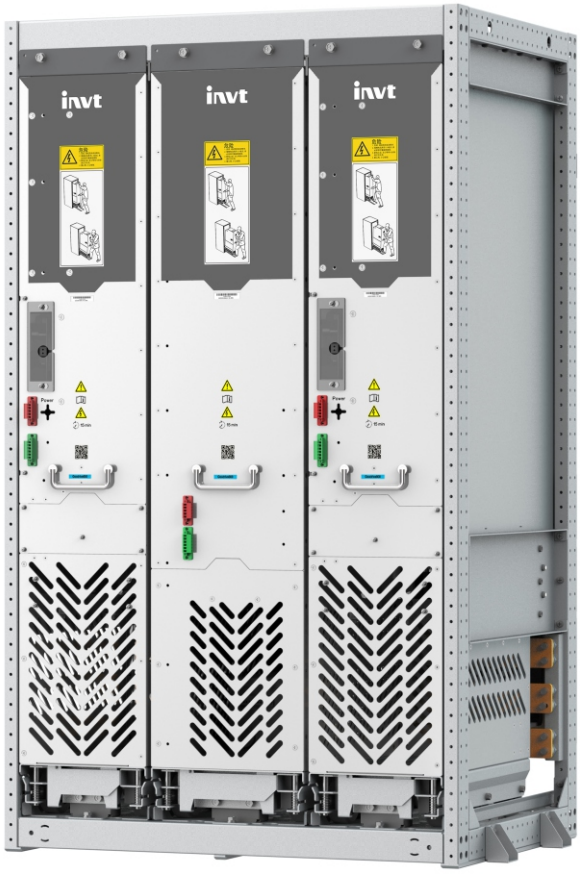
Goodrive800 Pro Series Active Rectifier

Hardware Manual



SHENZHEN INVT ELECTRIC CO., LTD.

No.	Change description	Version	Release date
1	First release.	V1.0	May 2023

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

Goodrive800-91 series is the active rectifier product of Goodrive800 Pro series. If not otherwise specified, the active rectifier in this manual refers to the active rectifier of Goodrive800 Pro series and Goodrive800-91 series product. The rated power of a single unit is 422kW–1214kW, and the max. parallel power can be 3642kW. The active rectifier consists of the active rectifier filter unit and the active rectifier unit. It is compact in structure and easy to integrate and maintain, reducing cabinet footprint.

This manual is Goodrive800 Pro series active rectifier 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 discharge	The PCBA may be damaged if related requirements are not followed.
	Hot sides	Do not touch. The active rectifier 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

	• 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

<table>
<tr><td></td><td>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">Model</th><th>Minimum waiting time</th></tr>
<tr><td>380V</td><td>>422kW</td><td>25 minutes</td></tr>
<tr><td>690V</td><td>>437kW</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.</td></tr>
</table>

1.4.1 Delivery and installation

<table>
<tr><td>  </td><td>● Do not install the active rectifier on inflammables. In addition, prevent the active rectifier from contacting or adhering to inflammables.
● Do not run the active rectifier If it is damaged or incomplete.
● Do not contact the rectifier unit with damp objects or body parts. Otherwise, electric shock may result.</td></tr>
<tr><td>Note</td><td>● Select appropriate tools for active rectifier delivery and installation to ensure the safe and proper running and avoid physical injury or death. The installation personnel must take mechanical protective measures like wearing safety shoes and working uniforms to protect personal safety.
● Protect the active rectifier against physical shock or vibration during the delivery and installation.
● Do not carry the active rectifier 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 rectifier unit.
● As the leakage current caused during active rectifier 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</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>
● R, S, and T are the power input terminals, while + and - are the DC bus output terminals. Connect the input power cables and output busbars properly; otherwise, the active rectifier may be damaged.</td></tr>
</table>

1.4.2 Commissioning and running

<table>
<tr><td>  </td><td>● Cut off all power supplies connected to the active rectifier before terminal wiring, and wait for at least the time designated on the rectifier unit after disconnecting the power supplies.</td></tr>
</table>

	• High voltage presents inside the active rectifier during running. Do not carry out any operation on the rectifier 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 active rectifier 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 active rectifier frequently. • If the active rectifier has been stored for a long time without use, perform checking and carry out pilot run for the active rectifier before using it again. • Close the active rectifier 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 active rectifier. • Cut off all power supplies connected to the active rectifier before terminal wiring, and wait for at least the time designated on the rectifier 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 active rectifier.
Note	• Use proper torque to tighten screws. • During maintenance and component replacement, keep the active rectifier 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 active rectifier, or measure the control circuits of the rectifier unit with a megohmmeter. • During maintenance and component replacement, take proper anti-static measures on the active rectifier and its internal parts.

1.4.4 Disposal

	• The active rectifier contains heavy metals. Dispose of a scrap rectifier 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 Pro series active rectifier products, the rated power of a single unit is 422kW–1214kW, while that of parallel units can be up to 3642kW. The active rectifier consists of the active rectifier filter unit and the active rectifier unit. It is compact in structure and easy to integrate and maintain, reducing cabinet footprint.

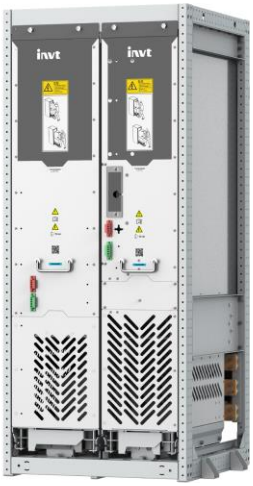
2.1 Product specifications

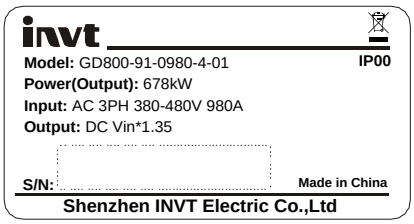
Table 2-1 Product specifications

Function description		Specifications
Basic performance	AC input voltage	400V system: 380–480V AC 3PH ±10%–15% < 1min 690V system: 520–690V AC 3PH ±10%–15% < 1min
	Input frequency	50Hz or 60Hz; Allowed range: 47–63Hz
	Unbalance	Less than ±3% of the rated interphase voltage
	Overload capacity	Light overload: Overload is allowed for 1 minute every 5 minutes and the overload current is 110%. Heavy overload: Overload is allowed for 1 minute every 5 minutes and the overload current is 150%.
	Working efficiency	⩾97%
	Power factor	⩾ 0.99 (of 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 function	Protection function	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

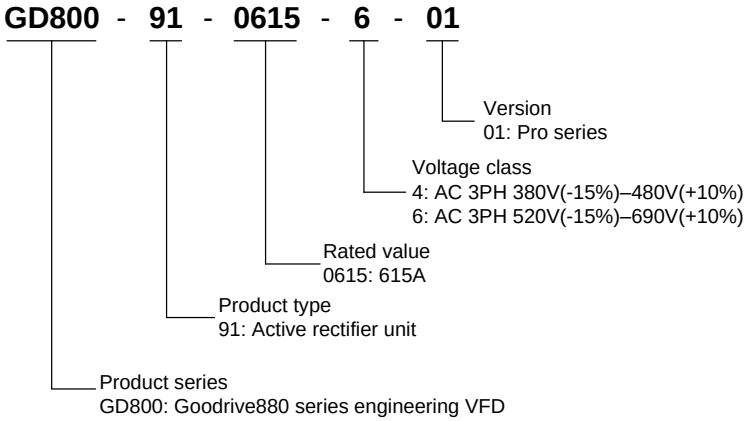




Note: The preceding nameplate is a standard product nameplate example. The marking varies slightly depending on the model.

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

Figure 2-2 Product model



Note:

- The preceding model is only an example of GD800-91 models.
- The model name of the active rectifier unit contains the suffix ZJ.

2.3 Product ratings

UN=400V (Range from 380V to 480V). The rated power (422kW–3167kW) is valid when the rated voltage is 400V .

Table 2-2 Ratings of 400V system product model

Model	Rating					Light overload application		Heavy overload application		Structure	Heat dissipation	Air volume
	I_N	I_N	I_{max}	S_N	P_N	I_{Ld}	P_{Ld}	I_{hd}	P_{Hd}			
	P_{Hd}	A (DC)	A (DC)	kVA	kW (DC)	A (DC)	kW (DC)	A (DC)	kW (DC)		kW	m^3/h
GD800-91-0615-4-01	615	701	911	426	422	673	405	526	317	A8+LCL	12.66	3000
GD800-91-0810-4-01	810	926	1204	561	556	889	533	694	417	A8+LCL	16.68	3000
GD800-91-0980-4-01	980	1117	1452	678	672	1080	645	838	505	2* A8+ LCL	20.16	4500
GD800-91-1168-4-01	1168	1332	1731	809	802	1288	769	999	602	2* A8+ LCL	24.06	4500
GD800-91-1539-4-01	1539	1759	2287	1066	1056	1689	1013	1319	792	2* A8+ LCL	31.68	4500
GD800-91-1960-4-01	1960	2234	2904	1356	1344	2160	1290	1676	1010	2*(2* A8+ LCL)	40.32	9000
GD800-91-2336-4-01	2336	2664	3462	1618	1604	2576	1538	1998	1204	2*(2* A8+ LCL)	48.12	9000
GD800-91-3078-4-01	3078	3519	4574	2132	2111	3378	2027	2639	1583	2*(2* A8+ LCL)	63.33	9000
GD800-91-4617-4-01	4617	5278	6861	3199	3167	5067	3040	3958	2375	3*(2* A8+ LCL)	95.01	13500

UN=690V (Range from 520V to 690V). The rated power (437–3642kW) is valid when the rated voltage is 690V.

Table 2-3 Ratings of 690V system product model

Model	Rating					Light overload application		Heavy overload application		Structure	Heat dissipation	Air volume
	I_N	I_N	I_{max}	S_N	P_N	I_{Ld}	P_{Ld}	I_{hd}	P_{Hd}			
	A (AC)	A (DC)	A (DC)	kVA	kW (DC)	A (DC)	kW (DC)	A (DC)	kW (DC)		kW	m^3/h
GD800-91-0369-6-01	369	422	548	441	437	405	419	316	327	A8+LCL	13.11	3000
GD800-91-0540-6-01	540	617	802	645	639	593	613	463	479	A8+LCL	19.17	3000
GD800-91-0701-6-01	701	801	1042	838	829	769	796	601	622	2* A8+ LCL	24.87	4500
GD800-91-1026-6-01	1026	1173	1525	1226	1214	1126	1165	880	910	2* A8+ LCL	36.42	4500
GD800-91-1402-6-01	1402	1603	2083	1676	1659	1539	1592	1202	1244	2*(2* A8+ LCL)	49.77	9000
GD800-91-2052-6-01	2052	2346	3049	2452	2428	2252	2331	1759	1821	2*(2* A8+ LCL)	72.84	9000
GD800-91-3078-6-01	3078	3519	4574	3678	3642	3378	3496	2639	2731	3*(2* A8+ LCL)	109.26	13500
GD800-91-5022-6-01	5022	6147	7991	6002	5726	5901	5497	4610	4294	3*(2* A8+ LCL)	36.9	13500

Note:

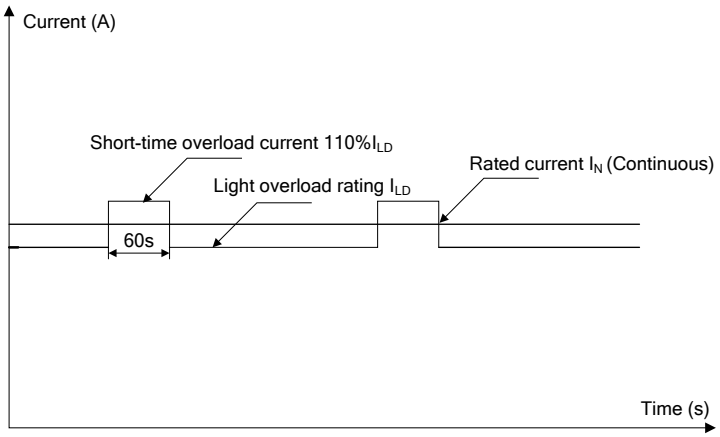
- To obtain optimal harmonic parameters, the capacity of the grid transformer shall be at least 1.5 times the rectified power, and the transformer voltage drop shall not be less than 4.5%.
- I_N indicates the rated current for continuous running when no overload occurs at 40°C, while I_{max} indicates the max. output current.
- Light overload application: I_{Ld} indicates the continuous running current at light overload. Every 5 minutes, the overload with the current of 110%*I_{Ld} can last for 1 minutes at 40°C.

- Heavy overload application: I_{Hd} indicates the continuous running current at heavy overload. Every 5 minutes, the overload with the current of 150%*I_{Hd} can last for 1 minutes at 40°C.

2.4 Overload capability

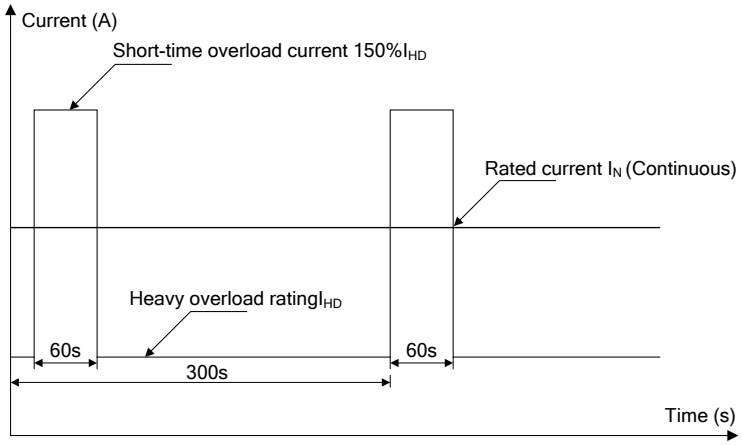
Based on the light overload continuous run current (I_{Ld}), the active rectifier can keep running for 60s at 110% of the rated current. See Figure 2-3.

Figure 2-3 Light overload application



Based on the heavy overload continuous run current (I_{Hd}), the active rectifier can keep running for 60s at 150% of the rated current. See Figure 2-4.

Figure 2-4 Heavy overload application



2.5 Hardware principles

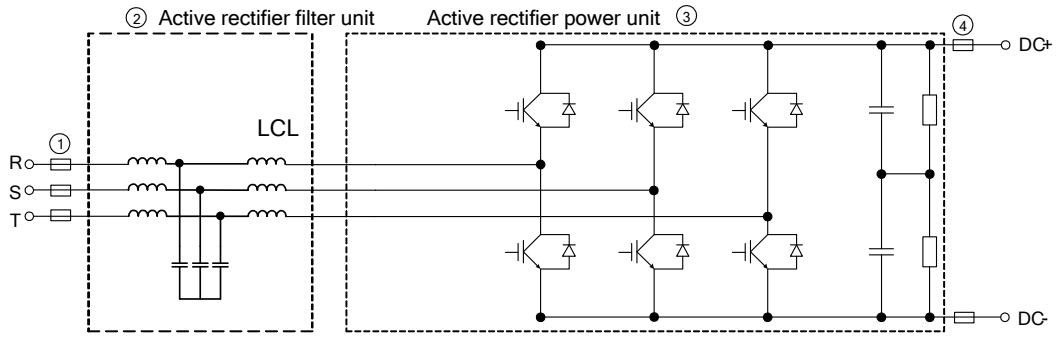
2.5.1 Basic principles

The active rectifier, a four-quadrant rectifier system, mainly consists of active rectifier filter unit and active rectifier unit. It is used with the pre-charge circuit and control unit. The intermediate DC voltage can supply the subsequent inverter modules. One or more inverter modules can be installed.

The active rectifier converts 3PH AC voltage into DC voltage, and the DC voltage can supply the subsequent inverter modules to drive motors. It can also feed the regenerative energy of the motor back to the grid. The active rectifier filter unit, which is the filter, is used to suppress input or regenerative current harmonics.

The active rectifier mainly consists of AC fuse, active rectifier filter unit, active rectifier unit, and DC fuse. Figure 2-5 shows the simplified main circuit diagram.

Figure 2-5 Simplified main circuit diagram of the active rectifier



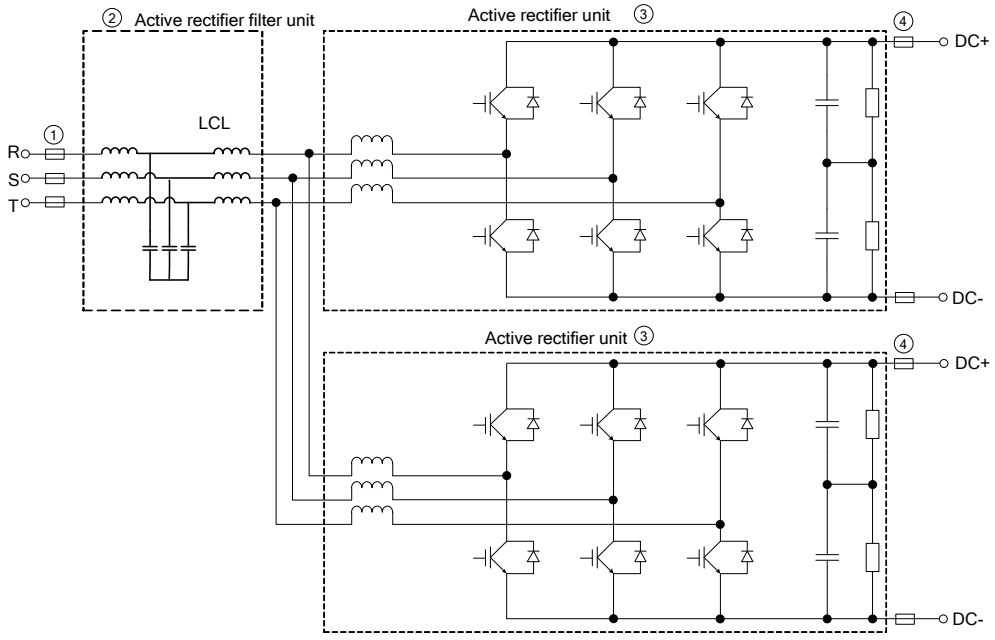
No.	Name	Description
1	AC fuse	To protect against overload and short-circuit on the active rectifier side.
2	Active rectifier filter unit	To suppress AC voltage and current harmonics.
3	Active rectifier power unit	To convert AC current to DC current.
4	DC fuse	To prevent backend short circuit from causing machine burndown.

