Goodrive800 Pro Series Inverter Unit

Hardware Manual

SHENZHEN INVT ELECTRIC CO., LTD.

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1	First release.	V1.0	Feb 2022

Preface

Thank you for choosing INVT Goodrive800 Pro series engineering variable-frequency drive (VFD).

For ease of use, read the manual carefully before using Goodrive800 Pro series product.

As an upgrade product of Goodrive800 series engineering VFD, Goodrive800 Pro series engineering VFD inherits the high reliability feature of Goodrive800 platform but optimizes the upgrade, structure, and components, achieving unit modularization, flexible cabinet configuration, more compact structure, easier installation and maintenance, and optimum protection.

- Excellent speed and torque control performance
- Modular design, as flexible as building blocks, which makes the project integration simple and efficient
- Long-life component selection and fast fault recovery design to ensure efficient process control
- Ergonomic design to make installation and maintenance easier
- Enriched expansion capability to support various protection options

Goodrive800 Pro series engineering VFD can be widely used in:

Metallurgy: Such as high-speed wire rod and hot strip rolling equipment, wide and thick plate equipment, cold rolling equipment, pickling lines, annealing lines, galvanizing line, color coating lines, non-ferrous metal alloy manufacturing equipment, and non-ferrous metal rolling equipment

Petroleum: All-electric oil drilling rigs, large well repair machines, large oil machinery and equipment electric-drive power transformation, oilfield water injection equipment and other heavy oil equipment

Paper making: Paper making joint equipment, including flow box, net section, press section, drying section, sizing, hard calendering, coating, super calender, rewinder and other continuous production lines

Port and other large lifting equipment: Such as shore-side container overhead cranes, tire-type (orbital) container gantry cranes, grab unloaders, grab gantry cranes, large shipbuilding gantry cranes, and large metallurgical casting cranes

Others: Such as unit test benches, military equipment, oil and gas transmission, and mining transmission equipment

Goodrive800-51 series is the inverter unit of Goodrive800 Pro series. If not otherwise specified, the inverter unit in this manual refers to the inverter unit of Goodrive800 Pro series, that is, Goodrive800-51 series product. The rated power of a single inverter unit is 355kW–720kW, and the max. parallel power can be 4100kW. The inverter unit consists of fuse, bus capacitor, IGBT, output reactor, and other components. It is compact in structure and easy to integrate and maintain.

This manual is Goodrive800 Pro series inverter unit hardware manual, presenting safety precautions, product information, mechanical and electrical installation, and precautions related to daily maintenance. Read through this manual carefully before installation to ensure the VFD is installed and operated in a proper manner to give full play to its excellent performance and powerful functions. If you have any question about the function and performance of the product, please consult our technical support.

If the product is ultimately used for military affairs or weapon manufacture, comply with the export control regulations in the Foreign Trade Law of the People's Republic of China and complete related formalities.

To continuously improve the performance of the product to meet higher application requirements, we reserve the right to continuously improve the product and accordingly the product manual, which may be made without prior notice. We have the final interpretation of the manual content.

Contents

1 Safety precautions

1.1 Safety declaration

Read this manual carefully and follow all safety precautions before moving, installing, operating and servicing the product. Otherwise, equipment damage or physical injury or death may be caused.

We shall not be liable or responsible for any equipment damage or physical injury or death caused due to your or your customers' failure to follow the safety precautions.

1.2 Safety definition

Danger: Severe personal injury or even death can result if related requirements are not followed.

Warning: Personal injury or equipment damage can result if related requirements are not followed.

Note: Actions taken to ensure proper running.

Trained and qualified professionals: People operating the equipment must have received professional electrical and safety training and obtained the certificates, and must be familiar with all steps and requirements of equipment installing, commissioning, running and maintaining and capable to prevent any emergencies.

1.3 Warning symbols

Warnings caution you about conditions that can result in severe injury or death and/or equipment damage and advice on how to prevent dangers. The following table lists the warning symbols in this manual.

Symbol	Name	Description
	Danger	Severe personal injury or even death can result if related requirements are not followed.
	Warning	Personal injury or equipment damage can result if related requirements are not followed.
	Electrostatic sensitive	The PCBA may be damaged if related requirements are not followed.
	Hot sides	Do not touch. The inverter unit base may become hot.
	Electric shock	As high voltage still presents in the bus capacitor after power off, wait for at least 25 minutes (depending on the warning symbols on the machine) after power off to prevent electric shock.
Note	Note	Actions taken to ensure proper running.

1.4 Safety guidelines

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

Only trained and qualified professionals are allowed to carry out related operations.
Do not perform wiring, inspection or component replacement when power supply is applied. Ensure all the input power supplies have been disconnected before wiring or inspection, and wait for at least the time designated on the Goodrive800 Pro series product or until the DC bus voltage is less than 36V. The minimum waiting time is listed in the following.

<table>
<tr><th colspan="2">Inverter unit model</th><th>Minimum waiting time</th></tr>
<tr><td>380V</td><td>>355kW</td><td>25 minutes</td></tr>
<tr><td>690V</td><td>>400kW</td><td>25 minutes</td></tr>
</table>
</td></tr>
<tr><td>  </td><td>

Do not refit the Goodrive800 Pro series product unless authorized; otherwise fire, electric shock or other injury may result.

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

The base may become hot when the Goodrive800 Pro series product is running. Do not touch. Otherwise, you may get burnt.

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

The electrical parts and components inside the Goodrive800 Pro series product are electrostatic sensitive. Take measurements to prevent electrostatic discharge when performing related operations.

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</table>

1.4.1 Delivery and installation

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

Do not install the inverter unit on inflammables. In addition, prevent the inverter unit from contacting or adhering to inflammables.
Do not run the inverter unit if it is damaged or incomplete.
Do not contact the inverter unit with damp objects or body parts. Otherwise, electric shock may result.

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

Select appropriate tools for inverter unit delivery and installation to ensure the safe and proper running and avoid physical injury or death. To ensure personal safety, take mechanical protective measures like wearing safety shoes and working uniforms.
Protect the inverter unit against physical shock or vibration during the delivery and installation.
Do not carry the inverter unit only by its front cover as the cover may fall off.
The installation site must be away from children and other public places.
Prevent the screws, cables and other conductive parts from falling into the inverter unit.
As inverter unit leakage current caused during running may exceed 3.5mA, ground properly and ensure the grounding resistance is less than 10Ω. The conductivity of PE grounding conductor must meet the following requirements:

<table>
<tr><th>Power cable conductor cross-sectional area S (mm²)</th><th>Grounding conductor cross-sectional area (mm²)</th></tr>
<tr><td>S⩽16</td><td>S</td></tr>
<tr><td>16<S⩽35</td><td>16</td></tr>
<tr><td>35<S</td><td>S/2</td></tr>
</table>

(+) and (-) are the DC bus input terminals, while U, V, and W are the output terminals.

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

	Connect the input power and motor cables properly; otherwise, the inverter unit may be damaged.

1.4.2 Commissioning and running

	• Cut off all power supplies connected to the inverter unit before terminal wiring, and wait for at least the time designated on the inverter unit after disconnecting the power supplies. • High voltage presents inside the inverter unit during running. Do not carry out any operation on the inverter unit during running except for keypad setup. For products at voltage class of 4 or 6, the control terminals form extra-low voltage circuits. Therefore, you need to prevent the control terminals from connecting to accessible terminals of other devices. • Before turning on the power supply, check the cable connection status. • Prevent anyone from directly touching the energized part of the cabinet door. Pay special attention to safety when handling shields that are made of metal sheets. • Do not do any withstand voltage testing during unit connection. Disconnect the motor cable before performing any insulation and voltage withstand tests for the motor or motor cable. • Do not open the cabinet door since high voltage presents inside the Goodrive800 Pro series product during running.
Note	• Do not switch on or switch off the input power supplies of the inverter unit frequently. • If the inverter unit has been stored for a long time without use, perform checking and carry out pilot run for the inverter unit before using it again. • Close the inverter unit front cover before running; otherwise, electric shock may occur.

1.4.3 Maintenance and component replacement

	• Only trained and qualified professionals are allowed to perform maintenance, inspection, and component replacement for the inverter unit. • Cut off all power supplies connected to the inverter unit before terminal wiring, and wait for at least the time designated on the inverter unit after disconnecting the power supplies. • During maintenance and component replacement, take measures to prevent screws, cables and other conductive matters from falling into the internal of the inverter unit.
Note	• Use proper torque to tighten screws. • During maintenance and component replacement, keep the inverter unit and its parts and components away from combustible materials and ensure they have no combustible materials adhered. • Do not carry out insulation voltage-endurance test on the inverter unit, or measure the control circuits of the inverter unit with a megohmmeter. • During maintenance and component replacement, take proper anti-static measures on the inverter unit and its internal parts.

1.4.4 Disposal

	• The inverter unit contains heavy metals. Dispose of a scrap inverter unit as industrial waste.
	• Dispose of a scrap product separately at an appropriate collection point but not place it in the normal waste stream.

2 Product overview

For Goodrive800-51 series inverter units, the rated power of a single unit is 355kW–720kW, while that of parallel units can be up to 4100kW. The inverter unit consists of fuse, bus capacitor, IGBT, output reactor, and other components. It is compact in structure and easy to integrate and maintain.

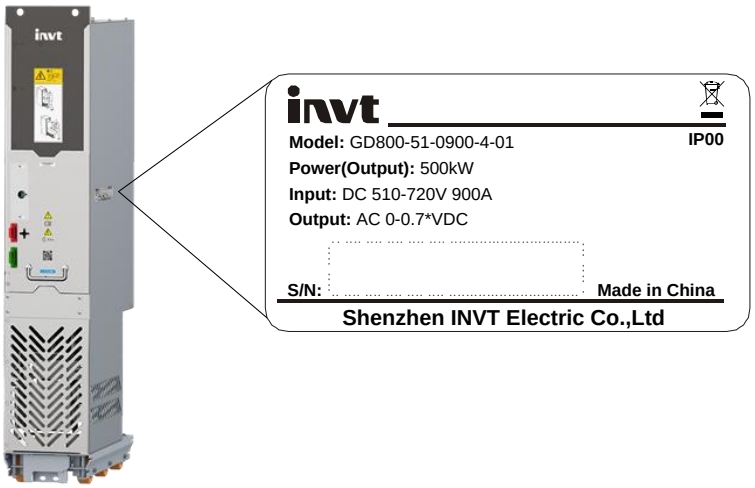
2.1 Product specifications

Table 2-1 Product specifications

Description		Specifications
Power input	Input voltage (V)	510~720V DC 3PH, ±10%, -15% < 1min 700~1035V DC 3PH, ±10%, -15% < 1min
	Input current (A)	See section 2.3 Product ratings.
	Input frequency (Hz)	50Hz or 60Hz; Allowed range: 47–63Hz
Power output	Output voltage (V)	Input voltage * 1.35
	Output current (A)	See section 2.3 Product ratings.
	Output power (kW)	See section 2.3 Product ratings.
	Working efficiency	⩾98.5% (at the rated current)
Environment condition	Working temperature	-10°C – +50°C; Derating is required when the ambient temperature exceeds 40°C.
	Relative humidity	5%–95%, no condensation
	Installation altitude	Below 1000m (Derating is required when the altitude exceeds 1000m. Derate by 1% for every increase of 100m.)
Mechanical data	Anti-vibration performance	Compliant with 3M4 vibration level in GB/T4798.3
	IP rating	For the module: IP00 For the cabinet: IP20 (Optional: IP23 and IP42)
	Safety performance	Compliant with EN 61800-5-1
	Cooling method	Forced air cooling
Protection functions	Protection functions	Including functions of protection against short circuit, overcurrent, overload, overvoltage, undervoltage, overtemperature, and phase loss

2.2 Product nameplate and model

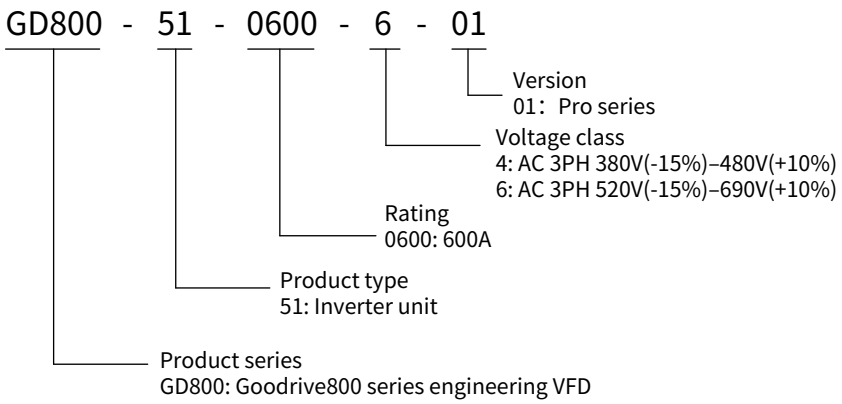
Figure 2-1 Product nameplate



Note: The preceding nameplate is a standard product nameplate example. The marking varies slightly depending on the model.

The model designation code contains basic product information such as rated current and rated voltage. You can find the model designation code on the product nameplate.

Figure 2-2 Product model



Note: The preceding model is only an example of GD800-51 models.

2.3 Product ratings

Table 2-2 AC 3PH 380V(-15%)–480V(+10%)

510–720VDC (Rectifier incoming voltage: 3PH 380–480VAC)										
Model	Rating			Light overload application		Heavy overload application		Structure	Heat dissipation	Air volume
	I_N	I_{max}	P_N	I_{Ld}	P_{Ld}	I_{Hd}	P_{Hd}			
	A (AC)	A (AC)	kW	A (AC)	kW	A (AC)	kW		kW	m^3/h
GD800-51-0639-4-01	639	766	355	613	315	479	250	A8i	6.8	1500
GD800-51-0757-4-01	757	909	400	727	400	568	315	A8i	8	1500

510–720VDC (Rectifier incoming voltage: 3PH 380–480VAC)										
Model	Rating			Light overload application		Heavy overload application		Structure	Heat dissipation	Air volume
	I_N	I_{max}	P_N	I_{Ld}	P_{Ld}	I_{Hd}	P_{Hd}			
	A (AC)	A (AC)	kW	A (AC)	kW	A (AC)	kW		kW	m^3/h
GD800-51-0900-4-01	900	1080	500	864	450	675	355	A8i	10	1500
GD800-51-1213-4-01	1213	1456	630	1165	630	910	500	2*A8i	13.6	3000
GD800-51-1439-4-01	1439	1727	800	1381	800	1079	630	2*A8i	16	3000
GD800-51-1710-4-01	1710	2052	1000	1642	900	1283	710	2*A8i	20	3000
GD800-51-2158-4-01	2158	2590	1200	2072	1200	1619	900	3*A8i	24	4500
GD800-51-2565-4-01	2565	3078	1400	2463	1400	1924	1000	3*A8i	30	4500
GD800-51-3420-4-01	3420	4104	1800	3283	1800	2565	1400	4*A8i	40	6000
GD800-51-4275-4-01	4275	5130	2400	4104	2000	3206	1800	5*A8i	50	7500
GD800-51-5130-4-01	5130	6156	2800	4925	2400	3848	2000	6*A8i	60	9000
GD800-51-0985-4-S	985	1440	560	960	560	860	450	A8s	10.2	3900
GD800-51-1260-4-S	1260	1845	710	1230	710	1127	560	A8s	12	3900
GD800-51-1405-4-S	1405	2055	800	1370	800	1257	710	A8s	13	3900

Table 2-3 AC 3PH 520V(-15%)–690V(+10%)

700–1035VDC (Rectifier incoming voltage: 3PH 520–690VAC)										
Model	Rating			Light overload application		Heavy overload application		Structure	Heat dissipation	Air volume
	I_N	I_{max}	P_N	I_{Ld}	P_{Ld}	I_{Hd}	P_{Hd}			
	A (AC)	A (AC)	kW	A (AC)	kW	A (AC)	kW		kW	m^3/h
GD800-51-0410-6-01	410	492	400	394	355	308	315	A8i	6.2	1500
GD800-51-0530-6-01	530	636	500	509	450	398	355	A8i	8	1500
GD800-51-0600-6-01	600	720	560	576	560	450	400	A8i	9.1	1500
GD800-51-0650-6-01	650	780	630	624	560	488	450	A8i	10.3	1500
GD800-51-0720-6-01	720	864	710	690	630	540	500	A8i	11.7	1500
GD800-51-0779-6-01	779	935	800	748	710	584	560	2*A8i	12.4	3000
GD800-51-1007-6-01	1007	1208	1000	967	900	755	710	2*A8i	16	3000
GD800-51-1140-6-01	1140	1368	1100	1094	1000	855	800	2*A8i	18.2	3000
GD800-51-1235-6-01	1235	1482	1200	1186	1000	927	900	2*A8i	21	3000
GD800-51-1368-6-01	1368	1642	1300	1311	1200	1026	1000	2*A8i	22.5	3000
GD800-51-1510-6-01	1510	1813	1400	1450	1400	1133	1100	3*A8i	24	4500
GD800-51-1710-6-01	1710	2052	1600	1642	1600	1283	1200	3*A8i	27.3	4500
GD800-51-2052-6-01	2052	2462	2000	1967	1800	1539	1500	3*A8i	32.3	4500
GD800-51-2280-6-01	2280	2736	2000	2189	2000	1710	1600	4*A8i	36.4	6000
GD800-51-2850-6-01	2850	3420	2800	2736	2400	2138	2000	5*A8i	45.5	7500
GD800-51-3420-6-01	3420	4104	3200	3283	3200	2565	2400	6*A8i	54.6	9000

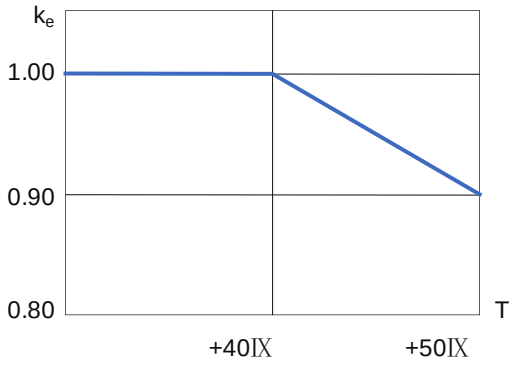
700–1035VDC (Rectifier incoming voltage: 3PH 520–690VAC)										
Model	Rating			Light overload application		Heavy overload application		Structure	Heat dissipation	Air volume
	I_N	I_{max}	P_N	I_{Ld}	P_{Ld}	I_{Hd}	P_{Hd}			
	A (AC)	A (AC)	kW	A (AC)	kW	A (AC)	kW		kW	m^3/h
GD800-51-0810-6-S	810	1185	800	790	800	724	710	A8s	11.5	3900
GD800-51-0910-6-S	910	1320	900	880	900	814	800	A8s	11.7	3900
GD800-51-1025-6-S	1025	1500	1000	1000	1000	917	900	A8s	13.2	3900
GD800-51-1270-6-S	1270	1845	1200	1230	1200	1136	1000	A8s	16	3900
GD800-51-1481-6-S	1481	2165	1400	1405	1400	1320	1200	A8s	18.2	3900

2.4 Derated application

2.4.1 Derating due to temperature

The standard ambient temperature of inverter unit is in the range of +40°C ~ +50°C, and the rated output current of inverter unit must be derated by 1% for every 1°C increase when the temperature exceeds 50°C. The current reference value multiplied by the derating coefficient (k_e) is the output current at the temperature higher than 50°C.

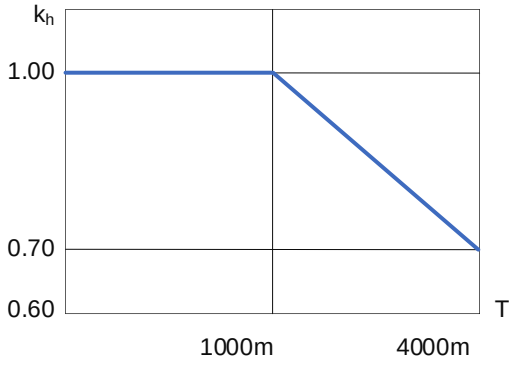
Figure 2-3 Derating due to temperature



2.4.2 Derating due to altitude

The inverter unit needs to be derated by 1% for every increase of 100m when the altitude exceeds 1000m. Contact our local technical support for model selection when the altitude exceeds 2000m.

Figure 2-4 Derating due to altitude



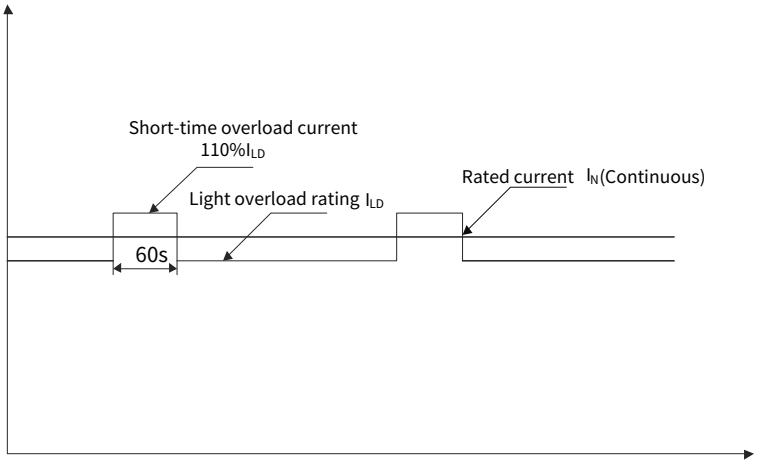
2.4.3 Derating due to carrier frequency

Model	Rating Power	Carrier frequency (kHz)					
	P(kW)	1.2	1.5	2	2.5	3.2	4
GD800-51-0516-4	250	100%	100%	100%	92%	90%	80%
GD800-51-0639-4	355	100%	100%	100%	92%	90%	80%
GD800-51-0757-4	400	100%	100%	100%	92%	90%	80%
GD800-51-0900-4	500	100%	100%	100%	92%	90%	80%
GD800-51-0410-6	400	100%	100%	85%	75%	70%	57%
GD800-51-0530-6	500	100%	100%	85%	75%	66%	54%
GD800-51-0600-6	560	100%	100%	85%	75%	66%	56%
GD800-51-0650-6	630	100%	100%	85%	75%	66%	56%
GD800-51-0720-6	710	100%	100%	85%	72%	62%	53%

2.5 Overload capability

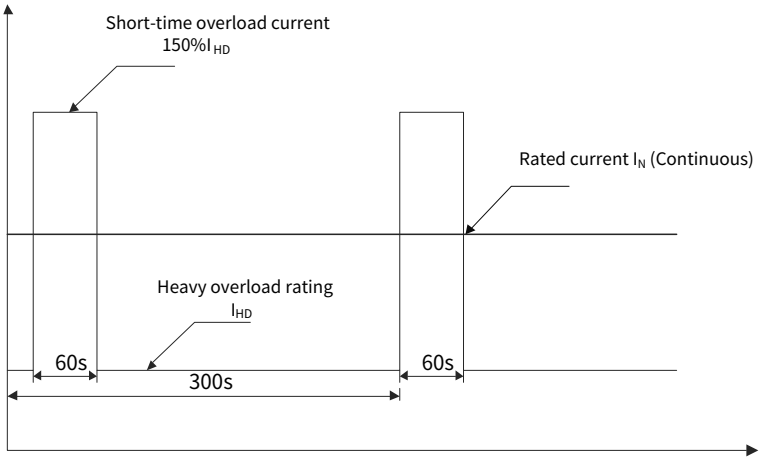
Based on the light overload continuous run current (I_{Ld}), the inverter unit can keep running for 60s at 110% of the rated current. See Figure 2-5.

Figure 2-5 Light overload application



Based on the heavy overload continuous run current (I_{Ld}), the inverter unit can keep running for 60s at 150% of the rated current. See Figure 2-6.

Figure 2-6 Heavy overload application



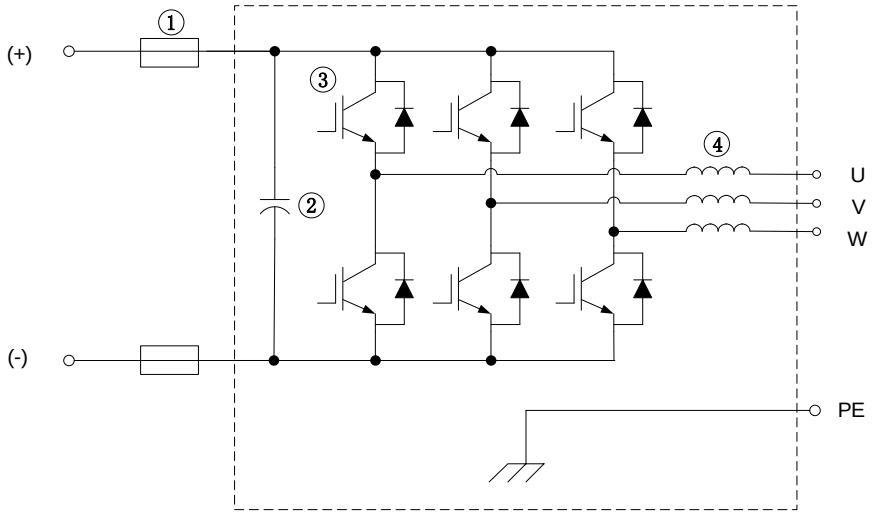
2.6 Hardware principles

2.6.1 Basic principles

The inverter unit converts DC voltage into AC frequency-variable voltage and supports driving asynchronous and synchronous motors. The inverter unit models are classified into the 380V voltage class and 690V voltage class.

