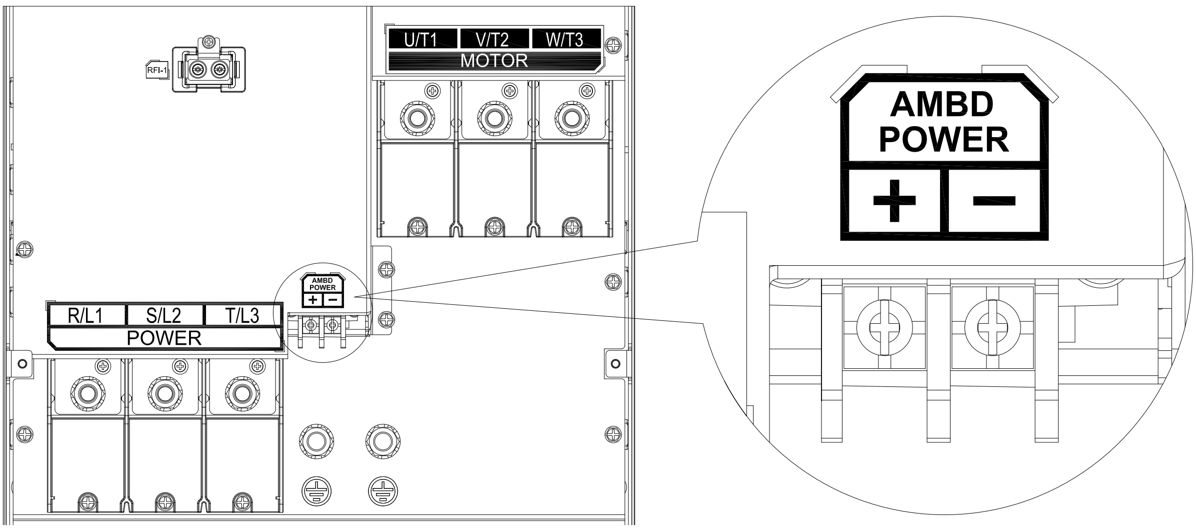


Figure 3-29

- If you install at Ta 50°C environment, use coper wires that have a voltage rating of 600V and are temperature resistance to 75°C or 90°C.
- If you install at Ta 50°C above environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 90°C or above.
- To be UL installation resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire.
- For AMBD Terminal, use wires that are recognized by UL or IEC with a voltage resistance of 600 V_{AC} or above, and are temperature resistance to 90°C or above.

Model	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3			Terminal ⏚			AMBD Terminal		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)
VFD460VP43AFTCA	240 mm²*2 (400 MCM*2)	185 mm²*2 (350 MCM*2)	M10 153 kg-cm (132.8 lb-in.) (15.00 Nm)	240 mm² (400 MCM)	185 mm² (350 MCM)	M10 153 kg-cm (132.8 lb-in.) (15.00 Nm)	1.5 mm² (16 AWG*1)	0.5 mm² (20 AWG*1)	M4 15 kg-cm (13.1 lb-in.) (1.47 Nm)
VFD485VP43AFTCA		185 mm²*2 (350 MCM*2)		240 mm² (400 MCM)	185 mm² (350 MCM)				
VFD460VP43BFTCA		185 mm²*2 (350 MCM*2)		240 mm² (400 MCM)	185 mm² (350 MCM)				
VFD485VP43BFTCA		185 mm²*2 (350 MCM*2)		240 mm² (400 MCM)	185 mm² (350 MCM)				
VFD460VP43BSTCA		185 mm²*2 (350 MCM*2)		240 mm² (400 MCM)	185 mm² (350 MCM)				
VFD485VP43BSTCA		185 mm²*2 (350 MCM*2)		240 mm² (400 MCM)	185 mm² (350 MCM)				

Table 3-23

Frame L

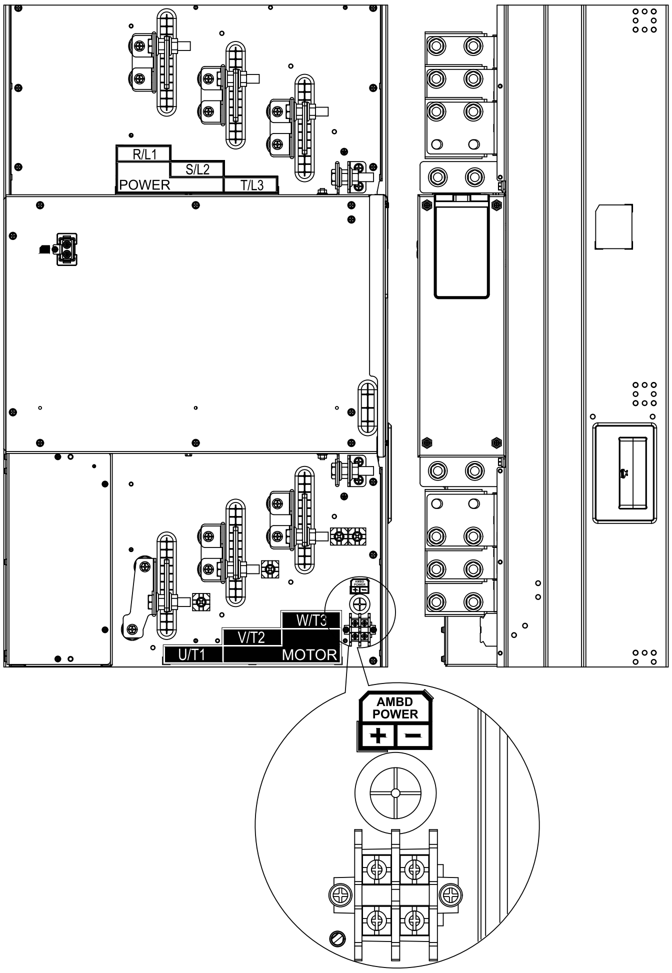


Figure 3-30

- If you install at Ta 50°C environment, use coper wires that have a voltage rating of 600V and are temperature resistance to 75°C or 90°C.
- If you install at Ta 50°C above environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 90°C or above.
- To be UL installation resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire.
- For AMBD Terminal, use wires that are recognized by UL or IEC with a voltage resistance of 600 V_{AC} or above, and are temperature resistance to 90°C or above.

Model	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3			Terminal ⏚			AMBD Terminal		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)
VFD530VP43SHTCA	150 mm^2*4 (300 MCM*4)	70 mm^2*4 (2/0 AWG*4)	M12 360 kg-cm (312.5 lb-in.) (35.28 Nm)	150 mm^2*2 (300 AWG*2)	70 mm^2*2 (2/0 AWG*2)	M12 360 kg-cm (312.5 lb-in.) (35.28 Nm)	1.5 mm^2 (16 AWG*1)	0.5 mm^2 (20 AWG*1)	M4 15 kg-cm (13.1 lb-in.) (1.47 Nm)
VFD616VP43SHTCA		95 mm^2*4 (3/0 AWG*4)			95 mm^2*2 (3/0 AWG*2)				
VFD683VP43SHTCA		120 mm^2*4 (4/0 AWG*4)			120 mm^2*2 (4/0 AWG*2)				
VFD770VP43SHTCA		120 mm^2*4 (250 MCM*4)			120 mm^2*2 (250 MCM*2)				

Table 3-24

Frame M

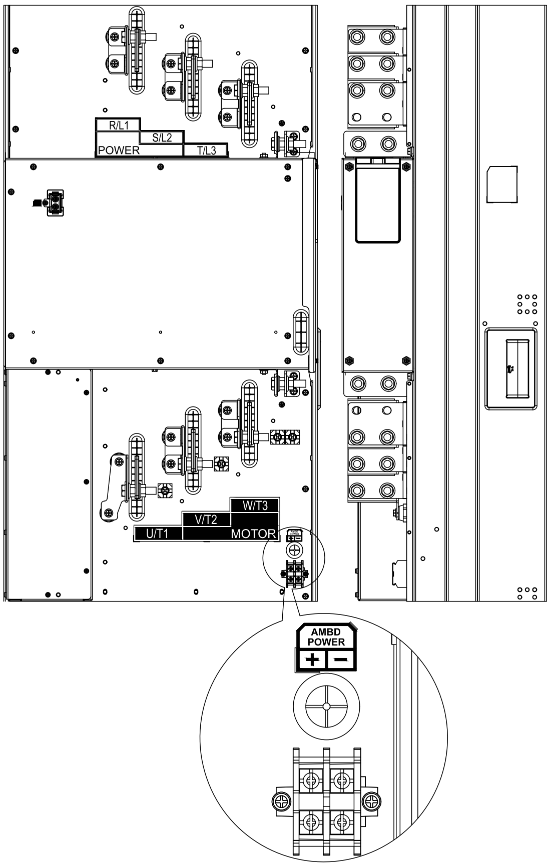


Figure 3-31

- If you install at Ta 50°C environment, use coper wires that have a voltage rating of 600V and are temperature resistance to 75°C or 90°C.
- If you install at Ta 50°C above environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 90°C or above.
- For VFD1K1VP43SHTCA models: if you install at Ta 45°C above environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 90°C or above.
- For VFD1K2VP43SHTCA models: if you install at Ta 35°C above environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 90°C or above.
- To be UL installation resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire.
- For AMBD Terminal, use wires that are recognized by UL or IEC with a voltage resistance of 600 V_{AC} or above, and are temperature resistance to 90°C or above.

Model	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3			Terminal ⏚			AMBD Terminal		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)
VFD866VP43SHTCA	240 mm²*4 (500 MCM*4)	150 mm²*4 (300 MCM*4)	M12 360 kg-cm (312.5 lb-in.) (35.28 Nm)	240 mm²*2 (500 MCM*2)	150 mm²*2 (300 MCM*2)	M12 360 kg-cm (312.5 lb-in.) (35.28 Nm)	1.5 mm² (16 AWG*1)	0.5 mm² (20 AWG*1)	M4 15 kg-cm (13.1 lb-in.) (1.47 Nm)
VFD930VP43SHTCA		185 mm²*4 (350 MCM*4)			185 mm²*2 (350 MCM*2)				
VFD1K1VP43SHTCA		240 mm²*4 (500 MCM*4)			240 mm²*2 (500 MCM*2)				
VFD1K2VP43SHTCA		240 mm²*4 (500 MCM*4)			240 mm²*2 (500 MCM*2)				

Table 3-25

3-4 Control Circuits

3-4-1 Wiring

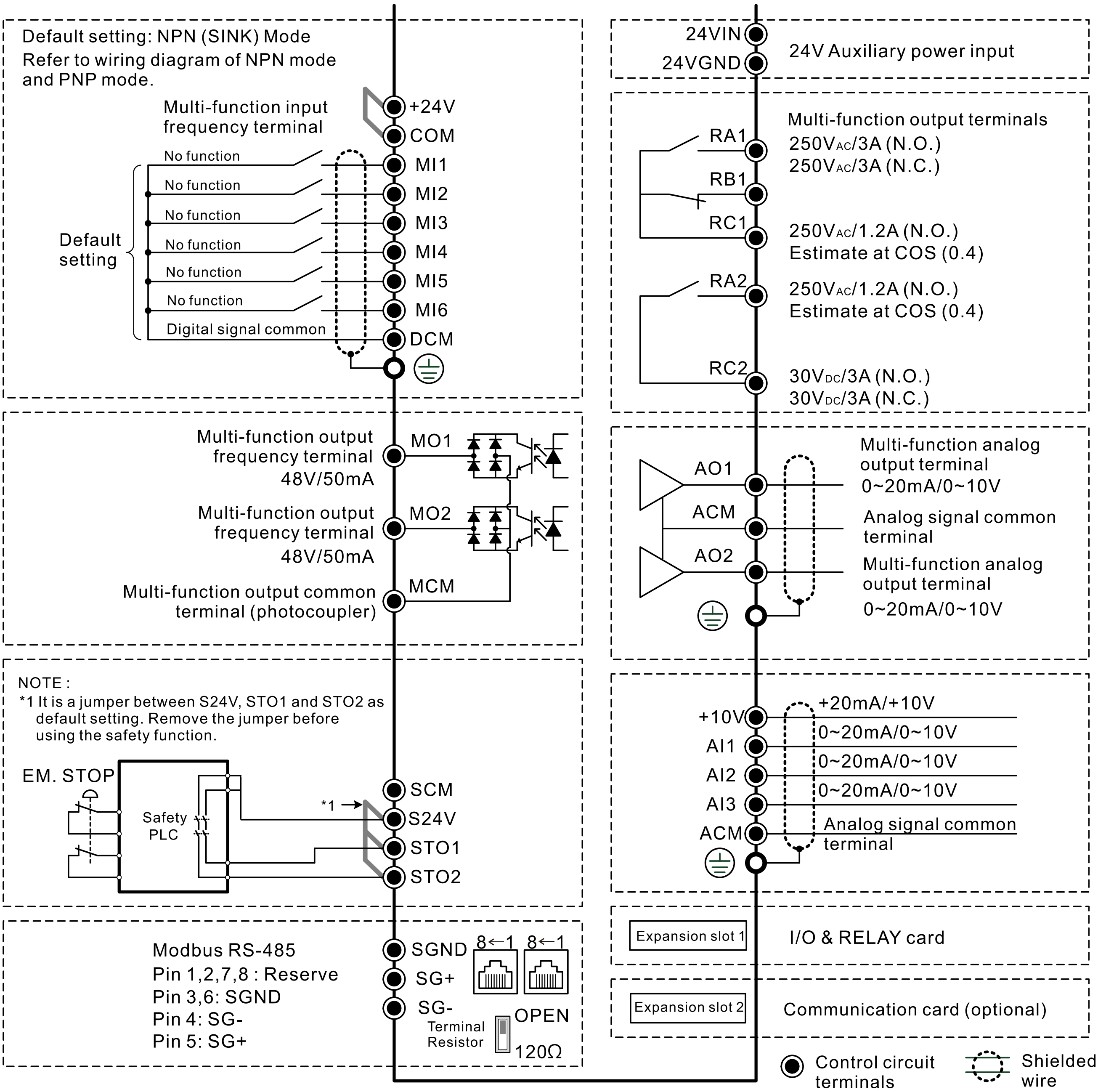


Figure 3-32

- SINK (NPN) / SOURCE (PNP) Mode

Sink Mode

With internal power (+24 V_{DC})

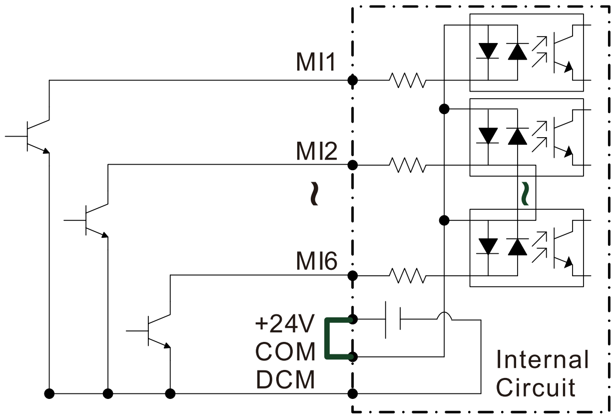


Figure 3-33

Source Mode

With internal power (+24 V_{DC})

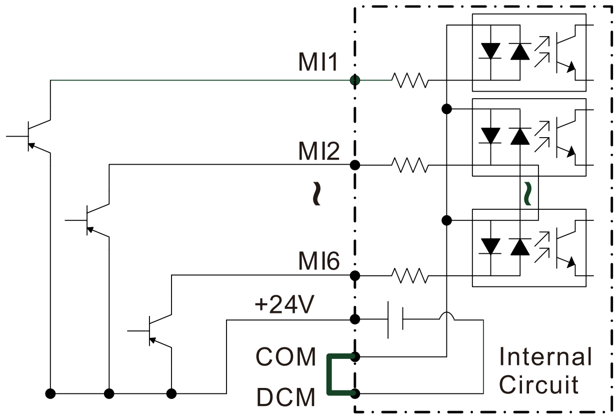


Figure 3-34

Sink Mode

With external power

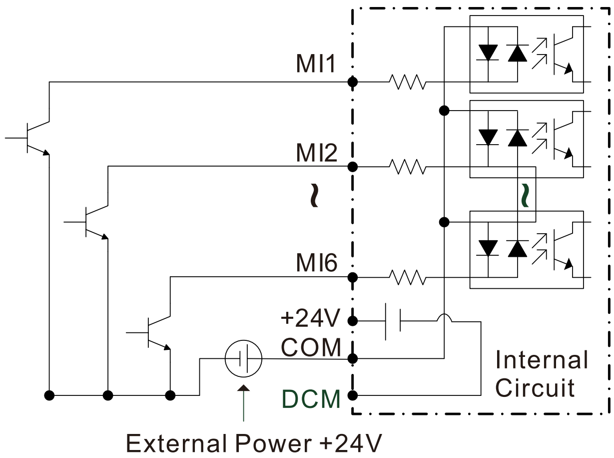


Figure 3-35

Source Mode

With external power

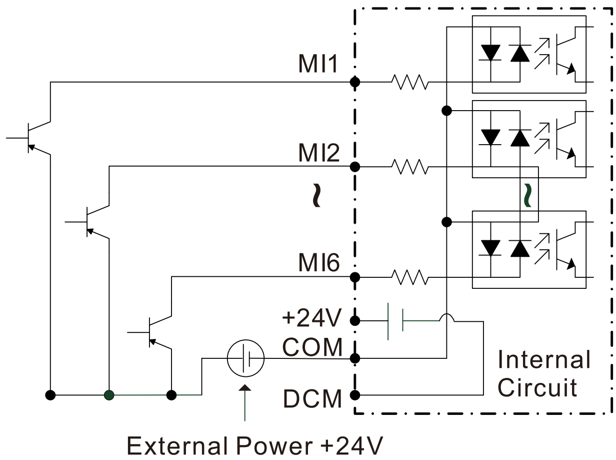


Figure 3-36

3-4-1-1 The Wiring of Multi-pump Controlled Communication Cable

To use multi-pump function, you have to connect the first RS-485 port of each station in parallel (SG+/ SG-) or use a network cable to plug into the RJ45 communication port of each station.

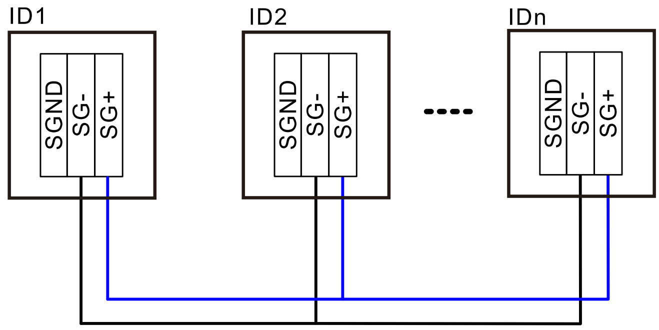


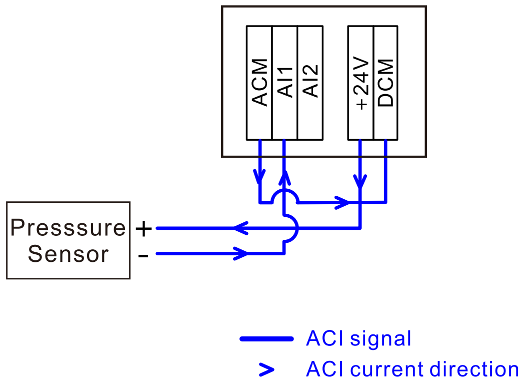
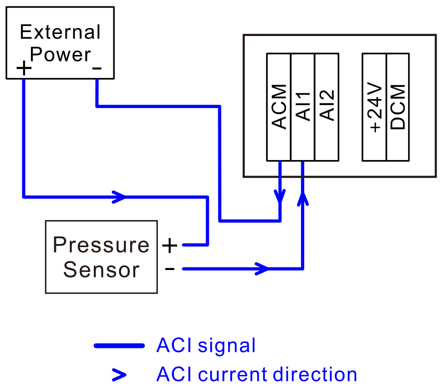
Figure 3-37

3-4-1-2 The Wiring of Pressure Sensor

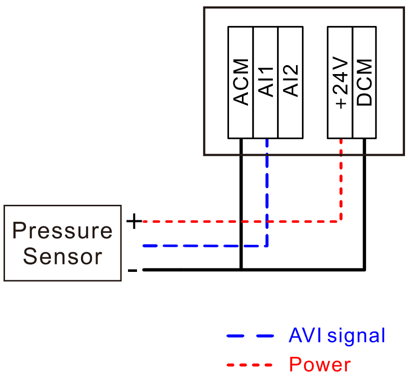
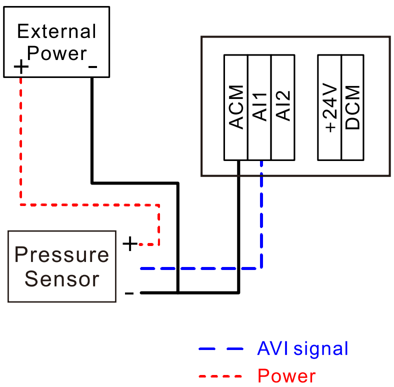
Set multi-master for the auto-change pump system, if require using the pressure feedback sensor signals to control the constant pressure in system, both master station and backup master station must have pressure signals feedback. In the situation, you can set one more pressure sensor for transferring feedback signals to the backup master station, or master station and backup master station use the same one.

Single pump: one pressure sensor to one drive

- ACI

Sensor using internal power	Sensor using external power
 Figure 3-38	 Figure 3-39

- AVI

Sensor using internal power	Sensor using external power
 Figure 3-40	 Figure 3-41

Multi-pump: one pressure sensor to more than one drive

- ACI

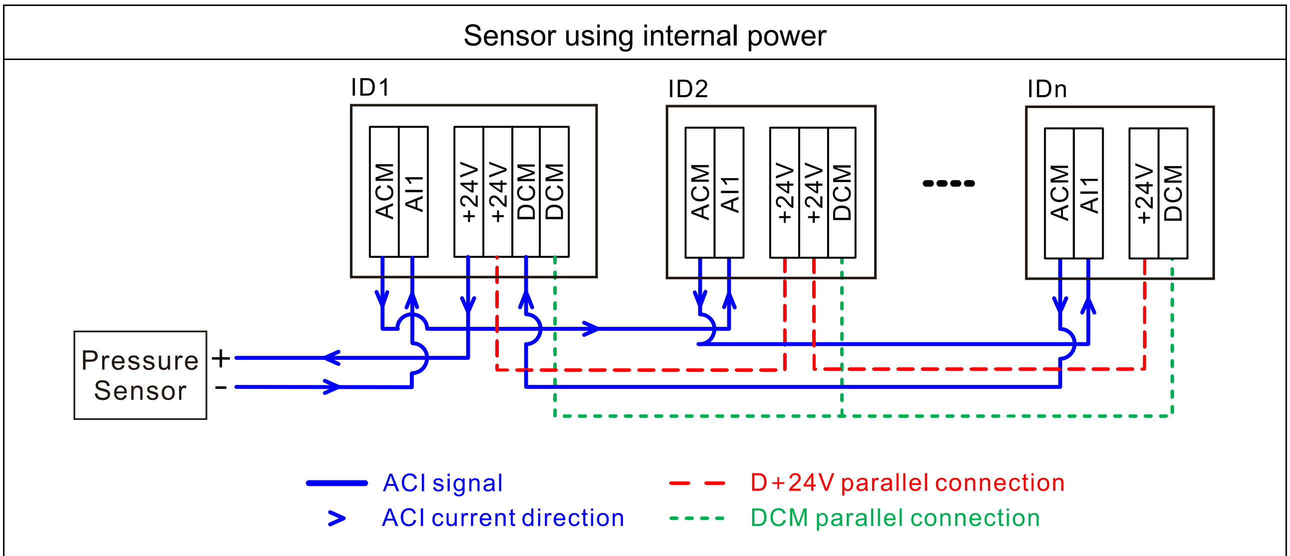


Figure 3-42

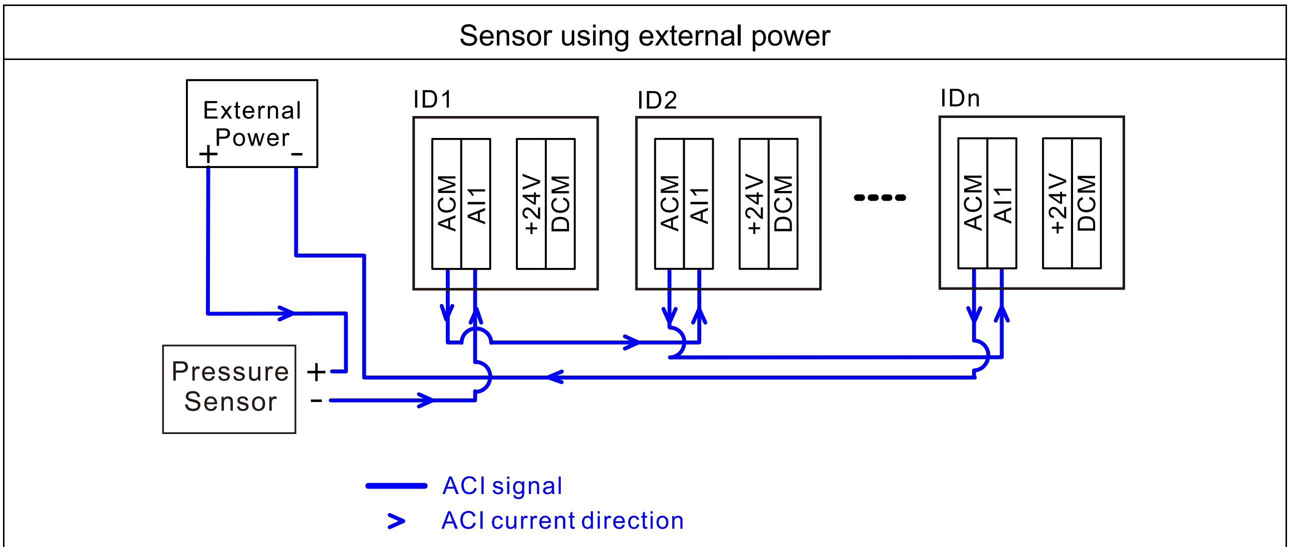


Figure 3-43

- AVI

Sensor using internal power

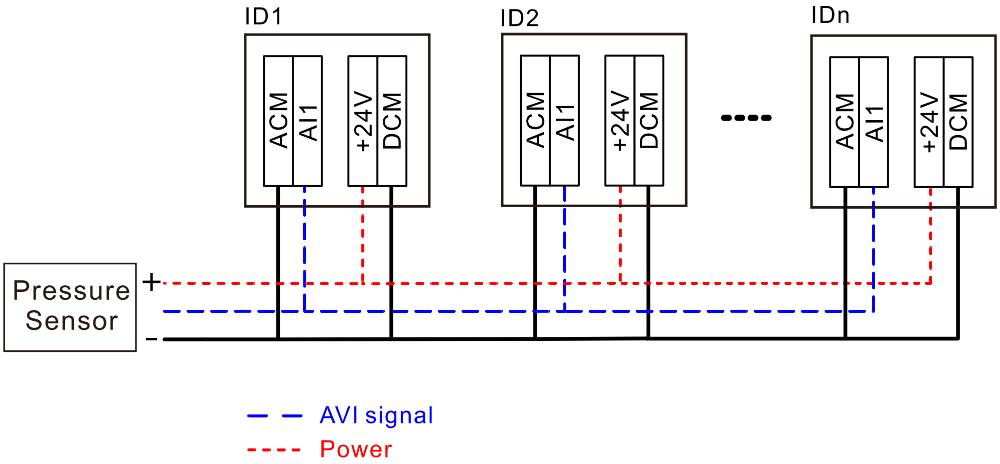


Figure 3-44

Sensor using external power

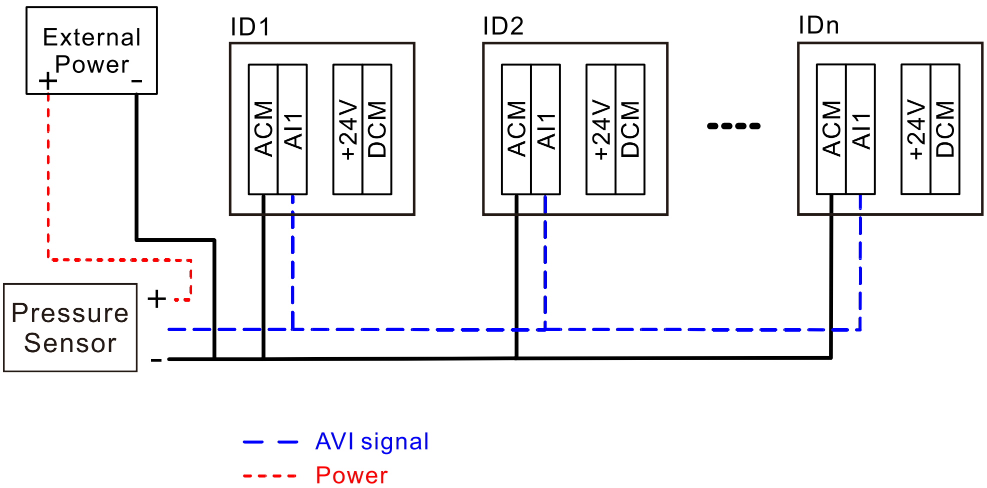


Figure 3-45

3-4-2 Terminal Specification

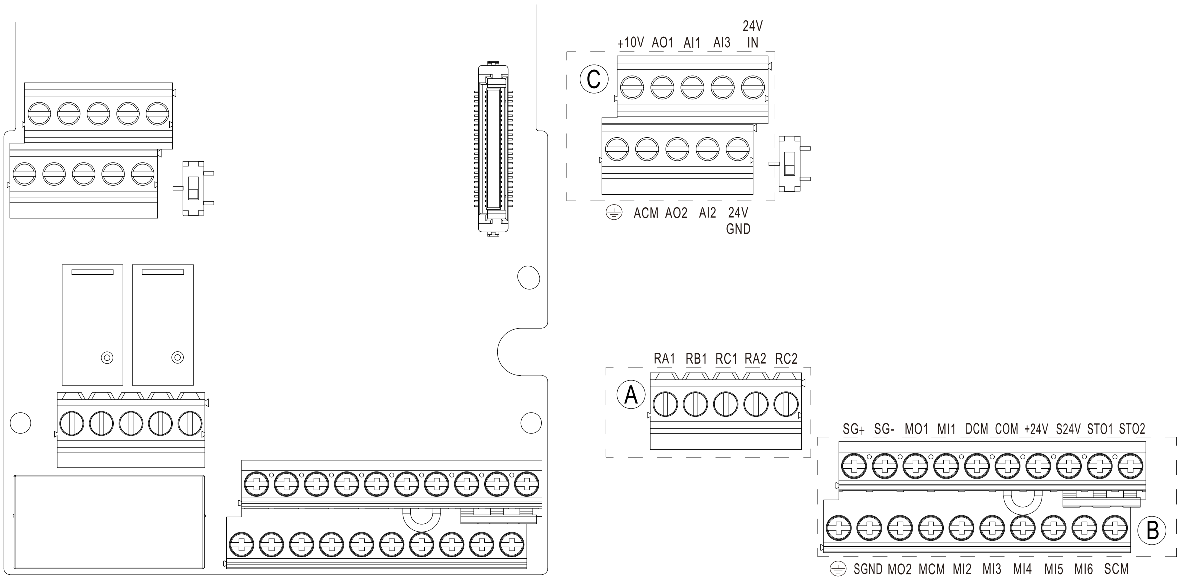


Figure 3-46

Terminal Name	Area	Conductor	Stripping Length (mm)	Max. Wire Gauge	Min. Wire Gauge	Tightening Torque (±10%))
Relay Terminals	Ⓐ	Solid wire	6–7	0.75 mm^2 (18 AWG)	0.2 mm^2 (24 AWG)	5 kg-cm (4.3 lb-in.) (0.49 Nm)
		Stranded wire				
Control Terminals	Ⓑ	Solid wire				
		Stranded wire				
Control Terminals	Ⓒ	Solid wire				
		Stranded wire				

Table 3-26

Wiring Precautions:

- In the figure above, the default for STO1, STO2 and +24V are short-circuited. Use the +24V power supply of the safety function (as shown in section Ⓑ of above figure) for STO only. Do NOT use it for other purposes. The default setting for +24V-COM is short-circuited and SINK mode (NPN); refer to Chapter 3 Wiring for detail.
- Tighten the wiring with slotted screwdriver: 3.5 mm (wide) x 0.4 mm (thick)
- When wiring bare wires, ensure that they are perfectly arranged to go through the wiring holes.

Terminals Name	Terminal Function	Descriptions
+24V	+24V power supply	+24 V_{DC} ± 10% 200 mA For DI/O use
COM	Digital control signal common (Sink)	Multi-function input common terminal
MI1 | MI6	Multi-function Input Selection 1–6	MI1–MI6 support three-wire / two-wire control MI5 supports pulse input (basic input frequency 599 Hz) Refer to the MI setting in Parameter Group G0 for MI1–MI6 function selection. Source Mode: ON: activation voltage ≥ 15 V_{DC} OFF: cut-off voltage ≤ 5 V_{DC}

Terminals Name	Terminal Function	Descriptions
		Sink Mode: ON: activation voltage ≤ 9 V_{DC} OFF: cut-off voltage ≥ 19 V_{DC}
DCM	Digital frequency signal common	Digital frequency signal common
MO1 | MO2	Multi-function Output 1–2 (photo coupler)	MO2 supports single-pulse output (basic output frequency 599 Hz) As pulse output: max. current 48 V_{DC} / 50 mA Not as pulse output: max. current 48 V_{DC} / 25 mA
MCM	Multi-function Output Common (photo coupler)	Multi-function Output Common
RA1	Multi-function relay output 1 (N.O.) a	To output various kinds of monitoring signals such as motor drive in operation, frequency reached, and overload indication. Resistive Load 3 A (N.O.) / 3 A (N.C.) 250 V_{AC} 3 A (N.O.) / 3 A (N.C.) 30 V_{DC} Inductive Load (COS 0.4) 1.2 A (N.O.) / 1.2 A (N.C.) 250 V_{AC} 1.2 A (N.O.) / 1.2 A (N.C.) 30 V_{DC}
RB1	Multi-function relay output 1 (N.C.) b	
RC1	Multi-function relay common (Relay)	
RA2	Multi-function relay output 2 (N.O.) a	
RC2	Multi-function relay common (Relay)	
+10V	Potentiometer power supply	Power supply for analog frequency setting: +10–11 V_{DC} / 20 mA
AI1 – AI3	Analog voltage frequency command	● The three analog input formats all support 0–10 V (AI3 default) and 0–20 mA / 4–20 mA (AI1 / AI2 default) ● Voltage type input resistance: 164 kΩ; Current type input resistance: 250 Ω ● The three analog input formats all support KTY84-130, PTC, PT100 and PT1000. It is recommended to use current signal input. Temperature range -20–200°C
AO1	Multi-function analog voltage output	● The two analog inputs both support 0–+10V / 0–20 mA / 4–20 mA ● Under voltage mode (0–10 V), the max. output current is 2 mA ● Voltage type load limit: > 5 kΩ; Current type load limit: < 500 Ω
AO2		
ACM	Analog Signal Common	Analog signal common terminal
24VIN	24V auxiliary power input	When the drive uses AC power input to the RST terminal, all functions of the drive work normally. When the above power supply at the input side of the drive is forced to be cut off due to the supply end, the drive is powered off and shut down. Some functions can continue operate through the 24V auxiliary power input, as follows: 1. All communication cards work normally 2. Parameters and be read, written, and copied through keypad, RS-485, USB and communication cards. 3. Keypad is able to display and operate normally

Terminals Name	Terminal Function	Descriptions
		4. Analog input can be read and written normally 5. When Digital I/O uses external input, the 24 V_{DC} power supplies normally (refer to external power Sink / Source mode) ● Input voltage range: 24V ± 5% **NOTE:** the following functions cannot work Relay output, I/O extension card and PLC function
24V GND	24V auxiliary power input common	For 24 Vin use
STO1	Default short circuit of STO1-STO2-S24V (disable STO function). Only provide Source trigger mode. Built-in STO/SIL3 according to IEC61800-5-2, EN 61508 SIL3/ EN ISO 13849-1 PLe STO1–SCM; STO2–SCM ON: voltage ≥ 15 V_{DC} STO1–SCM; STO2–SCM OFF: voltage ≤ 5 V_{DC} S24V–SCM only use for STO1 and STO2 circuit	
STO2		
S24V		
SCM	STO1, STO2 and S24V common	
SG+	Modbus RS-485	
SG-		
SGND		
RJ45	PIN1, 2, 7, 8: Reserve PIN3, 6: SGND PIN4: SG- PIN5: SG+	

Table 3-27

NOTE: When the drive input side is connected to USB (not connected to the RST main power supply), it mainly provides parameter reading, writing and software burning function, other functions (including control terminals) cannot be used.

3-4-3 Calendar Battery Installation

To ensure the calendar function is normal, check and install the CR2032 battery and adjust the time before use. Follow the following steps to install the battery:

1. Press and hold the top tab of the keypad panel and pull forward (outward) to remove it.

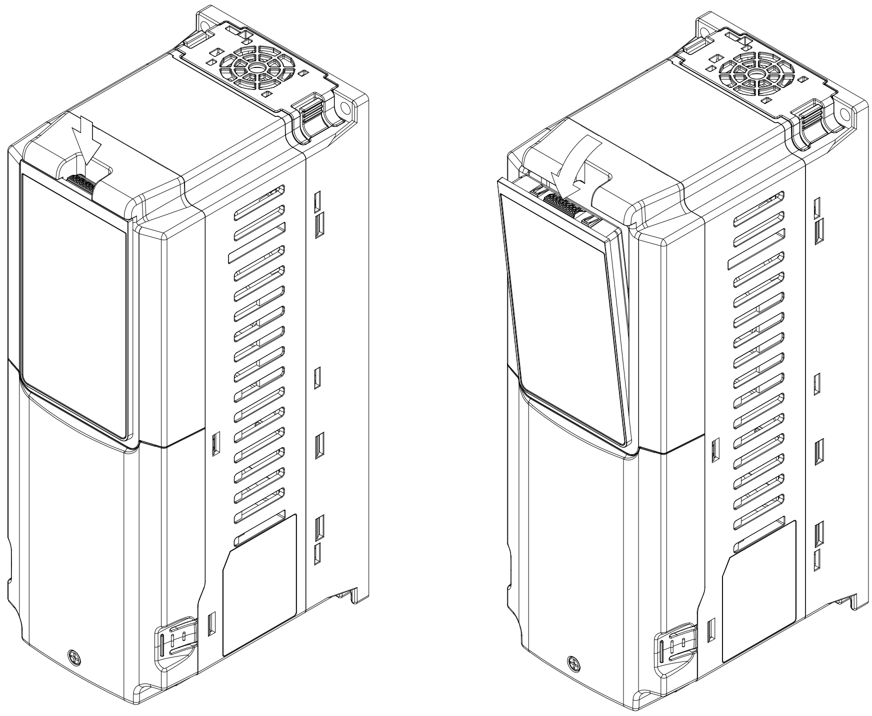


Figure 3-47

2. Press inward both sides of the bottom of the cover as the arrows indicated in the figure below and lift it up to remove the bottom cover.

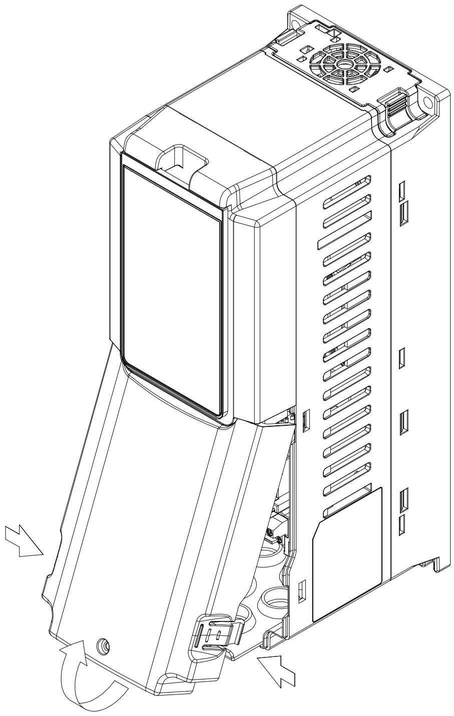


Figure 3-48

3. Press inward both sides at the middle of the drive as the arrows indicated in the figure below and lift it up to remove the top cover.

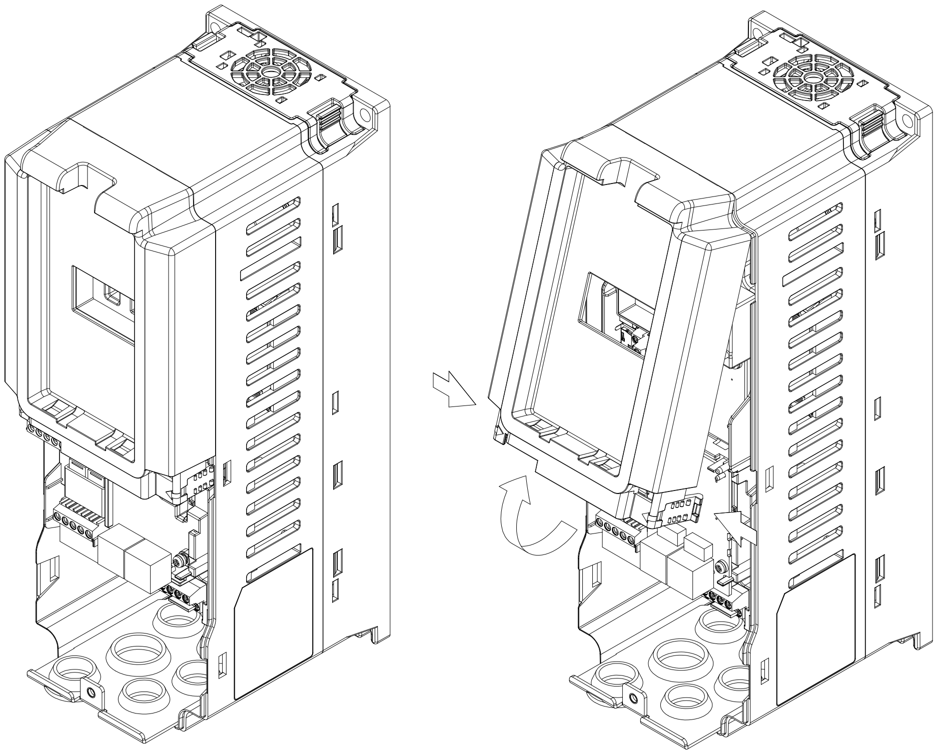


Figure 3-49

4. Install the battery. The battery holder locates on the upper left half of the drive. Put the CR2032 battery in and press it down so that it is flat on the battery holder and placed in the hook.

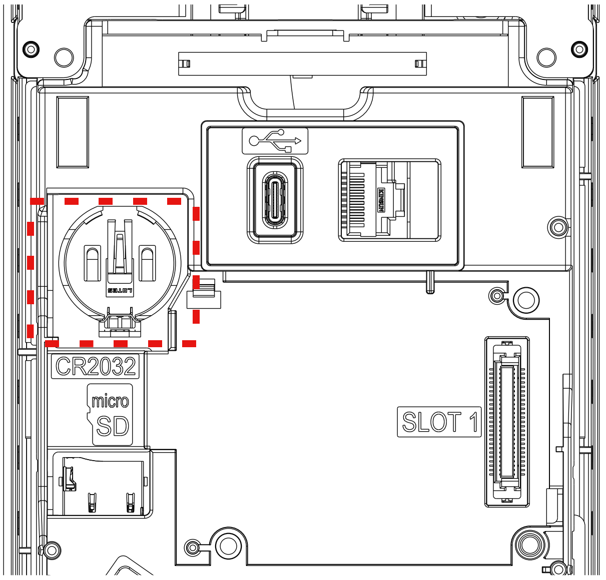


Figure 3-50

5. Install the top cover, put the buckle at the front end of the cover towards the top of the drive, press down the bottom edge of the cover so that the hooks on both sides stick in the middle of the drive.
6. Install the bottom cover, put the buckle at the front end of the cover into the bottom edge of the top cover, press down the bottom edge of the cover so that the hooks on both sides stick on the bottom of the drive.
7. Install the keypad panel, put the bottom edge of the panel against the bottom of the panel-shape groove of the drive, press the upper edge of the panel down to fit into the groove, and the battery installation is completed.

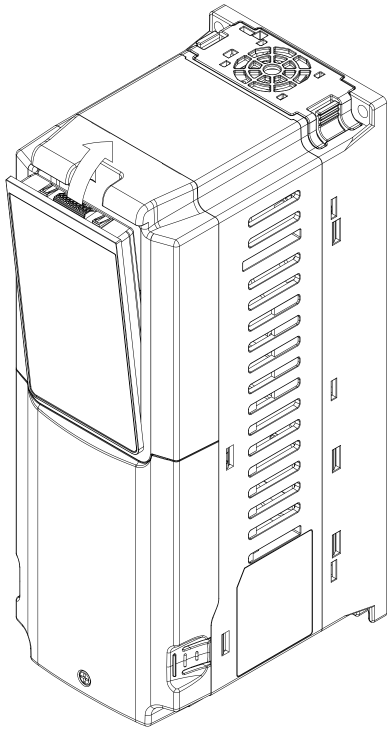


Figure 3-51

NOTE: When you need to replace the battery, after performing steps 1–3, press down the battery hook to pop up the battery and take it off, and then perform steps 4–7 in sequence.

3-5 Safe Torque Off

3-5-1 Basic Function

The VP3000 series provide a Safe Torque Off (STO) function, through the dual-channel STO_1 and STO_2 signal input to turn off the IGBT switching, prevent the motor from generating torque, so as to achieve the purpose of safe stop. Refer to Figure 3-43 for STO circuit diagram.

VP3000 STO function comply with the following regulations:

- ISO 13849-1:2015 Category 3 PL e
- IEC 61508 SIL3
- EN 62061 SIL CL 3
- EN 60204-1 Category 0

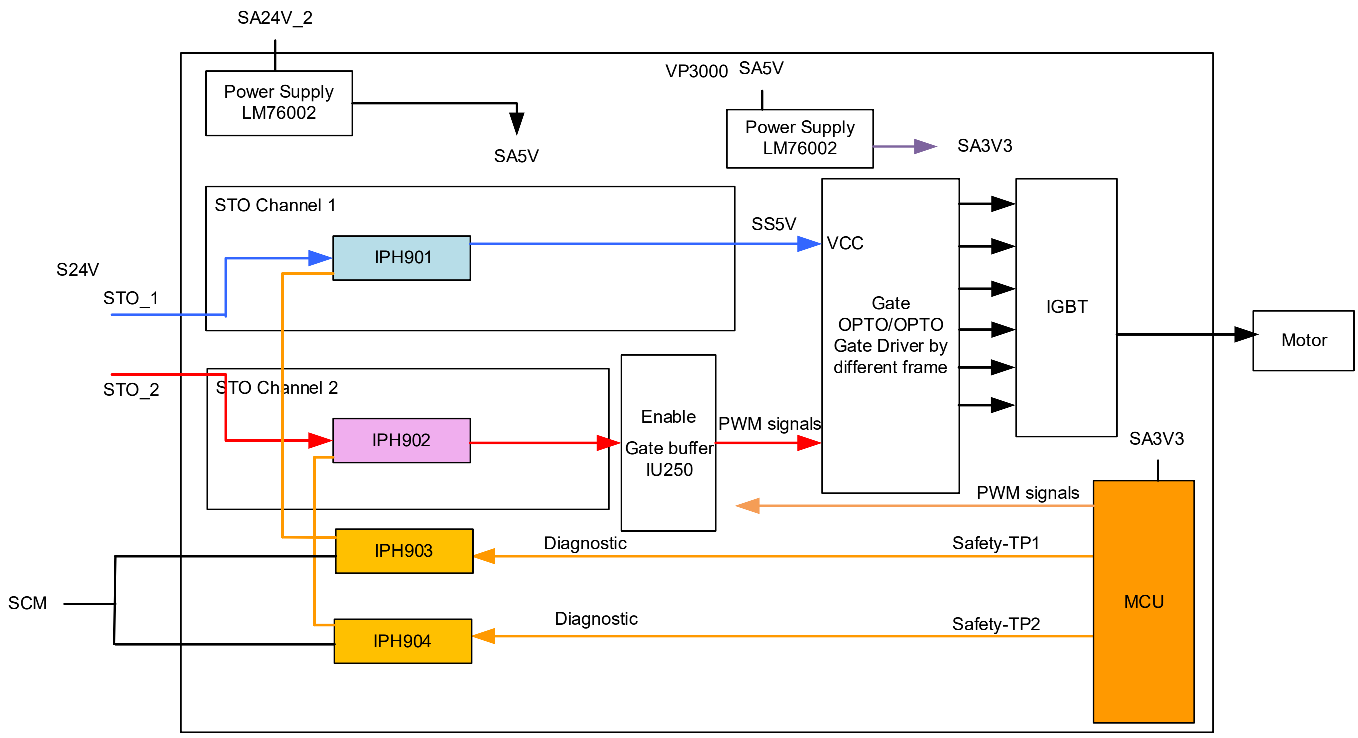


Figure 3-52

3-5-2 STO Failure Rate

Refer to the table below for the safe parameters of STO function:

Item	Definition	Standard	Performance
S.F.F	Safe Failure Fraction STO Failure Rate	IEC61508	≥ 90%
HFT (Type A subsystem)	Hardware Fault Tolerance	IEC61508	1
SIL	Safety Integrity Level	IEC61508	SIL 3
		IEC62061	SILCL 3
PFH	Average frequency of dangerous failure [h-1]	IEC61508	$10^{-4} \leq x < 10^{-3}$
PFD_{av}	Probability of Dangerous Failure on Demand	IEC61508	$10^{-8} \leq x < 10^{-7}$
Category	Category	ISO13849-1	Category 3
PL	Performance level	ISO13849-1	e

Item	Definition	Standard	Performance
$MTTF_d$	Mean time to dangerous failure Probability of Dangerous Failure on Demand	ISO13849-1	High
DC	Diagnostic Coverage	ISO13849-1	Medium
PTI	Proof Test Interval	IEC61508	20 years

Table 3-28

3-5-3 Terminal Function

Refer to Section 3-4 Control Circuit for description of STO function

The table below is the operation principle and display description after STO1 / STO2 signal input:

Signal	Status			
STO1–SCM	ON	ON	OFF	OFF
STO2–SCM	ON	OFF	ON	OFF
Drive Output Status	Ready to output	STO2 mode Torque output off	STO1 mode Torque output off	STO mode Torque output off
Fault Displays	No fault displays	STO2	STO1	STO
Response Time	N.A	≤ 6 ms		
RESET	N.A	Directly reset	Directly reset	Directly reset

Table 3-29

- STO means that Channel 1 and Channel 2 enable Safe Torque Off at the same time.
- STO1 indicates that the difference between Channel 1 and Channel 2 is too large, and Channel 1 is active. Check the external wiring.
- STO2 indicates that the difference between Channel 1 and Channel 2 is too large, and Channel 2 is active. Check the external wiring.
- STL1 indicates Channel 1 internal circuit detected abnormal.
- STL2 indicates Channel 2 internal circuit detected abnormal.
- STO1–SCM / STO2–SCM ON: means STO1–SCM / STO2–SCM input voltage > 15 V_{DC} power
- STO1–SCM / STO2–SCM OFF: means STO1–SCM / STO2–SCM input voltage < 15 V_{DC} power

3-5-4 Wiring

Internal STO circuit is as the figure below:

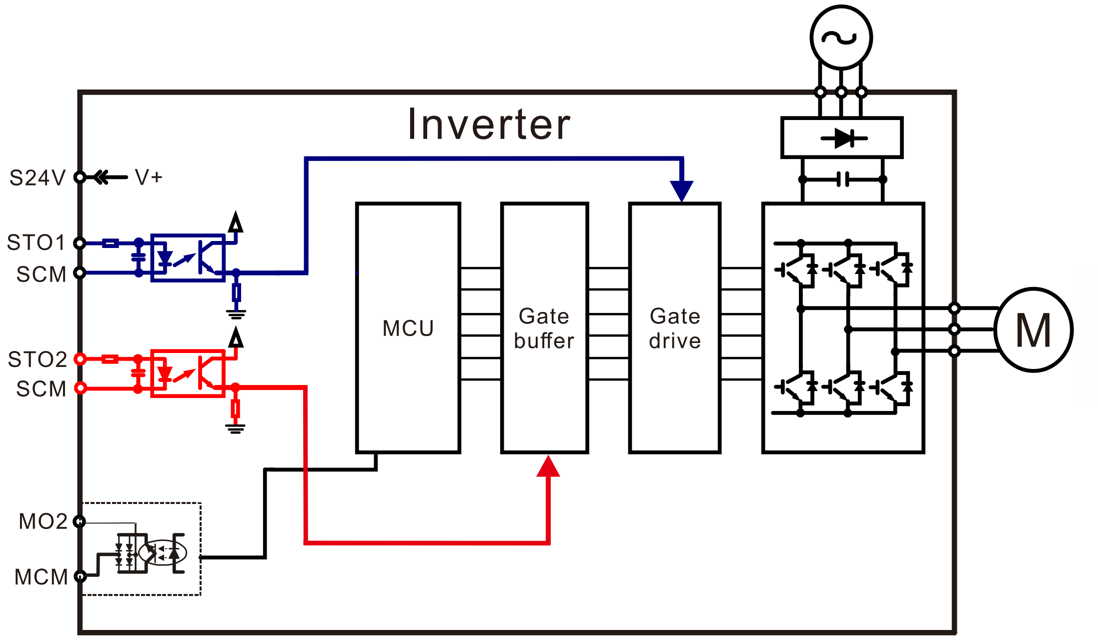


Figure 3-53

In the figure below, the default setting for S24V-STO1-STO2 is short-circuited:

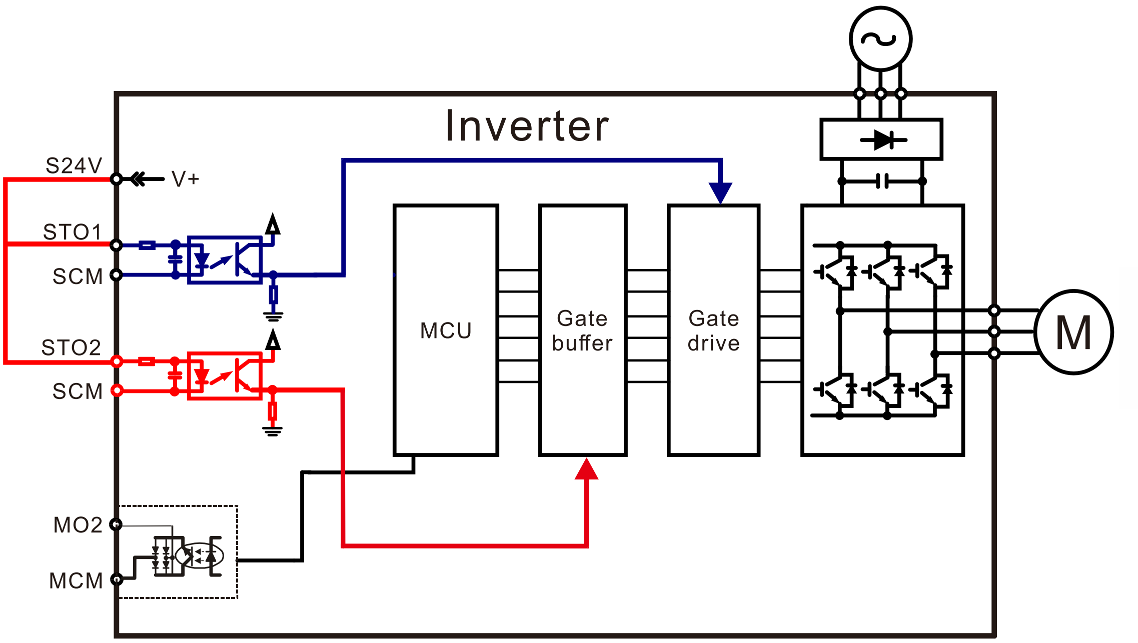


Figure 3-54

Control loop wiring

1. Default wiring

   The S24V-STO1-STO2 terminals are shorted together as default wiring. If you need to use the Safety function (refer to wiring method 2 & 3), remove the short-circuit.

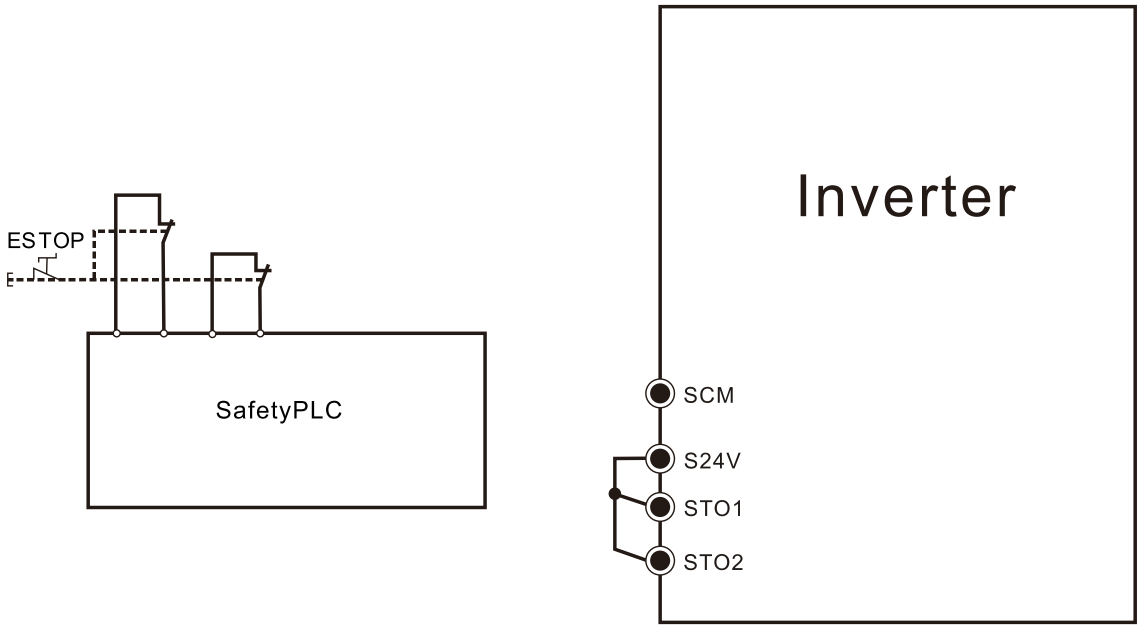


Figure 3-55

2. Built-in 24V power wiring
   - Remove the short-circuit of S24V-STO1-STO2.
   - As shown in the figure below, the ESTOP switch must be closed in normal situation so the drive can output normally.
   - In STO mode, the ESTOP switch is turned ON, the drive stops output, and the keypad displays STO.
   - With this connection, the SCM does not need to be wired (empty connection). Connect 24V Safety dedicated power terminal, do NOT use the general +24V terminal power supply.

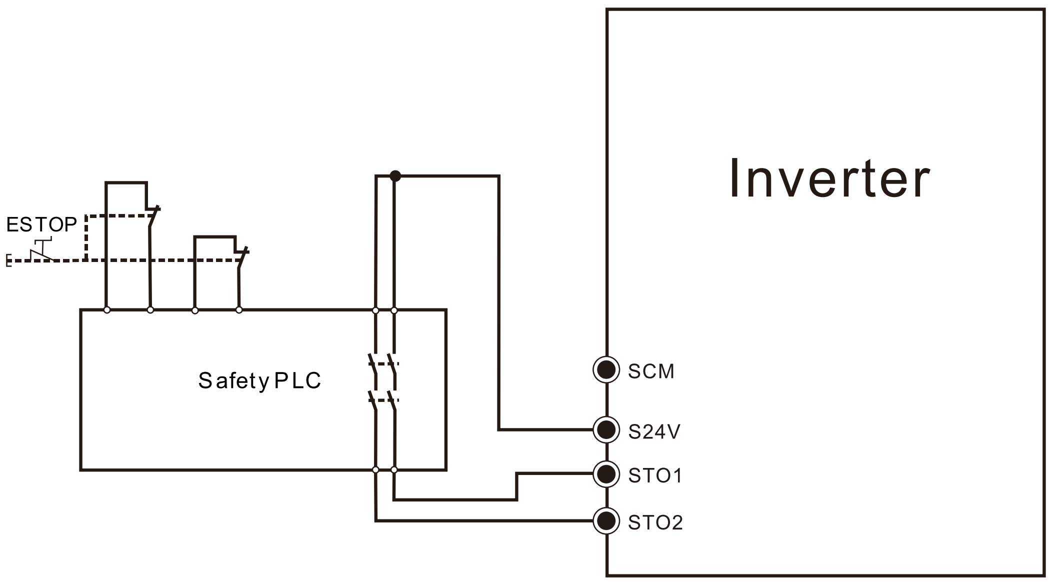


Figure 3-56

3. External 24V power wiring
   - Remove the short-circuit of S24V-STO1-STO2.
   - As shown in the figure below, the ESTOP switch must be closed in normal situation so the drive can output normally.
   - In STO mode, the ESTOP switch is turned ON, the drive stops output, and the keypad displays STO.
   - With this connection, the SCM must be connected to the negative terminal of the external power supply to form a power supply circuit.

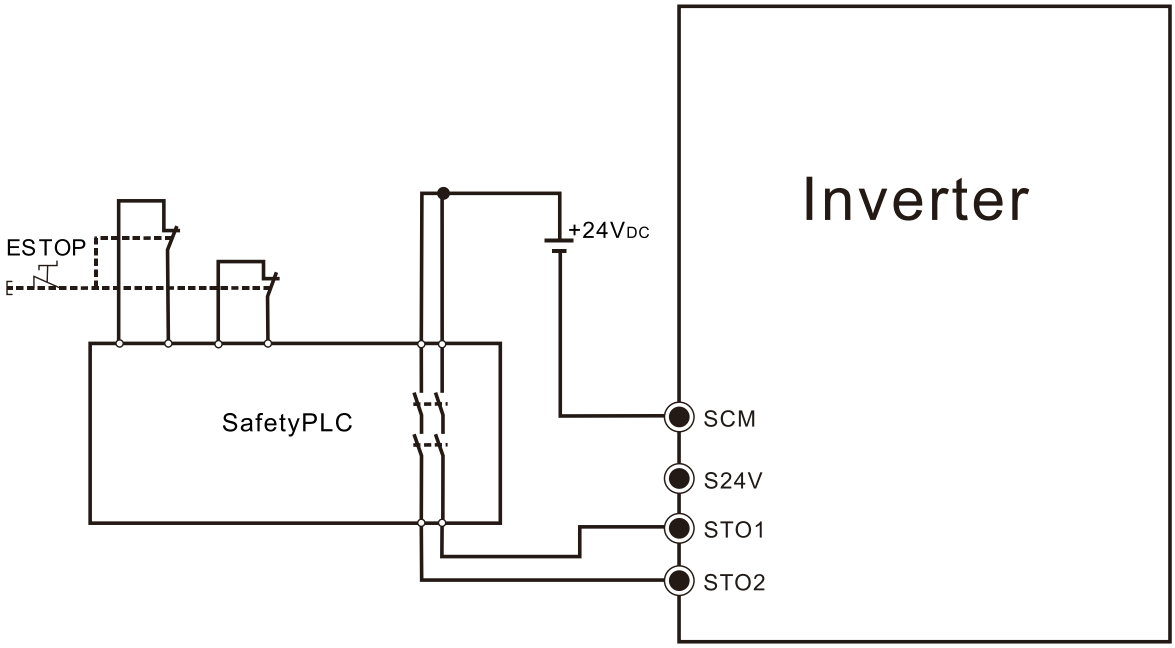


Figure 3-57

3-5-5 Parameters and Fault Codes

- Pr.H0-14 sets the reset method of STO fault, refer to Chapter 13 for detail.
- Refer to Parameter Group O for detail description of fault records, refer to Chapter 8 for fault treatment.

Pr.	Parameter Name
o4-00	Fault Code REC 1
o4-19	Fault Code REC 2
o5-00	Fault Code REC 3
o5-19	Fault Code REC 4
o6-00	Fault Code REC 5
o6-19	Fault Code REC 6

Table 3-30

3-5-6 Operating Sequential Diagram

The STO1 and STO2 circuits must be conducted (ON: default short-circuit of STO terminal) when the STO function is under general operation, and then the drive can operate normally. If any one of the STO circuit is disconnected (OFF), the drive is unable to run, or stop running. The following sequence diagrams describe the signal status under different conditions:

1. Pr.H0-14 STO Auto Reset = 0 Disable, manual-reset is valid

The STO function is triggered after the drive runs, STO1 changes from ON (conducting) to OFF (non-conducting), the drive stops output immediately, and starts counting after the filter time, and then the STO2 is OFF. When the counting time of two circuits of STO are less than then allowable difference time of STO1 / STO2 (Pr.H0-12), and the STO indication delay time (Pr.H0-13) is reached, the drive displays STO fault message.

Since the STO fault message is invalid under the manual RESET command when the two STO channels are both OFF (non-conductive), the drive still cannot run after receiving the RUN command.

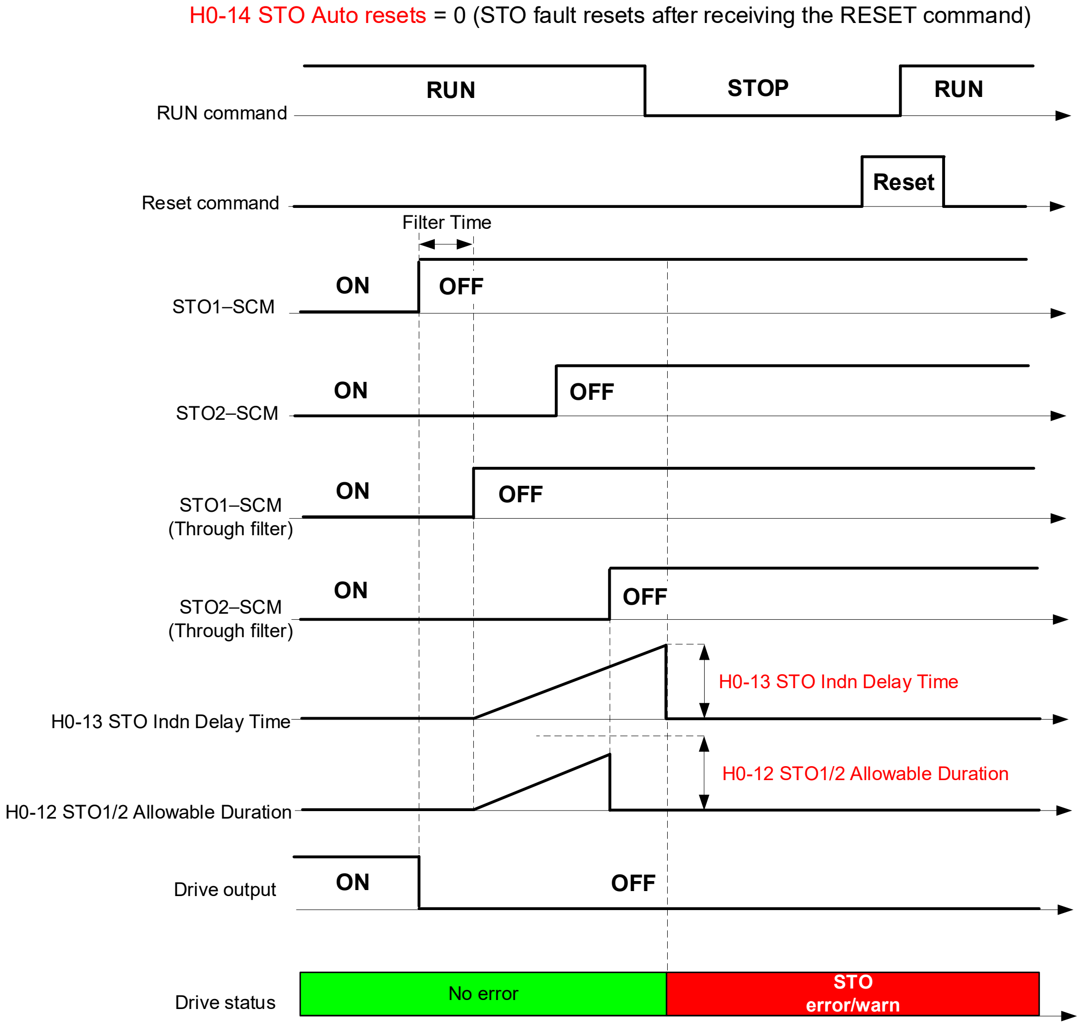


Figure 3-58

2. Pr.H0-14 STO Auto Reset = 1 Enable, auto-reset is valid)

The STO function is triggered after the drive runs, STO1 changes from ON (conducting) to OFF (non-conducting), the drive stops output immediately, and starts counting after the filter time, and then the STO2 is OFF. When the counting time of two circuits of STO are less than then allowable difference time of STO1 / STO2 (Pr.H0-12), and the STO indication delay time (Pr.H0-13) is reached, the drive displays STO fault message.

Since the STO fault message is invalid under the manual RESET command when the two STO channels are both OFF (non-conductive), the drive still cannot run after receiving the RUN command.

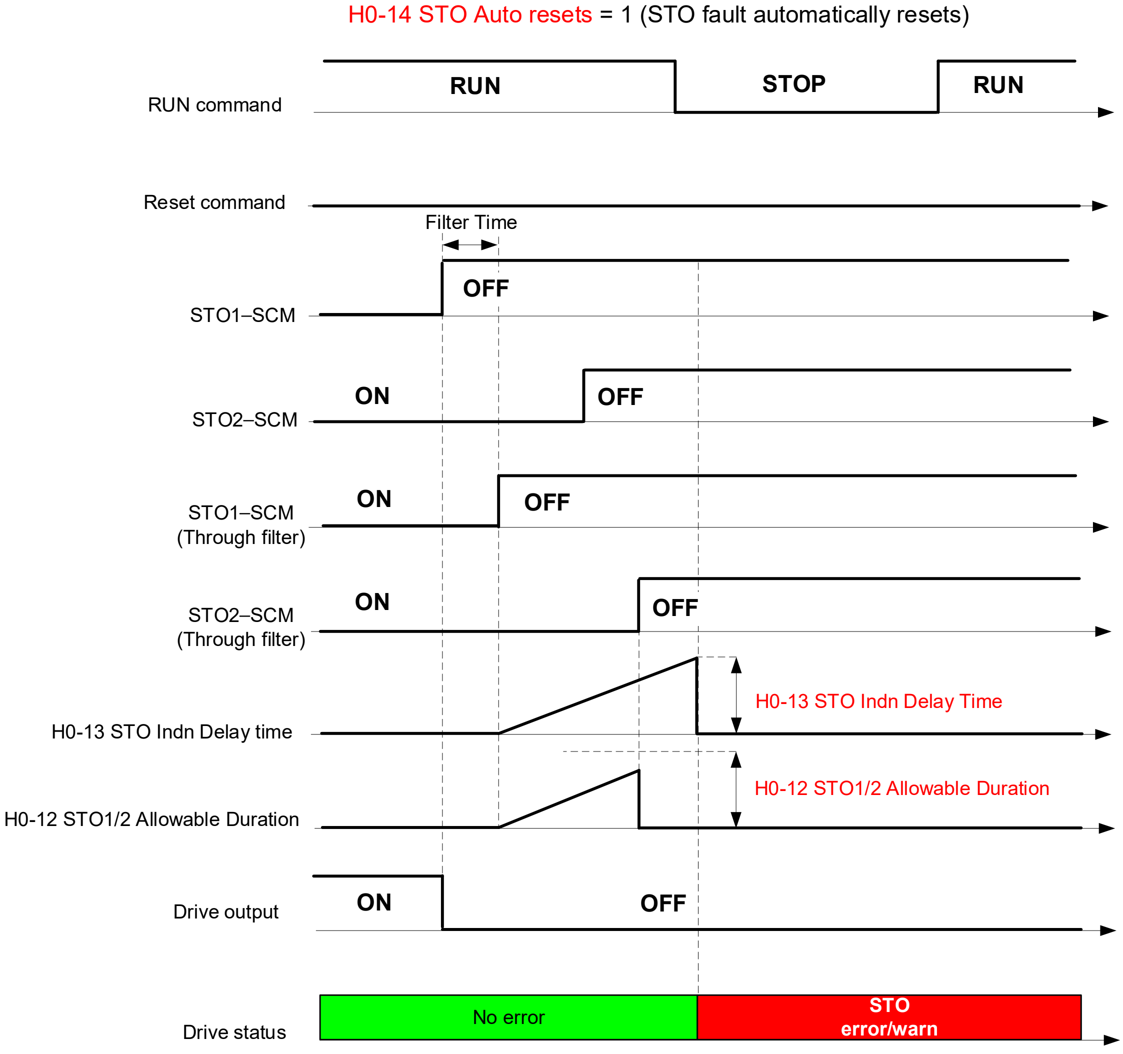


Figure 3-59

3. Pr.H0-14 STO Auto Reset = 0 Disable, manual-reset is valid

The STO function is triggered after the drive runs, the original STO1 is OFF (non-conductive) only for a brief time and then turns back to ON (conductive). When it is OFF, the drive stops outputting immediately. When the counting time of two circuits of STO are less than then allowable difference time of STO1 / STO2 (Pr.H0-12), and the STO indication delay time (Pr.H0-13) is reached, the drive displays STO fault message.

Since the STO fault message is valid under the manual RESET command when the two STO channels are both ON (conductive), the drive clears the fault message, after the RESET command and the Fault Restart Delay Time (Pr.H0-10) is reached, the drive receives the RUN command and resumes to operate

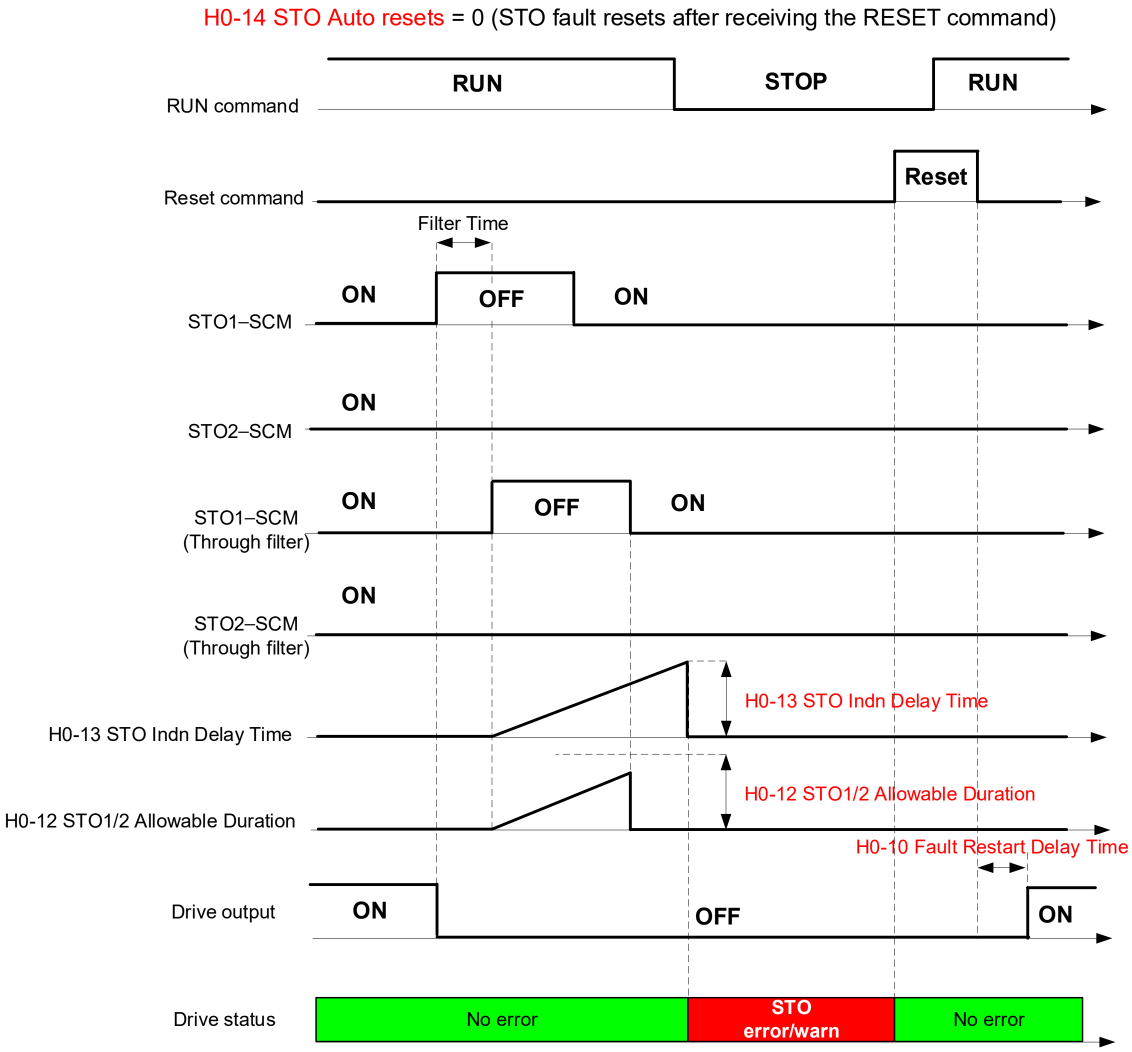


Figure 3-60

4. Pr.H0-14 STO Auto Reset = 1 Enable, auto-reset is valid

The STO function is triggered after the drive runs, the original STO1 is OFF (non-conductive) only for a brief time and then turns back to ON (conductive). When it is OFF, the drive stops outputting immediately. When the counting time of two circuits of STO are less than then allowable difference time of STO1 / STO2 (Pr.H0-12), and the STO indication delay time (Pr.H0-13) is reached, the drive displays STO fault message.

Since the STO fault message is valid under the auto RESET command when the two STO channels are both ON (conductive), the drive clears the fault message when the Fault Auto Reset Delay Time (Pr.H0-09) is reached. And then the Fault Restart Delay Time (Pr.H0-10) is reached, the drive receives the RUN command and resumes to operate

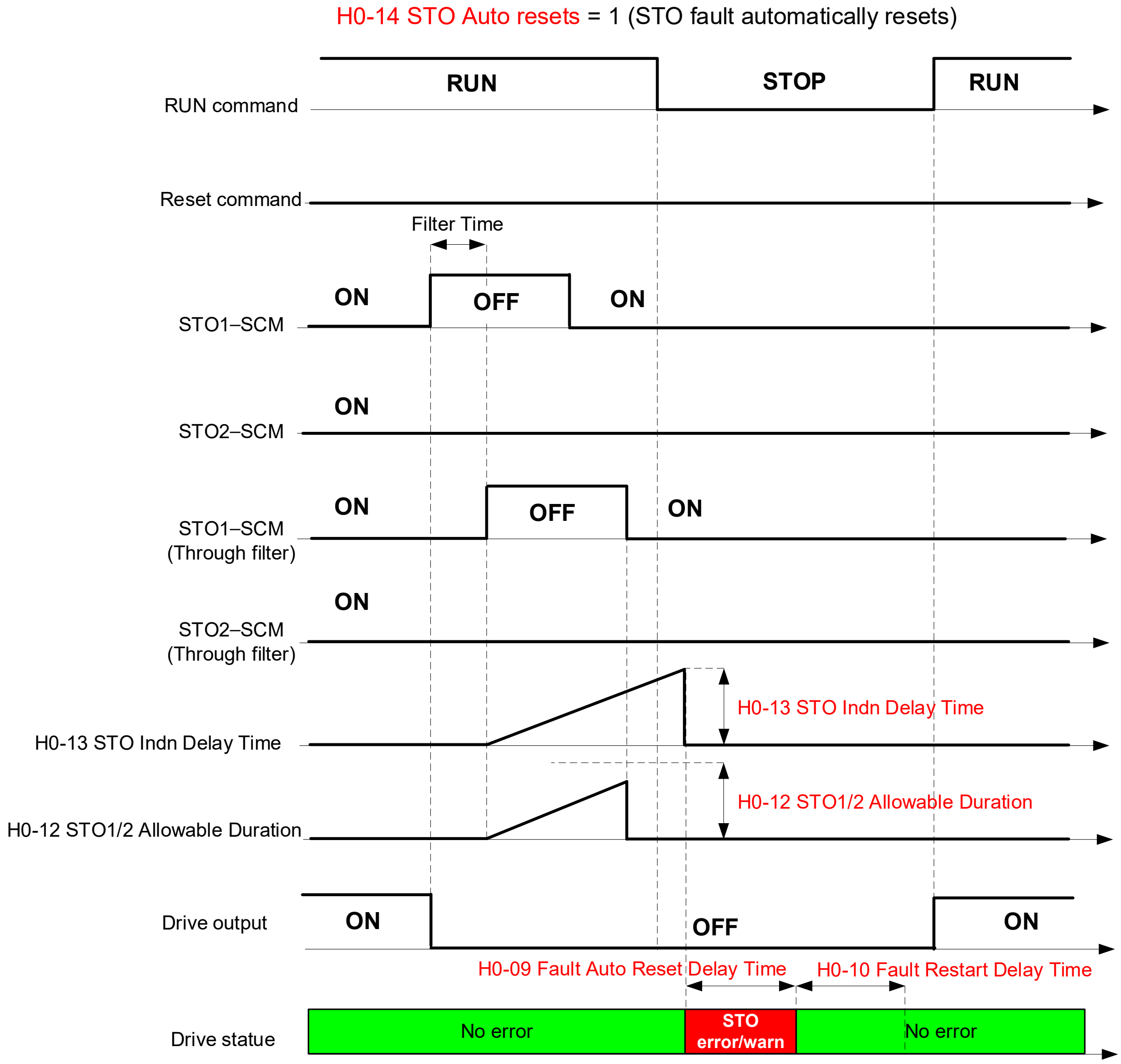


Figure 3-61

5. Pr.H0-14 STO Auto Reset = 0 Disable, manual-reset is valid

The STO function is triggered after the drive runs, STO1 changes from ON (conducting) to OFF (non-conducting), the drive stops output immediately, and starts counting after the filter time. When the counting time of two circuits of STO are less than then allowable difference time of STO1 / STO2 (Pr.H0-12), and the STO indication delay time (Pr.H0-13) is reached, the drive displays STO1 fault message.

Since the STO1 fault message is invalid under the manual RESET command when the STO1 is OFF (non-conductive), the drive still cannot run after receiving the RUN command.

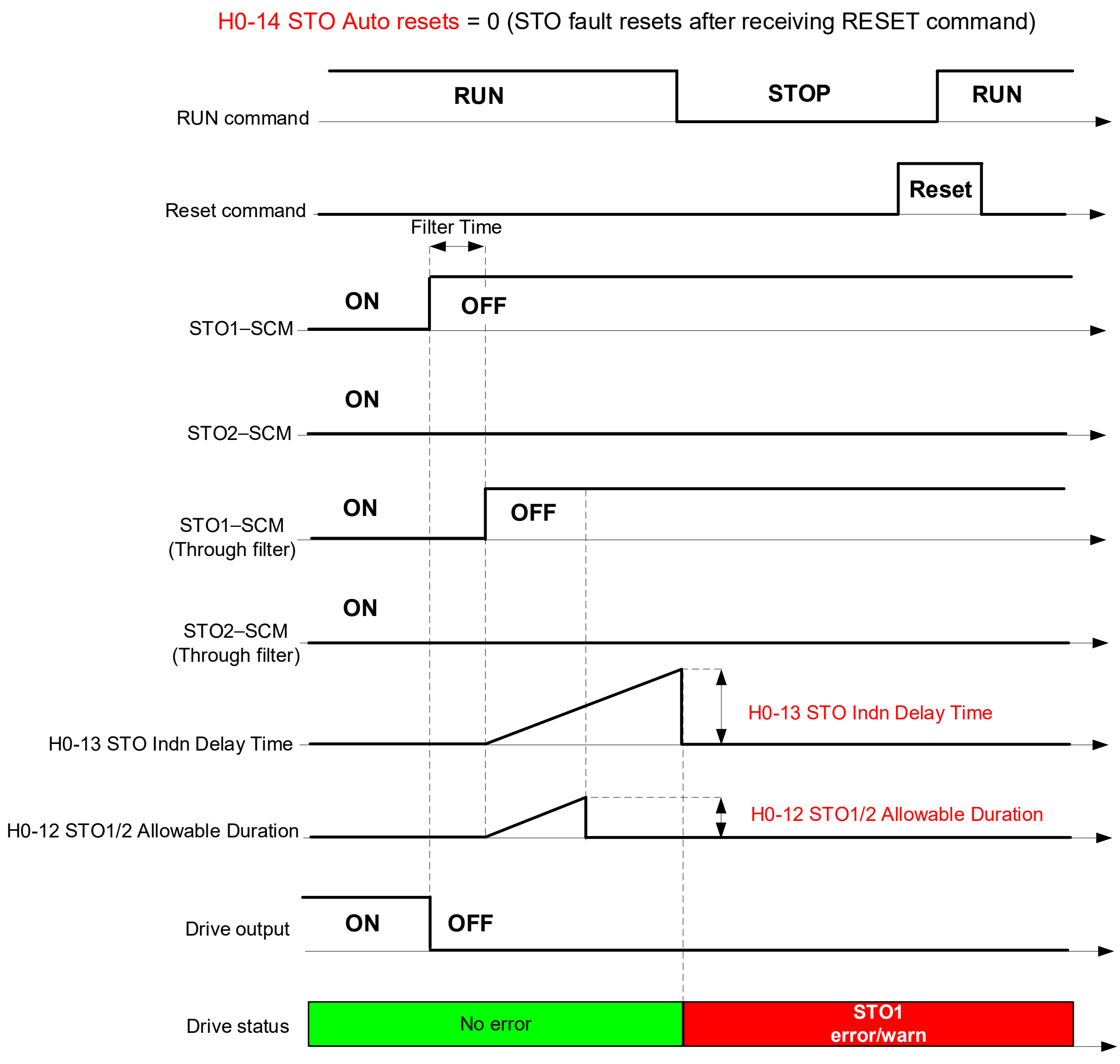


Figure 3-62

6. Pr.H0-14 STO Auto Reset = 1 Enable, auto-reset is valid

The STO function is triggered after the drive runs, STO1 changes from ON (conducting) to OFF (non-conducting), the drive stops output immediately, and starts counting after the filter time. When the counting time of two circuits of STO are less than then allowable difference time of STO1 / STO2 (Pr.H0-12), and the STO indication delay time (Pr.H0-13) is reached, the drive displays STO1 fault message.

Since the STO1 fault message is invalid under the auto RESET command when the STO1 is OFF (non-conductive), the drive still cannot run after receiving the RUN command.

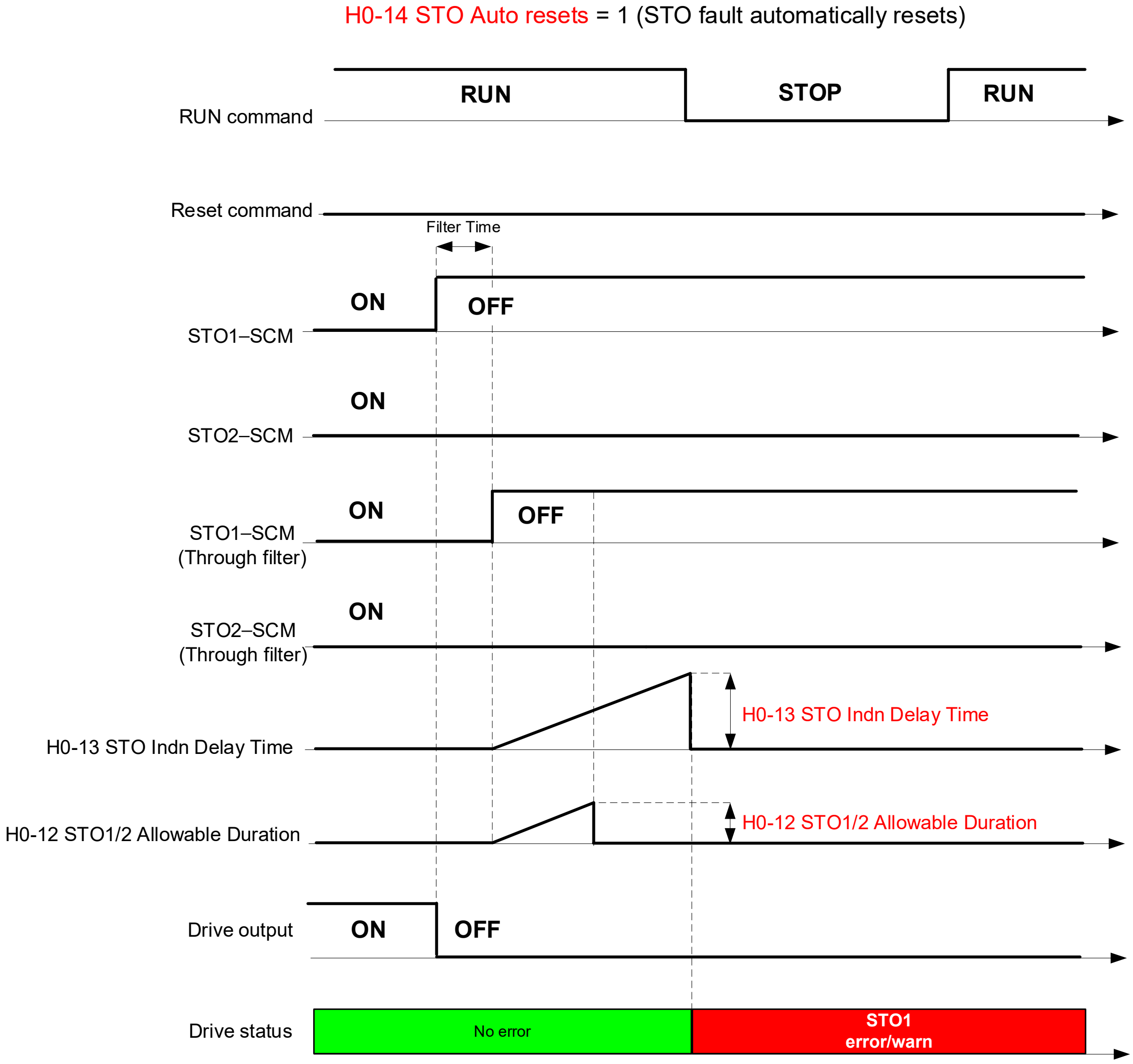


Figure 3-63

7. Pr.H0-14 STO Auto Reset = 0 Disable, manual-reset is valid

The STO function is triggered after the drive runs, STO1 changes from ON (conducting) to OFF (non-conducting), the drive stops output immediately, and starts counting after the filter time. When the counting time of two circuits of STO are less than then allowable difference time of STO1 / STO2 (Pr.H0-12), and the STO indication delay time (Pr.H0-13) is reached, the drive displays STO1 fault message.

Since the STO1 fault message is invalid under the manual RESET command when the two STO channels are both OFF (non-conductive), the drive still cannot run after receiving the RUN command.

H0-14 STO Auto resets = 0 (STO fault resets after receiving RESET command)

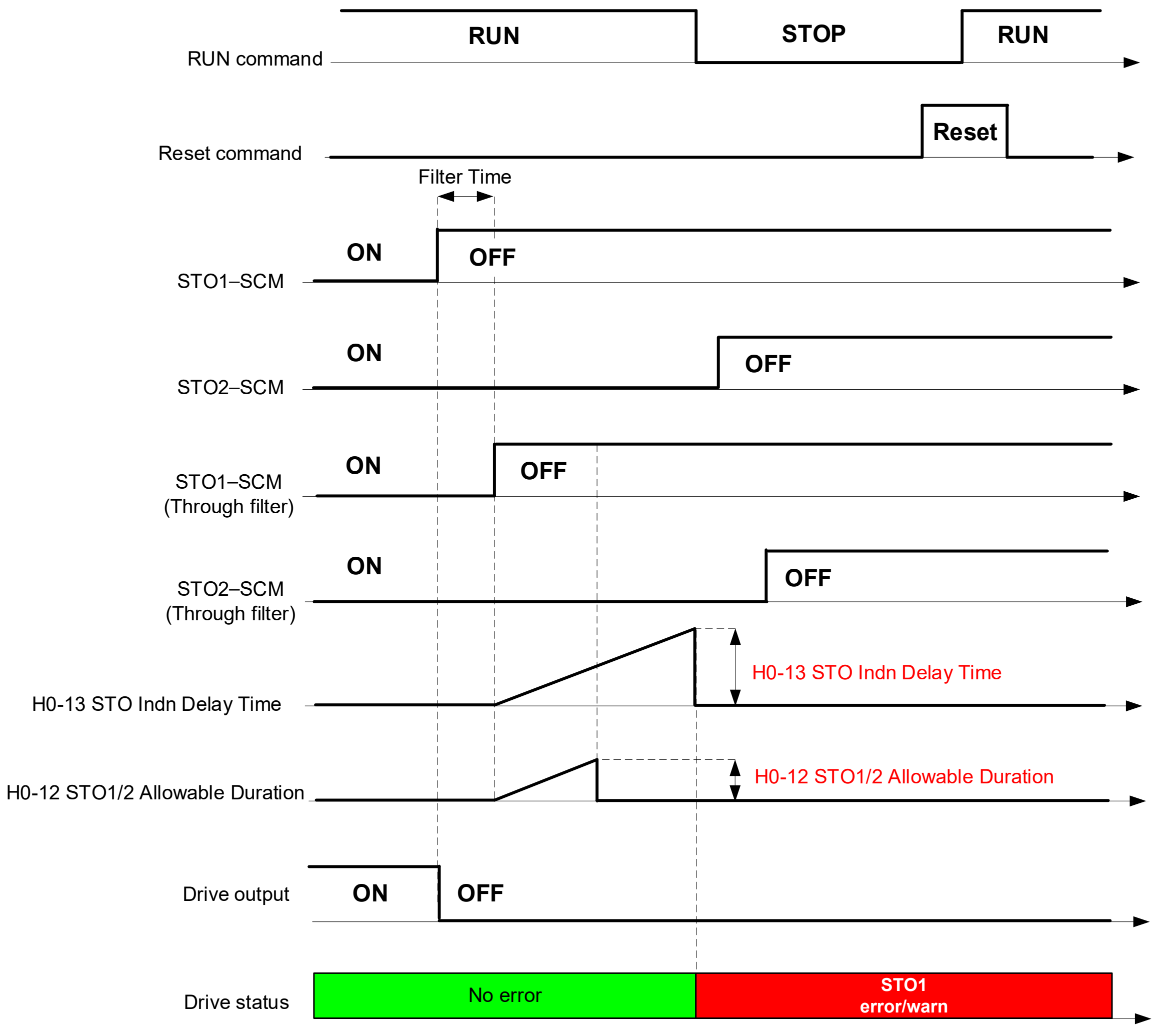


Figure 3-64

8. Pr.H0-14 STO Auto Reset = 1 Enable, auto-reset is valid

The STO function is triggered after the drive runs, STO1 changes from ON (conducting) to OFF (non-conducting), the drive stops output immediately, and starts counting after the filter time. When the counting time of two circuits of STO are less than then allowable difference time of STO1 / STO2 (Pr.H0-12), and the STO indication delay time (Pr.H0-13) is reached, the drive displays STO1 fault message.

Since the STO1 fault message is invalid under the auto RESET command when the two STO channels are both OFF (non-conductive), the drive still cannot run after receiving the RUN command.

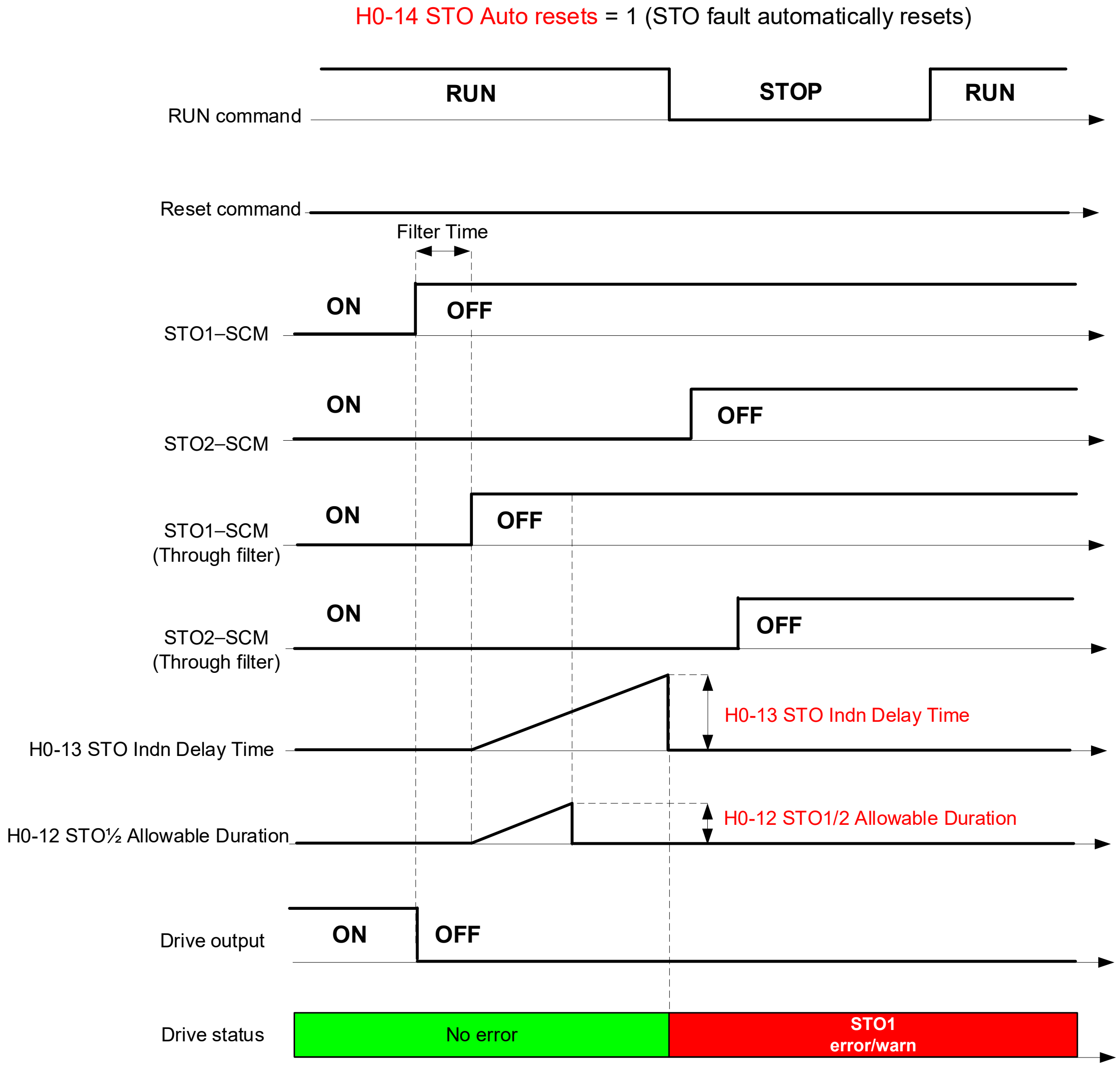


Figure 3-65

3-6 RFI Jumper and Leakage Current

RFI Jumper:

1. The drive contains Varistors / MOVs that are connected from phase to phase and from phase to ground to prevent the drive from unexpected stop or damage caused by mains surges or voltage spikes. Because the Varistors / MOVs from phase to ground are connected to ground with the RFI jumper, removing the RFI jumper disables the protection.
2. In models with a built-in EMC filter, the RFI jumper connects the filer capacitors to ground to form a return path for high frequency noise in order to isolate the noise from contaminating the mains power. Removing the RFI jumper strongly reduces the effect of the built-in EMC filter. Although a single drive complies with the international standards for leakage current, an installation with several drives with built-in EMC filters can trigger the RCD. Removing the RFI jumper helps, but the EMC performance of each drive is no longer guaranteed.

Frame A1–B1 (Take Frame A1 as example shown in the following figures)

Applicable models: VFD3A0VP43ANTAA, VFD4A2VP43ANTAA, VFD5A6VP43ANTAA, VFD7A2VP43ANTAA, VFD011VP43ANTAA, VFD013VP43ANTAA, VFD018VP43ANTAA

1. Loosen and remove the screws.
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.8–1.0 Nm)

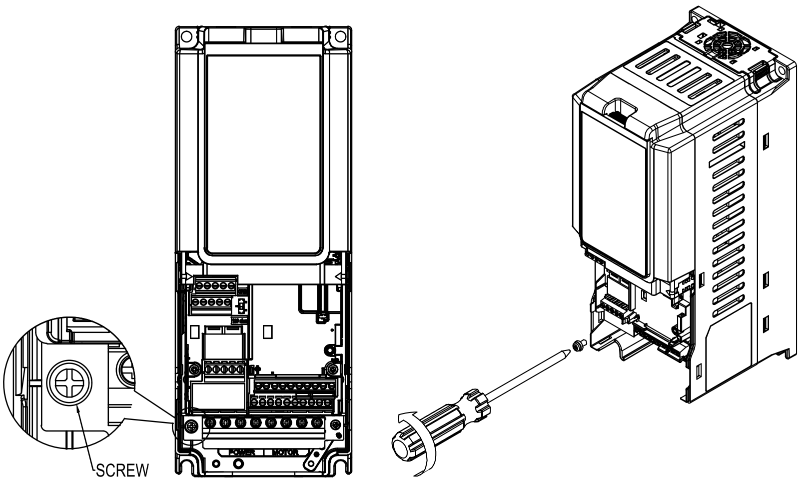


Figure 3-66

2. Fasten the screws to the RFI jumper storage placement.
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.8–1.0 Nm)

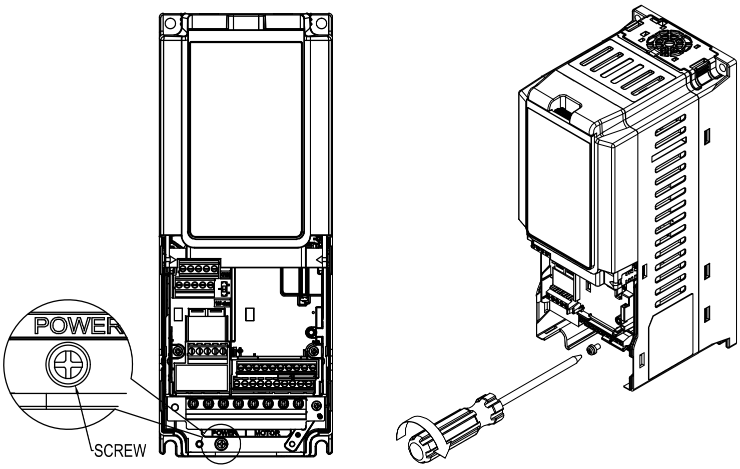


Figure 3-67

Frame A2–B2 (Take Frame A1 as example shown in the following figures)

Applicable models: VFD3A0VP43BFTAA, VFD4A2VP43BFTAA, VFD5A6VP43BFTAA, VFD7A2VP43BFTAA, VFD011VP43BFTAA, VFD013VP43BFTAA, VFD018VP43BFTAA

1. Loosen and remove the screws.
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.8–1.0 Nm)

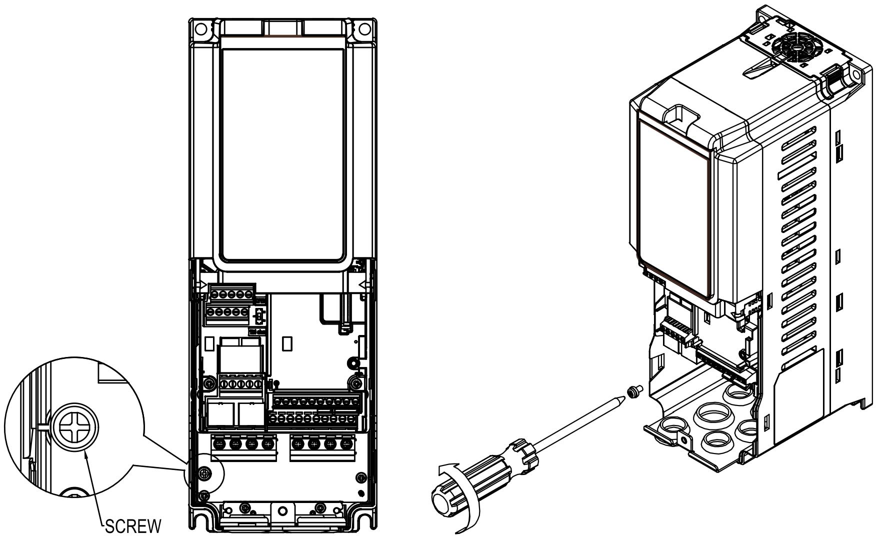


Figure 3-68

2. Fasten the screws to the RFI jumper storage placement.
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.8–1.0 Nm)

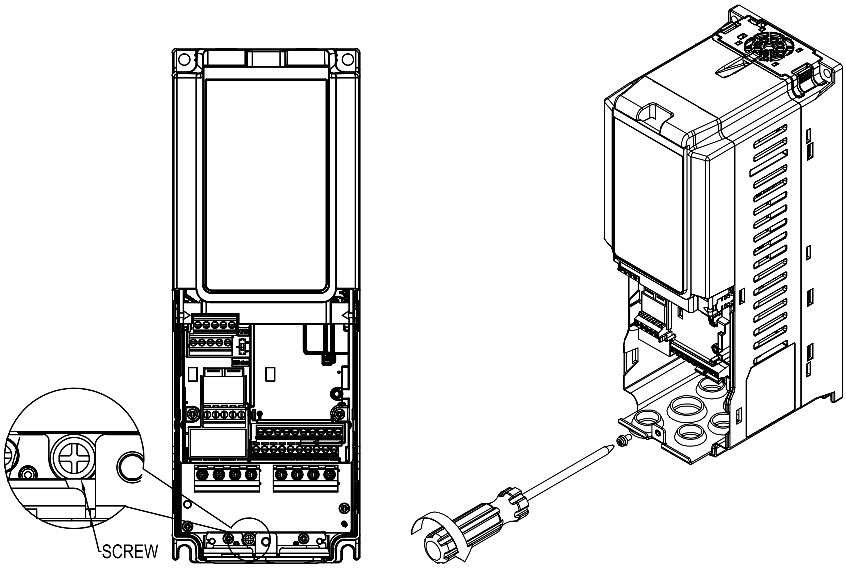


Figure 3-69

Frame C1

Applicable models: VFD025VP43ANTAA, VFD032VP43ANTAA, VFD038VP43ANTAA

1. Loosen and remove the screws.
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in) / (0.78–0.98 Nm)

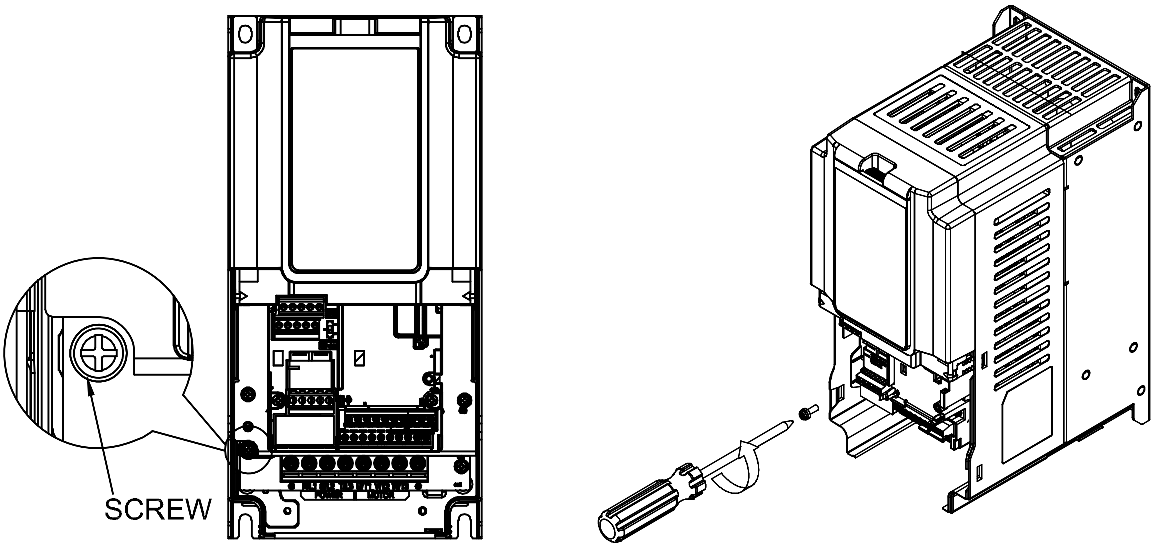


Figure 3-70

2. Fasten the screws to the RFI jumper storage placement.
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in) / (0.78–0.98 Nm)

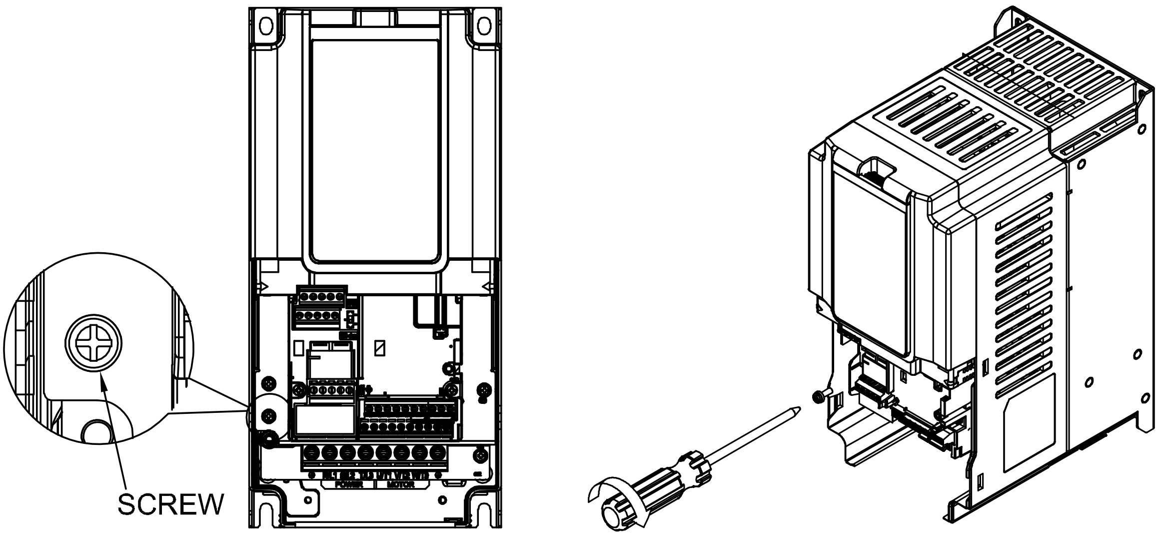


Figure 3-71

Frame C2

Applicable models: VFD025VP43BFTAA, VFD032VP43BFTAA, VFD038VP43BFTAA

1. Loosen and remove the screws.
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in) / (0.78–0.98 Nm)

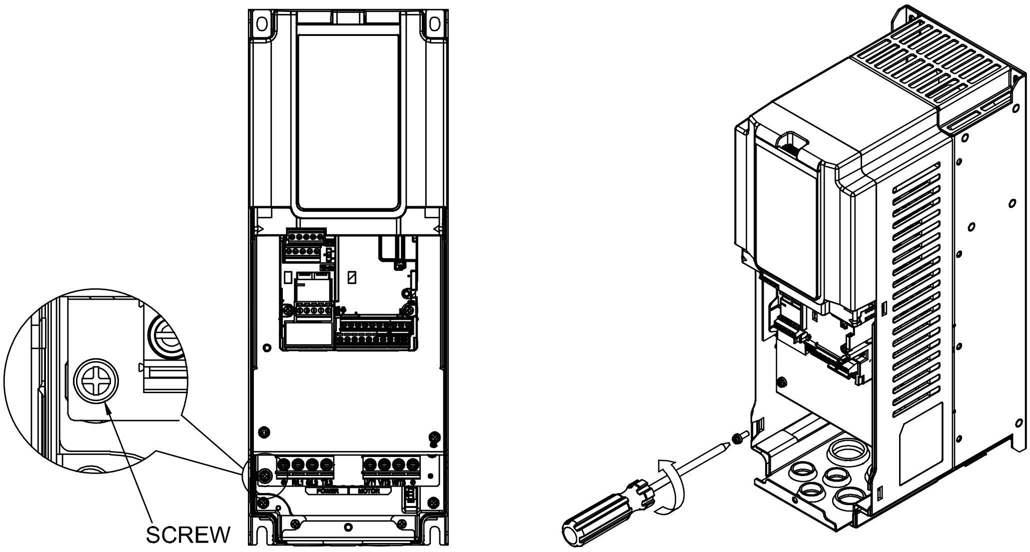


Figure 3-72

2. Fasten the screws to the RFI jumper storage placement.
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in) / (0.78–0.98 Nm)

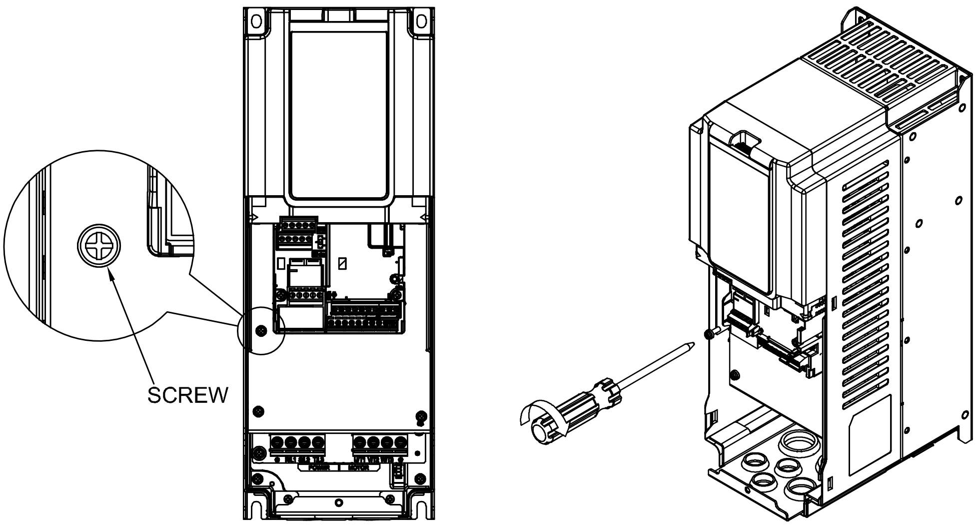


Figure 3-73

Frame D1

Applicable models: VFD045VP43ANTCA, VFD062VP43ANTCA

1. Loosen and remove the screws.

   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in) / (0.78–0.98 Nm)

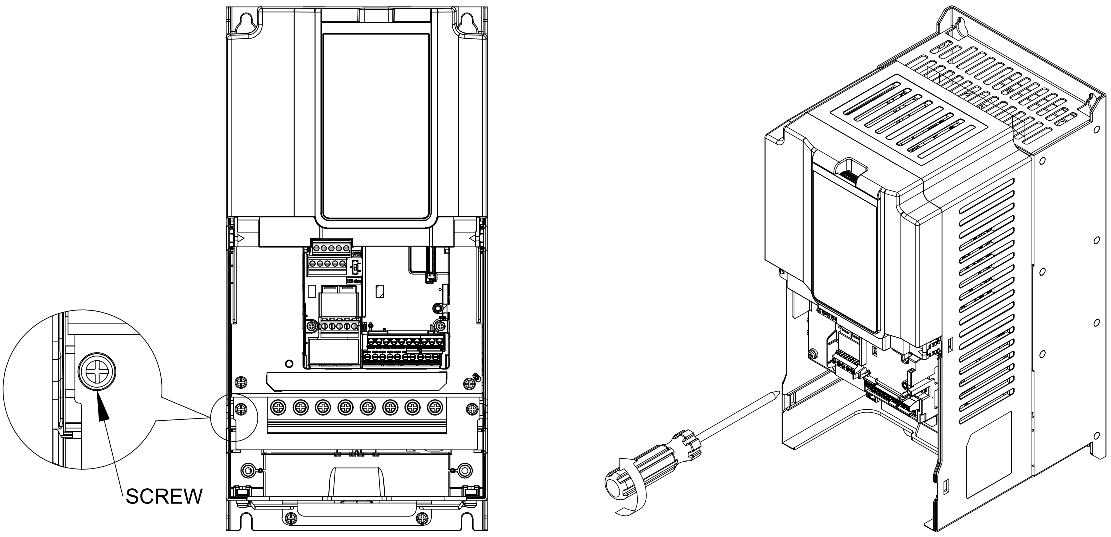


Figure 3-74

2. Fasten the screws to the RFI jumper storage placement.

   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in) / (0.78–0.98 Nm)

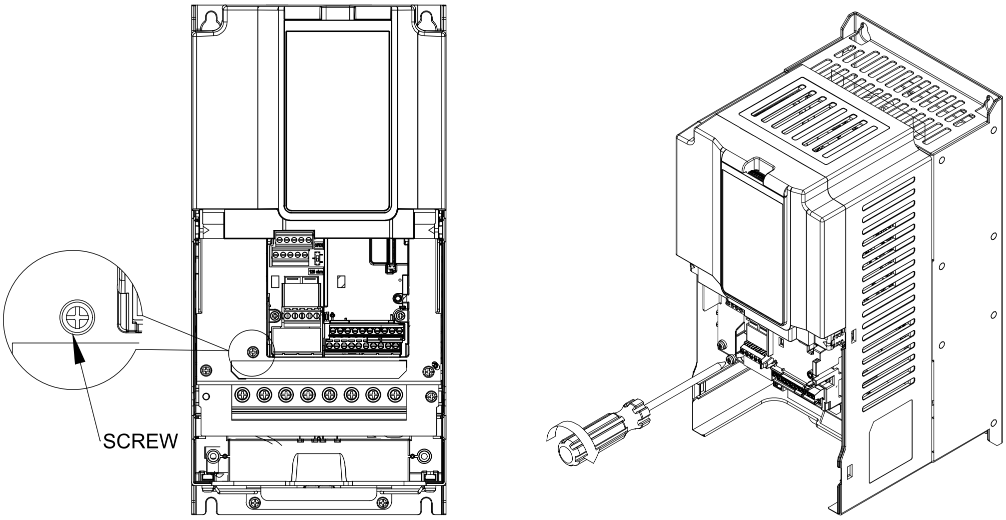


Figure 3-75

Frame D2

Applicable models: VFD045VP43BFTCA, VFD062VP43BFTCA, VFD045VP43BSTCA, VFD062VP43BSTCA

1. Loosen and remove the screws.

   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in) / (0.78–0.98 Nm)

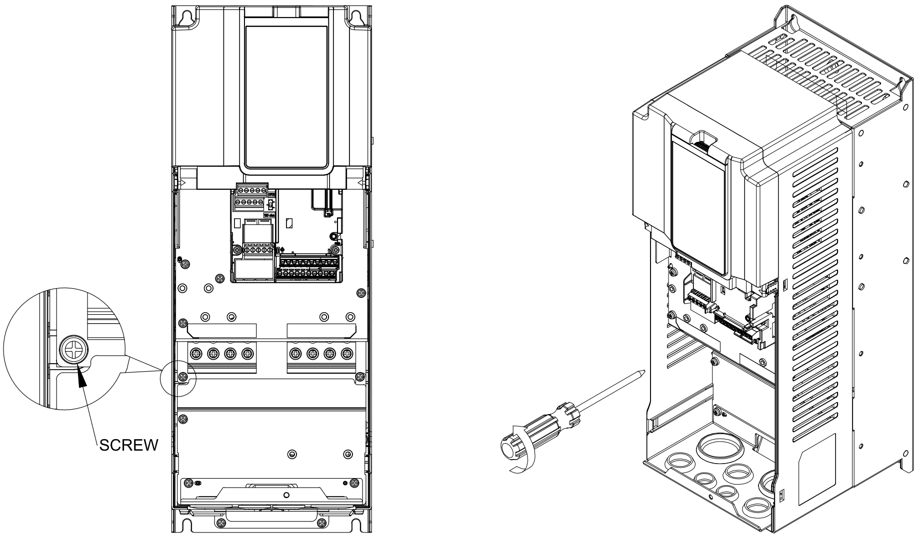


Figure 3-76

2. Fasten the screws to the RFI jumper storage placement.

   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in) / (0.78–0.98 Nm)

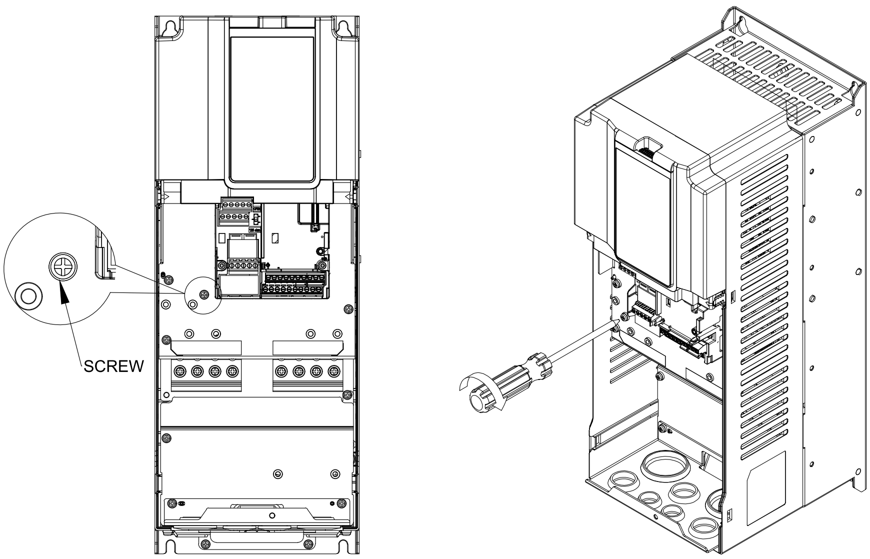


Figure 3-77

Frame E1

Applicable models: VFD073VP43ANTCA, VFD090VP43ANTCA

1. Loosen and remove the screws.
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in) / (0.78–0.98 Nm)

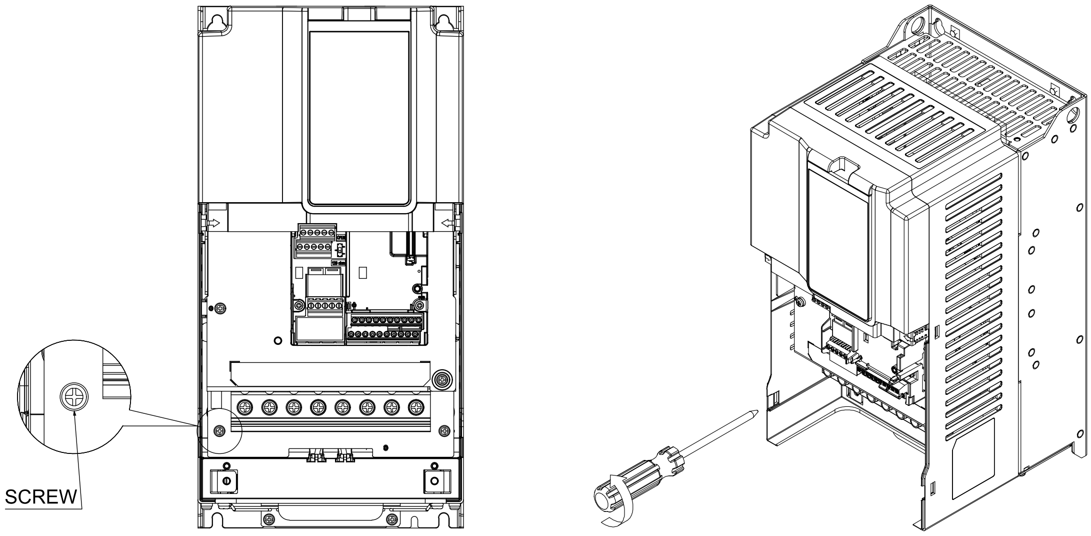


Figure 3-78

2. Fasten the screws to the RFI jumper storage placement.
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in) / (0.78–0.98 Nm)

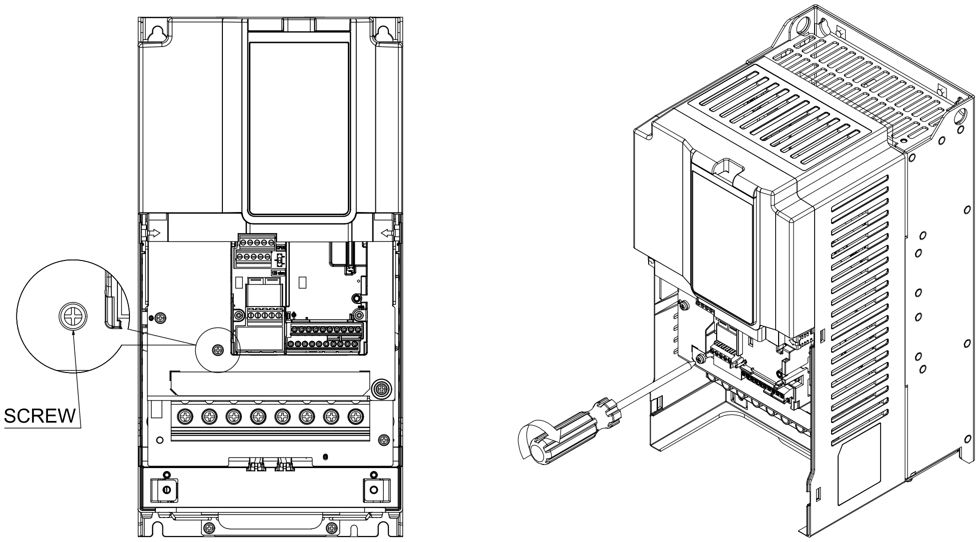


Figure 3-79

Frame E2

Applicable models: VFD073VP43BFTCA, VFD090VP43BFTCA, VFD073VP43BSTCA, VFD090VP43BSTCA

1. Loosen and remove the screws.

   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in) / (0.78–0.98 Nm)

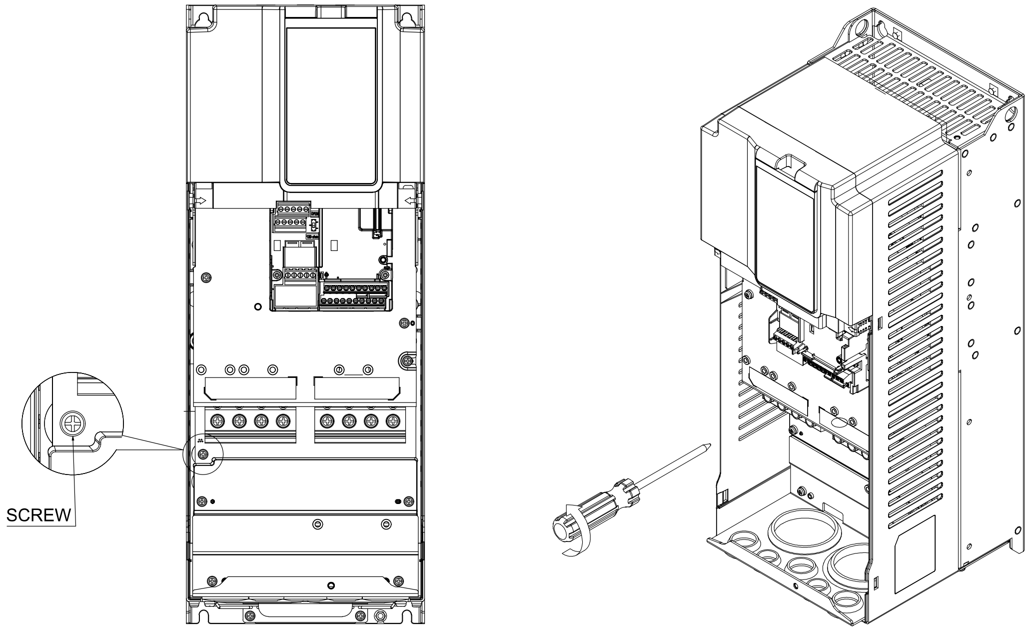


Figure 3-80

2. Fasten the screws to the RFI jumper storage placement.

   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in) / (0.78–0.98 Nm)

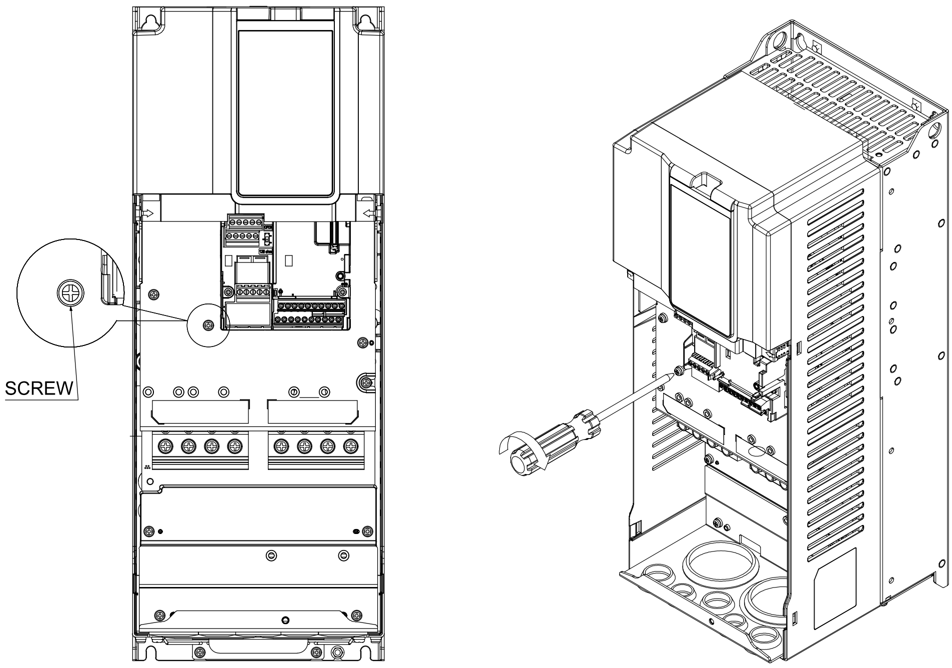


Figure 3-81

Frame F1

Applicable models: VFD110VP43AFTCA

1. Loosen the RFI jumper screw and the fix screw, remove the RFI jumper and keep the fix screw on the plate.
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.78–0.98 Nm)

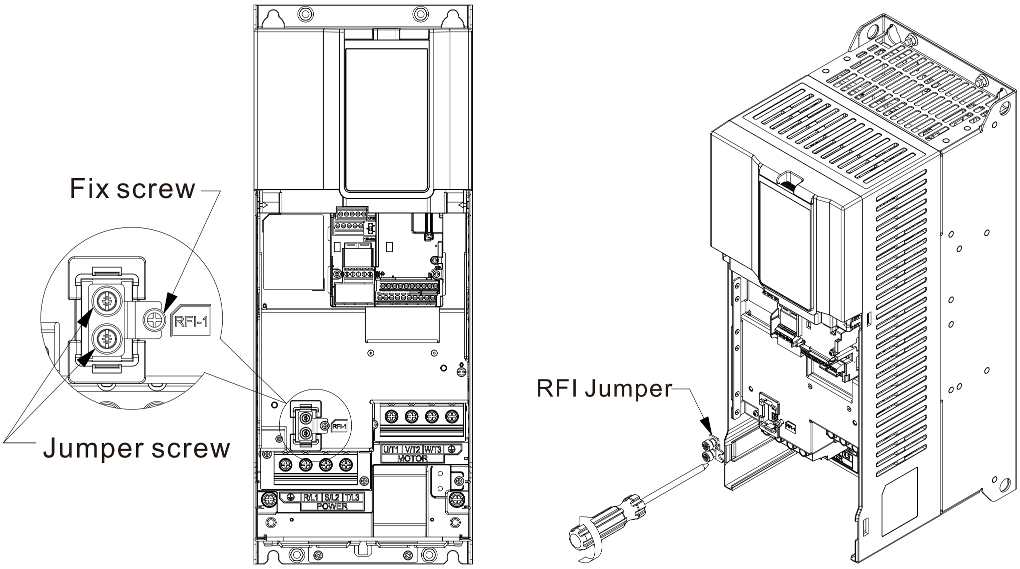


Figure 3-82

2. Loosen the screws on the jumper storage placement, after placing the RFI jumper, fasten back the screws.
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.78–0.98 Nm)

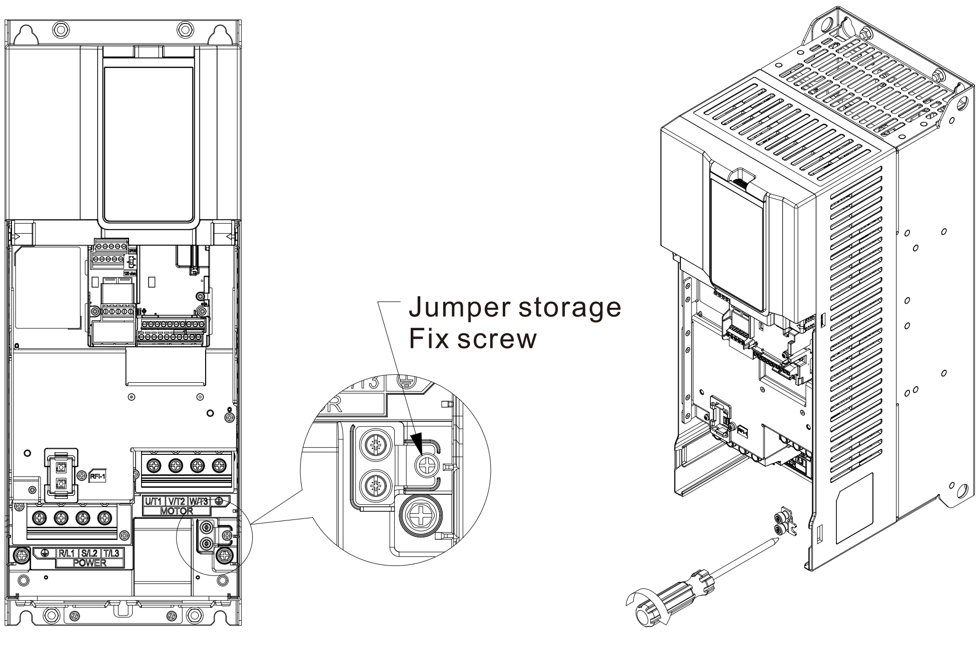


Figure 3-83

Frame F2

Applicable models: VFD110VP43BFTCA, VFD110VP43BSTCA

1. Loosen the RFI jumper screw and the fix screw, remove the RFI jumper and keep the fix screw on the plate.
   Screw torque: 6–8 kg-cm / (5.2–6.9 lb-in) / (0.59–0.78 Nm)

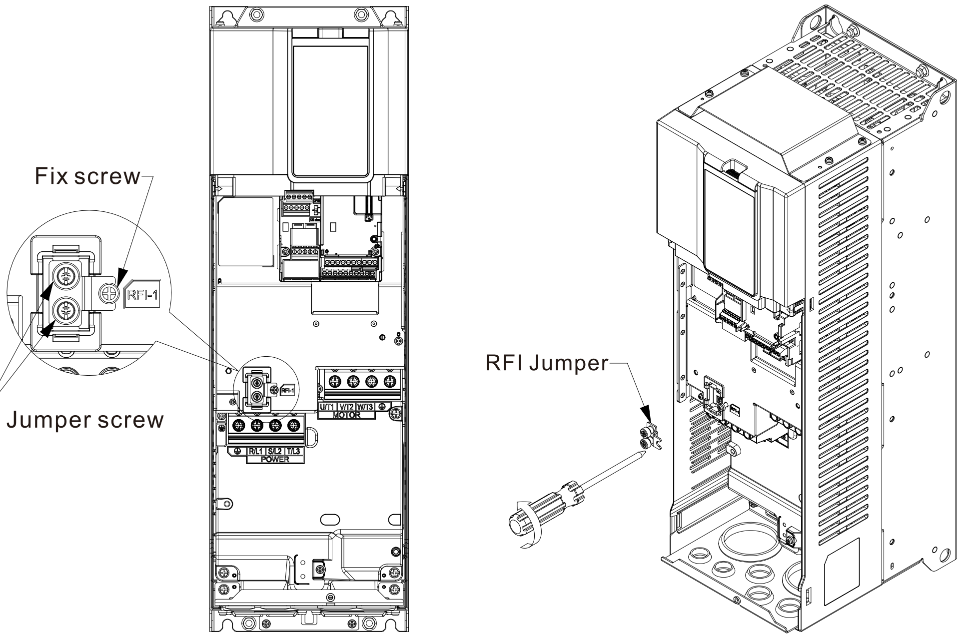


Figure 3-84

2. Loosen the screws on the jumper storage placement, after placing the RFI jumper, fasten back the screws.
   Screw torque: 6–8 kg-cm / (5.2–6.9 lb-in) / (0.59–0.78 Nm)

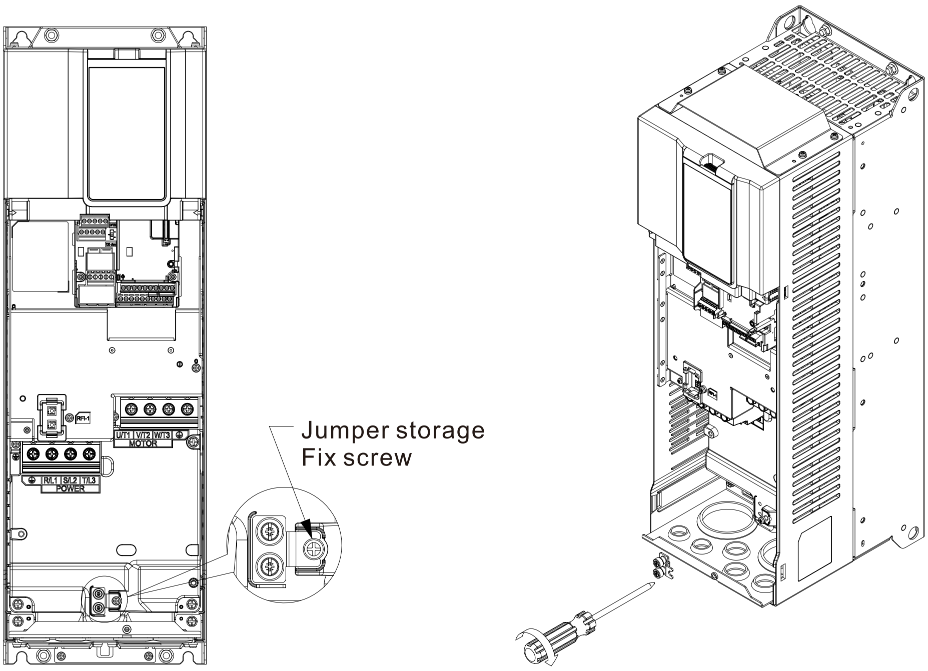


Figure 3-85

Frame G1

Applicable models: VFD150VP43AFTCA

1. Loosen the RFI jumper.
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.78–0.98 Nm)

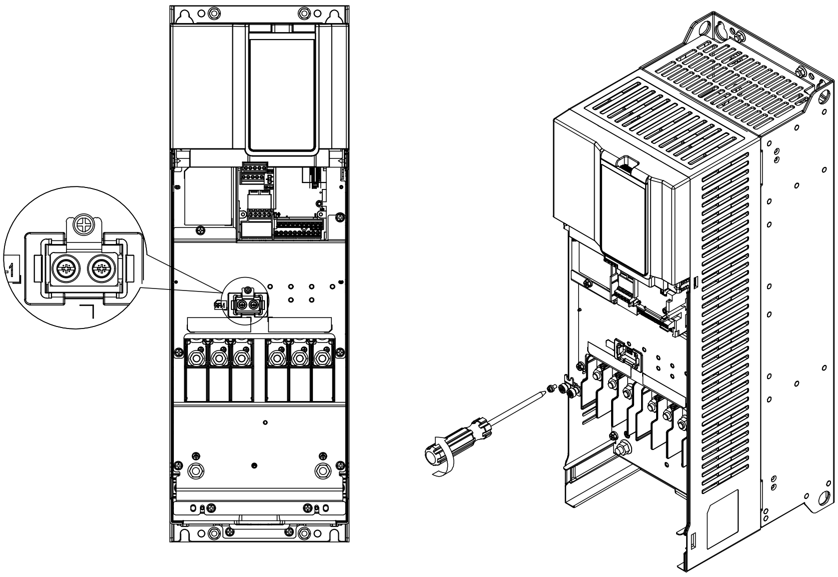


Figure 3-86

2. Place the RFI jumper and fasten back the screws.
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.78–0.98 Nm)

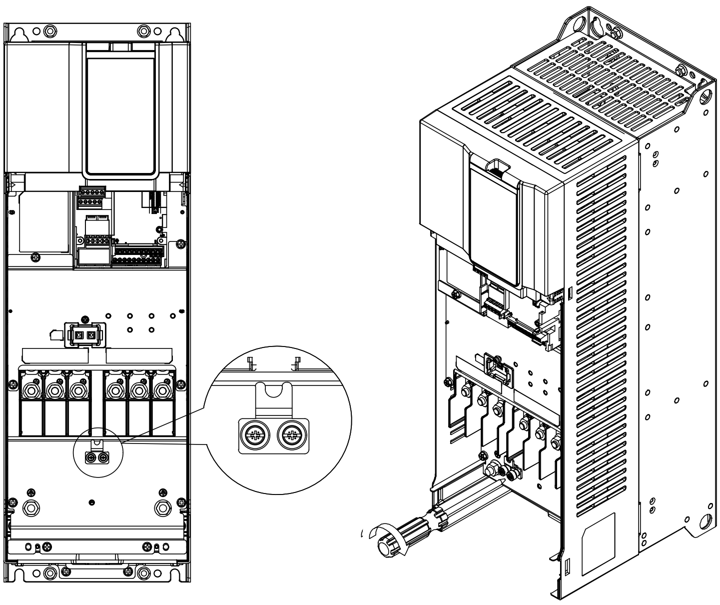


Figure 3-87

Frame G2

Applicable models: VFD150VP43BFTCA, VFD150VP43BSTCA

1. Loosen the RFI jumper.
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.78–0.98 Nm)

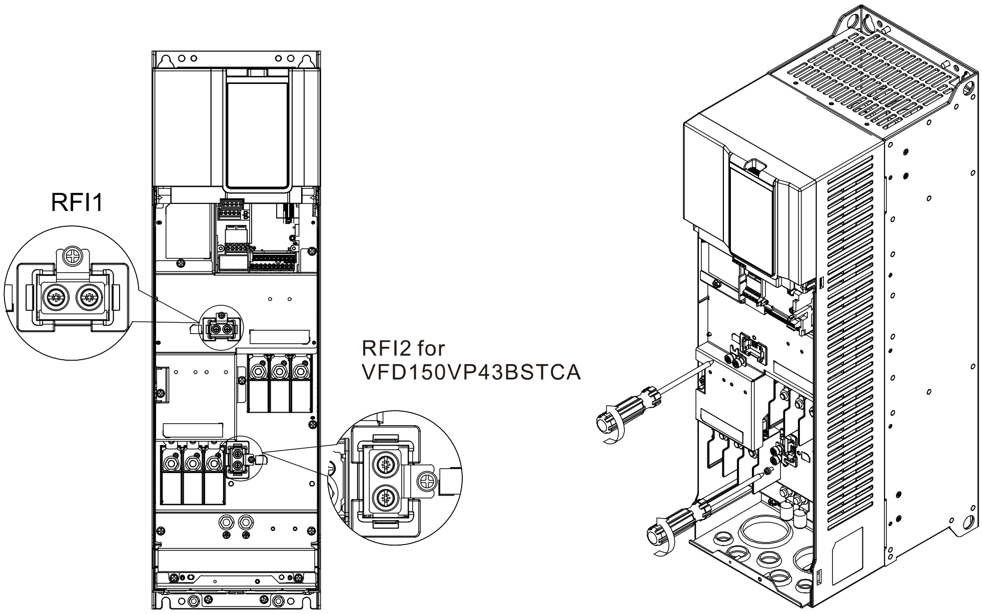


Figure 3-88

2. Place the RFI jumper and fasten back the screws.
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.78–0.98 Nm)

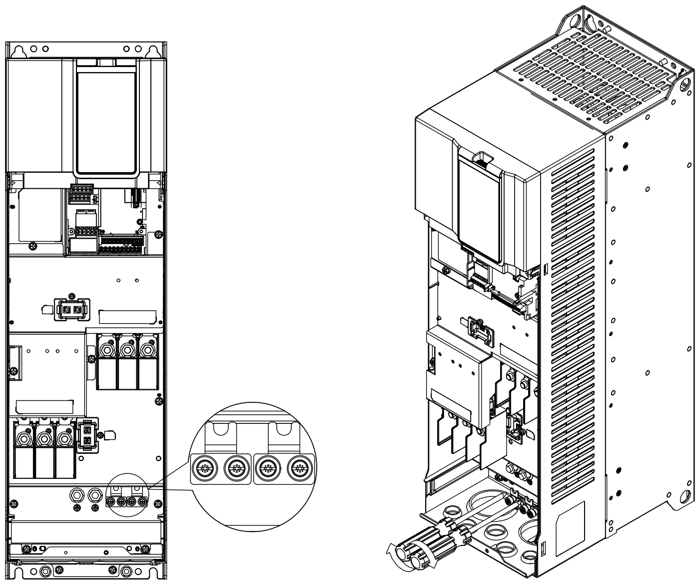


Figure 3-89

Frame H1

Applicable models: VFD180VP43AFTCA–VFD220VP43AFTCA

1. Loosen the RFI jumper.
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.78–0.98 Nm)

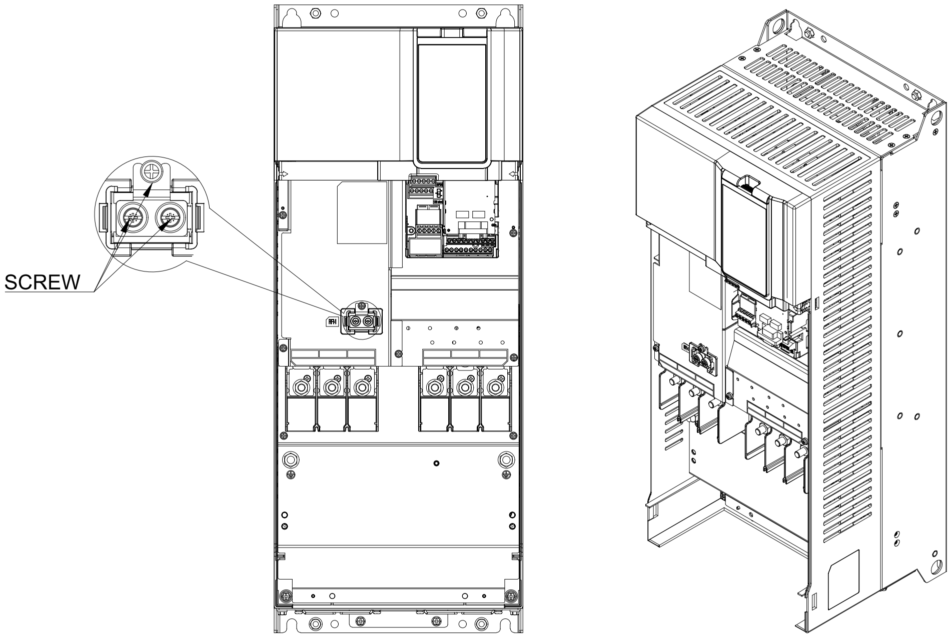


Figure 3-90

2. Place the RFI jumper and fasten back the screws.
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.78–0.98 Nm)

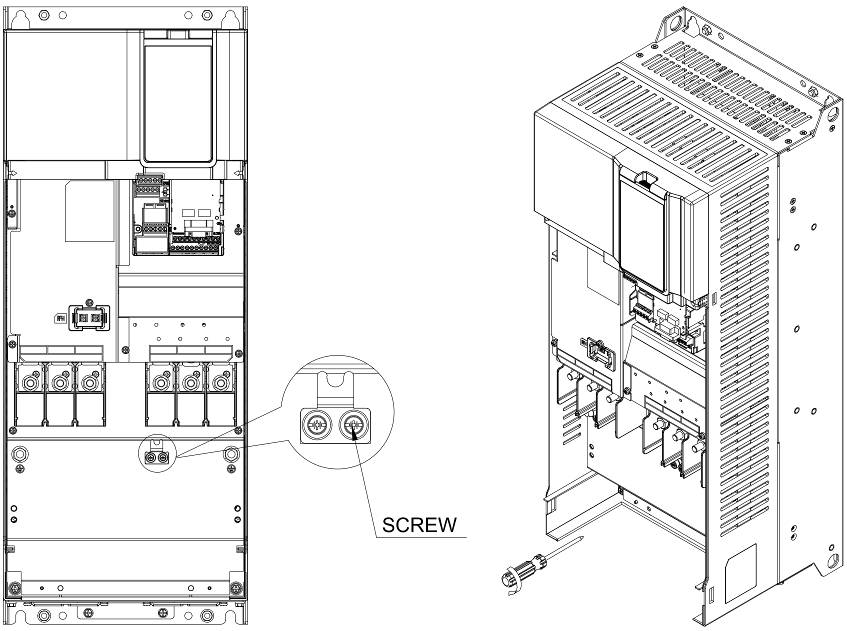


Figure 3-91

Frame H2

Applicable models: VFD180VP43BSTCA–VFD220VP43BSTCA

1. Loosen the RFI jumper.

   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.78–0.98 Nm)

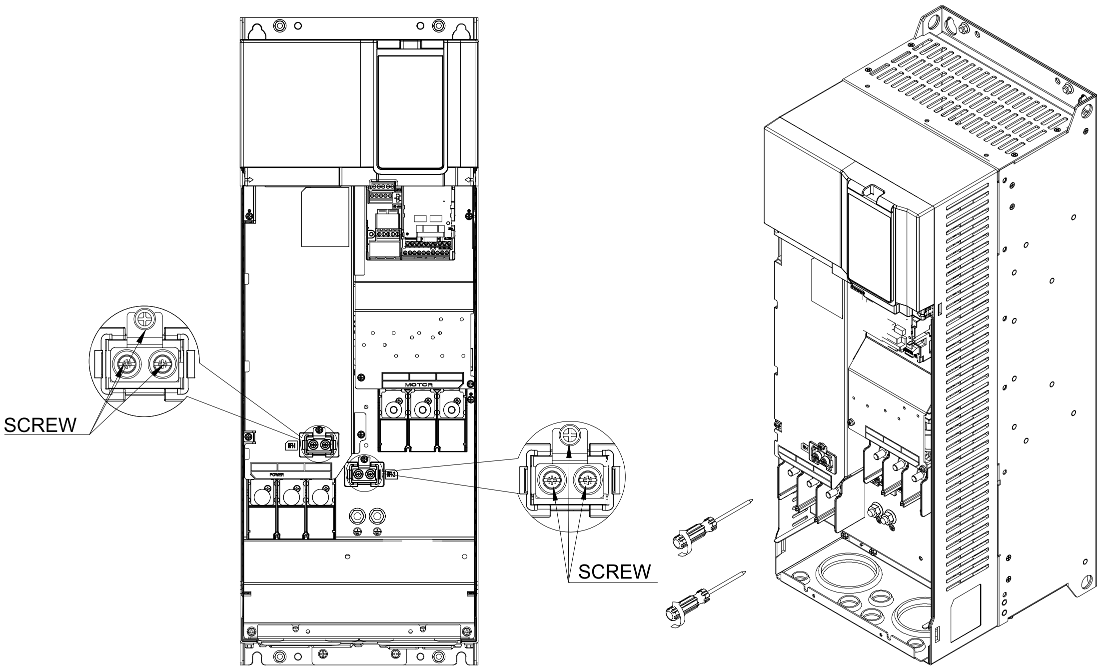


Figure 3-92

2. Place the RFI jumper and fasten back the screws.

   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.78–0.98 Nm)

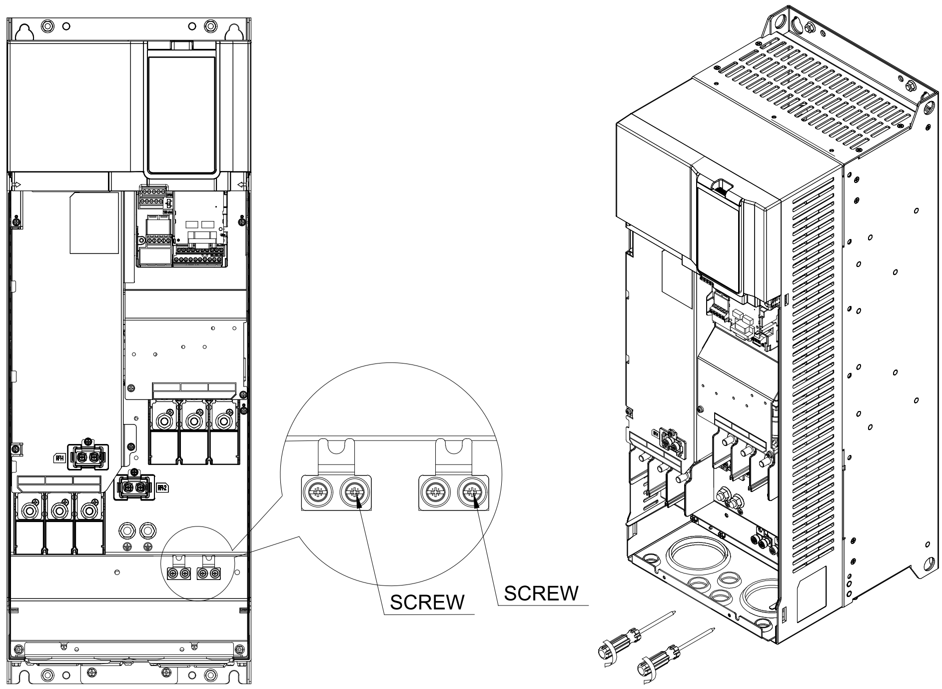


Figure 3-93

Frame H2

Applicable models: VFD180VP43BFTCA–VFD220VP43BFTCA

1. Loosen the RFI jumper.
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.78–0.98 Nm)

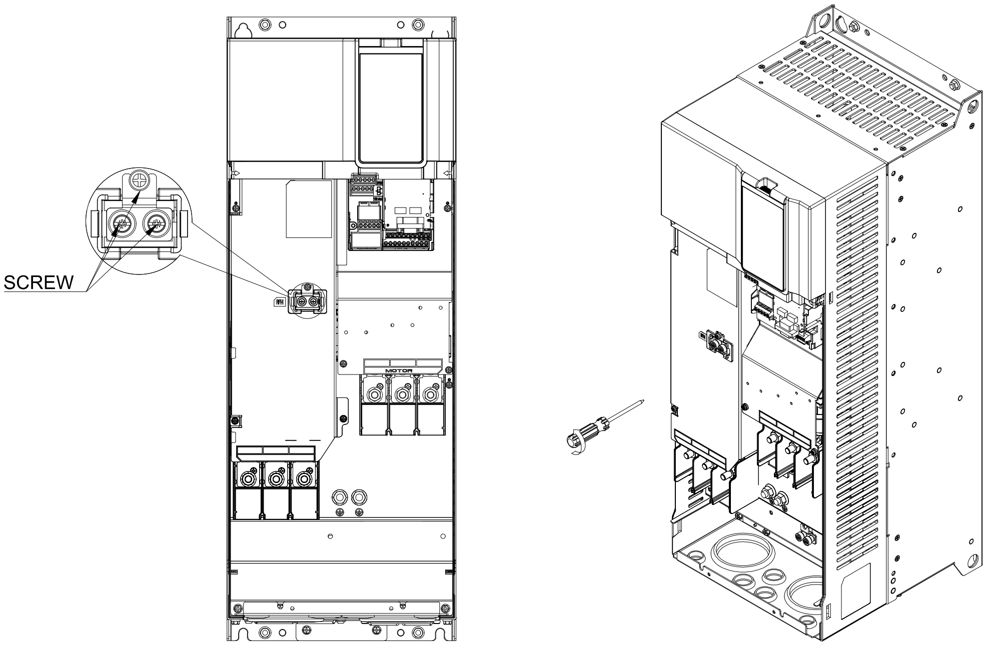


Figure 3-94

2. Place the RFI jumper and fasten back the screws.
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.78–0.98 Nm)

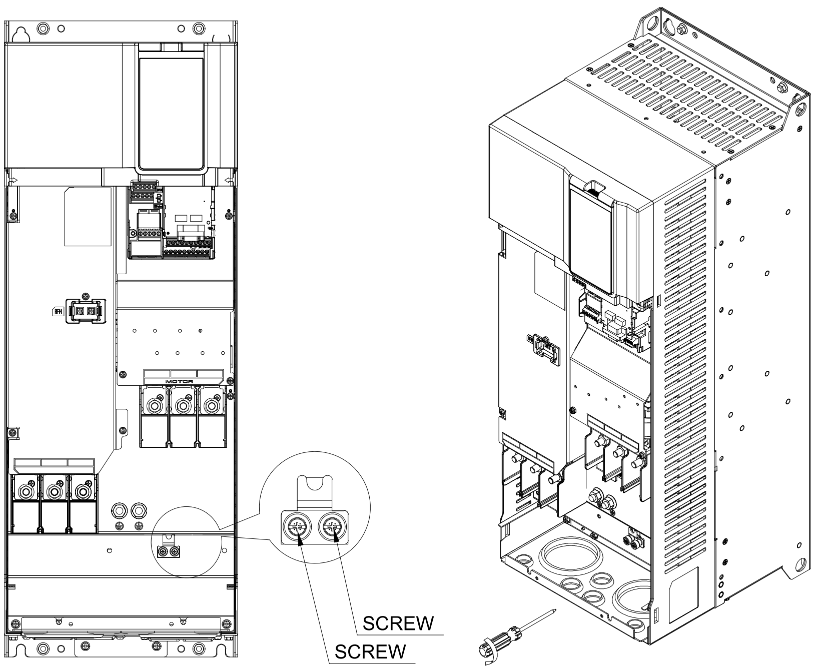


Figure 3-95

Frame I1

Applicable models: VFD260VP43AFTCA–VFD310VP43AFTCA

1. Loosen the RFI jumper and keep the screws on the plate.
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.78–0.98 Nm)

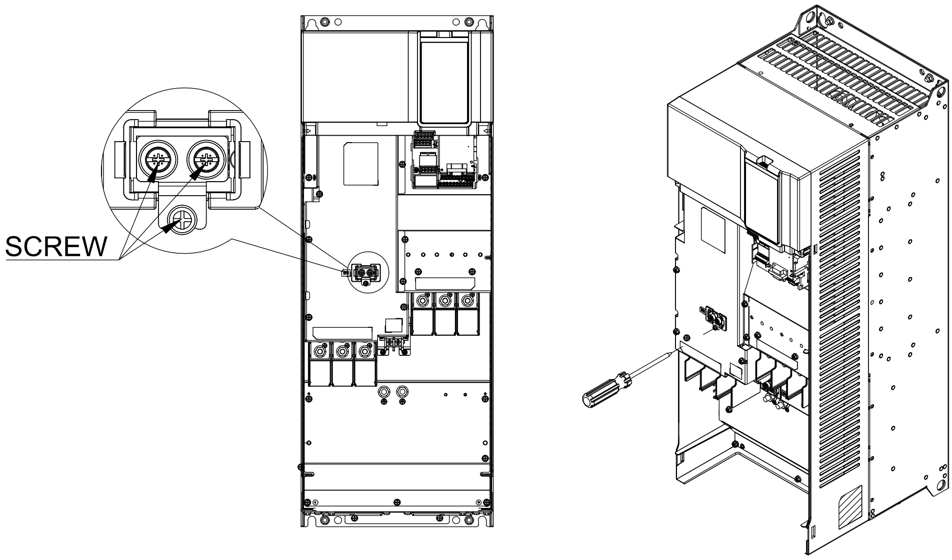


Figure 3-96

2. Place the RFI jumper and fasten back the screws.
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.78–0.98 Nm)

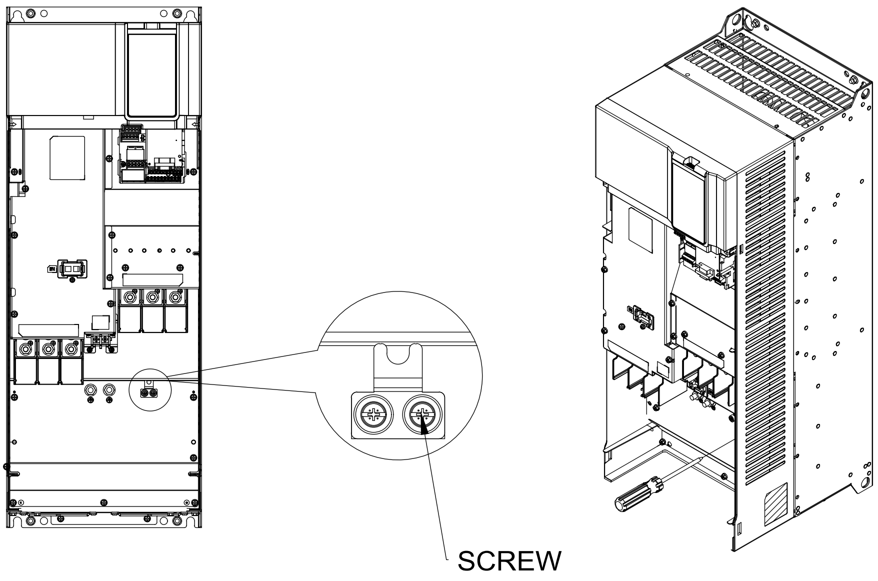


Figure 3-97

Frame I2

Applicable models: VFD260VP43BFTCA–VFD310VP43BFTCA, VFD260VP43BSTCA–VFD310VP43BSTCA

1. Loosen the RFI jumper and keep the screws on the plate.
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.78–0.98 Nm)

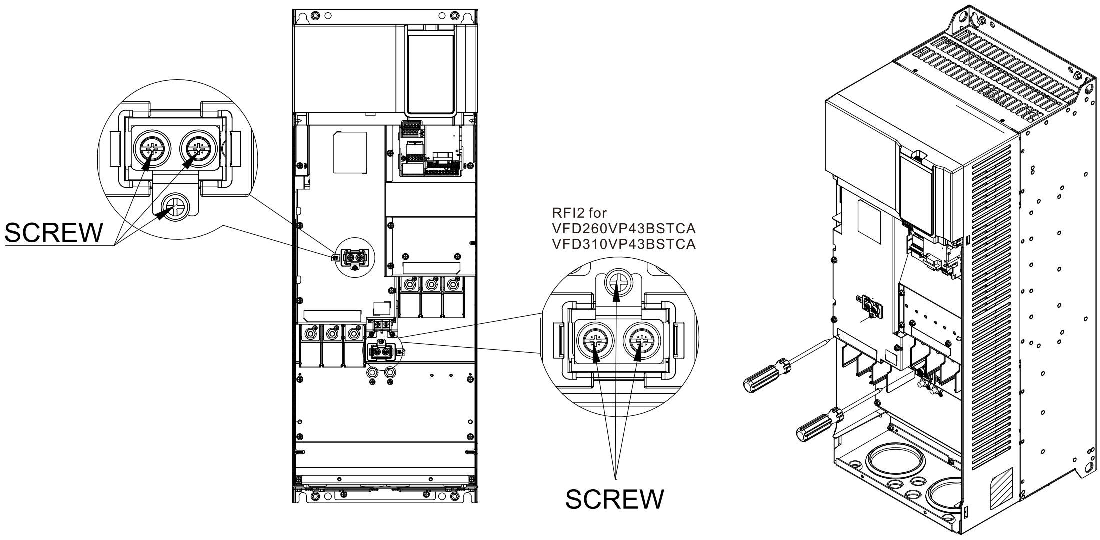


Figure 3-98

2. Place the RFI jumper and fasten back the screws.
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.78–0.98 Nm)

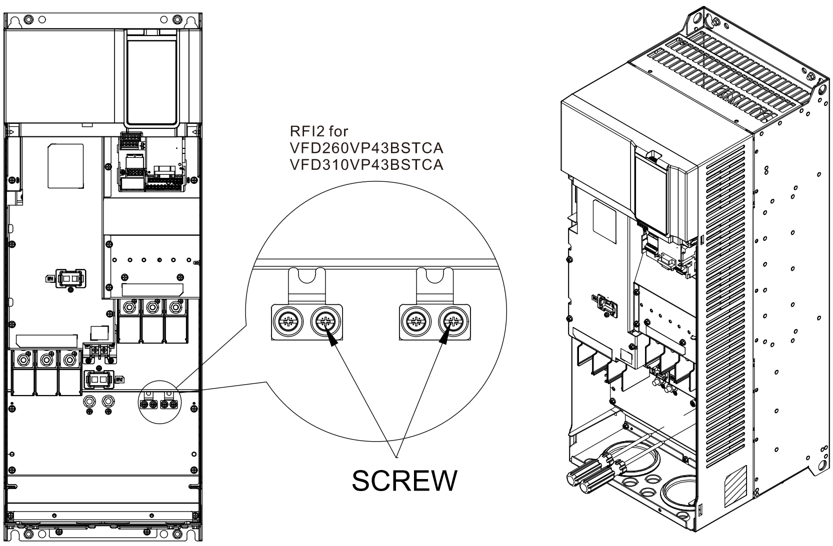


Figure 3-99

Frame J

Applicable models: VFD370VP43AFTCA–VFD395VP43AFTCA, VFD370VP43BSTCA–VFD395VP43BSTCA
VFD370VP43BFTCA–VFD395VP43BFTCA

1. Loosen the RFI jumper (fasten the M4 screws back to the original place).
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.78–0.98 Nm)

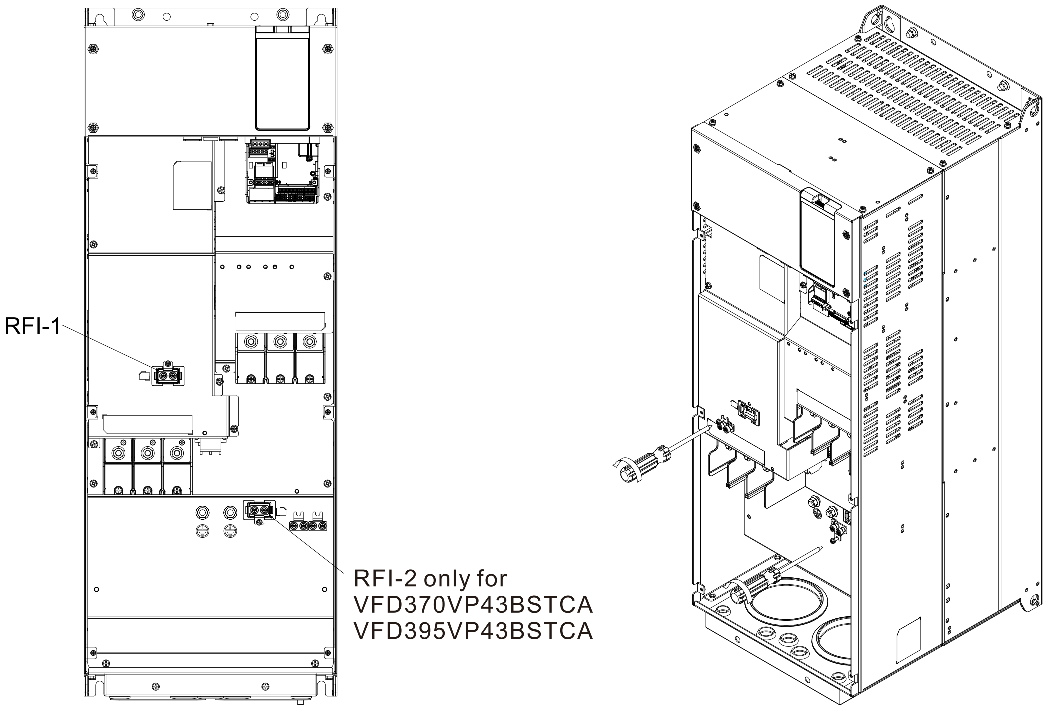


Figure 3-100

2. Place the RFI jumper and fasten back the screws.
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.78–0.98 Nm)

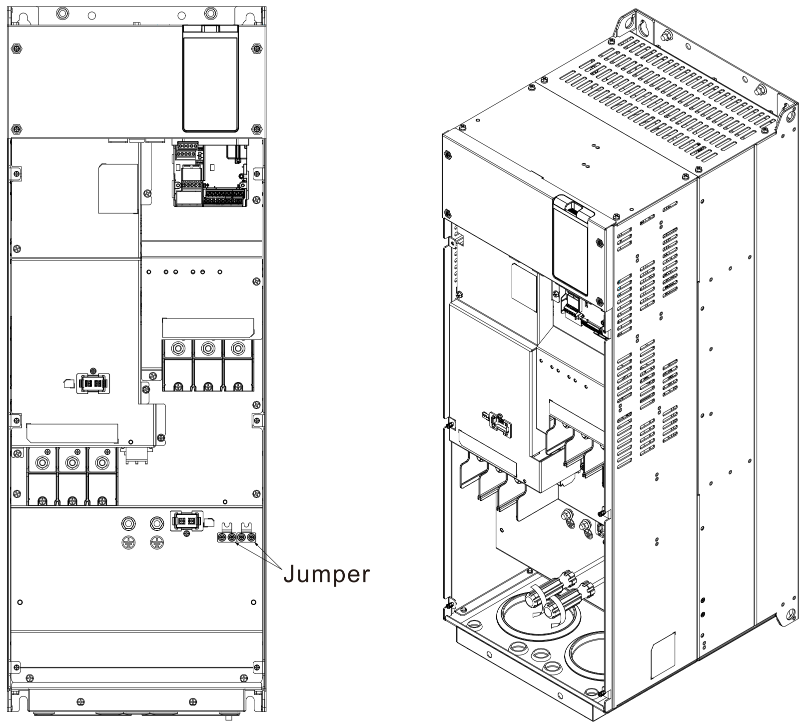


Figure 3-101

Frame K1

Applicable models: VFD460VP43AFTCA, VFD485VP43AFTCA

1. Loosen the RFI jumper (fasten the M4 screws back to the original place).
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.78–0.98 Nm)

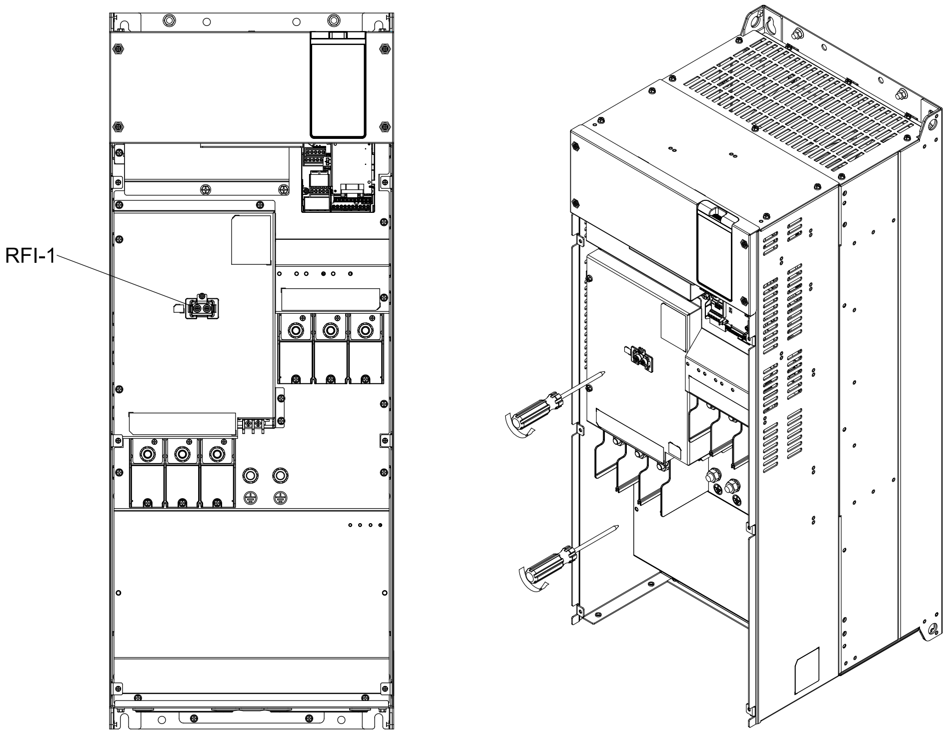


Figure 3-102

2. Place the RFI jumper and fasten back the screws.
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.78–0.98 Nm)

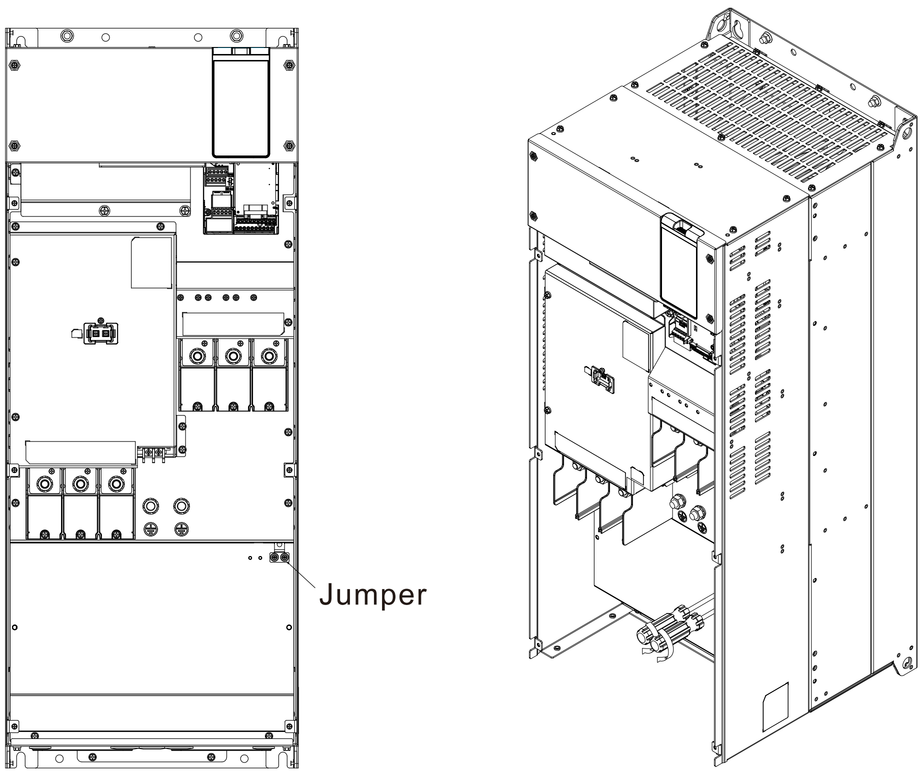


Figure 3-103

Frame K2

Applicable models: VFD460VP43BSTCA–VFD485VP43BSTCA, VFD460VP43BFTCA–VFD485VP43BFTCA

1. Loosen the RFI jumper (fasten the M4 screws back to the original place).
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.78–0.98 Nm)

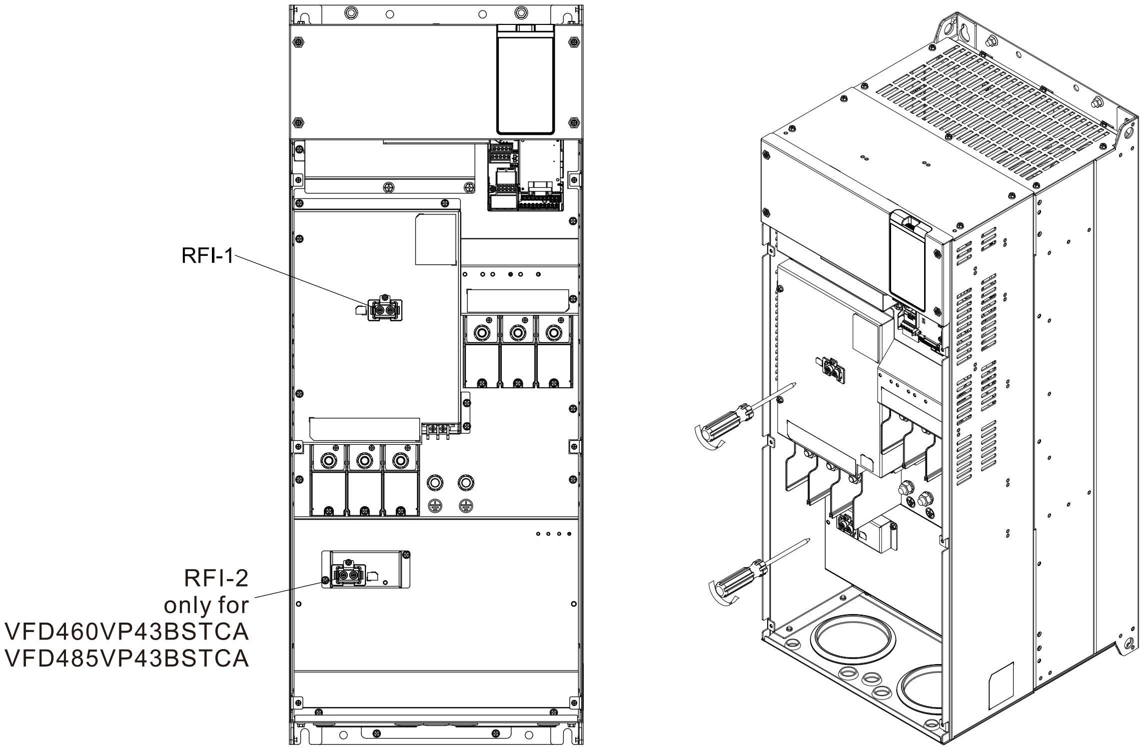


Figure 3-104

2. Place the RFI jumper and fasten back the screws.
   Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in) / (0.78–0.98 Nm)

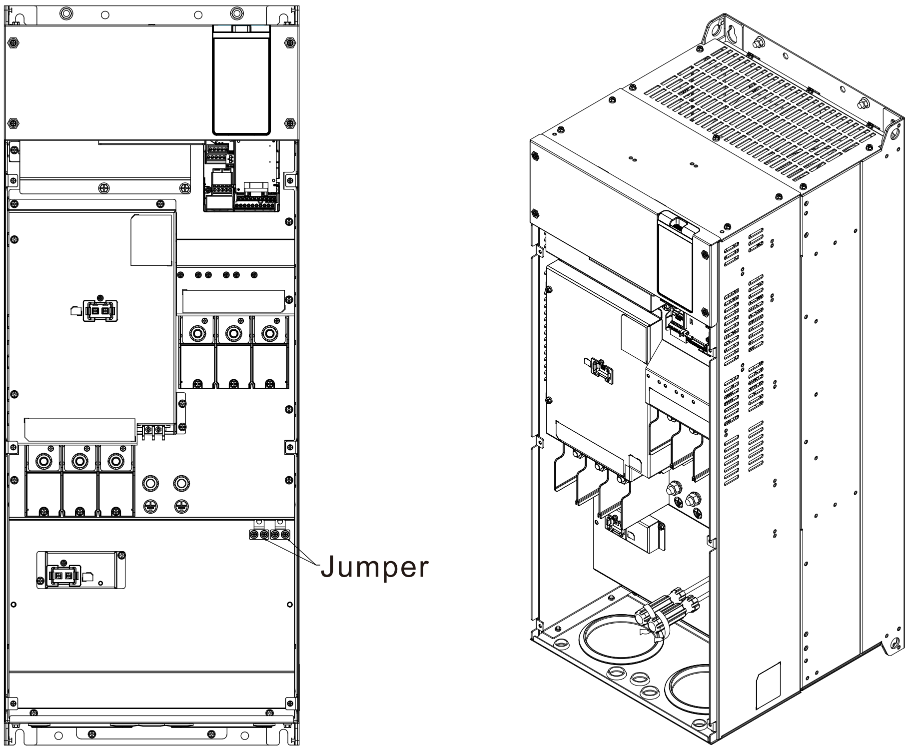


Figure 3-105

Frame L–M

Applicable models: VFD530VP43SHTCA–VFD1K2VP43SHTCA

1. Loosen the three screws on the RFI jumper and remove the jumper.

   M4 screw torque: 14–16 kg-cm / (12.2–13.9 lb-in.) / (1.37–1.57 Nm)

   RFI jumper screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.78–0.98 Nm)

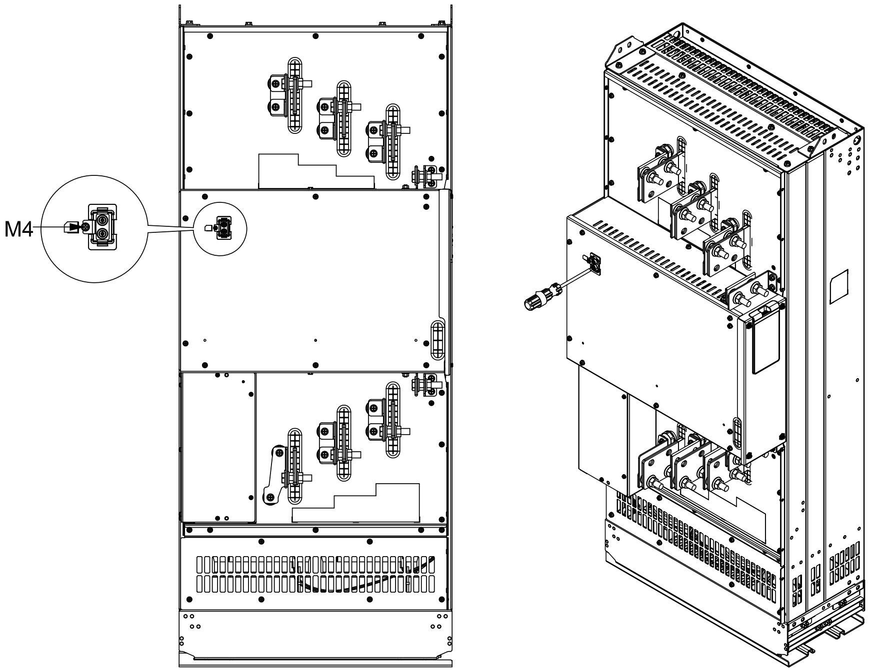


Figure 3-106

2. Fasten the M4 screws back to its original position and put the RFI jumper to the position indicated in the figure below and fasten it.