Note: The AC fuse is not a component of the active rectifier. You can choose to configure AC fuses according to the actual application requirements.

2.5.2 Paralleling principle

The active rectifier supports parallel use in LCL+2A8 frame structure, that is, one active rectifier filter unit is connected with two active rectifier units, as shown in Figure 2-6. To meet the requirements of greater capacity, the parallel pattern (L+2*A8)*N should be used, where N cannot be greater than 3. In parallel connection, ensure that the active rectifier filter units have the same specifications and active rectifier units use the same software and hardware.

Figure 2-6 Simplified parallel system diagram of the active rectifier



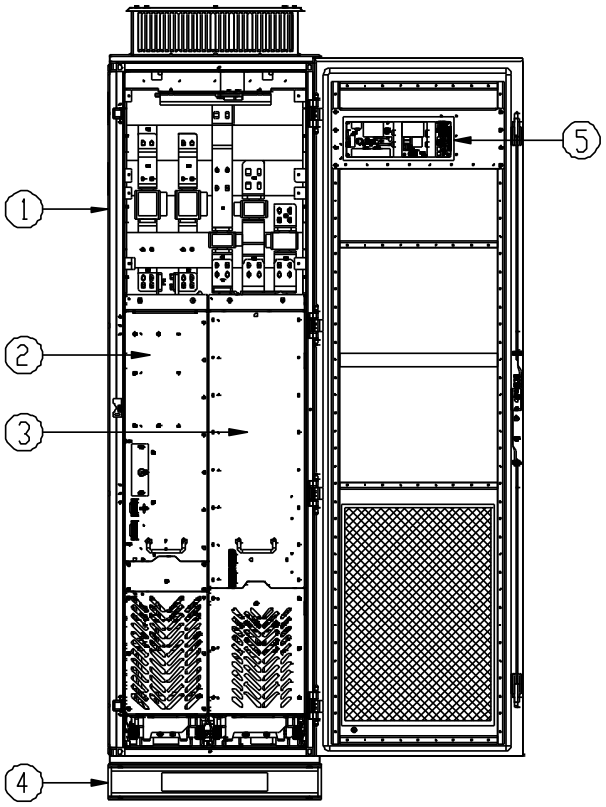
No.	Name	Description
1	AC fuse	To protect against overload and short-circuit on the active rectifier side.
2	Active rectifier filter unit	To suppress AC voltage and current harmonics.
3	Active rectifier unit	To convert AC current to DC current.
4	DC fuse	To prevent backend short circuit from causing machine burndown.

2.6 Product structure

2.6.1 Layout of LCL+A8

The following figure shows the layout of LCL+A8.

Figure 2-7 Structure of active rectifier frame (LCL+A8)

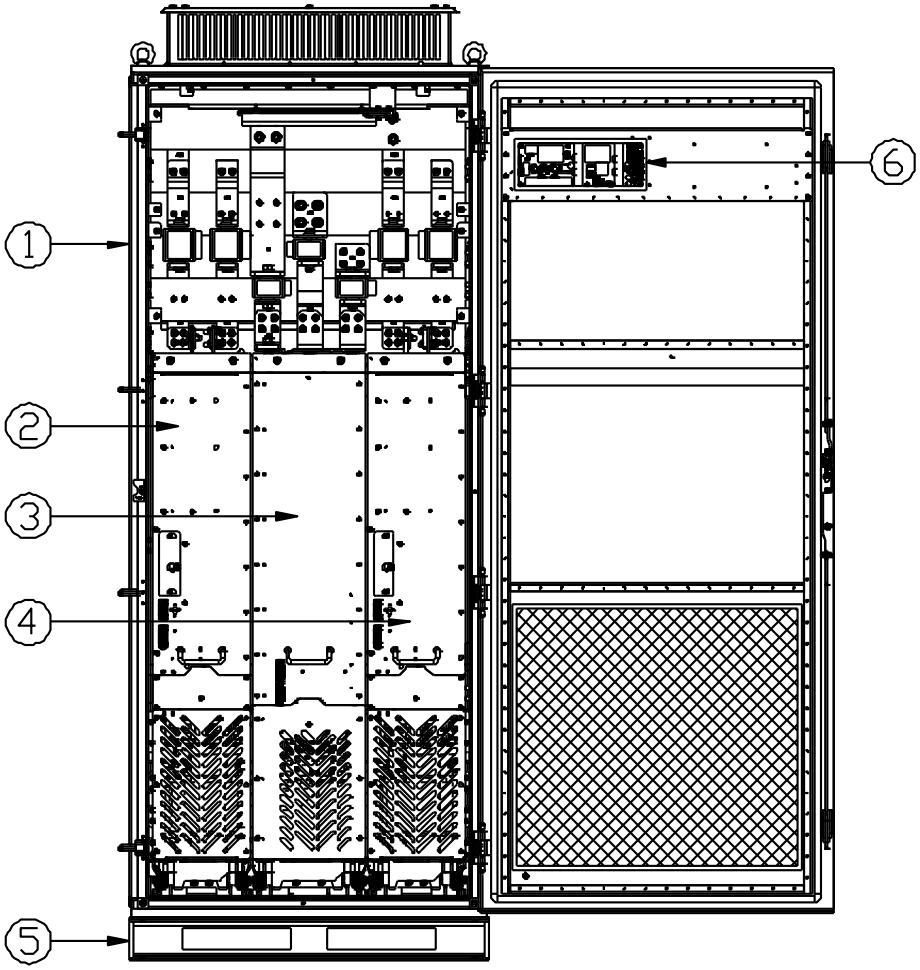


No.	Name
1	Cabinet
2	Active rectifier unit
3	Active rectifier filter unit
4	Channel steel base (optional)
5	Fan power supply board

2.6.2 Layout of LCL +2*A8

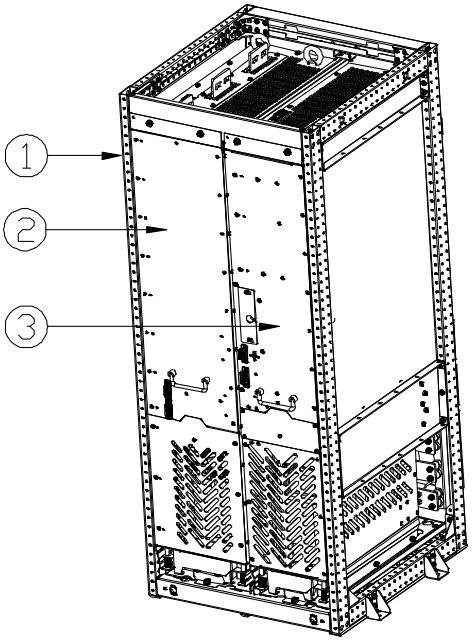
The following figure shows the layout of LCL +2*A8.

Figure 2-8 Structure of active rectifier frame (LCL +2*A8)



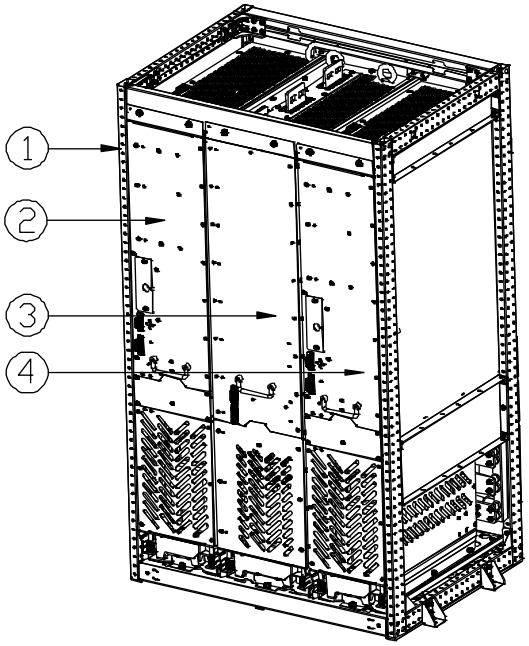
No.	Name
1	Cabinet
2	Active rectifier unit
3	Active rectifier filter unit
4	Active rectifier unit
5	Channel steel base (optional)
6	Fan power supply board

2.6.3 Frame layout of LCL+A8



No.	Name
1	Frame
2	Active rectifier unit
3	Active rectifier filter unit

2.6.4 Frame layout of LCL +2*A8

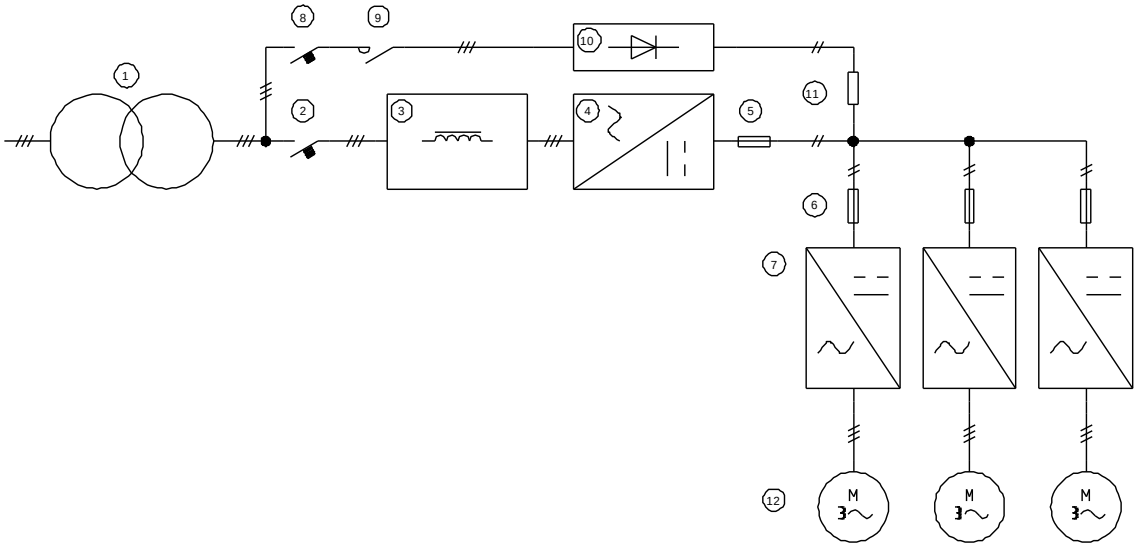


No.	Name
1	Frame
2	Active rectifier unit
3	Active rectifier filter unit
4	Active rectifier unit

2.7 System configuration

Figure 2-9 shows the typical topology in which the active rectifier works with three inverter units.

Figure 2-9 System configuration



No.	Name
1	Transformer
2	Breaker
3	Active rectifier filter unit
4	Active rectifier unit
5	Rectifier unit DC fuse
6	Inverter unit DC fuse
7	Inverter unit
8	Buffer breaker
9	Buffer contactor
10	Rectifier bridge
11	Buffer resistor
12	Motor

2.8 Electrical model selection

2.8.1 Buffer component

The buffer component consists of breaker, contactor, rectifier bridge, and buffer resistor, as shown in Figure 2-9.

Table 2-4 Buffer component selection

Power supply module	Rated current	Recommended specification	Recommended model	Qty
Buffer breaker				
400V	615–1539A	690V 63A	CDM6i-63L/3300	1
690V	369–1026A	690V 63A	CDM6i-125L/3300	1
Buffer contactor				
400V	615–1539A	690V 65A	LC1-D65M7C	1

Power supply module	Rated current	Recommended specification	Recommended model	Qty
690V	369–1026A	690V 65A	LC1-D65M7C	1
Buffer rectifier bridge				
400V	615–1539A	200A, 1600V	3-phase rectifier bridge MDS200-16	1
690V	369–1026A	200A, 2400V	3-phase rectifier bridge MD200S24M3	1
Buffer resistor				
400V	615–1539A	5Ω, 1000W	Power resistor; 520W; 10Ω	2
690V	369–1026A	5Ω, 1000W	Power resistor; 520W; 10Ω	2

2.8.2 Breaker

A breaker can effectively prevent the overload of the variable-frequency equipment and break the fault current generated by the phase-to-phase or to-ground short circuit, and at the same time it has the function of isolation so as to avoid electric shock accidents during maintenance.

Note: The breaker should be equipped with an external terminal to controls the opening and closing of the breaker and a status feedback auxiliary contact!

Table 2-5 Breaker model selection

Power supply module	Frame size	Recommended specification	Recommended breaker (ABB)	Qty
GD800-91-0615-4-01	A8+LCL	690V 800A	T6 S800	1
GD800-91-0810-4-01	A8+LCL	690V 1000A	T7 S1000M	1
GD800-91-0980-4-01	2* A8+ LCL	690V 1250A	T7 S1250M	1
GD800-91-1168-4-01	2* A8+ LCL	690V 1600A	T7 S1600M	1
GD800-91-1539-4-01	2* A8+ LCL	690V 2000A	E2.2N2000	1
GD800-91-1960-4-01	2*(2* A8+ LCL)	690V 2500A	E2.2N2500	1
GD800-91-2336-4-01	2*(2* A8+ LCL)	690V 3200A	E4.2N3200	1
GD800-91-3078-4-01	2*(2* A8+ LCL)	690V 4000A	E4.2N4000	1
GD800-91-4617-4-01	3*(2* A8+ LCL)	690V 5000A	E6.2H5000	1
GD800-91-0369-6-01	A8+LCL	690V 400A	T5 S400	1
GD800-91-0540-6-01	A8+LCL	690V 630A	T5 S630	1
GD800-91-0701-6-01	2* A8+ LCL	690V 800A	T6 S800	1
GD800-91-1026-6-01	2* A8+ LCL	690V 1250A	T7 S1250M	1
GD800-91-1402-6-01	2*(2* A8+ LCL)	690V 1600A	T7 S1600M	1
GD800-91-2052-6-01	2*(2* A8+ LCL)	690V 2500A	E2.2N2500	1
GD800-91-3078-6-01	3*(2* A8+ LCL)	690V 4000A	E4.2N4000	1

2.8.3 AC fuse

An AC fuse protects the rectifier unit and input power cable in case of short circuit, avoiding thermal overload. See the following table to select AC fuses.

Table 2-6 AC fuse model selection

Power supply module	Frame size	Voltage (V)	Current (A)	Qty
GD800-91-0615-4-01	A8+LCL	690V	1000	3
GD800-91-0810-4-01	A8+LCL	690V	1250	3
GD800-91-0980-4-01	2* A8+ LCL	690V	1600	3
GD800-91-1168-4-01	2* A8+ LCL	690V	1000	6

Power supply module	Frame size	Voltage (V)	Current (A)	Qty
GD800-91-1539-4-01	2* A8+ LCL	690V	1250	6
GD800-91-0369-6-01	A8+LCL	690V	630	3
GD800-91-0540-6-01	A8+LCL	690V	900	3
GD800-91-0701-6-01	2* A8+ LCL	690V	1100	3
GD800-91-1026-6-01	2* A8+ LCL	690V	900	6

2.8.4 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.

Table 2-7 DC fuse model selection

Power supply module	Frame size	Voltage (V)	Current (A)	Qty
GD800-91-0615-4-01	A8+LCL	690V	1000	2
GD800-91-0810-4-01	A8+LCL	690V	1250	2
GD800-91-0980-4-01	2* A8+ LCL	690V	900	4
GD800-91-1168-4-01	2* A8+ LCL	690V	1000	4
GD800-91-1539-4-01	2* A8+ LCL	690V	1250	4
GD800-91-0369-6-01	A8+LCL	1250V	700	2
GD800-91-0540-6-01	A8+LCL	1250V	1000	2
GD800-91-0701-6-01	2* A8+ LCL	1250V	700	4
GD800-91-1026-6-01	2* A8+ LCL	1250V	1000	4

2.9 Lightning protection component

The product adopts INVT lightning protection component to prevent damage from lightning and surge. The lightning protection component is installed in the incoming cable cabinet and connected to the outgoing side of main circuit breaker. Figure 2-10 shows the dimensions of the component.