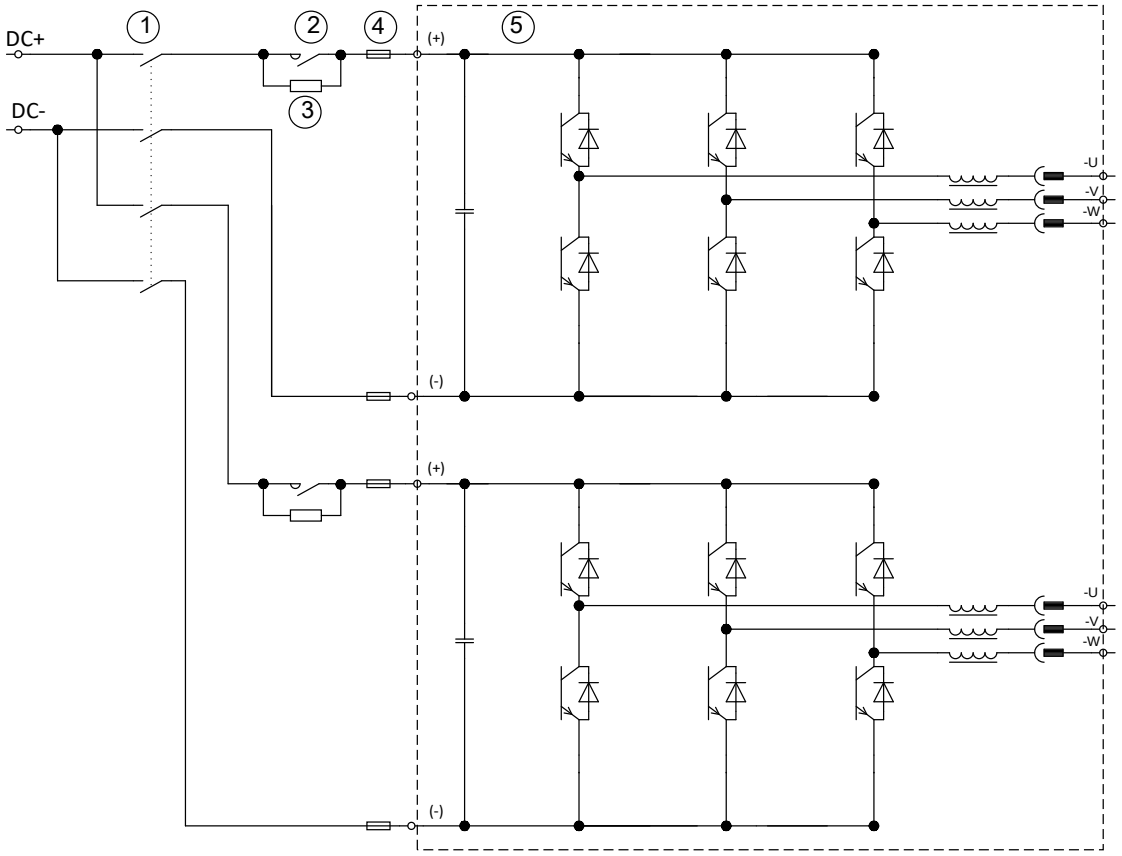
The inverter unit consists of fuse, bus capacitor, IGBT, output reactor, and other components. Figure 2-7 shows the simplified main circuit.

Figure 2-7 Simplified main circuit diagram



No.	Name	Description
1	DC fuse	To prevent backend device short circuit from causing machine burndown. This protective device is located in the cabinet but not the unit.
2	Bus capacitor	To make the voltage stable by filtering out the AC part from the bus voltage.
3	Inverter module	To convert DC current to AC current.
4	Output reactor	To suppress peak voltage to protect the motor and VFD.

2.6.2 Paralleling principle

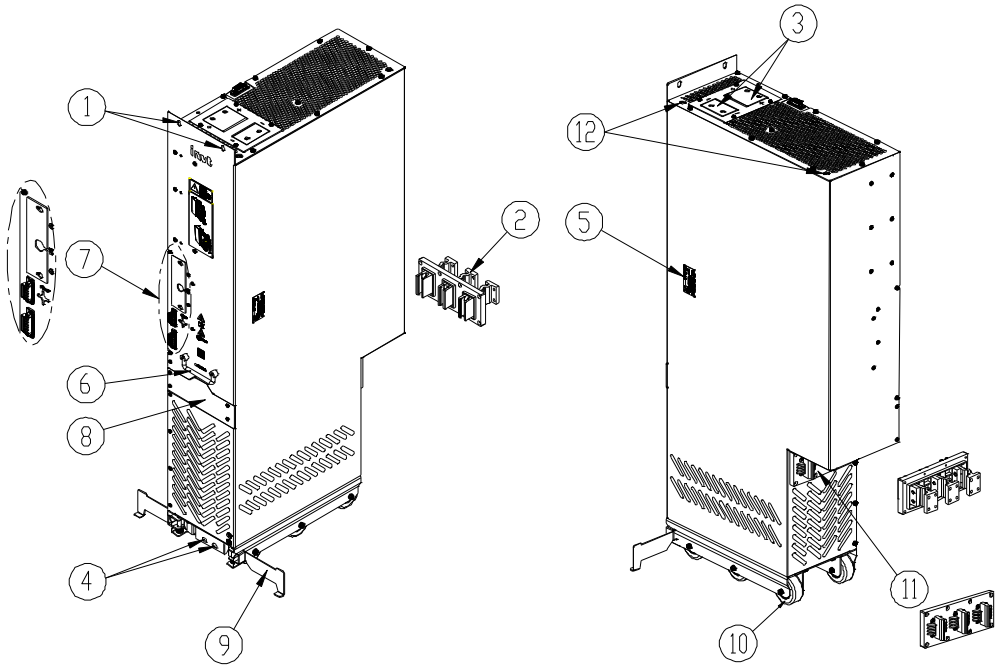


No.	Name
1	(Optional) Isolation switch
2	(Optional) DC contactor
3	(Optional) Buffer resistor
4	DC fuse
5	Inverter unit

2.7 Product structure

The following figure shows the inverter unit structure (taking GD800-51-0600-6-01 for example).

Figure 2-8 Unit structure



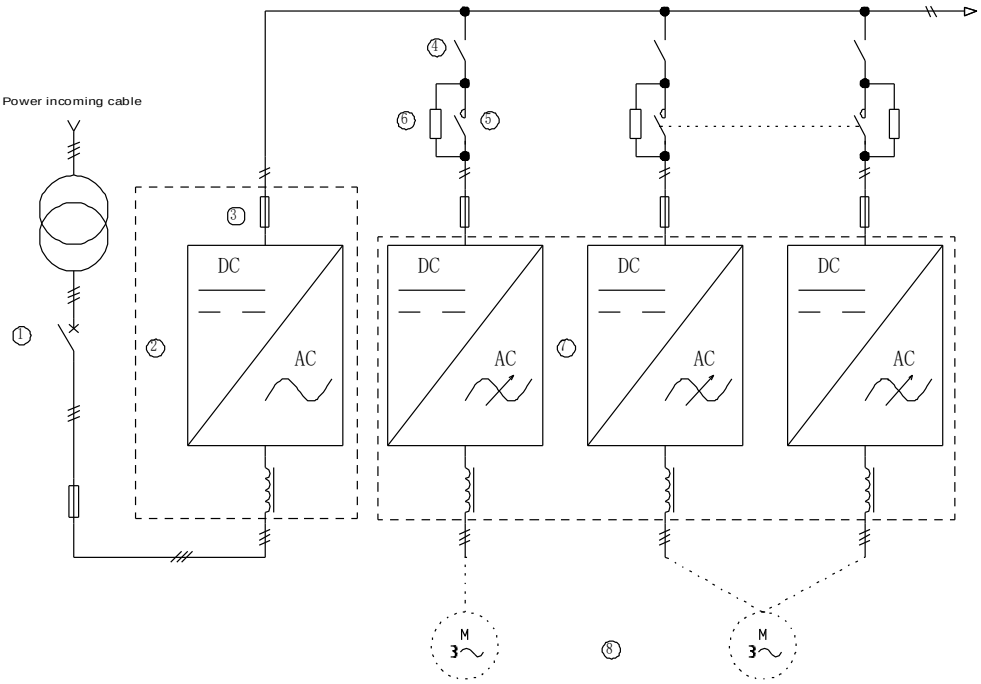
No.	Description
1	Module top fixing hole
2	Female connector, installed and fixed to the cabinet
3	(+) and (-) bus input copper bar
4	Module bottom fixing hole
5	Nameplate
6	Handle
7	User terminals on the fiber optic and control boards
8	Fan coverplate
9	Anti-tipping stand
10	Pulley
11	UVW AC output terminals
12	Lifting-ring installation holes

2.8 System configuration

Figure 2-9 shows a typical common DC bus drive system.

The rectifier module converts AC voltage to DC voltage, and the DC voltage is distributed to all inverter modules through the DC bus, then the inverter modules convert the DC voltage to AC voltage to drive the motor to rotate. An external DC fuse is required for the connection between each inverter module and DC bus.

Figure 2-9 System configuration



No.	Description
1	AC power
2	Rectifier unit
3	DC fuse
4	(Optional) Isolation switch
5	(Optional) DC contactor
6	(Optional) Buffer resistor
7	Inverter unit (each consisting of two modules)
8	Motor

2.9 Electrical model selection

2.9.1 DC fuse

A DC fuse protects the rectifier unit and DC bus in case of short circuit, avoiding thermal overload. The same brand replacement principle should be followed. See the following table for selection.

Model	Frame size	Voltage (V)	Current (A)	Qty
GD800-51-0639-4-01	A8i	690V	1100A	2
GD800-51-0757-4-01	A8i	690V	1250A	2
GD800-51-0900-4-01	A8i	690V	1600A	2
GD800-51-0985-4-S	A8s	690V	1250A	4
GD800-51-1260-4-S	A8s	690V	1600A	4
GD800-51-1405-4-S	A8s	690V	1600A	4
GD800-51-0410-6-01	A8i	1250V	800A	2
GD800-51-0530-6-01	A8i	1250V	900A	2

Model	Frame size	Voltage (V)	Current (A)	Qty
GD800-51-0600-6-01	A8i	1250V	1000A	2
GD800-51-0810-6-S	A8s	1250V	800A	4
GD800-51-0910-6-S	A8s	1250V	900A	4
GD800-51-1025-6-S	A8s	1250V	1000A	4
GD800-51-1270-6-S	A8s	1250V	2000A	4
GD800-51-1481-6-S	A8s	1250V	2000A	4

2.9.2 Isolation switch

An isolation switch acts as an isolator for the circuit, causing an obvious break in the circuit and ensuring work safety during inspection or maintenance. The same brand replacement principle should be followed. See the following table for selection.

Model	Frame size	Voltage (V)	Current (A)	Qty
GD800-51-0639-4-01	A8i	1000V	1600A	1
GD800-51-0757-4-01	A8i	1000V	1600A	1
GD800-51-0900-4-01	A8i	1000V	1600A	1
GD800-51-0985-4-S	A8s	1000V	1600A	1
GD800-51-1260-4-S	A8s	1000V	1600A	1
GD800-51-1405-4-S	A8s	1000V	1600A	1
GD800-51-0410-6-01	A8i	1000V	1600A	1
GD800-51-0530-6-01	A8i	1000V	1600A	1
GD800-51-0600-6-01	A8i	1000V	1600A	1
GD800-51-0810-6-S	A8s	1000V	1600A	1
GD800-51-0910-6-S	A8s	1000V	1600A	1
GD800-51-1025-6-S	A8s	1000V	1600A	1
GD800-51-1270-6-S	A8s	1000V	1600A	1
GD800-51-1481-6-S	A8s	1000V	1600A	1

2.9.3 Contactor

A contactor connects and disconnects DC circuit and automatically switches between buffer circuit and bus main circuit. The same brand replacement principle should be followed. See the following table for selection.

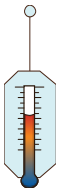
Model	Frame size	Voltage (V)	Current (A)	Qty
GD800-51-0639-4-01	A8i	1000V	600A	2
GD800-51-0757-4-01	A8i	1000V	600A	2
GD800-51-0900-4-01	A8i	1000V	600A	2
GD800-51-0410-6-01	A8i	1000V	600A	2
GD800-51-0530-6-01	A8i	1000V	600A	2
GD800-51-0600-6-01	A8i	1000V	600A	2

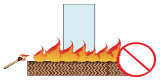
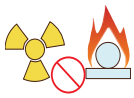
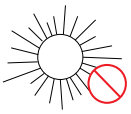
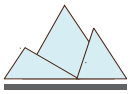
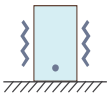
3 Mechanical installation

3.1 Safety notes

	Equipment can tip over if transported incorrectly or with disallowed means of transport. Serious injury, property damage, or even death may result. • Only trained and qualified professionals are allowed to carry out the operations mentioned in this chapter. Please carry out operations according to instructions presented in 1.4.1 Delivery and installation. Ignoring these safety precautions may lead to physical injury or death, or device damage. • Ensure the inverter unit power has been disconnected before installation. If the inverter unit has been powered on, disconnect the inverter unit power and wait for at least the time specified on the inverter unit, and ensure the POWER indicator is off. You are recommended to use a multimeter to check and ensure the inverter unit DC bus voltage is below 36V. • The equipment installation must be designed and done according to applicable local laws and regulations. We do not assume any liability whatsoever for any equipment installation which breaches local laws or regulations. If recommendations given by us are not followed, the inverter unit may experience problems that the warranty does not cover. • Only trained and qualified professionals are allowed to carry out related operations. • Do not perform wiring, inspection or component replacement when power supply is applied. Ensure all the input power supplies have been disconnected before wiring or inspection, and wait for at least the time designated on the Goodrive800 Pro series product or until the DC bus voltage is less than 36V.

3.2 Installation environment

Environment	Condition
Ambient temperature 	• -10–+50°C • When the ambient temperature exceeds 40°C, derate 1% for every increase of 1°C. • Do not use the VFD when the ambient temperature exceeds 50°C. • To improve reliability, do not use the VFD in the places where the temperature changes rapidly. • When the VFD is used in a closed space, such as control cabinet, use a cooling fan or air conditioner for cooling, preventing the internal temperature from exceeding the temperature required. • When the temperature is too low, if you want to use the VFD that has been idled for a long time, install an external heating device before the use to eliminate the freeze inside the VFD. Otherwise, the VFD may be damaged.

<table>
<tr><th>Environment</th><th colspan="4">Condition</th></tr>
<tr><td>Relative humidity (RH)</td><td> 
RH: less than 90%</td><td> 
Condensation is not allowed.</td><td colspan="2"> 
The max. RH cannot exceed 60% in the environment where there are corrosive gases.</td></tr>
<tr><td rowspan="3">Running environment</td><td colspan="4">Install the VFD in a place:</td></tr>
<tr><td> 
Away from electromagnetic radiation sources</td><td> 
Away from oil mist, corrosive gases, or combustible gases</td><td> 
Without the chance for foreign objects such as metal powder, dust, oil and water to fall into the VFD</td><td> 
Do not install the VFD onto combustible objects.</td></tr>
<tr><td> 
Without radioactive substances or combustible objects</td><td> 
Without hazard gases or liquids</td><td> 
With low salt content</td><td> 
Without direct sunlight</td></tr>
<tr><td>Altitude</td><td>  </td><td colspan="3">• Lower than 1000 meters
• When the altitude exceeds 1000m, derate by 1% for every additional 100m.
• When the altitude exceeds 3000m, consult INVT local dealer or office.</td></tr>
<tr><td>Vibration</td><td>  </td><td colspan="3">The max. ACC speed cannot exceed 5.8m/s^2 (0.6g).</td></tr>
</table>

3.3 Installation procedure

The installation procedure is as follows:

Step 1 Perform unpacking inspection. For details, see 3.3.1 Unpacking inspection.

Step 2 Transport before unpacking. For details, see 3.3.2 Transportation.

Step 3 Unpack. For details, see 3.3.3 Unpacking.

Step 4 Lift the modules. For details, see 3.3.4 Lifting.

Step 5 Install the modules. For details, see 3.3.5 Installation.

3.3.1 Unpacking inspection

After receiving the product, perform the following steps to ensure the product use safety.

Step 1 Before unpacking, check whether the product package is intact–whether the package is damaged, dampened, soaked, or deformed.

Step 2 Check whether the nameplate and label on the product body are consistent with the model ordered.

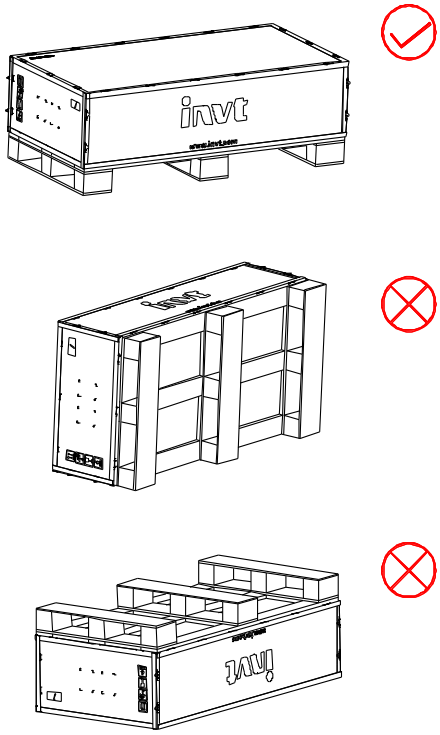
Step 3 After unpacking, check whether the interior surface of the packing box is abnormal, for example, in wet condition, and whether the equipment enclosure is damaged or cracked.

Step 4 Check whether the parts (including the complete equipment of unit, keypad, and manual) inside the packing box are complete.

3.3.2 Transportation

The inverter unit is shipped in a wooden box with pallets, which are heavy as a whole and must be carried with a lifting tool, such as a forklift and crane; operators must be professionally trained; the inverter unit must be transported in strict accordance with the allowed ways marked on the box, and not allowed to be transported upside down or on the sides.

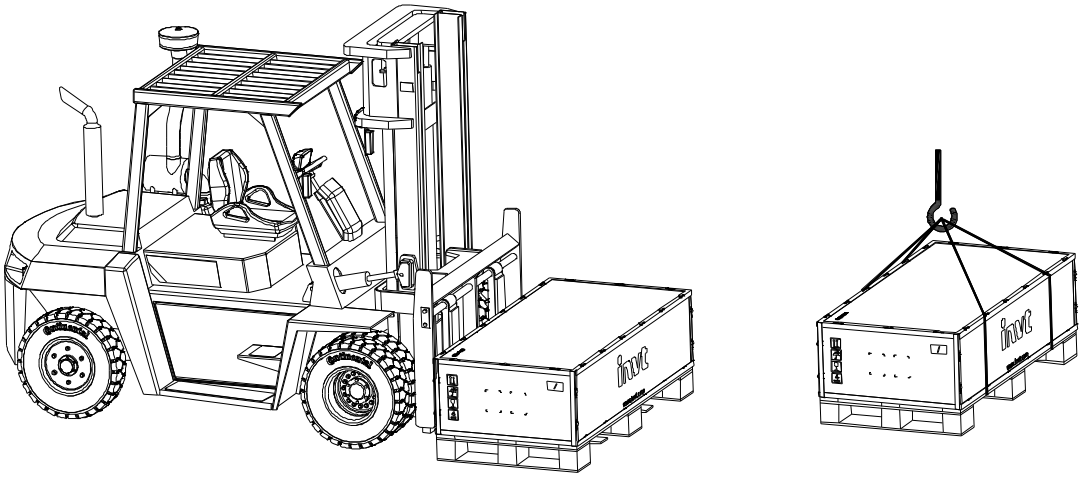
Figure 3-1 Transportation requirements



When transported with a forklift, the inverter unit must be fixed to the pallets and transported together, which means you are not allowed to remove the pallets to transport the inverter unit. If the forklift's fork tines are too short, it may cause the unit/cabinet to tip over, resulting in serious injury, property damage or even death.

When transported with a crane, the inverter unit must be fixed to the pallets and lifted together.

Figure 3-2 Transportation means



3.3.3 Unpacking

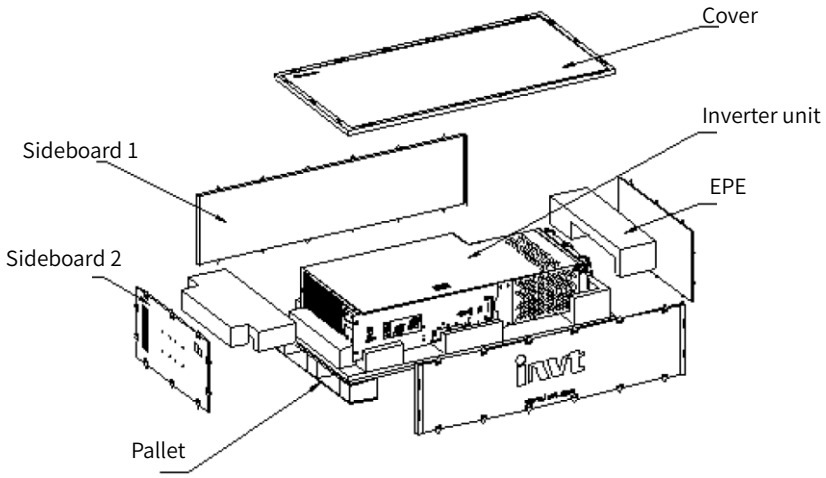
The unit is delivered in the wooden box padded with EPE.

To remove the packing, do as follows:

Step 1 Place the well-packed unit in an empty and flat place.
Step 2 Use tools such as a pry bar or large one-piece screwdriver to remove the wooden box cover and the steel tongue nails of the surrounding boards.
Step 3 Remove the surrounding boards and EPE filling materials from the wooden box.
Step 4 Cut off the plastic windings.
Step 5 Take out of the unit.
Step 6 Ensure that the unit is intact without any damage.

Dispose of or recycle packaging in accordance with local regulations.

Figure 3-3 Unpacking

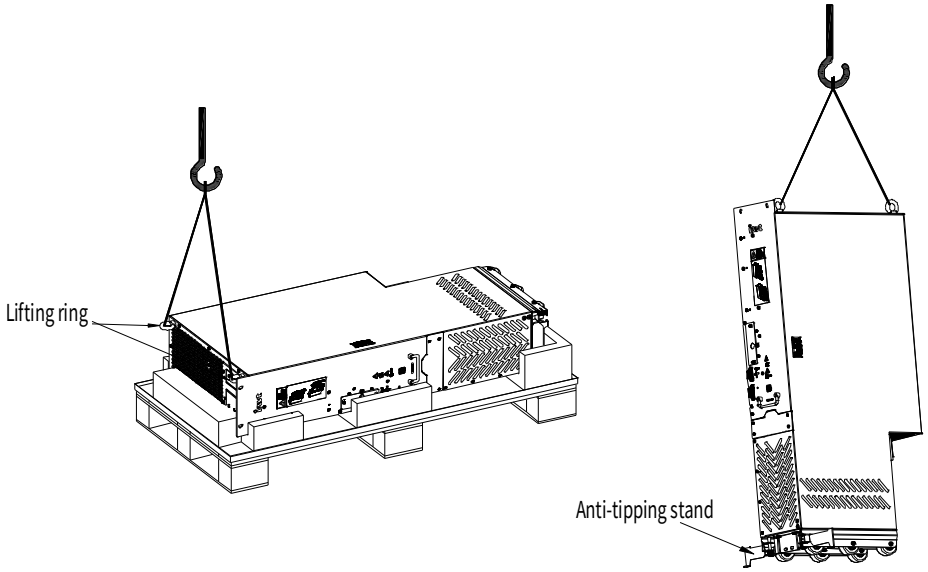


3.3.4 Lifting

Attach the required lifting ring to the locations shown in the figure, use the sling to slowly lift the unit end, move the unit until it is completely lifted, place it vertically in the empty and flat place, and then unfold the

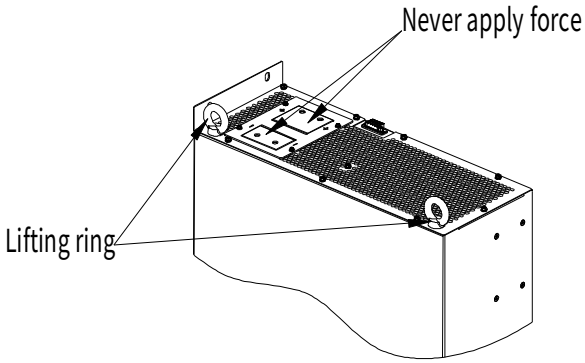
anti-tipping stand at the lower front of the unit. Figure 3-4 shows the anti-tipping stand location.

Figure 3-4 Unit lifting



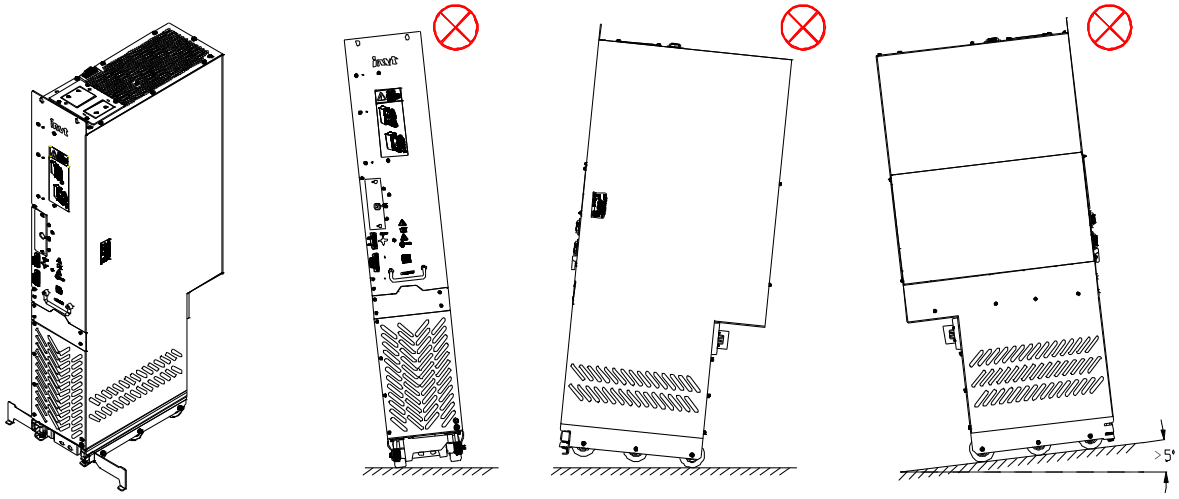
Note: Use the lifting ring on the top of inverter unit for lifting and moving. Never apply force to the positive or negative bus terminals.

Figure 3-5 Unit-top structure



The inverter unit has a high center of gravity and must be placed on a flat and solid ground with sufficient support strength and a tilt angle of less than 5°. Failure to comply with this requirement will cause the inverter unit to tip over or topple over, which may result in serious injury or property damage.

Figure 3-6 Unit placing requirements



Note the following to fold or unfold the anti-tipping stand:

- To unfold the anti-tipping stand, pull down the anti-tipping stand to press the spring, wrap it around the restraining pin and rotate it 180° to snap into the slot as shown in Figure 3-8.
- To fold the anti-tipping stand, rotate the anti-tipping stand in the slot by 180° to restore the pressed spring back to its original state to clamp the anti-tipping stand, as shown in Figure 3-9.