   M4 screw torque: 14–16 kg-cm / (12.2–13.9 lb-in.) / (1.37–1.57 Nm)

   RFI jumper screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.78–0.98 Nm)

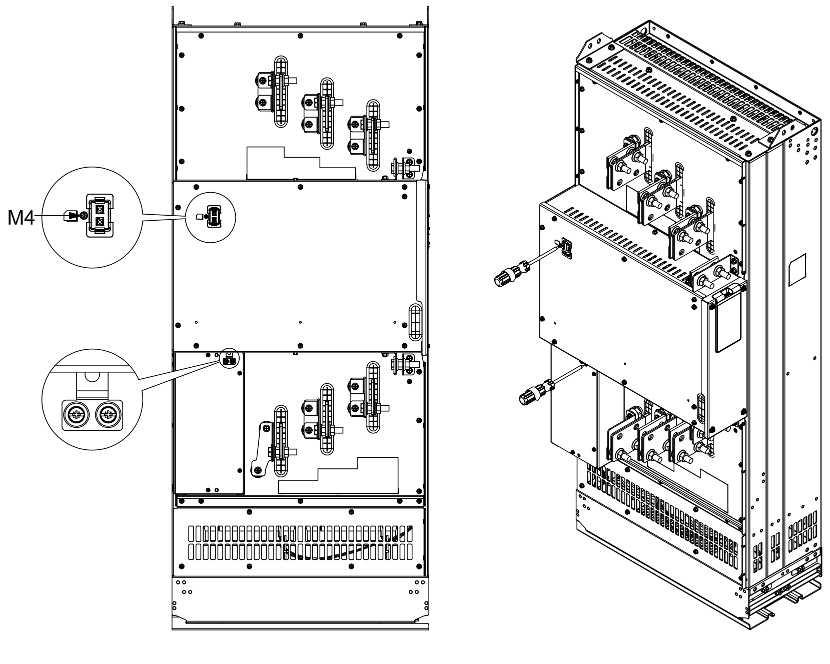


Figure 3-107

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

Important points regarding ground connection:

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

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

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

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

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

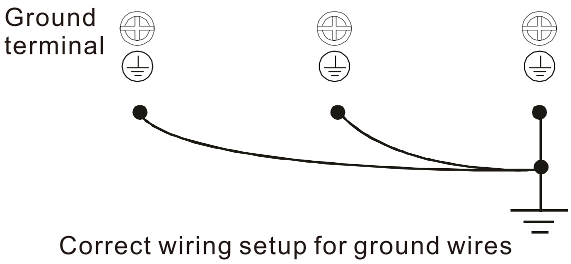


Figure 3-108

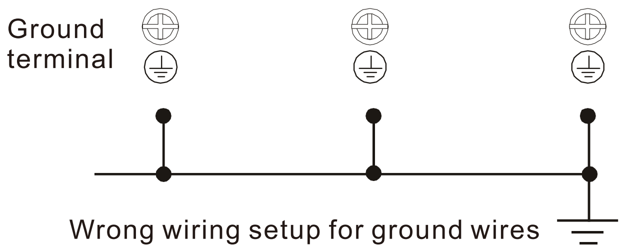


Figure 3-109

Pay particular attention to the following points:

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

☑ Make sure that the main power supply has been cut off before removing the RFI jumper.

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

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

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

Floating Ground System (IT Systems)

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

1. Remove the RFI jumper to disconnect the ground cable from the internal filter capacitor and surge absorber.
2. In situations where EMC is required, check for excess electromagnetic radiation affecting nearby low voltage circuits. In some situations, the adapter and cable naturally provide enough suppression. If in doubt, install an extra electrostatic shielded cable on the power supply side between the main circuit and the control terminals to increase shielding.
3. Do not install an external RFI / EMC filter. The external EMC filter passes through a filter capacitor and connects power input to the ground. This is extremely dangerous and damages the motor drive.

Asymmetric Ground System (Corner Grounded TN Systems)

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

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

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

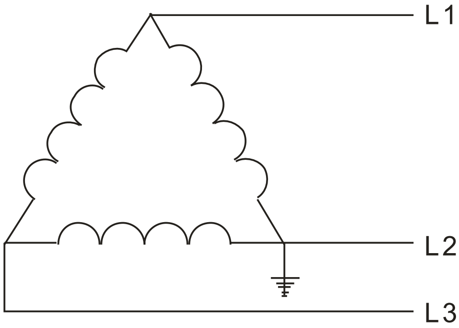



Figure 3-110</td><td>Grounding at a midpoint in a polygonal configuration

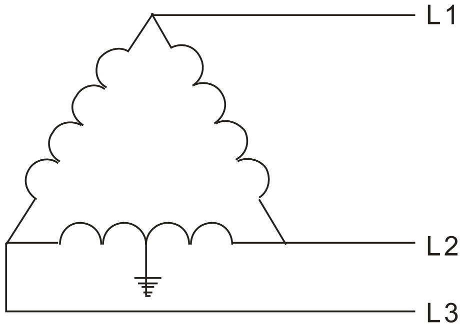



Figure 3-111</td></tr>
<tr><td>Grounding at one end in a single-phase configuration

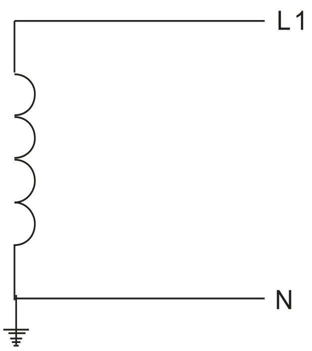



Figure 3-112</td><td>4. No stable neutral grounding in a three-phase autotransformer configuration

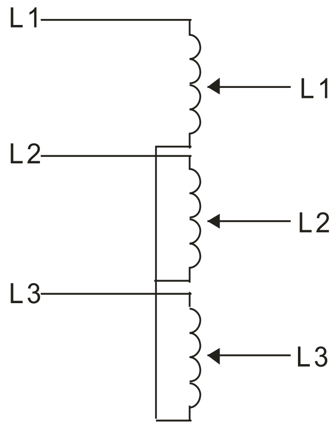
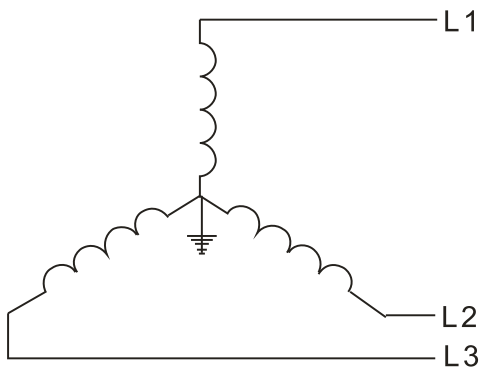



Figure 3-113</td></tr>
<tr><th colspan="2">You can use the RFI jumper for a symmetrical grounding power system</th></tr>
<tr><td>An internal ground is formed through a ground capacitor, which reduces electromagnetic radiation. The requirements for electromagnetic compatibility are more stringent. In the application of power system using symmetrical grounding, you can install an EMC filter. Refer to the figure on the right for the symmetrical grounding power system.</td><td>
Figure 3-114</td></tr>
</table>

3-7 Harmonic Interference Prevention

Connection of AC Reactor

In order to suppress rapid changes in current and high-order harmonic current, AC reactors are required. While suppressing the high-order harmonic current, it also improves the power factor of the drive input side.

For the following situation, connect an AC reactor to the input side (primary side).

- When you need to suppress the high-order harmonic current or improve power factor at the power side.
- When you need to switch the phase advance capacitors.
- When you connect the drive to a larger capacity power transformer (600 kVA and above).

Wiring of AC Reactor

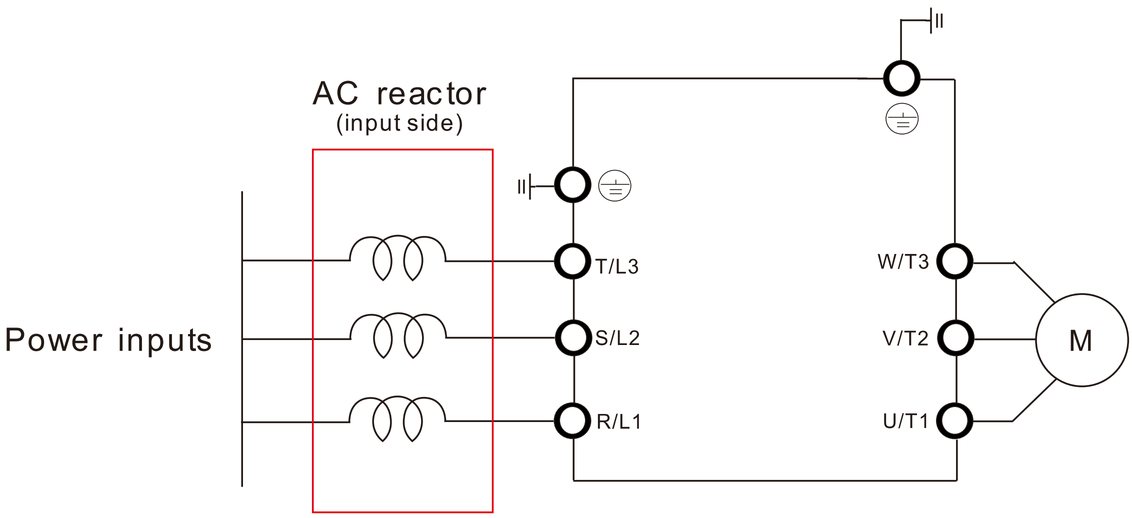


Figure 3-115

NOTE: Refer to Section 10-3-1 AC Reactor for selection.

3-8 Long Wiring Application

Motor Cable Length

1. Consequence of leakage current on the motor
   If the cable length is too long, the stray capacitance between cables increases and may cause leakage current. In this case, It activates the over-current protection, increases leakage current, or may affect the current display. The worst case is that it may damage the AC motor drive. If more than one motor is connected to one AC motor drive, the total wiring length should be the sum of the wiring length from AC motor drive to each motor. For the 460V series AC motor drive, when you install an overload thermal relay between the drive and the motor to protect the motor from overheating, the connecting cable must be shorter than 50 m; however, an overload thermal relay malfunction may still occur. To prevent the malfunction, install an output reactor (optional) to the drive or lower the carrier frequency setting.
2. Consequence of the surge voltage on the motor
   When a motor is driven by a PWM-type AC motor drive, the motor terminals experience surge voltages (dv/dt) due to power transistor conversion of AC motor drive. When the motor cable is exceptionally long (especially for the 460V series), surge voltages (dv/dt) may damage the motor insulation and bearing. To prevent this, follow these rules:
   a. Use a motor with enhanced insulation (refer to the table below).
   b. Reduce the cable length between the AC motor drive and motor to suggested values.
   c. Connect an output reactor (optional) to the output terminals of the AC motor drive.

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

460V Model	kW	HP	Rated Current (Arms)	Without an AC output reactor		With an AC output reactor	
			Normal Duty	Shielded Cable (meter)	Non-shielded Cable (meter)	Shielded Cable (meter)	Non-shielded Cable (meter)
VFD3A0VP43A	0.75	1	3	50	75	75	115
VFD4A2VP43A	1.5	2	4.2	50	75	75	115
VFD5A6VP43A	2.2	3	5.6	50	75	75	115
VFD7A2VP43A	3	4	7.2	50	75	75	115
VFD011VP43A	4	5.3	11	50	75	75	115
VFD013VP43A	5.5	7.5	13	50	75	75	115
VFD018VP43A	7.5	10	18	100	150	150	225
VFD025VP43A	11	15	25	100	150	150	225
VFD032VP43A	15	20	32	100	150	150	225
VFD038VP43A	18.5	25	38	100	150	150	225
VFD045VP43A	22	30	45	100	150	150	225
VFD062VP43A	30	40	62	100	150	150	225
VFD073VP43A	37	50	73	100	150	150	225
VFD091VP43A	45	60	91	150	225	225	325
VFD110VP43A	55	75	110	150	225	225	325

460V Model	kW	HP	Rated Current (Arms)	Without an AC output reactor		With an AC output reactor	
			Normal Duty	Shielded Cable (meter)	Non-shielded Cable (meter)	Shielded Cable (meter)	Non-shielded Cable (meter)
VFD150VP43A	75	100	150	150	225	225	325
VFD180VP43A	90	125	180	150	225	225	325
VFD220VP43A	110	150	220	150	225	225	325
VFD260VP43A	132	175	260	150	225	225	325
VFD310VP43A	160	215	310	150	225	225	325
VFD370VP43A	185	250	370	150	225	225	325
VFD395VP43A	200	270	395	150	225	225	325
VFD460VP43A	220	300	460	150	225	225	325
VFD485VP43A	250	340	485	150	225	225	325
VFD530VP43A	280	375	530	150	225	225	325
VFD616VP43A	315	425	616	150	225	225	325
VFD683VP43A	355	475	683	150	225	225	325
VFD770VP43A	400	530	770	150	225	225	325
VFD866VP43A	450	600	866	150	225	225	325
VFD930VP43A	500	665	930	150	225	225	325
VFD1K1VP43A	560	745	1100	150	225	225	325
VFD1K2VP43A	630	840	1212	150	225	225	325

Table 3-31

Wiring of AC Output Reactor

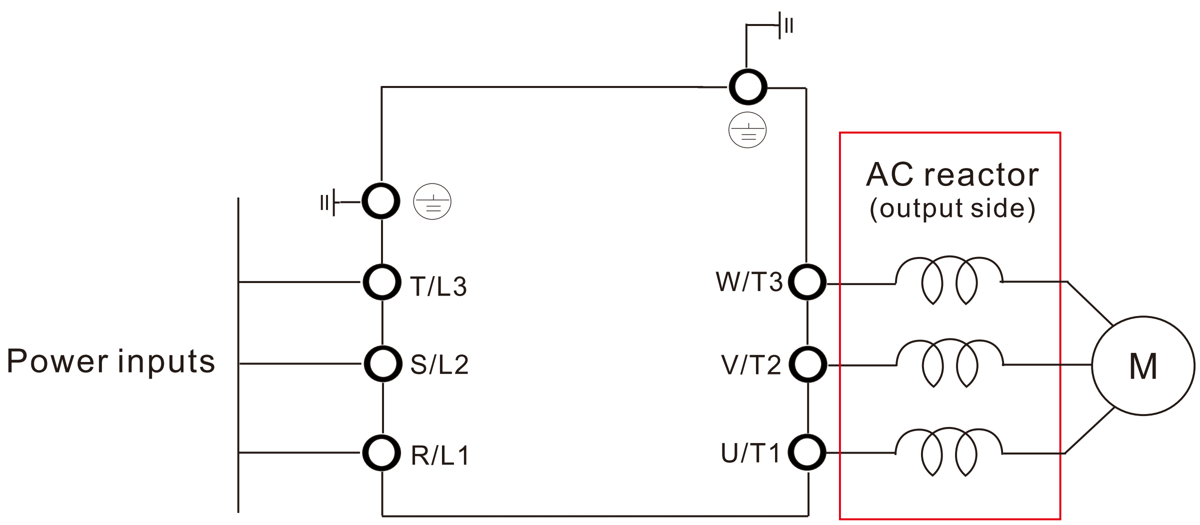


Figure 3-116

3-9 Electromagnetic Interference Prevention

When using an AC motor drive to drive the equipment, the harmonic noise will be generated on the power input and output sides of the drive and generates EMC interference on the power supply network and the electrical equipment around the AC motor drive. The AC motor drive is usually installed in an industrial environment with high electromagnetic interference. Under these circumstances, the drive may not only be a noise generator, but more possibly a noise receiver.
Delta drives have been optimized for EMC during design and comply with the EMC power system product standard EN61800-3. Correctly install the drive can reduce the EMC interference. To ensure a long-term normal operation of the power system, the drive must be correct wiring and grounding.
The prevention methods are as follows.

3-9-1 Grounding

The grounding can be set with different forms of grounding terminals as grounding electrodes according to different equipment. Use a grounding wire on the electrical equipment that needs to be grounded to guide the leakage current to the ground. According to Ohm's law, there may be different potential difference between these electrodes and the earth due to different grounding resistance values.

The main purpose of EMC is to prevent noise, and the main consideration of this kind of signal grounding is frequency. When the frequency is lower than 10 kHz, single-point grounding is sufficient; but if the frequency is higher than 10 kHz, multi-point grounding is more effective.

- Single-point ground: Gather the signal grounding points of all IT equipment and connect them to one point. In terms of the grounding, it can be connected to the earth or to the grounding reference. You can also consider connecting the ground to a safety ground point that has been connected to the earth.
- Multi-point ground: Gather the signal grounding points of all IT equipment and ground them independently.

When the DC passes through a conductor, it passes through the entire conductor. If the AC passes through a conductor, and the current moves increasingly close to the surface of the conductor as the frequency increases, this is so-called the Skin effect. In this case, the effective cross-sectional area of the conductor will be smaller, and the resistance value will increase. In conclusion, in order to reduce the influence of the skin effect, you should enlarge the effective cross-sectional area of grounding to increase the current flow at high frequencies. For the above circumstances, you may consider changing the grounding wire from a single wire to a braided conductor or a strip conductor.

3-9-2 Shield

What is a shield?
Electrostatic Shielding: In order to avoid the influence of the external electric filed on the equipment, or to avoid the influence of the internal electric filed of the electrical equipment on other equipment, use a conductor to cover the external electrical filed, so that the internal circuit and the external equipment are not affected, that is called the electrostatic shielding.

In order to avoid interference, some electronic devices or measuring equipment must implement electrostatic shielding. For example, the grounded metal cover or denser metal mesh cover is used for indoor high-voltage equipment. Another example is a power transformer for full-wave rectification or bridge rectification. A metal sheet or a layer of enameled wire is wrapped between the primary winding and the secondary winding and grounded to achieve the shielding effect. In addition, in high-voltage live work, workers wear pressure equalizing suits woven with metal wires or conductive fibers, which can protect human body as a shield.

3-9-3 Wire and Cable

The Shielded Twisted Pair (often abbreviated as STP) is a copper wire. This type of wire is twisted with each other in two pairs and packed in an insulating sleeve. The metal mesh (usually copper) outside the twisted pair can shield the transmission line from external electromagnetic field interference and also serve as a ground.

The outermost layer of the ware and cable is generally rubber or rubber synthetic sleeve. The function of this layer is to insulate and to protect the cable from damage.
Cables are divided into high-voltage and low-voltage cables. If it is a high-voltage cable, there will be a layer of resin-like filler inside to achieve insulation. In high-voltage cables, this layer is the most important part of insulation. Low-voltage cables do not have this layer of filler but are wrapped with something like a ribbon inside. This is to fix each core of the cable and fill the gap in the middle.
The two functions for the shielding layer of the power cable are as follows:

1. The current passing through the power cable is relatively large, resulting in a magnetic field around the current. To avoid affecting other components, the shielding layer can shield this electromagnetic field in the cable.
2. To achieve a certain degree of ground protection. If the cable core is damaged, the leaked current flows into the grounding grid along the shielding layer to achieve safety protection.

3-9-4 Filter

Electromagnetic interference is divided into ration and conduction according to the energy transmitting methods. For radiated interference, shielding technology can generally achieve the best results; as for conducted interference, the most effective and economical methods is to use magnetic filter components to eliminate and suppress it.
In noise interference, the 150K–300 MHz frequency band is called high-frequency; and 120–3000 Hz frequency band is called low-frequency. The high-frequency noise current has a small amplitude but high frequency, and the low-frequency noise current has a large amplitude but low frequency. Both of them are transmitted to the power supply system through the power line.
The high-frequency interference conducted by the power supply needs to be effectively eliminated and suppressed by using a filter. The filter is composed of an inductance coil and a capacitor. Not all the drives have built-in filters, in which case an external filter must be purchased. Refer to Figure 3-95 for general standard filter wiring diagram.

3-9-4-1 External Filter

Install the drive and filter on a metal plate such as a grounded control cabinet. Use shielded wires for motor cables and keep the wiring distance as short as possible. Generally, the drive provides the corresponding type of filter, because only the filter that has been tested and certified can pass the EMC standard.

EMC Filter Installation

Foreword

All electrical equipment, including AC motor drives, generate high frequency / low frequency noise and interfere with peripheral equipment by radiation or conduction when in operation. You can eliminate most of the interference by install an EMC filter correctly. It is recommended to use DELTA EMC filter to have the best interference elimination performance.
We assure that it can comply with following rules when AC motor drive and EMC filter are installed and wired according to user manual:

1. EN61000-6-4
2. EN61800-3 1996
3. EN55011 (1991) Class A Group 1

General Precautions

To ensure EMC filter can maximize the effect of suppressing the interference of AC motor drive, the installation and wiring of AC motor drive should follow the user manual. In addition, be sure to observe the following precautions:

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

Choose suitable motor cable and precautions

Improper installation and choice of motor cable affect the performance of EMC filter. Be sure to follow the precautions below when selecting motor cable.

1. Use the cable with shielding (double shielding is the best). The shielding on both ends of the motor cable should be grounded with the minimum length and maximum contact area.
2. Remove any paint on metal saddle for good ground contact with the saddle and the metal plate, as shown in Figure 3-93.
3. The connection between the motor cable isolated copper mesh and the metal plate must be correct. The isolated copper mesh at both ends of the motor cable should be fixed to the metal plate with a saddle. Refer to Figure 3-94 for correct connecting method.

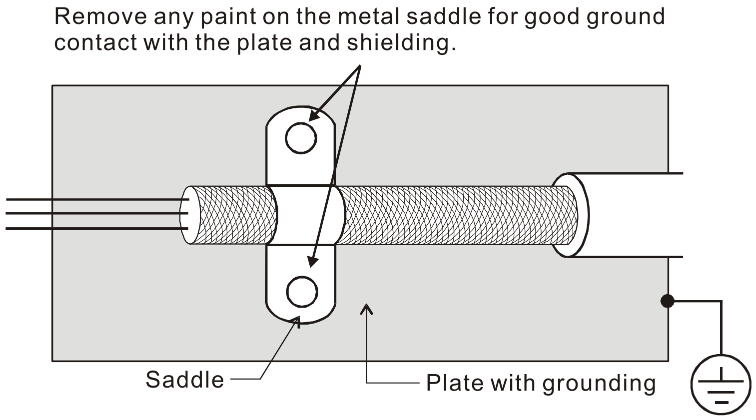


Figure 3-117

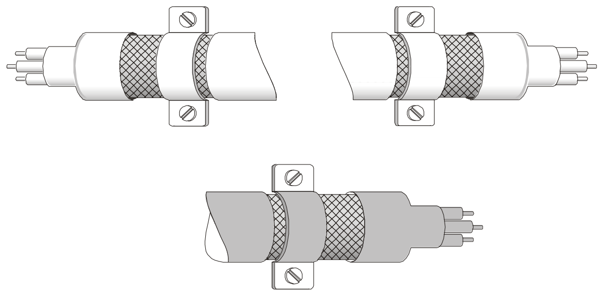


Figure 3-118

3-9-4-2 Connection of EMC Filter

Since the output of the drive switches at high speed, the noise is transmitted from the drive power line, which may cause interference to external equipment (radio, telephone, non-contact switch, pressure sensor or position detector). It is recommended to install an EMC filter on the input side to reduce the noise from the drive to the power line and the reverse noise as well.

NOTE:

1. Use an EMC filter dedicated to the drive.
2. Install the EMC filter as close to the drive as possible.

Connect an EMC filter to the input side of the drive to reduce the radio noise and induction noise. Filter wiring is shown as the figure below.

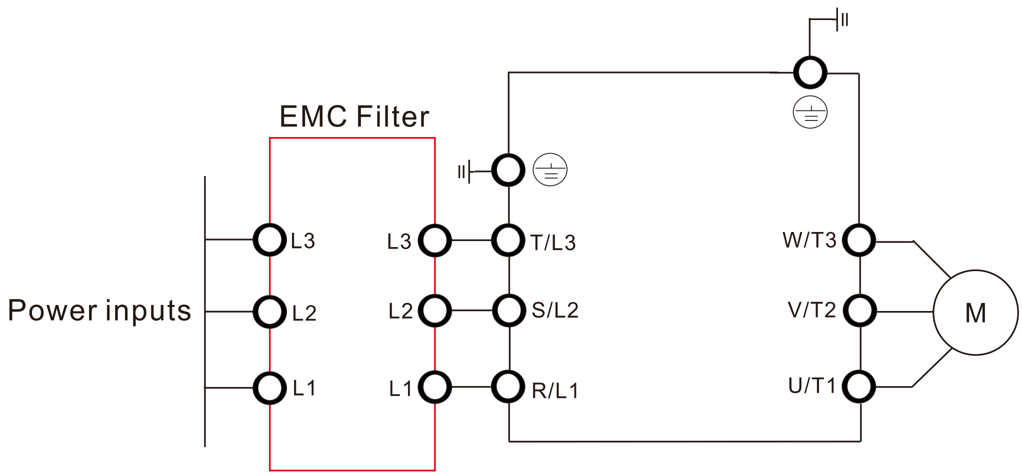


Figure 3-119

NOTE: Do NOT connect phase advanced capacitors and LC/RC filters to the output circuit of the drive. Otherwise, the drive, phase advanced capacitor, EMC filter and earth-leakage circuit-breaker may be damaged.

3-9-4-3 Induction Noise Prevention

In addition to install the EMC filter to suppress induction noise from the output side, you can also consolidate the wiring in a grounded metal pipe for the same purpose. If the signal cable is over 30 cm away from the drive, the influence of induction noise will be reduced. Be sure to ground the metal pipe.

3-9-5 Zero Phase Reactor (choke)

Install a zero-phase reactor on the input or output side can also reduce the interference. Due to the large current passing through the power input/ output line, be more attention to the saturation of the magnetic core. Due to the large load current on the zero-phase reactor on the power input/ output line, the ideal material is the composite magnetic powder core. This material is highly anti-saturated, its resistivity is several times larger than pure metal magnetic material; therefore, it can be applied in a higher frequency band. You can also increase the number of turns to obtain high impedance capability.

Zero phase reactor installation position diagram:

1. Install at the cable between the power supply and the EMC filter.
2. Install at the cable between the EMC filter and the drive.
3. Install at the cable between the drive and the motor.

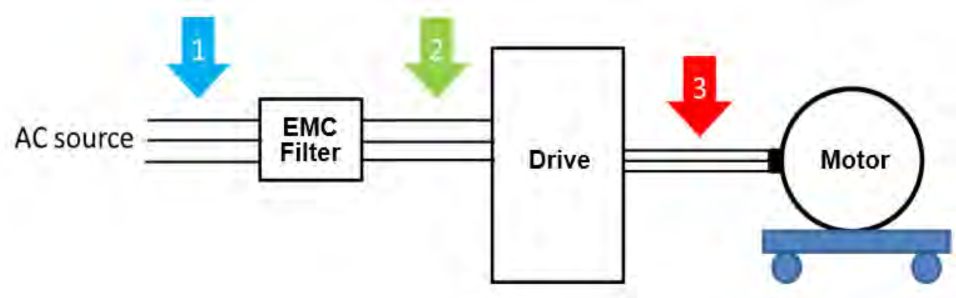


Figure 3-120

Harmonic Interference

The load of the AC motor drive is a non-linear load and generates different components of harmonic current according to the design of the input rectifier. The harmonic current generally needs to be limited within a certain range. This is to ensure that the harmonic voltage and current distortion of the power grid do not exceed the specified range, so as to avoid affecting other equipment. Generally speaking, the drive with built-in DC reactor can effectively suppress the harmonic current (Total Harmonic Current Distortion, THID) within a certain range, which can also reduce the distortion of harmonic voltage (Total Harmonic Voltage Distortion, THVD).

3-9-6 Reactors

In the input circuit of the drive, harmonic with lower frequency (5, 7, 9 and 11 times) has higher proportion. In addition to possibly interfering with the normal operation of other equipment, they also consume a large amount of reactive power and greatly reduce the power factor of the line. Connecting reactors in series in the input circuit is an effective way to suppress lower-order harmonic current.

AC reactor

Connected in series between the power supply and the input side of the drive, the main functions of AC reactors are as follows:

1. Lower the harmonic generated from the drive while increasing the impedance of the power supply side.
2. Absorb and weaken the impact of the surge voltage/ current generated from nearby equipment, and the surge voltage of the main power supply on the drive.
3. Improve power factors.

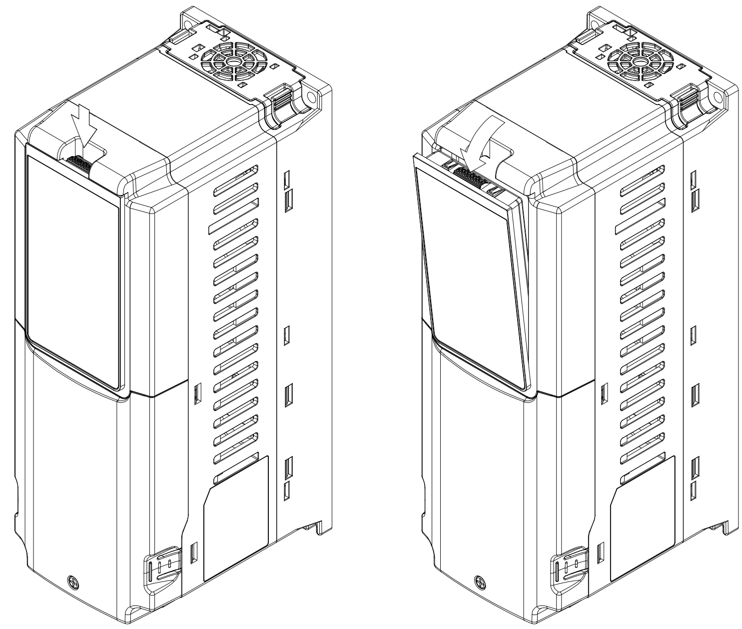
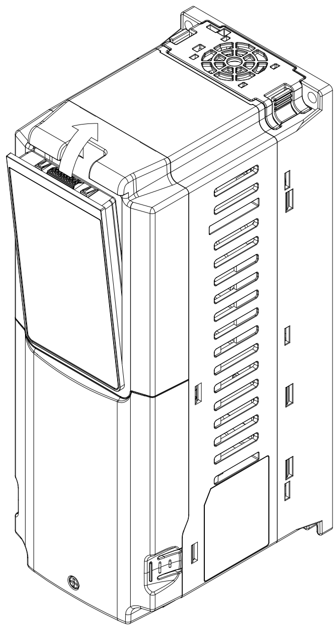
Chapter 4 Operation Interface

4-1 Digital Keypad

Model Name	KPV-CE02	KPV-CC01	KPV-CC02
	 Figure 4-1	 Figure 4-2	 Figure 4-3

- Communication Interface: RS-485 interface, RJ45 (socket)
- Communication protocol: 115200, 8, N, 2
- Installation method: The embedded type can be installed flat on the surface of the control box. The front cover is waterproof.
- Optional accessory: buy an MKV-KPPK model for wall mounting or embedded mounting. Its protection level is IP66.
- The maximum RJ45 extension lead is 5 m (16 ft)
- This keypad is applicable for Delta drives VP3000, VS3000 and VH3000.

Install and detach the digital keypad

Detach the keypad	Install the keypad
 Figure 4-4	 Figure 4-5

4-1-1 Dimensions

KPV-CE02

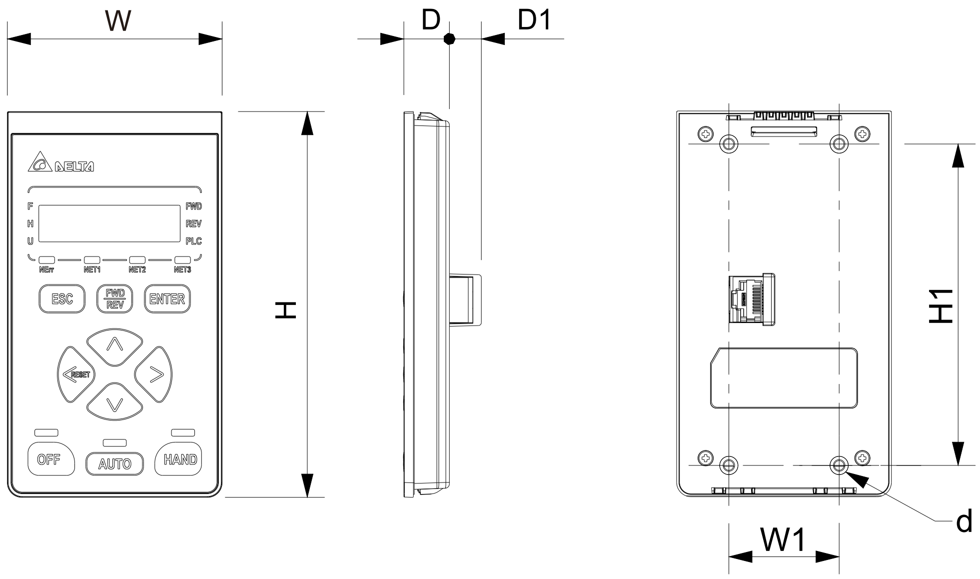


Figure 4-6

Unit: mm (inch)

	W	W1	H	H1	D	D1	d
KPV-CE02	74 (2.91)	38 (1.50)	132.5 (5.22)	110.4 (4.35)	15.7 (0.62)	11 (0.43)	M4xP0.7

Table 4-1

KPV-CC01/ KPV-CC02

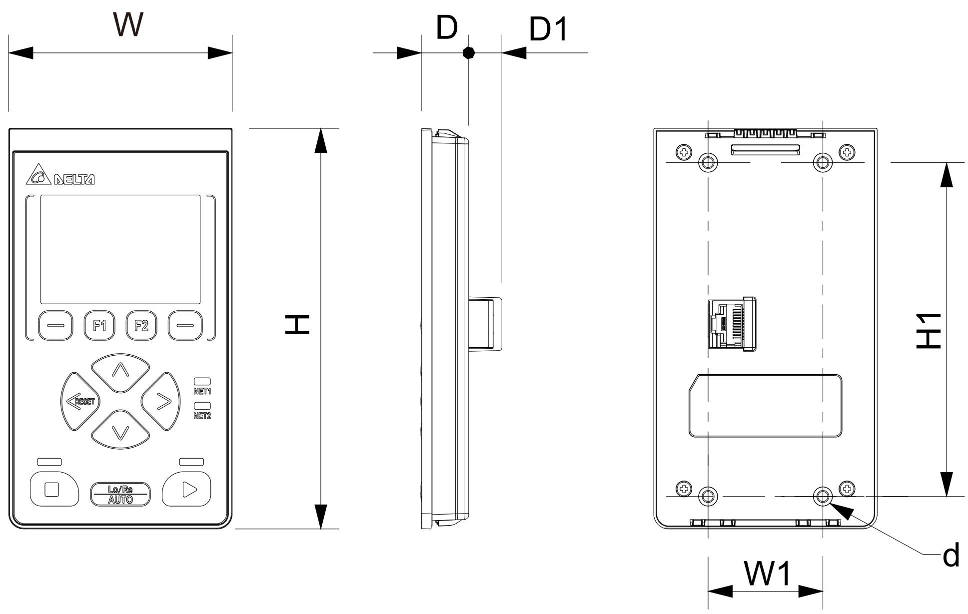


Figure 4-7

Unit: mm (inch)

	W	W1	H	H1	D	D1	d
KPV-CC01 KPV-CC02	74 (2.91)	38 (1.50)	132.5 (5.22)	110.4 (4.35)	15.7 (0.62)	11 (0.43)	M4xP0.7

Table 4-2

4-1-2 Descriptions of Digital Keypad

KPV-CE02

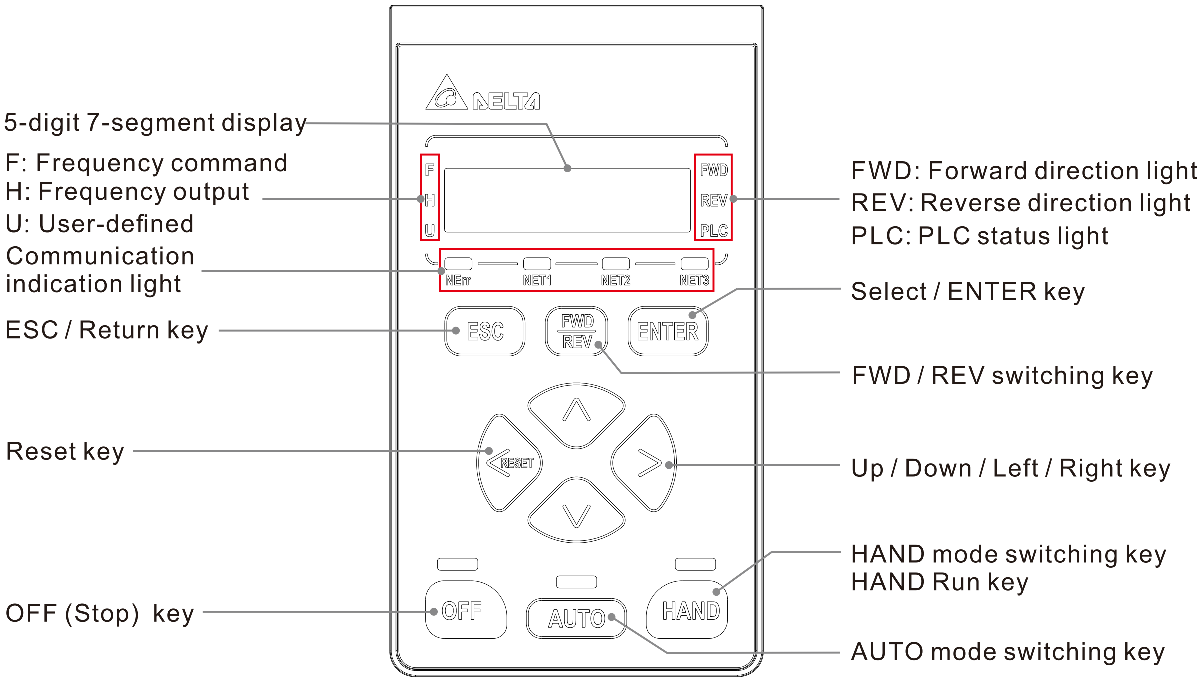


Figure 4-8

KPV-CC01

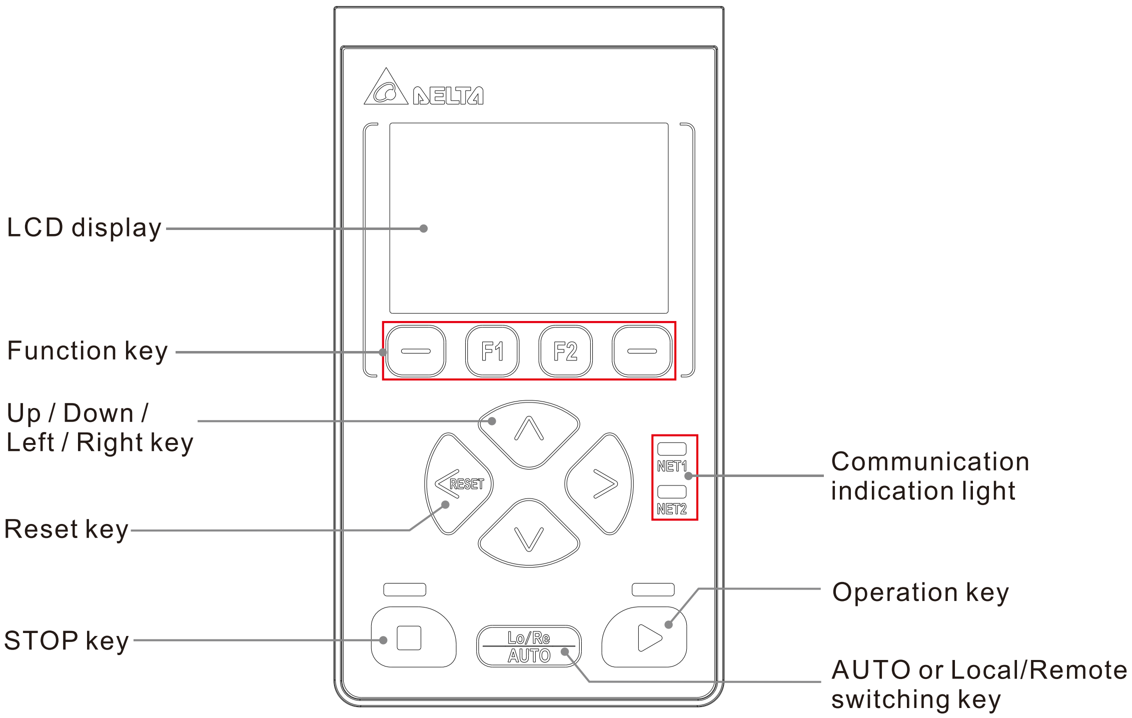


Figure 4-9

4-1-3 Keypad Function Descriptions

4-1-3-1 Keypad Function Descriptions of KPV-CE02

Key	Name	Function Description
	Operation key/ HAND key	**HAND key** 1. Operates the drive in HAND mode. 2. Press the HAND key at STOP, then the setting switches to HAND frequency source and HAND operation source. **Operation Key** 1. Only valid when the source of operation command is the keypad. 2. Operates the AC motor drive.
	OFF key	1. This key has the highest priority when the command is from the keypad. 2. When it receives the OFF command, regardless of whether the AC motor drive is in operation or stop status, the AC motor drive executes the “STOP” command.
	AUTO key	1. Operates the drive in AUTO mode. 2. Press the AUTO key at STOP, then the setting switches to AUTO frequency source and AUTO operation source.
	Up key	1. In the numeric value setting mode, use the UP/DOWN key to add and subtract the values. 2. Use the up key to change the number from 0 to 9, and the down key in reverse. 3. In the menu/text selection mode, selects an item.
	Down key	1. In the numeric value setting mode, use the UP/DOWN key to add and subtract the values. 2. In the menu/text selection mode, selects an item. 3. Use down key to enter next option; and the up key to return to previous option.
	Left key	1. In the numeric value setting mode, use the Left/ right key to: • Move the cursor • Switch between high bit and low bit • Switch between bit00–32 and the status setting 0–1 2. When setting Calendar, use left/ right keys to switch month, day, hour and minute. 3. Use left/ right keys to switch the Pr Group, for example, switch from Group A0 to Group b0. 4. When a fault occurs, use the Left key to reset the fault. 5. When setting the copied file name, use left/ right keys to move the cursor.

Key	Name	Function Description
	Right key	1. In the numeric value setting mode, use the Left key to move the cursor. 2. When the keypad is locked, press ESC and the Right key for 3 seconds to unlock the keypad.
	ENTER Key	1. Goes to the next menu level. 2. If at the last level, press ENTER to execute the command.
	ESC key	1. Goes to the menu. 2. When in the menu, use ESC to go back to the previous page. Menu: 1. Pr Management 2. I/O monitor 3. Keypad lock 4. App Macros and Quick Setting 5. Option cards 6. Fault record 7. PLC Function 8. Copy function 9. Keypad settings 10. Serial Number
	FWD/ REV Switch key	Operation direction key The Fwd/Rev function only controls the operation direction of the drive, NOT the drive activation. FWD is forward direction; REV is Reverse direction.

4-1-3-2 Keypad Function Descriptions of KPV-CC01

Key	Name	Function Description
	Operation key	**Operation Key** 1. Only valid when the source of operation command is the keypad. 2. Operates the AC motor drive according to the function setting. 3. Allowed repeatedly operation during the STOP process. **HAND key** 1. Operates the drive in HAND mode. 2. Press the HAND key at STOP, then the setting switches to HAND frequency source and HAND operation source. 3. Successful mode switching for the KPV-CC01 displays HAND mode on the screen.
	OFF key	1. This key has the highest priority when the command is from the keypad. 2. When it receives the STOP command, regardless of whether the AC motor drive is in operation or stop status, the AC motor drive executes the “STOP” command.

Key	Name	Function Description
	Lo/Re Switch and AUTO key	1. The default function of this key is Local / Remote switching function. 2. Use parameter to change this key to AUTO mode switching key. 3. Press the AUTO key at STOP, then the setting switches to AUTO frequency source and AUTO operation source. 4. Successful mode switching for the KPV-CC01 displays Local, Remote or AUTO mode on the screen.
	Up key	1. In the numeric value setting mode, use the UP/DOWN key to add and subtract the values. 2. In the menu/text selection mode, selects an item.
	Down key	1. In the numeric value setting mode, use the UP/DOWN key to add and subtract the values. 2. In the menu/text selection mode, selects an item.
	Left key	1. In the numeric value setting mode, use the Left key to move the cursor. 2. When a fault occurs, use the Left key to reset the fault.
	Right key	1. In the numeric value setting mode, use the Right key to move the cursor. 2. When the keypad is locked, press ESC and the Right key for 3 seconds to unlock the keypad.

Function Key

The following functions of each key display in the bottom of the screen and vary with the displayed content.

Key	Functions	Descriptions
	ESC	**Delete Key** When the function list displays “ESC” on the screen, this key is defined as “Delete and return to previous page”.
	Func	**Function selection key** When the function list displays “Func” on the screen, press this key to go to the function selection page. Menu: 1. Pr Management / 7. PLC Function 2. I/O monitor / 8. Copy function 3. Keypad lock / 9. Drive Information 4. App Macros and Quick Setting / 10. Start Wizard 5. Option cards / 11. Keypad settings 6. Fault record / 12. SD card management
	Back	When the function list displays “Back” on the screen, this key is defined as “Return to previous page”.

Key	Functions	Descriptions
	No	When the function list displays “No” on the screen, this key is defined as “No”.
	Fwd / Rev	**Forward / Reverse direction switching key** When the function list displays “Fwd / Rev” on the screen, the F1 key is defined as “Operation direction switching key”. 1. The Fwd/Rev function only controls the operation direction of the drive, NOT the drive activation. 2. Fwd is forward direction; Rev is Reverse direction.
	Home	**Home key** When the function list displays “Home” on the screen, press F1 key to go to the Home page.
	Default	**Return to default key** When the function list displays “Default” on the screen, press F1 key to go to parameter settings return to the default selection page.
	JOG	**JOG operation key** When the function list displays “JOG” on the screen, F2 key is defined as JOG operation.
	Add	**Add parameter into the user industry application list** When the function list displays “Add” on the screen, press F2 key to add the parameter displayed on the screen into the user industry application parameter list.
	Next	**Go to next page** When the function list displays “Next” on the screen, press F2 key to go to next page.
	ErrDisp	**Go back to the error display page** When the function list displays “ErrDisp” on the screen, press F2 key to see detailed information of the error.
	ENTER	**Confirm function key** When the function list displays “ENTER” on the screen, this key is defined as “Confirm”.
	Select	**Select function key** When the function list displays “Select” on the screen, press this key to go to next level of the chosen function.
	Edit	**Edit function key** When the function list displays “Edit” on the screen, press this key to edit the content on the displayed page.
	F set	**Frequency setting key** When the function list displays “Freq set” on the screen, press this key on Home page to execute Frequency command setting.

Key	Functions	Descriptions
	Yes	**Yes key** When the function list displays “Yes” on the screen, this key is defined as “Yes”.
	Diffe	**Difference comparison function key** When the function list displays “Diffe” on the screen, press this key to check the difference information of parameters comparison.
	Info	**Fault information key** When the function list displays “Info” on the screen, press this key to see detailed information of the fault.
	Fix	**Fault treatment key** When the function list displays “Fix” on the screen, press this key to display the QR code of the fault for further treatment.

4-1-4 LED Function Descriptions

4-1-4-1 LED Function Descriptions of KPV-CE02

LED	Descriptions	
	Operation LED	ON: 1. AC motor drive is operating. 2. The drive operates in HAND mode
	AUTO mode LED	ON: The drive operates in AUTO mode
	STOP / Error LED	ON: 1. The drive is in STOP status 2. The drive is in OFF status Flashes The drive is in FAULT status
  	Communication indication light 1–3	
	Communication error indication light	

4-1-4-2 LED Function Descriptions of KPV-CC01

LED	Descriptions	
	Operation LED	ON: 1. AC motor drive is operating. 2. The drive operates in HAND mode
	STOP / Error LED	ON: 1. The drive is in STOP status 2. The drive is in OFF status Flashes The drive is in FAULT status

4-1-4-3 Description of Communication Lights

CMC-DN01

Lights	Definition	Description	
NET1 (MS)	Comm. Card status indication	OFF	no power
		Green light	ON: Comm. Card is working Flashes: stand by
		Red light	Flashes: a recoverable error has occurred to the Comm. card ON: an unrecoverable error has occurred to the Comm. Card, such as hardware error
		Orange light	Flashes: the Comm. card is self-testing
NET2 (NS)	Communication connection status indication	OFF	no working power or the IP address is not configured
		Green light	Flashes: Comm. card is online, but has not established a connection with the main station ON: Comm. card is online and connects normally with the main station, the I/O data is normal
		Red light	Flashed: connection timed out ON: use duplicate IP address
		Orange light	Flashes: the Comm. card is self-testing

CMC-EIP01

<table>
<tr><th>Lights</th><th>Definition</th><th colspan="2">Description</th></tr>
<tr><td rowspan="4">NET1
(MS)</td><td rowspan="4">Comm. Card status indication</td><td>OFF</td><td>No power</td></tr>
<tr><td>Green light</td><td>ON: Comm. Card is working
Flashes: stand by</td></tr>
<tr><td>Red light</td><td>Flashes: a recoverable error has occurred to the Comm. card
ON: an unrecoverable error has occurred to the Comm. Card</td></tr>
<tr><td>Orange light</td><td>Flashes: the Comm. card is self-testing</td></tr>
<tr><td rowspan="4">NET2
(NS)</td><td rowspan="4">Communication connection status indication</td><td>OFF</td><td>No working power or the IP address is not configured</td></tr>
<tr><td>Green light</td><td>Flashes: Comm. card is online, but has not established a connection with the main station
ON: Comm. card is online and connects normally with the main station, the I/O data is normal</td></tr>
<tr><td>Red light</td><td>Flashed: connection timed out
ON: use duplicate IP address</td></tr>
<tr><td>Orange light</td><td>Flashes: the Comm. card is self-testing</td></tr>
</table>

CMC-EIP02

<table>
<tr><th>Lights</th><th>Definition</th><th colspan="2">Description</th></tr>
<tr><td rowspan="4">NET1
(MS)</td><td rowspan="4">Comm. Card status indication</td><td>OFF</td><td>No power</td></tr>
<tr><td>Green light</td><td>ON: Comm. Card is working
Flashes: stand by</td></tr>
<tr><td>Red light</td><td>Flashes: a recoverable error has occurred to the Comm. card
ON: an unrecoverable error has occurred to the Comm. Card</td></tr>
<tr><td>Orange light</td><td>Flashes: the Comm. card is self-testing</td></tr>
<tr><td rowspan="2">NET2
(NS)</td><td rowspan="2">Communication connection status indication light</td><td>OFF</td><td>No working power or the IP address is not configured</td></tr>
<tr><td>Green light</td><td>Flashes: Comm. card is online, but has not established a connection with the main station
ON: Comm. card is online and connects normally with the main station, the I/O data is normal</td></tr>
</table>

Lights	Definition	Description	
		Red light	Flashed: connection timed out ON: use duplicate IP address
		Orange light	Flashes: the Comm. card is self-testing

CMC-PN01

Lights	Definition	Description	
NET1 (SF)	Malfunction indication	Red light	OFF: no error ON: an error occurred to the system
NET2 (BF)	Bus error indication	Red light	OFF: no error ON: an error occurred to the communication bus
NET3 (Rx/Tx)	Data transmission/ reception status indication	Orange light	OFF: stop transmitting/ receiving data ON: data transmitting/ receiving

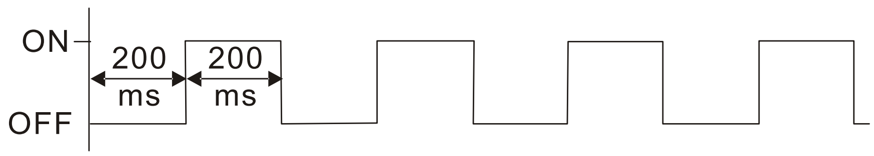
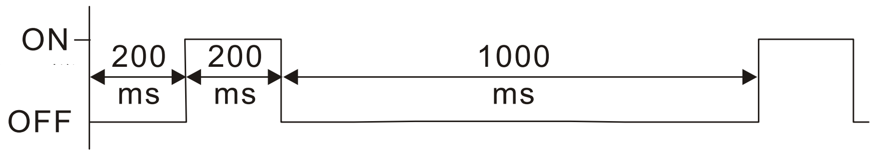
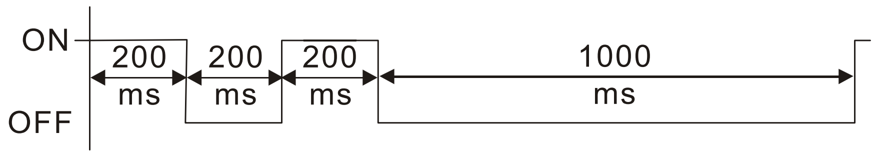
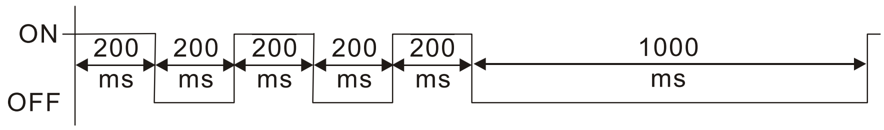
CMC-PD01

Lights	Definition	Description	
NET1 (SF)	Malfunction indication	Red light	ON: an error occurred to the system OFF: no error
NET2 (BF)	Bus error indication	Red light	OFF: no error ON: an error occurred to the communication bus
NET3 (Rx/Tx)	Data transmission/ reception status indication	Orange light	ON: data transmitting/ receiving OFF: stop transmitting/ receiving data

CMC-COP01

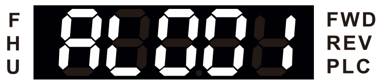
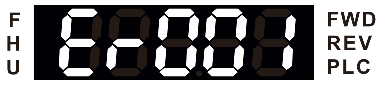
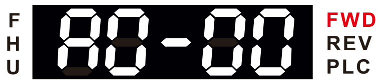
Lights	Definition	Description	
NET1 (ERR)	Fault Indication	Red light	ON: Bus OFF Single flash: at least one CANopen packet failure Double flash: Guarding fail or heartbeat fail Triple flash: SYNC failure
NET2 (RUN)	Communication connection status indication	Green light	ON: CANopen is in operation OFF: CANopen is in initial status Blinking: CANopen is in pre-operation status Single flash: CANopen is in stop status

4-1-4-4 Communication light flashing mode

Name	Definition
Blinking	
Single flash	
Double flash	
Triple flash	

4-1-5 KPV-CE02 Function Display Instructions and Operation Flow

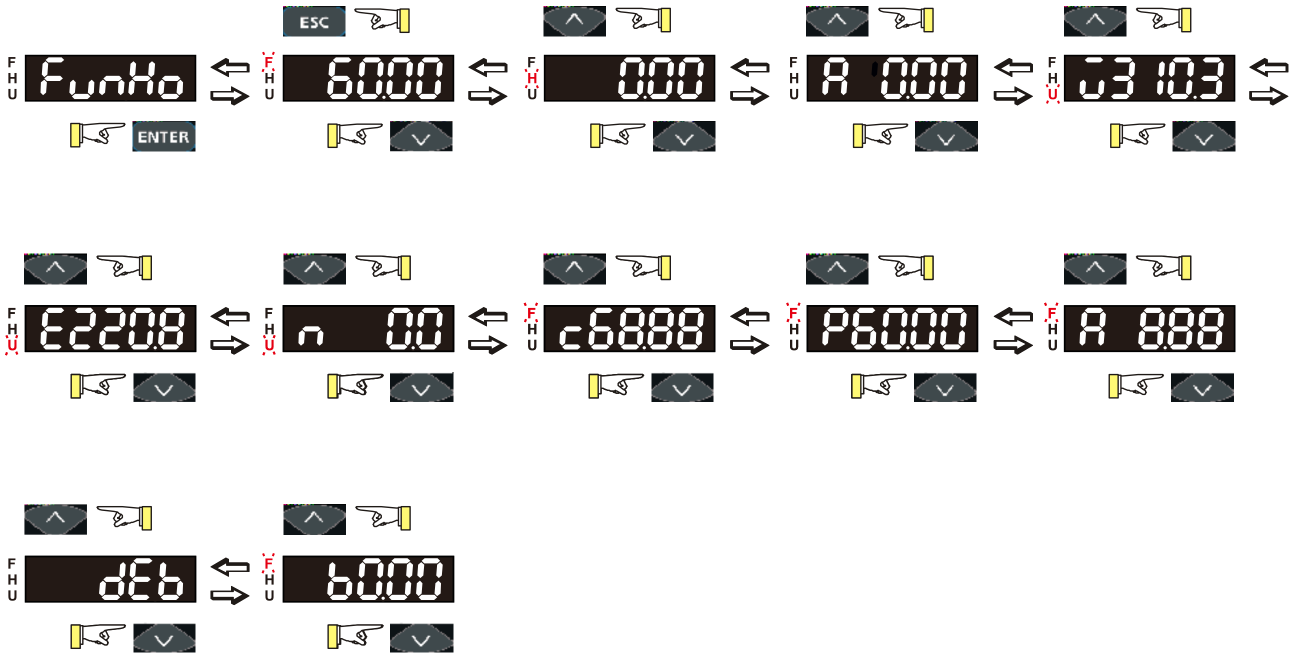
4-1-5-1 Function Display

Function Display	Descriptions
	Display current set frequency and the drive is operating in FWD direction
	Display current set frequency and the drive is operating in REV direction
	Display the drive actual output frequency to the motor
	Display the output current
	Multi-function Display 1 The example on the left is Pr.o0-00 = 3 DC bus voltage
	Multi-function Display 2 The example on the left is Pr.o0-01 = 1 Counter value
	Multi-function Display 3 The example on the left is Pr.o0-02 = 44 PID Feedback
	Display the frequency command of the main and auxiliary frequency synthesis
	Display the main frequency command
	Display the auxiliary frequency command
	Drive status display
	Display current warning code
	Display current error code
	Display the selected parameter
	Display the parameter value
	If End message is displayed on the keypad (as shown on the left), it means that the data has been accepted and stored automatically in the internal memory
	Displayed when the set data is not accepted, or the value exceeds the setting range

Drive status display

Drive Status	LED Display	Descriptions
dEb	dEb	Deceleration Energy Backup
DCIn	dcin	DC injection
AutoT	Autot	Auto tuning
B.B.	b.b	Base Block
Sleep	SLEEP	Sleep function
Stall	StALL	Stall function
PHeat	PHEAt	Pre-heat
FlySr	FLYSt	Flying start
Fire	FirE	FireMode

4-1-5-2 KPV-CE02 Main Screen Display and Operation Flow

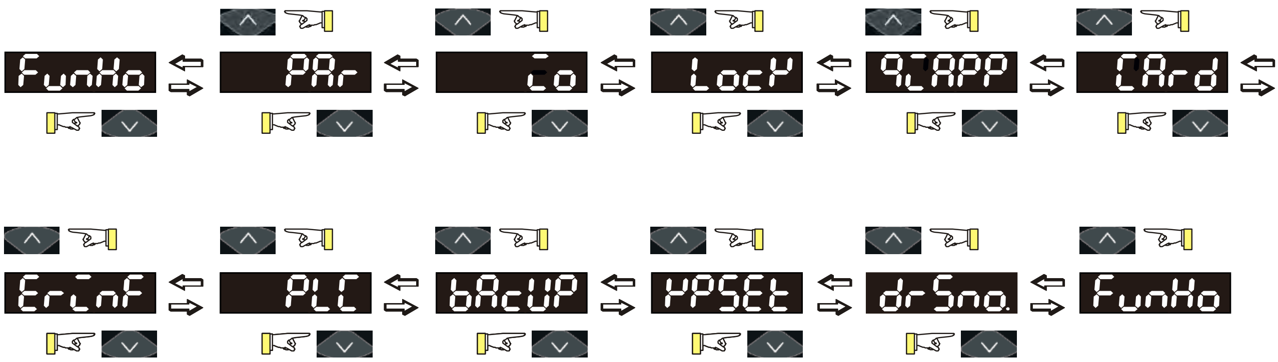


4-1-5-3 KPV-CE02 Function List and Operation Flow

KPV-CE02 Function List

No.	Display	Function Name	No.	Display	Function Name
1	PAr	Pr Management	6	ErInF	Fault record information
2	io	I/O monitor	7	PLC	PLC Function
3	LocK	Keypad lock	8	bAcUP	Copy function
4	qAPP	App Macros and Quick Setting	9	KPSEt	Keypad settings
5	CArd	Option cards	10	drSno	Serial Number

KPV-CE02 Function List Operation Flow

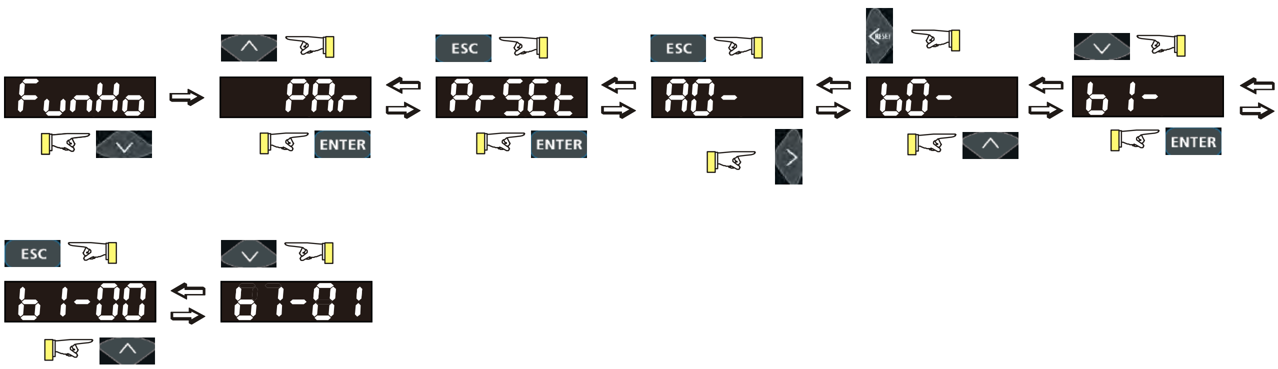


1. Pr Management

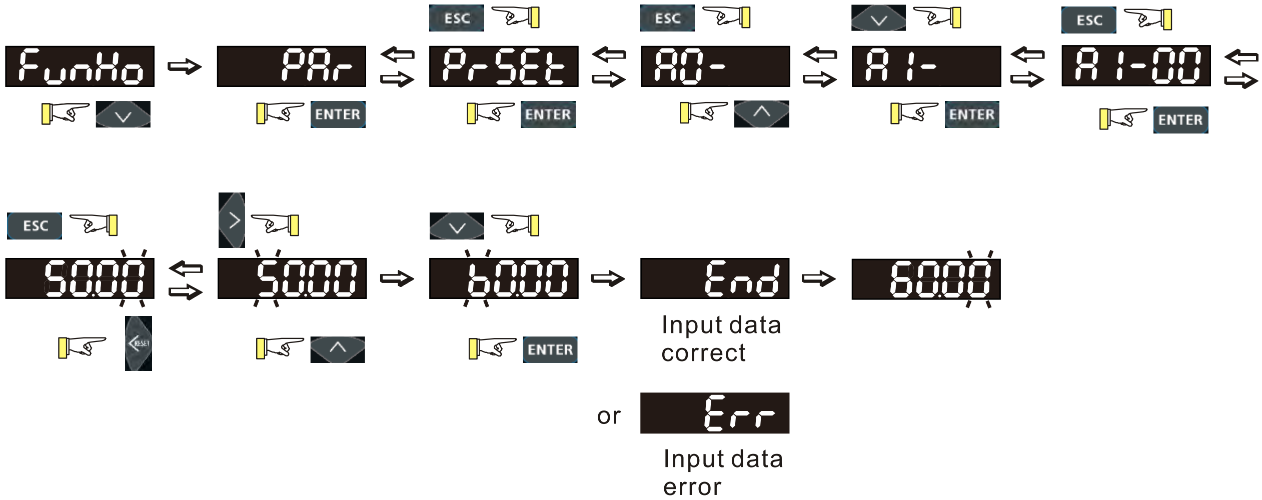
Pr management includes two functions: parameter setting and modified parameter.

Parameter Setting

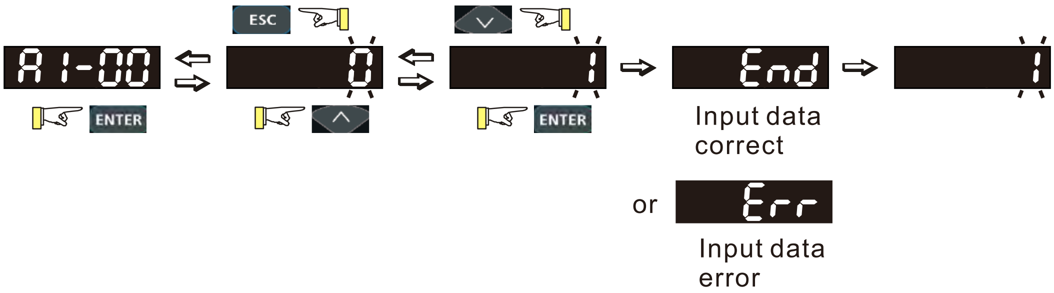
Select parameters



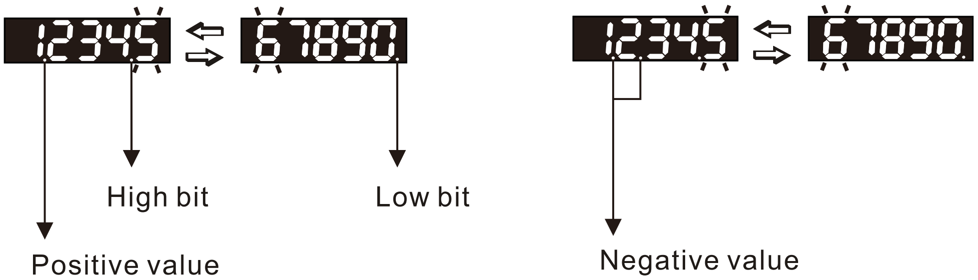
Numeric value parameter setting



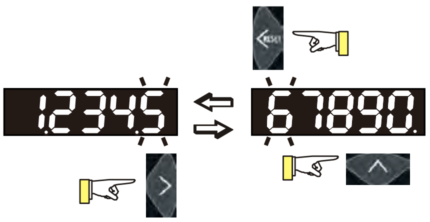
Function option parameter setting



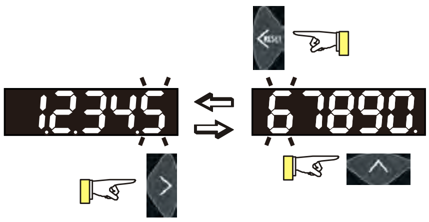
Tens digits value description



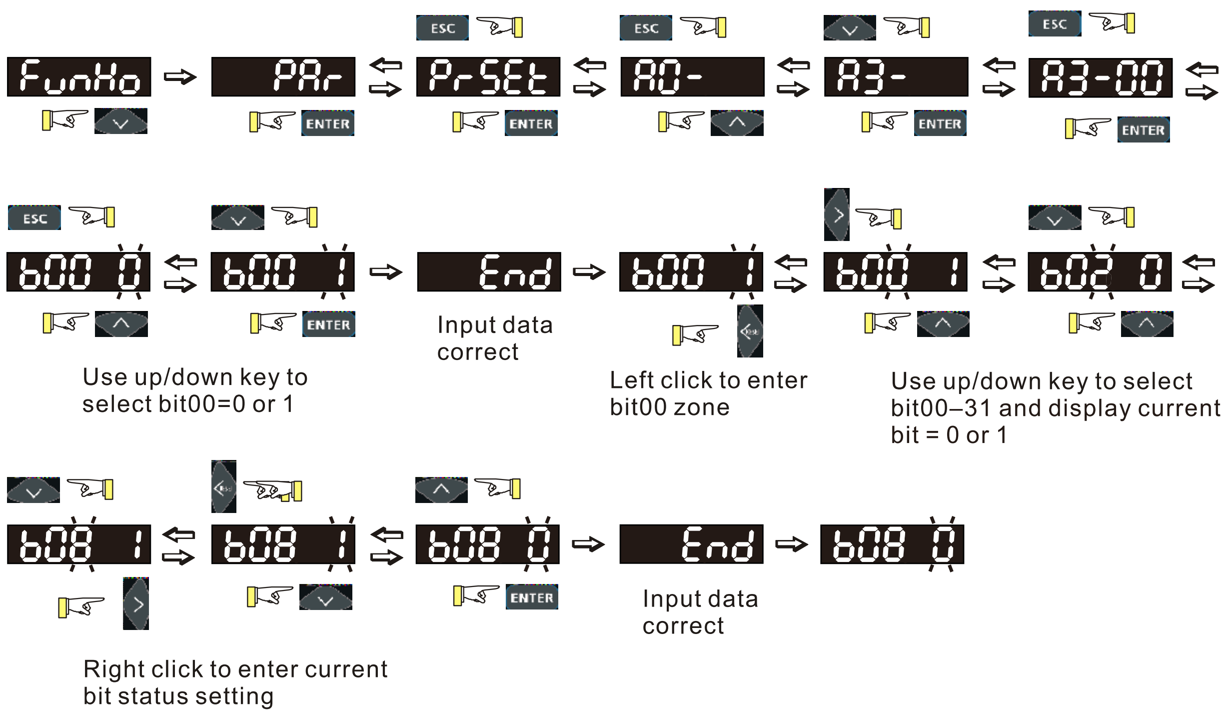
For example: value = 1234567890



For example: value = -1234567890

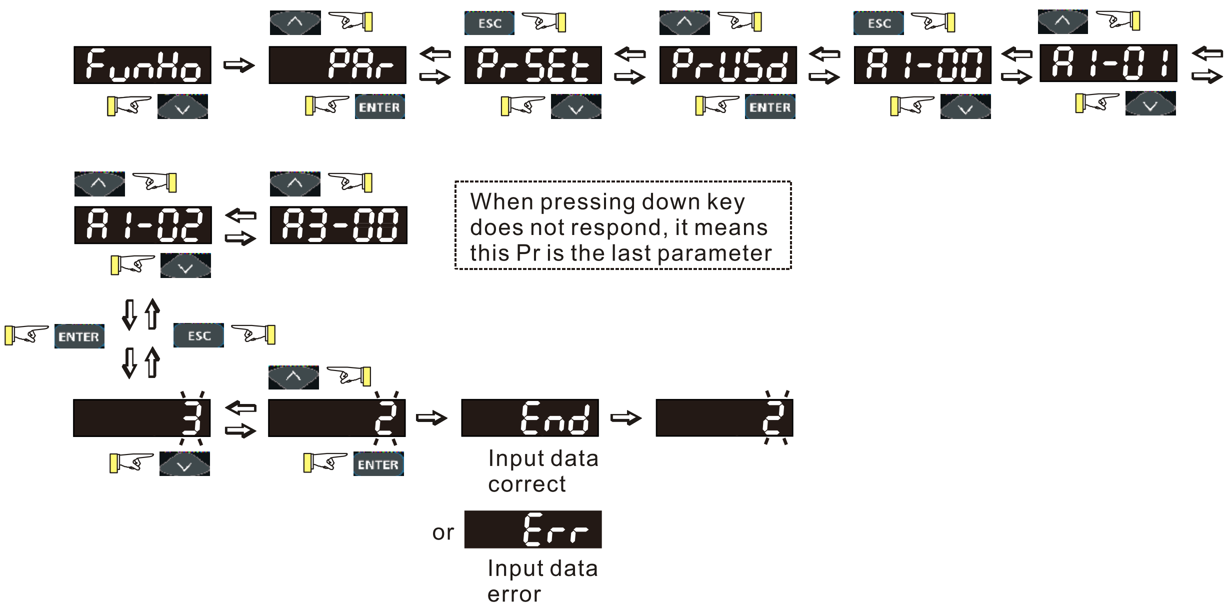


Binary parameter setting



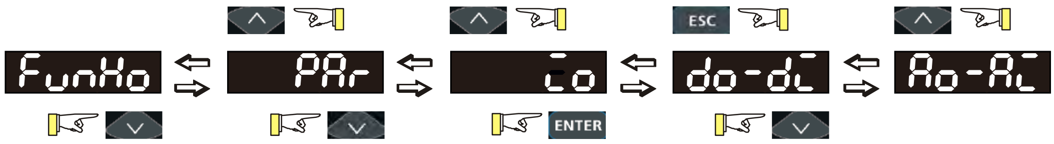
Modified parameter

Display and change setting

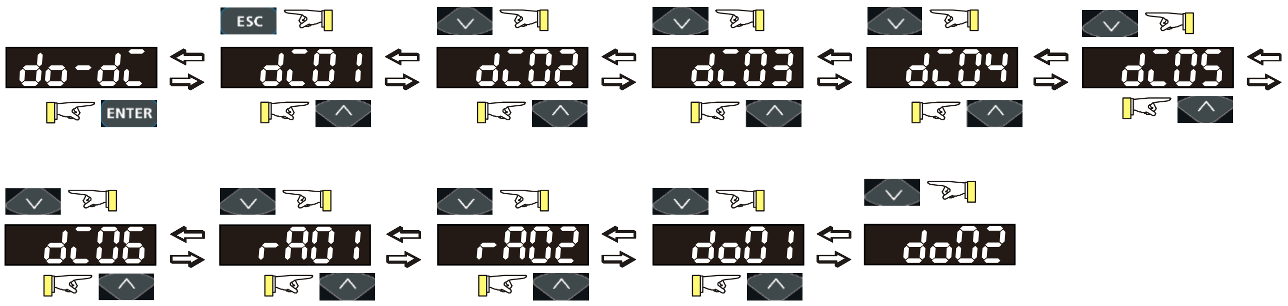


2. I/O monitor

I/O monitor operation flow includes digital terminals (do-di) and analog terminals (Ao-Ai).

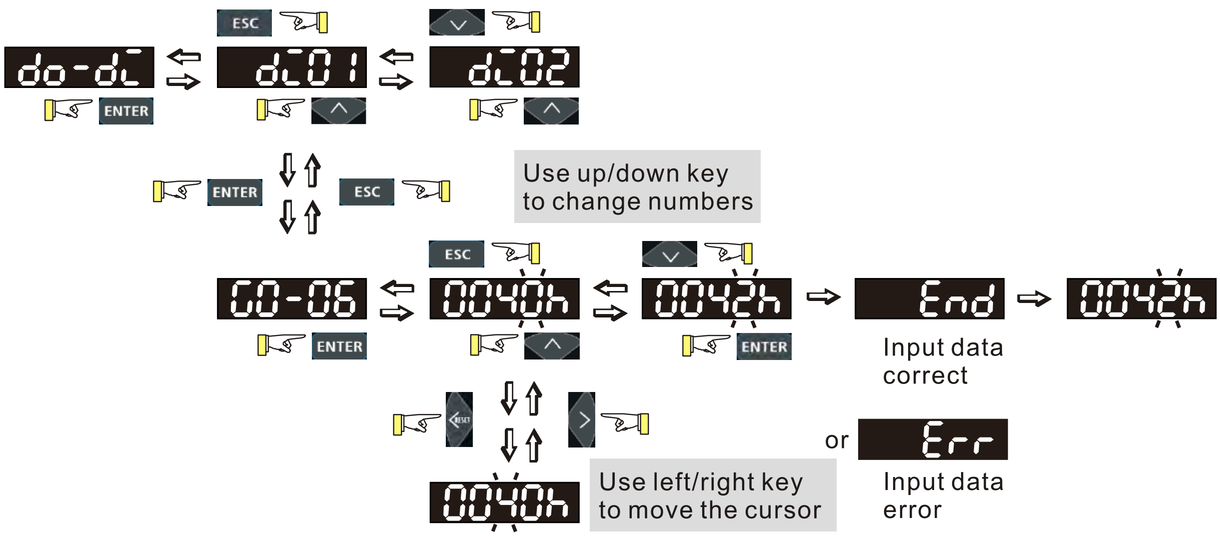


Digital input/ output terminal operation

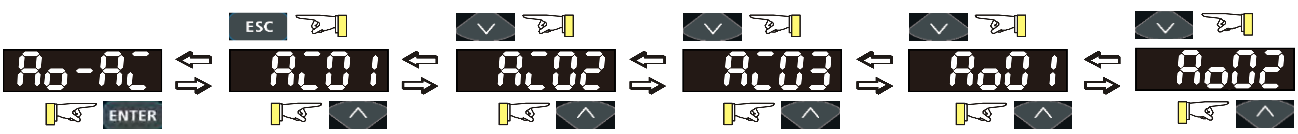


Digital input/ output terminal - check current setting and change setting

For example: check the setting value of MI1 (di01) (Pr. G0-06: LED displays g0-06) and change the value from 40h to 42h.

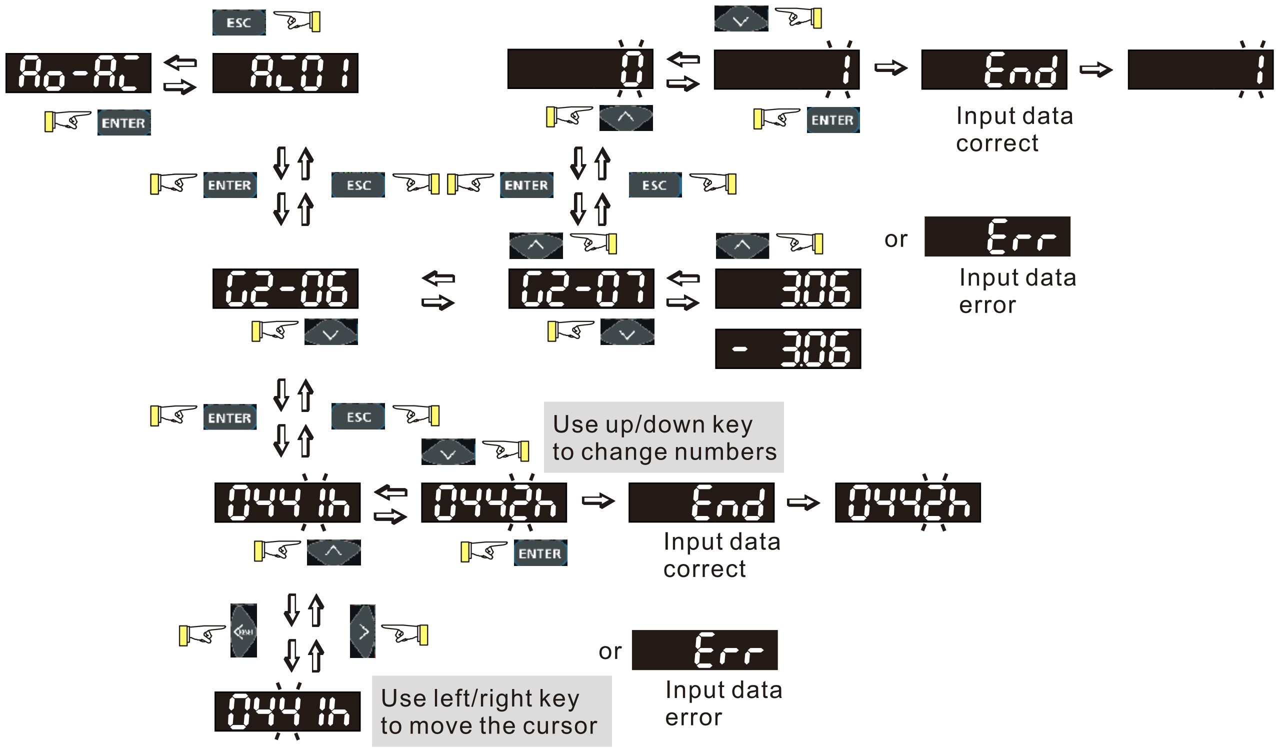


Analog input/ output terminal operation



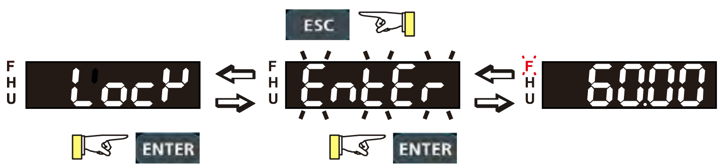
Analog input/ output terminal - check current setting and change setting

For example: check the setting of AI1 (Ai01). When you enter Ai01, the keypad displays g2-06 (Ai01 function selection parameter) first, press [Down key] to display g2-07 (Ai01 input signal type), and then press [Down key] again to display the current Ai01 input value.



3. Keypad lock

When EntEr displays and flashes, press ENTER again to enable the keypad lock function.

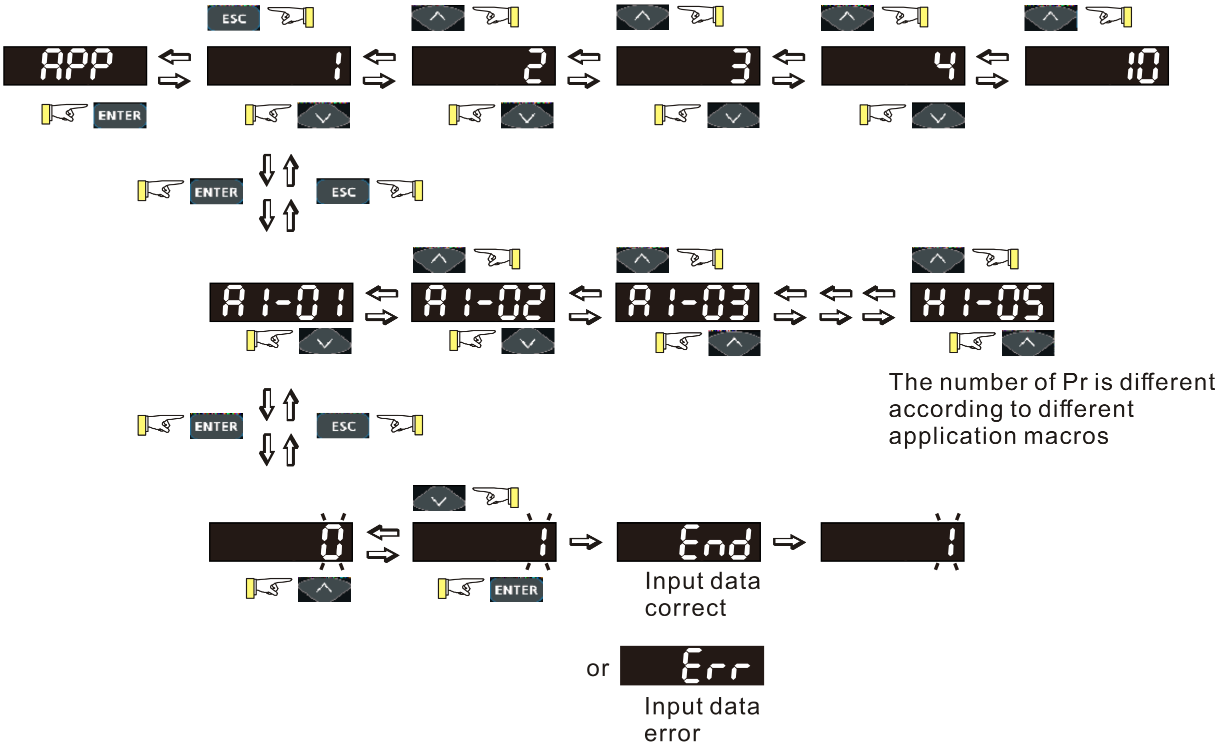


4. App Macros and Quick Setting

App Macros and Quick Setting function includes application macros and quick setting.

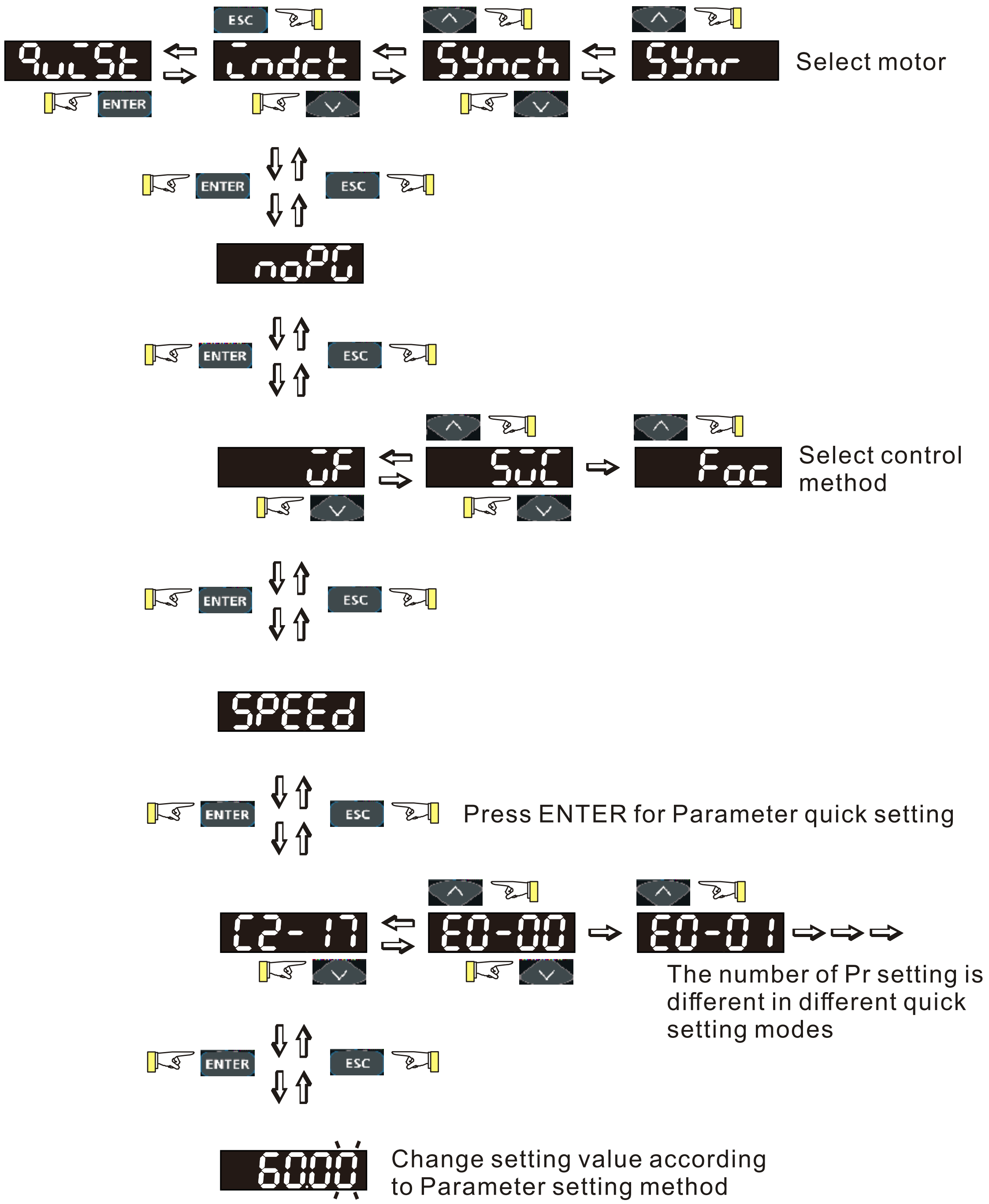
Application MACRO

0: Disable, 1: User-defined, 2: Compressor, 3: Fan, 4: Pump, 10: Air handling unit



Quick Setting

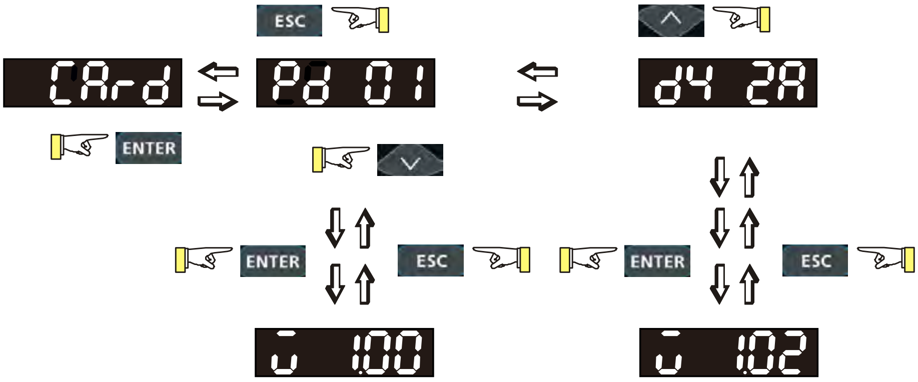
IMVF, IMSVC, IMFOC, PMSVC, PMFOC, SycnRMFOC



5. Option cards

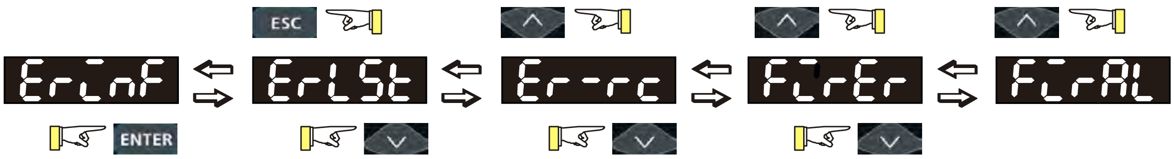
No option card: when noCrd displays, it means there is no option card installed.

Install communication card and IO card: press ENTER and use up/down keys to check the current installed cards. When you select the installed option card and press ENTER, you can check the firmware version of the card.



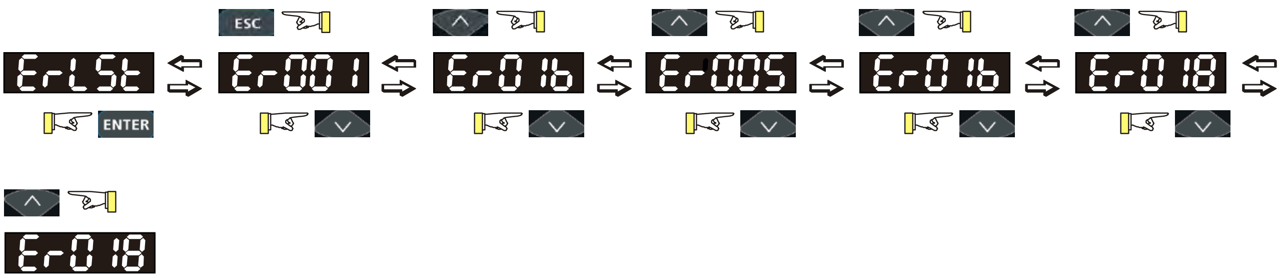
6. Fault record information

Fault record information includes fault record, fault information record, fault record at Fire and warning record at Fire.



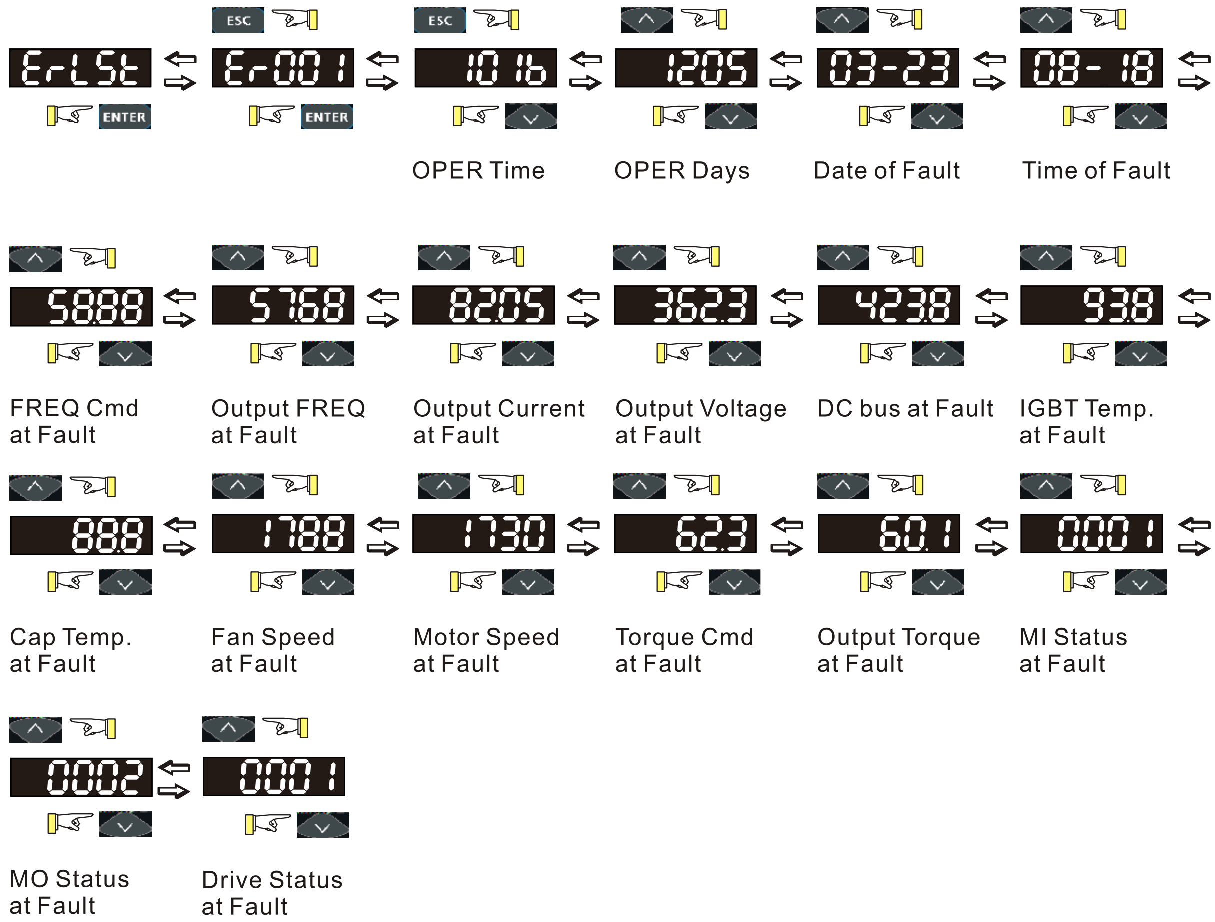
Fault record

Records 6 faults.



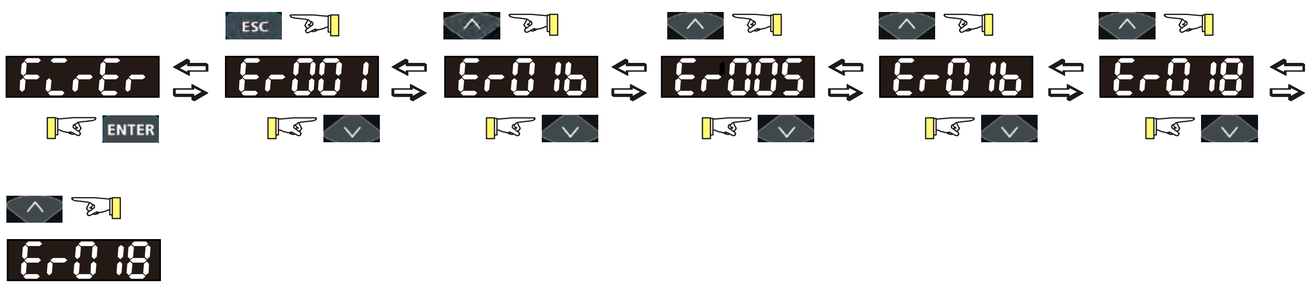
Fault information record

Records the following information when a fault occurs: operation time at fault, operation days at fault, date of fault_month/ day, time of fault_hour/ minute, frequency command at fault, output frequency at fault, output current at fault, output voltage at fault, DC bus at fault, IGBT temperature at fault, Cap temperature at fault, fan speed at fault, motor speed at fault, torque command at fault, output torque at fault, MI status at fault, MO status at fault and drive status at fault.



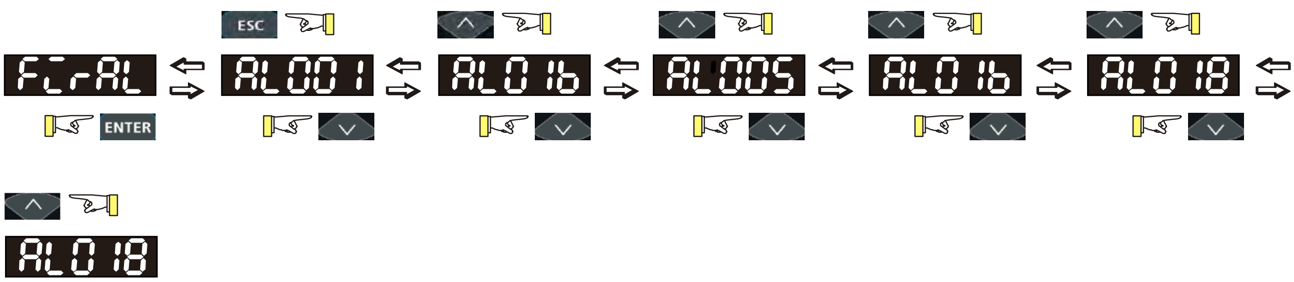
Fault record at Fire

Records 6 errors in FireMode



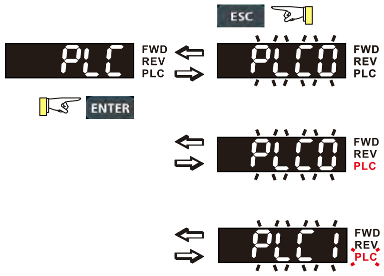
Warning record at Fire

Records 6 warnings in FireMode

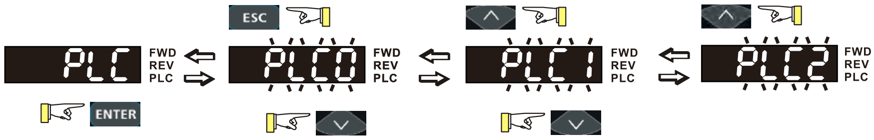


7. PLC Function

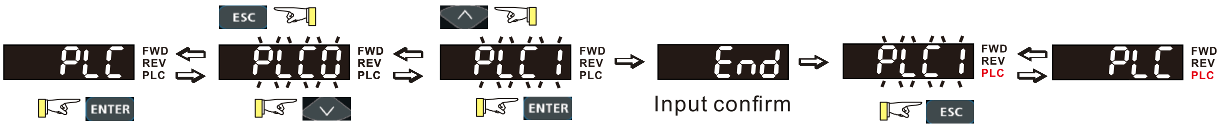
(1) After entering the PLC setting page, there will be three possible PLC status: PLC0 (no PLC function), PLC1 (PLC is running) and PLC2 (PLC stops running).



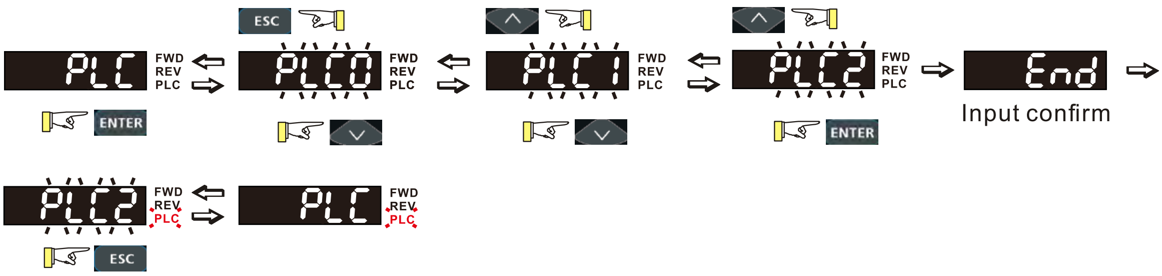
(2) Use the up/down key to switch PLC0, PLC1 and PLC2.



(3) Press ENTER at PLC1 setting page to start the PLC program, and the PLC light starts to stay on. After pressing ESC to return to the PLC function page, the PLC light remains on.



(4) Press ENTER at PLC2 setting page to stop the PLC program, and the PLC light starts to flash. After pressing ESC to return to the PLC function page, the PLC light remains flashing.

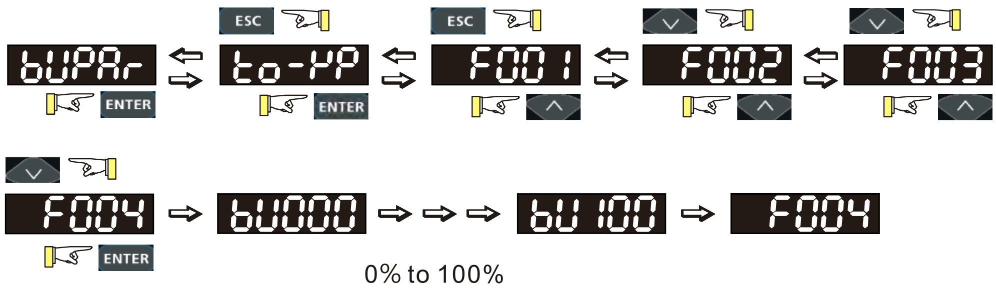


8. Copy function

Copy function includes copy parameter, restore parameter backup, delete parameter backup, copy PLC program, restore PLC program backup and delete PLC program backup.

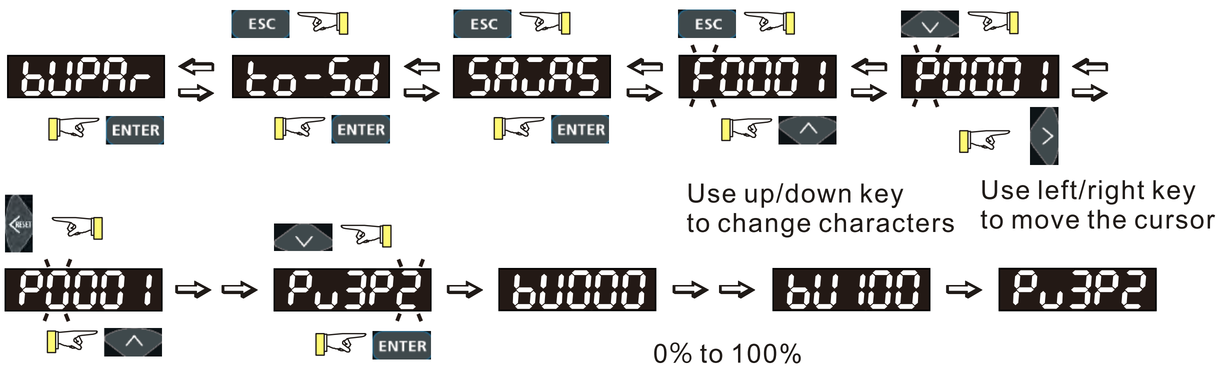
Copy parameter

Copy parameter to Keypad (up to 4 groups: F001–F004)

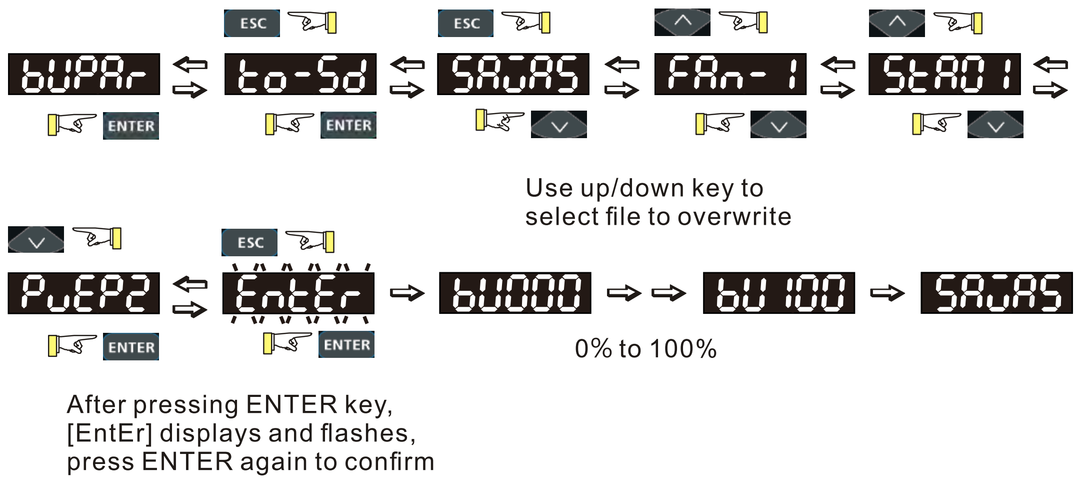


Copy parameter

Copy parameter to SD card - save as a new file

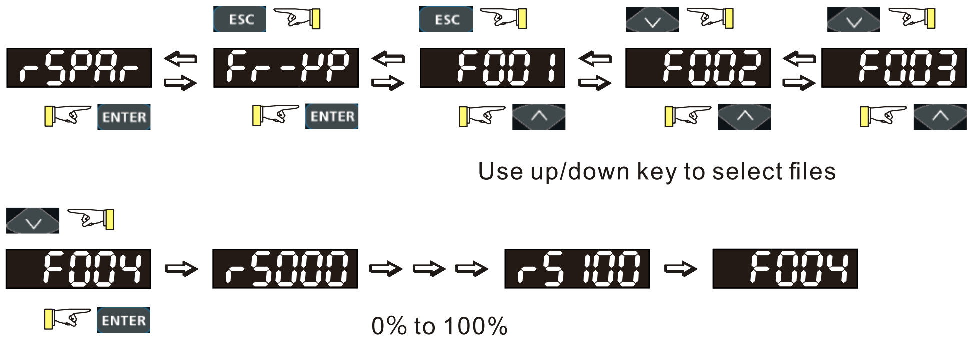


Copy parameter to SD card - overwrite the original file



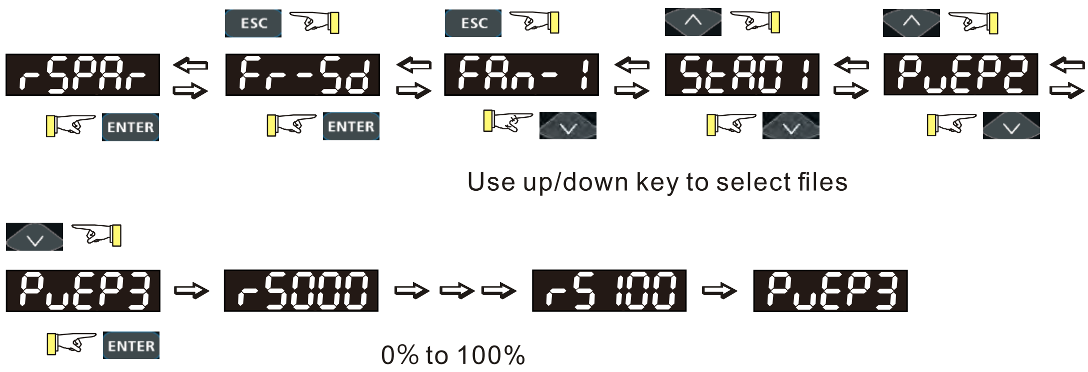
Restore parameter backup

Restore parameter backup source - Keypad

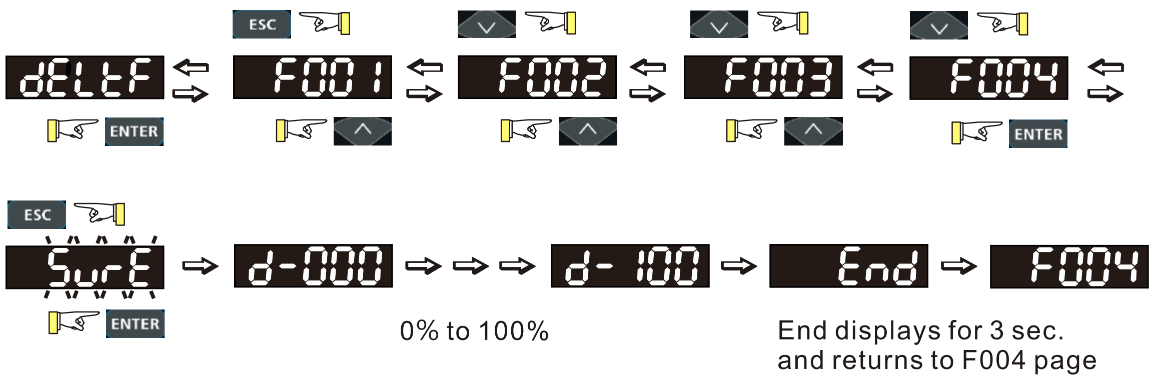


Restore parameter backup

Restore parameter backup source - SD card

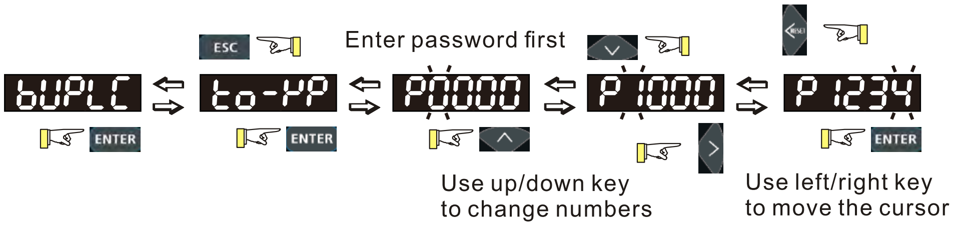


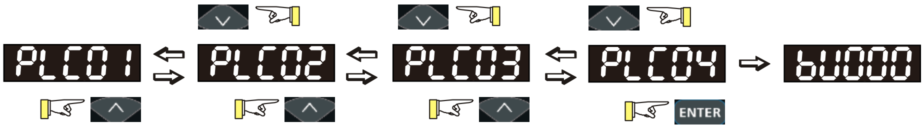
Delete parameter backup



Copy PLC program

Copy PLC program to Keypad (up to 4 groups: PLC01–PLC04)

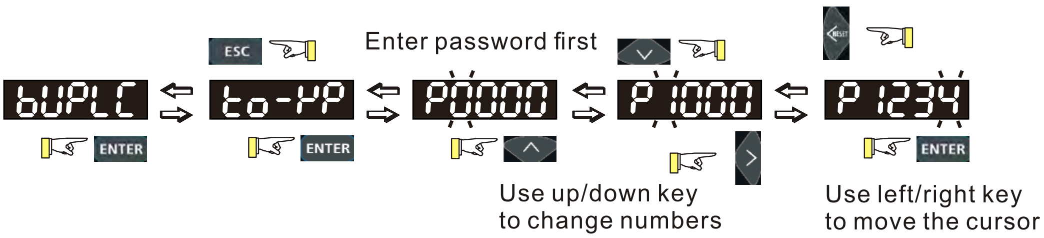




If the password is entered correctly,
enter PLC01–04 page

0% to 100%

Input password error

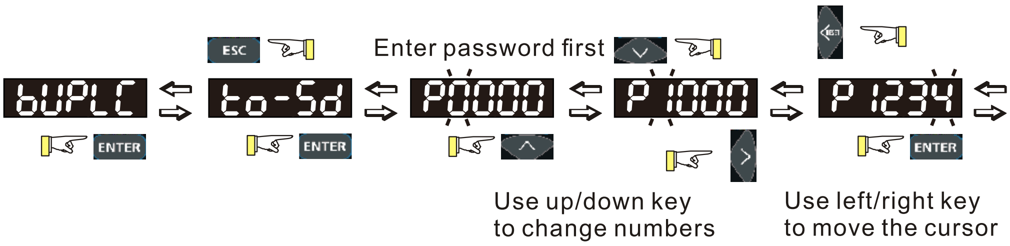


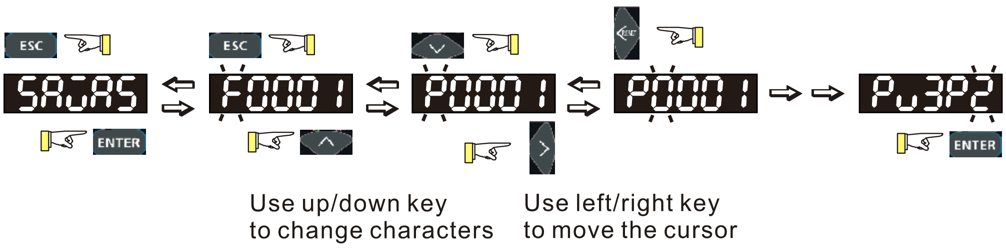
After entering the wrong password the remaining times displays

Enter the password again

Copy PLC program

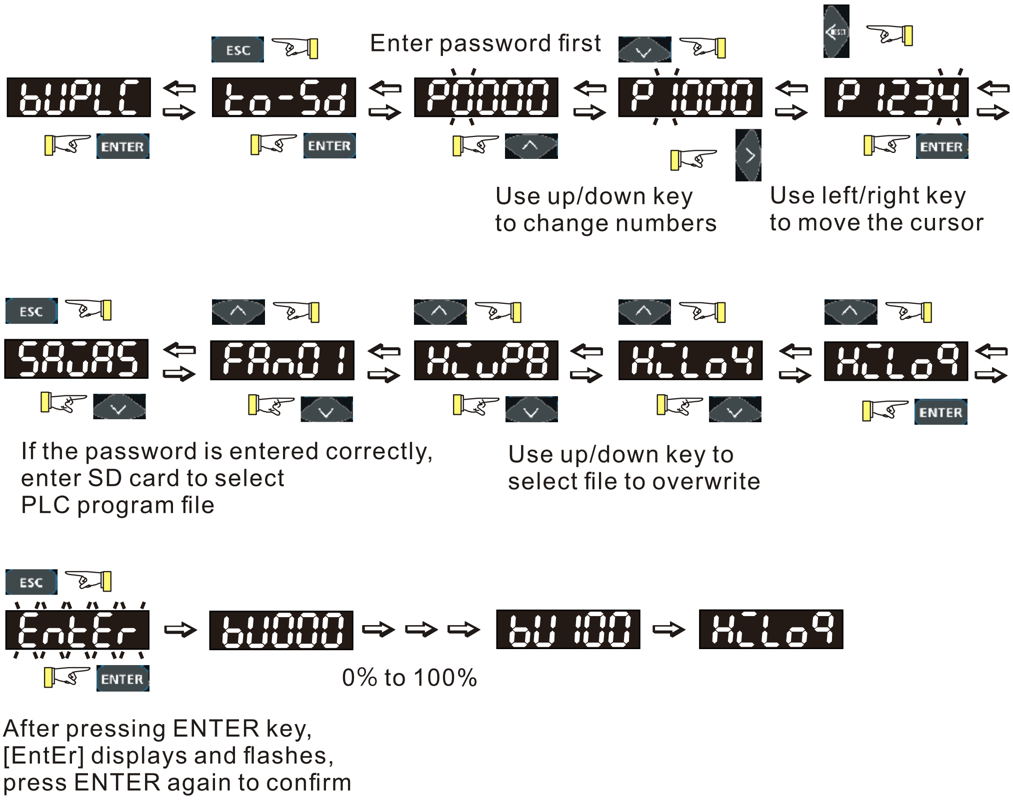
Copy PLC program to SD card - save as a new file





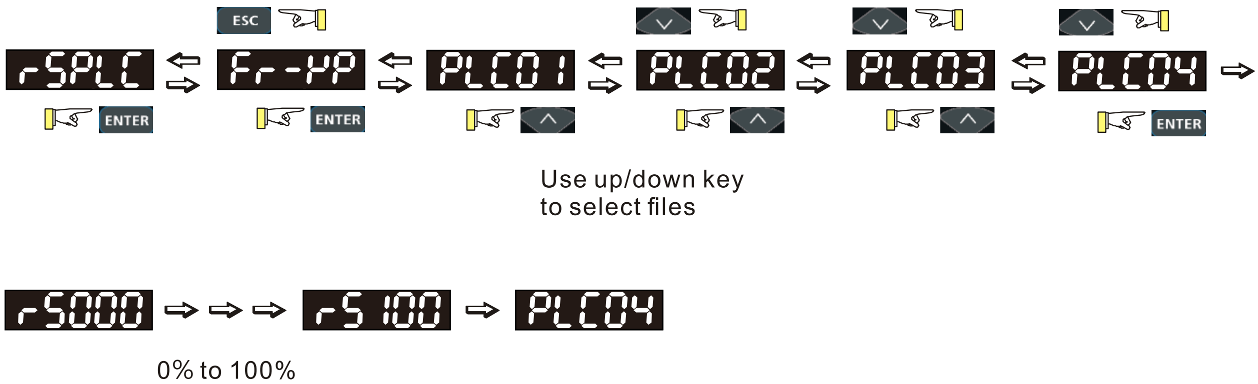
0% to 100%

Copy PLC program to SD card - overwrite the original file

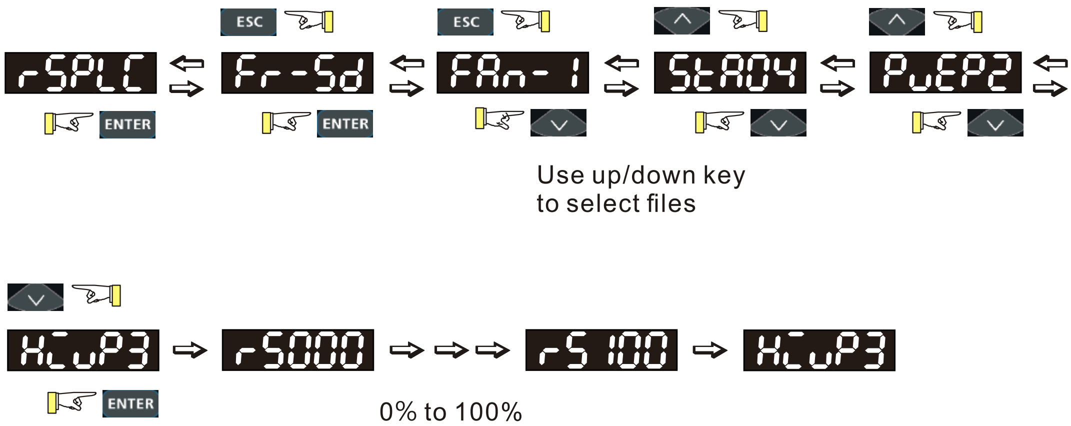


Restore PLC program backup

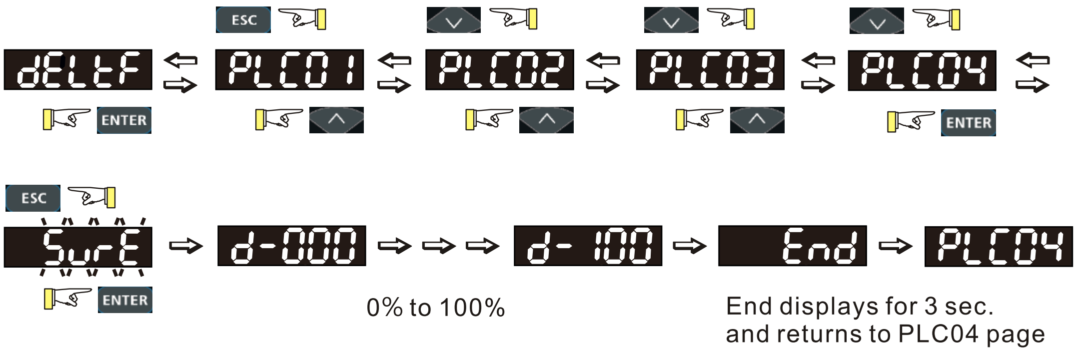
Restore PLC program backup source - Keypad



Restore PLC program backup source - SD card

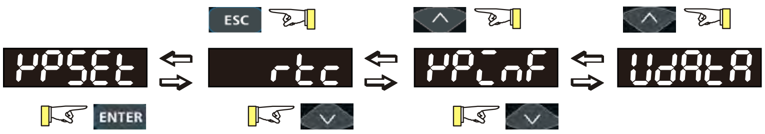


Delete PLC program backup



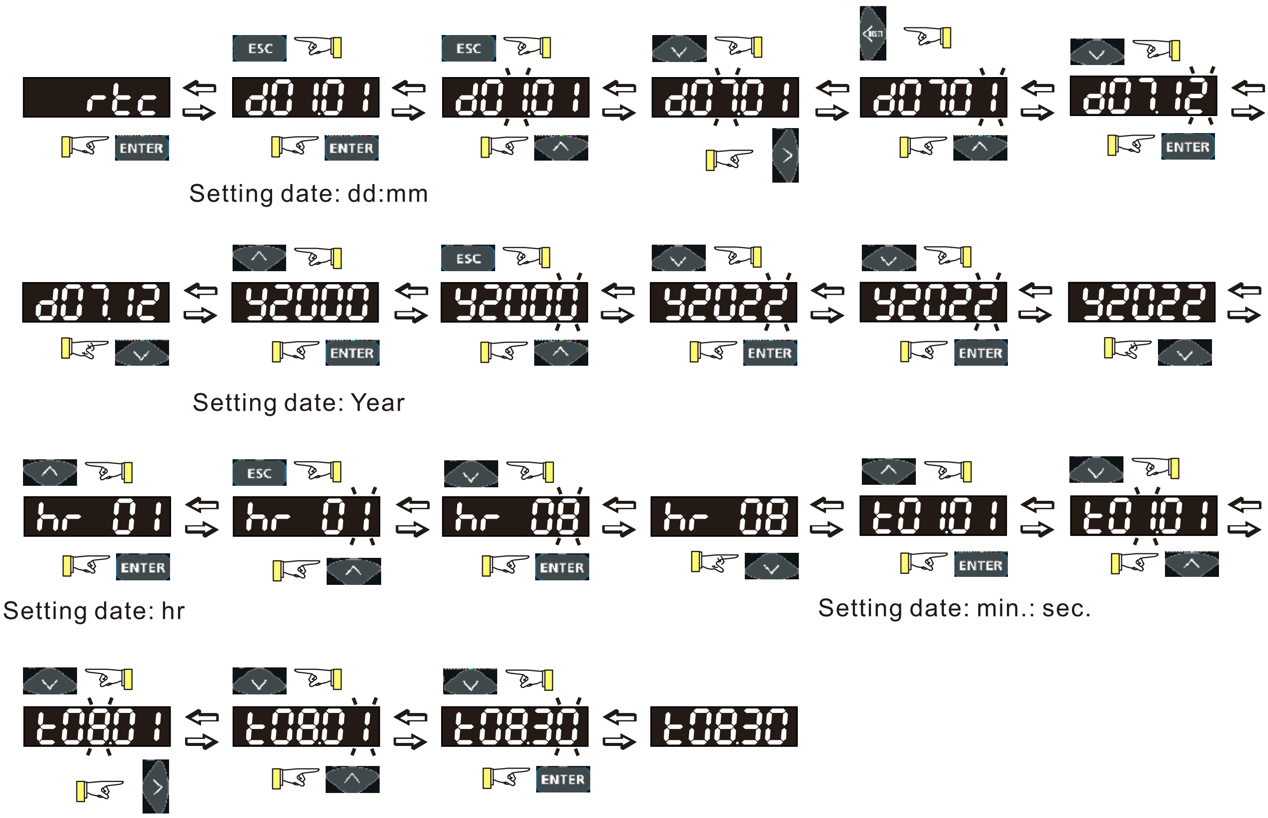
9. Keypad settings

Keypad setting includes Calendar, Keypad version and Firmware update.



Calendar setting

Sets day, month, year, hour, minute and second according to the following process.



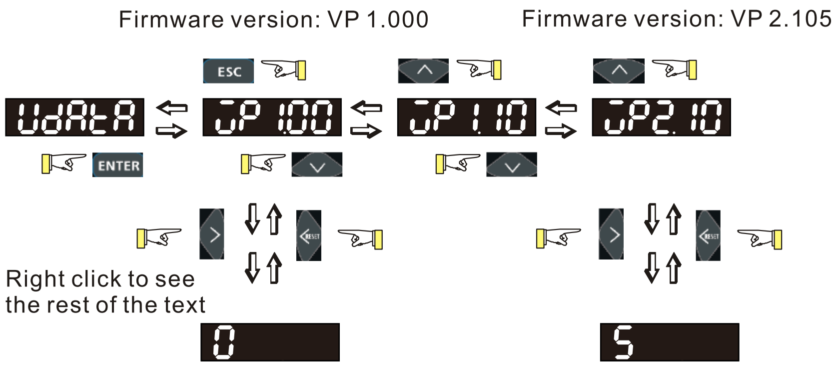
Keypad version

Display current keypad firmware version

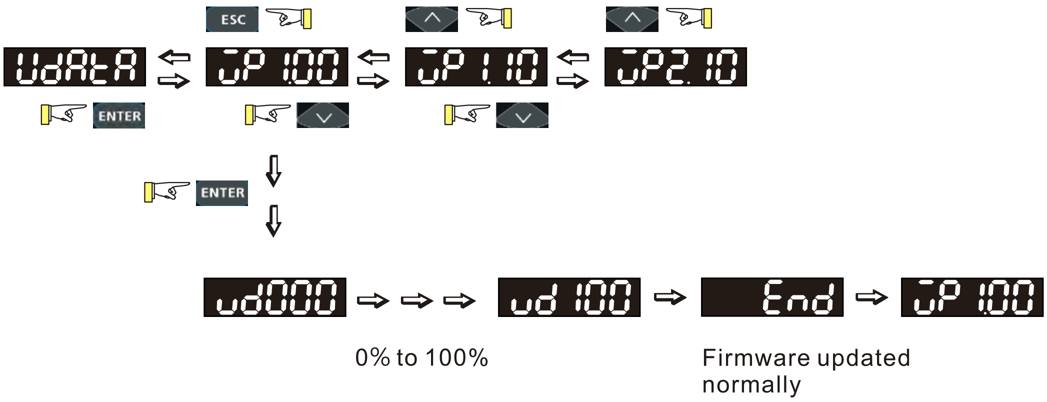
Firmware update

Update the drive firmware

(1) Check firmware version



(2) Select the firmware and start updating the firmware.



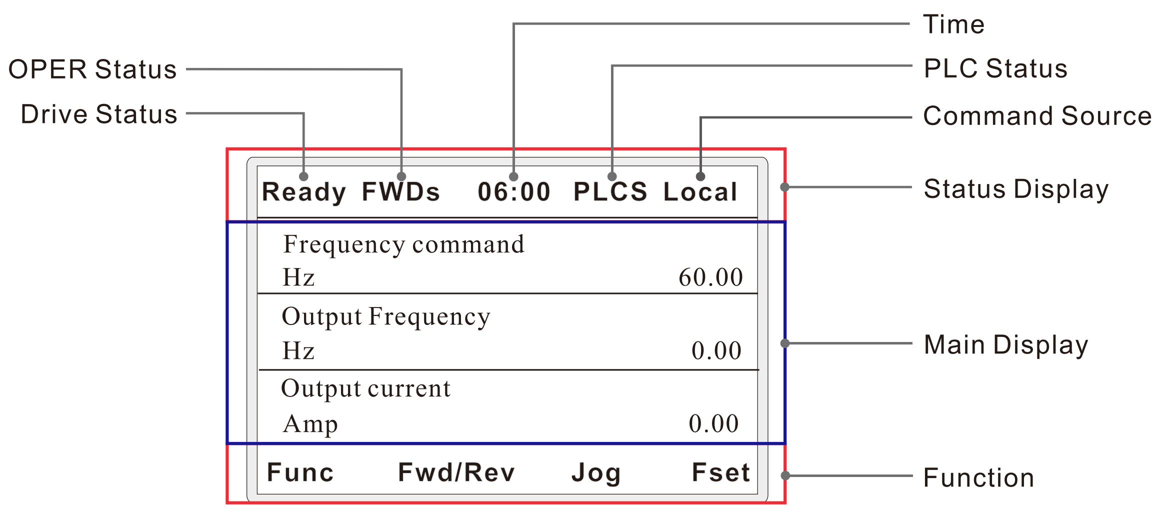
10. Serial Number

Serial Number: 1K2P4309W23010001	
1K2	Current specification 1200A
P	P: VP3000
43	43: 460V Models
09	Serial number
W	W: made in WJ factory, LED keypad display with J instead of W T: made in Taiwan
23	Year 2023
01	Week 1
0001	Product production sequence number for each week

Reference table for the seven-segment digital keypad LED display

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

4-1-6 KPV-CC01 Display Description



4-1-6-1 KPV-CC01 Status Display

Keypad status information support list:

Status	Descriptions	KPV-CE02	KPV-CC01	KPV-CC02
Drive Status	Display current executing function, for example: Error, Ready, dEb, Sleep...etc.	X	✓	✓
Operation Status	Display the drive current operating status, for example: FWDs, FWDn, FWDa, FWDd, etc.	X	✓	✓
Bluetooth Status	Display the Bluetooth status A display indicates that the Bluetooth function is enabled.	X	X	✓
Time	Display current time (hour: minute)	X	✓	✓
PLC Status	PLCR: PLC program is running PLCS: PLC program is stop No display indicates no PLC function is used.	X	✓	✓
Command Source	Display current command source: HAND, OFF, AUTO, Local, Remote	X	✓	✓

Drive status instruction

Drive Status	Name	Descriptions
Error	Fault	When a fault occurs to the drive, the status column displays Error.
RUN	Operation	When the drive is in operation, the status column displays Run.
Ready	Ready	When the drive is ready, the status column displays Ready.
dEb	Deceleration Energy Backup	When the drive executes dEb function, the status column displays dEb.
DCIn	DC Injection	When the drive executes DC injection (DC brake at start and stop), the status column displays DCIn.

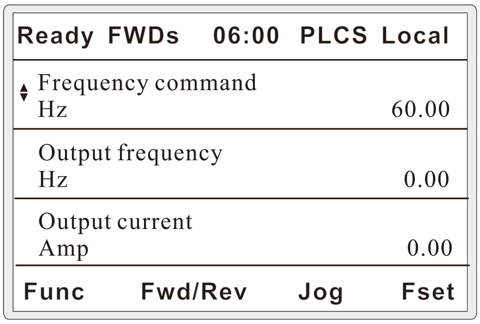
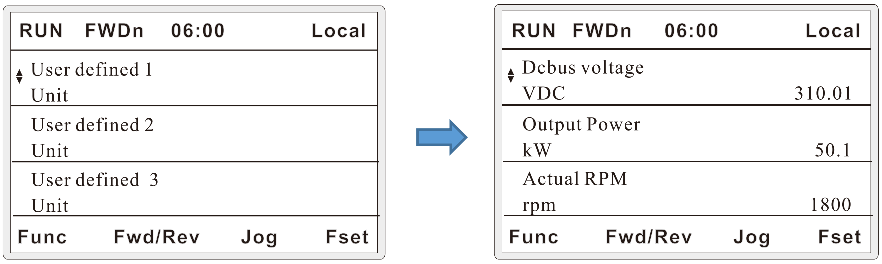
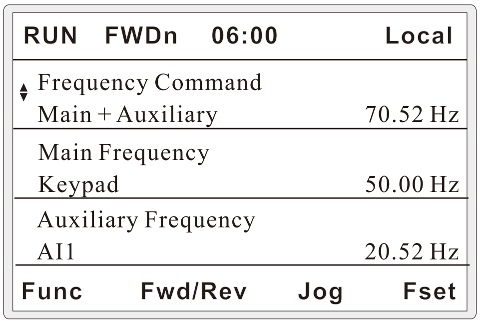
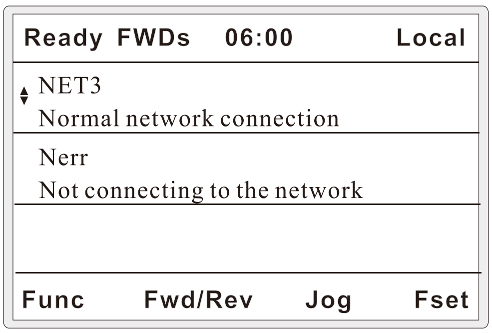
Drive Status	Name	Descriptions
AutoT	Motor parameter auto-tuning	When the drive executes motor parameter auto-tuning, the status column displays AutoT.
B.B.	Base Block	When the drive is in Base Block, the status column displays B.B.
Sleep	Sleep	When the drive is in sleep, the status column displays Sleep.
Stall	Stall function	When the drive is in stall, the status column displays Stall.
PHeat	Pre-heat	When the motor executes pre-heating, the status column displays PHeat.
FlySr	Flying start	When the drive is in flying start, the status column displays FlySr.
Fire	FireMode	When the drive is in FireMode, the status column displays Fire.

Operation Status:

Drive Status	Name	Descriptions
FWDs	Stop status + forward operation	The drive is STOP and the operation direction is FWD, the operation status displays FWDs.
REVs	Stop status + reverse operation	The drive is STOP and the operation direction is REV, the operation status displays REVs.
FtoR	FWD switch to REV	Switching from forward to reverse deceleration (follows REVa to reverse)
RtoF	REV switch to FWD	Switching from reverse to forward deceleration (follows FWDa to forward)
FWDn	FWD normal speed	When the drive operates in FWD constant speed, the operation status displays FWDn.
FWDa	FWD acceleration	When the drive is in FWD acceleration, the operation status displays FWDa.
FWDd	FWD deceleration	When the drive is in FWD deceleration, the operation status displays FWDd.
REVn	REV normal speed	When the drive operates in REV constant speed, the operation status displays REVn.
REVa	REV acceleration	When the drive is in REV acceleration, the operation status displays REVa.
REVd	REV deceleration	When the drive is in REV deceleration, the operation status displays REVd.
JOGf	JOG forward	When the drive is in JOG forward, the operation status displays JOGf.
JOGr	JOG reverse	When the drive is in JOG reverse, the operation status displays JOGr.
PTQC	Positive torque control	When the drive operates with positive torque control, the operation status displays PTQC.
NTQC	Negative torque control	When the drive operates with negative torque control, the operation status displays NTQC.

4-1-6-2 KPV-CC01 Monitoring Screen

KPV-CC01 Monitoring Screen

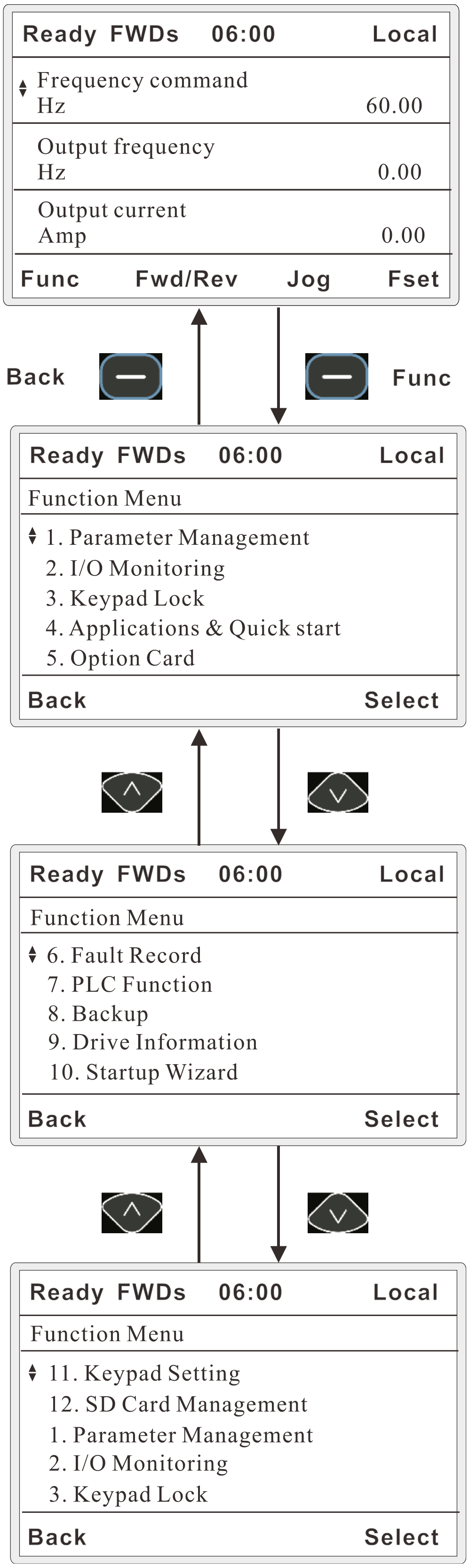
<table>
<tr><th>Monitoring Screen</th><th>Descriptions</th></tr>
<tr><td>Main screen</td><td>The main screen displays frequency command, output frequency and output current. Use the up/ down keys to move the cursor or press ENTER to go to the frequency setting page.

</td></tr>
<tr><td>User-defined screen</td><td>There are 3 monitoring display in user-defined screen. Use the up/ down keys to move the cursor or press ENTER to go to the use-defined setting page.

</td></tr>
<tr><td>Master and auxiliary frequency screen</td><td>This page provides monitoring Master and auxiliary frequency simultaneously.

</td></tr>
<tr><td>Communication monitoring screen</td><td>The communication monitoring screen displays NET3 and Nerr status information.

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

4-1-6-3 KPV-CC01 Function List

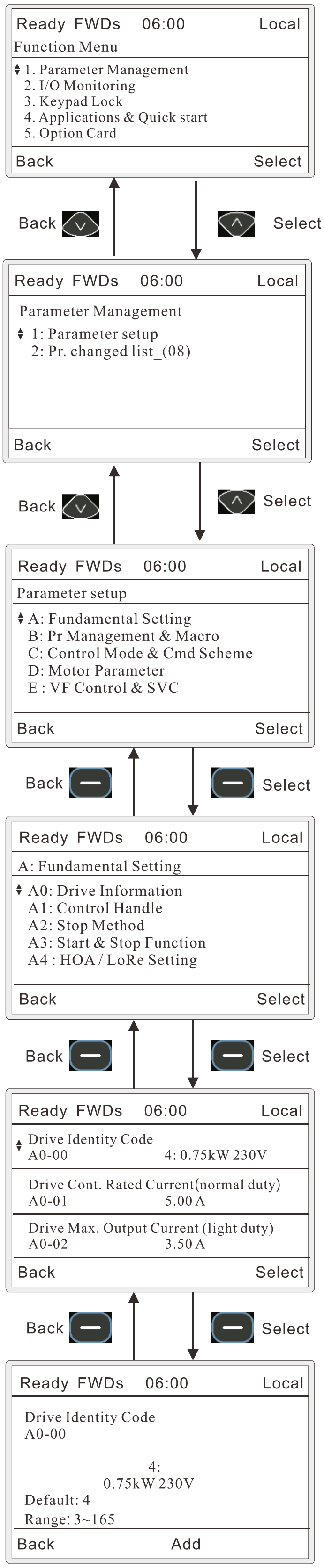
The KPV-CC01 and KPV-CC02 support the following characters:

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

KPV-CC01 Function List

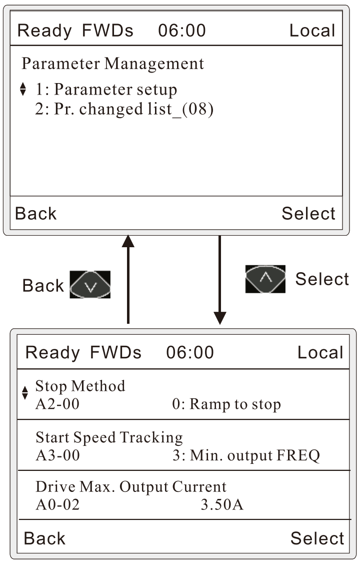
Function Name	Function Menu	Descriptions
Keypad function	1. Pr Management 2. I/O Monitoring 3. Keypad Lock 4. Applications & Quick start 5. Option Card 6. Fault Record 7. PLC Function 8. Backup 9. Drive Information 10. Startup Wizard 11. Keypad Setting 12. SD Card Management	

Function Name	Function Menu	Descriptions
Pr Management	Parameter Setting	1. This function displays and sets the drive parameter groups. 2. Use up/ down keys to select the parameter group, and press Select to enter the parameter sub-group and parameter list.



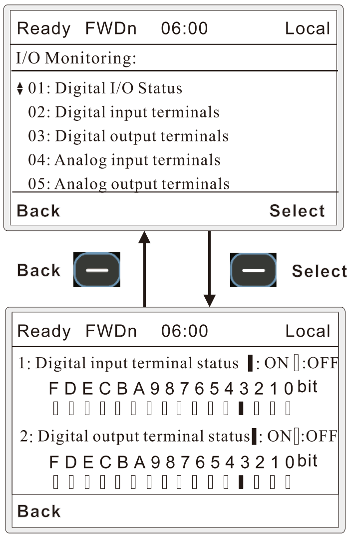
<table>
<tr><th>Function Name</th><th>Function Menu</th><th>Descriptions</th></tr>
<tr><td></td><td>Modified parameter_XX</td><td>

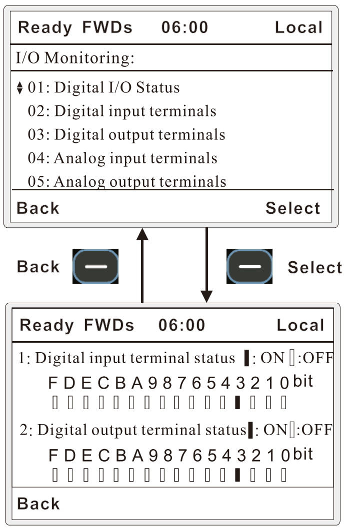
1. This function displays parameters that is modified, you can directly enter the parameter setting page and change setting value.
2. Modified parameter (08): it means there are 8 parameters that have been modified.



</td></tr>
<tr><td>I/O monitor</td><td>Digital I/O status</td><td>

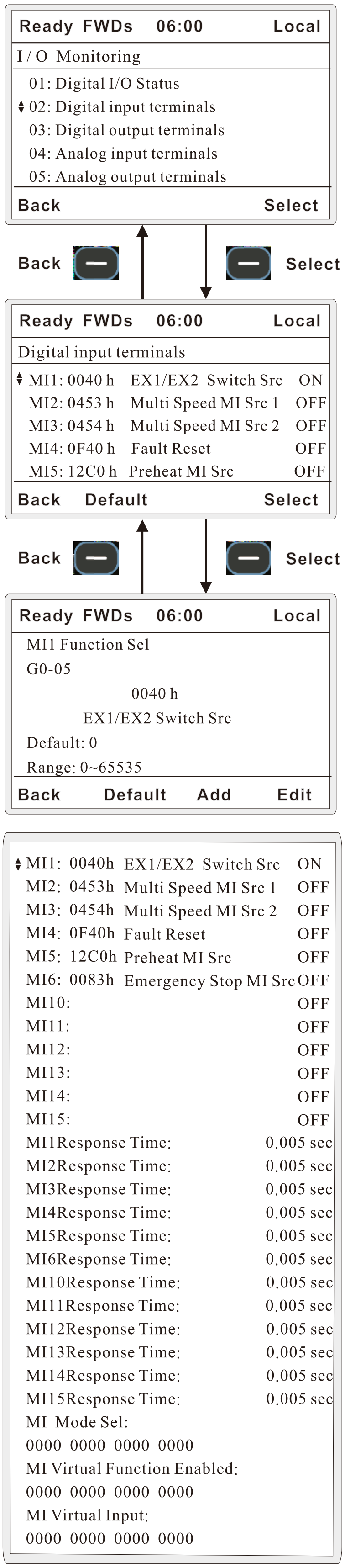
Displays the status of digital input/ output terminals



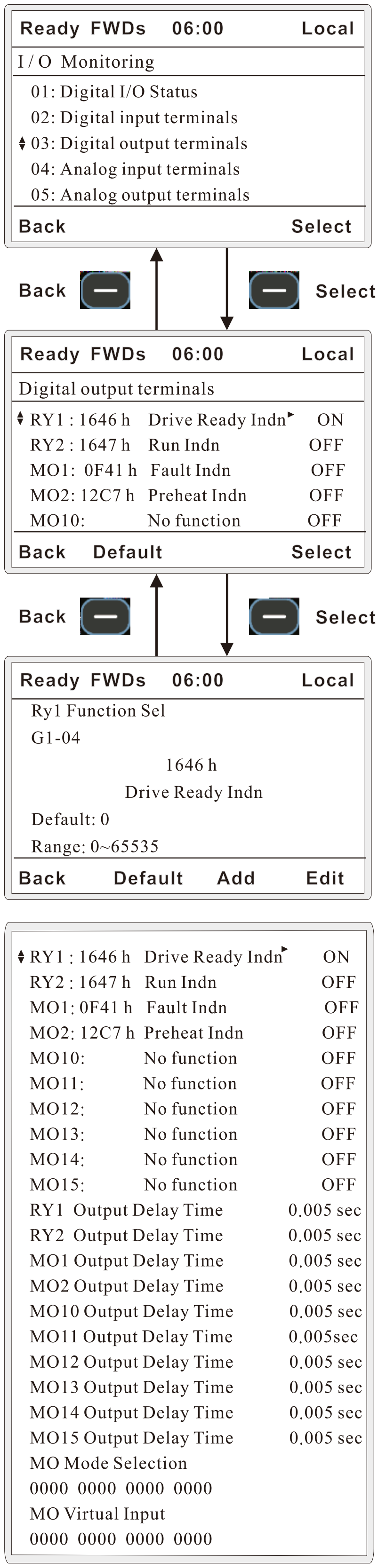


</td></tr>
</table>

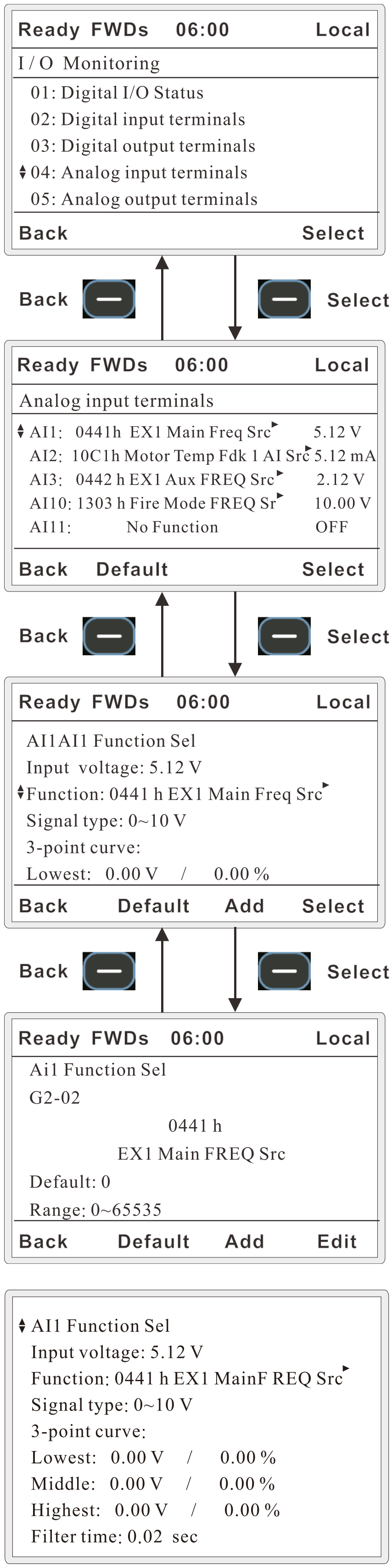
Function Name	Function Menu	Descriptions
	Digital input terminals	1. Displays the information of digital input terminal function setting, ON/ OFF status, respond time, N.O./ N.C. modes and virtual input. 2. Press Select to enter the parameter setting page and change the setting value.



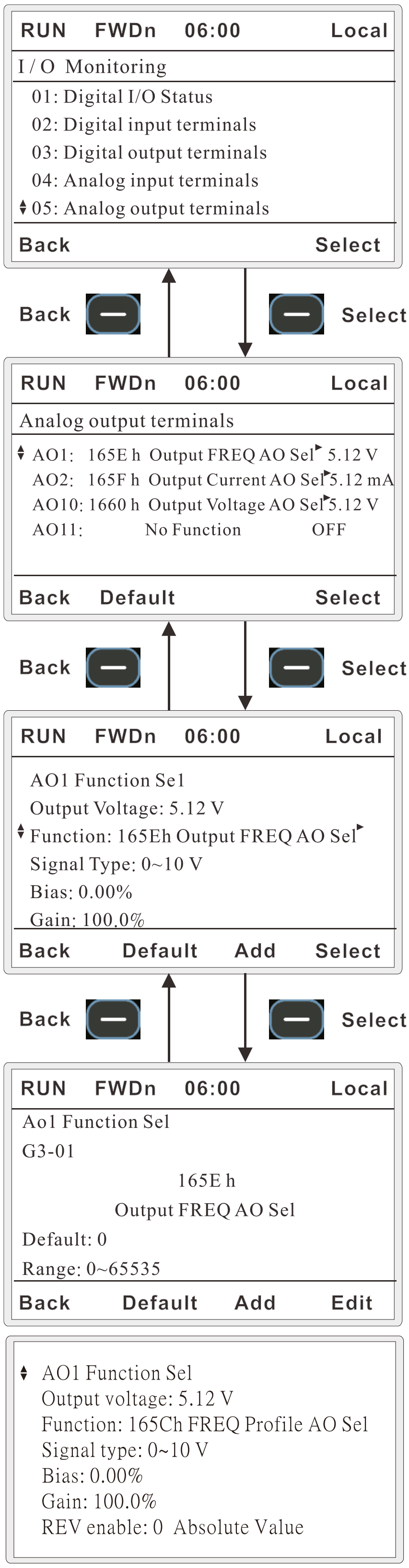
Function Name	Function Menu	Descriptions
	Digital output terminals	1. Displays the information of digital output terminal function setting, ON/ OFF status, output delay time, N.O./ N.C. modes and virtual input. 2. Press Select to enter the parameter setting page and change the setting value.