Figure 2-10 Dimension drawings of lightning protection component (unit: mm)

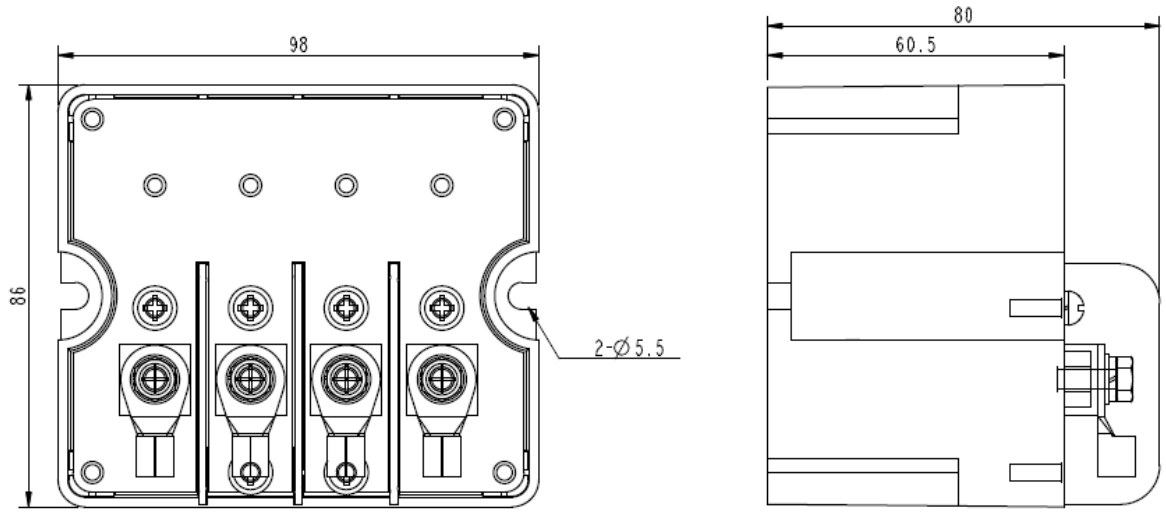


Table 2-8 Lightning protection component selection

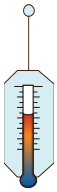
Model	Grid voltage (V)
RV-380V	380
RV-660V	660

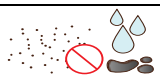
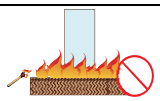
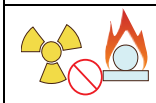
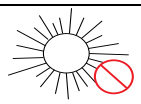
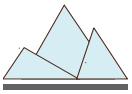
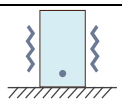
3 Mechanical installation

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 section 1.4.1 Delivery and installation. Ignoring these safety precautions may lead to physical injury or death, or device damage. ● Ensure the active rectifier power has been disconnected before installation. If the active rectifier has been powered on, disconnect the active rectifier unit power and wait for at least the time specified on the rectifier unit, and ensure the POWER indicator is off. You are recommended to use a multimeter to check and ensure the rectifier 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 active rectifier 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.	
Relative humidity (RH)	 RH: less than 90%	 Condensation is	 The max. RH cannot exceed 60% in

<table>
<tr><th>Environment</th><th colspan="4">Condition</th></tr>
<tr><td></td><td></td><td colspan="2">not allowed.</td><td>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 equipment</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 and 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 installation site altitude exceeds 3000m, consult the local INVT dealer or office.</td></tr>
<tr><td>Vibration</td><td>  </td><td colspan="3">The max. ACC speed cannot exceed 5.9m/s² (0.6g).</td></tr>
</table>

3.3 Preparing

3.3.1 Unpacking inspection

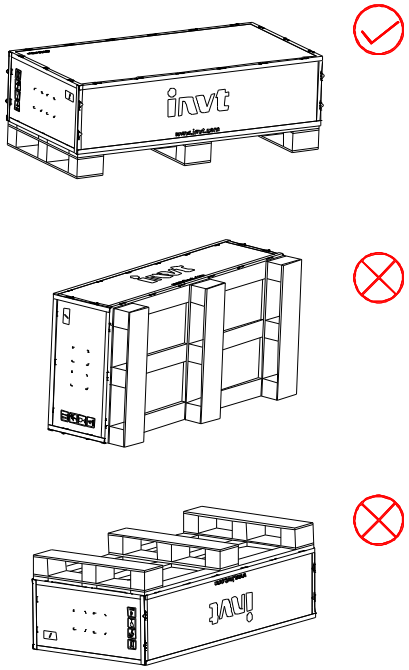
After receiving the product, perform the following steps to ensure the product use safety.

1. Before unpacking, check whether the product package is intact–whether the package is damaged, dampened, soaked, or deformed.
2. Check whether the nameplate and label on the product body are consistent with the model ordered.
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.
4. Check whether the parts (including the complete equipment of active rectifier, keypad, and manual) inside the packing box are complete.

3.3.2 Transportation

The GD800 Pro series active rectifier 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 regenerative rectifier 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.

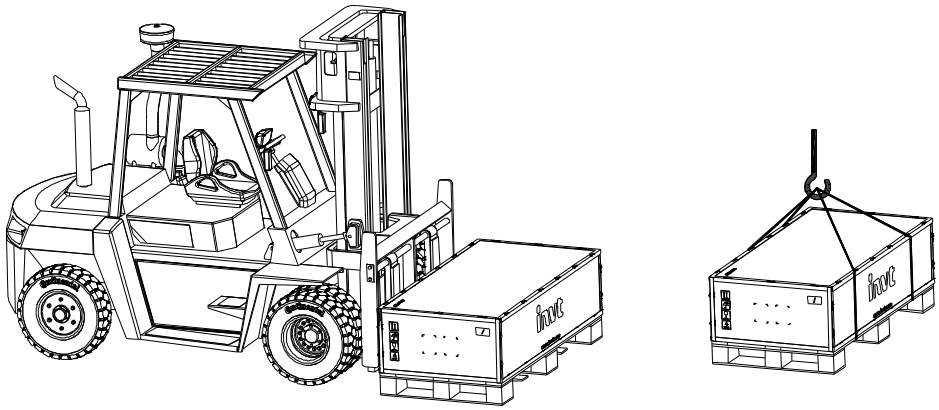
Figure 3-1 Transportation requirements



When transported with a forklift, the active rectifier must be fixed to the pallets and transported together, which means you are not allowed to remove the pallets to transport the active rectifier. 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 active rectifier 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:

1. Place the well-packed unit in an empty and flat place.
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.
3. Remove the surrounding boards and EPE filling materials from the wooden box.
4. Cut off the plastic windings.
5. Take out of the unit.

6. Ensure that the unit is intact without any damage.

Dispose of or recycle packaging in accordance with local regulations.

Figure 3-3 Unpacking diagram 1 for the active rectifier unit

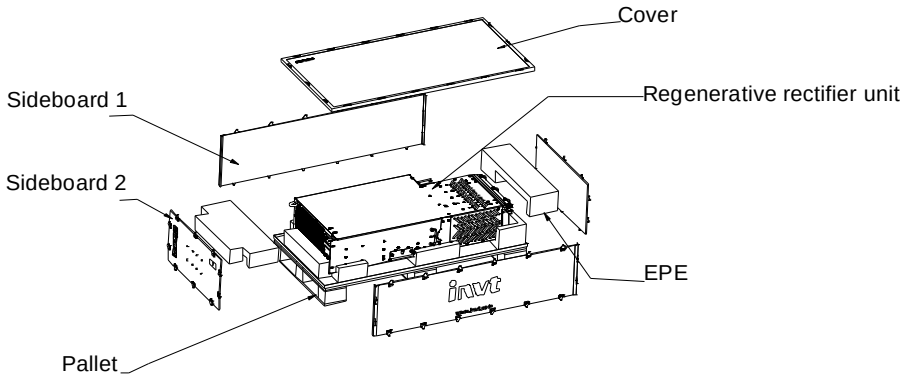
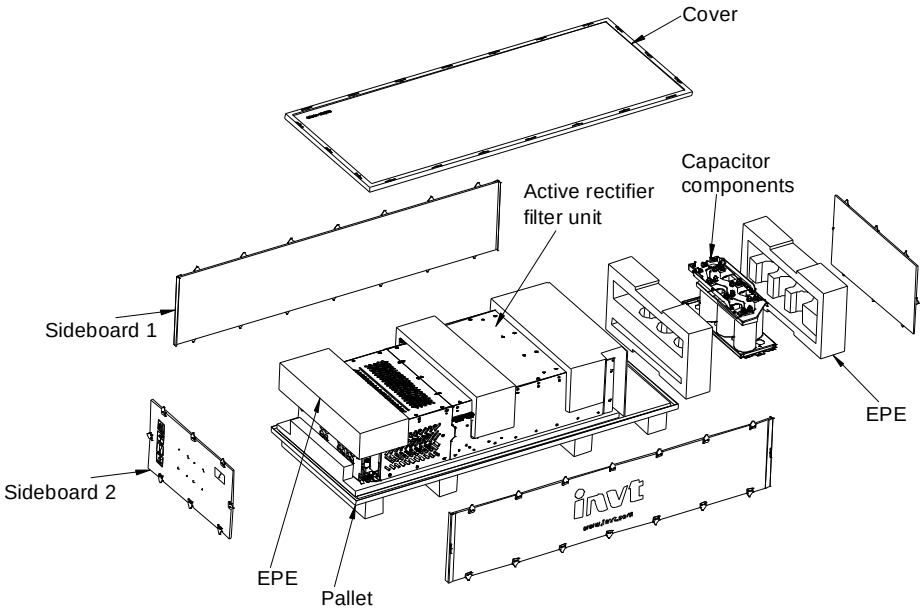
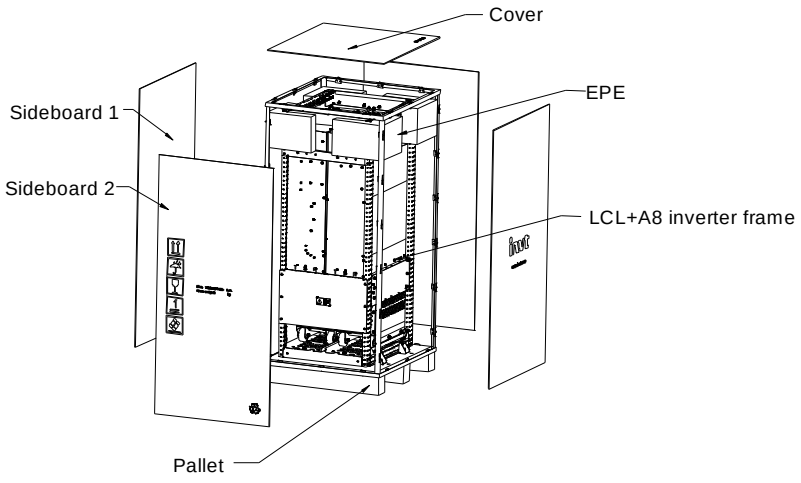


Figure 3-4 Unpacking diagram 2 for the active rectifier filter unit



Note: After removing the package of the capacitor assembly, install the capacitor assembly into the unit in accordance with section 6.2.2 Replacement of active rectifier filter unit filter capacitor.

Figure 3-5 Unpacking diagram 3 for the active rectifier frame

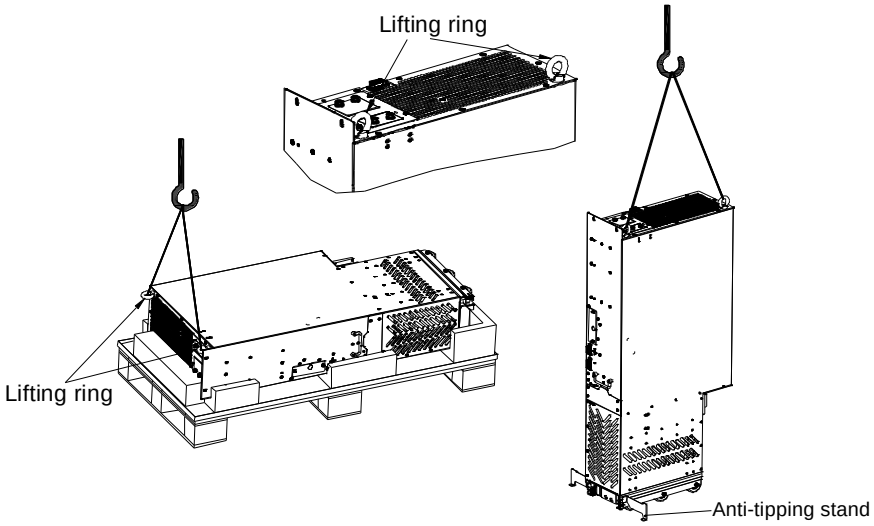


3.3.4 Lifting

1. Active rectifier unit/active filter unit

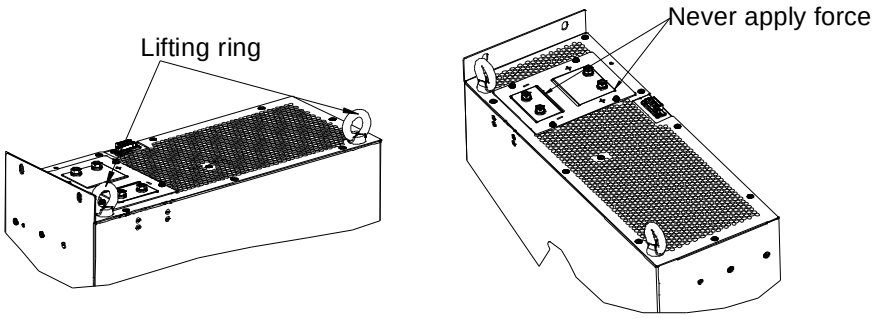
Attach the required lifting ring to the locations shown in the figure, use the sling to slowly lift the unit end, move the unit until it is completely lifted, place it vertically in the empty and flat place, and then unfold the anti-tipping stand at the lower front of the unit. Figure 3-6 shows the anti-tipping stand location.

Figure 3-6 Unit lifting

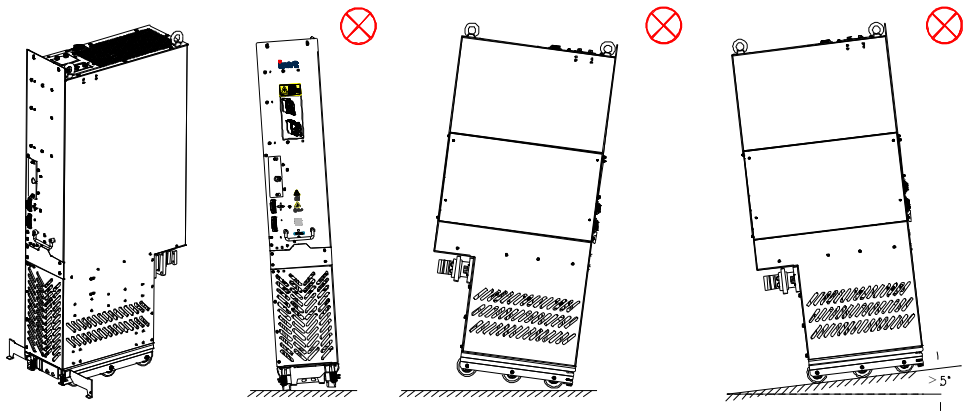


Note: Use the lifting ring on the top of active rectifier unit for lifting and moving. Never apply force to the positive or negative bus terminals.

Figure 3-7 Unit top structure



The active rectifier 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 unit to tip over or topple over, which may result in serious injury or property damage.



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

1. 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 3-9.

2. 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 3-10.

The restraint of the pin ensures that the anti-tipping stand will not unfold due to shaking. The anti-tipping stand folds, as shown in Figure 3-8.

Figure 3-8 Unit bottom structure

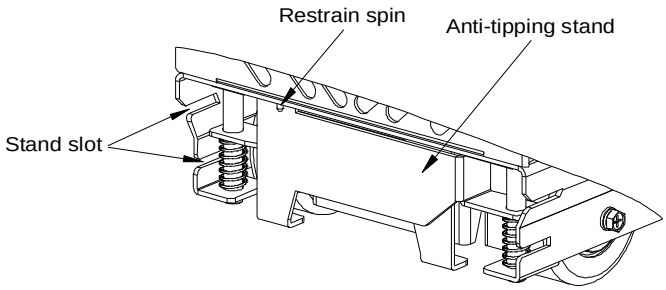


Figure 3-9 Unfolding the anti-tipping stand

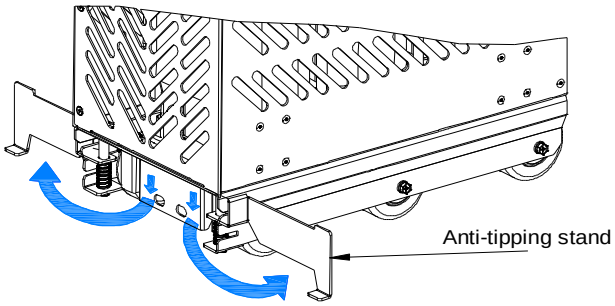
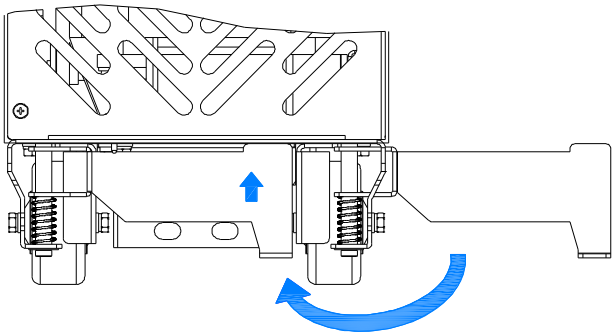


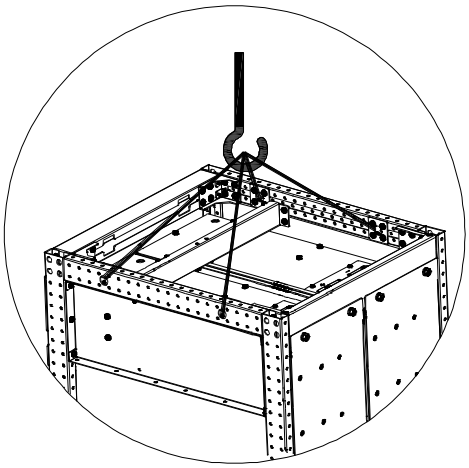
Figure 3-10 Folding the anti-tipping stand



2. Active rectifier frame

Remove the wooden packaging box of the inverter frame, remove four fixing bolts fixed to the bottom of the frame, use the sling to slowly lift the frame through the four lifting holes on the top of the frame (recommended length of the sling>0.7m) until it is completely lifted, and place it vertically in the empty and flat place, as shown in Figure 3-11.