The restraint pin ensures that the anti-tipping stand will not unfold due to shaking. The anti-tipping stand folds, as shown in Figure 3-7.

Figure 3-7 Unit-bottom structure

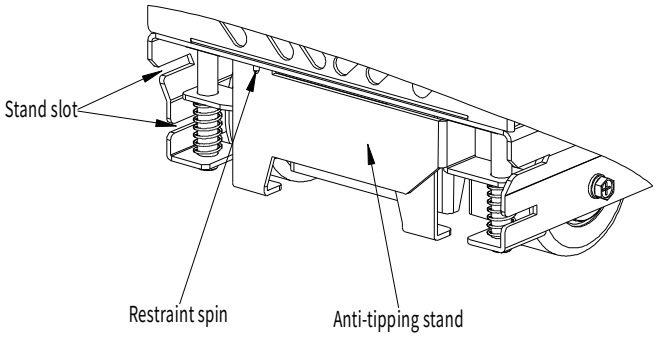


Figure 3-8 Unfolding the anti-tipping stand

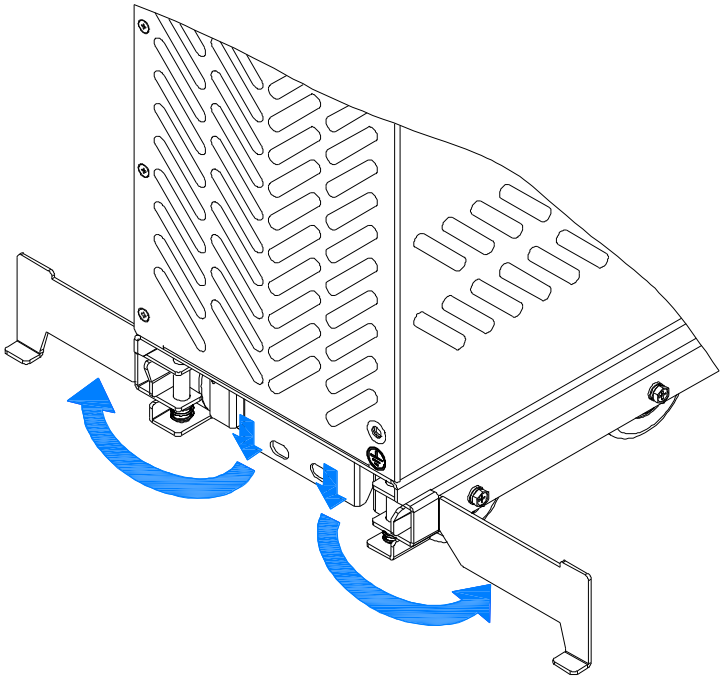
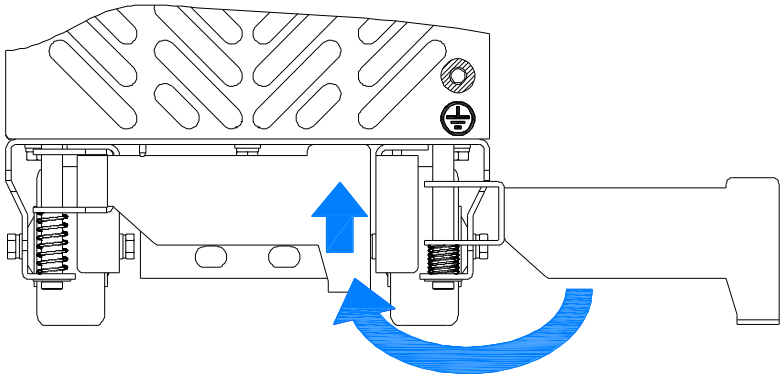


Figure 3-9 Folding the anti-tipping stand



3.3.5 Installation

3.3.5.1 Installation space and heat dissipation

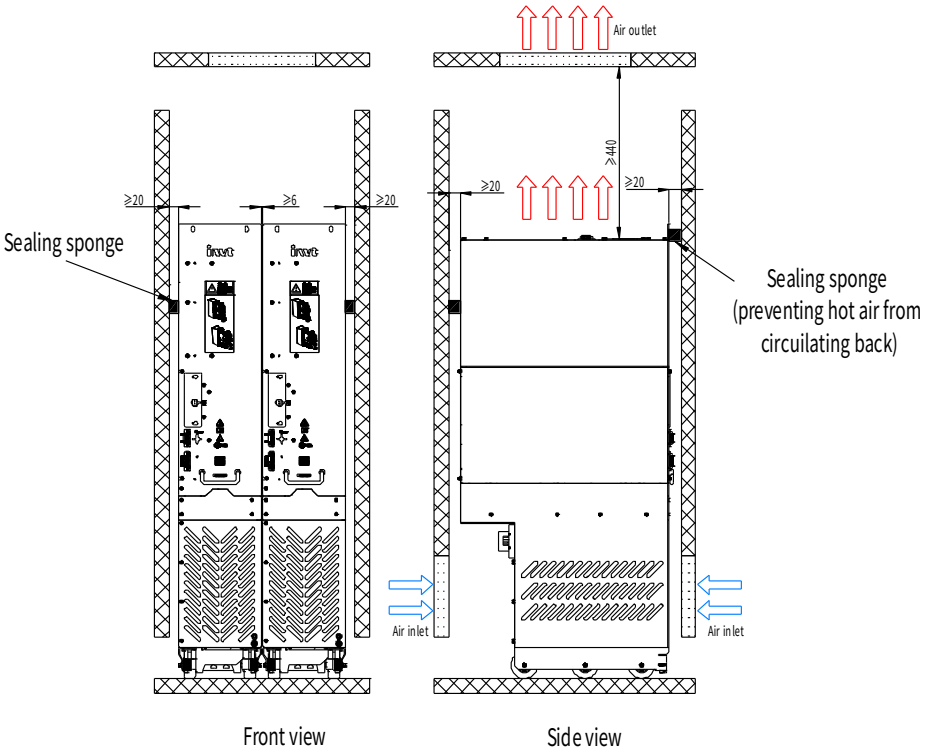
To ensure that the invert unit is installed reliably and in good heat dissipation, pay attention to the following:

Step 1 The inverter unit must be installed and used in a cabinet.

Step 2 A minimum ventilation clearance must be kept from the top and bottom of the inverter unit to ensure good heat dissipation. See Figure 3-10.

Step 3 Both sides of the inverter unit are designed with air baffle and sealing sponge for isolation to prevent the hot air at the inverter unit top outlet from circulating inside the cabinet and ensure that the heat of the inverter unit is discharged from the heat dissipation holes at the cabinet top outlet cover. See Figure 3-10.

Figure 3-10 Installation space requirements



To ensure good heat dissipation of the inverter unit, design the air inlet and outlet as follows:

Air inlet area formula: S_{in}=(1.5~2.0) x ($S_{module1}$+$S_{module2}$+ $S_{module3}$+.....+ $S_{module\ N}$)

S: System ventilation area

S_{module}: Each module ventilation area (cm^2)

Air outlet area formula: S_{out}=(1.2~1.5) x S_{in}

For details about the air volume required by the units, see Table 3-1.

Table 3-1 Ventilation areas and actual air volumes of inverter units

No.	Frame size	Ventilation area S_{in} (cm^2)	Actual air volume (CFM)
1	A8i	982	882
2	2*A8i	1964	1764
3	3*A8i	2946	2646

- Violation of the requirements in 3.3.5.1 Installation space and heat dissipation will shorten the inverter unit life and may result in inverter unit failure or malfunction.

3.3.5.2 Cabinet requirements

It is recommended that the cabinet adopts the nine-fold profile cabinet (PS cabinet). Before installing the inverter unit, install two bottom support crossbeams, an installation bracket, and an installation rail in the cabinet, and design the installation crossbeam for inverter unit fixing, and reserve fixing holes on the installation crossbeam (see Appendix B for the specific location and size).

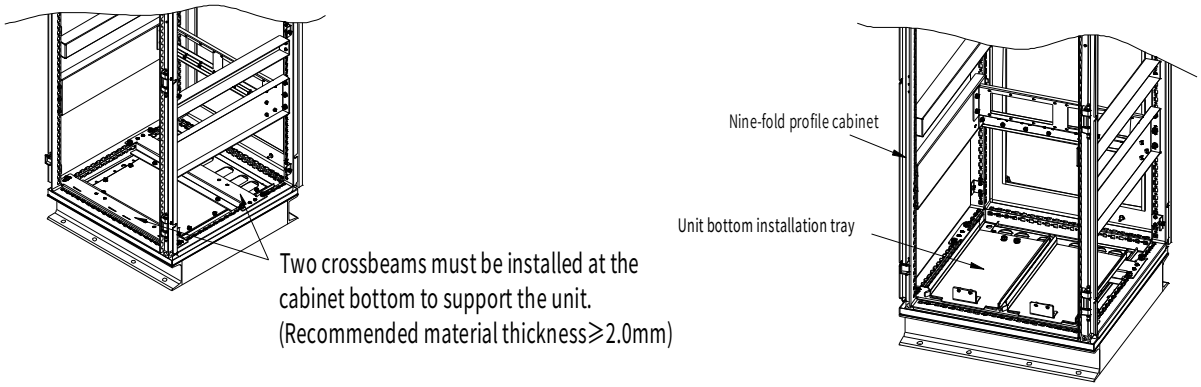
Fix the bottom support crossbeams and installation bracket. See Figure 3-11.

(1) Use eight M8 cage nuts to fix the two bottom support crossbeams to the base of the nine-fold profile cabinet frame. (For the support crossbeams, T≥2.0mm, firmly installed)

(2) Fix the installation bracket to the nine-fold profile cabinet frame base with six M5 self-tapping screws, as shown in the following figure.

(3) If you use another type of cabinet but not nine-fold profile cabinet, the fixing holes for the installation bracket need to be drilled and assembled on site.

Figure 3-11 Bottom installation bracket diagram



3.3.5.3 Layout and installation for one A8i inverter unit

With the precharge function

Figure 3-12 shows the cabinet layout for one A8i inverter unit with the precharge function.

Figure 3-12 Cabinet layout for one A8i inverter unit with the precharge function

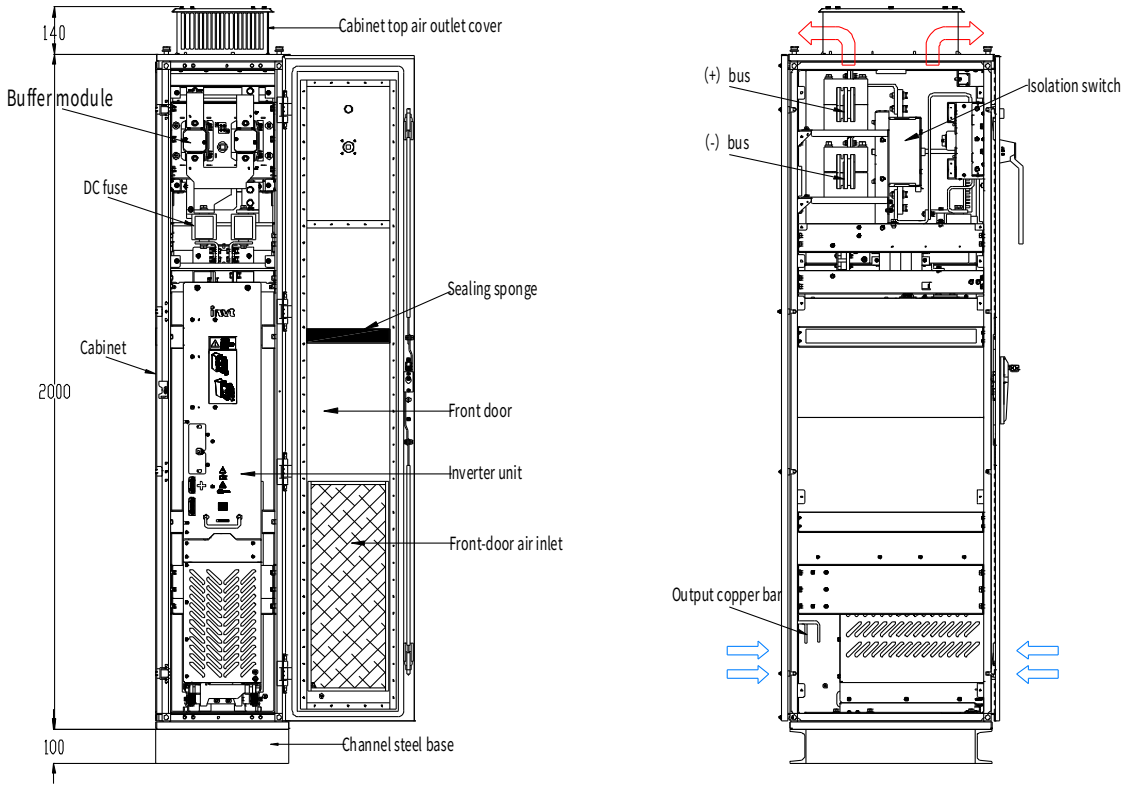
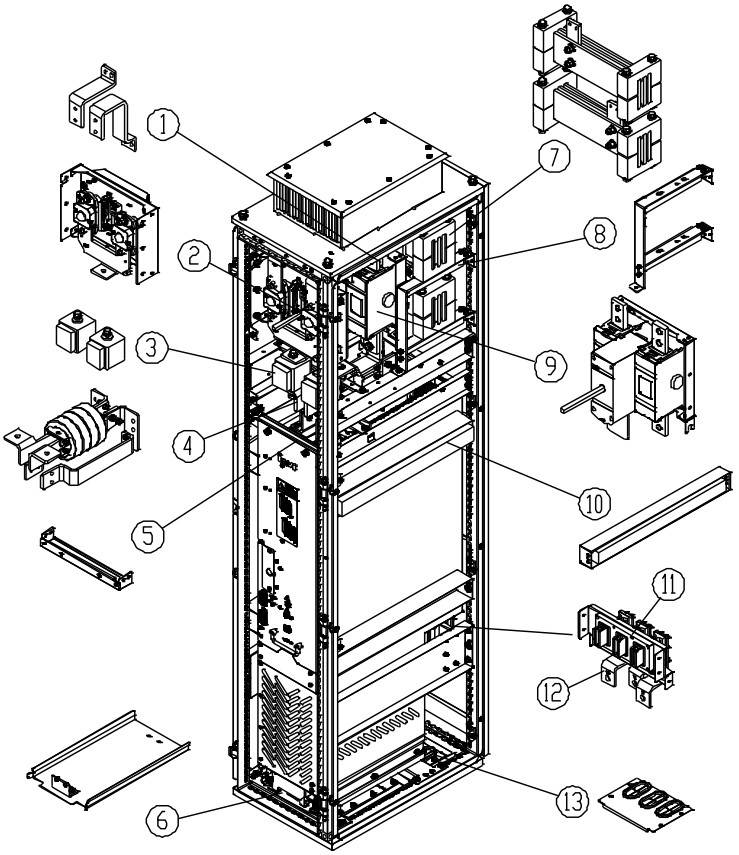


Figure 3-13 shows the installation of one A8i inverter unit with the precharge function in a cabinet.

Figure 3-13 Installing one A8i inverter unit with the precharge function in a 400mm-wide cabinet



No.	Name
1	Input copper bar
2	Buffer module
3	DC fuse
4	Magnet ring assembly
5	Unit-top fixing beam
6	Unit-bottom fixing plate
7	(+) and (-) busbars and busbar clamps
8	Busbar clamp support
9	Isolation switch
10	Side air baffle assembly (with sealing sponge)
11	Fast connector female end
12	Output copper bar
13	Bottom outgoing hole

Without the precharge function

Figure 3-14 shows the cabinet layout for one A8i inverter unit without the precharge function.

Figure 3-14 400mm-wide cabinet layout for one A8i inverter unit without the precharge function

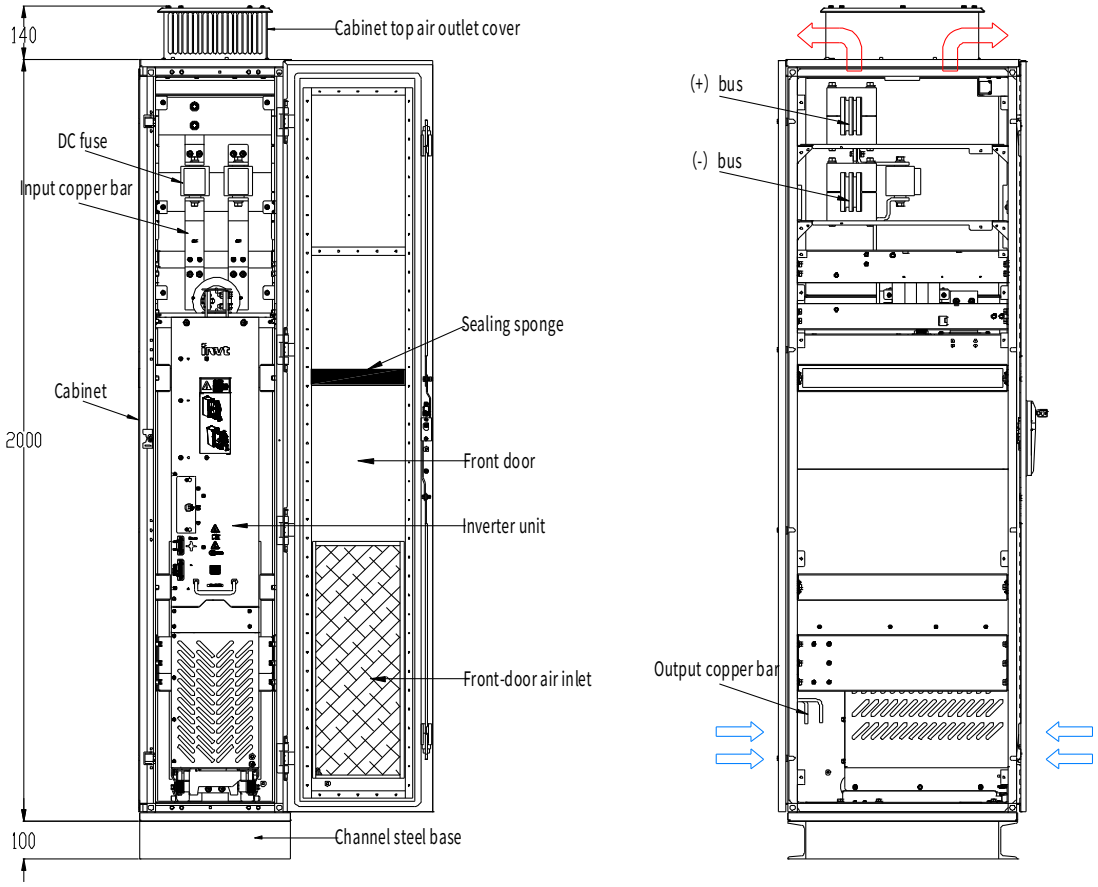
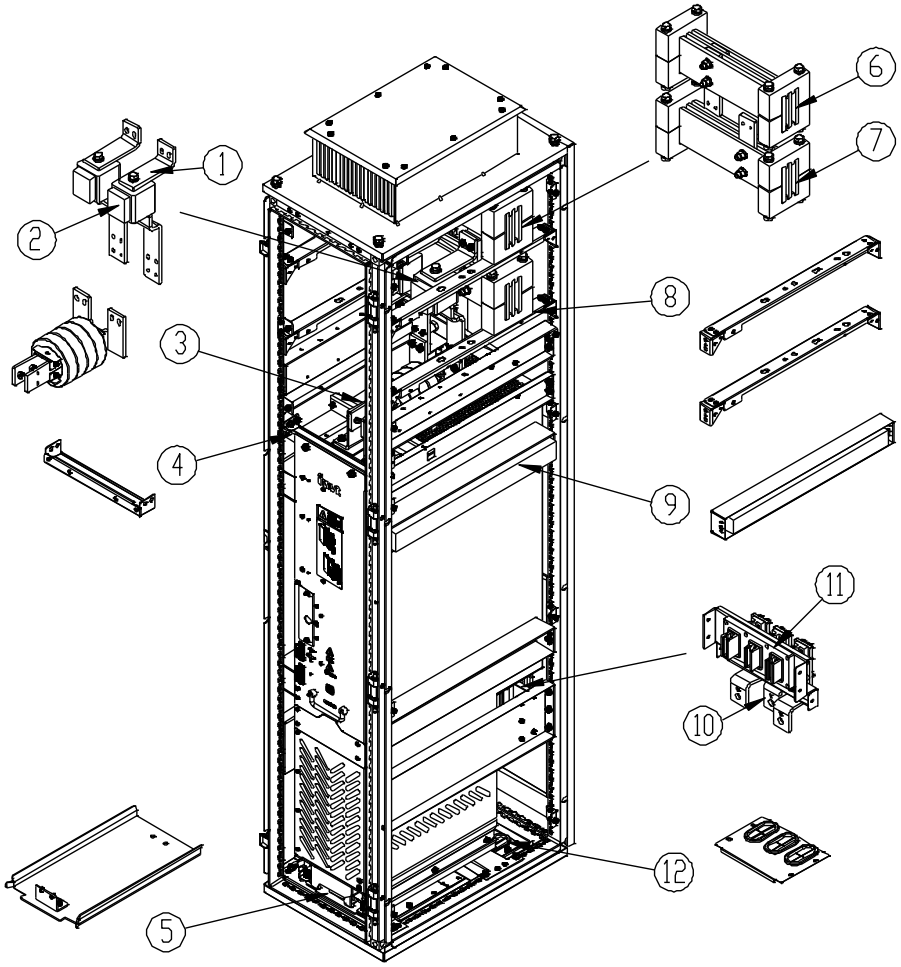


Figure 3-15 shows the installation of one A8i inverter unit without the precharge function in a cabinet.

Figure 3-15 Installing one A8i inverter unit without the precharge function in a 400mm-wide cabinet



No.	Name
1	Input copper bar
2	DC fuse
3	Magnet ring assembly
4	Unit-top fixing beam
5	Unit-bottom fixing plate
6	(+) busbar and busbar clamp
7	(-) busbar and busbar clamp
8	Busbar clamp support
9	Side air baffle assembly (with sealing sponge)
10	Output copper bar
11	Fast connector female end
12	Bottom outgoing hole

3.3.5.4 Layout and installation for two A8i inverter units

With the precharge function

Figure 3-16 shows the cabinet layout for two A8i inverter units with the precharge function.

Figure 3-16 Cabinet layout for two A8i inverter units with the precharge function

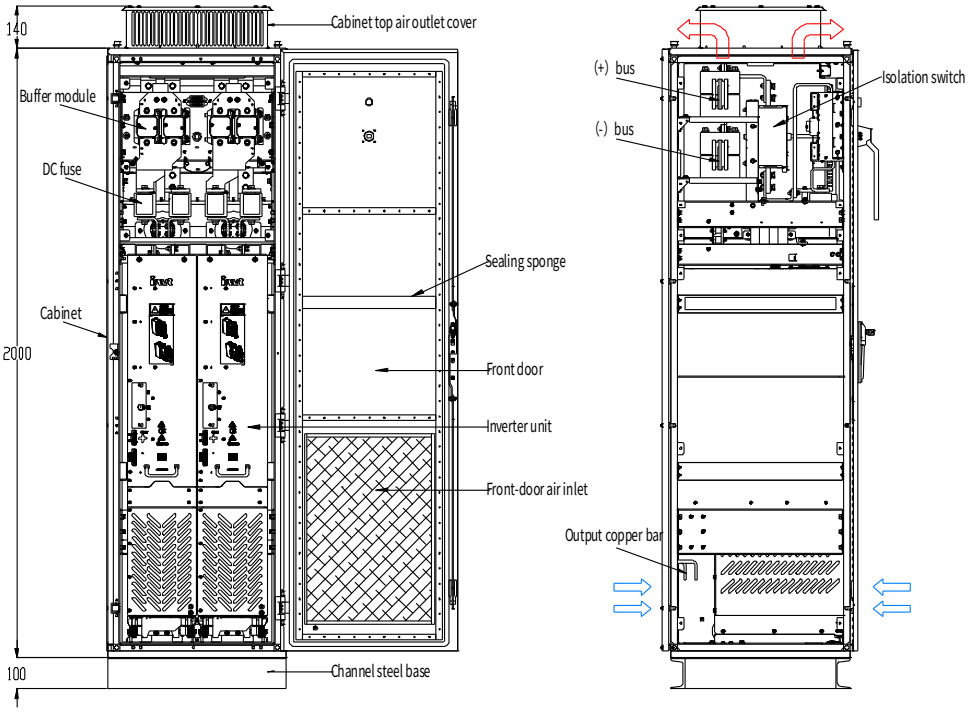
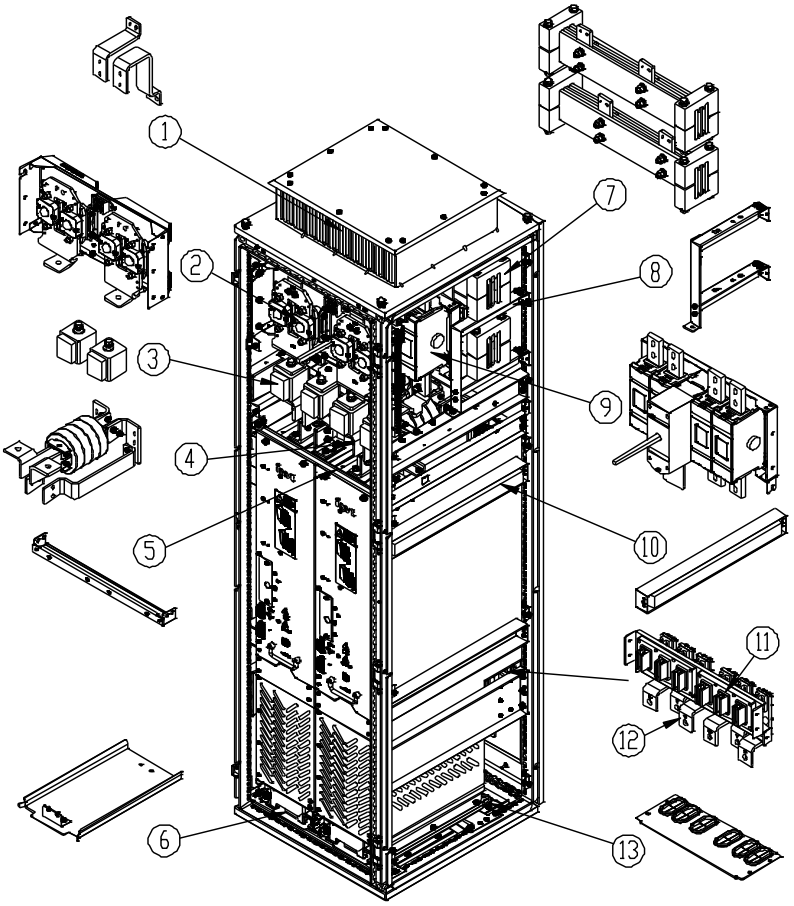


Figure 3-17 shows the installation of two A8i inverter units with the precharge function in a cabinet.