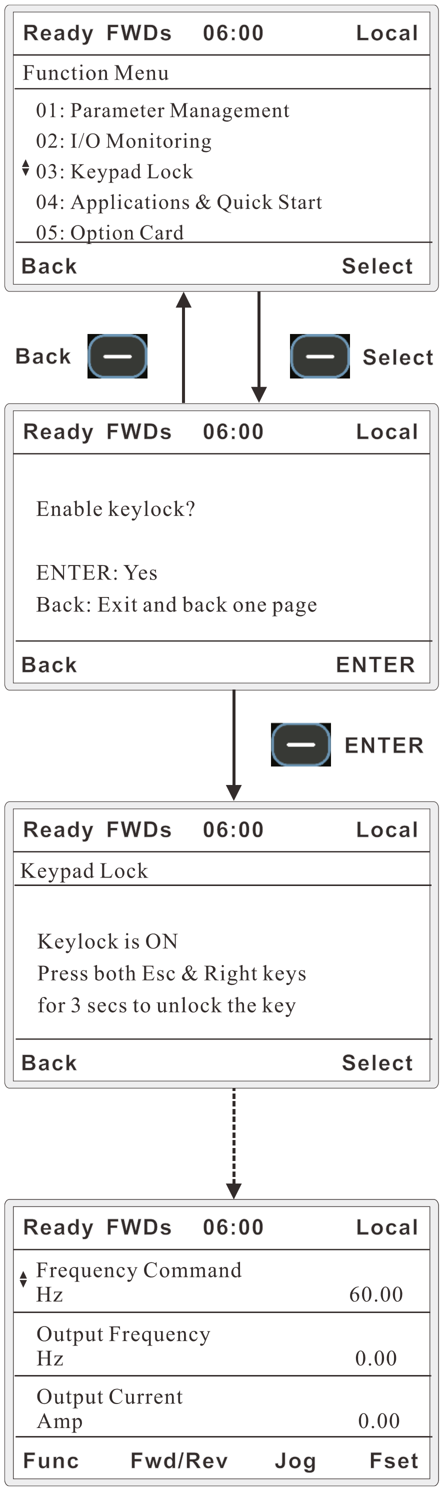


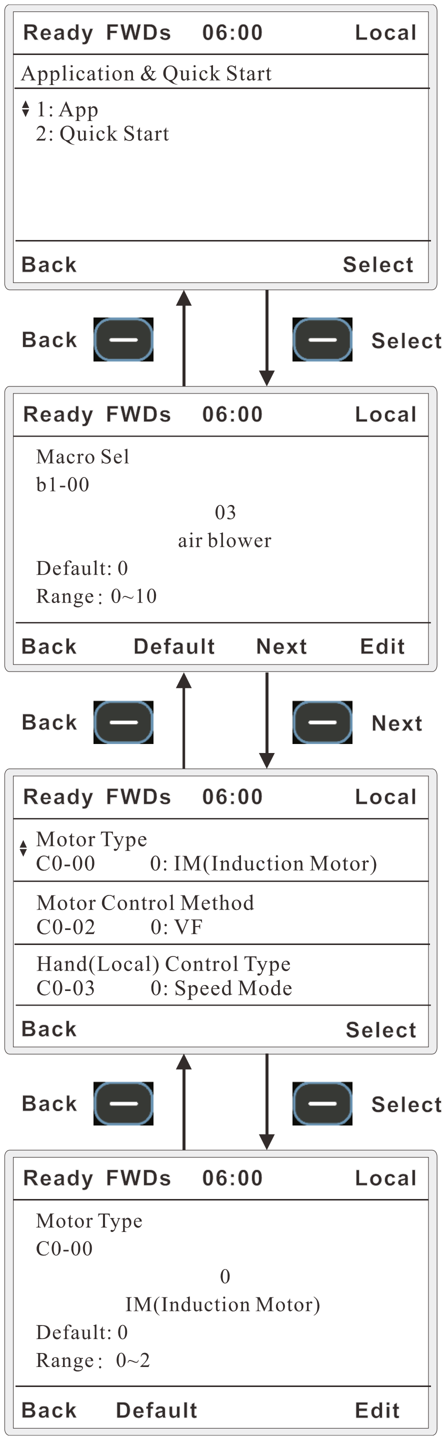
Function Name	Function Menu	Descriptions
	Analog input terminals	1. Displays the information of analog input terminal function setting, current input value, filter time, three-point setting and signal type. 2. Press Select to enter the parameter setting page and change the setting value.

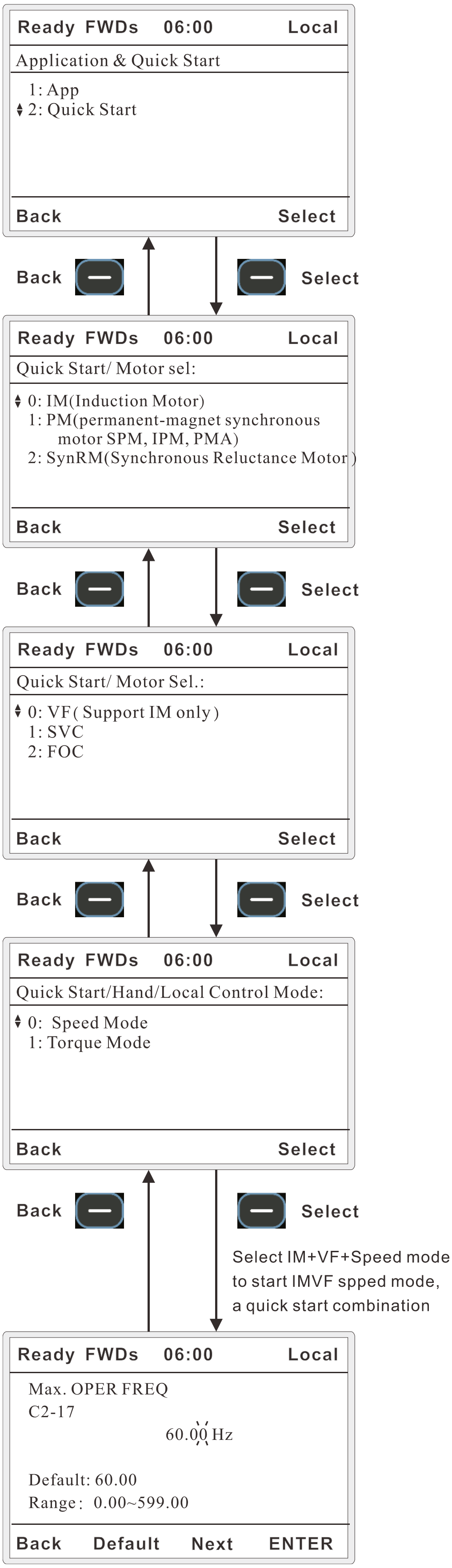


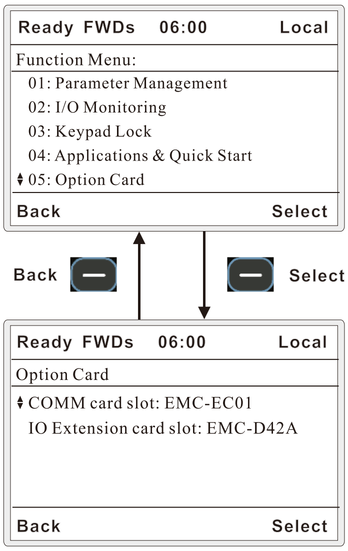
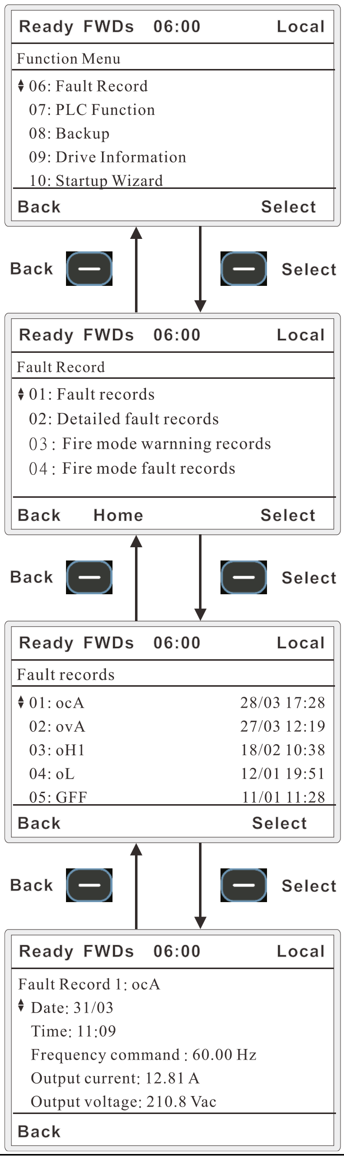
Function Name	Function Menu	Descriptions
	Analog output terminals	1. Displays the information of analog output terminal function setting, current output value, signal type, bias, gain and reverse enable. 2. Press Select to enter the parameter setting page and change the setting value.

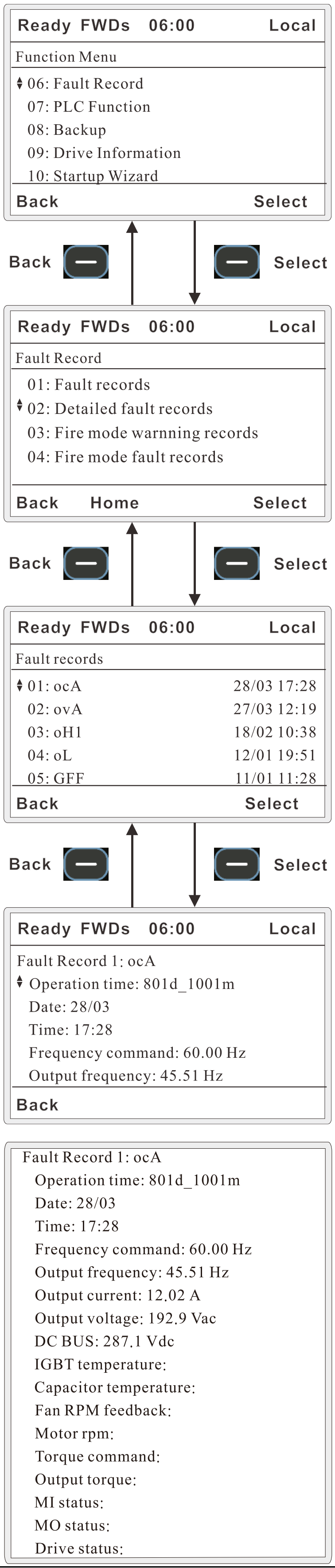


Function Name	Function Menu	Descriptions
Keypad lock		1. This function locks the keys on the keypad. 2. The main screed does not display lock status after the keypad is locked, but shows “Keypad lock is enabled” when you press any key under lock status. Press [ESC + right key] for three seconds to unlock the keypad. 

Function Name	Function Menu	Descriptions
Application & Quick Start	Application MACRO 0. Reserve 1. Use defined 2. Compressor 3. Fan 4. Pump 10. AHU	1. This function displays the application macro and its parameter combination. 2. Press Select to enter the parameter setting page and change the setting value. 

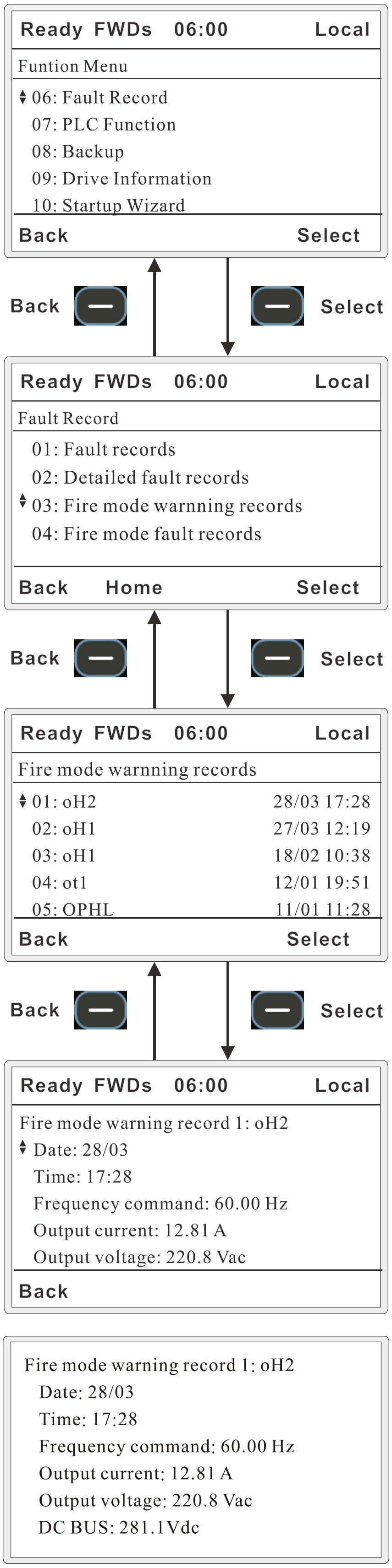
Function Name	Function Menu	Descriptions
	Quick setting 1. VF 2. IMSVC 3. IMFOC 4. PMSVC 5. PMFOC 6. SynSVC	1. This function displays the parameter combination of quick setting. 2. Press ENTER or Edit to enter the parameter setting page and change the setting value. 

Function Name	Function Menu	Descriptions
Option cards		1. Displays current used option card. 2. Press Select to read further information. 
Fault record	Fault record	1. Displays 30 fault records. 2. Press Select to read further information of the fault records. 

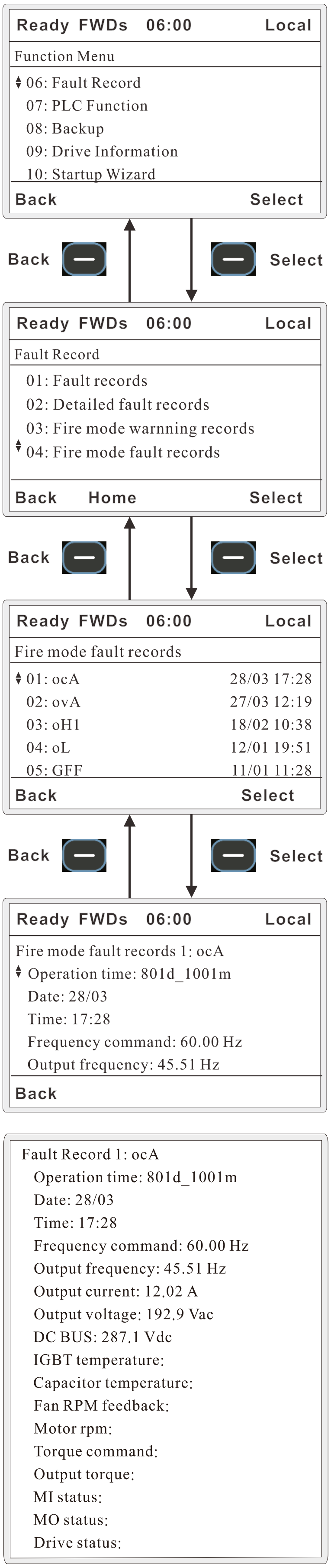
<table>
<tr><th>Function Name</th><th>Function Menu</th><th>Descriptions</th></tr>
<tr><td></td><td>Further fault information</td><td>1. Displays 6 fault records.
2. Press Select to read further information of the fault records.


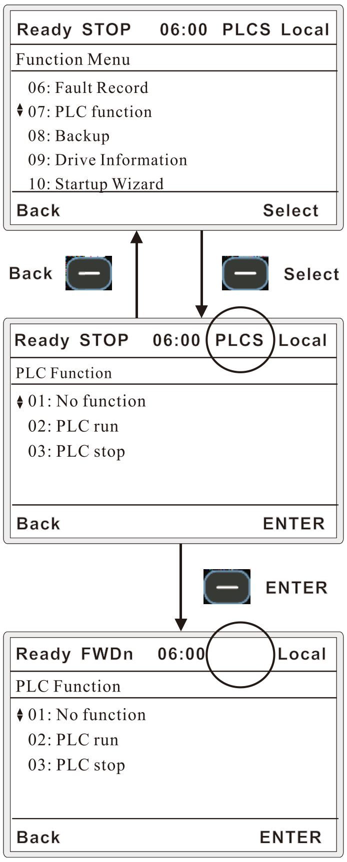
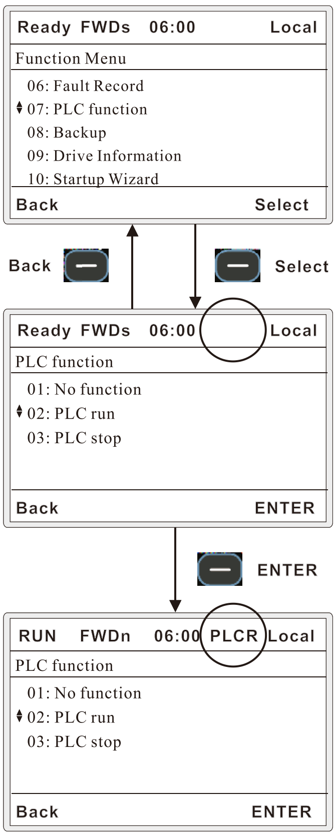
</td></tr>
</table>

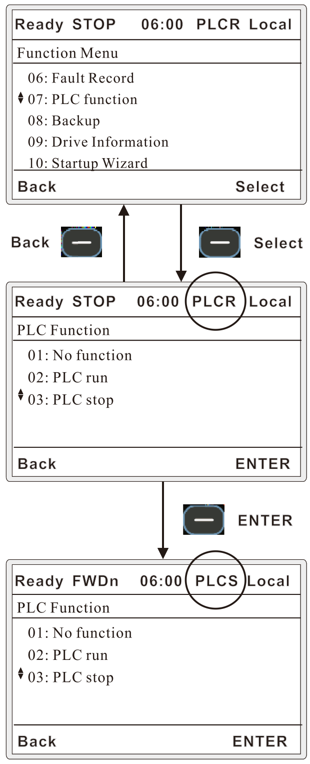
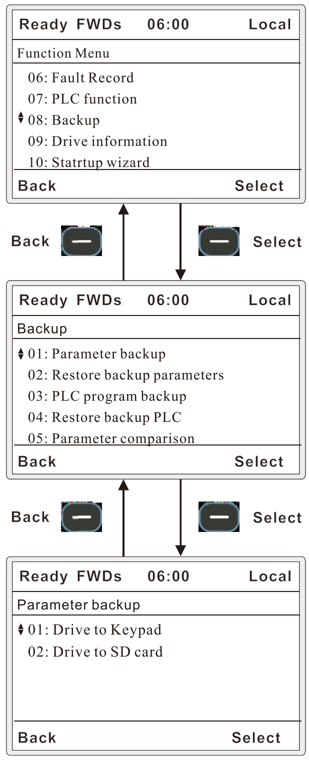
Function Name	Function Menu	Descriptions
	Warning records at Fire	1. Displays 6 warning records in FireMode. 2. Press Select to read further information of the fault records.

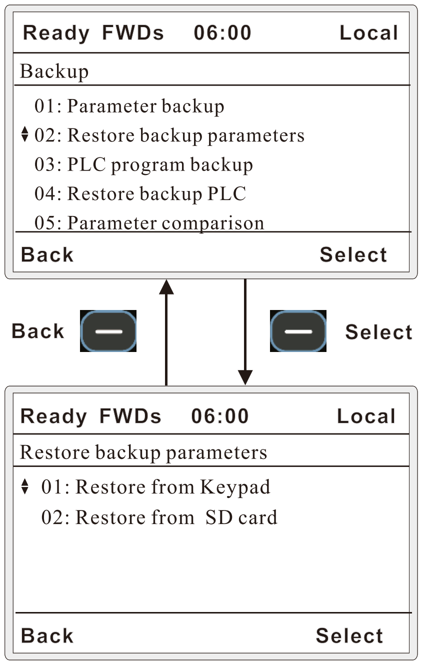
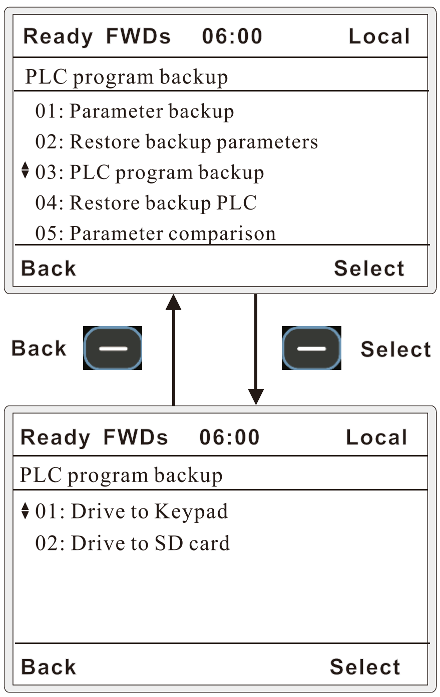


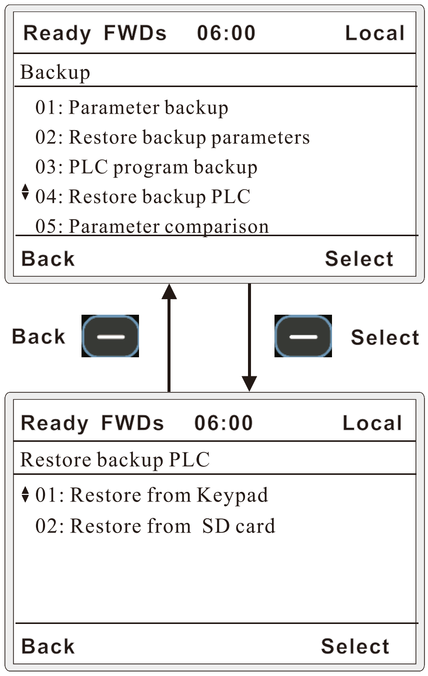
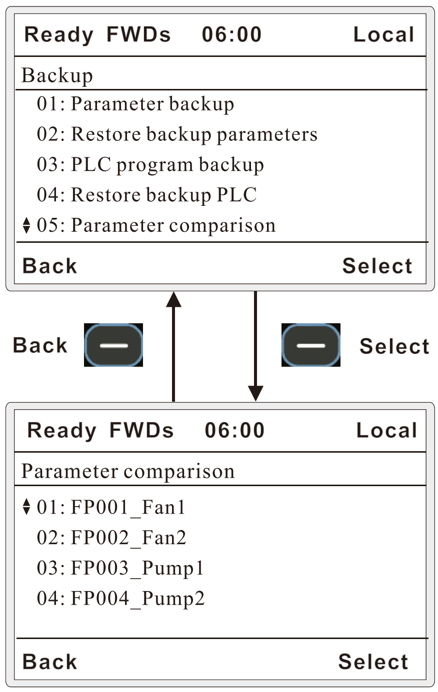
Function Name	Function Menu	Descriptions
	Fault record at Fire	1. Displays 6 fault records in FireMode. 2. Press Select to read further information of the fault records.

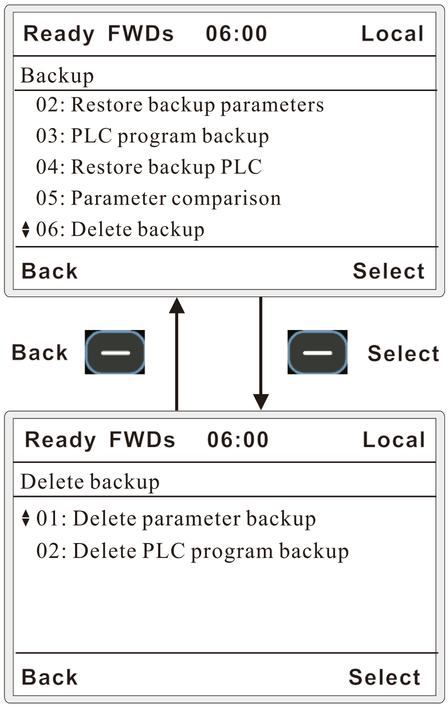
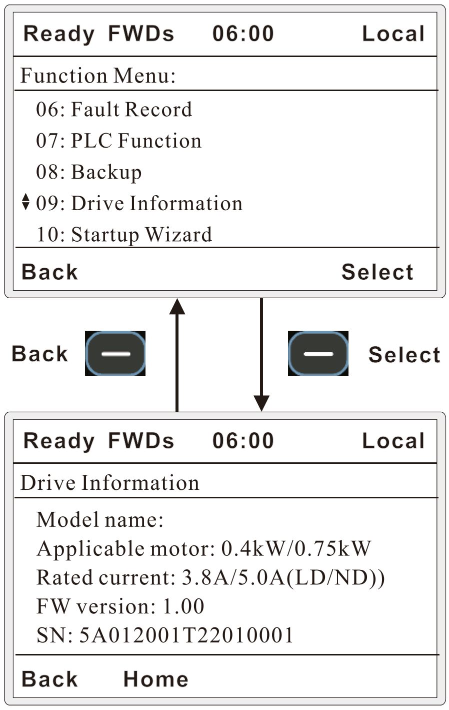


Function Name	Function Menu	Descriptions
PLC Function	No Function	1. Select PLC function. 2. When you select “No function”, it does not display the PLC status. 
	PLC Run	1. Select PLC operation on this page to start the PLC program. 2. PLC status display: PLCR 

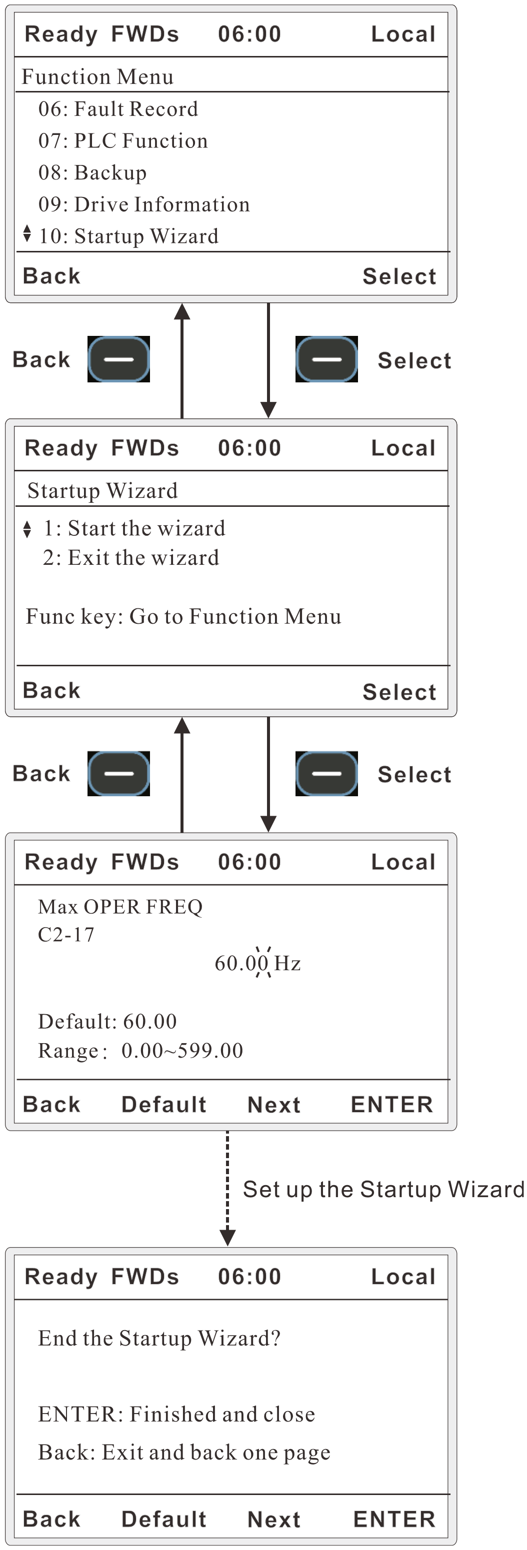
Function Name	Function Menu	Descriptions
	PLC Stop	1. Select PLC stop on this page to stop the PLC program. 2. PLC status display: PLCS 
Backup	Parameter backup	1. Displays the function combination of copy parameter: 1. Copy to Keypad. 2. Copy to SD card. 2. Option 1: Copy to Keypad, saves 4 groups of parameters. 3. Option 2: Copy to SD card, save the parameters in SD card. 

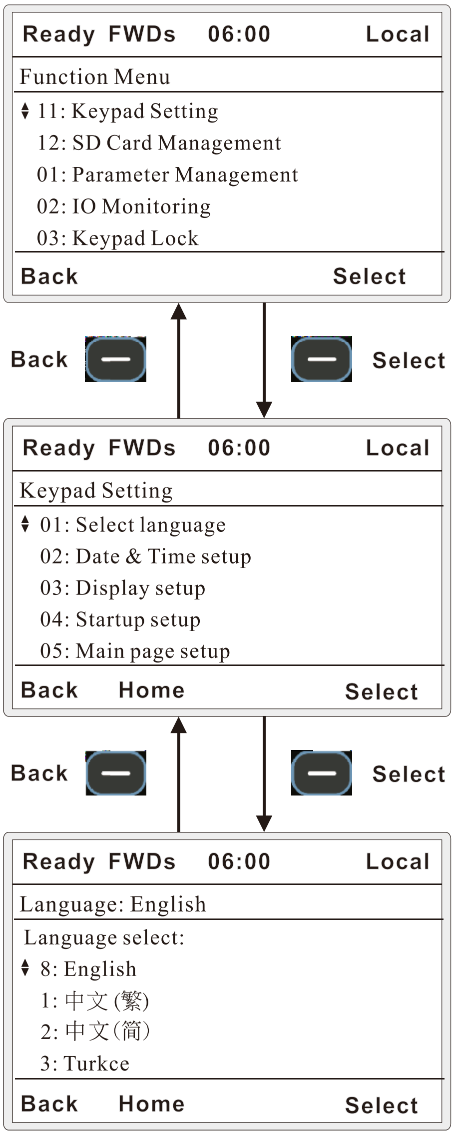
Function Name	Function Menu	Descriptions
	Restore backup parameters	1. Displays the function combination of restore parameter backup: 1. From Keypad. 2. From SD card. 2. Option 1: Restore from Keypad, recover 4 groups of parameter settings that are stored in the Keypad. 3. Option 2: Restore from SD card, recover all parameter settings that are stored in the SD card. 
	PLC program backup	1. Displays the function combination of copy PLC program: 1. Copy to Keypad. 2. Copy to SD card. 2. Option 1: Copy to Keypad, saves 4 groups of PLC program 3. Option 2: Copy to SD card, save the PLC program in SD card. 

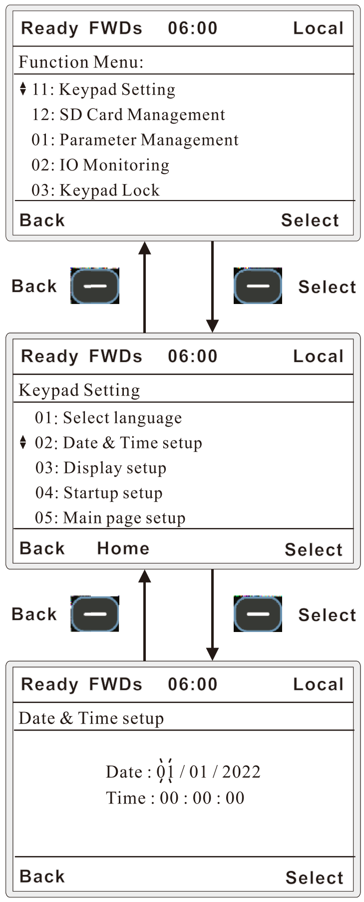
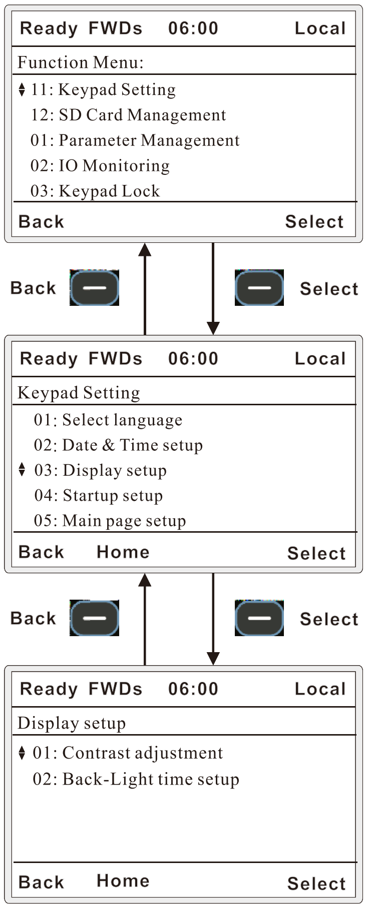
<table>
<tr><th>Function Name</th><th>Function Menu</th><th>Descriptions</th></tr>
<tr><td></td><td>Restore backup PLC</td><td>1. Displays the function combination of restore PLC program backup: 1. From Keypad. 2. From SD card.
2. Option 1: Restore from Keypad, recover 4 groups of PLC program that are stored in the Keypad.
3. Option 2: Restore from SD card, recover PLC program that is stored in the SD card.

</td></tr>
<tr><td></td><td>Parameter comparison</td><td>1. This function compares the current parameter setting with the parameter setting combination backed up in the Keypad, and can check the difference in the parameter setting.

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

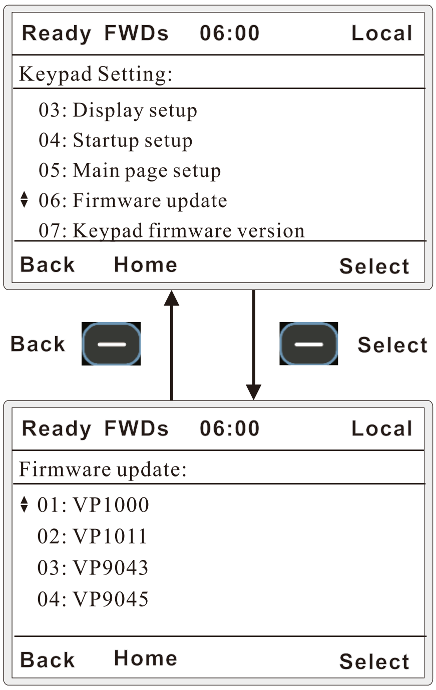
Function Name	Function Menu	Descriptions
	Delete backup	1. This function selects the parameter backup or PLC program backup to be deleted. 
Drive Information		1. This function displays the drive information. 

Function Name	Function Menu	Descriptions
Startup Wizard	Enter Startup Wizard	1. Select option 1 in this page: enter Startup Wizard for basic function setting.
	Exit Startup Wizard	2. Select option 2 in this page: exit Startup Wizard and return to the menu.

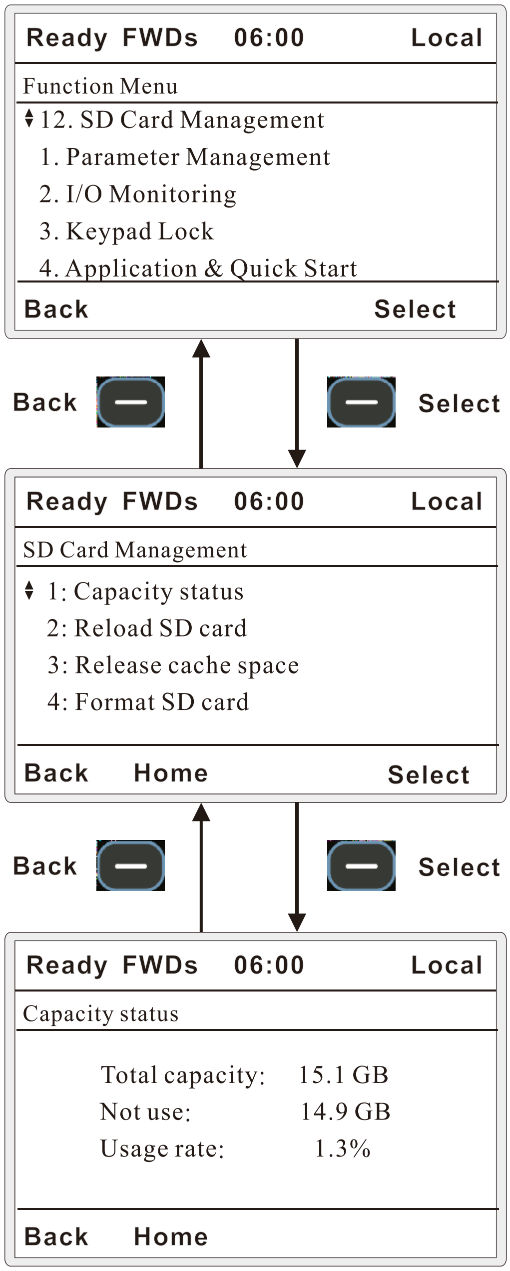


Function Name	Function Menu	Descriptions
Keypad settings	Language select	1. This function sets the keypad language. Language select: ● English ● 繁體中文 (Traditional Chinese) ● 简体中文 (Simplified Chinese) ● Turkish ● Russian ● Spanish ● Portuguese ● French ● Polish ● German ● Italian ● Swedish 

<table>
<tr><th>Function Name</th><th>Function Menu</th><th>Descriptions</th></tr>
<tr><td></td><td>Date & Time setup</td><td>1. This function sets the keypad time.

</td></tr>
<tr><td></td><td>Display setup</td><td>1. This function sets the keypad display: 1. Contrast, 2. Backlight.

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

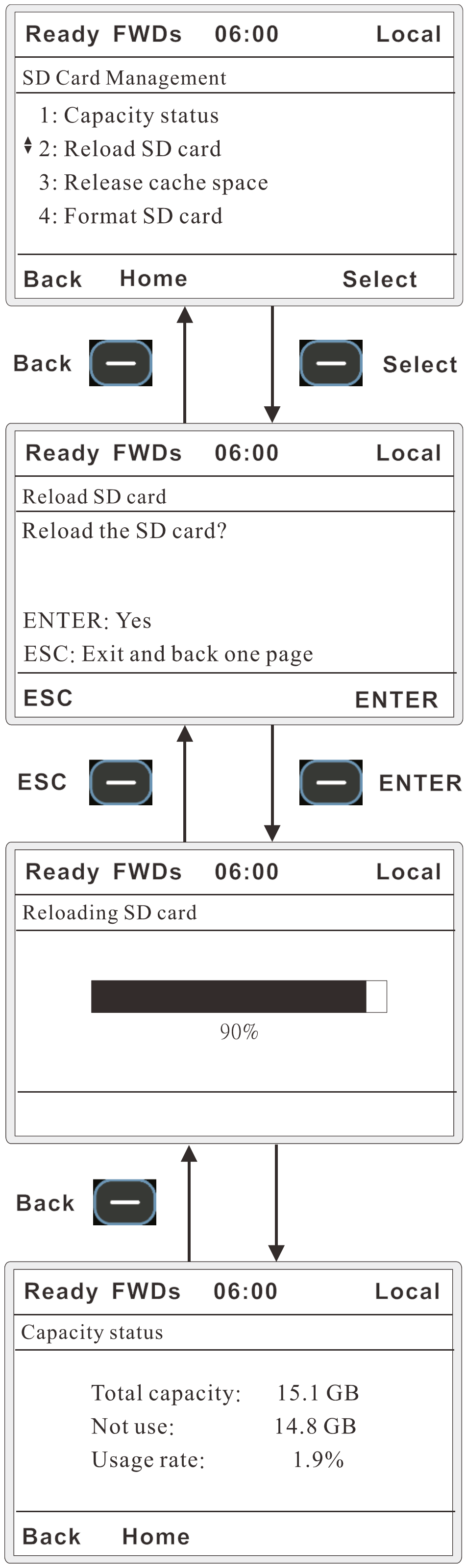
Function Name	Function Menu	Descriptions
	Firmware update	1. This function updates the drive firmware. 
	Firmware Version	1. This function displays the keypad firmware version and the product serial number. 

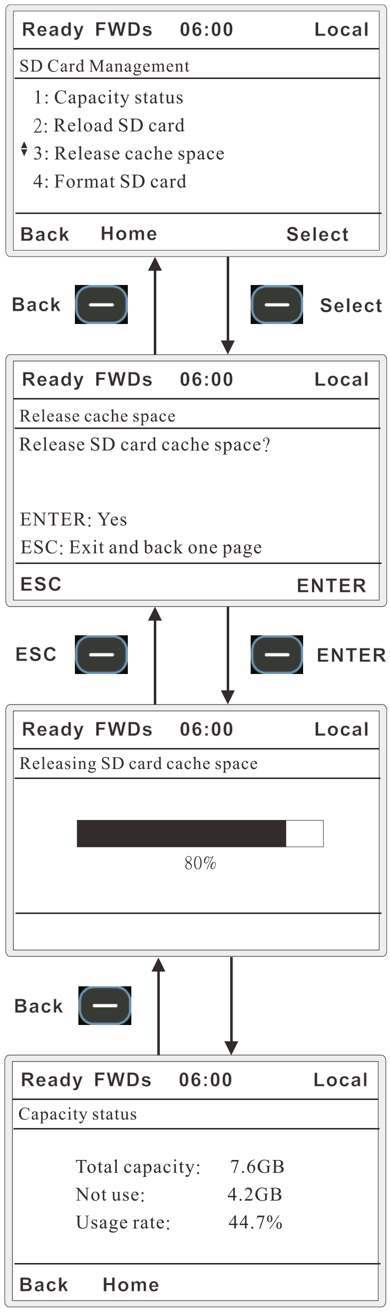
Function Name	Function Menu	Descriptions
SD Card Management	Capacity status	1. This function displays the capacity information of the current inserted SD card.

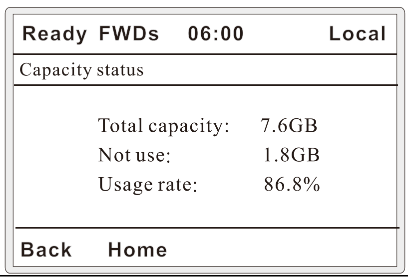


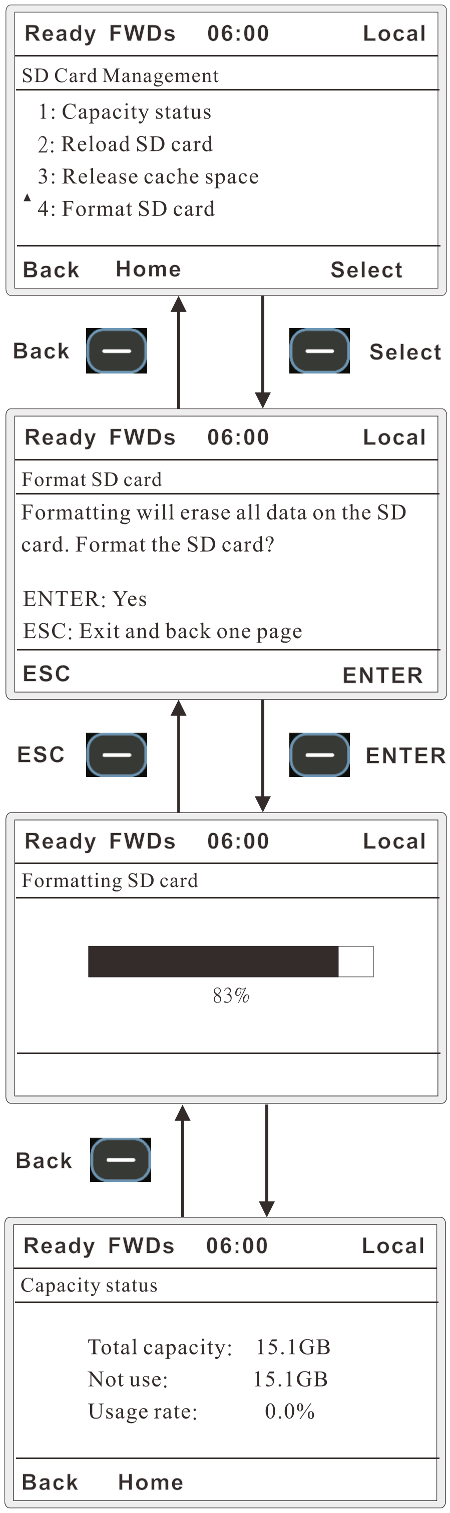
Function Name	Function Menu	Descriptions
		2. The followings are warning messages for SD card functions. Follows the indications shown on the display for further operation. Ready FWDs 06:00 Local No SD card 1. Ensure inserted an SD card 2. Reload SD card 3. Check the SD card capacity Func Home Ready FWDs 06:00 Local SD card format incompatible Use a FAT32 format SD card. Or use SD card function: 3: Format SD card Func Home Ready FWDs 06:00 Local SD card capacity is full Replace the SD card. Or use SD card function: 2: Release cache space 3: Format SD card Func Home Ready FWDs 06:00 Local SD card prohibited execution SD card related function is in progressing. Please close it before using other functions. Func Home

Function Name	Function Menu	Descriptions
	Reload SD card	1. Reloads the SD card information. When the SD card is inserted after the drive starts, execute the reload function first, then the SD card function can be operated.



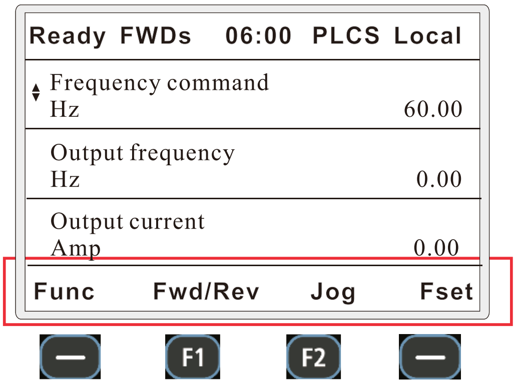
<table>
<tr><th>Function Name</th><th>Function Menu</th><th>Descriptions</th></tr>
<tr><td></td><td>Release cache space</td><td>1. This function releases cache space, especially when the SD card is highly used. Releasing cache space could erase the cache file in the SD card and reduce ths usage rate of the SD card.


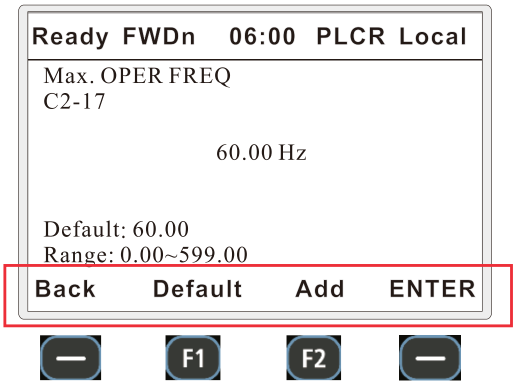
The usage rate of SD card before releasing cache space is is 86%, and 44% after executing the release cache space function (as the demonstration result above).

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

Function Name	Function Menu	Descriptions
	Format SD Card	1. The SD card function only supports SD card with FAT32 format, with suggested configuration of 64KB (refer to Section 4-2 SD card for Using Precautions). 2. This function foramts the SD card to FAT32 and the best configuration unit 64KB. 

4-1-6-4 KPV-CC01 Operation Flow

Function key display

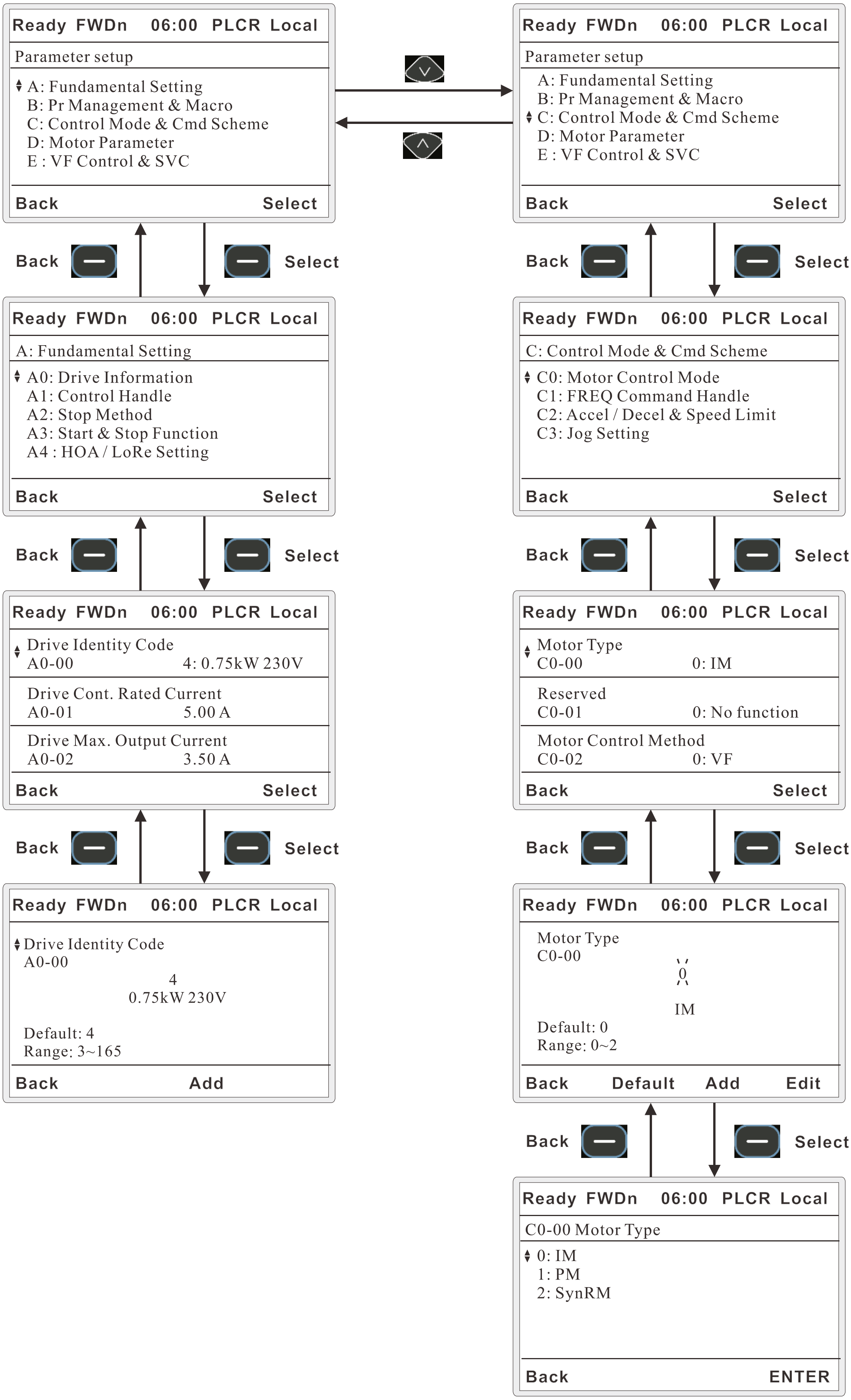
<table>
<tr><td colspan="2">The names and definitions of the 4 function keys are different according to the functional requirements of current display page and are fixedly displayed in the bottom column of the screen.</td></tr>
<tr><td>On the main page, the names and definitions are as below:


Left key: Func
F1 key: Fwd/ Rev
F2 key: Jog
Right key: Fset</td><td>On the parameter setting page, the names and definitions are as below:


Left key: Back
F1 key: Default
F2 key: Add
Right key: ENTER</td></tr>
</table>

NOTE: refer to Section 4-1-3-2 Keypad Function Description of KPV-CC01 for the available functions of each key.

For example: In parameter setting function: Select motor type



Support function list for each Keypad:

Function Name	Function Menu	KPV-CE02	KPV-CC01	KPV-CC02
Pr Management	Parameter Setting	v	v	v
	Modified parameter_XX	v	v	v
I/O monitor	Digital input/ output terminal status	x	v	v
	Multi-function digital input terminals	x	v	v
	Multi-function digital output terminals	x	v	v
	Multi-function analog input terminals	x	v	v
	Multi-function analog output terminals	x	v	v
Keypad lock		v	v	v
APP	Application MACRO	v	v	v
	Quick setting	v	v	v
Option cards	Slot 1	v	v	v
	Slot 2	v	v	v
	Slot 3	v	v	v
Fault record	Fault record	v	v	v
	Further fault information	x	v	v
	Fault record at Fire	v	v	v
	Warning records at Fire	v	v	v
	ChatBox Link (QR Code)	x	v	v
PLC	PLC0	v	v	v
	PLC1	v	v	v
	PLC2	v	v	v
Copy function	Copy parameter (Read)	v	v	v
	Save parameter (Save)	v	v	v
	Delete backup	v	v	v
	Copy PLC program	v	v	v
	Save PLC program	v	v	v
Drive Information		x	v	v
Start Wizard	Enter Start Wizard	x	v	v
	Exit Start Wizard.	x	v	v
Keypad settings	Language setup	x	v	v
	Time setup	v	v	v
	Display setup	x	v	v
	Start page display	x	v	v
	Main screen display	x	v	v
	Firmware update	v	v	v
	Firmware Version	v	v	v
Bluetooth setup	Bluetooth enable/ disable	x	x	v
	Bluetooth name	x	x	v
	Pairing setup	x	x	v

4-2 SD Card

4-2-1 Specification and Using Precautions:

Specification

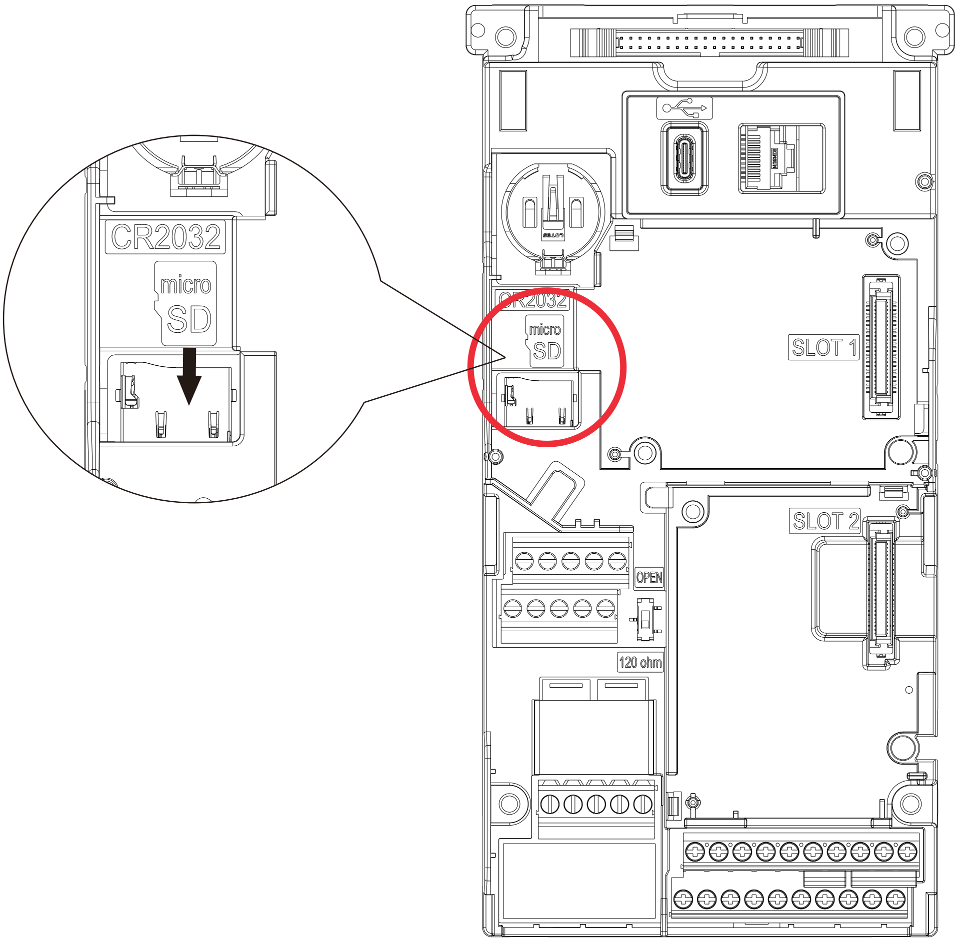
1. SD card type: microSD
2. Maximum capacity: 4–32 GB (SDHC)
3. Transmission speed: Speed Class 10 and above
4. Format restrictions: FAT32, configured unit 64KB

Using Precautions

1. When you first use the SD card function of the drive, it is recommended to format the SD card through the drive, so the SD card can be configured to meet the drive requested format restrictions (FAT32 and configured unit 64 KB).
2. If you format the SD card through the PC, pay attention to the format restrictions.
3. The AC motor drive detects whether the SD card exists when the drive is power ON (auto detection) or when using Reload SD card function (manual detection).
4. If the SD card is formatted and inserted into the drive before the drive is powered ON, the SD card related functions can be operated after the drive is ON, such as backup, upgrade firmware or the recorder function.
5. If the SD card is formatted but inserted into the drive after the drive is powered ON, the drive cannot identify the SD card. To identify the SD card and operate the related functions, it must be executed in one of the following two methods:
   (1) Restart the AC motor drive
   (2) Execute the reload SD card function in the SD Card Management function list
6. When the SD card capacity is full, it stops writing data into the SD card. Refer to Section 4-2-3 Saving data for detailed information.
7. The writing speed may be affected due to the different manufacturing processes of each brand, it is suggested to choose the SD card produced by a well-known brand.
8. When the format configuration unit is set incorrect, it may affect the write in speed of the SD card and causing communication time-out or abnormal data reading.

4-2-2 Installation

Install the SD card as shown in the figure below:



4-2-3 Saving Data

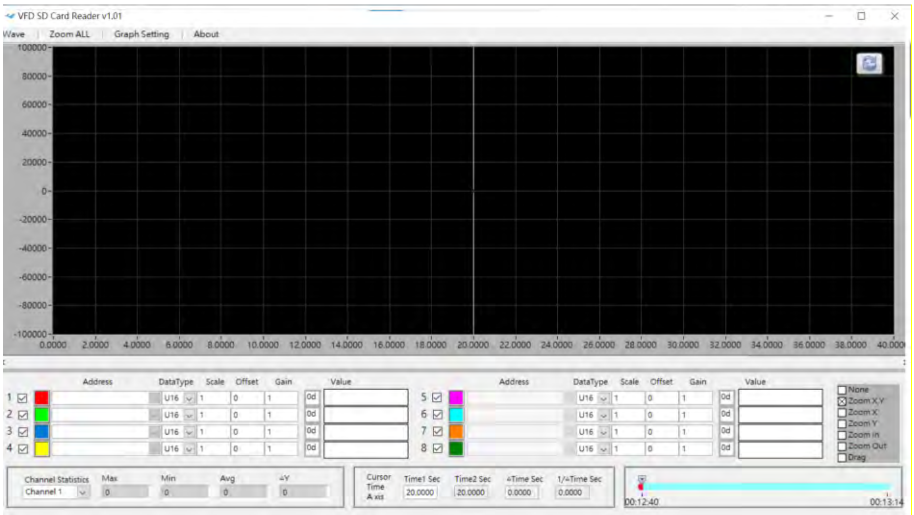
1. The folders in the SD card are defined according to different functions as listed in the following table. When you first use the SD card function and insert the card into the drive, it automatically generates a parent folder called VP3000 and its children folders when the drive identifies the SD card (refer to the using precautions in Section 4-2-1).

Parent Folder	Children Folder	Function	File Extension	Note
VP3000	FIRMWARE	Firmware file	.vp	
	LANGUAGE	Language pack	.lan	
	LOGFOLD	Recorder	.txt (wave file .bak (backup file) .tmp (temporary archieve)	'.bak' and '.tmp' files are automatically saved by the system. '.tmp' files can be erased through the Release Cache Space function in the SD Card Management function list
	PARM	Parameter files	.PR	
	PLC	Program	.PLC	

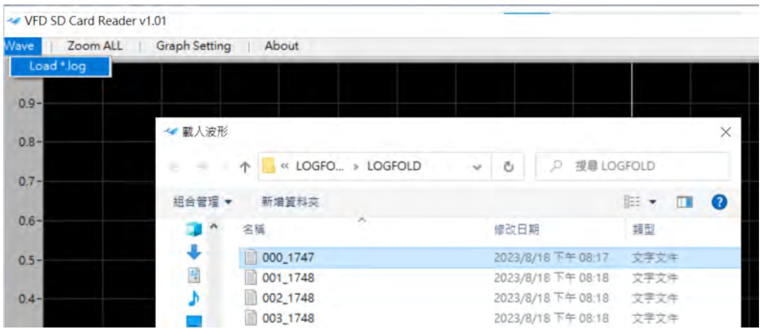
2. Each function corresponds to different children folders above, for example, if you need to upgrade the firmware, save the firmware file into the FIRMWARE folder, then the drive can execute the upgrade function. Other functions can be deducted in the same way.
3. The number of characters in folder name and backup file name is limited to 8 English letters or numbers.
4. When the SD card is used to save data that includes drive function files (files save in VP3000 Parent folder and children folders) and other external files, and the SD card use rate reaches 99%, the drive stops write in data and the SD card shows SDfu (the capacity is full), but the data inside the SD card can still be read.
5. When the SD card is used to save data that only includes the drive function files (files save in VP3000 Parent folder and children folder), it starts and uses the recorder function to continuously record the wave form data. When the SD card use rate reaches 80%, the temporary archive will be rewritten with new temporary archive, and the previous temporary archive will be deleted. If there are no temporary archives, the recorder function stops operating and the drive displays SDfu (the SD card is full). In this case, other functions except the recorder can still operate until the SD card capacity use rate reaches 99%, such as parameter backup function.
6. Refer to Chapter 8 Troubleshooting for the SD card related fault/ warning messages and corrective actions.

4-2-4 Recorder Data Review

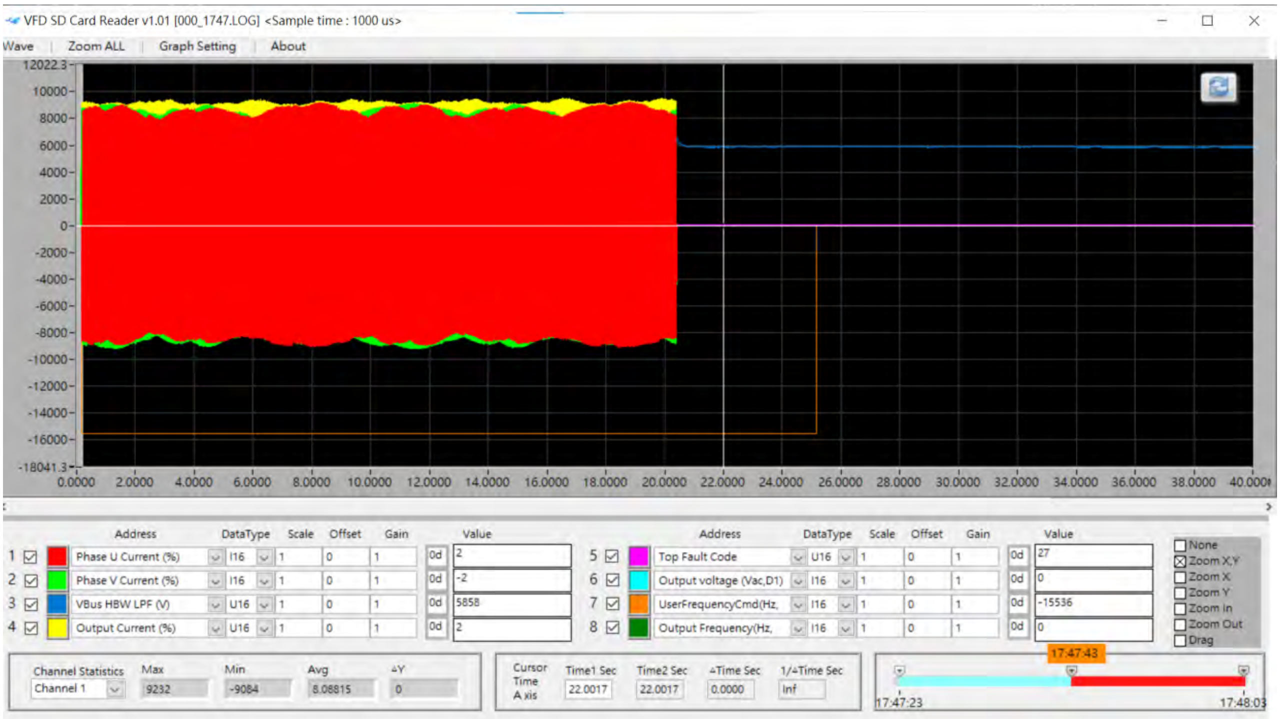
1. Start the recorder software VFD SD Card Reader.exe



2. Click Load *.log under the Wave menu and choose the Waveform file.

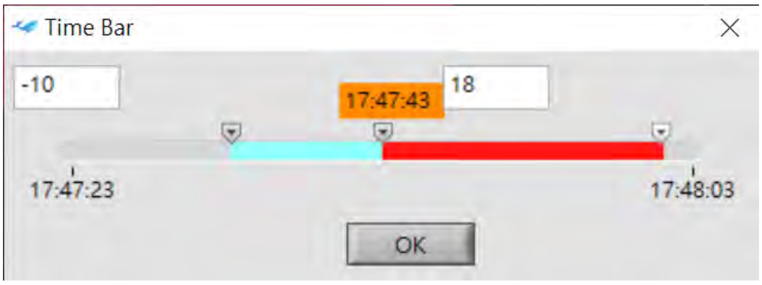


3. After you choose the file and load the waveform, the screen displays as below. From the demonstrated screen below, you can see information of Channel 1–8, by dragging the white line in the center of the screen, you can observe the information of recorded waveform. You can also click the left mouse button to select an area and zoom in. The screen will be partially enlarged according to the selected area. To return to the original wave form, click Zoon ALL menu.

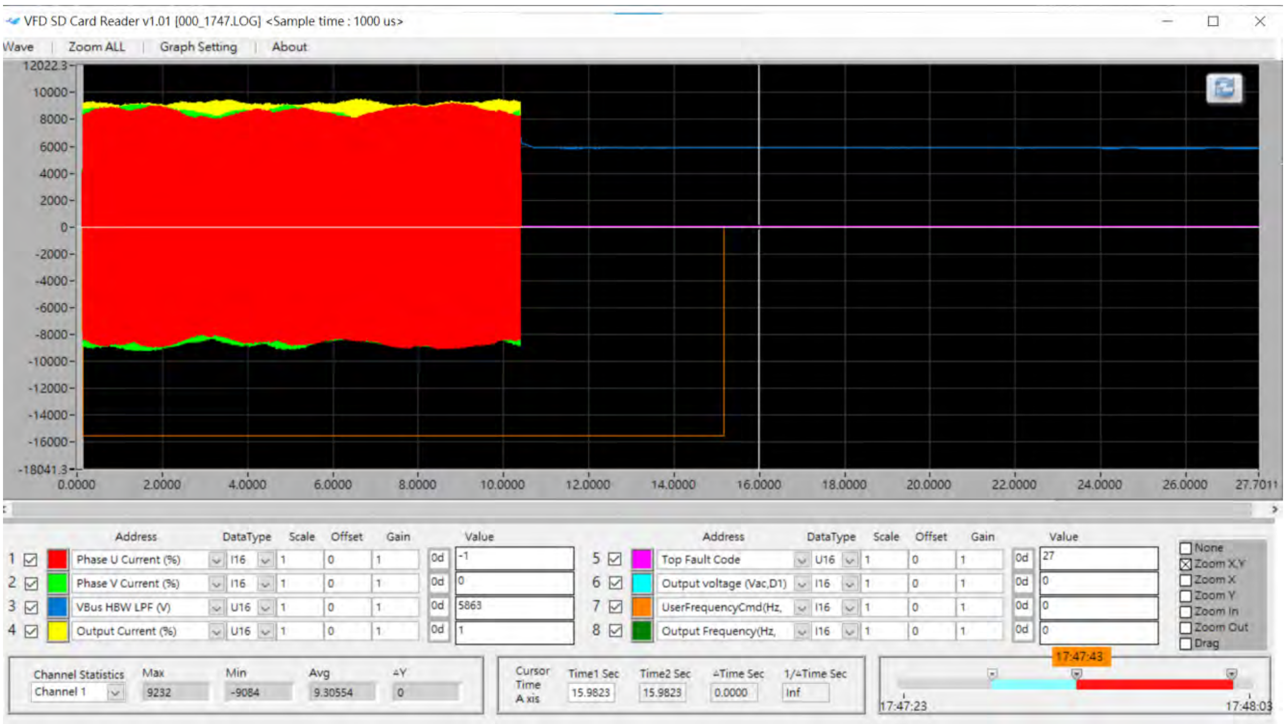


4. In addition, the waveform presentation interval can also be selected through the Time Bar function on the lower right, for example, the current presented waveform time interval is 40 seconds. Click the Time Bar icon and the screen displays as below.

Adjust the dragging timeline left and right, for example, drag left to -10 seconds and right to 18 seconds.



Click OK, then the waveform is presented as below, the total interval becomes 28 seconds.



4-3 Tuning Software

4-3-1 Foreword

DIADesigner is one of the software of DIAStudio integrated software package, which is the development software for Delta's new generation of automation products. DIADesigner provides users with functions such as program editing, network and hardware configuration and parameter setting, etc. for Delta's full range of industrial automation products, and completes various tasks in a consistent user interface and operating experience. It also provides plenty of auxiliary tools and multi-language pack, bringing users a convenient and highly efficient development environment.

4-3-2 Software Download Instruction

DIAInstaller is a resident program for managing Delta's industrial automation software. You can download, install and update Delta's industrial automation software here, and all process are executed in the background without affecting other operations. Download DIAInstaller from the following path:

https: //diastudio.deltaww.com/

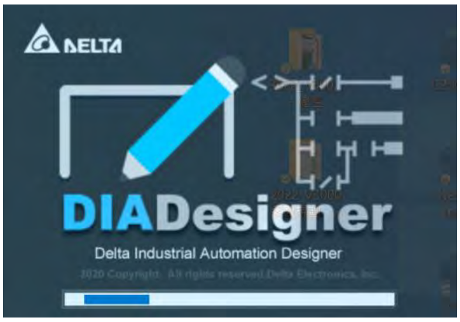
1. Refer to the Download and Installation manual to complete the software installation.

Figure: DIAInstaller

2. Start DIADesigner.
3. After completing the installation, double-click the DIADesigner desktop shortcut to start the program, as shown in the figure below.

Figure: DIADesigner desktop shortcut

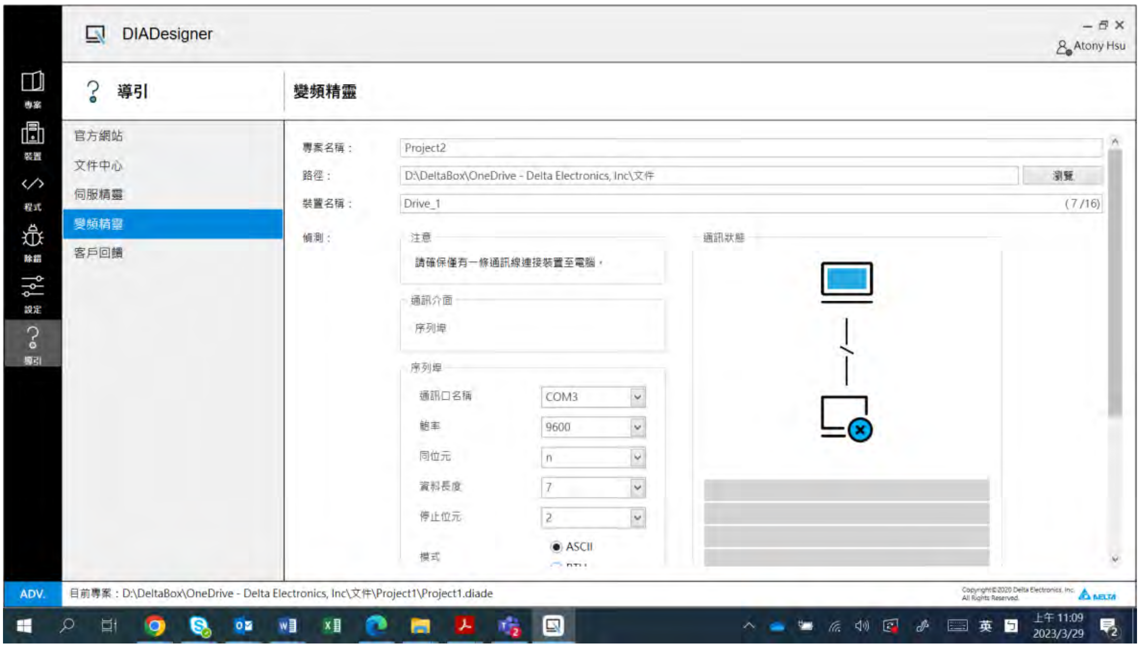
4. When you enter the DIADesigner, the screen in as follows:



5. The startup screen displays the initial welcome screen of the software, as shown in the figure below:

Figure: DIADesigner startup screen

6. Select Drive Wizard and enter the the setting page, as shown in the figure below:



7. Refer to the DIADesigner manual for further information of connection methods, description of each part of the screen and operation method, etc.

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Chapter 5 Initial Operation and Adjustment

5-1 Safety Precautions

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

5-2 Check Items before Start

Check Items before Power ON:

1. R, S and T are the input terminals of the drive, which are connected to the power supply and there is no voltage between the phase-to-phase or phase-to-ground.
2. U, V and W are the output terminals of the drive, which are connected to the motor and there is no voltage between the phase-to-phase or phase-to-ground.
3. Make sure the resistance of U-V, V-W and W-U are the same.
4. Check whether the input voltage matches the voltage of the drive and motor.
5. Check whether the screws on terminals are tighten well.
6. Check whether the control circuit terminal is short-circuited.
7. Make sure to close the top cover of the drive to avoid accidental touch.
8. Make sure all the power switches of the drive are OFF.

Check Items after Power ON:

1. Check whether the keypad on the drive displays the initial setting page or main page.
2. Check whether the status column of the keypad displays Ready.
3. If a fault code shows, refer to Chapter 8 Troubleshooting to clear the fault.

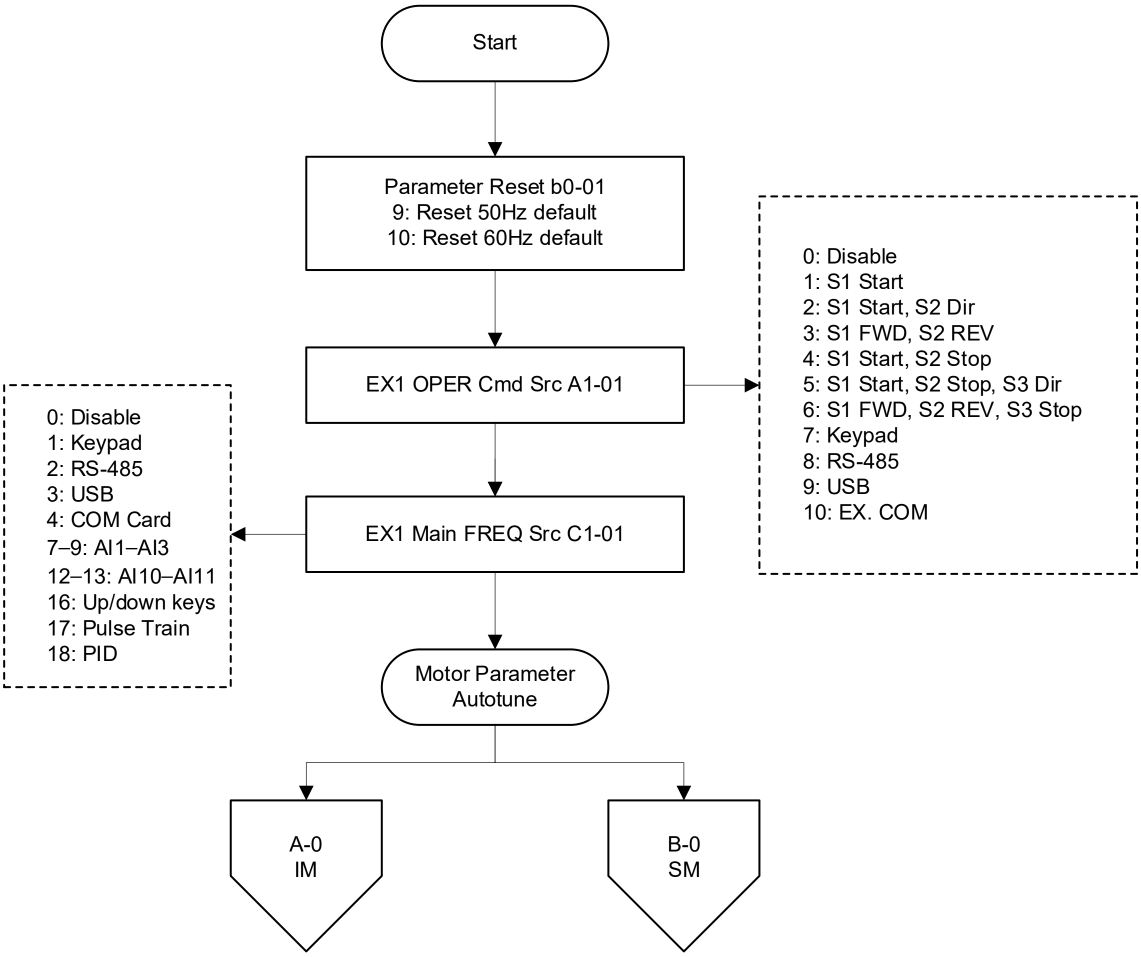
5-3 Start Process

The following are abbreviations for different types of motors:

- IM: Induction motor
- SM: Synchronous AC motor
- PM: Permanent magnet synchronous AC motor
- IPM: Interior permanent magnet synchronous AC motor
- SPM: Surface permanent magnet synchronous AC motor
- PMA: Permanent magnet assisted synchronous reluctance motor
- SynRM: Synchronous reluctance motor

5-3-1 Parameter Setting

5-3-1-1 Adjustment Flowchart



5-3-1-2 Adjustment Steps

1. Parameter Reset

   Pr. b0-01 = 9: Reset 50 Hz default or 10: Reset 60 Hz default.

2. Set the operation command source.

Pr.	Parameter Name	Settings
A1-01	EX1 OPER Cmd Src	0: Disable 1: S1 Start 2: S1 Start, S2 Dir 3: S1 FWD, S2 REV 4: S1 Start, S2 Stop 5: S1 Start, S2 Stop, S3 Dir 6: S1 FWD, S2 REV, S3 Stop 7: Keypad 8: RS-485 9: USB 10: EX. COM

3. Set the frequency command source.

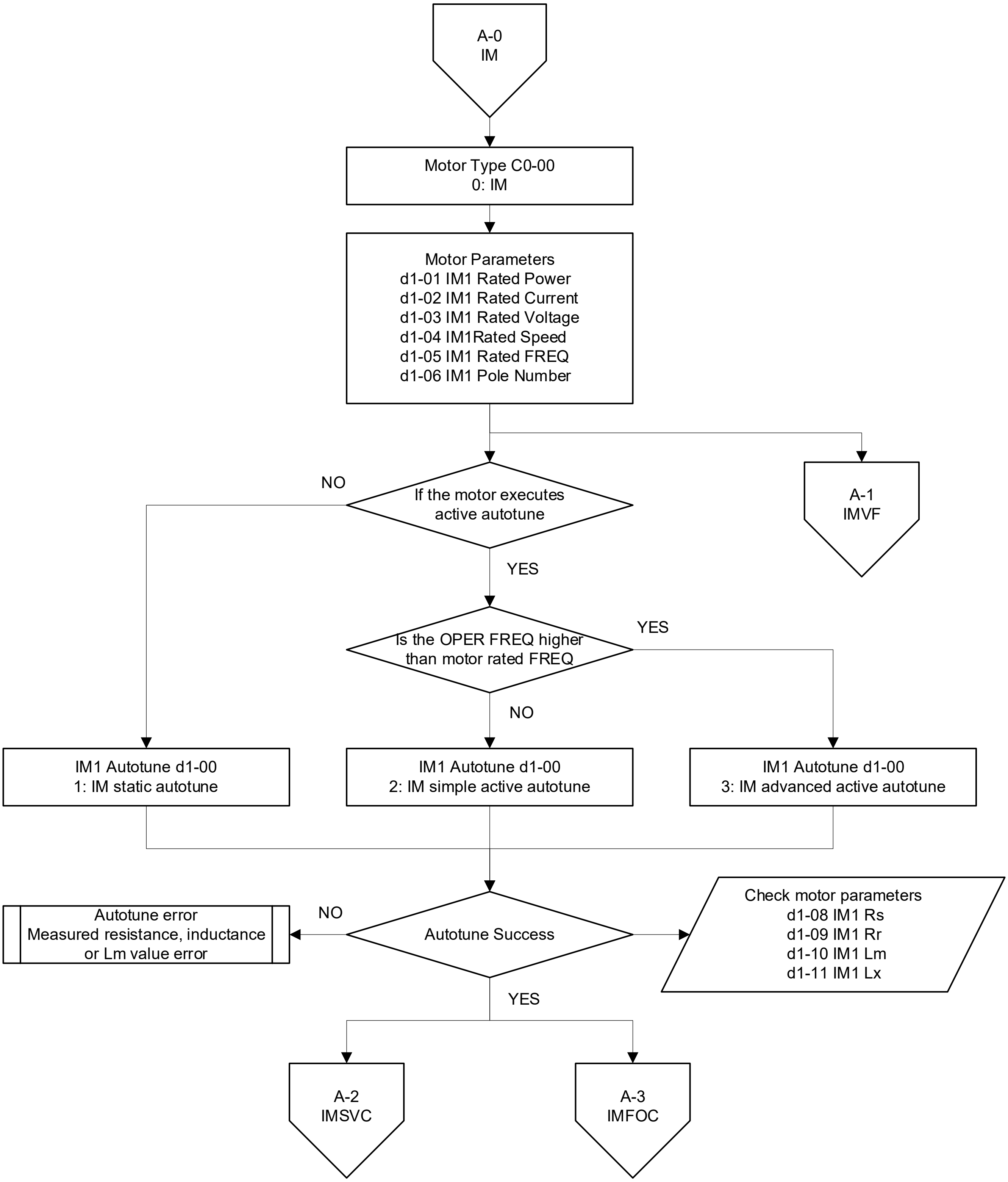
Pr.	Parameter Name	Settings
C1-01	EX1 Main FREQ Src	0: Disable 1: Keypad 2: RS-485 3: USB 4: EX. COM 7–9: AI1–AI3 12–13: AI10–AI11 16: Up/down keys 17: Pulse Train 18: PID

4. Select motor autotune.

   Refer to Section 5-3-2 IM Autotune or Section 5-3-3 SM Autotune.

5-3-2 IM Autotune

5-3-2-1 Adjustment Flowchart



5-3-2-2 Adjustment Steps

1. Select motor type.
   Set Pr. C0-00 = 0: IM.
2. Set motor parameters.

Pr.	Parameter Name
d1-01	IM1 Rated Power
d1-02	IM1 Rated Current
d1-03	IM1 Rated Voltage
d1-04	IM1 Rated Speed
d1-05	IM1 Rated FREQ
d1-06	IM1 Pole Number

NOTE: If you choose to operate the motor with VF control method, directly refer to Section 5-4-1 IMVF.

3. Select the type of motor autotune.
   (1) If the motor is connected to a load or cannot rotate, set Pr. d1-00 = 1: IM static autotune.
   (2) If the motor does not connect to a load and is able to rotate, when it operates lower than the rated frequency, set Pr. d1-00 = 2: IM simple active autotune.
   (3) If the motor does not connect to a load and is able to rotate, when it operates higher than the rated frequency, set Pr. d1-00 = 3: IM advanced active autotune.
   (4) If Pr. C0-00 is set as SynRM, set Pr. d5-00 = 2: SM blocked rotor autotune.
4. Execute autotune.
   (1) Autotune success, check the motor parameters.

Pr.	Parameter Name
d1-08	IM1 Rs
d1-09	IM1 Rr
d1-10	IM1 Lm
d1-11	IM1 Lx

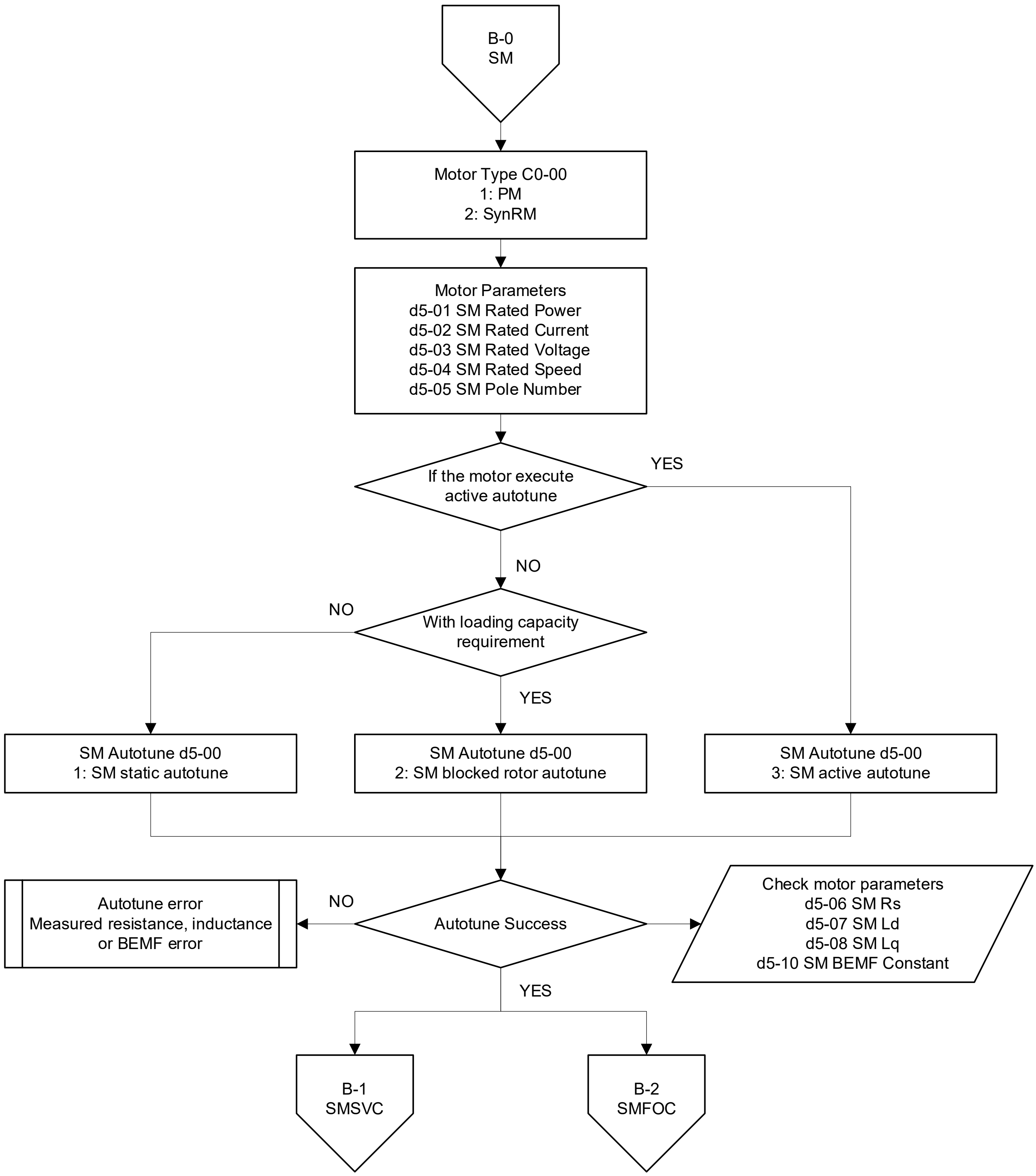
   (2) Autotune error, refer to the Chapter 8 for fault code information of the drive and keypad.

Error code	Description
AUE (40)	The motor autotune process does not complete.
AUE1 (142)	No-feedback current error during motor autotune.
AUE3 (145)	Rs measuring error during motor autotune.
AUE4 (148)	Rr measuring error during motor autotune.
AUE6 (150)	No-load current (I_0) error during motor autotune.
AUE8 (152)	High-frequency testing error during motor autotune.
AUE9 (153)	Lsigma measuring error during motor autotune.

5. Choose the motor control method.
   Refer to Section 5-4-2 IMSVC or Section 5-4-3 IMFOC.

5-3-3 SM Autotune

5-3-3-1 Adjustment Flowchart



5-3-3-2 Adjustment Steps

1. Select motor type.

   Set Pr. C0-00 = 1: PM or 2: SynRM.

2. Set motor parameters.

Pr.	Parameter Name
d5-01	SM Rated power
d5-02	SM Rated Current
d5-03	SM Rated Voltage
d5-04	SM Rated Speed
d5-05	SM Pole Number

3. Select the type of motor autotune.

   (1) If the motor is connected to a load or cannot rotate, and there is no loading capacity requirement, set Pr. d5-00 = 1: SM static autotune.

   (2) If the motor is connected to a load or cannot rotate, and there is loading capacity requirement, set Pr. d5-00 = 2: SM blocked rotor autotune.

   (3) If the motor does not connect to a load and is able to rotate, set Pr. d5-00 = 3: SM active autotune.

4. Execute autotune.

   (1) Autotune success, check the motor parameters.

Pr.	Parameter Name
d5-06	SM Rs
d5-07	SM Ld
d5-08	SM Lq
d5-10	SM BEMF Constant

   (2) Autotune error, refer to the Chapter 8 for fault code information of the drive and keypad.

Error code	Description
AUE (40)	The motor autotune process does not complete.
AUE1 (142)	No-feedback current error during motor autotune.
AUE3 (145)	Rs measuring error during motor autotune.
AUE7 (151)	Ld and Lq measuring error during motor autotune.

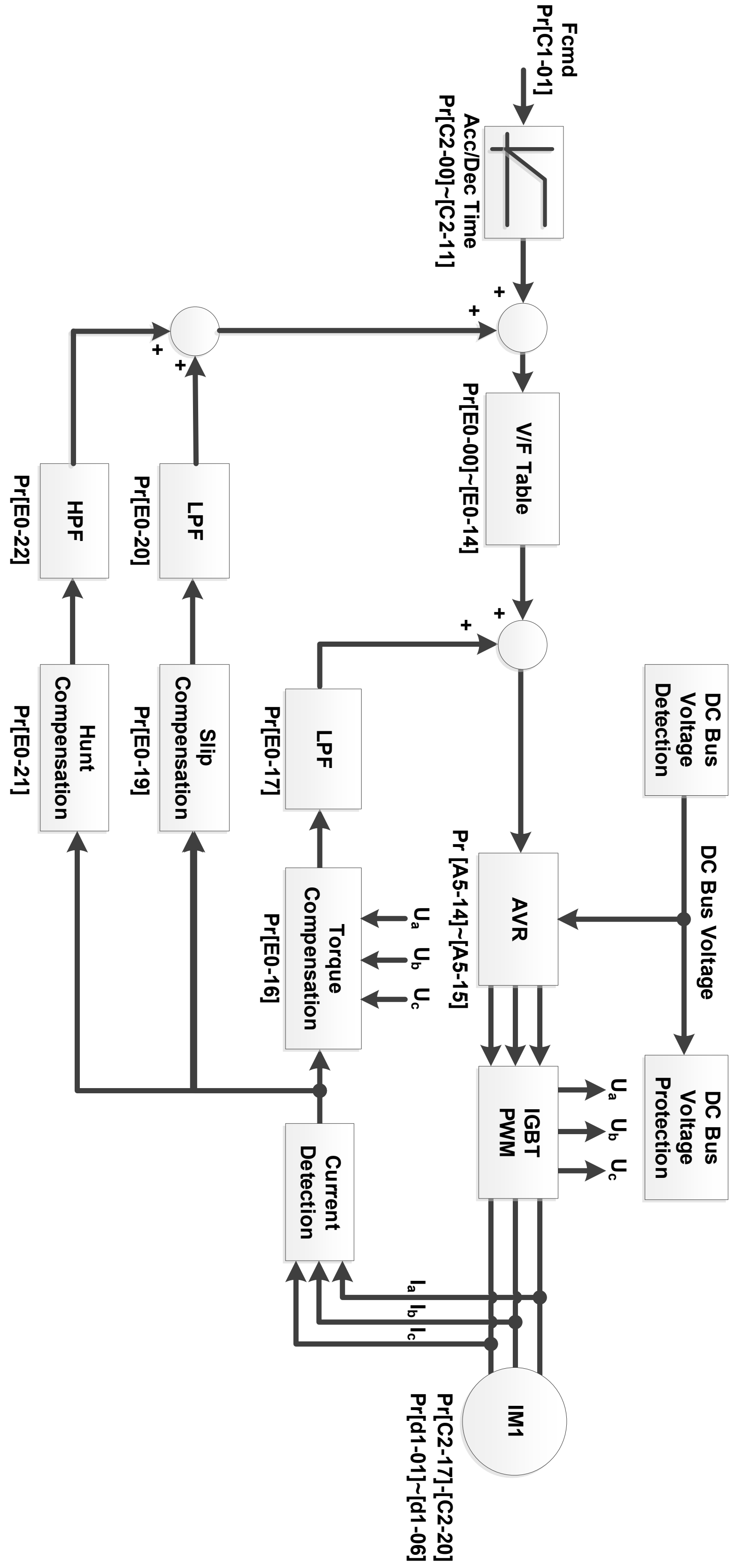
5. Choose the motor control method.

   Refer to Section 5-4-4 SMSVC or Section 5-4-5 SMFOC.

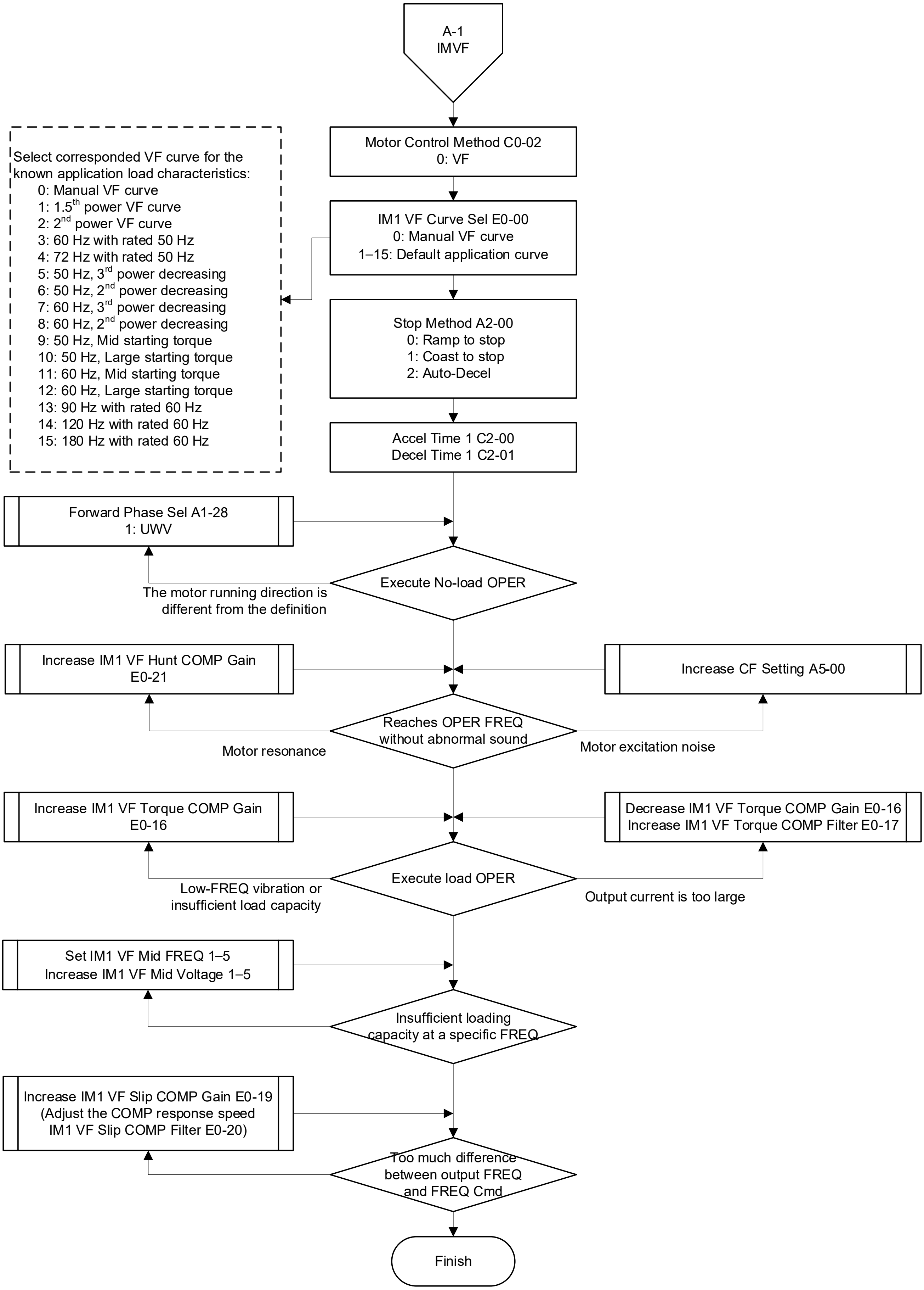
5-4 Control Mode and Adjustment

5-4-1 IMVF

5-4-1-1 Control Diagram



5-4-1-2 Adjustment Flowchart



5-4-1-3 Adjustment Steps

1. Choose the motor control method.
   Set Pr. C0-02 = 0: VF.
2. Set IM1 VF curve selection.

Pr.	Parameter Name	Settings
E0-00	IM1 VF Curve Sel	0: Manual VF curve 1: 1.5th power V/F curve 2: 2nd power V/F curve 3: 60Hz with rated 50Hz 4: 72Hz with rated 60Hz 5: 50 Hz, 3rd power decreasing 6: 50 Hz, 2nd power decreasing 7: 60 Hz, 3rd power decreasing 8: 60 Hz, 2nd power decreasing 9: 50 Hz, Mid starting torque 10: 50 Hz, Large starting torque 11: 60 Hz, Mid starting torque 12: 60 Hz, Large starting torque 13: 90 Hz with rated 60 Hz 14: 120Hz with rated 60 Hz 15: 180Hz with rated 60 Hz

3. Setup stop method.

Pr.	Parameter Name	Settings
A2-00	Stop Method	0: Ramp to stop 1: Coast to stop 2: Auto-Decel

4. Set the acceleration and deceleration time

Pr.	Parameter Name
C2-00	Accel Time 1
C2-01	Decel Time 1

5. Execute no-load operation.
   If the motor operating direction is different from the definition, adjust Pr. A1-28 Forward Phase Selection = 1: UWV.
6. Check if the motor can operate to the operation frequency without abnormal sound.
   (1) If the motor resonates, increase setting for Pr. E0-21 IM1 VF Hunt Compensation Gain.
   (2) If there is motor excitation noise, increase setting for Pr. A5-00 Carrier Frequency Setting.

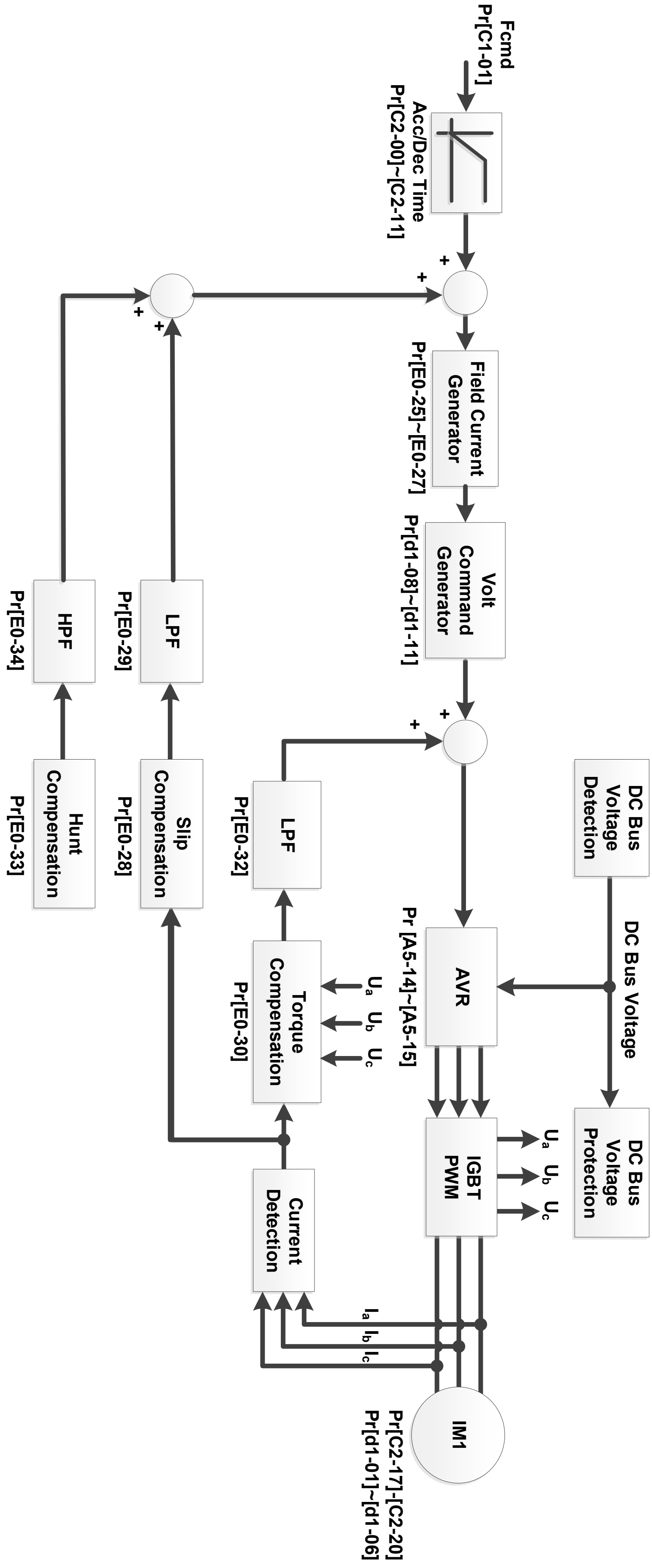
7. Execute load operation.
   (1) If the motor vibrates in low-frequency or has insufficient loading capacity, increase setting for Pr. E0-16 IM1 VF Torque Compensation Gain to enhance the loading capacity for full frequency range; however, it may cause over current if you set this parameter too large.
   (2) If the output current is too large, decrease setting for Pr. E0-16 IM1 VF Torque Compensation Gain or increase setting for Pr. E0-17 IM1 VF Torque Compensation Filter, you can also adjust the VF curve if the motor loading capacity at this time is insufficient.
8. If the loading capacity at specific frequency is insufficient, adjust the VF curve manually to increase the output voltage corresponding to the specific frequency.

Pr.	Parameter Name	Pr.	Parameter Name
E0-03	IM1 VF Mid FREQ 5	E0-04	IM1 VF Mid Voltage 5
E0-05	IM1 VF Mid FREQ 4	E0-06	IM1 VF Mid Voltage 4
E0-07	IM1 VF Mid FREQ 3	E0-08	IM1 VF Mid Voltage 3
E0-09	IM1 VF Mid FREQ 3	E0-10	IM1 VF Mid Voltage 3
E0-11	IM1 VF Mid FREQ 1	E0-12	IM1 VF Mid Voltage 1

9. If there is too much difference between the output frequency and the frequency command, increase setting for Pr. E0-19 IM1 VF Slip Compensation Gain, you can also adjust the compensation response speed through Pr. E0-20 IM1 VF Slip Compensation Filter.

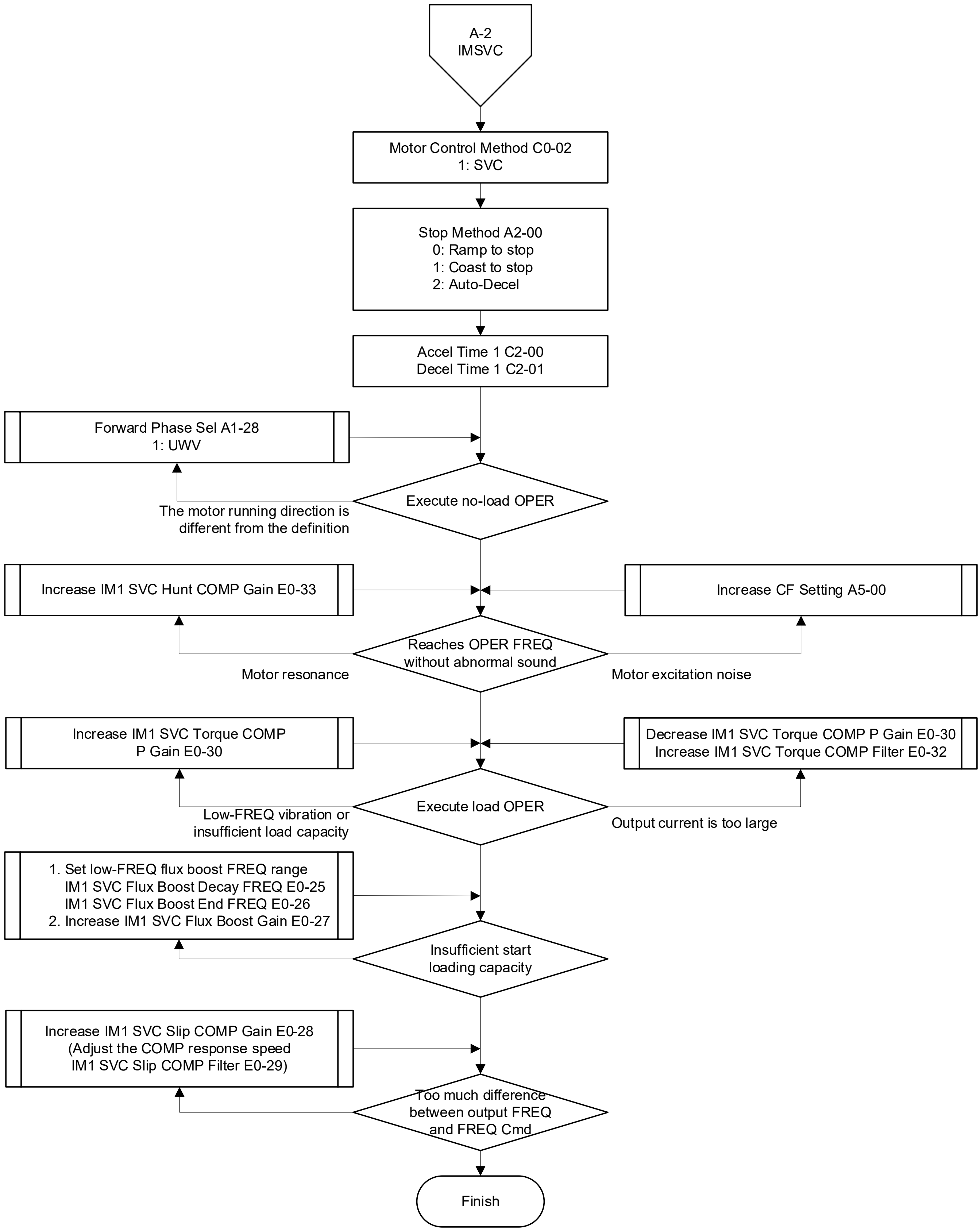
5-4-2 IMSVC

5-4-2-1 Control Diagram



5-4-2-2 Adjustment Flowchart

※ You need to complete A-0 IM Autotune first (refer to Section 5-3-2).



5-4-2-3 Adjustment Steps

※ You need to complete A-0 IM Autotune first (refer to Section 5-3-2).

1. Choose the motor control method.
   Set Pr. C0-02 = 1: SVC.
2. Setup stop method.

Pr.	Parameter Name	Settings
A2-00	Stop Method	0: Ramp to stop 1: Coast to stop 2: Auto-Decel

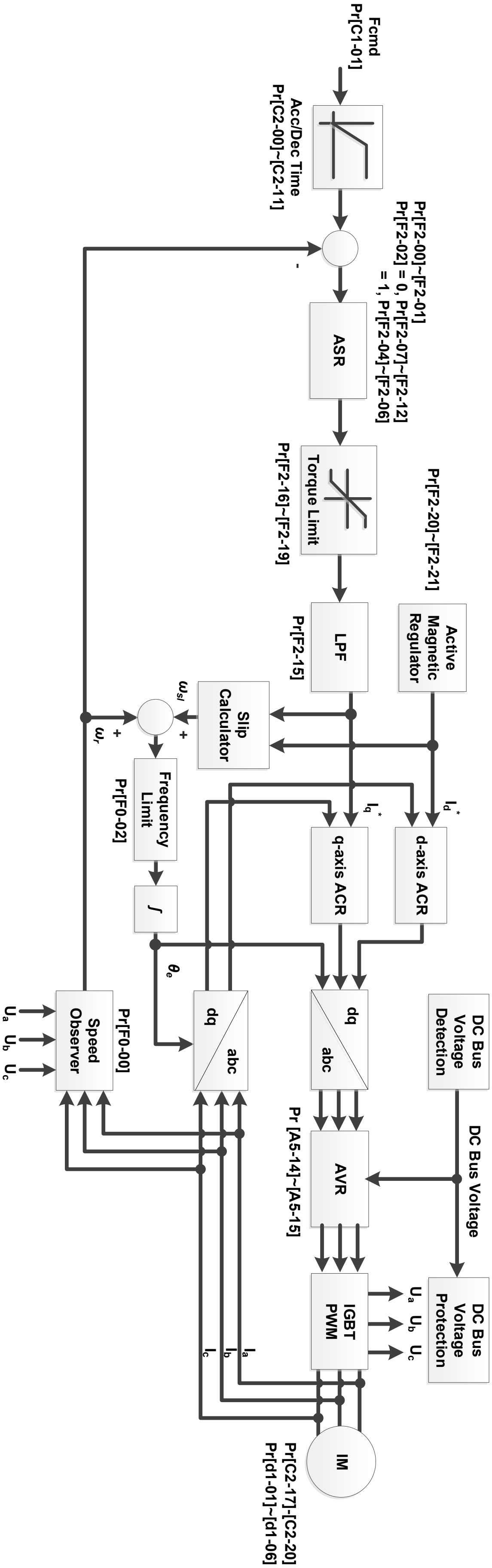
3. Set the acceleration and deceleration time

Pr.	Parameter Name
C2-00	Accel Time 1
C2-01	Decel Time 1

4. Execute no-load operation.
   If the motor operating direction is different from the definition, adjust Pr. A1-28 Forward Phase Selection = 1: UWV.
5. Check if the motor can operate to the operation frequency without abnormal sound.
   (1) If the motor resonates, increase setting for Pr. E0-33 IM1 SVC Hunt Compensation Gain.
   (2) If there is motor excitation noise, increase setting for Pr. A5-00 Carrier Frequency Setting.
6. Execute load operation.
   (1) If the motor vibrates in low-frequency or has insufficient loading capacity, increase setting for Pr. E0-30 IM1 SVC Torque Compensation P Gain to enhance the loading capacity for full frequency range; however, it may cause over current if you set this parameter too large.
   (2) If the output current is too large, decrease setting for Pr. E0-30 IM1 SVC Torque Compensation P Gain or increase setting for Pr. E0-32 IM1 SVC Torque Compensation Filter.
7. If the start loading capacity is insufficient, set the required low-frequency flux boost frequency range through Pr. E0-25 IM1 SVC Flux Boost Decay FREQ and Pr. E0-26 IM1 SVC Flux Boost End FREQ, and increase setting for Pr. E0-27 IM1 SVC Flux Boost Gain.
8. If there is too much difference between the output frequency and the frequency command, increase setting for Pr. E0-28 IM1 SVC Slip Compensation Gain, you can also adjust the compensation response speed through Pr. E0-29 IM1 SVC Slip Compensation Filter.

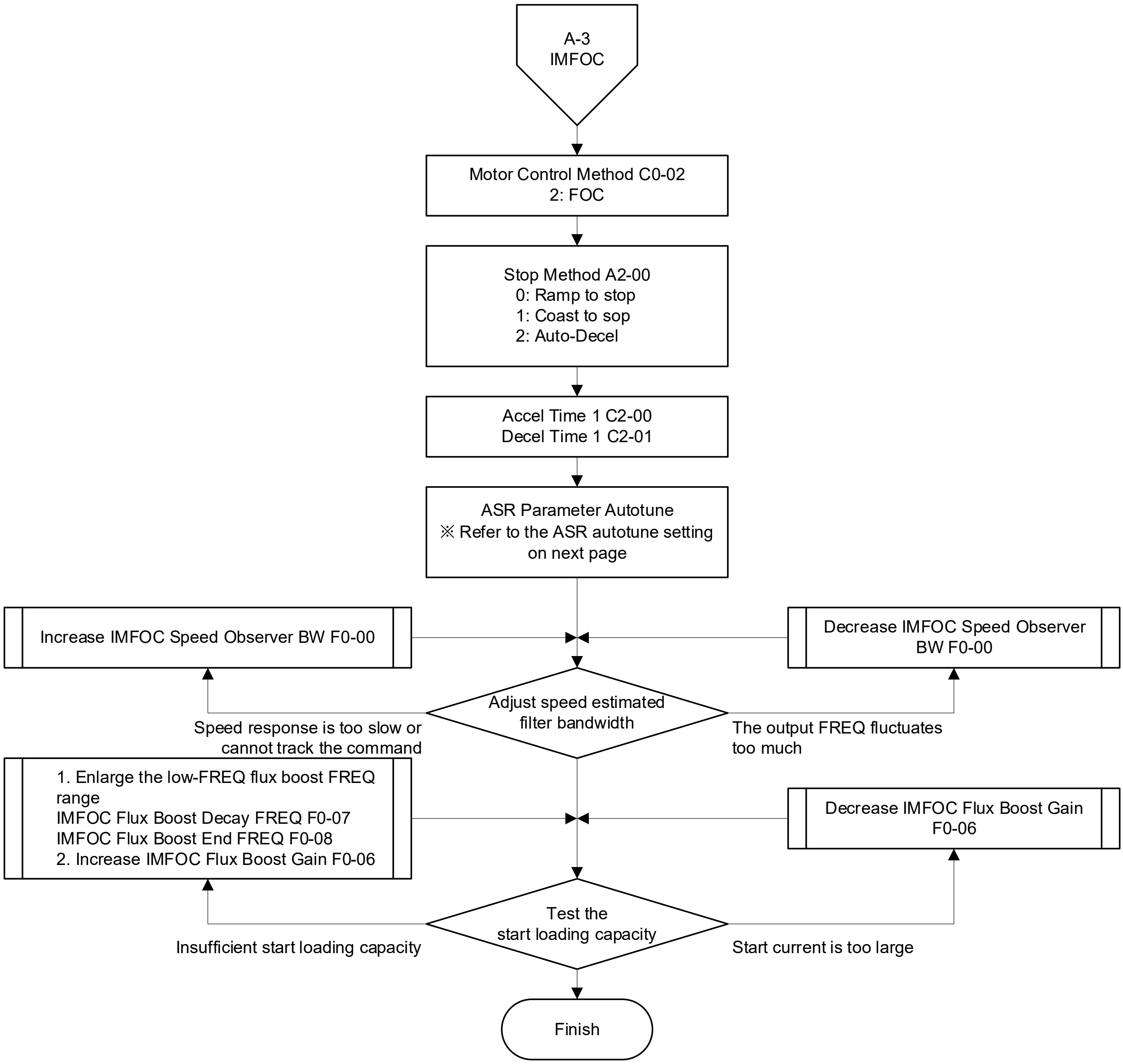
5-4-3 IMFOC

5-4-3-1 Control Diagram

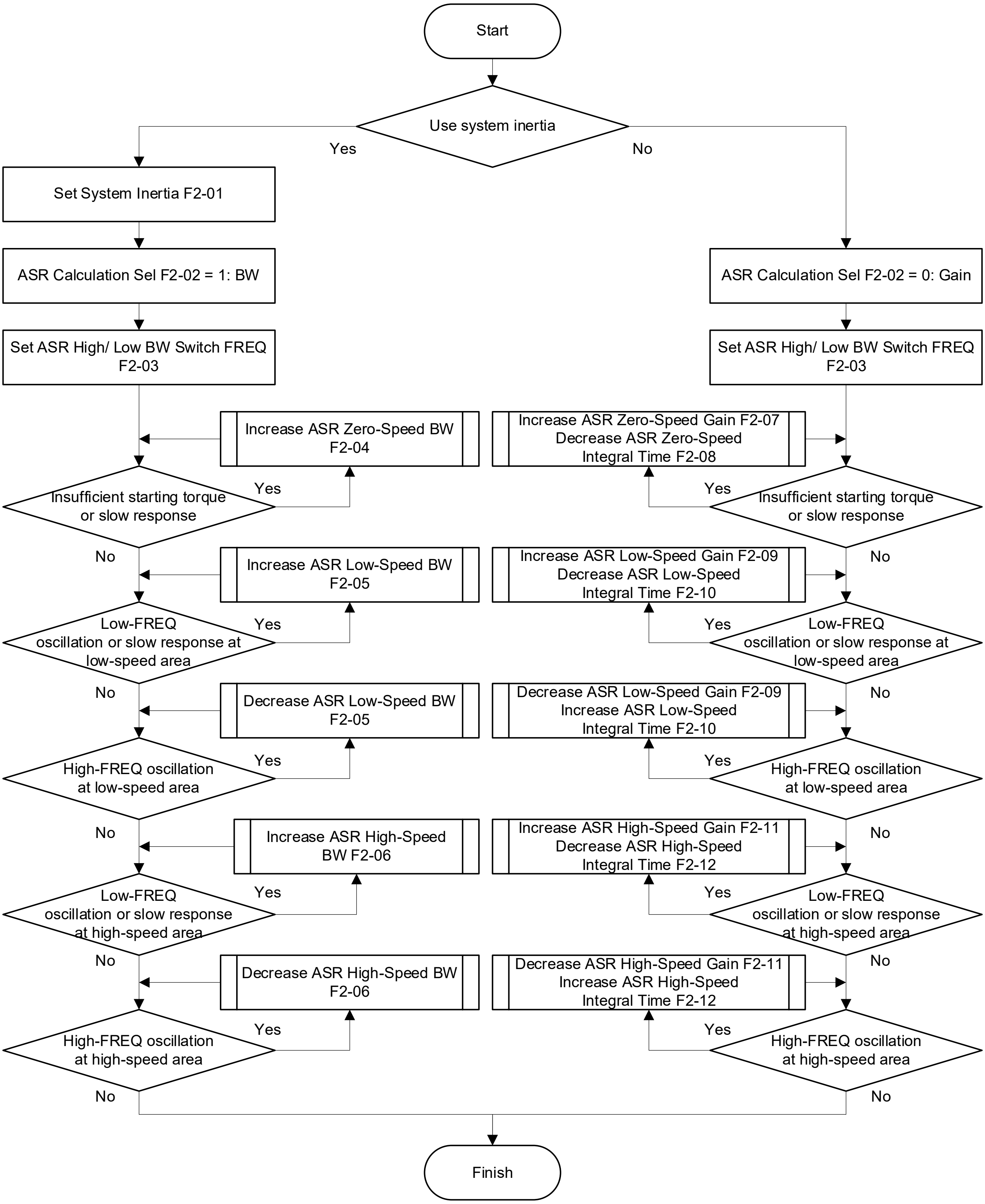


5-4-3-2 Adjustment Flowchart

※ You need to complete A-0 IM Autotune first (refer to Section 5-3-2).



- ASR Parameter Autotune



5-4-3-3 Adjustment Steps

※ You need to complete A-0 IM Autotune first (refer to Section 5-3-2).

1. Choose the motor control method.
   Set Pr. C0-02 = 2: FOC.
2. Setup stop method.

Pr.	Parameter Name	Settings
A2-00	Stop Method	0: Ramp to stop 1: Coast to stop 2: Auto-Decel

3. Set the acceleration and deceleration time

Pr.	Parameter Name
C2-00	Accel Time 1
C2-01	Decel Time 1

4. ASR Parameter Autotune
   A. Use system inertia and ASR bandwidth adjustment.
      (0) Set Pr. F2-01 System Inertia.
      (1) Set ASR Calculation Selection F2-02 = 1: Bandwidth.
      (2) Adjust the ASR high-speed and low-speed area through Pr. F2-03 ASR High/ Low BW Switch FREQ.
      (3) If the starting torque is insufficient or the speed response is slow, increase setting for Pr. F2-04 ASR Zero-Speed BW.
      (4) If the speed in the low-speed area oscillates at low frequency or responds slowly, increase setting for Pr. F2-05 ASR Low-Speed BW.
      (5) If the speed in the low-speed area oscillates at high frequency, decrease setting for Pr. F2-05 ASR Low-Speed BW.
      (6) If the speed in the high-speed area oscillates at low frequency or responds slowly, increase setting for Pr. F2-06 ASR High-Speed BW.
      (7) If the speed in the high-speed area oscillates at high frequency, decrease setting for Pr. F2-06 ASR High-Speed BW.
   B. Adjust ASR gain
      (1) Set ASR Calculation Selection F2-02 = 0: Gain.
      (2) Adjust the ASR high-speed and low-speed area through Pr. F2-03 ASR High/ Low BW Switch FREQ.
      (3) If the starting torque is insufficient or the speed response is slow, increase setting for Pr. F2-07 ASR Zero-Speed Gain or decrease setting for Pr. F2-08 ASR Zero-Speed Integral Time.
      (4) If the speed in the low-speed area oscillates at low frequency or responds slowly, increase setting for Pr. F2-09 ASR Low-Speed Gain or decrease setting for Pr. F2-10 ASR Low-Speed Integral Time.
      (5) If the speed in the low-speed area oscillates at high frequency, decrease setting for Pr. F2-09 ASR Low-Speed Gain or increase setting for Pr. F2-10 ASR Low-Speed

Integral Time.

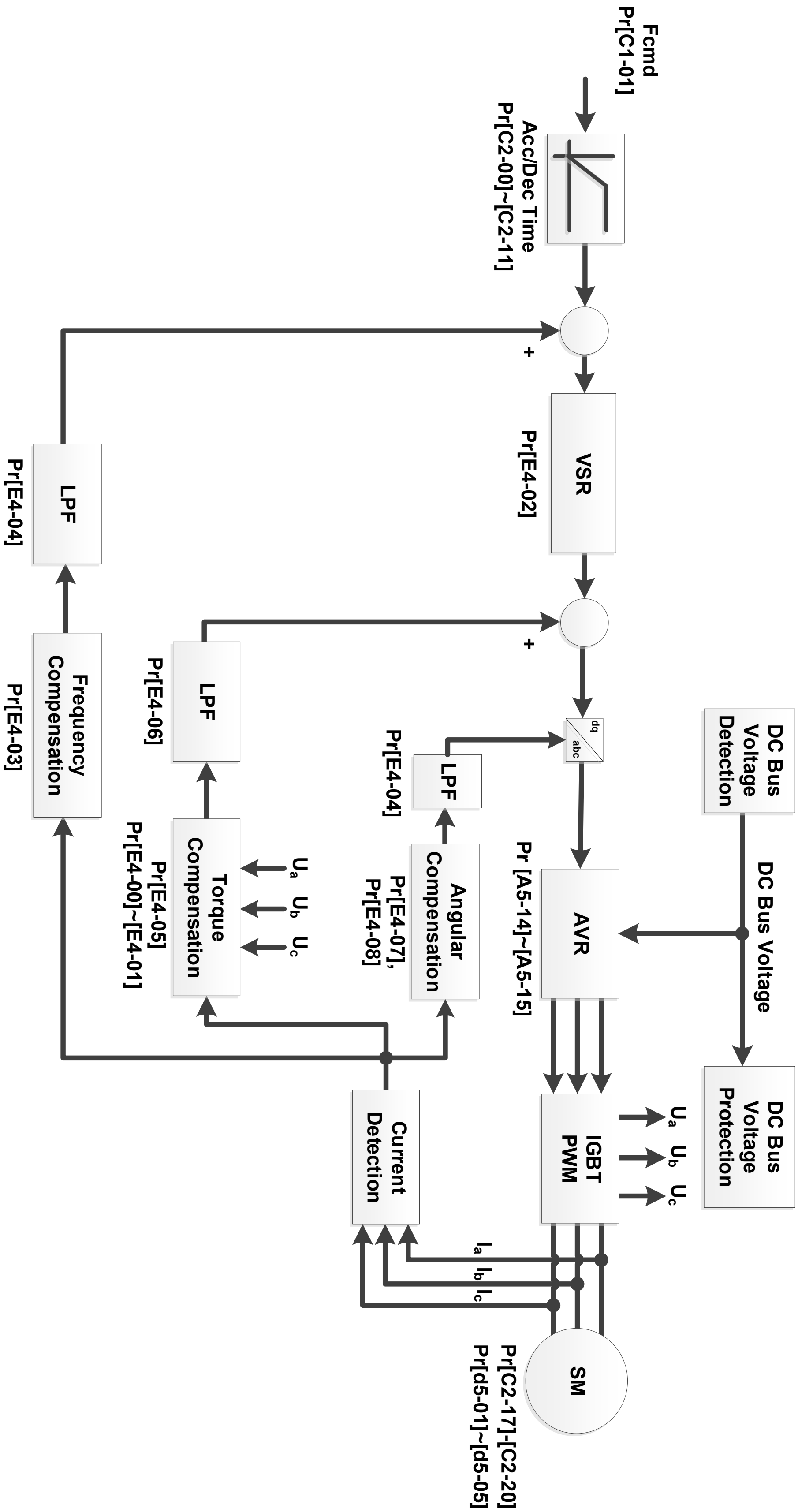
(6) If the speed in the high-speed area oscillates at low frequency or responds slowly, increase setting for Pr. F2-11 ASR High-Speed Gain or decrease setting for Pr. F2-12 ASR High-Speed Integral Time.

(7) If the speed in the high-speed area oscillates at high frequency, decrease setting for Pr. F2-11 ASR High-Speed Gain or increase setting for Pr. F2-12 ASR High-Speed Integral Time.

5. Adjust speed observer filter bandwidth.
   (1) If the speed response is too slow or the frequency command cannot be tracked, increase setting for Pr. F0-00 IMFOC Speed Observer BW.
   (2) If the output frequency fluctuates too much, decrease setting for Pr. F0-00 IMFOC Speed Observer BW.
6. Test the start loading capacity.
   (1) If the motor start loading capacity is insufficient, enlarge low-frequency flux boost frequency range through Pr. F0-07 IMFOC Flux Boost Decay FREQ and Pr. F0-08 IMFOC Flux Boost End FREQ, and increase setting for Pr. F0-06 IMFOC Flux Boost Gain.
   (2) If the motor start current is too large, decrease setting for Pr. F0-06 IMFOC Flux Boost Gain.

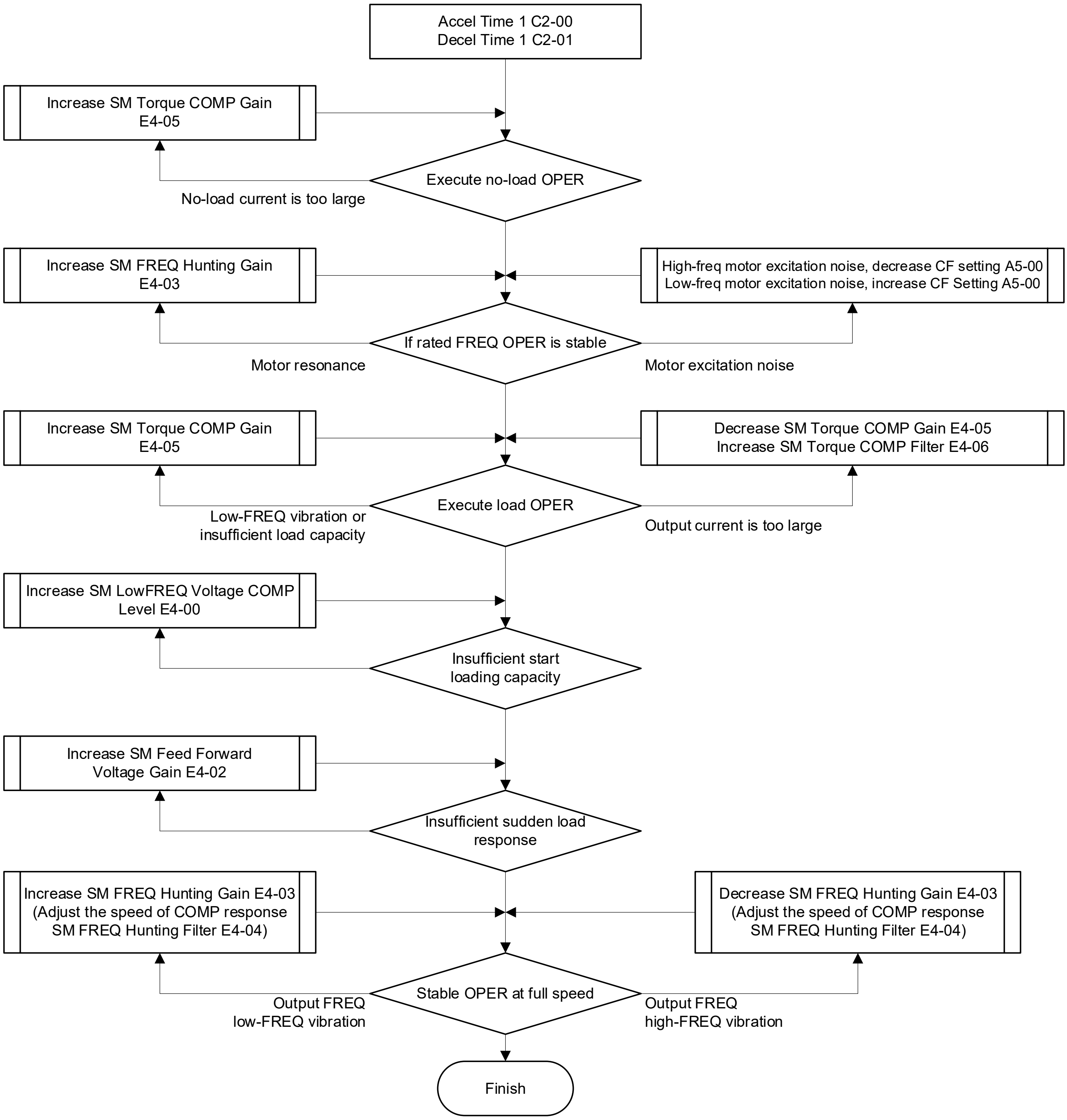
5-4-4 SMSVC

5-4-4-1 Control Diagram



5-4-4-2 Adjustment Flowchart

※ You need to complete B-0 SM Autotune first (refer to Section 5-3-3).


Accel Time 1 C2-00
Decel Time 1 C2-01
Increase SM Torque COMP Gain E4-05
Execute no-load OPER
No-load current is too large
Increase SM FREQ Hunting Gain E4-03
High-freq motor excitation noise, decrease CF setting A5-00
Low-freq motor excitation noise, increase CF Setting A5-00
If rated FREQ OPER is stable
Motor resonance
Motor excitation noise
Increase SM Torque COMP Gain E4-05
Decrease SM Torque COMP Gain E4-05
Increase SM Torque COMP Filter E4-06
Execute load OPER
Low-FREQ vibration or insufficient load capacity
Output current is too large
Increase SM LowFREQ Voltage COMP Level E4-00
Insufficient start loading capacity
Increase SM Feed Forward Voltage Gain E4-02
Insufficient sudden load response
Increase SM FREQ Hunting Gain E4-03
(Adjust the speed of COMP response
SM FREQ Hunting Filter E4-04)
Decrease SM FREQ Hunting Gain E4-03
(Adjust the speed of COMP response
SM FREQ Hunting Filter E4-04)
Stable OPER at full speed
Output FREQ low-FREQ vibration
Output FREQ high-FREQ vibration
Finish

5-4-4-3 Adjustment Steps

※ You need to complete B-0 SM Autotune first (refer to Section 5-3-3).

1. Choose the motor control method.
   Set Pr. C0-02 = 1: SVC.
2. Select the SM rotor initial detection method.
   (1) If the mechanism or process allows reversal, set Pr. A3-17 = 1: Force alignment.
   If the alignment force at start is insufficient, increase setting for Pr. A3-18 Force Alignment Current Value; if the alignment current is too large, decrease setting for Pr. A3-18 Force Alignment Current Value.
   (2) If the motor is SPM and the system does not allow reversal, set Pr. A3-17 = 2: Pulse inject.
   If the operation direction at start is incorrect, increase setting for Pr. A3-20 Pulse Inject Current Threshold; if the start current is too large or causes ocA, decrease setting for Pr. A3-20 Pulse Inject Current Threshold.
   (3) If the motor is IPM, PMA and SynRM and the system does not allow reversal, set Pr. A3-17 = 3: HFI.
   If the operation direction at start is incorrect, increase setting for Pr. A3-22 HFI Amplitude; if there is evidence of electromagnetic noise, decrease setting for Pr. A3-22 HFI Amplitude.
3. Setup stop method.

Pr.	Parameter Name	Settings
A2-00	Stop Method	0: Ramp to stop 1: Coast to stop 2: Auto-Decel

4. Set the acceleration and deceleration time

Pr.	Parameter Name
C2-00	Accel Time 1
C2-01	Decel Time 1

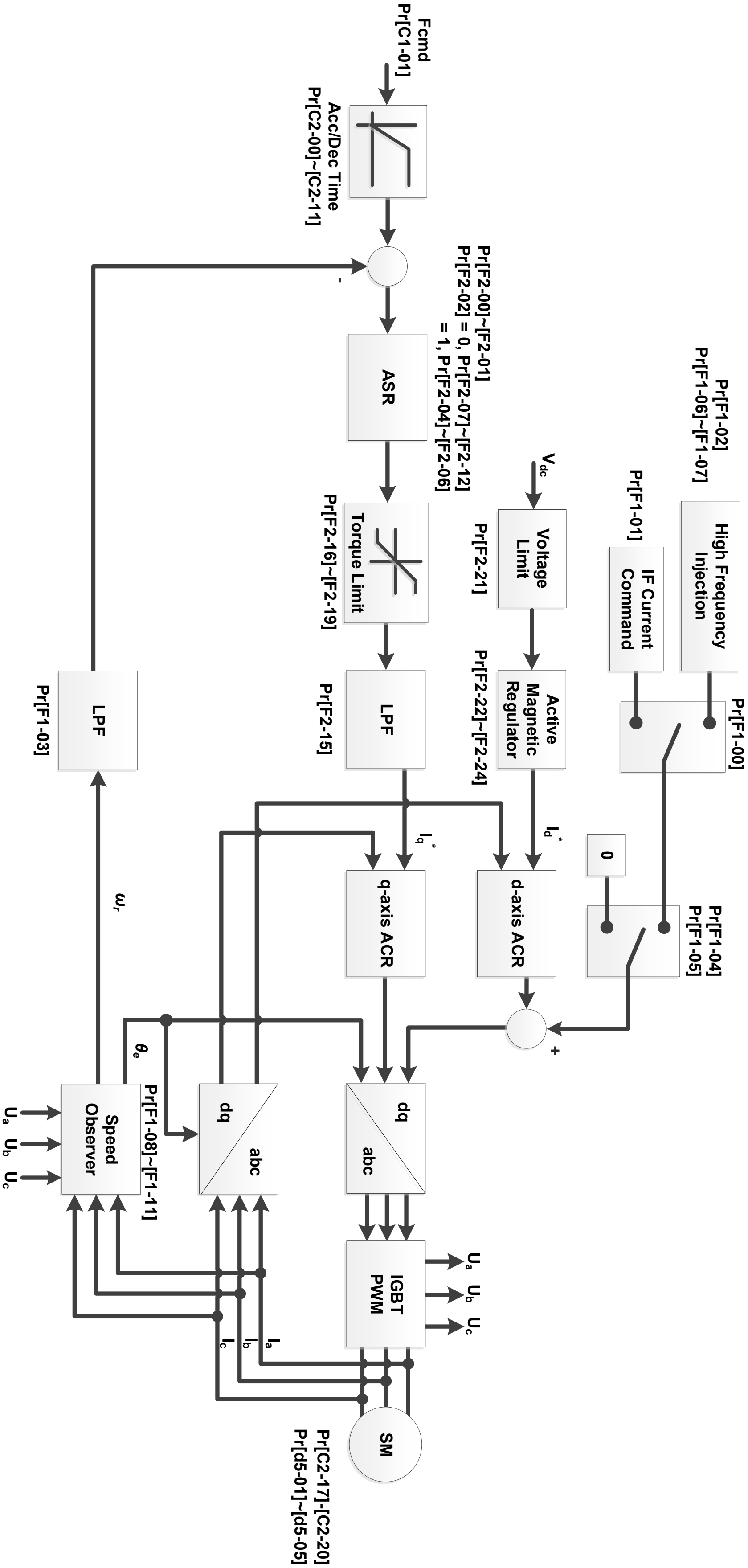
5. Execute no-load operation.
   If the no-load current is too large, increase setting for Pr. E4-05 SM Torque COMP Gain.
6. Check if the motor rated frequency operates stably.
   (1) If the motor resonates, increase setting for Pr. E4-03 SM FREQ Hunting Gain.
   (2) If there is high-frequency motor excitation noise, decrease setting for Pr. A5-00 Carrier Frequency Setting.
   If there is low-frequency motor excitation noise, increase setting for Pr. A5-00 Carrier Frequency Setting.
7. Execute load operation.
   (1) If the motor vibrates in low-frequency or has insufficient loading capacity, increase setting for Pr. E4-05 SM Torque COMP Gain to enhance the loading capacity for full frequency range; however, it may cause over current if you set this parameter too large.
   (2) If the output current is too large, decrease setting for Pr. E4-05 SM Torque COMP Gain

or increase setting for Pr. E4-06 SM Torque COMP Filter.

8. If the start loading capacity is insufficient, increase setting for Pr. E4-00 SM LowFREQ Voltage COMP Level.
9. If the response of sudden load is insufficient, increase setting for Pr. E4-02 SM Feed Forward Voltage Gain.
10. Check if the operation is stable at full speed.
    (1) If the motor output frequency oscillates at low-frequency, increase setting for Pr. E4-03 SM FREQ Hunting Gain, you can also adjust the compensation response speed through Pr. E4-04 SM FREQ Hunting Filter.
    (2) If the motor output frequency oscillates at high-frequency, decrease setting for Pr. E4-03 SM FREQ Hunting Gain, you can also adjust the compensation response speed through Pr. E4-04 SM FREQ Hunting Filter.

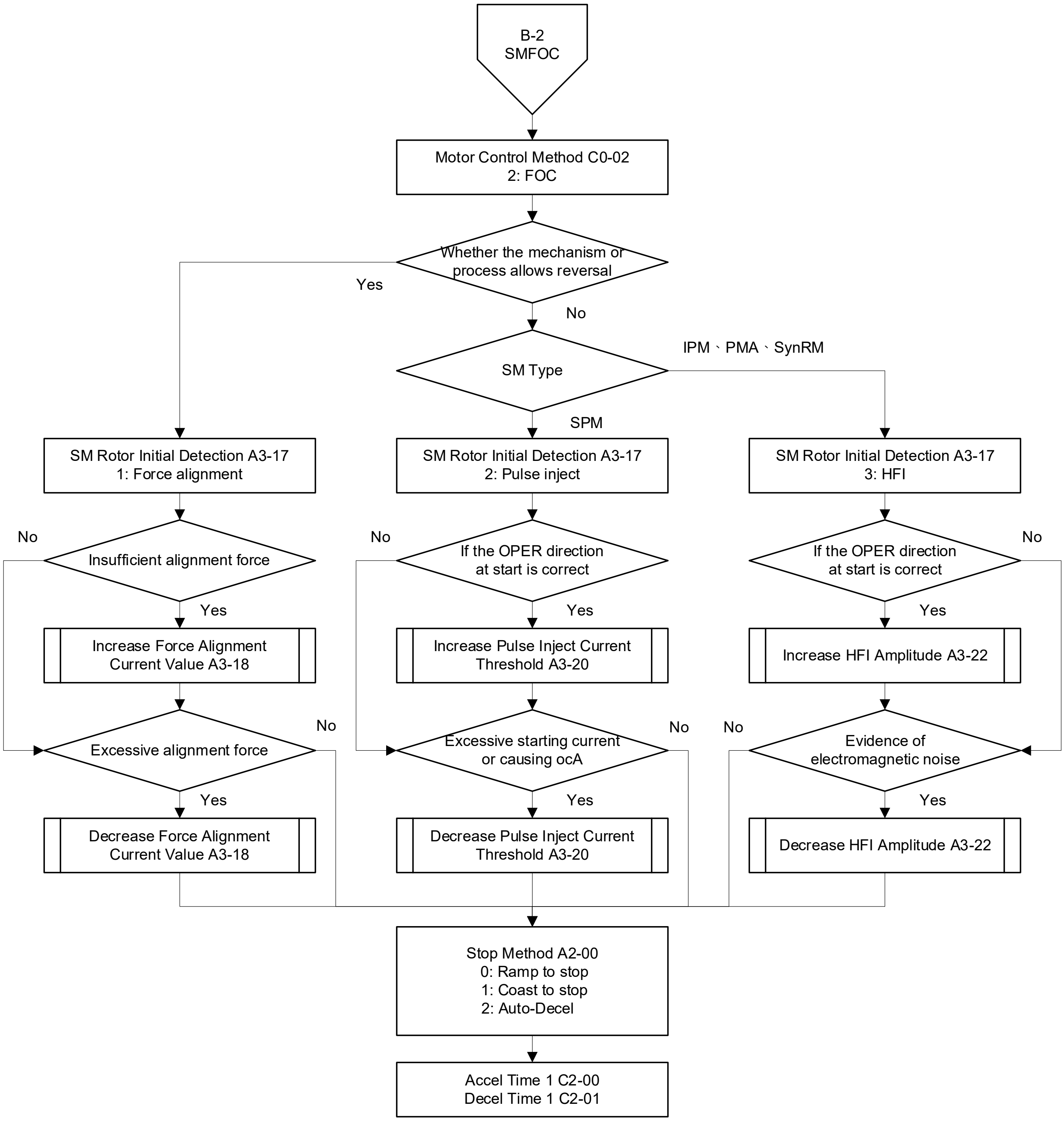
5-4-5 SMFOC

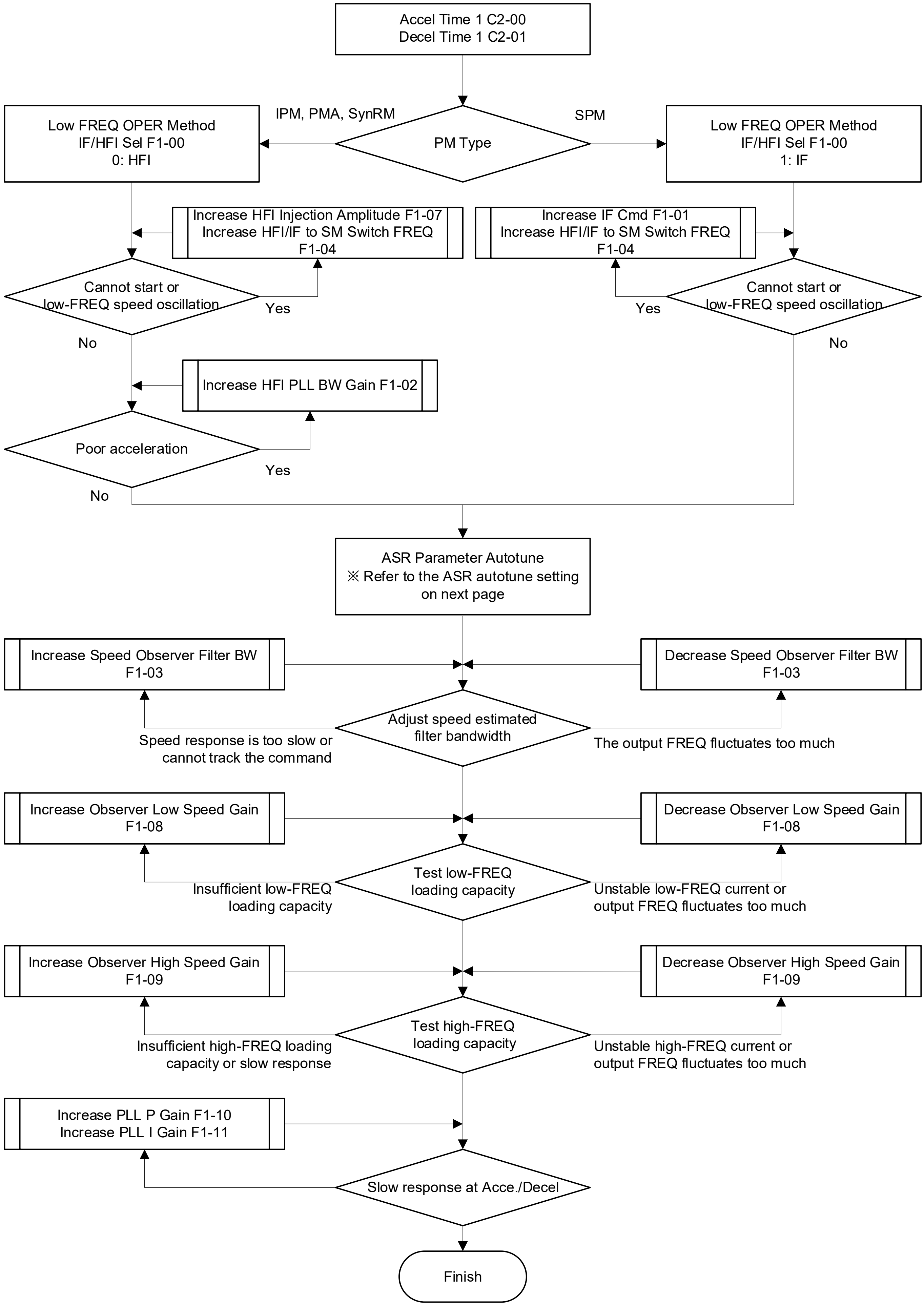
5-4-5-1 Control Diagram



5-4-5-2 Adjustment Flowchart

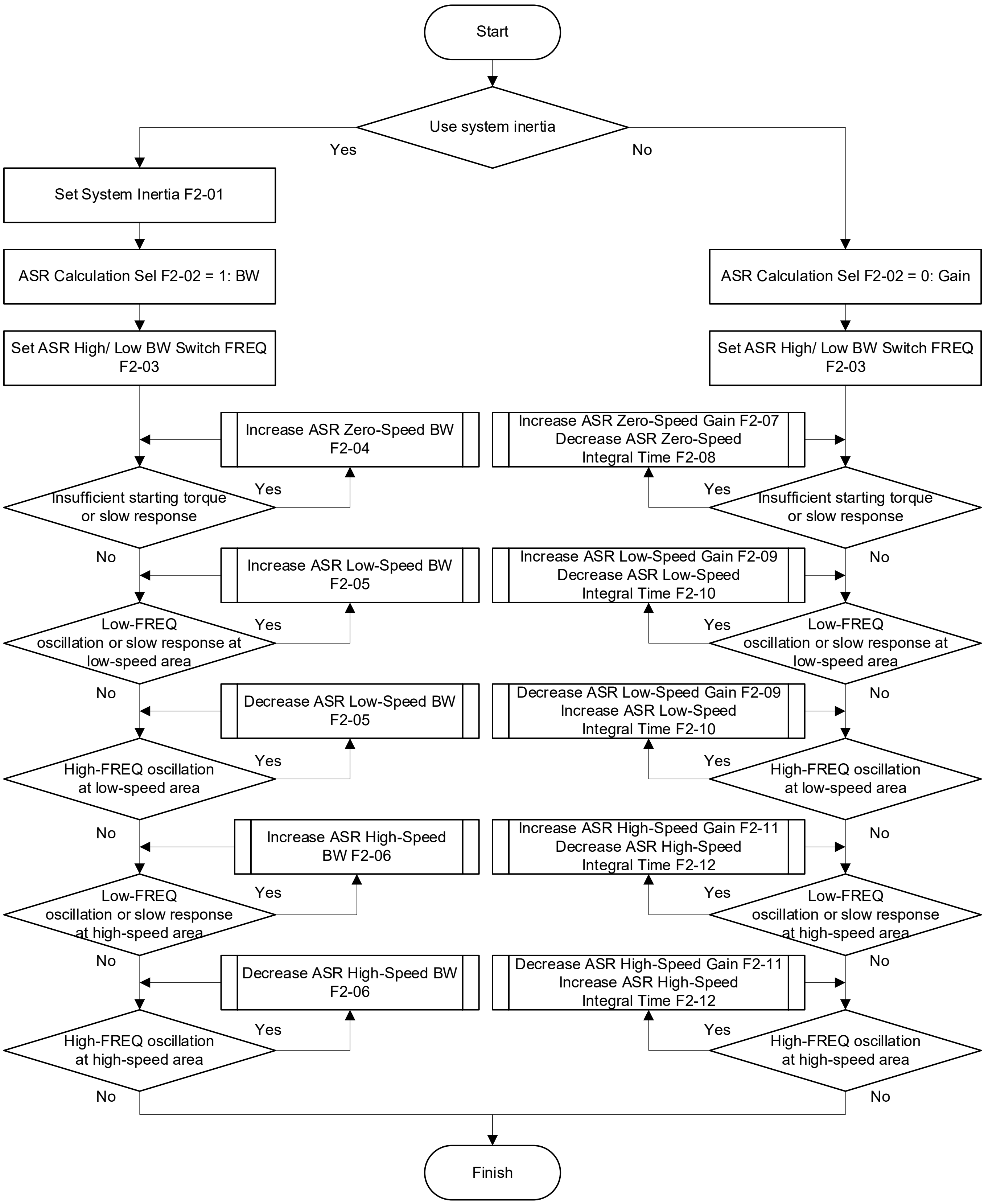
※ You need to complete B-0 SM Autotune first (refer to Section 5-3-3).





Accel Time 1 C2-00
Decel Time 1 C2-01
PM Type
IPM, PMA, SynRM
SPM
Low FREQ OPER Method
IF/HFI Sel F1-00
0: HFI
Low FREQ OPER Method
IF/HFI Sel F1-00
1: IF
Increase HFI Injection Amplitude F1-07
Increase HFI/IF to SM Switch FREQ
F1-04
Increase IF Cmd F1-01
Increase HFI/IF to SM Switch FREQ
F1-04
Cannot start or
low-FREQ speed oscillation
Yes
No
Cannot start or
low-FREQ speed oscillation
Yes
No
Increase HFI PLL BW Gain F1-02
Poor acceleration
Yes
No
ASR Parameter Autotune
※ Refer to the ASR autotune setting
on next page
Increase Speed Observer Filter BW
F1-03
Decrease Speed Observer Filter BW
F1-03
Adjust speed estimated
filter bandwidth
Speed response is too slow or
cannot track the command
The output FREQ fluctuates too much
Increase Observer Low Speed Gain
F1-08
Decrease Observer Low Speed Gain
F1-08
Test low-FREQ
loading capacity
Insufficient low-FREQ
loading capacity
Unstable low-FREQ current or
output FREQ fluctuates too much
Increase Observer High Speed Gain
F1-09
Decrease Observer High Speed Gain
F1-09
Test high-FREQ
loading capacity
Insufficient high-FREQ loading
capacity or slow response
Unstable high-FREQ current or
output FREQ fluctuates too much
Increase PLL P Gain F1-10
Increase PLL I Gain F1-11
Slow response at Acce./Decel
Finish

- ASR Parameter Autotune



5-4-5-3 Adjustment Steps

※ You need to complete B-0 SM Autotune first (refer to Section 5-3-3).

1. Choose the motor control method.
   Set Pr. C0-02 = 2: FOC.
2. Select the SM rotor initial detection method.
   (1) If the mechanism or process allows reversal, set Pr. A3-17 = 1: Force alignment.
   If the alignment force at start is insufficient, increase setting for Pr. A3-18 Force Alignment Current Value; if the alignment current is too large, decrease setting for Pr. A3-18 Force Alignment Current Value.
   (2) If the motor is SPM and the system does not allow reversal, set Pr. A3-17 = 2: Pulse inject.
   If the operation direction at start is incorrect, increase setting for Pr. A3-20 Pulse Inject Current Threshold; if the start current is too large or causes ocA, decrease setting for Pr. A3-20 Pulse Inject Current Threshold.
   (3) If the motor is IPM, PMA and SynRM and the system does not allow reversal, set Pr. A3-17 = 3: HFI.
   If the operation direction at start is incorrect, increase setting for Pr. A3-22 HFI Amplitude; if there is evidence of electromagnetic noise, decrease setting for Pr. A3-22 HFI Amplitude.
3. Setup stop method.

Pr.	Parameter Name	Settings
A2-00	Stop Method	0: Ramp to stop 1: Coast to stop 2: Auto-Decel

4. Set the acceleration and deceleration time

Pr.	Parameter Name
C2-00	Accel Time 1
C2-01	Decel Time 1

5. Select operation method at low-frequency.
   (1) If the motor is IPM, PMA and SynRM, set Pr. F1-00 IF/ HFI Selection = 0: HFI.
      a. If the motor cannot be started or the speed oscillates at low-frequency, increase setting for Pr. F1-07 HFI Injection Amplitude or increase setting for Pr. F1-04 IF/HFI to SM Switch FREQ.
      b. If the acceleration is poor, increase setting for Pr. F1-02 HFI PLL BW Gain.
   (2) If the motor is SPM, set Pr. F1-00 IF/ HFI Selection = 1: IF.
      a. If the motor cannot be started or the speed oscillates at low-frequency, increase setting for Pr. F1-01 IF Command or increase setting for Pr. F1-04 IF/HFI to SM Switch FREQ.
6. ASR Parameter Autotune
   A. Use system inertia and ASR bandwidth adjustment.
      (0) Set Pr. F2-01 System Inertia.

(1) Set ASR Calculation Selection F2-02 = 1: Bandwidth.
(2) Adjust the ASR high-speed and low-speed area through Pr. F2-03 ASR High/ Low BW Switch FREQ.
(3) If the starting torque is insufficient or the speed response is slow, increase setting for Pr. F2-04 ASR Zero-Speed BW.
(4) If the speed in the low-speed area oscillates at low frequency or responds slowly, increase setting for Pr. F2-05 ASR Low-Speed BW.
(5) If the speed in the low-speed area oscillates at high frequency, decrease setting for Pr. F2-05 ASR Low-Speed BW.
(6) If the speed in the high-speed area oscillates at low frequency or responds slowly, increase setting for Pr. F2-06 ASR High-Speed BW.
(7) If the speed in the high-speed area oscillates at high frequency, decrease setting for Pr. F2-06 ASR High-Speed BW.

B. Adjust ASR gain

(1) Set ASR Calculation Selection F2-02 = 0: Gain.
(2) Adjust the ASR high-speed and low-speed area through Pr. F2-03 ASR High/ Low BW Switch FREQ.
(3) If the starting torque is insufficient or the speed response is slow, increase setting for Pr. F2-07 ASR Zero-Speed Gain or decrease setting for Pr. F2-08 ASR Zero-Speed Integral Time.
(4) If the speed in the low-speed area oscillates at low frequency or responds slowly, increase setting for Pr. F2-09 ASR Low-Speed Gain or decrease setting for Pr. F2-10 ASR Low-Speed Integral Time.
(5) If the speed in the low-speed area oscillates at high frequency, decrease setting for Pr. F2-09 ASR Low-Speed Gain or increase setting for Pr. F2-10 ASR Low-Speed Integral Time.
(6) If the speed in the high-speed area oscillates at low frequency or responds slowly, increase setting for Pr. F2-11 ASR High-Speed Gain or decrease setting for Pr. F2-12 ASR High-Speed Integral Time.
(7) If the speed in the high-speed area oscillates at high frequency, decrease setting for Pr. F2-11 ASR High-Speed Gain or increase setting for Pr. F2-12 ASR High-Speed Integral Time.

7. Adjust speed observer filter bandwidth.

(1) If the speed response is too slow or the frequency command cannot be tracked, increase setting for Pr. F1-03 Speed Observer Filter BW.
(2) If the output frequency fluctuates too much, decrease setting for Pr. F1-03 Speed Observer Filter BW.

8. Test loading capacity at low-frequency.

(1) If the loading capacity at low-frequency is insufficient, increase setting for Pr. F1-08 Observer Low Speed Gain.
(2) If the low-frequency current is unstable or the output frequency fluctuates too much, decrease setting for Pr. F1-08 Observer Low Speed Gain.

9. Test loading capacity at high-frequency.
   (1) If the loading capacity at high-frequency is insufficient or the response is slow, increase setting for Pr. F1-09 Observer High Speed Gain.
   (2) If the high-frequency current is unstable or the output frequency fluctuates too much, decrease setting for Pr. F1-09 Observer High Speed Gain.
10. If the response is slow during acceleration and deceleration, increase setting for Pr. F1-10 PLL P Gain or Pr. F1-11 PLL I Gain.

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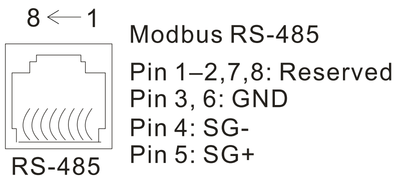
Chapter 6 Drive Communication Network

6-1 Modbus Communication

6-1-1 Specification

Item		Specifications
Interface		RS-485
Sync Method		Asynchronous
Communication Parameters	Transmission Speed	4.8, 9.6, 19.2, 38.4, 57.6, 78, 115.2 Kbps
	Data length	7-bit, 8-bit
	Calibration	Even number (E), Odd number (O), None (N)
	Stop bit	1-bit, 2-bit
Communication Protocol		Modbus RTU/ ASCII
Number of Connected Drives		Up to 31 drives

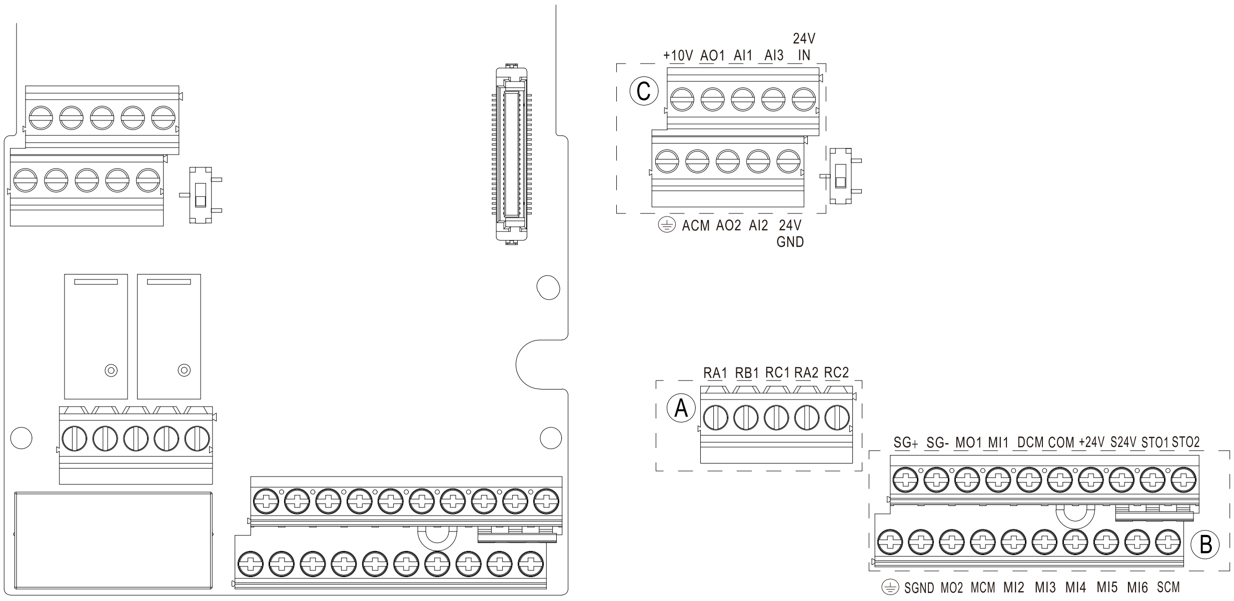
- When using the communication interface, the diagram on the right shows the communication port pin definitions. We recommend that you connect the AC motor drive to your PC by using Delta IFD6530 or IFD6500 as a communication converter. Refer to the RJ45 terminal on Section 3-4-1 Wiring for details of the communication port on the right.



- Default communication format of the port:
  1. Modbus ASCII mode
  2. 9600 bps transmission speed
  3. 7 data bits
  4. No calibration (NONE)
  5. 2 stop bits
- Modbus ASCII (American Standard Code for Information Interchange): Each byte of data is the combination of two ASCII characters. For example, one byte of data: 64 Hex, shown as ‘64’ in ASCII, consists of ‘6’ (36Hex) and ‘4’ (34Hex).

6-1-2 Wiring Configuration

Drive Communication Port

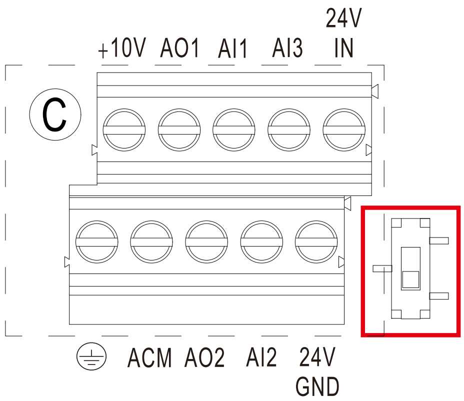


There are two ways of wiring:

1. Connect with RJ45 connector.
2. Use terminal SG+, SG- and SGND.

Terminal Resistor Setting

When using Modbus communication, the terminal equipment needs to be connected to a terminal resistor. You can use the built-in terminal resistor on the control board by switching the dip switch to the bottom (120).



Slave Mode	Master Mode
	

6-1-3 Related Parameters

Modbus

NOTE: means that you can set this parameter during operation.

Pr.	Comm. Address	Parameter Name	Description	Default
n0-00	0x1540	RS-485 COM Port Protocol Sel	Defines RS-485 communication port protocol selection 0: Modbus Slave 1: Modbus Master 2: BACnet MS/TP	0
n1-01	0x1581	Modbus Address	Defines the Modbus communication address 1–254	1
n1-02	0x1582	Modbus COM Baud Rate	Defines the Modbus transmission speed (Baud Rate). 0: 4.8 Kbps 1: 9.6 Kbps 2: 19.2 Kbps 3: 38.4 Kbps 4: 57.6 Kbps 5: 76.8 Kbps 6: 115.2 Kbps	1
n1-03	0x1583	Modbus Package Format	Defines the Modbus communication format 0: 7, N, 2 (ASCII) 1: 7, E, 1 (ASCII) 2: 7, O, 1 (ASCII) 3: 7, E, 2 (ASCII) 4: 7, O, 2 (ASCII) 5: 8, N, 1 (ASCII) 6: 8, N, 2 (ASCII) 7: 8, E, 1 (ASCII) 8: 8, O, 1 (ASCII) 9: 8, E, 2 (ASCII) 10: 8, O, 2 (ASCII) 11: 8, N, 1 (RTU) 12: 8, N, 2 (RTU) 13: 8, E, 1 (RTU) 14: 8, O, 1 (RTU) 15: 8, E, 2 (RTU) 16: 8, O, 2 (RTU)	0

	Pr.	Comm. Address	Parameter Name	Description	Default
✎	n1-04	0x1584	Modbus Timeout Check Time	Defines communication timeout when the drive does not receive any signal in the setting time. Set the timeout check time as 0 sec. to disable the timeout detection. 0.0–100.0 sec.	0.0
✎	n1-05	0x1585	Modbus Timeout Disposal	Defines the drive treatment after communication timeout when the control command source or the frequency command source is Modbus. 0: Continue OPER 1: Warning & continue OPER 2: Fault & ramp to stop 3: Fault & coast to stop	0
✎	n1-06	0x1586	Modbus Response Delay Time	Defines the delay time of the drive responding to the upper Modbus package. 0.0–200.0 ms	2.0
✎	n1-07	0x1587	Modbus MO Mask	0: Disable 1: Enable bit0–1: Relay1–2 bit2–3: MO1–MO2 bit4–8: Reserve bit9–14: MO10–MO15	0
✎	n1-08	0x1588	Modbus AO Mask	0: Disable 1: Enable bit0–1: AO1–2 bit2–3: Reserve bit4–5: AO10–AO11	0
	n1-09	0x1589	Modbus Master Target Selection	0: None 1: InnerPLC 2: D2D	0

Code Description

The communication protocol is in hexadecimal, ASCII: ”0”…“9”, “A”…“F”, every hexadecimal value represents an 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

1. Communication Data Frame

ASCII mode:

STX	Start character = ‘ : ’ (3AH)
Address High	Communication address: one 8-bit address consists of 2 ASCII codes
Address Low	
Function High	Command code: one 8-bit command consists of 2 ASCII codes
Function Low	
DATA (n-1)	Contents of data: n x 8-bit data consists of 2n ASCII codes n ≤ 16, maximum of 32 ASCII codes (20 sets of data)
…….	
DATA 0	
LRC Check High	LRC checksum: one 8-bit checksum consists of 2 ASCII codes
LRC Check Low	
END High	End characters: END High = CR (0DH), END Low = LF (0AH)
END Low	

RTU mode:

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

2. Communication Address (Address)

00H: Broadcast to all AC motor drives

01H: AC motor drive at address 01

0FH: AC motor drive at address 15

10H: AC motor drive at address 16, and so on, up to address 254 (FEH)

Function code (Function)

Command code:	Functions
03H	Read data from register
06H	Write single register
10H	Write continuous multiple data (can write at most 20 sets of data simultaneously).