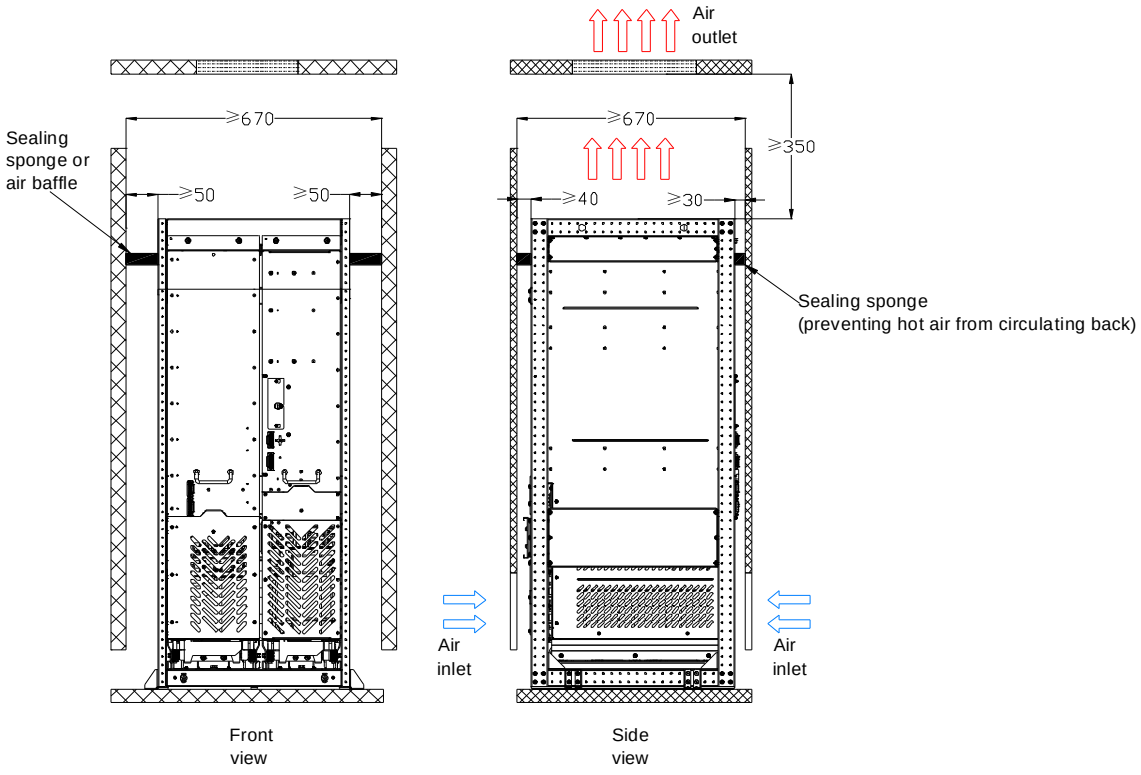
Figure 3-11 Inverter frame lifting



3.3.5 Installation space and heat dissipation

3.3.5.1 Installation space requirements for active rectifier frame

Figure 3-12 Installation space requirements for active rectifier frame



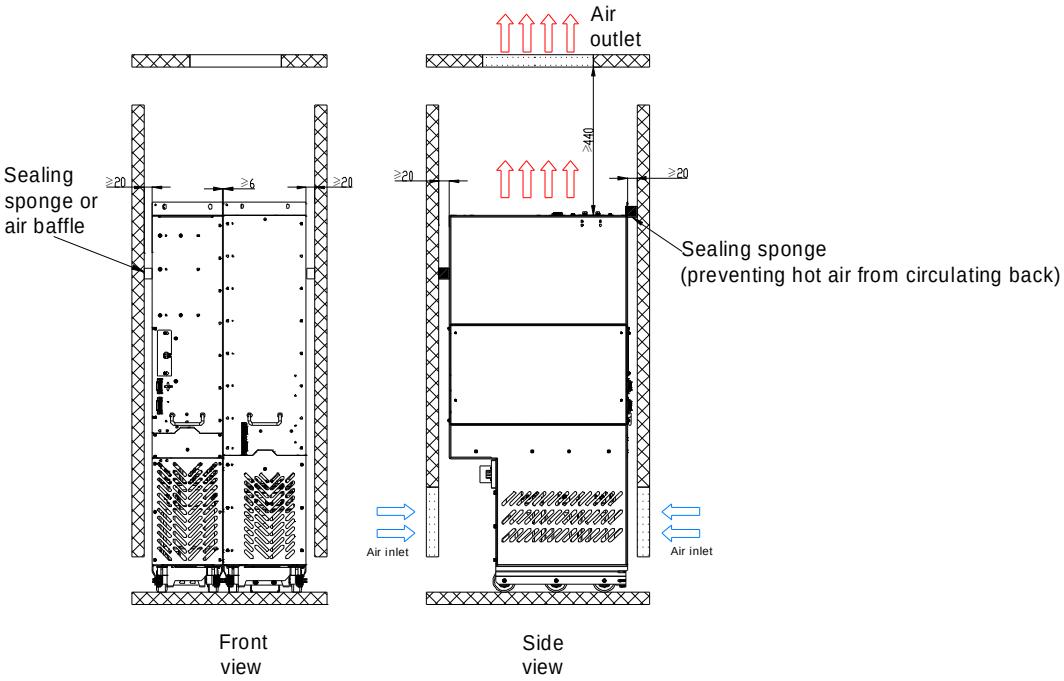
3.3.5.2 Installation space requirements for active rectifier units

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

1. The active rectifier must be installed and used in a cabinet.
2. A minimum ventilation clearance must be kept from the top and bottom of the active rectifier to ensure good heat dissipation. See Figure 3-13.
3. Both sides of the active rectifier are designed with air baffle and sealing sponge for isolation to prevent

the hot air at the unit top outlet from circulating inside the cabinet and ensure that the heat of the active rectifier is discharged from the heat dissipation holes at the cabinet top outlet cover. See Figure 3-13.

Figure 3-13 Installation space requirements for active rectifier units



To ensure good heat dissipation of the active rectifier, 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 volumes required by the active rectifier, see Table 3-1.

Table 3-1 Ventilation areas and actual air volumes of active rectifier

No.	Frame size	Ventilation area S_{in} (cm^2)	Actual air volume (CFM)
1	LCL+A8	1550	1758
2	LCL +2* A8	2360	2637

⚠	Violation of the requirements in section 3.3.5 Installation space and heat dissipation will shorten the active rectifier life and may result in active rectifier failure or malfunction.

3.3.6 Cabinet installation

3.3.6.1 Cabinet requirements

It is recommended that the cabinet adopts the nine-fold profile cabinet (PS cabinet). Before mounting the active rectifier, install five bottom support crossbeams, a mounting bracket, and a mounting rail in the cabinet, and design the mounting crossbeam for the active rectifier fixing, and reserve fixing holes on the mounting crossbeam (see Appendix C Dimension drawings for the specific location and size).

To fix the bottom support crossbeams and install the unit tray:

(1) Use ten M8 cage nuts to fix the five 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 mounting bracket to the nine-fold profile cabinet frame base with twenty M5 self-tapping screws. See Figure 3-13.

(3) Install the unit tray on the support crossbeams with ten M8 screws. See Figure 3-14.

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

Figure 3-14 Installing the support crossbeams

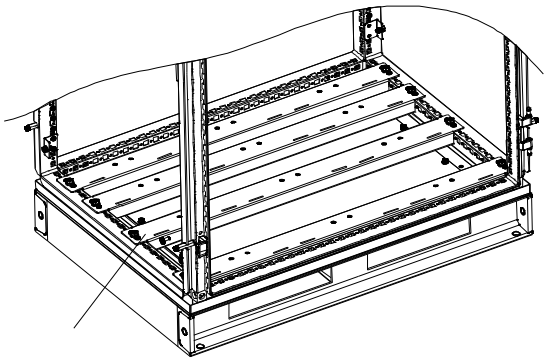
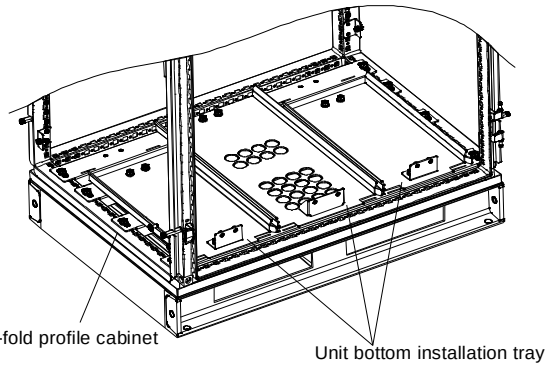


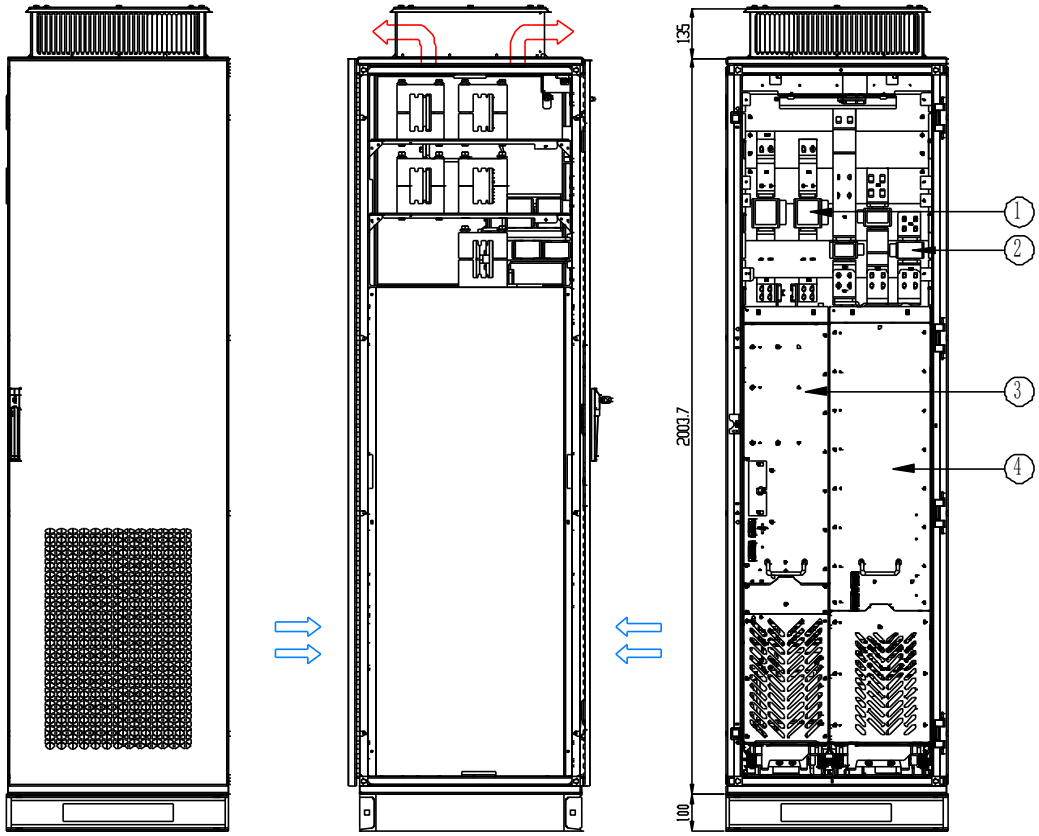
Figure 3-15 Installing the unit tray



3.3.6.2 Layout and mounting for LCL+A8

Figure 3-16 shows the 600mm-wide cabinet layout for LCL+A8.

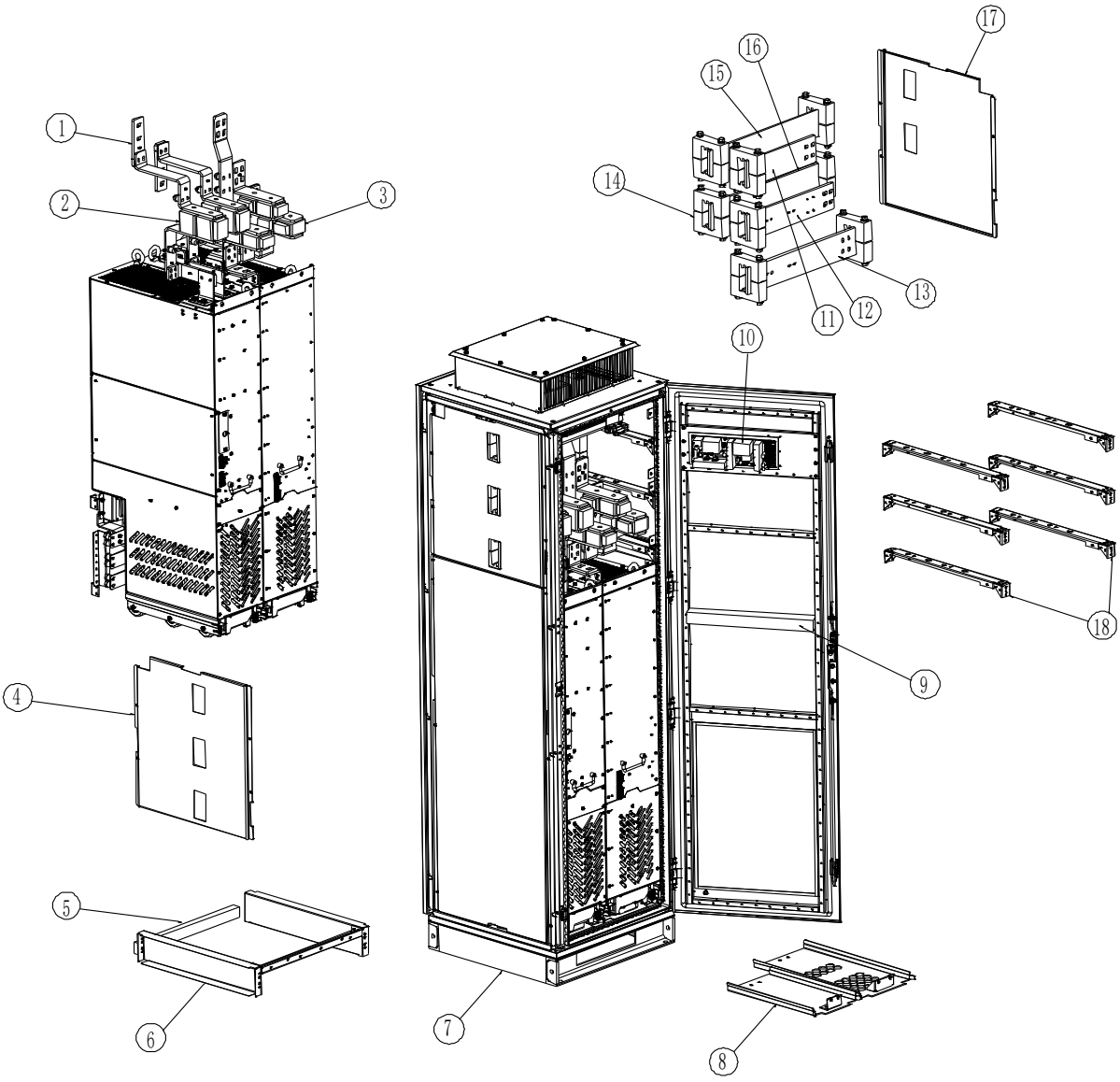
Figure 3-16 Layout of 600mm-wide cabinet for LCL+A8



No.	Name
1	DC fuse
2	AC fuse
3	Active rectifier unit
4	Active rectifier filter unit

Figure 3-17 shows the 600mm-wide cabinet installation for LCL+A8.