Figure 3-17 Installing two A8i inverter units with the precharge function in a 600mm-wide cabinet



No.	Name
1	Input copper bar
2	Buffer module
3	DC fuse
4	Magnet ring assembly
5	Unit-top fixing beam
6	Unit-bottom fixing plate
7	(+) and (-) busbars and busbar clamps
8	Busbar clamp support
9	Isolation switch
10	Side air baffle assembly (with sealing sponge)
11	Fast connector female end
12	Output copper bar
13	Bottom outgoing hole

Without the precharge function

Figure 3-18 shows the cabinet layout for two A8i inverter units without the precharge function.

Figure 3-18 600mm-wide cabinet layout for two A8i inverter units without the precharge function

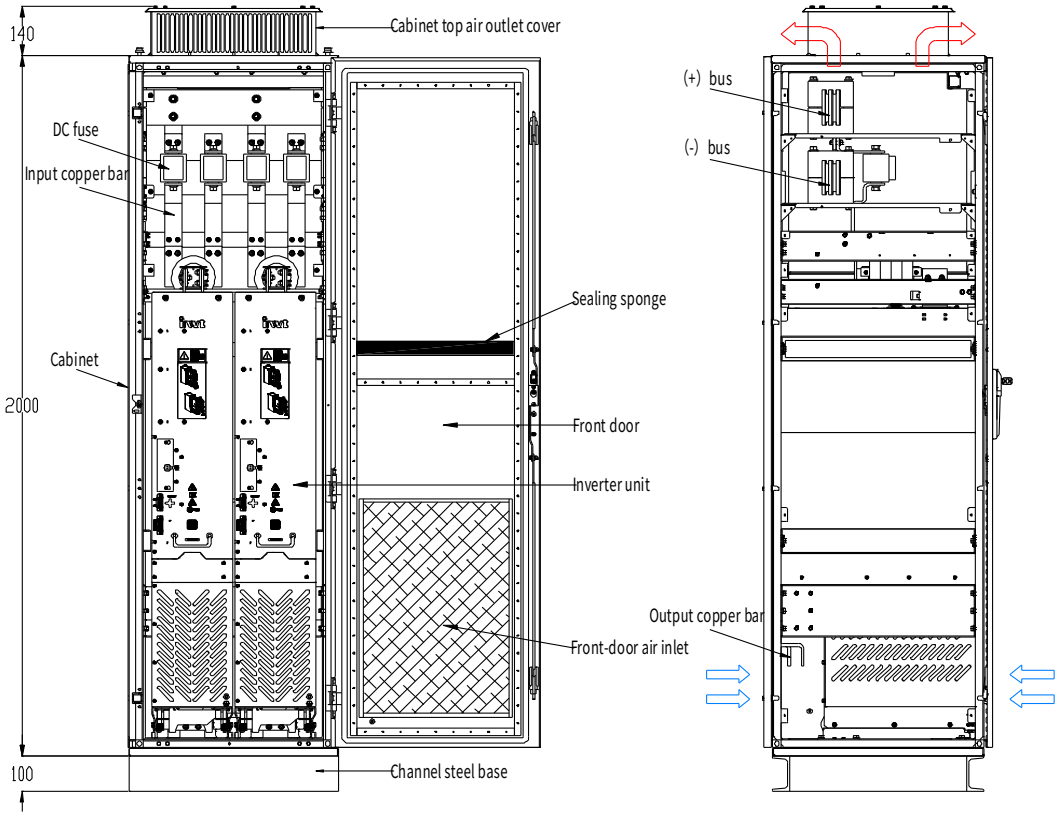
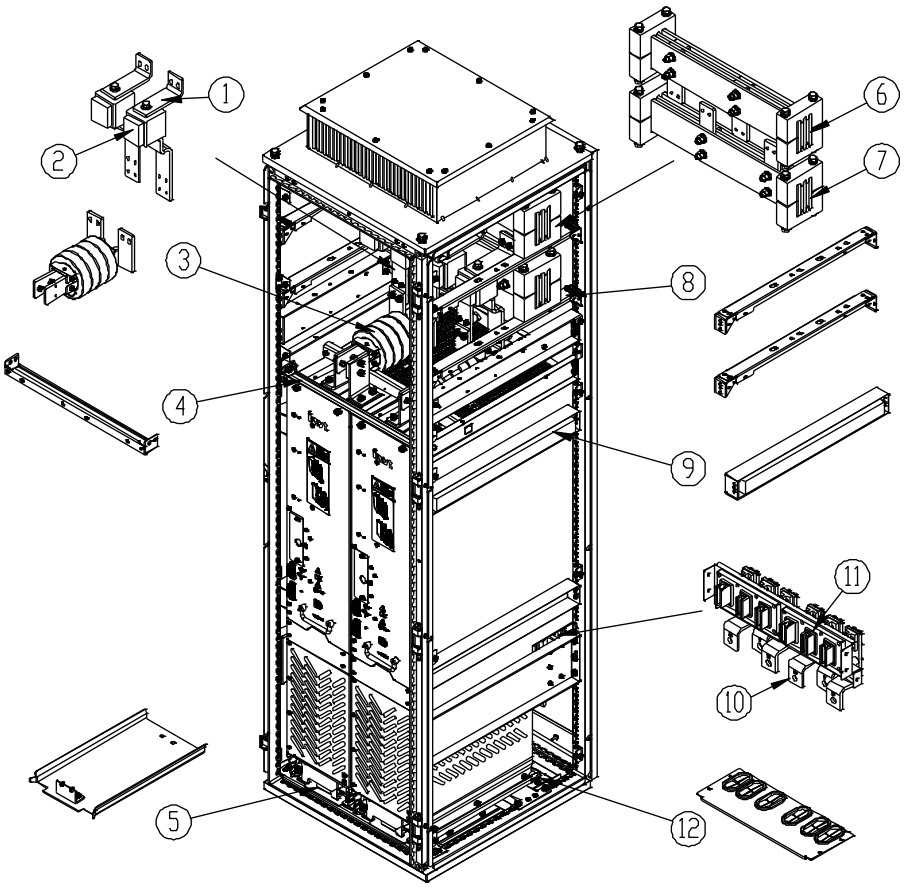


Figure 3-19 shows the installation of two A8i inverter units without the precharge function in a cabinet.

Figure 3-19 Installing two A8i inverter units with the precharge function in a 600mm-wide cabinet



No.	Name
1	Input copper bar
2	DC fuse
3	Magnet ring assembly
4	Unit-top fixing beam
5	Unit-bottom fixing plate
6	(+) busbar and busbar clamp
7	(-) busbar and busbar clamp
8	Busbar clamp support
9	Side air baffle assembly (with sealing sponge)
10	Output copper bar
11	Fast connector female end
12	Bottom outgoing hole

Note: A 40x40 sealing sponge must be used at the position corresponding to the air baffle in the front/back door panel, which prevents air duct reflow.

3.3.5.5 Layout and installation for three A8i inverter units

Figure 3-20 shows the 800mm-wide cabinet layout for three A8i inverter units.

Figure 3-20 800mm-wide cabinet layout for three A8i inverter units

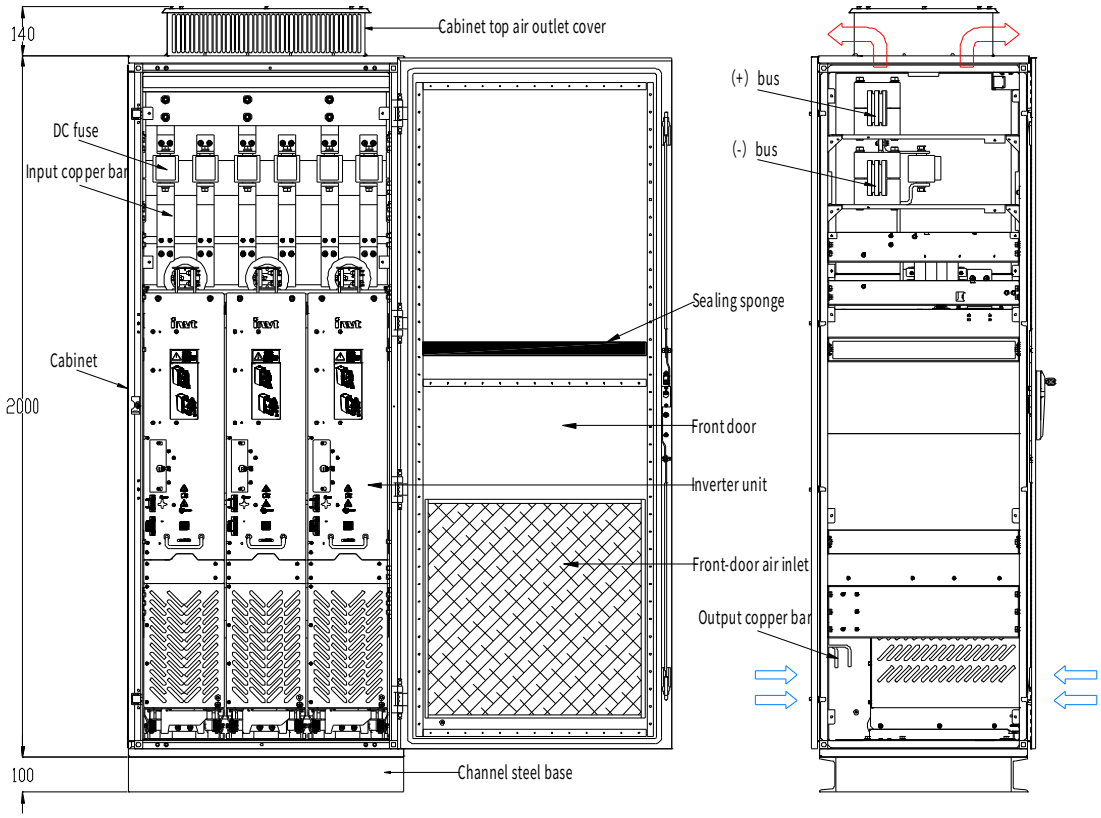
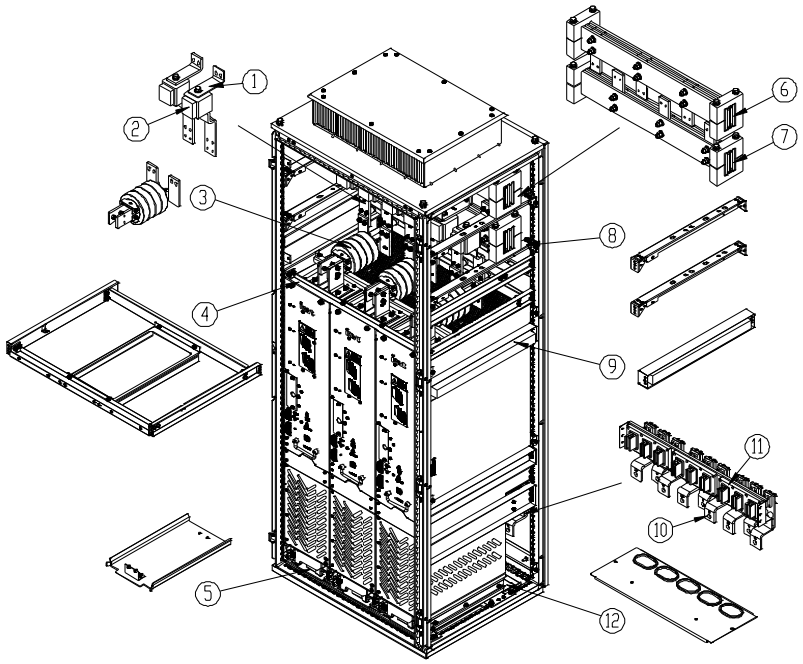


Figure3-21 shows the installation of three A8i inverter units in an 800mm-wide cabinet.

Figure3-21 Installing three A8i inverter units in an 800mm-wide cabinet



No.	Name
1	Input copper bar
2	DC fuse
3	Magnet ring assembly
4	Unit-top fixing assembly (unit guide included)
5	Unit-bottom fixing plate
6	(+) busbar and busbar clamp
7	(-) busbar and busbar clamp
8	Busbar clamp support
9	Side air baffle assembly (with sealing sponge)
10	Output copper bar
11	Fast connector female end
12	Bottom outgoing hole

3.3.5.6 Unit installation and replacement

Assembly procedure

Step 1 Insert the unit entry/exit guide rail into the slot of the cabinet front bottom beam. See Figure 3-22.

Step 2 Push the unit into the cabinet.

(1) Align the unit casters to the rail. See Figure 3-23.

Figure 3-22 Unit entry/exit guide rail placement

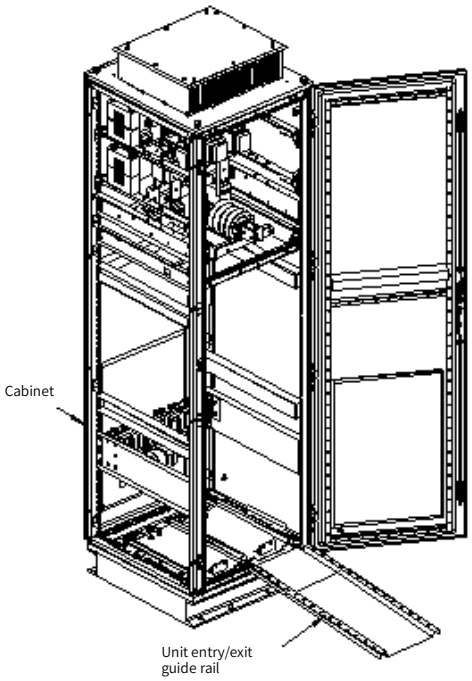
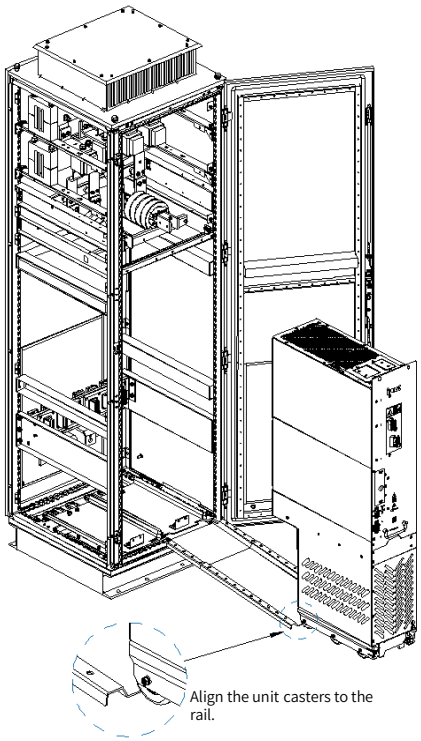


Figure 3-23 Unit placement



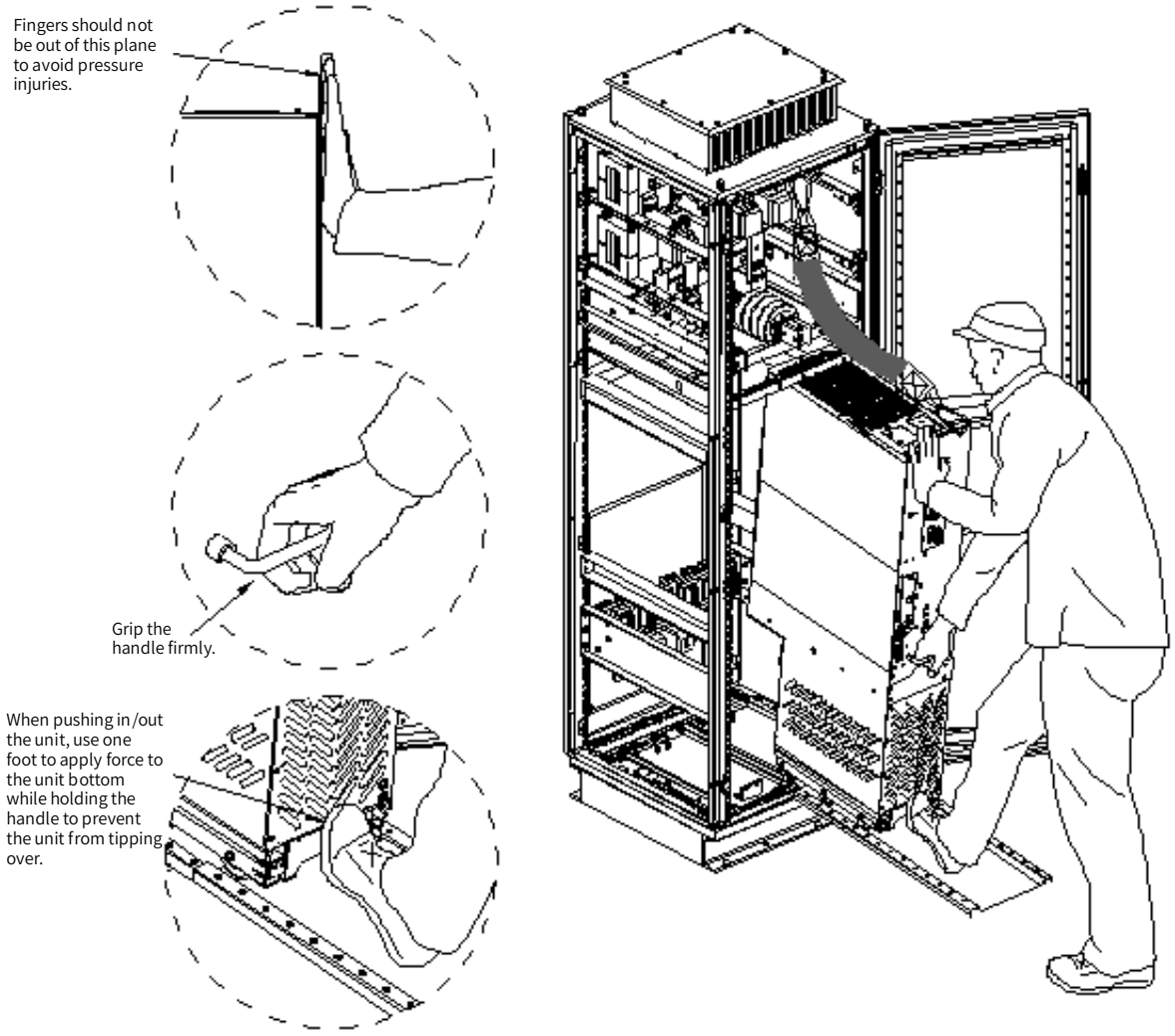
(2) Push the unit into the cabinet.

Note:

- Since the inverter unit barycenter is too high, use the auxiliary rope for installation to prevent the inverter unit from rollover during the push-in or push-out.

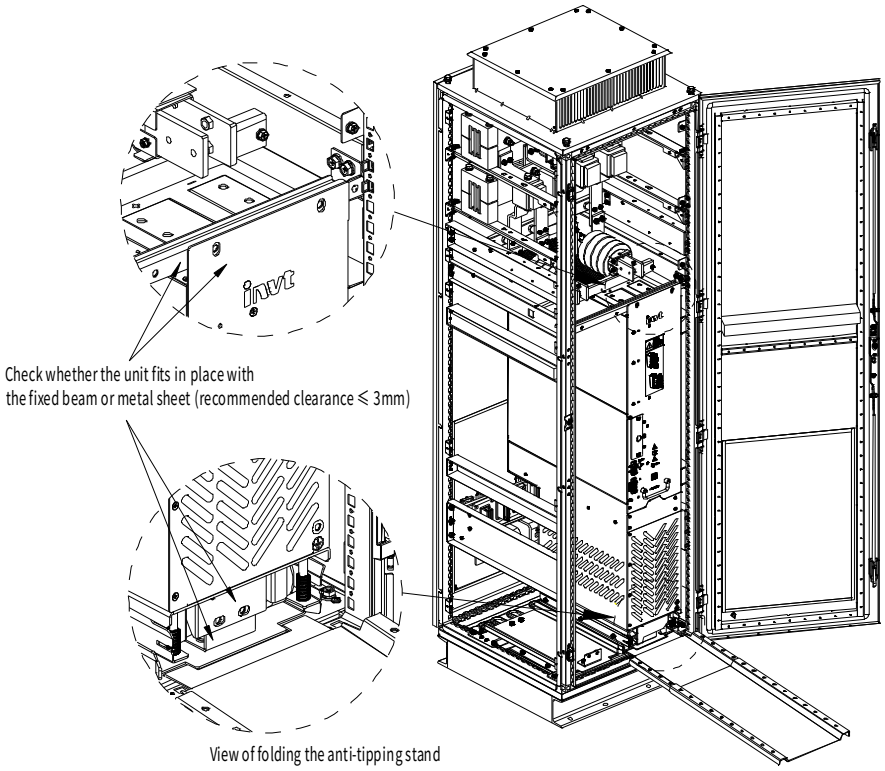
- When pushing in/out the inverter unit, use one foot to apply force to the bottom of the unit while holding the handle to prevent the unit from tipping over, falling over, hitting or injury. See Figure 3-24.
- When installing or replacing the inverter unit, wear gloves and safety shoes to prevent against scratching or smashing.

Figure 3-24 Unit entry to the cabinet



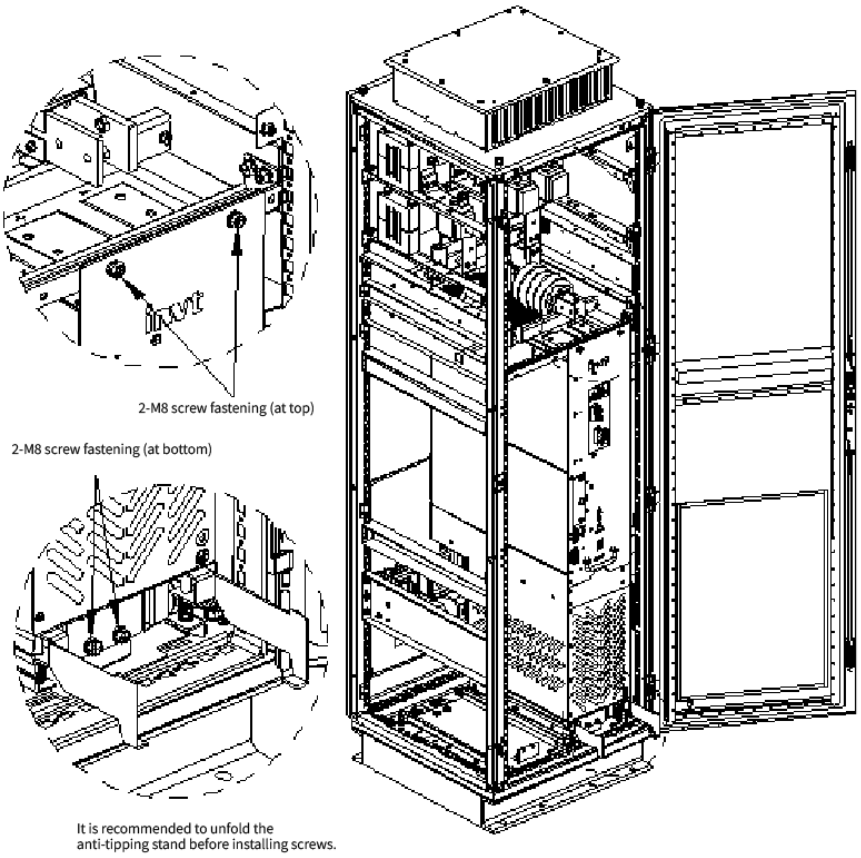
(3) Ensure that the unit is pushed into place. See Figure 3-25.

Figure 3-25 Checking whether the unit is pushed into place



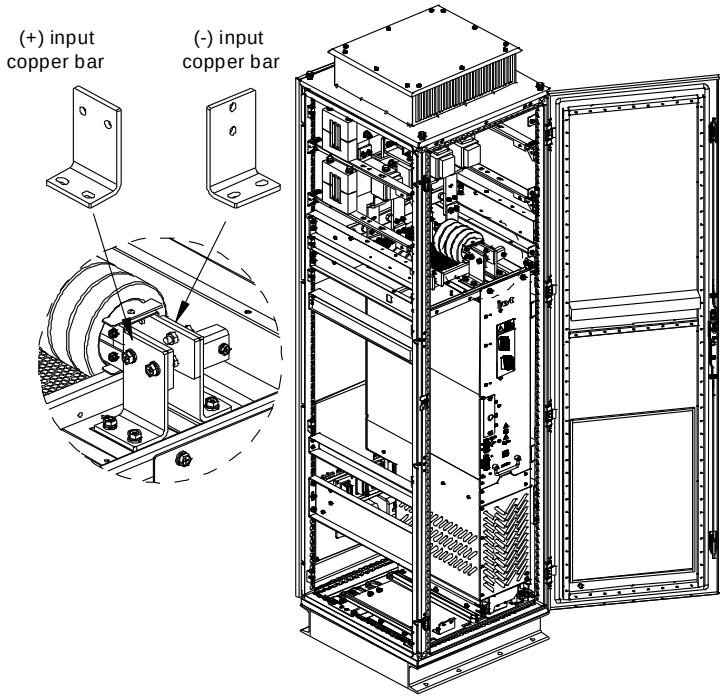
Step 3 After confirming that the unit is pushed into place, install the unit fixing screws and remove the unit entry/exit guide rail.

Figure 3-26 Unit fixing



Step 4 Install the (+) and (-) input copper bars of the inverter unit.

Figure 3-27 Unit input copper bar connection



3.3.5.7 Keypad installation

The inverter unit is equipped with an externally installed keypad (as shown in Figure 3-28), which is used with a keypad bracket that can be fixed to the cabinet door or external support sheet metal, and the keypad bracket installation structure is shown in Figure 3-29.