3. 03H: Read data from register

Example: Reading two continuous data from register address 2102H. AMD address is 01H.

ASCII mode:

Command Message

STX	‘:’
Address (station)	‘0’
	‘1’
Function	‘0’
	‘3’
Starting register (address)	‘2’
	‘1’
	‘0’
	‘2’
Number of register (count by word)	‘0’
	‘0’
	‘0’
	‘2’
LRC Check	‘D’
	‘7’
END	CR
	LF

Response Message

STX	‘:’
Address	‘0’
	‘1’
Function	‘0’
	‘3’
Number of register (count by byte)	‘0’
	‘4’
Content of starting register 2102H	‘1’
	‘7’
	‘7’
	‘0’
Content of register 2103H	‘0’
	‘0’
	‘0’
	‘0’
LRC Check	‘7’
	‘1’
END	CR
	LF

RTU mode:

Command Message

Address	01H
Function	03H
Starting data register	21H
	02H
Number of register (count by word)	00H
	02H
CRC Check Low	6FH
CRC Check High	F7H

Response Message

Address	01H
Function	03H
Number of register (count by byte)	04H
Content of register address 2102H	17H
	70H
Content of register address 2103H	00H
	00H
CRC Check Low	FEH
CRC Check High	5CH

4. Function code 06H: Write single register

Example: Writing data 6000 (1770H) to register 0100H. AMD address is 01H.

ASCII mode:

Command Message

STX	‘:’
Address	‘0’
	‘1’
Function	‘0’
	‘6’
Target register	‘0’
	‘1’
	‘0’
	‘0’
Register content	‘1’
	‘7’
	‘7’
	‘0’
LRC Check	‘7’
	‘1’
END	CR
	LF

Response Message

STX	‘:’
Address	‘0’
	‘1’
Function	‘0’
	‘6’
Target register	‘0’
	‘1’
	‘0’
	‘0’
Register content	‘1’
	‘7’
	‘7’
	‘0’
LRC Check	‘7’
	‘1’
END	CR
	LF

RTU mode:

Command Message

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

Response Message

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

5. Command code: 10H, write continuous multiple data (can write at most 20 sets of data simultaneously).

   For example: change the drive (address 01H) multi-speed Pr. C1-23 = 50.00 (1388H), Pr. C1-24 = 40.00 (0FA0H).

   ASCII mode:

Command Message

STX	‘:’
ADR 1 ADR 0	‘0’
	‘1’
CMD 1	‘1’
CMD 0	‘0’
Target register	‘0’
	‘4’
	‘5’
	‘7’
Number of register (count by word)	‘0’
	‘0’
	‘0’
	‘2’
Number of register (count by byte)	‘0’
	‘4’
The first data content	‘1’
	‘3’
	‘8’
	‘8’
The second data content	‘0’
	‘F’
	‘A’
	‘0’
LRC Check	‘4’
	‘4’
END	CR
	LF

Response Message

STX	‘:’
ADR 1 ADR 0	‘0’
	‘1’
CMD 1	‘1’
CMD 0	‘0’
Target register	‘0’
	‘4’
	‘5’
	‘7’
Number of register (count by word)	‘0’
	‘0’
	‘0’
	‘2’
LRC Check	‘9’
	‘2’
END	CR
	LF

RTU mode:

Command Message

ADR	01H
CMD	10H
Target register	04H
	57H
Number of register (count by word)	00H
	02H
Quantity of data (byte)	04H
The first data content	13H
	88H
The second data content	0FH
	A0H
CRC Check Low	04H
CRC Check High	93H

Response Message

ADR	01H
CMD	10H
Target register	04H
	57H
Number of register (count by word)	00H
	02H
CRC Check Low	F1H
CRC Check High	28H

6. ASCII mode (LRC Check):

LRC (Longitudinal Redundancy Check) is calculated by summing up the values of the bytes from ADR1 to the 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, take complementary number of 2 = D7H

RTU mode (CRC Check):

CRC check is from Address to Data content. It 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, and put the result in the CRC register.

Step 3: Examine the LSB of CRC register.

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

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

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

6-1-4 Address list

1. ASCII

(1) Read one or multiple parameters: 3Ah (start word ':') + 30h 31h (station 01) + 30h 33h (function code 03h) + 30h 30h xxh xxh – 32h 36h xxh xxh (Modbus address 00xxh–26xxh) + xxh xxh xxh xxh (read data length 1) + LRC (checksum) + CR/LF

(2) Write in one parameter: 3Ah (start word ':') + 30h 31h (station 01) + 30h 36h (function code 06h) + 30h 30h xxh xxh – 32h 36h xxh xxh (Modbus address 00xxh–26xxh) + xxh xxh xxh xxh (read data length 1) + LRC (checksum) + CR/LF

(3) Write in 20 parameters: 3Ah (start word ':') + 30h 31h (station 01) + 31h 30h (function code 10h) + 30h 30h xxh xxh – 32h 36h xxh xxh (Modbus address 00xxh–26xxh) + 30h 30h 31h 34h (word data length) + 30h 30h 32h 38h (byte data length) + xxh xxh xxh xxh (the first write in value) + ... + xxh xxh xxh xxh (the 20th write in value) + LRC (checksum) + CR/LF

2. RTU

(1) Read one or multiple parameters: 01h (station 01) + 03h (function code 03h) + 00xxh–26xxh (Modbus address) + xxxxh (read data length) + CRC (checksum)

(2) Write in one parameter: 01h (station 01) + 06h (function code 06h) + 00xxh–26xxh (Modbus address) + xxxxh (write in value) + CRC (checksum)

(3) Write in 20 parameters: 01h (station 01) + 10h (function code 10h) + 00xxh–26xxh (Modbus address) + 0014h (word data length) + 0028h (byte data length) + xxxxh (the first write in value) + xxxxh (the 20th write in value) + CRC (checksum)

3. Control command (20xx):

<table>
<tr><th>Function Name</th><th>Modbus Address</th><th>Attribute</th><th>Size</th><th colspan="3">Function Description</th></tr>
<tr><td rowspan="15">Operation command</td><td rowspan="15">2000H</td><td rowspan="15">R/W</td><td rowspan="4">U16</td><td rowspan="4">bit1–0</td><td>00B: Disable</td><td rowspan="9">1: Once the drive receives one command, it remains in the operation status specified by the command and will not change the operation status until it receives another new command.
2: The function is only valid when the operation command source is set as communication (Pr. A1-01 or A1-08 = 8).</td></tr>
<tr><td>01B: Stop</td></tr>
<tr><td>10B: Run</td></tr>
<tr><td>11B: JOG Enable</td></tr>
<tr><td rowspan="11">U16</td><td>bit3–2</td><td>Reserve</td></tr>
<tr><td rowspan="4">bit5–4</td><td>00B: Disable</td></tr>
<tr><td>01B: FWD</td></tr>
<tr><td>10B: REV</td></tr>
<tr><td>11B: Change direction</td></tr>
<tr><td rowspan="4">bit7–6</td><td>00B: 1st acceleration / deceleration</td><td rowspan="6">1: To enable this function, you need to set 2000h bit12 as 1 first.
2: By reading 2367h, you can get the currently executed step speed.</td></tr>
<tr><td>01B: 2nd acceleration / deceleration</td></tr>
<tr><td>10B: 3rd acceleration / deceleration</td></tr>
<tr><td>11B: 4th acceleration / deceleration</td></tr>
<tr><td rowspan="2">bit11–8</td><td>0000B: Main speed</td></tr>
<tr><td>0001B: 1st Step Speed</td></tr>
</table>

Function Name	Modbus Address	Attribute	Size	Function Description		
					0010B: 2nd Step Speed	
					0011B: 3rd Step Speed	
					0100B: 4th Step Speed	
					0101B: 5th Step Speed	
					0110B: 6th Step Speed	
					0111B: 7th Step Speed	
					1000B: 8th Step Speed	
					1001B: 9th Step Speed	
					1010B: 10th Step Speed	
					1011B: 11th Step Speed	
					1100B: 12th Step Speed	
					1101B: 13th Step Speed	
					1110B: 14th Step Speed	
					1111B: 15th Step Speed	
				bit12	1: Enable function of bit6–11	
				bit15–13	Reserve	
Frequency command	2001H	R/W		Frequency command (xxx.xx Hz), two decimal points for standard drives; one decimal point for high-speed drive.		
Fault/ Control command source	2002H	R/W		bit0	Reserve	
				bit1	1: Reset	Used to clear the fault status.
				bit15–2	Reserve	

4. Status monitor read only (21xx)

Function Name	Modbus Address	Attribute	Size	Function Description	
AC Motor drive status (Low word)	2300H	R	U16	bit1–0	AC motor drive operation status 00b: Drive stops (keypad RUN light OFF/ STOP light ON) 01b: Drive stopping (keypad RUN light flashes / STOP light ON) 10b: Drive standby (keypad RUN light ON / STOP light flashes) 11b: Drive operating (keypad RUN light ON / STOP light OFF) NOTE: this bit is used to detect the drive operating status, to control the LED display for the operation status.
				bit3–2	Operation Direction 00b: The drive is in FWD run status (Keypad REV light OFF / FWD light ON) 01b: The drive runs from current REV direction to target FWD direction (keypad REV light flashes / FWD light ON) 10b: The drive runs from current FWD direction to target REV direction (keypad REV light ON / FWD light flashes) 11b: The drive is in REV direction (keypad REV light ON / FWD light OFF) NOTE: this bit is used to detect the drive operating direction, to control the LED display for the running

Function Name	Modbus Address	Attribute	Size	Function Description	
					direction.
				bit4	JOG Operation Status 1b: JOG active
				bit7–5	Drive HOA and LOC/ REM operation source status 000b: HOA mode OFF 001b: HOA mode HAND-ON 010b: HOA mode AUTO-ON 011b: LOC/ REM mode LOC-ON 100b: LOC/ REM mode REM-ON
				bit8	Drive ready status 1b: Ready Active - The drive is ready to receive command
				bit9	Drive output status 1b: The drive is outputting
			U16	bit10	Command reach status (speed reach, position reach, torque reach, homing complete) 1b: Command reaches active
				bit12	Drive quick stop status 1b: Quick stop active
				bit13	Drive Halt status 1b: The drive pauses
				bit14	Drive fault status 1b: The drive fault is triggered
				bit15	Drive warning status 1b: The drive warning is triggered
AC Motor drive status (How word)	2301H	R		bit0	Drive status (High word) Acceleration/ deceleration status 0b: Dec - the drive output frequency is decelerating 1b: Acc - the drive output frequency is accelerating
				bit1	FireMode Status 1b: FireMode active
				bit2	Drive dEb status 1b: dEb active
				bit3	Preheat output status 1b: Preheat output active
				bit4–11	Reserve
				bit12	Parameter Lock Status 1b: Parameter is locked
				bit13	Parameters read-only status 1b: Parameters are read-only
				bit14	Enable parameter copy function 1b: The drive is copying or resuming parameters
				bit15	Reserve
Frequency command	2302H	R		Frequency command (Hz), one decimal point for high-speed models	
Current output frequency	2303H	R		Motor actual operating frequency (XXXXX Hz), one decimal point for high-speed models	
Fault code	2304H	R		Fault code that occurs to the drive	
Warning code	2305H	R		Warning code that occurs to the drive	
Error status	2306H	R		Error status (0b: does not trigger errors, 1b: error triggered)	
				bit0	Low voltage warning (Lv)

Function Name	Modbus Address	Attribute	Size	Function Description	
				bit1	Overheat warning
				bit2	PID feedback error
				bit3	Slip error (oSL)
				bit4	Over-voltage warning
				bit5	Over-current stall prevention
				bit6	Over-voltage stall prevention
			U16	bit7	Under current output
				bit15–8	Reserve
Current control mode	2308H	R		1: Speed mode, 2: Torque mode, 3: Position mode, 4: Auto-tune mode	
Motor actual speed rpm (low word)	230AH	R		The motor speed estimated by the drive or feedback by the encoder, the unit is rpm	
Motor actual speed rpm (high word)	230BH	R		The motor speed estimated by the drive or feedback by the encoder, the unit is rpm	
Motor actual speed Hz	230CH	R		The motor speed estimated by the drive or feedback by the encoder, the unit is Hz	
Output current	2310H	R		Unit: A	
U-phase current	2312H	R		Unit: A	
V-phase current	2314H	R		Unit: A	
W-phase current	2316H	R		Unit: A	
Actual Id command (Low word)	2318H	R		Unit: A	
Actual Id command (High word)	2319H	R		Unit: A	
Actual Id feedback (Low word)	231AH	R		Unit: A	
Actual Id feedback (High word)	231BH	R		Unit: A	
Actual Iq command (Low word)	231CH	R		Unit: A	
Actual Iq command (High word)	231DH	R		Unit: A	
Actual Iq feedback (Low word)	231EH	R		Unit: A	
Actual Iq feedback (High word)	231FH	R		Unit: A	
DC bus voltage (XXX.X V)	2322H	R		Drive DC bus voltage (XXX.X V)	
DC bus voltage ripple	2323H	R		Drive DC bus ripple (XXX.X V)	

Function Name	Modbus Address	Attribute	Size	Function Description
Output voltage	2324H	R		Drive output voltage (XXX.X V)
Drive Output PF Angle	2327H	R		Drive Output PF Angle (XXX.X) (0.0–180.0 degree)
Output power	2328H	R		Display the output power of U, V and W (XXXX kW)
kWh	232AH	R		kWh display (XXXX.X)
Model type	232FH	R		bit 0: 0b: standard models; 1b: high-speed models
				bit 15–1: Reserve
Fan speed	2330H	R		Drive fan speed (XXX%)
Capacitor temperature	2331H	R		The drive capacitor temperature (XXX.X°C)
IGBT temperature	2332H	R		The power model IGBT temperature (XXX.X°C)
Actual torque command	2336H	R	U16	Actual torque command (XXX.X%)
Output torque	2337H	R		The output positive and negative torque calculated by the drive (XXX.X Nt-m).
Average output torque	2338H	R		The average output positive and negative torque calculated by the drive (XXX.X Nt-m).
Process PID1 Output frequency	2340	R		Process PID output frequency, the unit is Hz External PID output frequency, the unit is %
Process PID1 target value	2341	R		PID target value (XXX.XX %)
Process PID1 compensation	2342	R		PID offset (XXX.XX%)
Process PID2 Output frequency	2344	R		PID output frequency (XXX.XX Hz)
Process PID2 target value	2345	R		PID target value (XXX.XX %)
Process PID2 compensation	2346	R		PID offset (XXX.XX%)
External PID1 output frequency	2348	R		PID output frequency (XXX.XX Hz)
External PID1 target value	2349	R		PID target value (XXX.XX %)
External PID1 compensation	234A	R		PID offset (XXX.XX%)
External PID2 output frequency	234C	R		PID output frequency (XXX.XX Hz)
External PID2 target value	234D	R		PID target value (XXX.XX %)
External PID2 compensation	234E	R		PID offset (XXX.XX%)
External PID3 output frequency	2350	R		PID output frequency (XXX.XX Hz)
External PID3 target value	2351	R		PID target value (XXX.XX %)

Function Name	Modbus Address	Attribute	Size	Function Description
External PID3 compensation	2352	R		PID offset (XXX.XX%)
External PID4 output frequency	2354	R		PID output frequency (XXX.XX Hz)
External PID4 target value	2355	R		PID target value (XXX.XX %)
External PID4 compensation	2356	R		PID offset (XXX.XX%)
PWM Carrier Frequency	2366	R		Drive operation carrier frequency (X.X kHz)
Multi-step speed status	2367	R		Drive currently executed step speed from the multi-step speed command (0 represents main speed)
Overload counter	2368	R		
GFF protection proportion	236A	R		GFF (XX%) value
PLC buffer overflow	236B	R		PLC register D1043 data
PMFOC Ke estimation	236C	R		PMFOC Ke estimation

5. Remote IO (26xx):

Function Name	Modbus Address	Attribute	Size	Function Description
Digital input terminal MI6–MI1 status	2600H	R	U16	Each bit corresponds to different terminal input contact
Digital input terminal MI6–MI1 CPU Pin status	2608	R		Each bit corresponds to different terminal CPU Pin
Digital output terminal MI6–MI1 status	2640H	R/W		Each bit corresponds to different terminal output contact
Digital output terminal MI6–MI1 CPU Pin status	2648H	R		Each bit corresponds to different terminal CPU Pin
AI0 Proportional value	2660H	R		Analog input signal AI0 percentage
AI1 Proportional value	2661H	R		Analog input signal AI1 percentage
AI2 Proportional value	2662H	R		Analog input signal AI2 percentage
Analog input signal AI10 percentage	266AH	R		Extension card AI10, 0.0–1100.0% (EMV-A22A)
Analog input signal AI11 percentage	266BH	R		Extension card AI11, 0.0–1100.0% (EMV-A22A)

Function Name	Modbus Address	Attribute	Size	Function Description
AFM1 output value	2680H	R		AFM1 output percentage (%)
AFM2 output value	2681H	R		AFM2 output percentage (%)
AO10 output value	268AH	R		Extension card AO10 output percentage (%)
AO11 output value	268BH	R		Extension card AO11 output percentage (%)
AFM1 output percentage (%)	26A0H	R/W		AFM1 output percentage (%)
AFM2 output percentage (%)	26A1H	R/W	U16	AFM2 output percentage (%)
Analog output signal AO10 percentage	26AAH	R/W		Extension card AO10, 0.0–100.0% (EMV-A22A)
Analog output signal AO11 percentage	26ABH	R/W		Extension card AO11, 0.0–100.0% (EMV-A22A)

6-1-5 Exception response:

When the drive is using the communication connection, if an error occurs, the drive responds to the error code and sets the highest bit (bit 7) of the command code to 1 (function code AND 80H) then responds to the control system to signal that an error occurred. Refer to the table of error codes for communication error for reference. Example:

ASCII mode:

STX	‘:’
Address	‘0’
	‘1’
Function	‘8’
	‘6’
Exception code	‘0’
	‘2’
LRC Check	‘7’
	‘7’
END	CR
	LF

RTU mode:

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

The explanation of exception codes:

Fault code	Descriptions
1	Function code is not supported or unrecognized.
2	Address is not supported or unrecognized.
3	Data is incorrect or unrecognized.
4	Failure to execute this function code

6-2 BACnet Communication

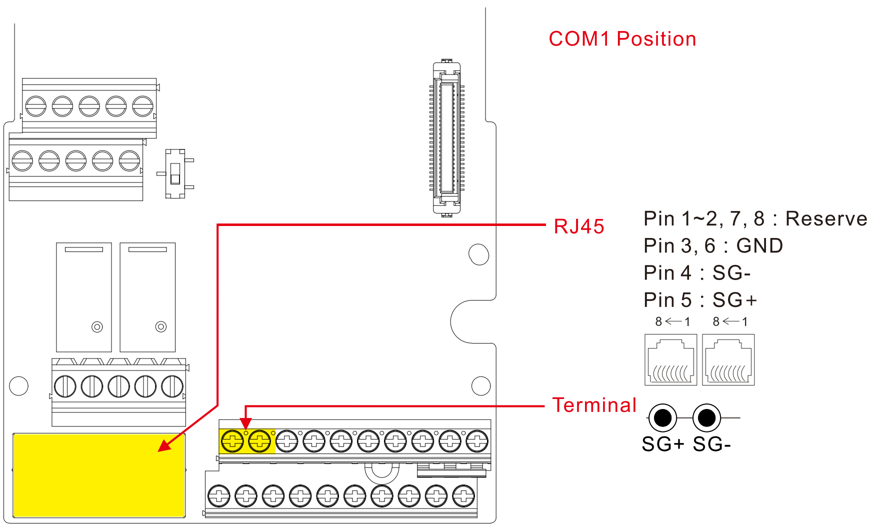
6-2-1 Specification

Item		Specifications
Interface		RS-485
Sync Method		Asynchronous
Communication Parameters	Transmission Speed	9.6, 19.2, 38.4, 78 Kbps
	Data length	8-bit
	Calibration	None (N)
	Stop bit	1-bit
Communication Protocol		RTU

About BACnet:
BACnet is an ASHRAE communication protocol for building automation and control networks. (ASHRAE: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.).
VP3000's BACnet is based on version 2004.
BACnet's regulations are related to several kinds of physical layers' interfaces. The physical layer built inside VP3000 is achieved via MS/TP interface.
The BACnet of VP3000 supports a device type called B-ASC. B-ASC supports six types of services such as DS-RP-B, DS-RPM-B, DS-WP-B, DM-DDB-B, DM-DOB-B and DM-DCC-B.

6-2-2 Wiring Configuration

- Connection of the communication cable is as shown in the diagram below:
  Pay extra attention that HW Pins of COM1_Port are shared by RJ45 and RS-485. That means you can use RJ45_cable or RS-485_lines to access the COM1_Port.
  When BACnet is enabled, COM1_Port will be dominated by BACnet function. Under this condition, you will not be able to use Modbus VFD Soft, VFD Explorer or PLC function on COM1_Port.



6-2-3 Parameter Setting

To use VP3000 BACnet function, there are two parts of parameter settings:

Part 1: Setup parameters related to Communication at Pr_Group n.

Part 2: Setup parameters related to Communication at Pr_Group A and C.

Part 1: Pr_Group n Communication

1-1.1. Set Pr. n0-00 = 2, BACnet is enabled, then the COM1_Port will be accessed by BACnet. (**Note:** The HW Pins of COM1_Port are shared by RJ45 and RS-485. When BACnet is enabled, BACnet will access the COM1_Port, that also means we can NOT use Modbus, PLC connections, VFDSoft and VFD Explorer by COM1_Port). When this is set, the COM1_Port communication format will be changed to RTU 8, N, 1, and will not refer to the setting of Pr. n1-03.

1-1.2. Set Pr. n3-01, default = 10, BACnet's MS/TP station number 0–127.

1-1.3. Set Pr. n3-03, default = 38400, BACnet communication baud rate, 9600, 19200, 38400 or 76800 bps.

1-1.4. Set Pr. n3-04, the default setting of Device Object_Identifier is = 0x000A. The setting range of Device Instance can be 0–4194303.

1-1.5. Set Pr. n3-02, default = 127, set the station search range.

1-1.6. Set Pr. n3-05, set up the BACnet password. If setup is successful, the keypad will display 8888.

Part 2: Pr_Group A and C, System parameter

2-1. Set Pr. C0-01 or C1-05 = 2, that means the frequency command source is RS-485 interface.

2-2. Set Pr. A1-01 or A1-08 = 8, that means the operation command source is RS-485 interface.

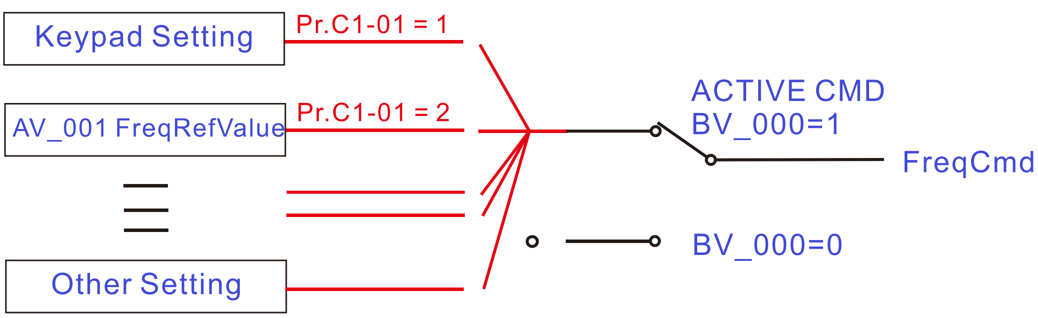
Example:

After setting the above 2 parts of parameters, we have enabled the BACnet function in VP3000. Thus, we can control the VP3000 RUN or STOP or gets the operation status through the BACnet objects.

Step 1. Write_Service on AV_000 (FreqRefValue), Present_Value = 60.0 (Hz)

Step 2. Write_Service on BV_000 (Active CMD), Present_Value = Active

Step 3. Read_Service on AV_050 (Output frequency), Present_Value retrieves.



NOTE:

In VP3000, we can set different reference source of FreqCmd by setting different parameter or IO settings. Refer to the description of Keypad, PR, and IO in the user manual for further details.

6-2-4 VP3000 BACnet Object and Property:

In VP3000, BACnet supports 3 types of object: Device, Analog Value (AV) and Binary Value (BV). In each object type, we have the following table to show the Properties list:

Property ID		Object Type		
		Device	Analog Value	Binary Value
#4	ACTIVE_TEXT			V
#11	APDU_TIMEOUT	V		
#12	APPLICATION_SOFTWARE_VERSION	V		
#28	DESCRIPTION	V	V	V
#30	DEVICE_ADDRESS_BINDING	V	V	
#36	EVENT_STATE		V	V
#44	FIRMWARE_REVISION	V		
#46	INACTIVE_TEXT			V
#62	MAX_APDU_LENGTH_ACCEPTED	V		
#63	MAX_INFO_FRAMES	V		
#64	MAX_MASTER	V		
#70	MODEL_NAME	V		
#73	NUMBER_OF_APDU_RETRIES	V		
#75	OBJECT_IDENTIFIER	V*1	V	V
#76	OBJECT_LIST	V		
#77	OBJECT_NAME	V*1	V	V
#79	OBJECT_TYPE	V	V	V
#81	OUT_OF_SERVICE		V	V
#85	PRESENT_VALUE		V*2	V*2
#87	PRIORITY_ARRAY		V*3	V*3
#96	PROTOCOL_OBJECT_TYPES_SUPPORTED	V		
#97	PROTOCOL_SERVICES_SUPPORTED	V		
#98	PROTOCOL_VERSION	V		
#104	RELINQUISH_DEFAULT		V*3	V*3
#107	SEGMENTATION_SUPPORTED	V		
#111	STATUS_FLAGS		V	V
#112	SYSTEM_STATUS	V		
#117	UNITS		V	
#120	VENDOR_IDENTIFIER	V		
#121	VENDOR_NAME	V		
#139	PROTOCOL_REVISION	V		
#155	DATABASE_REVISION	V		

NOTE:

*1. The Object_ID and Object_Name Properties of Device are writeable.

*2. The Present_Value Property of some AV and BV objects is commandable.

*3. Only Commandable objects support Priority_Array and Relinquish_Default.

The AV objects are divided into 'Commandable' and 'Read-only" cases.

- Commandable case: You can use Write_Serivce to access the Present_Value property of commandable AV objects. Therefore, the commandable AV objects are linking to the Control_Word and Pr_Word in VP3000.
- Read-only case: You can only use Read_Service to access the Present_Value property of read-only AV objects. Therefore, the read-only AV objects are linking to the Status_Word in VP3000.

The BV objects are divided into 'Commandable' and 'Read-only" cases.

- Commandable case: You can use Write_Serivce to access the Present_Value property of commandable BV objects. Therefore, the commandable BV objects are linking to the Control_Bit in VP3000.
- Read-only case: You can only use Read_Service to access the Present_Value property of read-only BV objects. Therefore, the read-only BV objects are linking to the Status_Bit in VP3000.

6-2-4-1 AnalogValue (AV) Object

- Commandable AnalogValue (AV) Object

  In VP3000, AV_000–AV_005 support the commandable Present_Value property. Meanwhile, these objects also support Priority_Arryay and Relinquish_Default properties. Therefore, we can use (multiple) Read_Serivce to access the data.

Object Number	R/W	Object Name	Object Description	Unit
AV 000	RW	AV 000	Frequency Reference Value	UNITS_HERTZ
AV 001	RW	AV 001	AO 0 Set Value	UNITS_PERCENT
AV 002	RW	AV 002	AO 1 Set Value	UNITS_PERCENT
AV 003	RW	AV 003	AO 10 Set Value	UNITS_PERCENT
AV 004	RW	AV 004	AO 11 Set Value	UNITS_PERCENT
AV 005	RW	AV 005	DO Set Value	UNITS_NO_UNITS

- Read-only AnalogValue (AV) Object

  In VP3000, AV_050–AV_073 support the read-only Present_Value property. Meanwhile, these objects do not support Priority_Array and Relinquish_Default properties.

Object Number	R/W	Object Name	Object Description	Unit
AV 050	R	AV 050	Display output frequency	UNITS_HERTZ
AV 051	R	AV 051	Display output torque	UNITS_PERCENT
AV 052	R	AV 052	Warn code	UNITS_NO_UNITS
AV 053	R	AV 053	Error code	UNITS_NO_UNITS
AV 054	R	AV 054	Display output current	UNITS_AMPERES
AV 055	R	AV 055	Display DC bus voltage	UNITS_VOLTS
AV 056	R	AV 056	Display output voltage of U, V, W	UNITS_VOLTS

Object Number	R/W	Object Name	Object Description	Unit
AV 057	R	AV 057	Display output power angle of U, V, W	UNITS_DEGREES_ANGULAR
AV 058	R	AV 058	Display actual output power of U, V, W	UNITS_KILOWATTS
AV 059	R	AV 059	Display the IGBT temperature	UNITS_DEGREES_CELSIUS
AV 060	R	AV 060	Display the temperature of capacitance	UNITS_DEGREES_CELSIUS
AV 061	R	AV 061	Display real carrier frequency of the drive	UNITS_KILOHERTZ
AV 062	R	AV 062	Display overload condition	UNITS_PERCENT
AV 063	R	AV 063	Display GND fail detect level	UNITS_PERCENT
AV 064	R	AV 064	Display DC bus voltage ripples	UNITS_VOLTS
AV 065	R	AV 065	Fan speed of the drive	UNITS_PERCENT
AV 066	R	AV 066	Output speed	UNITS_REVOLUTIONS_PER_MINUTE
AV 067	R	AV 067	KW per Hour	UNITS_KILOWATT_HOURS
AV 068	R	AV 068	Real multi-speed switch	UNITS_NO_UNITS
AV 069	R	AV 069	Digital input status	UNITS_NO_UNITS
AV 070	R	AV 070	Digital output status	UNITS_NO_UNITS
AV 071	R	AV 071	Corresponding CPU pin status of digital input	UNITS_NO_UNITS
AV 072	R	AV 072	Corresponding CPU pin status of digital output	UNITS_NO_UNITS
AV 073	R	AV 073	PLC D1043 value	UNITS_NO_UNITS

6-2-4-2 BinaryValue (BV) Object

- Commandable BinaryValue (BV) Object

  In VP3000, BV_000–BV_002 support the commandable Present_Value property. Meanwhile, these objects also support Priority_Array and Relinquish_Default properties. Therefore, we can use (multiple) Read_Serivce to access the data.

Object Number	R/W	Object Name	Object Description
BV 000	RW	BV 000	Run/Stop Cmd Inactive (0): FreqCmd = 0 Active (1): FreqCmd = FreqRefValue
BV 001	RW	BV 001	Fwd/Rev Cmd Inactive (0): Forward Active (1): Reverse
BV 002	RW	BV 002	Reset Cmd Inactive (0): Do nothing Active (1): Reset Fault

- Read-only BinaryValue (BV) Object
  In VP3000, BV_050–BV_053 support the read-only Present_Value property. Meanwhile, these objects do not support Priority_Array and Relinquish_Default properties.

Object Number	R/W	Object Name	Object Description
BV 050	R	BV 050	Run/Stop State Inactive (0): VFD Stop Active (1): VFD Running
BV 051	R	BV 051	Fwd/Rev State Inactive (0): Forward Active (1): Reverse
BV 052	R	BV 052	Warn state Inactive (0): No Warn Active (1): Occur Warn
BV 053	R	BV 053	Error State Inactive (0): No Error Active (1): Occur Error

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Chapter 7 Second Development Platform

7-1 Specification of Second Development Platform

Item	Specification	Remark
Algorithmic control method	Stored program, scanning back and forth	
Input / output control method	Batch processing method (when END instruction is executed), with input / output refresh instructions	
Algorithmic processing speed	Basic instructions (several μs)	Application instructions (1 to dozens of μs)
Programming language	Instruction list + Ladder diagram	
Program capacity	20000 steps	
Input / output contacts	Input (X): 6, output (Y): 4	These input / output contacts (on control board) are for VP3000, other series might be different.

<table>
<tr><th>Type</th><th>Device</th><th colspan="2">Item</th><th colspan="2">Range of use</th><th>Function</th></tr>
<tr><td rowspan="6">Relay (bit type)</td><td>X</td><td colspan="2">External input relay</td><td>X0–X177, 128 points, octal number system</td><td rowspan="2">Total 256 points</td><td>Correspond to the external inputs</td></tr>
<tr><td>Y</td><td colspan="2">External output relay</td><td>Y0–Y177, 128 points, octal number system</td><td>Correspond to the external outputs</td></tr>
<tr><td rowspan="2">M</td><td rowspan="2">Auxiliary relay</td><td>General use</td><td>M0–M999, 1000 points</td><td rowspan="2">Total 1360 points</td><td rowspan="2">The contacts can be switched ON / OFF withing the program</td></tr>
<tr><td>Special purpose</td><td>M1000–M1359, 360 points</td></tr>
<tr><td>T</td><td>Timer</td><td>100 ms</td><td>T0–T159, 160 points</td><td>Total 160 points</td><td>For the timer specified by TMR instruction, the contacts correspond to T will be ON if the time reaches the setting.</td></tr>
<tr><td>C</td><td>Counter</td><td>16-bit count up</td><td>C0–C79, 80 points</td><td>Total 80 points</td><td>For the counter specified by CNT instruction, the contacts correspond to C will be ON if the time reaches the setting.</td></tr>
<tr><td rowspan="5">Register (word)</td><td>T</td><td colspan="2">Current value of timer</td><td colspan="2">T0–T159, 160 points</td><td>The contacts of the timer are conducted when the time reaches the setting.</td></tr>
<tr><td>C</td><td colspan="2">Current value of counter</td><td colspan="2">C0–T79, 16-bit counter, 80 points</td><td>The contacts of the counter are conducted when the count reaches the setting.</td></tr>
<tr><td rowspan="3">D</td><td rowspan="3">Data register</td><td>Data retention</td><td>D0–D499, 500 points</td><td rowspan="3">Total 2920 points</td><td rowspan="3">As a memory area for data storage</td></tr>
<tr><td>Special purpose</td><td>D1000–D1619, 620 points
D2000–D2799, 800 points</td></tr>
<tr><td>General use</td><td>D3000–M3999, 1000 points</td></tr>
<tr><td rowspan="4">Constant</td><td rowspan="2">K</td><td rowspan="2">Decimal</td><td>Single-byte</td><td colspan="3">Setting range: K-32,768–K32,767</td></tr>
<tr><td>Double-byte</td><td colspan="3">Setting range: K-2,147,483,648–K2,147,483,647</td></tr>
<tr><td rowspan="2">H</td><td rowspan="2">Hexadecimal</td><td>Single-byte</td><td colspan="3">Setting range: H0000–HFFFF</td></tr>
<tr><td>Double-byte</td><td colspan="3">Setting range: H00000000–HFFFFFFFF</td></tr>
</table>

Type	Device	Item	Range of use	Function
Serial port (for writing / reading programs)			RS-485 / keypad port	
Analog input / output			Built-in three analog inputs and two analog outputs	
Function expansion module		Optional accessory	EMV-D42A; EMV-R6AA; EMV-A22A	

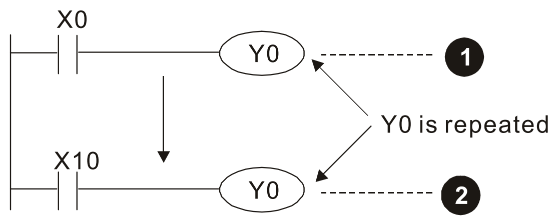
7-1-1 Introduction to Device Functions

Input / output contacts

Function of input contact X: the input contact X connects with an input device, and reads input signals entering the PLC. There is no limit to the number of times that contact A or B of each input contact X can be used in the program. The ON / OFF of input contact X only can change with the ON / OFF of input device; a peripheral device (WPLsoft) cannot be used to force input contact X to be ON / OFF.

Output contact Y

The task of output contact Y is to send an ON / OFF signal to drive the load connected with output contact Y. Output contacts are divided into two types: relay and transistor. There is no limit to the number of times that contact A or B of each output contact Y. It is recommended that the number of output coil Y is used only once in a program, otherwise the right to determine the output state when the PLC performs program scanning will be assigned to the program's final output Y circuit.



The output of Y0 will be decided by circuit ❷,
i.e. decided by ON/OFF of X10.

Numerical value, constant [K] / [H]

Constant	Single-byte	K	Decimal	K-32,768–K32,767
	Double-byte			K-2,147,483,648–K2,147,483,647
	Single-byte	H	Hexadecimal	H0000–HFFFF
	Double-byte			H00000000–HFFFFFFFF

PLC can use five types of numerical values to implement calculations based on its control tasks; the following content is explanations of the tasks and functions of different numerical values.

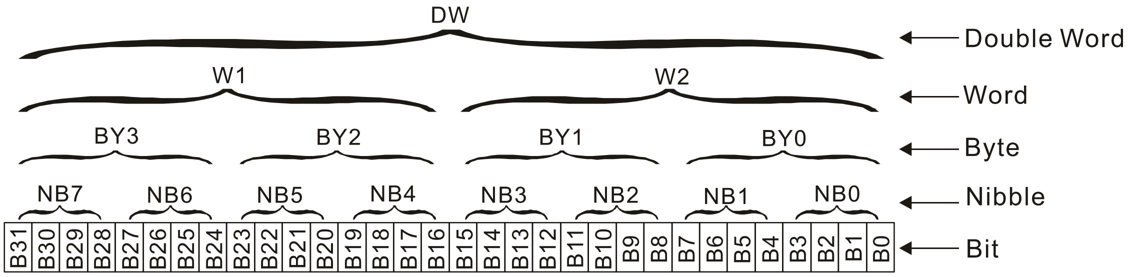
- Binary Number (BIN)

  PLC's numerical operations and memory use binary numbers. Binary values and related terms are as follows:

bit	Bit is the fundamental unit of binary system, and its state is either 1 or 0
Nibble	Consist of four consecutive bits, e.g., b3–b0. To indicate a value which range between 0–9 in decimal or a value which range between 0–F in hexadecimal .

Byte	Consist of two consecutive nibbles, that is, eight bits, b7–b0. To indicate a value which range between 00–FF in hexadecimal.
Word	Consist of two consecutive bytes, that is, 16 bits, b15–b0. To indicate a value which range between 0000–FFFF in hexadecimal.
Double Word	Consist of two consecutive words, that is, 32 bits, b31–b0. To indicate a value which range between 00000000–FFFFFFFF in hexadecimal.

The bit, nibble, byte, word, and double word in a binary system:



- Octal Number (OCT)
  The external input and output terminals of DVP-PLC are numbered in octal format.
  Example:
  External input: X0–X7, X10–X17, ... (No. of device)
  External output: Y0–Y7, Y10–Y17, ... (No. of device)

- Decimal Number (DEC)
  The timing of decimal applications in PLC system is as follows:
  - As setting values for timer (T), counter (C), e.g., TMR C0 K50. (constant K)
  - The numbers of M, T, C, D devices, e.g., M10, T30. (No. of device)
  - As operands in application instructions, e.g., MOV K123 D0. (constant K)

- Binary-Coded Decimal (BCD)
  Take one nibble or four bits to indicate a decimal value, so that data of consecutive 16 bits can indicate a four-nibble decimal value. Mainly used in reading the input values from DIP switches or outputting the data to a 7-segment display.

- Hexadecimal Number (HEX)
  The timing of hexadecimal applications in PLC system is to use it as operands in application instructions, e.g., MOV H1A2B D0. (H constant)

- Constant K
  A decimal number in PLC system is generally preceded by K, e.g., K100 indicates that it is decimal, and the value is 100.
  Exception: if K is used with a X / Y / M / S device, a data in nibble, byte, word, or double word format will be formed. Example: K2Y10, K4M100. K1 represents a 4-bit combination, and K2–K4 represents 8-bit, 12-bit and 16-bit combinations individually.

- H Constant
  A hexadecimal number in PLC system is generally preceded by H, e.g., H100 indicates that it is hexadecimal, and the value is 100.

Auxiliary Relay

Like an output relay Y, an auxiliary relay M has an output coil and contacts A and B, and the number of times they can be used in a program is unrestricted. Users can use an auxiliary relay M to configure the control circuit but cannot use it to directly drive an external load. Auxiliary relay is divided into two types according to its characteristics, see the following content:

- General type: for this type of auxiliary relay, the state returns to OFF if power outage occurs in PLC operation, it is still OFF even power ON again.
- Special type: each special-purpose auxiliary relay has its own specific use. Do not use any undefined special purpose auxiliary relays

Timer

The unit of the timer is 100 ms, and the counting method is counting up. When the current value in the timer equals the setting value, the associated output coil is conducted. The setting value should be a K value in decimal and can be specified by the content of data register D.

The actual setting time of the timer = the unit of timer x setting value

Counter

If the counting pulse input signals of the counter are OFF→ON, when the current value in the counter equals the setting value, the associated output coil is conducted. The setting value should be a K value in decimal and can be specified by the content of data register D.

16-Bit counter C0–C79:

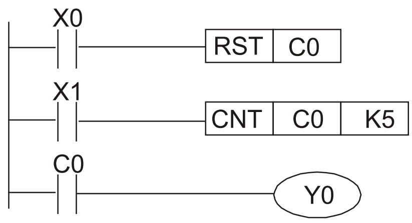
- The setting range of 16-bit counter: K0–K32,767. (K0 and K1 are identical, their output contacts are conducted immediately at the first counting)
- For general type counter, the current value is cleared when a power failure occurs in PLC.
- If a value greater than the setting value is transmitted to the register of C0 current value by using MOV instruction or WPLSoft, when X1 is OFF→ON in the next time, the contact of C0 counter becomes ON, and the current value becomes the same as the setting value.
- The setting value of counter can be set by using constant K directly, or by using the numeral value of register D (data register D1000–D1199 and D2000–D2799 are not included) indirectly.
- The setting value can only be positive if the constant K is used, and the setting value can be a positive or negative if the data register D is used. The current value changes from 32,767 to -32,768 as the counting continues to accumulate.

Features of Counter

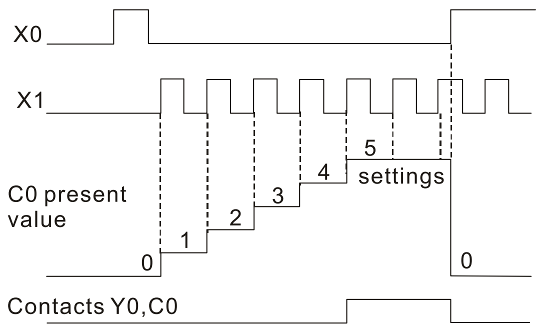
Item	16-bit counter
Type	General
Counting direction	Counting up
Setting value	0–32,767
Designation of setting value	Constant K or data register D
Change of the current value	The counting stops when it reaches the setting value.
Output contacts	The output contacts conduct and remain when the counting reaches the setting value.
Reset	The current value returns to zero when RST instruction is executed, and the contacts are also reset to OFF.
Action of contacts	Act at the end of the scanning.

Example:

LD	X0
RST	C0
LD	X1
CNT	C0, K5
LD	C0
OUT	Y0



1. When X0 = ON, RST instruction is executed, the current value of C0 returns to zero, and the output contacts are also reset to OFF.
2. When X1 is OFF→ON, the current value counts up (add 1).
3. When the counting of the counter C0 reaches the setting value K5, the contact of C0 is conducted, the current value of C0 = setting value = K5 C0 do not receive the trigger signal sent from X1 afterward, the current value of C0 remains at K5.



7-1-2 Device communication address of PLC

Device	Range of use	Type	Address (Hex)
X	00–37 (Octal)	bit	0400–041F
Y	00–37 (Octal)	bit	0500–051F
T	00–159	bit / word	0600–069F
M	000–999	bit	0800–0BE7
M	1000–1359	bit	0BE8–0D4F
C	0–79	bit / word	0E00–0E47
D	0–499	word	1000–11F3
D	1000–1619	word	13E8–1653
D	3000–3999	word	1BB8–1F9F

The available command codes

Command code	Function	Device
01	Read the status of Coil	Y, M, T, C
02	Read the status of input	X, Y, M, T, C
03	Read one piece of data	T, C, D
05	Force to change the status of one Coil	Y, M, T, C
06	Write one piece of data	T, C, D
0F	Force to change the status of multiple Coil	Y, M, T, C
10	Write multiple pieces of data	T, C, D

NOTE: When the built-in PLC function of VP3000 is activated, Modbus can visit the device information of built-in PLC and parameters of AC motor drive at the same time by the different addresses (default: AC motor drive is 1, built-in PLC is 2).

7-2 Introduction to the Functions of Instructions

7-2-1 Overview of basic instructions

Basic instructions

Instruction code	Function	Operand	Execution speed (μs)
LD	Load contact A	X, Y, M, T, C	0.8
LDI	Load contact B	X, Y, M, T, C	0.8
AND	Connect contact A in serial	X, Y, M, T, C	0.8
ANI	Connect contact B in serial	X, Y, M, T, C	0.8
OR	Connect contact A in parallel	X, Y, M, T, C	0.8
ORI	Connect contact B in parallel	X, Y, M, T, C	0.8
ANB	Connect a block in serial	N/A	0.3
ORB	Connect a block in parallel	N/A	0.3
MPS	PUSH operation to stack	N/A	0.3
MRD	POP operation to stack (the stack pointer stays intact)	N/A	0.3
MPP	POP operation to stack	N/A	0.3

Output instructions

Instruction code	Function	Operand	Execution speed (μs)
OUT	Drive coil	Y, M	1
SET	Maintain the action (ON)	Y, M	1
RST	Clear the contacts or register	Y, M, T, C, D	1.2

Timer, counter

Instruction code	Function	Operand	Execution speed (μs)
TMR	16-bit timer	T-K or T-D	1.1
CNT	16-bit counter	C-K or C-D (16-bit)	0.5

Master-Control Instructions

Instruction code	Function	Operand	Execution speed (μs)
MC	The connection between the contacts of common lists	N0–N7	0.4
MCR	Remove the connection between the contacts of common lists	N0–N7	0.4

Rising-Edge / Falling-Edge Contact Detection Instructions

Instruction code	Function	Operand	Execution speed (μs)
LDP	Rising edge detection	X, Y, M, T, C	1.1
LDF	Falling edge detection	X, Y, M, T, C	1.1
ANDP	Detect serial connection at rising edge	X, Y, M, T, C	1.1
ANDF	Detect serial connection at falling edge	X, Y, M, T, C	1.1
ORP	Detect parallel connection at rising edge	X, Y, M, T, C	1.1
ORF	Detect parallel connection at falling edge	X, Y, M, T, C	1.1

Differential Instructions

Instruction code	Function	Operand	Execution speed (μs)
PLS	Differential output at rising edge	Y, M	1.2
PLF	Differential output at falling edge	Y, M	1.2

End Instruction

Instruction code	Function	Operand	Execution speed (μs)
END	Program end	N/A	0.2

Other Instructions

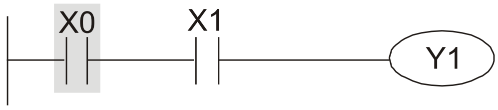
Instruction code	Function	Operand	Execution speed (μs)
NOP	No operation	N/A	0.2
INV	Inverse operation result	N/A	0.2
P	Pointer	P	0.3

7-2-2 Instructions of basic instructions

Instruction	Function					
LD	Load contact A					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	-
Description	LD instruction is used on the contact A that has its start from the left BUS bar or contact A that is the start of a contact circuit. The functions are to save the present contents and store the acquired contact status into the accumulative register.					

Example

Ladder diagram:

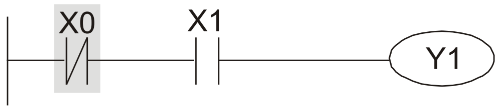


Instruction code		Operation
LD	**X0**	**Load X0 (the contact A)**
AND	X1	Connect X1 (the contact A) in serial
OUT	Y1	Drive Coil Y1

Instruction	Function					
LDI	Load contact B					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	-
Description	LDI instruction is used on the contact B that has its start from the left BUS bar or contact B that is the start of a contact circuit. The functions are to save the present contents and store the acquired contact status into the accumulative register.					

Example

Ladder diagram:

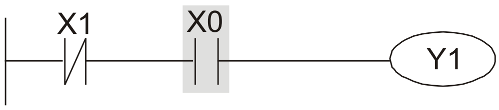


Instruction code		Operation
LDI	**X0**	**Load X0 (the contact B)**
AND	X1	Connect X1 (the contact A) in serial
OUT	Y1	Drive Coil Y1

Instruction	Function					
AND	Connect contact A in serial					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	-
Description	AND instruction is used in the serial connection of contact A. The functions are to read out the contacts' status of present serial connection and perform "AND" operation with the logical operation result obtained. The final result will be stored in the accumulative register.					

Example

Ladder diagram:

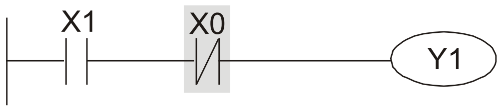


Instruction code		Operation
LDI	X1	Load X1 (the contact B)
AND	**X0**	**Connect X0 (the contact A) in serial**
OUT	Y1	Drive Coil Y1

Instruction	Function					
ANI	Connect contact B in serial					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	-
Description	ANI instruction is used in the serial connection of contact B. The functions are to read out the contacts' status of present serial connection and perform "AND" operation with the logical operation result obtained. The final result will be stored in the accumulative register.					

Example

Ladder diagram:

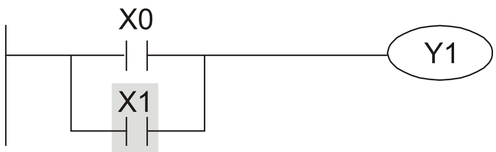


Instruction code		Operation
LD	X1	Load X1 (the contact A)
ANI	**X0**	**Connect X0 (the contact B) in serial**
OUT	Y1	Drive Coil Y1

Instruction	Function					
OR	Connect contact A in parallel					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	-
Description	OR instruction is used in the parallel connection of contact A. The functions are to read out the contacts' status of present serial connection and perform "OR" operation with the logical operation result obtained. The final result will be stored in the accumulative register.					

Example

Ladder diagram:

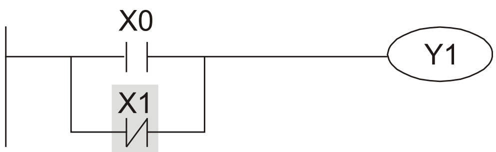


Instruction code		Operation
LD	X0	Load X0 (the contact A)
OR	**X1**	**Connect X1 (the contact A) in serial**
OUT	Y1	Drive Coil Y1

Instruction	Function					
ORI	Connect contact B in parallel					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	-
Description	ORI instruction is used in the parallel connection of contact B. The functions are to read out the contacts' status of present serial connection and perform "OR" operation with the logical operation result obtained. The final result will be stored in the accumulative register.					

Example

Ladder diagram:

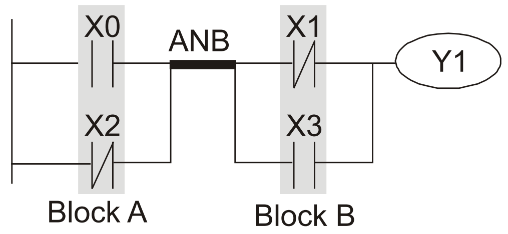


Instruction code		Operation
LD	X0	Load X0 (the contact A)
ORI	**X1**	**Connect X1 (the contact B) in serial**
OUT	Y1	Drive Coil Y1

Instruction	Function
ANB	Connect a block in serial
Operand	N/A
Description	To perform "AND" operation of the previous saved logical result and the present content in the accumulative register.

Example

Ladder diagram:

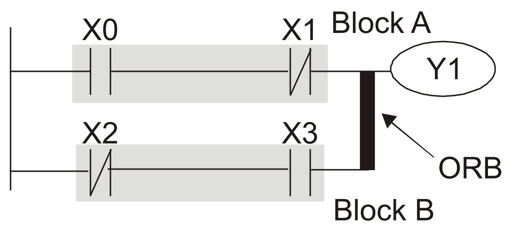


Instruction code		Operation
LD	X0	Load X0 (the contact A)
ORI	X2	Connect X2 (the contact B) in parallel
LDI	X1	Load X1 (the contact B)
OR	X3	Connect X3 (the contact A) in parallel
ANB		**Connect a block in serial**
OUT	Y1	Drive Coil Y1

Instruction	Function
ORB	Connect a block in parallel
Operand	N/A
Description	To perform "OR" operation of the previous saved logical result and the present content in the accumulative register.

Example

Ladder diagram:



Instruction code		Operation
LD	X0	Load X0 (the contact A)
ANI	X1	Connect X1 (the contact B) in parallel
LDI	X2	Load X2 (the contact B)
AND	X3	Connect X3 (the contact A) in parallel
ORB		**Connect a block in parallel**
OUT	Y1	Drive Coil Y1

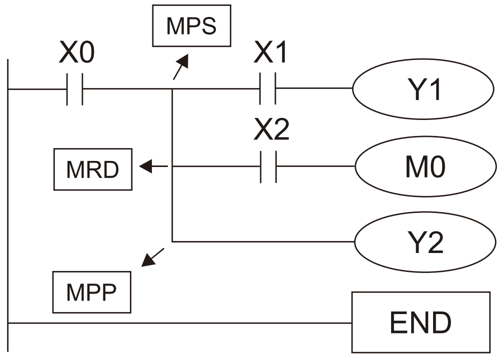
Instruction	Function
MPS	PUSH operation to stack
Operand	N/A
Description	To save the content in the accumulative register into the stack. (the stack pointer plus 1)

Instruction	Function
MRD	POP operation to stack (the stack pointer stays intact)
Operand	N/A
Description	To read the stack and store it into the accumulative register. POP operation to stack (the stack pointer stays intact)

Instruction	Function
MPP	POP operation to stack
Operand	N/A
Description	To retrieve the previous saved logical result and store it into the accumulative register. (the stack pointer minus 1)

Example

Ladder diagram:



Instruction code		Operation
LD	X0	Load X0 (the contact A)
MPS		**PUSH operation to stack**
AND	X1	Connect X1 (the contact A) in serial
OUT	Y1	Drive Coil Y1
MRD		**POP operation to stack (the stack pointer stays intact)**
AND	X2	Connect X2 (the contact A) in serial
OUT	M0	Drive Coil M0
MPP		**POP operation to stack**
OUT	Y2	Drive Coil Y2
END		Program end

Instruction	Function					
OUT	Drive coil					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	-	✓	✓	-	-	-

Description

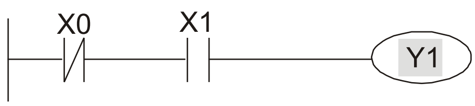
To output the logical operation result before OUT instruction into a designated device.

Action of the Coil contact:

Operation result	OUT instruction		
	Coil	Contact	
		Contact A (Normally Open)	Contact B (Normally Close)
FALSE	OFF	Not conducting	Conducting
TRUE	ON	Conducting	Not conducting

Example

Ladder diagram:

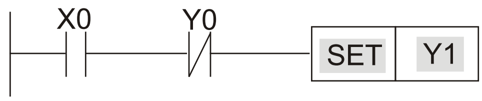


Instruction code		Operation
LDI	X0	Load X0 (the contact B)
AND	X1	Connect X1 (the contact A) in parallel
OUT	**Y1**	**Drive Coil Y1**

Instruction	Function					
SET	Maintain the action (ON)					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	-	✓	✓	-	-	-
Description	When the SET instruction is driven, its designated device will be "ON" and keep being ON both when SET instruction is still being driven or not driven. Use RST instruction to set the device to be OFF.					

Example

Ladder diagram:



Instruction code		Operation
LD	X0	Load X0 (the contact A)
ANI	Y0	Connect Y0 (the contact B) in parallel
SET	**Y1**	**Maintain the action (ON)**

Instruction	Function					
RST	Clear the contacts or register					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	-	✓	✓	✓	✓	✓

Description

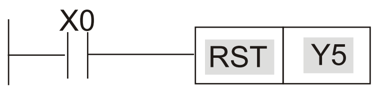
When the RST instruction is driven, the actions of the designated devices are:

Device	Status
Y, M	Coil and contacts are set to "OFF".
T, C	The current value of the timer or the counter are set to "0", the coil and the contacts are set to "OFF".
D	The value is set to "0".

If RST instruction is not being executed, the status of the designated device stays intact.

Example

Ladder diagram:



Instruction code		Operation
LD	X0	Load X0 (the contact A)
RST	**Y5**	**Clear the contacts or register**

Instruction	Function
TMR	16-bit timer
Operand: T-K	T0–T159, K0–K32,767
Operand: T-D	T0–T159, D0–D399

Description

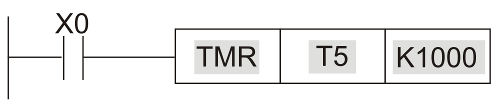
When TMR instruction is executed, the designated coil of the timer receives power, and the timer starts to count. When the counting reaches the setting value (current value ≥ setting value), the contact will be:

Normally Open (NO) contact	Closed
Normally Close (NC) contact	Open

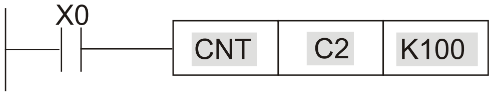
If RST instruction is not being executed, the status of the designated device stays intact.

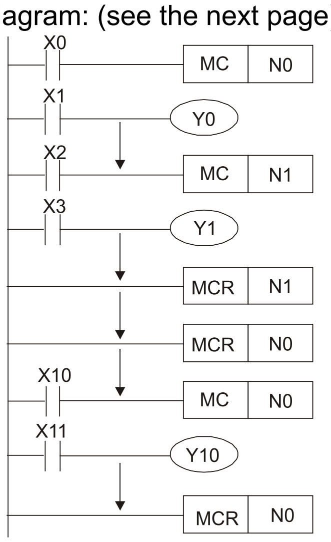
Example

Ladder diagram:

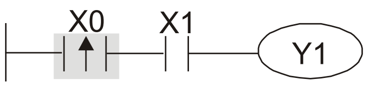


Instruction code		Operation
LD	X0	Load X0 (the contact A)
TMR	**T5 K1000**	**T5 Timer Setting value is K1000**

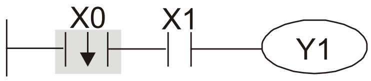
<table>
<tr><td>Instruction</td><td colspan="3">Function</td></tr>
<tr><td>CNT</td><td colspan="3">16-bit counter</td></tr>
<tr><td rowspan="2">Operand</td><td>C-K</td><td colspan="2">C0–C79, K0–K32,767</td></tr>
<tr><td>C-D</td><td colspan="2">C0–C79, D0–D399</td></tr>
<tr><td>Description</td><td colspan="3">When CNT instruction goes from OFF→ON, the designated counter coil is from losing power→receiving power , and the current value in the counter plus 1. When the counting reaches the setting value (current value = setting value), the contact will be:
<table><tr><td>Normally Open (NO) contact</td><td>Closed</td></tr><tr><td>Normally Close (NC) contact</td><td>Open</td></tr></table>If there are other counting pulses input after the counting reaches its target, the contact and current value stay intact. Use RST instruction to restart or reset the counting.</td></tr>
<tr><td rowspan="3">Example</td><td rowspan="3">Ladder diagram:

</td><td colspan="1">Instruction code</td><td>Operation</td></tr>
<tr><td>LD X0</td><td>Load X0 (the contact A)</td></tr>
<tr><td>CNT C2 K100</td><td>C2 Counter
Setting value is K100</td></tr>
</table>

<table>
<tr><td>Instruction</td><td colspan="4">Function</td></tr>
<tr><td>MC / MCR</td><td colspan="4">The connection / disconnection between the contacts of common lists</td></tr>
<tr><td>Operand</td><td colspan="4">N0–N7</td></tr>
<tr><td>Description</td><td colspan="4">MC instruction is master-control start instruction. When MC instruction is executed, the execution of instructions between MC and MCR are not be interrupted. When MC instruction is OFF, the execution of instructions between MC and MCR are:
<table><tr><td>Instruction type</td><td>Description</td></tr><tr><td>General purpose timer</td><td>The value returns 0, the coil loses power, and no action for the contacts</td></tr><tr><td>Counter</td><td>The coil loses power, the value and the contacts stay intact</td></tr><tr><td>The coil driven by OUT instruction</td><td>None receives power</td></tr><tr><td>Devices driven by SET and RST instructions</td><td>Stay intact</td></tr><tr><td>Application instructions</td><td>All disabled</td></tr></table>MCR is the master-control end instruction that is placed in the end of the master-control program. There should not be any contact instructions prior to MCR instruction.
MC-MCR master-control program instructions support the nested program structure (max. 8 layers) and use the instructions in the order N0–N7.</td></tr>
<tr><td rowspan="10">Example</td><td rowspan="10">Ladder diagram: (see the next page)

</td><td colspan="2">Instruction code</td><td>Operation</td></tr>
<tr><td>LD</td><td>X0</td><td>Load X0 (the contact A)</td></tr>
<tr><td>MC</td><td>N0</td><td>The connection of the NO common serial contacts</td></tr>
<tr><td>LD</td><td>X1</td><td>Load X1 (the contact A)</td></tr>
<tr><td>OUT</td><td>Y0</td><td>Drive Coil Y0</td></tr>
<tr><td>⋮</td><td></td><td></td></tr>
<tr><td>LD</td><td>X2</td><td>Load X2 (the contact A)</td></tr>
<tr><td>MC</td><td>N1</td><td>The connection of the N1 common serial contacts</td></tr>
<tr><td>LD</td><td>X3</td><td>Load X3 (the contact A)</td></tr>
</table>

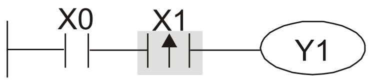
		OUT	Y1	Drive Coil Y1
		⋮		
		MCR	**N1**	**Remove the connection of the N1 common serial contacts**
		⋮		
		MCR	**N0**	**Remove the connection of the N0 common serial contacts**
		⋮		
		LD	X10	Load X10 (the contact A)
		MC	**N0**	**The connection of the NO common serial contacts**
		LD	X11	Load X11 (the contact A)
		OUT	Y10	Drive Coil Y10
		⋮		
		MCR	**N0**	**Remove the connection of the N0 common serial contacts**

<table>
<tr><td>Instruction</td><td colspan="6">Function</td></tr>
<tr><td>LDP</td><td colspan="6">Rising edge detection</td></tr>
<tr><td rowspan="2">Operand</td><td>X0–X17</td><td>Y0–Y17</td><td>M0–M799</td><td>T0–159</td><td>C0–C79</td><td>D0–D399</td></tr>
<tr><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>-</td></tr>
<tr><td>Description</td><td colspan="6">The method of using LDP is the same as using LD, but the actions of the two instructions differ. LDP saves the current content and store the detected status of rising-edge to the accumulative register.</td></tr>
<tr><td rowspan="4">Example</td><td colspan="3" rowspan="4">Ladder diagram:

</td><td colspan="2">Instruction code</td><td>Operation</td></tr>
<tr><td>LDP</td><td>X0</td><td>Rising edge of X0 detection starts</td></tr>
<tr><td>AND</td><td>X1</td><td>Connect X1 (the contact A) in serial</td></tr>
<tr><td>OUT</td><td>Y1</td><td>Drive Coil Y1</td></tr>
<tr><td>Remark</td><td colspan="6">See the specification of each model for the range of operands.
If the status of a designated rising-edge is ON before the PLC is powered, the contact of the rising-edge is TRUE after PLC is powered.</td></tr>
</table>

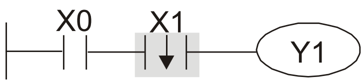
<table>
<tr><td>Instruction</td><td colspan="6">Function</td></tr>
<tr><td>LDF</td><td colspan="6">Falling edge detection</td></tr>
<tr><td rowspan="2">Operand</td><td>X0–X17</td><td>Y0–Y17</td><td>M0–M799</td><td>T0–159</td><td>C0–C79</td><td>D0–D399</td></tr>
<tr><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>-</td></tr>
<tr><td>Description</td><td colspan="6">The method of using LDF is the same as using LD, but the actions of the two instructions differ. LDF saves the current content and store the detected status of falling-edge to the accumulative register.</td></tr>
</table>

<table>
<tr><td rowspan="4">Example</td><td rowspan="4">Ladder diagram:
</td><td colspan="2">Instruction code</td><td>Operation</td></tr>
<tr><td>LDF</td><td>X0</td><td>Falling edge of X0 detection starts</td></tr>
<tr><td>AND</td><td>X1</td><td>Connect X1 (the contact A) in serial</td></tr>
<tr><td>OUT</td><td>Y1</td><td>Drive Coil Y1</td></tr>
</table>

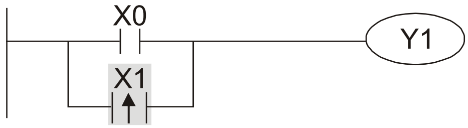
<table>
<tr><td>Instruction</td><td colspan="6">Function</td></tr>
<tr><td>ANDP</td><td colspan="6">Detect serial connection at rising edge</td></tr>
<tr><td rowspan="2">Operand</td><td>X0–X17</td><td>Y0–Y17</td><td>M0–M799</td><td>T0–159</td><td>C0–C79</td><td>D0–D399</td></tr>
<tr><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>-</td></tr>
<tr><td>Description</td><td colspan="6">ANDP instruction is used in the serial connection of the contacts’ rising-edge detection</td></tr>
</table>

<table>
<tr><td rowspan="4">Example</td><td rowspan="4">Ladder diagram:
</td><td colspan="2">Instruction code</td><td>Operation</td></tr>
<tr><td>LD</td><td>X0</td><td>Load X0 (the contact A)</td></tr>
<tr><td>ANDP</td><td>X1</td><td>Detect serial connection at rising edge of X1</td></tr>
<tr><td>OUT</td><td>Y1</td><td>Drive Coil Y1</td></tr>
</table>

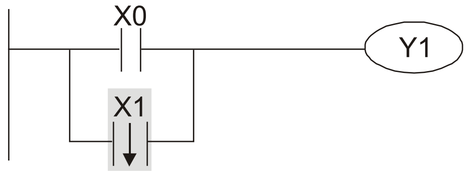
<table>
<tr><td>Instruction</td><td colspan="6">Function</td></tr>
<tr><td>ANDF</td><td colspan="6">Detect serial connection at falling edge</td></tr>
<tr><td rowspan="2">Operand</td><td>X0–X17</td><td>Y0–Y17</td><td>M0–M799</td><td>T0–159</td><td>C0–C79</td><td>D0–D399</td></tr>
<tr><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>-</td></tr>
<tr><td>Description</td><td colspan="6">ANDP instruction is used in the serial connection of the contacts’ rising-edge detection</td></tr>
</table>

<table>
<tr><td rowspan="4">Example</td><td rowspan="4">Ladder diagram:
</td><td colspan="2">Instruction code</td><td>Operation</td></tr>
<tr><td>LD</td><td>X0</td><td>Load X0 (the contact A)</td></tr>
<tr><td>ANDF</td><td>X1</td><td>Detect serial connection at falling edge of X1</td></tr>
<tr><td>OUT</td><td>Y1</td><td>Drive Coil Y1</td></tr>
</table>

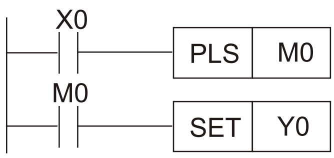
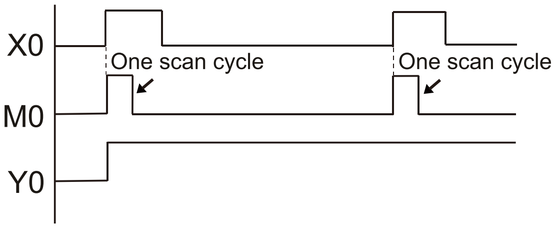
Instruction	Function					
ORP	Detect parallel connection at rising edge					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	-
Description	ORP instruction is used in the parallel connection of the contacts' rising-edge detection					

Example	Ladder diagram:	Instruction code		Operation
		LD	X0	Load X0 (the contact A)
		ORP	**X1**	**Detect parallel connection at rising edge of X1**
		OUT	Y1	Drive Coil Y1

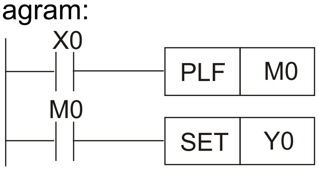
Instruction	Function					
ORF	Detect parallel connection at falling edge					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	-
Description	ORF instruction is used in the parallel connection of the contacts' falling-edge detection					

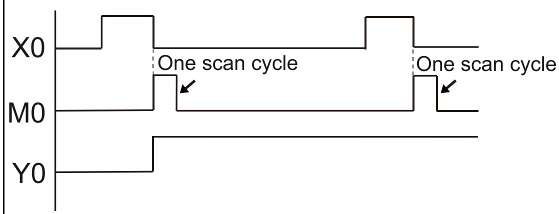
Example	Ladder diagram:	Instruction code		Operation
		LD	X0	Load X0 (the contact A)
		ORF	**X1**	**Detect parallel connection at falling edge of X1**
		OUT	Y1	Drive Coil Y1

Instruction	Function					
PLS	Differential output at rising edge					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	-	✓	✓	-	-	-
Description	Differential output at rising edge instruction. When X0 goes from OFF→ON (the rising-edge is triggered), PLS instruction is executed, M0 sends pulses once and the pulse length is one scanning time.					

Example	Ladder diagram:	Instruction code		Operation
		LD	X0	Load X0 (the contact A)
		PLS	**M0**	**Differential output at rising edge of M0**
		LD	M0	Load M0 (the contact A)
	Sequence diagram: 	SET	Y0	Maintain the action of Y0 (ON)

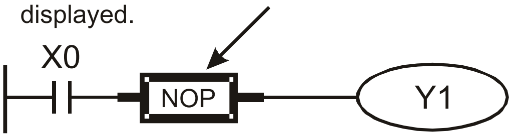
<table>
<tr><td>Instruction</td><td colspan="6">Function</td></tr>
<tr><td>PLF</td><td colspan="6">Differential output at falling edge</td></tr>
<tr><td rowspan="2">Operand</td><td>X0–X17</td><td>Y0–Y17</td><td>M0–M799</td><td>T0–159</td><td>C0–C79</td><td>D0–D399</td></tr>
<tr><td>-</td><td>✓</td><td>✓</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Description</td><td colspan="6">Differential output at falling edge instruction. When X0 goes from ON→OFF (the falling-edge is triggered), PLF instruction is executed, M0 sends pulses once and the pulse length is one scanning time.</td></tr>
</table>

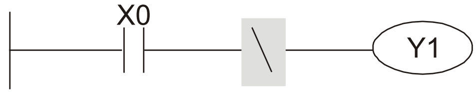
<table>
<tr><td rowspan="6">Example</td><td rowspan="6">Ladder diagram:


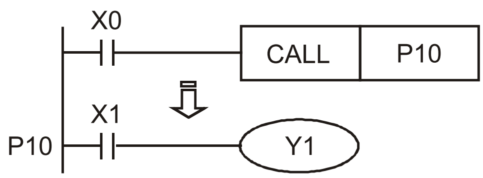
Sequence diagram:

</td><td colspan="2">Instruction code</td><td>Operation</td></tr>
<tr><td>LD</td><td>X0</td><td>Load X0 (the contact A)</td></tr>
<tr><td>PLF</td><td>M0</td><td>Differential output at falling edge of M0</td></tr>
<tr><td>LD</td><td>M0</td><td>Load M0 (the contact A)</td></tr>
<tr><td>SET</td><td>Y0</td><td>Maintain the action of Y0 (ON)</td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

Instruction	Function
END	Program end
Operand	N/A
Description	END instruction has to be placed in the end of a ladder diagram or instruction program. PLC scans from address 0 to END instruction, and then return to address 0 to restart the scan.

Instruction	Function
NOP	No operation
Operand	N/A
Description	NOP instruction does not perform any operations in the program; therefore, after the execution of NOP, the existing logical operation result will be kept. If you want to delete a certain instruction without altering the length of the program, you can use NOP instruction.

<table>
<tr><td rowspan="5">Example</td><td rowspan="5">Ladder diagram:
NOP command will be simplified and not displayed when the ladder diagram is displayed.

</td><td colspan="2">Instruction code</td><td>Operation</td></tr>
<tr><td>LD</td><td>X0</td><td>Load X0 (the contact B)</td></tr>
<tr><td>NOP</td><td></td><td>No operation</td></tr>
<tr><td>OUT</td><td>Y1</td><td>Drive Coil Y1</td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

<table>
<tr><td>Instruction</td><td colspan="4">Function</td></tr>
<tr><td>INV</td><td colspan="4">Inverse operation result</td></tr>
<tr><td>Operand</td><td colspan="4">N/A</td></tr>
<tr><td>Description</td><td colspan="4">Invert the logical operation result before INV instruction and store it in the accumulative register.</td></tr>
<tr><td rowspan="4">Example</td><td rowspan="4">Ladder diagram:
</td><td colspan="2">Instruction code</td><td>Operation</td></tr>
<tr><td>LD</td><td>X0</td><td>Load X0 (the contact B)</td></tr>
<tr><td>INV</td><td></td><td>Inverse operation result</td></tr>
<tr><td>OUT</td><td>Y1</td><td>Drive Coil Y1</td></tr>
</table>

<table>
<tr><td>Instruction</td><td colspan="4">Function</td></tr>
<tr><td>P</td><td colspan="4">Pointer</td></tr>
<tr><td>Operand</td><td colspan="4">P0–P255</td></tr>
<tr><td>Description</td><td colspan="4">Pointer P is used for call instruction API 01 CALL of subprogram. The use of P does not need to start from number 0, and the number cannot be used repeatedly; otherwise, unexpected errors may occur.</td></tr>
<tr><td rowspan="7">Example</td><td rowspan="7">Ladder diagram:
</td><td colspan="2">Instruction code</td><td>Operation</td></tr>
<tr><td>LD</td><td>X0</td><td>Load X0 (the contact A)</td></tr>
<tr><td>CALL</td><td>P10</td><td>CALL instruction reaches P10</td></tr>
<tr><td>⋮</td><td></td><td></td></tr>
<tr><td>P10</td><td></td><td>Pointer P10</td></tr>
<tr><td>LD</td><td>X1</td><td>Load X1 (the contact A)</td></tr>
<tr><td>OUT</td><td>Y1</td><td>Drive Coil Y1</td></tr>
</table>

7-2-3 Overview of application instructions

Category	API	Instruction code		P instruction	Function	Steps	
		16-bit	32-bit			16-bit	32-bit
Loop Control	01	CALL	-	✓	Call subprograms	3	-
	02	SRET	-	-	Subprograms end	1	-
	06	FEND	-	-	Main programs end	1	-
	08	FOR	-	-	Start of a FOR-NEXT loop	3	
	09	NEXT	-	-	End of a FOR-NEXT loop	1	
	317	BREAK	-	✓	Jump out of a FOR-NEXT loop	3	-
Transmission Comparison	10	CMP	DCMP	✓	Compare output value	7	13
	11	ZCP	DZCP	✓	Zone compares	9	17
	12	MOV	DMOV	✓	Move	5	9
	13	SMOV	-	✓	Shift move	11	-
	15	BMOV	-	✓	Block move	7	-
	18	BCD	DBCD	✓	Convert BIN to BCD	5	9
	19	BIN	DBIN	✓	Convert BCD to BIN	5	9
Arithmetic and Logical Operations	20	ADD	DADD	✓	BIN addition	7	13
	21	SUB	DSUB	✓	BIN subtraction	7	13
	22	MUL	DMUL	✓	BIN multiplication	7	13
	23	DIV	DDIV	✓	BIN division	7	13
	24	INC	DINC	✓	BIN increment (add one)	3	5
	25	DEC	DDEC	✓	BIN decrement (subtract one)	3	5
	26	WAND	DAND	✓	Logical operation with AND operator	7	13
	27	WOR	DOR	✓	Logical operation with OR operator	7	13
	28	WXOR	DXOR	✓	Logical operation with XOR operator	7	13
	29	NEG	DNEG	✓	2's complement (negative)	3	5
	114	MUL16	MUL32	✓	Multiplying binary numbers for 16-bit / 32-bit	7	13
	115	DIV16	DIV32	✓	Dividing binary numbers for 16-bit / 32-bit	7	13
Rotation & Displacement	30	ROR	DROR	✓	Rotate right	5	9
	31	ROL	DROL	✓	Rotate left	5	9
Data processing	40	ZRST	-	✓	Zone reset	5	-
	41	DECO	-	✓	Decode	7	-
	42	ENCO	-	✓	Encode	7	-
	43	SUM	DSUM	✓	Sum of active bits	5	9
	44	BON	DBON	✓	Check specified bit status	7	13
	45	MEAN	DMEAN	✓	Mean	7	13
	49	-	DFLT	✓	Convert BIN integer to binary floating-point number	-	9
Communication	150	MODRW	-	✓	Read / write Modbus data	7	-
Floating point operation	110	-	DECMP	✓	Binary floating-point number comparison	-	13
	111	-	DEZCP	✓	Binary floating-point number zone comparison	-	17
	116	-	DRAD	✓	Degree → Radian	-	9
	117	-	DDEG	✓	Radian → Degree	-	9
	120	-	DEADD	✓	Binary floating-point number addition	-	13
	121	-	DESUB	✓	Binary floating-point number subtraction	-	13

Category	API	Instruction code		P instruction	Function	Steps	
		16-bit	32-bit			16-bit	32-bit
	122	-	DEMUL	✓	Binary floating-point number multiplication	-	13
	123	-	DEDIV	✓	Binary floating-point number division	-	13
	124	-	DEXP	✓	Binary floating-point number exponentiation	-	9
	125	-	DLN	✓	Binary floating-point number natural logarithm operation	-	9
	127	-	DESQR	✓	Binary floating-point number square root	-	9
	129	-	DINT	✓	Binary floating-point number → BIN integer	-	9
	130	-	DSIN	✓	Binary floating-point number sine operation	-	9
	131	-	DCOS	✓	Binary floating-point number cosine operation	-	9
	132	-	DTAN	✓	Binary floating-point number tangent operation	-	9
	133	-	DASIN	✓	Binary floating-point number arcsine operation	-	9
	134	-	DACOS	✓	Binary floating-point number arccosine operation	-	9
	135	-	DATAN	✓	Binary floating-point number arctangent operation	-	9
	136	-	DSINH	✓	Binary floating-point number hyperbolic sine operation	-	9
	137	-	DCOSH	✓	Binary floating-point number hyperbolic cosine operation	-	9
	138	-	DTANH	✓	Binary floating-point number hyperbolic tangent operation	-	9
	172	-	DADDR	✓	Floating-point number addition	-	13
	173	-	DSUBR	✓	Floating-point number subtraction	-	13
	174	-	DMULR	✓	Floating-point number multiplication	-	13
	175	-	DDIVR	✓	Floating-point number division	-	13
Additional instruction	202	SCAL	-	✓	Proportional calculation	9	-
RTC (real-time clock)	160	TCMP	-	✓	Time comparison	11	-
	161	TZCP	-	✓	Time zone comparison	9	-
	162	TADD	-	✓	Time addition	7	-
	163	TSUB	-	✓	Time subtraction	7	-
	166	TRD	-	✓	Time read	3	-
Gray code	170	GRY	DGRY	✓	Binary code → Gray code	5	9
	171	GBIN	DGBIN	✓	Gray code → Binary code	5	9
Contact type logical operation	215	LD&	DLD&	-	Contact type logical operation LD#	5	9
	216	LD|	DLD|	-	Contact type logical operation LD#	5	9
	217	LD^	DLD^	-	Contact type logical operation LD#	5	9

Category	API	Instruction code		P instruction	Function	Steps	
		16-bit	32-bit			16-bit	32-bit
	218	AND&	DAND&	-	Contact type logical operation AND#	5	9
	219	ANDI	DANDI	-	Contact type logical operation AND#	5	9
	220	AND^	DAND^	-	Contact type logical operation AND#	5	9
	221	OR&	DOR&	-	Contact type logical operation OR#	5	9
	222	OR|	DOR|	-	Contact type logical operation OR#	5	9
	223	OR^	DOR^	-	Contact type logical operation OR#	5	9
Contact type comparison	224	LD =	DLD =	-	Contact type comparison LD※	5	9
	225	LD >	DLD >	-	Contact type comparison LD※	5	9
	226	LD <	DLD <	-	Contact type comparison LD※	5	9
	228	LD < >	DLD < >	-	Contact type comparison LD※	5	9
	229	LD < =	DLD < =	-	Contact type comparison LD※	5	9
	230	LD > =	DLD > =	-	Contact type comparison LD※	5	9
	232	AND =	DAND =	-	Contact type comparison AND※	5	9
	233	AND >	DAND >	-	Contact type comparison AND※	5	9
	234	AND <	DAND <	-	Contact type comparison AND※	5	9
	236	AND < >	DAND < >	-	Contact type comparison AND※	5	9
	237	AND < =	DAND < =	-	Contact type comparison AND※	5	9
	238	AND > =	DAND > =	-	Contact type comparison AND※	5	9
	240	OR =	DOR =	-	Contact type comparison OR※	5	9
	241	OR >	DOR >	-	Contact type comparison OR※	5	9
	242	OR <	DOR <	-	Contact type comparison OR※	5	9
	244	OR < >	DOR < >	-	Contact type comparison OR※	5	9
	245	OR < =	DOR < =	-	Contact type comparison OR※	5	9
	246	OR > =	DOR > =	-	Contact type comparison OR※	5	9
Floating-point contact type comparison	275	-	FLD =	-	Floating-point number contact type comparison LD※	-	9
	276	-	FLD >	-	Floating-point number contact type comparison LD※	-	9
	277	-	FLD <	-	Floating-point number contact type comparison LD※	-	9

Category	API	Instruction code		P instruction	Function	Steps	
		16-bit	32-bit			16-bit	32-bit
	278	-	FLD < >	-	Floating-point number contact type comparison LD※	-	9
	279	-	FLD < =	-	Floating-point number contact type comparison LD※	-	9
	280	-	FLD > =	-	Floating-point number contact type comparison LD※	-	9
	281	-	FAND =	-	Floating-point number contact type comparison AND※	-	9
	282	-	FAND >	-	Floating-point number contact type comparison AND※	-	9
	283	-	FAND <	-	Floating-point number contact type comparison AND※	-	9
	284	-	FAND < >	-	Floating-point number contact type comparison AND※	-	9
	285	-	FAND < =	-	Floating-point number contact type comparison AND※	-	9
	286	-	FAND > =	-	Floating-point number contact type comparison AND※	-	9
	287	-	FOR =	-	Floating-point number contact type comparison OR※	-	9
	288	-	FOR >	-	Floating-point number contact type comparison OR※	-	9
	289	-	FOR <	-	Floating-point number contact type comparison OR※	-	9
	290	-	FOR < >	-	Floating-point number contact type comparison OR※	-	9
	291	-	FOR < =	-	Floating-point number contact type comparison OR※	-	9
	292	-	FOR > =	-	Floating-point number contact type comparison OR※	-	9
Special instruction for drive	139	RPR	DRPR	✓	Read parameters of drive	5	9
	140	WPR	DWPR	✓	Write parameters of drive	5	9
	323	WPRA	DWPRA	✓	Write parameters of drive (in RAM only)	5	9
	142	FREQ	-	✓	Operation control for drive	7	-
	263	TORQ	-	✓	Set target torque	5	-

7-2-4 Instructions of application instructions

Instruction codes can be divided into 16-bit and 32-bit instructions. We prefix "D” to instruction code to indicate 32-bit instruction, and suffix “P” to instruction code to indicate a pulse executing instruction.

API	Instruction code			Operand	Function
01		**CALL**	P	S	Call subprograms

Type / Operand	Bit devices			Word devices								
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D	

Caution for using operand
- Operand S can assign P
- Operand S of VP3000 can assign P0–P63

16-bit instruction (3 steps)

CALL	Continuous execution type	CALLP	Pulse execution type

32-bit instruction

-	-	-	-

Associated flag: none

Description	● S: the pointer of the call subprogram ● Subprogram must be placed after FEND instruction. ● Subprogram must end with SRET instruction. ● Refer to the description and example of FEND instruction for more details.

API	Instruction code	Operand	Function
02	**SRET**	-	Subprograms end

Type / Operand	Bit devices			Word devices								
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D

Caution for using operand

- No operand
- No contact to drive the instruction is required.

16-bit instruction (1 step)

SRET	Continuous execution type	-	-

32-bit instruction

-	-	-	-

Associated flag: none

Description

- No contact to drive the instruction is required. Automatically returns program execution to the address after CALL instruction
- This instruction code indicates the end of subprogram. The subprogram returns to main program and begins the execution with the instruction after CALL instruction.
- Refer to the description and example of FEND instruction for more details.

API	Instruction code	Operand	Function
06	**FEND**	-	Main programs end

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D

Caution for using operand

- No operand
- No contact to drive the instruction is required.

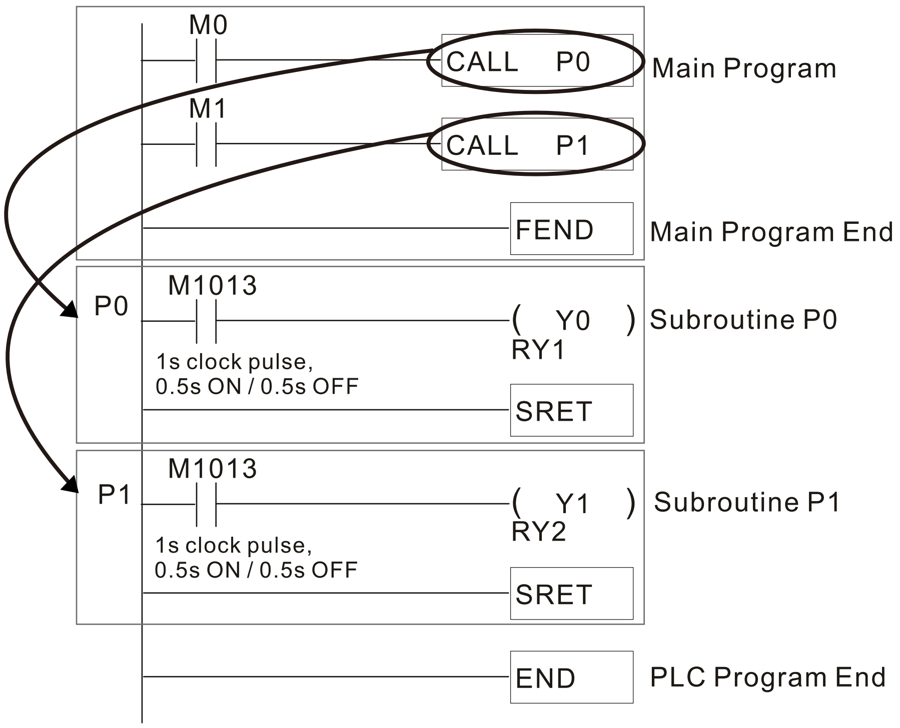
16-bit instruction (1 step)			
FEND	Continuous execution type	-	-

32-bit instruction			
-	-	-	-

Associated flag: none

Description	● This instruction code indicates the end of main program. It is the same as END instruction in PLC operation process. ● The subprogram of CALL instruction must be placed after FEND instruction, and each subprogram must end with SRET instruction. ● An END instruction is also required when using FEND instruction. But END instruction must be placed after main program and subprogram to the last.

CALL instruction program flow



API	Instruction code			Operand	Function
08		**FOR**		S	Start of a FOR-NEXT loop

Type / Operand	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
	Bit devices			Word devices							
S							*	*	*	*	*

Caution for using operand

- No contact to drive the instruction is required.

16-bit instruction (3 steps)

FOR	Continuous execution type	-	-

32-bit instruction

-	-	-	-

Associated flag: none

Description	● S: the number of repeated nested loops ● The designated scope of FOR is K1–K32767 If N ≤ K1, then the programs in this FOR-NEXT loop will be ignored.

API	Instruction code	Operand	Function
09	**NEXT**	-	End of a FOR-NEXT loop

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D

Caution for using operand

- No operand
- No contact to drive the instruction is required.

16-bit instruction (1 step)

NEXT	Continuous execution type	—	—

32-bit instruction

-	-	-	-

Associated flag: none

API	Instruction code		Operand	Function
317	**BREAK**	P	D	Jump out of a FOR-NEXT loop

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D							*	*	*	*	*

Caution for using operand

- Only escape the FOR-NEXT loop of the level
- After triggering, do not perform the operation from BREAK to NEXT of the level.

16-bit instruction (3 steps)

BREAK	Continuous execution type	BREAKP	Pulse execution type

32-bit instruction

-	-	-	-

Associated flag: none

Description

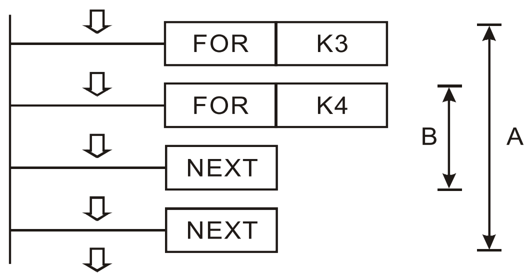
- D: the number of nested loops not completed (including the loop jumps out this time)
- An error occurs when:
  1. The number of instructions between FOR and NEXT differs.
  2. FOR and NEXT are not paring (the NEXT that appears first finds the closest FOR of it in front to pair, and the FOR and the NEXT have been paired cannot be paired for the following instruction).
  3. FEND or END is between the paired FOR-NEXT.
  4. BREAK is out of the paired FOR-NEXT.
- FOR-NEXT loops can be nested for maximum five levels. Be careful that if there are too many loops, the increased PLC scan time may cause timeout of watchdog timer and error. You can increase D1000 to change the time for watchdog
- The input variable of FOR must be positive (K1–K32767), otherwise FOR-NEXT program operation will be ignored.
- The number of FOR loop operation is mainly based on the input variable when the FOR operation is reached. The number will not be changed by changing the input value midway.
- When BREAK is triggered, the programs between this triggered BREAK and the NEXT of this level does not perform operation.

Example

Constants cannot be entered into FOR, the following examples are only for explanations.

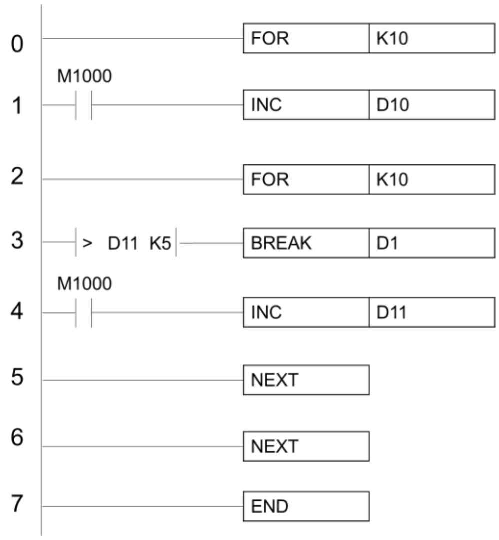
- Example 1

  After program A executes three times, the programs after NEXT continue to execute. Program B executes four times whenever program A executes once. Therefore, program B executes 3 x 4 = 12 times in total.



- Example 2

When the programs between FOR-NEXT are not to be executed, you can use BREAK instruction to jump out. The following programs are two layers of loop (0–6, 2–5), when the program operation is finished: D10 = 10, D11 = 6, D1 = 10.



D11 executes six times in the loop of second layer, D11 > 5, and then jumps out the loop of second layer to no.6, the rest of the number for D1 loop is five at the moment.

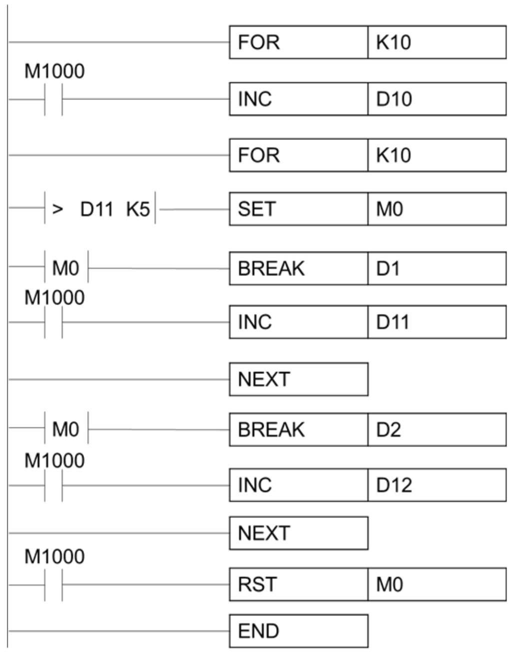
Only jump out one layer of loop, so the operation will go back to no.1 and start.

When enter the second layer of loop again, D11 > 5, so the loop jumps out directly. The rest of the number for D1 loop is 10.

Repeat this until the end of the first layer of loop, D10 = 10.

- Example 3

If you want the operation to jump out all layers of loops, it is recommended to set another flag and use BREAK after every NEXT. See the figure below, when the program operation is finished, D10 = 1, D11 = 6, D12 = 0, D1 = 5, D2 = 10.



API	Instruction code			Operand	Function
10	D	**CMP**	P	S_1, S_2, D	Compare output value

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*
D		*	*								

Caution for using operand

- Operand D occupies 3 consecutive devices.

16-bit instruction (7 steps)

CMP	Continuous execution type	CMPP	Pulse execution type

32-bit instruction (13 steps)

DCMP	Continuous execution type	DCMPP	Pulse execution type

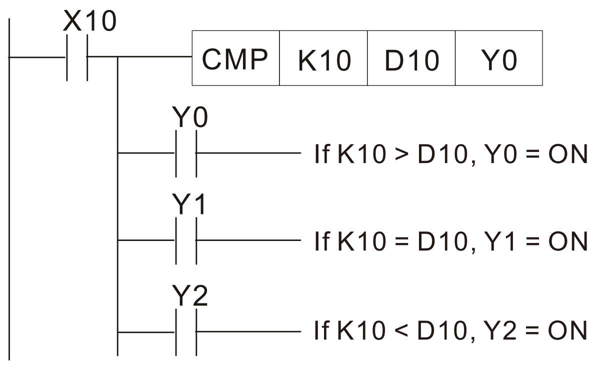
Associated flag: none

Description

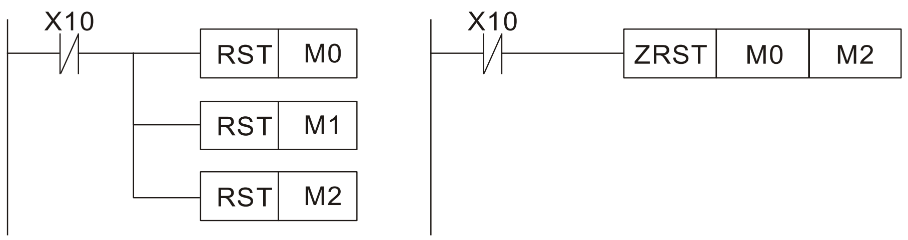
- S_1: comparison value 1
  S_2: comparison value 2
  D: comparison result
- Compare operand S_1 and S_2, and the comparison result is stored in D.
- The two comparison values are compared algebraically, and the two values are signed binary values. When b15 = 1 in 16-bit instruction, the comparison regards the value as negative binary values.

Example

- Designate device Y0, and operand D automatically occupies Y0, Y1, and Y2.
- When X10 = ON, CMP instruction is executed, and one of Y0, Y1, and Y2 will be ON. When X10 = OFF, CMP instruction is not executed, and Y0, Y1, and Y2 remain their status before X10 = OFF.
- If you need to obtain a comparison result with ≥, ≤, and ≠, make a serial-parallel connection between Y0–Y2.



- To clear the comparison result, use RST or ZRST instruction.



API	Instruction code			Operand	Function
11	D	**ZCP**	P	S_1, S_2, S, D	Zone compares

Type / Operand	Bit devices X	Y	M	Word devices K	H	KnX	KnY	KnM	T	C	D
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*
S				*	*	*	*	*	*	*	*
D		*	*								

16-bit instruction (9 steps)

ZCP	Continuous execution type	ZCPP	Pulse execution type

32-bit instruction (17 steps)

DZCP	Continuous execution type	DZCPP	Pulse execution type

Associated flag: none

Caution for using operand

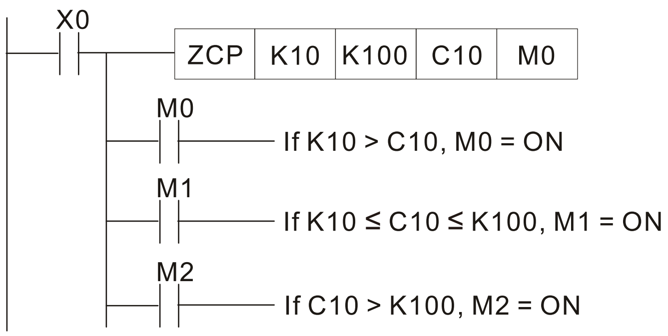
- The content in S_1 should be smaller than the content in S_2.
- Operand D occupies 3 consecutive devices.

Description

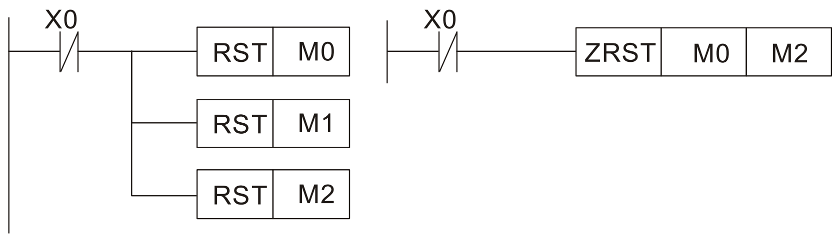
- S_1: lower bound of zone comparison
  S_2: upper bound of zone comparison
  S: comparison value
  D: comparison result
- S is compared with its S_1 and S_2, and the result is stored in D.
- When S_1 > S_2, the instruction performs comparison by using S_1 as the lower / upper bound.
- The two comparison values are compared algebraically, and the two values are signed binary values. When b15 = 1 in 16-bit instruction, the comparison regards the value as negative binary values.

Example

- Designate device M0, and operand D automatically occupies M0, M1 and M2.
- When X0 = ON, ZCP instruction is executed, and one of M0, M1, and M2 will be ON. When X0 = OFF, ZCP instruction is not executed, and M0, M1, and M2 remain their status before X0 = OFF.
- If you need to obtain a comparison result with ≥, ≤, and ≠, make a serial-parallel connection between M0–M2.



- To clear the comparison result, use RST or ZRST instruction.



API	Instruction code			Operand	Function
12	D	**MOV**	P	S, D	Move

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Caution for using operand: none

16-bit instruction (5 steps)

MOV	Continuous execution type	MOVP	Pulse execution type

32-bit instruction (9 steps)

DMOV	Continuous execution type	DMOVP	Pulse execution type

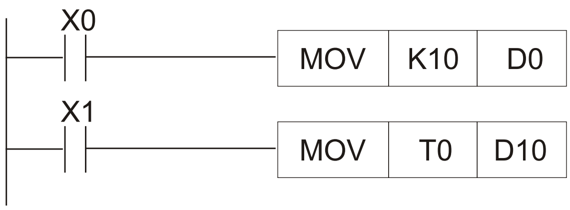
Associated flag: none

Description

- S: source of data
  D: destination of data
- When this instruction is executed, the content of S is moved directly to D. When this instruction is not executed, the content of D remains unchanged.

Example

- When X0 = OFF, the content in D10 remains unchanged. If X0 = ON, the value K10 is moved to D10 data register.
- When X1 = OFF, the content in D10 remains unchanged. If X1 = ON, the current value T0 is moved to D10 data register.



API	Instruction code			Operand	Function
13		**SMOV**	P	S, m_1, m_2, D, n	Shift move

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S						*	*	*	*	*	*
m_1				*	*						
m_2				*	*						
D						*	*	*	*	*	*
n				*	*						

Caution for using operand

- M1168 can adjust BCD (OFF), BIN (ON) modes.

16-bit instruction (11 steps)

SMOV	Continuous execution type	SMOVP	Pulse execution type

32-bit instruction

-	-	-	-

Associated flag: none

Description

- S: source of data

  m_1: start digit to be moved of the source data

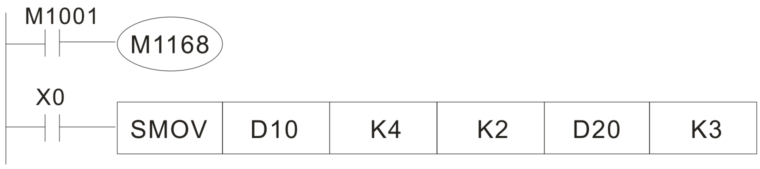
  m_2: number of digits to be moved of the source data

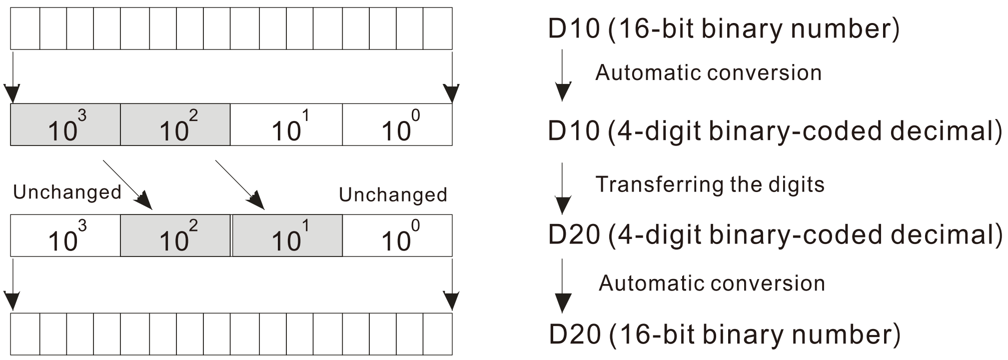
  D: destination device

  n: start digit of the destination position for the moved digits
- BCD mode (M1168 = OFF): in this mode, SMOV enables to operate BCD number, the operation is similar to the way SMOV operates decimal numbers. That is to say, this instruction copies the designated digit of the operand S (a 4-digit BCD number) and send to the operand D (also a 4-digit BCD number).
- BIN mode (M1168 = ON): this instruction copies the designated digit of the operand S (a 4-digit decimal number) and send to the operand D (also a 4-digit decimal number). The current data on the target register will be covered.
- Scope of m_1: 1–4
- Scope of m_2: 1–m_1 (m_2 cannot be larger than m_1)
- Scope of n: m_2 –4 (n cannot be smaller than m_2)

Example

- Example 1
  1. When M1168 = OFF (BCD mode) and X0 = ON, transfer the two digit content that starts calculating from the 4th digit (means the thousands digit) of D10's decimal value to the two digit content that starts from the 3rd digit (means the hundreds digit) of D20's decimal number. 10^3 and 10^0 of D20 remain unchanged after this instruction is executed.
  2. When the BCD value exceeds the range of 0–9,999, PLC determines an operation error and will not execute the instruction. M1067, M1068 = ON, and D1067 records the error code OE18 (hex).

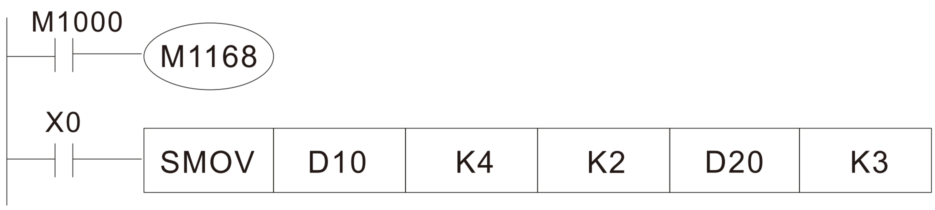


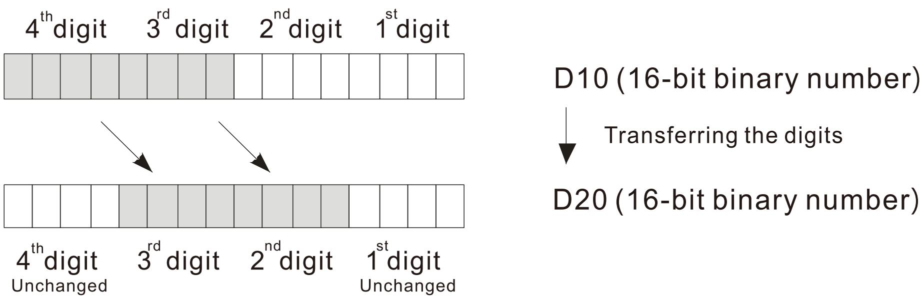


3. Before the execution, assume D10 = K1234 and D20 = K5678. After the execution, D10 remains unchanged and D20 becomes K5128.

- Example 2

When M1168 = ON (BIN mode) and use SMOV instruction, D10 and D20 does not be converted in BCD format but be moved in BIN format (4 digits as a unit).





API	Instruction code			Operand	Function
15		**BMOV**	P	S, D, n	Block move

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S						*	*	*	*	*	*
D							*	*	*	*	*
n				*	*				*	*	

Caution for using operand

- Scope of n = 1–512

16-bit instruction (7 steps)			
BMOV	Continuous execution type	BMOVP	Pulse execution type

32-bit instruction			
-	-	-	-

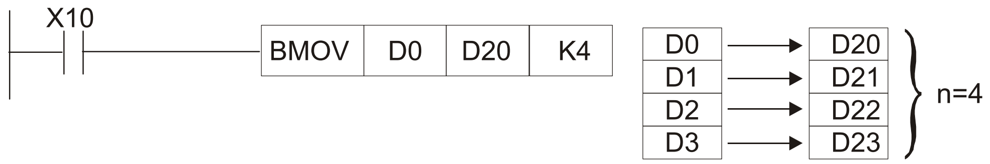
Associated flag: none

Description

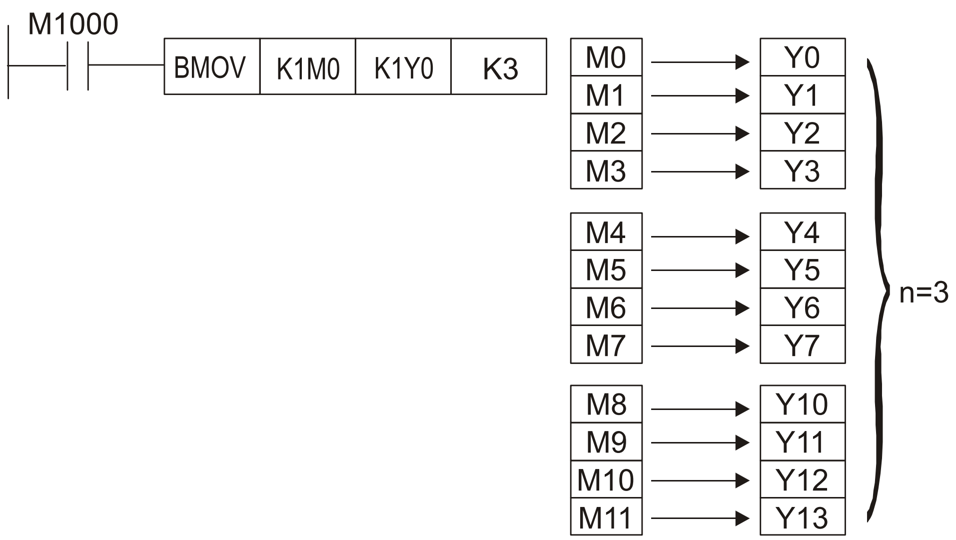
- S: start of source devices
  D: start of destination devices
  n: number of data to be moved
- The contents in n registers starting from the device designated by S is moved to n registers starting from the device designated by D. If n exceeds the actual number of available source devices, only the devices that fall within the valid range will be used.

Example

- Example 1
  When X10 = ON, the contents of four registers of D1–D3 is moved to the four registers of D20–D23.



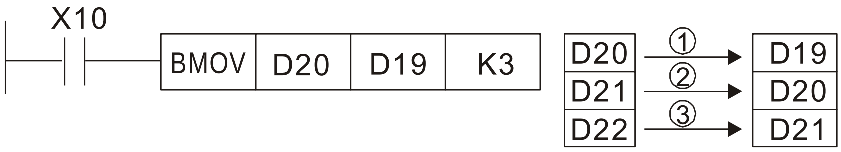
- Example 2
  Assume the bit devices KnX, KnY, and KnM are designated for moving, the number of digits of S and D has to be the same, that is, their n has to be the same.



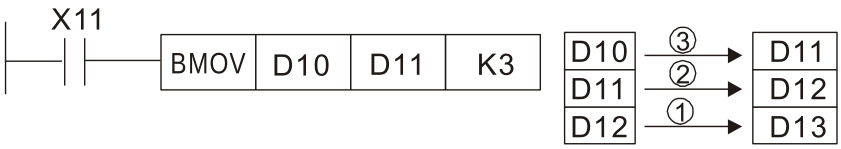
- Example 3

To avoid coincidence of the device numbers to be moved designated by the two operands and cause confusion, be aware of the arrangement on the designated device numbers, as shown below:

When S > D, the instruction is processed following the order①→②→③.



When S < D, the instruction is processed following the order③→②→①.



API	Instruction code			Operand	Function
18	D	**BCD**	P	S, D	Convert BIN to BCD

Type / Operand	Bit devices X	Bit devices Y	Bit devices M	Word devices K	Word devices H	Word devices KnX	Word devices KnY	Word devices KnM	Word devices T	Word devices C	Word devices D
S						*	*	*	*	*	*
D							*	*	*	*	*

Caution for using operand

- Scope of S is BIN: 0–9999

16-bit instruction (5 steps)

BCD	Continuous execution type	BCDP	Pulse execution type

32-bit instruction (9 steps)

DBCD	Continuous execution type	DBCDP	Pulse execution type

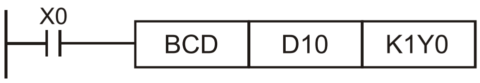
Associated flag: none

Description

- S: source of data
  D: destination of data
- The content in S (BIN value, 0–9999) is converted into BCD value and stored in D.
- Operand S, D use device F, and they can only use 16-bit instructions.

Example

- When X0 = ON, the binary value of D10 is converted into BCD value, and the unit digit of the conversion result is stored in K1Y0 (Y0–Y3, the 4 bit devices).



When D10 = 001E (Hex) = 0030 (decimal), the execution result is: Y0–Y3 = 0000 (BIN).

API	Instruction code			Operand	Function
19	D	**BIN**	P	S, D	Convert BCD to BIN

Type / Operand	Bit devices X	Bit devices Y	Bit devices M	Word devices K	H	KnX	KnY	KnM	T	C	D
S						*	*	*	*	*	*
D							*	*	*	*	*

Caution for using operand

- Scope of S is BCD: 0–9,999, DBCD: 0–99,999,999

16-bit instruction (5 steps)

BIN	Continuous execution type	BINP	Pulse execution type

32-bit instruction (9 steps)

DBIN	Continuous execution type	DBINP	Pulse execution type

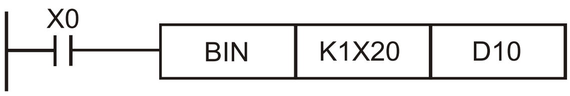
Associated flag: none

Description

- S: source of data
  D: conversion result
- The content in S (BCD value, 0–9999) is converted into BIN value and stored in D.
- The scope of valid value of S is BCD: 0–9,999, DBCD: 0–99,999,999
- Provided the content in S is not a BCD value, an operation error will occur.

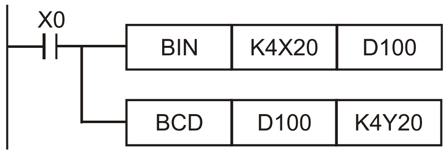
Example

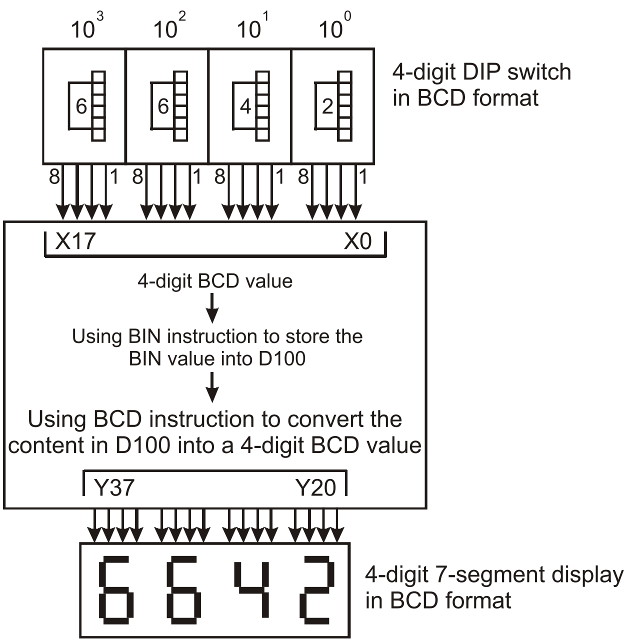
- When X0 = ON, the BCD value of K1X20 is converted to BIN value and stored in D10.



Remark

- When PLC needs to read an external DIP switch in BCD format, BIN instruction has to be first adopted to convert the read data into BIN value and store the data in PLC.
- When PLC needs to display its stored data by a 7-segment display in BCD format, BCD instruction has to be first adopted to convert the data into BCD value and send the data to the 7-segment display.
- When X0 = ON, the BCD value of K4X20 is converted into BIN value and sent it to D100. The BIN value of D100 will then be converted into BCD value and sent to K4Y20.





API	Instruction code			Operand	Function
20	D	**ADD**	P	S_1, S_2, D	BIN addition

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Caution for using operand: none

16-bit instruction (7 steps)

ADD	Continuous execution type	ADDP	Pulse execution type

32-bit instruction (13 steps)

DADD	Continuous execution type	DADDP	Pulse execution type

Associated flag:

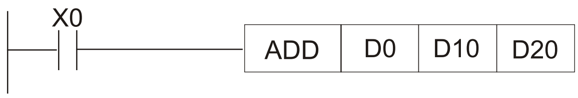
M1020: Zero flag
M1021: Borrow flag
M1022: Carry flag
See the following descriptions.

Description

- S_1: summand
  S_2: addend
  D: sum
- This instruction adds S_1 and S_2 in BIN format and store the result in D.
- The highest bit is symbolic bit 0 (+) and 1 (-), which is suitable for algebraic addition, e.g., 3 + (-9) = -6.
- Flag changes in binary addition:
  1. If the operation result = 0, zero flag M1020 = ON.
  2. If the operation result < -32,768, borrow flag M1021 = ON.
  3. If the operation result > 32,767, carry flag M1022 = ON.

Example

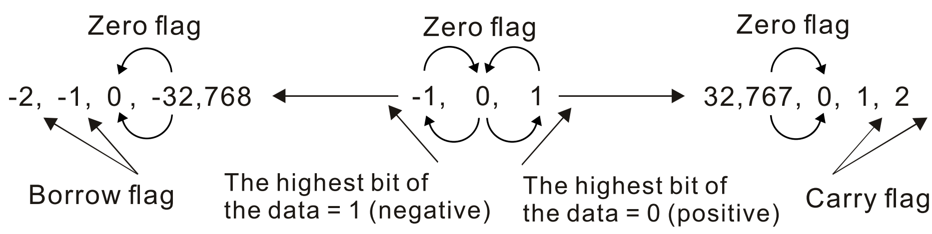
- In 16-bit BIN addition:
  When X0 = ON, the content in D0 plus the content in D10 and the sum is stored in D20.



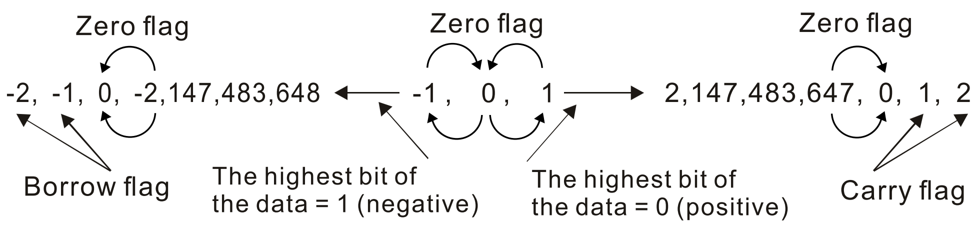
Remark

- Flags and the positive / negative sign of the values:

16-bit:



32-bit:



API	Instruction code			Operand	Function
21	D	**SUB**	P	S_1, S_2, D	BIN subtraction

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Caution for using operand: none

16-bit instruction (7 steps)

SUB	Continuous execution type	SUBP	Pulse execution type

32-bit instruction (13 steps)

DSUB	Continuous execution type	DSUBP	Pulse execution type

Associated flag:

M1020: Zero flag
M1021: Borrow flag
M1022: Carry flag
See the following descriptions.

Description

- S_1: minuend

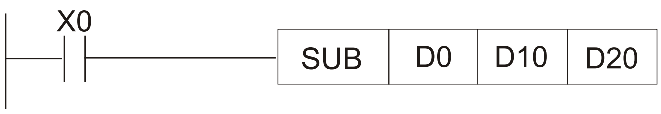
  S_2: subtrahend

  D: difference
- This instruction subtracts S_1 and S_2 in BIN format and stores the result in D.
- The highest bit is symbolic bit 0 (+) and 1 (-), which is suitable for algebraic subtraction.
- Flag changes in binary subtraction:
  1. If the operation result = 0, zero flag M1020 = ON.
  2. If the operation result < -32,768, borrow flag M1021 = ON.
  3. If the operation result > 32,767, carry flag M1022 = ON.

Example

- In 16-bit BIN subtraction:

  When X0 = ON, the content in D0 minus the content in D10 and the difference is stored in D20.



API	Instruction code			Operand	Function
22	D	**MUL**	P	S_1, S_2, D	BIN multiplication

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Caution for using operand

- In 16-bit instruction, operand D occupies 2 consecutive devices.

16-bit instruction (7 steps)

MUL	Continuous execution type	MULP	Pulse execution type

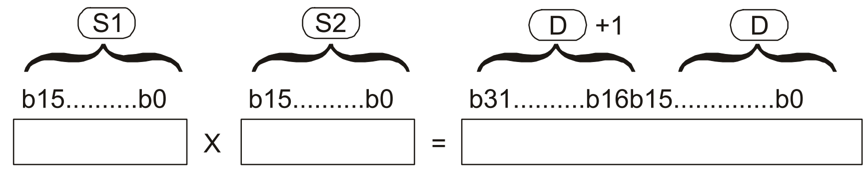
32-bit instruction (13 steps)

DMUL	Continuous execution type	DMULP	Pulse execution type

Associated flag: none

Description

- S_1: Multiplicand
  S_2: Multiplicator
  D: Product
- This instruction multiplies S_1 by S_2 in BIN format and stores the result in D.
- In 16-bit BIN multiplication,



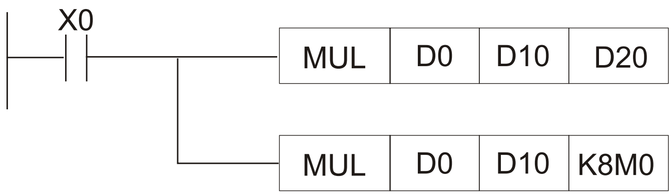
b15 is a symbol bit b15 is a symbol bit b31 is a symbol bit (b15 of D+1)

Symbol bit = 0 refers to a positive value
Symbol bit = 1 refers to a negative vlalue

When D serves as a bit device, it can designate K1–K4 and construct a 16-bit result, occupying consecutive 2 groups of 16-bit data.

Example

- The 16-bit D0 is multiplied by the 16-bit D10 and brings forth a 32-bit product. The higher 16 bits are stored in D21, and the lower 16-bit are stored in D20. ON / OFF of the most left bit indicates the positive / negative status of the result value.



API	Instruction code			Operand	Function
23	D	**DIV**	P	S_1, S_2, D	BIN division

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Caution for using operand

- In 16-bit instruction, operand D occupies 2 consecutive devices.

16-bit instruction (7 steps)

DIV	Continuous execution type	DIVP	Pulse execution type

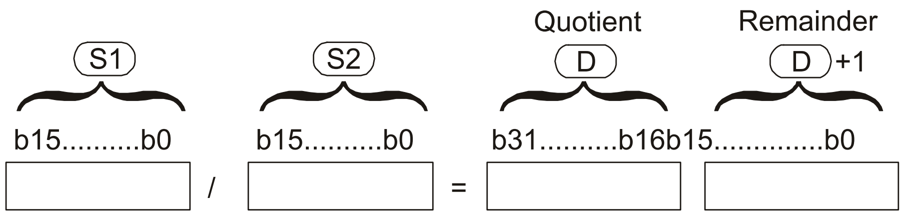
32-bit instruction (13 steps)

DDIV	Continuous execution type	DDIVP	Pulse execution type

Associated flag: none

Description

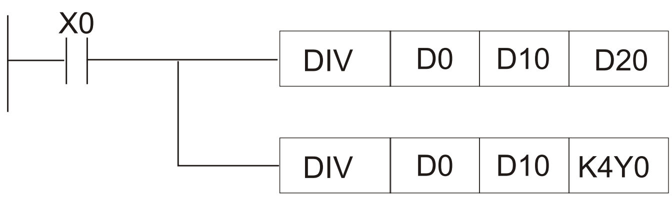
- S_1: Dividend
  S_2: Divisor
  D: Quotient and remainder
- This instruction divides S_1 and S_2 in BIN format and stores the result in D. Be careful with the positive / negative signs of S_1, S_2 and D when doing 16-bit operation.
- In 16-bit BIN division,



When D serves as a bit device, it can designate K1–K4 and construct a 16-bit result, occupying consecutive 2 groups of 16-bit data and bringing forth the quotient and remainder.

Example

- When X0 = ON, D0 is divided by D10, and the quotient will be stored in D20 and remainder in D21. ON / OFF of the highest bit indicates the positive / negative status of the result value.



API	Instruction code			Operand	Function
24	D	**INC**	P	D	BIN increment (add one)

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D							*	*	*	*	*

Caution for using operand: none

16-bit instruction (3 steps)			
INC	Continuous execution type	INCP	Pulse execution type

32-bit instruction (5 steps)			
DINC	Continuous execution type	DINCP	Pulse execution type

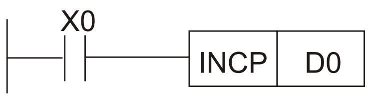
Associated flag: none

Description

- D: destination devices
- If the instruction is not a pulse execution one, the content in the designated device D will plus "1" in every scan period whenever the instruction is executed.
- This instruction adopts pulse execution instructions (INCP).
- In 16-bit operation, 32,767 plus 1 and obtains -32,768. In 32-bit operation, 2,147,483,647 plus 1 and obtains -2,147,483,648.

Example

- When X0 = OFF→ON, the content in D0 plus 1 automatically.



API	Instruction code			Operand	Function
25	D	**DEC**	P	D	BIN decrement (subtract one)

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D							*	*			

Caution for using operand: none

16-bit instruction (3 steps)

DEC	Continuous execution type	DECP	Pulse execution type

32-bit instruction (5 steps)

DECC	Continuous execution type	DDECP	Pulse execution type

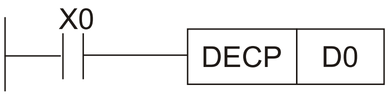
Associated flag: none

Description

- D: destination devices
- If the instruction is not a pulse execution one, the content in the designated device D will minus "1" in every scan period whenever the instruction is executed.
- This instruction adopts pulse execution instructions (DECP).
- In 16-bit operation, -32,768 minus 1 and obtains 32,767. In 32-bit operation, -2,147,483,648 minus 1 and obtains 2,147,483,647.

Example

- When X0 = OFF→ON, the content in D0 minus 1 automatically.



API	Instruction code			Operand	Function
26	D	**WAND / DAND**	P	S_1, S_2, D	Logical operation with AND operator (16-bit) / logical operation with AND operator (32-bit)

Type / Operand	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
	Bit devices			Word devices							
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Caution for using operand: none

16-bit instruction (7 steps)

WAND	Continuous execution type	WANDP	Pulse execution type

32-bit instruction (13 steps)

DAND	Continuous execution type	DANDP	Pulse execution type

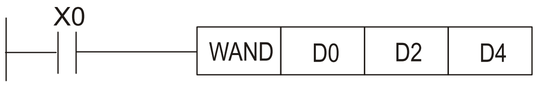
Associated flag: none

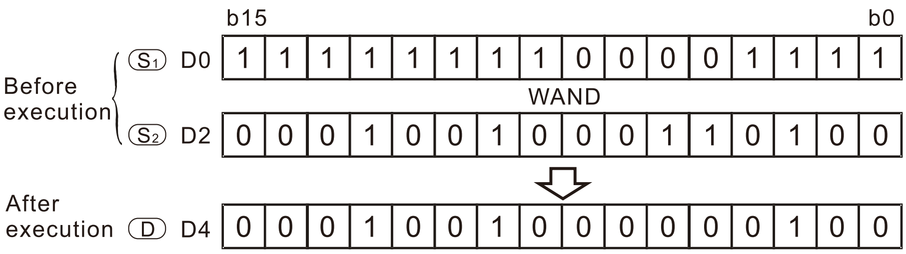
Description

- S_1 source data device 1
  S_2 source data device 2
  D: operation result
- This instruction conducts logical AND operation of S_1 and S_2 and stores the result in D.
- The corresponding bit of the operation result in D will be "0" if any of the bits in S1 or S2 is "0".

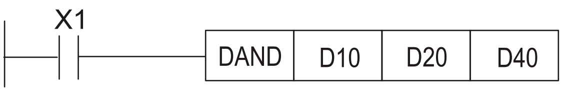
Example

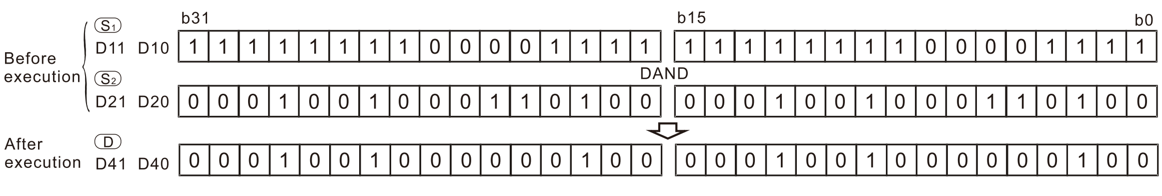
- When X0 = ON,16-bit D0 and D2 perform WAND, logical AND operation, and the result will be stored in D4.





- When X1 = ON, 32-bit (D11, D10) and (D21, D20) perform DAND, logical AND operation, and the result will be stored in (D41, D40).





API	Instruction code		Operand	Function
27	**WOR / DOR**	P	S1, S2, D	Logical operation with OR operator (16-bit) / logical operation with OR operator (32-bit)

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Caution for using operand: none

16-bit instruction (7 steps)

WOR	Continuous execution type	WORP	Pulse execution type

32-bit instruction (13 steps)

DOR	Continuous execution type	DORP	Pulse execution type

Associated flag: none

Description

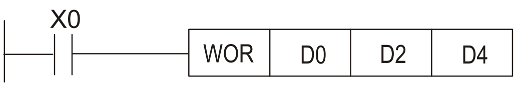
- S_1 source data device 1

  S_2 source data device 2

  D: operation result
- This instruction conducts logical OR operation of S_1 and S_2 and stores the result in D.
- The corresponding bit of the operation result in D will be “0” if any of the bits in S1 or S2 is “0”.

Example

- When X0 = ON,16-bit D0 and D2 perform WOR, logical OR operation, and the result will be stored in D4.



		b15															b0
Before execution	S_1 D0	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
	WOR																
	S_2 D2	0	0	0	0	1	1	1	1	1	0	1	0	0	1	0	1
After execution	D D4	0	1	0	1	1	1	1	1	1	1	1	1	0	1	0	1

- When X1 = ON, 32-bit (D11, D10) and (D21, D20) perform DOR, logical OR operation, and the result will be stored in (D41, D40).

		b31																b15															b0
Before execution	S_1 D11 D10	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	1
	DOR																																
	S_2 D21 D20	0	0	0	1	0	0	1	0	0	0	1	1	0	1	0	0	0	0	0	1	0	0	1	0	0	0	1	1	0	1	0	0
After execution	D D41 D40	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1

API	Instruction code			Operand	Function
28	D	**WXOR / DXOR**	P	S_1, S_2, D	Logical operation with XOR operator (16-bit) / logical operation with XOR operator (32-bit)

Type / Operand	Bit devices X	Y	M	Word devices K	H	KnX	KnY	KnM	T	C	D
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Caution for using operand: none

16-bit instruction (7 step)

WXOR	Continuous execution type	WXORP	Pulse execution type

32-bit instruction (13 steps)

DXOR	Continuous execution type	DXORP	Pulse execution type

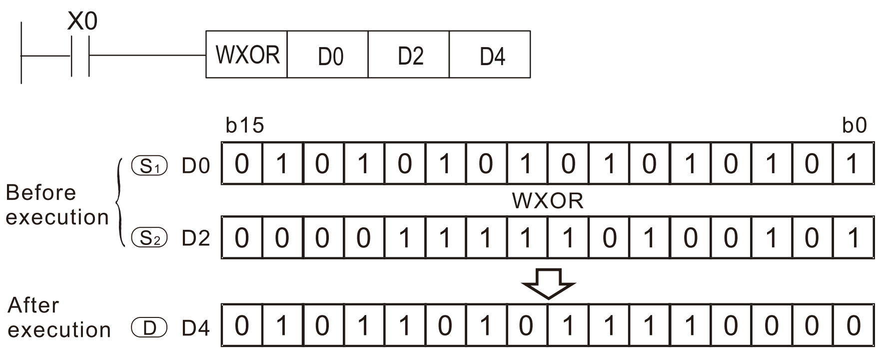
Associated flag: none

Description

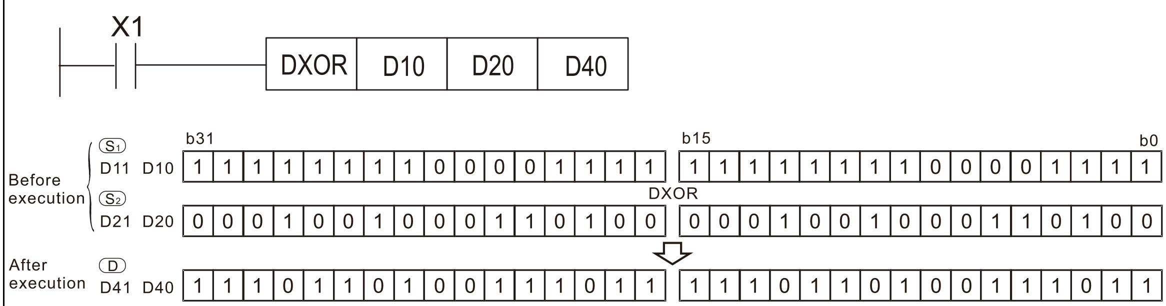
- S_1 source data device 1
  S_2 source data device 2
  D: operation result
- This instruction conducts logical XOR operation of S_1 and S_2 and stores the result in D.
- If the bits in S_1 and S_2 are the same, the corresponding bit of the operation result in D will be "0";
  if the bits in S_1 and S_2 are different, the corresponding bit of the operation result in D will be "1".

Example

- When X0 = ON,16-bit D0 and D2 perform XWOR, logical XOR operation, and the result will be stored in D4.



- When X1 = ON, 32-bit (D11, D10) and (D21, D20) perform XDOR, logical XOR operation, and the result will be stored in (D41, D40).



API	Instruction code			Operand	Function
29	D	**NEG**	P	D	2’s complement (negative)

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D							*	*	*	*	*

Caution for using operand: none

16-bit instruction (3 steps)

NEG	Continuous execution type	NEGP	Pulse execution type

32-bit instruction (5 steps)

DNEG	Continuous execution type	DNEGP	Pulse execution type

Associated flag: none

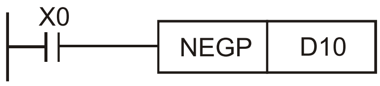
Description

- Device to store 2’s complement
- Each bit in D is reverse (0 → 1, 1 → 0) at first, and then the least significant bit plus 1 and is stored in the original register. This instruction can be used for converting a negative BIN value into an absolute value.
- This instruction adopts pulse execution instructions (NEGP, DNEGP).
- Operand D uses device F, and they can only use 16-bit instructions.

Example

- Example 1

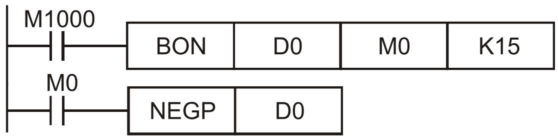
When X0 goes from OFF → ON, each bit in D10 is reverse (0 → 1, 1 → 0) at first, and then the least significant bit plus 1 and is stored in D10.



- Example 2

To obtain the absolute value of a negative value:

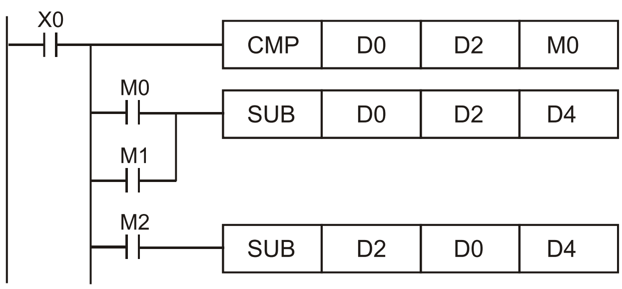
1. When the 15th bit of D0 is “1”, M0 = ON. (D0 is a negative value).
2. When M0 = ON, the absolute value of D0 can be obtained by NEG instruction.



- Example 3

Obtain the absolute value of the difference of the subtraction. When X0 = ON:

1. If D0 > D2, M0 = ON.
2. If D0 = D2, M1 = ON.
3. If D0 < D2, M2 = ON.
4. D4 is then able to remain positive.



Remark	● Negative value and its absolute value 1. The positive / negative numbers are represented by the leftmost bit of the register (MSB), MSB = 0 indicates the value is positive, and MSB = 1 indicates the value is negative. 2. NEG instruction is able to convert a negative value into its absolute value.

(D0=2)	0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0		
(D0=1)	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1		
(D0=0)	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		
(D0=-1)	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	$\overline{(D0)}+1=1$	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1
(D0=-2)	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0	$\overline{(D0)}+1=2$	0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0
(D0=-3)	1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 1	$\overline{(D0)}+1=3$	0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1
(D0=-4)	1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0	$\overline{(D0)}+1=4$	0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0
(D0=-5)	1 1 1 1 1 1 1 1 1 1 1 1 1 0 1 1	$\overline{(D0)}+1=5$	0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1
⋮	⋮		⋮
(D0=-32,765)	1 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1	$\overline{(D0)}+1=32,765$	0 1 1 1 1 1 1 1 1 1 1 1 1 1 0 1
(D0=-32,766)	1 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0	$\overline{(D0)}+1=32,766$	0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0
(D0=-32,767)	1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1	$\overline{(D0)}+1=32,767$	0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
(D0=-32,768)	1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	$\overline{(D0)}+1=-32,768$	1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

The absolute value can only be up to 32,767

API	Instruction code		Operand	Function
114	**MUL16 / MUL32**	P	S_1, S_2, D	Multiplying binary numbers for 16-bit / Multiplying binary numbers for 32-bit

Type / Operand	Bit devices: X	Y	M	Word devices: K	H	KnX	KnY	KnM	T	C	D
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Caution for using operand: see the remark below

16-bit instruction (7 steps)

MUL	Continuous execution type	MULP	Pulse execution type

32-bit instruction (13 steps)

DMUL	Continuous execution type	DMULP	Pulse execution type

Associated flag: none

Description

- S_1: Multiplicand
  S_2: Multiplicator
  D: Product
- MUL16 and MUL16P are 16-bit instructions. MUL32 and MUL32P are 32-bit instructions.
- The signed binary value in S_1 is multiplied by the signed binary value in S_2, and the product is stored in D. Notice that it is applicable to normal algebraic regulations.
- If the sign bit is 0, it represents a positive value. If the sign bit is 1, it represents a negative value.
- 16-bit BIN multiplication

S_1		S_2		D
b15 .... b0	X	b15 .... b0	=	b15 .... b0
b15 is a sign bit		b15 is a sign bit		b15 is a sign bit

16-bit value × 16-bit value = 16-bit value

When D serves as a bit device, it can designate K1–K4 and construct a 16-bit result, occupying one 16-bit data.

- 32-bit BIN multiplication

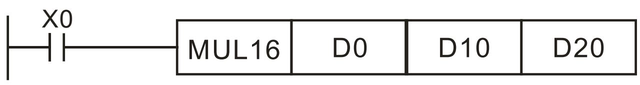
S_1+1	S_1		S_2+1	S_2		D+1	D
b31 … b16	b15 … b0	X	b31 … b16	b15 … b0	=	b31 … b16	b15 … b0
b31 is a sign bit			b31 is a sign bit			b31 is a sign bit	

32-bit value × 32-bit value = 32-bit value

When D serves as a bit device, it can designate K1–K8 and construct a 32-bit result, occupying one 32-bit data.

Example

- The 16-bit value K100 in D0 is multiplied by the 16-bit value K200 in D10, and the product is stored in D20. Whether the value is positive or negative is indicated by OFF / ON of MSB. OFF indicates the positive value (0), and ON indicates the negative value (1).



16-bit value × 16-bit value = 16-bit value

⇨ D0 × D10 = D20

D0 = K100, D10 = K200, D20 = K20,000

Remark	● If the product of 16-bit multiplication exceeds the expressible range of 16-bit signed numbers, when the value is larger than the 16-bit maximum positive number (K32767) or when the value is smaller than the minimum negative number (K-32768), M1022 carry flag is ON, and only write the value of the lower 16 bits. ● If the multiplication result of the 16-bit instruction needs to obtain a complete value (recorded as 32-bit), use API22 MUL / MULP instruction instead. See this description for more details. ● If the product of 32-bit multiplication exceeds the expressible range of 32-bit signed numbers, when the value is larger than the 32-bit maximum positive number (K2147483647) or when the value is smaller than the minimum negative number (K-2147483648), M1022 carry flag is ON, and only write the value of the lower 32 bits. ● If the multiplication result of the 32-bit instruction needs to obtain a complete value (recorded as 64-bit), use API22 DMUL / DMULP instruction instead. See this description for more details.

API	Instruction code		Operand	Function
115	**DIV16 / DIV32**	P	S_1, S_2, D	Dividing binary numbers for 16-bit / dividing binary numbers for 32-bit

Type / Operand	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
	Bit devices			Word devices							
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*
D							*	*	*	*	*

16-bit instruction (7 steps)

DIV16	Continuous execution type	DIV16P	Pulse execution type

32-bit instruction (13 steps)

DDIV32	Continuous execution type	DDIV32P	Pulse execution type

Associated flag: none

Caution for using operand

- If a remainder by 16-bit division should be recorded, use DIV / DIVP instruction instead.
- If a remainder by 32-bit division should be recorded, use DDIV / DDIVP instruction instead.

Description

- S_1: Dividend
  S_2: Divisor
  D: Quotient
- DIV16 and DIV16P are 16-bit instructions. DIV32 and DIV32P are 32-bit instructions.
- The singed binary value in S_1 is divided by the signed binary value in S_2, and the quotient is stored in D. It is not a normal algebraic regulation. Be careful with the positive / negative signs of S_1, S_2 and D when doing 16-bit and 32-bit operation.
- If the divisor is 0, the instruction will not be executed. M1067 and M1068 = ON, and the error code in D1067 is H0E19.
- In 16-bit BIN division,

S_1		S_2		D
b15 .... b0	/	b15 .... b0	=	b15 .... b0
b15 is a sign bit		b15 is a sign bit		b15 is a sign bit

When D serves as a bit device, it can designate K1–K4 and construct a 16-bit result, occupying a 16-bit quotient.

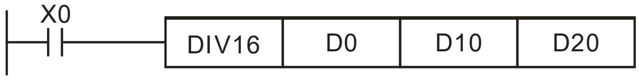
- In 32-bit BIN division,

S_1+1	S_1		S_2+1	S_2		Quotient D+1	Quotient D	Remainder D+3	Remainder D+2
b15.....b0	b15.....b0	/	b15.....b0	b15.....b0	=	b15.....b0	b15.....b0	b15.....b0	b15.....b0

When D serves as a bit device, it can designate K1–K8 and construct a 32-bit result, occupying a 32-bit quotient.

Example

- Example 1
  When X0 = ON, the dividend K103 in D0 is divided by the divisor K5 in D10, and the quotient is stored in D20. ON / OFF of the highest bit indicates the positive / negative status of the result value.

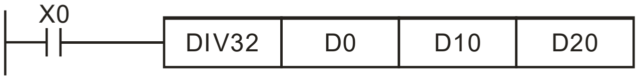


D0 / D10 = D20 ⇨ K103 / K5 = K20, the remainder is K3

D20 = K20 (the remainder is left out.)

- Example 2

When X0 = ON, the dividend K81,000 in (D1, D0) is divided by the divisor K40,000 in (D11, D10), and the quotient is stored in (D21, D20). ON / OFF of the highest bit indicates the positive / negative status of the result value.



(D1, D0) / (D11, D10) = (D21, D20) ⇨ K81,000 / K40,000 = K2, the remainder is K1,000

(D21, D20) = K2 (the remainder is left out.)

API	Instruction code	Operand	Function
30	D **ROR** P	D, n	Rotate right

Type / Operand	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
	Bit devices			Word devices							
D							*	*	*	*	*
n				*	*						

Caution for using operand:

- If D is designated as KnY, KnM, only K4 (16-bit) is valid.
- Scope of n = K1–K16 (16-bit)

16-bit instruction (5 steps)

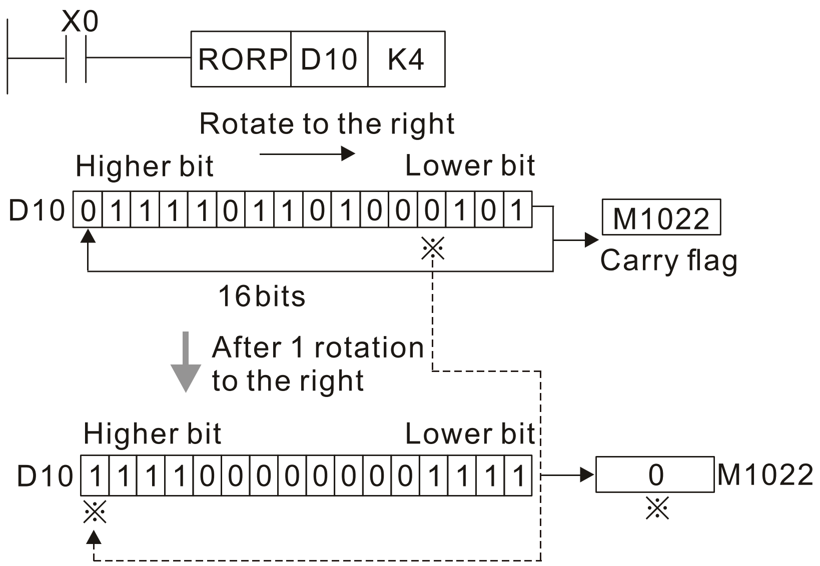
ROR	Continuous execution type	RORP	Pulse execution type

32-bit instruction (9 steps)

DROR	Continuous execution type	DRORP	Pulse execution type

Associated flag: M1022, Carry flag

Description	● D: device to be rotated n: number of bits to be rotated in 1 rotation ● This instruction rotates the device content designated by D to the right for n bits. ● This instruction adopts pulse execution instructions (RORP).
Example	● When X0 = OFF→ON, the 16 bits (4 bits as a group) in D10 rotates to the right, as shown in the figure below. The bit marked with ※ is sent to carry flag M1022.



API	Instruction code	Operand	Function
31	D **ROL** P	D, n	Rotate left

Operand \ Type	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D							*	*	*	*	*
n				*	*						

Caution for using operand

- If D is designated as KnY, KnM, only K4 (16-bit) is valid.
- Scope of n = K1–K16 (16-bit)

16-bit instruction (5 steps)

ROL	Continuous execution type	ROLP	Pulse execution type

32-bit instruction (9 steps)

DROL	Continuous execution type	DROLP	Pulse execution type

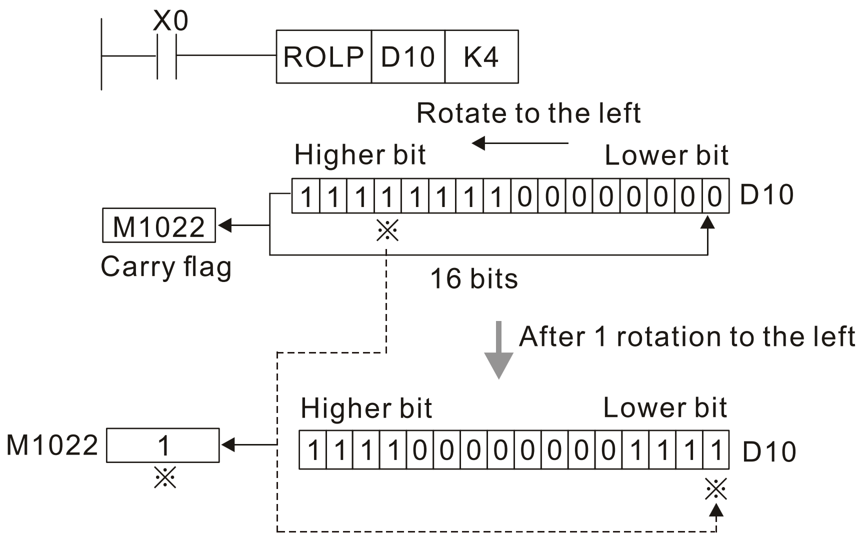
Associated flag: M1022, Carry flag

Description

- D: device to be rotated
  n: number of bits to be rotated in 1 rotation
- This instruction rotates the device content designated by D to the left for n bits.
- This instruction adopts pulse execution instructions (ROLP).

Example

- When X0 = OFF→ON, the 16 bits (4 bits as a group) in D10 rotates to the left, as shown in the figure below. The bit marked with ※ is sent to carry flag M1022.



API	Instruction code			Operand	Function
40		**ZRST**	P	D_1, D_2	Zone reset

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D_1		*	*						*	*	*
D_2		*	*						*	*	*

16-bit instruction (5 steps)

ZRST	Continuous execution type	ZRSTP	Pulse execution type

32-bit instruction

-	-	-	-

Associated flag: none

Caution for using operand

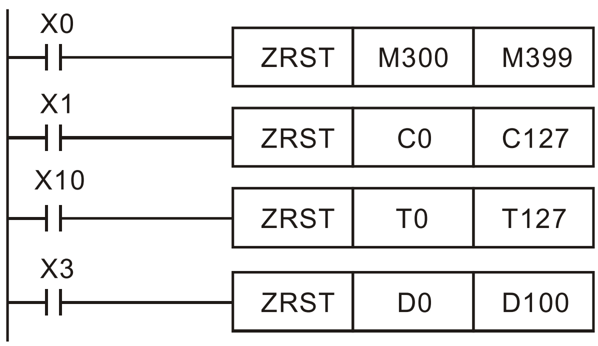
- Number of operand $D_1 \leq$ number of operand D_2
- Operand D_1 and D_2 have to designate devices of the same type.
- See the specification of each model for the scope of device's usage.

Description

- D_1: the start device of zone reset
  D_2: the end device of zone reset
- When number of operand D_1 > number of operand D_2, only operand designated by D_2 will be reset.

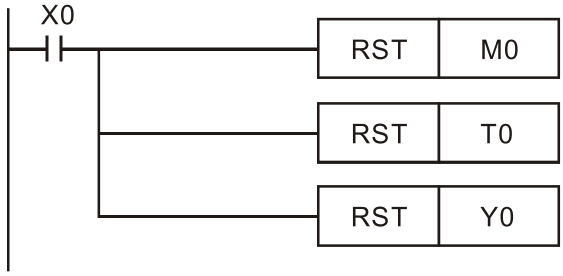
Example

- When X0 = ON, auxiliary relay M300 to M399 will be reset to OFF.
- When X1 = ON, 16-bit counter C0 to C127 will all be reset.
  (write in 0 and reset the contact and coil to OFF)
- When X10 = ON, timer T0 to T127 will be reset to OFF.
  (write in 0 and reset the contact and coil to OFF)
- When X3 = ON, data register D0 to D100 will be reset to 0



Remark

- Devices (i.e., bit device Y, M; and word device T, C, D) can be individually reset by RST instruction.



API	Instruction code			Operand	Function
41		**DECO**	P	S, D, n	Decode

Type / Operand	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
	Bit devices			Word devices							
S	*	*	*	*	*				*	*	*
D		*	*				*	*	*	*	*
n				*	*						

16-bit instruction (7 steps)			
DECO	Continuous execution type	DECOP	Pulse execution type

32-bit instruction			
-	-	-	-

Associated flag: none

Caution for using operand

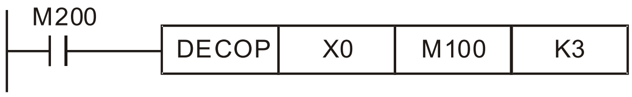
- When operand D is bit device, n = 1–8, and when operand D is word device, n = 1–4.

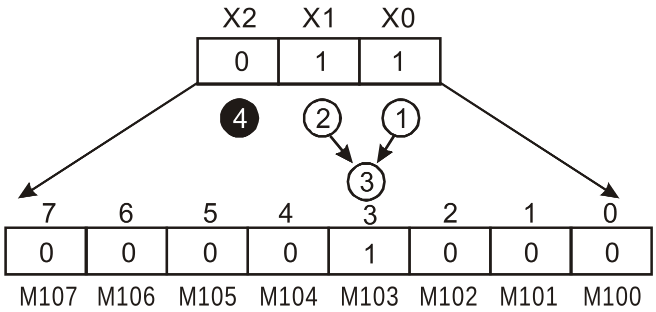
Description

- S: source device to be decoded
  D: device for storing the decoded result
  n: length of decoded bits
- The instruction decodes the lower "n" bits of S and stores the result of "2^n" bits in D.

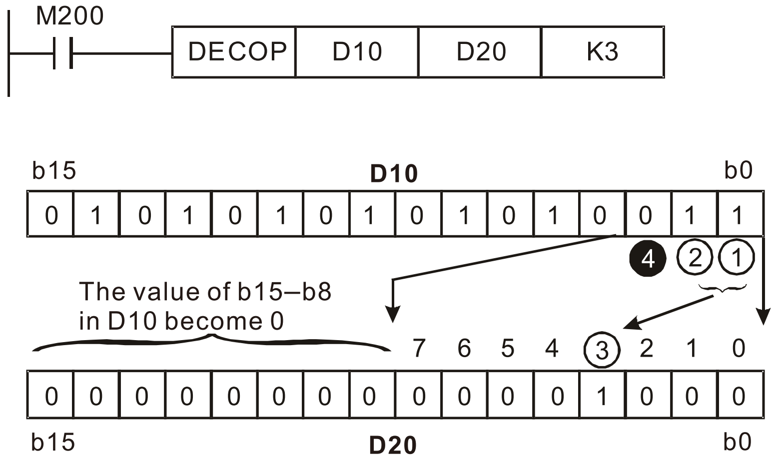
Example

- Example 1
  1. When D is used as a bit device, the valid range is 0 < n ≤ 8. Error occurs when n = 0 or n > 8.
  2. When n = 8, the maximum points to decode is 2^8 = 256 points.
  3. When M200 = OFF→ON, this instruction decodes the content in X0–X2 to M100–M107
  4. If S = 3, M103 (third bit from M100) = ON.
  5. After the execution is completed, M200 becomes OFF. The decoded results have been output retain their operation.





- Example 2
  1. When D is used as a word device, the valid range is 0 < n ≤ 4. Error occurs when n = 0 or n > 4.
  2. When n = 4, the maximum points to decode is 2^4 = 16 points.
  3. When M200 = OFF→ON, this instruction decodes the content in D10 (b2–b0) to D20 (b7–b0). The unused bits in D20 (b15–b8) become 0.
  4. The lower 3 bits of D10 are decoded and stored in the lower 8 bits of D20. The higher 8 bits of D20 are all 0.
  5. After the execution is completed, M200 becomes OFF. The decoded results have been output retain their operation.


M200
DECOP
D10
D20
K3
b15
D10
b0
0 1 0 1 0 1 0 1 0 1 0 1 0 0 1 1
4 2 1
The value of b15–b8
in D10 become 0
7 6 5 4 3 2 1 0
0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0
b15
D20
b0

API	Instruction code			Operand	Function
42		**ENCO**	P	S, D, n	Decode

Type / Operand	Bit devices X	Bit devices Y	Bit devices M	Word devices K	Word devices H	KnX	KnY	KnM	T	C	D
S	*	*	*						*	*	*
D		*	*						*	*	*
n				*	*						

16-bit instruction (7 steps)

ENCO	Continuous execution type	ENCOP	Pulse execution type

32-bit instruction

-	-	-	-

Associated flag: none

Caution for using operand

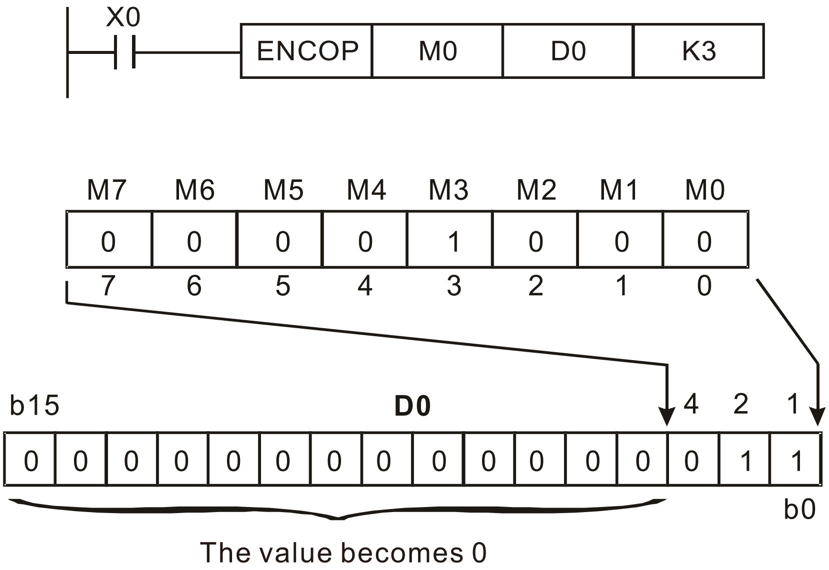
- When operand S is bit device, n = 1–8, and when operand S is word device, n = 1–4.

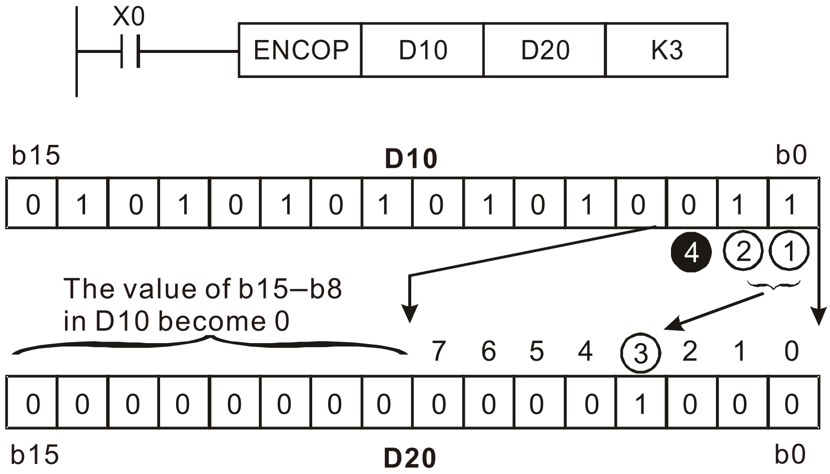
Description

- S: source device to be decoded
  D: device for storing the decoded result
  n: length of decoded bits
- The instruction decodes the lower "n" bits of S and stores the result in D.
- If several bits of S are 1, the first bit that is 1 will be processed orderly from high bit to low bit.

Example

- Example 1
  1. When S is used as a bit device, the valid range is $0 < n \leq 8$. Error occurs when n = 0 or n > 8.
  2. When n = 8, the maximum points to encode is 2^8 = 256 points.
  3. When X0 = OFF→ON, this instruction encodes the content in 2^3 bits (M0–M7) and stores in the lower 3-bit (b2–b0) of D0. The unused bits in D0 (b15–b3) become 0.
  4. After the execution is completed, X0 becomes OFF, and the data in D remains unchanged.



	● Example 2 1. When S is used as a word device, the valid range is $0 < n \leq 4$. Error occurs when n = 0 or n > 4. 2. When n = 4, the maximum points to encode is 2^4 = 16 points. 3. When X0 = OFF→ON, this instruction encodes the content in 2^3 bits (b0–b7) of D10 and stores in the lower 3-bit (b2–b0) of D0. The unused bits in D20 (b15–b3) become 0. (b8–b15 in D10 are invalid data) 4. After the execution is completed, X0 becomes OFF, and the data in D remains unchanged. 

API	Instruction code			Operand	Function
43	D	**SUM**	P	S, D	Sum of active bits

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*	*	*	*	*	*	*
D									*	*	*

Caution for using operand

- When using 32-bit instruction, D occupies two registers.

16-bit instruction (5 steps)

SUM	Continuous execution type	SUMP	Pulse execution type

32-bit instruction (9 steps)

DSUM	Continuous execution type	DSUMP	Pulse execution type

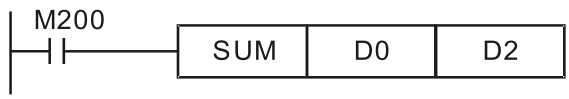
Associated flag: none

Description

- S: source device
  D: destination device for storing counted value
- The sum of all bits whose contents are "1" in S will be stored in D.

Example

- When X0 = OFF→ON, the 16 bits (4 bits as a group) in D10 rotates to the left, as shown in the figure below. The bit marked with ※ is sent to carry flag M1022.
- When M200 = ON, the sum of whose contents are “1” in 16 bits of D0 will be stored in D2.



0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0

D0

3

D2

API	Instruction code			Operand	Function
44	D	**BON**	P	S, D, n	Check specified bit status

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*	*	*	*	*	*	*
D		*	*								
n				*	*				*	*	*

Caution for using operand

- Valid range of operand n : n = 0–15 (16-bit), n = 0–31 (32-bit)

16-bit instruction (7 steps)

BON	Continuous execution type	BONP	Pulse execution type

32-bit instruction (13 steps)

DBON	Continuous execution type	DBONP	Pulse execution type

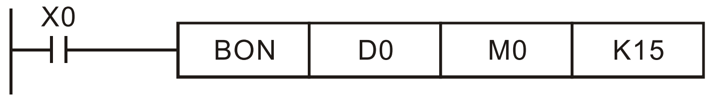
Associated flag: none

Description

- S: source device
  D: device for storing check result
  n: bit number to be checked (numbered from 0)
- The instruction checks the status of designated bit (specified by n) in S and stores the result in D.
- Operand S uses device F, and they can only use 16-bit instructions.

Example

- When X0 = ON, if the bit15 of D0 is “1”, then M0 = ON; if it is “0”, then M0 = OFF.
- X0 becomes OFF, M0 remains in its previous status.



b15 … b0

0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	M0=Off

D0

b15 … b0

1	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	M0=On

D0

API	Instruction code	Operand	Function
45	D **MEAN** P	S, D, n	Mean

Type / Operand	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
	Bit devices			Word devices							
S						*	*	*	*	*	*
D							*	*	*	*	*
n				*	*	*	*	*	*	*	*

Caution for using operand

- Valid range of operand n : n = 0–64

16-bit instruction (7 steps)

MEAN	Continuous execution type	MEANP	Pulse execution type

32-bit instruction (13 steps)

DMEAN	Continuous execution type	DMEANP	Pulse execution type

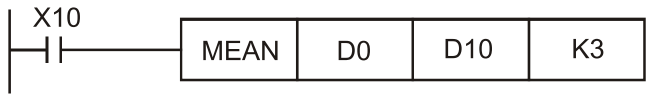
Associated flag: none

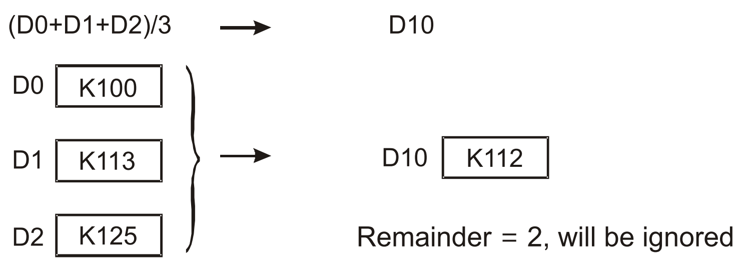
Description

- S: start device to obtain mean value
  D: destination device for storing mean value
  n: The number of consecutive source devices used
- Add the contents of n devices starting from S, obtain the mean value, and store in D. Remainders in the operation will be truncated.
- If n is out of the valid range, PLC will determine it as an “instruction operation error” and stop.

Example

- When X10 = ON, the contents in 3 (n = 3) registers starting from D0 will be summed and then divided by 3. The obtained mean value will be stored in D10, and the remainder will be truncated.





API	Instruction code			Operand	Function
49	D	**FLT**	P	S, D	BIN integer → binary floating-point number

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S									*	*	*
D									*	*	*

Caution for using operand

- Operand D occupies 2 consecutive devices.
- See the specification of each model for the scope of device's usage.

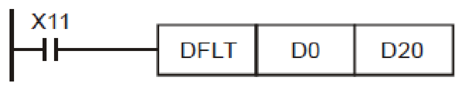
16-bit instruction

-	-	-	-

32-bit instruction (9 steps)

DFLT	Continuous execution type	DFLTP	Pulse execution type

Associated flag: none

Description	● S: source device for conversion D: device for storing the conversion result ● Convert BIN integer to binary floating-point number.
Example	● When X11 = ON, convert the BIN integers corresponding to D0 and D1 to floating-point numbers and put into D20 and D21. 

API	Instruction code	Operand	Function
150	**MODRW**	S_1, S_2, S_3, S, n	Read / write Modbus data

Type / Operand	Bit devices			Word devices								
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*						*
S_2				*	*						*
S_3				*	*						*
S											*
n				*	*						*

16-bit instruction (11 steps)

MODRW	Continuous execution type	MODRWP	Pulse execution type

32-bit instruction

-	-	-	-

Associated flag: M1077, M1078, M1079, M1080, M1081

Caution for using operand

- Since the communication process goes through PLC scan for many times, it is recommended to use the pulse execution type of this function code.

Description

- S_1: address of communication device
  S_2: function code
  S_3: device address of data to be read / written
  S: register for storing read / written data
  n: length of read / written data
- Before using this instruction, COM1 must be defined as being controlled by PLC (set Pr.N1-07 = 1). After that, set the corresponding communication speed and format (Pr.N1-02 and Pr.N1-03). For function code (S_2), only these function codes listed below are available currently, others are still not executable.