Figure 3-17 Installation diagram of LCL+A8 in an 600mm-wide cabinet



No.	Name
1	Unit-top copper bar assembly
2	AC fuse
3	DC fuse
4	Left protective plate
5	Back sealing sponge
6	Unit-top fixing assembly
7	Cabinet
8	Unit bottom fixed plate

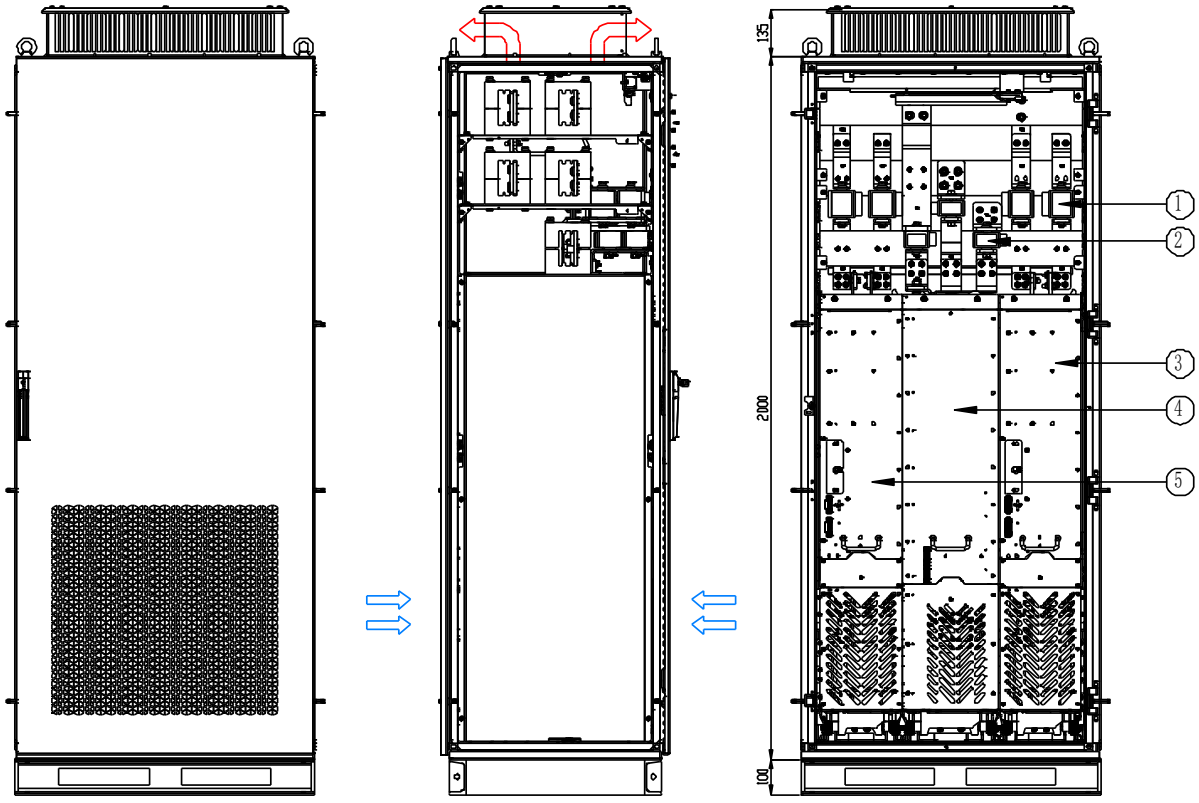
No.	Name
9	Front sealing sponge
10	Power supply board
11	R-phase copper busbar
12	S-phase copper busbar
13	T-phase copper busbar
14	Busbar clamp
15	Copper busbar of (+)
16	Copper busbar of (-)
17	Right protective plate
18	Busbar clamp support

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.

3.3.6.3 Layout and mounting for LCL+2*A8

Figure 3-18 shows the 850mm-wide cabinet layout for LCL +2* A8.

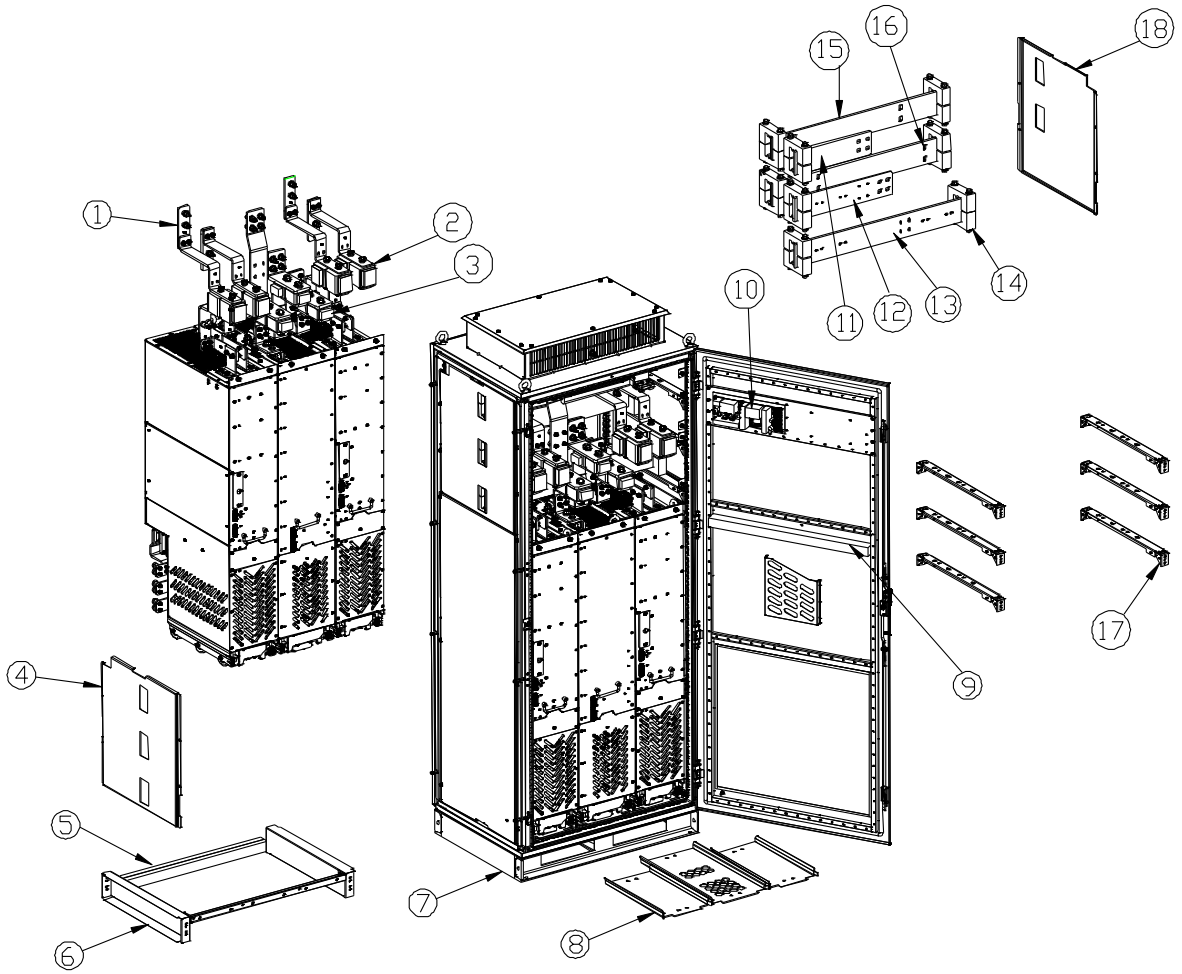
Figure 3-18 Layout of 850mm-wide cabinet for LCL +2*A8



No.	Name
1	DC fuse
2	AC fuse
3	Active rectifier unit
4	Active rectifier filter unit
5	Active rectifier unit

Figure 3-19 shows the 850mm-wide cabinet installation for LCL +2* A8.

Figure 3-19 Installation diagram of L+2*A8 in an 850mm-wide cabinet



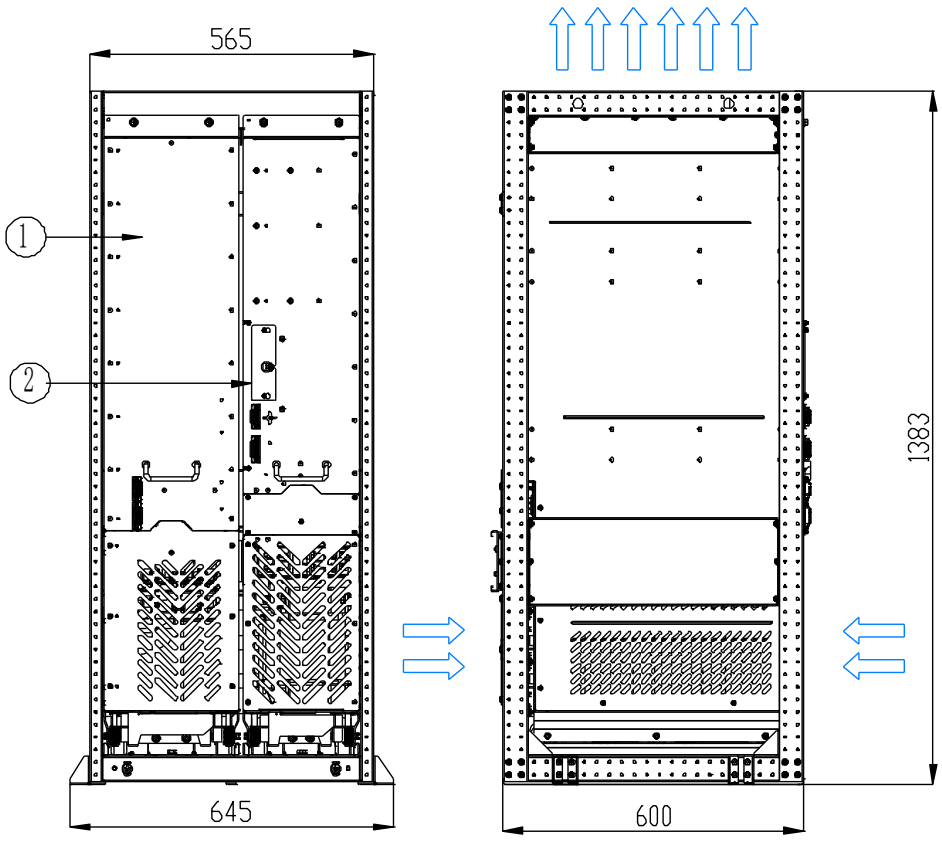
No.	Name
1	Unit-top copper bar assembly
2	DC fuse
3	AC fuse
4	Left protective plate
5	Back sealing sponge
6	Unit-top fixing assembly
7	Cabinet
8	Unit bottom fixed plate
9	Front sealing sponge
10	Power supply board
11	R-phase copper busbar
12	S-phase copper busbar
13	T-phase copper busbar
14	Busbar clamp
15	Copper busbar of (+)
16	Copper busbar of (-)
17	Busbar clamp support
18	Right protective plate

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.

3.3.6.4 Frame layout and mounting for LCL+A8

Figure 3-20 shows the 565mm-wide frame layout for LCL+A8.

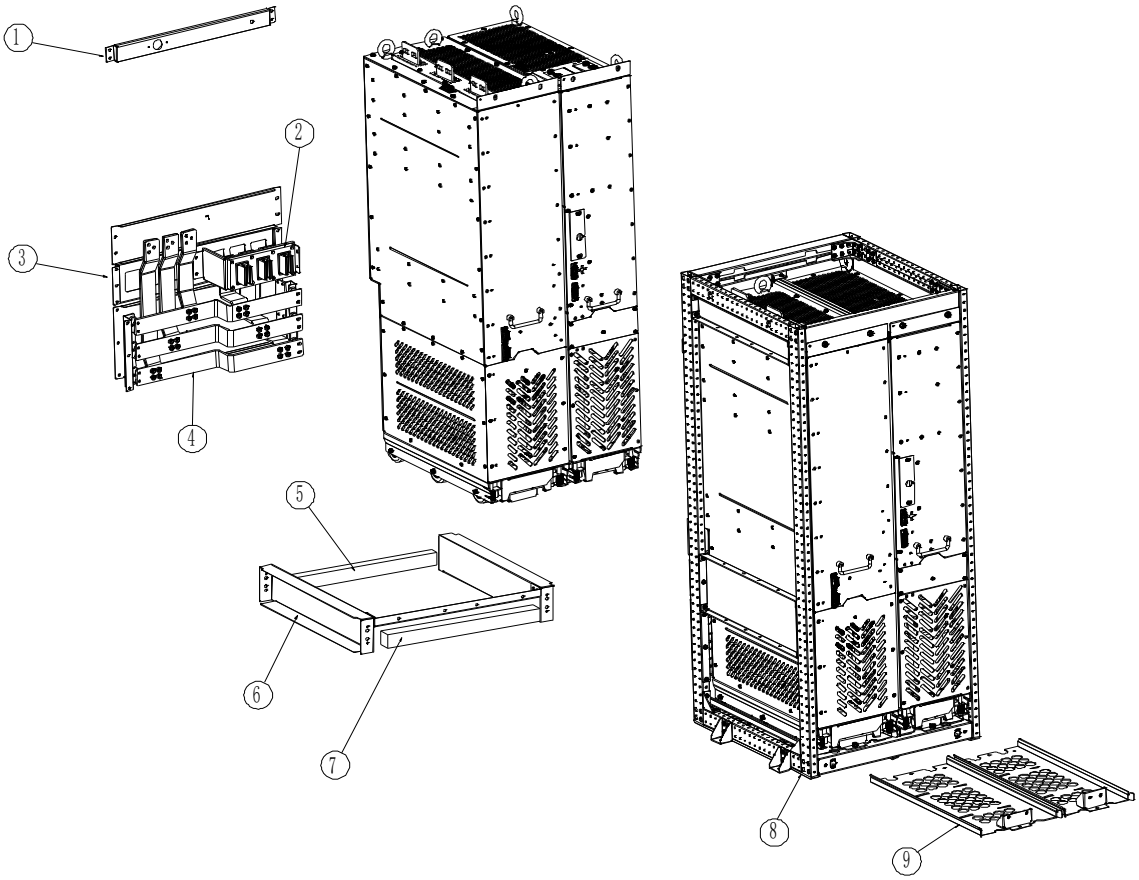
Figure 3-20 Layout of 565mm-wide frame for LCL+A8



No.	Name
1	Active rectifier unit
2	Active rectifier filter unit

Figure 3-21 shows the 565mm-wide frame installation for LCL+A8.

Figure 3-21 Installation diagram of LCL+A8 in an 565mm-wide frame



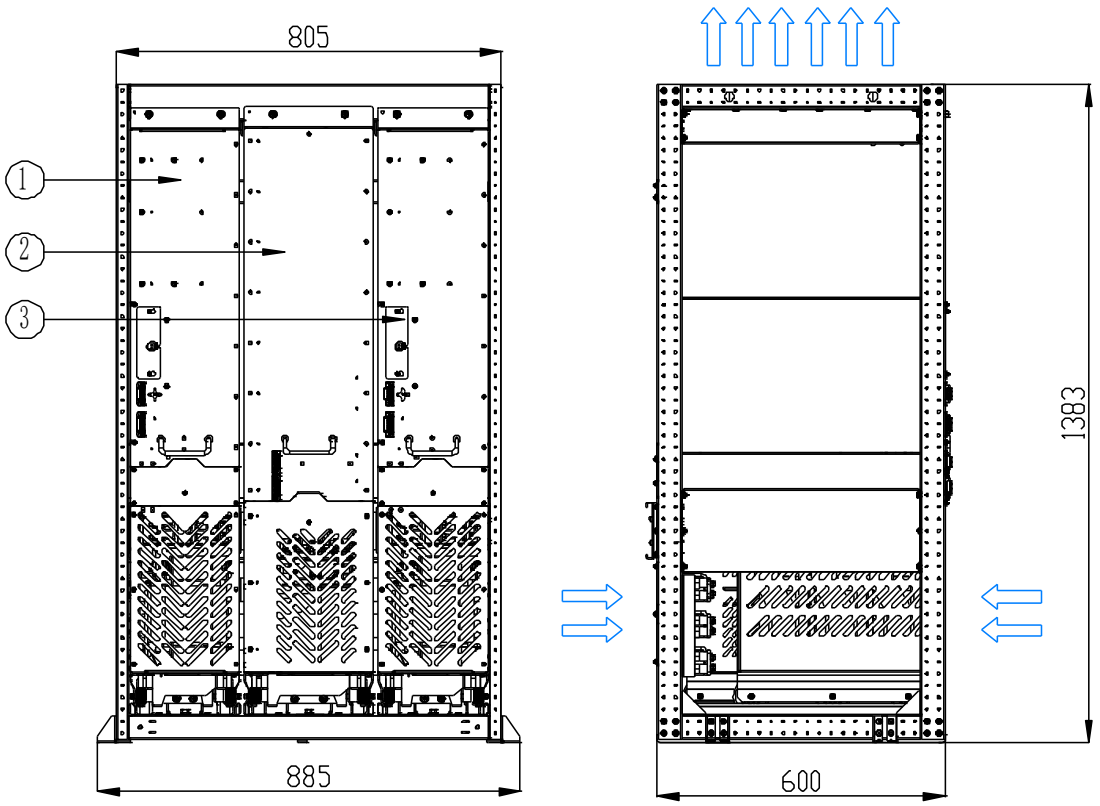
No.	Name
1	Transportation
2	Fast-inserting assembly
3	Protection assembly
4	Copper bar assembly
5	Back sealing sponge
6	Unit-top fixing assembly
7	Front sealing sponge
8	Frame
9	Unit bottom fixed plate

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.

3.3.6.5 Frame layout and mounting for LCL+2*A8

Figure 3-22 shows the 805mm-wide frame layout for LCL+2*A8.