Figure 3-28 LED keypad structure

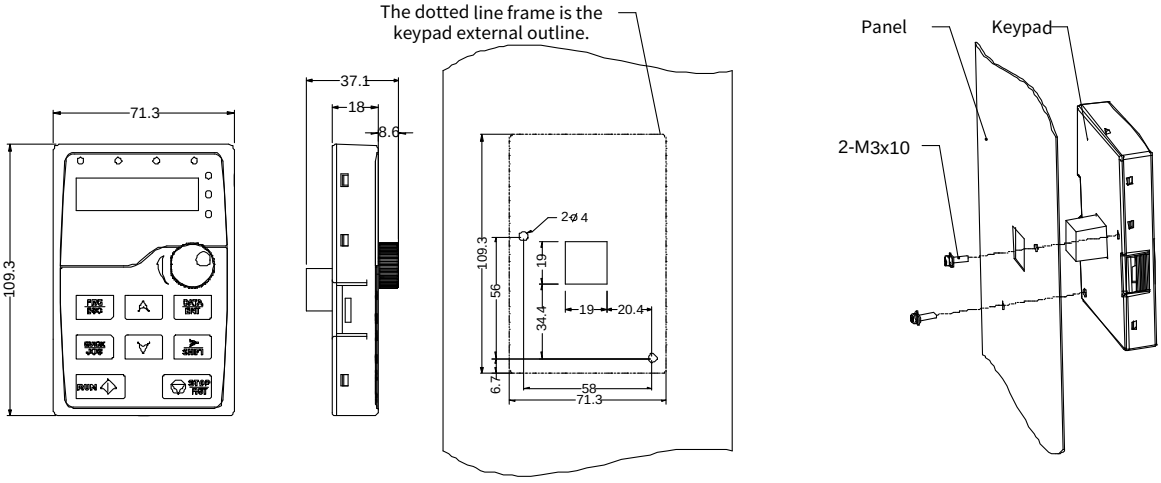
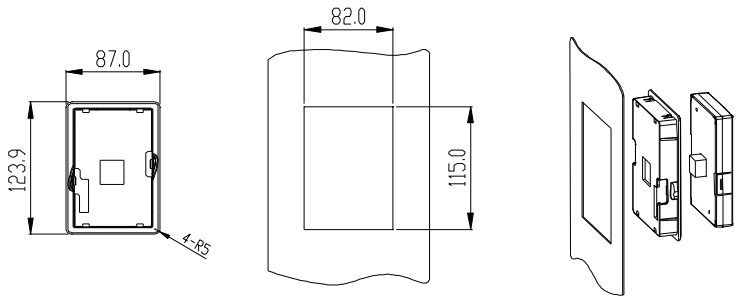


Figure 3-29 Installing the keypad bracket



3.3.6 Fastening torque

You need the following tools to install the inverter unit:

- Standard toolbox, including screwdrivers, nut wrenches, socket wrenches
- Torque wrenches with torques from 1.5 N・m to 100 N・m
- Socket wrench extension bars, 400 mm long

The inverter unit installation involves conductive components (AC input connectors, DC bus connectors, and cable terminals) and other component connections (grounding terminals, protective ground terminals, and fixing screws), and the screw tightening torques must meet the requirements in the following table.

Table 3-2 Recommended values of screw thread tightening torque

Screw/Bolt	Strength grade	Recommended torque (N・m)
M4	4.8	1.5
M5	5.8	3
M6	5.8	5
M8	5.8	11
M10	4.8	22
M12	4.8	39

3.3.7 Checklist

No.	Operation	Compliant	Completed
1	Installed the beam for inverter unit fixing in the nine-fold profile cabinet.	☐	☐
2	Installed the bottom tray for inverter unit fixing in the nine-fold profile cabinet.	☐	☐
3	Installed the copper bars of the inverter unit in the cabinet.	☐	☐
4	Assembled the installation guide rail (optional part) and installed it in the cabinet.	☐	☐
5	In the cooperation of two people, aligned the inverter unit casters with the installation guide rail and pushed the inverter unit to the cabinet. (See Figure 3-23, Figure 3-24, and Figure 3-25. The auxiliary rope for installation has been used to prevent the unit from side tipping during the push-in or push-out.)	☐	☐
6	Removed the auxiliary rope for installation, and ensured that the unit was pushed into place.	☐	☐
7	Inserted screws into the fixing holes at the unit front top and bottom to fix the unit to the cabinet. (See Figure 3-26.)	☐	☐
8	Installed the (+) and (-) bus copper bars.	☐	☐
9	Remove the installation guide rail when you ensure the installation is secure.	☐	☐
10	Checked the screw tightening state.	☐	☐

4 Electrical installation

4.1 Safety notes

- All safety precautions in this manual must be read and followed. Only trained and qualified professionals are allowed to carry out the operations mentioned in this chapter.
- All work on electrical equipment must comply with the following:
  - The power is off.
  - Re-power on must not occur.
  - Wait for at least the time designated on the inverter unit, and ensure the voltage between (+) and (-) is lower than 36V through measurement.
  - The equipment is well grounded.
  - Live parts have been shielded or isolated.
- All installation work can be performed only in power-off (no voltage) state since high voltage is present in the inverter unit internal during the running.
- Do not perform wiring, inspection or component replacement when power supply is applied. Before wiring or inspection, ensure all the input power supplies have been disconnected, and wait for at least 25 minutes or until the DC bus voltage is lower than 36V.
- If the auxiliary control power of the inverter unit is supplied externally, the disconnecting the circuit break device cannot disconnect the entire power supply. The inverter unit control system may be live even if not started. Please refer to the electrical schematic diagram for inspection to avoid personal injury caused by contacting the live part of the inverter unit.
- If the safety device on a current branch trips, check the inverter unit for the fault cause, rectify the fault, and replace the damaged parts.

4.2 Insulation inspection

Inverter unit

Before delivery, each inverter unit has been tested for insulation of the main circuit to the housing. Moreover, there is voltage limiting circuit inside the VFD, and the circuit will automatically cut off the test voltage of the withstand voltage test. Do not carry out insulation withstand test on the VFD, or measure the control circuit of the VFD with a megohmmeter.

Input power cable

Check the insulation conditions of the input power cable of the VFD according to the local regulations before connecting it.

Motor and motor cable

Check the motor and motor cable insulation status as follows:

Step 1 Ensure that the motor cable has been connected to the motor.

Step 2 Remove the motor cable from the U, V, and W output terminals of the VFD.

Step 3 Measure the insulation resistance between the motor cable and each phase of the motor and the

protective ground with a 1kV DC megohmmeter.
Insulation resistance must be greater than 1M Ohm.

4.3 EMC regulations

General knowledge of electromagnetic compatibility

EMC is short for electromagnetic compatibility, which refers to the ability of a device or system to function properly in its electromagnetic environment and not constitute an unbearable electromagnetic disturbance to anything in that environment. EMC includes two aspects: electromagnetic interference and electromagnetic immunity.

Electromagnetic interference can be divided into two categories according to the transmission paths: conducted interference and radiation interference.

Conducted interference propagates along any conductor. Therefore, any conductor, such as wire, transmission line, inductor, and capacitor, is a transmission channel for conducted interference.

Radiated interference is in the form of electromagnetic waves that propagate with energy that is inversely proportional to the square of the distance.

Electromagnetic interference must have three conditions or three elements at the same time: interference source, transmission channel, and sensitive receiver, each of which is indispensable. The solution of EMC problem mainly focuses the three elements. For users, the solution of EMC problem is mainly in transmission channels because the equipment as interference source or receiver cannot be changed.

Different electric and electronic devices have different EMC capacities because of adopting different EMC standards or classes.

General EMC guidelines on variable-frequency regulation system wiring

The following introduces general EMC guidelines on VFDs in several aspects including noise control, site wiring and grounding for reference in site installation, with consideration of ECM characteristics of VFDs where the input current and output voltage harmonics are relatively small but the voltage is high and the current is large.

1. Noise control

All the connections to the VFD control terminals must use shielded wires. The shield layer of wire must be grounded near the VFD entrance. The ground mode is 360-degree loop connection formed by cable clips. It is not allowed to connect the twisted shield layer to the ground of the VFD, which greatly decreases or loses the shield effect.

2. Site wiring

Power supply wiring: The shield layer of power supply incoming cables of the VFD shall be grounded reliably. It is not allowed to route the power cables and control cables in parallel.

Device categorization: There are different electric devices in the same distribution system, which have different ability of emitting and withstanding electromagnetic noise. Therefore, it needs to categorize these devices into strong noise device and noise sensitive device. The same kind of devices needs to be placed in the same area, and the distance between devices in different categories needs to be more than 20cm.

Wiring in the control cabinet: During wiring, signal cables and power cables need to be arranged in different areas. It is not allowed to arrange them in parallel or in interlaced state at a close distance (less than 20cm) or tie them together. If the signal cables have to cross the power cables, they need to be arranged in 90 degree angle.

3. Grounding

The VFD must be grounded safely and reliably in operation. Grounding has the priority in all EMC methods because it does not only ensure the safety of equipment and persons, but also it is the simplest, most

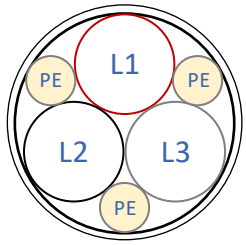
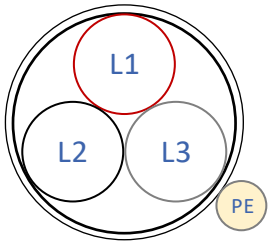
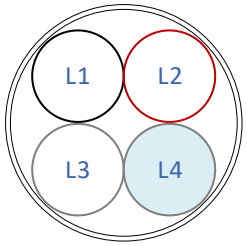
effective and lowest-cost solution for EMC problems.

Three categories of grounding: special pole grounding, common pole grounding and series-wound grounding. Different control system needs to use special pole grounding, different devices in the same control system needs to use common pole grounding, and different devices connected by the same power cables needs to use series-wound grounding.

4.3.1 Power cable

To meet the EMC requirements stipulated in the CE standards, you must use symmetrical shielded cables as motor cables.

Four-core cables can be used as input cables, but symmetrical shielded cables are recommended. Compared with four-core cables, symmetrical shielded cables can reduce electromagnetic radiation as well as the current and loss of the motor cables.

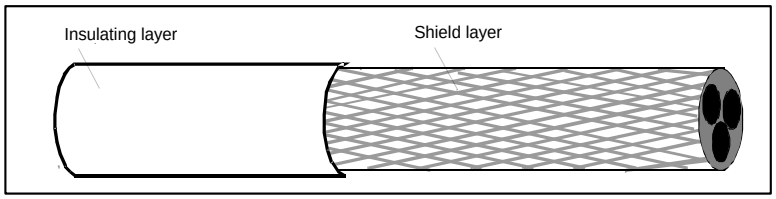
		
Symmetrical shielded cable, PEs in symmetrical manner	Symmetrical shielded cable, PE in separated manner	Asymmetrical four-core cable

Power cables must meet the following requirements:

- The sizes of the input power cables and motor cables must comply with local regulations.
- The input power cables and motor cables must be able to carry the corresponding load currents.
- The maximum temperature margin of the motor cables in continuous operation cannot be lower than 70°C.
- PE grounding conductor conductivity must be as good as possible to reduce the grounding resistance to achieve better impedance continuity. If the electrical conductivity of the motor cable shield layer does not meet the requirements, a separate PE conductor must be used.

To effectively restrict the emission and conduction of radio frequency (RF) interference, the conductivity of the shielded cable must at least be 1/10 of the conductivity of the phase conductor. This requirement can be well met by a copper or aluminum shield layer. The following figure shows the minimum requirement on motor cables of a VFD. The cable must consist of a layer of spiral-shaped copper strips. The denser the shield layer is, the more effectively the electromagnetic interference is restricted.

Figure 4-1 Cable cross section



Note: Check the insulation conditions of the input power cable of a VFD according to the local regulations before connecting it.

4.3.2 Control cable

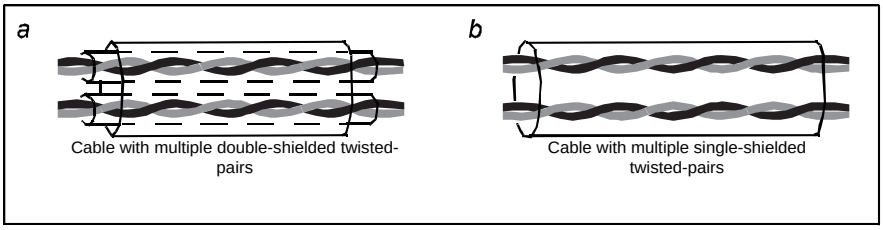
All analog signal cables, communication cables, and encoder cables must be shielded cables.

Analog signal cables need to be double-shielded twisted-pair cables (as shown in figure a). Use one separate shielded twisted pair for each signal. Do not use the same ground wire for different analog signals.

Communication cables and encoder cables need to be single-shielded twisted-pair cables (as shown in figure b). The shield layer of cable is connected to the system PE by means of a 360-degree connection or twisting into a single bundle, and the exposed shield layer is wrapped with insulating tape to prevent interference introduced by the shield layer in contact with other equipment and structural components.

The keypad needs to be connected by using a network cable. In complicated electromagnetic environments, a shielded network cable is recommended.

Figure 4-2 Control cable



Note: Analog signals and digital signals cannot share a same cable, and their cables must be routed separately.

4.3.3 Wiring suggestions

Motor cables and input cables in a drive system are interference cables, while communication cables, encoder cables, analog signals, and high-speed signal cables are sensitive cables. It is recommended that you arrange the motor cables, input power cables, and control cables separately in different trays, reducing electromagnetic interference caused by the du/dt of the VFD output to other cables. The general cable arrangement rules are shown in Figure 4-3. The recommended values for the spacing between sensitive and interference cables are shown in the following table.

Figure 4-3 General cable arrangement rules

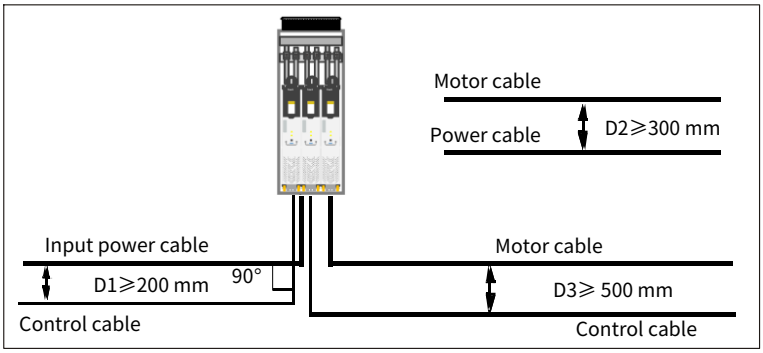


Table 4-1 Recommended values for the spacing between sensitive and interference cables

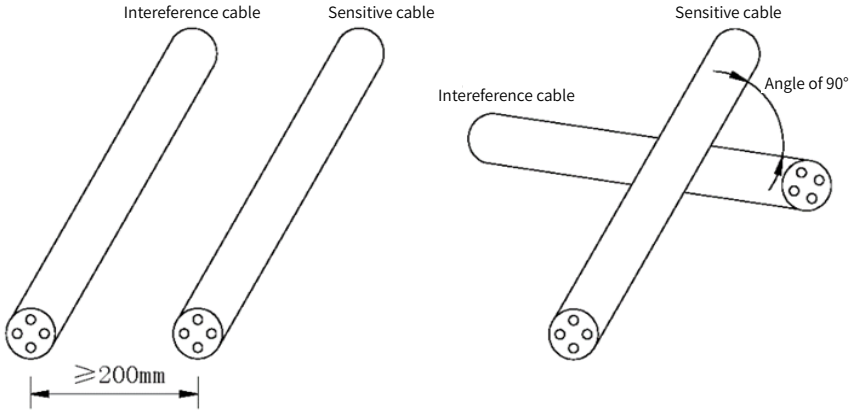
D1	D2	D3
⩾200mm	⩾300mm	⩾500mm

Note:

- The motor cables of different VFDs/inverters can be arranged in parallel, but motor cables must be arranged far away from sensitive cables.

- Analog signals and digital signals cannot share a same cable, and their cables must be routed separately.
- If a control cable and power cable must cross each other, ensure that the angle between them is 90 degrees.

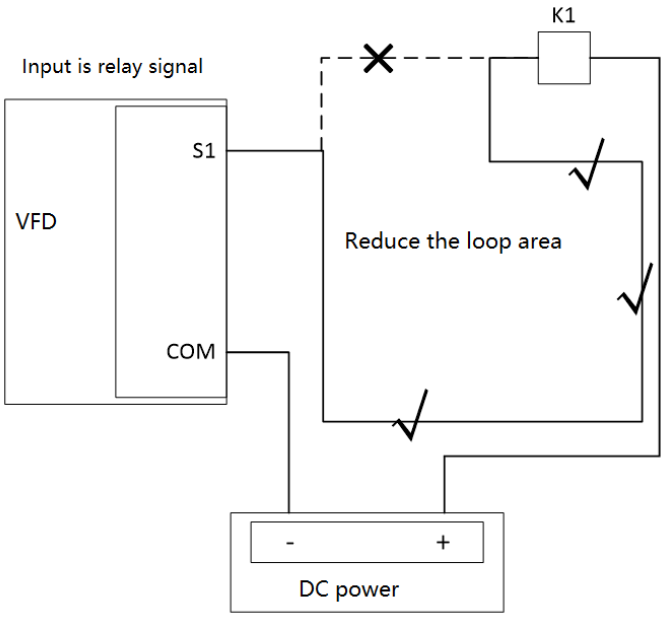
Table 4-4 Routing sensitive and interference cables



The cable trays must be connected properly and well grounded. Aluminum trays can implement local equipotential.

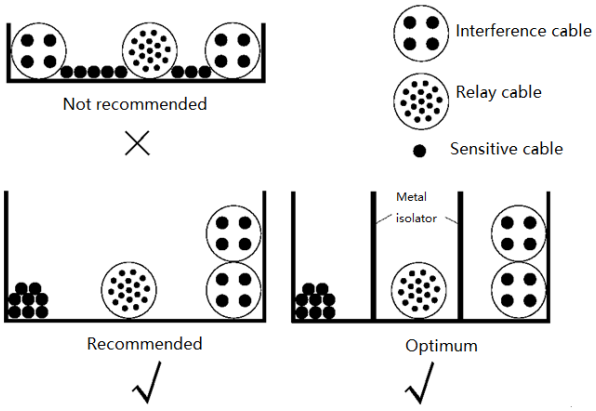
For inputs of such as relay signals and other non-differential signals, non-twisted pair cables can be used, and the wiring should minimize the loop area and a pair of signal lines should be routed as close as possible.

Figure 4-5 Non-differential signal wiring loop



When laying multiple types of cables, the cables should always be routed along the alignment grooves or metal pipes in equipotential connection, with different types of cables separated as much as possible. You can better improve electromagnetic compatibility by using metal spacers to isolate different types of cables in the same metal groove or metal pipe.

Figure 4-6 Routing multiple types of cable

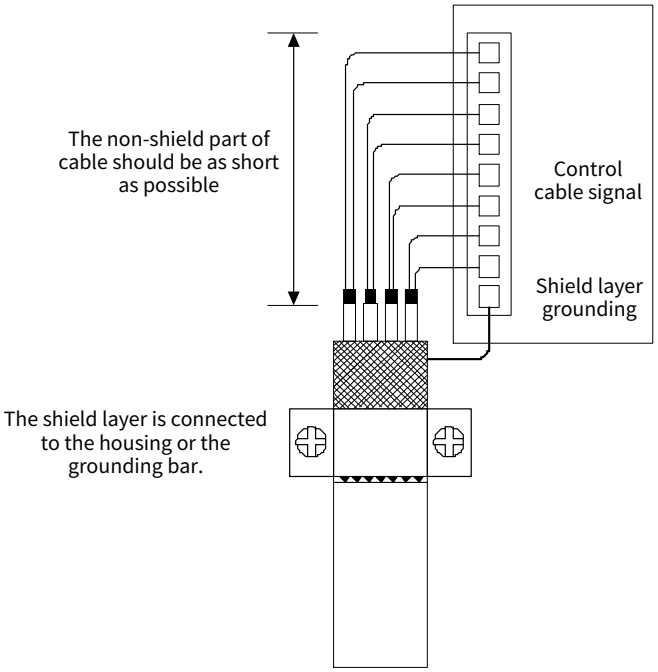


4.3.4 Shielded cable connection

The shield layer of signal cable is grounded at both ends, of which the grounding points must be the same. That is, if the shield layer at the upper computer side is connected to PE, the shield layer at the drive side is also connected to PE; if the shield layer at the upper computer side is connected to GND, the shield layer at the drive side is also connected to GND. It is recommended to connect the both ends of the shield layer to PE, which is the housing.

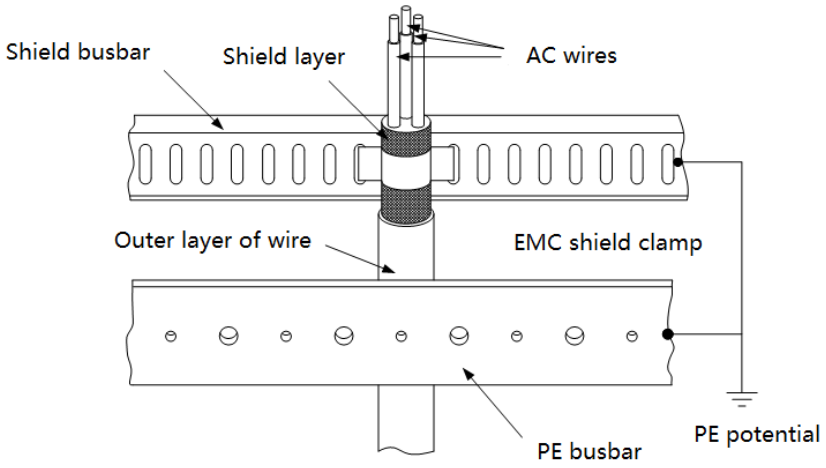
The unshielded part of the control cable that is shielded should be as short as possible, and the shield layer is connected to the nearest PE end. If the cable is stripped too long, the core is susceptible to interference of signals, especially analog, communication, and encoder signals.

Figure 4-7 Control cable shield connection



The shield layers of the input power and output motor cables should have large contact with the shield board inside the installation cabinet to achieve good EMC shield effect. The specific installation and fixing method can be referred to the following diagram.

Figure 4-8 Power cable shield connection

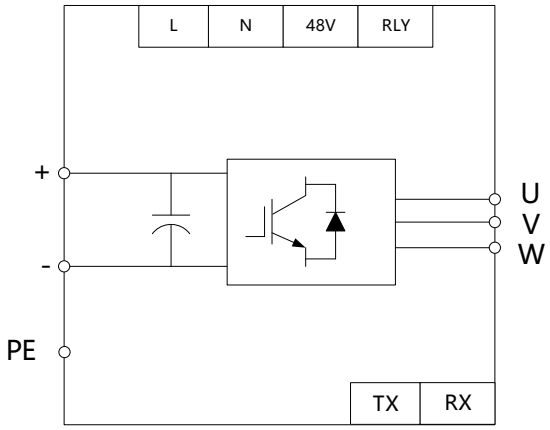


4.4 Electrical wiring

4.4.1 Main circuit wiring

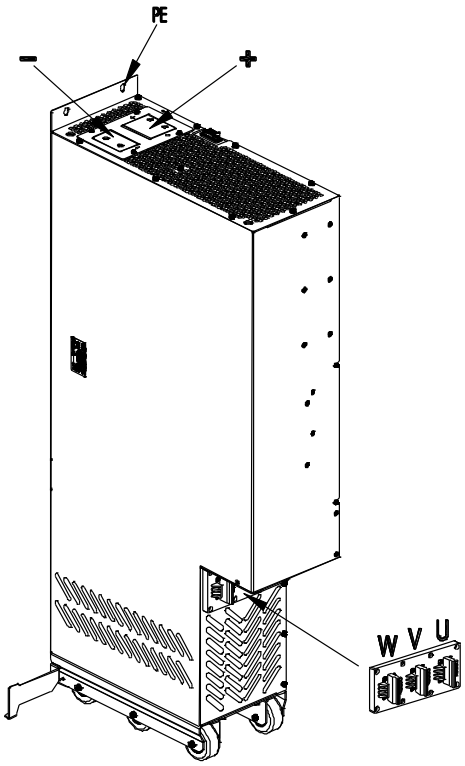
4.4.1.1 Main circuit wiring diagrams

Figure 4-9 Inverter unit wiring



4.4.1.2 Main circuit wiring terminals

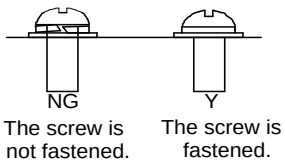
Figure 4-10 Terminals of an inverter module in the A8i frame



Name	Description
(+), (-)	DC bus voltage input terminals
U, V, W	3PH AC output terminals
PE	Grounding terminal

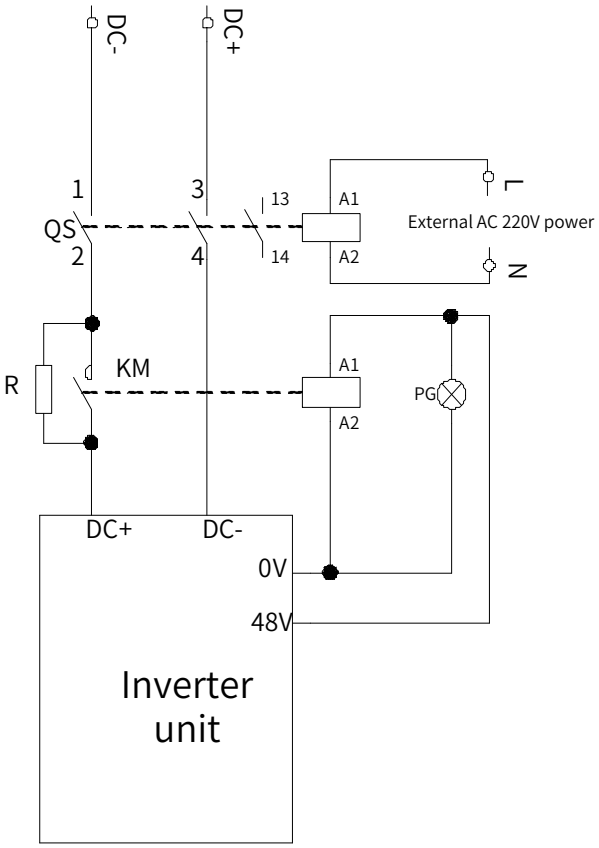
4.4.1.3 Screw tightening

Figure 4-11 Screw installation requirements



4.4.2 Isolation switch connection

4.4.2.1 Electrical connection



Note:

- QS indicates the isolation switch, KM indicates the DC contactor, while R indicates the buffer resistor; QS and KM form the main circuit, while QS and R form the buffer circuit connected in parallel to the main circuit.
- 13–14 indicate QS feedback signals.
- X1 indicates the indicator.