Function	Description
H02	Read multiple coil (bit)
H03	Read multiple word
H06	Write single word
H0F	Write multiple coil (bit)
H10	Write multiple word

- After the instruction is executed, M1077, M1078, M1079, M1080 and M1081 becomes 0 immediately.
- For example, if you want the PLC master of the drive to control another drive slave and PLC slave, assume the station number of drive slave is 10, and the one of PLC slave is 20. See explanation below:

The drive to control slave devices

No.	Example	MODRW Instruction				
		S_1	S_2	S_3	S	n
		Station number	Command code	Address	Register	Length
1	Read the parameters Pr.A0-00–Pr.A0-03 of drive slave, 4 records in total. And store the data to D0–D3.	K10	H3	H0000	D0	K4

No.	Example	MODRW Instruction S1 Station number	S2 Command code	S3 Address	S Register	n Length
2	Read the address H2100–H2102 of drive slave, 3 records in total. And store the data to D5–D7.	K10	H3	H2100	D5	K3
3	Write the parameters Pr.L1-00–Pr.L1-02 of drive slave, 3 records in total. And the written values are D10, D11, and D12.	K10	H10	H1440	D10	K3
4	Write the address H2000–H2001of drive slave, 2 records in total. And the written values are D15 and D16.	K10	H10	H2000	D15	K2

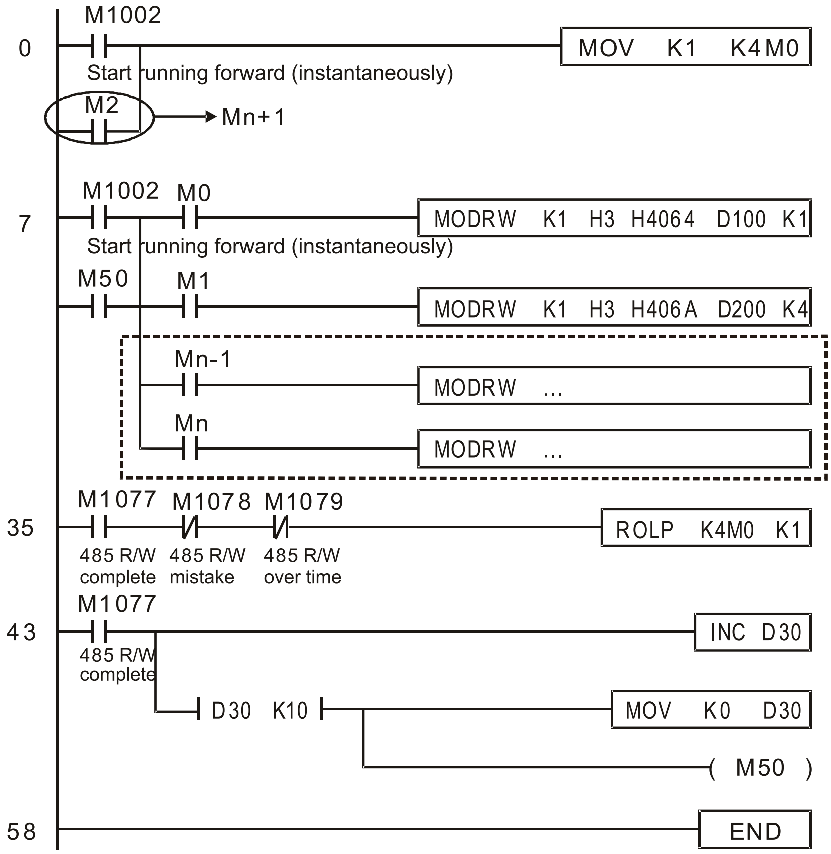
The PLC to control slave devices

No.	Example	MODRW instruction S1 Station number	S2 Command code	S3 Address	S Register	n Length
1	Read X0–X3 status of PLC slave, 4 records in total. And store the read data in bit0–bit3 of D0.	K20	H2	H400	D0	K4
2	Read Y0–Y3 status of PLC slave, 4 records in total. And store the read data in bit0–bit3 of D1.	K20	H2	H500	D1	K4
3	Read M0–M3 status of PLC slave, 4 records in total. And store the read data in bit0–bit3 of D2.	K20	H2	H800	D2	K4
4	Read T0–T3 status of PLC slave, 4 records in total. And store the read data in bit0–bit3 of D3.	K20	H2	H600	D3	K4
5	Read C0–C3 status of PLC slave, 4 records in total. And store the read data in bit0–bit3 of D4.	K20	H2	HE00	D4	K4
6	Read T0–T3 count values of PLC slave, 4 records in total. And store the read data in D10–D13.	K20	H3	H600	D10	K4
7	Read C0–C3 count values of PLC slave, 4 records in total. And store the read data in D20–D23.	K20	H3	HE00	D20	K4
8	Read D0–D3 count values of PLC slave, 4 records in total. And store the read data in D30–D33.	K20	H3	H1000	D30	K4
9	Write Y0–Y3 status of PLC slave, 4 records in total. And the written values are bit0–bit3 of D1.	K20	HF	H500	D1	K4
10	Write M0–M3 status of PLC slave, 4 records in total. And the written data are bit0–bit3 of D2.	K20	HF	H800	D2	K4
11	Write T0–T3 status of PLC slave, 4 records in total. And the written data are bit0–bit3 of D3.	K20	HF	H600	D3	K4

No.	Example	MODRW instruction				
		S_1	S_2	S_3	S	n
		Station number	Command code	Address	Register	Length
12	Write C0–C3 status of PLC slave, 4 records in total. And the written data are bit0–bit3 of D4.	K20	HF	HE00	D4	K4
13	Write T0–T3 count values of PLC slave, 4 records in total. And the written data are D10–D13.	K20	H10	H600	D10	K4
14	Write C0–C3 count values of PLC slave, 4 records in total. And the written data are D20–D23.	K20	H10	HE00	D20	K4
15	Write D0–D3 count values of PLC slave, 4 records in total. And the written data are D30–D33.	K20	H10	H1000	D30	K4

Example

- PLC triggers M0 to be ON when it starts and sends the instruction to execute one MODRW.
- After receiving a response from the slave device, if the instruction is correct, then ROL is executed once, and M1 becomes ON.
- After receiving a response from the slave device, delays 10 PLC scan cycles, trigger M50 = 1, and then MODRW is executed once again.
- After receiving a response from the slave device again, if the instruction is correct, then ROL is executed once, and M2 becomes ON (M2 can be defined as repeat M), K4M0 becomes K1 again, that is, only M0 is 1, and the instructions can be sent cyclically. If you want to add instructions to be sent, you just have to add instructions in the dotted line box and replace the M of repeat M to be Mn+1.



API	Instruction code	Operand	Function
110	D **ECMP** P	S_1, S_2, D	Binary floating-point number comparison

Type / Operand	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
	Bit devices			Word devices							
S_1				*	*						*
S_2				*	*						*
D											*

Caution for using operand

- Operand D occupies 3 consecutive devices.
- See the specification of each model for the scope of device's usage.

16-bit instruction

-	-	-	-

32-bit instruction (13 steps)

DECMP	Continuous execution type	DECMPP	Pulse execution type

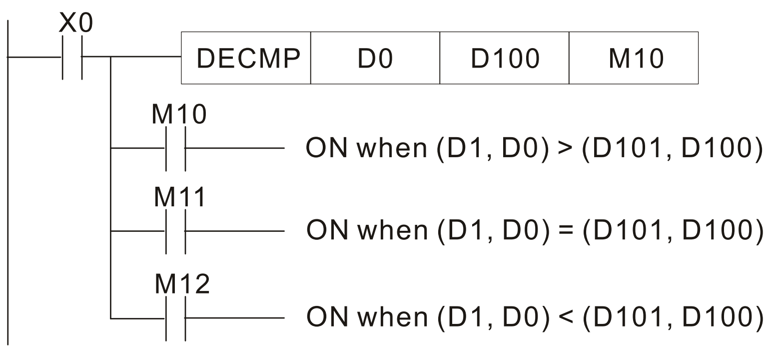
Associated flag: none

Description

- S_1: binary floating-point number comparison value 1
  S_2: binary floating-point number comparison value 2
  D: comparison result, occupies 3 consecutive devices
- The binary floating-point value 1 and 2 are compared with each other. The comparison result (>, =, <) is stored in D.
- If S_1 or S_2 is a designated constant K or H, the instruction will convert the constant into a binary floating-point value before the comparison.

Example

- Designate the device to be M10, and this automatically occupies M10 to M12.
- When X0 = ON, DECMP instruction is executed, and one of M10, M11, and M12 will be ON. When X0 = OFF, DECMP instruction is not executed, and M10, M11, and M12 remain their status before X0 = OFF.
- If you need to obtain a comparison result with ≥,≤, and ≠, make a serial-parallel connection between M10 –M12.
- To clear the comparison result, use RST or ZRST instruction.



API	Instruction code			Operand	Function
111	D	**EZCP**	P	S_1, S_2, S, D	Binary floating-point number zone comparison

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*						*
S_2				*	*						*
S				*	*						*
D		*	*								

16-bit instruction

-	-	-	-

32-bit instruction (17 steps)

DEZCP	Continuous execution type	DEZCPP	Pulse execution type

Associated flag: none

Caution for using operand

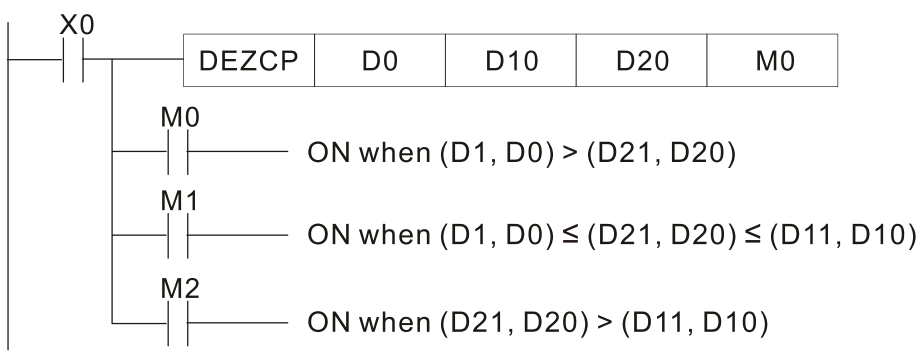
- Operand D occupies 3 consecutive devices.
- See the specification of each model for the scope of device's usage.

Description

- S_1: lower bound of binary floating-point in zone comparison
  S_2: upper bound of binary floating-point in zone comparison
  S: binary floating-point number comparison value
  D: comparison result, occupies 3 consecutive devices
- S is compared with S_1 and S_2, and the result is stored in D.
- If S_1 or S_2 is a designated constant K or H, the instruction will convert the constant into a binary floating-point value before the comparison.
- When $S_1 > S_2$, the instruction uses S_1 as upper / lower bound for comparison.

Example

- Designate the device to be M0, and this automatically occupies M0 to M2.
- When X0 = ON, DEZCP instruction is executed, and one of M0, M1, and M2 will be ON. When X0 = OFF, EZCP instruction is not executed, and M0, M1, and M2 remain their status before X0 = OFF.
- To clear the comparison result, use RST or ZRST instruction.



API	Instruction code			Operand	Function
116	D	**RAD**	P	S, D	Degree → Radian

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D		*	*								

Caution for using operand

- See the specification of each model for the scope of device's usage.

16-bit instruction

-	-	-	-

32-bit instruction (9 steps)

DRAD	Continuous execution type	DRADP	Pulse execution type

Associated flag: none

Description

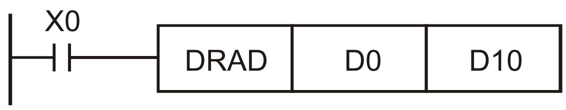
- S: source of data (degree)

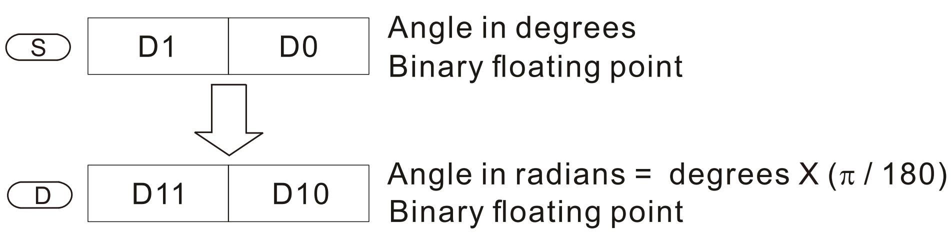
  D: result (radian)
- Use the following formula to convert degree to radian.

  Radian = Degree x (π / 180)

Example

- When X0 = ON, designate the degree of binary floating-point number (D1, D0). Convert the degree into radian and store the result in binary floating point in (D11, D10).





API	Instruction code	Operand	Function
117	D **DEG** P	S, D	Radian → Degree

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Caution for using operand

- See the specification of each model for the scope of device's usage.

16-bit instruction

-	-	-	-

32-bit instruction (9 steps)

DDEG	Continuous execution type	DDEGP	Pulse execution type

Associated flag: none

Description

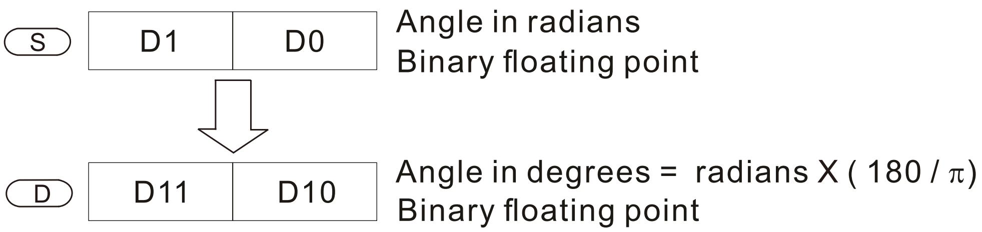
- S: source of data (radian)

  D: result (degree)
- Use the following formula to convert radian to degree.

  Degree = Radian x (π / 180)

Example

- When X0 = ON, designate the degree of binary floating-point number (D1, D0). Convert the radian into degree and store the result in binary floating point in (D11, D10).



API	Instruction code			Operand	Function
120	D	**EADD**	P	S_1, S_2, D	Binary floating-point number addition

Type / Operand	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
	Bit devices			Word devices							
S_1				*	*						*
S_2				*	*						*
D											*

Caution for using operand

- See the specification of each model for the scope of device's usage.

16-bit instruction

-	-	-	-

32-bit instruction (13 steps)

DEADD	Continuous execution type	DEADDP	Pulse execution type

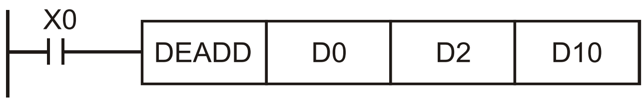
Associated flag: none

Description

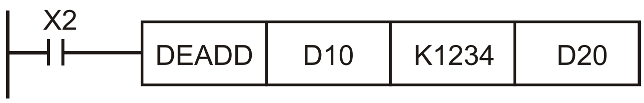
- S_1: summand
  S_2: addend
  D: sum
- The content of the register that S_1 designates adds the content of the register that S_2 designates, and its sum is stored in the register that D designates. This addition is performed in the form of binary floating-point numbers.
- If S_1 or S_2 is a designated constant K or H, the instruction will convert the constant into a binary floating-point value before the addition.
- S_1 and S_2 can designate the same register. In this case, if the instruction is specified as "continuous execution type" instruction (pulse execution type DEADDP is generally used) and the drive contact is ON, the register will be added once in every scan.

Example

- Example 1
  When X0 = ON, the binary floating-point numbers (D1, D0) add the binary floating-point numbers (D3, D2), and stores the result in (D11, D10).



- Example 2
  When X2 = ON, the binary floating-point numbers (D11, D10) add K1234 (convert to binary floating-point number automatically), and stores the result in (D21, D20).



API	Instruction code			Operand	Function
121	D	**ESUB**	P	S_1, S_2, D	Binary floating-point number subtraction

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*						*
S_2				*	*						*
D											*

Caution for using operand

- See the specification of each model for the scope of device's usage.

16-bit instruction

-	-	-	-

32-bit instruction (13 steps)

DESUB	Continuous execution type	DESUBP	Pulse execution type

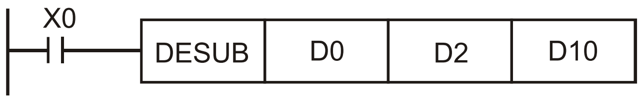
Associated flag: none

Description

- S_1: minuend
  S_2: subtrahend
  D: difference
- Subtract the content of the register that S_2 designates from the content of the register that S_1 designates , and its difference is stored in the register that D designates. This subtraction is performed in the form of binary floating-point numbers.
- If S_1 or S_2 is a designated constant K or H, the instruction will convert the constant into a binary floating-point value before the subtraction.
- S_1 and S_2 can designate the same register. In this case, if the instruction is specified as "continuous execution type" instruction (pulse execution type DESUBP is generally used) and the drive contact is ON, the register will be subtracted once in every scan.

Example

- Example 1
  When X0 = ON, the binary floating-point numbers (D1, D0) subtract the binary floating-point numbers (D3, D2), and stores the result in (D11, D10).



- Example 2
  When X2 = ON, subtract the binary floating-point numbers (D1, D0) from K1234 (convert to binary floating-point number automatically), and stores the result in (D11, D10).

API	Instruction code			Operand	Function
122	D	**EMUL**	P	S_1, S_2, D	Binary floating-point number multiplication

Type / Operand	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
	Bit devices			Word devices							
S_1				*	*						*
S_2				*	*						*
D											*

Caution for using operand

- See the specification of each model for the scope of device's usage.

16-bit instruction

-	-	-	-

32-bit instruction (13 steps)

DEMUL	Continuous execution type	DEMULP	Pulse execution type

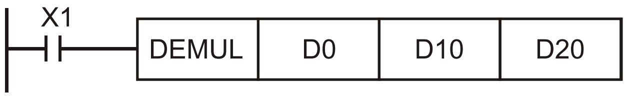
Associated flag: none

Description

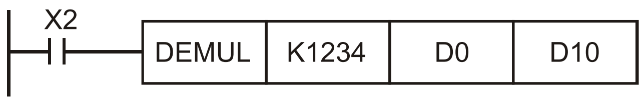
- S_1: Multiplicand
  S_2: Multiplicator
  D: Product
- The content of the register that S_1 designates multiplies the content of the register that S_2 designates, and its product is stored in the register that D designates. This multiplication is performed in the form of binary floating-point numbers.
- If S_1 or S_2 is a designated constant K or H, the instruction will convert the constant into a binary floating-point value before the multiplication.
- S_1 and S_2 can designate the same register. In this case, if the instruction is specified as "continuous execution type" instruction (pulse execution type DEMULP is generally used) and the drive contact is ON, the register will be multiplied once in every scan.

Example

- Example 1
  When X1 = ON, multiply the binary floating-point number (D1, D0) and (D11, D11), and store the product to the register that (D21, D20) designate.



- Example 2
  When X2 = ON, multiply K1234 (convert to binary floating-point number automatically) and the binary floating-point numbers (D1, D0), and stores the result in (D11, D10).



API	Instruction code	Operand	Function
123	D **EDIV** P	S_1, S_2, D	Binary floating-point number division

Type / Operand	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
	Bit devices			Word devices							
S_1				*	*						*
S_2				*	*						*
D											*

Caution for using operand

- See the specification of each model for the scope of device's usage.

16-bit instruction

-	-	-	-

32-bit instruction (13 steps)

DEDIV	Continuous execution type	DEDIVP	Pulse execution type

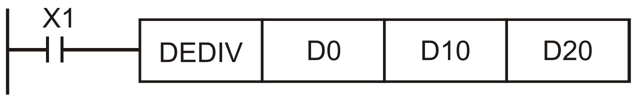
Associated flag: none

Description

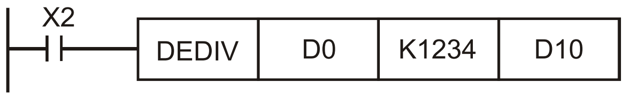
- S_1: Dividend
  S_2: Divisor
  D: Quotient and remainder
- The content of the register that S_1 designates divides by the content of the register that S_2 designates, and its quotient is stored in the register that D designates. This division is performed in the form of binary floating-point numbers.
- If S_1 or S_2 is a designated constant K or H, the instruction will convert the constant into a binary floating-point value before the division.

Example

- Example 1
  When X1 = ON, the binary floating-point number (D1, D0) divides by the binary floating-point number (D11, D10), and store the quotient to the register that (D21, D20) designate.



- Example 2
  When X2 = ON, the binary floating-point numbers (D1, D0) divides by K1234 (convert to binary floating-point number automatically), and stores the result in (D11, D10).



API	Instruction code			Operand	Function
124	D	**EXP**	P	S, D	Binary floating-point number exponentiation

Type / Operand	Bit devices: X	Y	M	Word devices: K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Caution for using operand

- See the specification of each model for the scope of device's usage.

16-bit instruction

-	-	-	-

32-bit instruction (9 steps)

DEXP	Continuous execution type	DEXPP	Pulse execution type

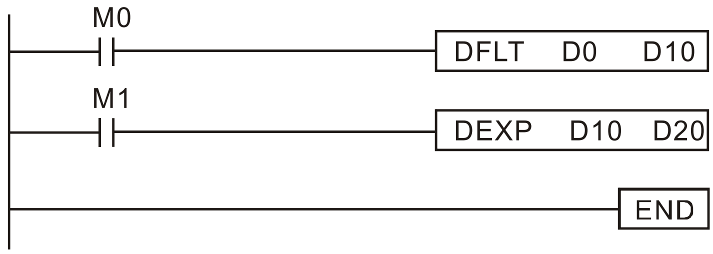
Associated flag: none

Description

- S: device of operation source
  D: device of operation result
- e = 2.71828 is as a base number, and S is the exponent to do EXP operation.
  $[D+1, D] = e^{[S+1, S]}$
- Both positive and negative values are valid for S. The 32-bit format must be used to designate register D. The operation is executed in floating-point numbers, so the value in S needs to be converted into floating-point number before exponent operation.
- The content of operand D = e^S, e =2.71828, and S is the designated source data.

Example

- When M0 = ON, convert (D0, D1) to be binary floating-point numbers and store in the register (D11, D10).
- When M1 = ON, (D11, D10) are the exponent to do EXP operation. Their value is binary floating-point numbers and store in the register (D21, D20).



API	Instruction code			Operand	Function
125	D	**LN**	P	S, D	Binary floating-point number natural logarithm operation

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Caution for using operand

- See the specification of each model for the scope of device's usage.

16-bit instruction

-	-	-	-

32-bit instruction (9 steps)

DLN	Continuous execution type	DLNP	Pulse execution type

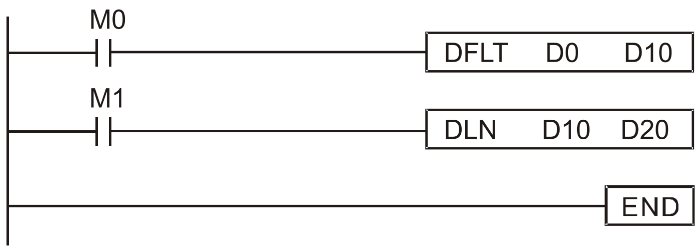
Associated flag: none

Description

- S: device of operation source
  D: device of operation result
- e = 2.71828 is as a base number, and S is the exponent to do LN operation.
  $[D+1, D] = \ln^{[S+1, S]}$
- Both positive and negative values are valid for S. The 32-bit format must be used to designate register D. The operation is executed in floating-point numbers, so the value in S needs to be converted into floating-point number before exponent operation.
- The content of operand D = $\ln^{S} = \log_e S$, e =2.71828, and S is the designated source data.

Example

- When M0 = ON, convert (D0, D1) to be binary floating-point numbers and store in the register (D11, D10).
- When M1 = ON, (D11, D10) are the exponent to do LN operation. Their value is binary floating-point numbers and store in the register (D21, D20).



API	Instruction code			Operand	Function
127	D	**ESQR**	P	S, D	Binary floating-point number square root

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Caution for using operand

- See the specification of each model for the scope of device's usage.

16-bit instruction

-	-	-	-

32-bit instruction (9 steps)

DESQR	Continuous execution type	DESQRP	Pulse execution type

Associated flag: none

Description

- S: the source device for calculating square root
  D: operation result
- Calculate square root of the content in register that S designates, the result will be stored in the register that D designates. The square root operation is performed in the form of binary floating-point numbers.
- If S is a designated constant K or H, the instruction will convert the constant into a binary floating-point value before the square root operation.

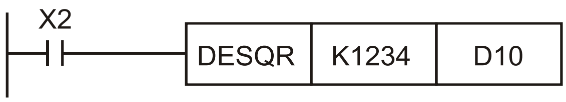
Example

- Example 1
  When X0 = ON, calculate the square root of the binary floating-point number (D1, D0), and store result to the register that (D11, D10) designate.

$$\sqrt{(D1 \cdot D0)} \longrightarrow (D11 \cdot D10)$$

Binary floating point　　Binary floating point

- Example 2
  When X2 = ON, calculate the square root of K1234 (convert to binary floating-point number automatically), and stores the result in (D11, D10).



API	Instruction code			Operand	Function
129	D	**INT**	P	S, D	Binary floating-point number → BIN integer

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S											*
D											*

Caution for using operand

- See the specification of each model for the scope of device's usage.

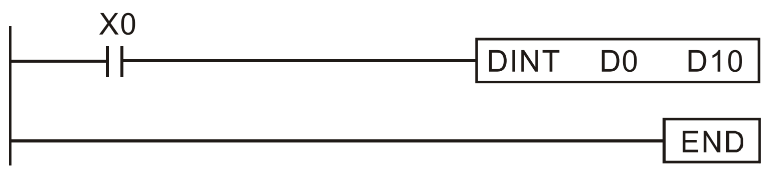
16-bit instruction (5 steps)

-	-	-	-

32-bit instruction (9 steps)

DINT	Continuous execution type	DINTP	Pulse execution type

Associated flag: none

Description	● S: source device for conversion D: the conversion result ● The content in the register that S designates is converted from binary floating-point form to BIN integer and store them to the register that D designates. The decimal of the operation result will be left out. ● This instruction is the opposite of the API 49 (FLT) instruction.
Example	● When X0 = ON, convert the binary floating-point numbers (D1, D0) to BIN integer, and store the result to (D10). The decimal of the operation result will be left out. 

API	Instruction code			Operand	Function
130	D	**SIN**	P	S, D	Binary floating-point number sine operation

Type / Operand	Bit devices			Word devices								
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D	
S				*	*						*	
D											*	

Caution for using operand

- See the specification of each model for the scope of device's usage.

16-bit instruction

-	-	-	-

32-bit instruction (9 steps)

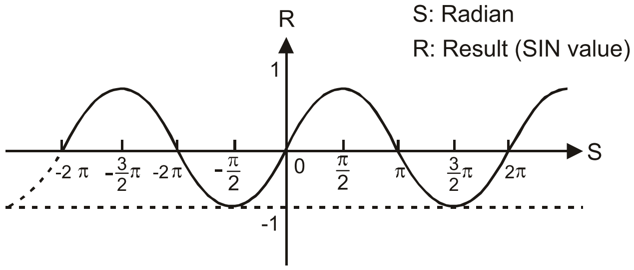
DSIN	Continuous execution type	DSINP	Pulse execution type

Associated flag: none

Description

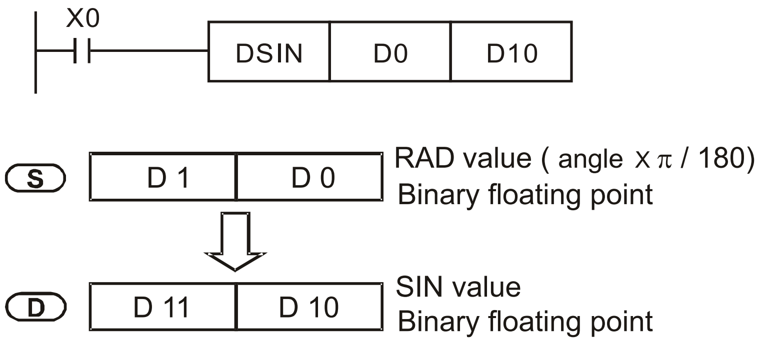
- S: source value
  D: operation result of sine
- The source designated by S is radian.
- RAD value = degree x π / 180
- Find sine value from the source value designated by S, and store in the register that D designates.

See the figure below for the relation between the radian and the operation result:



Example

- When X0 = ON, designate the RAD value of the binary floating-point number (D1, D0) to find the sine value and stores in (D11, D10). The content is binary floating-point number.



API	Instruction code			Operand	Function
131	D	**COS**	P	S, D	Binary floating-point number cosine operation

Type / Operand	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
	Bit devices			Word devices							
S				*	*						*
D											*

Caution for using operand
- See the specification of each model for the scope of device's usage.

16-bit instruction			
-	-	-	-

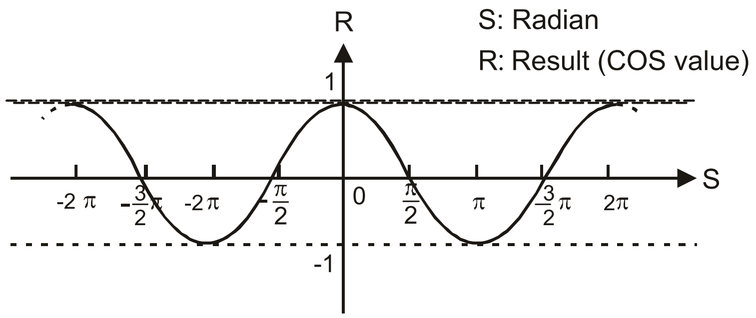
32-bit instruction (9 steps)			
DCOS	Continuous execution type	DCOSP	Pulse execution type

Associated flag: none

Description

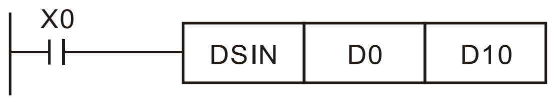
- S: source value
  D: operation result of cosine
- The source value designated by S can be set as radian or degree, and this is decided by flag M1018.
- M1018 = OFF, radian mode, RAD value = degree x π / 180
- M1018 = ON, degree mode, range: 0° ≤ degree < 360°
- If the operation result is 0, M1020 = ON
- Find cosine value from the source value designated by S, and store in the register that D designates.

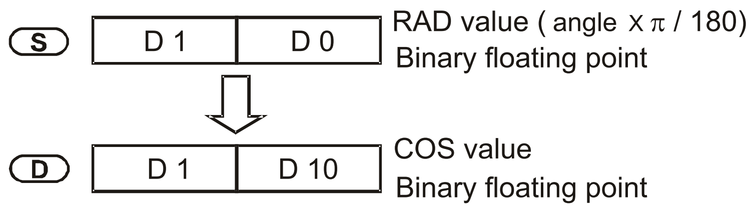
See the figure below for the relation between the radian and the operation result:



Example

- When X0 = ON, designate the RAD value of the binary floating-point number (D1, D0) to find the sine value and stores in (D11, D10). The content is binary floating-point number.





API	Instruction code			Operand	Function
132	D	**TAN**	P	S, D	Binary floating-point number tangent operation

Type / Operand	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
	Bit devices			Word devices							
S				*	*						*
D											*

Caution for using operand

- See the specification of each model for the scope of device's usage.

16-bit instruction

-	-	-	-

32-bit instruction (9 steps)

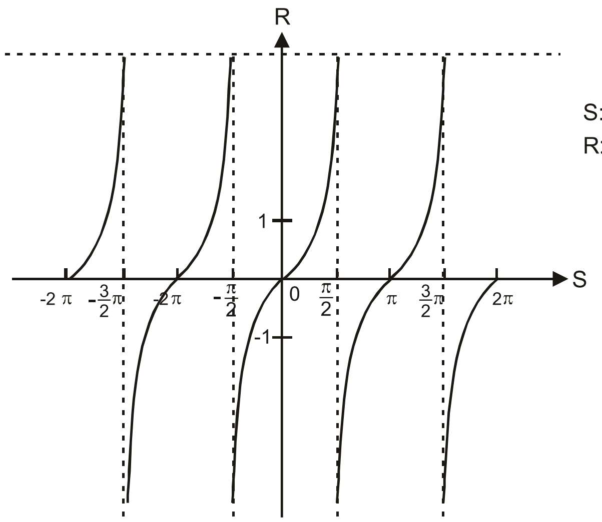
DTAN	Continuous execution type	DTANP	Pulse execution type

Associated flag: none

Description

- S: source value
  D: operation result of tangent
- The source value designated by S can be set as radian or degree, and this is decided by flag M1018.
- M1018 = OFF, radian mode, RAD value = degree x π / 180
- M1018 = ON, degree mode, range: 0° ≤ degree < 360°
- If the operation result is 0, M1020 = ON
- Find tangent value from the source value designated by S, and store in the register that D designates.

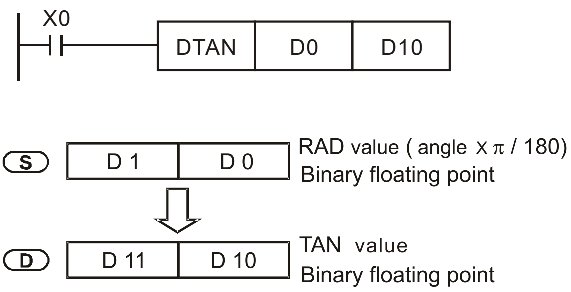
See the figure below for the relation between the radian and the operation result:



S: Radian
R: Result (TAN value)

Example

- When X0 = ON, designate the RAD value of the binary floating-point number (D1, D0) to find the tangent value and stores in (D11, D10). The content is binary floating-point number.



API	Instruction code			Operand	Function
133	D	**ASIN**	P	S, D	Binary floating-point number arcsine operation

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Caution for using operand

- See the specification of each model for the scope of device's usage.

16-bit instruction			
-	-	-	-

32-bit instruction (9 steps)			
DASIN	Continuous execution type	DASINP	Pulse execution type

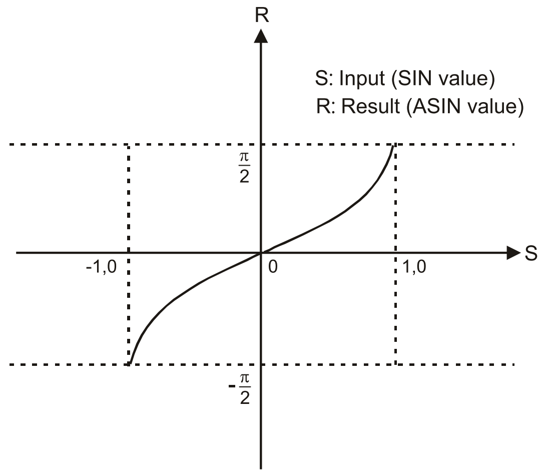
Associated flag: none

Description

- S: source value (binary floating-point number)

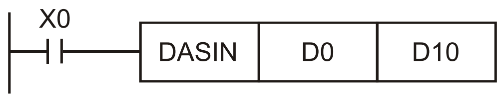
  D: operation result of arcsine
- ASIN value = $\sin^{-1}$

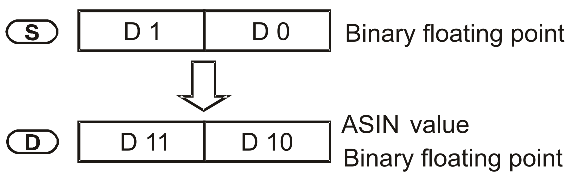
  See the figure below for the relation between the input value and the operation result:



Example

- When X0 = ON, designate the binary floating-point number (D1, D0) to find the arcsine value and stores in (D11, D10). The content is binary floating-point number.





API	Instruction code	Operand	Function
134	D **ACOS** P	S, D	Binary floating-point number arccosine operation

Type / Operand	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
	Bit devices			Word devices							
S				*	*						*
D											*

Caution for using operand

- See the specification of each model for the scope of device's usage.

16-bit instruction

-	-	-	-

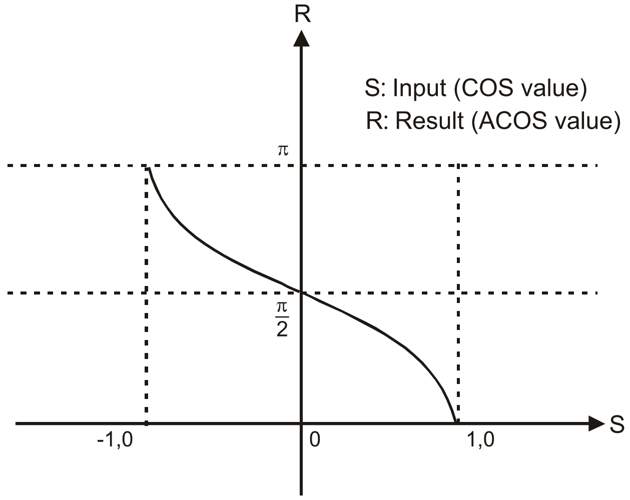
32-bit instruction (9 steps)

DACOS	Continuous execution type	DACOSP	Pulse execution type

Associated flag: none

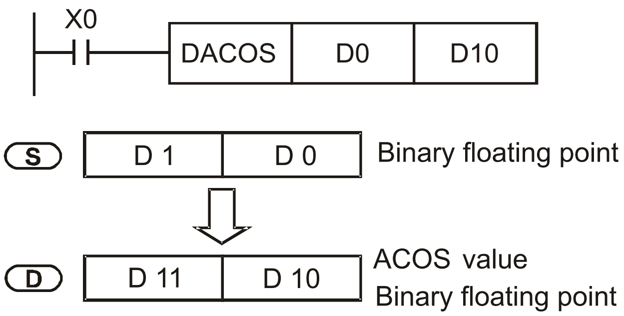
Description

- S: source value (binary floating-point number)
  D: operation result of arccosine
- ACOS value = $\cos^{-1}$
  See the figure below for the relation between the input value and the operation result:



Example

- When X0 = ON, designate the binary floating-point number (D1, D0) to find the arccosine value and stores in (D11, D10). The content is binary floating-point number.



API	Instruction code	Operand	Function
135	D **ATAN** P	S, D	Binary floating-point number arctangent operation

Type / Operand	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
	Bit devices			Word devices							
S				*	*						*
D											*

Caution for using operand

- See the specification of each model for the scope of device's usage.

16-bit instruction

-	-	-	-

32-bit instruction (9 steps)

DATAN	Continuous execution type	DATANP	Pulse execution type

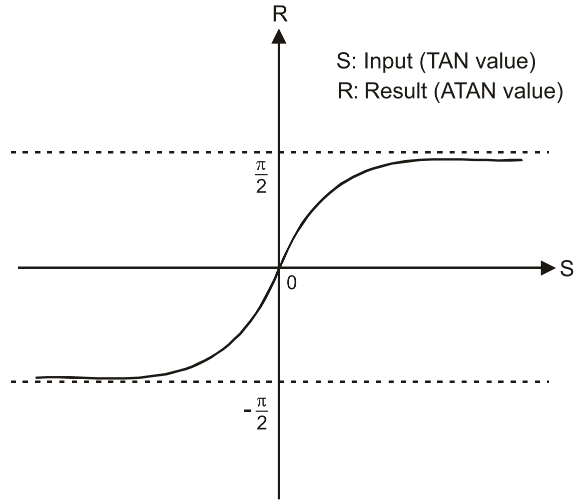
Associated flag: none

Description

- S: source value (binary floating-point number)

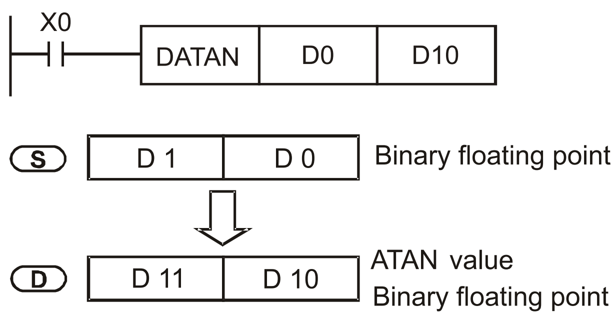
  D: operation result of arctangent
- ATAN value = $\tan^{-1}$

  See the figure below for the relation between the input value and the operation result:



Example

- When X0 = ON, designate the binary floating-point number (D1, D0) to find the arctangent value and stores in (D11, D10). The content is binary floating-point number.



API	Instruction code			Operand	Function
136	D	**SINH**	P	S, D	Binary floating-point number hyperbolic sine operation

Type / Operand	Bit devices			Word devices								
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Caution for using operand

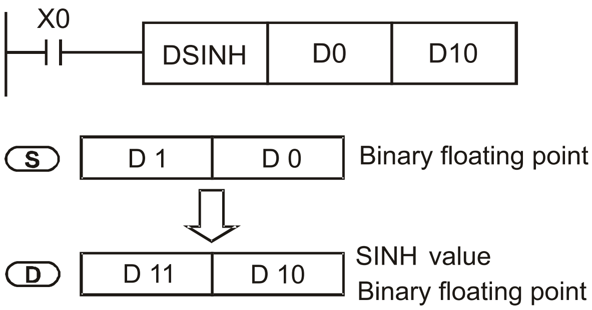
- See the specification of each model for the scope of device's usage.

16-bit instruction			
-	-	-	-

32-bit instruction (9 steps)			
DSINH	Continuous execution type	DSINHP	Pulse execution type

Associated flag: none

Description	● S: source value (binary floating-point number) D: operation result of hyperbolic sine ● sinh value = $(e^{s}-e^{-s}) / 2$
Example	● When X0 = ON, designate the binary floating-point number (D1, D0) to find the hyperbolic sine value and stores in (D11, D10). The content is binary floating-point number.



API	Instruction code			Operand	Function
137	D	**COSH**	P	S, D	Binary floating-point number hyperbolic cosine operation

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Caution for using operand

- See the specification of each model for the scope of device’s usage.

16-bit instruction

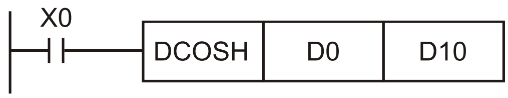
-	-	-	-

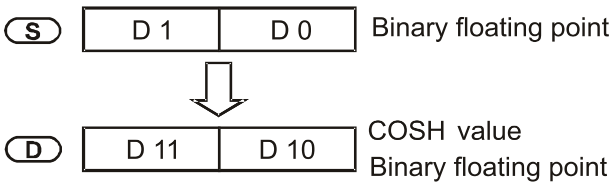
32-bit instruction (9 steps)

DCOSH	Continuous execution type	DCOSHP	Pulse execution type

Associated flag: none

Description	● S: source value (binary floating-point number) D: operation result of hyperbolic cosine ● cosh value = $(e^{s} + e^{-s}) / 2$
Example	● When X0 = ON, designate the binary floating-point number (D1, D0) to find the hyperbolic cosine value and stores in (D11, D10). The content is binary floating-point number.





API	Instruction code			Operand	Function
138	D	**TANH**	P	S, D	Binary floating-point number hyperbolic tangent operation

Type / Operand	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
	Bit devices			Word devices							
S				*	*						*
D											*

Caution for using operand

- See the specification of each model for the scope of device's usage.

16-bit instruction

-	-	-	-

32-bit instruction (9 steps)

DTANH	Continuous execution type	DTANHP	Pulse execution type

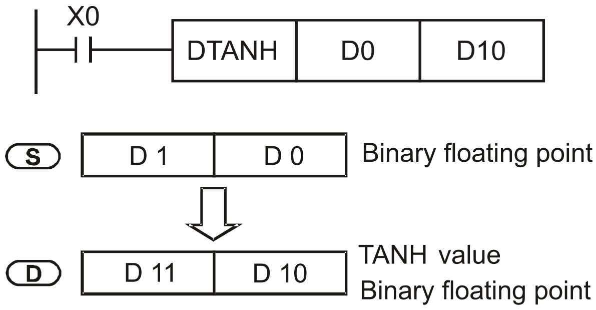
Associated flag: none

Description

- S: source value (binary floating-point number)
  D: operation result of hyperbolic tangent
- tanh value= $(e^{s} - e^{-s}) / (e^{s} + e^{-s})$

Example

- When X0 = ON, designate the binary floating-point number (D1, D0) to find the hyperbolic tangent value and stores in (D11, D10). The content is binary floating-point number.



API	Instruction code			Operand	Function
172	D	**ADDR**	P	S_1, S_2, D	Floating-point number addition

Type / Operand	Bit devices X	Bit devices Y	Bit devices M	Word devices K	H	KnX	KnY	KnM	T	C	D
S_1											*
S_2											*
D											*

Caution for using operand

- The floating-point values (e.g., F1.2) can be entered directly into S_1 and S_2
- The floating-point value after the operation will be stored in operand D

16-bit instruction

-	-	-	-

32-bit instruction (13 steps)

DADDR	Continuous execution type	DADDRP	Pulse execution type

Associated flag: none

Description

- S_1: floating-point number summand
  S_2: floating-point number addend
  D: sum (floating-point)
- When the floating-point values of S_1 and S_2 are stored in the register D, its function is the same as API 120 DEADD.
- S_1 and S_2 can designate the same register. In this case, if the instruction is specified as "continuous execution type" instruction (pulse execution type DADDRP is generally used) and the drive contact is ON, the register will be added once in every scan.
- If the absolute value of the operation result is larger than the maximum floating-point displayable, the carry flag M1022 = ON. If the absolute value of the operation result is smaller than the maximum floating-point displayable, the carry flag M1021 = ON. If the operation result ＝ 0, zero flag M1020 = ON.

Example

- Example 1
  When X0 = ON, add the floating-point value F1.200E+0 (input the floating-point number F1.2, the ladder diagram shows a scientific notation F1.200E+0. You can set the floating-point digit by using WPLSoft) to the floating-point value F2.200E+0, the operation result is F3.400E+0 and is stored in the register (D10, D11).

X0	DADDR	F1.200E+0	F2.200E+0	D10

- Example 2
  When X0 = ON, the floating-point numbers (D1, D0) add the floating-point numbers (D3, D2), and stores the result in (D11, D10).

X0	DADDR	D0	D2	D10

API	Instruction code			Operand	Function
173	D	**SUBR**	P	S_1, S_2, D	Floating-point number subtraction

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1											*
S_2											*
D											*

Caution for using operand

- The floating-point values (e.g., F1.2) can be entered directly into S_1 and S_2
- The floating-point value after the operation will be stored in operand D

16-bit instruction

-	-	-	-

32-bit instruction (13 steps)

DSUBR	Continuous execution type	DSUBRP	Pulse execution type

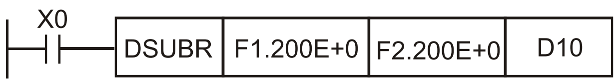
Associated flag: none

Description

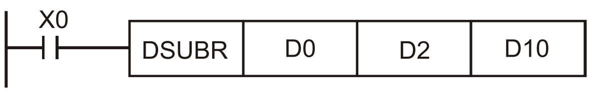
- S_1: floating-point number minuend
  S_2: floating-point number subtrahend
  D: difference (floating-point)
- When the floating-point values of S_1 and S_2 are stored in the register D, its function is the same as API 121 DESUB.
- S_1 and S_2 can designate the same register. In this case, if the instruction is specified as "continuous execution type" instruction (pulse execution type DSUBRP is generally used) and the drive contact is ON, the register will operate once in every scan.

Example

- Example 1
  When X0 = ON, subtract the floating-point value F2.200E+0 from the floating-point value F1.200E+0 (input the floating-point number F1.2, the ladder diagram shows a scientific notation F1.200E+0. You can set the floating-point digit by using WPLSoft), the operation result is F-1.000E+0 and is stored in the register (D10, D11).



- Example 2
  When X0 = ON, subtract the floating-point numbers (D3, D2) from the floating-point numbers (D1, D0), and stores the result in (D11, D10).



API	Instruction code			Operand	Function
174	D	**MULR**	P	S_1, S_2, D	Floating-point number multiplication

Type / Operand	Bit devices: X	Y	M	Word devices: K	H	KnX	KnY	KnM	T	C	D
S_1											*
S_2											*
D											*

16-bit instruction

-	-	-	-

32-bit instruction (13 steps)

DMULR	Continuous execution type	DMULRP	Pulse execution type

Associated flag: none

Caution for using operand

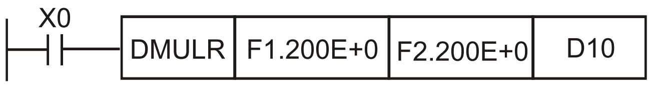
- The floating-point values (e.g., F1.2) can be entered directly into S_1 and S_2
- The floating-point value after the operation will be stored in operand D

Description

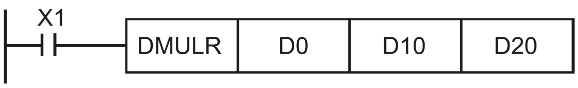
- S_1: floating-point number multiplicand
  S_2: floating-point number multiplicator
  D: product (floating-point)
- When the floating-point values of S_1 and S_2 are stored in the register D, its function is the same as API 122 DEMUL.
- S_1 and S_2 can designate the same register. In this case, if the instruction is specified as "continuous execution type" instruction (pulse execution type DMULRP is generally used) and the drive contact is ON, the register will operate once in every scan.

Example

- Example 1
  When X0 = ON, the floating-point value F1.200E+0 (input the floating-point number F1.2, the ladder diagram shows a scientific notation F1.200E+0. You can set the floating-point digit by using WPLSoft) multiplies the floating-point value F2.200E+0, the operation result is F2.640E+0 and is stored in the register (D10, D11).



- Example 2
  When X1 = ON, multiply the floating-point number (D1, D0) and (D11, D11), and store the product to (D21, D20).



API	Instruction code			Operand	Function
175	D	**DIVR**	P	S_1, S_2, D	Floating-point number division

Type / Operand	Bit devices X	Y	M	Word devices K	H	KnX	KnY	KnM	T	C	D
S_1											*
S_2											*
D											*

Caution for using operand

- The floating-point values (e.g., F1.2) can be entered directly into S_1 and S_2
- The floating-point value after the operation will be stored in operand D

16-bit instruction

-	-	-	-

32-bit instruction (13 steps)

DDIVR	Continuous execution type	DDIVRP	Pulse execution type

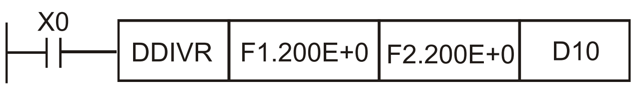
Associated flag: none

Description	● S_1: floating-point number dividend S_2: floating-point number divisor D: quotient (floating-point) ● When the floating-point values of S_1 and S_2 are stored in the register D, its function is the same as API 123 DEDIV. ● S_1 and S_2 can designate the same register. In this case, if the instruction is specified as "continuous execution type" instruction (pulse execution type DDIVRP is generally used) and the drive contact is ON, the register will operate once in every scan.

Example

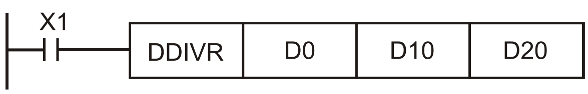
● Example 1

When X0 = ON, the floating-point value F1.200E+0 (input the floating-point number F1.2, the ladder diagram shows a scientific notation F1.200E+0. You can set the floating-point digit by using WPLSoft) divided by the floating-point value F2.200E+0, the operation result is F0.545E+0 and is stored in the register (D10, D11).



● Example 2

When X1 = ON, the floating-point number (D1, D0) divided by (D11, D11), and store the quotient to (D21, D20).



API	Instruction code		Operand	Function
202	**SCAL**	P	S_1, S_2, S_3, n	Proportional calculation

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*						*
S_2				*	*						*
S_3				*	*						*
D											*

16-bit instruction (9 steps)

SCAL	Continuous execution type	SCALP	Pulse execution type

32-bit instruction

-	-	-	-

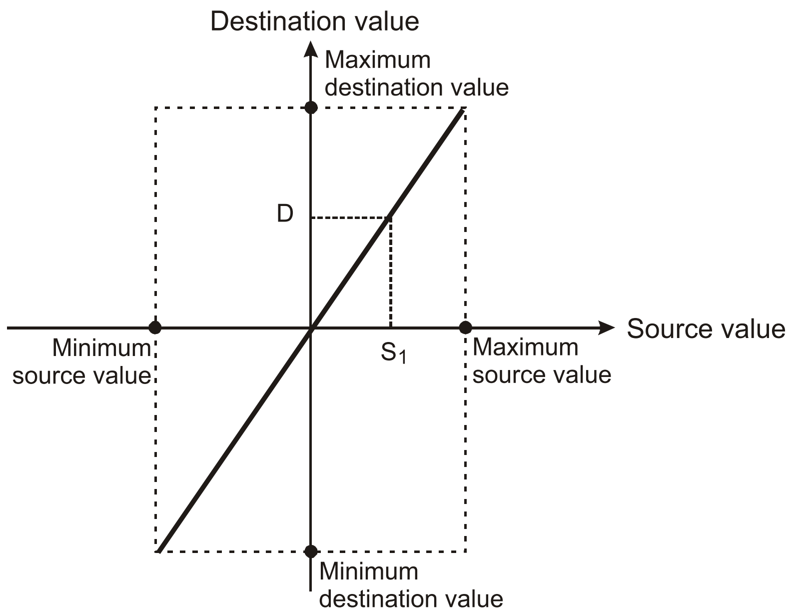
Associated flag: none

Caution for using operand

- The range of S_1, S_2, S_3 is -32768–32767
- If D > 32,767, then D = 32,767
  If D < -32,768, then D = -32,768

Description

- S_1: source value
  S_2: slope (unit: 0.001)
  S_3: offset
  D: destination devices
- Operation formula in the instruction: $D = (S_1 \times S_2) \div 1{,}000 + S_3$
- Users have to obtain S_2 and S_3 (decimals are rounded up into 16-bit integers) by using the slope and offset formulas below.
- Formula for slope: S_2 = [(max. destination value – min. destination value) ÷ (max. source value – min. source value)] × 1,000
- Formula for offset: S_3 = min. destination value – min. source value x S_2 ÷ 1,000
- Using the formula for slope must be noted that the max. source value has to be greater than the min. source value, and it is not limited that the max. destination value to be greater than the min. destination value.
- The output curve is shown as the figure:

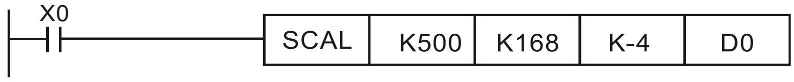


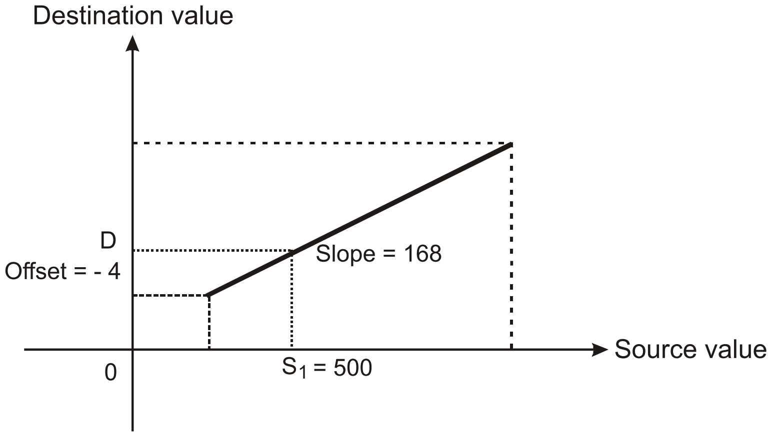
Example

- Example 1

  Assume S_1 = 500, S_2 = 168, S_3 = -4 When X0 = ON, after executing SCAL instruction, you can obtain the required ratio in D0.

  Calculation: D0 = (500 × 168) ÷ 1000 + (-4) = 80

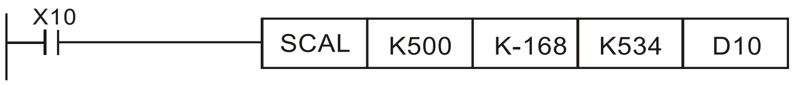


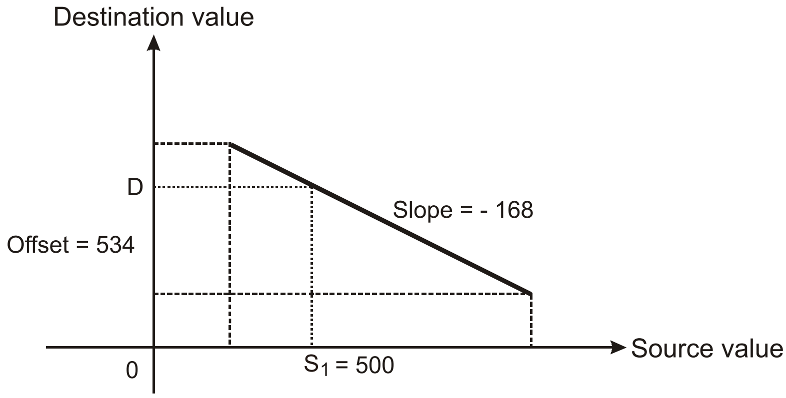


- Example 2

  Assume S_1 = 500, S_2 = -168, S_3 = 534 When X0 = ON, after executing SCAL instruction, you can obtain the required ratio in D10.

  Calculation: D10 = (500 × -168) ÷ 1000+ 534 = 450





API	Instruction code			Operand	Function
160		**TCMP**	P	S_1, S_2, S_3, S, D	Time comparison

Type / Operand	Bit devices X	Bit devices Y	Bit devices M	Word devices K	H	KnX	KnY	KnM	T	C	D
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*
S_3				*	*	*	*	*	*	*	*
S									*	*	*
D		*	*								

Caution for using operand

- See the specification of each model for the scope of device's usage.

16-bit instruction (11 steps)

TCMP	Continuous execution type	TCMPP	Pulse execution type

32-bit instruction

-	-	-	-

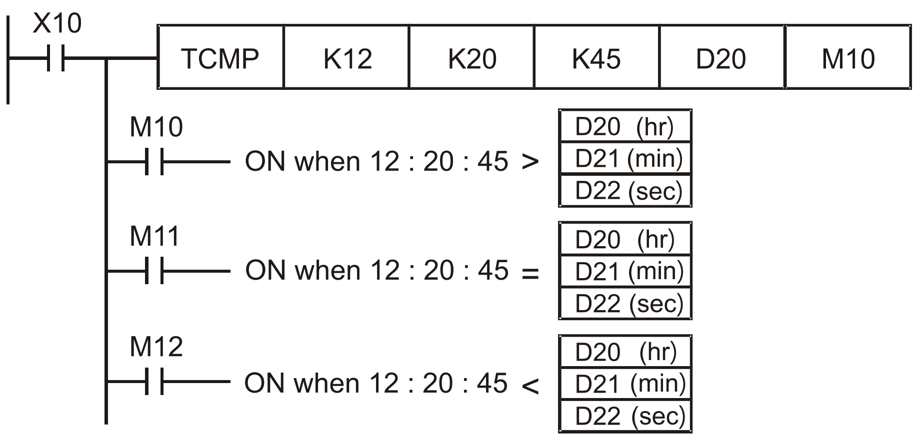
Associated flag: none

Description

- S_1: hour setting for time comparison, setting range: K0–K23
  S_2: minute setting for time comparison, setting range: K0–K59
  S_3: second setting for time comparison, setting range: K0–K59
  S: current time of RTC
  D: comparison result
- Compare the setting value of S_1, S_2, S_3 and the current value of start of S, and the comparison result is stored in D.
- S is the "hour" of the current time (K0–K23) in RTC. S+1 is the "minute" of the current time (K0–K59) in RTC. S+2 is the "second" of the current time (K0–K59) in RTC.
- Usually, the current time of RTC that S designates is read by using TRD instruction and then doing comparison by TCMP instruction. If S value exceeds the available range, it is operation error, so the instruction is not executed, M1068 = ON.

Example

- When X10 = ON, the instruction is executed to compare the current time of RTC D20–D22 and the setting value 12:20:45. The comparison result is stored in M10–M12. When X10 goes from ON→OFF, the instruction is not executed, but the previous ON / OFF statuses of M10–M12 remain.



API	Instruction code		Operand	Function
161	**TZCP**	P	S_1, S_2, S, D	Time zone comparison

Type / Operand	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
	Bit devices			Word devices							
S_1									*	*	*
S_2									*	*	*
S									*	*	*
D		*	*								

Caution for using operand

- See the specification of each model for the scope of device's usage.

16-bit instruction (9 steps)

TZCP	Continuous execution type	TZCPP	Pulse execution type

32-bit instruction

-	-	-	-

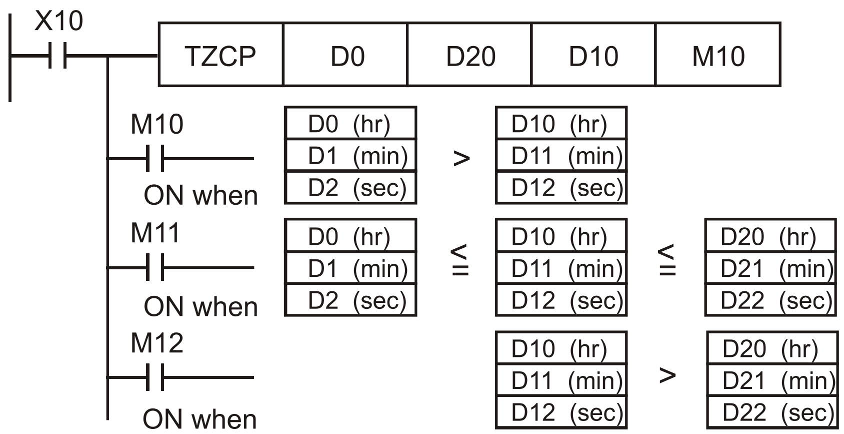
Associated flag: none

Description

- S_1: the lower bound setting value for time comparison
  S_2: the upper bound setting value for time comparison
  S: current time of RTC
  D: comparison result
- Compare the current time of RTC that S designates with S1–S2, the comparison result is stored in D.
- S_1, S_1 + 1, S_1 + 2: the hour, minute, second of the lower bound setting value for comparison.
- S_2, S_2 + 1, S_2 + 2: the hour, minute, second of the upper bound setting value for comparison.
- S, S + 1, S + 2: the hour, minute, second of the current time of RTC.
- D0 that S designates is usually read the current time of RTC by using TRD instruction and then doing comparison by TZCP instruction. If S_1, S_2 and S value exceed the available range, it is operation error, so the instruction is not executed, M1068 = ON.
- If S < S_1 and S < S_2, then D = ON; if S > S_1 and S < S_2, then D+2 = ON. For other conditions are D+1 = ON

Example

- When X10 = ON, TZCP instruction is executed, and one of M10, M11, and Y2 will be ON. When X10 = OFF, TZCP instruction is not executed, and M10, M11, and M12 remain their statuses before X10 = OFF.



API	Instruction code			Operand	Function
162		**TADD**	P	S_1, S_2, D	Time addition

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1									*	*	*
S_2									*	*	*
D		*	*						*	*	*

Caution for using operand

- See the specification of each model for the scope of device's usage.

16-bit instruction (7 steps)

TADD	Continuous execution type	TADDP	Pulse execution type

32-bit instruction

-	-	-	-

Associated flag:

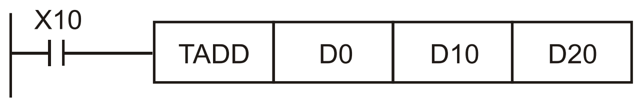
M1020: Zero flag
M1022: Carry flag
M1068 RTC error

Description

- S_1: time augend
  S_2: time addend
  D: time sum
- Add the hour, minute, second that S_1 designates and the hour, minute, second that S_2 designates, the result is stored in the hour, minuet, second of the register that D designates.
- If S_1, S_2 exceed the range, it's operation error, so the instruction is not executed. M1067, M1068 = ON, and record fault code 0E1A (HEX) in D1067.
- If the sum ≥ 24 hours, carry flag M1022 = ON, and the result in D is the value of the sum minus 24 hours.
- If the sum equals to 0 (00:00:00), zero flag M1020 = ON.

Example

- When X10 = ON, TADD instruction is executed. The hour, minute, second that D0–D2 designate plus the hour, minute, second that D10–D12 designates, the result is stored in the hour, minuet, second of the register that D20–D22 designates.



		+			→		
D0	8(hr)		D10	6(hr)		D20	14(hr)
D1	10(min)		D11	40(min)		D21	50(min)
D2	20(sec)		D12	6(sec)		D22	26(sec)
8 : 10 : 20			6 : 40 : 6			14 : 50 : 26	

API	Instruction code			Operand	Function
163		**TSUB**	P	S_1, S_2, D	Time subtraction

Type / Operand	Bit devices X	Bit devices Y	Bit devices M	Word devices K	H	KnX	KnY	KnM	T	C	D
S_1									*	*	*
S_2									*	*	*
D									*	*	*

Caution for using operand

- See the specification of each model for the scope of device's usage.

16-bit instruction (7 steps)

TSUB	Continuous execution type	TSUBP	Pulse execution type

32-bit instruction

-	-	-	-

Associated flag:

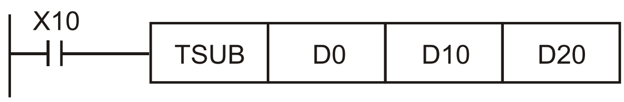
M1020: Zero flag
M1022: Carry flag
M1068 RTC error

Description

- S_1: time minuend
  S_2: time subtrahend
  D: time difference
- Add the hour, minute, second that S_1 designates and the hour, minute, second that S_2 designates, the result is stored in the hour, minuet, second of the register that D designates.
- If S_1, S_2 exceed the range, it's operation error, so the instruction is not executed. M1067, M1068 = ON, and record fault code 0E1A (HEX) in D1067.
- If the difference is a negative, borrow flag M1021 = ON, and the result of the negative number plus 24 hours will be displayed in the register D designates.
- If the difference equals to 0 (00:00:00), zero flag M1020 = ON.

Example

- When X10 = ON, TSUB instruction is executed. The hour, minute, second that D0–D2 designate minus the hour, minute, second that D10–D12 designates, the result is stored in the register that D20–D22 designates.



D0 20(hr)		D10 14(hr)		D20 5(hr)
D1 20(min)	–	D11 30(min)	→	D21 49(min)
D2 5(sec)		D12 8(sec)		D22 57(sec)

20 : 20 : 5   14 : 30 : 8   5 : 49 : 57

API	Instruction code			Operand	Function
166		**TRD**	P	D	Time read

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D									*	*	*

Caution for using operand

- See the specification of each model for the scope of device's usage.

16-bit instruction (3 steps)

TRD	Continuous execution type	TRDP	Pulse execution type

32-bit instruction

-	-	-	-

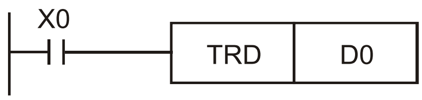
Associated flag: none

Description

- S: the device for storing the current time read in RTC
- The RTC offers year, week, month, day, hour, minute, second, a total of 7 sets of data to store in D1063–D1069. The function of TRD instruction allows programmers to read the current time of RTC and store in the designated 7 registers.
- D1063 only stores the last 2 digits of the A.D. year.

Example

- When X0 = ON, read the current time of RTC and store in D0–D6 registers.
- The content of D1064, 1 = Monday, 2 = Tuesday ... 7 = Sunday



Special D	Item	Content		General D	Item
D1063	Year (A.D.)	00–99	→	D0	Year (A.D.)
D1064	Week	1–7	→	D1	Week
D1065	Month	1–12	→	D2	Month
D1066	Day	1–31	→	D3	Day
D1067	Hour	0–23	→	D4	Hour
D1068	Minute	0–59	→	D5	Minute
D1069	Second	0–59	→	D6	Second

API	Instruction code			Operand	Function
170	D	**GRY**	P	S, D	Binary code → Gray code

Type / Operand	Bit devices: X	Y	M	Word devices: K	H	KnX	KnY	KnM	T	C	D
S				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Caution for using operand

- See the specification of each model for the scope of device's usage.

16-bit instruction (5 steps)

GRY	Continuous execution type	GRYP	Pulse execution type

32-bit instruction (9 steps)

DGRY	Continuous execution type	DGRYP	Pulse execution type

Associated flag: none

Description

- S: source device
  D: device for storing Gray code
- Convert the binary value of the device designated by S to Gray code, and store in the device that D designates.
- The available range of S is as below. If the value exceeds the range, it is operation error, and the instruction is not executed.
  16-bit instruction: 0–32,767
  32-bit instruction: 0–2,147,483,647

Example

- When X0 = ON, convert the constant K6513 to Gray code, and store in D0.

b15 … b0

K6513=H1971 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 |

↓

b15 … b0

GRAY CODE 6513 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 |

D0

API	Instruction code			Operand	Function
171	D	**GBIN**	P	S, D	Gray code → Binary code

Type / Operand	Bit devices X	Bit devices Y	Bit devices M	Word devices K	H	KnX	KnY	KnM	T	C	D
S				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Caution for using operand

- See the specification of each model for the scope of device's usage.

16-bit instruction (5 steps)

GBIN	Continuous execution type	GBINP	Pulse execution type

32-bit instruction (9 steps)

DGBIN	Continuous execution type	DGBINP	Pulse execution type

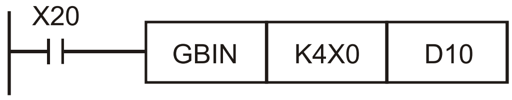
Associated flag: none

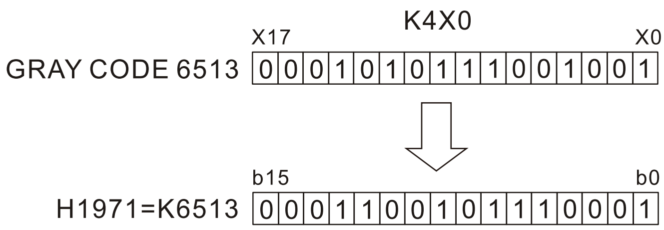
Description

- S: source device for storing Gray code
  D: device for storing the binary value
- Convert the content (Gray code) of the device designated by S to binary value, and store in the device that D designates.
- This instruction is to convert the content of the absolute position type encoder (the output value is generally Gray code) which connects with input side of PLC to be binary value, and store in the designated register.
- The available range of S is as below. If the value exceeds the range, it is operation error, and the instruction is not executed.
  16-bit instruction: 0–32,767
  32-bit instruction: 0–2,147,483,647

Example

- When X20 = ON, convert the Gray code from the absolute position encoder which connects with X0–X17 input side to be binary value, and store in D10.





API	Instruction code			Operand	Function
215–217	D	**LD#**		S_1, S_2	Contact type logical operation LD#

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*

Caution for using operand: # : & | ^

- See the specification of each model for the scope of device’s usage.

16-bit instruction (5 steps)

LD#	Continuous execution type	-	-

32-bit instruction (9 steps)

DLD#	Continuous execution type	-	-

Associated flag: none

Description

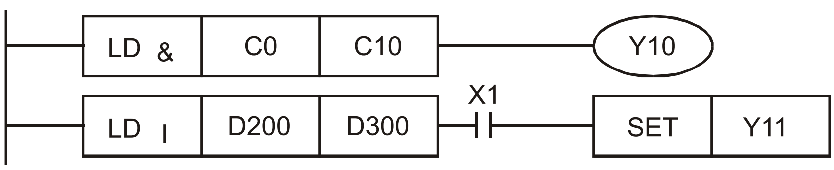
- S_1: source device 1
  S_2: source device 2
- This instruction is to compare S_1 and S_2, if the result ≠ 0, the continuity of the instruction is enabled; if the result = 0, the continuity of the instruction is disabled.
- LD# (#: &, |, ^) instruction is used for direct connection with busbar

API No.	16-bit instruction	32-bit instruction	Continuity condition	Discontinuity condition
215	LD&	**D**LD&	**S1** & **S2** ≠ 0	**S1** & **S2** = 0
216	LD|	**D**LD|	**S1** | **S2** ≠ 0	**S1** | **S2** = 0
217	LD^	**D**LD^	**S1** ^ **S2** ≠ 0	**S1** ^ **S2** = 0

- &: logical operation with AND operator
- |: Logical operation with OR operator
- ^: Logical operation with XOR operator

Example

- C1 and C10 perform “AND” logical operation, if the result is not 0, Y10 = ON
- D200 and D300 perform “OR” logical operation, if the result is not 0 and X1 = ON, then Y11 = ON and hold.



API		Instruction code		Operand	Function
218–220	D	AND#		S_1, S_2	Contact type logical operation AND#

Type / Operand	Bit devices X	Y	M	Word devices K	H	KnX	KnY	KnM	T	C	D
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*

Caution for using operand: # : & | ^

- See the specification of each model for the scope of device's usage.

16-bit instruction (5 steps)

AND#	Continuous execution type	-	-

32-bit instruction (9 steps)

DAND#	Continuous execution type	-	-

Associated flag: none

Description

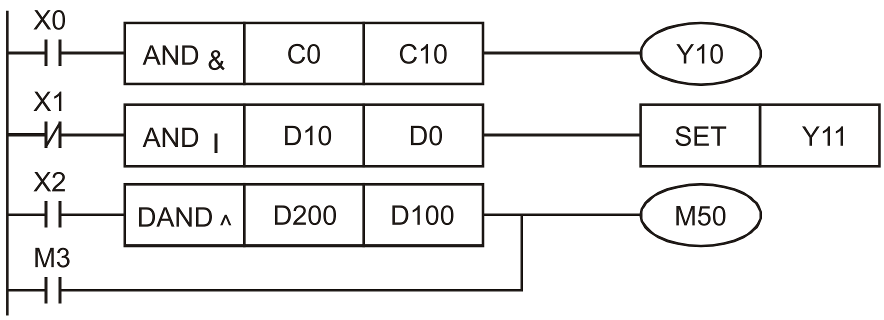
- S_1: source device 1
  S_2: source device 2
- This instruction is to compare S_1 and S_2, if the result ≠ 0, the continuity of the instruction is enabled; if the result = 0, the continuity of the instruction is disabled.
- AND# (#: &, |, ^) instruction is used for serial connection with contacts

API No.	16-bit instruction	32-bit instruction	Continuity condition	Discontinuity condition
218	AND&	**D**AND&	**S_1** & **S_2** ≠ 0	**S_1** & **S_2** = 0
219	AND|	**D**AND|	**S_1** | **S_2** ≠ 0	**S_1** | **S_2** = 0
220	AND^	**D**AND^	**S_1** ^ **S_2** ≠ 0	**S_1** ^ **S_2** = 0

- &: logical operation with AND operator
- |: Logical operation with OR operator
- ^: Logical operation with XOR operator

Example

- When X0 =ON, and C1 and C10 perform "AND" logical operation with the result is not 0, then Y10 = ON
- When X1 = OFF, and D10 and D0 perform "OR" logical operation with the result is not 0, then Y11 = ON and hold.
- When X2 = ON, and 32-bit registers D200 (D201) and D100 (D101) perform "XOR" logical operation with the result is not 0 or M3 = ON, then M50 = ON.



API	Instruction code			Operand	Function
221–223	D	**OR#**		S_1, S_2	Contact type logical operation OR#

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*

Caution for using operand: # : & | ^

- See the specification of each model for the scope of device's usage.

16-bit instruction (5 steps)

OR#	Continuous execution type	-	-

32-bit instruction (9 steps)

DOR#	Continuous execution type	-	-

Associated flag: none

Description

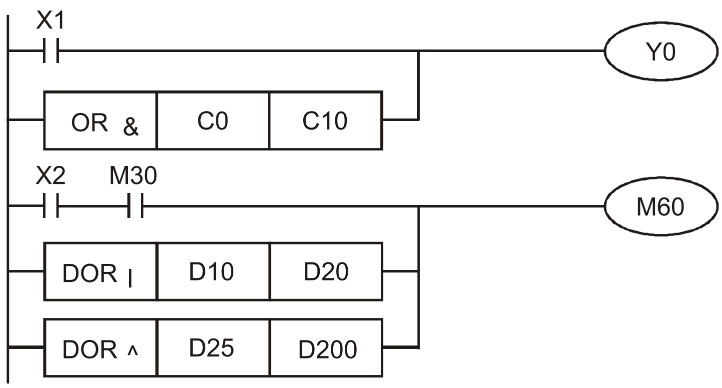
- S_1: source device 1
  S_2: source device 2
- This instruction is to compare S_1 and S_2, if the result ≠ 0, the continuity of the instruction is enabled; if the result = 0, the continuity of the instruction is disabled.
- OR# (#: &, |, ^) instruction is used for parallel connection with contacts

API No.	16-bit instruction	32-bit instruction	Continuity condition	Discontinuity condition
221	OR&	**D**OR&	S_1 & S_2 ≠ 0	S_1 & S_2 = 0
222	OR|	**D**OR|	S_1 | S_2 ≠ 0	S_1 | S_2 = 0
223	OR^	**D**OR^	S_1 ^ S_2 ≠ 0	S_1 ^ S_2 = 0

- &: logical operation with AND operator
- |: Logical operation with OR operator
- ^: Logical operation with XOR operator

Example

- When X0 =ON, or C0 and C10 perform "AND" logical operation with the result is not 0, then Y0 = ON
- When both X2 and M30 are ON, or 32-bit registers D10 (D11) and D20 (D21) perform "OR" logical operation with the result is not 0, or 32-bit counter C235 and 32-bit register D200 (D201) perform "XOR" logical operation with the result is not 0, then M60 = ON.



API	Instruction code			Operand	Function
224–230	D	**LD※**		S_1, S_2	Contact type comparison LD※

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*

Caution for using operand ※: =, >, <, <>, ≦, ≧

- See the specification of each model for the scope of device’s usage.

16-bit instruction (5 steps)

LD※	Continuous execution type	-	-

32-bit instruction (9 steps)

DLD※	Continuous execution type	-	-

Associated flag: none

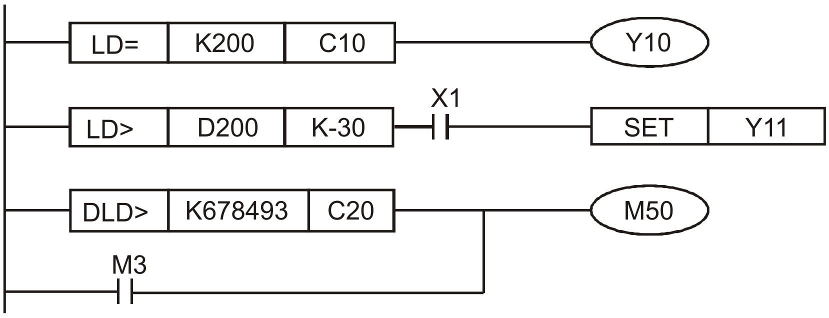
Description

- S_1: source device 1
  S_2: source device 2
- This instruction is to compare S_1 and S_2, take API 224 (LD=) as an example, if the result is “equal to”, the continuity of the instruction is enabled; if the result is “not equal to”, the continuity of the instruction is disabled.
- LD※ (※: =, >, <, <>, ≦, ≧) instruction is used for direct connection with busbar

API No.	16-bit instruction	32-bit instruction	Continuity condition	Discontinuity condition
224	LD=	**D**LD=	$\mathbf{S_1 = S_2}$	$\mathbf{S_1 \neq S_2}$
225	LD>	**D**LD>	$\mathbf{S_1 > S_2}$	$\mathbf{S_1 \leq S_2}$
226	LD<	**D**LD<	$\mathbf{S_1 < S_2}$	$\mathbf{S_1 \geq S_2}$
228	LD<>	**D**LD<>	$\mathbf{S_1 \neq S_2}$	$\mathbf{S_1 = S_2}$
229	LD<=	**D**LD<=	$\mathbf{S_1 \leq S_2}$	$\mathbf{S_1 > S_2}$
230	LD>=	**D**LD>=	$\mathbf{S_1 \geq S_2}$	$\mathbf{S_1 < S_2}$

Example

- When C10 = K200, Y10 = ON.
- When D200 > K-30 and X1 = ON, Y11 = ON and hold.



API	Instruction code			Operand	Function
232–238	D	AND※		S_1, S_2	Contact type comparison AND※

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*

Caution for using operand ※: =, >, <, <>, ≦, ≧

- See the specification of each model for the scope of device's usage.

16-bit instruction (5 steps)

AND※	Continuous execution type	-	-

32-bit instruction (9 steps)

DAND※	Continuous execution type	-	-

Associated flag: none

Description

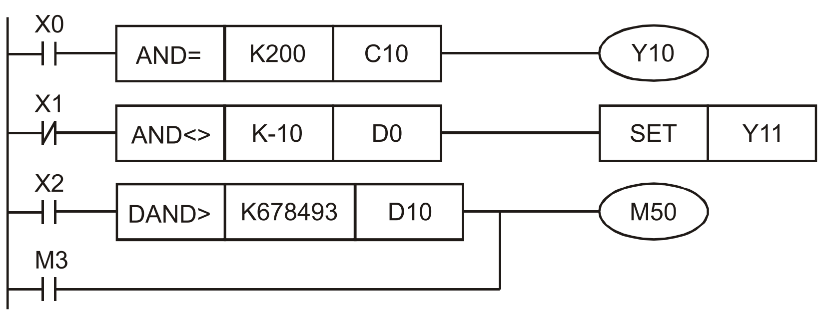
- S_1: source device 1

  S_2: source device 2
- This instruction is to compare S_1 and S_2, take API 232 (AND=) as an example, if the result is "equal to", the continuity of the instruction is enabled; if the result is "not equal to", the continuity of the instruction is disabled.
- AND※ (※: =, >, <, <>, ≦, ≧) instruction is used for serial connection with contacts

API No.	16-bit instruction	32-bit instruction	Continuity condition	Discontinuity condition
232	AND=	**D**AND=	$S_1 = S_2$	$S_1 \neq S_2$
233	AND>	**D**AND>	$S_1 > S_2$	$S_1 \leq S_2$
234	AND<	**D**AND<	$S_1 < S_2$	$S_1 \geq S_2$
236	AND<>	**D**AND<>	$S_1 \neq S_2$	$S_1 = S_2$
237	AND<=	**D**AND<=	$S_1 \leq S_2$	$S_1 > S_2$
238	AND>=	**D**AND>=	$S_1 \geq S_2$	$S_1 < S_2$

Example

- When X0 = ON, and the current value of C10 = K200, then Y10 = ON
- When X1 =OFF, and D0 ≠ K-10, then Y11 = ON and hold.
- When X2 = ON, the 32-bit register D0 (D11) is less than 678,493 or M3 = ON, then M50 = ON.



API	Instruction code			Operand	Function
240–246	D	**OR※**		S_1, S_2	Contact type comparison OR※

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*	*	*	*	*	*	*
S_2				*	*	*	*	*	*	*	*

Caution for using operand ※: =, >, <, <>, ≦, ≧

- See the specification of each model for the scope of device's usage.

16-bit instruction (5 steps)			
OR※	Continuous execution type	-	-

32-bit instruction (9 steps)			
DOR※	Continuous execution type	-	-

Associated flag: none

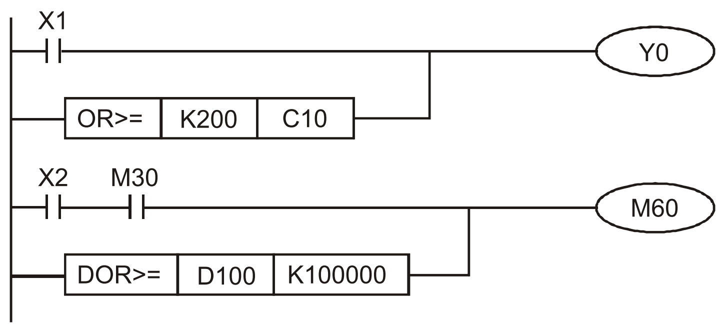
Description

- S_1: source device 1
  S_2: source device 2
- This instruction is to compare S_1 and S_2, take API 240 (OR=) as an example, if the result is "equal to", the continuity of the instruction is enabled; if the result is "not equal to", the continuity of the instruction is disabled.
- OR※ (※: =, >, <, <>, ≦, ≧) instruction is used for parallel connection with contacts

API No.	16-bit instruction	32-bit instruction	Continuity condition	Discontinuity condition
240	OR=	**D**OR=	$\mathbf{S_1 = S_2}$	$\mathbf{S_1 \neq S_2}$
241	OR>	**D**OR>	$\mathbf{S_1 > S_2}$	$\mathbf{S_1 \leq S_2}$
242	OR<	**D**OR<	$\mathbf{S_1 < S_2}$	$\mathbf{S_1 \geq S_2}$
244	OR<>	**D**OR<>	$\mathbf{S_1 \neq S_2}$	$\mathbf{S_1 = S_2}$
245	OR<=	**D**OR<=	$\mathbf{S_1 \leq S_2}$	$\mathbf{S_1 > S_2}$
246	OR>=	**D**OR>=	$\mathbf{S_1 \geq S_2}$	$\mathbf{S_1 < S_2}$

Example

- When X0 = ON, and the current value of C10 = K200, then Y10 = ON
- When X1 =OFF, and D0 ≠ K-10, then Y11 = ON and hold.
- When X2 = ON, the 32-bit register D0 (D11) is less than 678,493 or M3 = ON, then M50 = ON.



API	Instruction code			Operand	Function
275–280	D	**FLD※**		S_1, S_2	Floating-point number contact type comparison LD※

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1									*	*	*
S_2									*	*	*

Caution for using operand: # : & | ^

- See the specification of each model for the scope of device's usage.

16-bit instruction

-	-	-	-

32-bit instruction (9 steps)

FLD※	Continuous execution type	-	-

Associated flag: none

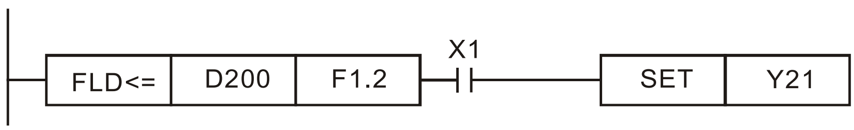
Description

- S_1: source device 1
  S_2: source device 2
- This instruction compares the content in S_1 and S_2. Take "FLD=" as an example, if the result is "equal to", the continuity of the instruction is enabled; if the result is "not equal to", the continuity of the instruction is disabled.
- Use FLD※ instruction, users can execute operation directly by inputting floating-point value (e.g., F1.2) in S_1, S_2 or storing floating-point value in the register D.
- The instruction is used for direct connection with busbar

API No.	32-bit instruction	Continuity condition	Discontinuity condition
275	FLD=	$S_1 = S_2$	$S_1 \neq S_2$
276	FLD>	$S_1 > S_2$	$S_1 \leq S_2$
277	FLD<	$S_1 < S_2$	$S_1 \geq S_2$
278	FLD<>	$S_1 \neq S_2$	$S_1 = S_2$
279	FLD<=	$S_1 \leq S_2$	$S_1 > S_2$
280	FLD>=	$S_1 \geq S_2$	$S_1 < S_2$

Example

- When the floating-point value in D200 (D201) ≤ F1.2 and X1 is ON, then Y21 is being triggered and hold.



API	Instruction code			Operand	Function
281–286	D	**FAND※**		S_1, S_2	Floating-point number contact type comparison AND※

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1									*	*	*
S_2									*	*	*

Caution for using operand: # : & | ^

- See the specification of each model for the scope of device's usage.

16-bit instruction

-	-	-	-

32-bit instruction (9 steps)

FAND※	Continuous execution type	-	-

Associated flag: none

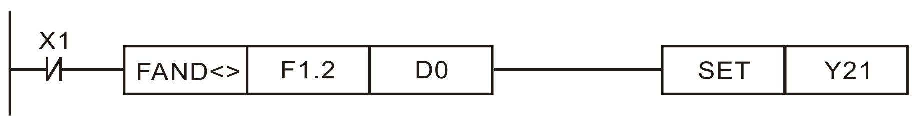
Description

- S_1: source device 1
  S_2: source device 2
- This instruction compares the content in S_1 and S_2. Take "FAND=" as an example, if the result is "equal to", the continuity of the instruction is enabled; if the result is "not equal to", the continuity of the instruction is disabled.
- Use FAND※ instruction, users can execute operation directly by inputting floating-point value (e.g., F1.2) in S_1, S_2 or storing floating-point value in the register D.
- The instruction is used for direct connection with busbar

API No.	32-bit instruction	Continuity condition	Discontinuity condition
281	FAND=	$S_1 = S_2$	$S_1 \neq S_2$
282	FAND>	$S_1 > S_2$	$S_1 \leq S_2$
283	FAND<	$S_1 < S_2$	$S_1 \geq S_2$
284	FAND<>	$S_1 \neq S_2$	$S_1 = S_2$
285	FAND<=	$S_1 \leq S_2$	$S_1 > S_2$
286	FAND>=	$S_1 \geq S_2$	$S_1 < S_2$

Example

- When X1 = OFF, and D100 (D101) ≠ F1.2, then Y21 = ON and hold.



API	Instruction code	Operand	Function
287–292	**FOR※**	S_1, S_2	Floating-point number contact type comparison OR※

Type / Operand	Bit devices X	Y	M	Word devices K	H	KnX	KnY	KnM	T	C	D
S_1									*	*	*
S_2									*	*	*

Caution for using operand: # : & | ^

- See the specification of each model for the scope of device's usage.

16-bit instruction

-	-	-	-

32-bit instruction (9 steps)

FOR※	Continuous execution type	-	-

Associated flag: none

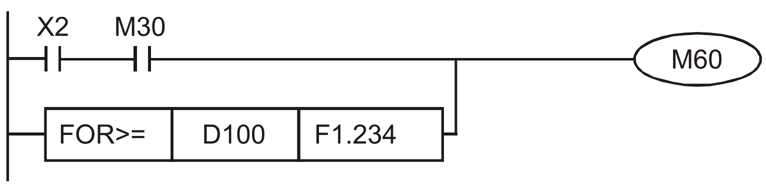
Description

- S_1: source device 1
  S_2: source device 2
- This instruction compares the content in S_1 and S_2. Take "FOR=" as an example, if the result is "equal to", the continuity of the instruction is enabled; if the result is "not equal to", the continuity of the instruction is disabled.
- Use FOR※ instruction, users can execute operation directly by inputting floating-point value (e.g., F1.2) in S_1, S_2 or storing floating-point value in the register D.
- The instruction is used for direct connection with busbar

API No.	32-bit instruction	Continuity condition	Discontinuity condition
287	FOR=	$S_1 = S_2$	$S_1 \neq S_2$
288	FOR>	$S_1 > S_2$	$S_1 \leq S_2$
289	FOR<	$S_1 < S_2$	$S_1 \geq S_2$
290	FOR<>	$S_1 \neq S_2$	$S_1 = S_2$
291	FOR<=	$S_1 \leq S_2$	$S_1 > S_2$
292	FOR>=	$S_1 \geq S_2$	$S_1 < S_2$

Example

- When both X2 and M30 are ON, or the content in D100 (D101) ≥ F1.234, then M60 = ON.



7-2-5 Instructions of special application instructions for AC motor drives

API	Instruction code			Operand	Function
139	D	**RPR**	P	S_1, S_2	Read parameters of drive

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*						*
S_2											*

Caution for using operand: none

16-bit instruction (5 steps)

RPR	Continuous execution type	RPRP	Pulse execution type

32-bit instruction (9 steps)

DRPR	Continuous execution type	DRPRP	Pulse execution type

Associated flag:

M1016 parameters written error
M1017 parameters written successfully

Description	
Description	● S_1: the parameter address for reading data S_2: the register for storing the read data

API	Instruction code			Operand	Function
140	D	**WPR**	P	S_1, S_2	Write parameters of drive

Type / Operand	Bit devices X	Bit devices Y	Bit devices M	Word devices K	Word devices H	KnX	KnY	KnM	T	C	D
S_1				*	*						*
S_2				*	*						*

Caution for using operand: none

16-bit instruction (5 steps)

WPR	Continuous execution type	WPRP	Pulse execution type

32-bit instruction (9 steps)

DWPR	Continuous execution type	DWPRP	Pulse execution type

Associated flag:

M1016 parameters written error
M1017 parameters written successfully

Description	● S_1: the data to be written S_2: the parameter address for writing data
Suggestion	● Note that when you use WPR instruction and write in parameters, most parameters are recorded at the same time of writing, and these parameters allows 10^9 times for change. A memory write error may occur if parameters are written more than 10^9 times. ● The following commonly used parameters have been specially processed, so there is no limit to the number of write times. 1. PLC application parameters: L1-00–L1-49, L2-00–L2-49 2. The source selection of PLC mode control digital terminal, bit0–bit1: L0-07–L0-08 3. Acceleration time 1: Pr.C2-00 4. Deceleration time 1: Pr.C2-01 5. Acceleration time 2: Pr.C2-02 6. Deceleration time 2: Pr.C2-03 7. Acceleration time 3: Pr.C2-04 8. Deceleration time 3: Pr.C2-05 9. Acceleration time 4: Pr.C2-06 10. Deceleration time 4: Pr.C2-07 11. JOG acceleration time 4: Pr.C3-01 12. JOG deceleration time 4: Pr.C3-02 ● The calculation of write times is based on the written value whether is being changed or not. For example, write the same value 100 times at the same time counts as once only. ● If you are not sure that the use of WPR instruction in PLC writing, we recommend you use WPRA instruction.

API	Instruction code			Operand	Function
323	D	**WPRA**	P	S_1, S_2	Write parameters of drive (in RAM only)

Type / Operand	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
	Bit devices			Word devices							
S_1				*	*						*
S_2				*	*						*

Caution for using operand: none

16-bit instruction (5 steps)

WPRA	Continuous execution type	WPRAP	Pulse execution type

32-bit instruction (9 steps)

DWPRA	Continuous execution type	DWPRAP	Pulse execution type

Associated flag:

M1016 parameters written error
M1017 parameters written successfully

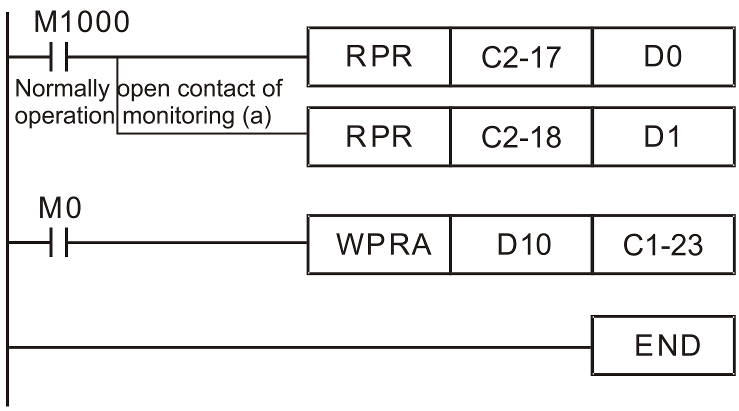
Description

- S_1: the data to be written

  S_2: the parameter address for writing data

Example

- Read Pr.C2-17 data of VP3000 and write into D0, read Pr.C2-18 data and write into D1.
- When M0 = ON, write the content of D10 into VP3000's Pr.C1-23 (multi-speed 1).
- If parameters are written successfully, M1017 = ON.



API	Instruction code			Operand	Function
142		**FREQ**	P	S_1, S_2, S_3	AC motor drive speed control

Type / Operand	Bit devices			Word devices							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S_1				*	*						*
S_2				*	*						*
S_3				*	*						*

Caution for using operand: none

16-bit instruction (7 steps)

FREQ	Continuous execution type	FREQP	Pulse execution type

32-bit instruction

-	-	-	-

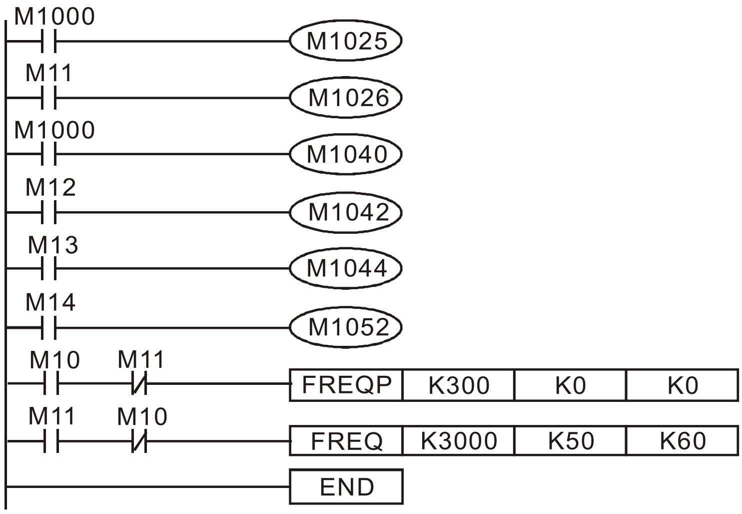
Associated flag: M1015

Description

- S_1: frequency command
  S_2: acceleration time
  S_3: deceleration time
- S_2, S_3: for the setting of acceleration time / deceleration time, the number of decimal places is determined by Pr.C2-13.
  For example, when Pr.C2-13 = 0 (unit: 0.01 second)
  See the ladder diagram below, if set S_2 as 50, it means 0.5 seconds; if set S_3 as 60, it means 0.6 seconds.
- The FREQ instruction can control AC motor drive's frequency command, acceleration time and deceleration time.; and it also can control operation by using special register.
  Such as:
  1. M1025: control RUN (ON) / STOP (OFF) of AC motor drive
     [Note: RUN is valid when servo ON (M1040 = ON).]
  2. M1026: control the direction of operation FWD (OFF) / REV (ON) of AC motor drive
  3. M1040: control servo ON (ON) / servo OFF (OFF)
  4. M1042: trigger quick stop (ON) / do not trigger quick stop (OFF)
  5. M1044: pause (ON) / release pause (OFF)
  6. M1052: lock frequency (ON) / release lock frequency (OFF)

Example

- M1025: control RUN (ON) / STOP (OFF) of AC motor drive
  M1026: control the direction of operation FWD (OFF) / REV (ON) of AC motor drive
  M1015: frequency reached
- When M10 = ON, set AC motor drive's frequency command K300 (3.00 Hz) with acceleration time and deceleration time of 0.
  When M11 = ON, set AC motor drive's frequency command K3000 (30.00 Hz) with acceleration time of 50 (0.5 sec.) and deceleration time of 60 (0.6 sec.). (When Pr.C2-13 = 0)
- When M11 = OFF, AC motor drive's frequency command becomes 0.

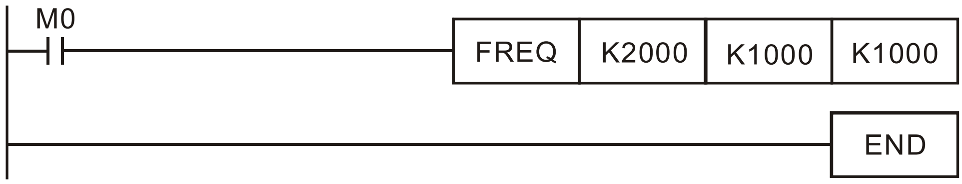


- Pr. L0-01 is defined as whether the reference command before PLC execution is cleared.

  bit 0: before the PLC scan, whether the target frequency is cleared to be 0.

  (PLC is ON, and FREQ instruction is in the program)

  For example: when a user is writing a program,



  we force M0 to be 1, then the frequency command is 20.00 Hz. If M0 = 0, it has different situations:

  Case1: when Pr.L0-01 bit0 is 0, and M0 = 0, then the frequency command remains at 20.00 Hz.

  Case2: when Pr.L0-01 bit0 is 1, and M0 = 0, then the frequency command becomes 0.00 Hz.

  This is because that before the PLC scans the programs, when Pr.L0-01 bit0 = 1, the frequency will be cleared to be 0 first; when Pr.L0-01 bit0 = 0, the action to clear the frequency to be 0 is not performed.

API	Instruction code	Operand	Function
322	CATCH P	S_1, S_2, S_3, n	Word read of internal control

Type / Operand	Bit devices: X	Y	M	Word devices: K	H	KnX	KnY	KnM	T	C	D
S_1				*	*						*
S_2				*	*						*
S_3				*	*						*
D				*	*						*

Caution for using operand: stored in D and D+1

16-bit instruction (9 steps)			
CATCH	Continuous execution type	CATCHP	Pulse execution type

32-bit instruction			
-	-	-	-

Associated flag: none

Description

- S_1: channel selection

  S_2: the address to read

  S_3: the address to read (SUB)

  D: destination for storing (D and D+1)
- The definition of channels:

  0: Reserved

  1: RS485

  2: Reserved

  3: COM Card

  4: CANopen
- The definition of S_2:

  20XXH: refer to the communication related chapter for details

  26XXH: refer to the communication related chapter for details

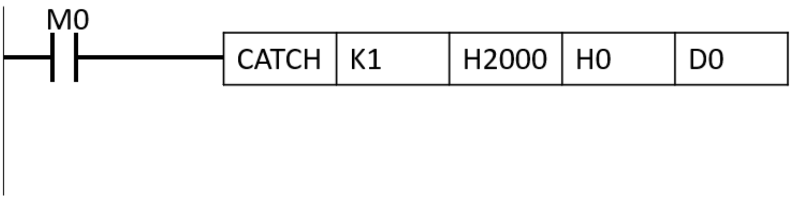
  60XXH: refer to the communication related chapter for details
- The definition of S_3:

  Only supported by 60XXH, refer to the communication related chapter for details

Example

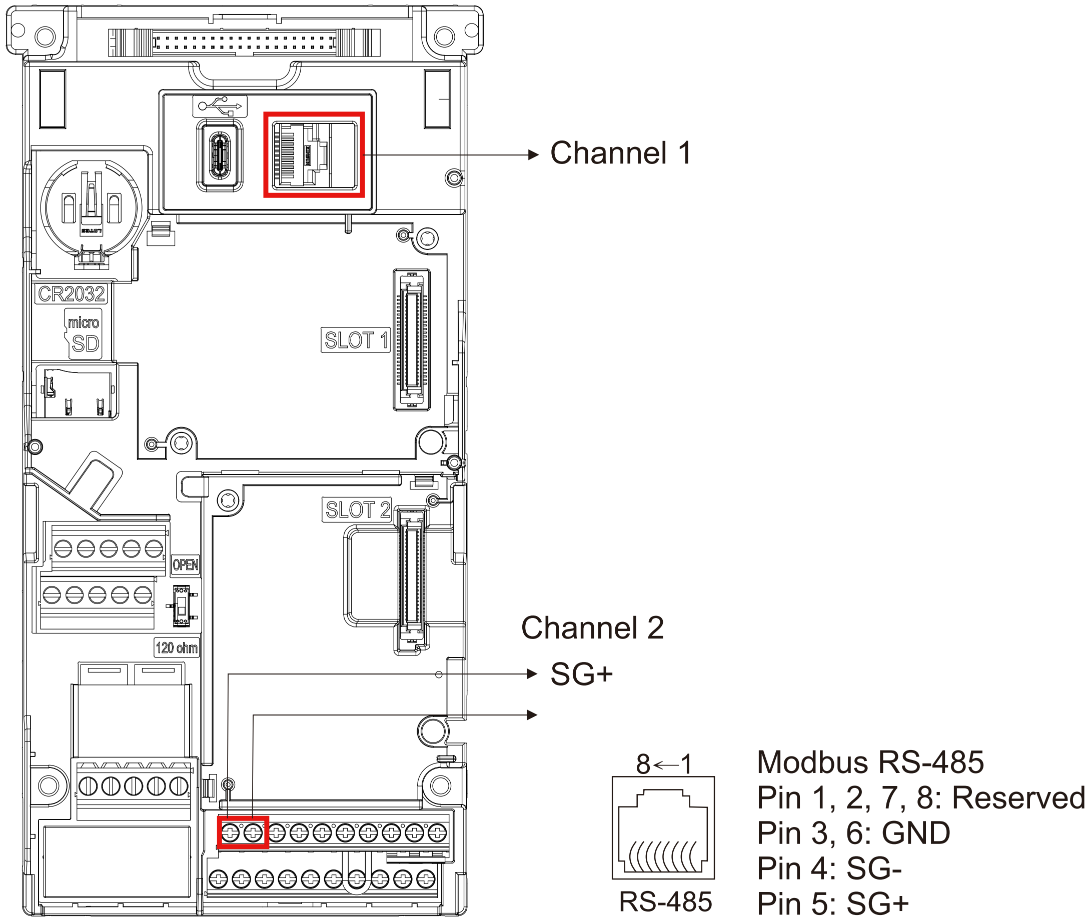
See the example below:

If M0 = ON, then CATCH instruction read RS485 communication address 2000H (H0 is invalid), and store the result in [D1, D0].



7-3 The Setting of Initialization

1. The default communication format of PLC is 7, N, 2, 9600, and station number is 2. You can change this station number in Pr.L0-00, but the address cannot be the same as Pr.N1-01 of AC motor drive.
2. VP3000 provides two communication ports for upload / download PLC programs, see the figure below. The communication format of Channel 1 is fixed in 19200, 8, N, and 2 RTU.



3. A master device can store data in AC motor drive and inner PLC at the same time. The method of execution is by the recognitions the station numbers, for example, if the station number of the AC motor drive is 1, and the station number of inner PLC is 2, then the commands from the master device are:
   01 (station no.) 03 (read) 0001 (address) 0001 (one data item), this is to read the data of Pr.A0-01 in AC motor drive.
   02 (station no.) 03 (read) 1000 (address) 0001 (one data item), this is to read the data of D0 in inner PLC.
4. When uploading / downloading programs, the PLC programs stop working.
5. Noted that using WPR instruction to write parameters, the value can be changed less than 10^9 times, or a memory write error will occur. The calculation of write times is based on the written value whether is being changed or not. If the written value left unchanged, the changed times would not increase in the next parameter operation; if the written value differs from the last time, then the changed times increase by one.

6. When Pr.o0-00 = 29, the display is the value of PLC register D1043, see the figures below:

<table>
<tr><th>Digital Keypad: KPV-CC01</th><th colspan="2">Digital Keypad: KPV-CE02</th></tr>
<tr><td>Allowable display range: 0–65535

</td><td>0–9999

</td><td>Exceed 9999

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

7. In RUN mode of PLC or STOP mode of PLC, the setting value 9 and 10 of Pr.b0-01 cannot be set, which means that cannot return to the default.
8. When Pr.b0-01 = 6, PLC can return to the default.
9. When PLC controls the operation of AC motor drive, the control command depends on whether the associated flag of Pr.L0-02 allows the operation command to be from PLC.
10. When PLC controls the frequency of AC motor drive (FREQ instruction), the frequency command depends on whether the associated flag of Pr.L0-02 allows the frequency command to be from PLC.
11. When PLC controls the specific digital output terminals of AC motor drive, the command of the specific digital output terminals depends on whether the associated flag of Pr.L0-04 allows their command to be from PLC.
12. When PLC controls the specific analog output terminals of AC motor drive, the command of the specific analog output terminals depends on whether the associated flag of Pr.L0-06 allows their command to be from PLC.
13. When PLC controls the operation of AC motor drive, if set Pr.A4-12 (the STOP is valid for keypad) at this moment, the stop is triggered when keypad gives order.

7-4 The Examples for the External PID Function of PLC

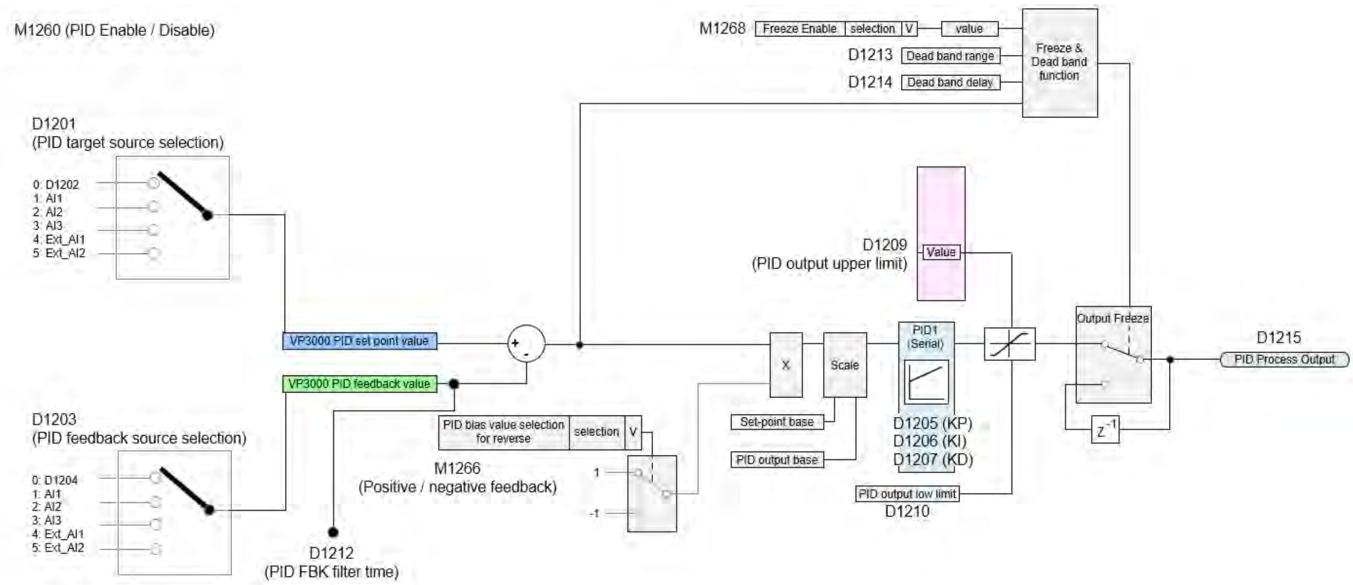
Use external PID function of PLC and freely designate reference input, the control of gain, positive / negative feedback, upper / lower bound of output to affect the output result. And it can also connect with any target in the ladder diagram. In addition, there are eight groups of PID control functions to achieve special application scenarios by setting integral value.

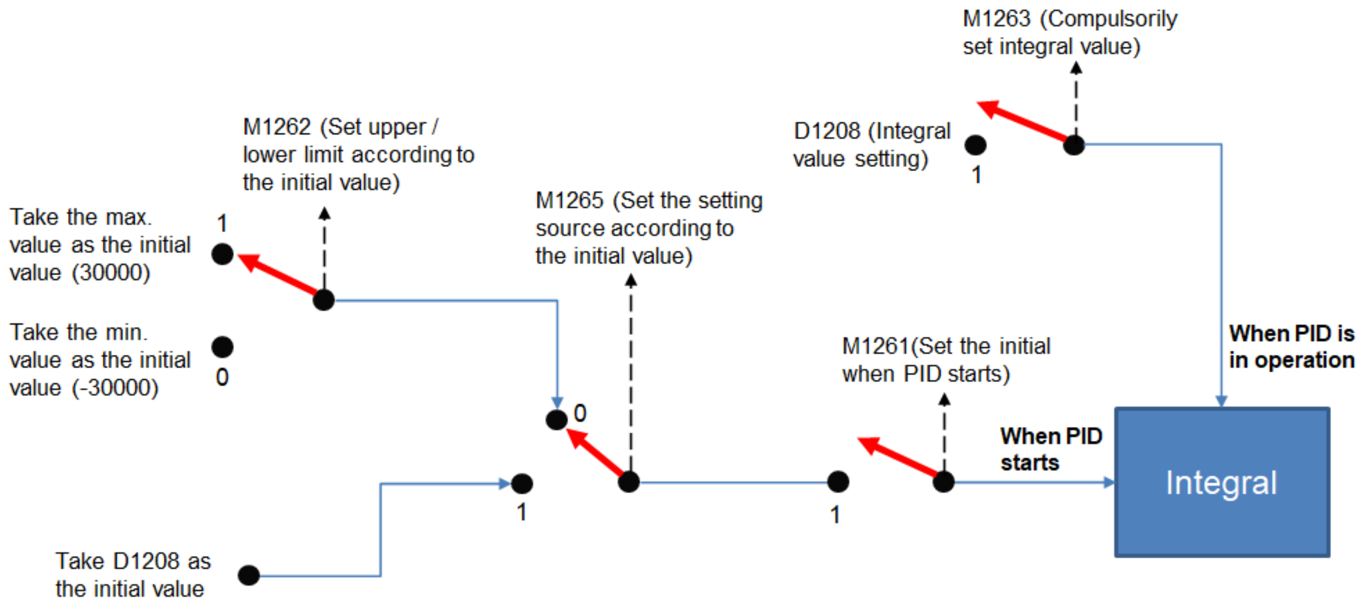
The description below lists the special D number of the first group, the special D numbers of the following groups 2–N can be got by the first group's special D number + 20 x (N-1), the maximum of N is eight.

If the setting value of the special D which relates with PID1 module exceeds the setting range or transgress the setting principles, then M1264 becomes ON and PID output returns zero. And the corresponding value of errors will be displayed in D1216 with bit format. Refer to the definition of bit below:

- bit0: the command value exceeds the limiting value
- bit1: the feedback value exceeds the limiting value
- bit2: the gain value (ratio, integral time, differential time) of the controller exceeds the limiting value
- bit3: the upper / lower bound setting value of output exceeds the limiting value
- bit4: the upper / lower bound setting error (the upper bound must always be greater than the lower bound)
- bit5: the integration setting value of the controller exceed the limiting value
- bit6: differential controller, feedback filter time exceed the limiting value
- bit7: the deadband exceeds the limiting value
- bit8: the deadband delay time exceeds the limiting value

- bIt9–bit15：Reserve





For the external PID function of PLC, see D1201–1366 for special D, M1260–M1338 for special M.

The relevant registers in speed mode are listed below:

Control special M

Special M	Function	Attribute
M1025	Frequency of AC motor drive = frequency setting (ON) / frequency of AC motor drive = 0 (OFF)	RW
M1026	The operating direction of AC motor drive, FWD (OFF) / REV (ON)	RW
M1040	Power supply by hardware (Servo ON)	RW
M1042	Quick stop	RW
M1044	Halt	RW
M1052	Lock, the frequency is locked at the current operating frequency	RW

Status special M

Special M	Function	Attribute
M1015	Frequency reached (use with M1025)	RO
M1056	Already power supply by hardware (Servo ON ready)	RO
M1058	On quick stopping	RO

Control special D

Special D	Function	Attribute
D1060	Mode setting (speed mode = 0)	RW

Status special D

Special D	Function	Attribute
D1037	The output frequency of AC motor drive (0.00–600.00)	RO
D1050	Actual operating mode (speed mode = 0)	RO

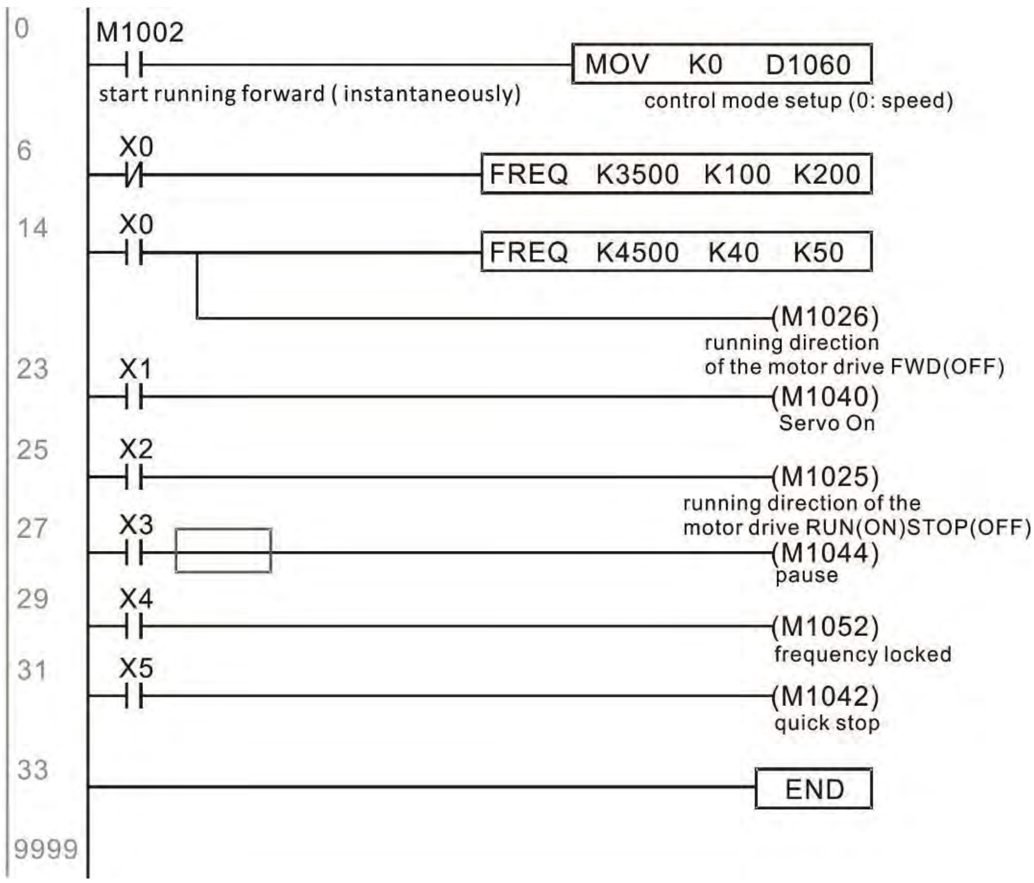
Speed mode control command:

FREQ(P)	S1	S2	S3
	Target speed	1st acceleration time	1st deceleration time

The example for speed mode control:

Before executing speed control, if the control method is FOC (magnetic field orientation), you have to set up the motor parameters to be used first.

1. Set D1060 = 0, to make the AC motor drive be speed mode (default).
2. Control frequency, acceleration time and deceleration time by FREQ instruction.
3. Set M1040 =1, AC motor drive is being magnetized, but the frequency is zero.
4. Set M1025 = 1, the frequency command of AC motor drive becomes the frequency that FREQ instruction designates. The acceleration and deceleration also operate according to the acceleration time and deceleration time that FREQ instruction designates.
5. Available to lock the current operating frequency by controlling M1052.
6. Available to execute temporarily stop (halt) by controlling M1044, the deceleration method is according to the deceleration setting.
7. Available to execute quick stop by controlling M1042, the deceleration method will decelerate as soon as possible on the premise that no error occurs. (An error may occur if the load is too large)
8. The authority to control is M1040 (Servo ON) > M1042 (Quick stop) > M1044 (Halt) > M1052 (LOCK)



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Chapter 8 Troubleshooting

8-1 Alarm List

8-1-1 AC Motor Drive Warning Codes

ID No.	Warning Name	ID No.	Warning Name
0	No record	71	ExCom power loss (ECLv)
5	Communication error 10 (CE10)	72	ExCom test mode (ECtt)
7	Save error 1 (SE1)	73	ExCom BUS off (ECbF)
8	Save error 1 (SE2)	74	ExCom no power (ECnP)
9	IGBT overheating warning (oH1)	75	ExCom factory defect (ECFF)
10	Capacitor overheating warning (oH2)	76	ExCom inner error (ECiF)
12	AI1 analog signal loss (AnL)	77	ExCom IO Net break (ECio)
13	Under current (uC)	78	ExCom IO net break (ECPP)
15	Run disable (RuDs)	79	ExCom configuration data error (ECPi)
16	Safe torque off (STO)	80	Ethernet link fail (ECEF)
20	Over-torque 1 (ot1)	81	Communication time-out (ECto)
21	Over-torque 1 (ot2)	82	Checksum error (ECCS)
22_1	Motor overheating PTC (oH3)	83	Return defect (ECrF)
22_2	Motor overheating KTY84 (oH3)	84	Modbus TCP over (Eco0)
22_3	Motor overheating PT100 (oH3)	85	EtherNet/IP over (Eco1)
22_4	Motor overheating PT1000 (oH3)	86	IP fail (ECiP)
24	Over slip error (oSL)	87	Mail fail (EC3F)
26	Output U phase loss (OPHL)	88	ExCom busy (ECbY)
27	Output V phase loss (OPHL)	89	ExCom card break (ECCb)
28	Output W phase loss (OPHL)	123	Deceleration energy backup error (dEb)
30	Copy model error 3 (SE3)	140	SD memory error (SDiv)
31	Under load (ULD)	142	AI2 analog signal loss (AnL)
32	Overload (OLD)	143	AI3 analog signal loss (AnL)
34	Low voltage (LV)	144	AI10 analog signal loss (AnL)
50	PLC opposite defect (PLod)	145	AI11 analog signal loss (AnL)
51	PLC save memory error (PLSv)	146	Monitor signal 1 trigger (BX1n)
52	Data defect (PLdA)	147	Monitor signal 2 trigger (BX2n)
53	Function defect (PLFn)	148	Monitor signal 3 trigger (BX3n)
54	PLC buffer overflow (PLor)	149	Monitor signal 4 trigger (BX4n)
55	Function defect (PLFF)	150	Monitor signal 5 trigger (BX5n)
56	Checksum error (PLSn)	151	Monitor signal 6 trigger (BX6n)
57	No end command (PLEd)	152	Monitor signal 7 trigger (BX7n)
59	PLC download fail (PLdF)	153	Monitor signal 8 trigger (BX8n)
60	PLC scan time fail (PLSF)	154	Battery low voltage (RtLv)
70	ExCom ID fail (ECid)	155	Electronic thermal relay 1 protection (EoL1)

ID No.	Warning Name	ID No.	Warning Name
156	Electronic thermal relay 2 protection (EoL2)	165	SD card format error (SDfe)
157	Electronic thermal relay 3 protection (EoL3)	166	SD card prohibited execution (SDih)
158	Electronic thermal relay 4 protection (EoL4)	167	SD card time out (SDto)
159	Safe torque off 1 (STO1)	300	Leakage warning (LEKn)
160	Safe torque off 2 (STO2)	301	Low pressure warning (LPSn)
161	ECAP models low voltage (ECLV)	302	Dry pump warning (dryn)
162	Controller overload (MCOL)	303	Cleaning process warning (CLE)
163	SD card capacity is full (SDfu)	304	Cavitation warning (Cavi)
164	No SD card (SDno)		

8-1-2 AC Motor Drive Fault Codes

ID No.	Fault Name	ID No.	Fault Name
0	No record	27	Over-torque 2 (ot2)
1	Over-current during acceleration (ocA)	28	Under current (uC)
2	Over-current during deceleration (ocd)	30	EEPROM write error (cF1)
3	Over-current during steady operation (ocn)	31	EEPROM read error (cF2)
4	Ground fault (GFF)	33	U-phase error (cd1)
5	IGBT short circuit between upper bridge and lower bridge (occ)	34	V-phase error (cd2)
6	Over-current at stop (ocS)	35	W-phase error (cd3)
7	Over-voltage during acceleration (ovA)	37	oc hardware error (HD1)
8	Over-voltage during deceleration (ovd)	39	occ hardware error (Hd3)
9	Over-voltage at constant speed (ovn)	40	Auto-tuning error (AUE)
10	Over-voltage at stop (ovS)	48	AI1 loss (ACE)
11	Low-voltage during acceleration (LvA)	49	External Fault (EF)
12	Low-voltage during deceleration (Lvd)	50	Emergency stop (EF1)
13	Low-voltage at constant speed (Lvn)	52	Password is locked (Pcod)
15	Phase loss protection (OrP)	58	Modbus transmission time-out (CE10)
16	IGBT overheating (oH1)	61	Y-connection / D-connection switch error (ydc)
17	Capacitor overheating (oH2)	63	Over slip error (oSL)
18	IGBT temperature detection failure (tH1o)	68	Reverse direction of the speed feedback (SdRv)
19	Capacitor hardware error (tH2o)	69	Over speed rotation feedback (SdOr)
21	Overload (oL)	70	Large deviation of speed feedback (SdDe)
22	Electronic thermal relay 1 protection (EoL1)	71	Watchdog (WDTT)
23	Electronic thermal relay 2 protection (EoL2)	72	STO Loss 1 (STL1)
24_1	Motor overheating PTC (oH3)	76	Safe torque off (STO)
24_2	Motor overheating KTY84 (oH3)	77	STO Loss 2 (STL2)
24_3	Motor overheating PT100 (oH3)	79	Safe torque off 1 (STO1)
24_4	Motor overheating PT1000 (oH3)	80	Safe torque off 2 (STO2)
25	Interrupt error (INTR)	82	Output phase loss U phase (OPHL)
26	Over-torque 1 (ot1)	83	Output phase loss V phase (OPHL)

ID No.	Fault Name	ID No.	Fault Name
84	Output phase loss W phase (OPHL)	133	Overload protection (OLD)
87	Overload protection at low frequency (oL3)	134	Electronic thermal relay 3 protection (EoL3)
88	Model ID change (IDCH)	135	Electronic thermal relay 4 protection (EoL4)
89	Rotor position detection error (RoPd)	142	Auto-tune error (AUE1)
94	Initializing power board communication error when power ON (POCF)	143	Auto-tune error (AUE2)
95	Board identification error during power-on initialization (IDDE)	144	Auto-tune error (AUE3)
96	Power board communication error (PMCF)	148	Auto-tune error (AUE4)
97	AI2 loss (ACE)	149	Auto-tune error (AUE5)
98	AI3 loss (ACE)	150	Auto-tune error (AUE6)
99	AI10 loss (ACE)	151	Auto-tune error (AUE7)
100	AI11 loss (ACE)	152	Auto-tune error (AUE8)
101	CANopen guarding error (CGdE)	153	Auto-tune error (AUE9)
102	CANopen heartbeat error (CHbE)	154	Auto-tuning error (AUEa)
104	CANopen bus off error (CbFE)	155	Auto-tuning error (AUEb)
114	ECAP models over voltage (ECOV)	156	Auto-tuning error (AUEc)
115	ECAP models low voltage (ECLV)	213	Protection initialization error (ThIF)
118	Monitor signal 1 trigger (BX1e)	214	Power-on process initialization time-out (POTO)
119	Monitor signal 2 trigger (BX2e)	300	Large amount leakage error (LEKE)
120	Monitor signal 3 trigger (BX3e)	301	High pressure error (HPS)
121	Monitor signal 4 trigger (BX4e)	302	Low pressure error (LPSE)
122	Monitor signal 5 trigger (BX5e)	303	Dry pump error (dryE)
123	Monitor signal 6 trigger (BX6e)	304	Dry pump auto-tune error (dAUE)
124	Monitor signal 7 trigger (BX7e)	305	Pipe blockage (JAME)
125	Monitor signal 8 trigger (BX8e)	306	ExCom card break (ECCb)
132	Under load protection (ULD)	307	Communication time-out (ECto)

8-1-3 PLC Fault Codes

Code	ID	Descriptions	Corrective Actions
PLod	50	The device number in the downloaded program has exceeded the defined range	Check if the device number used by the program has exceeded the model definition 1 and re-download the program
PLSv	51	Device number write error during program execution	Check the PLC program with D1014 and re-download the program
PLdA	52	The read/ write device number or the uploaded command error during Modbus communication	Check if the used communication address is correct and retransmit the communication packet
PLFn	53	Command error while downloading program	Check whether the used API model supports the command and re-download the program
PLor	54	Program exceeds memory capacity during program execution	Check if the PLC program is correct and re-download the program
PLFF	55	Command error during program execution	Check the PLC program with D1014 and re-download the program 1. If the FOR/NEXT command is written correctly 2. Is MC/ MCR paired 3. If the break command is written correctly 4. If the FOR/NEXT command is written correctly 5. If the break command is written correctly 6. Ensure the used model supports all API codes
PLSn	56	Checksum error during program execution	Clear the current PLC program and re-download the program
PLEd	57	Program has no END stop command	Check if the PLC program is correct and re-download the program
PLdF	59	Communication loss or the drive power off while downloading the program	Check if the connection and the power supply is normal and re-download the program
PLSF	60	PLC scan time-out during program execution	Check if the PLC program uses excessive FOR and CALL commands, reduce the usage and re-download the program.

8-1-4 Digital Keypad Fault Codes

Fault code	Causes
Erk1	The read or write data flash does not respond in one second
Erk3	Fail to write data to Flash (read error after write in)
Erk4	Flash has not been written; the keypad parameter value has been set exceeding the defined range
Erk8	The structure of the received communication packet is wrong, the retransmission is still wrong, and the fault jumps three times in a row
Erk9	Communication time-out at start (the digital keypad cannot connect with the drive in 9 seconds after power-on)
Erk10	Communication time-out (the digital keypad cannot connect with the drive in 6 seconds during normal communication)
Erk11	The drive does not support the communication of backup and restore function
Erk12	Parameters are not unlocked while restoring backup
Erk13	The drive modes (normal mode, restore mode and backup mode) error while restoring backup
Erk14	1. When restoring the backup, switch the modes of the drive. If the switching command fails, the keypad retransmits up to 3 times, each time at an interval of 1 second; if it still fails, the Erk14 fault shows. 2. When switching the drive modes while restoring the backup, the drive replies "In progress" during the switching process and the digital keypad waits for up to 20 seconds. If the drive is still in progress, the Erk14 fault shows.
Erk15	Failed to verify the file compatibility with the drive while restoring the backup
Erk16	Failed to verify the file size with the drive while restoring the backup
Erk17	Failed to write data while restoring the backup
Erk18	Check the file size is empty while restoring the backup
Erk19	SD card is loss in the SD card displaying screen.
Erk20	The drive does not support the SD card function in the SD card displaying screen
Erk21	The drive does not support the communication in the download function (ex. Language packet)
Erk22	The drive mode (boot/ user mode) error in the download function (ex. Language packet)
Erk23	The file size exceeds the upper limit (24440 bytes) during parameter backup; and exceeds upper limit (65400 bytes) during PLC backup
Erk24	The Erk24 fault shows when firmware CC01 is burned into hardware CE02 or firmware CE02 is burned into hardware CC01, and the keypad cannot work normally.

8-2 Warning Codes and Troubleshooting

ID No.	Warning Name	Descriptions
5	Communication error 10 (CE10)	RS-485 Modbus transmission time-out

Action and Reset	
Action Condition	When the communication time exceeds the detection time of Pr. n1-04 (Modbus timeout check time)
Action Time	Setting for Pr. n1-04.
Warning Setting Parameter	N/A
Reset Method	"Warning" occurs when Pr. n1-05 = 0 and the motor drive keeps running. The drive resets automatically when receiving the next communication packet. 0: Continue OPER 1: Warning & continue OPER 2: Fault & ramp to stop 3: Fault & coast to stop
Reset Condition	Immediately reset
Record	No
Cause	**Corrective Actions**
The upper unit does not transmit the communication command within Pr. n1-04 setting time	Check if the upper unit transmits the communication command within the setting time for Pr. n1-04.
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degrees for effective anti-interference performance.
Different communication setting from upper unit	Check if the setting for Pr. n1-03 is the same as the setting for the upper unit.
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.

Warning Name	Descriptions
Keypad communication time out (CK10)	Keypad communication data, transmission time-out (Keypad auto-detect this error and display it.)
Action and Reset	
Action Condition	When the communication time exceeds the detection time of Pr. n1-04 (Modbus timeout check time)
Action Time	Setting for Pr. n1-04.
Warning Setting Parameter	N/A
Reset Method	Remove the keypad and then reconnect it to the motor drive
Reset Condition	Immediately reset
Record	No

Cause	Corrective Actions
Incorrect communication command from keypad	Keypad and the motor drive do not communicate properly. It is recommended to remove the keypad and then reconnect it to the motor drive.
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degrees for effective anti-interference performance.
Different communication setting from keypad	Check if the Baud rate = 115200 bps. Format = RTU8, N, 2.
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.

ID No.	Warning Name	Descriptions
7	Save error 1 (SE1)	Keypad COPY error 1: Keypad copy time-out

Action and Reset	
Action Condition	"SE1" warning occurs when the keypad does not transmit the COPY command to the drive and does not transmit any data to the drive again in 10 sec. at the time you copy the parameters to the drive.
Action Time	10 sec.
Warning Setting Parameter	N/A
Reset Method	Manual reset
Reset Condition	Immediately reset
Record	No

Cause	Corrective Actions
Communication connection error Keypad error Control board error	SE1: The causes of error are mostly communication problems between the keypad and control board. Potential causes include communication signal interference and the unacceptable communication command to the Slave. It is recommended to rule out communication quality factors first. Check if the error occurs randomly, or only occurs when copying certain parameters (the error displays on the upper right corner of the copy page). If you cannot clear the error, please contact Delta.

ID No.	Warning Name	Descriptions
8	Save error 2 (SE2)	Keypad COPY error 2: parameter writing error
Action and Reset		
Action Condition		If the copied parameter is incorrect when coping parameters to the drive, SE2 warning occurs.
Action Time		No
Warning Setting Parameter		N/A
Reset Method		Manual reset
Reset Condition		Immediately reset
Record		No
Cause		Corrective Actions
Copy parameters using upload files with large version differences		When the Slave compares the parameter copy data and find that the data is wrong (wrong status such as exceeding the parameter upper and lower limit, etc.), the SE2 warning occurs. If the SE2 warning occurs, it is recommended to use the same version of firmware for upload and download parameters. If the warning still exists, contact Delta.
Malfunction caused by interference		Verify the wiring and grounding of the main circuit, control circuit and the encoder for effective anti-interference performance.

ID No.	Warning Name	Descriptions
9	IGBT over-heating warning (oH1)	The AC motor drive detects over-heating of IGBT which exceeds the protection level of oH1 warning. (When Pr. H4-00 is higher than the IGBT overheating level, the drive shows oH1 error without displaying oH1 warning.)

Action and Reset	
Action Condition	Pr. H4-00
Action Time	Immediately acts when IGBT voltage is higher than Pr. H4-00
Warning Setting Parameter	N/A
Reset Method	Auto-reset
Reset Condition	The drive auto-resets when IGBT temperature is lower than oH1 warning level minus (–) 5°C
Record	No

Cause	Corrective Actions
Check if the ambient temperature or temperature inside the cabinet is too high, or if there is obstruction in the ventilation hole of the control cabinet.	1. Check the ambient temperature. 2. Regularly inspect the ventilation hole of the control cabinet. 3. Change the installed place if there are heating objects, such as braking resistors, in the surroundings. 4. Install / add cooling fan or air conditioner to lower the temperature inside the cabinet.
Check if there is any obstruction on the heat sink or if the fan is running	Remove the obstruction or replace the cooling fan.
Insufficient ventilation space	Increase ventilation space of the drive.
Check if the drive matches the corresponded loading.	1. Decrease loading. 2. Decrease the carrier. 3. Replace with a drive with larger capacity.
The drive has run 100% or more of the rated output for a long time	Replace with a drive with larger capacity.

ID No.	Warning Name	Descriptions
10	Capacitor overheating warning (oH2)	The drive has detected the capacitors are overheat and the temperature exceeds the warning protection level

Action and Reset	
Action Condition	oH2 error level minus (–) 5°C
Action Time	The oH2 warning occurs when the temperature sensor of capacitor detects the temperature is higher than oH2 warning level
Warning Setting Parameter	N/A
Reset Method	Auto-reset
Reset Condition	The drive auto-resets when the capacitor temperature is lower than oH2 warning level minus (–) 10°C
Record	No

Cause	Corrective Actions
Check if the ambient temperature or temperature inside the cabinet is too high, or if there is obstruction in the ventilation hole of the control cabinet.	1. Check the ambient temperature. 2. Regularly inspect the ventilation hole of the control cabinet. 3. Change the installed place if there are heating objects, such as braking resistors, in the surroundings. 4. Install / add cooling fan or air conditioner to lower the temperature inside the cabinet.
Check if there is any obstruction on the heat sink or if the fan is running	Remove the obstruction or replace the cooling fan.
Insufficient ventilation space	Increase ventilation space of the drive.
Check if the drive matches the corresponded loading.	1. Decrease loading. 2. Decrease the carrier. 3. Replace with a drive with larger capacity.
The drive has run 100% or more of the rated output for a long time	Replace with a drive with larger capacity.
Unstable power	Install reactor(s).
The load changes frequently	Reduce the changes of the load.

<table>
<tr><th>ID No.</th><th>Warning Name</th><th colspan="2">Descriptions</th></tr>
<tr><td>12</td><td>AI1 analog signal loss (AnL)</td><td colspan="2">Analog input current loss (including all analog 4–20mA signals)</td></tr>
<tr><td colspan="4">Action and Reset</td></tr>
<tr><td colspan="2">Action Condition</td><td colspan="2">When the analog input (Pr. G2-03 = 2) is lower than 3.6 mA (only detects analog input 4–20 mA)</td></tr>
<tr><td colspan="2">Action Time</td><td colspan="2">The action condition is attained for 0.1s</td></tr>
<tr><td colspan="2">Warning Setting Parameter</td><td colspan="2">G2-11
AI1 signal loss action:
0: Disable
1: Warning & continue OPER
2: Fault & Ramp to Stop
3: Fault & Auto-Decel
4: Fault & Coast to Stop
5: Fault & by Quick Stop Time
6: Warning & FREQ Lower Limit OPER</td></tr>
<tr><td colspan="2" rowspan="2">Reset Method</td><td>Auto</td><td>It is “Warning” when Pr. G2-11 = 1, and the warning will be automatically cleared when the analog input signal is ≥ 4 mA.</td></tr>
<tr><td>Manual</td><td>It is “Fault” when Pr. G2-11 = 2–5, which must be reset manually.</td></tr>
<tr><td colspan="2">Reset Condition</td><td colspan="2">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">It is “Fault” when Pr. G2-11 = 2–5 and will be recorded.</td></tr>
<tr><td colspan="2">Cause</td><td colspan="2">Corrective Actions</td></tr>
<tr><td colspan="2">Loose or broken AI1 wiring</td><td colspan="2">Tighten the terminals again.
Replace with a new cable.</td></tr>
<tr><td colspan="2">External device error</td><td colspan="2">Replace new device.</td></tr>
<tr><td colspan="2">Hardware failure</td><td colspan="2">If the AnL error still occurs after checking all the wiring, return to the factory for repair.</td></tr>
</table>

<table>
<tr><th>ID No.</th><th>Warning Name</th><th colspan="2">Descriptions</th></tr>
<tr><td>13</td><td>Under current
(uC)</td><td colspan="2">Low current</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action Condition</td><td colspan="2">H2-12</td></tr>
<tr><td colspan="2">Action Time</td><td colspan="2">H2-13</td></tr>
<tr><td colspan="2">Warning Setting Parameter</td><td colspan="2">H2-14
0: Warning & continue OPER
1: Fault & Ramp to Stop
2: Fault & Auto-Decel
3: Fault & coast to stop
4: Fault & by Quick Stop Time</td></tr>
<tr><td colspan="2" rowspan="2">Reset Method</td><td>Auto</td><td>“Warning” occurs when Pr. H2-14 = 0. The “Warning” automatically clears when the output current is > (Pr. H2-12 × 105%).</td></tr>
<tr><td>Manual</td><td>“Error” occurs when Pr. H2-14 = 1–4. You must reset manually.</td></tr>
<tr><td colspan="2">Reset Condition</td><td colspan="2">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">Does not record when Pr. H2-14 = 0 and uC displays “Warning”</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Motor cable disconnection</td><td colspan="2">Exclude the connection issue of the motor and its load.</td></tr>
<tr><td colspan="2">Improper setting for the low current protection</td><td colspan="2">Set the proper settings for Pr. H2-12, Pr. H2-13, and Pr. H2-14.</td></tr>
<tr><td colspan="2">Low load</td><td colspan="2">Check the load status.
Make sure the motor capacity matches the load.</td></tr>
</table>

ID No.	Warning Name	Descriptions
15	Run disable (RuDs)	When enabling Pr. A1-21, the corresponded MI terminal is OFF and receiving a RUN command

Action and Reset	
Action Condition	The corresponded MI terminal of Pr. A1-21 is OFF and receiving a RUN command
Action Time	Immediately act
Warning Setting Parameter	N/A
Reset Method	Auto resets when the MI terminal is ON
Reset Condition	Immediately reset
Record	No

Cause	Corrective Actions
Incorrect wiring or the function signal has not input	Check whether the wiring and upper unit function output is correct.

ID No.	Warning Name	Descriptions
16	Safe torque off (STO)	Safety Torque Off function activates

Action and Reset	
Action Condition	Hardware detection
Action Time	Immediately act
Warning Setting Parameter	Pr. H0-11 0: STO Fault 1: Fault at Run; Warning at Stop 2: STO Warning 3: No STO Display at Stop
Reset Method	It is “Warning”, which will be automatically reset
Reset Condition	Channel 1 and Channel 2 return to no action level
Record	No

Cause	Corrective Actions
The switch action of STO1/SCM1 and STO2/SCM2 (OPEN)	Check whether the wiring and upper unit function output is correct.

ID No.	Warning Name	Descriptions
20	Over-torque (ot1)	Over-torque 1 warning

Action and Reset	
Action Condition	Pr. H5-04
Action Time	Pr. H5-05
Warning Setting Parameter	Pr. H5-00 (ot Action) = 0 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time
Reset Method	The ot1 warning automatically clears when the output current is < (Pr. H5-04 × 95%)
Reset Condition	The ot1 warning automatically clears when the output current is < (Pr. H5-04 × 95%)
Record	No

Cause	Corrective Actions
Incorrect parameter setting	Reset Pr. H5-04 and Pr. H5-05.
Mechanical failure (E.g., over-torque, mechanical lock)	Rule out the causes of malfunction.
The load is too large	Reduce the load. Replace the motor with a larger capacity model.
Accel./Decel. time and working cycle are too short	Increase the setting values for Pr. C2-00–Pr. C2-07 (accel./decel. time)
V/F voltage is too high	Adjust settings for Pr.E0-04, E0-06, E0-08, E1-04, E1-06, E1-08 (V/F curve). Adjust the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low speed).
The motor capacity is too small	Replace the motor with a larger capacity model.
Overload during low-speed operation	Decrease low-speed operation time. Enlarge the motor capacity.
Torque compensation is too large	Adjust the torque compensation (refer to Pr. E0-16 torque compensation gain) until the current reduces and the motor does not stall.
Improper parameter settings for speed tracking function (Including restart after momentary power loss and restart after fault)	Correct the parameter settings for speed tracking. Start the speed tracking function. Adjust the maximum current for Pr. A3-01 speed tracking.

ID No.	Warning Name	Descriptions
21	Over-torque (ot2)	Over-torque 2 warning

Action and Reset	
Action Condition	Pr. H5-06
Action Time	Pr. H5-07
Warning Setting Parameter	Pr. H5-02 (Normal speed ot action) = 0 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time
Reset Method	The ot2 warning automatically clears when the output current is < (Pr. H5-06 × 95%)
Reset Condition	The ot2 warning automatically clears when the output current is < (Pr. H5-06 × 95%)
Record	No

Cause	Corrective Actions
Incorrect parameter setting	Reset Pr. H5-06 and Pr. H5-07.
Mechanical failure (E.g., over-torque, mechanical lock)	Rule out the causes of malfunction.
The load is too large	Reduce the load. Replace the motor with a larger capacity model.
Accel./Decel. time and working cycle are too short	Increase the setting values for Pr. C2-00–Pr. C2-07 (accel./decel. time)
V/F voltage is too high	Adjust settings for Pr.E0-04, E0-06, E0-08, E1-04, E1-06, E1-08 (V/F curve). Adjust the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low speed).
The motor capacity is too small	Replace the motor with a larger capacity model.
Overload during low-speed operation	Decrease low-speed operation time. Enlarge the motor capacity.
Torque compensation is too large	Adjust the torque compensation (refer to Pr. E0-16 torque compensation gain) until the current reduces and the motor does not stall.
Improper parameter settings for speed tracking function (Including restart after momentary power loss and restart after fault)	Correct the parameter settings for speed tracking. Start the speed tracking function. Adjust the maximum current for Pr. A3-01 speed tracking.

ID No.	Warning Name	Descriptions
22_1	Motor overheating (oH3) PTC	Motor overheating warning. The AC motor drive detects the temperature inside the motor is too high
Action and Reset		
Action Condition		Pr. H6-03 = 1 (PTC), PTC input level > Pr. H6-07 (default = 50%)
Action Time		Immediately act
Warning Setting Parameter		Fault treatment: Pr. H6-09 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time When Pr. H6-09 = 0 and when the temperature is ≤ Pr. H6-07 level, the oH3 warning is automatically cleared. It is “Warning” when Pr. H6-09 = 0, which will be automatically reset
Reset Method		The oH3 is “Warning” when Pr. H6-09 = 0. When the temperature is ≤ Pr. H6-07 level, the oH3 warning is automatically cleared.
Reset Condition		When the temperature is ≤ Pr. H6-07 level, the oH3 warning is automatically cleared.
Record		No
Cause		Corrective Actions
Motor locked		Clear the motor lock status.
The load is too large		Reduce the load. Replace the motor with a larger capacity model.
Ambient temperature is too high		Change the installed place if there are heating devices in the surroundings. Install / add cooling fan or air conditioner to lower the ambient temperature.
Motor cooling system error		Check the cooling system to make it work normally.
Motor fan error		Replace the fan.
Operates at low speed too long		Decrease low-speed operation time. Change to dedicated motor for the drive. Enlarge the motor capacity.
Accel./Decel. time and working cycle are too short		Increase the setting values for Pr. C2-00–Pr. C2-07 (accel./decel. time)
V/F voltage is too high		Adjust settings for Pr.E0-03–E0-14 (V/F curve). Adjust the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low speed).
Check if the motor rated current matches the motor nameplate		Configure the correct rated current value of the motor again.
Check if the PTC is properly set and wired		Check the connection between PTC thermistor resistor and the heat protection.

Cause	Corrective Actions
Check if the setting for stall prevention is correct	Set the stall prevention to the proper value.
Unbalance three-phase impedance of the motor	Replace the motor.
Harmonics is too high	Use remedies to reduce harmonics.

ID No.	Warning Name	Descriptions
22_2	Motor overheating (oH3) KTY84	Motor overheating warning. The AC motor drive detects the temperature inside the motor is too high

Action and Reset	
Action Condition	Pr. H6-03 = 2 (KTY84), and the KTY84 temperature is > Pr. H6-07
Action Time	Immediately act
Warning Setting Parameter	Pr. H6-09 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time The oH3 is automatically cleared when Pr. H6-09 = 0 and the temperature is < Pr. H6-07 level
Reset Method	The oH3 is "Warning" when Pr. H6-09 = 0. When the temperature is < Pr. H6-07 level, the oH3 warning is automatically cleared.
Reset Condition	When the temperature is < Pr. H6-07 level, the oH3 warning is automatically cleared.
Record	No

Cause	Corrective Actions
Motor locked	Clear the motor lock status.
The load is too large	Reduce the load. Replace the motor with a larger capacity model.
Ambient temperature is too high	Change the installed place if there are heating devices in the surroundings. Install / add cooling fan or air conditioner to lower the ambient temperature.
Motor cooling system error	Check the cooling system to make it work normally.
Motor fan error	Replace the fan.
Operates at low speed too long	Decrease low-speed operation time. Change to dedicated motor for the drive. Enlarge the motor capacity.
Accel./Decel. time and working cycle are too short	Increase the setting values for Pr. C2-00–Pr. C2-07 (accel./decel. time)
V/F voltage is too high	Adjust settings for Pr.E0-03–E0-14 (V/F curve). Adjust the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low speed).
Check if the motor rated current matches the motor nameplate	Configure the correct rated current value of the motor again.
Check if the KTY84 is properly set and wired	Check the connection between PTC thermistor resistor and the heat protection.
Check if the setting for stall prevention is correct	Set the stall prevention to the proper value.

Cause	Corrective Actions
Unbalance three-phase impedance of the motor	Replace the motor.
Harmonics is too high	Use remedies to reduce harmonics.

ID No.	Warning Name	Descriptions
22_3	Motor overheating (oH3) PT100	Motor overheating warning. The AC motor drive detects the temperature inside the motor is too high

Action and Reset	
Action Condition	Pr. H6-03 = 3 (PT100), and the PT100 temperature is > Pr. H6-07
Action Time	Immediately act
Warning Setting Parameter	Pr. H6-09 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time The oH3 is automatically cleared when Pr. H6-09 = 0 and the temperature is < Pr. H6-07 level
Reset Method	The oH3 is "Warning" when Pr. H6-09 = 0. When the temperature is < Pr. H6-07 level, the oH3 warning is automatically cleared.
Reset Condition	When the temperature is < Pr. H6-07 level, the oH3 warning is automatically cleared.
Record	No

Cause	Corrective Actions
Motor locked	Clear the motor lock status.
The load is too large	Reduce the load. Replace the motor with a larger capacity model.
Ambient temperature is too high	Change the installed place if there are heating devices in the surroundings. Install / add cooling fan or air conditioner to lower the ambient temperature.
Motor cooling system error	Check the cooling system to make it work normally.
Motor fan error	Replace the fan.
Operates at low speed too long	Decrease low-speed operation time. Change to dedicated motor for the drive. Enlarge the motor capacity.
Accel./Decel. time and working cycle are too short	Increase the setting values for Pr. C2-00–Pr. C2-07 (accel./decel. time)
V/F voltage is too high	Adjust settings for Pr. E0-03–E0-14 (V/F curve). Adjust the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low speed).
Check if the motor rated current matches the motor nameplate	Configure the correct rated current value of the motor again.
Check if the PT100 is properly set and wired	Check the connection between PT100 thermistor resistor and the heat protection.
Check if the setting for stall prevention is correct	Set the stall prevention to the proper value.

Cause	Corrective Actions
Unbalance three-phase impedance of the motor	Replace the motor.
Harmonics is too high	Use remedies to reduce harmonics.

ID No.	Warning Name	Descriptions
22_4	Motor overheating (oH3) PT1000	Motor overheating warning. The AC motor drive detects the temperature inside the motor is too high

Action and Reset	
Action Condition	Pr. H6-03 = 4 (PT1000), and the PT1000 temperature is > Pr. H6-07
Action Time	Immediately act
Warning Setting Parameter	Pr. H6-09 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time The oH3 is automatically cleared when Pr. H6-09 = 0 and the temperature is < Pr. H6-07 level
Reset Method	The oH3 is "Warning" when Pr. H6-09 = 0. When the temperature is < Pr. H6-07 level, the oH3 warning is automatically cleared.
Reset Condition	When the temperature is < Pr. H6-07 level, the oH3 warning is automatically cleared.
Record	No

Cause	Corrective Actions
Motor locked	Clear the motor lock status.
The load is too large	Reduce the load. Replace the motor with a larger capacity model.
Ambient temperature is too high	Change the installed place if there are heating devices in the surroundings. Install / add cooling fan or air conditioner to lower the ambient temperature.
Motor cooling system error	Check the cooling system to make it work normally.
Motor fan error	Replace the fan.
Operates at low speed too long	Decrease low-speed operation time. Change to dedicated motor for the drive. Enlarge the motor capacity.
Accel./Decel. time and working cycle are too short	Increase the setting values for Pr. C2-00–Pr. C2-07 (accel./decel. time)
V/F voltage is too high	Adjust settings for Pr. E0-03–E0-14 (V/F curve). Adjust the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low speed).
Check if the motor rated current matches the motor nameplate	Configure the correct rated current value of the motor again.
Check if the PT1000 is properly set and wired	Check the connection between PT1000 thermistor resistor and the heat protection.
Check if the setting for stall prevention is correct	Set the stall prevention to the proper value.

Cause	Corrective Actions
Unbalance three-phase impedance of the motor	Replace the motor.
Harmonics is too high	Use remedies to reduce harmonics.

ID No.	Warning Name	Descriptions
24	Over slip (oSL)	Over slip warning On the basis of the maximum slip (Pr. H5-50). When the motor drive outputs at constant speed, F > H or F < H exceeds the level set via Pr. H5-54, and it exceeds the time set via Pr. H5-55, oSL shows. oSL occurs in induction motors only.
Action and Reset		
Action Condition		When the drive outputs at constant speed, and F > H or F < H exceeds the Pr. H5-54 level
Action Time		H5-55
Warning Setting Parameter		H5-48 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time
Reset Method		The oSL warning is automatically cleared when Pr. H5-48 = 0, the drive outputs at constant speed, and F > H or F < H does not exceed the Pr. H5-54 level anymore.
Reset Condition		No
Record		No
Cause		Corrective Actions
Any of the motor parameters in parameter group 5 may be incorrect		Check the motor parameter.
The load is too large		Reduce the loading.
Check if Pr. H5-54, Pr. H5-55, and Pr. H5-48 are properly set.		Check the parameter settings for oSL protection.

ID No.	Warning Name	Descriptions
26	Output U phase loss warning (OPHL)	The drive output U phase loss

Action and Reset	
Action Condition	Pr. H3-02
Action Time	Pr. H3-03
Warning Setting Parameter	Pr. H3-05 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time
Reset Method	If Pr. H3-05 is set to 0, the OPHL warning automatically clears after the drive stops.
Reset Condition	No
Record	No

Cause	Corrective Actions
Unbalance three-phase impedance of the motor	Replace the motor.
Check if the wiring is incorrect	Check the cable. Replace the cable.
Check if the motor is a single-phase motor	Choose a three-phase motor.
Check if the current sensor is broken	Check if the control board cable is loose. If yes, reconnect the cable and run the drive to test. If the error still occurs, return to the factory for repair. Check if the three-phase current is balanced with a current clamp meter. If the current is balanced and the OPHL error still shows on the display, return to the factory for repair.
If capacity of the drive is larger than the motor	Choose the matches capacity of the drive and motor.

ID No.	Warning Name	Descriptions
27	Output V phase loss warning (OPHL)	The drive output V phase loss

Action and Reset	
Action Condition	Pr. H3-02
Action Time	Pr. H3-03
Warning Setting Parameter	Pr. H3-05 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time
Reset Method	If Pr. H3-05 is set to 0, the OPHL warning automatically clears after the drive stops.
Reset Condition	No
Record	No

Cause	Corrective Actions
Unbalance three-phase impedance of the motor	Replace the motor.
Check if the wiring is incorrect	Check the cable. Replace the cable.
Check if the motor is a single-phase motor	Choose a three-phase motor.
Check if the current sensor is broken	Check if the control board cable is loose. If yes, reconnect the cable and run the drive to test. If the error still occurs, return to the factory for repair. Check if the three-phase current is balanced with a current clamp meter. If the current is balanced and the OPHL error still shows on the display, return to the factory for repair.
If capacity of the drive is larger than the motor	Choose the matches capacity of the drive and motor.

ID No.	Warning Name	Descriptions
28	Output W phase loss warning (OPHL)	Output phase loss
Action and Reset		
Action Condition		Pr. H3-02
Action Time		Pr. H3-03
Warning Setting Parameter		Pr. H3-05 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time
Reset Method		If Pr. H3-05 is set to 0, the OPHL warning automatically clears after the drive stops.
Reset Condition		No
Record		No
Cause		Corrective Actions
Unbalance three-phase impedance of the motor		Replace the motor.
Check if the wiring is incorrect		Check the cable. Replace the cable.
Check if the motor is a single-phase motor		Choose a three-phase motor.
Check if the current sensor is broken		Check if the control board cable is loose. If yes, reconnect the cable and run the drive to test. If the error still occurs, return to the factory for repair. Check if the three-phase current is balanced with a current clamp meter. If the current is balanced and the OPHL error still shows on the display, return to the factory for repair.
If capacity of the drive is larger than the motor		Choose the matches capacity of the drive and motor.

ID No.	Warning Name	Descriptions
30	Copy model error 3 (SE3) (SE3)	Keypad COPY error 3: copy model error

Action and Reset	
Action Condition	"SE3" warning occurs when different drive identity codes are found during copying parameters.
Action Time	Immediately act when the error is detected
Warning Setting Parameter	N/A
Reset Method	Manual reset
Reset Condition	No
Record	No
Cause	**Corrective Actions**
Keypad copy between different power range drives	It is mainly to prevent parameter copies between different HP/models. Use the same model ID to upload and download parameter copying.

ID No.	Warning Name	Descriptions
31	Under load (ULD)	The load does not reach the user defined loading curve and triggers under load protection.

Action and Reset	
Action Condition	H7-19–H7-28
Action Time	Pr. H7-18
Warning Setting Parameter	H7-16 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time
Reset Method	The warning is automatically cleared when the load is higher than the setting loading curve.
Reset Condition	The warning is automatically cleared when the load is higher than the setting loading curve.
Record	No

Cause	Corrective Actions
Incorrect settings that trigger the protection	Check if the setting for Pr. H7-19–H7-28 corresponds to the exact loading.

ID No.	Warning Name	Descriptions
32	Overload (OLD)	The load is higher than the user defined loading curve and triggers overload protection.
Action and Reset		
Action Condition		The loading condition is higher than Pr. H7-05–H7-14 loading curve
Action Time		Pr. H7-04
Warning Setting Parameter		H7-02 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time
Reset Method		The warning is automatically cleared when the load is lower than the setting loading curve.
Reset Condition		The warning is automatically cleared when the load is lower than the setting loading curve.
Record		Yes
Cause		Corrective Actions
Incorrect settings that trigger the protection		Check if the setting for H7-05–H7-14 is correct.

ID No.	Warning Name	Descriptions
34	Low voltage (LV)	Before the AC motor drive operates, it detects that the DC bus voltage is lower than Pr. H1-02 setting value
Action and Reset		
Action Condition		DC bus voltage is lower than Pr. H1-02 setting value
Action Time		Immediately act when DC bus voltage is lower than Pr. H1-02
Warning Setting Parameter		N/A
Reset Method		Auto-reset
Reset Condition		It can be reset after the DC bus voltage exceeds the following voltage. 460V models: Pr. H1-02 + 60 V_{DC}
Record		No
Cause		Corrective Actions
Power-off		Improve power supply condition.
Power voltage changes		Adjust voltage to the power range of the drive.
Start up the motor with large capacity		Check the power system. Enlarge the capacity of power equipment.
The load is too large		Reduce the load. Enlarge the drive capacity.

ID No.	Warning Name	Descriptions
50	PLC download fail (PLod)	The device number in the downloaded program has exceeded the defined range

Action and Reset	
Action Condition	During PLC download process, the program source code detects incorrect address (e.g., the address exceeds the range), the PLod warning shows.
Action Time	Immediately act when the error is detected
Warning Setting Parameter	N/A
Reset Method	Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.
Reset Condition	No
Record	No
Cause	**Corrective Actions**
Incorrect component number is found when downloading the PLC program	Check if the device number used by the program has exceeded the model definition and re-download the program.

ID No.	Warning Name	Descriptions
51	PLC save memory error (PLSv)	Device number write error during program execution
Action and Reset		
Action Condition		The program detects incorrect written address (e.g., the address has exceeded the range) during PLC operation, then the PLSv warning shows.
Action Time		Immediately act when the error is detected
Warning Setting Parameter		N/A
Reset Method		Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.
Reset Condition		No
Record		No
Cause		Corrective Actions
An incorrect written address is detected during PLC operation		Check the PLC program with D1014 and re-download the program.

ID No.	Warning Name	Descriptions
52	Data defect (PLdA)	The read/ write device number or the uploaded command exceed the range, or other data error occurs during Modbus communication
Action and Reset		
Action Condition		When the program detects incorrect read address (for example, the address is out of the range) during PLC program uploading, the PLdA warning occurs.
Action Time		Immediately act when the error is detected
Warning Setting Parameter		N/A
Reset Method		Check if the program is correct and re-upload the program. If the program does not detect any problem, the warning automatically clears.
Reset Condition		No
Record		No
Cause		Corrective Actions
During PLC operation, the external Modbus has written/read incorrect data to internal PLC program		Check if the used communication address has exceeded the model defined range and retransmit the communication packet again.

ID No.	Warning Name	Descriptions
53	Function defect (PLFn)	Command error while downloading program

Action and Reset	
Action Condition	The program detects incorrect command (unsupported command) during PLC downloading, then PLFn warning acts.
Action Time	Immediately act when the error is detected
Warning Setting Parameter	N/A
Reset Method	Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.
Reset Condition	No
Record	No

Cause	Corrective Actions
Unsupported command has used while downloading the program	Check whether the used API model supports the command and re-download the program.

ID No.	Warning Name	Descriptions
54	PLC buffer overflow (PLor)	Program exceeds memory capacity during program execution
Action and Reset		
Action Condition		When PLC runs the last command and the command exceeds the maximum capacity of the program, the PLor warning shows.
Action Time		Immediately act when the error is detected
Warning Setting Parameter		N/A
Reset Method		Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.
Reset Condition		No
Record		No
Cause		Corrective Actions
The total size of the program code exceeds the model capacity.		Check if the PLC program is correct and re-download the program.

ID No.	Warning Name	Descriptions
55	Function defect (PLFF)	Command error during program execution

Action and Reset	
Action Condition	PLFF warning occurs when an unresolved command is found during the program operation
Action Time	Immediately act when the error is detected
Warning Setting Parameter	N/A
Reset Method	Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.
Reset Condition	No
Record	No

Cause	Corrective Actions
The PLC runs an incorrect command during operation	Check the PLC program with D1014 and re-download the program 1. If the FOR/NEXT command is written correctly 2. Is MC/ MCR paired 3. If the break command is written correctly 4. If the FOR/NEXT command is written correctly 5. If the break command is written correctly 6. Ensure the used model supports all API codes

ID No.	Warning Name	Descriptions
56	Checksum error (PLSn)	PLC checksum error

Action and Reset	
Action Condition	PLC checksum error is detected after power on, then PLSn warning shows
Action Time	Immediately act when the error is detected
Warning Setting Parameter	N/A
Reset Method	Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.
Reset Condition	No
Record	No
Cause	**Corrective Actions**
The program detects checksum error during PLC operation	1. Disable PLC 2. Delete PLC program (Pr. b0-01 = 6) 3. Enable PLC 4. Re-download PLC program

ID No.	Warning Name	Descriptions
57	No end commands (PLEd)	Program has no END stop command
Action and Reset		
Action Condition		The “End” command is missing until the last command is executed, the PLEd warning shows
Action Time		Immediately act when the error is detected
Warning Setting Parameter		N/A
Reset Method		Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.
Reset Condition		No
Record		No
Cause		Corrective Actions
There is no “END” command during PLC operation		Check if the PLC program is correct and re-download the program.

ID No.	Warning Name	Descriptions
59	PLC download fail (PLdF)	Communication loss or the drive power off while downloading the program
Action and Reset		
Action Condition		The communication package is loss while downloading the program
Action Time		Immediately act when the error is detected
Warning Setting Parameter		N/A
Reset Method		The communication package is loss while downloading the program
Reset Condition		No
Record		No
Cause		Corrective Actions
PLC download is forced to stop, so the program write-in is uncompleted		Check if the connection and the power supply is normal and re-download the program.

ID No.	Warning Name	Descriptions
60	PLC scan time fail (PLSF)	PLC scan time-out during program execution
Action and Reset		
Action Condition		When the PLC scan time exceeds the maximum allowable time (200 ms), PLSF warning shows.
Action Time		Immediately act when the error is detected
Warning Setting Parameter		N/A
Reset Method		Check if the program is correct and re-download the program. If the fault does not exist after re-download the program, the warning automatically clears.
Reset Condition		No
Record		No
Cause		Corrective Actions
The PLC scan time exceeds the maximum allowable time (200 ms)		Check if the PLC program uses excessive FOR and CALL commands, reduce the usage and re-download the program.

ID No.	Warning Name	Descriptions
70	ExCom ID fail (ECid)	Duplicate MAC ID error Node address setting error
Action and Reset		
Action Condition		Duplicate setting of MAC ID Node address setting error
Action Time		No
Warning Setting Parameter		N/A
Reset Method		Correct the setting and cycle the power
Reset Condition		No
Record		No
Cause		Corrective Actions
The setting address exceeds the range (0–63)		Check the address setting of the communication card (Pr. n4-01, n4-06).
The speed setting exceeds the range		Standard: 0–2, non-standard: 0–7
The address is duplicated with other nodes on the BUS		Reset the address

ID No.	Warning Name	Descriptions
71	ExCom power loss (ECLv)	Low voltage of communication card

Action and Reset	
Action Condition	The 5V power that drive provides to communication card is too low
Action Time	Immediately act
Warning Setting Parameter	N/A
Reset Method	Cycle the power
Reset Condition	No
Record	No

Cause	Corrective Actions
The 5V power that drive provides to communication card is too low	1. Switch the communication card to other AC motor drives and observe if there is ECLv warning shown. If yes, replace with a new communication card; if not, replace the drive. 2. Use another communication card to test if the ECLv warning has shown as well. If not, replace the card; if yes, replace the drive.
Communication cards break off	Make sure the communication card is well inserted.

ID No.	Warning Name	Descriptions
72	ExCom test mode (ECtt)	Communication card is in the test mode
Action and Reset		
Action Condition		Communication card is in the test mode
Action Time		Immediately act
Warning Setting Parameter		N/A
Reset Method		Cycle the power and enter the normal mode
Reset Condition		No
Record		No
Cause		Corrective Actions
Communication command error		Cycle the power

ID No.	Warning Name	Descriptions
73	ExCom BUS off (ECbF)	The communication card detects too many errors in the BUS, then enters the BUS-OFF status and stop communicating
Action and Reset		
Action Condition		When the drive detects BUS-off (for DeviceNet)
Action Time		Immediately act
Warning Setting Parameter		N/A
Reset Method		Cycle the power
Reset Condition		No
Record		No
Cause		Corrective Actions
Poor connection of the cable		Re-connect the cable.
Bad quality of the cable		Replace the cable.

ID No.	Warning Name	Descriptions
74	ExCom no power (ECnP)	There is no power supply on the DeviceNet
Action and Reset		
Action Condition		There is no power supply on the DeviceNet
Action Time		Immediately act
Warning Setting Parameter		N/A
Reset Method		Cycle the power
Reset Condition		No
Record		No
Cause		Corrective Actions
The drive detects that DeviceNet has no power		Check if the cable and power is normal. If yes, return to the factory for repair.

ID No.	Warning Name	Descriptions
75	ExCom factory defect (ECFF)	Factory default setting error
Action and Reset		
Action Condition		Factory default setting error
Action Time		Immediately act
Warning Setting Parameter		N/A
Reset Method		Cycle the power
Reset Condition		No
Record		No
Cause		Corrective Actions
Factory default setting error		Use DCISoft to reset to the default value.

ID No.	Warning Name	Descriptions
76	ExCom inner error (ECiF)	Serious internal error

Action and Reset	
Action Condition	Internal memory saving error
Action Time	Immediately act
Warning Setting Parameter	N/A
Reset Method	Cycle the power
Reset Condition	No
Record	No

Cause	Corrective Actions
Noise interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference. Cycle the power
The memory is broken	Reset to the default value and check if the error still exists. If yes, replace the communication card.

ID No.	Warning Name	Descriptions
77	ExCom IO Net break (ECio)	IO connection breaks off
Action and Reset		
Action Condition		IO connection between the communication card and the master is broken off
Action Time		Immediately act
Warning Setting Parameter		N/A
Reset Method		Manual reset
Reset Condition		Immediately reset
Record		No
Cause		Corrective Actions
The cable is loose		Re-install the cable.
Incorrect parameter setting for master communication		Check the setting for master communication parameter.

ID No.	Warning Name	Descriptions
78	ExCom IO net break (ECPP)	Profibus data error
Action and Reset		
Action Condition		No
Action Time		No
Warning Setting Parameter		N/A
Reset Method		Manual reset
Reset Condition		Immediately reset
Record		No
Cause		Corrective Actions
The used GSD file is incorrect		Use the correct GSD file for the software.