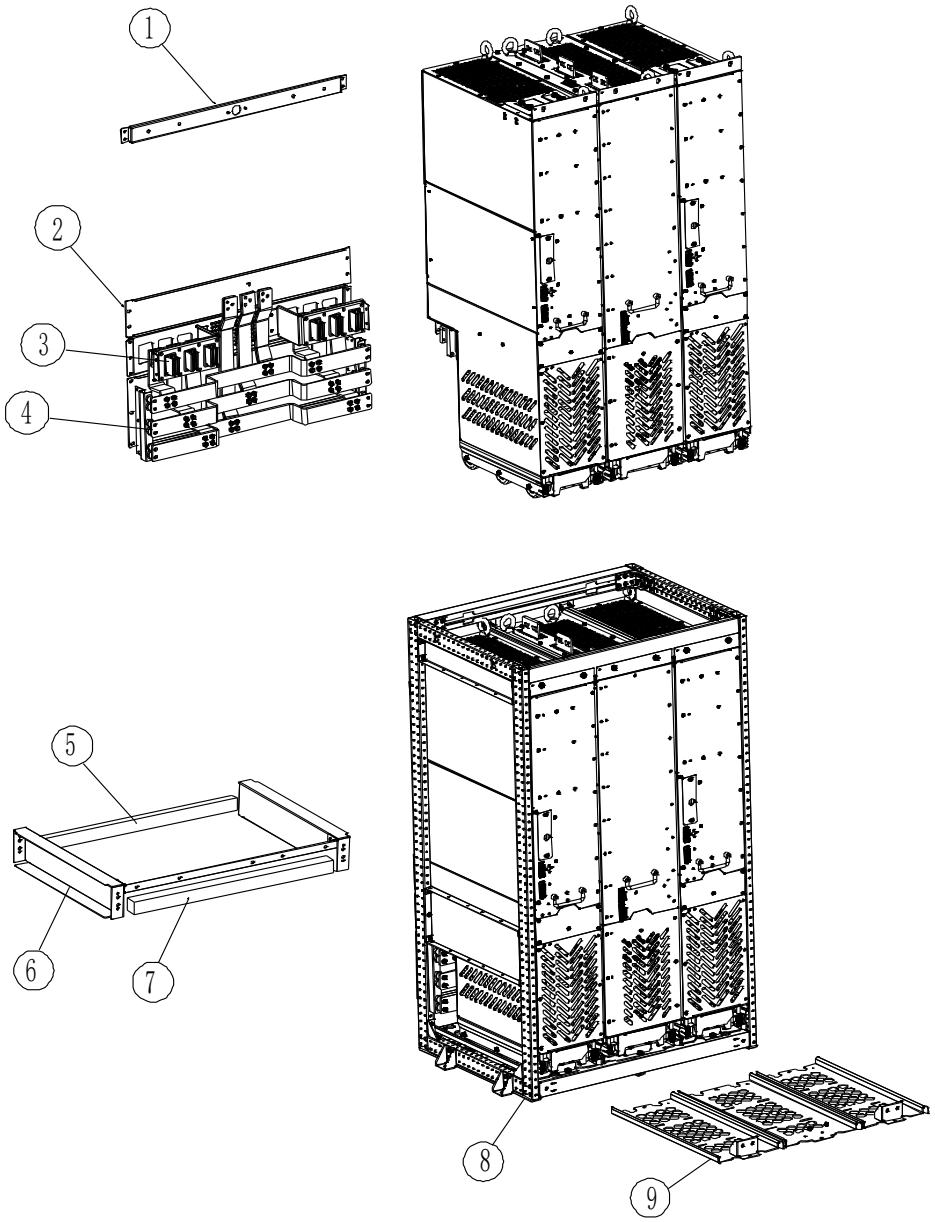
Figure 3-22 Layout of 805mm-wide frame for LCL +2*A8



No.	Name
1	Active rectifier unit
2	Active rectifier filter unit
3	Active rectifier unit

Figure 3-23 shows the 805mm-wide frame installation for LCL+2*A8.

Figure 3-23 Installation diagram of LCL+2*A8 in an 805mm-wide frame



No.	Name
1	Fixed beam for transportation
2	Protection assembly
3	Fast-inserting assembly
4	Copper bar assembly
5	Back sealing sponge
6	Unit-top fixing assembly
7	Front sealing sponge
8	Frame
9	Unit bottom fixed plate

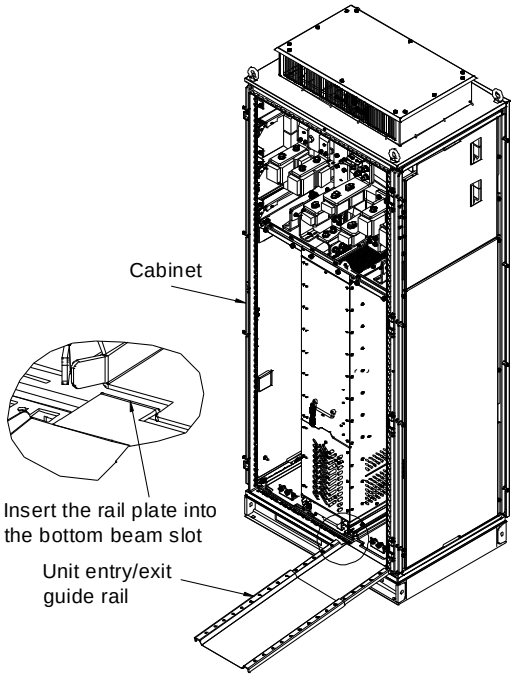
Note: A 40X40 sealing sponge must be used at the position corresponding to the air baffle in the front/back door panel, which prevents air duct reflow.

3.3.6.6 Unit installation and replacement

The installation procedure is as follows:

1. Insert the unit entry/exit guide rail into the slot of the cabinet front bottom beam. See Figure 3-24.

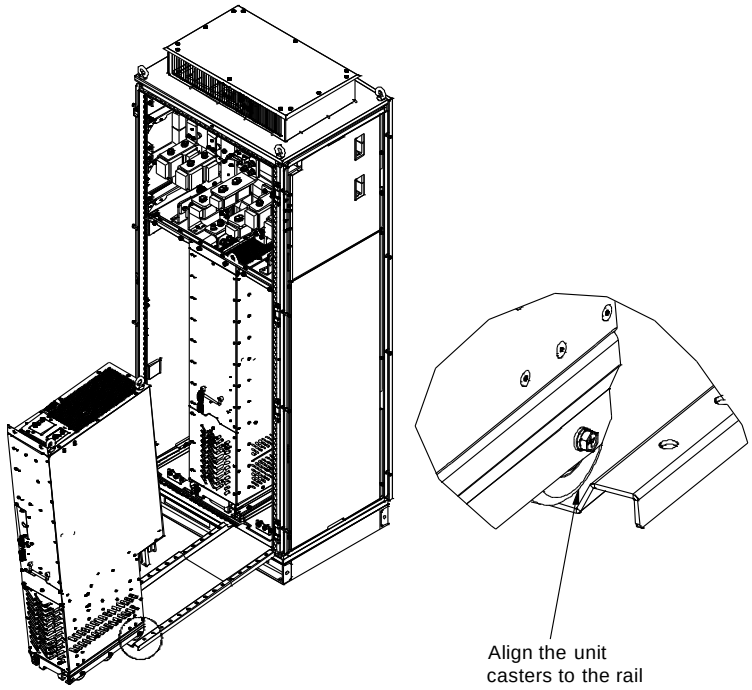
Figure 3-24 Unit entry/exit guide rail placement



2. Push the unit into the cabinet.

(1) Align the unit casters to the rail. See Figure 3-25.

Figure 3-25 Unit placement

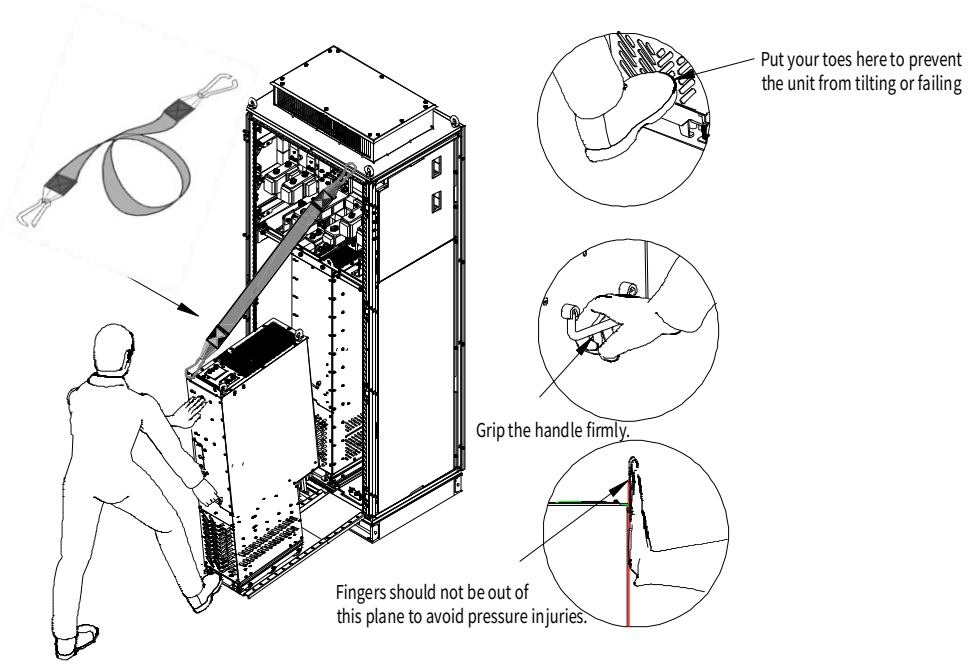


(2) Push the active rectifier unit into the cabinet slowly. See Figure 3-26.

Note:

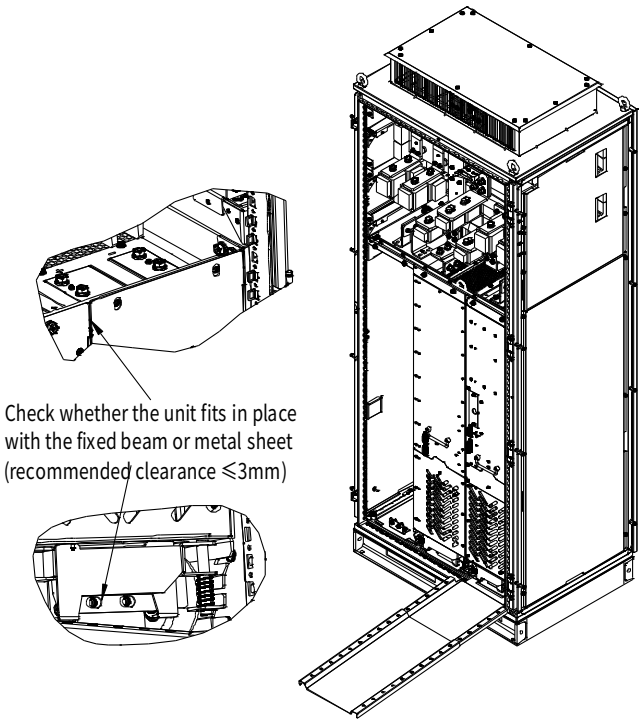
- Since the active rectifier unit barycenter is too high, use the auxiliary rope for mounting to prevent the unit from rollover during the push-in or push-out.
- When pushing in/out the active rectifier unit, use one foot to apply force to the bottom of the unit while holding the handle to prevent the unit from tipping over, falling over, hitting or injury. See Figure 3-26.
- When installing or replacing the unit, wear gloves and safety shoes to prevent against scratching or smashing.

Figure 3-26 Pushing the active rectifier unit into the cabinet



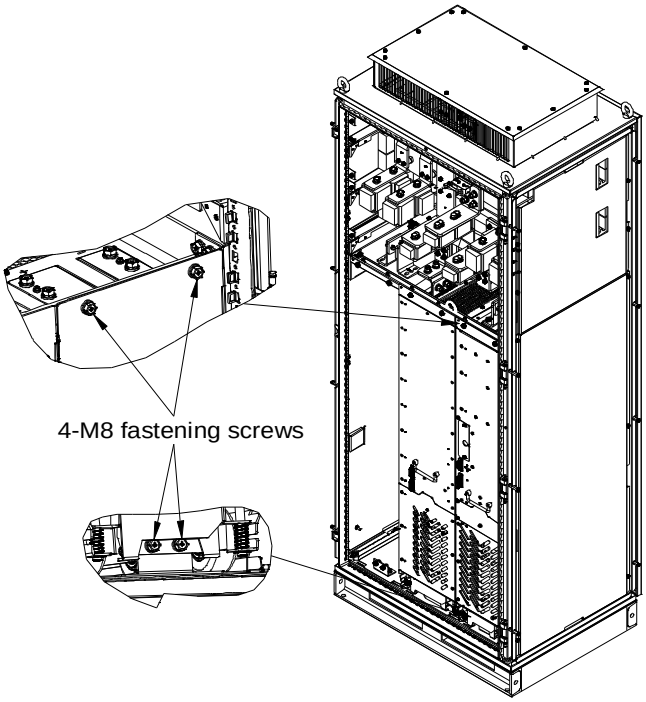
(3) Ensure that the unit is pushed into place. See Figure 3-27.

Figure 3-27 Checking whether the unit is pushed into place



(4) After confirming that the unit is pushed into place, install the unit fixing screws and remove the unit entry/exit guide rail. It is shown as Figure 3-28.

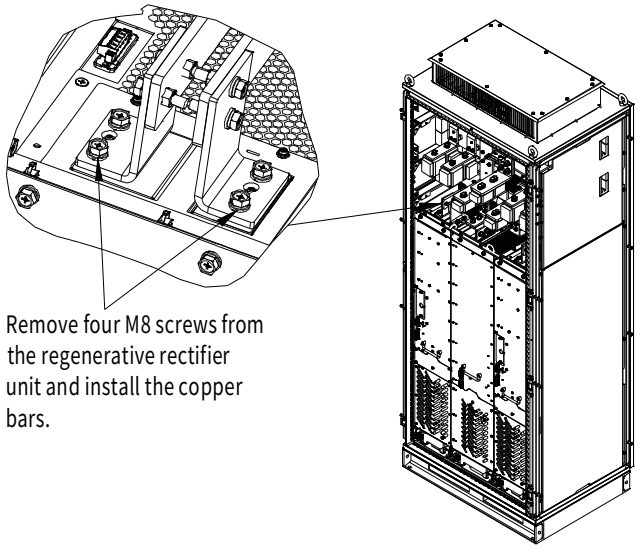
Figure 3-28 Unit fixing



(5) Install the active rectifier on the other side in the same way.

(6) Remove the copper bar fixing screws at the unit top and then install the unit-top copper bars as shown in Figure 3-29.

Figure 3-29 Installing unit-top copper bars



3.3.6.7 Keypad installation

The GD800-91 active rectifier is equipped with an externally mounted keypad (as shown in Figure 3-30), which is used with a keypad bracket that can be fixed to the cabinet door or external support sheet metal, and the keypad bracket mounting structure is shown in Figure 3-31.

Figure 3-30 LED keypad structure

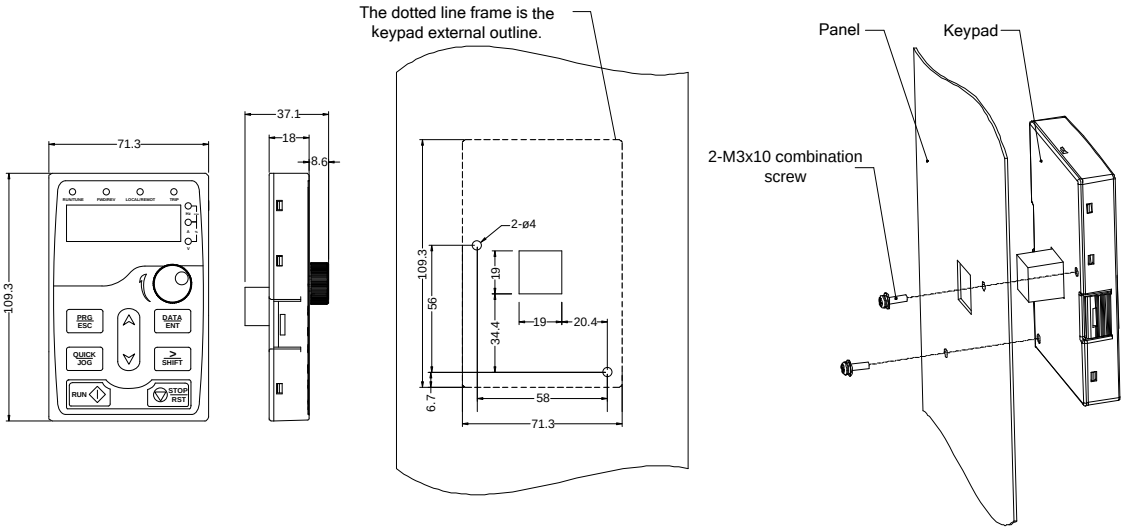
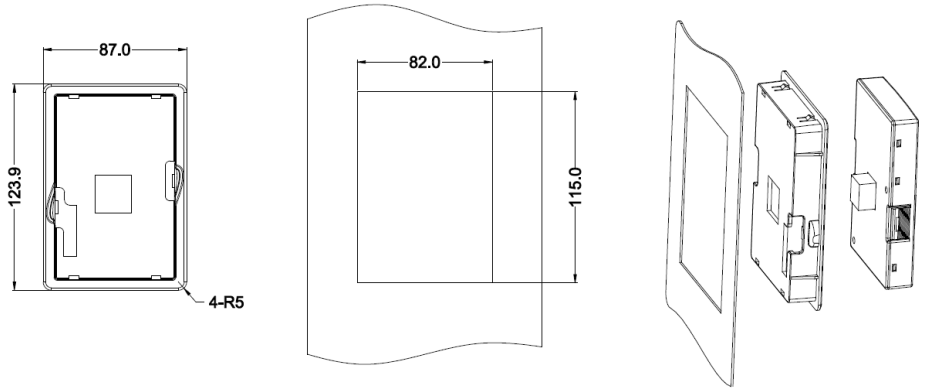


Figure 3-31 Mounting the keypad bracket



3.3.7 Fastening torque

You need the following tools to install the active rectifier 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, 400mm long

The 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

3.3.8 Checklist

No.	Operation	Compliant	Completed
1	Installed the beam for active rectifier fixing in the nine-fold profile cabinet.	☐	☐
2	Installed the bottom tray for active rectifier fixing in the nine-fold profile cabinet.	☐	☐
3	Installed the copper bars of the 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 active rectifier unit casters with the mounting guide rail and pushed the inverter unit to the cabinet. (See Figure 3-26. The auxiliary rope for mounting has been used to prevent the unit from side tipping during the push-in or push-out.)	☐	☐
6	Removed the auxiliary rope for mounting, 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 3-28.)	☐	☐
8	Installed the (+) and (-) bus copper bars.	☐	☐
9	Removed the mounting rail when you ensure the mounting 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 active rectifier, 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 active rectifier 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 15 minutes or until the DC bus voltage is lower than 36V.
- If the auxiliary control power of the active rectifier is supplied externally, disconnecting the circuit break device cannot disconnect the entire power supply. The active rectifier 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 unit.
- If the safety device on a current branch trips, check the active rectifier for the fault cause, rectify the fault, and replace the damaged parts.