4.4.2.2 Procedure

Step 1 Initial state

QS is opened, KM is not closed, 13 and 14 are in N.O. state, while X1 has no indication.

Step 2 Precharge state

QS is closed, KM is not closed, the buffer circuit is started through the loop between QS and R to precharge the inverter unit, 13 and 14 are in N.C. state, while X1 has no indication.

Step 3 Working state

QS is closed, the inverter unit finishes charging, the bus voltage has been established with output of DC 48V voltage, KM is closed, while the main circuit is switched on.

Note: The QS electrical interlock coil must be powered by external power supply of AC 220V, so that QS cannot be operated with electricity.

4.4.3 Electrical installation checklist

No.	Operation	Compliant	Completed
1	Checked the input and output power wiring and ensured the wiring positions and voltages were correct.	☐	☐
2	Ensured that the input and output power wiring was correct and fastened.	☐	☐
3	Ensured that the input and output power cable carrying capacity selection was correct.	☐	☐
4	Ensured that routing the input and output power cables that were shielded complied with EMC regulations.	☐	☐
5	Checked the external auxiliary power wiring and ensured the wiring positions and voltages are correct.	☐	☐
6	The date of manufacture can be known from the inverter unit nameplate. If the interval to the first commissioning time or the power module downtime is less than 2 years, precharge for the DC bus capacitors is not needed; if the downtime is more than 2 years, precharge for the DC bus capacitors is needed. For details about precharge, see 6.2.1 Capacitor.	☐	☐
7	Routed the control power cables and power cables separately, complying with EMC regulations.	☐	☐

5 Inverter Control Unit (ICU)

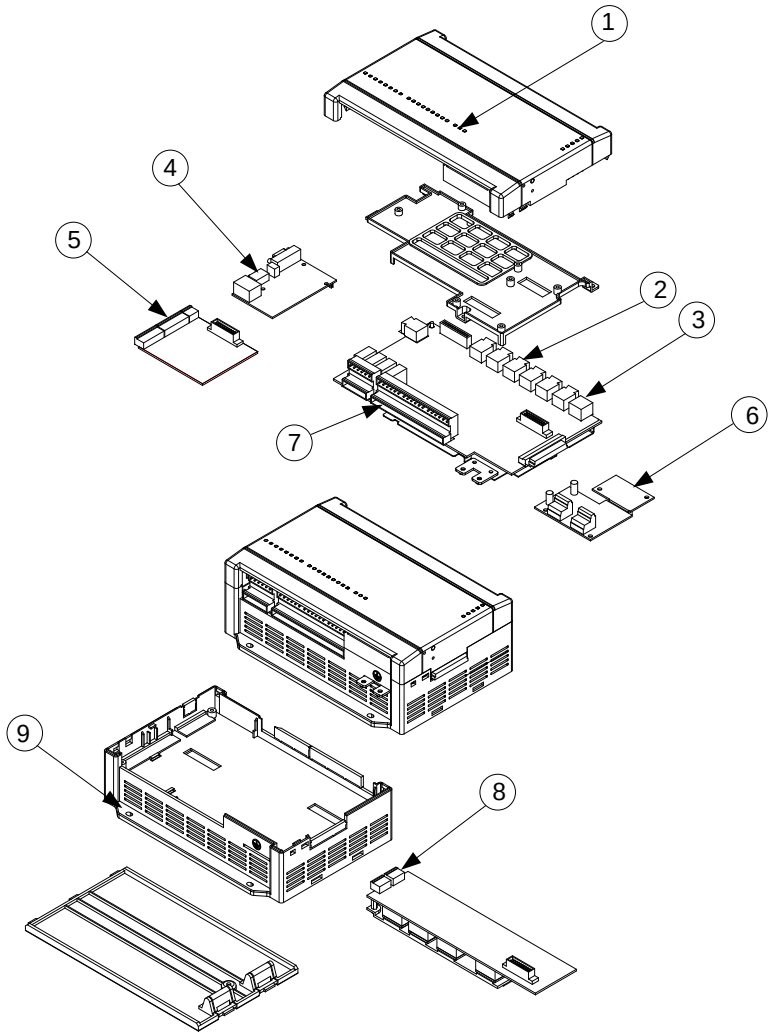


Figure 5-1 Components

No.	Component	Description
1	Indicator	Indicators for the power, run, fault, and status
2	Fiber optic interface	Fiber optic communication interface
3	Keypad interface	Human-machine interface (HMI)
4	Expansion card 1	Communication expansion card
5	Expansion card 2	IO expansion card
6	Expansion card 3	PG expansion card
7	User's wiring terminal	Standard input and output terminals for users
8	Power interface	24V power input terminal
9	Fixing hole	Four fixing holes

5.1 ICU size and installation

5.1.1 Preparing

- Before installation, ensure the cabinet has been powered off (excluding external power) for at least 25 minutes.
- Prevent the ICU from falling or shock to avoid damage.
- Do not disassemble the ICU to avoid damage.
- Do not fasten with excessive torque; otherwise, terminals may be damaged.

5.1.1.1 Required tools

Phillips screwdriver of size No.1 may be required during installation.

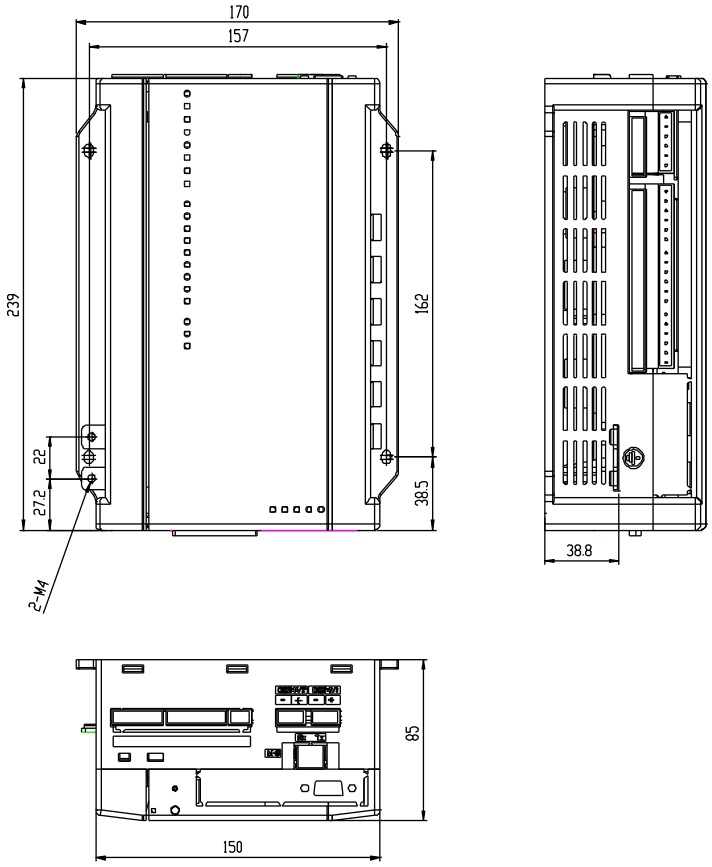
5.1.1.2 Fastening torque

Screws are used to install the ICU with fastening torque.

Screw	Fastening torque
M4	1.5N.M

5.1.2 ICU size

Figure 5-2 ICU dimensions (unit: mm)

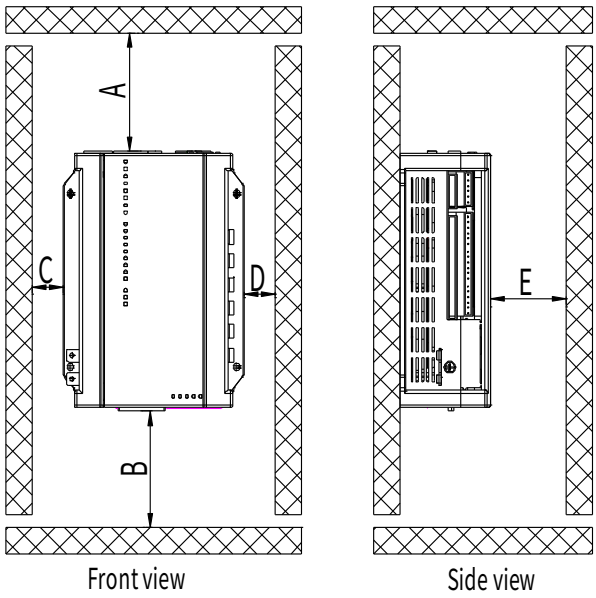


5.1.3 ICU installation space

To make the ICU installation smooth, the distance between the upper and lower parts of the ICU and the

building and its components should be left as shown in the following figure, and the ICU must be installed on a conductive metal plate, the entire conductive bottom of the ICU must properly work with the installation surface.

Figure 5-3 ICU installation front and side views



Requirements on ICU installation space (unit: mm)

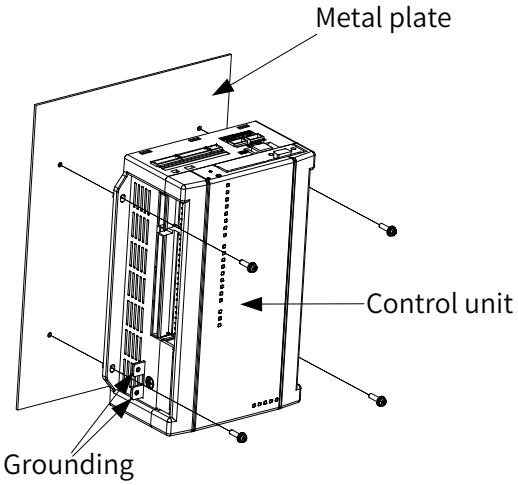
A	B	C	D	E
⩾100	⩾100	⩾30	⩾30	⩾100

5.1.4 ICU installation procedure

Step 1 Place the ICU as shown in the figure.

Step 2 Use No.1 Phillips screwdriver to tighten the four M4 screws to fix the ICU to the metal plate as shown in the figure.

Figure 5-4 ICU installation diagram

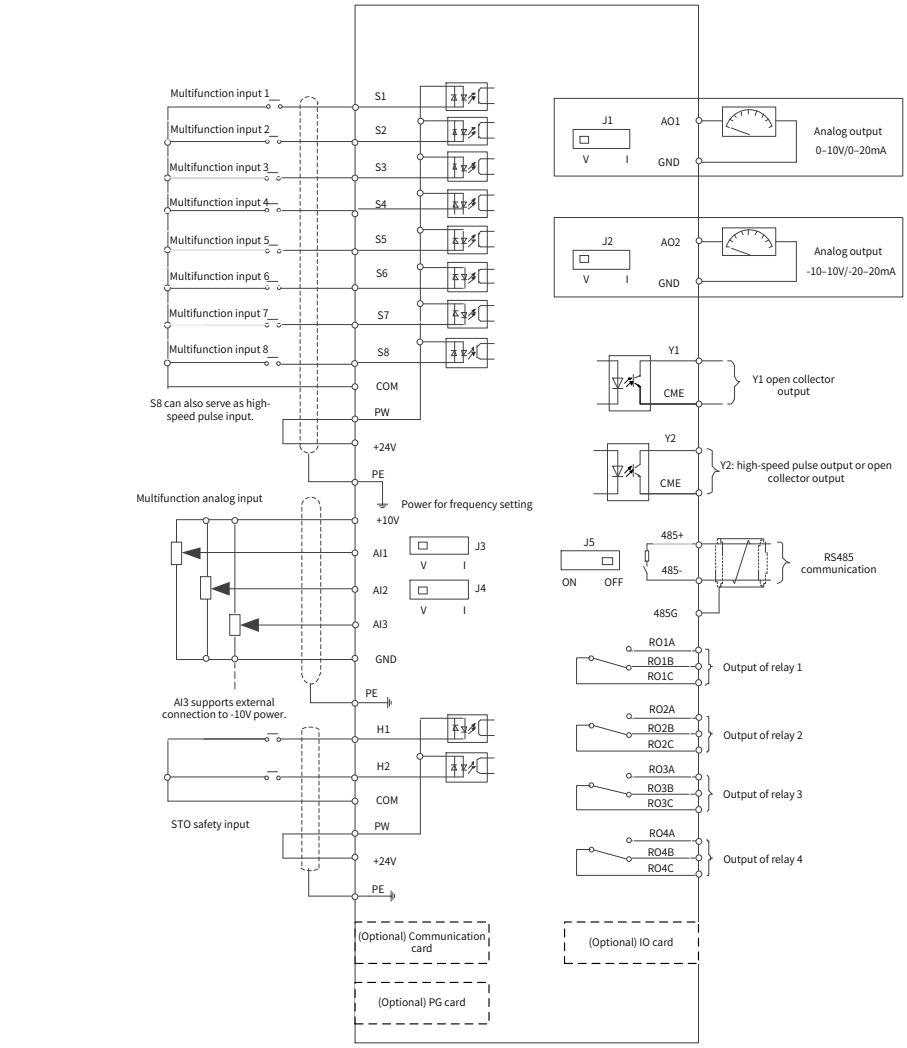


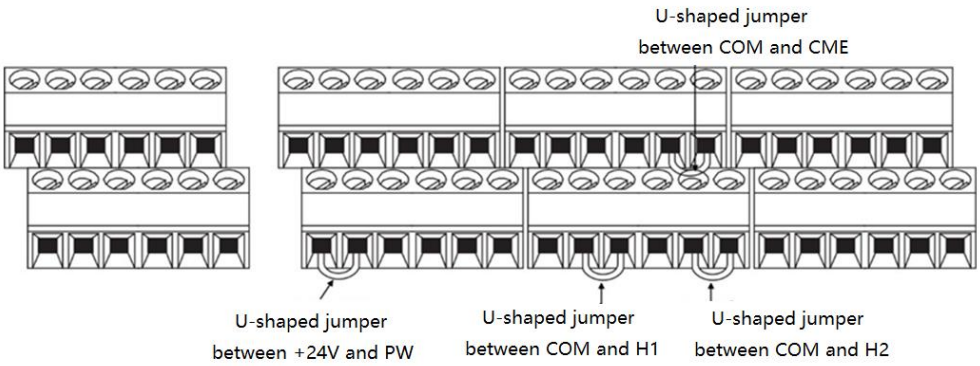
The ICU assembly plate must be a bare entry metal plate and ensure that the metal plate can be reliably grounded.

The ICU housing will be connected to the cabinet housing via a grounding plate.

5.2 ICU interface

Figure 5-5 ICU circuit wiring





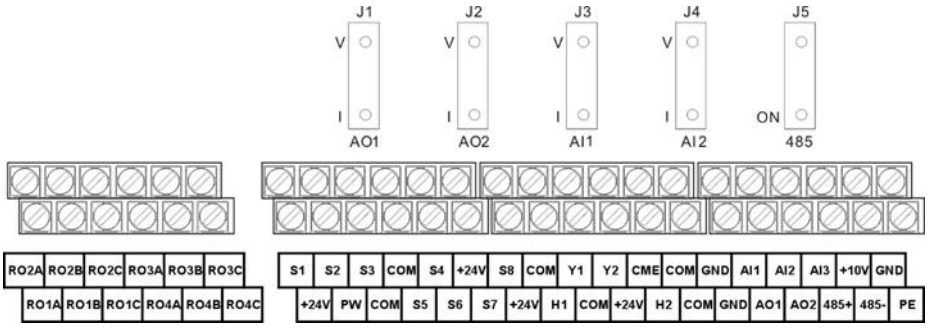


Table 5-1 ICU interface

Category	Terminal	Name	Description
Power supply	+10V	10V power supply	10.5V reference power supply for the local machine
	+24V	24V power supply	Used to provide 24V power supply. Max. output current: 200mA
	PW	External power	Used to provide the working power supply for switch input/output from the external to the internal Voltage range: 12–24V
	GND	Power reference ground	Reference zero potential of +10V
	COM	+24V common terminal	+24V common terminal
Analog input	AI1	Analog input 1	1. Input range: 0–10V or 0–20mA 2. Voltage or current input is determined by J3
	AI2	Analog input 2	1. Input range: 0–10V or 0–20mA 2. Voltage or current input is determined by J4
	AI3	Analog input 3	Input range: -10–10V
Analog output	AO1	Analog output 1	1. Output range: 0–10V or 0–20mA 2. Whether the output type is voltage or current is determined by J1
	AO2	Analog output 2	1. Output range: -10–10V or -20–20mA 2. Whether the output type is voltage or current is determined by J2
Digital input	S1	Digital input 1	1. Input impedance: 3.3kΩ 2. Voltage input range: 12–30V 3. Supporting bidirectional input of NPN and PNP
	S2	Digital input 2	
	S3	Digital input 3	
	S4	Digital input 4	
	S5	Digital input 5	
	S6	Digital input 6	
	S7	Digital input 7	
	S8	Digital input 8	In addition to S1–S7 functions, the terminals can also act as high frequency pulse input channels. Max. input frequency: 50kHz
Digital output	Y1	Open collector output 1	1. Switch capacity: 200mA/30V 2. Output frequency range: 0–1kHz
	Y2	Open collector output 2	1. Switch capacity: 1A/30V 2. Output frequency range: 0–50kHz
Safety	H1	Safety input 1	It is short connected to COM by default. If safety

Category	Terminal	Name	Description
function	H2	Safety input 2	input is required, remove the jumpers between H1 and COM and between H2 and COM.
Relay output	RO1A	NO contact of relay 1	1. Contact capacity: AC250V/3A, DC30V/1A 2. Cannot be used as high frequency digital output **Note: If any input of STO functions H1 and H2 is valid, RO4 is forced to output, which can be used as a regular relay usually.**
	RO1B	NC contact of relay 1	
	RO1C	Common contact of relay 1	
	RO2A	NO contact of relay 2	
	RO2B	NC contact of relay 2	
	RO2C	Common contact of relay 2	
	RO3A	NO contact of relay 3	
	RO3B	NC contact of relay 3	
	RO3C	Common contact of relay 3	
	RO4A	NO contact of relay 4	
	RO4B	NC contact of relay 4	
	RO4C	Common contact of relay 4	
Communi-cation	485+	RS485 communication	RS485 communication terminals, using the Modbus protocol You can determine whether to connect a 120Ω terminal resistor through J5.
	485-		

6 Maintenance and inspection

6.1 Periodical inspection

6.1.1 Overview

Only trained and qualified professionals are allowed to maintain the equipment.

Before operating the interior of the equipment:

- Disconnect the power to the equipment (note that no switch/breaker installed in the cabinet can disconnect the power to the equipment).
- Wait 25 minutes for the DC circuit capacitor to discharge.
- Ensure that the DC bus voltage is lower than 36V.

6.1.2 Required tools

These tools are used to remove and install devices, screws, and other components during maintenance and repair.

- A set of torque wrench or sleeve
- A set of open-end wrench or sleeve
- A set of hexagonal wrench
- A medium-sized straight screwdriver and a small-sized straight screwdriver
- A medium-sized cross screwdriver
- Cart

Table 6-1 Screw thread tightening torque (Fastener grade: 4.8; unit: kgf.cm)

Screw thread specification	Copper bar connection	Metal sheet connection	Remarks
M5	30	20	
M6	45	30	
M8	110	85	
M10	220	164	
M12	390	285	
M16	980	710	

6.1.3 Maintenance cycle

Little maintenance is required when the VFD is installed in an environment that meets requirements. The following table describes the routine maintenance periods recommended by us.

Maintenance cycle	Maintenance work description
Once per 6–12 months (based on the site installation environment)	Check according to the following table
Once per 6–12 months (based on the site installation environment)	Heat sink inspection and cleaning
Once per year (VFD stored without use)	Capacitor aging
Once per year	Air filter check. Replace it when necessary.
Every 6 years	Replace the fans for the filter and power units
Every 10 years	Capacitor replacement

Little maintenance is required when the VFD is installed in an environment that meets requirements. The following table describes the routine maintenance periods recommended by INVT. The following table describes the routine maintenance periods recommended by INVT.

Check scope		Item	Method	Criterion
Ambient environment		Check the temperature, and humidity, and whether there is vibration, dust, gas, oil spray, and water droplets in the environment.	Visual inspection, and use instruments for measurement.	The requirements stated in this manual are met.
		Check whether there are foreign matters, such as tools, or dangerous substances placed nearby.	Visual inspection	There are no tools or dangerous substances placed nearby.
Voltage		Check the voltage of the main circuit and control circuit.	Use multimeters or other instruments for measurement.	Comply with the requirements stated in this manual. (Do not use a multimeter to measure the bus voltage.)
Keypad		Check the display of information.	Visual inspection	The characters are displayed properly.
		Check whether characters are not completely displayed.	Visual inspection	The requirements stated in this manual are met.
Main circuit	Common	Check whether the bolts loose or come off.	Screw them up.	No exception occurs.
		Check whether the machine is deformed, cracked, or damaged, or their color changes due to overheating and aging.	Visual inspection	No exception occurs.

Check scope		Item	Method	Criterion
		Check whether there are stains and dust attached.	Visual inspection	No exception occurs. **Note: Discoloration of copper bars does not mean that they cannot work properly.**
	Conductor and wire	Check whether conductors are deformed or color change for overheat.	Visual inspection	No exception occurs.
		Check whether the wire sheaths are cracked or their color changes.	Visual inspection	No exception occurs.
	Terminal block	Check whether there is damage.	Visual inspection	No exception occurs.
	Reactor	Check whether there is unusual vibration sounds or smells.	Auditory, olfactory, and visual inspection	No exception occurs.
Control circuit	Control PCB and connector	Check whether the screws and connectors loose.	Screw them up.	No exception occurs.
		Check whether there is unusual smell or discoloration.	Olfactory and visual inspection	No exception occurs.
		Check whether there are cracks, damage, deformation, or rust.	Visual inspection	No exception occurs.
		Check whether there is electrolyte leakage or deformation.	Visual inspection, and determine the service life based on the maintenance information.	No exception occurs.
Cooling system	Cooling fan	Check whether there are unusual sounds or vibration.	Auditory and visual inspection, and turn the fan blades with your hand.	The rotation is smooth.
		Check whether the bolts loose.	Screw them up.	No exception occurs.
		Check whether there is discoloration caused due to overheat. Check whether there is dust.	Visual inspection, and determine the service life based on the maintenance information.	No exception occurs.
	Ventilation duct	Check whether there are foreign matters blocking or attached to the cooling fan, air inlets, or air outlets. Check whether there are foreign objects attached.	Visual inspection	No exception occurs.

For more details about maintenance, contact the local INVT office, or visit our website http://www.invt.com, and choose **Support** > **Services**.

6.2 Replacement of wearing parts

6.2.1 Capacitor

6.2.1.1 Capacitor reforming

If the inverter unit has been left unused for a long time, you need to follow the instructions to reform the DC bus capacitor before using it. The storage time is calculated from the date the VFD is delivered.

Storage time	Operation principle
Less than 1 year	No charging operation is required.
1 to 2 years	The inverter unit needs to be powered on for 1 hour before the first running command.
2 to 3 years	Use a voltage controlled power supply to charge the inverter unit: ● Charge the VFD at 25% of the rated voltage for 30 minutes, ● and then charge it at 50% of the rated voltage for 30 minutes, ● at 75% for another 30 minutes, ● and finally charge it at 100% of the rated voltage for 30 minutes.
More than 3 years	Use a voltage controlled power supply to charge the inverter unit: ● Charge the VFD at 25% of the rated voltage for 2 hours, ● and then charge it at 50% of the rated voltage for 2 hours, ● at 75% for another 2 hours, ● and finally charge it at 100% of the rated voltage for 2 hours.

The method for using a voltage controlled power supply to charge the inverter unit is described as follows:

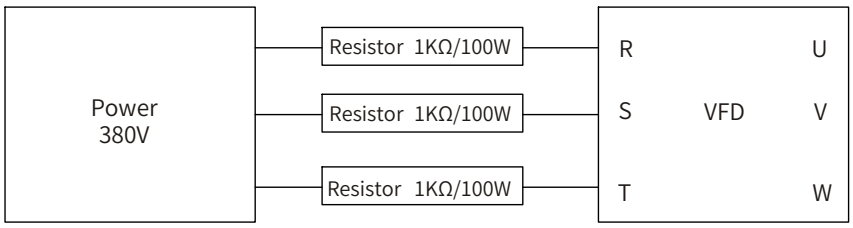
For VFDs of a high voltage class, ensure that the voltage requirement (for example, 380 V) is met during charging. Capacitor changing requires little current, and therefore you can use a small-capacity power supply (2A is sufficient).

The method for using a resistor (incandescent lamp) to charge the inverter unit is described as follows:

If you directly connect the drive device to a power supply to charge the DC bus capacitor, it needs to be charged for a minimum of 60 minutes. The charging operation must be performed at a normal indoor temperature without load, and you must connect a resistor in series mode in the 3PH circuit of the power supply.

For a 380 V drive device, use a resistor of 1 kΩ/100W. If the voltage of the power supply is no higher than 380V, you can also use an incandescent lamp of 100W. If an incandescent lamp is used, it may go off or the light may become very weak.

Figure 6-2 380V driving-device charging circuit example



6.2.1.2 Electrolytic capacitor replacement

⚠	• Read chapter 1 Safety precautions carefully and follow the instructions to perform operations. Ignoring these safety precautions may lead to physical injury or death, or device damage.

The electrolytic capacitor of a VFD must be replaced if it has been used for more than 35,000 hours. For details about the replacement, contact the local INVT office.

6.2.2 Cooling fan

The service life of the cooling fan of the inverter unit is more than 35000 hours. The actual service life of the cooling fan is related to the use of the unit and the temperature in the ambient environment.

You can view the running duration of the unit through P07.14 (Accumulated running time).