ID No.	Warning Name	Descriptions
79	ExCom configuration data error (ECPi)	Profibus configuration data error
Action and Reset		
Action Condition		No
Action Time		No
Warning Setting Parameter		N/A
Reset Method		Manual reset
Reset Condition		Immediately reset
Record		No
Cause		Corrective Actions
The used GSD file is incorrect		Use the correct GSD file for the software.

ID No.	Warning Name	Descriptions
80	Ethernet link fail (ECEF)	Ethernet cable is not connected
Action and Reset		
Action Condition		Hardware detection
Action Time		Immediately act
Warning Setting Parameter		N/A
Reset Method		Manual reset
Reset Condition		No
Record		No
Cause		Corrective Actions
The cable is loose		Re-connect the network cable.
Bad quality of the cable		Replace the cable.

ID No.	Warning Name	Descriptions
81	Communication time-out (ECto)	Communication time-out for communication card and the upper unit
Action and Reset		
Action Condition		No
Action Time		No
Warning Setting Parameter		N/A
Reset Method		No
Reset Condition		Auto resets when the communication with the upper unit is back to normal
Record		No
Cause		Corrective Actions
Communication card is not connected with the upper unit		Check if the connection of the communication cable is correct.
Communication error of the upper unit		Check if the communication of the upper unit is normal.

ID No.	Warning Name	Descriptions
82	Checksum error (ECCS)	A fault occurs to the communication checksum between communication card and the drive
Action and Reset		
Action Condition		Software detection
Action Time		No
Warning Setting Parameter		N/A
Reset Method		Manual reset
Reset Condition		Immediately reset
Record		No
Cause		Corrective Actions
Noise interference		Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.

ID No.	Warning Name	Descriptions
83	Return defect (ECrF)	The communication card has returned to the default
Action and Reset		
Action Condition		The communication card has returned to the default
Action Time		No
Warning Setting Parameter		N/A
Reset Method		Manual reset
Reset Condition		Immediately reset
Record		No
Cause		Corrective Actions
The communication card is returning to the default.		No need to handle the warning.

ID No.	Warning Name	Descriptions
84	Modbus TCP over (ECo0)	The connection of Modbus TCP has exceeded the limit

Action and Reset	
Action Condition	Hardware detection
Action Time	Immediately act
Warning Setting Parameter	N/A
Reset Method	Manual reset
Reset Condition	Immediately reset
Record	No

Cause	Corrective Actions
The number of master station connection is larger than the number of the communication card that can be connected	Reduce the connected number of the master station.
Though there is no communication after the upper unit is connected, the Modbus TCP is still on-line, which caused the connection being occupied.	Modify the upper unit program. It must be disconnected when it is not used for a long time.
Every time the upper unit connects with the communication card, it opens a new Modbus TCP connection, which causes the connection to be occupied	Modify the upper unit program. Uses the same Modbus TCP connection when connecting to the same communication card.

ID No.	Warning Name	Descriptions
85	EtherNet/IP over (ECo1)	The connection of Ethernet/IP has exceeded the limit
Action and Reset		
Action Condition		Hardware detection
Action Time		Immediately act
Warning Setting Parameter		N/A
Reset Method		Manual reset
Reset Condition		Immediately reset
Record		No
Cause		Corrective Actions
The number of master station connection is larger than the number of the communication card that can be connected		Reduce the connected number of the master station.
Though there is no communication after the upper unit is connected, the Ethernet/IP is still on-line, which caused the connection being occupied.		Modify the upper unit program. It must be disconnected when it is not used for a long time.
Every time the upper unit connects with the communication card, it opens a new Ethernet/IP connection, which causes the connection to be occupied		Modify the upper unit program. Uses the same Ethernet/IP connection when connecting to the same communication card.

ID No.	Warning Name	Descriptions
86	IP fail (ECiP)	IP setting failure
Action and Reset		
Action Condition		Software detection
Action Time		Immediately act
Warning Setting Parameter		N/A
Reset Method		Manual reset
Reset Condition		Immediately reset
Record		No
Cause		Corrective Actions
IP conflicts		Reset IP
DHCP IP configuration is incorrect		Contact your MIS member to check if the DHCP server works normally.

ID No.	Warning Name	Descriptions
87	Mail fail (EC3F)	Mail warning: When the communication card setting Alarm condition is met, an Alarm mail is sent.
Action and Reset		
Action Condition		When the communication card setting Alarm condition is met
Action Time		Immediately act
Warning Setting Parameter		N/A
Reset Method		Manual reset
Reset Condition		Immediately reset
Record		No
Cause		Corrective Actions
Alarm setting condition is met		No need to handle the warning.

ID No.	Warning Name	Descriptions
88	ExCom busy (ECbF)	ExCom busy: receiving too many packets, the communication card is busy

Action and Reset	
Action Condition	Software detection
Action Time	No
Warning Setting Parameter	N/A
Reset Method	Manual reset
Reset Condition	No
Record	No
Cause	**Corrective Actions**
There are too many communication packages for the communication card to process	Reduce the communication packages.

ID No.	Warning Name	Descriptions
89	ExCom card break (ECCb)	Communication cards break off warning
Action and Reset		
Action Condition		Communication cards break off
Action Time		The time between communication card break off and ECCb displays: 1. EtherNet/IP: 5 sec. 2. Modbus TCP: 5 sec. 3. DeviceNet: 1 sec. 4. PROFIBUS: 1 sec. 5. EtherCAT: 0.1 sec.
Warning Setting Parameter		N/A
Reset Method		Auto resets after communication card is re-installed
Reset Condition		Immediately reset
Record		No
Cause		Corrective Actions
Communication cards break off		Re-install communication card.

ID No.	Warning Name	Descriptions
123	Deceleration energy backup error (dEb)	Deceleration energy backup error
Action and Reset		
Action Condition		Software detection
Action Time		No
Warning Setting Parameter		Pr. J2-00 0: Disable 1: Auto-decel, stop after restore 2: Auto-decel, run after restore 3: Low speed high voltage control 4: All high voltage control 5: dEb Decel, stop after restore 6: FOC Decel, stop after restore 7: FOC Decel, run after restore
Reset Method		Manual reset
Reset Condition		Immediately reset
Record		No
Cause		Corrective Actions
Momentary power loss, or too low and unstable power voltage, or power supply sliding down because of sudden heavy load.		Check the field electricity consumption.
Unexpected power shut down or power loss		Check the field electricity consumption.

ID No.	Warning Name	Descriptions
140	SD card function error (SDiv)	The SD card is not inserted, or the disk format does not match when using the SD card memory function
Action and Reset		
Action Condition		Auto-detect
Action Time		Immediately act
Warning Setting Parameter		No
Reset Method		Press RESET key
Reset Condition		No
Record		Yes
Cause		Corrective Actions
The SD card does not use FAT32 format		Format the SD card to FAT32 by a PC.
Use the SD card memory function		Check if the SD card memory function is used and if the SD card is correctly inserted.

<table>
<tr><th>ID No.</th><th>Warning Name</th><th colspan="2">Descriptions</th></tr>
<tr><td>142</td><td>AI2 analog signal loss (AnL)</td><td colspan="2">Analog input current loss (including all analog 4–20 mA signals)</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action Condition</td><td colspan="2">When the analog input (Pr. G2-22 = 2) is lower than 3.6 mA (only detects analog input 4–20 mA)</td></tr>
<tr><td colspan="2">Action Time</td><td colspan="2">The action condition is attained for 0.1s</td></tr>
<tr><td colspan="2">Warning Setting Parameter</td><td colspan="2">G2-30
AI2 signal loss action:
0: Disable
1: Warning & continue OPER
2: Fault & Ramp to Stop
3: Fault & Auto-Decel
4: Fault & Coast to Stop
5: Fault & by Quick Stop Time
6: Warning & FREQ Lower Limit OPER</td></tr>
<tr><td colspan="2" rowspan="2">Reset Method</td><td>Auto</td><td>It is “Warning” when Pr. G2-30 = 1, and the warning will be automatically cleared when the analog input signal is ≥ 4 mA.</td></tr>
<tr><td>Manual</td><td>It is “Fault” when Pr. G2-30 = 2–5, which must be reset manually.</td></tr>
<tr><td colspan="2">Reset Condition</td><td colspan="2">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">It is “Fault” when Pr. G2-30 = 2–5 and will be recorded.</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Loose or broken AI2 wiring</td><td colspan="2">Tighten the terminals again.
Replace with a new cable.</td></tr>
<tr><td colspan="2">External device error</td><td colspan="2">Replace new device.</td></tr>
<tr><td colspan="2">Hardware failure</td><td colspan="2">If the AnL error still occurs after checking all the wiring, return to the factory for repair.</td></tr>
</table>

<table>
<tr><th>ID No.</th><th>Warning Name</th><th colspan="2">Descriptions</th></tr>
<tr><td>143</td><td>AI3 analog signal loss (AnL)</td><td colspan="2">Analog input current loss (including all analog 4–20 mA signals)</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action Condition</td><td colspan="2">When the analog input (Pr. G2-41 = 2) is lower than 3.6 mA (only detects analog input 4–20 mA)</td></tr>
<tr><td colspan="2">Action Time</td><td colspan="2">The action condition is attained for 0.1s</td></tr>
<tr><td colspan="2">Warning Setting Parameter</td><td colspan="2">G2-49
AI3 signal loss action:
0: Disable
1: Warning & continue OPER
2: Fault & Ramp to Stop
3: Fault & Auto-Decel
4: Fault & Coast to Stop
5: Fault & by Quick Stop Time
6: Warning & FREQ Lower Limit OPER</td></tr>
<tr><td colspan="2" rowspan="2">Reset Method</td><td>Auto</td><td>It is “Warning” when Pr. G2-49 = 1, and the warning will be automatically cleared when the analog input signal is ≥ 4 mA.</td></tr>
<tr><td>Manual</td><td>It is “Fault” when Pr. G2-49 = 2–5, which must be reset manually.</td></tr>
<tr><td colspan="2">Reset Condition</td><td colspan="2">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">It is “Fault” when Pr. G2-49 = 2–5 and will be recorded.</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Loose or broken AI3 wiring</td><td colspan="2">Tighten the terminals again.
Replace with a new cable.</td></tr>
<tr><td colspan="2">External device error</td><td colspan="2">Replace new device.</td></tr>
<tr><td colspan="2">Hardware failure</td><td colspan="2">If the AnL error still occurs after checking all the wiring, return to the factory for repair.</td></tr>
</table>

ID No.	Warning Name	Descriptions	
144	AI10 analog signal loss (AnL)	Analog input current loss (including all analog 4–20mA signals)	
Action and Reset			
Action Condition		When the analog input (Pr. G6-02 = 2) is lower than 3.6 mA (only detects analog input 4–20 mA)	
Action Time		The action condition is attained for 0.1s	
Warning Setting Parameter		G6-10 AI10 signal loss action: 0: Disable 1: Warning & continue OPER 2: Fault & Ramp to Stop 3: Fault & Auto-Decel 4: Fault & Coast to Stop 5: Fault & by Quick Stop Time 6: Warning & FREQ Lower Limit OPER	
Reset Method		Auto	It is “Warning” when Pr. G6-10 = 1, and the warning will be automatically cleared when the analog input signal is ≥ 4 mA.
		Manual	It is "Fault” when Pr. G6-10 = 2–5, which must be reset manually.
Reset Condition		Immediately reset	
Record		It is “Fault” when Pr. G6-10 = 2–5 and will be recorded.	
Cause		Corrective Actions	
Loose or broken AI10 wiring		Tighten the terminals again. Replace with a new cable.	
External device error		Replace new device.	
Hardware failure		If the AnL error still occurs after checking all the wiring, return to the factory for repair.	

<table>
<tr><th>ID No.</th><th>Warning Name</th><th colspan="2">Descriptions</th></tr>
<tr><td>145</td><td>AI11 analog signal loss (AnL)</td><td colspan="2">Analog input current loss (including all analog 4–20mA signals)</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action Condition</td><td colspan="2">When the analog input (Pr. G6-14 = 2) is lower than 3.6 mA (only detects analog input 4–20 mA)</td></tr>
<tr><td colspan="2">Action Time</td><td colspan="2">The action condition is attained for 0.1s</td></tr>
<tr><td colspan="2">Warning Setting Parameter</td><td colspan="2">G6-22
AI11 signal loss action:
0: Disable
1: Warning & continue OPER
2: Fault & Ramp to Stop
3: Fault & Auto-Decel
4: Fault & Coast to Stop
5: Fault & by Quick Stop Time
6: Warning & FREQ Lower Limit OPER</td></tr>
<tr><td colspan="2" rowspan="2">Reset Method</td><td>Auto</td><td>It is “Warning” when Pr. G6-22 = 1, and the warning will be automatically cleared when the analog input signal is ≥ 4 mA.</td></tr>
<tr><td>Manual</td><td>It is "Fault” when Pr. G6-22 = 2–5, which must be reset manually.</td></tr>
<tr><td colspan="2">Reset Condition</td><td colspan="2">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">It is “Fault” when Pr. G6-22 = 2–5 and will be recorded.</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Loose or broken AI11 wiring</td><td colspan="2">Tighten the terminals again.
Replace with a new cable.</td></tr>
<tr><td colspan="2">External device error</td><td colspan="2">Replace new device.</td></tr>
<tr><td colspan="2">Hardware failure</td><td colspan="2">If the AnL error still occurs after checking all the wiring, return to the factory for repair.</td></tr>
</table>

ID No.	Warning Name	Descriptions
146	Monitor signal 1 trigger (BX1n)	Sets the monitor signal source o2-01 according to the trigger condition, and the monitoring signal meets the trigger condition.
Action and Reset		
Action Condition		Meet Pr. o2-02 trigger condition
Action Time		Immediately act
Warning Setting Parameter		Pr. o2-03 0: Disable 1: Warning 2: Fault and ramp stop 3: Fault and coast stop
Reset Method		Manual reset
Reset Condition		Does not meet Pr. o2-02 trigger condition
Record		Records when Pr. o2-03 = 2 or 3
Cause		Corrective Actions
Incorrect settings that trigger the protection		Check if the setting for o2-01, o2-02 and o2-03 is correct.

ID No.	Warning Name	Descriptions
147	Monitor signal 2 trigger (BX2n)	Sets the monitor signal source o2-08 according to the trigger condition, and the monitoring signal meets the trigger condition.
Action and Reset		
Action Condition		Meet Pr. o2-09 trigger condition
Action Time		Immediately act
Warning Setting Parameter		Pr. o2-10 0: Disable 1: Warning 2: Fault and ramp stop 3: Fault and coast stop
Reset Method		Manual reset
Reset Condition		Does not meet Pr. o2-09 trigger condition
Record		Records when Pr. o2-10 = 2 or 3
Cause		Corrective Actions
Incorrect settings that trigger the protection		Check if the setting for o2-08, o2-09 and o2-10 is correct.

ID No.	Warning Name	Descriptions
148	Monitor signal 3 trigger (BX3n)	Sets the monitor signal source o2-15 according to the trigger condition, and the monitoring signal meets the trigger condition.
Action and Reset		
Action Condition		Meet Pr. o2-16 trigger condition
Action Time		Immediately act
Warning Setting Parameter		Pr. o2-17 0: Disable 1: Warning 2: Fault and ramp stop 3: Fault and coast stop
Reset Method		Manual reset
Reset Condition		Does not meet Pr. o2-16 trigger condition
Record		Records when Pr. o2-17 = 2 or 3
Cause		Corrective Actions
Incorrect settings that trigger the protection		Check if the setting for o2-15, o2-16 and o2-17 is correct.

ID No.	Warning Name	Descriptions
149	Monitor signal 4 trigger (BX4n)	Sets the monitor signal source o2-22 according to the trigger condition, and the monitoring signal meets the trigger condition.
Action and Reset		
Action Condition		Meet Pr. o2-23 trigger condition
Action Time		Immediately act
Warning Setting Parameter		Pr. o2-24 0: Disable 1: Warning 2: Fault and ramp stop 3: Fault and coast stop
Reset Method		Manual reset
Reset Condition		Does not meet Pr. o2-23 trigger condition
Record		Records when Pr. o2-24 = 2 or 3
Cause		Corrective Actions
Incorrect settings that trigger the protection		Check if the setting for o2-22, o2-23 and o2-24 is correct.

ID No.	Warning Name	Descriptions
150	Monitor signal 5 trigger (BX5n)	Sets the monitor signal source o2-29 according to the trigger condition, and the monitoring signal meets the trigger condition.

Action and Reset	
Action Condition	Meet Pr. o2-30 trigger condition
Action Time	Immediately act
Warning Setting Parameter	Pr. o2-31 0: Disable 1: Warning 2: Fault and ramp stop 3: Fault and coast stop
Reset Method	Manual reset
Reset Condition	Does not meet Pr. o2-30 trigger condition
Record	Records when Pr. o2-31 = 2 or 3
Cause	**Corrective Actions**
Incorrect settings that trigger the protection	Check if the setting for o2-29, o2-30 and o2-31 is correct.

ID No.	Warning Name	Descriptions
151	Monitor signal 6 trigger (BX6n)	Sets the monitor signal source o2-36 according to the trigger condition, and the monitoring signal meets the trigger condition.

Action and Reset	
Action Condition	Meet Pr. o2-37 trigger condition
Action Time	Immediately act
Warning Setting Parameter	Pr. o2-38 0: Disable 1: Warning 2: Fault and ramp stop 3: Fault and coast stop
Reset Method	Manual reset
Reset Condition	Does not meet Pr. o2-37 trigger condition
Record	Records when Pr. o2-38 = 2 or 3
Cause	**Corrective Actions**
Incorrect settings that trigger the protection	Check if the setting for o2-36, o2-37 and o2-38 is correct.

ID No.	Warning Name	Descriptions
152	Monitor signal 7 trigger (BX7n)	Sets the monitor signal source o2-43 according to the trigger condition, and the monitoring signal meets the trigger condition.
Action and Reset		
Action Condition		Meet Pr. o2-44 trigger condition
Action Time		Immediately act
Warning Setting Parameter		Pr. o2-45 0: Disable 1: Warning 2: Fault and ramp stop 3: Fault and coast stop
Reset Method		Manual reset
Reset Condition		Does not meet Pr. o2-44 trigger condition
Record		Records when Pr. o2-45 = 2 or 3
Cause		Corrective Actions
Incorrect settings that trigger the protection		Check if the setting for o2-43, o2-44 and o2-45 is correct.

ID No.	Warning Name	Descriptions
153	Monitor signal 8 trigger (BX8n)	Sets the monitor signal source o2-50 according to the trigger condition, and the monitoring signal meets the trigger condition.
Action and Reset		
Action Condition		Meet Pr. o2-51 trigger condition
Action Time		Immediately act
Warning Setting Parameter		Pr. o2-52 0: Disable 1: Warning 2: Fault and ramp stop 3: Fault and coast stop
Reset Method		Manual reset
Reset Condition		Does not meet Pr. o2-51 trigger condition
Record		Records when Pr. o2-52 = 2 or 3
Cause		Corrective Actions
Incorrect settings that trigger the protection		Check if the setting for o2-50, o2-51 and o2-52 is correct.

ID No.	Warning Name	Descriptions
154	Battery low voltage (RtLv)	Insufficient voltage of the external battery
Action and Reset		
Action Condition		The battery voltage is lower than 2.4 V
Action Time		1 second
Warning Setting Parameter		Pr. J6-00 0: No warning 1: Warning after power on 2: Warning each hour 3: Warning each day
Reset Method		Immediately resets or automatically clears when the level returns to 2.4V
Reset Condition		Immediately resets or automatically clears when the level returns to 2.4V
Record		Yes
Cause		Corrective Actions
Insufficient battery voltage		Replace with a new battery.
Battery detection abnormal		If the warning cannot be cleared after replacing the battery and the warning still exists after restarting the drive, return to the factory for repair.

ID No.	Warning Name	Descriptions
155	Electronic thermal relay 1 protection (EoL1)	Electronic thermal relay 1 protection.
Action and Reset		
Action Condition		Start counting when output current > 100% of motor 1 rated current
Action Time		Pr. H5-09 (if the output current is larger than 100% of motor 1 rated current again within 60 sec., the counting time reduces and is less than Pr. H5-09 setting value)
Warning Setting Parameter		Pr. H5-10 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time
Reset Method		"Error" occurs when Pr. H5-10 = 1–4. You must reset manually.
Reset Condition		Reset in 5 sec. after the fault is cleared
Record		Records when Pr. H5-10 = 1–4
Cause		Corrective Actions
The load is too large		Reduce the load.
Accel./Decel. time and working cycle are too short		Increase the setting values for Pr. C2-00–Pr. C2-07 (accel./decel. time)
V/F voltage is too high		Adjust settings for Pr.E0-03–E0-14 (V/F curve). Adjust the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low speed).
Overload during low-speed operation When using a general motor, even it operates below rated current, an overload may still occur during low-speed operation.		Decrease low-speed operation time. Change to dedicated motor for the drive. Enlarge the motor capacity.
When using motor drive dedicated motors, Pr. H5-08 = 2 (Constant torque mode)		Pr. H5-08 = 1 electronic thermal relay selection motor 1 = standard motor (motor with fan on the shaft).
Incorrect value of electronic thermal relay		Reset to the correct motor rated current.
The maximum motor frequency is set too low		Reset to the correct motor rated frequency.
One drive to multiple motors		Set Pr. H5-08 = 0 (electronic thermal relay selection motor 1= disable) and install thermal relay on each motor.
Check if the setting for stall prevention is correct		Set the stall prevention to the proper value.

Cause	Corrective Actions
Torque compensation is too large	Adjust the torque compensation (refer to Pr. E0-16 torque compensation gain) until the current reduces and the motor does not stall.
Motor fan error	Check the status of the fan or replace the fan.
Unbalance three-phase impedance of the motor	Replace the motor.

<table>
<tr><th>ID No.</th><th>Warning Name</th><th>Descriptions</th></tr>
<tr><td>156</td><td>Electronic thermal relay 2 protection (EoL2)</td><td>Electronic thermal relay 2 protection.</td></tr>
<tr><th colspan="3">Action and Reset</th></tr>
<tr><td colspan="2">Action Condition</td><td>Start counting when output current > 100% of motor 2 rated current</td></tr>
<tr><td colspan="2">Action Time</td><td>Pr. H5-20 (if the output current is larger than 100% of motor 2 rated current again within 60 sec., the counting time reduces and is less than Pr. H5-20 setting value)</td></tr>
<tr><td colspan="2">Warning Setting Parameter</td><td>Pr. H5-21
0: Warning & continue OPER
1: Fault & Ramp to Stop
2: Fault & Auto-Decel
3: Fault & coast to stop
4: Fault & by Quick Stop Time</td></tr>
<tr><td colspan="2">Reset Method</td><td>“Error” occurs when Pr. H5-21 = 1–4. You must reset manually.</td></tr>
<tr><td colspan="2">Reset Condition</td><td>Reset in 5 sec. after the fault is cleared</td></tr>
<tr><td colspan="2">Record</td><td>Records when Pr. H5-21 = 1–4</td></tr>
<tr><th colspan="2">Cause</th><th>Corrective Actions</th></tr>
<tr><td colspan="2">The load is too large</td><td>Reduce the load.</td></tr>
<tr><td colspan="2">Accel./Decel. time and working cycle are too short</td><td>Increase the setting values for Pr. C2-00–Pr. C2-07 (accel./decel. time)</td></tr>
<tr><td colspan="2">V/F voltage is too high</td><td>Adjust settings for Pr.E0-03–E0-14 (V/F curve). Adjust the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low speed).</td></tr>
<tr><td colspan="2">Overload during low-speed operation
When using a general motor, even it operates below rated current, an overload may still occur during low-speed operation.</td><td>Decrease low-speed operation time.
Change to dedicated motor for the drive.
Enlarge the motor capacity.</td></tr>
<tr><td colspan="2">When using motor drive dedicated motors, Pr. H5-19 = 2 (IM2 EoL1 Mode = 2 Constant Torque mode)</td><td>Pr. H5-19 = 1 (IM2 EoL1 mode = Variable Torque mode).</td></tr>
<tr><td colspan="2">Incorrect value of electronic thermal relay</td><td>Reset to the correct motor rated current.</td></tr>
<tr><td colspan="2">The maximum motor frequency is set too low</td><td>Reset to the correct motor rated frequency.</td></tr>
<tr><td colspan="2">One drive to multiple motors</td><td>Set Pr. H5-19 = 0 (IM2 EoL1 mode= disable) and install thermal relay on each motor.</td></tr>
<tr><td colspan="2">Check if the setting for stall prevention is correct</td><td>Set the stall prevention to the proper value.</td></tr>
</table>

Cause	Corrective Actions
Torque compensation is too large	Adjust the torque compensation (refer to Pr. E0-16 torque compensation gain) until the current reduces and the motor does not stall.
Motor fan error	Check the status of the fan or replace the fan.
Unbalance three-phase impedance of the motor	Replace the motor.

ID No.	Warning Name	Descriptions
157	Electronic thermal relay 3 protection (EoL3)	Electronic thermal relay 3 protection.
Action and Reset		
Action Condition		Start counting when output current > 100% of motor 3 rated current
Action Time		Pr. H5-31 (if the output current is larger than 100% of motor 3 rated current again within 60 sec., the counting time reduces and is less than Pr. H5-31 setting value)
Warning Setting Parameter		Pr. H5-32 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time
Reset Method		"Error" occurs when Pr. H5-32 = 1–4. You must reset manually.
Reset Condition		Reset in 5 sec. after the fault is cleared
Record		Records when Pr. H5-32 = 1–4
Cause		Corrective Actions
The load is too large		Reduce the load.
Accel./Decel. time and working cycle are too short		Increase the setting values for Pr. C2-00–Pr. C2-07 (accel./decel. time)
V/F voltage is too high		Adjust settings for Pr.E0-03–E0-14 (V/F curve). Adjust the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low speed).
Overload during low-speed operation When using a general motor, even it operates below rated current, an overload may still occur during low-speed operation.		Decrease low-speed operation time. Change to dedicated motor for the drive. Enlarge the motor capacity.
When using motor drive dedicated motors, Pr. H5-30 = 2 (Constant torque mode)		Pr. H5-30 = 1 (IM3 EoL1 mode = Variable Torque mode).
Incorrect value of electronic thermal relay		Reset to the correct motor rated current.
The maximum motor frequency is set too low		Reset to the correct motor rated frequency.
One drive to multiple motors		Set Pr. H5-30 = 0 (IM3 EoL1 mode= disable) and install thermal relay on each motor.
Check if the setting for stall prevention is correct		Set the stall prevention to the proper value.

Cause	Corrective Actions
Torque compensation is too large	Adjust the torque compensation (refer to Pr. E0-16 torque compensation gain) until the current reduces and the motor does not stall.
Motor fan error	Check the status of the fan or replace the fan.
Unbalance three-phase impedance of the motor	Replace the motor.

ID No.	Warning Name	Descriptions
158	Electronic thermal relay 4 protection (EoL4)	Electronic thermal relay 4 protection. The drive coasts to stop once it activates.

Action and Reset	
Action Condition	Start counting when output current > 100% of motor 4 rated current
Action Time	Pr. H5-42 (if the output current is larger than 100% of motor 4 rated current again within 60 sec., the counting time reduces and is less than Pr. H5-42 setting value)
Warning Setting Parameter	Pr. H5-43 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time
Reset Method	"Error" occurs when Pr. H5-43 = 1–4. You must reset manually.
Reset Condition	Reset in 5 sec. after the fault is cleared
Record	Records when Pr. H5-43 = 1–4

Cause	Corrective Actions
The load is too large	Reduce the load.
Accel./Decel. time and working cycle are too short	Increase the setting values for Pr. C2-00–Pr. C2-07 (accel./decel. time)
V/F voltage is too high	Adjust settings for Pr.E0-03–E0-14 (V/F curve). Adjust the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low speed).
Overload during low-speed operation When using a general motor, even it operates below rated current, an overload may still occur during low-speed operation.	Decrease low-speed operation time. Change to dedicated motor for the drive. Enlarge the motor capacity.
When using motor drive dedicated motors, Pr. H5-43 = 2 (Constant torque mode)	Pr. H5-43 = 1 (IM4 EoL1 mode = Variable Torque mode).
Incorrect value of electronic thermal relay	Reset to the correct motor rated current.
The maximum motor frequency is set too low	Reset to the correct motor rated frequency.
One drive to multiple motors	Set Pr. H5-43 = 0 (IM4 EoL1 mode= disable) and install thermal relay on each motor.
Check if the setting for stall prevention is correct	Set the stall prevention to the proper value.

Cause	Corrective Actions
Torque compensation is too large	Adjust the torque compensation (refer to Pr. E0-16 torque compensation gain) until the current reduces and the motor does not stall.
Motor fan error	Check the status of the fan or replace the fan.
Unbalance three-phase impedance of the motor	Replace the motor.

ID No.	Warning Name	Descriptions
159	Safe torque off 1 (STO1)	The action time difference between Channel 1 and Channel 2 are too large and Channel 1 activates.
Action and Reset		
Action Condition		There is action time difference between two channels
Action Time		Pr. H0-12
Warning Setting Parameter		Pr. H0-11 0: STO Fault 1: Fault at Run; Warning at Stop 2: STO Warning 3: No STO Display at Stop
Reset Method		It is “Warning”, which will be automatically reset
Reset Condition		Channel 1 and Channel 2 return to no action level
Record		No
Cause		Corrective Actions
Channel external appliance problems		1. Check whether Channel 1 and Channel 2 use appliance as input, and whether there is time difference in the appliance action time; replace the appliance with the same action time. 2. Check whether the appliance is broken.

ID No.	Warning Name	Descriptions
160	Safe torque off 2 (STO2)	The action time difference between Channel 1 and Channel 2 are too large and Channel 2 activates.
Action and Reset		
Action Condition		There is action time difference between two channels
Action Time		Pr. H0-12
Warning Setting Parameter		Pr. H0-11 0: STO Fault 1: Fault at Run; Warning at Stop 2: STO Warning 3: No STO Display at Stop
Reset Method		It is "Warning", which will be automatically reset
Reset Condition		Channel 1 and Channel 2 return to no action level
Record		No
Cause		Corrective Actions
Channel external appliance problems		1. Check whether Channel 1 and Channel 2 use appliance as input, and whether there is time difference in the appliance action time; replace the appliance with the same action time. 2. Check whether the appliance is broken.

ID No.	Warning Name	Descriptions
161	ECAP models low voltage (ECLV)	ECAP models detect that the internal DC bus voltage is lower than Pr. H1-04

Action and Reset	
Action Condition	H1-04
Action Time	Immediately act when DC bus voltage is lower than Pr. H1-04
Warning Setting Parameter	N/A
Reset Method	Manual reset
Reset Condition	DC bus voltage is larger than Pr. H1-04
Record	Yes
Cause	**Corrective Actions**
Power-off	Improve power supply condition.
Power voltage changes	Adjust voltage to the power range of the drive.
Start up the motor with large capacity	Check the power system. Enlarge the capacity of power equipment.
The load is too large	Reduce the load. Enlarge the drive capacity. Increase the acceleration time.

ID No.	Warning Name	Descriptions
162	Controller calculation overload (MCOL)	Controller calculation is overload

Action and Reset	
Action Condition	Warning occurs when the controller calculation is more than 85%
Action Time	Immediately displayed
Warning Setting Parameter	N/A
Reset Method	Auto-reset
Reset Condition	Controller calculation is lower than 80%
Record	No

Cause	Corrective Actions
Controller calculation is overload	Decrease the carrier frequency of Pr. A5-00.

ID No.	Warning Name	Descriptions
163	SD card capacity is full (SDfu)	SD card capacity is full, the recorder function will be disabled
Action and Reset		
Action Condition		Auto detection
Action Time		Immediately displayed
Warning Setting Parameter		N/A
Reset Method		Press the Reset key
Reset Condition		N/A
Record		Yes
Cause		Corrective Actions
The usage rate of the SD card is 99%		1. Release the cache space or format the SD card. 2. Replace the SD card. 3. Clean the Log files if there are too many of it.
The recorder function is filled up with Log files, and there is no Temp files to overwrite automatically		

ID No.	Warning Name	Descriptions
164	No SD card (SDno)	SD card is not inserted

Action and Reset	
Action Condition	Auto detection
Action Time	Immediately displayed
Warning Setting Parameter	N/A
Reset Method	Press the Reset key
Reset Condition	N/A
Record	Yes

Cause	Corrective Actions
The SD card is not correctly inserted while executing the SD card related functions (ex. Backup, recorder, etc.)	1. Check if the SD card is inserted. 2. Replace the SD card.
SD card does not reload after hot swapping	
Unsupported SD card type (ex. SDXC, SDUC…)	

ID No.	Warning Name	Descriptions
165	SD card format error (SDfe)	SD card format is incorrect
Action and Reset		
Action Condition		Auto detection
Action Time		Immediately displayed
Warning Setting Parameter		N/A
Reset Method		Press the Reset key
Reset Condition		N/A
Record		Yes
Cause		Corrective Actions
The SD card format is detected error (ex. FAT16 or exFAT, etc.) when powering ON or reloading SD card		1. Format SD card to FAT32 (via AC motor drive or PC). 2. Replace the SD card.

ID No.	Warning Name	Descriptions
166	SD card prohibited execution (SDih)	SD card function is prohibited execution

Action and Reset	
Action Condition	Auto detection
Action Time	Immediately displayed
Warning Setting Parameter	N/A
Reset Method	Press the Reset key
Reset Condition	N/A
Record	Yes

Cause	Corrective Actions
Enable the recorder function and restore the backup file to the SD card	The recorder function cannot be executed with some functions (read, write SD card or PLC) at the same time. Verify the recorder function (Pr.o1-33 Recorder Function) status: Pr.o1-33 = 0, Disabled Pr.o1-33 ≥ 1, Enabled
Enable the recorder function and reload	
Enable PLC function and execute the recorder function	

<table>
<tr><th>ID No.</th><th>Warning Name</th><th>Descriptions</th></tr>
<tr><td>167</td><td>SD card time-out
(SDto)</td><td></td></tr>
<tr><th colspan="3">Action and Reset</th></tr>
<tr><td colspan="2">Action Condition</td><td>Auto detection</td></tr>
<tr><td colspan="2">Action Time</td><td>Immediately displayed</td></tr>
<tr><td colspan="2">Warning Setting Parameter</td><td>N/A</td></tr>
<tr><td colspan="2">Reset Method</td><td>Press the Reset key</td></tr>
<tr><td colspan="2">Reset Condition</td><td>N/A</td></tr>
<tr><td colspan="2">Record</td><td>Yes</td></tr>
<tr><th colspan="2">Cause</th><th>Corrective Actions</th></tr>
<tr><td colspan="2">Enable the recorder function and restore the backup file to the SD card</td><td rowspan="3">The recorder function cannot be executed with some functions (read, write SD card or PLC) at the same time. Verify the recorder function (Pr.o1-33 Recorder Function) status:
Pr.o1-33 = 0, Disabled
Pr.o1-33 ≥ 1, Enabled</td></tr>
<tr><td colspan="2">Enable the recorder function and reload</td></tr>
<tr><td colspan="2">Enable PLC function and execute the recorder function</td></tr>
</table>

ID No.	Warning Name	Descriptions
300	Leakage warning (LEKn)	Triggers when detecting large amount water leakage
Action and Reset		
Action Condition		The feedback pressure is lower than Plow and the load current is larger than Pr. U3-03 setting Plow = [Target pressure × (1 – Pr. U3-01%)]
Action Time		Pr. U3-02
Warning Setting Parameter		Pr. U3-04 0: Warning & continue OPER
Reset Method		Automatically resets after the triggered condition is cleared
Reset Condition		When the drive output rated current percentage is < Pr. U3-03 level × 0.9
Record		No
Cause		Corrective Actions
The pipe outlet is broken		Check if the pipes are damaged.
Pressure sensor error		Maintain pressure sensor.

ID No.	Warning Name	Descriptions
301	Low pressure warning (LPSn)	The warning occurs when the pressure is lower than the set pressure.

Action and Reset	
Action Condition	The feedback pressure is lower than Plow Plow = [Target pressure × (1 – Pr. U3-08%)]
Action Time	Pr. U3-09
Warning Setting Parameter	Pr. U3-10 0: Warning & continue OPER
Reset Method	Automatically resets after the triggered condition is cleared
Reset Condition	Immediately reset
Record	No

Cause	Corrective Actions
Unable to establish water pressure	Check if the pipe has leakage, or if there is no water from the source.
Pressure sensor broken	Replace the pressure sensor.

ID No.	Warning Name	Descriptions
302	Dry pump warning (dryn)	Warning occurs when the drive detects dry pump.

Action and Reset	
Action Condition	The corresponded power of the target frequency is below the dry pump curve
Action Time	Pr. U3-16
Warning Setting Parameter	Pr. U3-19 1: Warn and coast to stop 2: Warn and ramp to stop
Reset Method	Automatically resets after the triggered condition is cleared
Reset Condition	Auto-reset
Record	No
Cause	**Corrective Actions**
Pipe has leakage or has no water	Check if the pipe is damaged, or if there is no water from the source.

ID No.	Warning Name	Descriptions
303	Cleaning process warning (CLE)	Warning occurs when the drive is in cleaning process
Action and Reset		
Action Condition		Pr. U3-20 (Pump clean function) is enabled
Action Time		Immediately acts
Warning Setting Parameter		N/A
Reset Method		Automatically resets when the cleaning process completes
Reset Condition		Auto-reset
Record		No
Cause		Corrective Actions
Cleaning function is enabled		Waits for the cleaning process complete or stop the cleaning process.

ID No.	Warning Name	Descriptions
304	Cavitation warning (Cavi)	Warning occurs when the drive is in cavitation status

Action and Reset	
Action Condition	Pr. U2-01 bit0 is enabled
Action Time	Immediately acts
Warning Setting Parameter	N/A
Reset Method	Automatically resets after the triggered condition is cleared
Reset Condition	Auto-reset
Record	No

Cause	Corrective Actions
There is cavitation inside the pump	Check if the pipe outlet is jammed.

8-3 Fault Codes and Troubleshooting

ID No.	Fault Name	Descriptions
1	Over-current during acceleration (ocA)	Output current exceeds 1.9 times of rated current during acceleration. When ocA occurs, the drive closes the gate of the output immediately, the motor runs freely, and the display shows an ocA error.

Action and Reset	
Action Condition	190% of the rated current
Action Time	Immediately act
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	Reset in 5 sec. after the fault is cleared
Record	Yes

Cause	Corrective Actions
Acceleration time is too short	1. Increase the acceleration time. 2. Increase the acceleration time of S-curve (Pr. C2-08–C2-11) 3. Adjust the accel/decel time (Pr.C2-00–C2-07) 4. Set over-current stall prevention function (Pr. H2-05–H2-07) 5. Replace the drive with a larger capacity model
Short circuit at motor output due to poor insulation wiring	Check the motor cable and remove causes of the short circuits or replace the cable before turning on the power.
Check for possible burnout or aging insulation of the motor	Check the motor insulation value with megger. Replace the motor if the insulation is poor.
The load is too large	Check if the output current during the whole working process exceeds the AC motor drive’s rated current. If yes, replace the AC motor drive with a larger capacity model.
Impulsive change of the load	Reduce the load or increase the capacity of AC motor drive.
Use special motor or motor with larger capacity than the drive	Check the motor capacity (the rated current on the motor’s nameplate should ≤ the rated current of the drive)
Use ON/OFF controller of an electromagnetic contactor at the output (U/V/W) of the drive	Check the action timing of the contactor and make sure it is not turned ON / OFF when the drive outputs the voltage.
V/F curve setting error	Adjust V/F curve setting and frequency/voltage. When the fault occurs, and the frequency voltage is too high, reduce the voltage.
Torque compensation is too large	Adjust the torque compensation (refer to Pr. E0-16 torque compensation gain) until the current reduces and the motor does not stall.
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.
The motor starts when in free run	Enable the speed tracking during start-up of Pr. A3-00.

Cause	Corrective Actions
Improper parameter settings for the speed tracking function (including restart after momentary power loss and restart after fault)	Correct the parameter settings for speed tracking. 1. Start the speed tracking function. 2. Adjust the maximum current for Pr. A3-01 speed tracking.
Incorrect combination of control mode and used motor	Check the settings for Pr. C0-02 control mode: 1. For IM, Pr. C0-02 =0 2. For PM, Pr. C0-02 =1 3. For SynRM, Pr. C0-02 =2
The length of motor cable is too long	Increase AC motor drive's capacity. Install AC reactor(s) on the output side (U/V/W).
Hardware failure	The ocA occurs due to short circuit or ground fault at the output side of the drive. Check for possible short circuits between terminals with the electric meter corresponds to U, V and W. If short circuit occurs, return to the factory for repair.
Check if the setting for stall prevention is correct	Set the stall prevention to the proper value.

ID No.	Fault Name	Descriptions
2	Over-current during deceleration (ocd)	Output current exceeds 1.9 times of rated current during deceleration. When ocd occurs, the drive closes the gate of the output immediately, the motor runs freely, and the display shows an ocd error.

Action and Reset	
Action Condition	190% of the rated current
Action Time	Immediately act
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	Reset in 5 sec. after the fault is cleared
Record	Yes

Cause	Corrective Actions
Deceleration time is too short	1. Increase the deceleration time 2. Increase the deceleration time of S-curve (Pr. C2-08–C2-11) 3. Adjust the accel/decel time (Pr.C2-00–C2-07) 4. Set over-current stall prevention function (Pr. H2-05–H2-07) 5. Replace the drive with a larger capacity model
Check if the mechanical brake of the motor activates too early	Check the action timing of the mechanical brake.
Short circuit at motor output due to poor insulation wiring	Check the motor cable and remove causes of the short circuits or replace the cable before turning on the power.
Check for possible burnout or aging insulation of the motor	Check the motor insulation value with megger. Replace the motor if the insulation is poor.
The load is too large	Check if the output current during the whole working process exceeds the AC motor drive's rated current. If yes, replace the AC motor drive with a larger capacity model.
Impulsive change of the load	Reduce the load or increase the capacity of AC motor drive.
Use special motor or motor with larger capacity than the drive	Check the motor capacity (the rated current on the motor's nameplate should ≤ the rated current of the drive)
Use ON/OFF controller of an electromagnetic contactor at the output (U/V/W) of the drive	Check the action timing of the contactor and make sure it is not turned ON / OFF when the drive outputs the voltage.
V/F curve setting error	Adjust V/F curve setting and frequency/voltage. When the fault occurs, and the frequency voltage is too high, reduce the voltage.
Torque compensation is too large	Adjust the torque compensation (refer to Pr. E0-16 torque compensation gain) until the current reduces and the motor does not stall.
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.
The length of motor cable is too long	Enlarge the AC motor drive's capacity. Install AC reactor(s) on the output side (U/V/W).

Cause	Corrective Actions
Hardware failure	The ocA occurs due to short circuit or ground fault at the output side of the drive. Check for possible short circuits between terminals with the electric meter corresponds to U, V and W. If short circuit occurs, return to the factory for repair.
Check if the setting for stall prevention is correct	Set the stall prevention to the proper value.

ID No.	Fault Name	Descriptions
3	Over-current during steady operation (ocn)	Output current exceeds 1.9 times of rated current at constant speed. When ocn occurs, the drive closes the gate of the output immediately, the motor runs freely, and the display shows an ocn error.
Action and Reset		
Action Condition		190% of the rated current
Action Time		Immediately act
Fault Treatment Parameter		No
Reset Method		Manual reset
Reset Condition		Reset in 5 sec. after the fault is cleared
Record		Yes
Cause		Corrective Actions
Short circuit at motor output due to poor insulation wiring		Check the motor cable and remove causes of the short circuits or replace the cable before turning on the power.
Check for possible shaft lock, burnout, or aging insulation of the motor		Troubleshoot the motor shaft lock. Check the motor insulation value with megger. Replace the motor if the insulation is poor.
Impulsive change of the load		Reduce the load or increase the capacity of AC motor drive.
Use special motor or motor with larger capacity than the drive		Check the motor capacity (the rated current on the motor's nameplate should ≤ the rated current of the drive)
Use ON/OFF controller of an electromagnetic contactor at the output (U/V/W) of the drive		Check the action timing of the contactor and make sure it is not turned ON / OFF when the drive outputs the voltage.
V/F curve setting error		Adjust V/F curve setting and frequency/voltage. When the fault occurs, and the frequency voltage is too high, reduce the voltage.
Torque compensation is too large		Adjust the torque compensation (refer to Pr. E0-16 torque compensation gain) until the current reduces and the motor does not stall.
Malfunction caused by interference		Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.
The length of motor cable is too long		Enlarge the AC motor drive's capacity. Install AC reactor(s) on the output side (U/V/W).
Hardware failure		The ocA occurs due to short circuit or ground fault at the output side of the drive. Check for possible short circuits between terminals with the electric meter corresponds to U, V and W. If short circuit occurs, return to the factory for repair.

ID No.	Fault Name	Descriptions
4	Ground fault (GFF)	When the AC motor drive detects that (one of) the output terminal(s) is grounded and the grounding current is higher than Pr. H2-00 setting value, GFF occurs. **NOTE:** the short circuit protection is provided for AC motor drive protection, not to protect the user.

Action and Reset	
Action Condition	Pr. H2-00 (Default = 60%)
Action Time	No
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	Reset in 5 sec. after the fault is cleared
Record	Yes

Cause	Corrective Actions
Motor burnout or aging insulation occurred	Check the motor insulation value with megger. Replace the motor if the insulation is poor.
Short circuit due to broken cable	Troubleshoot the short circuit. Replace the cable.
Larger stray capacitance of the cable and terminal	If the motor cable length exceeds 100 m, decrease the setting value for carrier frequency. Take remedies to reduce stray capacitance.
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degrees for effective anti-interference performance.
Hardware failure	Cycle the power after checking the status of motor, cable, and cable length. If GFF still exists, return to the factory for repair.

ID No.	Fault Name	Descriptions
5	IGBT short circuit between upper bridge and lower bridge (occ)	Short-circuit is detected between upper bridge and lower bridge of the IGBT module
Action and Reset		
Action Condition		Hardware protection
Action Time		Immediately act
Fault Treatment Parameter		No
Reset Method		Manual reset
Reset Condition		Reset after the fault is cleared
Record		Yes
Cause		Corrective Actions
IGBT error		Check the motor wiring. Cycle the power, if occ still exists, return to the factory for repair.
Short-circuit detecting circuit error		

ID No.	Fault Name	Descriptions
6	Over-current at stop (ocS)	Over-current or hardware failure in current detection at stop. Cycle the power after ocS occurs. If the hardware failure occurs, the display shows cd1, cd2 or cd3.

Action and Reset	
Action Condition	190% of the rated current
Action Time	Immediately act
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	Reset in 5 sec. after the fault is cleared
Record	Yes

Cause	Corrective Actions
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.
Hardware failure	Check if other error code such as cd1–cd3 occur after cycling the power. If yes, return to the factory for repair.

ID No.	Fault Name	Descriptions
7	Over-voltage during acceleration (ovA)	DC bus over-voltage during acceleration. When ovA occurs, the drive closes the gate of the output, the motor runs freely, and the display shows an ovA error.

Action and Reset	
Action Condition	460V models: 820 V_{DC}
Action Time	Immediately acts when DC bus voltage is higher than the condition
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	Reset only when DC bus voltage is lower than 90% of the over-voltage condition
Record	Yes

Cause	Corrective Actions
Acceleration is too slow (e.g., lifting load decreases acceleration time)	Decrease the acceleration time. Replace the drive with a larger capacity model.
The setting for stall prevention condition is smaller than no-load current	The setting for stall prevention condition should be larger than no-load current
Power voltage is too high	Check if the input voltage is within the rated AC motor drive input voltage range, and check for possible voltage spikes.
ON/OFF switch action of phase-in capacitor in the same power system	If the phase-in capacitor or active power supply unit acts in the same power system, the input voltage may surge abnormally in a brief time. In this case, install an AC reactor.
Regenerative voltage of motor inertia	Use over-voltage stall prevention (Pr. H1-08). Use a brake unit or DC bus.
Acceleration time is too short	Check if the over-voltage warning occurs after acceleration stops. When the warning occurs, do the following: 1. Increase the acceleration time. 2. Set Pr. H1-08 over-voltage stall prevention. 3. Increase setting value for Pr. C2-09 S-curve acceleration arrival time 2
Motor ground fault	The ground short circuit current charges the capacitor in the main circuit through the power. Check if there is ground fault on the motor cable, wiring box and its internal terminals. Troubleshoot the ground fault.
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.

ID No.	Fault Name	Descriptions
8	Over-voltage during deceleration (ovd)	DC bus over-voltage during deceleration. When ovd occurs, the drive closes the gate of the output immediately, the motor runs freely, and the display shows an ovd error.

Action and Reset	
Action Condition	460V models: 820 V_{DC}
Action Time	Immediately acts when DC bus voltage is higher than the condition
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	Reset only when DC bus voltage is lower than 90% of the over-voltage condition
Record	Yes

Cause	Corrective Actions
Deceleration time is too short, causing too large regenerative energy of the load	1. Increase the setting values for Pr. C2-01 C2-03, C2-05 and C2-07 (decel. time) 2. Reduce the brake frequency. 3. Replace with a drive with larger capacity. 4. Use S-curve acceleration/deceleration. 5. Use over-voltage stall prevention (Pr. H1-08).
The setting for stall prevention condition is smaller than no-load current	The setting for stall prevention condition should be larger than no-load current
Power voltage is too high	Check if the input voltage is within the rated AC motor drive input voltage range, and check for possible voltage spikes.
ON/OFF switch action of phase-in capacitor in the same power system	If the phase-in capacitor or active power supply unit acts in the same power system, the input voltage may surge abnormally in a brief time. In this case, install an AC reactor.
Motor ground fault	The ground short circuit current charges the capacitor in the main circuit through the power. Check if there is ground fault on the motor cable, wiring box and its internal terminals. Troubleshoot the ground fault.
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.

ID No.	Fault Name	Descriptions
9	Over-voltage at constant speed (ovn)	DC bus over-voltage at constant speed. When ovn occurs, the drive closes the gate of the output immediately, the motor runs freely, and the display shows an ovn error.

Action and Reset	
Action Condition	460V models: 820 V_{DC}
Action Time	Immediately acts when DC bus voltage is higher than the condition
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	Reset only when DC bus voltage is lower than 90% of the over-voltage condition
Record	Yes

Cause	Corrective Actions
Impulsive change of the load	1. Reduce the load. 2. Replace with a drive with larger capacity.
The setting for stall prevention condition is smaller than no-load current	The setting for stall prevention condition should be larger than no-load current
Regenerative voltage of motor inertia	Use over-voltage stall prevention (Pr. H1-08).
Power voltage is too high	Check if the input voltage is within the rated AC motor drive input voltage range, and check for possible voltage spikes.
ON/OFF switch action of phase-in capacitor in the same power system	If the phase-in capacitor or active power supply unit acts in the same power system, the input voltage may surge abnormally in a brief time. In this case, install an AC reactor.
Motor ground fault	The ground short circuit current charges the capacitor in the main circuit through the power. Check if there is ground fault on the motor cable, wiring box and its internal terminals. Troubleshoot the ground fault.
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.

ID No.	Fault Name	Descriptions
10	Over-voltage at stop (ovS)	Over-voltage at stop

Action and Reset	
Action Condition	460V models: 820 V_{DC}
Action Time	Immediately acts when DC bus voltage is higher than the condition
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	Reset only when DC bus voltage is lower than 90% of the over-voltage condition
Record	Yes
Cause	**Corrective Actions**
Power voltage is too high	Check if the input voltage is within the rated AC motor drive input voltage range, and check for possible voltage spikes.
ON/OFF switch action of phase-in capacitor in the same power system	If the phase-in capacitor or active power supply unit acts in the same power system, the input voltage may surge abnormally in a brief time. In this case, install an AC reactor.
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.
Hardware failure in voltage detection	Check if other error code such as cd1–cd3 occur after cycling the power. If yes, return to the factory for repair.
Motor ground fault	The ground short circuit current charges the capacitor in the main circuit through the power. Check if there is ground fault on the motor cable, wiring box and its internal terminals. Troubleshoot the ground fault.

ID No.	Fault Name	Descriptions
11	Low voltage during acceleration (LvA)	DC bus voltage is lower than Pr. H1-02 setting value during acceleration

Action and Reset	
Action Condition	Pr. H1-02 (Default = depending on the models)
Action Time	Immediately act when DC bus voltage is lower than Pr. H1-02
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	It can be reset after the DC bus voltage exceeds the following voltage. 460V models: Pr. H1-02 + 60 V_{DC}
Record	Yes

Cause	Corrective Actions
Power-off	Improve power supply condition.
Power voltage changes	Adjust voltage to the power range of the drive.
Start up the motor with large capacity	Check the power system. Enlarge the capacity of power equipment.
The load is too large	Reduce the load. Enlarge the drive capacity. Increase the acceleration time.

ID No.	Fault Name	Descriptions
12	Low voltage during deceleration (Lvd)	DC bus voltage is lower than Pr. H1-02 setting value during deceleration

Action and Reset	
Action Condition	Pr. H1-02 (Default = depending on the models)
Action Time	Immediately act when DC bus voltage is lower than Pr. H1-02
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	It can be reset after the DC bus voltage exceeds the following voltage. 460V models: Pr. H1-02 + 60 V_{DC}
Record	Yes

Cause	Corrective Actions
Power-off	Improve power supply condition.
Power voltage changes	Adjust voltage to the power range of the drive.
Start up the motor with large capacity	Check the power system. Enlarge the capacity of power equipment.
Sudden load	Reduce the load. Enlarge the drive capacity.

ID No.	Fault Name	Descriptions
13	Low voltage at constant speed (Lvn)	DC bus voltage is lower than Pr. H1-02 setting value at constant speed

Action and Reset	
Action Condition	Pr. H1-02 (Default = depending on the models)
Action Time	Immediately act when DC bus voltage is lower than Pr. H1-02
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	It can be reset after the DC bus voltage exceeds the following voltage. 460V models: Pr. H1-02 + 60 V_{DC}
Record	Yes

Cause	Corrective Actions
Power-off	Improve power supply condition.
Power voltage changes	Adjust voltage to the power range of the drive.
Start up the motor with large capacity	Check the power system. Enlarge the capacity of power equipment.
Sudden load	Reduce the load. Enlarge the drive capacity.

ID No.	Fault Name	Descriptions
15	Phase Loss Protection (OrP)	Phase loss of power input

Action and Reset	
Action Condition	The DC bus ripple is higher than the system allowed range
Action Time	No
Fault Treatment Parameter	Pr. H3-00 (OrP Action) 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time
Reset Method	Automatically resets when Pr. H3-00 = 0 as “Warning” It is “Fault” when Pr. H3-00 = 1–4, which must be reset manually.
Reset Condition	Immediately resets when the DC bus ripple is within the system allowed range.
Record	Records when Pr. H3-00 = 1–4 and OrP displays “Fault”

Cause	Corrective Actions
Phase loss of input power	Correctly install the wiring of the main circuit power.
Single phase power input to three-phase model	Choose the model whose power matches the voltage.
Power voltage changes	If the main circuit power works normally, verify the main circuit. Cycle the power after checking the power, if OrP error still exists, return to the factory for repair.
Loose wiring terminal of input power	Tighten the terminal screws according to the torque described in the user manual.
The input cable of three-phase power is cut off	Wire correctly. Replace the cut off cable.
Input power voltage changes too much	Check if the input power voltage signal fluctuates.
Unbalanced three-phase of input power	Check the power three-phase status.

ID No.	Fault Name	Descriptions
16	IGBT overheating (oH1)	IGBT temperature exceeds the protection level

Action and Reset	
Action Condition	When Pr.H4-00 is higher than the IGBT overheating protection level, oH1 error occurs instead of oH1 warning.
Action Time	IGBT temperature exceeds the protection level for more than 1 second, oH1 error occurs.
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	Resets only when IGBT temperature is lower than the oH1 error level
Record	Yes

Cause	Corrective Actions
Check if the ambient temperature or temperature inside the cabinet is too high, or if there is obstruction in the ventilation hole of the control cabinet.	Check the ambient temperature. Regularly inspect the ventilation hole of the control cabinet. Change the installed place if there are heating objects, such as braking resistors, in the surroundings. Install / add cooling fan or air conditioner to lower the temperature inside the cabinet.
Check if there is any obstruction on the heat sink or if the fan is running	Remove the obstruction or replace the cooling fan.
Insufficient ventilation space	Increase ventilation space of the drive.
Check if the drive matches the corresponded loading.	1. Reduce the load. 2. Decrease the carrier. 3. Replace the drive with a larger capacity model.
The drive has run 100% or more of the rated output for a long time	Replace the drive with a larger capacity model.

ID No.	Fault Name	Descriptions
17	Capacitor overheating (oH2)	The drive has detected the capacitors are overheat and the temperature exceeds Pr. H4-01 warning protection level

Action and Reset	
Action Condition	When Pr.H4-01 is higher than the IGBT overheating protection level, oH2 error occurs instead of oH2 warning.
Action Time	Capacitor temperature exceeds the protection level for more than 1 second, oH2 error occurs.
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	Resets when the capacitor temperature is lower than the oH2 warning
Record	Yes

Cause	Corrective Actions
Check if the ambient temperature or temperature inside the cabinet is too high, or if there is obstruction in the ventilation hole of the control cabinet.	Check the ambient temperature. Regularly inspect the ventilation hole of the control cabinet. Change the installed place if there are heating objects, such as braking resistors, in the surroundings. Install / add cooling fan or air conditioner to lower the temperature inside the cabinet.
Check if there is any obstruction on the heat sink or if the fan is running	Remove the obstruction or replace the cooling fan.
Insufficient ventilation space	Increase ventilation space of the drive.
Check if the drive matches the corresponded loading.	1. Reduce the load. 2. Decrease the carrier. 3. Replace the drive with a larger capacity model.
The drive has run 100% or more of the rated output for a long time	Replace the drive with a larger capacity model.
Unstable power	Install reactor(s).
The load changes frequently	Reduce the changes of the load.

ID No.	Fault Name	Descriptions
18	IGBT temperature detection failure (tH1o)	IGBT hardware failure in temperature detection
Action and Reset		
Action Condition		NTC broken or wiring failure
Action Time		When the IGBT temperature is higher than the protection condition, and detection time exceeds 100 ms, the tH1o protection activates.
Fault Treatment Parameter		No
Reset Method		Manual reset
Reset Condition		Immediately reset
Record		Yes
Cause		Corrective Actions
Hardware failure		Wait for 10 minutes, and then cycle the power. Check if tH1o protection still exists. If yes, return to the factory for repair.

ID No.	Fault Name	Descriptions
19	Capacitor hardware error (tH2o)	Hardware failure in capacitor temperature detection

Action and Reset	
Action Condition	NTC broken or wiring failure
Action Time	When the IGBT temperature is higher than the protection condition, and detection time exceeds 100 ms, the tH2o protection activates.
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	Immediately reset
Record	Yes

Cause	Corrective Actions
Hardware failure	Wait for 10 minutes, and then cycle the power. Check if tH2o protection still exists. If yes, return to the factory for repair.

ID No.	Fault Name	Descriptions
21	Overload (oL)	The AC motor drive detects excessive drive output current. The overload capacity sustains for 1 minute when the drive outputs 110% of the drive's rated output current.

Action and Reset	
Action Condition	Based on overload curve and derating curve
Action Time	When the load is higher than the protection level and exceeds allowable time, the oL protection activates
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	Reset in 5 sec. after the fault is cleared
Record	Yes

Cause	Corrective Actions
The load is too large	Reduce the load.
Accel./Decel. time and working cycle are too short	Increase the setting values for Pr. C2-00–Pr. C2-07 (accel./decel. time)
V/F voltage is too high	Adjust settings for Pr.E0-03–E0-14 (V/F curve). Adjust the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low speed). Refer to the V/F curve selection of Pr. E0-00.
The capacity of the drive is too small	Replace the motor with a larger capacity model.
Overload during low-speed operation	Decrease low-speed operation time. Enlarge the AC motor drive's capacity. Decrease the carrier frequency of Pr. A5-00.
Torque compensation is too large	Adjust the torque compensation (refer to Pr. E0-16 torque compensation gain) until the current reduces and the motor does not stall.
Check if the setting for stall prevention is correct	Set the stall prevention to the proper value.
Output phase loss	Check the status of three-phase motor. Check if the cable is broken or the screws are loose.
Improper parameter settings for speed tracking function (Including restart after momentary power loss and restart after fault)	Correct the parameter settings for speed tracking. Start the speed tracking function. Adjust the maximum current for Pr. A3-01 speed tracking.

ID No.	Fault Name	Descriptions
22	Electronic thermal relay 1 protection (EoL1)	Electronic thermal relay 1 protection. The drive coasts to stop once it activates.

Action and Reset	
Action Condition	Start counting when output current > 100% of motor 1 rated current
Action Time	Pr. H5-09 (if the output current is larger than 100% of motor 1 rated current again within 60 sec., the counting time reduces and is less than Pr. H5-09 setting value)
Fault Treatment Parameter	Pr. H5-10 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time
Reset Method	"Error" occurs when Pr. H5-10 = 1–4. You must reset manually.
Reset Condition	Reset in 5 sec. after the fault is cleared
Record	Records when Pr. H5-10 = 1–4

Cause	Corrective Actions
The load is too large	Reduce the load.
Accel./Decel. time and working cycle are too short	Increase the setting values for Pr. C2-00–Pr. C2-07 (accel./decel. time)
V/F voltage is too high	Adjust settings for Pr.E0-03–E0-14 (V/F curve). Adjust the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low speed).
Overload during low-speed operation When using a general motor, even it operates below rated current, an overload may still occur during low-speed operation.	Decrease low-speed operation time. Change to dedicated motor for the drive. Enlarge the motor capacity.
When using motor drive dedicated motors, Pr. H5-08 = 2 (Constant torque mode)	Pr. H5-08 = 1 (IM1 EoL1 mode = Variable Torque mode).
Incorrect value of electronic thermal relay	Reset to the correct motor rated current.
The maximum motor frequency is set too low	Reset to the correct motor rated frequency.
One drive to multiple motors	Set Pr. H5-08 = 0 (electronic thermal relay selection motor 1= disable) and install thermal relay on each motor.
Check if the setting for stall prevention is correct	Set the stall prevention to the proper value.

Cause	Corrective Actions
Torque compensation is too large	Adjust the torque compensation (refer to Pr. E0-16 torque compensation gain) until the current reduces and the motor does not stall.
Motor fan error	Check the status of the fan or replace the fan.
Unbalance three-phase impedance of the motor	Replace the motor.

ID No.	Fault Name	Descriptions
23	Electronic thermal relay 2 protection (EoL2)	Electronic thermal relay 2 protection. The drive coasts to stop once it activates.
Action and Reset		
Action Condition		Start counting when the output current is > 100% of motor 2 rated current
Action Time		Pr. H5-20 (if the output current is larger than 100% of motor 1 rated current again within 60 sec., the counting time reduces and is less than Pr. H5-20 setting value)
Fault Treatment Parameter		Pr. H5-21 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time
Reset Method		It is “Fault” when Pr. H5-21 = 1–4, which must be reset manually.
Reset Condition		Reset in 5 sec. after the fault is cleared
Record		Records when Pr. H5-21 = 1–4
Cause		Corrective Actions
The load is too large		Reduce the load.
Accel./Decel. time and working cycle are too short		Increase the setting values for Pr. C2-00–Pr. C2-07 (accel./decel. time)
V/F voltage is too high		Adjust settings for Pr.E0-03–E0-14 (V/F curve). Adjust the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low speed).
Overload during low-speed operation When using a general motor, even it operates below rated current, an overload may still occur during low-speed operation.		Decrease low-speed operation time. Change to dedicated motor for the drive. Enlarge the motor capacity.
When using motor drive dedicated motors, Pr. H5-19 = 2 (Constant torque mode)		Pr. H5-19 = 1 (IM2 EoL1 mode = Variable Torque mode).
Incorrect value of electronic thermal relay		Reset to the correct motor rated current.
The maximum motor frequency is set too low		Reset to the correct motor rated frequency.
One drive to multiple motors		Set Pr. H5-19 = 0 (IM2 EoL1 mode= disable) and install thermal relay on each motor.

Cause	Corrective Actions
Check if the setting for stall prevention is correct	Set the stall prevention to the proper value.
Torque compensation is too large	Adjust the torque compensation (refer to Pr. E0-16 torque compensation gain) until the current reduces and the motor does not stall.
Motor fan error	Check the status of the fan or replace the fan.
Unbalance three-phase impedance of the motor	Replace the motor.

ID No.	Fault Name	Descriptions
24_1	Motor overheating (oH3) PTC	Motor overheating (PTC) (Pr. H6-03 = 1 PTC), when PTC input > Pr. H6-07 setting value, the fault treatment acts according to Pr. H6-09.

Action and Reset	
Action Condition	PTC input value > Pr.H6-09 setting (Default = 50%)
Action Time	Immediately act
Fault Treatment Parameter	Fault treatment: Pr. H6-09 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time
Reset Method	It is “Warning” when Pr. H6-09 = 0, which will be automatically reset It is “Fault” when Pr. H6-09 = 1–4, which must be reset manually.
Reset Condition	Immediately reset
Record	Records when Pr. H6-09 = 1–4 and oH3 displays “Fault”

Cause	Corrective Actions
Motor locked	Clear the motor lock status.
The load is too large	Reduce the load. Enlarge the motor capacity.
Ambient temperature is too high	Change the installed place if there are heating devices in the surroundings. Install / add cooling fan or air conditioner to lower the ambient temperature.
Motor cooling system error	Check the cooling system to make it work normally.
Motor fan error	Replace the fan.
Operates at low speed too long	Decrease low-speed operation time. Change to dedicated motor for the drive. Enlarge the motor capacity.
Accel./Decel. time and working cycle are too short	Increase the setting values for Pr. C2-00–Pr. C2-07 (accel./decel. time)
V/F voltage is too high	Adjust settings for Pr.E0-03–E0-14 (V/F curve). Adjust the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low speed).
Check if the motor rated current matches that on the motor nameplate	Reset to the correct motor rated current.
Check if the PTC is properly set and wired	Check the connection between PTC thermistor resistor and the heat protection.
Check if the setting for stall prevention is correct	Set the stall prevention to the proper value.
Unbalance three-phase impedance of the motor	Replace the motor.
Harmonics is too high	Use remedies to reduce harmonics.

ID No.	Fault Name	Descriptions
24_2	Motor overheating (oH3) KTY84	Motor overheating (KTY84) (Pr. H6-03 = 2 KTY84), when KTY84 temperature is > Pr. H6-07 setting value, the fault treatment acts according to Pr. H6-09.
Action and Reset		
Action Condition		KTY84 temperature > Pr.06-07 setting
Action Time		Immediately act
Fault Treatment Parameter		Pr. H6-09 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time
Reset Method		When Pr. H6-09 = 0 and when the temperature is < Pr. H6-07 level, the oH3 is automatically cleared. It is “Fault” when Pr. H6-09 = 1–4, which must be reset manually.
Reset Condition		Immediately reset
Record		Records when Pr. H6-09 = 1–4 and oH3 displays “Fault”
Cause		Corrective Actions
Motor locked		Clear the motor lock status.
The load is too large		Reduce the load. Enlarge the motor capacity.
Ambient temperature is too high		Change the installed place if there are heating devices in the surroundings. Install / add cooling fan or air conditioner to lower the ambient temperature.
Motor cooling system error		Check the cooling system to make it work normally.
Motor fan error		Replace the fan.
Operates at low speed too long		Decrease low-speed operation time. Change to dedicated motor for the drive. Enlarge the motor capacity.
Accel./Decel. time and working cycle are too short		Increase the setting values for Pr. C2-00–Pr. C2-07 (accel./decel. time)
V/F voltage is too high		Adjust settings for Pr.E0-03–E0-14 (V/F curve). Adjust the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low speed).
Check if the motor rated current matches that on the motor nameplate		Reset to the correct motor rated current.
Check if the KTY84 is properly set and wired		Check the connection between PTC thermistor resistor and the heat protection.
Check if the setting for stall prevention is correct		Set the stall prevention to the proper value.

Cause	Corrective Actions
Unbalance three-phase impedance of the motor	Replace the motor.
Harmonics is too high	Use remedies to reduce harmonics.

ID No.	Fault Name	Descriptions
24_3	Motor overheating (oH3) PT100	Motor overheating (PT100) (Pr. H6-03 = 3 PT100), when PT100 temperature is > Pr. H6-07 setting value, the fault treatment acts according to Pr. H6-09.

Action and Reset	
Action Condition	PT100 temperature > Pr.06-07 setting
Action Time	Immediately act
Fault Treatment Parameter	Pr. H6-09 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time
Reset Method	When Pr. H6-09 = 0 and when the temperature is < Pr. H6-07 level, the oH3 is automatically cleared. It is “Fault” when Pr. H6-09 = 1–4, which must be reset manually.
Reset Condition	Immediately reset
Record	Records when Pr. H6-09 = 1–4 and oH3 displays “Fault”

Cause	Corrective Actions
Motor locked	Clear the motor lock status.
The load is too large	Reduce the load. Enlarge the motor capacity.
Ambient temperature is too high	Change the installed place if there are heating devices in the surroundings. Install / add cooling fan or air conditioner to lower the ambient temperature.
Motor cooling system error	Check the cooling system to make it work normally.
Motor fan error	Replace the fan.
Operates at low speed too long	Decrease low-speed operation time. Change to dedicated motor for the drive. Enlarge the motor capacity.
Accel./Decel. time and working cycle are too short	Increase the setting values for Pr. C2-00–Pr. C2-07 (accel./decel. time)
V/F voltage is too high	Adjust settings for Pr.E0-03–E0-14 (V/F curve). Adjust the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low speed).
Check if the motor rated current matches that on the motor nameplate	Reset to the correct motor rated current.
Check if the PT100 is properly set and wired	Check the connection between PT100 thermistor resistor and the heat protection.
Check if the setting for stall prevention is correct	Set the stall prevention to the proper value.

Cause	Corrective Actions
Unbalance three-phase impedance of the motor	Replace the motor.
Harmonics is too high	Use remedies to reduce harmonics.

ID No.	Fault Name	Descriptions
24_4	Motor overheating (oH3) PT1000	Motor overheating (PT1000) (Pr. H6-03 = 4 PT1000), when PT1000 temperature is > Pr. H6-07 setting value, the fault treatment acts according to Pr. H6-09.

Action and Reset	
Action Condition	PT1000 temperature > Pr.06-07 setting
Action Time	Immediately act
Fault Treatment Parameter	Pr. H6-09 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time
Reset Method	When Pr. H6-09 = 0 and when the temperature is < Pr. H6-07 level, the oH3 is automatically cleared. It is “Fault” when Pr. H6-09 = 1–4, which must be reset manually.
Reset Condition	Immediately reset
Record	Records when Pr. H6-09 = 1–4 and oH3 displays “Fault”

Cause	Corrective Actions
Motor locked	Clear the motor lock status.
The load is too large	Reduce the load. Enlarge the motor capacity.
Ambient temperature is too high	Change the installed place if there are heating devices in the surroundings. Install / add cooling fan or air conditioner to lower the ambient temperature.
Motor cooling system error	Check the cooling system to make it work normally.
Motor fan error	Replace the fan.
Operates at low speed too long	Decrease low-speed operation time. Change to dedicated motor for the drive. Enlarge the motor capacity.
Accel./Decel. time and working cycle are too short	Increase the setting values for Pr. C2-00–Pr. C2-07 (accel./decel. time)
V/F voltage is too high	Adjust settings for Pr.E0-03–E0-14 (V/F curve). Adjust the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low speed).
Check if the motor rated current matches that on the motor nameplate	Reset to the correct motor rated current.
Check if the PT1000 is properly set and wired	Check the connection between PT1000 thermistor resistor and the heat protection.
Check if the setting for stall prevention is correct	Set the stall prevention to the proper value.

Cause	Corrective Actions
Unbalance three-phase impedance of the motor	Replace the motor.
Harmonics is too high	Use remedies to reduce harmonics.

ID No.	Fault Name	Descriptions
25	Interrupt error (INTR)	MCU firmware error
Action and Reset		
Action Condition		Firmware detection
Action Time		Immediately act
Fault Treatment Parameter		No
Reset Method		Automatically reset after cycling the power
Reset Condition		No
Record		Yes
Cause		Corrective Actions
Firmware error		Cycle the power, if the fault still exists, contact Delta.

ID No.	Fault Name	Descriptions	
26	Over-torque 1 (ot1)	When output current exceeds the over-torque detection level (Pr. H5-04) and exceeds over-torque detection time (Pr. H5-05), and when Pr.H5-00 is set to 1–4, the ot1 error displays.	
Action and Reset			
Action Condition		Pr. H5-04	
Action Time		Pr. H5-05	
Fault Treatment Parameter		Pr. H5-00 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time	
Reset Method		Auto	When Pr. H5-00 = 0, ot1 is “Warning”. The ot1 warning automatically clears when the output current is < (Pr. H5-04 × 95%)
		Manual	“Error” occurs when Pr. H5-00 = 1–4. You must reset manually.
Reset Condition		Immediately reset	
Record		Records when Pr. H5-00 = 1–4, ot1 is “Fault”	
Cause		Corrective Actions	
Incorrect parameter setting		Reset Pr. H5-04 and Pr. H5-05.	
Mechanical failure (e.g., over-torque, mechanical lock)		Remove the causes of malfunction.	
The load is too large		Reduce the load. Replace the motor with a larger capacity model.	
Accel./Decel. time and working cycle are too short		Increase the setting values for Pr. C2-00–Pr. C2-07 (accel./decel. time)	
V/F voltage is too high		Adjust settings for Pr.E0-03–E0-14 (V/F curve). Adjust the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low speed).	
The motor capacity is too small		Replace the motor with a larger capacity model.	
Overload during low-speed operation		Decrease low-speed operation time. Enlarge the motor capacity.	
Torque compensation is too large		Adjust the torque compensation (refer to Pr. E0-16 torque compensation gain) until the current reduces and the motor does not stall.	
Improper parameter settings for speed tracking function (Including restart after momentary power loss and restart after fault)		Correct the parameter settings for speed tracking. Start the speed tracking function. Adjust the maximum current for Pr. A3-01 speed tracking.	

ID No.	Fault Name	Descriptions
27	Over-torque 2 (ot2)	When in the constant speed, the output current exceeds the over-torque detection level (Pr. H5-06) and exceeds over-torque detection time (Pr. H5-07), and when Pr.H5-02 is set to 1–4, the ot2 error displays.

Action and Reset		
Action Condition	Pr. H5-06	
Action Time	Pr. H5-07	
Fault Treatment Parameter	Pr. H5-02 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time	
Reset Method	Auto	When Pr. H5-00 = 0, ot2 is “Warning”. The ot2 warning automatically clears when the output current is < (Pr. H5-06 × 95%)
	Manual	It is “Fault” when Pr. H5-02 = 1–4, which must be reset manually.
Reset Condition	Immediately reset	
Record	Records when Pr. H5-00 = 1–4, ot2 is “Fault”	

Cause	Corrective Actions
Incorrect parameter setting	Reset Pr. H5-15 and Pr. H5-16.
Mechanical failure (e.g., over-torque, mechanical lock)	Remove the causes of malfunction.
The load is too large	Reduce the load. Replace the motor with a larger capacity model.
Accel./Decel. time and working cycle are too short	Increase the setting values for Pr. C2-00–Pr. C2-07 (accel./decel. time)
V/F voltage is too high	Adjust settings for Pr.E0-03–E0-14 (V/F curve). Adjust the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low speed).
The motor capacity is too small	Replace the motor with a larger capacity model.
Overload during low-speed operation	Decrease low-speed operation time. Enlarge the motor capacity.
Torque compensation is too large	Adjust the torque compensation (refer to Pr. E0-16 torque compensation gain) until the current reduces and the motor does not stall.
Improper parameter settings for speed tracking function (Including restart after momentary power loss and restart after fault)	Correct the parameter settings for speed tracking. Start the speed tracking function. Adjust the maximum current for Pr. A3-01 speed tracking.

<table>
<tr><th>ID No.</th><th>Fault Name</th><th colspan="2">Descriptions</th></tr>
<tr><td>28</td><td>Under current
(uC)</td><td colspan="2">Low current</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action Condition</td><td colspan="2">H2-12</td></tr>
<tr><td colspan="2">Action Time</td><td colspan="2">H2-13</td></tr>
<tr><td colspan="2">Fault Treatment Parameter</td><td colspan="2">H2-14
0: Warning & continue OPER
1: Fault & Ramp to Stop
2: Fault & Auto-Decel
3: Fault & coast to stop
4: Fault & by Quick Stop Time</td></tr>
<tr><td colspan="2" rowspan="2">Reset Method</td><td>Auto</td><td>“Warning” occurs when Pr. H2-14 = 0. The “Warning” is automatically cleared when the output current is > (Pr. H2-12 × 105%).</td></tr>
<tr><td>Manual</td><td>“Error” occurs when Pr. H2-14 = 1–4. You must reset manually.</td></tr>
<tr><td colspan="2">Reset Condition</td><td colspan="2">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">Records when Pr. H2-14 = 1–4 and uC displays “Fault”</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Motor cable disconnection</td><td colspan="2">Troubleshoot the connection between the motor and the load.</td></tr>
<tr><td colspan="2">Improper setting of low-current protection</td><td colspan="2">Reset Pr. H2-12, Pr. H2-13, and Pr. H2-14 to proper settings.</td></tr>
<tr><td colspan="2">The load is too low</td><td colspan="2">Check the load status.
Make sure the motor capacity matches the load.</td></tr>
</table>

ID No.	Fault Name	Descriptions
30	EEPROM write error (cF1)	Internal EEPROM cannot be programmed
Action and Reset		
Action Condition		When the firmware detects failure of parameter EEPROM write in, the cF1 fault occurs.
Action Time		cF1 acts immediately when the drive detects the fault
Fault Treatment Parameter		No
Reset Method		Manual reset
Reset Condition		Immediately reset
Record		Yes
Cause		Corrective Actions
Internal EEPROM write in error		Press RESET key or reset the parameter to the default setting, if cF1 still exists, return to the factory for repair. Reset parameters to default. If cF1 still exists, return to the factory for repair. Cycle the power, if cF1 still exists, return to the factory for repair.

ID No.	Fault Name	Descriptions
31	EEPROM read error (cF2)	Internal EEPROM cannot be read

Action and Reset	
Action Condition	When the firmware detects parameter data error, the cF2 fault occurs.
Action Time	cF2 acts immediately when the drive detects the fault
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	Immediately reset
Record	Yes
Cause	**Corrective Actions**
Parameter EEPROM cannot be read	Press RESET key or reset the parameter to the default setting, if cF1 still exists, return to the factory for repair. Reset parameters to default. If cF2 still exists, return to the factory for repair. Cycle the power, if cF2 still exists, return to the factory for repair.

ID No.	Fault Name	Descriptions
33	U-phase error (cd1)	U-phase current detection error when power is ON

Action and Reset	
Action Condition	Hardware detection
Action Time	cd1 acts immediately when the drive detects the fault
Fault Treatment Parameter	No
Reset Method	Power-off
Reset Condition	No
Record	Yes

Cause	Corrective Actions
Hardware failure	Cycle the power If the fault still exists, return to the factory for repair.

ID No.	Fault Name	Descriptions
34	V-phase error (cd2)	V-phase current detection error when power is ON

Action and Reset	
Action Condition	Hardware detection
Action Time	cd2 acts immediately when the drive detects the fault
Fault Treatment Parameter	No
Reset Method	Power-off
Reset Condition	No
Record	Yes

Cause	Corrective Actions
Hardware failure	Cycle the power If the fault still exists, return to the factory for repair.

ID No.	Fault Name	Descriptions
35	W-phase error (cd3)	W-phase current detection error when power is ON

Action and Reset	
Action Condition	Hardware detection
Action Time	cd3 acts immediately when the drive detects the fault
Fault Treatment Parameter	No
Reset Method	Power-off
Reset Condition	No
Record	Yes

Cause	Corrective Actions
Hardware failure	Cycle the power If the fault still exists, return to the factory for repair.

ID No.	Fault Name	Descriptions
37	occc hardware error (Hd1)	Protection error of oc hardware protection circuit when power is ON

Action and Reset	
Action Condition	Hardware detection
Action Time	Hd1 acts immediately when the drive detects the fault
Fault Treatment Parameter	No
Reset Method	Power-off
Reset Condition	No
Record	Yes

Cause	Corrective Actions
Hardware failure	Cycle the power If the fault still exists, return to the factory for repair.

ID No.	Fault Name	Descriptions
39	occ hardware error (Hd3)	Protection error of occ IGBT short-circuit detection when power is ON
Action and Reset		
Action Condition		Hardware detection
Action Time		Hd3 acts immediately when the drive detects the fault
Fault Treatment Parameter		No
Reset Method		Power-off
Reset Condition		No
Record		Yes
Cause		Corrective Actions
Hardware failure		Cycle the power If the fault still exists, return to the factory for repair.

ID No.	Fault Name	Descriptions
40	Auto-tuning error (AUE)	The motor autotune process does not complete.
Action and Reset		
Action Condition		Software detection
Action Time		Immediately act
Fault Treatment Parameter		No
Reset Method		Manual reset
Reset Condition		Immediately reset
Record		Yes
Cause		Corrective Actions
The motor auto-tune process does not complete.		Execute the auto-tune process again to ensure the process is complete.
Incorrect settings for the motor parameter		Verify the settings of parameter group d are correct.
Motor wiring is incorrect		Check if the motor wiring is correct.
Motor error		Check if the motor works normally.
The motor U/V/W wire is abnormal		Check if the wire is broken.
The electromagnetic contactor is ON at output side (U/V/W) of the drive		Make sure the electromagnetic valve is OFF.

<table>
<tr><th>ID No.</th><th>Fault Name</th><th colspan="2">Descriptions</th></tr>
<tr><td>48</td><td>AI1 Loss
(ACE)</td><td colspan="2">Analog input current loss (including all analog 4–20mA signals)</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action Condition</td><td colspan="2">When the analog input (Pr. G2-03 = 2) is lower than 3.6 mA (only detects analog input 4–20 mA)</td></tr>
<tr><td colspan="2">Action Time</td><td colspan="2">The action condition is attained for 0.1s</td></tr>
<tr><td colspan="2">Fault Treatment Parameter</td><td colspan="2">G2-11
AI1 signal loss action:
0: Disable
1: Warning & continue OPER
2: Fault & Ramp to Stop
3: Fault & Auto-Decel
4: Fault & Coast to Stop
5: Fault & by Quick Stop Time
6: Warning & FREQ Lower Limit OPER</td></tr>
<tr><td colspan="2" rowspan="2">Reset Method</td><td>Auto</td><td>It is “Warning” when Pr. G2-11 = 1, and the warning will be automatically cleared when the analog input signal is ≥ 4 mA.</td></tr>
<tr><td>Manual</td><td>It is “Fault” when Pr. G2-11 = 2–5, which must be reset manually.</td></tr>
<tr><td colspan="2">Reset Condition</td><td colspan="2">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">It is “Fault” when Pr. G2-11 = 2–5 and will be recorded.</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Loose or broken AI1 wiring</td><td colspan="2">Tighten the terminals again.
Replace with a new cable.</td></tr>
<tr><td colspan="2">External device error</td><td colspan="2">Replace new device.</td></tr>
<tr><td colspan="2">Hardware failure</td><td colspan="2">If the ACE error still occurs after checking all the wiring, return to the factory for repair.</td></tr>
</table>

ID No.	Fault Name	Descriptions
49	External Fault (EF) (EF)	External fault. When the drive decelerates based on the setting of Pr. A1-33, the EF fault displays on the keypad.
Action and Reset		
Action Condition		Pr. A1-32 = 2–7, 10–15 and the MI terminal is ON
Action Time		Immediately act
Fault Treatment Parameter		Pr. A1-33 0: Coast to stop 1: Ramp to stop 2: By EF decel Time 3: Auto-Decel
Reset Method		Manual reset
Reset Condition		Manual reset only after the external fault is cleared (terminal status is recovered)
Record		Yes
Cause		Corrective Actions
External fault		Press RESET key after the fault is cleared.

ID No.	Fault Name	Descriptions
50	Emergency stop (EF1)	When the contact of MIx = EF1 is ON, the output stops immediately and displays EF1 on the keypad. The motor is in free running.

Action and Reset	
Action Condition	Pr. A2-03 = 2–7, 10–15 and the MI terminal is ON
Action Time	Immediately act
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	Manual reset only after the external fault is cleared (terminal status is recovered)
Record	Yes

Cause	Corrective Actions
Emergency stop	Verify if the system is back to normal condition, and then press RESET key to go back to the default.

ID No.	Fault Name	Descriptions
52	Password is locked (Pcod)	Entering the wrong password three consecutive times
Action and Reset		
Action Condition		Entering the wrong password three consecutive times
Action Time		Immediately act
Fault Treatment Parameter		No
Reset Method		Manual reset
Reset Condition		Power-off
Record		Yes
Cause		Corrective Actions
Incorrect password input through Pr. b0-02		1. Input the correct password after rebooting the motor drive. 2. If you forget the password, input 9999 and press ENTER, and repeat it again. (You need to finish the above process within 10 seconds. If you do not finish it within 10 seconds, try again.) 3. The parameter settings return to the default when the "Input 9999" process is finished.

ID No.	Fault Name	Descriptions
58	Modbus transmission time-out occurs (CE10)	Modbus transmission time-out occurs

Action and Reset	
Action Condition	When the communication time exceeds the detection time for Pr. n1-04 time-out
Action Time	Setting for Pr. n1-04.
Fault Treatment Parameter	Setting for Pr. n1-05. 0: Continue OPER 1: Warning & continue OPER 2: Fault & Ramp to Stop 3: Fault & coast to stop
Reset Method	Manual reset
Reset Condition	Immediately reset
Record	Yes

Cause	Corrective Actions
The upper unit does not transmit the communication command within Pr. n1-04 setting time	Check if the upper unit transmits the communication command within the setting time for Pr. n1-04.
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degrees for effective anti-interference performance.
Different communication setting from upper unit	Check if the setting for Pr. n1-03 is the same as the setting for the upper unit.
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.

ID No.	Fault Name	Descriptions
61	Y-connection / D-connection switch error (ydc)	An error occurs when Y-D switches

Action and Reset	
Action Condition	1. ydc occurs when the confirmation signals of Y-connection and D-connection are conducted at the same time 2. If any of confirmation signals is not conducted within the setting time for Pr. d0-04, ydc occurs.
Action Time	Pr. d0-04
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	Can be reset only when the confirmation signal of Y-connection is conducted if it is Y-connection, or when the confirmation signal of D-connection is conducted if it is D-connection.
Record	Yes

Cause	Corrective Actions
The electromagnetic valve operates incorrectly during Y-D switch	Check if the electromagnetic valve works normally. If not, replace it.
Incorrect parameter setting	Check if related parameters are all set up and set correctly.
The wiring of Y-D switch function is incorrect	Check the wiring.

<table>
<tr><th>ID No.</th><th>Fault Name</th><th colspan="2">Descriptions</th></tr>
<tr><td>63</td><td>Over slip
(oSL)</td><td colspan="2">On the basis of the maximum slip limit set via Pr. H5-50, the speed deviation is abnormal. When the motor drive outputs at constant speed, F > H or F < H exceeds the level set via Pr. H5-54, and it exceeds the time set via Pr. H5-55, oSL shows. oSL occurs in induction motors only.</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action Condition</td><td colspan="2">When the drive outputs at constant speed, and F > H or F < H exceeds the Pr. H5-54 level</td></tr>
<tr><td colspan="2">Action Time</td><td colspan="2">H5-55</td></tr>
<tr><td colspan="2">Fault Treatment Parameter</td><td colspan="2">H5-48
0: Warning & continue OPER
1: Fault & Ramp to Stop
2: Fault & Auto-Decel
3: Fault & coast to stop
4: Fault & by Quick Stop Time</td></tr>
<tr><td colspan="2" rowspan="2">Reset Method</td><td>Auto</td><td>When Pr. H5-48 = 0, oSL is “Warning”.
When the drive outputs at constant speed, and F > H or F < H exceeds the Pr. H5-54 level, oSL warning will be cleared automatically.</td></tr>
<tr><td>Manual</td><td>“Error” occurs when Pr. H5-48 = 1–4, oSL is “Fault”. You must reset manually.</td></tr>
<tr><td colspan="2">Reset Condition</td><td colspan="2">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">Records when Pr. H5-48 = 1–4, oSL is “Fault”</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Any of the motor parameters in parameter group 5 may be incorrect</td><td colspan="2">Check the motor parameter.</td></tr>
<tr><td colspan="2">The load is too large</td><td colspan="2">Reduce the loading.</td></tr>
<tr><td colspan="2">Check if Pr. H5-54, Pr. H5-55, and Pr. H5-48 are properly set.</td><td colspan="2">Check the parameter settings for oSL protection.</td></tr>
</table>

ID No.	Fault Name	Descriptions
68	Reverse direction of the speed feedback (SdRv)	Rotating direction is different from the commanding direction detected by the sensorless
Action and Reset		
Action Condition		Software detection
Action Time		Pr. H8-06
Fault Treatment Parameter		Pr. H8-07 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time
Reset Method		Manual reset
Reset Condition		Immediately reset
Record		Records when Pr. H8-07 = 1–4, SdRv is "Fault"
Cause		Corrective Actions
Improper setting of the FOC speed observer bandwidth		Decrease setting value for Pr. H0-00.
The setting of motor parameter is incorrect		Reset the motor parameter and execute parameter tuning
The motor cable is abnormal or broken		Check if the cable is well functioned or replace the cable
A reverse force is exerted, or the motor runs in a reverse direction at start		Start speed tracking function (Pr. A3-00)
Malfunction caused by interference		Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.

ID No.	Fault Name	Descriptions
69	Over speed rotation feedback (SdOr)	Over speed rotation detected by sensorless

Action and Reset	
Action Condition	Pr. H8-03
Action Time	Pr. H8-04
Fault Treatment Parameter	Pr. H8-05 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time
Reset Method	Manual reset
Reset Condition	Immediately reset
Record	Records when Pr. H8-05 = 1–4, SdOr is "Fault"

Cause	Corrective Actions
Improper setting of the IMFOC speed observer bandwidth	Decrease setting value for Pr. F0-00.
The setting of ASR bandwidth of speed controller is improper	Increase the bandwidth of ASR speed controller
The setting of motor parameter is incorrect	Reset the motor parameter and execute parameter tuning
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.

ID No.	Fault Name	Descriptions
70	Large deviation of speed feedback (SdDe)	A large deviation between the rotating speed and the command detected by the sensorless

Action and Reset	
Action Condition	Pr. H8-00
Action Time	H8-01
Fault Treatment Parameter	H8-02 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time
Reset Method	Manual reset
Reset Condition	Immediately reset
Record	Records when Pr. H8-02 = 1–4, SdDe is “Fault”

Cause	Corrective Actions
Improper parameter setting for abnormal rotating slip function	Reset proper setting for Pr. H8-00 and Pr. H8-01.
Improper parameter setting for ASR and acceleration/deceleration	Reset ASR parameters. Set proper acceleration/deceleration time.
The acceleration/deceleration time is too short	Reset proper acceleration / deceleration time.
Motor shaft locked	Remove causes of the motor shaft lock.
The mechanical brake is not released	Verify the system action timeline.
Incorrect parameter setting for torque limit (Pr. C4-10–C4-14, F2-16–F2-19)	Adjust the setting to proper value
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.

ID No.	Fault Name	Descriptions
71	Watchdog (WDTT)	Controller Watchdog calculation time-out detection error

Action and Reset	
Action Condition	Hardware detection
Action Time	No
Fault Treatment Parameter	No
Reset Method	Hardware failure and cannot be reset. Cycle the power.
Reset Condition	No
Record	Yes

Cause	Corrective Actions
Controller calculation time-out	Cycle the power. If the fault still exists, contact Delta.

ID No.	Fault Name	Descriptions
72	STO Loss 1 (STL1)	STO1–SCM1 internal loop detection error
Action and Reset		
Action Condition		Hardware detection
Action Time		Immediately act
Fault Treatment Parameter		No
Reset Method		Hardware failure and cannot be reset. Cycle the power.
Reset Condition		No
Record		Yes
Cause		Corrective Actions
STO1 and SCM1 short circuit lines are not connected		Connect the short circuit line.
Hardware failure		Make sure all the wiring is correct and cycle the power. If the STL1 still exists, return to the factory for repair.

ID No.	Fault Name	Descriptions
76	Safe torque off (STO)	Safety Torque Off function activates

Action and Reset	
Action Condition	Hardware detection
Action Time	Immediately act
Fault Treatment Parameter	Pr. H0-11 0: STO Fault 1: Fault at Run; Warning at Stop 2: STO Warning 3: No STO Display at Stop
Reset Method	Pr. H0-14 = 0, manually reset. Pr. H0-14 = 1, auto reset
Reset Condition	Channel 1 and Channel 2 return to no action level
Record	Yes

Cause	Corrective Actions
The switch action of STO1/SCM1 and STO2/SCM2 (OPEN)	Check whether the wiring and upper unit function output is correct.

ID No.	Fault Name	Descriptions
77	STO Loss 2 (STL2)	STO2–SCM2 internal loop detection error
Action and Reset		
Action Condition		Hardware detection
Action Time		Immediately act
Fault Treatment Parameter		No
Reset Method		Hardware failure and cannot be reset. Cycle the power.
Reset Condition		No
Record		Yes
Cause		Corrective Actions
STO2 and SCM2 short circuit lines are not connected		Connect the short circuit line.
Hardware failure		Make sure all the wiring is correct and cycle the power. If the STL2 still exists, return to the factory for repair.

ID No.	Fault Name	Descriptions
79	Safe torque off 1 (STO1)	The action time difference between Channel 1 and Channel 2 are too large and Channel 1 activates.

Action and Reset	
Action Condition	There is action time difference between two channels
Action Time	Pr. H0-12
Fault Treatment Parameter	Pr. H0-11 0: STO Fault 1: Fault at Run; Warning at Stop 2: STO Warning 3: No STO Display at Stop
Reset Method	Pr. H0-14 = 0, manually reset. Pr. H0-14 = 1, auto reset
Reset Condition	Channel 1 and Channel 2 return to no action level
Record	Yes
Cause	**Corrective Actions**
Channel external appliance problems	1. Check whether Channel 1 and Channel 2 use appliance as input, and whether there is time difference in the appliance action time; replace the appliance with the same action time. 2. Check whether the appliance is broken.

<table>
<tr><th>ID No.</th><th>Fault Name</th><th>Descriptions</th></tr>
<tr><td>80</td><td>Safe torque off 2
(STO2)</td><td>The action time difference between Channel 1 and Channel 2 are too large and Channel 2 activates.</td></tr>
<tr><th colspan="3">Action and Reset</th></tr>
<tr><td colspan="2">Action Condition</td><td>There is action time difference between two channels</td></tr>
<tr><td colspan="2">Action Time</td><td>Pr. H0-12</td></tr>
<tr><td colspan="2">Fault Treatment Parameter</td><td>Pr. H0-11
0: STO Fault
1: Fault at Run; Warning at Stop
2: STO Warning
3: No STO Display at Stop</td></tr>
<tr><td colspan="2">Reset Method</td><td>Pr. H0-14 = 0, manually reset.
Pr. H0-14 = 1, auto reset</td></tr>
<tr><td colspan="2">Reset Condition</td><td>Channel 1 and Channel 2 return to no action level</td></tr>
<tr><td colspan="2">Record</td><td>Yes</td></tr>
<tr><th colspan="2">Cause</th><th>Corrective Actions</th></tr>
<tr><td colspan="2">Channel external appliance problems</td><td>1. Check whether Channel 1 and Channel 2 use appliance as input, and whether there is time difference in the appliance action time; replace the appliance with the same action time.
2. Check whether the appliance is broken.</td></tr>
</table>

ID No.	Fault Name	Descriptions
82	Output phase loss U phase (OPHL)	U phase output phase loss

Action and Reset	
Action Condition	Pr. H3-02
Action Time	Pr. H3-03 Pr. H3-04: When enabling the output phase loss detection function before starting, the confirmation time is half of this time, and the parameter H3-03 is only used in normal operation
Fault Treatment Parameter	Pr. H3-05 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time
Reset Method	Manual reset
Reset Condition	Immediately reset
Record	Records when Pr. H3-05 ≠ 0, H3-05 is “Fault”

Cause	Corrective Actions
Unbalance three-phase impedance of the motor	Replace the motor.
Check if the wiring is incorrect	Check the cable. Replace the cable.
Check if the motor is a single-phase motor	Choose a three-phase motor.
Check if the current sensor is broken	Check if the control board cable is loose. If yes, reconnect the cable and run the drive to test. If the error still occurs, return to the factory for repair. Check if the three-phase current is balanced with a current clamp meter. If the current is balanced and the OPHL error still shows on the display, return to the factory for repair.
If capacity of the drive is larger than the motor	Choose the matches capacity of the drive and motor.

ID No.	Fault Name	Descriptions
83	Output phase loss V phase (OPHL)	V phase output phase loss
Action and Reset		
Action Condition		Pr. H3-02
Action Time		Pr. H3-03 Pr. H3-04: When enabling the output phase loss detection function before starting, the confirmation time is half of this time, and the parameter H3-03 is only used in normal operation
Fault Treatment Parameter		Pr. H3-05 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time
Reset Method		Manual reset
Reset Condition		Immediately reset
Record		Records when Pr. H3-05 ≠ 0, H3-05 is "Fault"
Cause		Corrective Actions
Unbalance three-phase impedance of the motor		Replace the motor.
Check if the wiring is incorrect		Check the cable. Replace the cable.
Check if the motor is a single-phase motor		Choose a three-phase motor.
Check if the current sensor is broken		Check if the control board cable is loose. If yes, reconnect the cable and run the drive to test. If the error still occurs, return to the factory for repair. Check if the three-phase current is balanced with a current clamp meter. If the current is balanced and the OPHL error still shows on the display, return to the factory for repair.
If capacity of the drive is larger than the motor		Choose the matches capacity of the drive and motor.

ID No.	Fault Name	Descriptions
84	Output phase loss W phase (OPHL)	W phase output phase loss

Action and Reset	
Action Condition	Pr. H3-02
Action Time	Pr. H3-03 Pr. H3-04: When enabling the output phase loss detection function before starting, the confirmation time is half of this time, and the parameter H3-03 is only used in normal operation
Fault Treatment Parameter	Pr. H3-05 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time
Reset Method	Manual reset
Reset Condition	Immediately reset
Record	Records when Pr. H3-05 ≠ 0, H3-05 is “Fault”

Cause	Corrective Actions
Unbalance three-phase impedance of the motor	Replace the motor.
Check if the wiring is incorrect	Check the cable. Replace the cable.
Check if the motor is a single-phase motor	Choose a three-phase motor.
Check if the current sensor is broken	Check if the control board cable is loose. If yes, reconnect the cable and run the drive to test. If the error still occurs, return to the factory for repair. Check if the three-phase current is balanced with a current clamp meter. If the current is balanced and the OPHL error still shows on the display, return to the factory for repair.
If capacity of the drive is larger than the motor	Choose the matches capacity of the drive and motor.

ID No.	Fault Name	Descriptions
87	Overload protection at low frequency (oL3)	Low frequency and high current protection
Action and Reset		
Action Condition		Software detection
Action Time		Immediately act
Fault Treatment Parameter		No
Reset Method		Manual reset
Reset Condition		Immediately reset
Record		Yes
Cause		Corrective Actions
Power module overload		1. Reduce the motor drive's load. 2. Decrease the carrier frequency (Pr. A5-00). 3. Decrease the ambient temperature of the drive's operation. 4. Decrease the current limit. 5. Choose motor drives with lager power. 6. Increase the acceleration time. 7. If the drive is in V/F mode, decrease the output voltage for low-frequency operation.

ID No.	Fault Name	Descriptions
88	Model ID change (IDCH)	A fault occurs due to power board ID change
Action and Reset		
Action Condition		Software detection
Action Time		Immediately act
Fault Treatment Parameter		No
Reset Method		Manual reset
Reset Condition		Immediately reset
Record		Yes
Cause		Corrective Actions
Hardware ID circuit error		Cycle the power after manually reset, If the fault still exists, return to the factory for repair.
Model ID error		Check if the model name matches with Pr. A0-00 (refer to description in Section 1-1) and cycle the power after manually reset. If the fault still exists, return to the factory for repair.

ID No.	Fault Name	Descriptions
89	Rotor position detection error (RoPd)	Rotor position detection error protection
Action and Reset		
Action Condition		Software detection
Action Time		Immediately act
Fault Treatment Parameter		No
Reset Method		Manual reset
Reset Condition		Immediately reset
Record		Yes
Cause		Corrective Actions
The motor cable is abnormal or broken		Check if the cable is well functioned or replace the cable
Motor coil error		Replace the motor.
Hardware failure		IGBT broken. Return to the factory for repair.
Drive's current feedback line error		Cycle the power. If RoPd still occurs during operation, return to the factory for repair.

ID No.	Fault Name	Descriptions
94	Initializing power board communication error when power ON (POCF)	Initializing power board communication error when power ON
Action and Reset		
Action Condition		The initializing process cannot complete the communication detection when power ON
Action Time		Immediately act
Fault Treatment Parameter		No
Reset Method		Auto-reset
Reset Condition		Communication recovers
Record		Yes
Cause		Corrective Actions
Malfunction caused by interference		Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.
Hardware failure		Check if other error code occurs after cycling the power. If yes, return to the factory for repair.

ID No.	Fault Name	Descriptions
95	Board identification error during power-on initialization (IDDE)	Board identification error during power-on initialization
Action and Reset		
Action Condition		Internal identification error
Action Time		Immediately act
Fault Treatment Parameter		No
Reset Method		No
Reset Condition		No
Record		Yes
Cause		Corrective Actions
Hardware failure		Check if other error code occurs after cycling the power. If yes, return to the factory for repair.

ID No.	Fault Name	Descriptions
96	Power board communication error (PMCF)	Power board communication error
Action and Reset		
Action Condition		Internal communication time-out
Action Time		Immediately act
Fault Treatment Parameter		No
Reset Method		Auto-reset
Reset Condition		Communication recovers
Record		Yes
Cause		Corrective Actions
Malfunction caused by interference		Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.
Hardware failure		Check if other error code occurs after cycling the power. If yes, return to the factory for repair.

<table>
<tr><th>ID No.</th><th>Fault Name</th><th colspan="3">Descriptions</th></tr>
<tr><td>97</td><td>AI2 Loss
(ACE)</td><td colspan="3">Analog input current loss (including all analog 4–20mA signals)</td></tr>
<tr><th colspan="5">Action and Reset</th></tr>
<tr><td colspan="2">Action Condition</td><td colspan="3">When the analog input (Pr. G2-22 = 2) is lower than 3.6 mA (only detects analog input 4–20 mA)</td></tr>
<tr><td colspan="2">Action Time</td><td colspan="3">The action condition is attained for 0.1s</td></tr>
<tr><td colspan="2">Fault Treatment Parameter</td><td colspan="3">G2-30
AI2 signal loss action:
0: Disable
1: Warning & continue OPER
2: Fault & Ramp to Stop
3: Fault & Auto-Decel
4: Fault & Coast to Stop
5: Fault & by Quick Stop Time
6: Warning & FREQ Lower Limit OPER</td></tr>
<tr><td colspan="2" rowspan="2">Reset Method</td><td>Auto</td><td colspan="2">It is “Warning” when Pr. G2-30 = 1, and the warning will be automatically cleared when the analog input signal is ≥ 4 mA.</td></tr>
<tr><td>Manual</td><td colspan="2">It is "Fault” when Pr. G6-30 = 2–5, which must be reset manually.</td></tr>
<tr><td colspan="2">Reset Condition</td><td colspan="3">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="3">It is “Fault” when Pr. G2-30 = 2–5 and will be recorded.</td></tr>
<tr><th colspan="2">Cause</th><th colspan="3">Corrective Actions</th></tr>
<tr><td colspan="2">Loose or broken AI2 wiring</td><td colspan="3">Tighten the terminals again.
Replace with a new cable.</td></tr>
<tr><td colspan="2">External device error</td><td colspan="3">Replace new device.</td></tr>
<tr><td colspan="2">Hardware failure</td><td colspan="3">If the ACE error still occurs after checking all the wiring, return to the factory for repair.</td></tr>
</table>

<table>
<tr><th>ID No.</th><th>Fault Name</th><th colspan="2">Descriptions</th></tr>
<tr><td>98</td><td>AI3 loss
(ACE)</td><td colspan="2">Analog input current loss (including all analog 4–20mA signals)</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action Condition</td><td colspan="2">When the analog input (Pr. G2-41 = 2) is lower than 3.6 mA (only detects analog input 4–20 mA)</td></tr>
<tr><td colspan="2">Action Time</td><td colspan="2">The action condition is attained for 0.1s</td></tr>
<tr><td colspan="2">Fault Treatment Parameter</td><td colspan="2">Pr. G2-49
AI3 signal loss action:
0: Disable
1: Warning & continue OPER
2: Fault & Ramp to Stop
3: Fault & Auto-Decel
4: Fault & Coast to Stop
5: Fault & by Quick Stop Time
6: Warning & FREQ Lower Limit OPER</td></tr>
<tr><td colspan="2" rowspan="2">Reset Method</td><td>Auto</td><td>It is “Warning” when Pr. G2-49 = 1, and the warning will be automatically cleared when the analog input signal is ≥ 4 mA.</td></tr>
<tr><td>Manual</td><td>It is "Fault” when Pr. G6-49 = 2–5, which must be reset manually.</td></tr>
<tr><td colspan="2">Reset Condition</td><td colspan="2">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">It is “Fault” when Pr. G2-49 = 2–5 and will be recorded.</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Loose or broken AI3 wiring</td><td colspan="2">Tighten the terminals again.
Replace with a new cable.</td></tr>
<tr><td colspan="2">External device error</td><td colspan="2">Replace new device.</td></tr>
<tr><td colspan="2">Hardware failure</td><td colspan="2">If the ACE error still occurs after checking all the wiring, return to the factory for repair.</td></tr>
</table>

ID No.	Fault Name	Descriptions	
99	AI10 loss (ACE)	Analog input current loss (including all analog 4–20mA signals)	
Action and Reset			
Action Condition		When the analog input (Pr. G6-02 = 2) is lower than 3.6 mA (only detects analog input 4–20 mA)	
Action Time		The action condition is attained for 0.1s	
Fault Treatment Parameter		G6-10 AI10 signal loss action: 0: Disable 1: Warning & continue OPER 2: Fault & Ramp to Stop 3: Fault & Auto-Decel 4: Fault & Coast to Stop 5: Fault & by Quick Stop Time 6: Warning & FREQ Lower Limit OPER	
Reset Method		Auto	It is “Warning” when Pr. G6-10 = 1, and the warning will be automatically cleared when the analog input signal is ≥ 4 mA.
		Manual	It is "Fault” when Pr. G6-10 = 2–5, which must be reset manually.
Reset Condition		Immediately reset	
Record		It is “Fault” when Pr. G6-10 = 2–5 and will be recorded.	
Cause		Corrective Actions	
Loose or broken AI10 wiring		Tighten the terminals again. Replace with a new cable.	
External device error		Replace new device.	
Hardware failure		If the ACE error still occurs after checking all the wiring, return to the factory for repair.	

<table>
<tr><th>ID No.</th><th>Fault Name</th><th colspan="2">Descriptions</th></tr>
<tr><td>100</td><td>AI11 Loss
(ACE)</td><td colspan="2">Analog input current loss (including all analog 4–20mA signals)</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action Condition</td><td colspan="2">When the analog input (Pr. G6-16 = 2) is lower than 3.6 mA (only detects analog input 4–20 mA)</td></tr>
<tr><td colspan="2">Action Time</td><td colspan="2">The action condition is attained for 0.1s</td></tr>
<tr><td colspan="2">Fault Treatment Parameter</td><td colspan="2">Pr. G6-22
AI11 signal loss action:
0: Disable
1: Warning & continue OPER
2: Fault & Ramp to Stop
3: Fault & Auto-Decel
4: Fault & Coast to Stop
5: Fault & by Quick Stop Time
6: Warning & FREQ Lower Limit OPER</td></tr>
<tr><td colspan="2" rowspan="2">Reset Method</td><td>Auto</td><td>It is “Warning” when Pr. G6-22 = 1, and the warning will be automatically cleared when the analog input signal is ≥ 4 mA.</td></tr>
<tr><td>Manual</td><td>It is "Fault” when Pr. G6-22 = 2–5, which must be reset manually.</td></tr>
<tr><td colspan="2">Reset Condition</td><td colspan="2">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">It is “Fault” when Pr. G6-22 = 2–5 and will be recorded.</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Loose or broken AI11 wiring</td><td colspan="2">Tighten the terminals again.
Replace with a new cable.</td></tr>
<tr><td colspan="2">External device error</td><td colspan="2">Replace new device.</td></tr>
<tr><td colspan="2">Hardware failure</td><td colspan="2">If the ACE error still occurs after checking all the wiring, return to the factory for repair.</td></tr>
</table>

ID No.	Fault Name	Descriptions
101	CANopen guarding error (CGdE)	CANopen guarding error

Action and Reset	
Action Condition	When CANopen Node Guarding detects that one of the slaves does not response, the CGdE fault will activate. The upper unit sets factor and time during configuration.
Action Time	The time that upper unit sets during configuration
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	The upper unit sends a reset package to clear this fault.
Record	Yes

Cause	Corrective Actions
The guarding time is too short, or less detection times	Increase the guarding time (Index 100C) and detection times.
Malfunction caused by interference	1. Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degrees for effective anti-interference performance. 2. Make sure the communication circuit is wired in series. 3. Use CANopen cable or add terminating resistance.
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.

ID No.	Fault Name	Descriptions
102	CANopen heartbeat error (CHbE)	CANopen heartbeat error
Action and Reset		
Action Condition		When CANopen Heartbeat detects that one of the slaves does not response, the CHbE fault activates. The upper unit sets the confirming time of producer and consumer during configuration.
Action Time		The upper unit sets the confirming time of producer and consumer during configuration.
Fault Treatment Parameter		No
Reset Method		Manual reset
Reset Condition		The upper unit sends a reset package to clear this fault.
Record		Yes
Cause		Corrective Actions
The heartbeat time is too short		Increase heartbeat time (Index 100C).
Malfunction caused by interference		1. Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degrees for effective anti-interference performance. 2. Make sure the communication circuit is wired in series. 3. Use CANopen cable or add terminating resistance.
Disconnection or bad connection of the cable		Check the cable and replace it if necessary.

ID No.	Fault Name	Descriptions	
104	CANopen bus off error (CbFE)	CANopen bus off error	
Action and Reset			
Action Condition		Hardware	When CANopen card is not installed, CbFE fault will occur
		Software	When the master received wrong communication package, CbFE fault occurs. Too much interference on BUS. When the CAN_H and CAN_L communication cable is short, the master will receive wrong package, and CbFE fault occurs.
Action Time		Immediately act	
Fault Treatment Parameter		No	
Reset Method		Manual reset	
Reset Condition		Cycle the power	
Record		Yes	
Cause		Corrective Actions	
Check if the CANopen card is installed		Make sure the CANopen card is installed.	
Check if the CANopen speed is correct		Reset CANopen speed (Pr. n2-02).	
Malfunction caused by interference		1. Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degrees for effective anti-interference performance. 2. Make sure the communication circuit is wired in series. 3. Use CANopen cable or add terminating resistance.	
Disconnection or bad connection of the cable		4. Check the cable and replace it if necessary.	

ID No.	Fault Name	Descriptions
114	ECAP models over voltage (ECOV)	ECAP models detect that the internal DC bus over-voltage

Action and Reset	
Action Condition	820 V_{DC}
Action Time	Immediately acts when DC bus voltage is higher than the condition
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	Reset only when DC bus voltage is lower than 90% of the over-voltage condition
Record	Yes

Cause	Corrective Actions
Impulsive change of the load	1. Reduce the load. 2. Replace with a drive with larger capacity.
The setting for stall prevention condition is smaller than no-load current	The setting for stall prevention condition should be larger than no-load current
Regenerative voltage of motor inertia	Use over-voltage stall prevention (Pr. H1-08).
Power voltage is too high	Check if the input voltage is within the rated AC motor drive input voltage range, and check for possible voltage spikes.
ON/OFF switch action of phase-in capacitor in the same power system	If the phase-in capacitor or active power supply unit acts in the same power system, the input voltage may surge abnormally in a brief time. In this case, install an AC reactor.
Motor ground fault	The ground short circuit current charges the capacitor in the main circuit through the power. Check if there is ground fault on the motor cable, wiring box and its internal terminals. Troubleshoot the ground fault.
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.

ID No.	Fault Name	Descriptions
115	ECAP models low voltage (ECLV)	ECAP models detect that the internal DC bus voltage is lower than Pr. H1-04

Action and Reset	
Action Condition	H1-04
Action Time	Immediately act when DC bus voltage is lower than Pr. H1-04
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	DC bus voltage is larger than Pr. H1-04
Record	Yes

Cause	Corrective Actions
Power-off	Improve power supply condition.
Power voltage changes	Adjust voltage to the power range of the drive.
Start up the motor with large capacity	Check the power system. Enlarge the capacity of power equipment.
The load is too large	Reduce the load. Enlarge the drive capacity. Increase the acceleration time.

ID No.	Fault Name	Descriptions
118	Monitor signal 1 trigger (BX1e)	Sets the monitor signal source o2-01 according to the trigger condition, and the monitoring signal meets the trigger condition.
Action and Reset		
Action Condition		Meet Pr. o2-02 trigger condition
Action Time		Immediately act
Fault Treatment Parameter		Pr. o2-03 0: Disable 1: Warning 2: Fault and ramp stop 3: Fault and coast stop
Reset Method		Manual reset
Reset Condition		Does not meet Pr. o2-02 trigger condition
Record		Records when Pr. o2-03 = 2 or 3
Cause		Corrective Actions
Incorrect settings that trigger the protection		Check if the setting for o2-01, o2-02 and o2-03 is correct.

ID No.	Fault Name	Descriptions
119	Monitor signal 2 trigger (BX2e)	Sets the monitor signal source o2-08 according to the trigger condition, and the monitoring signal meets the trigger condition.
Action and Reset		
Action Condition		Meet Pr. o2-09 trigger condition
Action Time		Immediately act
Fault Treatment Parameter		Pr. o2-10 0: Disable 1: Warning 2: Fault and ramp stop 3: Fault and coast stop
Reset Method		Manual reset
Reset Condition		Does not meet Pr. o2-09 trigger condition
Record		Records when Pr. o2-10 = 2 or 3
Cause		Corrective Actions
Incorrect settings that trigger the protection		Check if the setting for o2-08, o2-09 and o2-10 is correct.

ID No.	Fault Name	Descriptions
120	Monitor signal 3 trigger (BX3e)	Sets the monitor signal source o2-15 according to the trigger condition, and the monitoring signal meets the trigger condition.
Action and Reset		
Action Condition		Meet Pr. o2-16 trigger condition
Action Time		Immediately act
Fault Treatment Parameter		Pr. o2-17 0: Disable 1: Warning 2: Fault and ramp stop 3: Fault and coast stop
Reset Method		Manual reset
Reset Condition		Does not meet Pr. o2-16 trigger condition
Record		Records when Pr. o2-17 = 2 or 3
Cause		Corrective Actions
Incorrect settings that trigger the protection		Check if the setting for o2-15, o2-16 and o2-17 is correct.

ID No.	Fault Name	Descriptions
121	Monitor signal 4 trigger (BX4e)	Sets the monitor signal source o2-22 according to the trigger condition, and the monitoring signal meets the trigger condition.
Action and Reset		
Action Condition		Meet Pr. o2-23 trigger condition
Action Time		Immediately act
Fault Treatment Parameter		Pr. o2-24 0: Disable 1: Warning 2: Fault and ramp stop 3: Fault and coast stop
Reset Method		Manual reset
Reset Condition		Does not meet Pr. o2-23 trigger condition
Record		Records when Pr. o2-24 = 2 or 3
Cause		Corrective Actions
Incorrect settings that trigger the protection		Check if the setting for o2-22, o2-23 and o2-24 is correct.

ID No.	Fault Name	Descriptions
122	Monitor signal 5 trigger (BX5e)	Sets the monitor signal source o2-29 according to the trigger condition, and the monitoring signal meets the trigger condition.

Action and Reset	
Action Condition	Meet Pr. o2-30 trigger condition
Action Time	Immediately act
Fault Treatment Parameter	Pr. o2-31 0: Disable 1: Warning 2: Fault and ramp stop 3: Fault and coast stop
Reset Method	Manual reset
Reset Condition	Does not meet Pr. o2-30 trigger condition
Record	Records when Pr. o2-31 = 2 or 3
Cause	**Corrective Actions**
Incorrect settings that trigger the protection	Check if the setting for o2-29, o2-30 and o2-31 is correct.

ID No.	Fault Name	Descriptions
123	Monitor signal 6 trigger (BX6e)	Sets the monitor signal source o2-36 according to the trigger condition, and the monitoring signal meets the trigger condition.
Action and Reset		
Action Condition		Meet Pr. o2-37 trigger condition
Action Time		Immediately act
Fault Treatment Parameter		Pr. o2-38 0: Disable 1: Warning 2: Fault and ramp stop 3: Fault and coast stop
Reset Method		Manual reset
Reset Condition		Does not meet Pr. o2-37 trigger condition
Record		Records when Pr. o2-38 = 2 or 3
Cause		Corrective Actions
Incorrect settings that trigger the protection		Check if the setting for o2-36, o2-37 and o2-38 is correct.

ID No.	Fault Name	Descriptions
124	Monitor signal 7 trigger (BX7e)	Sets the monitor signal source o2-43 according to the trigger condition, and the monitoring signal meets the trigger condition.

Action and Reset	
Action Condition	Meet Pr. o2-44 trigger condition
Action Time	Immediately act
Fault Treatment Parameter	Pr. o2-45 0: Disable 1: Warning 2: Fault and ramp stop 3: Fault and coast stop
Reset Method	Manual reset
Reset Condition	Does not meet Pr. o2-44 trigger condition
Record	Records when Pr. o2-45 = 2 or 3
Cause	**Corrective Actions**
Incorrect settings that trigger the protection	Check if the setting for o2-43, o2-44 and o2-45 is correct.

ID No.	Fault Name	Descriptions
125	Monitor signal 8 trigger (BX8e)	Sets the monitor signal source o2-50 according to the trigger condition, and the monitoring signal meets the trigger condition.
Action and Reset		
Action Condition		Meet Pr. o2-51 trigger condition
Action Time		Immediately act
Fault Treatment Parameter		Pr. o2-52 0: Disable 1: Warning 2: Fault and ramp stop 3: Fault and coast stop
Reset Method		Manual reset
Reset Condition		Does not meet Pr. o2-51 trigger condition
Record		Records when Pr. o2-52 = 2 or 3
Cause		Corrective Actions
Incorrect settings that trigger the protection		Check if the setting for o2-50, o2-51 and o2-52 is correct.

ID No.	Fault Name	Descriptions
132	Under load protection (ULD)	The load does not operate according to the user defined loading curve and triggers under load protection.
Action and Reset		
Action Condition		The loading condition is lower than Pr. H7-15 L/F underload curve or Pr. H7-19–H7-28 Underload L/F Frequency Set
Action Time		Pr. H7-18
Fault Treatment Parameter		Pr. H7-16 0: Warning & continue OPER 1: Fault & Ramp to Stop 2: Fault & Auto-Decel 3: Fault & coast to stop 4: Fault & by Quick Stop Time
Reset Method		Manual reset
Reset Condition		Immediately reset
Record		Yes
Cause		Corrective Actions
Incorrect settings that trigger the protection		Check if Pr. H7-15 or H7-19–H7-28 is set properly.

ID No.	Fault Name	Descriptions
133	Overload protection (OLD)	The load is higher than the user defined loading curve and triggers overload protection.
Action and Reset		
Action Condition		The loading condition is higher than Pr. H7-01 L/F overload curve or Pr. H7-05–H7-14 Overload L/F Frequency Set
Action Time		Pr. H7-04
Fault Treatment Parameter		Pr. H7-02 0: Warning & continue OPER 1: Fault & ramp to stop 2: Fault & auto-decel 3: Fault & Coast to stop 4: Fault & by Quick stop time
Reset Method		Manual reset
Reset Condition		Immediately reset
Record		Yes
Cause		Corrective Actions
Incorrect settings that trigger the protection		Check if Pr. H7-01 or H7-05–H7-14 is set properly.

ID No.	Fault Name	Descriptions
134	Electronic thermal relay 3 protection (EoL3)	Electronic thermal relay 3 protection. The drive coasts to stop once it activates.
Action and Reset		
Action Condition		Start counting when output current > 100% of motor 3 rated current
Action Time		Pr. H5-31 (if the output current is larger than 100% of motor 3 rated current again within 60 sec., the counting time reduces and is less than Pr. H5-31 setting value)
Fault Treatment Parameter		Pr. H5-32 0: Warning & continue OPER 1: Fault & ramp to stop 2: Fault & auto-decel 3: Fault & Coast to stop 4: Fault & by Quick stop time
Reset Method		"Error" occurs when Pr. H5-32 = 1–4. You must reset manually.
Reset Condition		Reset in 5 sec. after the fault is cleared
Record		Records when Pr. H5-32 = 1–4
Cause		Corrective Actions
The load is too large		Reduce the load.
Accel./Decel. time and working cycle are too short		Increase the setting values for Pr. C2-00–Pr. C2-07 (accel./decel. time)
V/F voltage is too high		Adjust settings for Pr.E0-03–E0-14 (V/F curve). Adjust the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low speed).
Overload during low-speed operation When using a general motor, even it operates below rated current, an overload may still occur during low-speed operation.		Decrease low-speed operation time. Change to dedicated motor for the drive. Enlarge the motor capacity.
When using motor drive dedicated motors, Pr. H5-30 = 2 (Constant torque mode)		Pr. H5-30 = 1 (IM3 EoL1 mode = Variable Torque mode).
Incorrect value of electronic thermal relay		Reset to the correct motor rated current.
The maximum motor frequency is set too low		Reset to the correct motor rated frequency.
One drive to multiple motors		Set Pr. H5-30 = 0 (IM3 EoL1 mode= disable) and install thermal relay on each motor.

Cause	Corrective Actions
Check if the setting for stall prevention is correct	Set the stall prevention to the proper value.
Torque compensation is too large	Adjust the torque compensation (refer to Pr. E0-16 torque compensation gain) until the current reduces and the motor does not stall.
Motor fan error	Check the status of the fan or replace the fan.
Unbalance three-phase impedance of the motor	Replace the motor.

ID No.	Fault Name	Descriptions
135	Electronic thermal relay 4 protection (EoL4)	Electronic thermal relay 4 protection. The drive coasts to stop once it activates.

Action and Reset	
Action Condition	Start counting when output current > 100% of motor 1 rated current
Action Time	Pr. H5-42 (if the output current is larger than 100% of motor 1 rated current again within 60 sec., the counting time reduces and is less than Pr. H5-42 setting value)
Fault Treatment Parameter	Pr. H5-43 0: Warning & continue OPER 1: Fault & ramp to stop 2: Fault & auto-decel 3: Fault & Coast to stop 4: Fault & by Quick stop time
Reset Method	“Error” occurs when Pr. H5-43 = 1–4. You must reset manually.
Reset Condition	Reset in 5 sec. after the fault is cleared
Record	Records when Pr. H5-43 = 1–4

Cause	Corrective Actions
The load is too large	Reduce the load.
Accel./Decel. time and working cycle are too short	Increase the setting values for Pr. C2-00–Pr. C2-07 (accel./decel. time)
V/F voltage is too high	Adjust settings for Pr.E0-03–E0-14 (V/F curve). Adjust the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low speed).
Overload during low-speed operation When using a general motor, even it operates below rated current, an overload may still occur during low-speed operation.	Decrease low-speed operation time. Change to dedicated motor for the drive. Enlarge the motor capacity.
When using motor drive dedicated motors, Pr. H5-43 = 2 (Constant torque mode)	Pr. H5-43 = 1 (IM4 EoL1 mode = Variable Torque mode).
Incorrect value of electronic thermal relay	Reset to the correct motor rated current.
The maximum motor frequency is set too low	Reset to the correct motor rated frequency.
One drive to multiple motors	Set Pr. H5-43 = 0 (IM4 EoL1 mode= disable) and install thermal relay on each motor.

Cause	Corrective Actions
Check if the setting for stall prevention is correct	Set the stall prevention to the proper value.
Torque compensation is too large	Adjust the torque compensation (refer to Pr. E0-16 torque compensation gain) until the current reduces and the motor does not stall.
Motor fan error	Check the status of the fan or replace the fan.
Unbalance three-phase impedance of the motor	Replace the motor.

ID No.	Fault Name	Descriptions
142	Auto-tune error (AUE1)	DC test error while motor parameter auto-tuning

Action and Reset	
Action Condition	Software detection
Action Time	Immediately act
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	Immediately reset
Record	Yes

Cause	Corrective Actions
Incorrect settings for the motor parameter	Verify the settings of parameter group d are correct.
Motor wiring is incorrect	Check if the motor wiring is correct.
Motor error	Check if the motor works normally.
The motor U/V/W wire is abnormal	Check if the wire is broken.
The electromagnetic contactor is ON at output side (U/V/W) of the drive	Make sure the electromagnetic valve is OFF.

ID No.	Fault Name	Descriptions
143	Auto-tune error (AUE2)	Rotating state measuring error while motor parameter auto-tuning

Action and Reset	
Action Condition	Software detection
Action Time	Immediately act
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	Immediately reset
Record	Yes

Cause	Corrective Actions
Incorrect settings for the motor parameter	Verify the settings of parameter group d are correct.
Motor wiring is incorrect	Check if the motor wiring is correct.
Motor error	Check if the motor works normally.
The motor U/V/W wire is abnormal	Check if the wire is broken.
The electromagnetic contactor is ON at output side (U/V/W) of the drive	Make sure the electromagnetic valve is OFF.
Motor does not operate correctly	Check whether the measurement of the motor rotation state cannot be performed correctly due to the coupled load.

ID No.	Fault Name	Descriptions
144	Auto-tune error (AUE3)	Rs measuring error during motor auto-tune.
Action and Reset		
Action Condition		Software detection
Action Time		Immediately act
Fault Treatment Parameter		No
Reset Method		Manual reset
Reset Condition		Immediately reset
Record		Yes
Cause		Corrective Actions
Incorrect settings for the motor parameter		Verify the settings of parameter group d are correct.
Motor wiring is incorrect		Check if the motor wiring is correct.
Motor error		Check if the motor works normally.
The motor U/V/W wire is abnormal		Check if the wire is broken.
The electromagnetic contactor is ON at output side (U/V/W) of the drive		Make sure the electromagnetic valve is OFF.

ID No.	Fault Name	Descriptions
148	Auto-tune error (AUE4)	Rr measuring error during motor auto-tune.

Action and Reset	
Action Condition	Software detection
Action Time	Immediately act
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	Immediately reset
Record	Yes

Cause	Corrective Actions
Incorrect settings for the motor parameter	Verify the settings of parameter group d are correct.
Motor wiring is incorrect	Check if the motor wiring is correct.
Motor error	Check if the motor works normally.
The motor U/V/W wire is abnormal	Check if the wire is broken.
The electromagnetic contactor is ON at output side (U/V/W) of the drive	Make sure the electromagnetic valve is OFF.

ID No.	Fault Name	Descriptions
149	Auto-tune error (AUE5)	IM Lx measuring error during motor auto-tune.

Action and Reset	
Action Condition	Software detection
Action Time	Immediately act
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	Immediately reset
Record	Yes

Cause	Corrective Actions
Incorrect settings for the motor parameter	Verify the settings of parameter group d are correct.
Motor wiring is incorrect	Check if the motor wiring is correct.
Motor error	Check if the motor works normally.
The motor U/V/W wire is abnormal	Check if the wire is broken.
The electromagnetic contactor is ON at output side (U/V/W) of the drive	Make sure the electromagnetic valve is OFF.

ID No.	Fault Name	Descriptions
150	Auto-tune error (AUE6)	IM no-load current (I_0) measuring error during motor auto-tune.

Action and Reset	
Action Condition	Software detection
Action Time	Immediately act
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	Immediately reset
Record	Yes

Cause	Corrective Actions
Incorrect settings for the motor parameter	Verify the settings of parameter group d are correct.
Motor wiring is incorrect	Check if the motor wiring is correct.
Motor error	Check if the motor works normally.
The motor U/V/W wire is abnormal	Check if the wire is broken.
The electromagnetic contactor is ON at output side (U/V/W) of the drive	Make sure the electromagnetic valve is OFF.

ID No.	Fault Name	Descriptions
151	Auto-tune error (AUE7)	IM Lm measuring error during motor auto-tune.

Action and Reset	
Action Condition	Software detection
Action Time	Immediately act
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	Immediately reset
Record	Yes
Cause	**Corrective Actions**
Incorrect settings for the motor parameter	Verify the settings of parameter group d are correct.
Motor wiring is incorrect	Check if the motor wiring is correct.
Motor error	Check if the motor works normally.
The motor U/V/W wire is abnormal	Check if the wire is broken.
The electromagnetic contactor is ON at output side (U/V/W) of the drive	Make sure the electromagnetic valve is OFF.

ID No.	Fault Name	Descriptions
152	Auto-tune error (AUE8)	High-frequency testing error during motor auto-tune.

Action and Reset	
Action Condition	Software detection
Action Time	Immediately act
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	Immediately reset
Record	Yes

Cause	Corrective Actions
Incorrect settings for the motor parameter	Verify the settings of parameter group d are correct.
Motor wiring is incorrect	Check if the motor wiring is correct.
Motor error	Check if the motor works normally.
The motor U/V/W wire is abnormal	Check if the wire is broken.
The electromagnetic contactor is ON at output side (U/V/W) of the drive	Make sure the electromagnetic valve is OFF.

ID No.	Fault Name	Descriptions
153	Auto-tune error (AUE9)	PM Ld measuring error during motor auto-tune.

Action and Reset	
Action Condition	Software detection
Action Time	Immediately act
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	Immediately reset
Record	Yes

Cause	Corrective Actions
Incorrect settings for the motor parameter	Verify the settings of parameter group d are correct.
Motor wiring is incorrect	Check if the motor wiring is correct.
Motor error	Check if the motor works normally.
The motor U/V/W wire is abnormal	Check if the wire is broken.
The electromagnetic contactor is ON at output side (U/V/W) of the drive	Make sure the electromagnetic valve is OFF.

ID No.	Fault Name	Descriptions
154	Auto-tuning error (AUEa)	PM Lq measuring error during motor auto-tune.

Action and Reset	
Action Condition	Software detection
Action Time	Immediately act
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	Immediately reset
Record	Yes

Cause	Corrective Actions
Incorrect settings for the motor parameter	Verify the settings of parameter group d are correct.
Motor wiring is incorrect	Check if the motor wiring is correct.
Motor error	Check if the motor works normally.
The motor U/V/W wire is abnormal	Check if the wire is broken.
The electromagnetic contactor is ON at output side (U/V/W) of the drive	Make sure the electromagnetic valve is OFF.

ID No.	Fault Name	Descriptions
155	Auto-tuning error (AUEb)	PM inductance measuring error during motor auto-tune.

Action and Reset	
Action Condition	Software detection
Action Time	Immediately act
Fault Treatment Parameter	No
Reset Method	Manual reset
Reset Condition	Immediately reset
Record	Yes

Cause	Corrective Actions
Incorrect settings for the motor parameter	Verify the settings of parameter group d are correct.
Motor wiring is incorrect	Check if the motor wiring is correct.
Motor error	Check if the motor works normally.
The motor U/V/W wire is abnormal	Check if the wire is broken.
The electromagnetic contactor is ON at output side (U/V/W) of the drive	Make sure the electromagnetic valve is OFF.

ID No.	Fault Name	Descriptions
156	Auto-tuning error (AUEc)	PM inductance meter measuring error during motor auto-tune.
Action and Reset		
Action Condition		Software detection
Action Time		Immediately act
Fault Treatment Parameter		No
Reset Method		Manual reset
Reset Condition		Immediately reset
Record		Yes
Cause		Corrective Actions
Incorrect settings for the motor parameter		Verify the settings of parameter group d are correct.
Motor wiring is incorrect		Check if the motor wiring is correct.
Motor error		Check if the motor works normally.
The motor U/V/W wire is abnormal		Check if the wire is broken.
The electromagnetic contactor is ON at output side (U/V/W) of the drive		Make sure the electromagnetic valve is OFF.

ID No.	Fault Name	Descriptions
213	Protection initialization error (ThIF)	Protection initialization error
Action and Reset		
Action Condition		Initialization detection error
Action Time		Immediately act
Fault Treatment Parameter		No
Reset Method		No
Reset Condition		No
Record		Yes
Cause		Corrective Actions
Hardware failure		Check if other error code occurs after cycling the power. If yes, return to the factory for repair.

ID No.	Fault Name	Descriptions
214	Power-on process initialization time-out (POTO)	Power-on process initialization time-out
Action and Reset		
Action Condition		Initialization detection time-out
Action Time		Immediately act
Fault Treatment Parameter		No
Reset Method		No
Reset Condition		No
Record		Yes
Cause		Corrective Actions
Malfunction caused by interference		Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.
Hardware failure		Check if other error code occurs after cycling the power. If yes, return to the factory for repair.

ID No.	Fault Name	Descriptions
300	Large amount leakage error (LEKE)	Triggers when detecting large amount water leakage

Action and Reset	
Action Condition	The feedback pressure is lower than Plow and the load current is larger than Pr. U3-03 setting Plow = [Target pressure × (1 – Pr. U3-01%)]
Action Time	Pr. U3-02
Fault Treatment Parameter	Pr. U3-04 1: Fault and coast to stop 2: Fault & ramp to stop
Reset Method	Manual reset
Reset Condition	When the drive output rated current percentage is < Pr. U3-03 level × 0.9
Record	Yes

Cause	Corrective Actions
The pipe outlet is broken	Check if the pipes are damaged.
Pressure sensor error	Maintain pressure sensor.

ID No.	Fault Name	Descriptions
301	High pressure error (HPS)	The pressure feedback is higher than the set water pressure warning level
Action and Reset		
Action Condition		The feedback pressure is higher than Phigh Phigh = [Target pressure × (1 + Pr. U3-05%)]
Action Time		Pr. U3-06
Fault Treatment Parameter		Pr. U3-07 1: Fault and coast to stop 2: Fault & ramp to stop
Reset Method		Manual reset
Reset Condition		The feedback pressure is lower than Phigh × 0.9
Record		Yes
Cause		Corrective Actions
The water pressure cannot be reduced		Check if the water outlet valve of the pipeline is open.
Pressure sensor broken		Replace the pressure sensor.

ID No.	Fault Name	Descriptions
302	Low pressure error (LPSE)	The pressure feedback is lower than the set water pressure warning level
Action and Reset		
Action Condition		The feedback pressure is lower than Plow Plow = [Target pressure × (1 – Pr. U3-08%)]
Action Time		Pr. U3-09
Fault Treatment Parameter		Pr. U3-10 1: Fault and coast to stop 2: Fault & ramp to stop
Reset Method		Manual reset
Reset Condition		The feedback pressure is higher than Plow × 1.1
Record		Yes
Cause		Corrective Actions
Unable to establish water pressure		Check if the pipe has leakage, or if there is no water from the source.
Pressure sensor broken		Replace the pressure sensor.

ID No.	Fault Name	Descriptions
303	Dry pump error (dryE)	Warning occurs when the drive detects dry pump.
Action and Reset		
Action Condition		The corresponded power of the target frequency is below the dry pump curve
Action Time		Pr. U3-16
Fault Treatment Parameter		Pr. U3-19 1: Warn and coast to stop 2: Warn and ramp to stop
Reset Method		Manual reset
Reset Condition		Immediately reset
Record		Yes
Cause		Corrective Actions
The pump inlet pipeline is broken or has no water		Check if the pipe is damaged, or if there is no water from the source.

ID No.	Fault Name	Descriptions
304	Dry pump auto-tune error (dAUE)	1. The high-speed power tuning value is lower than the low-speed power tuning value. 2. Any of the high speed or low speed tuning value exceeds the drive rated power If any of the above condition is met, the drive stops with STOP command and displays dAUE
Action and Reset		
Action Condition		Power tuning value does not meet the dry pump detection curve routine
Action Time		Immediately act
Fault Treatment Parameter		Fault and coast to stop
Reset Method		Manual reset
Reset Condition		Immediately reset
Record		Yes
Cause		Corrective Actions
The value measured automatically by the dry pump curve is abnormal		Measure the load auto-tuning curve again, set Pr. U3-11 = 1 to execute dry pump curve autotune.
There is water in the pump system.		Close the pump outlet and inlet.

ID No.	Fault Name	Descriptions
305	Pipe blockage (JAME)	The output current still exceeds Pr. U3-22 setting value after the locked rotor cleaning is complete
Action and Reset		
Action Condition		In the single cleaning cycle, when the cleaning times reaches Pr. U3-26, and the current is still larger than Pr. U3-22
Action Time		Pr. U3-23 time
Fault Treatment Parameter		Immediately coast to stop
Reset Method		Manual reset
Reset Condition		Immediately reset
Record		Yes
Cause		Corrective Actions
The pump blade is blocked by objects		The cleaning function cannot clear the objects that block the pump blade, remove the object manually.

ID No.	Fault Name	Descriptions
306	ExCom card break (ECCb)	Communication cards break off warning

Action and Reset	
Action Condition	Communication cards break off
Action Time	The time between communication card break off and ECCb displays: 1. EtherNet/IP: 5 sec. 2. Modbus TCP: 5 sec. 3. DeviceNet: 1 sec. 4. PROFIBUS: 1 sec. 5. EtherCAT: 0.1 sec.
Warning Setting Parameter	N/A
Reset Method	Auto resets after communication card is re-installed
Reset Condition	Immediately reset
Record	No

Cause	Corrective Actions
Communication cards break off	Re-install communication card

ID No.	Fault Name	Descriptions
307	Communication time-out (ECto)	Communication time-out for communication card and the upper unit

Action and Reset	
Action Condition	No
Action Time	No
Warning Setting Parameter	N/A
Reset Method	No
Reset Condition	Auto resets when the communication with the upper unit is back to normal
Record	No

Cause	Corrective Actions
Communication card is not connected with the upper unit	Check if the connection of the communication cable is correct
Communication error of the upper unit	Check if the communication of the upper unit is normal

Chapter 9 Maintenance and Inspections

CAUTION	
	☑ When a fault occurs, wait for five seconds after the fault is cleared before pressing RESET with the input terminal keypad. ☑ Before opening the cover for the maintenance, the drive must first be switched off for at least three minutes until the charging indicator turns off. ☑ Only qualified personnel can work on maintenance or replace parts. (Remove metal items such as watch, rings, and other metal items before operation, and use only insulated tools.) ☑ Never modify the internal components or wiring. ☑ The performance and the surrounding environment should meet the standard specifications. There should be no abnormal noise, vibration, or odor.

The AC motor drive has various warnings and protections against errors such as over-voltage, low voltage, or over-current. Once an error occurs, the protections activate, the AC motor drive stops output and activates the error contacts, and the motor coasts to stop. Refer to the error display from the AC motor drive and look up the corresponding causes and solutions. The fault record is stored in the AC motor drive internal memory. You can read it from the digital keypad or through the communications by accessing the parameters.

The AC motor drive contains a large number of electronic components including ICs, resistors, capacitors, transistors, and cooling fans. These components do not last forever. Even under normal circumstances, they will eventually become error-prone if used exceed their lifespan. Therefore, you must perform periodic preventive maintenance to identify defective and worn out parts, and eliminate the causes of malfunctions in the AC motor drive at an early stage. At the same time, parts that have exceeded their product life should be replaced to ensure safe operation.

Visual checks should be done regularly to monitor the AC motor drive's operation, and to make sure nothing unusual happens. Check the situations listed in this Chapter.

9-1 Maintenance and Inspections

Stop the drive operation, turn off the power and remove the cover before the maintenance. Even if the power has been turned off, a charge may still remain in the filter capacitors with hazardous voltages which takes a certain time to discharge. To avoid danger, strictly follow the waiting time mentioned in the precautions after the drive is powered off before performing the inspection.

- **Ambient Environment**

Check Item	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Check the ambient temperature, humidity, vibration and if there is any dust, gas, oil or water drops.	Visual inspection and measurement with equipment with standard specifications	○		
Check for any dangerous objects in the surroundings	Visual inspection	○		

- **Voltage**

Check Item	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
If the voltage of the main circuit and control circuit are correct	Measure with multi-meter with standard specifications	○		

- **Digital Keypad Display**

Check Item	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
If the display is clear for reading	Visual inspection	○		
If there is any missing characters on the display	Visual inspection	○		

- **Mechanical Parts**

Check Item	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Check for any abnormal sounds or vibrations	Visual and auditory inspection		○	
Check for any loose screws	Tighten the screws		○	
Check for deformed or damaged parts	Visual inspection		○	
Check for any color changed due to overheating	Visual inspection		○	
Check for any dust or dirt	Visual inspection		○	

- **Main Circuit - Terminal and wiring**

Check Item	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Check for any loose or missing screws	Tighten the screws	○		
If there is any deformed, cracked, or damaged machinery / insulation, or any color changed due to overheating and aging.	Visual inspection		○	
Check for any dust or dirt	Visual inspection		○	
Check for wiring insulation damage or color changed	Visual inspection		○	

- **Main Circuit - Filter Capacity**

Check Item	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Check for any leakage of liquid, color changed, cracking or deformation	Visual inspection		○	
Check if the safety valve is not removed or is obviously expanded	Visual inspection		○	
Measure the static capacity when required	Measure with equipment with standard specifications		○	

- **Main Circuit - Transformer and Reactor**

Check Item	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Check for any abnormal vibrations or peculiar odors	Visual and auditory inspection	○		

- **Main Circuit - Electromagnetic Contactor and Relay**

Check Item	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Check for any vibration sounds	Auditory inspection	○		
If the contact works correctly	Visual inspection	○		

- **Control Circuit - PCB and Connector**

Check Item	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Check for any loose screws and connectors	Tighten the screws		○	
Check for any peculiar odors or color changed	Visual inspection and smell		○	
Check for any cracking, damage, deformation or corrosion	Visual inspection		○	
Check for any leakage of liquid or deformation in the capacitors	Visual inspection		○	

- **Cooling System - Cooling Fan**

Check Item	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Check for any abnormal sounds or vibrations	Visual, auditory inspection and turn the fan by hand to check for smooth rotation (turn off the power before the inspection)		○	
Check for any loose screws	Tighten the screws		○	
Check for any color changed due to overheating	Visual inspection		○	

- **Cooling System - Ventilation Channel**

Check Item	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Check for any obstruction around the heat sink, air intake or air outlet	Visual and auditory inspection	○		

NOTE: Use chemically neutral cloth to clean and use a dust cleaner to remove dust when necessary.

9-2 Fan Kit

Frame A & B

Heat Sink Fan Model: MKVP-AFKM / MKVP-BFKM

1. Use a flathead screwdriver to insert into the groove of the middle cover, and then press the tab on both sides of the fan to remove it.

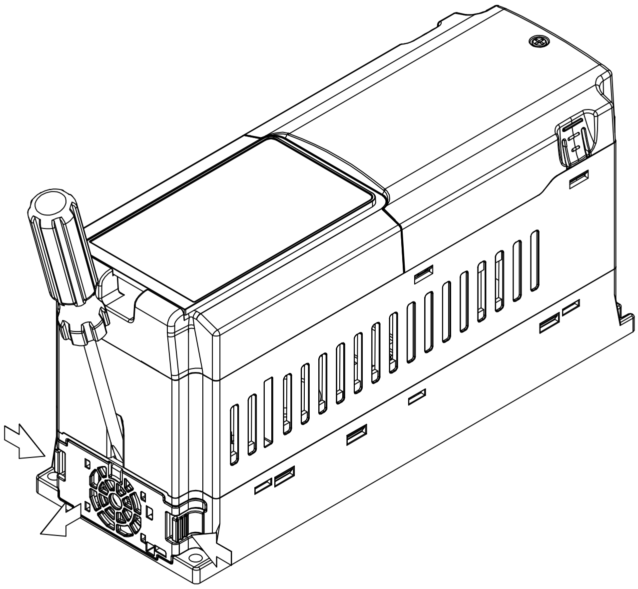


Figure 9-1

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

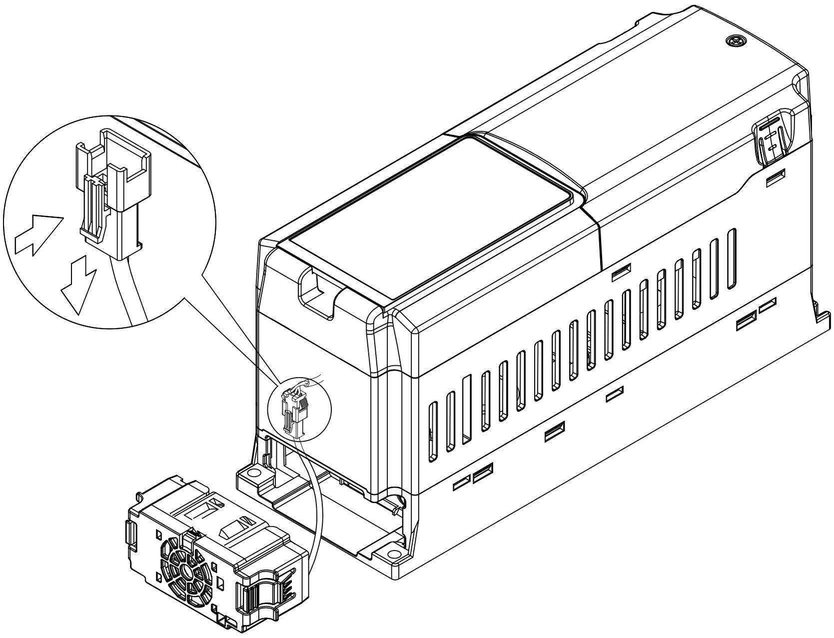
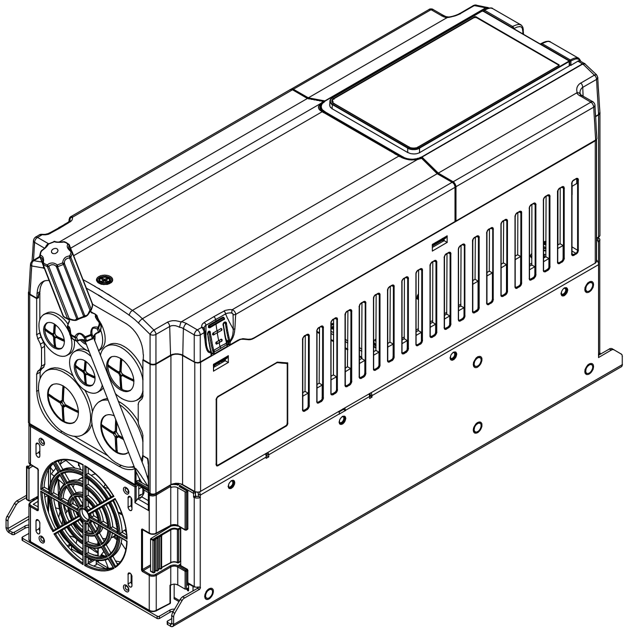


Figure 9-2

Frame C

Heat Sink Fan Model: MKVP-CFKM

1. Use a flathead screwdriver to insert to the groove of the middle cover, and open the fan hook (only for VFD025VP43BFTAA, VFD032VP43BFTAA and VFD038VP43BFTAA).