4.2 Insulation inspection

Active rectifier unit and active rectifier filter unit

Before delivery, each 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 requirements

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

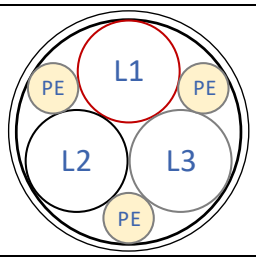
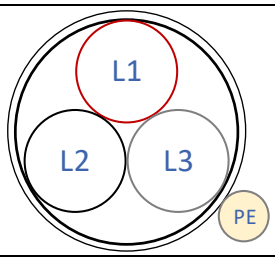
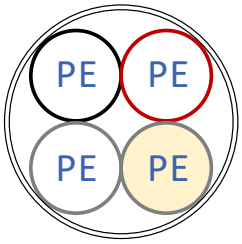
grounding. Different control system needs to use special pole grounding, different devices in the same control system needs to use common pole grounding, and different devices connected by the same power cables needs to use series-wound grounding.

This section introduces general EMC guidelines on VFDs in several aspects including noise control, site wiring and grounding for reference in site installation.

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.

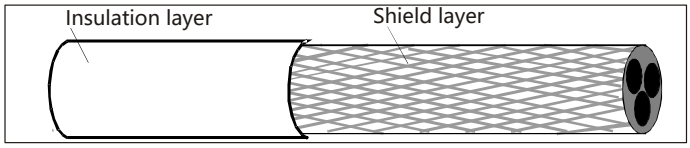
		
Symmetrical shielded cable, PEs in symmetrical manner	Symmetrical shielded cable, PE in separated manner	Asymmetrical four-core cable

Power cables mut 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 Cross-section of the cable



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.

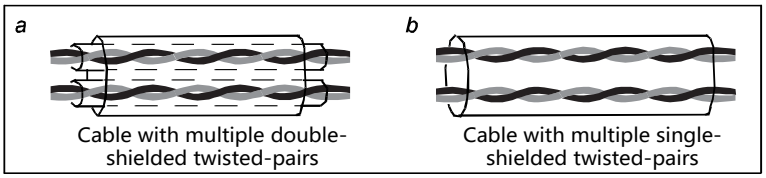
Analog signal cables need to be double-shielded twisted-pair cables (as shown in figure a). Use one separate

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 Table 4-1.

Figure 4-3 General cable arrangement rules

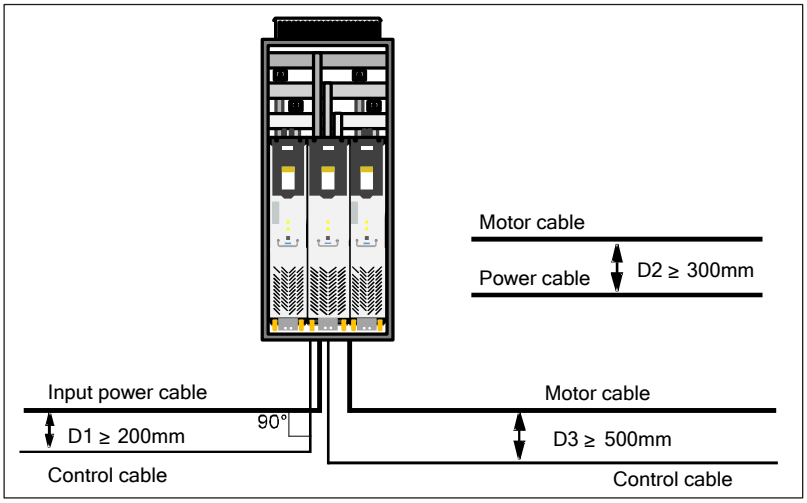


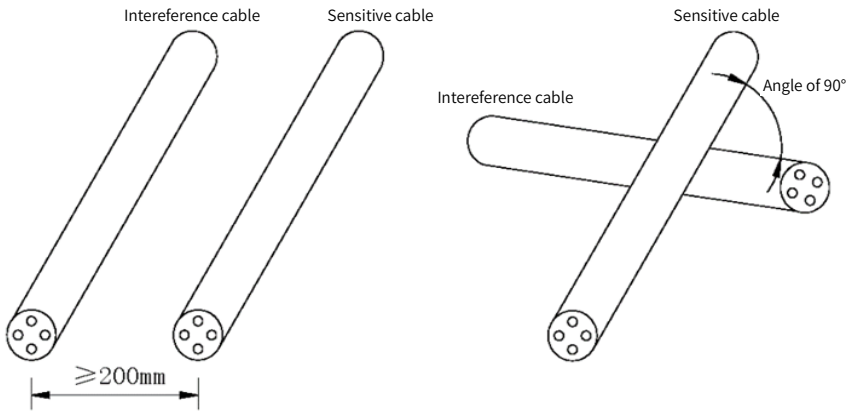
Table 4-1 Recommended values for the spacing between sensitive and interference cables

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.

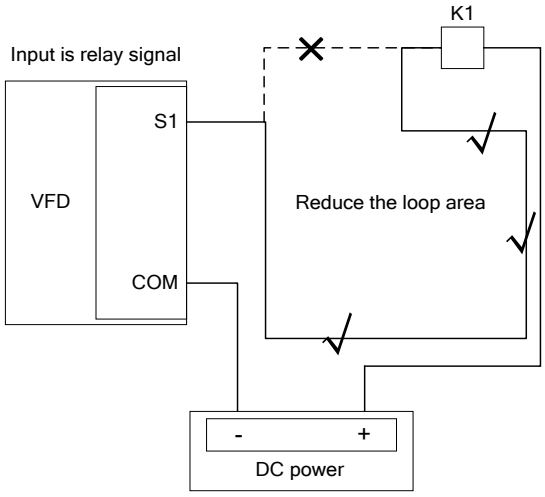
Table 4-4 Routing sensitive and interference cables



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

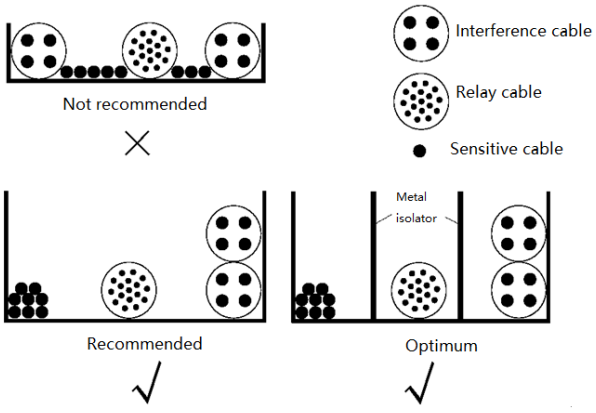
For inputs of such as relay signals and other non-differential signals, non-twisted pair cables can be used, and the wiring should minimize the loop area and a pair of signal lines should be routed as close as possible.

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

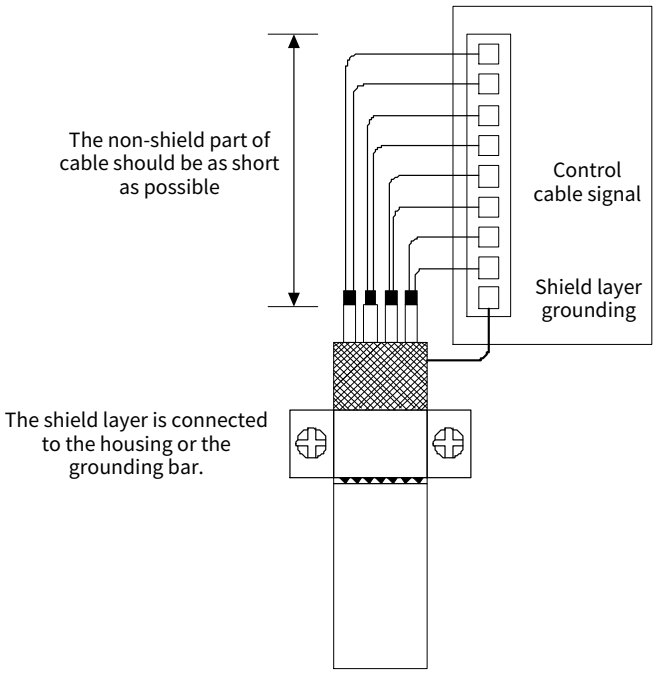


4.3.4 Shielded cable connection

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.

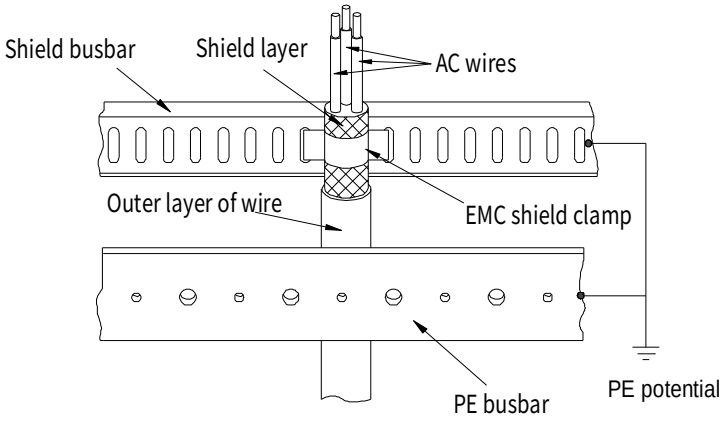
The unshielded part of the control cable that is shielded should be as short as possible, and the shield layer is connected to the nearest PE end. If the cable is stripped too long, the core is susceptible to interference of signals, especially analog, communication, and encoder signals.

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 diagram

Figure 4-9 Active rectifier unit wiring

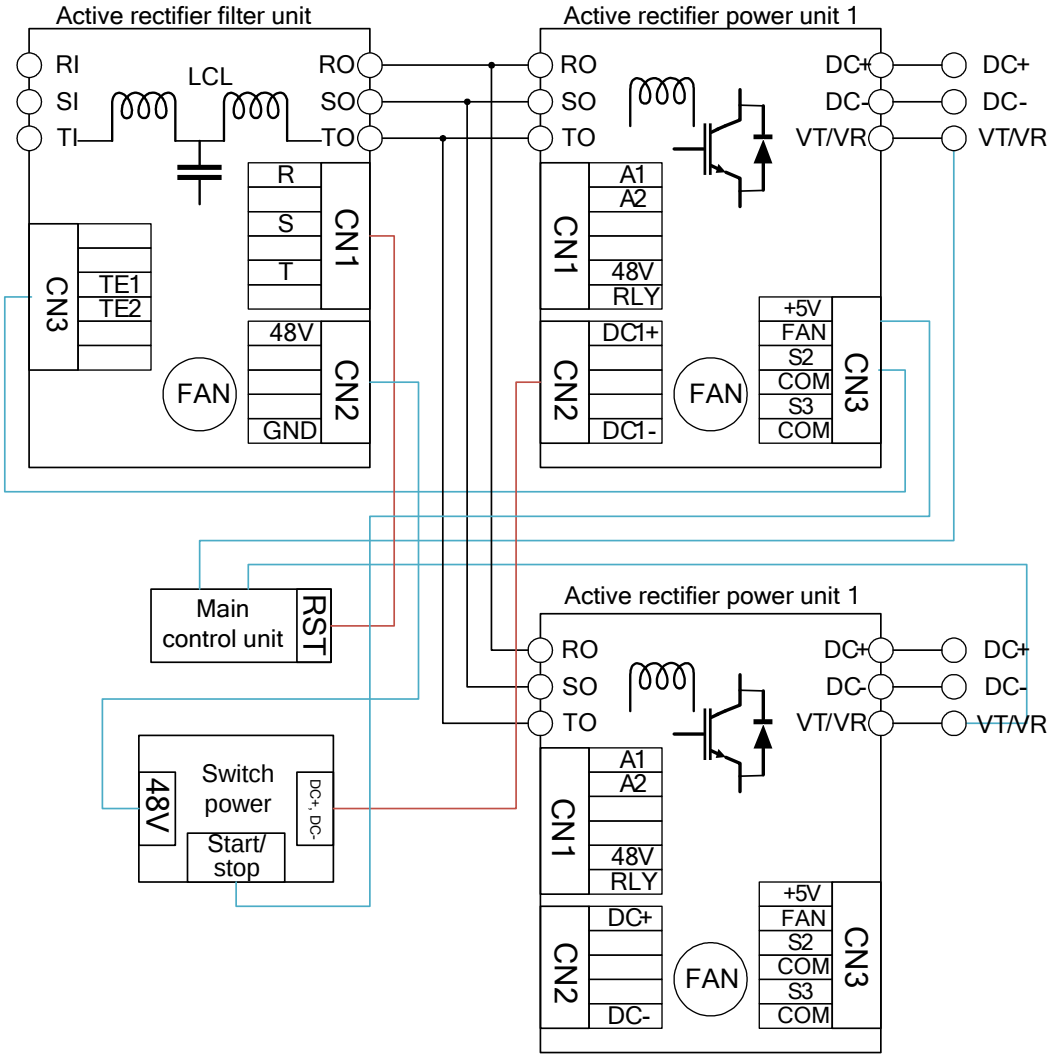


Table 4-2 Main circuit terminal description for active rectifier filter unit

No.	Terminal symbol	Description
1	RI	3PH AC input interface
	SI	
	TI	
2	RO	3PH AC output interface
	SO	
	TO	
3	R, S, T	Synchronous voltage detection. RST detection card is offered.
4	48V, GND	Fan board 48V power supply
5	TE1, TE2	Reactor over-temperature switch

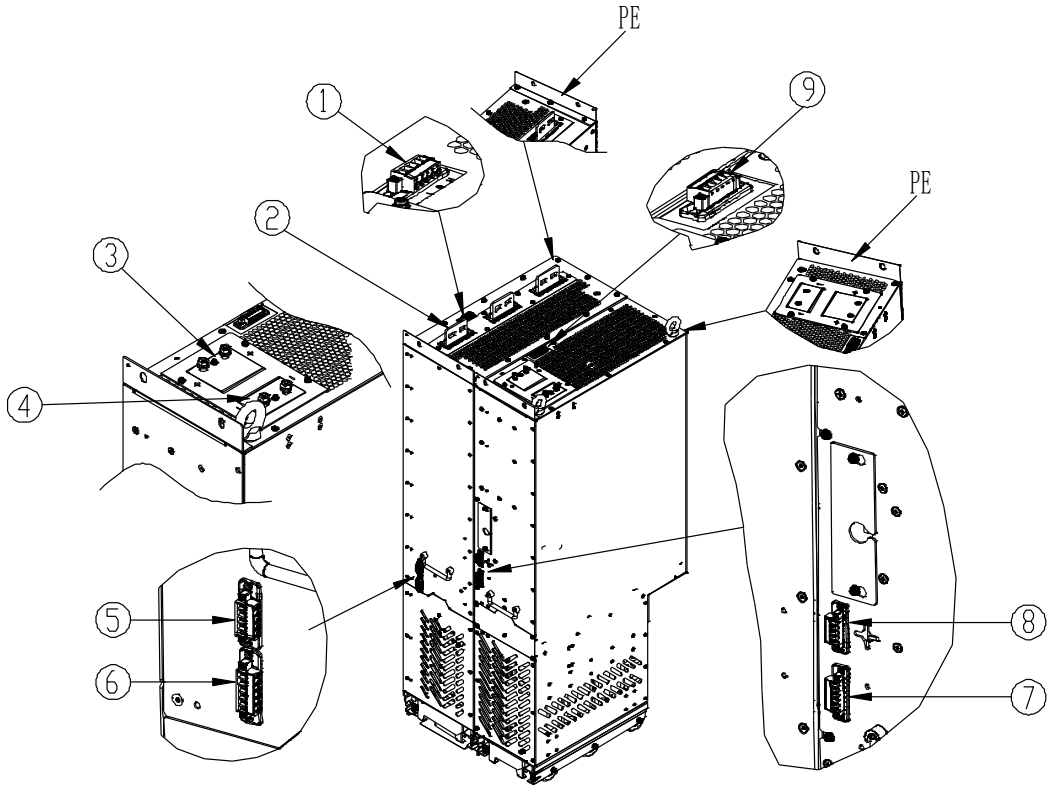
Table 4-3 Main circuit terminal description for active rectifier unit

No.	Terminal symbol	Description
1	RO	3PH AC input interface
	SO	
	TO	
2	DC+, DC-	DC bus output interface
3	VT/VR	Fiber optic interface, for optical-fiber communication between sub control and main control.
4	A1, A2	Commissioning terminal to connect the utility power 220V AC
	48V, RLY	Power unit DC buffer terminal
5	DC1+, DC1-	Fan switch power supply terminals
6	+5V, FAN	Fan control signal
	S2, COM2	Reactor over-temperature switch
	S3, COM3	Digital input interface

For details about the rectifier system electrical drawing, see Appendix D System electrical drawing.