The increase of the bearing noise indicates a fan fault. If the unit is applied in a key position, replace the fan once the fan starts to generate unusual noise. You can purchase spares of fans from INVT.

Cooling fan replacement:

⚠	• Read chapter 1 Safety precautions carefully and follow the instructions to perform operations. Ignoring these safety precautions may lead to physical injury or death, or device damage.

Step 1 Stop the unit, disconnect the AC power supply, and wait for a time no shorter than the waiting time designated on the unit.

Step 2 Remove the fan module front cover from the unit housing.

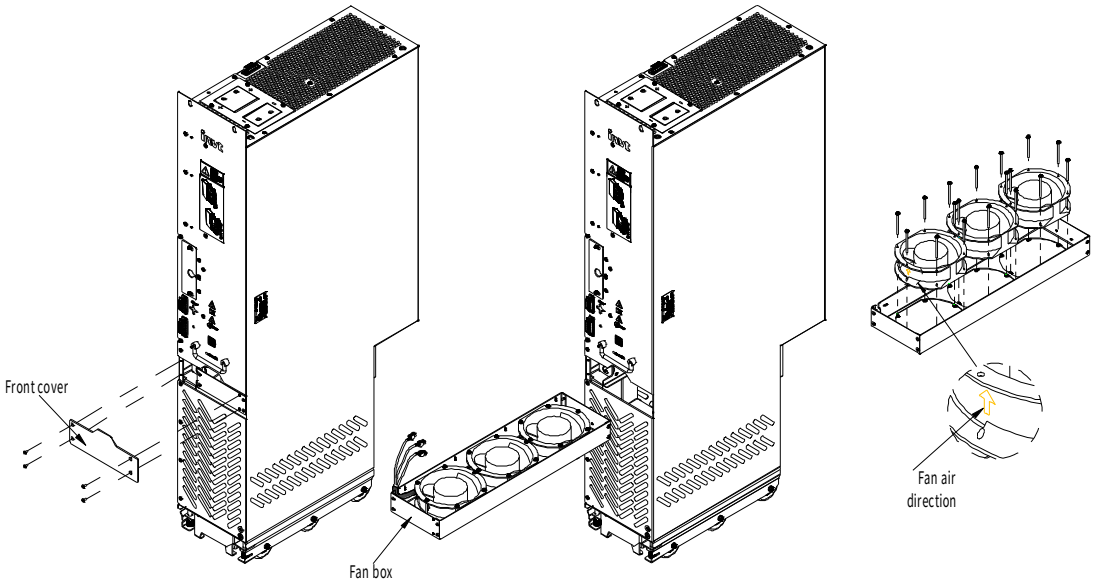
Step 3 Remove the fan module connection cable.

Step 4 Pull out the fan box and remove the fan with a screwdriver.

Step 5 Install a new fan in the fan box. Insert the fan module connection cable to the connector in reverse sequence. Install the front cover. Ensure that the air direction of the fan is consistent with that of the unit, as shown in the Figure 6-1.

Step 6 Connect to the power.

Figure 6-1 Unit fan maintenance



6.2.3 DC fuse

To check and replace the DC fuse of an A8i inverter unit, do as follows:

⚠	• Only qualified electricians can perform this task. Read all the safety precautions. Ignoring these safety precautions may lead to physical injury or death, or device damage.

Step 1 Stop the unit, disconnect the AC power supply, and wait for a time no shorter than the waiting time designated on the unit.

Step 2 Remove the screws of the protective cover plate of the unit DC fuse and remove the cover plate.

Step 3 Remove the copper bar fixing screws of the DC fuse assembly and remove the DC fuse assembly.

Step 4 Check the condition of the fuse and replace it as needed. When replacing it, install the new fuse and copper bar as an assembly and tighten the screws according to the tightening torque table.

Step 5 Install the protective cover and close the cabinet door.

Step 6 Connect to the power.

6.2.4 Inverter unit

To replace the inverter unit, do as follows:

Step 1 Stop the machine and disconnect the AC power.

Step 2 Open the cabinet door and check to ensure there is no voltage in the equipment.

Step 3 Disconnect the external connection cables of the inverter unit.

Step 4 Disconnect the (+) and (-) DC output copper bars.

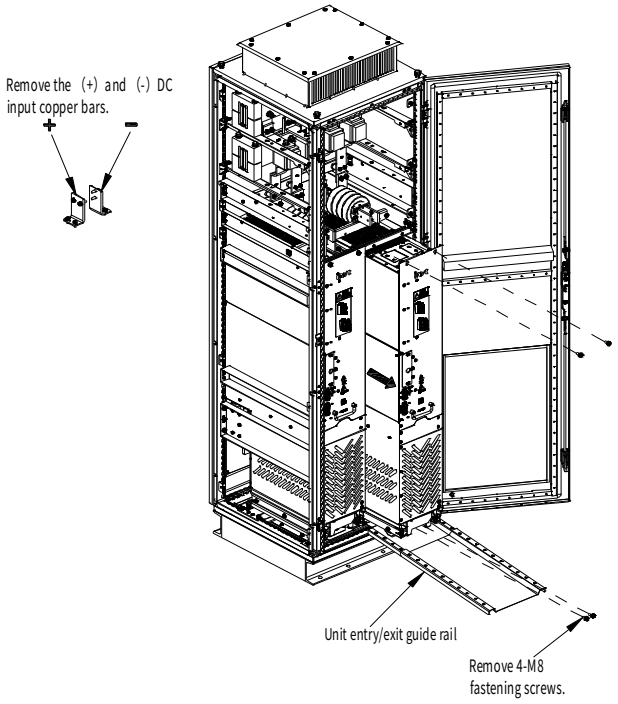
Step 5 Install the unit entry/exit guide rail.

Step 6 Remove the (four M8) fixing screws from the top and bottom of the inverter unit.

Step 7 Pull the inverter unit and unfold the anti-tipping stand.

Step 8 Install the new inverter unit according to 3.3.5.6 Unit installation and replacement.

Figure 6-2 Inverter unit replacement



Appendix A Technical data

A.1 Derated application

A.1.1 Capacity

Choose a VFD model based on the rated current and power of the motor. To endure the rated power of the motor, the rated output current of the VFD must be larger or equal to the rated current of the motor. The rated power of the VFD must be higher or equal to that of the motor.

Note:

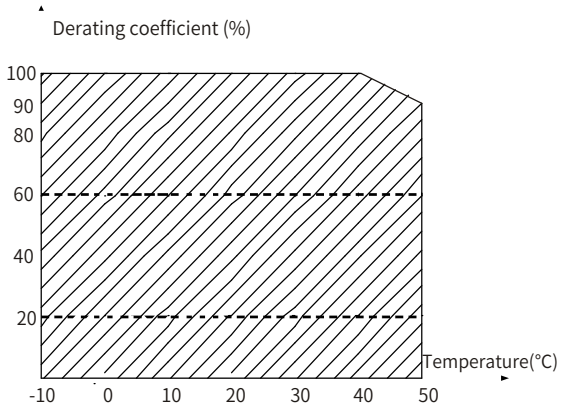
- The maximum allowable shaft power of the motor is limited to 1.5 times the rated power of the motor. If the limit is exceeded, the VFD automatically restricts the torque and current of the motor. This function effectively protects the input shaft against overload.
- The rated capacity is the capacity at the ambient temperature of 40°C.
- You need to check and ensure that the power flowing through the common DC connection in the common DC system does not exceed the rated power of the motor.

A.1.2 Derating

If the ambient temperature at the VFD installation site exceeds 40°C, the VFD installation site altitude exceeds 1000m, a cover with heat dissipation vents is used, or the carrier frequency is higher than the recommended, the VFD needs to be derated.

A.1.2.1 Derating due to temperature

When the temperature ranges from +40°C to +50 °C, the rated output current is derated by 1% for each increased 1 °C. For the actual derating, see the following figure.



Note: It is not recommended to use the VFD at an environment with the temperature higher than 50°C. If you do, you shall be held accountable for the consequences caused.

A.1.2.2 Derating due to altitude

When the altitude of the site where the VFD is installed is lower than 1000 m, the VFD can run at the rated power. When the altitude exceeds 1000m, derate by 1% for every increase of 100m. When the altitude exceeds 3000m, consult the local INVT dealer or office for details.

A.1.2.3 Derating due to carrier frequency

The carrier frequency of Goodrive800 Pro series VFD varies with power class. The VFD rated power is defined based on the carrier frequency factory setting. If the carrier frequency exceeds the factory setting, the VFD power is derated by 10% for each increased 1 kHz.

A.2 Grid specifications

Grid voltage	AC 3PH 380V(-15%)–440V(+10%) AC 3PH 520V(-15%)–690V(+10%)
Short-circuit capacity	According to the definition in IEC61439-1, the maximum allowable short-circuit current at the incoming end is 100 kA. Therefore, the VFD is applicable to scenarios where the transmitted current in the circuit is no larger than 100 kA when the VFD runs at the maximum rated voltage.
Frequency	50/60 Hz±5%, with a maximum change rate of 20%/s

A.3 Application standards

The following table describes the standards that VFDs comply with.

EN/ISO 13849-1	Safety of machinery—Safety-related parts of control systems—Part 1: General principles for design
IEC/EN 60204-1	Safety of machinery. Electrical equipment of machines. Part 1: General requirements
IEC/EN 62061	Safety of machinery—Safety-related functional safety of electrical, electronic, and programmable electronic control systems
IEC/EN 61800-3	Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods
IEC/EN 61800-5-1	Adjustable speed electrical power drive systems—Part 5-1: Safety requirements—Electrical, thermal and energy
IEC/EN 61800-5-2	Adjustable speed electrical power drive systems—Part 5-2: Safety requirements—Function
GB/T 30844.1-2014	General-purpose variable-frequency adjustable-speed equipment of 1 kV and lower—Part 1: Technical conditions
GB/T 30844.2-2014	General-purpose variable-frequency adjustable-speed equipment of 1 kV and lower—Part 2: Test methods
GB/T 30844.3-2017	General-purpose variable-frequency adjustable-speed equipment of 1 kV and lower—Part 3: Safety requirements

A.3.1 CE marking

The CE marking on the VFD nameplate indicates that the VFD is CE-compliant, meeting the regulations of the European low-voltage directive (2014/35/EU) and EMC directive (2014/30/EU).

A.3.2 EMC compliance declaration

European union (EU) stipulates that the electric and electrical devices sold in Europe cannot generate electromagnetic disturbance that exceeds the limits stipulated in related standards, and can work properly in environments with certain electromagnetic interference. The EMC product standard (EN 61800-3) describes the EMC standards and specific test methods for adjustable speed electrical power drive systems.

Our products have been compliant with these regulations.

A.4 EMC regulations

The EMC product standard (EN 61800-3) describes the EMC requirements on VFDs.

Application environment categories:

First environment: Civilian environment, including application scenarios where VFDs are directly connected to the civil power supply low-voltage grids without intermediate transformers.

Second environment: All locations outside a residential area.

VFD categories:

C1: Rated voltage lower than 1000 V, applied to the first environment.

C2:

Rated voltage lower than 1000 V, non-plug, socket, or mobile devices; power drive systems that must be installed and operated by specialized personnel when applied to the first environment.

Note: The EMC standard IEC/EN 61800-3 no longer restricts the power distribution of VFDs, but it specifies their use, installation, and commissioning. Specialized personnel or organizations must have the necessary skills (including the EMC-related knowledge) for installing and/or performing commissioning on the electrical drive systems.

C3: Rated voltage lower than 1000 V, applied to the second environment. They cannot be applied to the first environment.

C4: Rated voltage higher than 1000 V, or rated current higher or equal to 400 A, applied to complex systems in the second environment.

A.4.1 VFD category of C2

The induction disturbance limit meets the following stipulations:

- Select the motor and control cables according to the description in the manual.
- Install the VFD according to the description in the manual.

	• The VFD may generate radio interference, you need to take measures to reduce the interference.

A.4.2 VFD category of C3

The anti-interference performance of the VFD meets the requirements of the second environment in the IEC/EN 61800-3 standard.

The induction disturbance limit meets the following stipulations:

- Select the motor and control cables according to the description in the manual.
- Install the VFD according to the description in the manual.

	• VFDs of category C3 cannot be applied to civilian low-voltage common grids. When applied to such grids, the VFDs may generate radio frequency electromagnetic interference.

Appendix B Expansion card

B.1 Expansion cards supported by the ICU

B.1.1 Communication expansion card

B.1.1.1 External view

Figure B-1 Ethernet + PROFIBUS communication card

Figure B-2 Ethernet + CANopen communication card

Figure B-3 Ethernet + PROFINET communication card

B.1.1.2 Naming rule

EC-TX 1 03

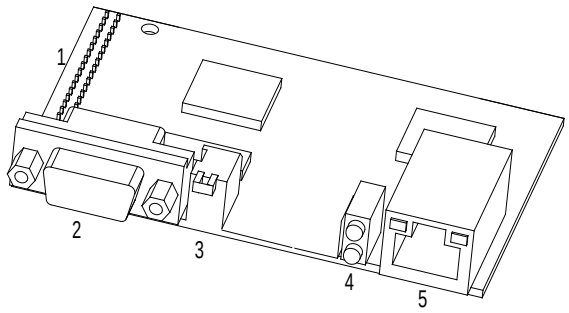
① ② ③ ④

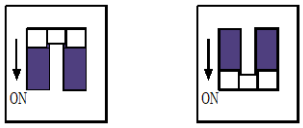
Field	Field description	Naming example
①	Product category	EC: Expansion card
②	Board card category	TX: communication card
③	Technology version	Indicates the generation of a technical version by using odd numbers, for example, 1, 3, 5, and 7 indicate the 1st, 2nd, 3rd and 4th generations of the technical version.

Field	Field description	Naming example
④	Card type identification	03: Ethernet + PROFIBUS communication card 05: Ethernet + CANopen communication card 09: PROFINET communication card

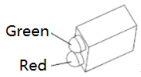
B.1.1.3 Ethernet + PROFIBUS communication card

Figure B-4 EC-TX103 communication card structure



<table>
<tr><th>No.</th><th>Name</th><th>Description</th></tr>
<tr><td>1</td><td>Interface with the control board</td><td>Used to connect to the control board</td></tr>
<tr><td>2</td><td>Bus communi-cation interface</td><td>Shielded twisted copper wire transmission is one of the most common PROFIBUS transmission means.
The connection pins are described as follows when PROFIBUS is used.
<table>
<tr><th colspan="2">Pin</th><th>Description</th><th colspan="2">Pin</th><th>Description</th></tr>
<tr><td>1</td><td>-</td><td>Unused</td><td>2</td><td>-</td><td>Unused</td></tr>
<tr><td>3</td><td>B-Line</td><td>Data+ (twisted pair 1)</td><td>4</td><td>RTS</td><td>Request sending</td></tr>
<tr><td>5</td><td>GND_BUS</td><td>Isolation ground</td><td>6</td><td>+5V BUS</td><td>Isolated power supply of 5 V DC</td></tr>
<tr><td>7</td><td>-</td><td>Unused</td><td>8</td><td>A-Line</td><td>Data- (twisted pair 2)</td></tr>
<tr><td>9</td><td>-</td><td>Unused</td><td>Housing</td><td>SHLD</td><td>PROFIBUS cable shielding line</td></tr>
</table></td></tr>
<tr><td>3</td><td>Bus terminator</td><td>EC-TX103 configuration, valid for PROFIBUS communication.
Bus terminator OFF Bus terminator ON
 

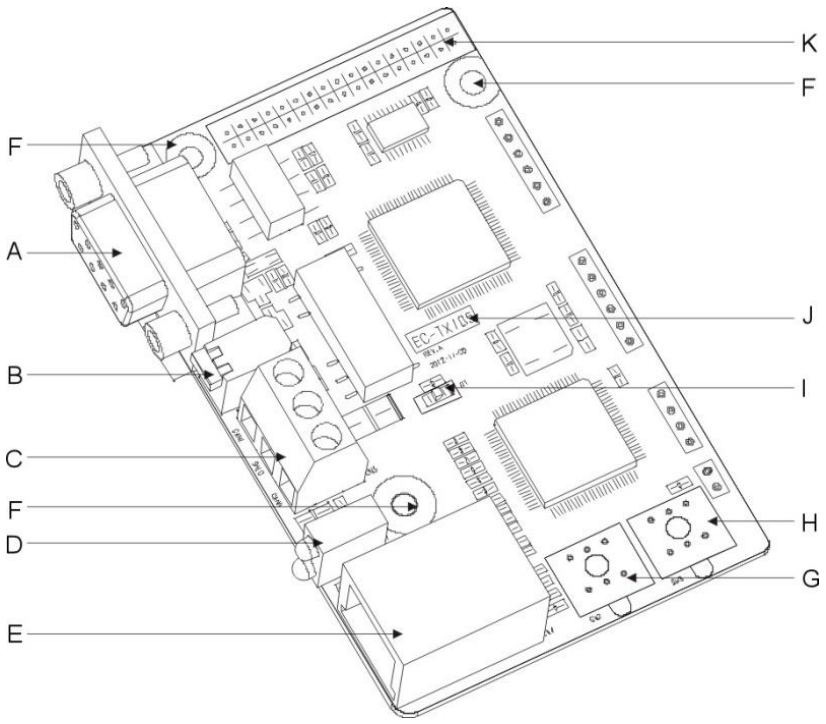
Each segment has a bus terminator at the head and one at the tail to ensure that the operation runs without errors. The bus terminator prevents signal reflection at the bus cable end. If the module is the last module or the first module in the network, the bus terminator must be set to ON. If you use a PROFIBUS D-sub connector with a built-in terminator, disconnect the EC-TX series communication card terminator.</td></tr>
<tr><td>5</td><td>Status indicator</td><td>An EC-TX series module is equipped with two fault indicators.</td></tr>
</table>

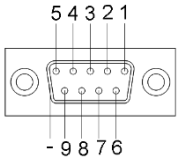
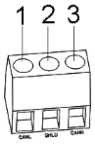
<table>
<tr><th>No.</th><th>Name</th><th>Description</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th>Indicator</th><th>Name</th><th>Color</th><th>Function</th></tr>
<tr><td rowspan="2"> 
</td><td>Online</td><td>Green</td><td>On: The module is online and data exchange can be performed.
Off: The module is not in the online state.</td></tr>
<tr><td>Offline/ Fault</td><td>Red</td><td>On: The module is offline and data exchange cannot be performed.
Off: The module is not in the offline state.
Blinking at 1Hz: Incorrect configuration. The length of the user parameter data set during the module initialization is different from that during the network configuration.
Blinking at 2 Hz: Incorrect user parameter data. The length or content of the user parameter data set during the module initialization is different from that during the network configuration.
Blinking at 4 Hz: An error occurs in the ASIC initialization of communication.</td></tr>
</table>
</td></tr>
<tr><td>6</td><td>Ethernet interface</td><td>Used to access the Ethernet</td></tr>
</table>

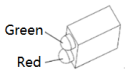
B.1.1.4 Ethernet + CANopen communication card

Figure B-5 shows the communication card components.

Figure B-5 EC-TX105 communication card structure

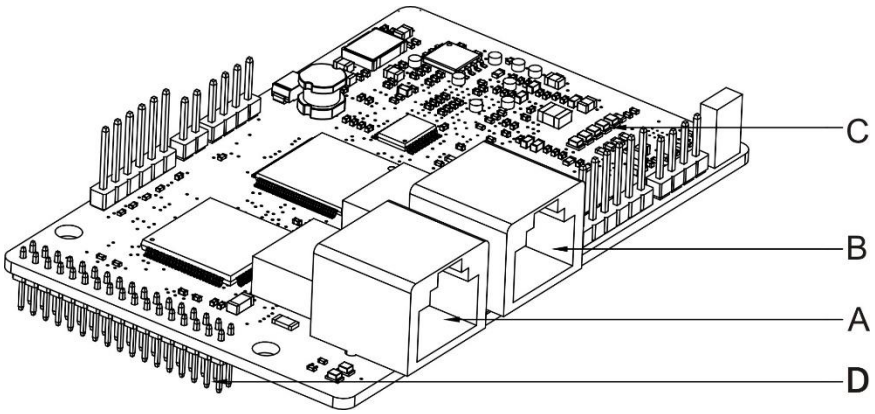


<table>
<tr><th>No.</th><th>Name</th><th>Description</th></tr>
<tr><td>A</td><td>CANopen communication interface (DB9 female end)</td><td>There are two CANopen communication interfaces, a DB9 female connector (A) and a 3-pin open interface terminal (C), either of which you can choose to use.
<table>
<tr><th>CANopen communication interface (DB9 female end)</th><th>Pin</th><th>Function</th><th>Description</th></tr>
<tr><td rowspan="10"> 
</td><td>1</td><td>-</td><td></td></tr>
<tr><td>2</td><td>CAN_L</td><td>CANopen bus low level signal</td></tr>
<tr><td>3</td><td>-</td><td></td></tr>
<tr><td>4</td><td>-</td><td></td></tr>
<tr><td>5</td><td>CAN_SHLD</td><td>CANopen bus shielding</td></tr>
<tr><td>6</td><td>-</td><td></td></tr>
<tr><td>7</td><td>CAN_H</td><td>CANopen bus high level signal</td></tr>
<tr><td>8</td><td>-</td><td></td></tr>
<tr><td>9</td><td>-</td><td></td></tr>
<tr><td>-</td><td>CAN_SHLD</td><td>CANopen bus shielding</td></tr>
</table></td></tr>
<tr><td>B</td><td>CANopen terminal resistor switch</td><td>Terminal resistor switch function description.
<table>
<tr><th>Terminal resistor switch</th><th>Position</th><th>Function</th><th>Description</th></tr>
<tr><td rowspan="2"> 
</td><td>Up</td><td>OFF</td><td>CAN_H and CAN_L are not connected to a terminal resistor.</td></tr>
<tr><td>Down</td><td>ON</td><td>CAN_H and CAN_L are connected to a terminal resistor of 120 Ω.</td></tr>
</table></td></tr>
<tr><td>C</td><td>CANopen communication interface terminals (3-pin)</td><td>There are two CANopen communication interfaces, a DB9 female connector (A) and a 3-pin open interface terminal (C), either of which you can choose to use.
<table>
<tr><th>3-pin open terminal</th><th>Pin</th><th>Function</th><th>Description</th></tr>
<tr><td rowspan="3"> 
</td><td>1</td><td>CAN_L</td><td>CANopen bus low level signal</td></tr>
<tr><td>2</td><td>CAN_SHLD</td><td>CANopen bus shielding</td></tr>
<tr><td>3</td><td>CAN_H</td><td>CANopen bus high level signal</td></tr>
</table></td></tr>
<tr><td>D</td><td>CANopen status indicator</td><td>Used to display faults.</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name</th><th>Description</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th>Indicator</th><th>Name</th><th>Color</th><th>Indication</th><th>Status</th><th>Description</th></tr>
<tr><td rowspan="7"> 
</td><td rowspan="4">Run indicator (RUN)</td><td rowspan="4">Green</td><td>Blinking once and then off</td><td>Stop</td><td>Component in stopped state</td></tr>
<tr><td>Blinking</td><td>Pre-operation</td><td>Component in pre-operation state</td></tr>
<tr><td>On</td><td>Operation</td><td>Component in operating state</td></tr>
<tr><td>Dark</td><td>Fault</td><td>Check whether the communication card reset pin and power supply connection.</td></tr>
<tr><td rowspan="3">Error indicator (ERROR)</td><td rowspan="3">Red</td><td>Dark</td><td>No fault</td><td>Component in operating state</td></tr>
<tr><td>On</td><td>Bus off or VFD fault</td><td>The CAN controller bus is off or a fault occurs on the VFD.</td></tr>
<tr><td>Blinking</td><td>Initialization error</td><td>Incorrect address setting.</td></tr>
<tr><td>Blinking once</td><td>Frame fault</td><td>Received frame lost or incorrect.</td></tr>
</table>
</td></tr>
<tr><td>E</td><td>Ethernet interface</td><td>Used to access the Ethernet</td></tr>
<tr><td>F</td><td>CANopen high address knob (Reserved)</td><td rowspan="2">Note: The two address knobs are not installed, communication addresses are set through function codes.</td></tr>
<tr><td>G</td><td>CANopen low address knob (Reserved)</td></tr>
<tr><td>H</td><td>Communication card power indicator</td><td></td></tr>
<tr><td>I</td><td>Interface with the control board</td><td>Used to connect to the control board</td></tr>
</table>

B.1.1.5 PROFINET communication card

Figure B-6 EC-TX109 communication card structure



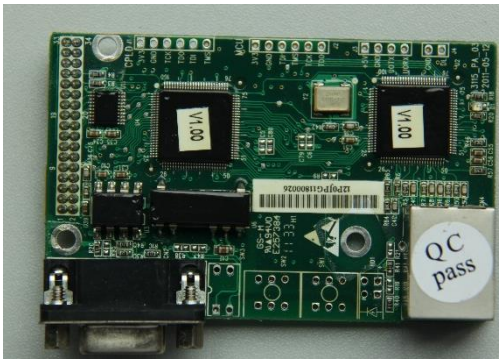
<table>
<tr><th>No.</th><th>Name</th><th>Description</th></tr>
<tr><td>A</td><td>Ethernet interface 1 for PROFINET communication</td><td rowspan="2">The PROFINET communication card uses two standard RJ45 interfaces, which do not distinguish the direction and can be swappable.
 