2. As shown in the figure below, press the tab on both sides of the fan to remove it.

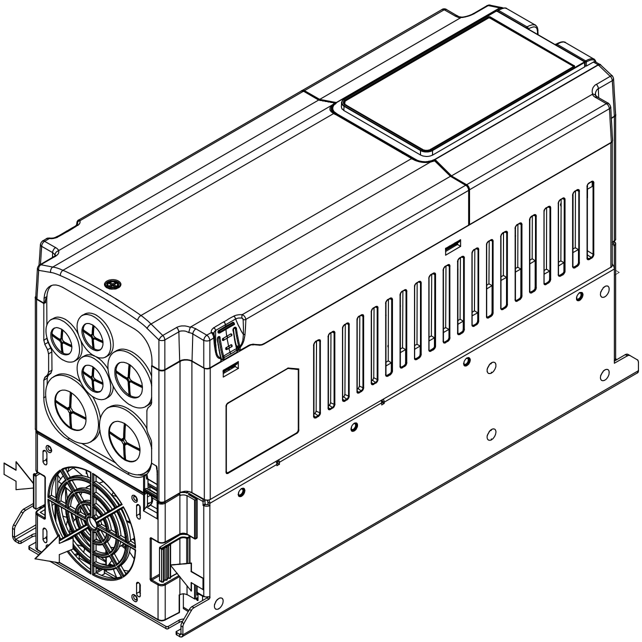


Figure 9-3

3. Disconnect the power terminal before removing the fan (as shown below).

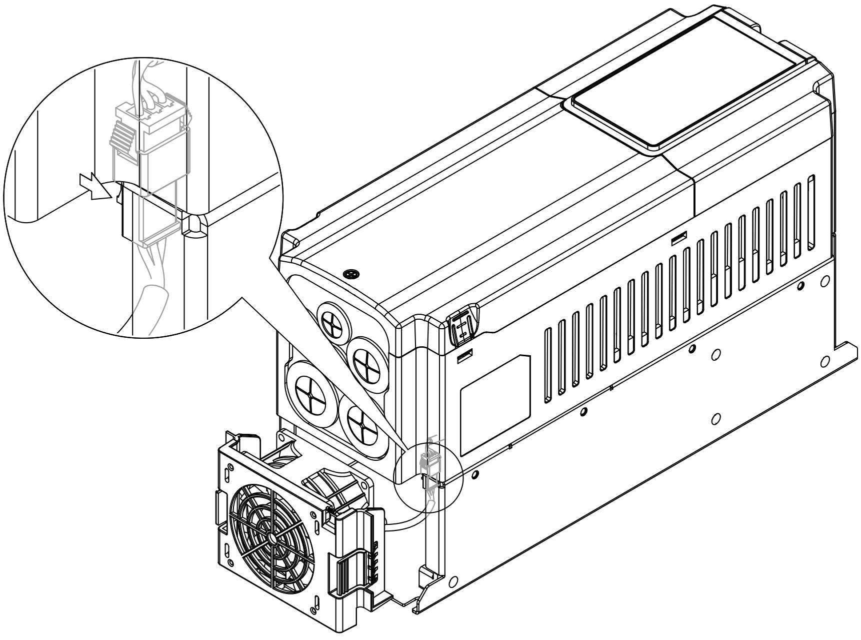


Figure 9-4

Frame D

Heat Sink Fan Model: MKVP-DFKM (OPEN TYPE)

1. Loosen the four screws to remove the fan, as shown in the figure below.
   Screw torque: 14–16 kg-cm / (12.2–13.9 lb-in.) / (1.37–1.57 Nm)

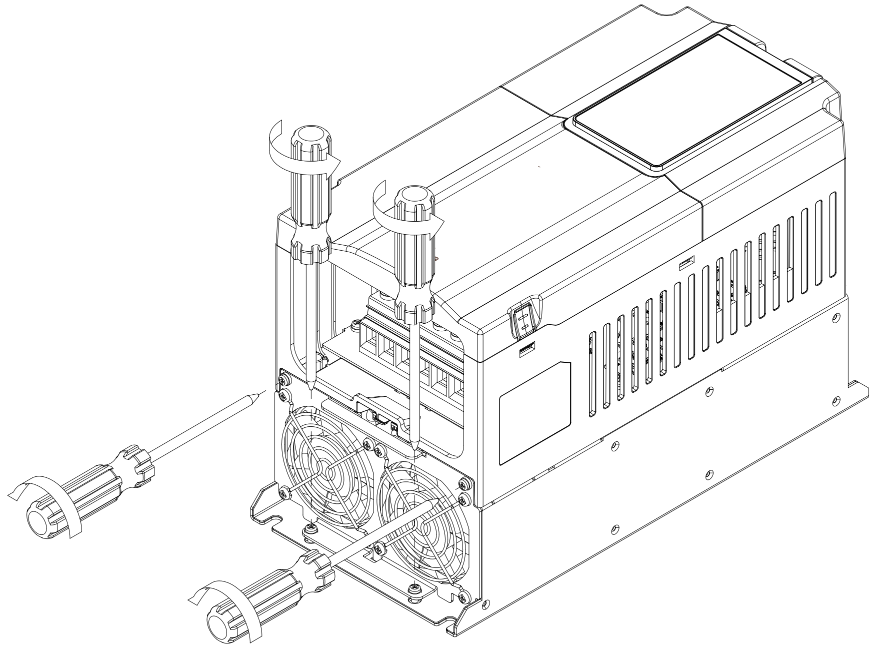


Figure 9-5

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

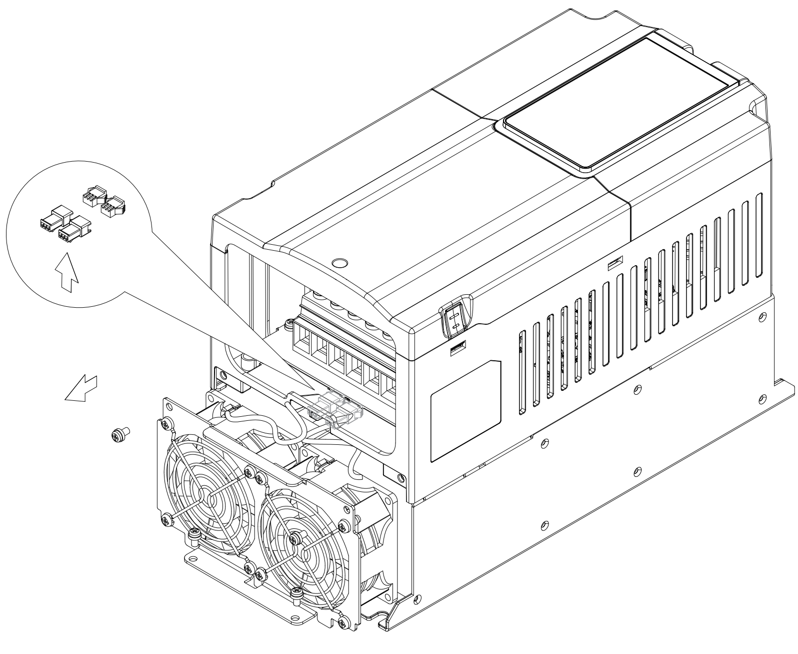


Figure 9-6

Frame D

Heat Sink Fan Model: MKVP-DFKM (TYPE1)

1. Loosen the four screws to remove the fan, as shown in the figure below.
   Screw torque: 14–16 kg-cm / (12.2–13.9 lb-in.) / (1.37–1.57 Nm)

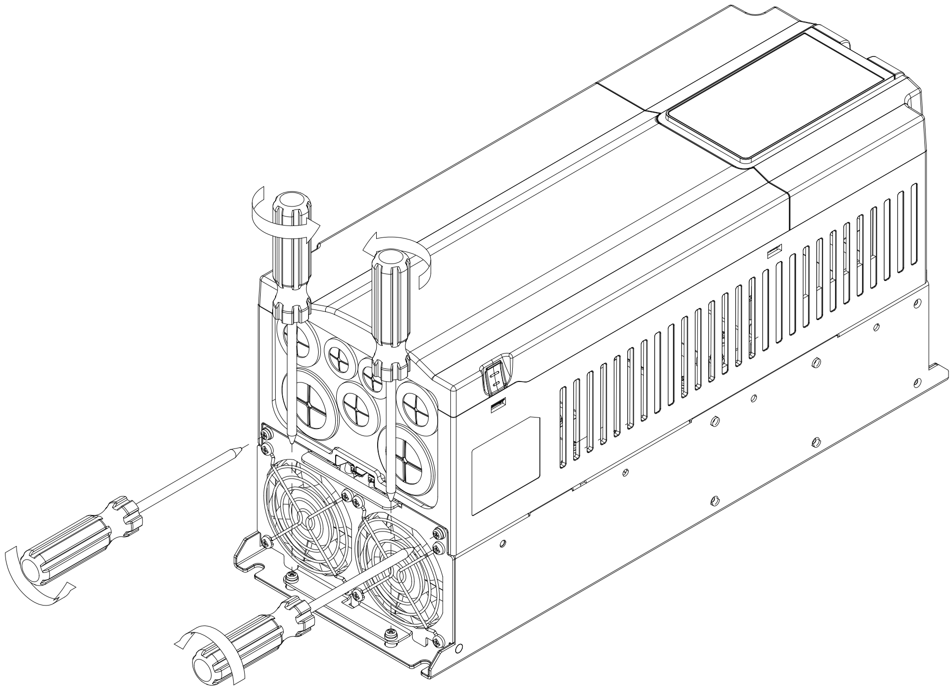


Figure 9-7

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

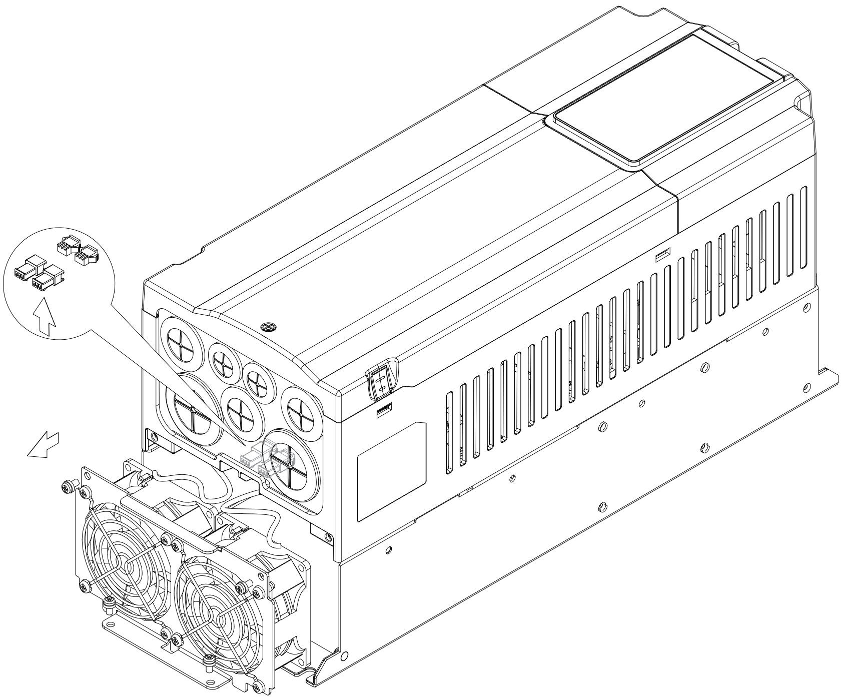


Figure 9-8

Frame E

Heat Sink Fan Model: MKVP-EFKM (OPEN TYPE)

1. Loosen the four screws to remove the fan, as shown in the figure below.
   Screw torque: 14–16 kg-cm / (12.2–13.9 lb-in.) / (1.37–1.57 Nm)

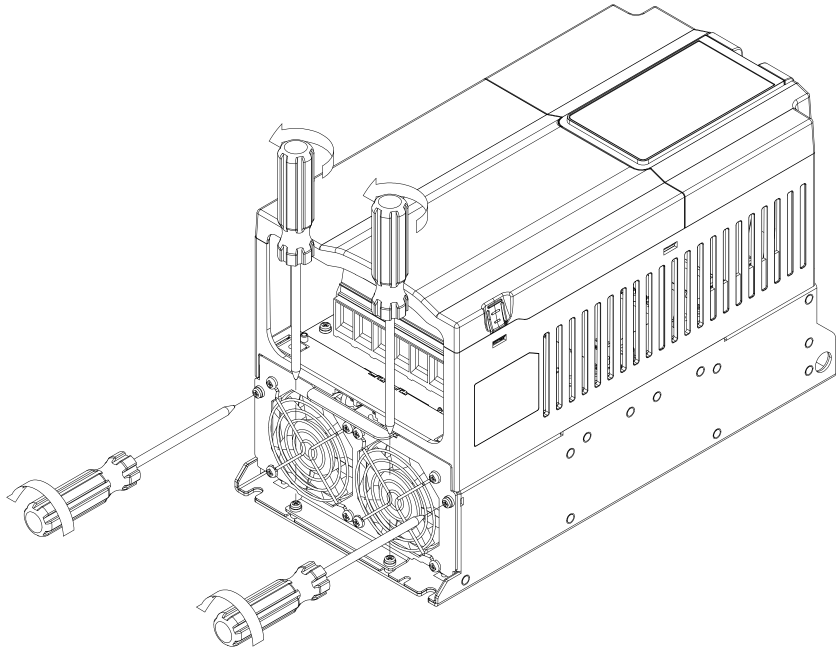


Figure 9-9

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

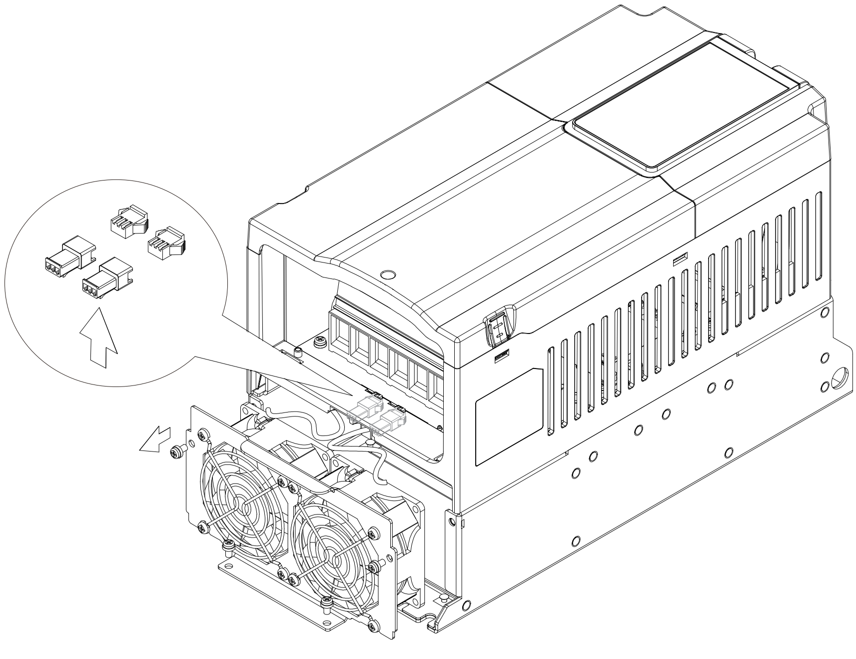


Figure 9-10

Frame E

Heat Sink Fan Model: MKVP-EFKM (TYPE1)

1. Loosen the four screws to remove the fan, as shown in the figure below.
   Screw torque: 14–16 kg-cm / (12.2–13.9 lb-in.) / (1.37–1.57 Nm)

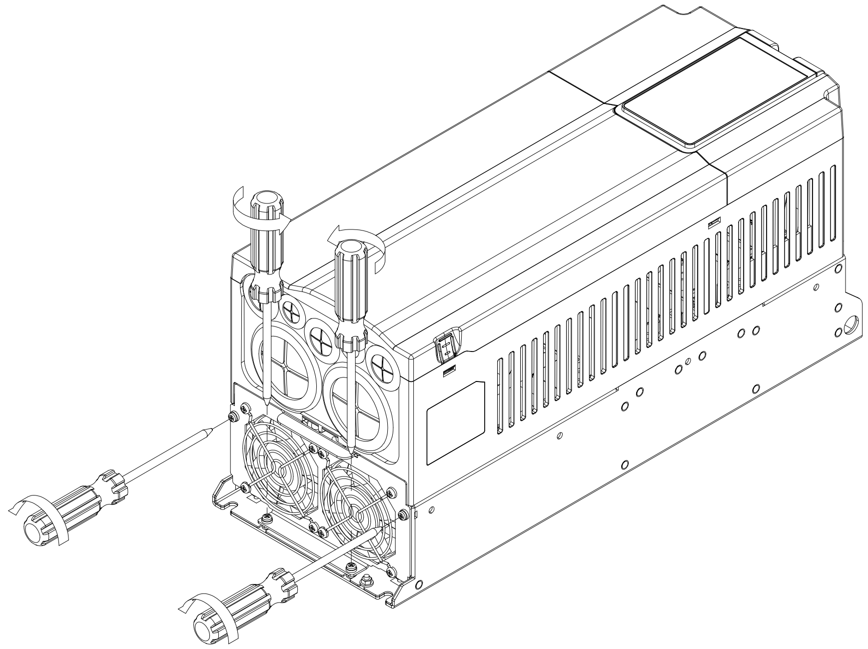


Figure 9-11

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

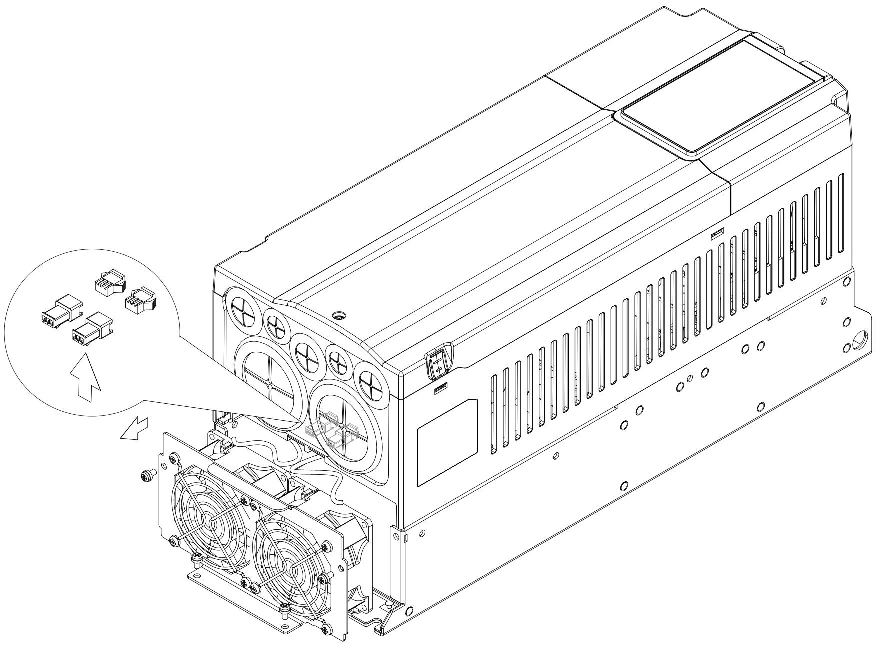


Figure 9-12

Frame F

Heat Sink Fan Model: MKVP-FFKM1 (OPEN TYPE)

1. Loosen the four screws to remove the fan, as shown in the figure below.
   Screw torque: 14–16 kg-cm / (12.2–13.9 lb-in.) / (1.37–1.57 Nm)

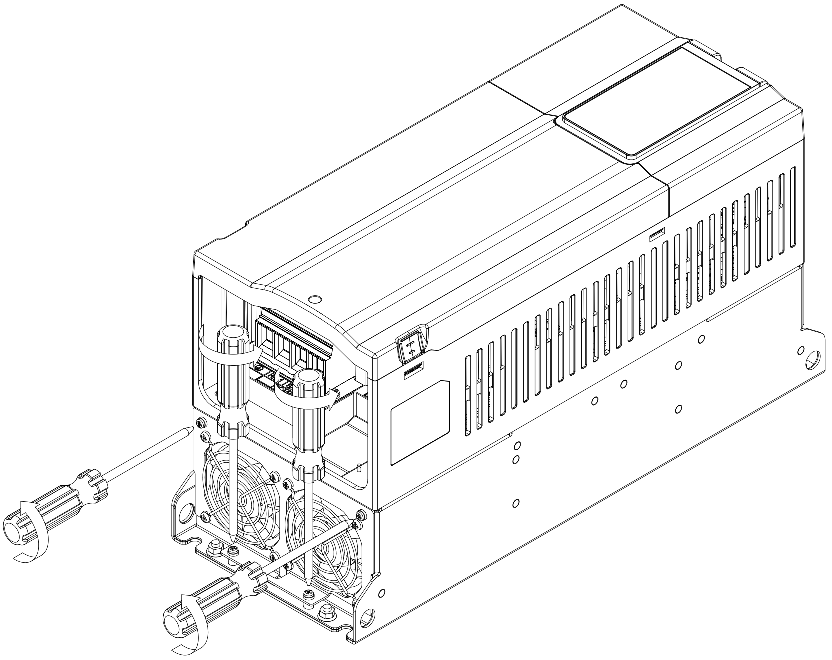


Figure 9-13

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

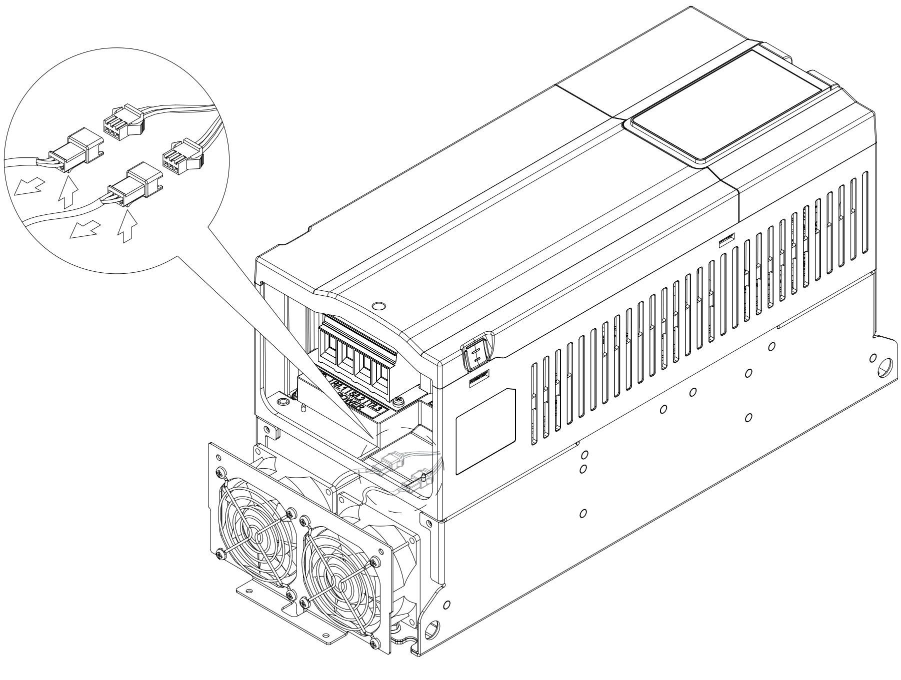


Figure 9-14

Frame F

Heat Sink Fan Model: MKVP-FFKM2 (TYPE1)

1. Loosen the four screws to remove the fan, as shown in the figure below.
   Screw torque: 14–16 kg-cm / (12.2–13.9 lb-in.) / (1.37–1.57 Nm)

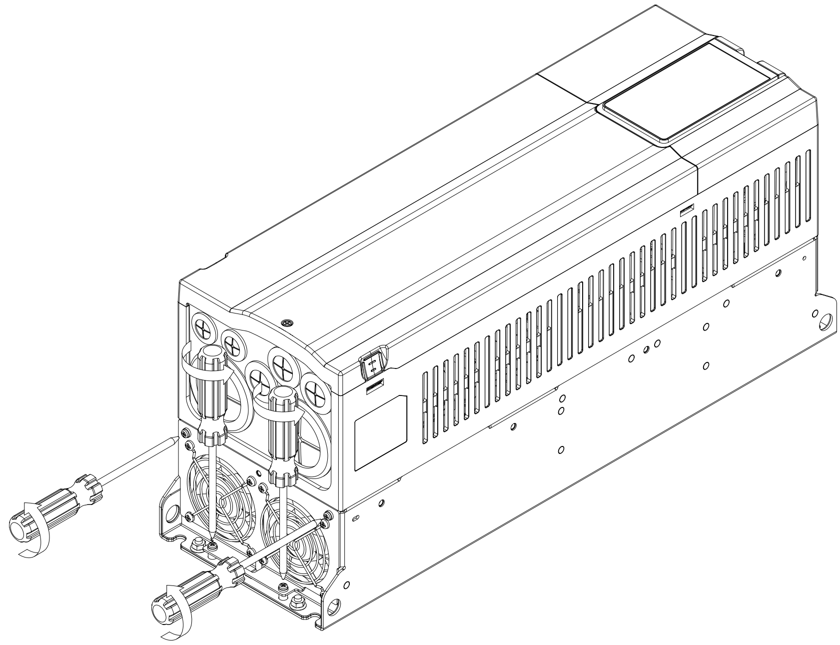


Figure 9-15

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

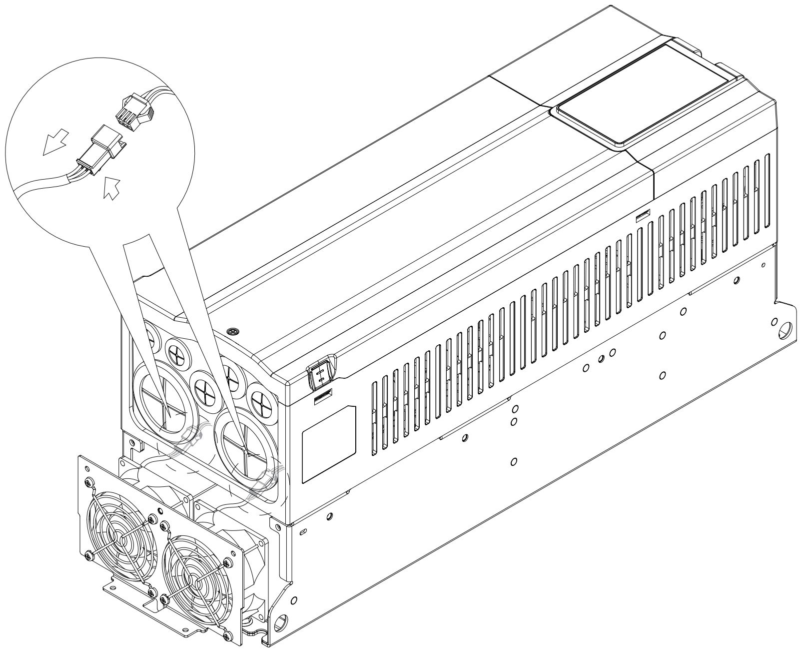


Figure 9-16

Frame G

Heat Sink Fan Model: MKVP-GFKM1 (OPEN TYPE)

1. Loosen the four screws to remove the fan, as shown in the figure below.
   Screw torque: 24–26 kg-cm / (20.8–22.6 lb-in.) / (2.35–2.55 Nm)

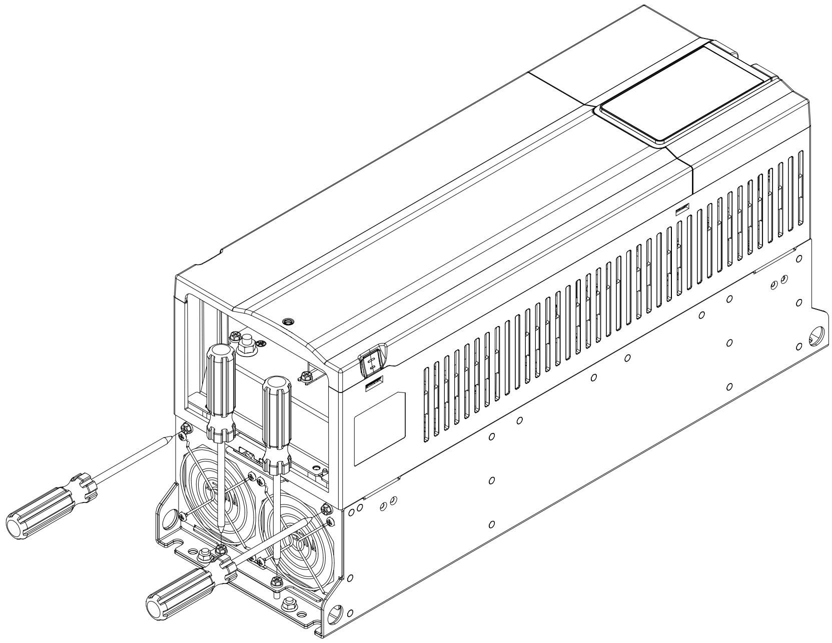


Figure 9-17

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

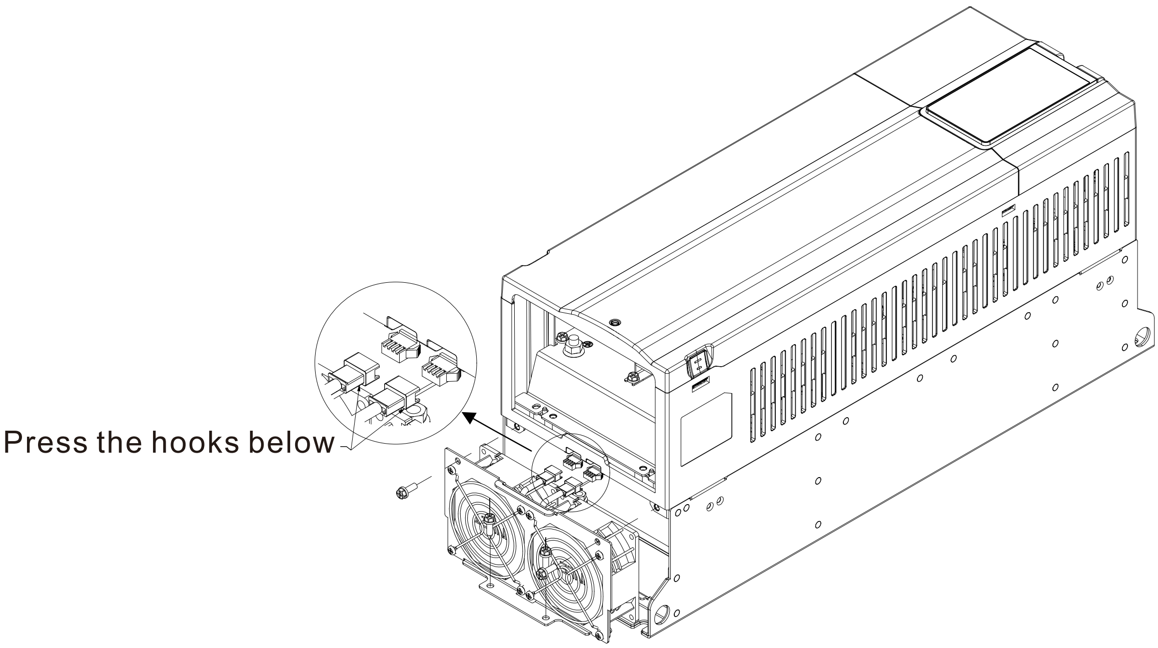


Figure 9-18

Frame G

Heat Sink Fan Model: MKVP-GFKM2 (TYPE1)

1. Loosen the four screws to remove the fan, as shown in the figure below.
   Screw torque: 24–26 kg-cm / (20.8–22.6 lb-in.) / (2.35–2.55 Nm)

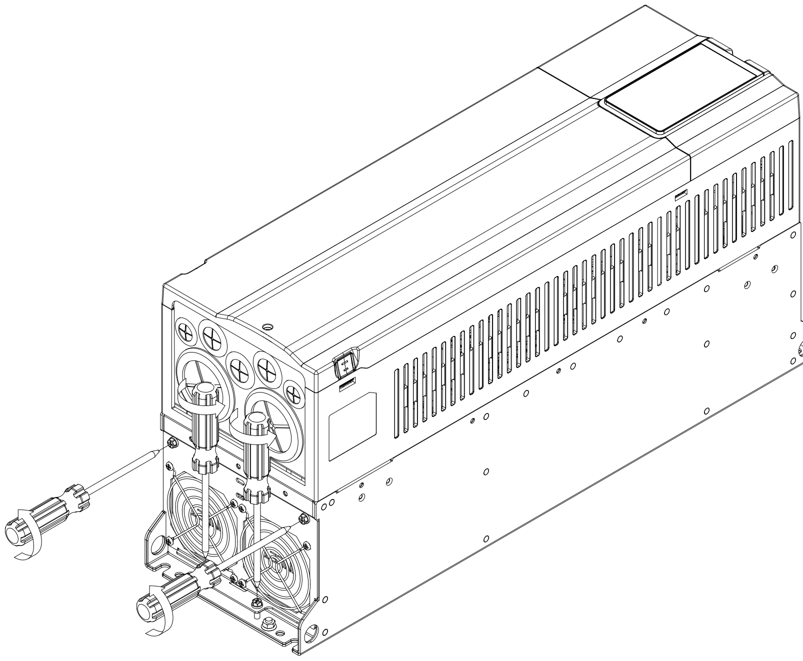


Figure 9-19

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

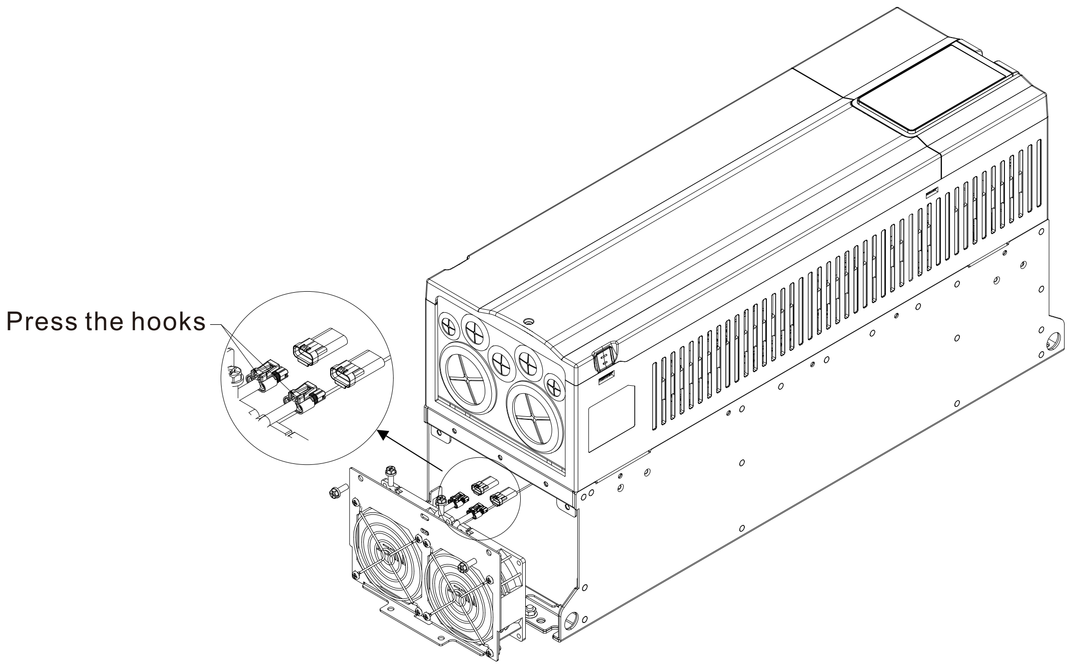


Figure 9-20

Frame H

Heat Sink Fan Model: MKVP-HFKM1 (OPEN TYPE)

1. Loosen the four screws to remove the fan, as shown in the figure below.
   Screw torque: 24–26 kg-cm / (20.8–22.6 lb-in.) / (2.35–2.55 Nm)

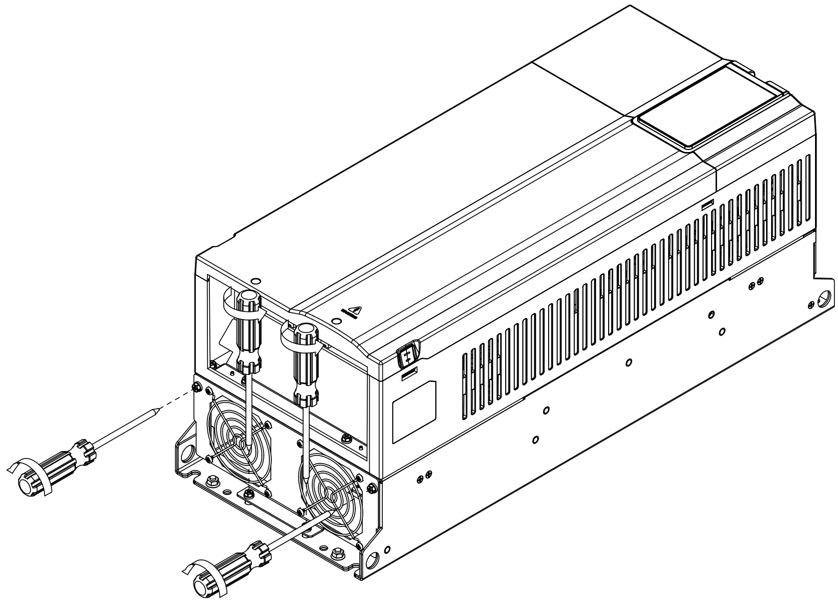


Figure 9-21

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

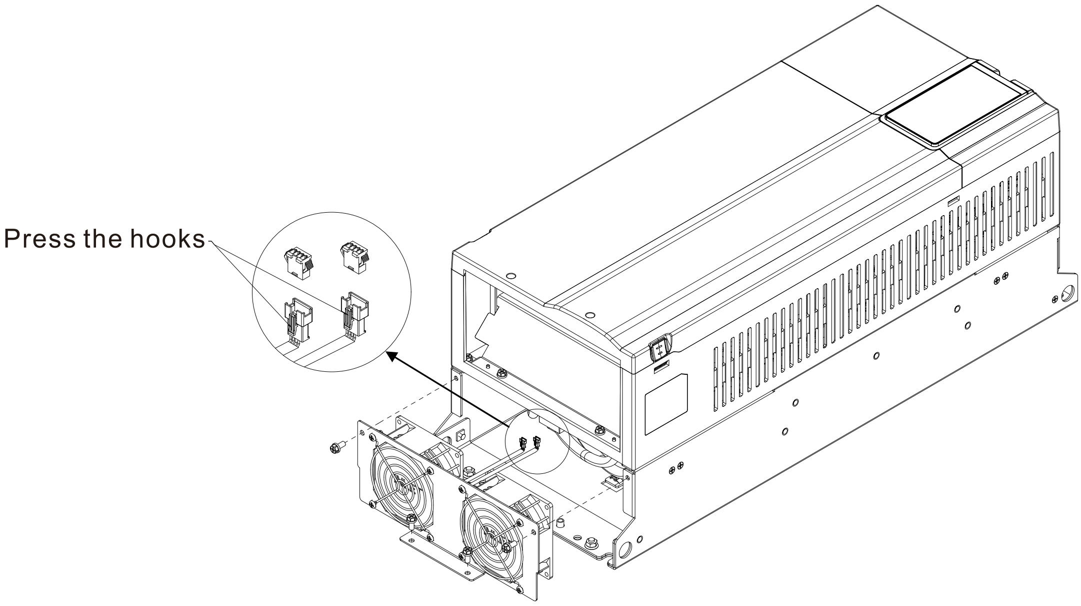


Figure 9-22

Frame H

Heat Sink Fan Model: MKVP-HFKM2 (TYPE1)

1. Loosen the four screws to remove the fan, as shown in the figure below.
   Screw torque: 24–26 kg-cm / (20.8–22.6 lb-in.) / (2.35–2.55 Nm)

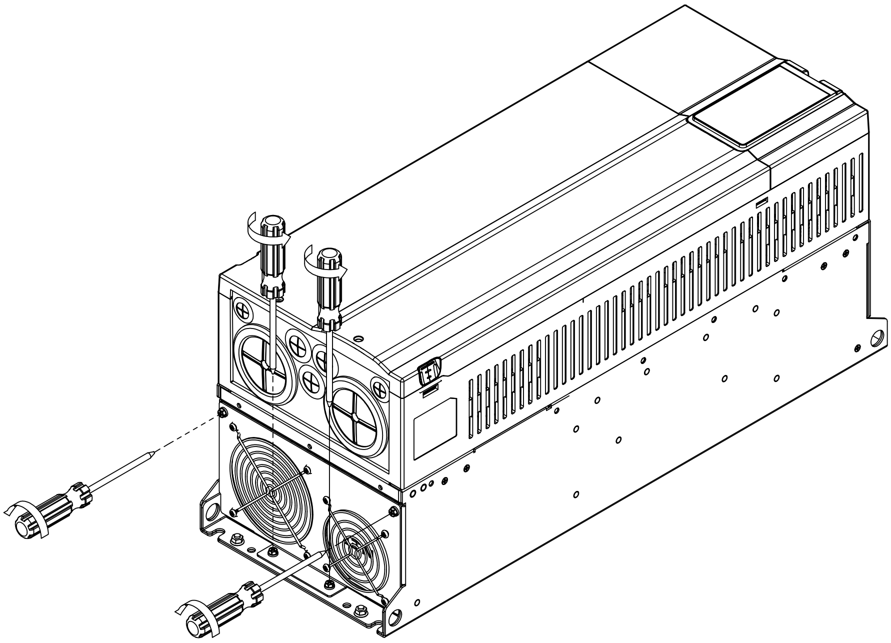


Figure 9-23

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

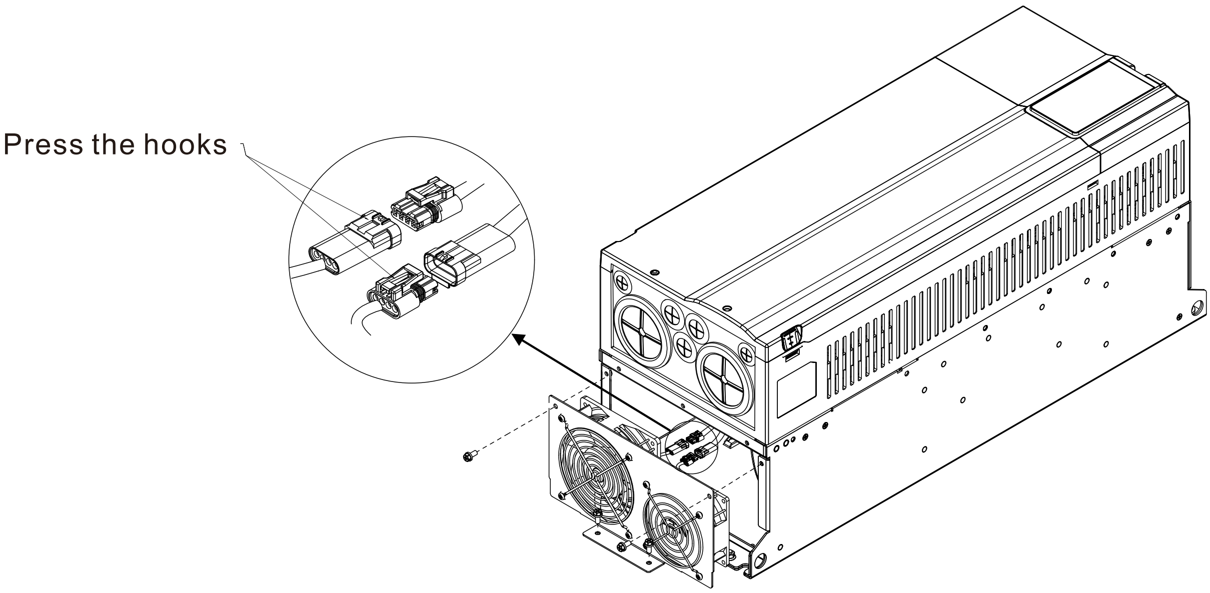


Figure 9-24

Frame I

Heat Sink Fan Model: MKVP-IFKM (OPEN TYPE)

1. Loosen the six screws to remove the fan, as shown in the figure below.
   Screw torque: 24–26 kg-cm / (20.8–22.6 lb-in.) / (2.35–2.55 Nm)

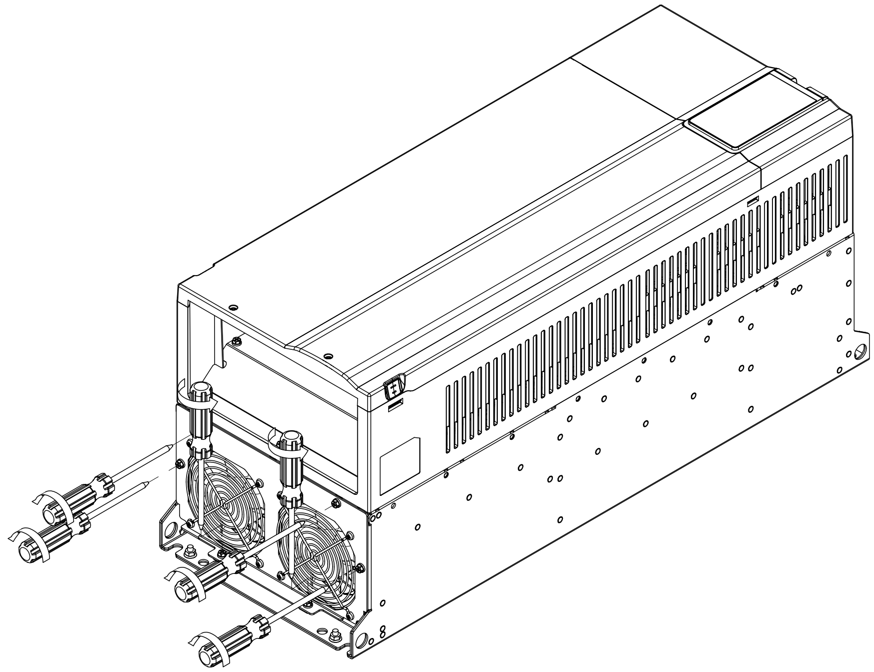


Figure 9-25

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

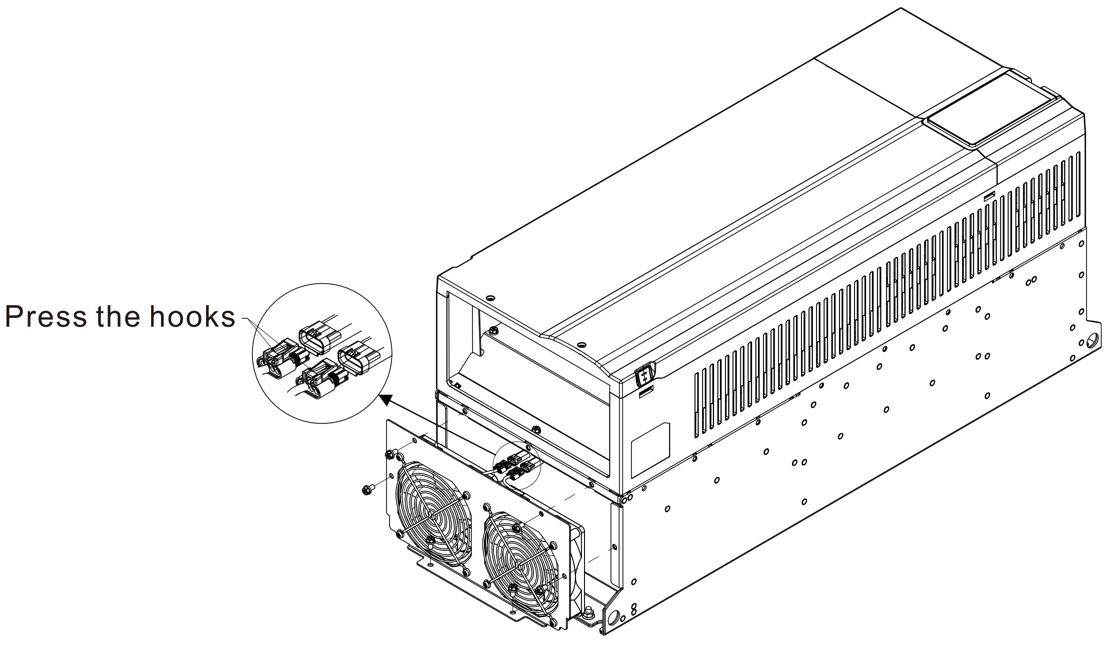


Figure 9-26

Frame I

Heat Sink Fan Model: MKVP-IFKM (TYPE1)

1. Loosen the six screws to remove the fan, as shown in the figure below.
   Screw torque: 24–26 kg-cm / (20.8–22.6 lb-in.) / (2.35–2.55 Nm)

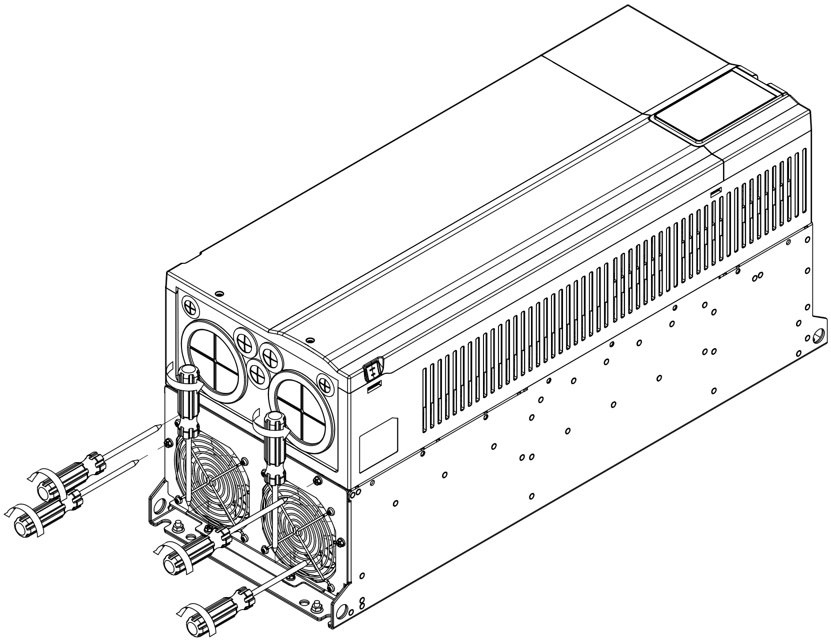


Figure 9-27

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

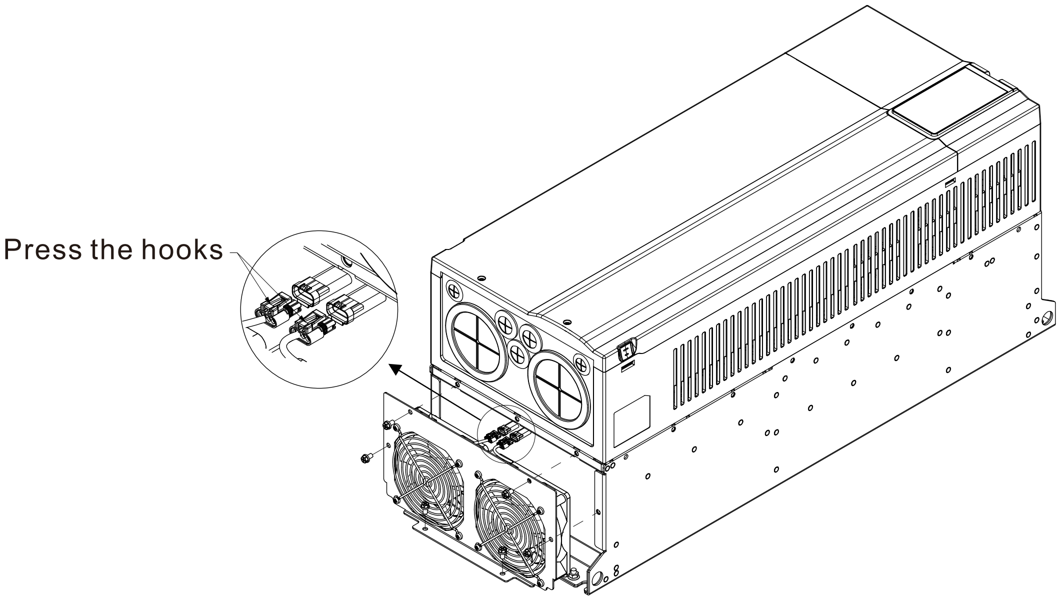


Figure 9-28

Frame J–K

Heat Sink Fan Model: MKVP-JFKM / MKVP-KFKM

1. Loosen the seven screws to remove the fan, as shown in the figure below.
   Screw torque: 24–26 kg-cm / (20.8–22.6 lb-in.) / (2.35–2.55 Nm)

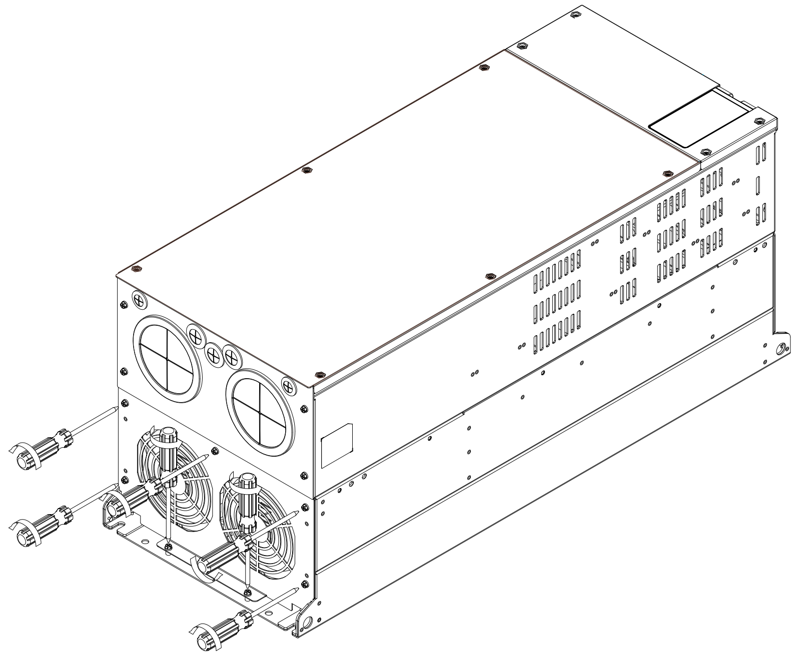


Figure 9-29

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

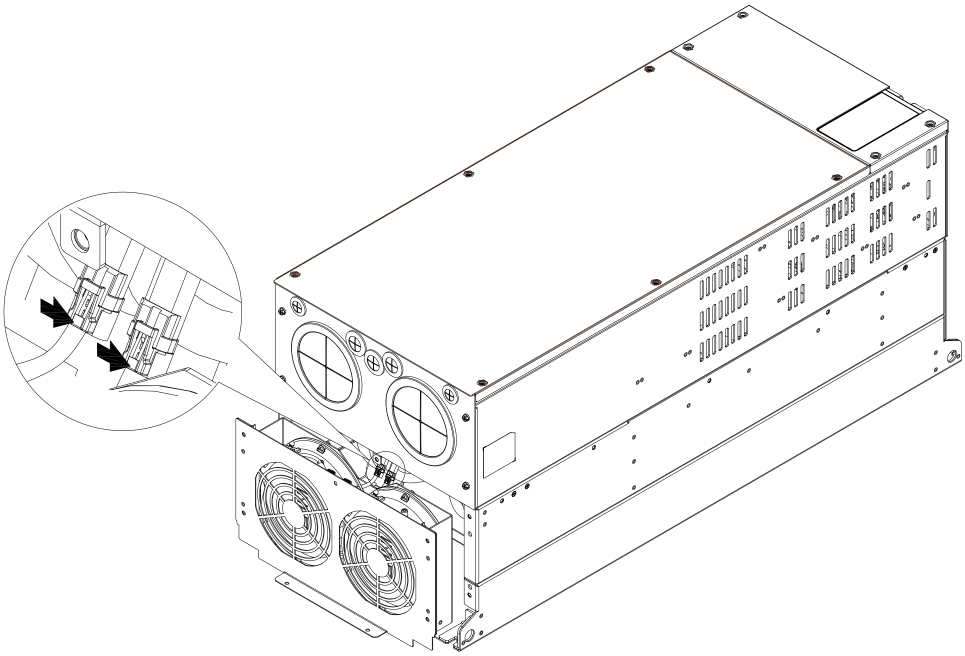


Figure 9-30

Frame L–M

Heat Sink Fan Model: MKVP-MFKM

1. Loosen the eleven screws (as shown in the figure below) and remove the cover.
   Screw torque: 24–26 kg-cm / (20.8–22.6 lb-in.) / (2.35–2.55 Nm)

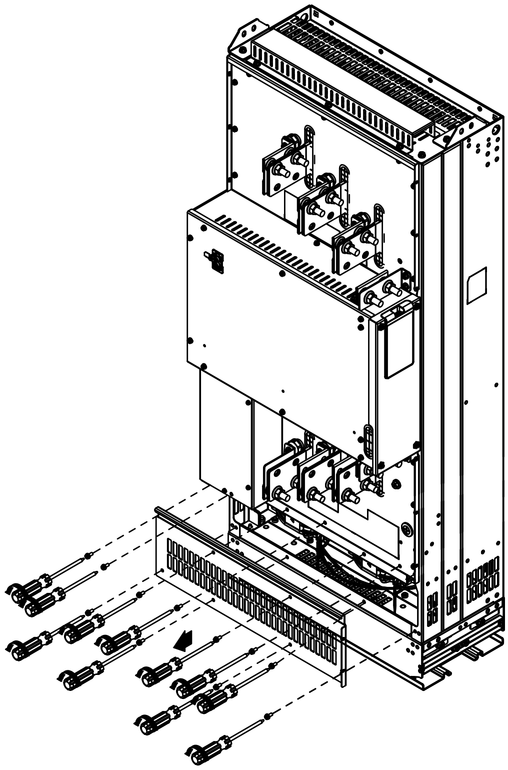


Figure 9-31

2. Cut off the two cable ties, press the latch to disconnect the power connectors (2pcs), as shown in Fig. 2 below. (When installing, buckle back the hooks of the power connector, and use the cable tie to fix the fan cable at the place marked in Fig.1.)

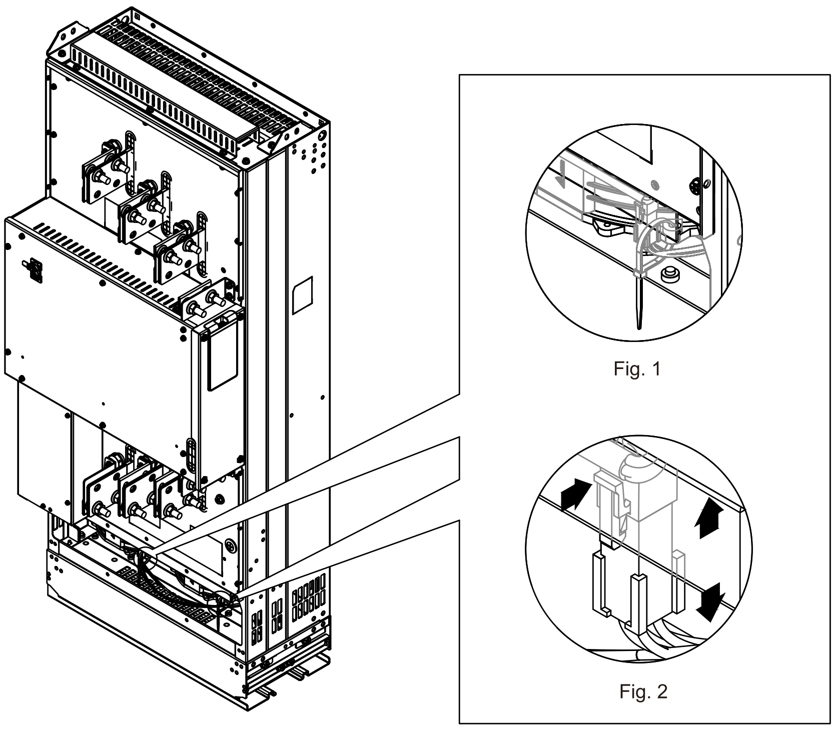


Figure 9-32

3. Remove the fan. (Make sure the fan power is properly disconnected before removal.)

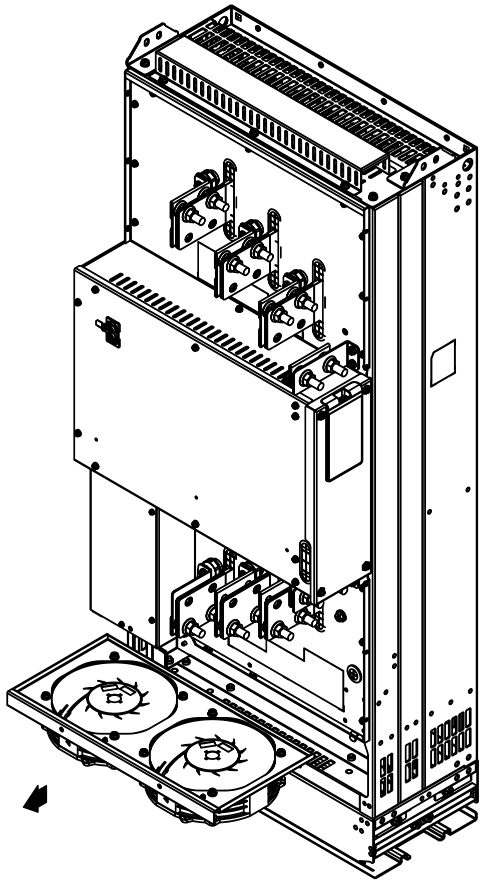


Figure 9-33

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Chapter 10 Accessories

10-1 Option Card

10-1-1 Option Card Installation

10-1-1-1 Detach Keypad Support Seat

Frame A–G

Press the hooks on both sides of the support seat and take out the keypad support seat.

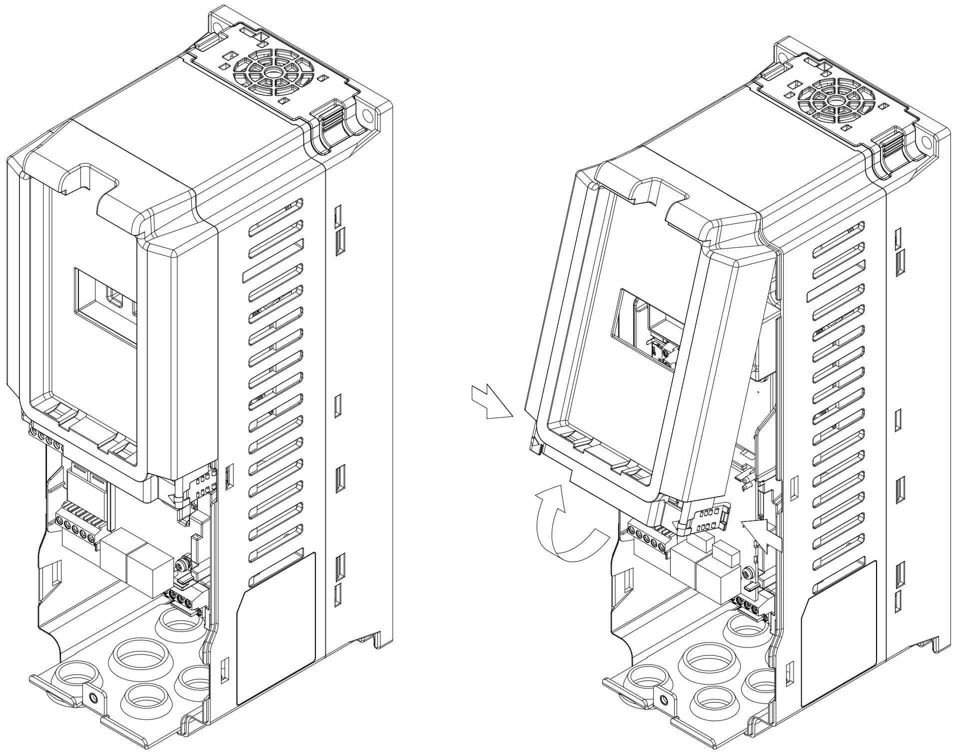


Figure 10-1

Frame H–I

Press the hooks on both sides of the support seat and take out the keypad support seat.

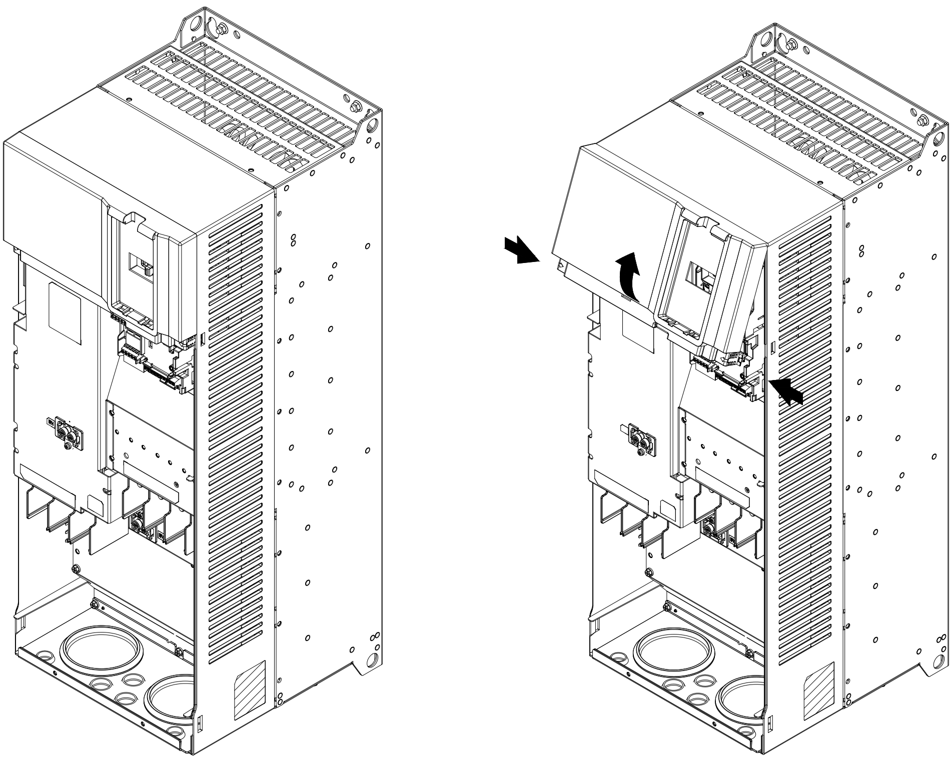


Figure 10-2

Frame J–K

Press the hooks on both sides of the support seat and take out the keypad support seat.

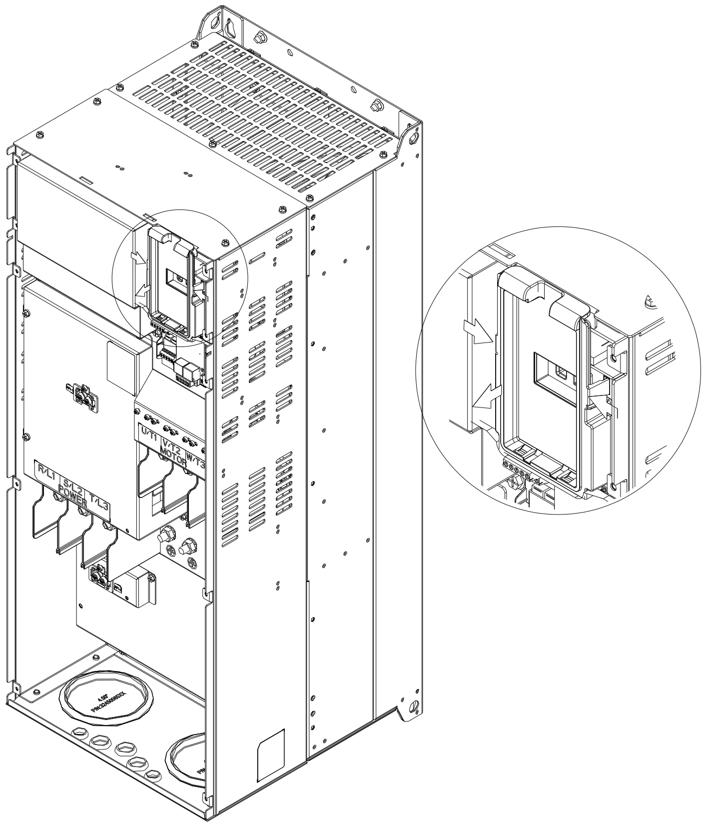


Figure 10-3

Frame L–M

Press the hooks on both sides of the support seat and take out the keypad support seat.

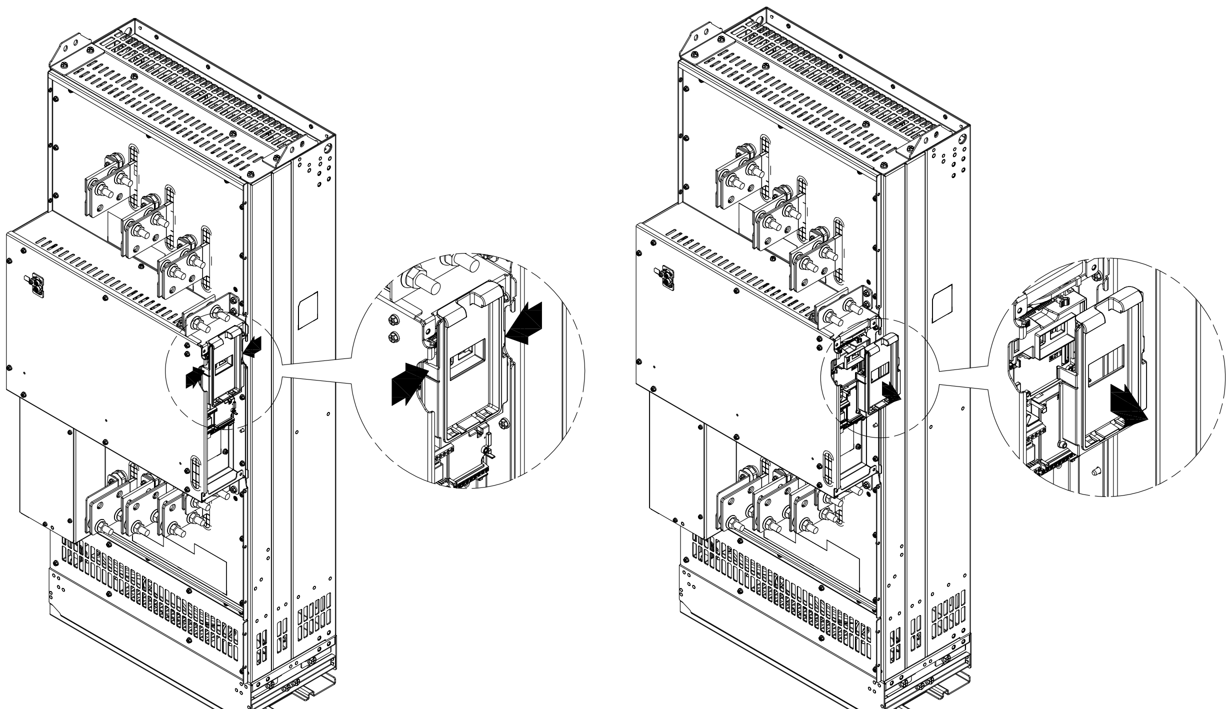


Figure 10-4

10-1-1-2 Option Card Installation Position

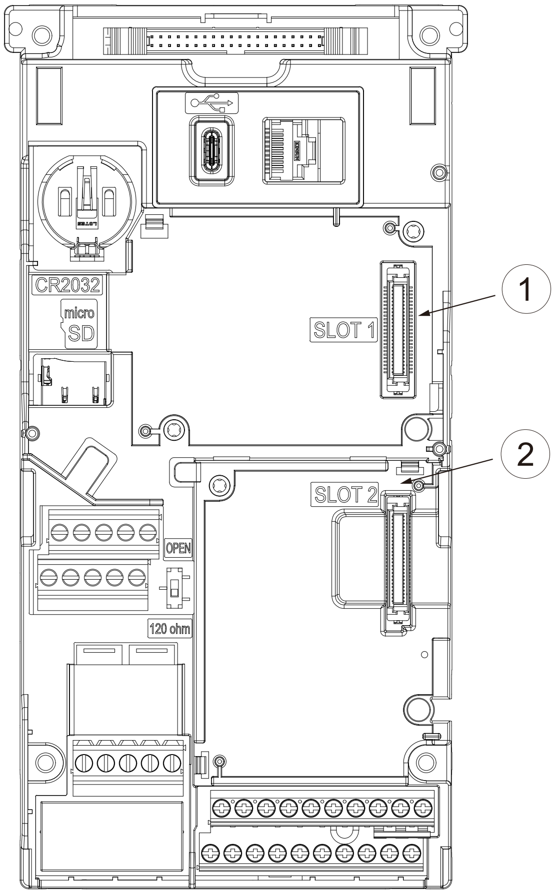


Figure 10-5

No.	Option Card Installation Position
1	I/O card (Slot 1) EMV-D42A; EMV-R6AA; EMV-A22A
2	Communication card (Slot 2) CMC-PD01; CMC-DN01; CMC-EIP01; CMC-COP01; CMC-PN01

Table 10-1

Screw specification for option card terminals

EMV-D42A	Wire Gauge	0.2–0.5 mm^2 (26–20 AWG)
	Torque	5 kg-cm / (4.4 lb-in.) / (0.5 Nm)
EMV-R6AA	Wire Gauge	0.2–0.5 mm^2 (26–20 AWG)
	Torque	8 kg-cm / (7 lb-in.) / (0.8 Nm)
EMV-A22A	Wire Gauge	0.2–4 mm^2 (24–12 AWG)
	Torque	5 kg-cm / (4.4 lb-in.) / (0.5 Nm)

Table 10-2

I/O card (Slot 1)

<table>
<tr><td>EMV-D42A

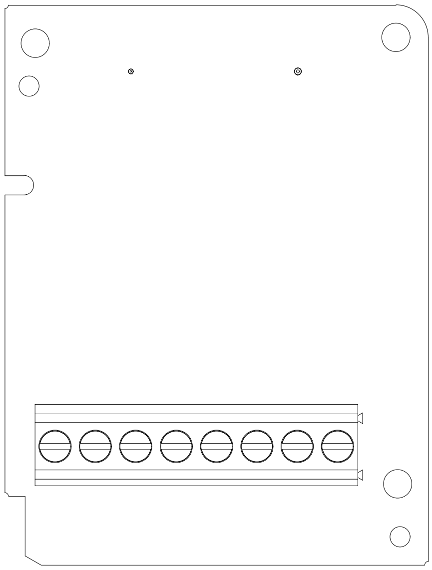



Figure 10-6</td><td>EMV-R6AA

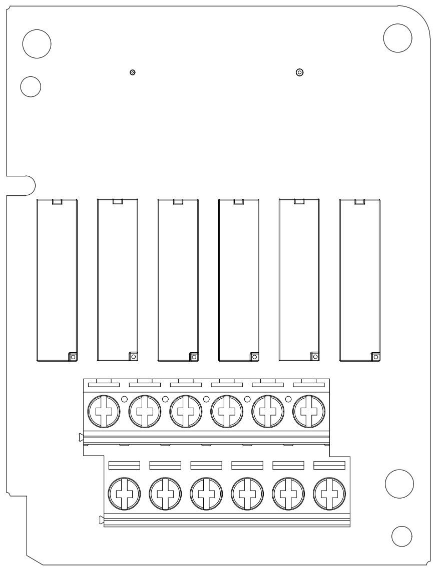



Figure 10-7</td></tr>
<tr><td>EMV-A22A

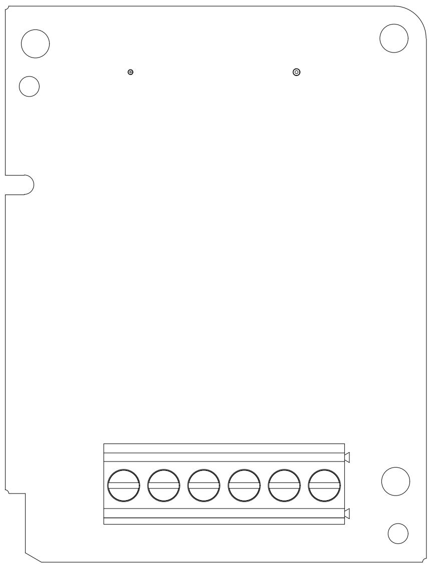
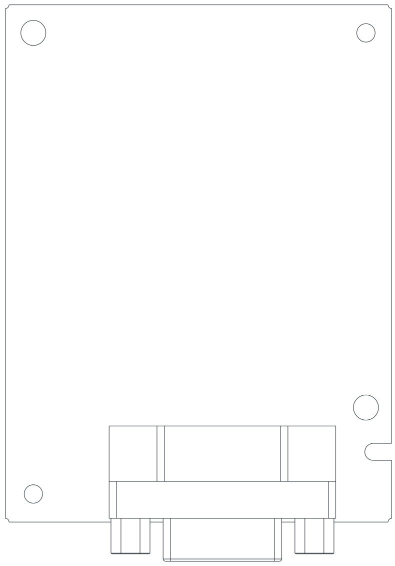
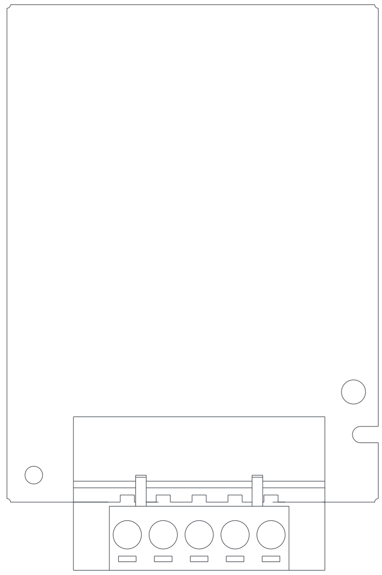
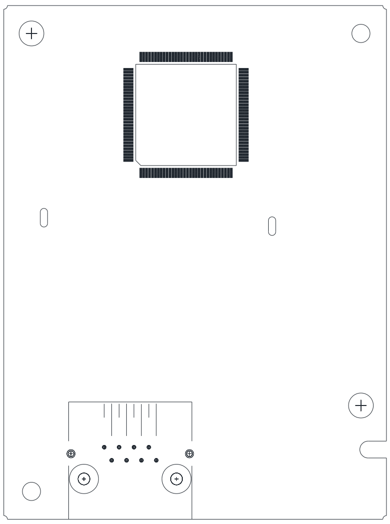
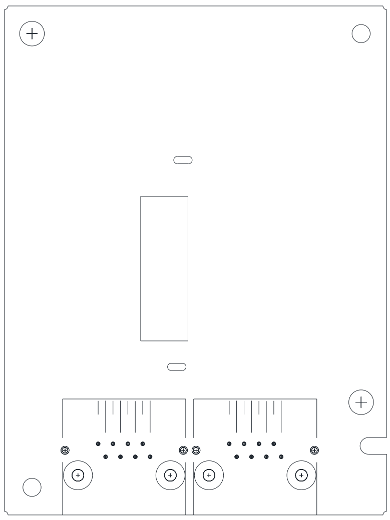
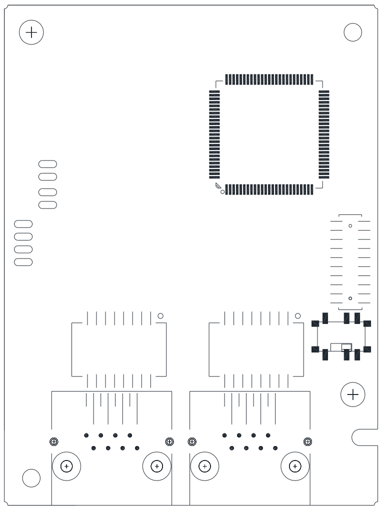



Figure 10-8</td><td></td></tr>
</table>

Communication card (Slot 2)

CMC-PD01  Figure 10-9	CMC-DN01  Figure 10-10
CMC-EIP01  Figure 10-11	EMC-COP01  Figure 10-12
CMC-PN01  Figure 10-13	

10-1-1-3 Option Card Installation

- I/O Card: EMV-D42A, EMV-R6AA, EMV-A22A

1. Put the terminals of the I/C card facing up, aim the two holes on the I/O card at the positioning pins and press down to make the clips catch the option card.

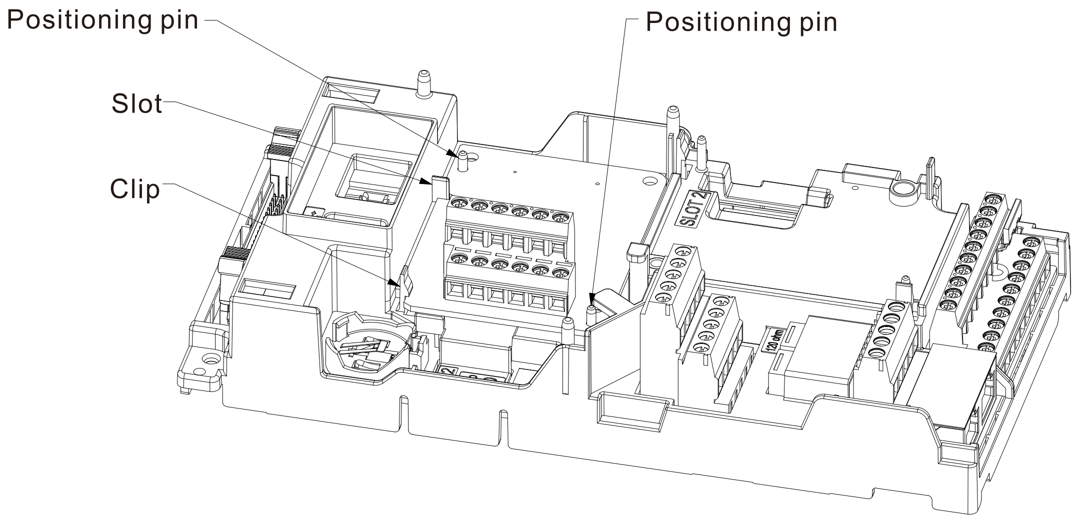


Figure 10-14

2. Fasten the screws after the I/O card is clipped with the hooks.

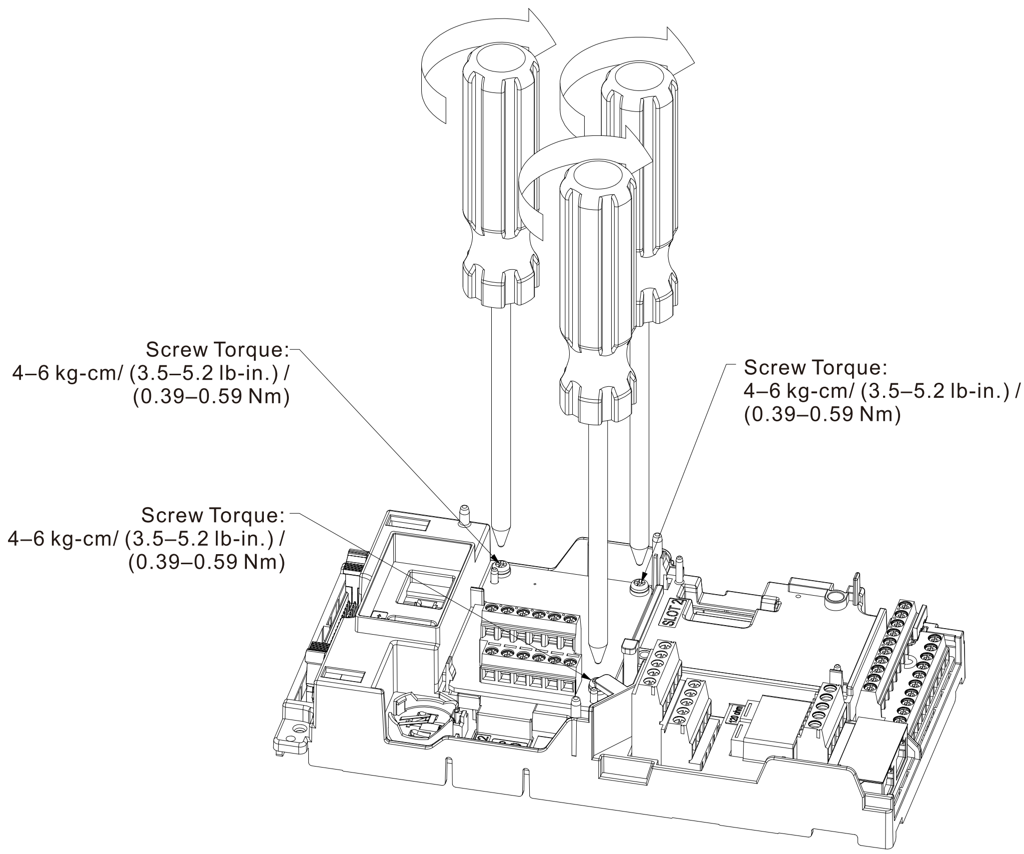


Figure 10-15

3. Installation is completed as shown in the figure below.

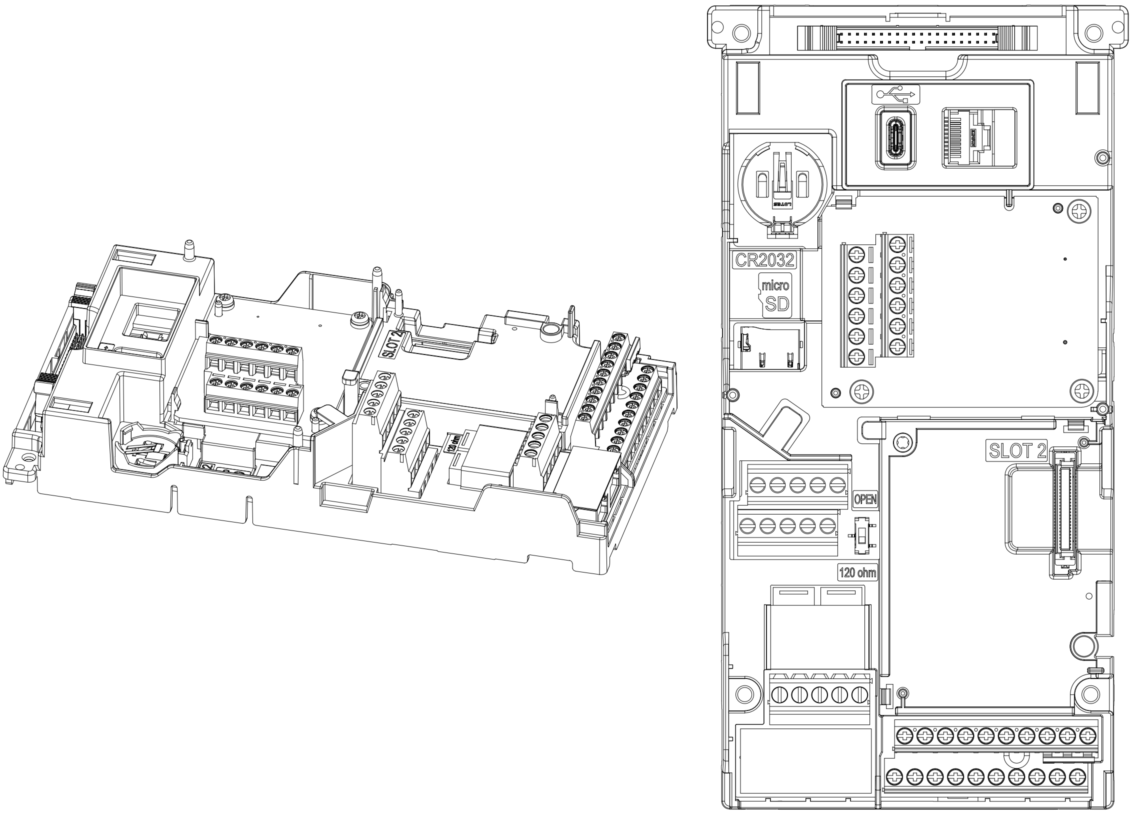


Figure 10-16

- Communication Card: EMC-COP01, CMC-EIP01, CMC-DN01, CMC-PD01, CMC-PN01
  1. Aim the connection card at the connector on the control board and insert the card.

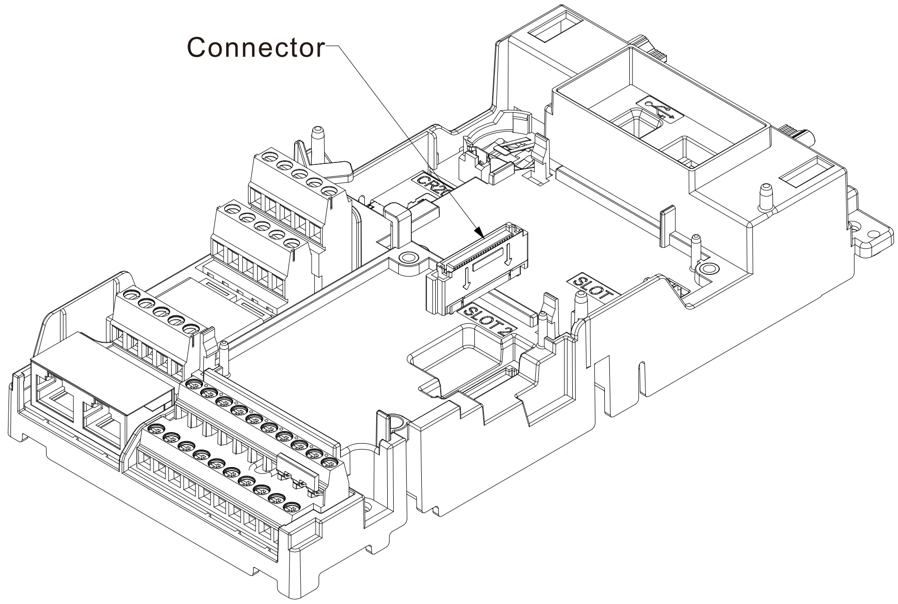


Figure 10-17

  2. Put the terminals of the communication card facing up, aim the two holes on the card at the positioning pins and press down to make the clips catch the option card.

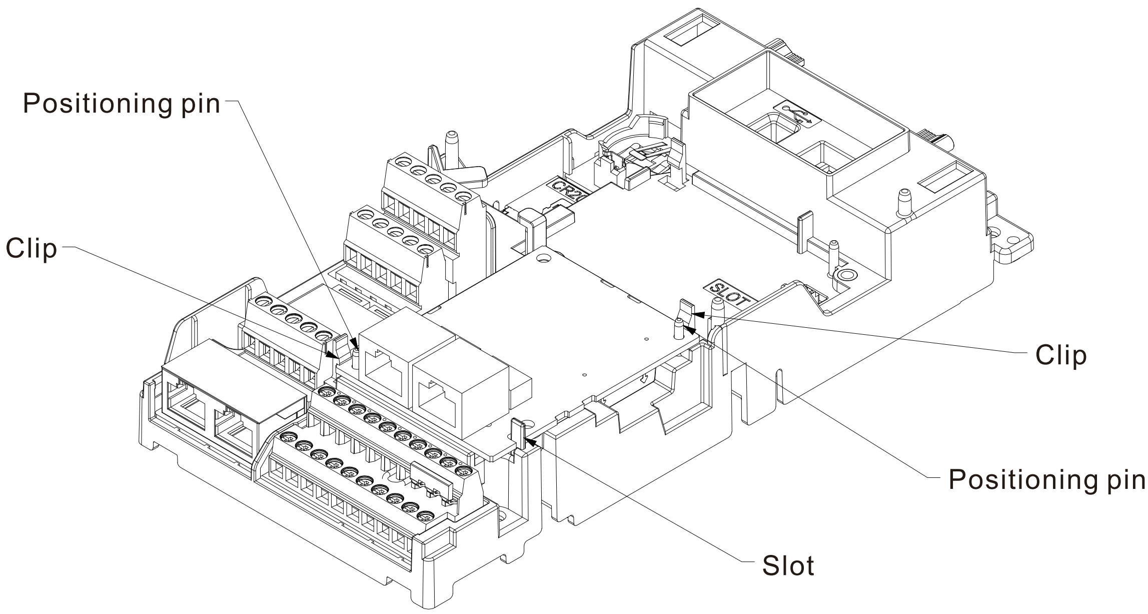


Figure 10-18

3. Fasten the screws after the communication card is clipped with the hooks.

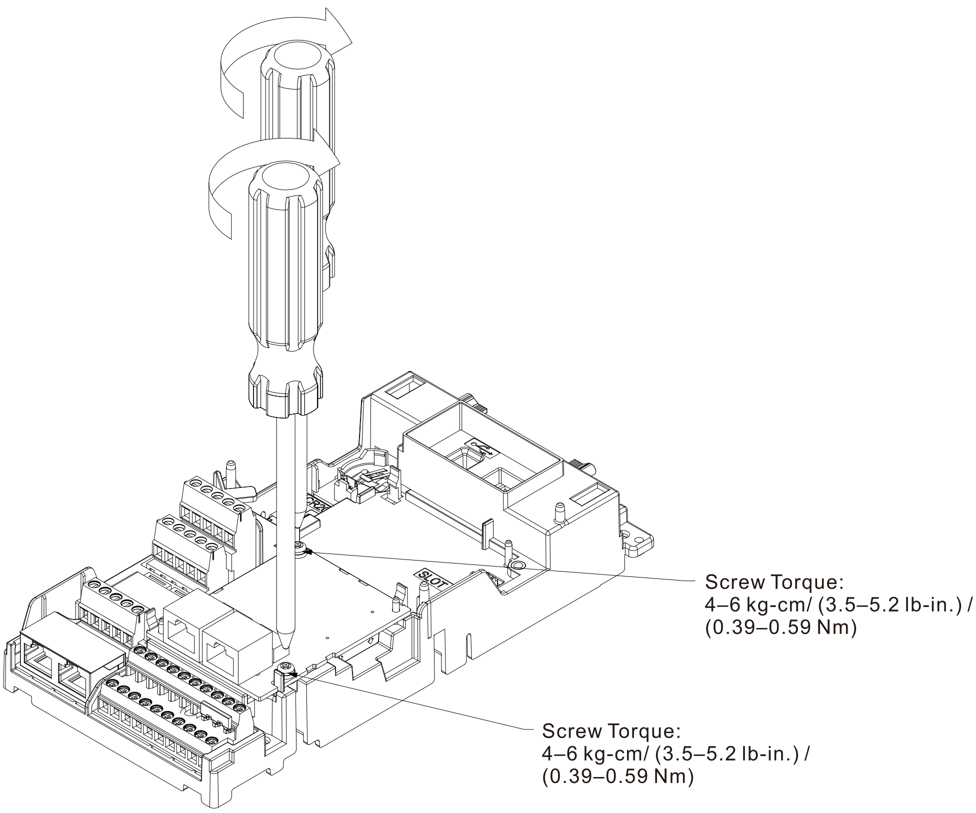


Figure 10-19

4. Installation is completed as shown in the figure below.

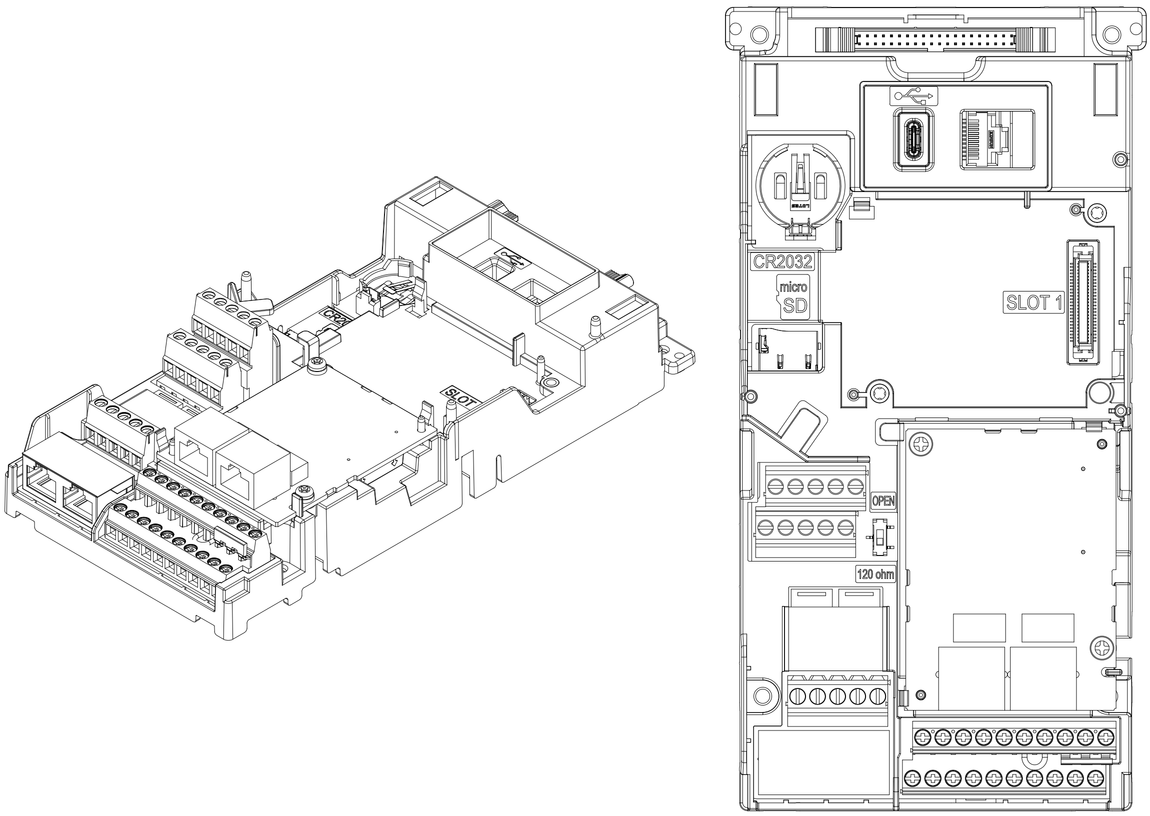
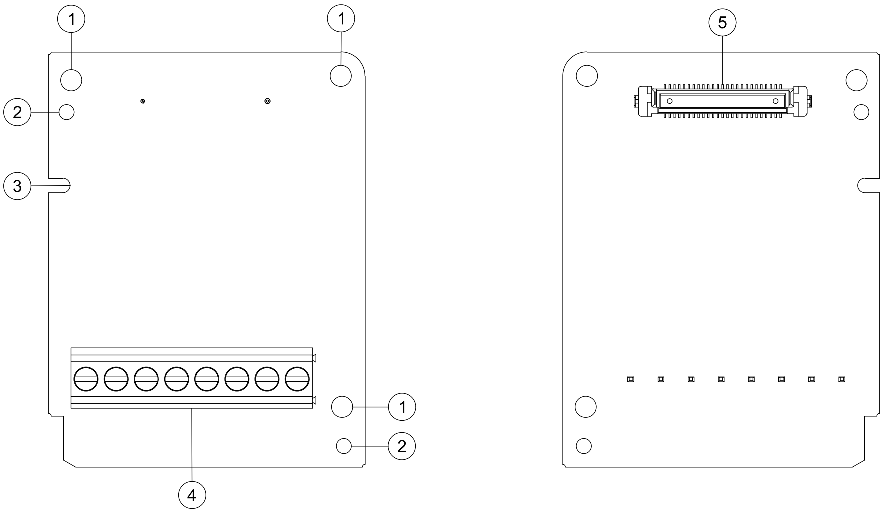


Figure 10-20

10-1-2 Extension Card for Digital Input/ Output

10-1-2-1 EMV-D42A -- Extension card for 4-point digital input/ 2-point digital input

- Product File



1. Screw fixing hole
2. Positioning hole
3. Fool-proof groove
4. Terminal block
5. AC motor drive connection port

Figure 10-21

- Terminal Specification

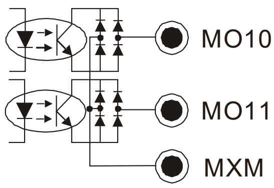
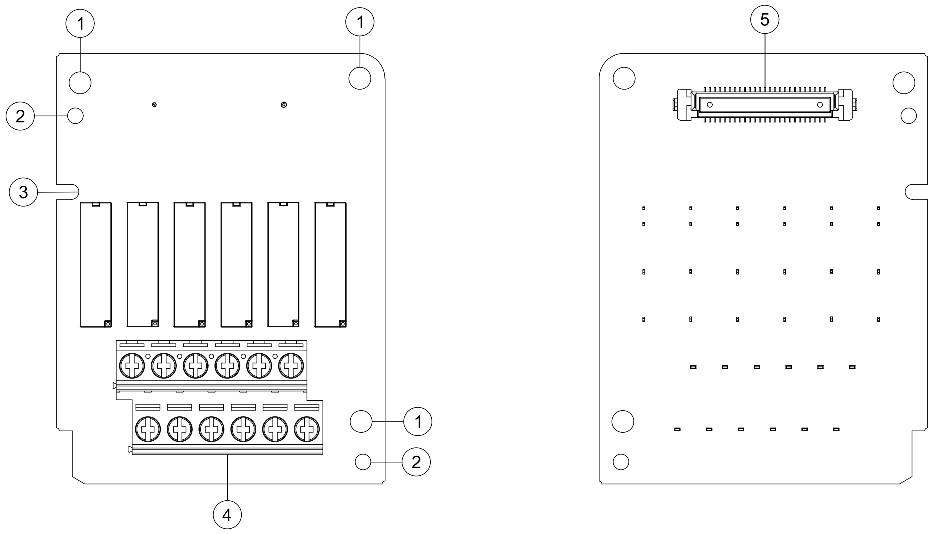
	Terminal	Descriptions
I/O Card	COM	Common for Multi-function input terminals Select SINK (NPN)/ SOURCE (PNP) in SJ1 jumper/ external power supply
	MI10–MI13	Refer to Parameter group G4 for multi-function input terminals selection. Internal power is applied from terminal E24: +24 V_{DC} ± 5% 200 mA, 5 W External power +24 V_{DC}: max. voltage 30 V_{DC}, min. voltage 19 V_{DC} ON: the activation current is 6.0 mA OFF: leakage current tolerance is 10μA
	MO10–MO11	Multi-function output terminals (photo coupler) Refer to Parameter group G5 for multi-function output terminals selection The AC motor drive releases various monitor signals, such as drive in operation, frequency attained and overload indication through a transistor.  Figure 10-22
	MXM	Common for multi-function output terminals MO10, MO11 (photo coupler) Max 48 V_{DC} 50 mA

Table 10-3

10-1-2-2 EMV-R6AA -- Relay output extension card (6-point N.O. output contact)

- Product File



1.	Screw fixing hole
2.	Positioning hole
3.	Fool-proof groove
4.	Terminal block
5.	AC motor drive connection port

Figure 10-23

- Terminal Specification

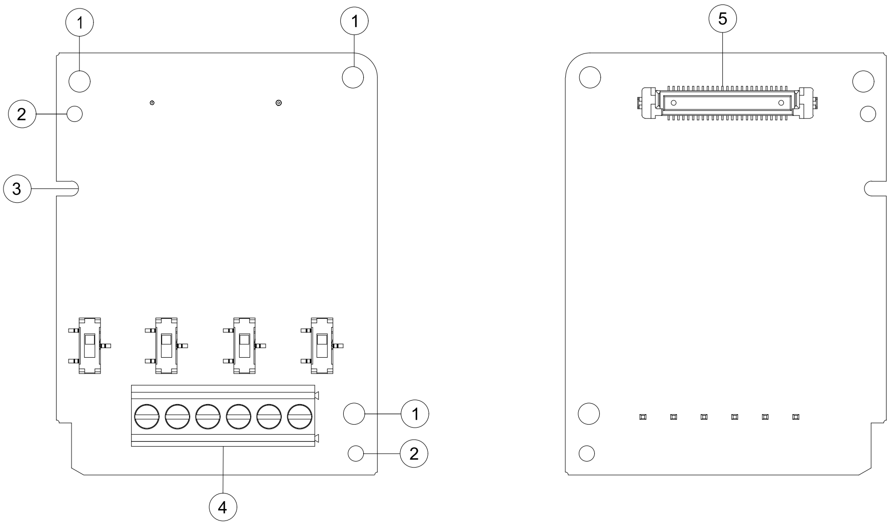
	Terminal	Descriptions
Relay Extension Card	RA10–RA15 RC10–RC15	Refer to Parameter group G5 for multi-function output terminals selection. Resistive Load 3 A (N.O.) / 250 V_{AC} 5 A (N.O.) / 30 V_{DC} Inductive Load (COS 0.4) 1.2 A (N.O.) / 250 V_{AC} 2.0 A (N.O.) / 30 V_{DC} To output various kinds of monitoring signals such as motor drive in operation, frequency reached, and overload indication.

Table 10-4

10-1-3 Extension Card for Analog Input/ Output

10-1-3-1 EMV-A22A -- Extension card for 2-point analog input/ 2-point analog output

- Product File



1. Screw fixing hole
2. Positioning hole
3. Fool-proof groove
4. Terminal block
5. AC motor drive connection port

Figure 10-24

- Terminal Specification

<table>
<tr><th></th><th>Terminal</th><th colspan="2">Descriptions</th></tr>
<tr><td rowspan="3">Analog I/O Card</td><td rowspan="3">AI10, AI11</td><td colspan="2">Refer to Parameter group G6 for analog input terminal and input mode selection.
There are two sets of AI port, SSW3 (AI10) and SSW4 (AI11), which can be switched to Voltage or Current mode.
Voltage mode: Input 0–10 V
Current mode: Input 0–20 mA / 4–20 mA</td></tr>
<tr><td>Analog voltage frequency command

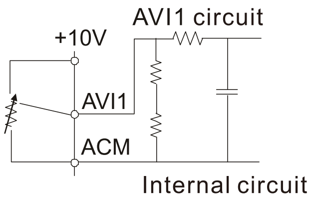



Figure 10-25</td><td>Impedance: 20 kΩ
Range: 0–10 V = 0
AI10, AI11 Switch, default is 0–10 V</td></tr>
<tr><td>Analog current frequency command

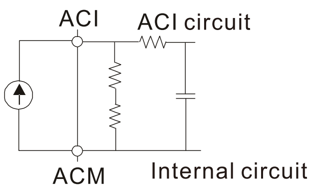



Figure 10-26</td><td>Impedance: 250 Ω
Range: 0–20 mA / 4–20 mA = 0
AI10, AI11 Switch, default is 0–10 V</td></tr>
</table>

<table>
<tr><td rowspan="4"></td><td rowspan="3">AO10, AO11</td><td colspan="2">Refer to Parameter group G7 for analog output terminal and output mode selection.
There are two sets of AO port, SSW1 (AO10) and SSW2 (AO11), which can be switched to Voltage or Current mode.
Voltage mode: Output 0–10 V
Current mode: Output 0–20 mA / 4–20 mA</td></tr>
<tr><td rowspan="2">Multi-function analog voltage output

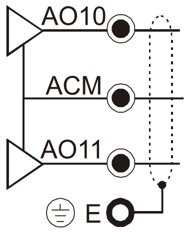



Figure 10-27</td><td>AVO:
0–10 V Max. output current 2 mA, Max. load 5 kΩ
Output current: 2mA max
Resolution: 10 mV (10V/1000)
Switch: AI10 / AI11 Switch, default is 0–10 V</td></tr>
<tr><td>ACO:
0–20 mA, Max. load 500 kΩ
Output current: 20 mA max
Resolution: 20 uA (20 mA/1000)
Switch: AI10 / AI11 Switch, default is 0–10 V</td></tr>
<tr><td>ACM</td><td>Analog Signal Common</td><td>Analog signal common terminal</td></tr>
</table>

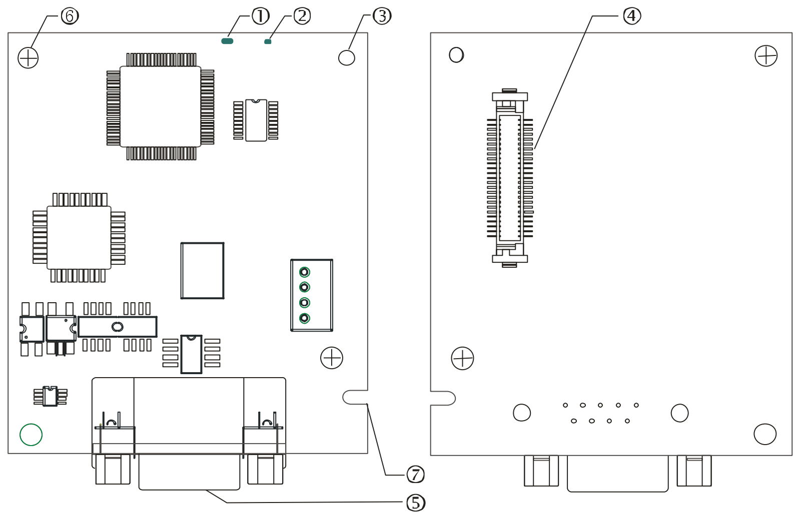
Table 10-5

10-1-4 Extension Card for RS-485

10-1-4-1 CMC-PD01 -- Communication card, PROFIBUS DP

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

- Product File



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

Figure 10-28

- Specifications

PROFIBUS DP Connector

Connector	DB9 connector
Transmission Method	High-speed RS-485
Transmission Cable	Shielded twisted pair cable
Electrical Isolation	500 V_{DC}

Table 10-6

Communication

Message Type	Cyclic data exchange
Module Name	CMC-PD01
GSD Document	DELA08DB.GSD
Company ID	08DB (HEX)
Serial Transmission Speed Supported (Auto-detection)	9.6 Kbps; 19.2 Kbps; 93.75 Kbps; 187.5 Kbps; 500 Kbps; 1.5 Mbps; 3 Mbps; 6 Mbps; 12 Mbps (bit per second)

Table 10-7

Electrical Specification

Power Supply Voltage	5 V_{DC} (supplied by the AC motor drive)
Insulation Voltage	500 V_{DC}
Power Consumption	1 W
Weight	28 g

Table 10-8

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: -10–50ºC (temperature), 90% (humidity) Storage: -25–70ºC (temperature), 95% (humidity)
Shock / Vibration Resistance	International standards: IEC61131-2, IEC60068-2-6 (TEST Fc) / IEC61131-2 & IEC60068-2-27 (TEST Ea)

Table 10-9

- 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

Table 10-10

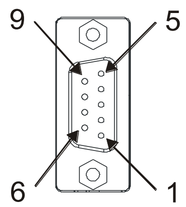


Figure 10-29

- LED Indicator & Troubleshooting

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

POWER LED

LED Status	Indication	Corrective Action
Green light ON	Power spply is in normal status	--
OFF	No power	Check if the connection between CMC-PD01 and AC motor drive is normal.

Table 10-11

NET LED

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

Table 10-12

10-1-4-2 CMC-DN01 -- Communication card, DeviceNet

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

- Product File

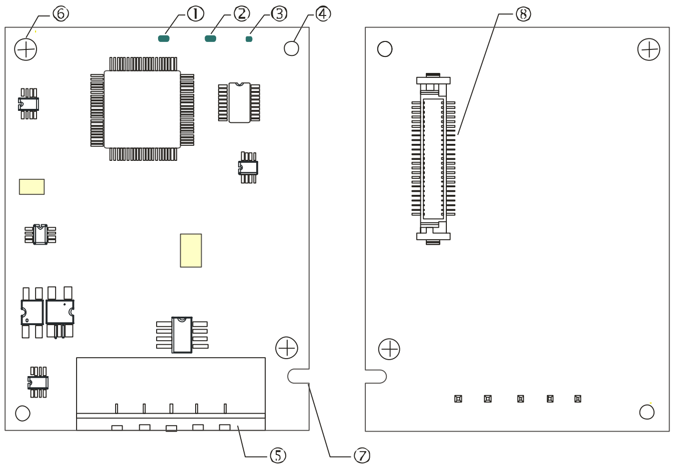


Figure 10-30

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

- Specifications

DeviceNet Connector

Connector	5-PIN open removable connector of 5.08 mm PIN interval
Transmission Method	CAN
Transmission Cable	Shielded twisted pair cable (with 2 power cables)
Transmission Speed	125 Kbps, 250 Kbps, 500 Kbps and extendable serial transmission speed
Network Protocol	DeviceNet Protocol

Table 10-13

AC Motor Drive Connection Port

Connector	50 PIN communication terminal
Transmission Method	SPI communication
Terminal Function	1. Communicating with AC motor drive 2. Transmitting power supply from AC motor drive
Communication	Delta HSSP protocol

Table 10-14

Electrical Specification

Power Supply Voltage	5 V_{DC} (supplied by the AC motor drive)
Insulation Voltage	500 V_{DC}
Communication Cable	0.85 W
Power Consumption	1 W
Weight	23 g

Table 10-15

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: -10–50ºC (temperature), 90% (humidity) Storage: -25–70ºC (temperature), 95% (humidity)
Shock / Vibration Resistance	International standards: IEC61800-5-1, IEC60068-2-6 / IEC61800-5-1, IEC60068-2-27

Table 10-16

- Installation

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

Table 10-17

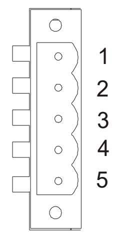


Figure 10-31

- LED Indicator & Troubleshooting

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

POWER LED

LED Status	Indication	Corrective Action
OFF	Power supply is in abnormal status	Check the power supply of CMC-DN01.
Green light ON	Power spply is in normal status.	--

Table 10-18

NS LED

LED Status	Indication	Corrective Action
OFF	No power supply or CMC-DN01 does not pass the MAC ID test	1. Check the power of CMC-DN01 and see if the connection is normal. 2. Make sure at least one or more nodes are on the bus. 3. Check if the serial transmission speed of CMCDN01 is the same as that of other nodes.
Green light flashes	CMC-DN01 is on-line but does not connect to the master	1. Configure CMC-DN01 to the scan list of the master. 2. Re-download the configured data to the master.
Green light ON	CMC-DN01 is on-line and normally connects to the master	--
Red light flashes	CMC-DN01 is on-line, but I/O connection is timed-out	1. Check if the network connection is normal. 2. Check if the master operates normally.
Red light ON	The communication is down MAC ID test failure No network power supply 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

Table 10-19

MS LED

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

Table 10-20

10-1-4-3 EMC-COP01 -- Communication card, CANopen

- Terminating Resistor Position

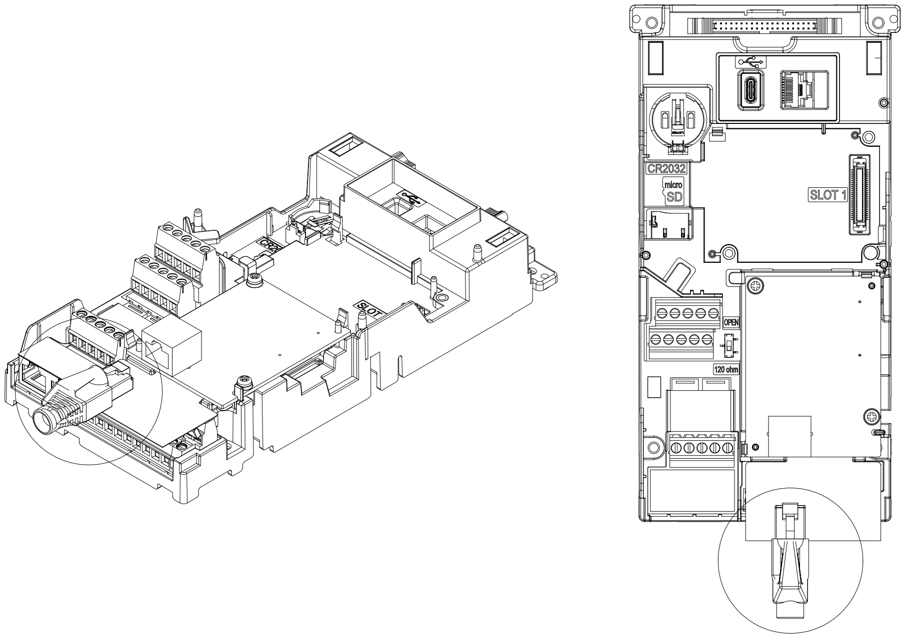
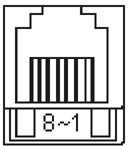


Figure 10-32

- RJ45 Pin Definition



RS-485 socket

Figure 10-33

PIN	Signal	Descriptions
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-

Table 10-21

- Specifications

Connector	RJ45
Number of Ports	2 Ports
Transmission Method	CAN
Transmission Cable	CAN standard cable
Transmission Speed	1 Mbps; 500 Kbps; 250 Kbps; 125 Kbps; 100 Kbps; 50 Kbps
Network Protocol	CANopen protocol

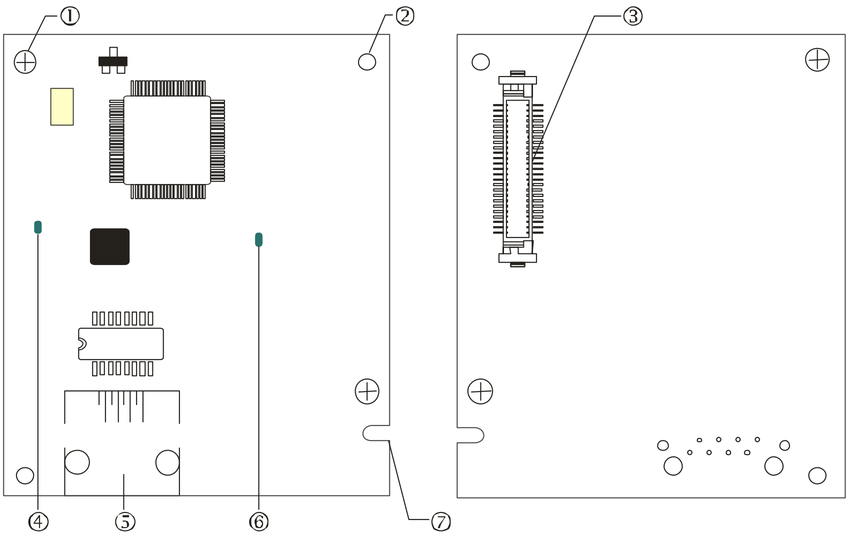
Table 10-22

10-1-5 Extension Card for EtherNet

10-1-5-1 CMC-EIP01 -- Communication card, EtherNet/IP

- Features
  1. Supports Modbus TCP and Ethernet/IP protocol
  2. User-defined corresponding parameters (use with EIP V1.06 and above)
  3. IP filter simple firewall function
  4. MDI / MDI-X auto-detect
  5. Baud rate: 10 / 100 Mbps auto-detect

- Product File



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

Figure 10-34

- Specifications

Network Interface

Connector	RJ45 with auto MDI/MDIX
Number of Ports	1 Port
Transmission Method	IEEE 802.3, IEEE 802.3u
Transmission Cable	Category 5e shielding 100M
Transmission Speed	10/100 Mbps Auto-Detect
Network Protocol	ICMP, IP, TCP, UDP, DHCP, BOOTP, SMTP, EhterNet/IP, Modbus TCP

Table 10-23

Electrical Specification

Weight	25 g
Insulation Voltage	500 V_{DC}
Power Consumption	0.8 W
Power Supply Voltage	5 V_{DC}

Table 10-24

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: -10–50ºC (temperature), 90% (humidity) Storage: -25–70ºC (temperature), 95% (humidity)
Shock / Vibration Resistance	International standards: IEC61800-5-1, IEC60068-2-6 / IEC61800-5-1, IEC60068-2-27

Table 10-25

- Installation

Connecting CMC-EIP01 to Network

1. Turn off the power of the drive
2. Open the cover of the AC motor drive
3. Connect a CAT-5e network cable to the RJ45 port on the CMC-EIP01, as shown in the figure on the right.

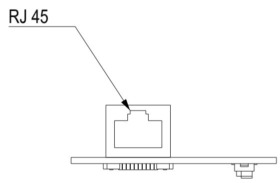


Figure 10-35

RJ45 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

Table 10-26

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

Table 10-27

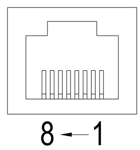


Figure 10-36

- VP3000 Communication Parameters Settings for Connecting to Ethernet

When the VP3000 is connected to an Ethernet network, set up the communication parameters for it according to the table below. The Ethernet master is only able to read and write the frequency words and control word of VP3000 after the communication parameters are set.

Parameter	Description	Set Value (Dec)	Definition
A1-00	EX1/EX2 Switch Src	0	EX1 selection
A1-01	EX1 OPER Cmd Src	10	COM Card
C1-00	EX1 Main & Aux FREQ Math	0	0: Main FREQ
C1-01	EX1 Main FREQ Src	4	COM Card
n5-00	EtherNET Decoding Method	0 or 1	Delta drive decoding method
n5-01	EtherNET IP Configuration	0	Static IP (0)
n5-02	EtherNET IP Address 1	192	IP address 192.168.1.5
n5-03	EtherNET IP Address 2	168	IP address 192.168.1.5

Parameter	Description	Set Value (Dec)	Definition
n5-04	EtherNET IP Address 3	1	IP address 192.168.1.5
n5-05	EtherNET IP Address 4	5	IP address 192.168.1.5
n5-06	EtherNET Mask Address 1	255	Netmask 255.255.255.0
n5-07	EtherNET Mask Address 2	255	Netmask 255.255.255.0
n5-08	EtherNET Mask Address 3	255	Netmask 255.255.255.0
n5-09	EtherNET Mask Address 4	0	Netmask 255.255.255.0
n5-10	EtherNET Gateway Address 1	192	Default gateway 192.168.1.1
n5-11	EtherNET Gateway Address 2	168	Default gateway 192.168.1.1
n5-12	EtherNET Gateway Address 3	1	Default gateway 192.168.1.1
n5-13	EtherNET Gateway Address 4	1	Default gateway 192.168.1.1

Table 10-28

- LED Indicator & Troubleshooting

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

LED Indicators

LED	Status		Indication	Corrective Action
POWER	Green	ON	Power supply in normal status	--
		OFF	No power supply	Check the power supply
LINK	Green	ON	Network connection is in normal status	--
		Flashes	Network is in operation	--
		OFF	Network is not connected	Check if the network cable is connected

Table 10-29

Troubleshooting

Abnormality	Cause	Corrective Action
POWER LED OFF	AC motor drive is not powered	Check the power of the AC motor drive, and see if the power supply is normal
	The CMC-EIP01 is not connected to the AC motor drive	Ensure that CMC-EIP01 is connected to the AC motor drive
LINK LED OFF	The CMC-EIP01 is not connected to network	Ensure that the network cable is correctly connected to network
	Poor contact to RJ45 connector	Ensure that RJ45 connector is connected to Ethernet port
Cannot find communication card	The CMC-EIP01 is not connected to network	Ensure that CMC-EIP01 is connected to network

Abnormality	Cause	Corrective Action
	The PC and CMC-EIP01 are in different network and blocked by network firewall	Search by IP or set up relevant settings by the AC motor drive keypad
Cannot open CMC-EIP01 setup page	The CMC-EIP01 is not connected to network	Ensure that CMC-EIP01 is connected to network
	Incorrect communication setting in DCISoft	Ensure that the communication setting in DCISoft is set to Ethernet
Cannot open CMC-EIP01 setup page	The PC and CMC-EIP01 are in different network and blocked by network firewall	Set up with the AC motor drive keypad
The CMC-EIP01 setup page opens successfully but webpage monitoring is unavailable	Incorrect network setting in CMC-EIP01	Check if the network setting for CMC-EIP01 is correct. For the Intranet setting in your company, consult your IT staff. For the Internet setting in your home, refer to the network setting instruction provided by your ISP.
Cannot send e-mail	Incorrect network setting in CMC-EIP01	Check if the network setting for CMC-EIP01 is correct
	Incorrect mail server setting	Confirm the IP address for SMTP-Server

Table 10-30

10-1-5-2 CMC-PN01 -- Communication card, PROFINET

- Features

CMC-PN01 connects VP3000 drive to PROFINET to exchange data with the host controller easily. This simple network solution saves cost and time for connection and installation of factory automation. Moreover, its components are compatible with suppliers.'

By installing CMC-PN01 in VP3000 through the main PROFINET device, you can:

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

- Product File

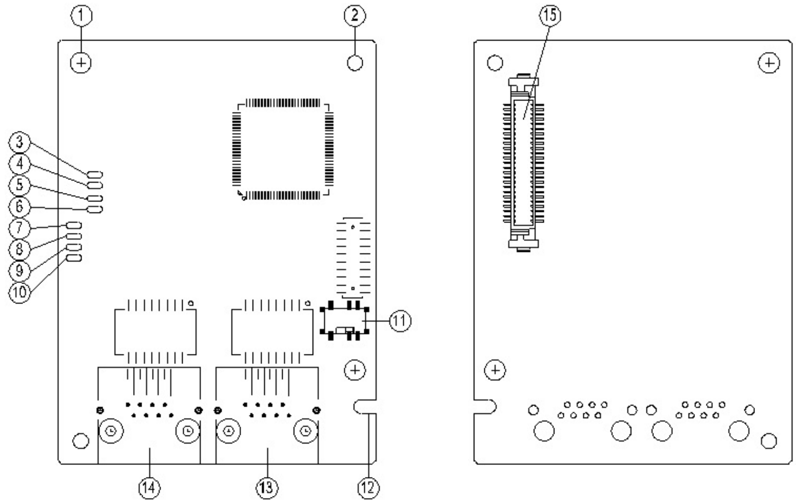


Figure 10-37

1. Screw fixing hole
2. Positioning hole
3. Ready out indicator
4. MT out indicator
5. SD indicator
6. BF out indicator
7. ACT PHY2 indicator
8. Link PHY2 indicator
9. ACT PHY1 indicator
10. Link PHY1 indicator
11. ON/ OFF switch
12. Fool-proof groove
13. RJ45 port (Port 2)
14. RJ45 port (Port 1)
15. A port to connect with control board

Label with MAC address

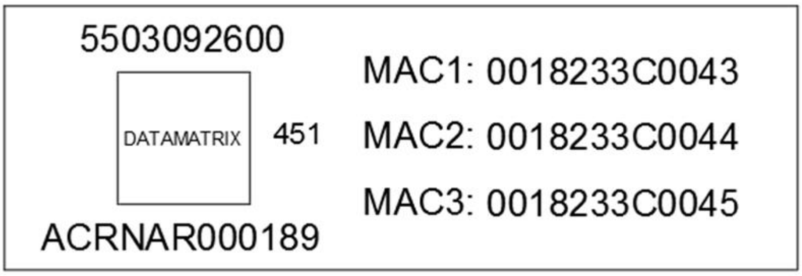


Figure 10-38

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

Table 10-31

- ## Specifications

Network Interface

Connector	RJ45
Number of Ports	2 Ports
Transmission Method	IEEE 802.3
Transmission Cable	Category 5e shielding 100 M
Transmission Speed	10/100 Mbps auto-negotiate
Network Protocol	PROFINET

Table 10-32

Electrical Specification

Power Supply Voltage	5 V_{DC}
Power Consumption	0.8 W
Insulation Voltage	500 V_{DC}
Weight (g)	27

Table 10-33

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 Temperature	-10–50ºC (temperature), 90% (humidity)
Storage Temperature	-25–50ºC (temperature), 95% (humidity)
Shock / Vibration Resistance	International standards: IEC61800-5-1, IEC60068-2-6 / IEC61800-5-1, IEC60068-2-27

Table 10-34

- ## Installation

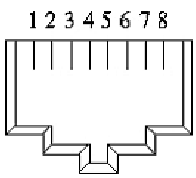
RJ45	PIN	Definition	Descriptions
 Figure 10-39	1	Tx+	Positive pole for data transmission
	2	Tx-	Negative pole for data transmission
	3	Rx+	Positive pole for data receiving
	4	--	N/C
	5	--	N/C
	6	Rx-	Negative pole for data receiving
	7	--	N/C
	8	--	N/C

Table 10-35

- VP3000 Communication Parameters Settings for Connecting to PROFINET

When you operate VP3000 through CMC-PN01, set up the communication card as the source of VP3000 controls and settings. You need to use the keypad to configure the following parameter addresses to the corresponding values:

Parameters	Setting Value	Description
A1-00	0	EX1/EX2 Switch Src
A1-01	10	EX1 OPER Cmd Src
C1-00	0	EX1 Main & Aux FREQ Math
C1-01	4	EX1 Main FREQ Src
n5-00	1 or 2	EtherNET Decoding Method
n0-03	12	COM Card ID: when connecting with CMC-PN01, the parameter shows 12.

Table 10-36

- LED Indicator Instruction

<table>
<tr><th>Name</th><th colspan="2">Status</th><th>Indication</th></tr>
<tr><td rowspan="3">Ready out indicator</td><td rowspan="3">Yellow LED</td><td>Always ON</td><td>PN Stack starts normally</td></tr>
<tr><td>Flashes</td><td>PN Stack starts normally, and waiting for syncing with MCU</td></tr>
<tr><td>OFF</td><td>PN Stack failed to start</td></tr>
<tr><td>MT out indicator</td><td>Green</td><td>-</td><td>-</td></tr>
<tr><td>SD indicator</td><td>Red LED</td><td>-</td><td>-</td></tr>
<tr><td rowspan="3">BF out indicator</td><td rowspan="3">Red LED</td><td>Always ON</td><td>Connection with PROFINET Controller is interrupted</td></tr>
<tr><td>Flashes</td><td>Connection is in normal state, but the communication with PROFINET Controller is abnormally</td></tr>
<tr><td>OFF</td><td>Connection with PROFINET Controller is in normal state</td></tr>
<tr><td rowspan="3">ACT PHY1 indicator</td><td rowspan="3">Orange LED</td><td>Always ON</td><td>It’s online, and exchanging the data with Master normally</td></tr>
<tr><td>Flashes</td><td>It’s offline, but hand shaking the data with Master</td></tr>
<tr><td>OFF</td><td>Initial state</td></tr>
<tr><td rowspan="2">LINK PHY1 indicator</td><td rowspan="2">Green</td><td>Always ON</td><td>Network connection is in normal status</td></tr>
<tr><td>OFF</td><td>Network is not connected</td></tr>
<tr><td rowspan="3">ACT PHY2 indicator</td><td rowspan="3">Orange LED</td><td>Always ON</td><td>It’s online, and exchanging the data with Master normally</td></tr>
<tr><td>Flashes</td><td>It’s offline, but hand shaking the data with Master</td></tr>
<tr><td>OFF</td><td>Initial state</td></tr>
<tr><td rowspan="2">LINK PHY2 indicator</td><td rowspan="2">Green</td><td>Always ON</td><td>Network connection is in normal status</td></tr>
<tr><td>OFF</td><td>Network is not connected</td></tr>
</table>

Table 10-37

- Network Connection

The wiring of CMC-PN01 shows as follows:

Figure 10-40

When the installation is finished, supply electricity to the drive. The Pr. n0-03 of the drive should be able to display “PROFINET” with a current value of 12. If not, make sure your version of the drive is correct and the communication card is correctly connected.

10-2 Delta Standard Fieldbus Cables

Type	Delta Standard Fieldbus Cables	Model	Description	Length
RS-485	CANopen Cable / RJ45 Extension Cable for Keypad	UC-CMC003-01A	CANopen cable, RJ45 connector	0.3 m
		UC-CMC005-01A	CANopen cable, RJ45 connector	0.5 m
		UC-CMC010-01A	CANopen cable, RJ45 connector	1 m
		UC-CMC015-01A	CANopen cable, RJ45 connector	1.5 m
		UC-CMC020-01A	CANopen cable, RJ45 connector	2 m
		UC-CMC030-01A	CANopen cable, RJ45 connector	3 m
		UC-CMC050-01A	CANopen cable, RJ45 connector	5 m
		UC-CMC100-01A	CANopen cable, RJ45 connector	10 m
		UC-CMC200-01A	CANopen cable, RJ45 connector	20 m
	DeviceNet Cable	UC-DN01Z-01A	DeviceNET cable	305 m
		UC-DN01Z-02A	DeviceNET cable	305 m
	PROFIBUS Cable	UC-PF01Z-01A	PROFIBUS DP cable	305 m
EtherNet	EtherNet/ EtherCAT Cable	UC-EMC003-02C	Ethernet / EtherCAT cable, Shielding	0.3 m
		UC-EMC005-02C	Ethernet / EtherCAT cable, Shielding	0.5 m
		UC-EMC010-02C	Ethernet / EtherCAT cable, Shielding	1 m
		UC-EMC020-02C	Ethernet / EtherCAT cable, Shielding	2 m
		UC-EMC050-02C	Ethernet / EtherCAT cable, Shielding	5 m
		UC-EMC100-02C	Ethernet / EtherCAT cable, Shielding	10 m
		UC-EMC200-02C	Ethernet / EtherCAT cable, Shielding	20 m

Table 10-38

Delta Fieldbus Cable TAP

Type	Delta Fieldbus Cable TAP	Model	Description	Length
RS-485	CANopen/ DeviceNet TAP	TAP-CN01	1 in 2 out, built-in 121 Ω terminal resistor	1 in 2 out
		TAP-CN02	1 in 4 out, built-in 121 Ω terminal resistor	1 in 4 out
		TAP-CN03	1 in 4 out, RJ45 connector, built-in 121 Ω terminal resistor	1 in 4 out

Table 10-39

10-3 Other Optional Accessories

10-3-1 AC Reactors

AC Input Reactor

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

NOTE:

1. When the power voltage exceeds the drive specification 380–480 V_{AC} with lower limit of ±20V, which is lower than 360 V_{AC} or higher than 500 V_{AC}, it is not recommended to install an AC reactor. If you need to install an AC reactor under this input voltage level, ensure that the output equivalent inductance of the transformer in the factory is less than the following recommended value:

   $$L = \frac{\text{Rated secondary voltage } V_{rms} \times \text{Short circuit impedance } \%}{\text{Rated secondary current } I_{rms} \times 2\pi \times \text{mains frequency } Hz \times 2} < 200uH$$

   For example:

   $L = \frac{480V \times 8\%}{250A \times 2\pi \times 60Hz \times 2} = 203.72uH$, then it is not recommended to install an AC input reactor.

2. If a three-phase generator is used to supply power to the drive, the generator output voltage should be set within the input voltage specification range marked on the drive, that is 380 V_{AC} ≤ V_{in} ≤ 480 V_{AC}.

Installation

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

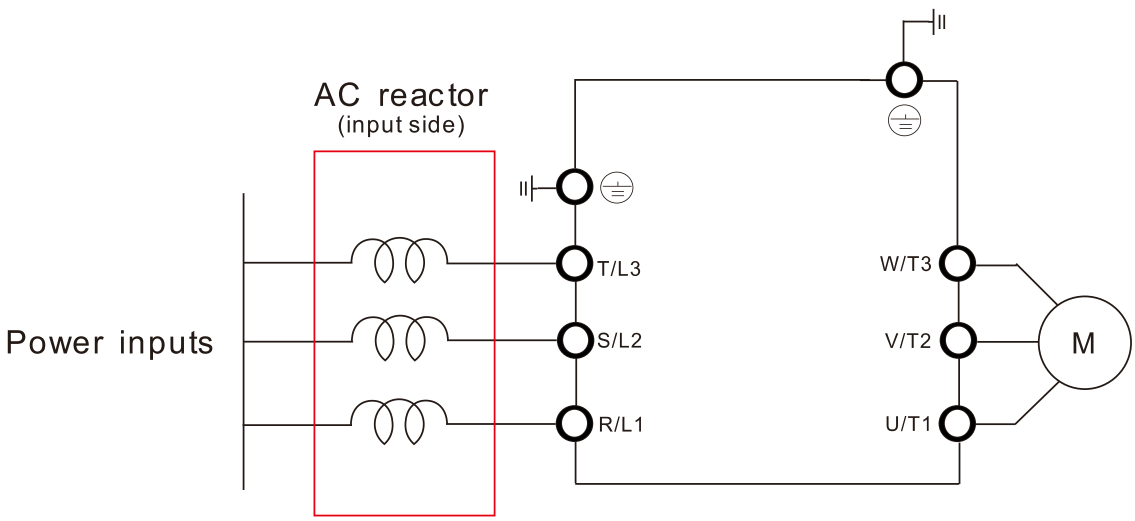


Figure 10-41

VP3000 AC Input Reactor Specifications

The following table is the recommended specifications for the Delta VP3000 AC input reactors:

380–460V, 50/ 60 Hz Normal Duty

Model	kW	HP	Rated Current (Arms)	Saturation Current (Arms)	3% Impedance (mH)	5% Impedance (mH)	Built-in DC Reactor	Input AC Reactor Delta Part #	Heat Dissipation (W)
VFD3A0VP43A	0.75	1	3	3.6	8.45	14.09	No	DR003A0810	20
VFD4A2VP43A	1.5	2	4.2	5.04	6.04	10.06	No	DR004A0607	21
VFD5A6VP43A	2.2	3	5.6	6.72	4.53	7.55	No	DR006A0405	31
VFD7A2VP43A	3	4	7.2	8.64	3.52	5.87	No	DR009A0270	40
VFD011VP43A	4	5.3	11	13.2	2.31	3.84	No	DR010A0231	50
VFD013VP43A	5.5	7.5	13	15.6	1.95	3.25	No	DR012A0202	50
VFD018VP43A	7.5	10	18	21.6	1.41	2.35	No	DR018A0117	54
VFD025VP43A	11	15	25	30	1.01	1.69	No	DR024AP881	60
VFD032VP43A	15	20	32	38.4	0.79	1.32	No	DR032AP660	80
VFD038VP43A	18.5	25	38	45.6	0.67	1.11	No	DR038AP639	85

NOTE: Table 10-40

1. The above heat dissipation is calculated based on AC reactor's rated current; the actual dissipation varies with the operation current.

AC Input Reactor Dimension and Specification:

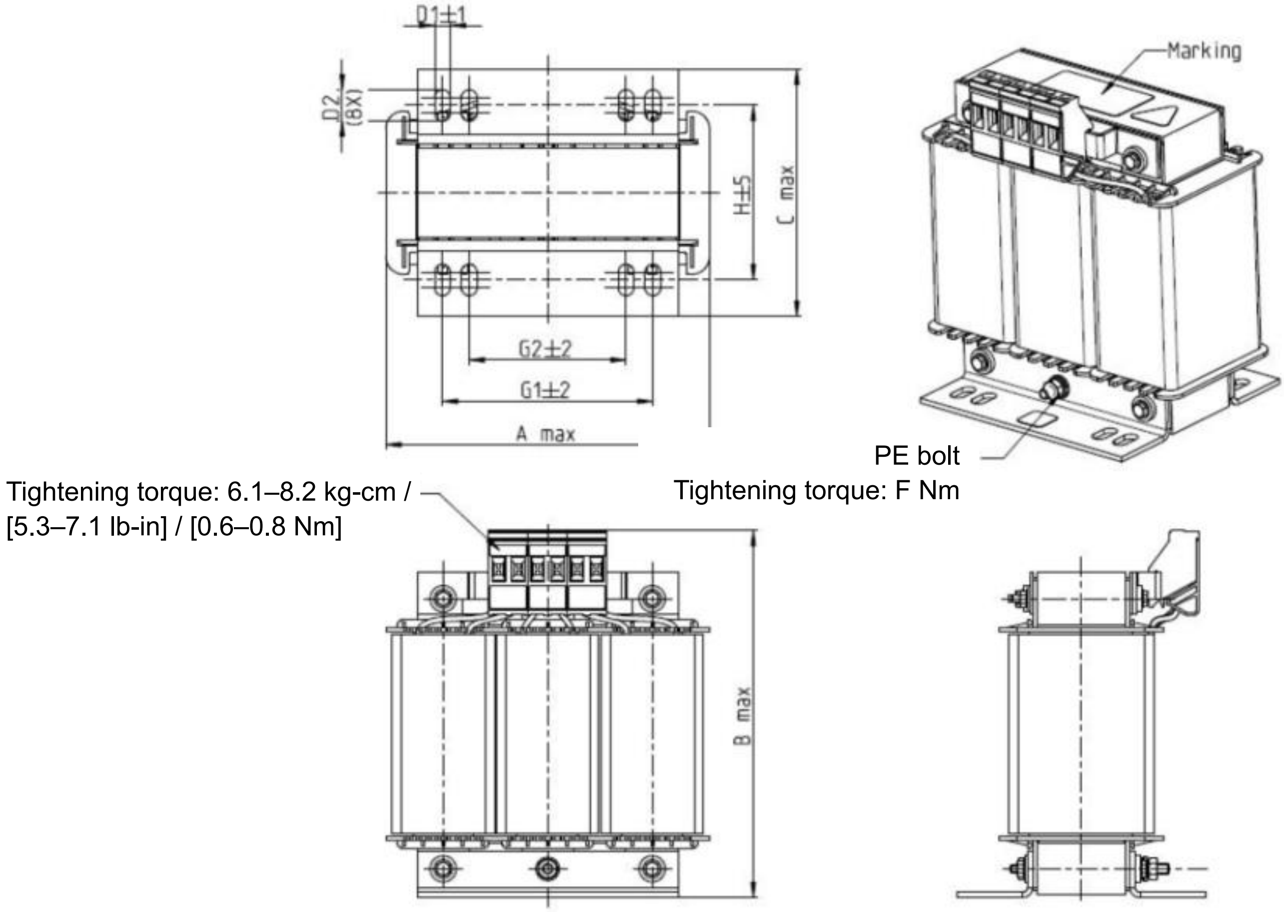


Figure 10-42

Unit: mm

Input AC Reactor Delta Part #	A	B	C	D1*D2	H	G1	G2	PE D
DR003A0810	100	125	65	6*9	43	60	40	M4
DR004A0607	100	125	65	6*9	43	60	40	M4
DR006A0405	130	15	95	6*12	60	80.5	60	M4
DR009A0270	160	160	105	6*12	75	107	75	M4
DR010A0231	160	160	115	6*12	90	107	75	M4
DR012A0202	160	160	115	6*12	90	107	75	M4
DR018A0117	160	160	115	6*12	90	107	75	M4

Table 10-41

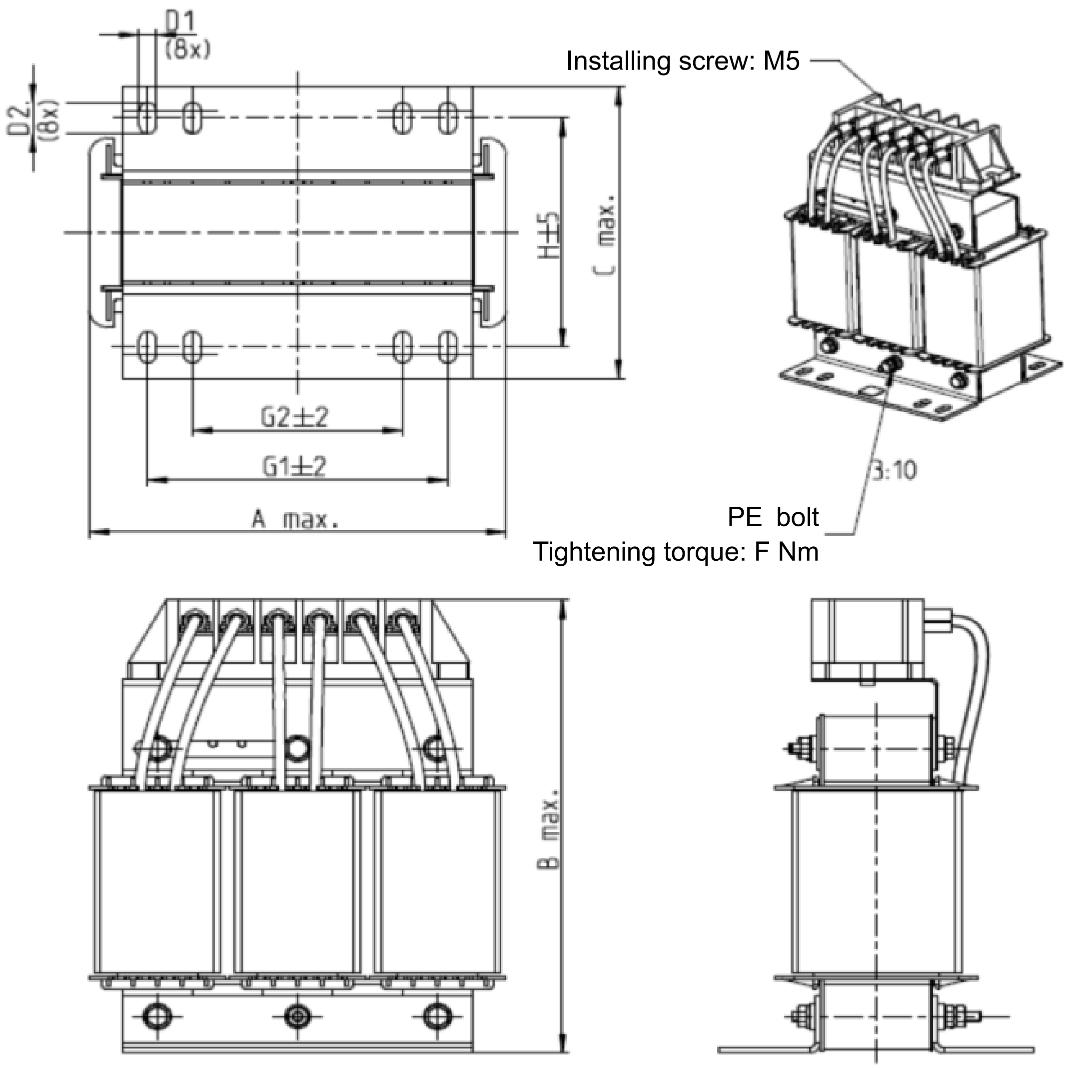


Figure 10-43

Unit: mm

Input AC Reactor Delta Part #	A	B	C	D1*D2	H	G1	G2	PE D
DR024AP881	160	175	115	6*12	90	107	75	M4
DR032AP660	195	200	145	6*12	115	122	85	M6
DR038AP639	190	200	145	6*12	115	122	85	M6

Table 10-42

AC Output Reactor

When using drives in long wiring output application, ground fault (GFF), over-current (OC) and motor over-voltage (OV) often occur. GFF and OC cause errors due to the drive's self-protective mechanism; over-voltage damages motor insulation.

The excessive length of the output wires makes the grounded stray capacitance too large, increase the three-phase output common mode current, and the reflected wave of the long wires makes the motor dv / dt and the motor terminal voltage too high. Thus, installing a reactor on the drive's output side can increase the high-frequency impedance to reduce the dv / dt and terminal voltage to protect the motor.

Installation

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

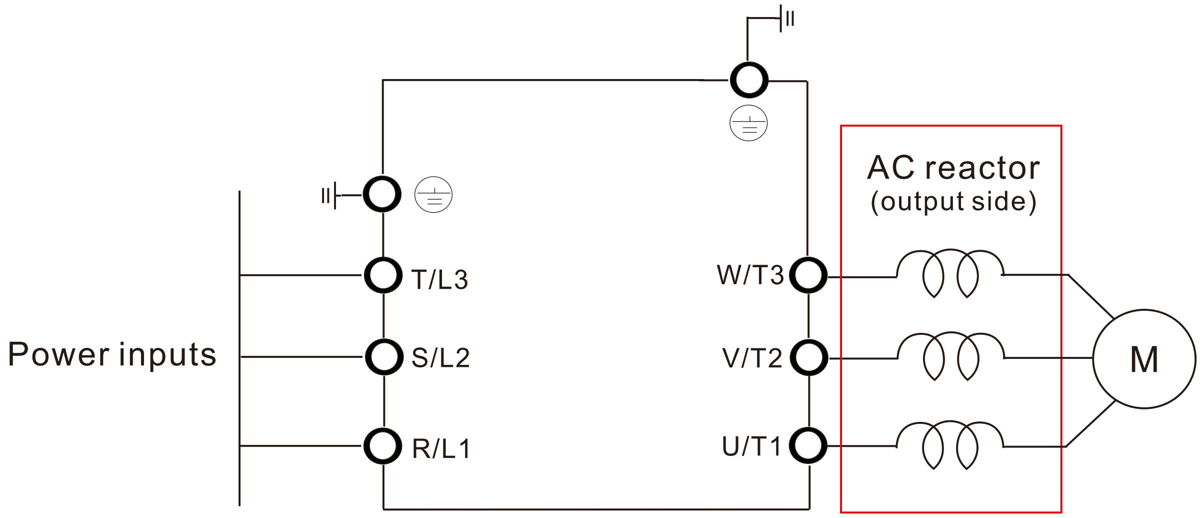


Figure 10-44

VP3000 AC Output Reactor Specifications

The following table is the specification of VP3000 AC output reactor:

380–460V, 50/ 60 Hz Normal Duty

HP	kW	HP	Rated Current (Arms)	Saturation Current (Arms)	3% Impedance (mH)	5% Impedance (mH)	Built-in DC Reactor	3% Output AC Reactor Delta Part #	Heat Dissipation (W)
VFD3A0VP43A	0.75	1	3	3.6	8.454	14.090	No	DR003L0810	13
VFD4A2VP43A	1.5	2	4.2	5.04	6.038	10.064	No	DR004L0607	18
VFD5A6VP43A	2.2	3	5.6	6.72	4.529	7.548	No	DR006L0405	22
VFD7A2VP43A	3	4	7.2	8.64	3.522	5.871	No	DR009L0270	35
VFD011VP43A	4	5.3	11	13.2	2.306	3.843	No	DR010L0231	40
VFD013VP43A	5.5	7.5	13	15.6	1.951	3.251	No	DR012L0202	45
VFD018VP43A	7.5	10	18	21.6	1.409	2.348	No	DR018L0117	48
VFD025VP43A	11	15	25	30	1.014	1.691	No	DR024LP881	52
VFD032VP43A	15	20	32	38.4	0.793	1.321	No	DR032LP660	66
VFD038VP43A	18.5	25	38	45.6	0.667	1.112	No	DR038LP639	70
VFD045VP43A	22	30	45	54	0.564	0.939	Yes	DR045LP541	85

HP	kW	HP	Rated Current (Arms)	Saturation Current (Arms)	3% Impedance (mH)	5% Impedance (mH)	Built-in DC Reactor	3% Output AC Reactor Delta Part #	Heat Dissipation (W)
VFD062VP43A	30	40	62	74.4	0.409	0.682	Yes	DR060LP405	85
VFD073VP43A	37	50	73	87.6	0.347	0.579	Yes	DR073LP334	110
VFD091VP43A	45	60	91	109.2	0.279	0.464	Yes	DR091LP267	130
VFD110VP43A	55	75	110	132	0.231	0.384	Yes	DR110LP221	150
VFD150VP43A	75	100	150	180	0.169	0.282	Yes	DR150LP162	175
VFD180VP43A	90	125	180	216	0.141	0.235	Yes	DR180LP135	195
VFD220VP43A	110	150	220	264	0.115	0.192	Yes	DR220LP110	235
VFD260VP43A	132	175	260	312	0.098	0.163	Yes	DR260LP098	285
VFD310VP43A	160	215	310	372	0.082	0.136	Yes	DR310LP078	300
VFD370VP43A	185	250	370	444	0.069	0.114	Yes	DR370LP066	345
VFD395VP43A	200	270	395	474	0.064	0.107	Yes	DR370LP066[*1]	410
VFD460VP43A	220	300	460	552	0.055	0.092	Yes	DR460LP054	410
VFD485VP43A	250	340	485	582	0.052	0.087	Yes	DR460LP054[*1]	440
VFD530VP43A	280	375	530	636	0.048	0.080	Yes	DR550LP044	440
VFD616VP43A	315	425	616	739.2	0.041	0.069	Yes	DR616LP039	465
VFD683VP43A	355	475	683	819.6	0.037	0.062	Yes	DR683LP036	495
VFD770VP43A	400	530	770	924	0.033	0.055	Yes	DR866LP028	600
VFD866VP43A	450	600	866	1039.2	0.029	0.049	Yes	DR866LP028	600
VFD930VP43A	500	665	930	1116	0.027	0.045	Yes	DR866LP028	600
VFD1K1VP43A	560	745	1100	1320	0.023	0.038	Yes	Contact Delta	
VFD1K2VP43A	630	840	1212	1454.4	0.021	0.035	Yes		

NOTE:

Table 10-43

*1: The inductance value for the above applications of Delta's reactors will be closed to, but less than 3%.

2: The above heat dissipation is calculated based on AC reactor's rated current; the actual dissipation varies with the operation current.

AC Output Reactor Dimension and Specification:

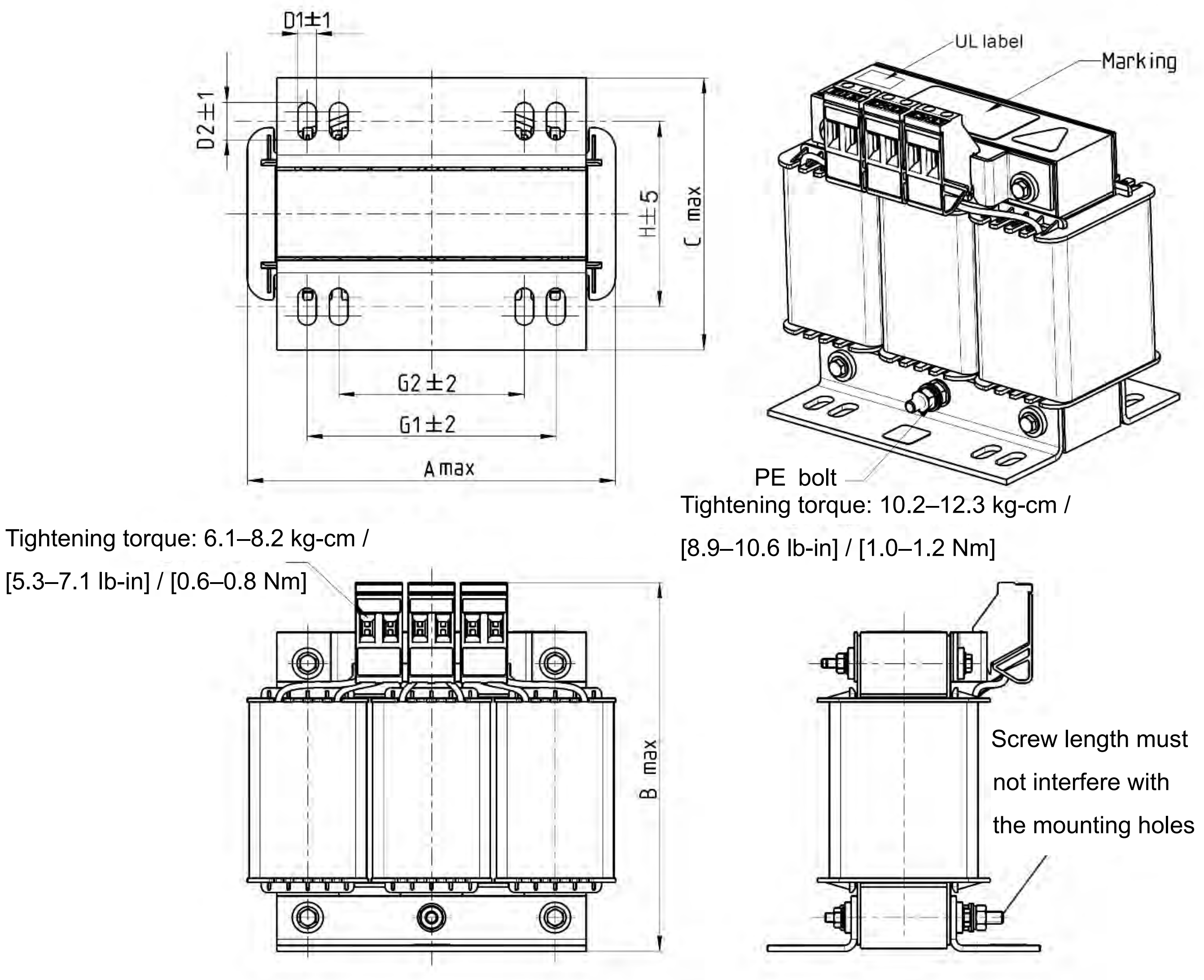


Figure 10-45

Unit: mm

Output AC Reactor Delta #	A	B	C	D1*D2	H	G1	G2	PE D
DR003L0810	96	115	65	6*9	42	60	40	M4
DR004L0607	120	135	95	6*12	60	80.5	60	M4
DR006L0405	120	135	95	6*12	60	80.5	60	M4
DR009L0270	150	160	100	6*12	74	107	75	M4
DR010L0231	150	160	115	6*12	88	107	75	M4
DR012L0202	150	160	115	6*12	88	107	75	M4
DR018L0117	150	160	115	6*12	88	107	75	M4
DR024LP881	150	160	115	6*12	88	107	75	M4
DR032LP660	180	190	145	6*12	114	122	85	M6

Table 10-44

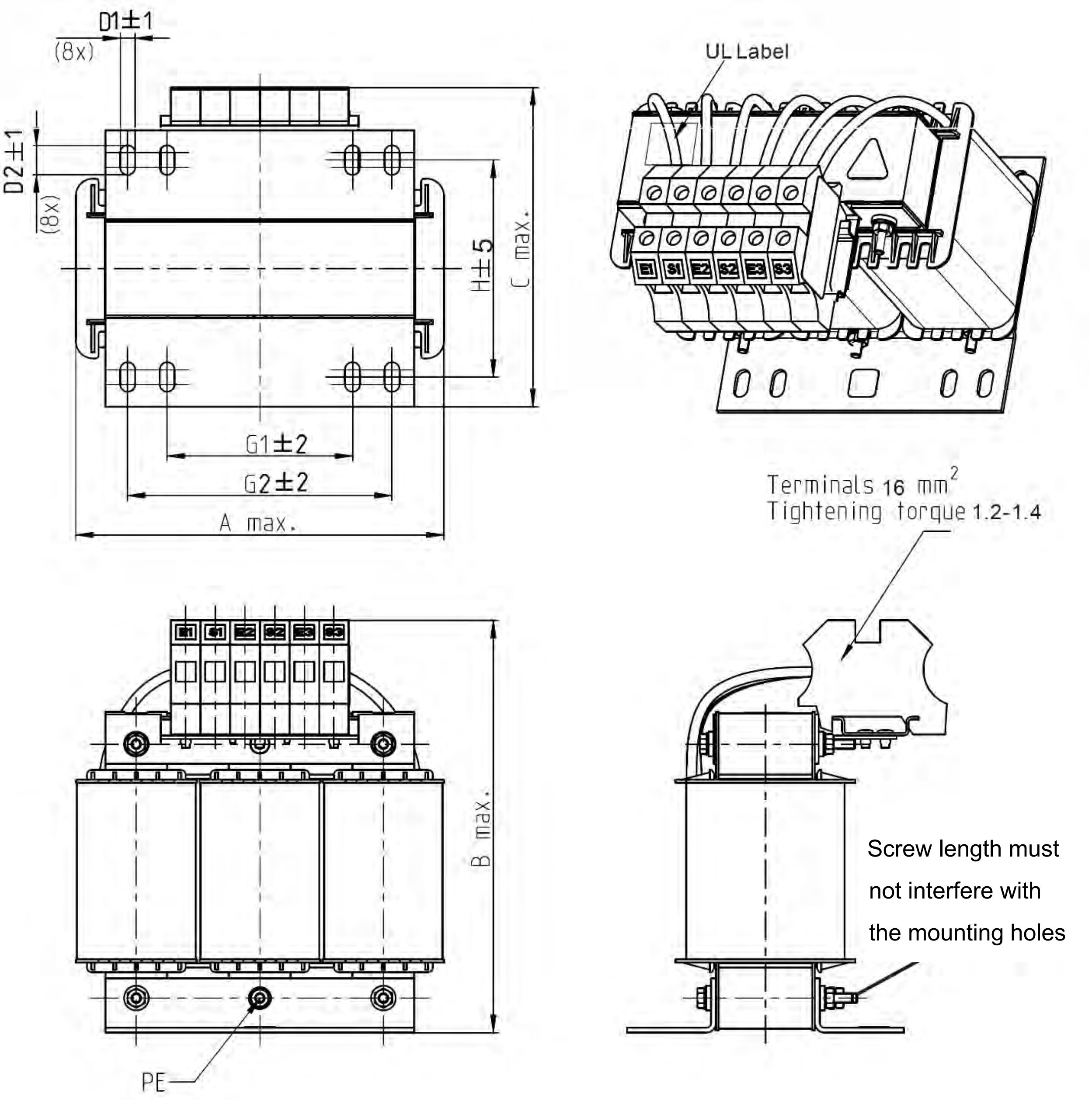


Figure 10-46

Unit: mm

Output AC Reactor Delta #	A	B	C	D1*D2	H	G1	G2	PE D
DR038LP639	180	205	170	6*12	115	85	122	M4
DR045LP541	235	245	155	7*13	85	/	176	M6

Table 10-45

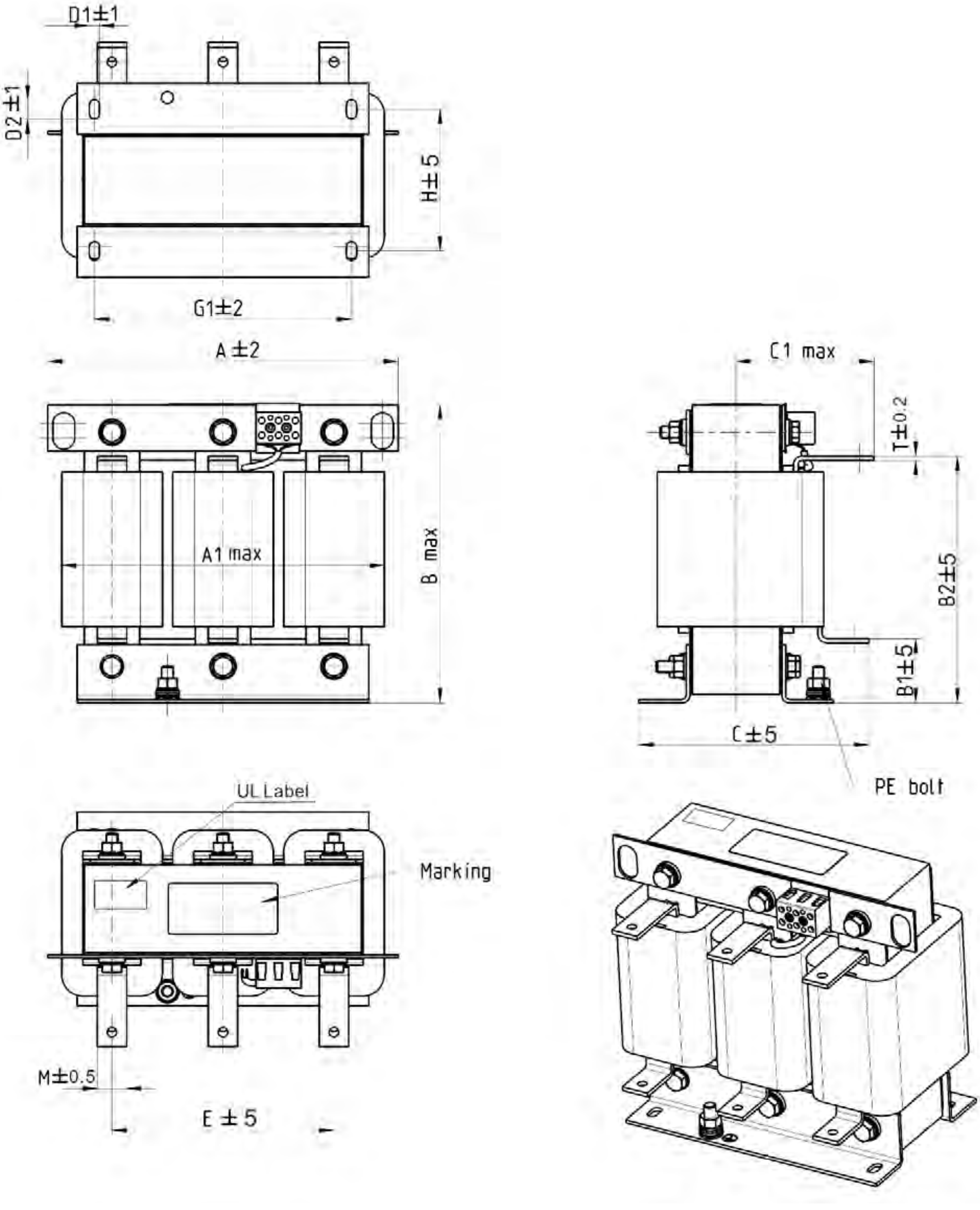


Figure 10-47

Unit: mm

Output AC Reactor Delta #	A	A1	B	B1	B2	C	C1	D1*D2	E	G1	H	M*T
DR060LP405	240	228	215	44	170	163	110	7*13	152	176	97	20*3
DR073LP334	250	235	235	44	186	174	115	11*18	160	190	124	20*3
DR091LP267	250	240	235	44	186	174	115	11*18	160	190	124	20*3
DR110LP221	270	260	245	50	192	175	115	10*18	176	200	106	20*3

Table 10-46

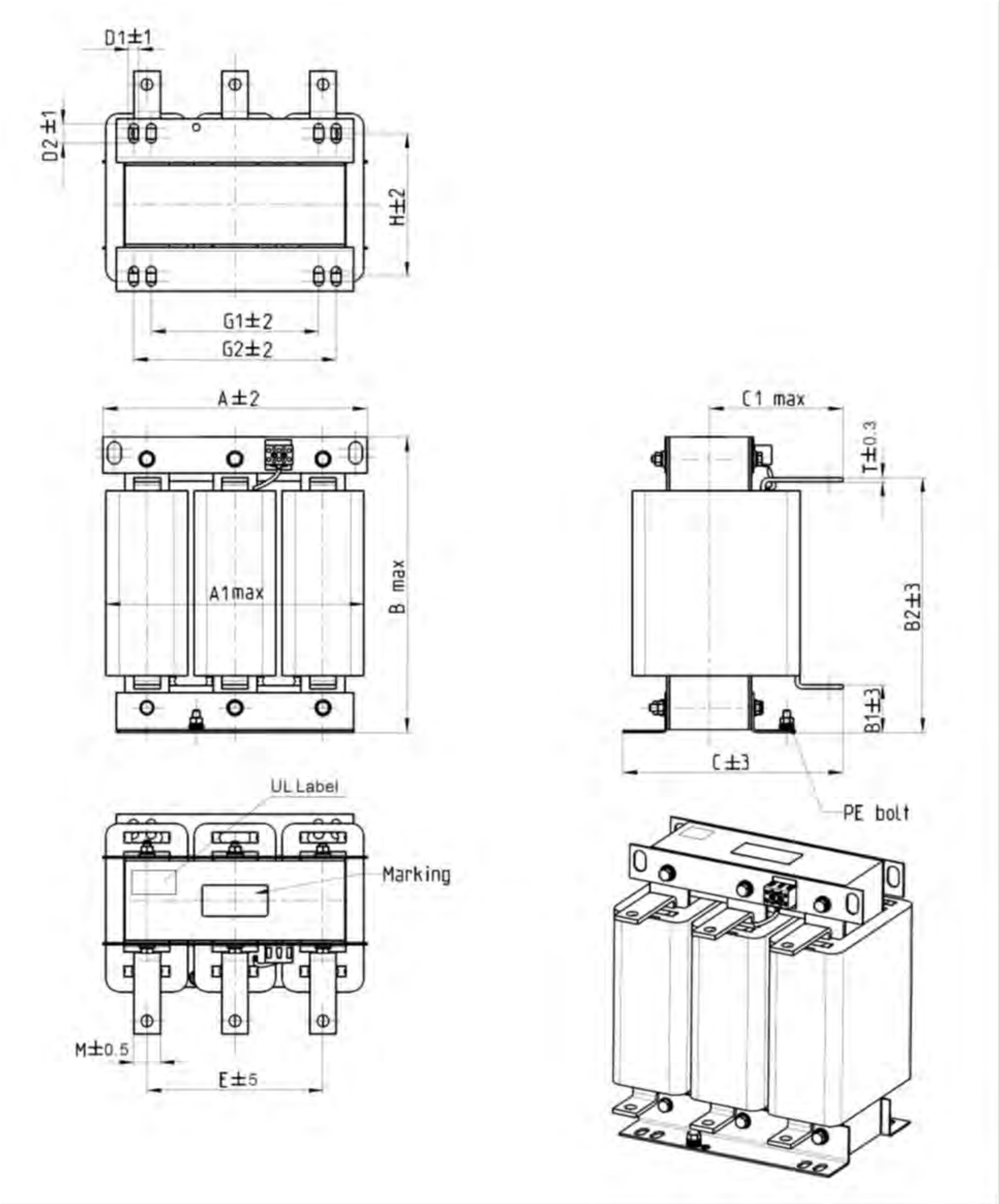


Figure 10-48

Unit: mm

Output AC Reactor Delta #	A	A1	B	B1	B2	C	C1	D1*D2	E	G1	G2	H	M*T
DR150LP162	270	264	265	51	208	192	125	10*18	176	200	/	118	30*3
DR180LP135	300	295	310	55	246	195	125	11*22	200	230	190	142	30*3
DR220LP110	300	298	310	57	248	210	140	11*22	200	230	190	142	30*5
DR260LP098	300	295	330	56	270	227	140	11*22	200	230	190	160	30*5
DR310LP078	300	298	350	54	288	233	145	11*22	200	230	190	160	30*5
DR370LP066	300	298	350	54	289	268	170	11*22	200	230	190	185	40*5

Table 10-47

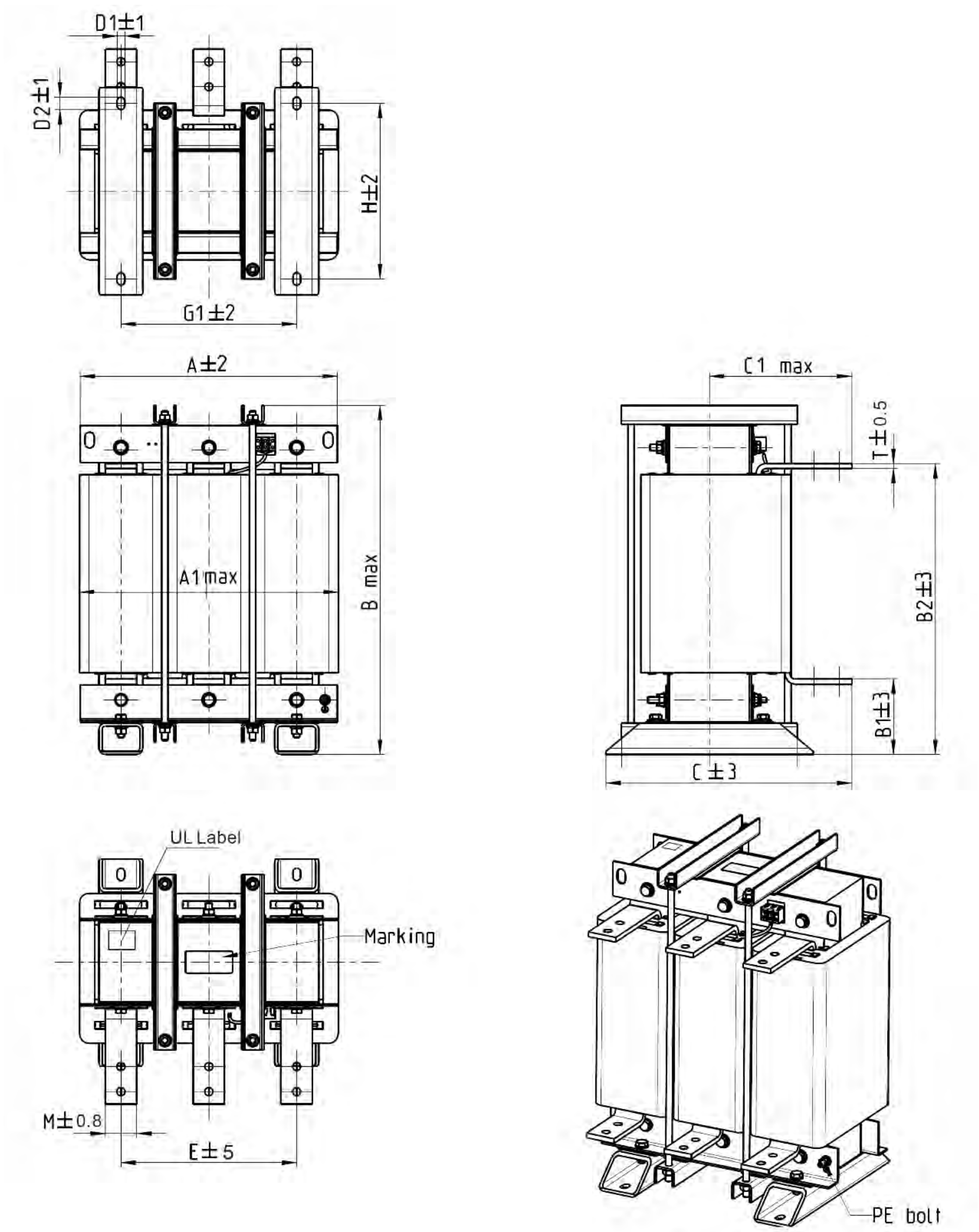


Figure 10-49

Unit: mm

Output AC Reactor Delta #	A	A1	B	B1	B2	C	C1	D1*D2	E	G1	H	M*T
DR460LP054	360	355	510	106	401	346	215	12*20	240	240	240	50*5
DR550LP044	360	355	510	106	401	358	220	12*20	240	240	250	50*5
DR616LP039	360	355	510	110	401	376	230	12*20	240	240	270	50*8
DR683LP036	360	355	510	110	401	396	240	12*20	240	240	290	50*8
DR866LP028	410	418	570	120	464	402	245	12*20	280	280	290	50*8

Table 10-48

The table below shows the THDi specification when using Delta drive to work with AC reactors:

Current Harmonics	Models without built-in reactors			Low Harmonic Models
	No AC Reactor	3% AC Reactor	5% AC Reactor	No AC Reactor
5th	46.85%	36.68%	29.87%	19.65%
7th	44.11%	14.51%	8.80%	14.58%
11th	36.39%	6.93%	6.03%	8.70%
13th	32.03%	3.43%	3.19%	9.96%
THDi	86.57%	40.44%	32.07%	35.83%

Table 10-49

NOTE: Low harmonic models can meet the 48% THDi required by the regulation without adding a reactor. These models cannot use with AC reactors to suppress the current harmonic; therefore, it is not recommended to add AC reactors for the low hormonic models.

10-3-2 Zero Phase Reactor

You can also suppress interference by installing a zero-phase reactor at the main input or the motor output of the drive, depending on the location of the interference. Delta provides two types of zero-phase reactors to solve interference problems.

A. Casing with mechanical fixed part

This solution is for the main input / motor output side and can withstand higher loading and be used at higher frequencies. You can get higher impedance by increasing the number of turns.

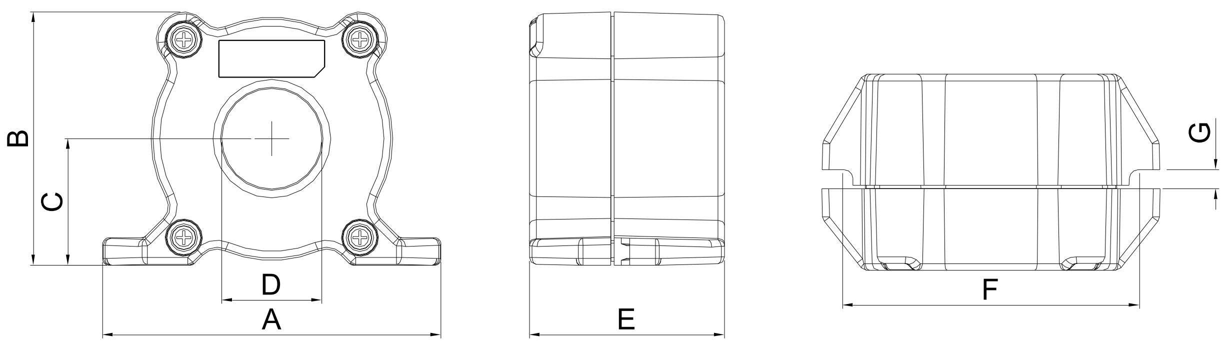


Figure 10-50

Unit: mm (inch)

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

Table 10-50

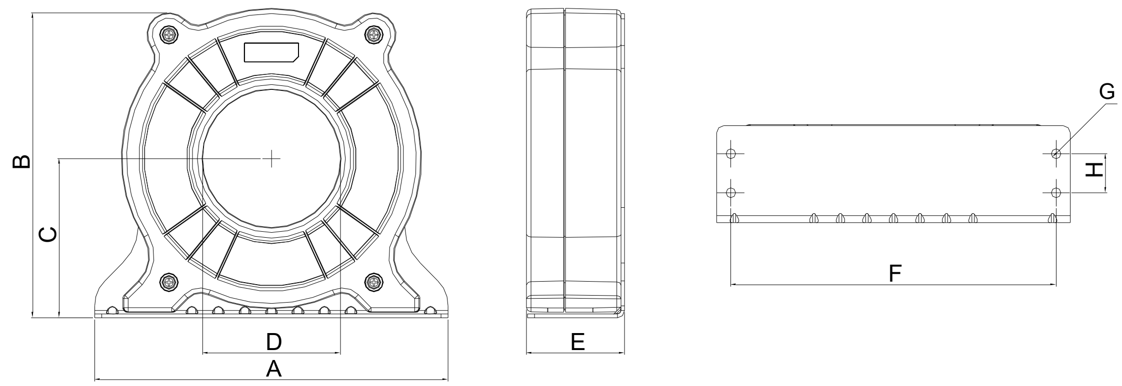


Figure 10-51

Unit: mm (inch)

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

Table 10-51

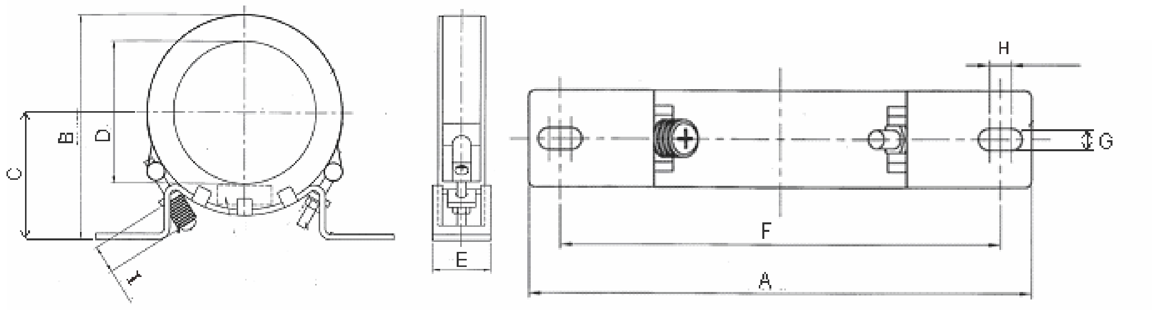


Figure 10-52

Unit: mm (inch)

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

Table 10-52

B. Casing without mechanical fixed part

This solution has higher performance: high initial magnetic permeability, high saturation induction density, low iron loss and perfect temperature characteristic. If the zero-phase reactor does not need to be fixed mechanically, use this solution.

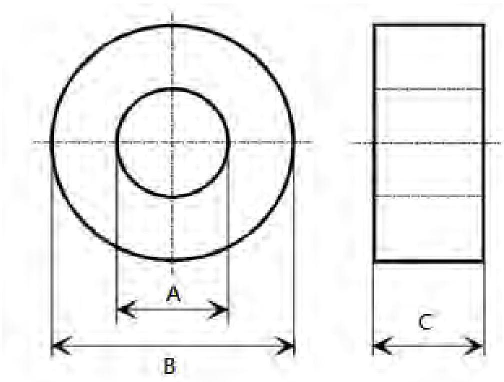


Figure 10-53

Model	A	B	C	Usage
RF008X00N	22.5	43.1	18.5	Motor cable
RF004X00N	36.3	53.5	23.4	Motor cable
RF410X00N	108.1	70	30.3	Motor cable
RF300X00N	166.9	123.9	30.5	Motor cable

Table 10-46

10-3-2-1 Installation

During installation, pass the cable through at least one zero-phase reactor. Use a suitable cable type (insulation class and wire section) so that the cable passes easily through the zero-phase reactor. Do not pass the grounding cable through the zero-phase reactor; only pass the motor wire through the zero-phase reactor.

With longer motor cables the zero-phase reactor can effectively reduce interference at the motor output. Install the zero-phase reactor as close to the output of the drive as possible. Figure A shows the installation diagram for a single turn zero-phase reactor. If the wire diameter allows several turns, Figure B shows the installation of a multi-turn zero-phase reactor. The more turns, the better the noise suppression effect.

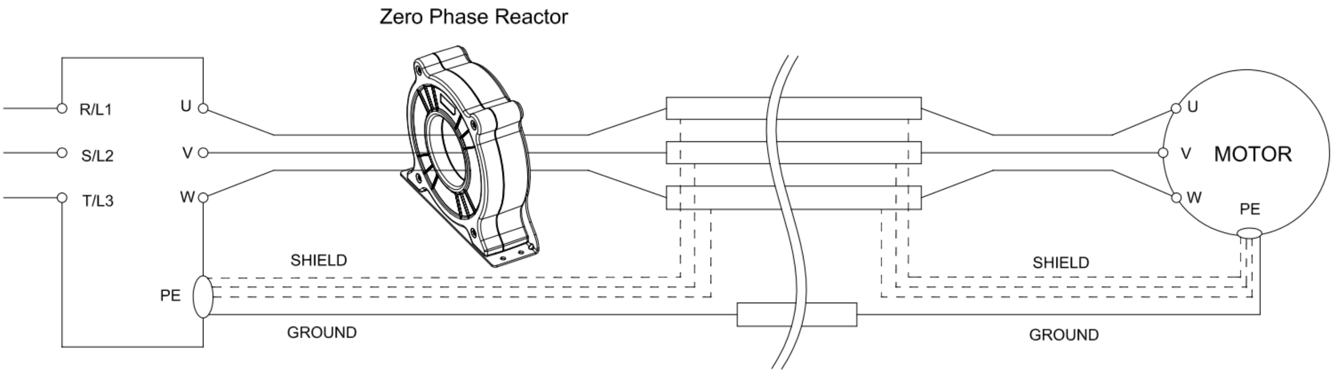


Figure A: Single turn wiring diagram for a shielding wire with a zero-phase reactor

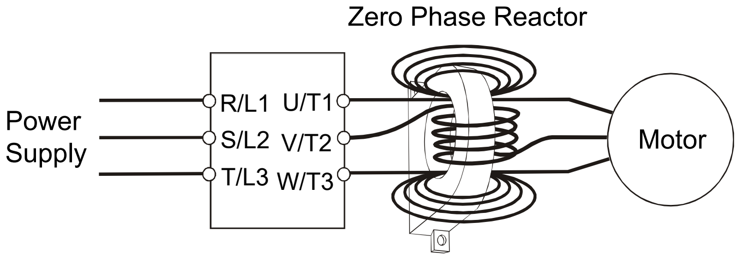


Figure B: Multi-turn zero-phase reactor

10-3-2-2 Installation Notes

Install the zero-phase reactor at the output terminal of the frequency converter (U, V, W). After the zero-phase reactor is installed, it reduces the electromagnetic radiation and load stress emitted by the wiring of the frequency converter. The number of zero-phase reactors required for the drive depends on the wiring length and the drive voltage.

The normal operating temperature of the zero-phase reactor should be lower than 85°C (176°F). However, when the zero-phase reactor is saturated, its temperature may exceed 85°C (176°F). In this case, increase the number of zero-phase reactors to avoid saturation. The following are reasons that might cause saturation of the zero-phase reactors: the drive wiring is too long, the drive has several sets of loads, the wiring is in parallel, or the drive uses high capacitance wiring. If the temperature of the zero-phase reactor exceeds 85°C (176°F) during the operation of the drive, increase the number of zero-phase reactors.

Recommended maximum wiring gauge when installing zero-phase reactor

Model	Recommended wiring gauge	
RF008X00A or RF008X00N	≤ 8 AWG	≤ 8.37 mm^2
RF004X00A or RF004X00N	≤ 4 AWG	≤ 21.15 mm^2
RF002X00A or RF410X00N	≤ 2 AWG	≤ 33.62 mm^2

Table 10-47

10-3-2-3 Zero-phase Reactor for Signal Cable

To solve interference problems between signal cables and electric devices, install a zero-phase reactor on the signal cable. Install it on the signal cable which is the source of the interference to suppress the noise for a better signal. The model names and dimensions are listed in the table below.

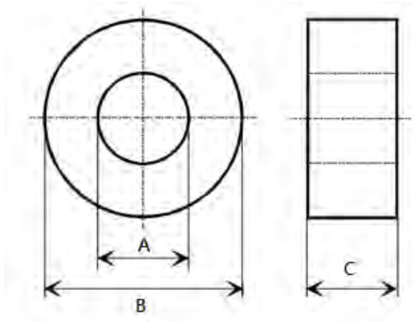


Figure 10-54

Unit: mm

Model	A	B	C	Purpose
RF026X00N	10.7	17.8	8.0	To use with signal cable
RF020X00N	17.5	27.3	12.3	To use with signal cable

Table 10-48

10-3-3 EMC Filter

Following table is the external EMC filter of VP3000 series, user can choose corresponding zero phase reactor and suitable shielded cable length in accord to required noise emission and electromagnetic interference level to have the best configuration to suppress the electromagnetic interference. When the application does not consider RE and only needs CE to comply with C2 or C1, there is no need to install zero phase reactor on the input side.

460V Models

AC Motor Drive		EMC Filter Model	Y-Capacitor Accessory	Zero Phase Reactor		Fc	Conducted Emission		Radiation Emission
Frame	Model Name		Input	Input	Output		Output Shielded Cable Length		EN61800-3*
			(R/S/T)	(R/S/T)	(U/V/W)		C1	C2*	
A	VFD4A2VP43ANTAA	EMF018A43A	N/A	RF008X00N	RF008X00N	9 kHz	50m	100m	C2
	VFD5A6VP43ANTAA								
	VFD7A2VP43ANTAA								
	VFD011VP43ANTAA								
B	VFD013VP43ANTAA	EMF23AM43B							
	VFD018VP43ANTAA								
C	VFD025VP43ANTAA	B84143D0050R127							
	VFD032VP43ANTAA			RF004X00N	RF004X00N				
	VFD038VP43ANTAA								
D	VFD045VP43ANTCA	B84143D075R127				6 kHz			
	VFD062VP43ANTCA			RF300X00N	RF300X00N				
E	VFD073VP43ANTCA	B84143D0090R127							
	VFD090VP43ANTCA								
F	VFD110VP43AFTCA	B84143D0200R127	CXY101-43A						
G	VFD150VP43AFTCA								
H	VFD180VP43AFTCA	MIF3400B							
	VFD220VP43AFTCA								
I	VFD310VP43AFTCA					3 kHz			
J	VFD370VP43AFTCA								
	VFD395VP43AFTCA								
K	VFD485VP43AFTCA	MIF3800							

Table 10-49

NOTE: * means no need to add Y-capacitor accessory.

Y-capacitor accessory diagram

Model: CXY101-43A

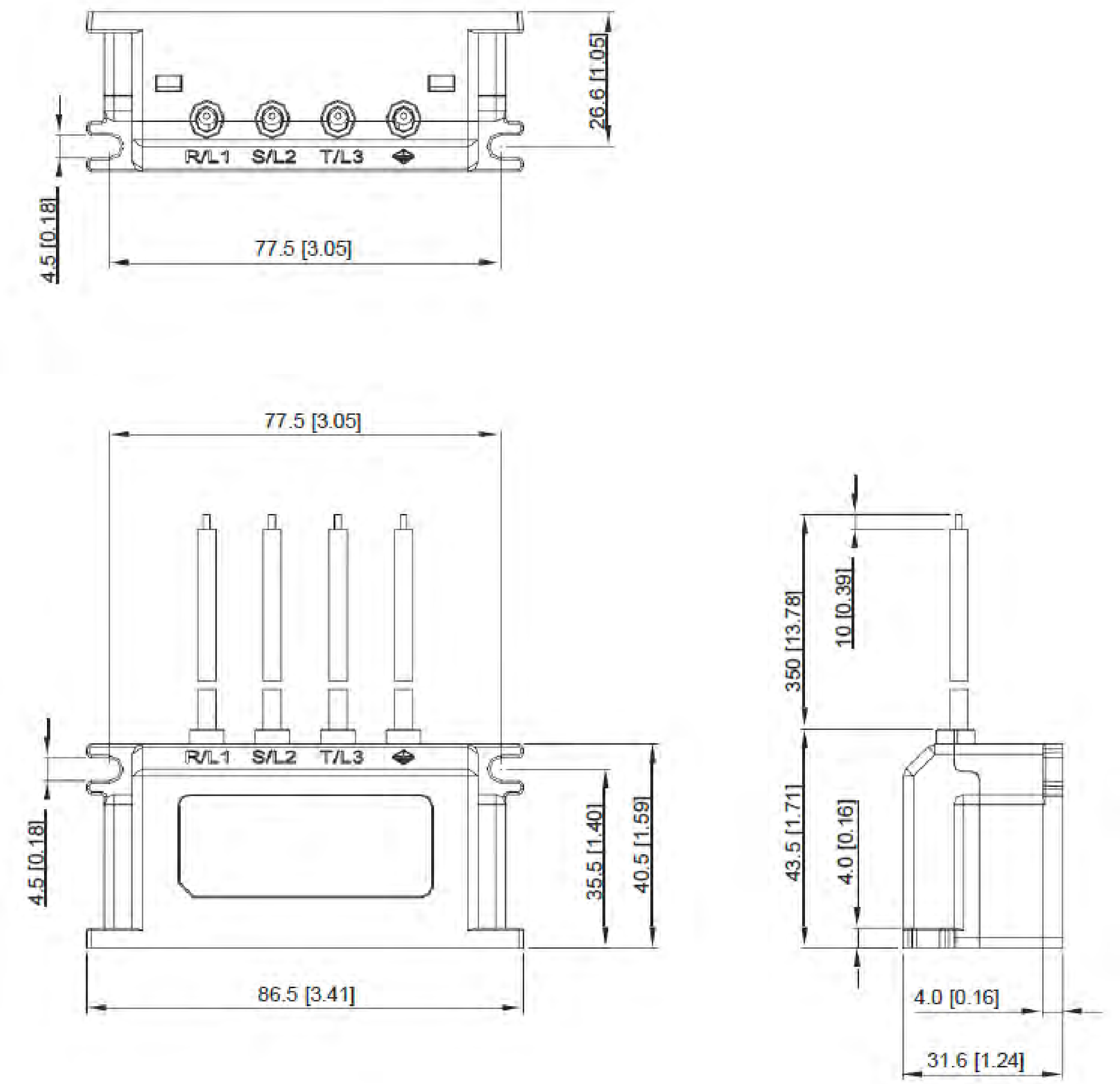


Figure 10-55

Model Name: EMF018A43A

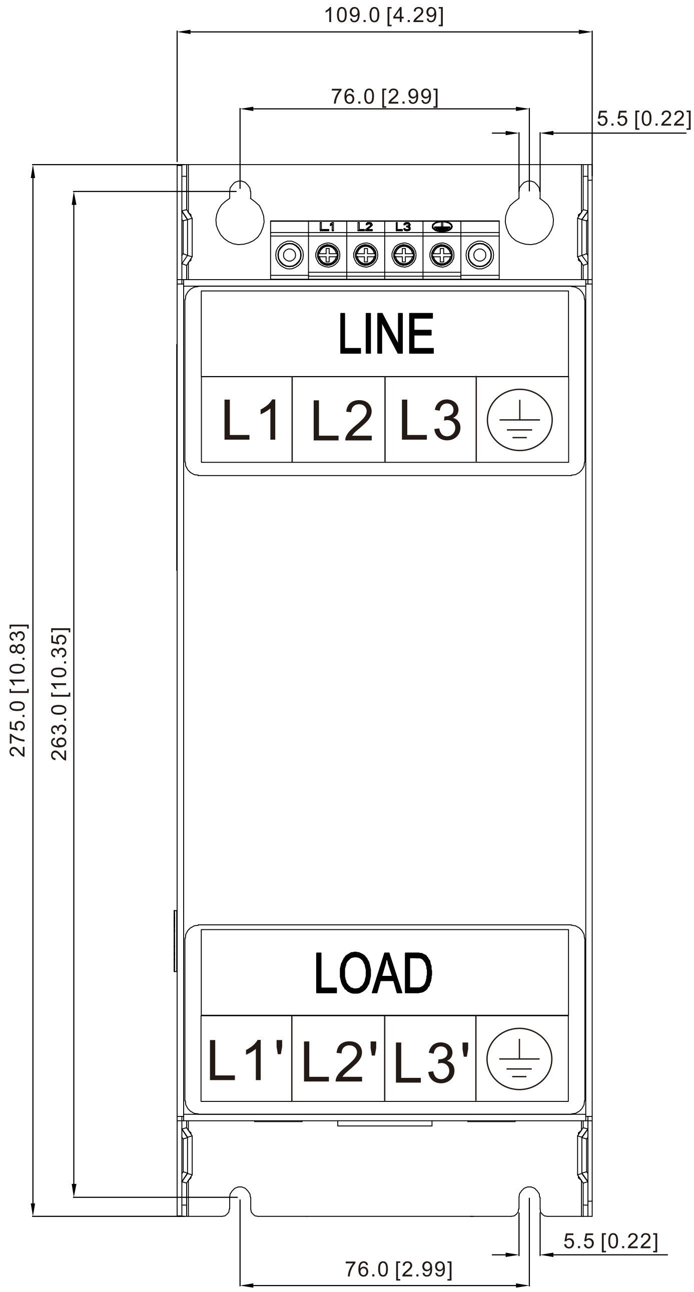


Figure 10-56

Model Name: EMF23AM43B

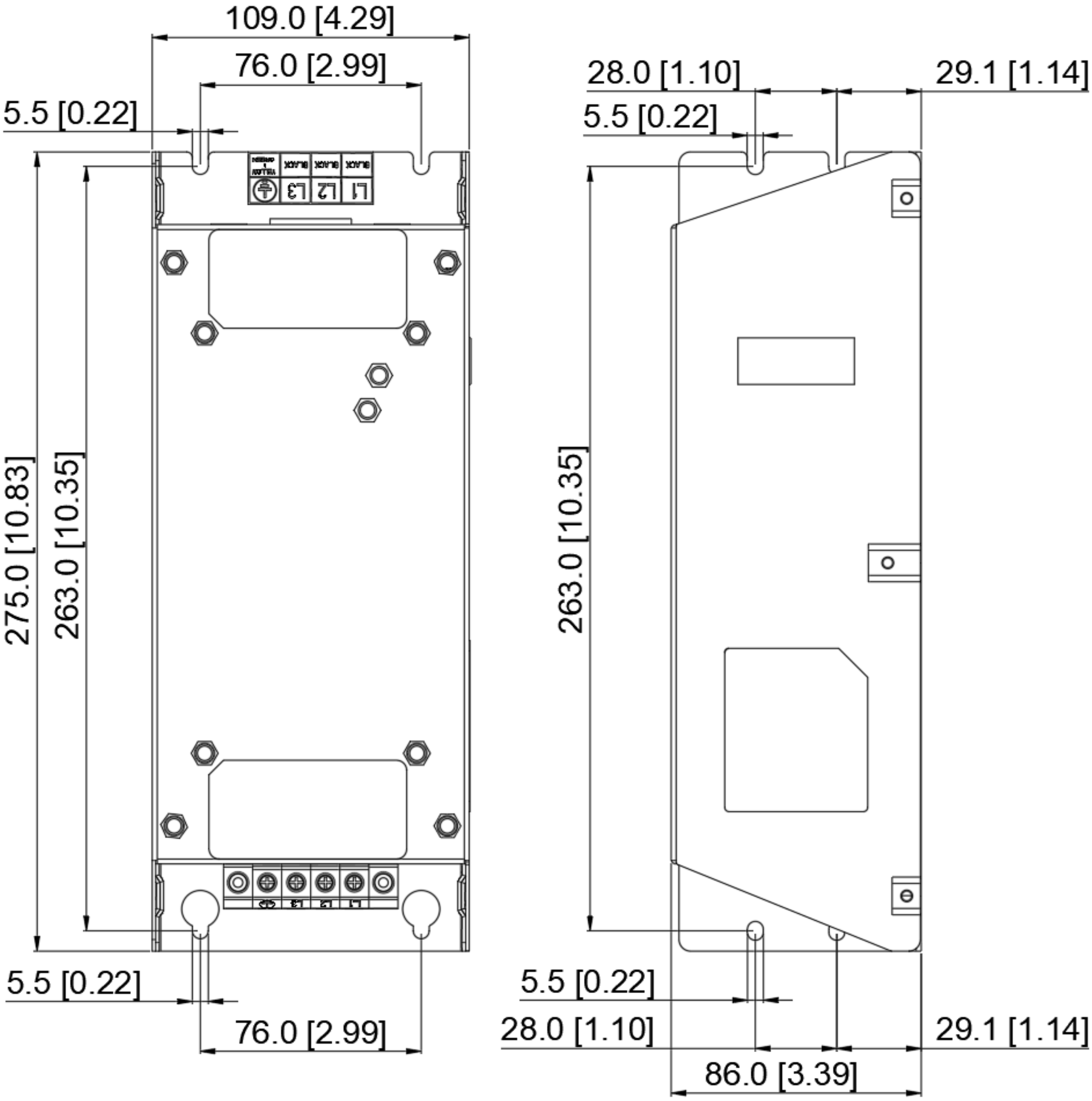


Figure 10-57

Model Name: B84143D0050R127

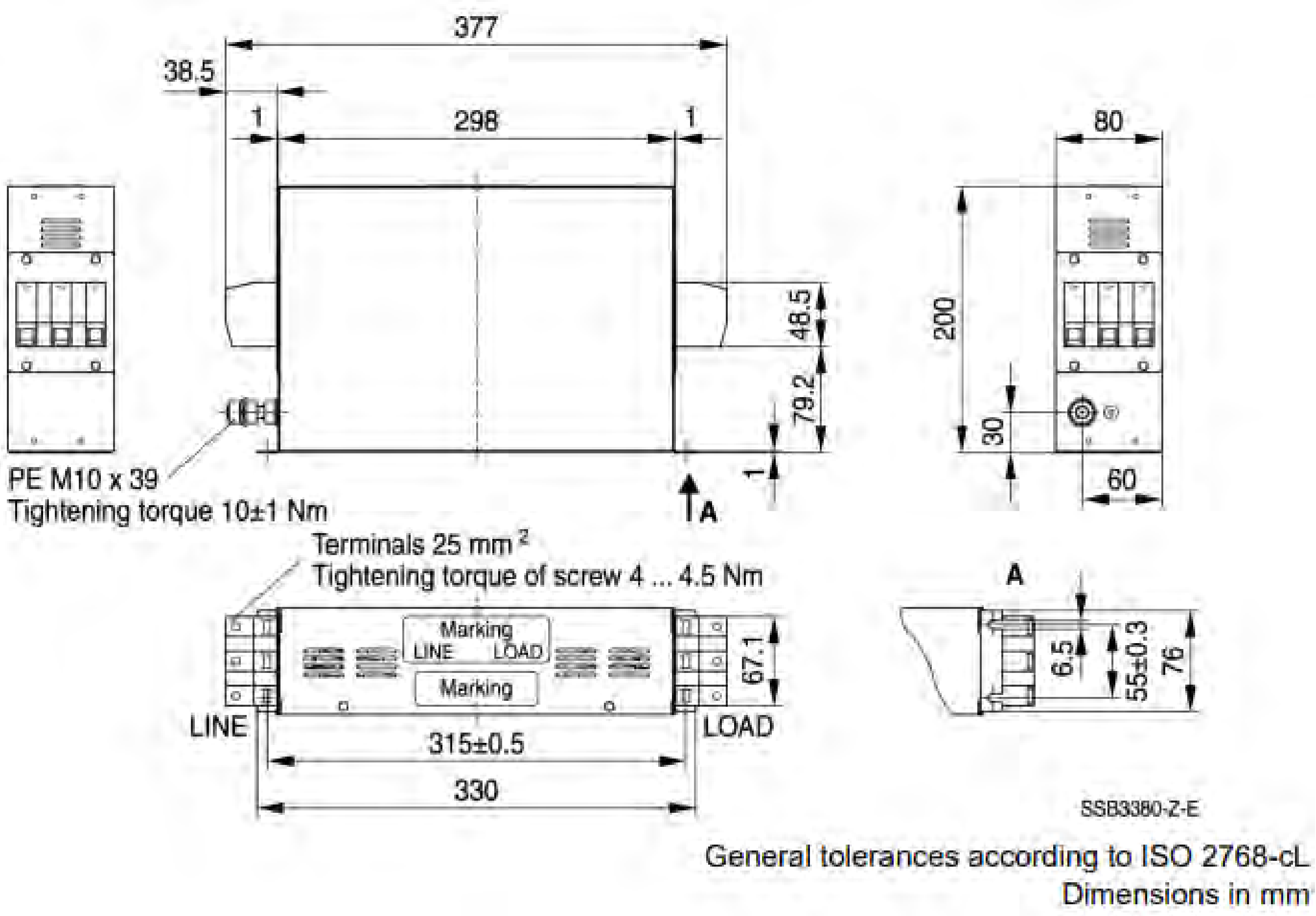


Figure 10-58

Model Name: B84143D0075R127

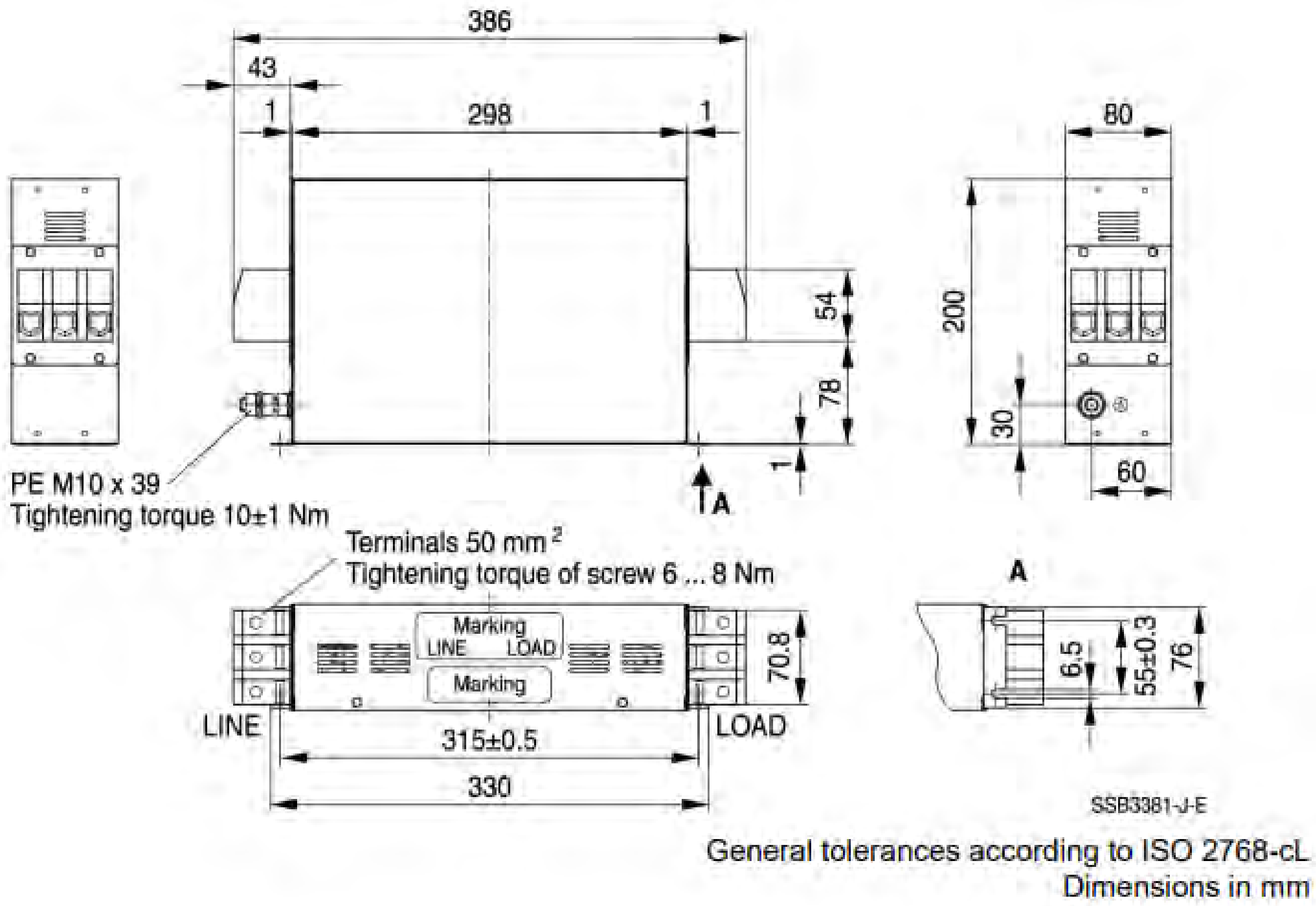


Figure 10-59

Model Name: B84143D0090R127

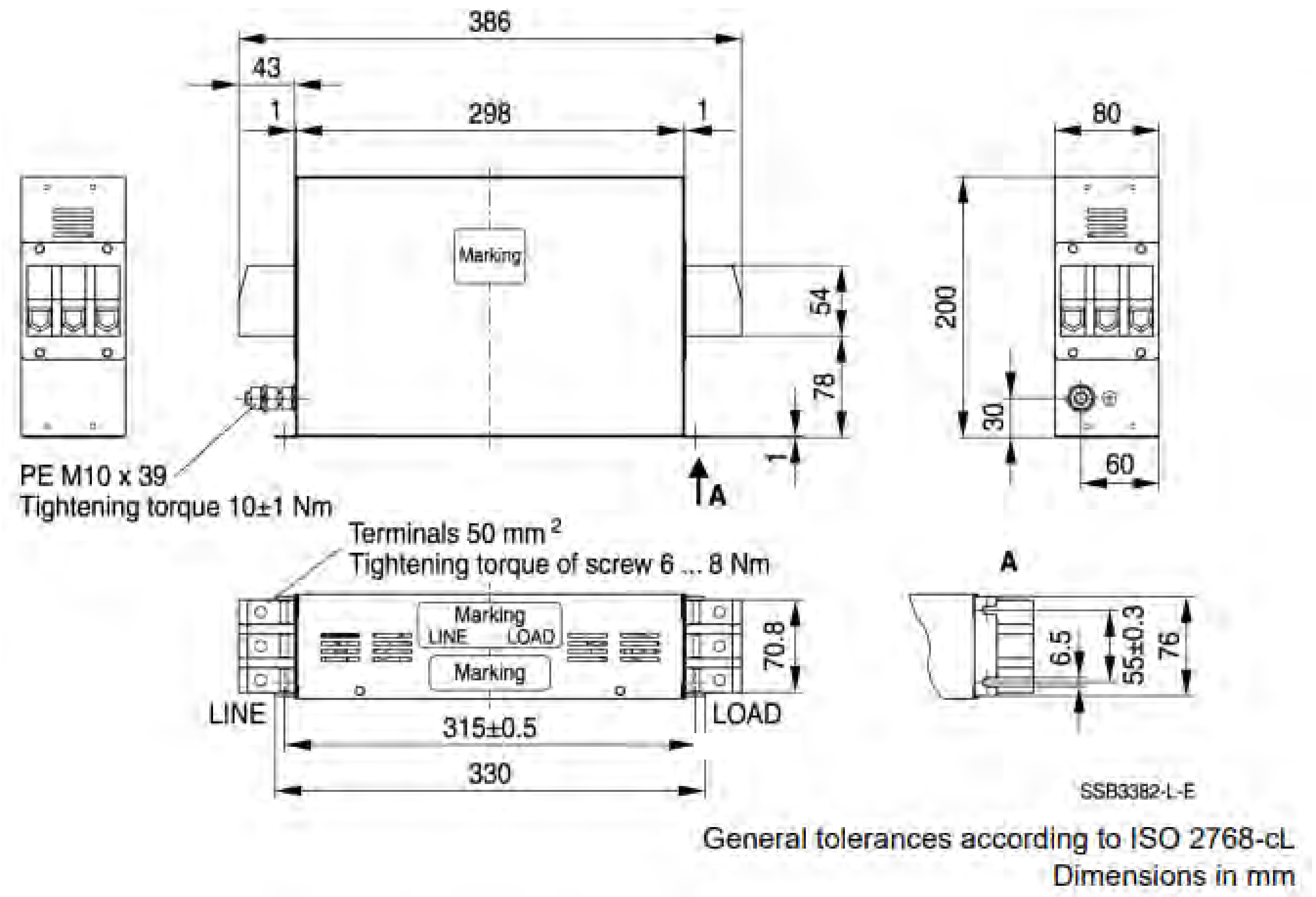


Figure 10-60

Model Name: B84143D0200R127

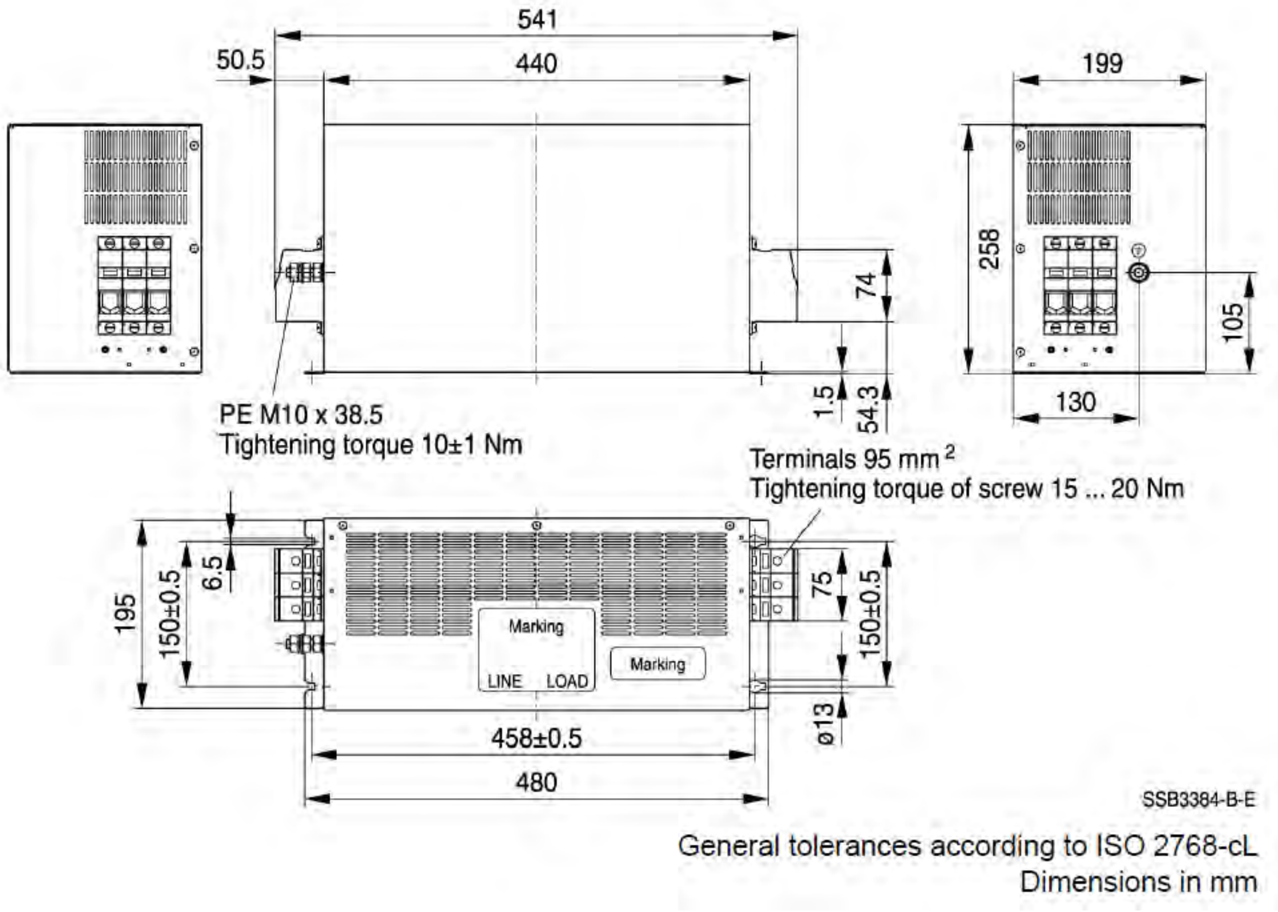


Figure 10-61

Model Name: MIF3400B

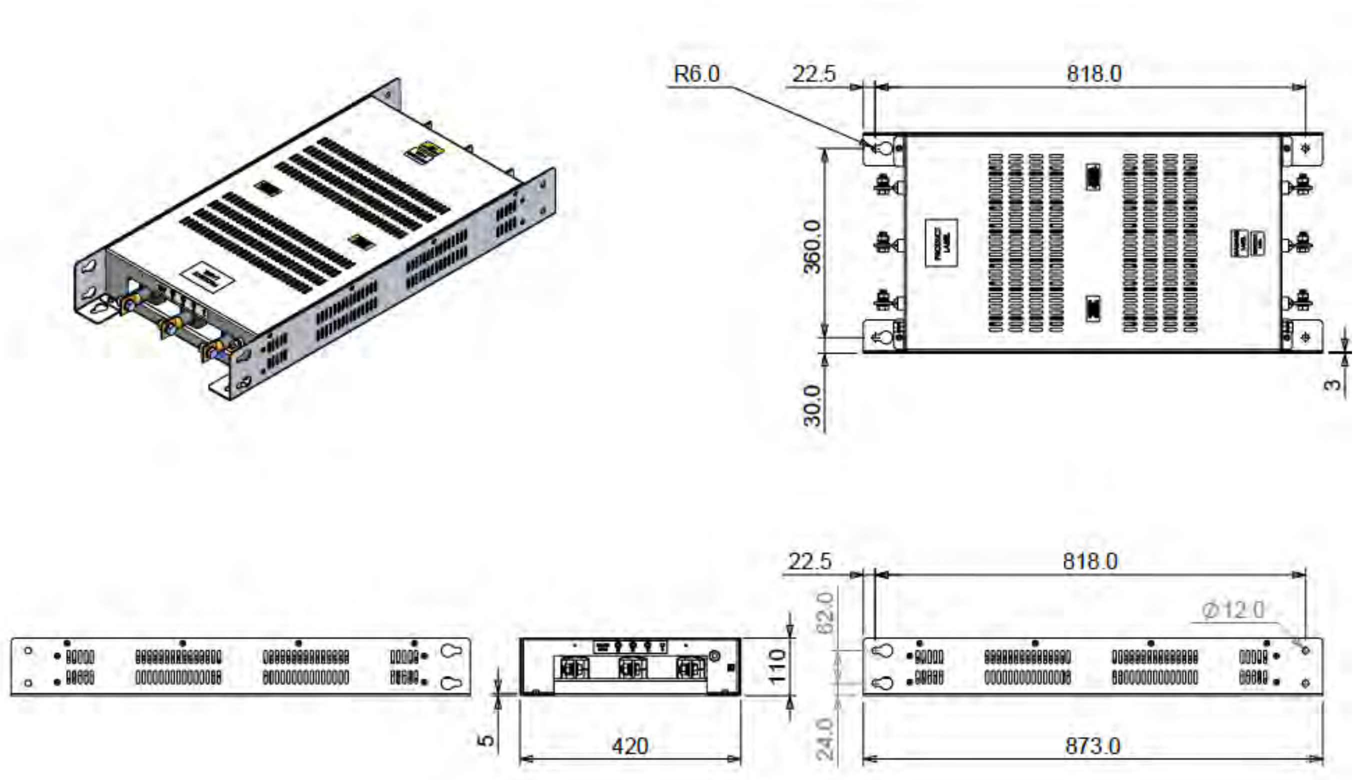


Figure 10-62

Model Name: MIF3800

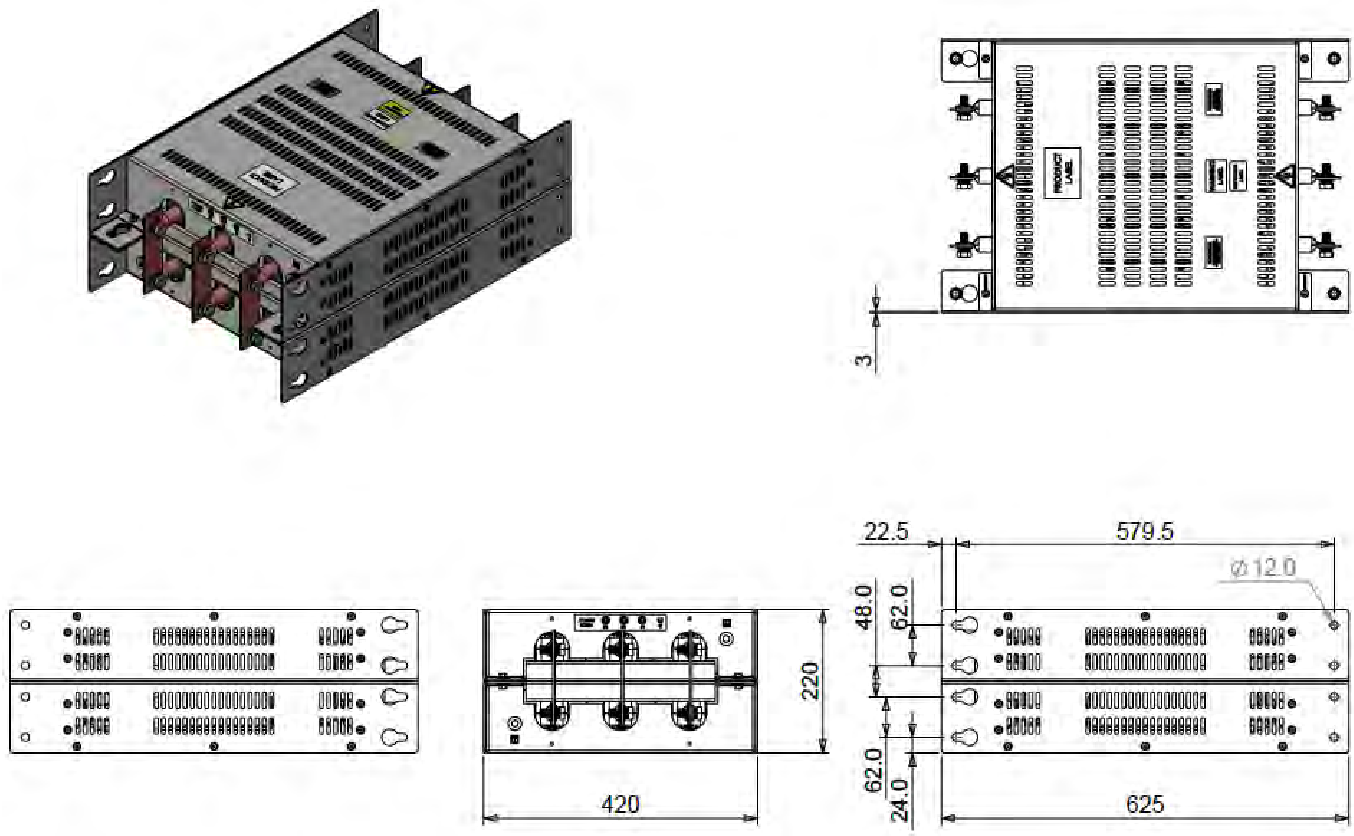


Figure 10-63

VP3000 built-in EMC Filter Overview:

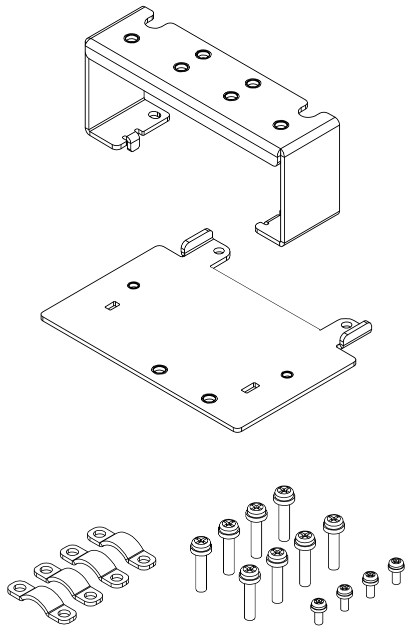
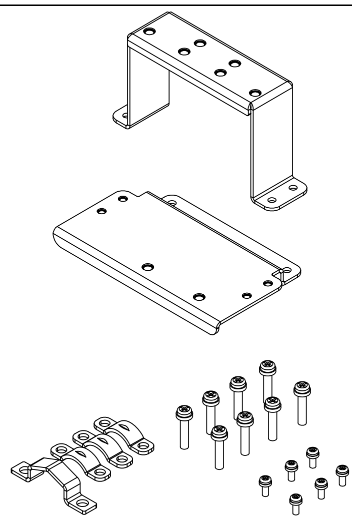
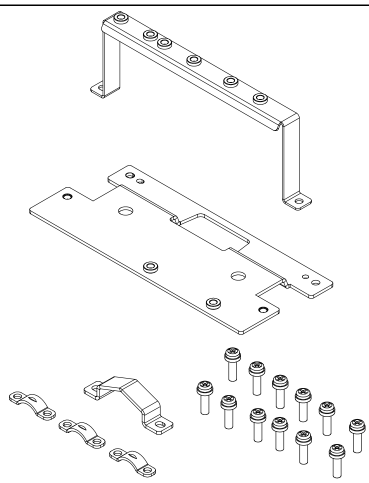
460V (kW)	Model - UL Open Type LED Keypad	Frame	EMC	Model EMC C3 UL Type 1 LCD Keypad	Frame	EMC	Model EMC C2 UL Type 1 LCD Keypad	Frame	EMC
0.75	VFD3A0VP43ANTAA*1	A1	-	VFD3A0VP43BFTAA*1	A2	C3 20m	-	-	-
1.5	VFD4A2VP43ANTAA*1	A1	-	VFD4A2VP43BFTAA*1	A2	C3 20m	-	-	-
2.2	VFD5A6VP43ANTAA*1	A1	-	VFD5A6VP43BFTAA*1	A2	C3 20m	-	-	-
3.7	VFD7A2VP43ANTAA*1	A1	-	VFD7A2VP43BFTAA*1	A2	C3 20m	-	-	-
4	VFD011VP43ANTAA*1	A1	-	VFD011VP43BFTAA*1	A2	C3 20m	-	-	-
5.5	VFD013VP43ANTAA*1	B1	-	VFD013VP43BFTAA*1	B2	C3 20m	-	-	-
7.5	VFD018VP43ANTAA*1	B1	-	VFD018VP43BFTAA*1	B2	C3 20m	-	-	-
11	VFD025VP43ANTAA*1	C1	-	VFD025VP43BFTAA*1	C2	C3 20m	-	-	-
15	VFD032VP43ANTAA*1	C1	-	VFD032VP43BFTAA*1	C2	C3 20m	-	-	-
18.5	VFD038VP43ANTAA*1	C1	-	VFD038VP43BFTAA*1	C2	C3 20m	-	-	-
22	VFD045VP43ANTCA	D1	-	VFD045VP43BFTCA	D2	C3 20m	VFD045VP43BSTCA	D2	C2 50m
30	VFD062VP43ANTCA	D1	-	VFD062VP43BFTCA	D2	C3 20m	VFD062VP43BSTCA	D2	C2 50m
37	VFD073VP43ANTCA	E1	-	VFD073VP43BFTCA	E2	C3 20m	VFD073VP43BSTCA	E2	C2 50m
45	VFD090VP43ANTCA	E1	-	VFD090VP43BFTCA	E2	C3 20m	VFD090VP43BSTCA	E2	C2 50m
55	VFD110VP43AFTCA	F1	C3 50m	VFD110VP43BFTCA	F2	C3 50m	VFD110VP43BSTCA	F2	C2 50m
75	VFD150VP43AFTCA	G1	C3 50m	VFD150VP43BFTCA	G2	C3 50m	VFD150VP43BSTCA	G2	C2 50m
90	VFD180VP43AFTCA	H1	C3 50m	VFD180VP43BFTCA	H2	C3 50m	VFD180VP43BSTCA	H2	C2 50m
110	VFD220VP43AFTCA	H1	C3 50m	VFD220VP43BFTCA	H2	C3 50m	VFD220VP43BSTCA	H2	C2 50m
132	VFD260VP43AFTCA	I1	C3 50m	VFD260VP43BFTCA	I2	C3 50m	VFD260VP43BSTCA	I2	C2 50m
160	VFD310VP43AFTCA	I1	C3 50m	VFD310VP43BFTCA	I2	C3 50m	VFD310VP43BSTCA	I2	C2 50m
185	VFD370VP43AFTCA	J1	C3 50m	VFD370VP43BFTCA	J2	C3 50m	VFD370VP43BSTCA	J2	C2 50m
200	VFD395VP43AFTCA	J1	C3 50m	VFD395VP43BFTCA	J2	C3 50m	VFD395VP43BSTCA	J2	C2 50m
220	VFD460VP43AFTCA	K1	C3 50m	VFD460VP43BFTCA	K2	C3 50m	VFD460VP43BSTCA	K2	C2 50m
250	VFD485VP43AFTCA	K1	C3 50m	VFD485VP43BFTCA	K2	C3 50m	VFD485VP43BSTCA	K2	C2 50m
280	-	-	-	VFD530VP43SHTCA*2	L	C3 150m	-	-	-
315	-	-	-	VFD616VP43SHTCA*2	L	C3 150m	-	-	-
350	-	-	-	VFD683VP43SHTCA*2	L	C3 150m	-	-	-
400	-	-	-	VFD770VP43SHTCA*2	L	C3 150m	-	-	-
450	-	-	-	VFD866VP43SHTCA*2	M	C3 150m	-	-	-
500	-	-	-	VFD930VP43SHTCA*2	M	C3 150m	-	-	-
560	-	-	-	VFD1K1VP43SHTCA*2	M	C3 150m	-	-	-
630	-	-	-	VFD1K2VP43SHTCA*2	M	C3 150m	-	-	-

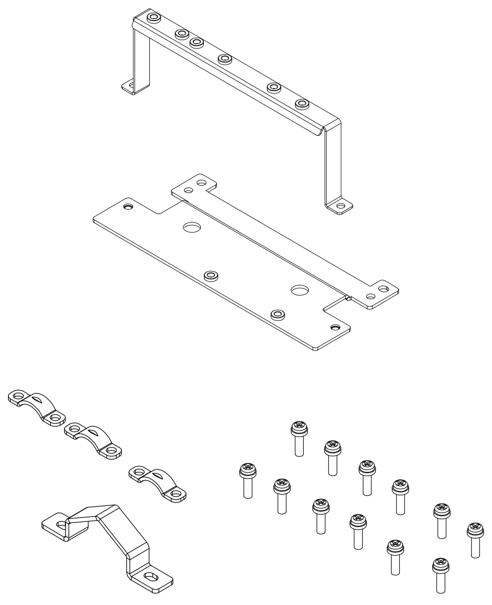
* **NOTE:** Table 10-50

1. *1 E-CAP models.
2. *2 Chassis open type models (Frame L & M).

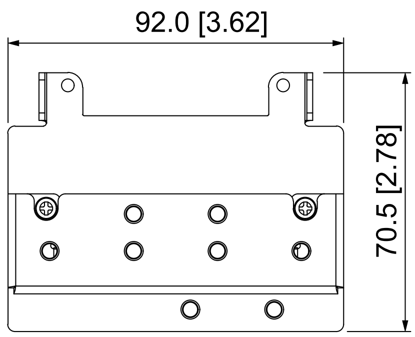
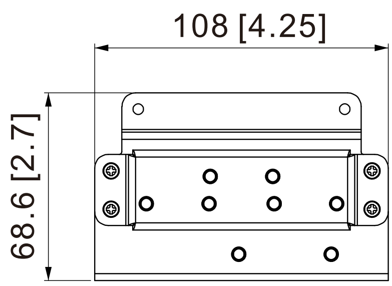
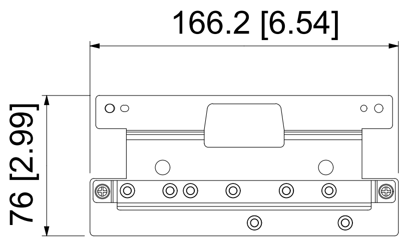
10-3-4 EMC Plate

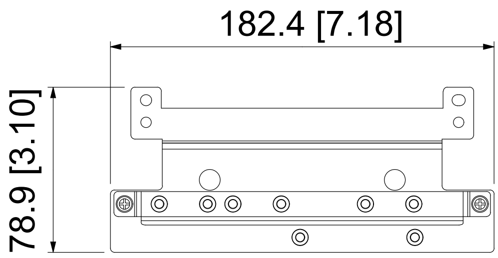
10-3-4-1 EMC Plate (use shielded cable)

Frame	Applicable Models	EMC Plate Model	Diagram
A	**Type 1** VFD3A0VP43BFTAA VFD4A2VP43BFTAA VFD5A6VP43BFTAA VFD7A2VP43BFTAA VFD011VP43BFTAA	MKVP-EPB	 Figure 10-64
	Open Type VFD011VP43ANTAA VFD3A0VP43ANTAA VFD4A2VP43ANTAA VFD5A6VP43ANTAA VFD7A2VP43ANTAA		
B	**Type 1** VFD013VP43BFTAA VFD018VP43BFTAA		
	Open Type VFD013VP43ANTAA VFD018VP43ANTAA		
C	**Open Type** VFD025VP43ANTAA VFD032VP43ANTAA VFD038VP43ANTAA	MKVP-EPC	 Figure 10-65
D	**TYPE1** VFD045VP43BFTCA VFD062VP43BFTCA VFD045VP43BSTCA VFD062VP43BSTCA	MKVP-EPD	 Figure 10-66
	Open Type VFD045VP43ANTCA VFD062VP43ANTCA		

Frame	Applicable Models	EMC Plate Model	Diagram
E	**TYPE1** VFD073VP43BFTCA VFD090VP43BFTCA VFD073VP43BSTCA VFD090VP43BSTCA	MKVP-EPE	 Figure 10-67
	Open Type VFD073VP43ANTCA VFD090VP43ANTCA		

10-3-4-2 Dimension

Frame	EMC Plate Model	Dimension - Unit: mm (inch)
A–B	MKVP-EPB	 Figure 10-68
C	MKVP-EPC	 Figure 10-69
D	MKVP-EPD	 Figure 10-70

Frame	EMC Plate Model	Dimension - Unit: mm (inch)
E	MKVP-EPE	 Figure 10-71

NOTE:

1. For EMC plate installation instruction, refer to Section 2-6 EMC Plate Installation.
2. The EMC plate for Frame F–H are shipped with the AC motor drive, which is not an optional accessory. Refer to Section 2-6 EMC Plate Installation for further instructions.

10-3-5 Panel Mounting (MKV-KPPK)

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

Applicable to the digital keypad KPV-CC01 & KPV-CE02.

Wall Mounting

Accessory*1

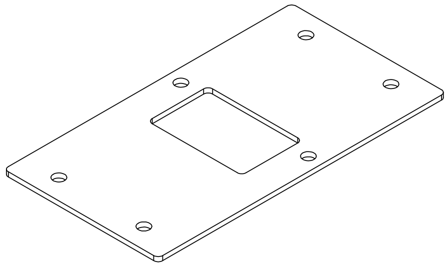


Figure 10-72

Screw*6 - M4*p0.7*L8mm*6

Screw torque: 10–12 kg-cm / (8.7–10.4 lb-in.) / (1.0–1.2 Nm)

Panel cutout dimension Unit: mm (inch)

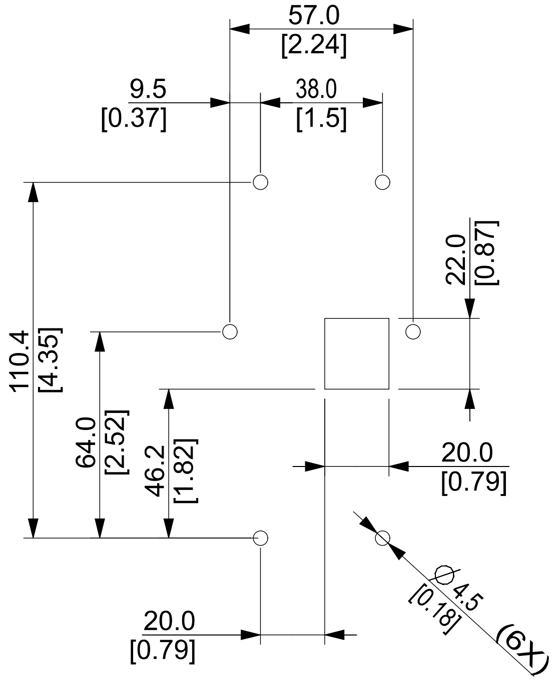


Figure 10-74

Embedded Mounting

Accessory*2

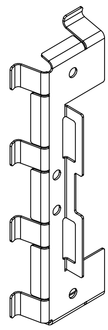


Figure 10-73

Screw*6 - M4*p0.7*L8mm*6

Screw torque: 10–12 kg-cm / (8.7–10.4 lb-in.) / (1.0–1.2 Nm)

Panel cutout dimension Unit: mm (inch)

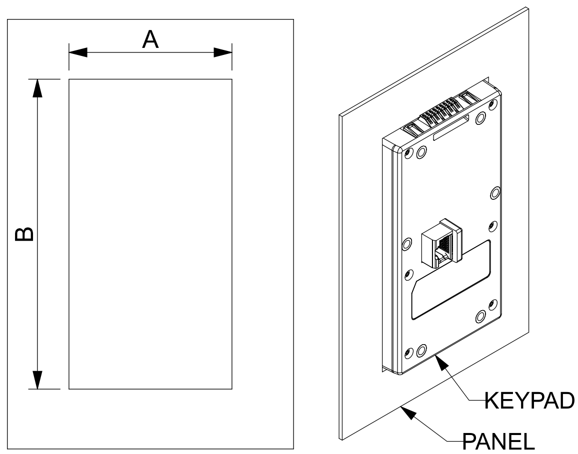


Figure 10-75

Normal cutout dimension

Unit: mm (inch)

Panel Thickness	1.2 mm	1.6 mm	2.0 mm
A	68.3 (2.69)		
B	127.3 (5.01)	128.5 (5.06)	129.9 (5.11)

Deviation: ±0.15 mm / ±0.0059 inch Table 10-51

Cutout dimension (Waterproof level: IP56)

Panel Thickness	1.2 mm	1.6 mm	2.0 mm
A	68.3 (2.69)		
B	127.9 (5.07)		

Deviation: ±0.15 mm / ±0.0059 inch Table 10-54

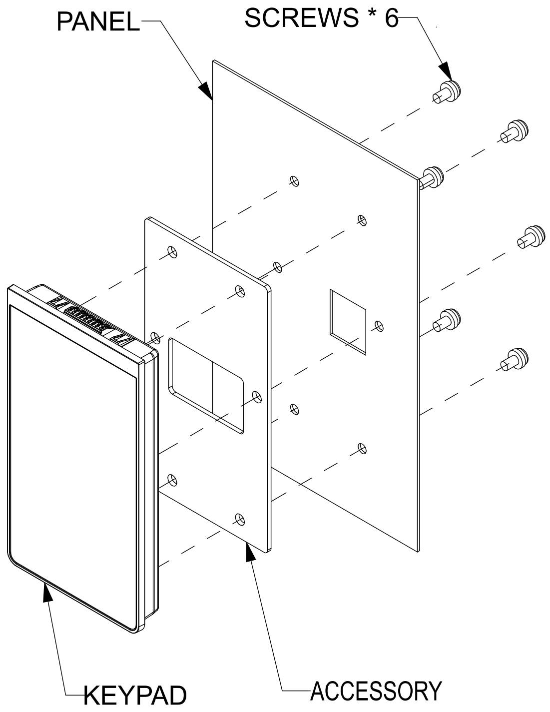
<table>
<tr><th>Wall Mounting</th><th>Embedded Mounting</th></tr>
<tr><td>

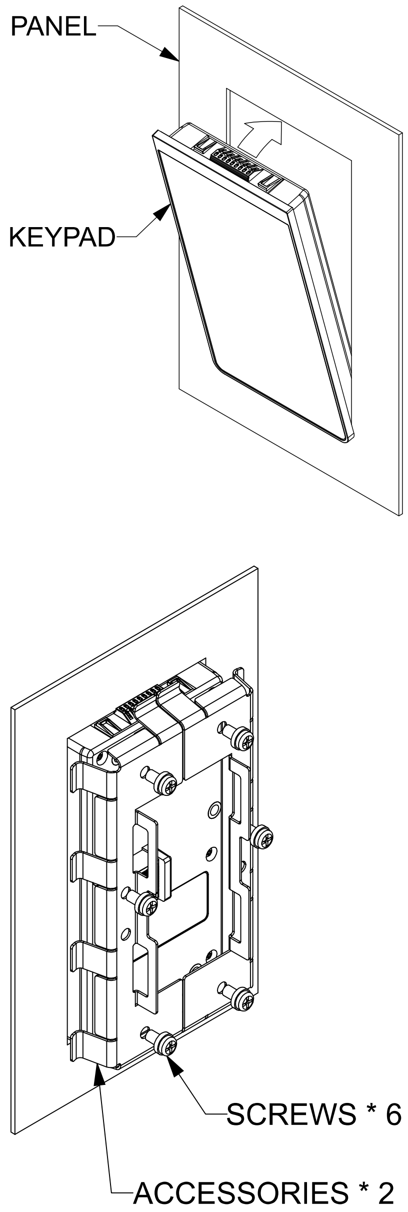
Figure 10-76</td><td>

Figure 10-77</td></tr>
</table>

10-3-6 Fan Kit

- Appearance

NOTE:

1. The fan does not support hot swap function. For replacement, turn the power off before replacing the fan.
2. Refer to Chapter 9 Maintenance and Inspections for the description of Fan kit installation.

Frame A

Heat Sink Fan Model “MKVP-AFKM”

Applicable Models

Open Type

VFD011VP43ANTAA; VFD3A0VP43ANTAA; VFD4A2VP43ANTAA; VFD5A6VP43ANTAA; VFD7A2VP43ANTAA

Type 1

VFD3A0VP43BFTAA; VFD4A2VP43BFTAA; VFD5A6VP43BFTAA; VFD7A2VP43BFTAA; VFD011VP43BFTAA

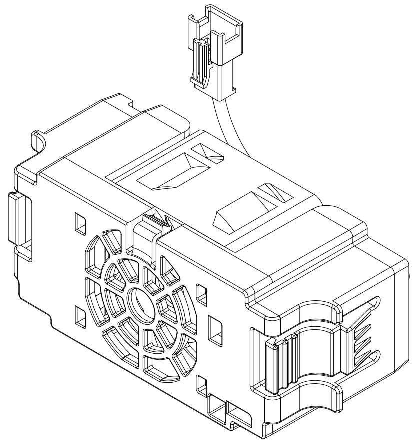


Figure 10-78

Frame B

Heat Sink Fan Model “MKVP-BFKM”

Applicable Models

Open Type

VFD013VP43ANTAA; VFD018VP43ANTAA

Type 1

VFD013VP43BFTAA; VFD018VP43BFTAA

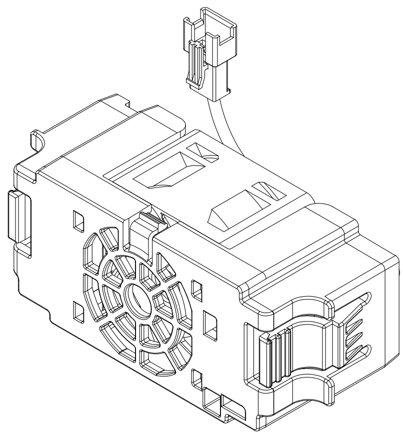


Figure 10-79

Frame C

Heat Sink Fan Model “MKVP-CFKM”

Applicable Models

VFD025VP43BFTAA; VFD032VP43BFTAA; VFD038VP43BFTAA; VFD025VP43ANTAA; VFD032VP43ANTAA; VFD038VP43ANTAA

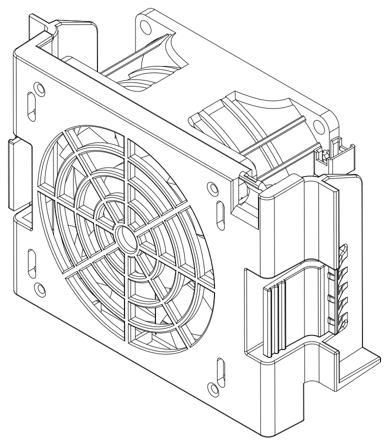


Figure 10-80

Frame D

Heat Sink Fan Model "MKVP-DFKM"

Applicable Models

Open Type

VFD045VP43ANTCA; VFD062VP43ANTCA

Type 1

VFD045VP43BFTCA; VFD062VP43BFTCA;
VFD045VP43BSTCA; VFD062VP43BSTCA

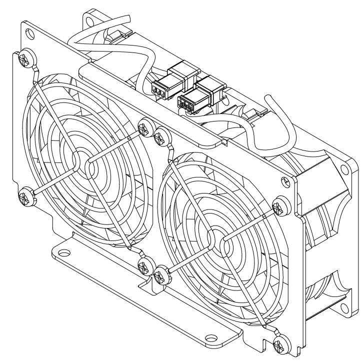


Figure 10-81

Frame E

Heat Sink Fan Model "MKVP-EFKM"

Applicable Models

Open Type

VFD073VP43ANTCA; VFD090VP43ANTCA

Type 1

VFD073VP43BFTCA; VFD090VP43BFTCA;
VFD073VP43BSTCA; VFD090VP43BSTCA

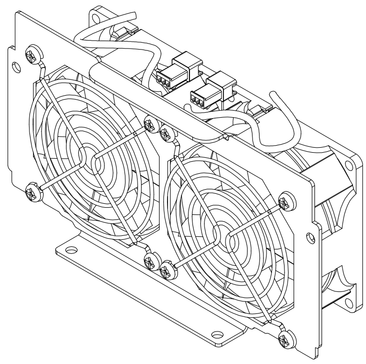


Figure 10-82

Frame F

Heat Sink Fan Model "MKVP-FFKM1"

Applicable Models

Open Type

VFD110VP43AFTCA

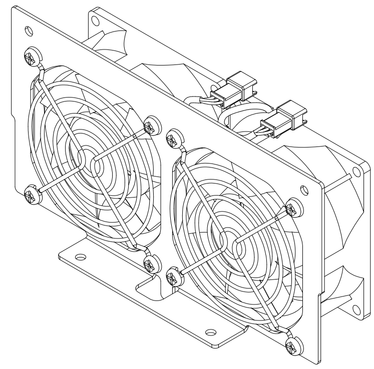


Figure 10-83

Frame F

Heat Sink Fan Model "MKVP-FFKM2"

Applicable Models

Type 1

VFD110VP43BFTCA; VFD110VP43BSTCA

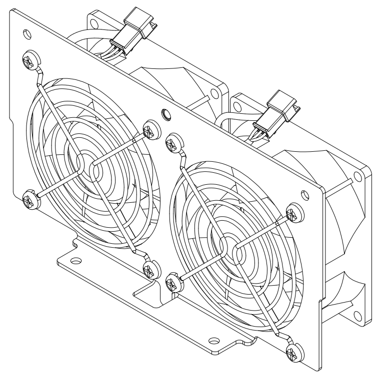
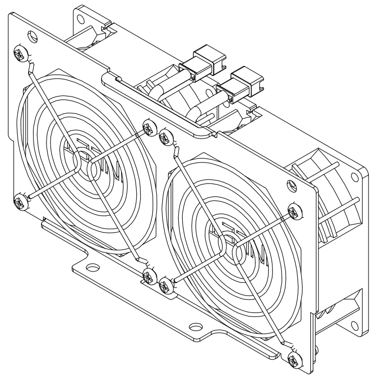
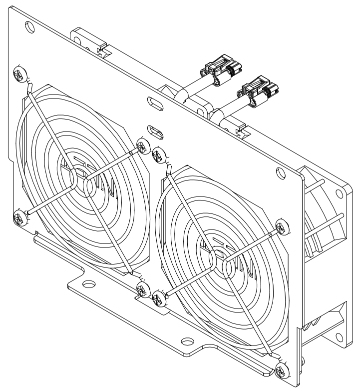
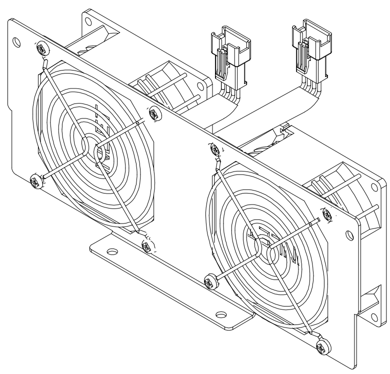
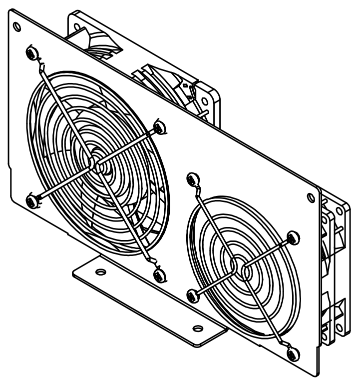


Figure 10-84

Frame G Applicable Models **Open Type** VFD150VP43AFTCA	Heat Sink Fan Model "MKVP-GFKM1"  Figure 10-85
Frame G Applicable Models **Type 1** VFD150VP43BSTCA; VFD150VP43BFTCA	Heat Sink Fan Model "MKVP-GFKM2"  Figure 10-86
Frame H Applicable Models **Open Type** VFD180VP43AFTCA; VFD220VP43AFTCA	Heat Sink Fan Model "MKVP-HFKM1"  Figure 10-87
Frame H Applicable Models **Type 1** VFD180VP43BFTCA; VFD220VP43BFTCA; VFD180VP43BSTCA; VFD220VP43BSTCA	Heat Sink Fan Model "MKVP-HFKM2"  Figure 10-88

Frame I

Applicable Models

Open Type

VFD260VP43AFTCA; VFD310VP43AFTCA

Type 1

VFD260VP43BFTCA; VFD310VP43BFTCA;

VFD260VP43BSTCA; VFD310VP43BSTCA

Heat Sink Fan Model “MKVP-IFKM”

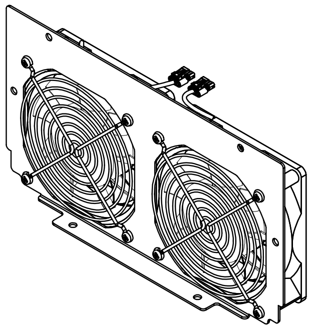


Figure 10-89

Frame J

Applicable Models

VFD370VP43AFTCA; VFD395VP43AFTCA;

VFD370VP43BFTCA; VFD395VP43BFTCA;

VFD370VP43BSTCA; VFD395VP43BSTCA

Heat Sink Fan Model “MKVP-JFKM”

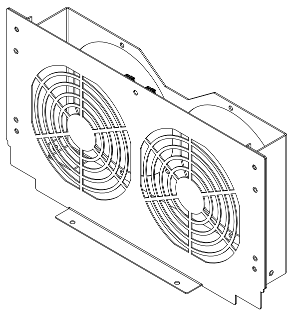


Figure 10-90

Frame K

Applicable Models

VFD460VP43AFTCA; VFD485VP43AFTCA;

VFD460VP43BFTCA; VFD485VP43BFTCA;

VFD460VP43BSTCA; VFD485VP43BSTCA

Heat Sink Fan Model “MKVP-KFKM”

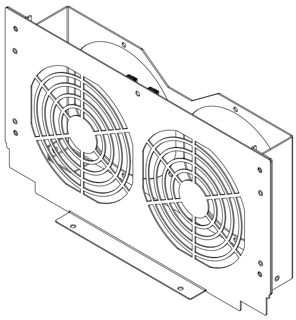


Figure 10-91

Frame L

Applicable Models

VFD530VP43SHTCA; VFD616VP43SHTCA;

VFD683VP43SHTCA; VFD770VP43SHTCA

Frame M

VFD866VP43SHTCA; VFD930VP43SHTCA;

VFD1K1VP43SHTCA; VFD1K2VP43SHTCA

Heat Sink Fan Model “MKVP-MFKM”

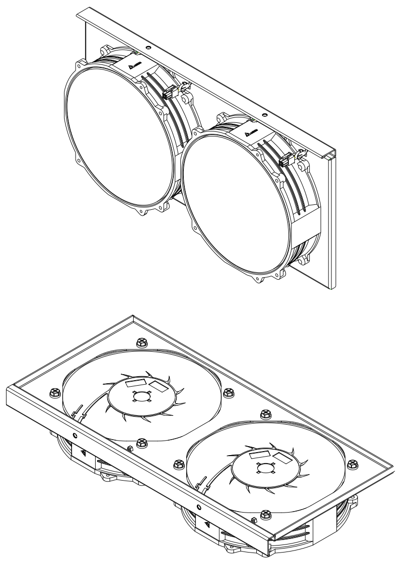


Figure 10-92

10-3-7 Chassis Rail (MKVP-CR01)

Frame L

Applicable models:

VFD530VP43SHTCA; VFD616VP43SHTCA;
VFD683VP43SHTCA; VFD770VP43SHTCA

Frame M

Applicable models:

VFD866VP43SHTCA; VFD930VP43SHTCA;
VFD1K1VP43SHTCA; VFD1K2VP43SHTCA

Model『MKVP-CR01』

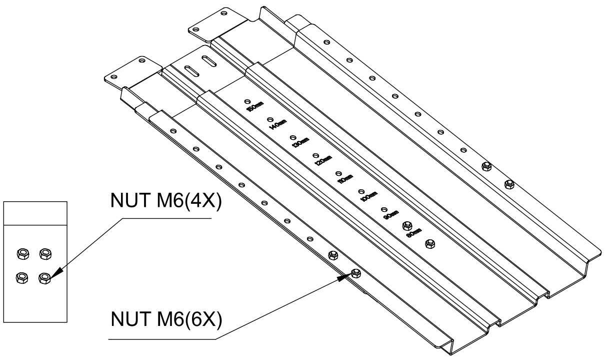


Figure 10-93

Recommended applicable range

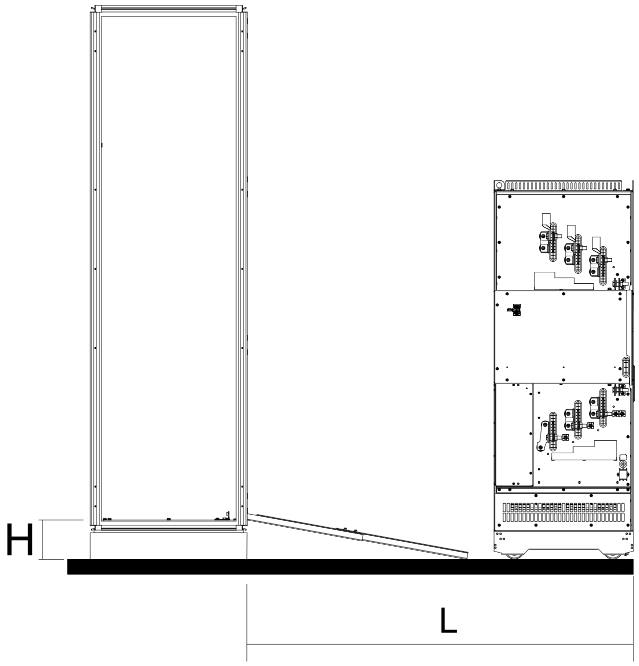


Figure 10-94

Cabinet Height Difference H (mm)	Recommended Installing Distance L (mm)
50	980
60	978
70	976
80	1103
90	1142
100	1181
110	1220
120	1259
130	1298
140	1337
150	1375

NOTE:

1. For the AC motor drive dimensions, refer to Section 2-5 Appearance and Dimensions.
2. For unpacking the AC motor drive, refer to Section 2-4-1 Unpacking.
3. For lifting the AC motor drive, refer to Section 2-4-2 The Lifting Hook.
4. For installing the Chassis, refer to Section 2-4-5 Chassis Installation.

Installation

1. Use 10 pcs of M6 screws and 2 pcs of M8 screws to lock the chassis rail to the cabinet.
   M6 Screw torque: 35–45 kg-cm / (30.4–39.1 lb-in.) / (3.43–4.41 Nm)
   M8 Screw torque: 100–110 kg-cm / (86.8–95.5 lb-in.) / (9.80–10.78 Nm)

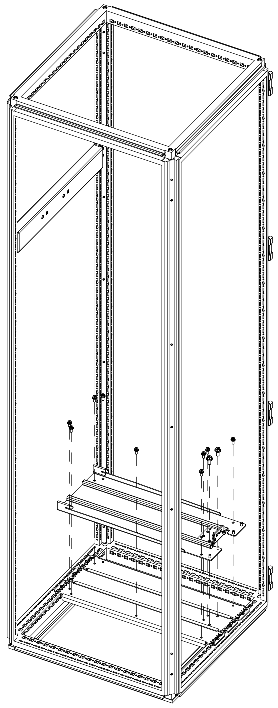


Figure 10-95

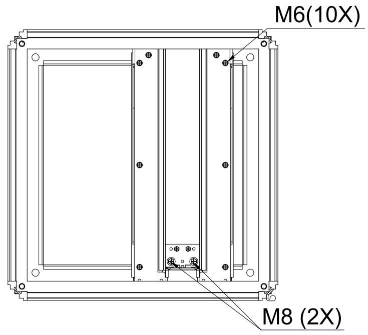


Figure 10-96

2. Use 4 pcs of M6 screws to lock the slide rail to the cabinet. Adjust the length according to the marking on the slide rail, and then fix it with the 6 pcs screws on the rail.
   M6 Screw torque: 35–45 kg-cm / (30.4–39.1 lb-in.) / (3.43–4.41 Nm)

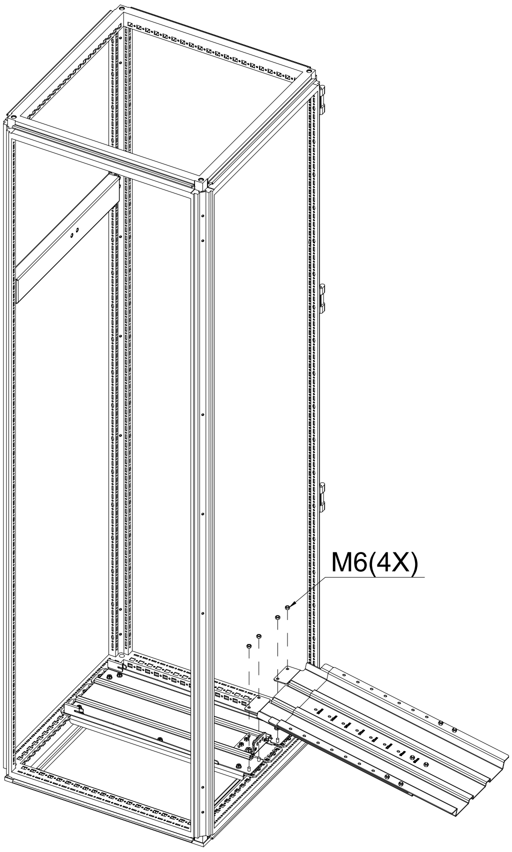


Figure 10-97

The cabinet height difference (H) is between 50–70 mm

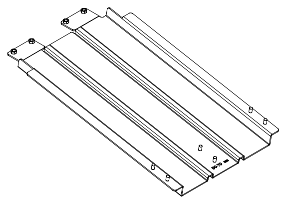


Figure 10-98

The cabinet height difference (H) is between 80–150 mm

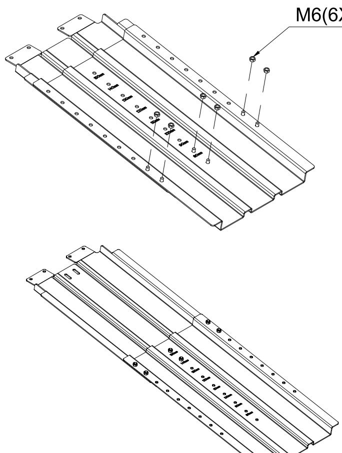


Figure 10-99

3. Install the safety buckle and push the drive into the cabinet along the slide rail. Make sure the cabinet is well fixed before pushing the drive.

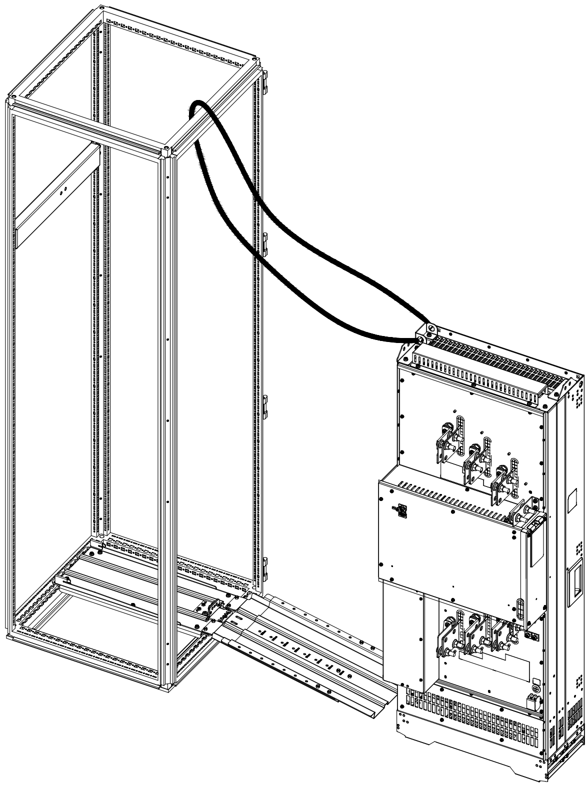


Figure 10-100

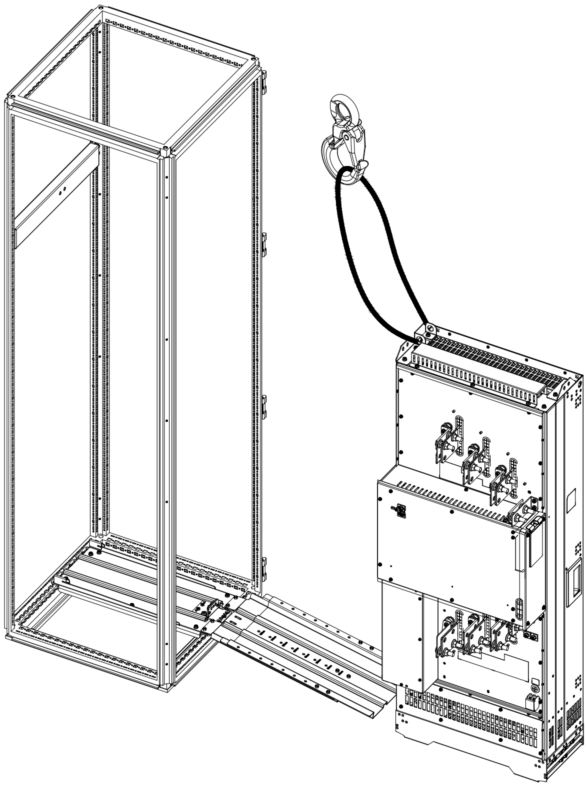


Figure 10-101

4. Use 4 pcs of M8 screws to lock the drive at the locations indicated in the following figures.
M8 Screw torque: 100–110 kg-cm / (86.8–95.5 lb-in.) / (9.80–10.78 Nm)

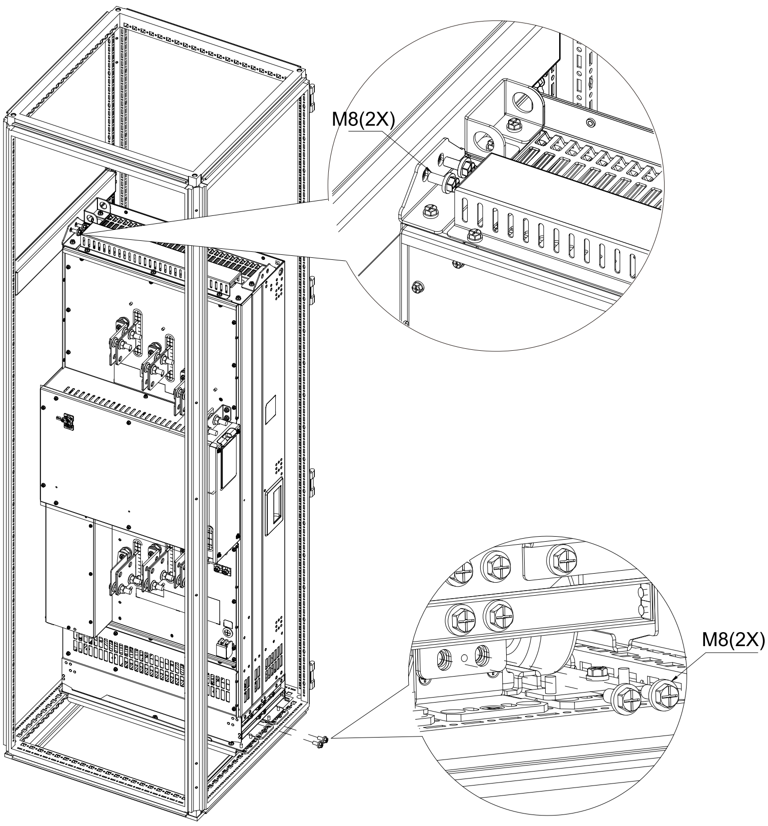


Figure 10-102

5. Install the front beam of the cabinet and use 2 pcs of M8 screws to lock the drive at the position indicated in the following figure.
   M8 Screw torque: 100–110 kg-cm / (86.8–95.5 lb-in.) / (9.80–10.78 Nm)

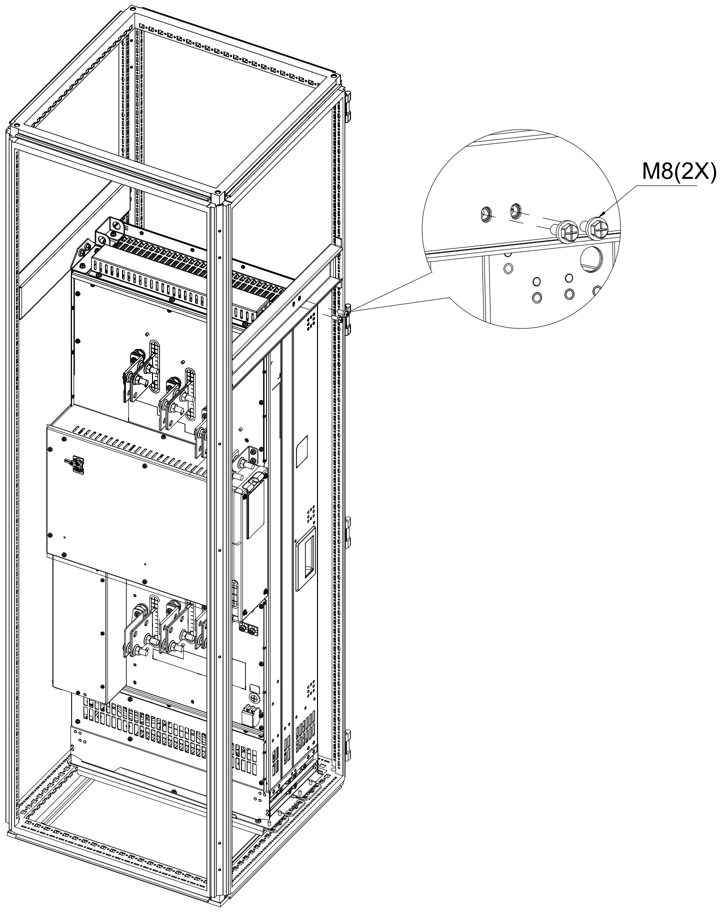


Figure 10-103

10-3-8 IP20 Shielded Cover

Assembly Component

Frame L

Model: MKVP-IP20L

Applicable models:

VFD530VP43SHTCA; VFD616VP43SHTCA; VFD683VP43SHTCA; VFD770VP43SHTCA

Item	Description	Q'ty
1	ACRY-COVER1	1
2	ACRY-COVER2	1
3	ACRY-COVER3	1
4	ACRY-COVER4	1
5	RST-COVER-1	1
5-1	Bushing Rubber D63	4
5-2	Bushing Rubber D103	1
6	RST-COVER-2	1
7	RST-COVER-3	1
8	RST-COVER-4	1
9	UVW-COVER-1	1
9-1	Bushing Rubber D17.5	1
9-2	Bushing Rubber D79	2
9-3	Bushing Rubber D103	1
10	UVW-COVER-2	1
11	UVW-COVER-3	1
12	UVW-COVER-4	1
13	SCREW M4x0.8x10L	44
14	RST-BUSBAR	5
15	UVW-BUSBAR	3
16	RST-PE1	1
17	UVW-PE2	1

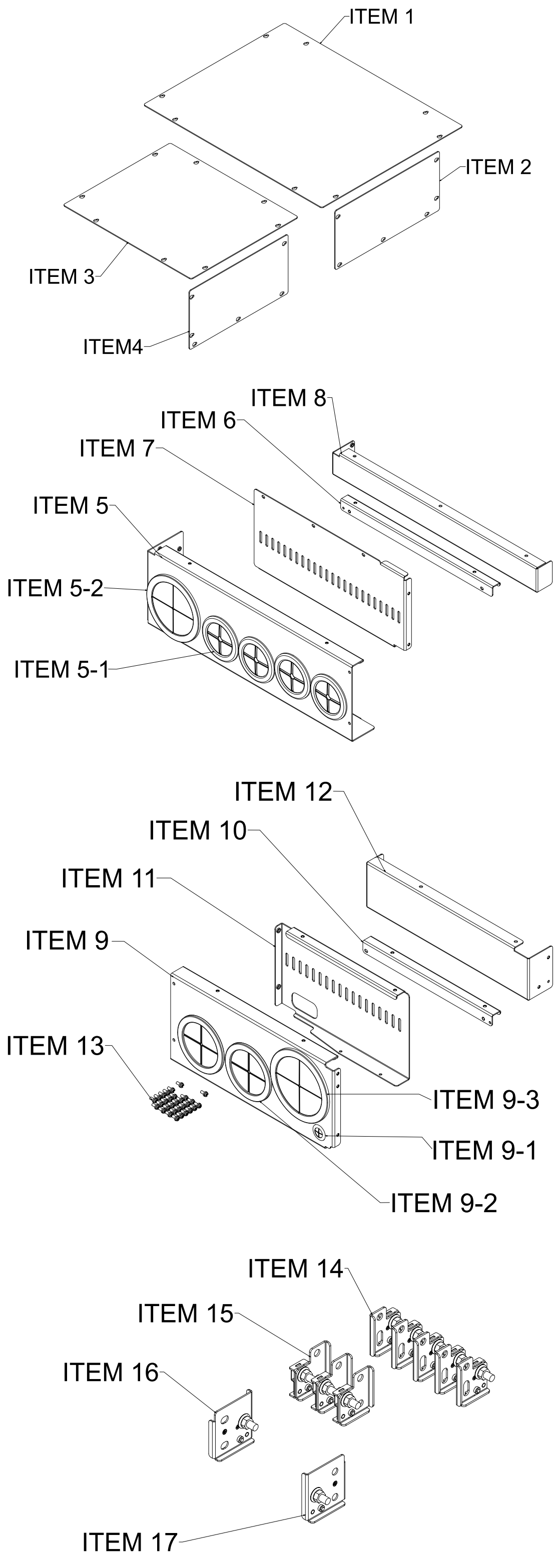


Figure 10-104

Frame M

Model: MKVP-IP20M

Applicable models:

VFD866VP43SHTCA; VFD930VP43SHTCA; VFD1K1VP43SHTCA; VFD1K2VP43SHTCA

Item	Description	Q'ty
1	ACRY-COVER1	1
2	ACRY-COVER2	1
3	ACRY-COVER3	1
4	ACRY-COVER4	1
5	RST-COVER-1	1
5-1	Bushing Rubber D79	2
5-2	Bushing Rubber D103	2
6	RST-COVER-2	1
7	RST-COVER-3	1
8	RST-COVER-4	1
9	UVW-COVER-1	1
9-1	Bushing Rubber D17.5	1
9-2	Bushing Rubber D79	2
9-3	Bushing Rubber D103	1
10	UVW-COVER-2	1
11	UVW-COVER-3	1
12	UVW-COVER-4	1
13	SCREW M4x0.8x10L	41
14	RST-BUSBAR	5
15	UVW-BUSBAR	3
16	RST-PE1	1
17	UVW-PE2	1
18	Voltage Insulator	8
19	SCREW M6x1.0x15L	8
20	SCREW M5x0.8x12L	6

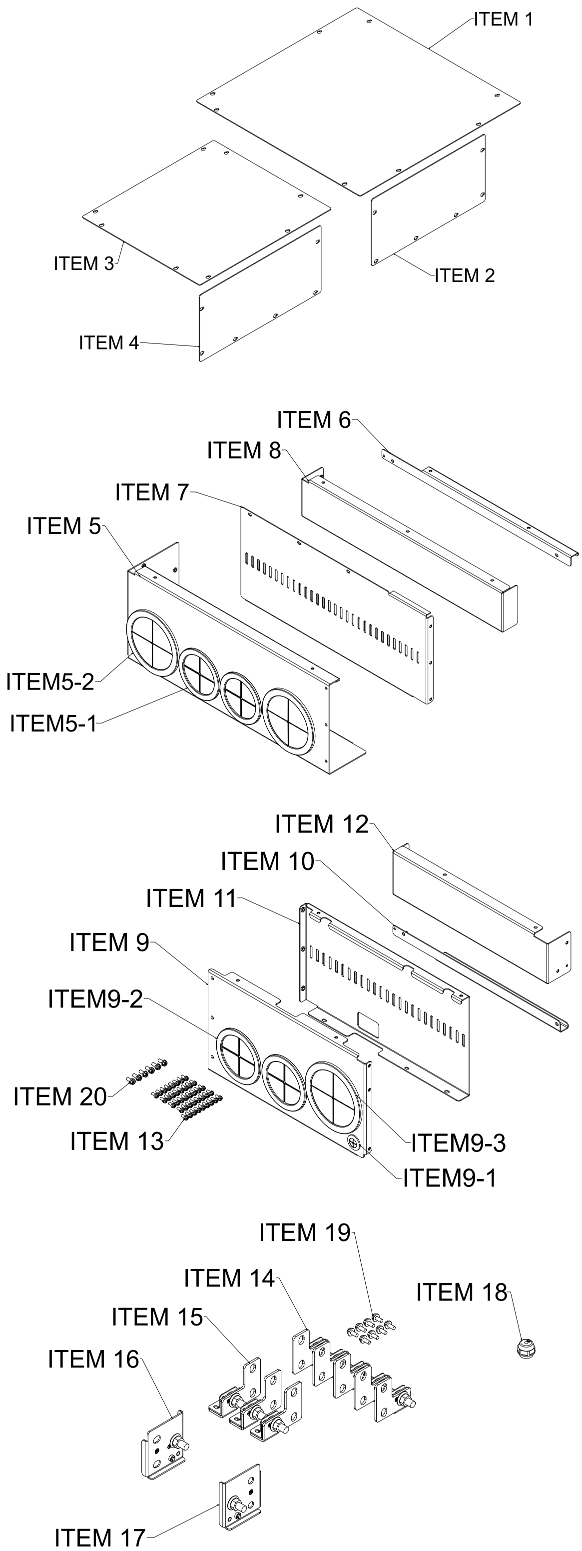


Figure 10-105

Installation

The IP20 shielded cover is applicable for Frame L and Frame M of VP3000, VP3000-E and VP3000-EHS, as shown in the figure below. The following installation description takes VP3000-E as demonstration.

VP3000

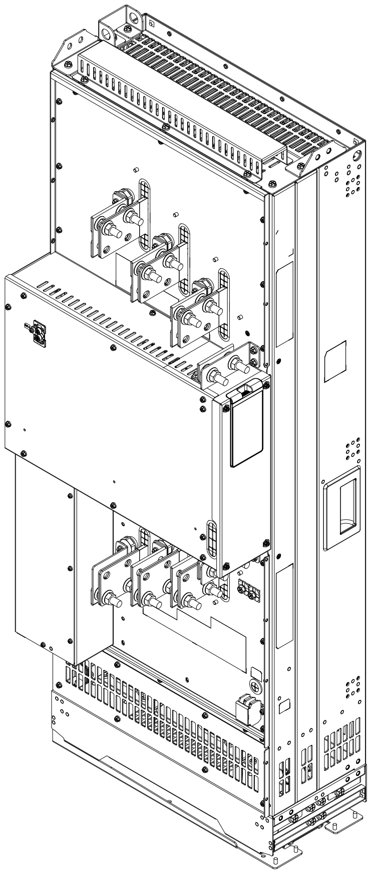


Figure 10-106

VP3000-E, VP3000-EHS

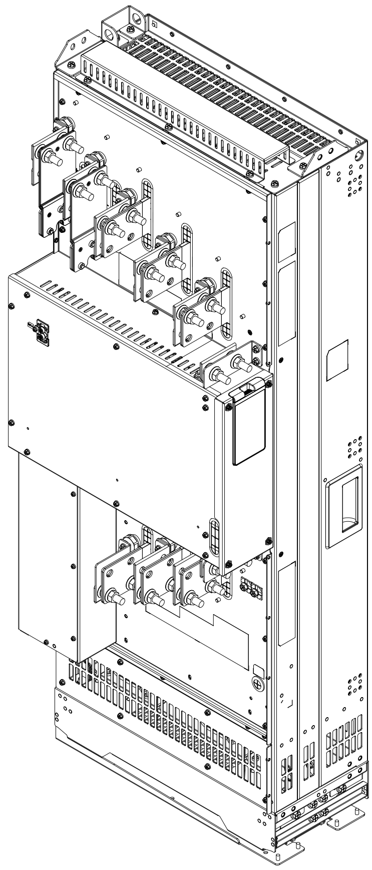


Figure 10-107

NOTE: In order to facilitate the disassembly of the acrylic board, place the fixed locking points of the cabinet and the drive referring to the dimension in the following figure.

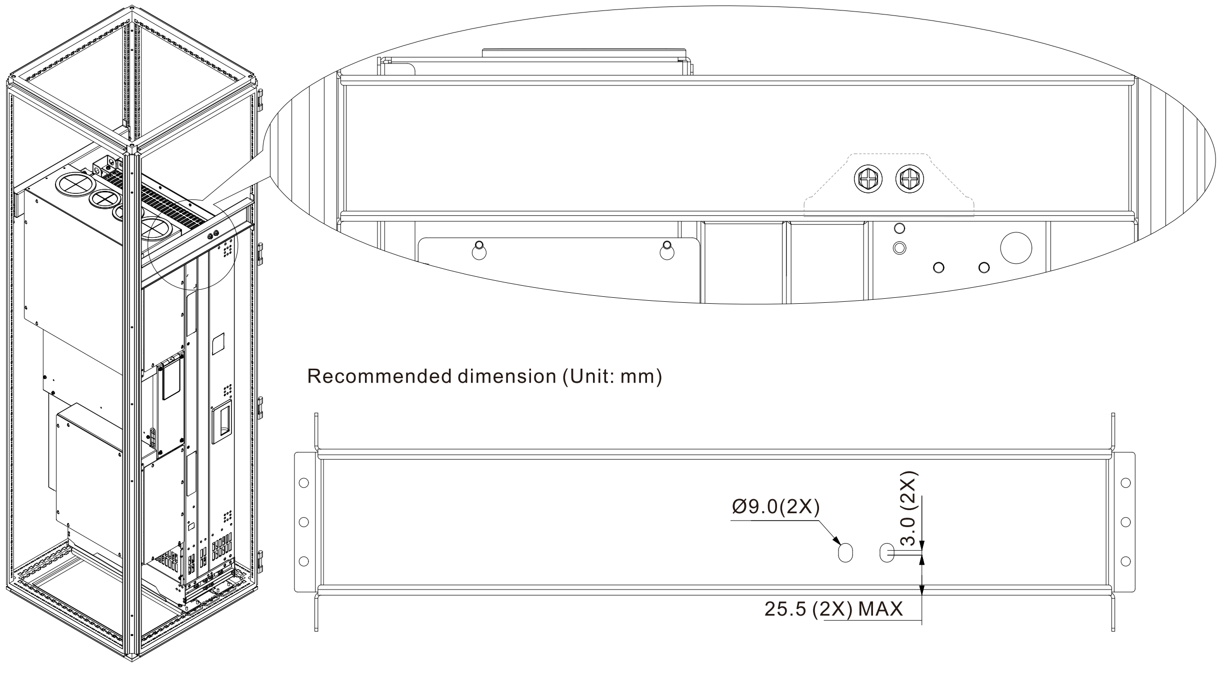


Figure 10-108

Step 1–3 are instructions for the side outlet direction (as shown in the figure below) that needs to be installed with ITEM 14–20 and continues with Step 4 for further assembly.

For the up/ down outlet direction, start the installation from Step 4.

(For Frame L installation, start with Step 2, and jumps to Step 4 for further assembly.)

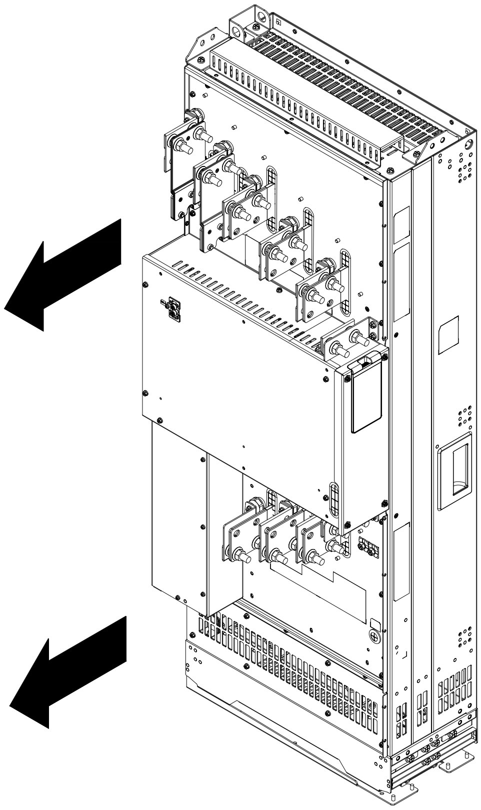


Figure 10-109

1. Fasten ITEM 18 Voltage Insulator, 8 pcs in total.
   Screw torque: 55–60 kg-cm / (47.7–52.1 lb-in.) / (5.39–5.88 Nm)

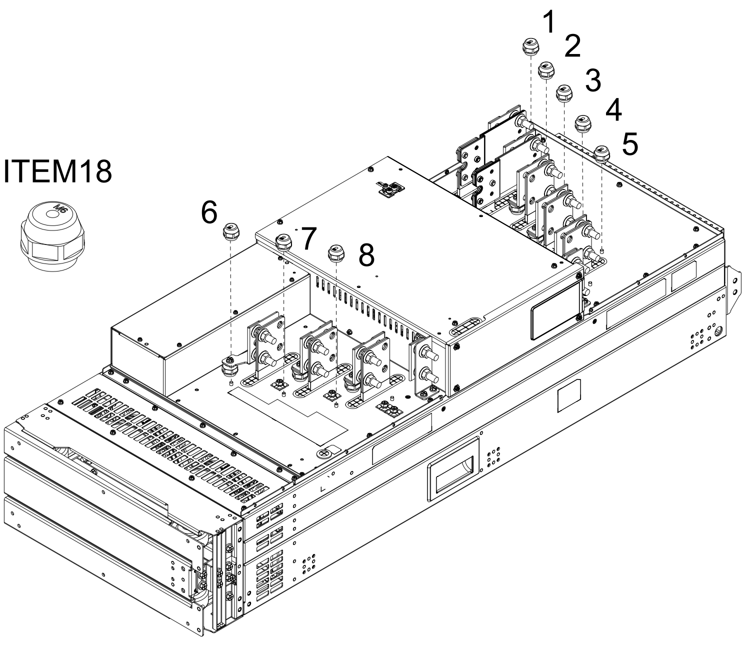


Figure 10-110

2. Unscrew 20 pcs of M12 nuts as shown in the the following figure, and attach ITEM 14–17 metal parts. Pre-lock Nut 1–10 in the figure below with the pre-lock torque first, and the adjust to the fixed torque after connecting the terminals. Nuts 11–20 can be directly locked with the fixed torque value.
   Pre-lock torque: 45–50 kg-cm / (39.1–43.4 lb-in.) / (4.41–4.90 Nm)
   Screw torque: 320–360 kg-cm / (277.8–312.5 lb-in.) / (31.36–35.28 Nm)

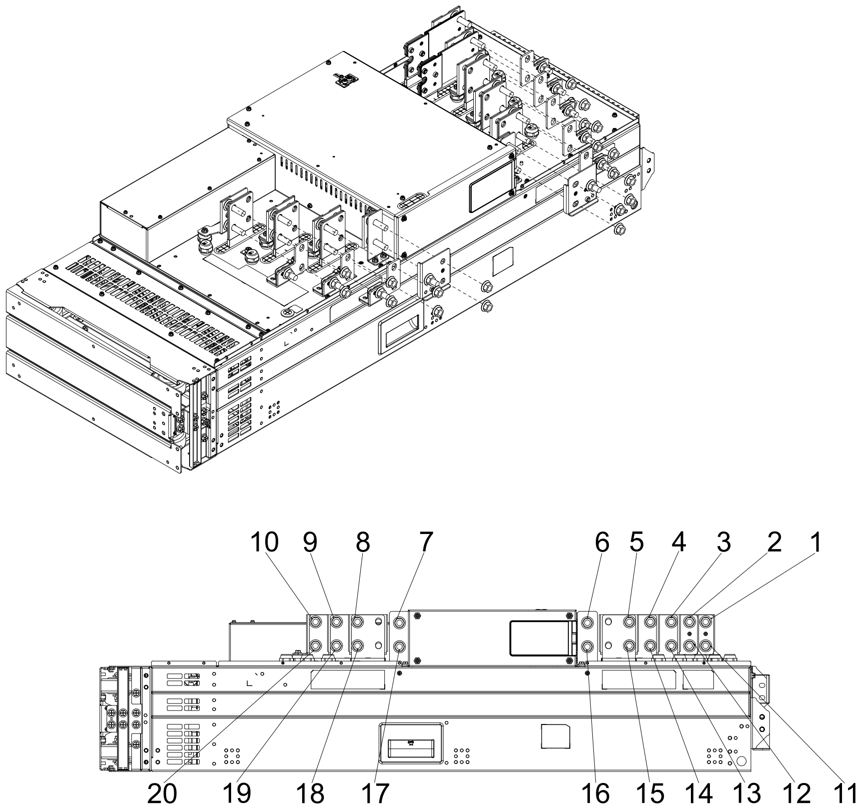


Figure 10-111

3. Fasten the M6x15L screws at the positions indicated in the following figure, 8 pcs in total.
   Screw torque: 35–45 kg-cm / (30.4–39.1 lb-in.) / (3.43–4.41 Nm)

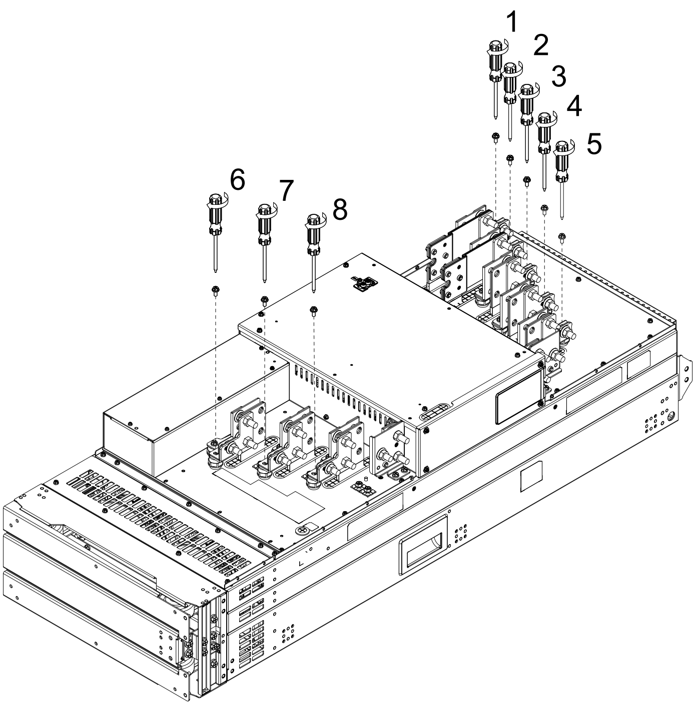


Figure 10-112

4. Unscrew the 5 pcs of M5 screws from the positions indicated in the following figure, and attach ITEM 8 and ITEM 12.
   Screw torque: 24–26 kg-cm / (20.8–22.6 lb-in.) / (2.35–2.55 Nm)

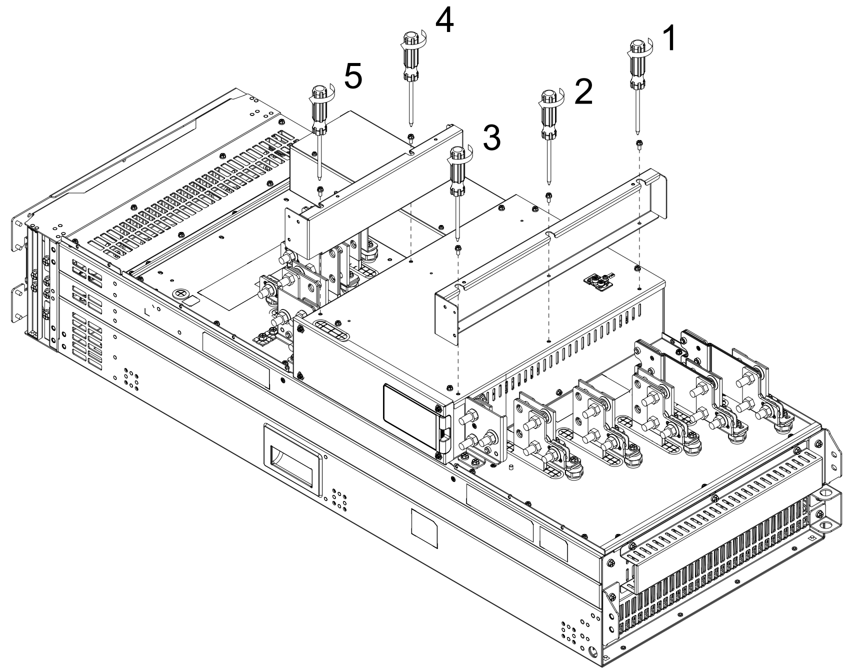


Figure 10-113

5. Attach ITEM 9 and ITEM11.
   Frame L: Use 5 pcs of M4x10L screws and attach ITEM 9 and ITEM 11 as shown in the following figure.
   Screw torque: 14–16 kg-cm / (12.2–13.9 lb-in.) / (1.37–1.57 Nm)

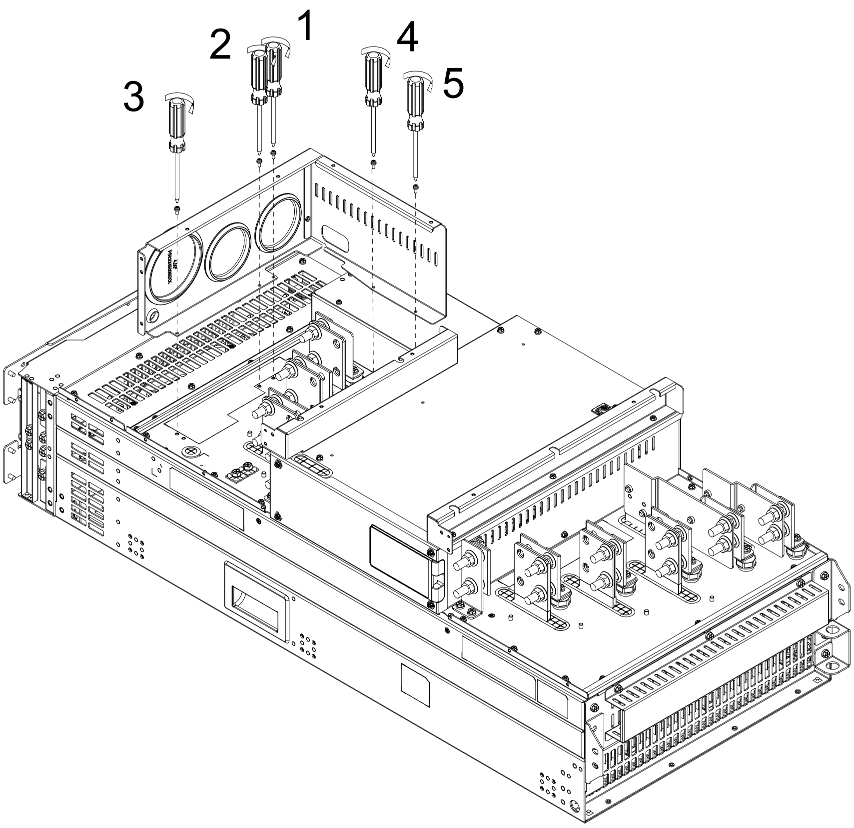


Figure 10-114

Frame M: Use 6 pcs of M5x12L screws and attach ITEM 9 and ITEM 11 as shown in the following figure.

Screw torque: 24–26 kg-cm / (20.8–22.6 lb-in.) / (2.35–2.55 Nm)

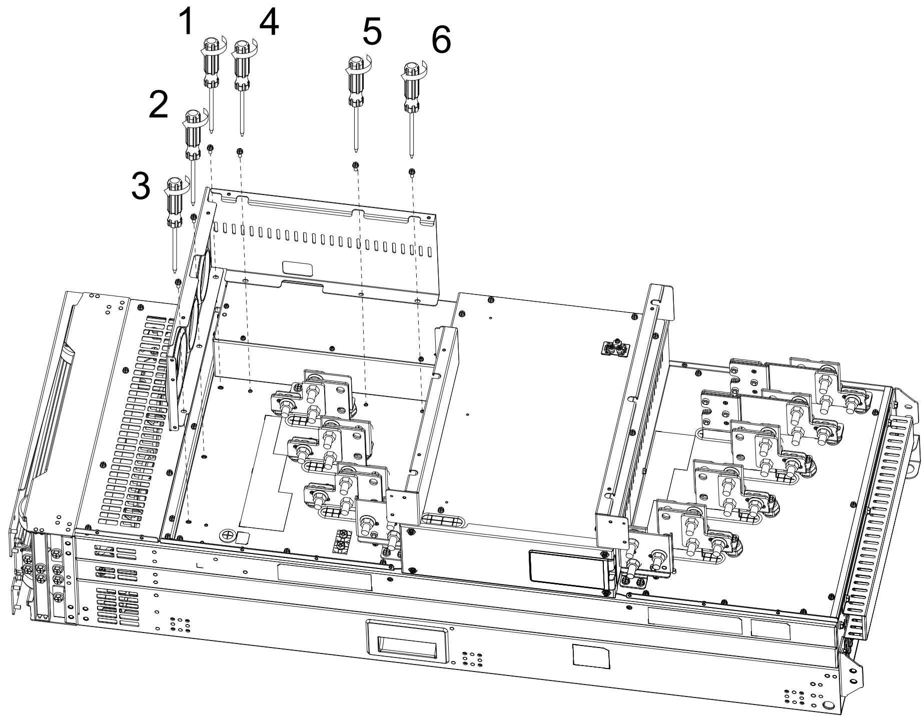


Figure 10-115

6. Use M4x10L screws (2 pcs for Frame L, 3 pcs for Frame M), and attach ITEM 9 and ITEM 11 as shown in the following figure.

   Screw torque: 14–16 kg-cm / (12.2–13.9 lb-in.) / (1.37–1.57 Nm)

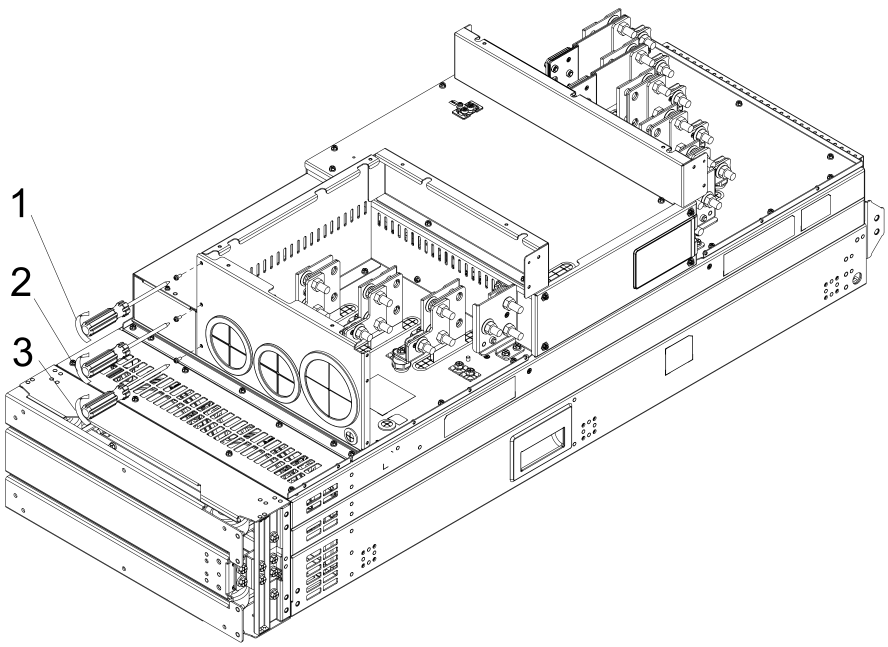


Figure 10-116

7. Use 6 pcs of M4x10L screws to attach ITEM 5 and ITEM 7.
   Screw torque: 14–16 kg-cm / (12.2–13.9 lb-in.) / (1.37–1.57 Nm)

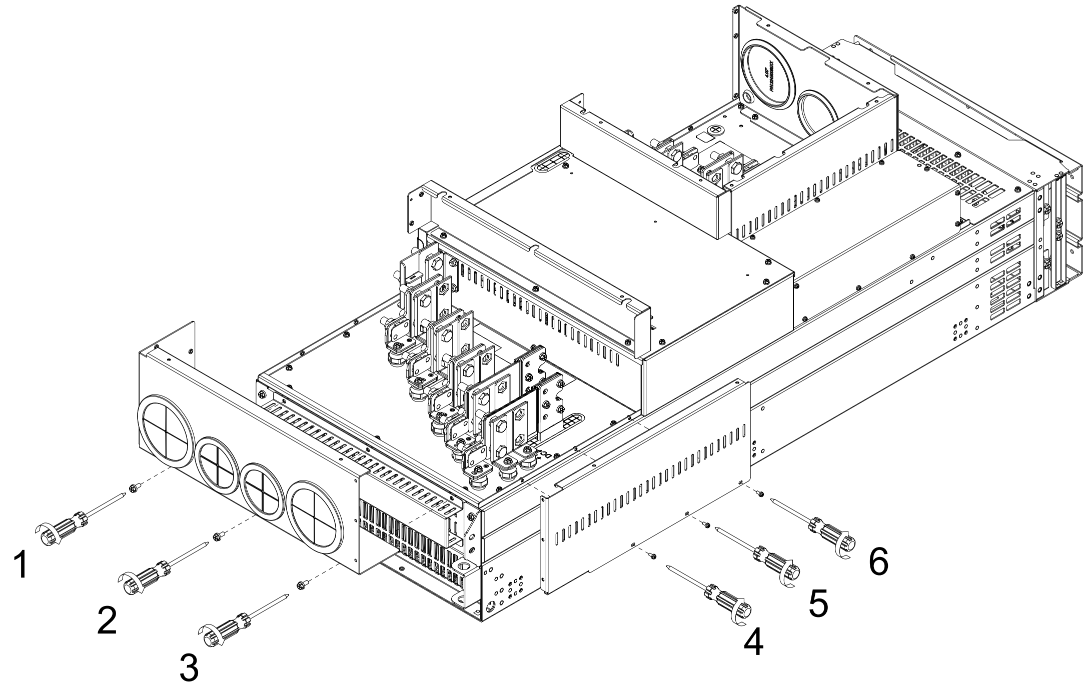


Figure 10-117

8. Use M4x10L screws (2 pcs for Frame L, 3 pcs for Frame M), and attach ITEM 5 and ITEM 7 as shown in the following figure.
   Screw torque: 14–16 kg-cm / (12.2–13.9 lb-in.) / (1.37–1.57 Nm)

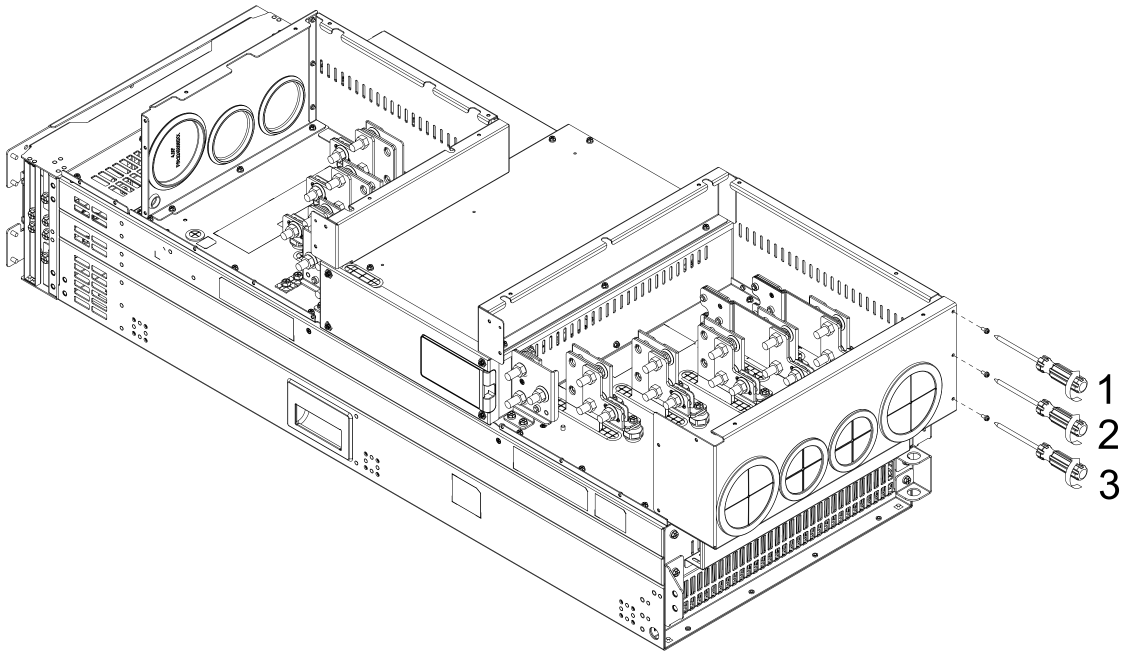


Figure 10-118

9. Use 4 pcs of M4x10L screws and attach ITEM 6 and ITEM 10 as shown in the following figure.
   Screw torque: 14–16 kg-cm / (12.2–13.9 lb-in.) / (1.37–1.57 Nm)

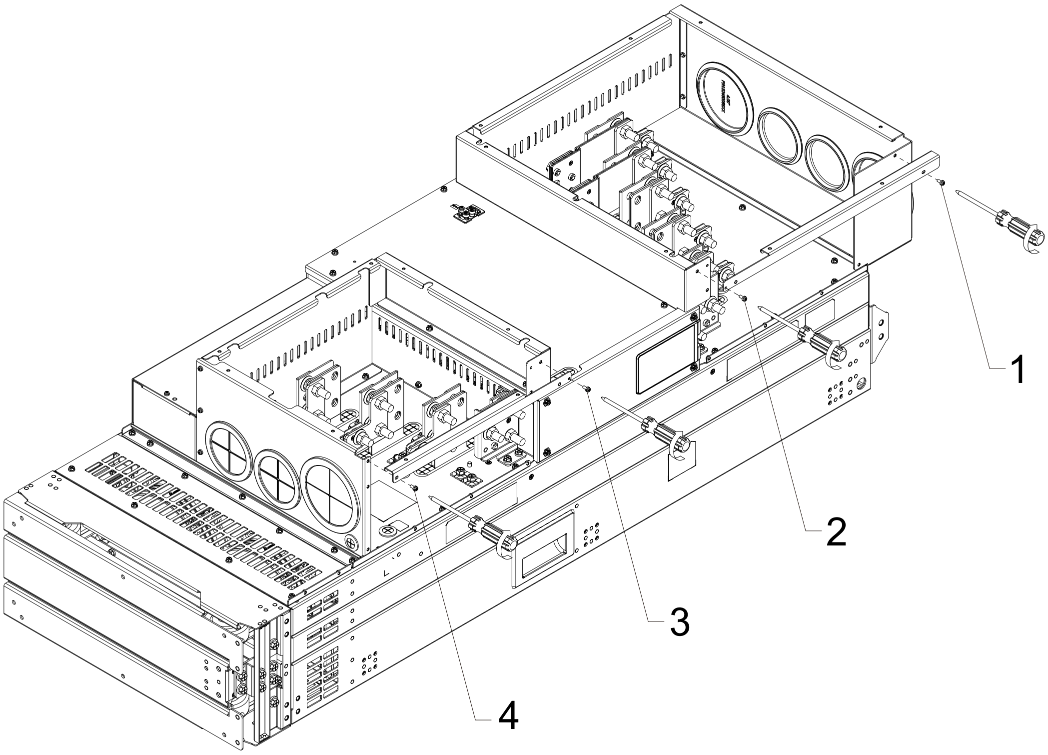


Figure 10-119

10. Use 28 pcs of M4x10L screws and attach ITEM 1–4 as shown in the following figure.
    Screw torque: 14–16 kg-cm / (12.2–13.9 lb-in.) / (1.37–1.57 Nm)

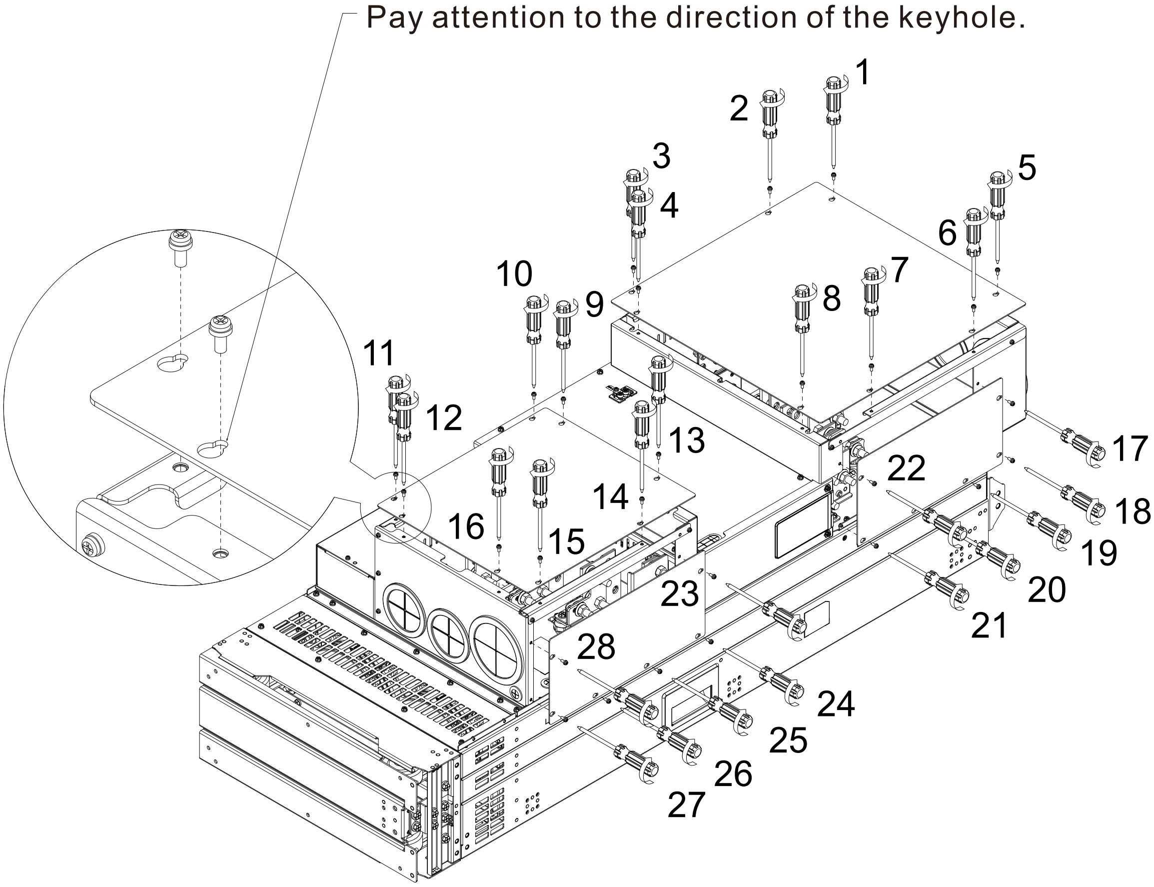


Figure 10-120

11. Installation completed.

Frame L

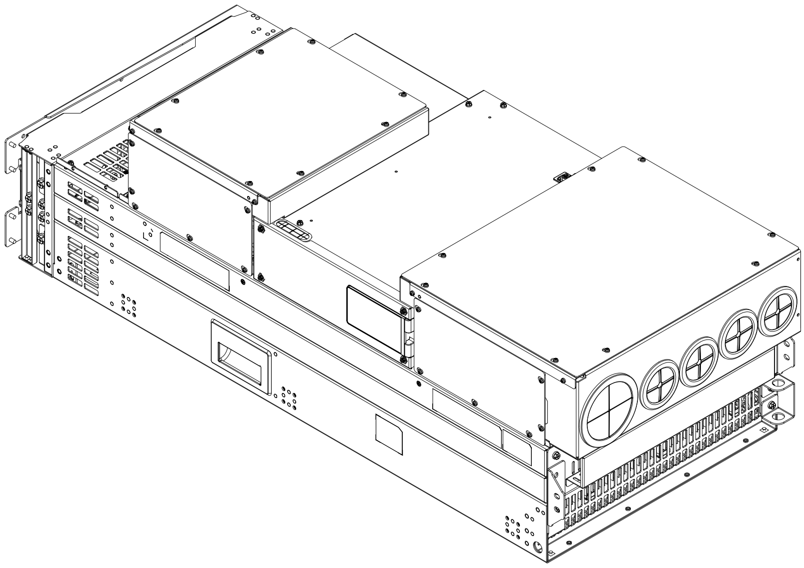


Figure 10-121

Frame M

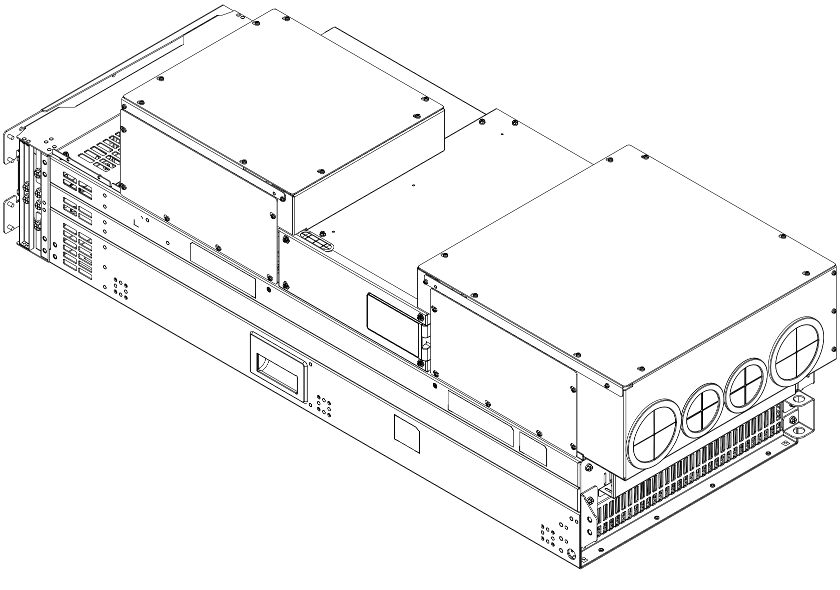


Figure 10-122

10-3-9 USB / RS-485 Communication Interface IFD6530

Warning

✓ Thoroughly read this instruction sheet before installation and putting it into use.

✓ The content of this instruction sheet and the driver file may be revised without prior notice. Consult our distributors or download the most updated instruction/driver version at Delta website.

Introduction

IFD6530 is a convenient RS-485-to-USB converter, which does not require external power-supply and complex setting process. It supports baud rate from 75 to 115.2 Kbps and auto switching direction of data transmission. In addition, it adopts RJ45 in RS-485 connector for users to wire conveniently. And its tiny dimension, handy use of plug-and-play and hot-swap provide more conveniences for connecting all DELTA IABG products to your PC.
Applicable Models: All DELTA IABG products.

■ Application & Dimension

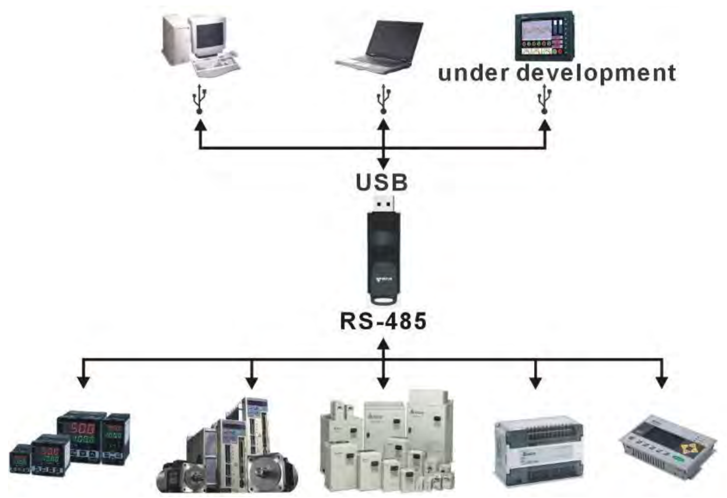


Figure 10-123

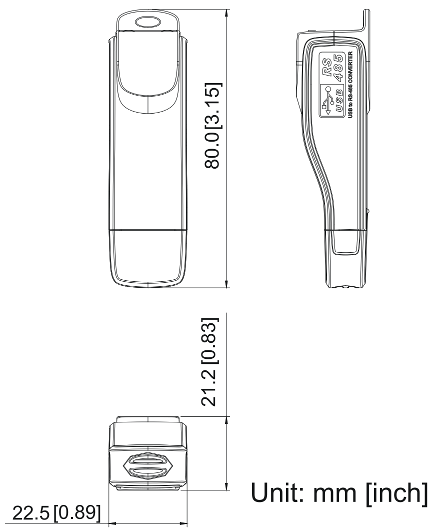


Figure 10-124

Specifications

Power supply	No external power is needed
Power Consumption	1.5 W
Isolated Voltage	2,500 V_{DC}
Baud Rate	75 Kbps, 150 Kbps, 300 Kbps, 600 Kbps, 1,200 Kbps, 2,400 Kbps, 4,800 Kbps, 9,600 Kbps, 19,200 Kbps, 38,400 Kbps, 57,600 Kbps, 115,200 Kbps
RS-485 Connector	RJ45
USB Connector	A type (plug)
Compatibility	Full compliance with USB V2.0 specification
Max. Cable Length	RS-485 Communication Port: 100 m
Support RS-485 half-duplex transmission	

Table 10-55

RJ45

Figure 10-125

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

Table 10-56

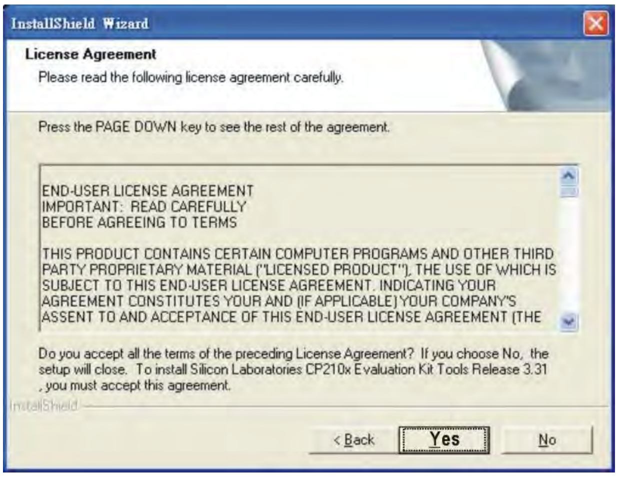
Preparations before Driver Installation

Download the USB Driver file (IFD6530_Drivers.exe) at Delta website (www.deltaww.com/iadownload_acmotordrive_TW/IFD6530_Drivers) and extract the driver file by the following steps.

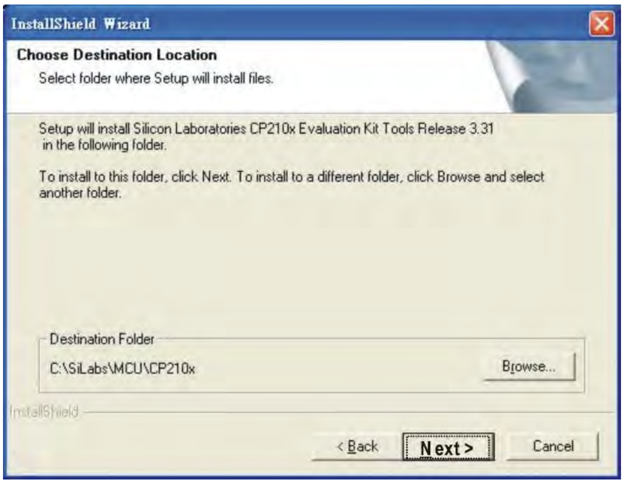
NOTE: DO NOT connect IFD6530 to PC before extracting the driver file.

STEP 1

STEP 2



STEP 3



STEP 4

STEP 5

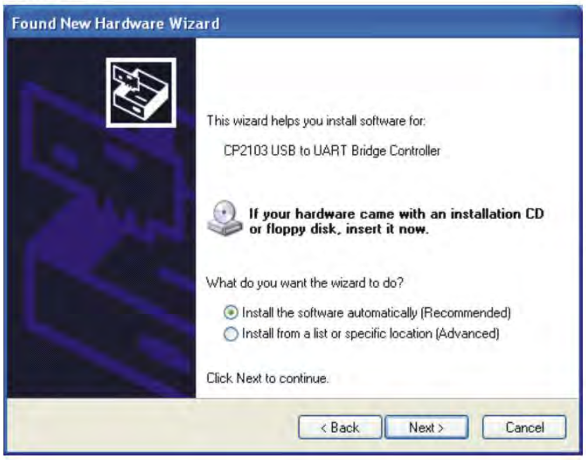
You should have a folder marked SiLabs under drive C. c:\ SiLabs

Driver Installation

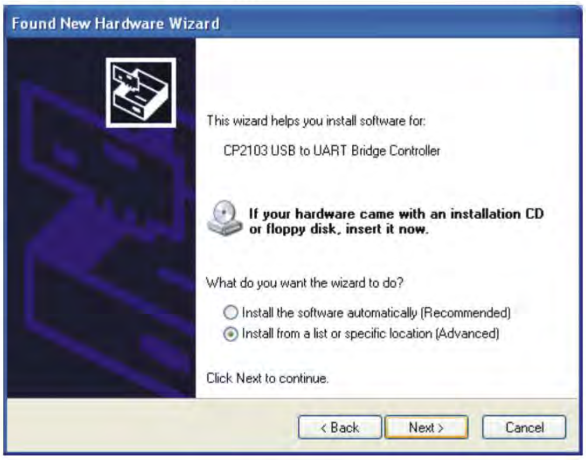
After connecting IFD6530 to PC, install the driver by following steps.

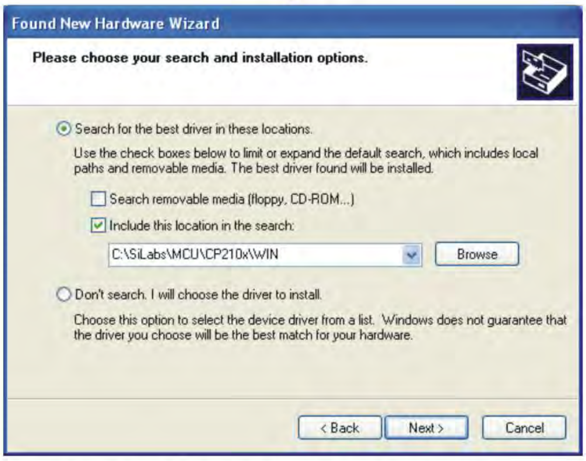
STEP 1

STEP 2



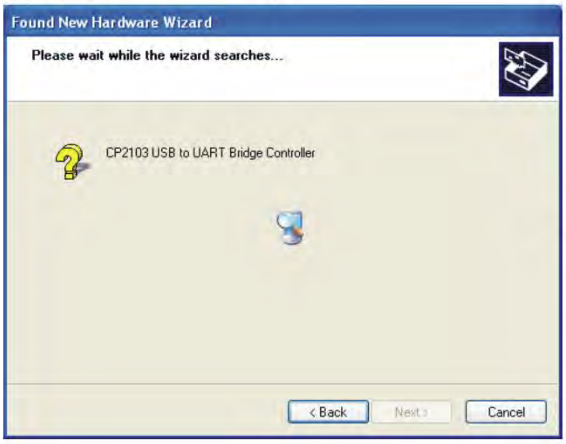
OR





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

STEP 3



STEP 4

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

LED Display

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

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Chapter 11 Specification

11-1 Specifications

11-1-1 460V Models

Model	Frame			Output					Input	Power
VFD_ _ _VP43	IP20 UL Open Type[*1]	IP20 UL Type 1 with C3 Filter	IP20 UL Type 1 with C2 Filter	Applicable Motor Power		Continuous Rated Output Current	Light Load Output Current	Max. Output Current	Rated Input Current	Power Supply Capacity
				(kW)	(HP)	I_{CON}	$I_{ld,}$	I_{max}	(A)[*2]	(kVA)[*3]
3A0	A1	A2	-	0.75	1	3	2.9	3.7	4.2	2.4
4A2	A1	A2	-	1.5	2	4.2	4	5.9	5.9	3.3
5A6	A1	A2	-	2.2	3	5.6	5.3	7.2	7.8	4.5
7A2	A1	A2	-	3	4	7.2	6.9	10.1	10.1	5.7
011	A1	A2	-	4	5	11	10	13	15.4	8.8
013	B1	B2	-	5.5	7.5	13	12	16	18.2	10.4
018	B1	B2	-	7.5	10	18	17	22.7	25	14
025	C1	C2	-	11	15	25	24	30.8	35	20
032	C1	C2	-	15	20	32	30.4	44.3	45	25
038	C1	C2	-	18.5	25	38	36.1	56.9	53	30
045	D1	D2	D2	22	30	45	43	67.9	45	36
062	D1	D2	D2	30	40	62	59	76.3	62	49
073	E1	E2	E2	37	50	73	70	104	73	58
090	E1	E2	E2	45	60	90	87	122	90	72
110	F1	F2	F2	55	75	110	105	148	110	88
150	G1	G2	G2	75	100	150	143	185	150	120
180	H1	H2	H2	90	125	180	171	247	180	143
220	H1	H2	H2	110	150	220	210	287	220	175
260	I1	I2	I2	132	175	260	248	350	260	207
310	I1	I2	I2	160	215	310	295	418	310	247
370	J1	J2	J2	185	250	370	352	455	370	295
395	J1	J2	J2	200	270	395	376	498	395	315
460	K1	K2	K2	220	300	460	438	566	460	366
485	K1	K2	K2	250	340	485	461	597	485	386
530	L	-	-	280	375	530	505	652	530	422
616	L	-	-	315	425	616	587	757	616	491
683	L	-	-	355	475	683	650	840	683	544
770	L	-	-	400	530	770	733	1020	770	613
866	M	-	-	450	600	866	825	1065	866	690
930	M	-	-	500	665	930	886	1143	930	741
1K1	M	-	-	560	745	1100	1042	1345	1100	876
1K2	M	-	-	630	840	1212	1154	1490	1212	966

I_{CON}	Continuous output current without overload
$I_{ld,}$	110% of rated output current in light load: 1 minute for every 5 minutes
I_{max}	Maximum output current: 2 sec. at start-up
Rated Input Voltage	Three-phase, 380–480 V_{AC} (-15– +10%)
Rated Input Frequency	50 / 60 Hz
Allowable Power Frequency Change	+15% (47–63 Hz)
Displacement Power Factor (cosϕ)	0.98
Efficiency (%)	Frame A–C: 97; Frame D–M: 98
Braking Chopper	Not apply
DC Choke	Frame A–C without built-in DC choke; Frame D and above = Low harmonic (THDi >35%)[*4]

Table 9-1

NOTE:

1. Frame L and M models are IP00 Chassis models.
2. The rated input current may fluctuate with the power supply impedance, power transformer, input reactors, DC chokes and the loads.
3. The power supply capacity is calculated based on the rated input power and 480 V_{AC}, which is used as a reference for selecting the power transformer capacity.
4. Refer to Model Name Explanation.
5. For high altitude, high ambient temperature, high carrier frequency, and advanced motor vector control, refer to Section 11-4 Derating in the user manual.
6. Refer to Section 11-4 for the default value of carrier frequency, adjustable range, and derating curve.

11-2 General Specifications

11-2-1 General Features

Control Characteristics	Control Mode	PWM control
	Control Method	1: V/F, 2: SVC, 3: PM Sensorless, 4: SynRM Sensorless
	Starting Torque	Reach up to 150% or above at 0.5 Hz
	V/F Curve	4-point adjustable V/F curve and square curve
	Speed Response Ability	IMVF, IMSVC: 1:50 IMFOC Sensorless: 1:100 PMSVC: 1:20 PMFOC Sensorless: 1:50
	Torque Limit	In FOC mode, torque quadrants can be set separately via parameters
	Torque Accuracy	±5%
	Max. Output Frequency (Hz)	599.00 Hz
	Frequency Output Accuracy	Digital command: ±0.01%, -10°C – +40°C Analog command: ±0.1%, 25 ±10°C
	Output Frequency Resolution	Digital command: 0.01 Hz Analog command: 0.03 × max. output frequency / 60 Hz (±11-bit)
	Overload Tolerance	Rated output current is 110%: 1 minute for every 5 minutes
	Frequency Setting Signal	0–10 V, 4–20 mA, 0–20 mA
	Accel. / Decel. Time	0.00–600.00/ 0.0–6000.0 sec.
	Main Control Function	Momentary power loss ride thru, Speed search, Over-torque detection, Torque limit, 16-step speed (Max.), Accel. / Decel. time switch, S-curve accel. / decel., Three-wire sequence, Auto-Tuning, Dwell, Slip compensation, Torque compensation, JOG frequency, Frequency upper/ lower limit settings, DC injection braking at start/ stop, High slip braking, Energy saving control, Modbus communication (RS-485 RJ45, max. 115.2 Kbps)
	Fan Control	Frame A–F: ON/ OFF switch control Frame G and above: PWM control
Protection Characteristics	Motor Protection	Electronic thermal relay protection
	Over-Current Protection	Over-current protection for 195% rated current
	Over-Voltage Protection	460V models: drive stops running when DC bus voltage exceeds 820 V
	Over-Temperature Protection	Built-in temperature sensor
	Stall Prevention	Stall prevention during acceleration, deceleration, and running independently
	Restart after Instantaneous Power Failure	Parameter setting up to 20 seconds
	Grounding Leakage Current Protection	Leakage current is higher than 50% of rated current of the AC motor drive
Certifications		CE Low Voltage Directive (LVD) 2014/35/EU, EN61800-5-1 EMC Directive 2014/30/EU, EN61800-3 UL61800-5-1/ CSA C22.2 No.274 WEEE 2012/19/EU, RoHs 2011/65/EU, 2015/863/EC Quality assurance system ISO9001 and Environmental system ISO 14001
STO		Safe Torque Off (STO per EN/ IEC61800-5-2) TUV Rheinland certification IEC62061/ IEC61508, SIL CL3 EN ISO13849-1, Cat.3/PL d

Table 9-2

NOTE:

1. The maximum output frequency setting range varies with different carrier and control modes.
2. According to the motor protection requirements, you can use the drive internal parameters to adjust the protection level.

11-2-2 Environment for Operation, Storage and Transportation

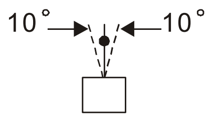
Do NOT expose the AC motor drive in the bad environment, such as dust, direct sunlight, corrosive/ inflammable gasses, humidity, liquid, and vibration environment. The salt in the air must be less than 0.01 mg/ cm^2 every year.			
Environment	Installation Location	IEC60364-1/ IEC60664-1 Pollution degree 2, Indoor use only	
	Surrounding Temperature (oC)	Storage	-25– +70
		Transportation	-25– +70
		Non-condensation, non-conductive pollution	
	Rated Humidity (%)	Operation	Max. 95
		Storage/ Transportation	Max. 95
		No condense water	
	Air Pressure (kPa)	Operation/ Storage	86–106
		Transportation	70–106
	Pollution Level	Operation	IEC60721-3-3 Class 3C3; Class 3S2
		Storage	IEC60721-3-1 Class 1C2; Class 1S2
		Transportation	IEC60721-3-2 Class 2C2; Class 2S2
		If you use the AC motor drive under harsh environment with high level of contamination (e.g., dew, water, dust), make sure it is installed in an environment qualified for IP54 such as in a cabinet.	
	Altitude	Operation	If the AC motor drive is installed at an altitude 0–1000 m, follow normal operation restriction. For it is installed at altitude over 1,000 m, decrease 1% of rated current or lower 0.5°C of temperature for every 100 m increase in altitude. Maximum altitude for Corner Grounded TN system is 2,000 m. Maximum altitude for 480 V_{AC} input voltage is 2,000 m. Maximum altitude for 380 V_{AC} input voltage is 4,000 m.
Package Drop	Storage/ Transportation	ISTA procedure 1A (according to weight) IEC60068-2-31	
Vibration	Frame A–K: 1.0 mm, peak to peak value range from 2 Hz to 13.2 Hz: 0.7–1.0G range from 13.2 Hz to 55 Hz: 1.0G range from 55 Hz to 512 Hz. Comply with IEC 60068-2-6 Frame L, M Chassis: 1.0 mm, peak to peak value range from 2 Hz to 13.2 Hz; 0.7G range from 13.2 Hz to 100 Hz		
Impact	IEC 60068-2-27		
Operation Position	Max. allowed offset angle ±10% (under normal installation position)		

Table 9-3

11-3 Specification for Operation Temperature and Protection Level

Frame	Top Cover	Conduit Box	Protection Level	Operation Temperature
A1–K1	Yes	N/A	IP20/ UL Open Type	-20–50°C
A2–K2	Yes	Yes	IP20/ UL Type 1	-20–45°C
L, M	N/A	N/A	IP00 Chassis	-20–50°C

Table 9-4

11-4 Derating Curve

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

Table 9-5

Ambient Temperature Derating Curve

460V

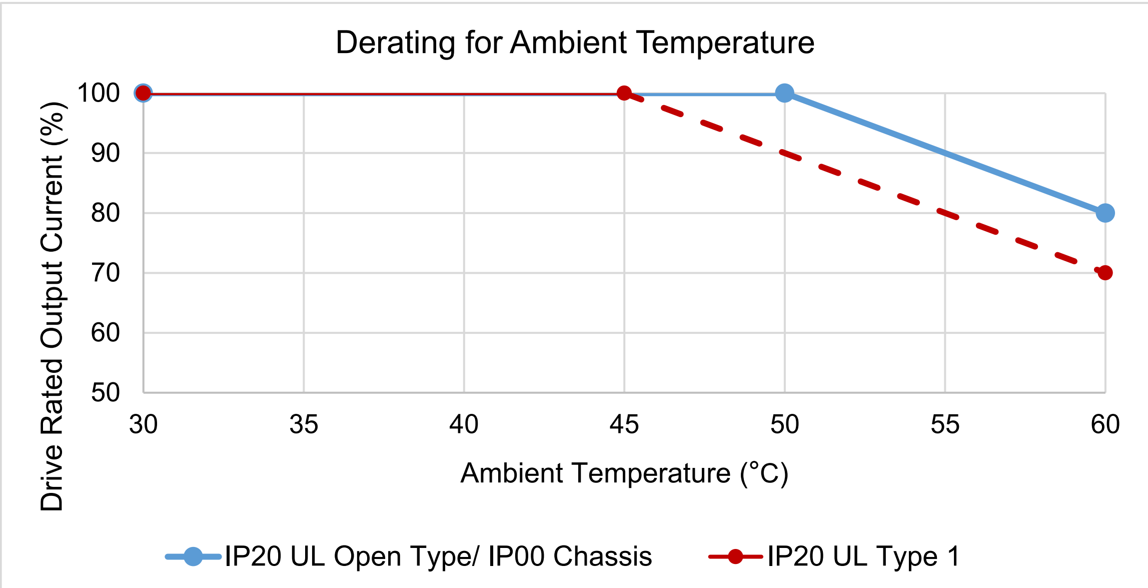


Figure 9-1

IP20 UL Open Type or IP00 Chassis:

The rated output current derating (%) when carrier frequency is the default value:

Ambient Temp. (Ta)/ 100% Load \ Carrier Frequency (kHz)	30°C	50°C	60°C
Default	100	100	80

Table 9-6

IP20 UL Type 1:

The rated output current derating (%) when carrier frequency is the default value:

Ambient Temp. (Ta)/ 100% Load \ Carrier Frequency (kHz)	30°C	45°C	60°C
Default	100	100	70

Table 9-7

Altitude Derating Curve

Condition	Operating Environment
High Altitude	If the AC motor drive is installed at an altitude 0–1000 m, follow normal operation restriction. For altitudes of 1000–2000 m, decrease 1% of the drive rated current or lower 0.5°C of temperature for every 100 m increase in altitude. The maximum altitude for Corner Grounded is 2,000 m. If installing at an altitude higher than 2000 m is required, contact Delta for more information.

Table 9-8

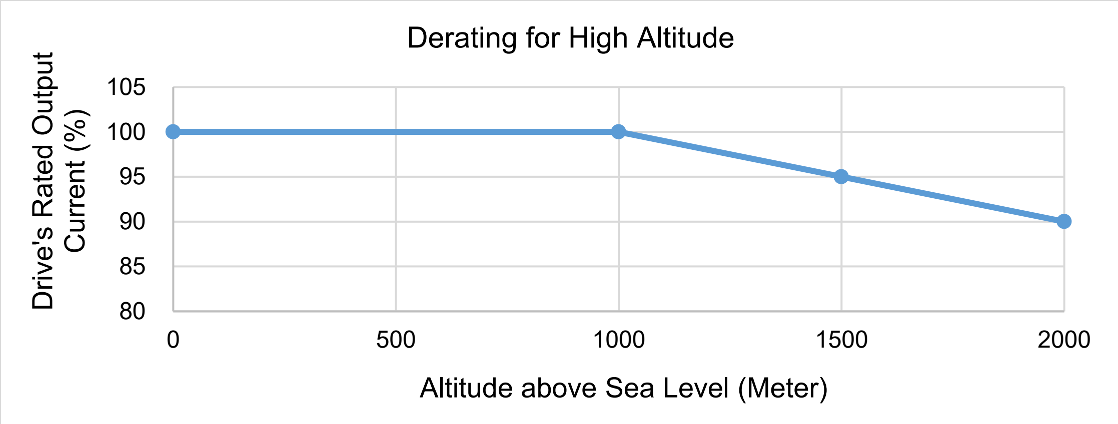


Figure 9-2

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

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

Table 9-9

Carrier Frequency Derating Curve

Frame A–D

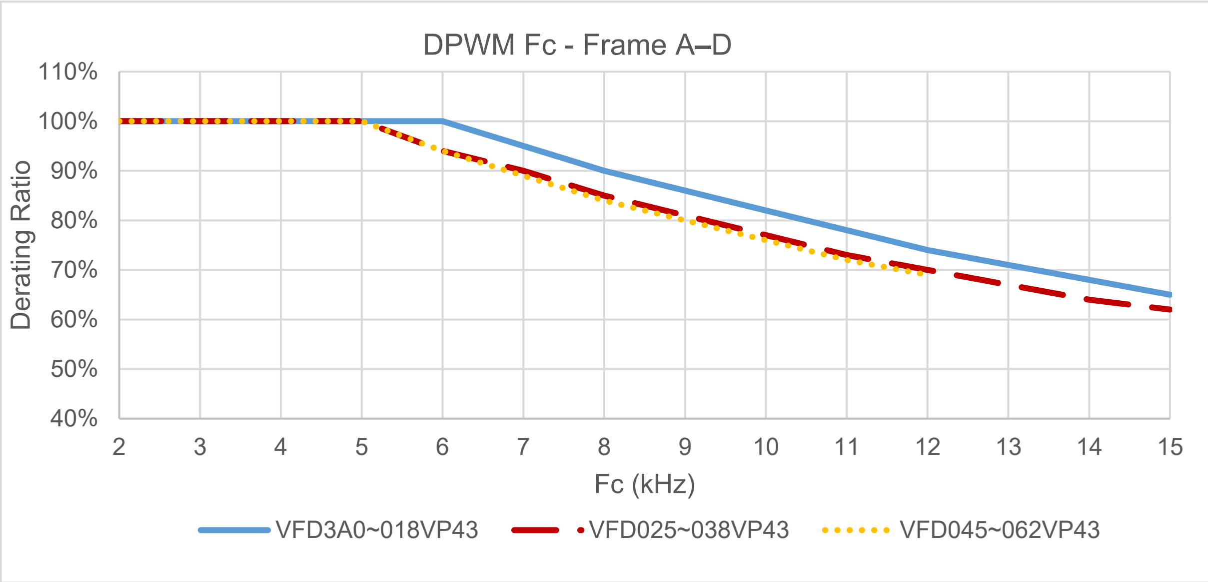


Figure 9-3

The rated output current derating for different carrier frequencies (unit: %):

Frame	Model	DPWM Fc (kHz)													
		2	3	4	5	6	7	8	9	10	11	12	13	14	15
A–B	VFD3A0–018VP43_ _ _ _ _	100	100	100	100	100	95	90	86	82	78	74	71	68	65
C	VFD025–038VP43_ _ _ _ _	100	100	100	100	94	90	85	81	77	73	70	67	64	62
D	VFD045–062VP43_ _ _ _ _	100	100	100	100	94	89	84	80	76	72	69	-	-	-

Table 9-10

Frame E–K

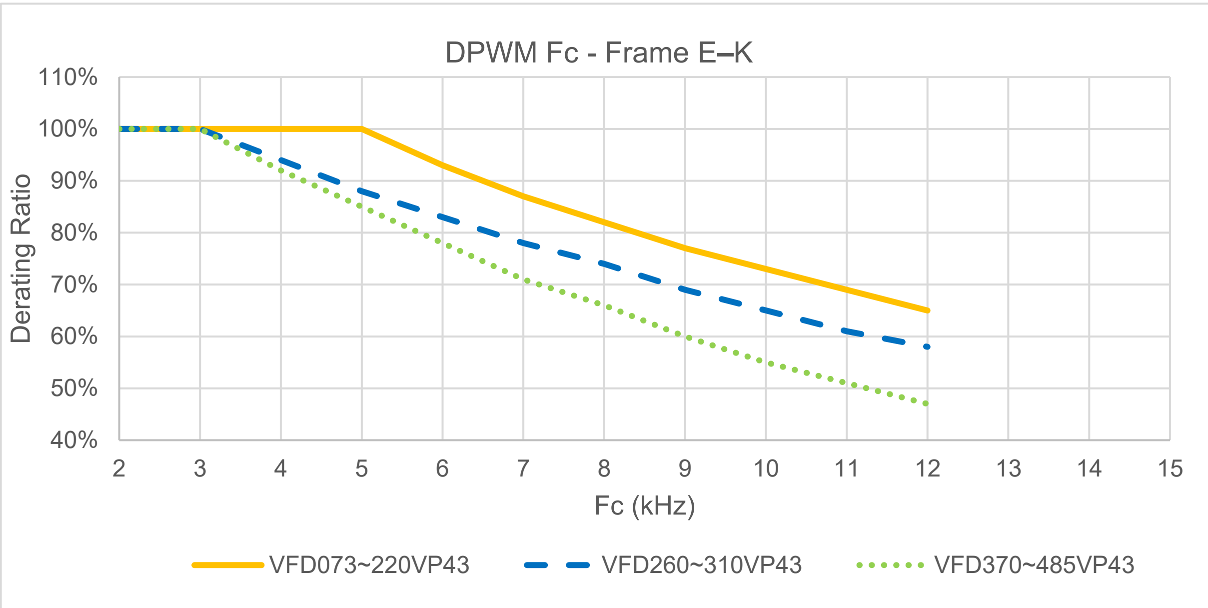


Figure 9-4

The rated output current derating for different carrier frequencies (unit: %):

Frame	Model	DPWM Fc (kHz)													
		2	3	4	5	6	7	8	9	10	11	12	13	14	15
E–H	VFD073–220VP43_ _ _ _ _	100	100	100	100	93	87	82	77	73	69	65	-	-	-
I	VFD260–310VP43_ _ _ _ _	100	100	94	88	83	78	74	69	65	61	58	-	-	-
J–K	VFD370–485VP43_ _ _ _ _	100	100	92	85	78	71	66	60	55	51	47	-	-	-

Table 9-11

Frame L–M

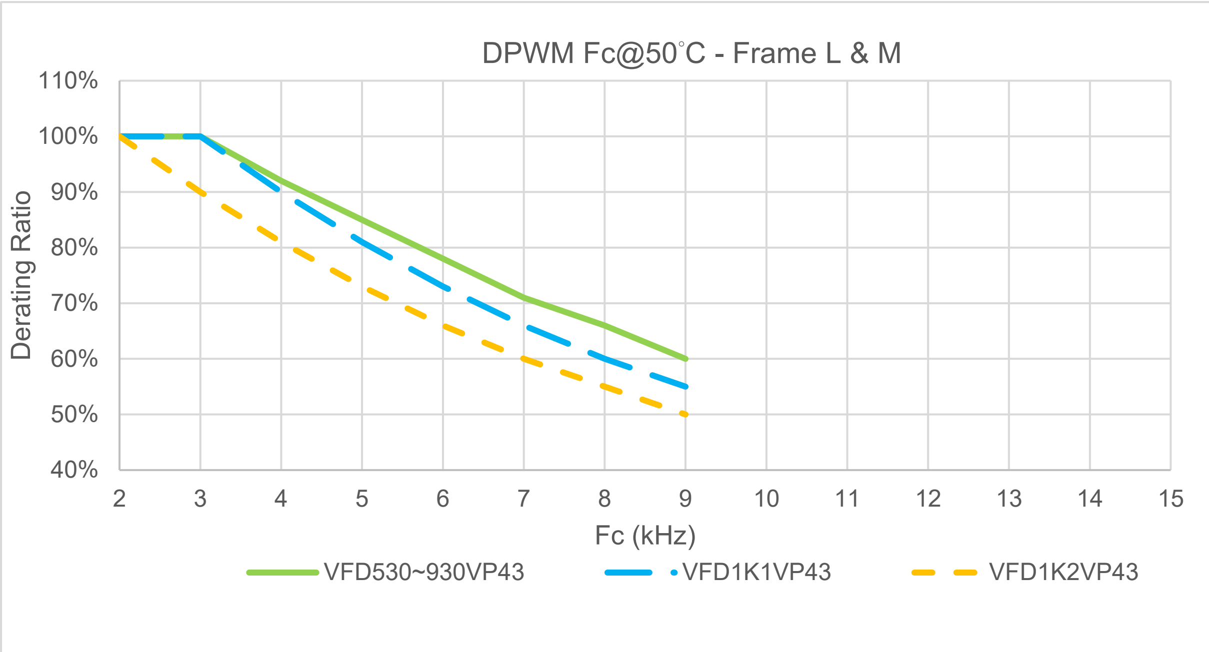


Figure 9-5

The rated output current derating for different carrier frequencies (unit: %):

Frame	Model	DPWM Fc (kHz)													
		2	3	4	5	6	7	8	9	10	11	12	13	14	15
L	VFD530–770VP43_ _ _ _ _	100	100	92	85	78	71	66	60	-	-	-	-	-	-
M	VFD866–930VP43_ _ _ _ _	100	100	92	85	78	71	66	60	-	-	-	-	-	-
M	VFD1K1VP43_ _ _ _ _	100	100	90	81	73	66	60	55	-	-	-	-	-	-
M	VFD1K2VP43_ _ _ _ _	100	90	81	73	66	60	55	50	-	-	-	-	-	-

Table 9-12

11-5 Efficiency Curve

- Models:
  VFD3A0VP43A–VFD011VP43A

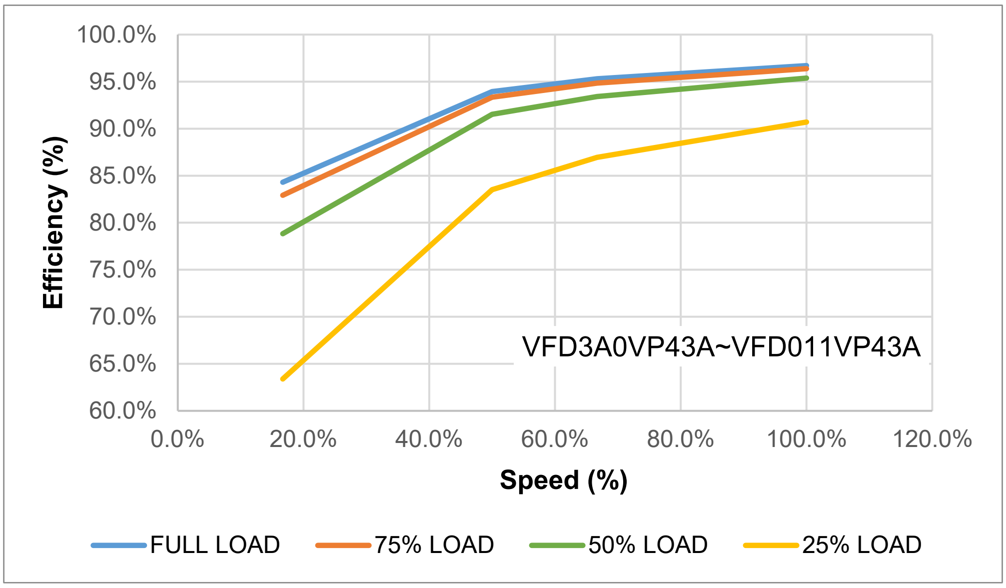


Figure 9-6

Efficiency (%) under different loads:

Speed (%) / Load (%)	16.7	50.0	66.7	100.0
100% Load	84.3	93.9	95.3	96.7
75% Load	82.9	93.3	94.8	96.4
50% Load	78.8	91.5	93.4	95.4
25% Load	63.4	83.5	87.0	90.7

Table 9-13

- Models:
  VFD013VP43A–VFD220VP43A

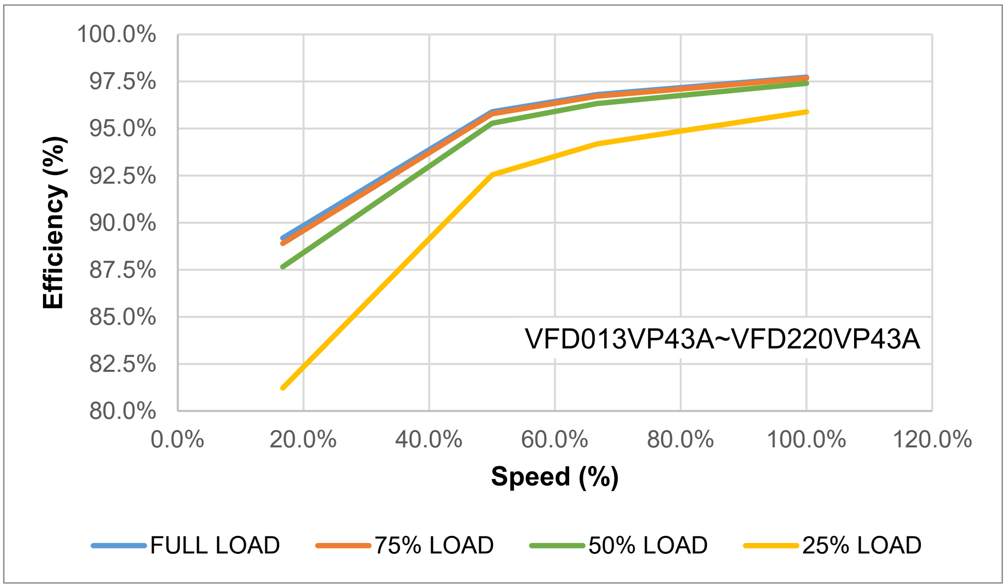


Figure 9-7

Efficiency (%) under different loads:

Speed (%) / Load (%)	16.7	50.0	66.7	100.0
100% Load	89.2	95.9	96.8	97.7
75% Load	88.9	95.8	96.7	97.7
50% Load	87.7	95.3	96.3	97.4
25% Load	81.2	92.5	94.2	95.9

Table 9-14

- Models:
  VFD260VP43A–VFD1K2VP43A

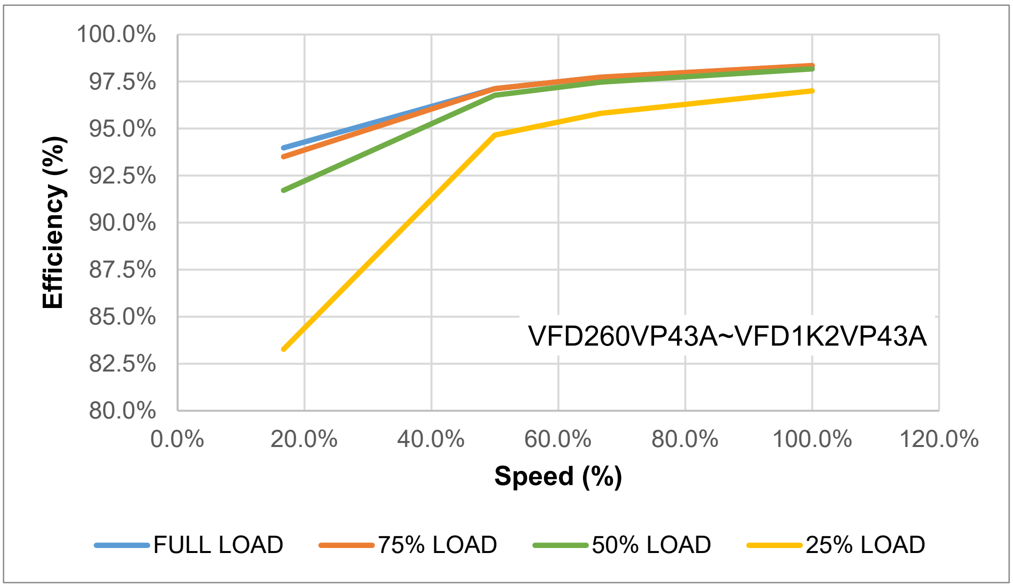


Figure 9-8

Efficiency (%) under different loads:

Speed (%) / Load (%)	16.7	50.0	66.7	100.0
100% Load	94.0	97.1	97.7	98.3
75% Load	93.5	97.1	97.7	98.3
50% Load	91.7	96.8	97.5	98.2
25% Load	83.3	94.7	95.8	97.0

Table 9-15

Appendix A. Revision History

Add Information	
Description	Related Chapter
Horizontal lifting figures and description for Frame L and M	Chapter 02
Dimensions for Frame L, M horizontal installation and IP20 instalation	Chapter 02
Multi-pump control communication cable wiring and pressure sensor wiring	Chapter 03
SD card related function	Chapter 04, 08
Chassis rail (MKVP-CR01) installation	Chapter 10
IP20 shielded cover (MKVP-IP20L/ MKVP-IP20M) installation	Chapter 10

Modified Information	
說明	影響範圍
Update description of Model Name	Chapter 01
Update the upright lifting figures for Frame L and M	Chapter 02
Update figures and descriptions for Chassis installation	Chapter 02
Update dimensions and weights of Frame L and M	Chapter 02
Update Fuse information	Chapter 03
Update ring terminal dimensions of main circuit terminals	Chapter 03
Update AC reactor information	Chapter 10
Update 460V power supply capacity	Chapter 11
Update derating curve and modify derating data	Chapter 11

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