Two standard RJ45 interfaces
<table>
<tr><th>Pin</th><th>Function</th><th>Description</th></tr>
<tr><td>1</td><td>TX+</td><td>Transmit Data+</td></tr>
<tr><td>2</td><td>TX-</td><td>Transmit Data-</td></tr>
<tr><td>3</td><td>RX+</td><td>Receive Data+</td></tr>
<tr><td>4</td><td>n/c</td><td>Not connected</td></tr>
<tr><td>5</td><td>n/c</td><td>Not connected</td></tr>
<tr><td>6</td><td>RX-</td><td>Receive Data-</td></tr>
<tr><td>7</td><td>n/c</td><td>Not connected</td></tr>
<tr><td>8</td><td>n/c</td><td>Not connected</td></tr>
</table></td></tr>
<tr><td>B</td><td>Ethernet interface 2 for PROFINET communication</td></tr>
<tr><td>C</td><td>PROFINET communication status indicator</td><td>Used to display faults
<table>
<tr><th>LED</th><th>Color</th><th>Status</th><th>Description</th></tr>
<tr><td>LED1</td><td>Green</td><td></td><td>3.3V power indicator</td></tr>
<tr><td rowspan="3">LED2
(Bus status indicator)</td><td rowspan="3">Red</td><td>On</td><td>No network connection</td></tr>
<tr><td>Blinking</td><td>The network cable connection with the between the PROFINET controller is OK, but the communication is not established.</td></tr>
<tr><td>Off</td><td>Communication with the PROFINET controller has been established.</td></tr>
<tr><td rowspan="2">LED3
(System fault indicator)</td><td rowspan="2">Red</td><td>On</td><td>PROFINET diagnosis exists.</td></tr>
<tr><td>Off</td><td>No PROFINET diagnosis.</td></tr>
<tr><td rowspan="3">LED4
(Slave ready indicator)</td><td rowspan="3">Green</td><td>On</td><td>TPS-1 protocol stack has started.</td></tr>
<tr><td>Blinking</td><td>TPS-1 waits for MCU initialization.</td></tr>
<tr><td>Off</td><td>TPS-1 protocol stack does not start.</td></tr>
<tr><td>LED5
(Maintenance status indicator)</td><td>Green</td><td></td><td>Manufacturer-specific, depending on the characteristics of the device</td></tr>
</table></td></tr>
</table>

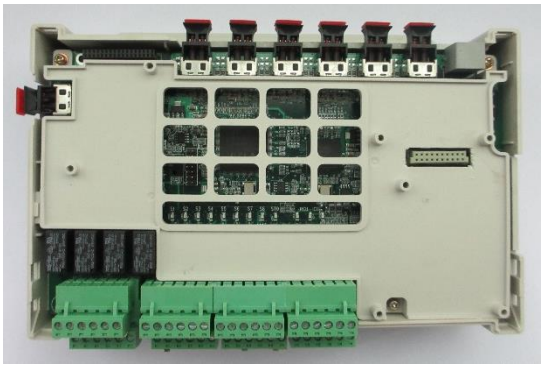
No.	Name	Description
D	PROFINET communication card interface pins	Used for hard connection with the main control box

B.1.1.6 Installation and fixing

Step 1 Insert the communication card to the target position on the control board, shown in the figure.

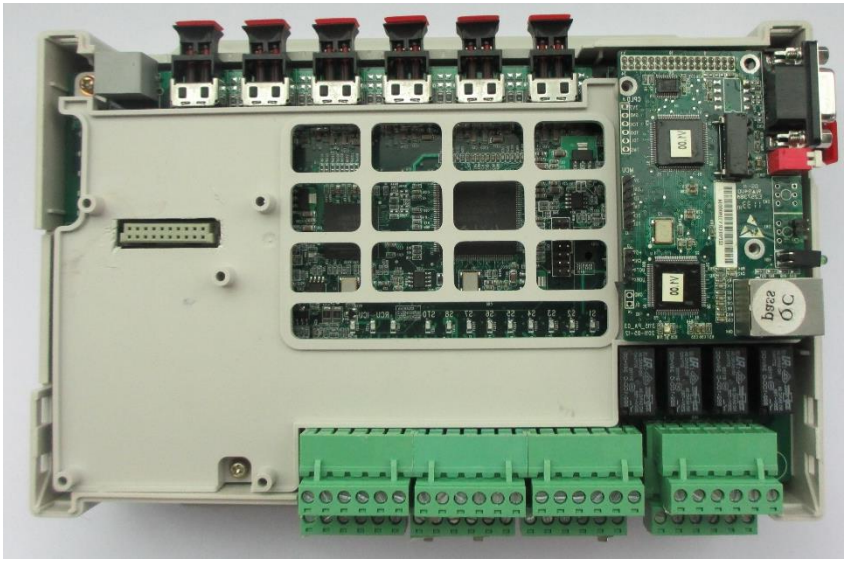
Figure B-7 Installation





Step 2 Fix the card.

Figure B-8 Fixing



Note:

- Before installation, disconnect power to the equipment and wait at least 3 minutes to ensure that the capacitor discharging is completed. Cut off dangerous voltages from external control circuits to unit inputs and inputs.

- Some electronic components on the communication card circuit board are sensitive to electrostatic discharge. Do not touch the circuit board with hands. If operating the electronic board is unavoidable, wear grounded wrist straps when handling the board.

B.1.2 PG card

B.1.2.1 External view

Figure B-9 Incremental PG card

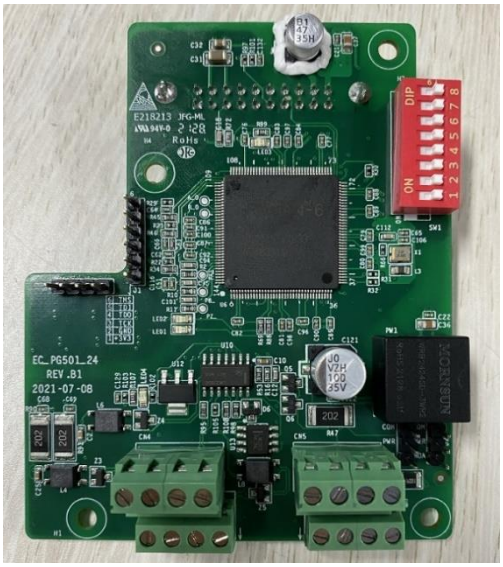
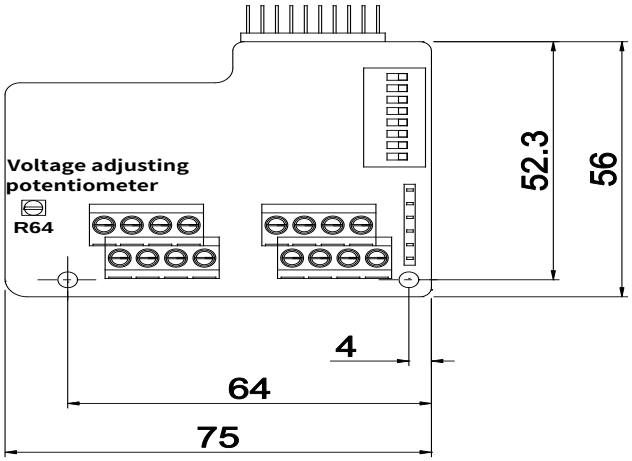


Figure B-10 Resolver PG card

B.1.2.2 Incremental encoder PG card use instructions

(1) Structure outline



(2) Model specifications

EC-PG 1 01-05

① ② ③ ④ ⑤

Sign	Field description	Naming example
①	Product category	EC: Expansion card
②	Board card category	PG: PG card

Sign	Field description	Naming example
③	Technology version	The odd numbers such as 1, 3, and 5 are used to represent the 1st, 2nd, and 3rd generations of the technical version.
④	Distinguishing code	01: Incremental encoder PG card 02: Sin/Cos encoder PG card 03: UVW encoder PG card 04: Resolver PG card
⑤	Working power	05: 5V 12: 12–15V 24: 24V

Technical specifications:

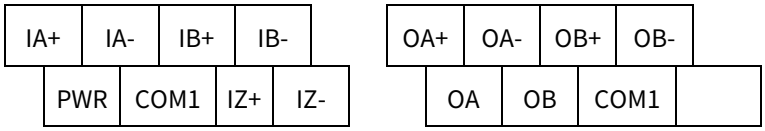
Model	EC-PG101-12	EC-PG101-24
Output power supply	Supporting the voltage output of 11.75–16V. Default: 12V±5%. Max. output current: 350mA	Voltage output of 24V±5%. Max. output current: 300mA
Input signal	Supporting the A, B, and Z signal inputs of differential, open collector, and push-pull encoders. Response speed: 0–100kHz	Supporting the A, B, and Z signal inputs of differential, open collector, and push-pull encoders. Response speed: 0–100kHz
Output signal	Output frequency: 0–80kHz Output mode: Differential output, push-pull output, open collector output, and frequency-divided output Range: 1–256 Output impedance: 70Ω	Output frequency: 0–80kHz Output mode: Differential output, push-pull output, open collector output, and frequency-divided output Range: 1–256 Output impedance: 70Ω

(3) Function

You must choose a PG card when using closed-loop vector control. The PG card functions include processing circuits for two quadrature encoder signals and supporting spindle positioning Z signal inputs, and receiving signals of differential, open collector and push-pull encoder. Frequency-divided output can be performed for the input encoder signals. The output quantity includes two channels of differential signals. You can choose to output push-pull signals or open collector signals through jumper J1 or J2 according to your actual use.

(4) Terminal and DIP switch description

The incremental encoder PG card has two 2*4P user wiring terminals. See the figure.



PWR and COM1 are for encoder working power output; IA+, IA-, IB+, IB-, IZ+, and IZ- are encoder signal input terminals; OA+, OA-, OB+, OB- are differential crossover signal output terminals, while OA, OB, and COM1 are frequency-divided push-pull signal and open collector signal output terminals (the output signal type is selected by jumper J1 or J2); the PG card does not connect PE to the earth internally, you can ground it during use.

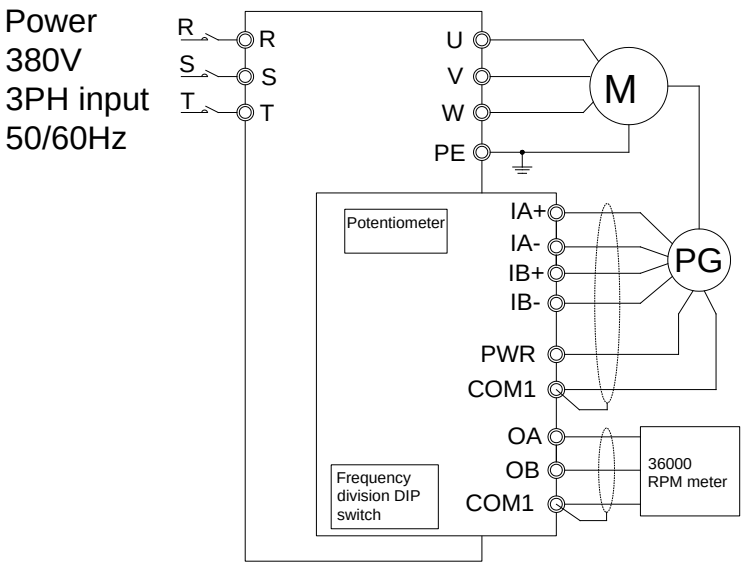
The frequency division coefficient of the incremental encoder PG card is determined by the dip switch on

the card. The dip switch have 8 bits, and the frequency division coefficient is determined by adding 1 to the binary number that the dip switch represents. The place labeled with "1" is the low binary bit, and the one labeled with "8" is the high binary bit. When the dip switch is turned to ON, the bit is valid, indicating "1"; otherwise, the bit indicates "0". See the following table for frequency division coefficients.

Table B-1 Frequency division coefficients

Decimal	Binary	Frequency division coefficient
0	00000000	1
1	00000001	2
2	00000010	3
...	...	...
m	...	m+1
255	11111111	256

(5) Wiring principles



(6) Wiring precautions

① A PG card signal line and a power line must be routed separately and disallow parallel routing.

② To avoid interference from encoder signals, use a shielded cable for the PG card signal line.

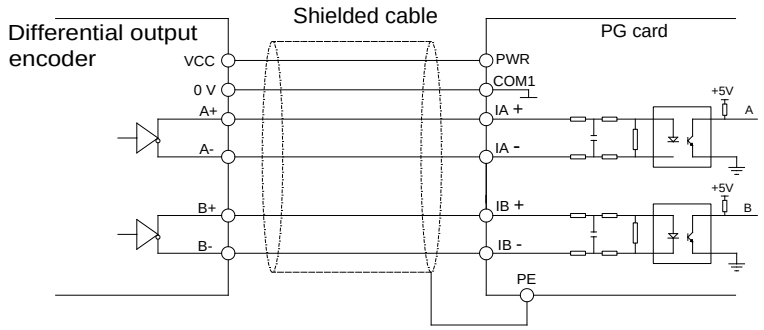
③ The shield layer of the encoder shield cable should be connected to the earth (such as the PE of Goodrive800 Pro series product), and it must be connected to earth only at one end to avoid signal interference.

④ If the PG card uses frequency-divided output when connecting to an external power supply, the voltage should be less than 24V; otherwise the PG card will be damaged.

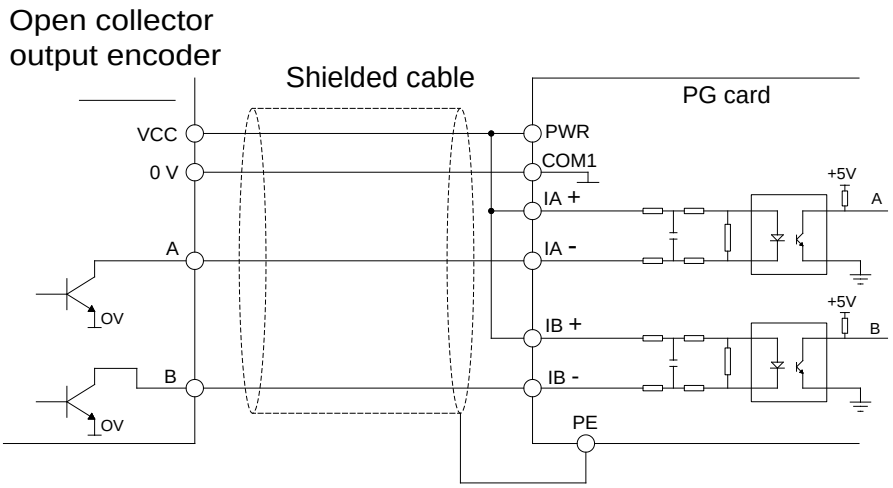
⑤ You can set the output voltage by adjusting the 12–15V incremental encoder PG card potentiometer (clockwise for voltage increases) according to actual needs, and the force should not be too great when rotating the potentiometer.

(7) Input application connection

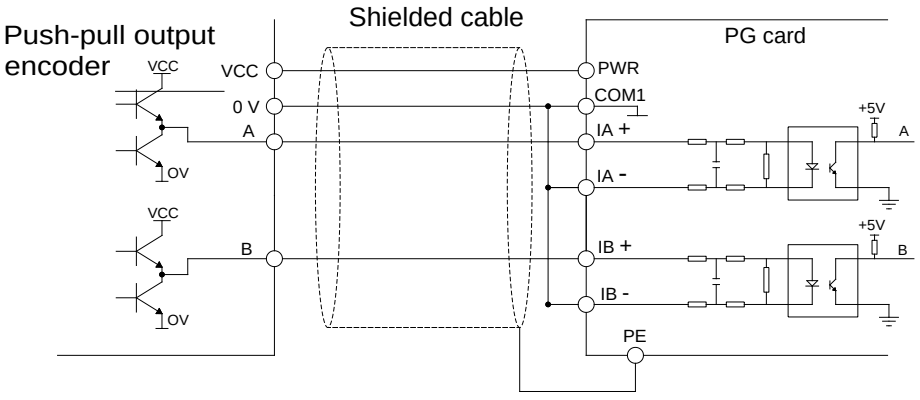
① Differential output encoder connection



② Open collector output encoder connection



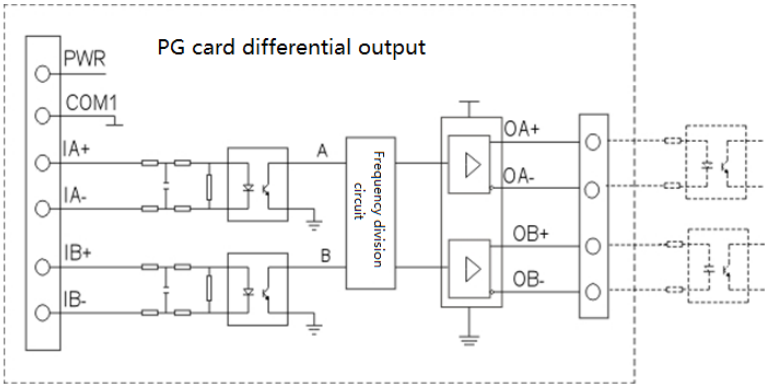
③ Push-pull output encoder connection



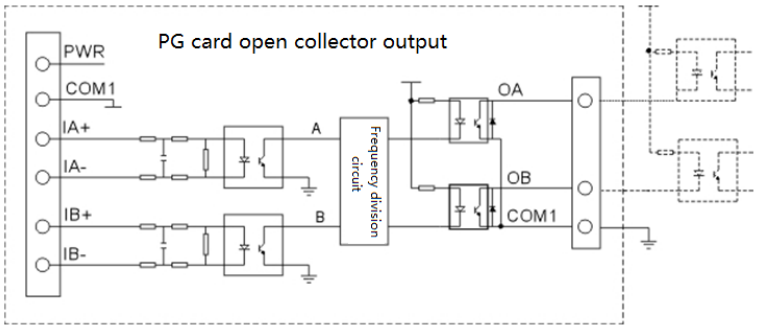
Note: When the spindle positioning VFD is supported, the Z signal needs to be connected, of which the wiring method is similar to that for the A and B signals.

(8) Output application connection

① PG card frequency-divided differential output connection

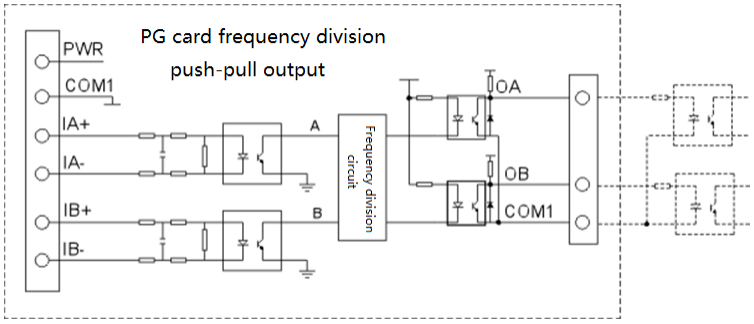


② PG card frequency-divided open collector output connection



Note: During open collector output, PWR at J1 and that at J2 are short connected to COA and COB.

③ PG card frequency-divided push-pull output connection



Note:

- Note: During push-pull output, PWR at J1 and that at J2 are short connected to HOA and HOB.
- Incremental encoder PG cards are mainly used to closed-loop vector control on asynchronous motors.

B.1.2.3 Sin/Cos encoder and UVW encoder PG card use instructions

(1) Model designation technical specification

See the following table for the specifications of Sin/Cos encoder and UVW encoder PG cards.

Model	EC-PG102-05	EC-PG103-05
Frequency division coefficient	1 (No frequency-division DIP switch)	1–256 (With frequency-division DIP switch)
Output power supply	Adjustable voltage range: 4.75–7V Default setting: 5V/±5% Max. output current: 300mA	Adjustable voltage range: 4.75–7V Default setting: 5V/±5% Max. output current: 300mA

Model	EC-PG102-05	EC-PG103-05
Output signal	Output form: Two quadrature frequency division differential outputs, and one open collector output Open collector output impedance: 70Ω	Output form: Two quadrature differential outputs, and one open collector output Open collector output impedance: 70Ω

You can choose the output voltage value according to the actual application. When the encoder signal is transmitted at a long distance, you can adjust the output power supply voltage by potentiometer (the regulation method is the same as incremental encoder card) to increase the wiring distance.

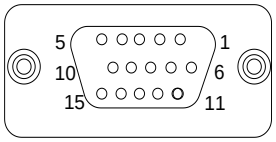
(2) UVW encoder PG card size and installation

Note:

- The UVW encoder PG card is installed in the same way and position as the incremental encoder PG card. It corresponds to a double row of 2 x 10 pins.
- The Sin/Cos encoder PG card has the same size and installation method as the UVW encoder PG card, except that it does not have a DIP switch for frequency division and the potentiometer position is R101.

(3) Terminal and DIP switch description

Same as the Sin/Cos encoder PG card, the UVW encoder PG card has one signal line interface and seven user terminals, as shown in the following figure.



OA+	OA-	OB+	OB-
OA	OB	COM1	

DB15 Frequency-divided output interface

OA+, OA-, OB+, and OB- are differential output signal terminals, while OA, OB, and COM1 are open collector signal output terminals.

Note:

- The PG card does not internally connect the PE to the earth, and you can connect the PE to the earth during use.
- The Sin/Cos encoder PG card and UVW type encoder PG card have the similar output signal wiring method as the incremental encoder PG card, but they do not support push-pull output.

The DB15 three-row female interface is the encoder signal input interface. The following is the PG card interface signal arrangement sequence table.

VFD interface	SIN/COS	UVW
5	A+	A+
6	A-	A-
8	B+	B+
1	B-	B-
3	R+	Z+
4	R-	Z-
11	C+	U+
10	C-	U-
12	D+	V+
13	D-	V-
9	PWR	PWR
7	GND	GND
14	Empty	W

VFD interface	SIN/COS	UVW
15	Empty	W-
2	Empty	Empty

When applying either of the two PG cards, you only need to insert the DB15 male connector of the Sin/Cos or UVW encoder into the DB15 female connector of the PG card.

Setting the frequency division coefficient of a UVW encoder PG card is similar to that for an incremental encoder PG card. For details about frequency division coefficients, see Table B-1 Frequency division coefficients.

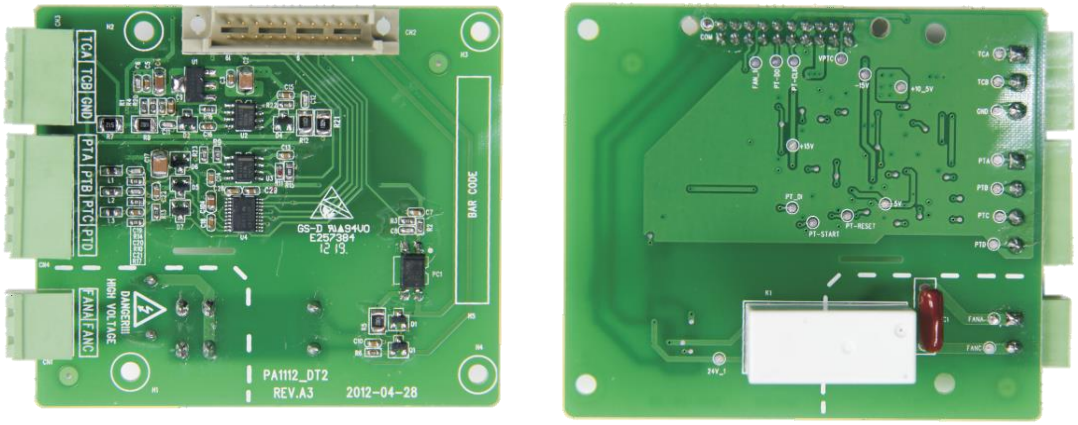
Note:

- Sin/Cos encoder and UVW encoder PG cards are mainly used to closed-loop vector control on synchronous motors.
- UVW encoder PG cards can support processing signals of 5V incremental encoders, have the similar wiring method with that for incremental encoder PG cards, and mainly use wiring ports include the A, B, Z, PWR, and GND ports on DB15.

B.1.3 Motor temperature detection card

Note: The temperature detection card model is ASY01_PA1112_DT2.

Note: The temperature detection card is used by Goodrive800 Pro series inverter control unit.



It is installed on the back of the control board.

Terminal structure:

TCA	TCB	GND	PTA	PTB	PTC	PTD	FANA	FANC

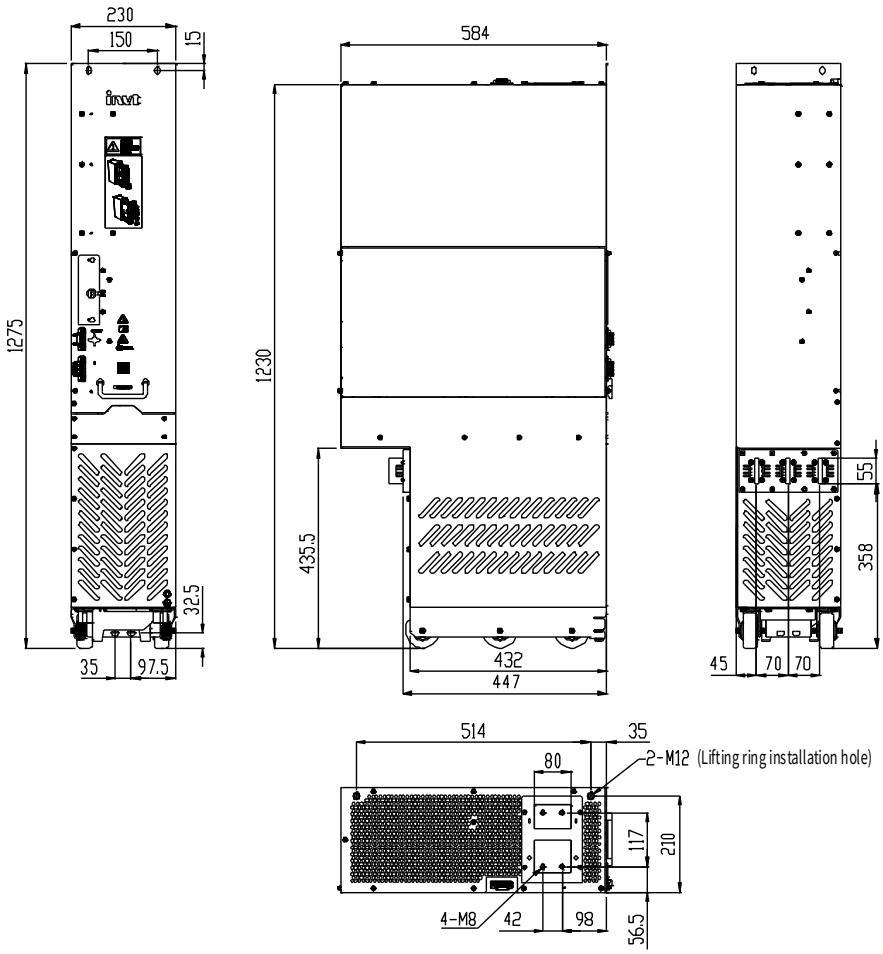
Terminal description:

Terminal symbol	Description
TCA	NTC and PTC temperature detection signal input port
TCB	
GND	Power reference ground
PTA	PT100 temperature detection signal input port PTB, PTC, and PTD connect to three-wired PT100.
PTB	
PTC	
PTD	
FANC	External fan control FANA is N.O. while FANC is the common terminal.
FANA	

Appendix C Dimension drawings

C.1 Installation dimensions

Figure C-1 Installation dimensions



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