4.4.1.2 Main circuit wiring terminals

Figure 4-10 Active rectifier filter wiring terminals

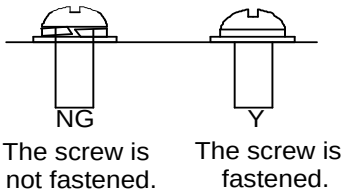


No.	Description
1	RST signal detection terminal, connected with the RST detection card in the main control box.
2	3PH input copper bars, from left to right, are: RI, SI, TI
3	DC positive pole copper bar
4	DC negative pole copper bar
5	Fan power supply terminal

No.	Description
6	LCL reactor temperature control detection signal terminal
7	Fan control signal terminal
8	Fan power supply terminal
9	DC pre-buffer terminal

4.4.1.3 Screw tightening

Figure 4-11 Screw installation requirements



4.4.2 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	Routed the control power cables and power cables separately, complying with EMC regulations.	☐	☐

5 Rectifier Control Unit (RCU)

5.1 RCU composition

Figure 5-1 RCU diagram

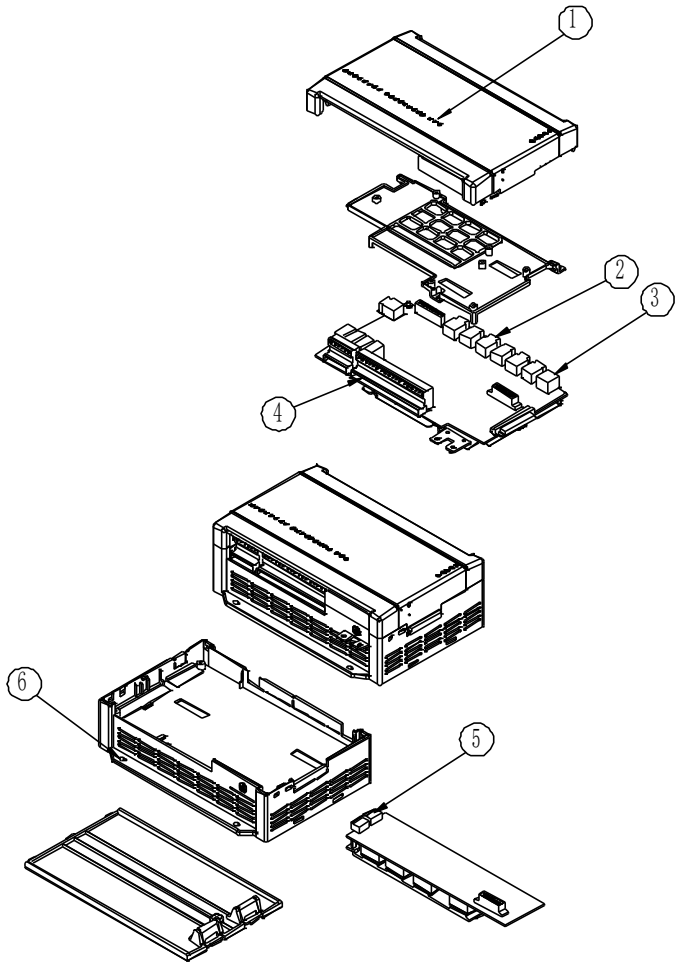


Table 5-1 Components

Symbol	Component	Function 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	User's wiring terminal	Standard input and output terminals for users
5	Power interface	24V power input terminal
6	Fixed hole	Four fixed holes

5.2 RCU size and installation

5.2.1 Preparing

1. Required tools

Phillips screwdriver may be required during installation.

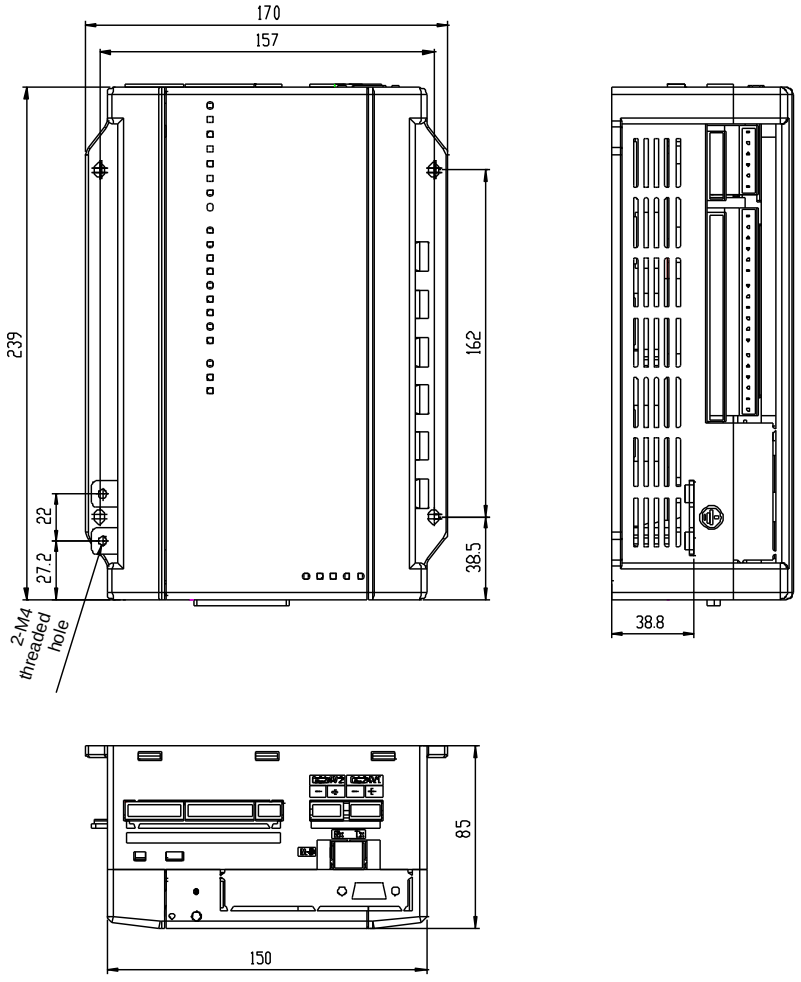
2. Fastening torque

Screws are used to install the RCU with fastening torque.

Screw	Fastening torque
M4	1.5N.M

5.2.2 RCU size

Figure 5-2 RCU dimensions (unit: mm)



5.2.3 RCU installation space

To make the RCU installation smooth, the distance between the upper and lower parts of the RCU and the building and its components should be left as shown in Figure 5-3, and the RCU must be installed on a conductive metal plate, the entire conductive bottom of the RCU must properly work with the installation surface.

Figure 5-3 RCU installation space diagram

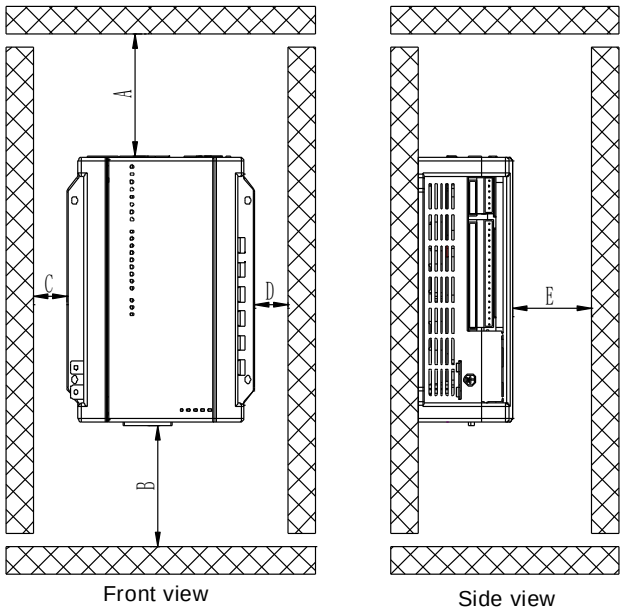


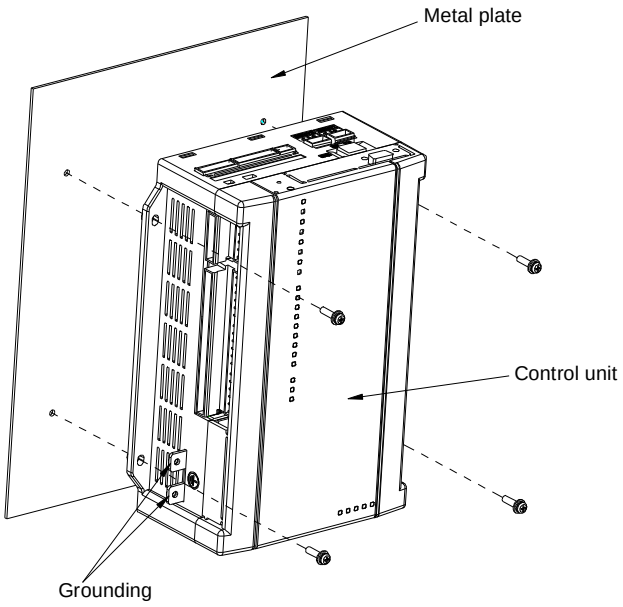
Table 5-2 Requirements on RCU installation space (unit: mm)

A	B	C	D	E
⩾100	⩾100	⩾30	⩾30	⩾100

5.2.4 RCU installation procedure

Use Phillips screwdriver to tighten the four M4 screws to fix the RCU to the metal plate as shown in Figure 5-4.

Figure 5-4 RCU installation diagram



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

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

5.3 RCU interface

Figure 5-5 RCU circuit wiring

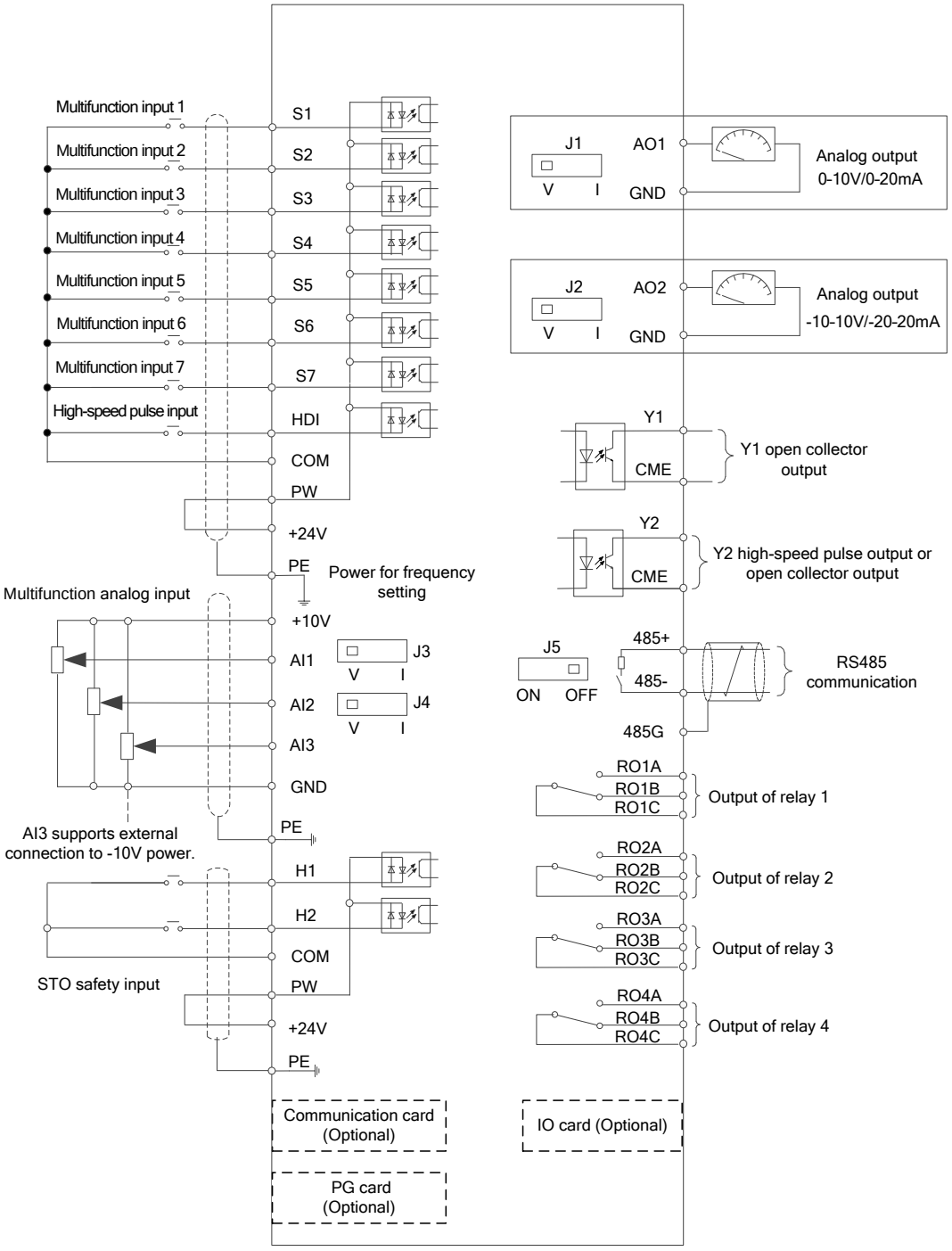


Figure 5-6 RCU interface diagram

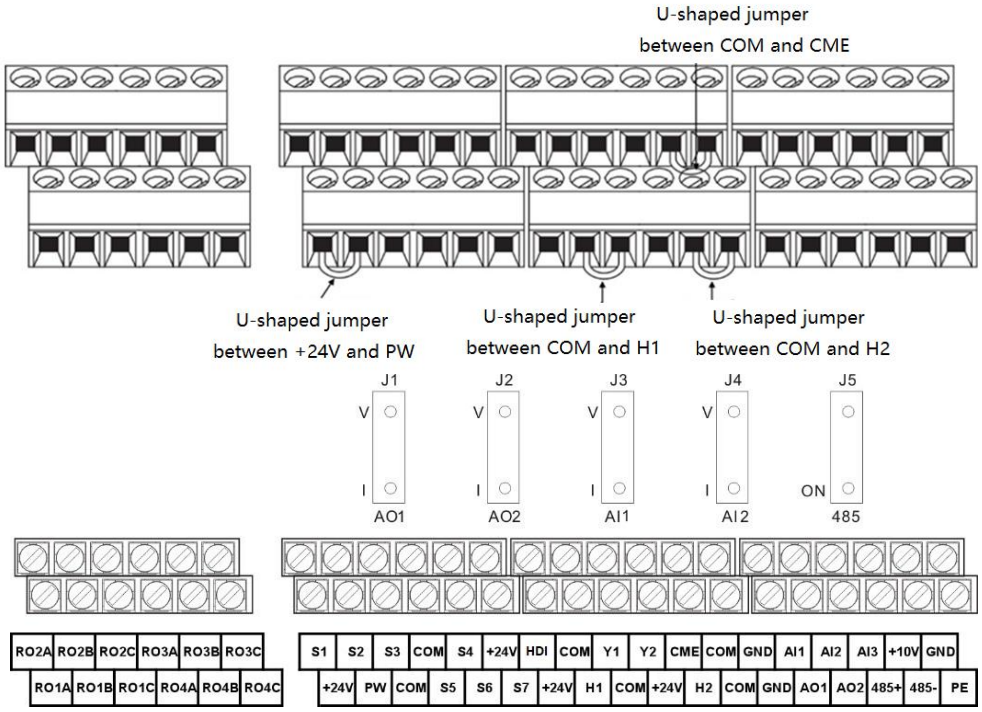


Table 5-3 RCU interface

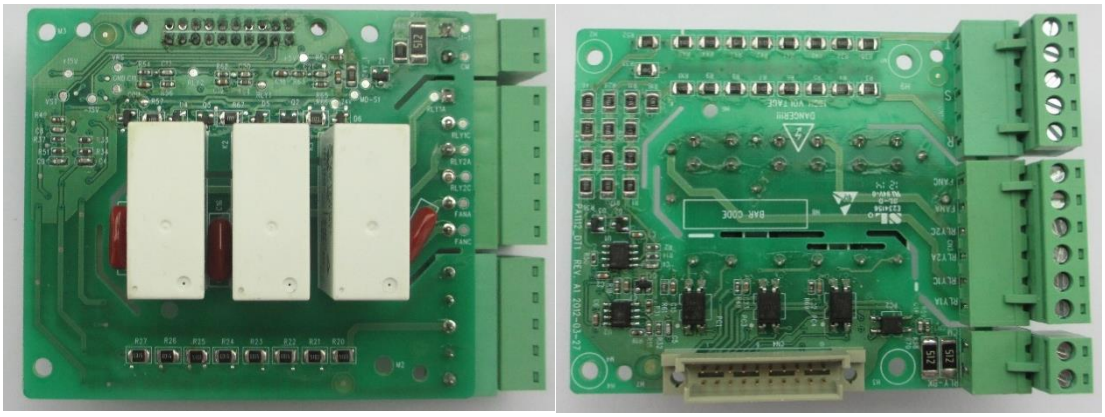
Category	Terminal symbol	Terminal name	Description
Power supply	+10V	10V power supply	10.5V reference power supply for the local machine
	+24V	24V power supply	Used to provide 24V power supply. Max. output current: 200mA.
	PW	External power	Provide the working power supply for switch input/output from external to internal Voltage range: 12–24V
	GND	Power reference ground	Reference zero potential of +10V
	COM	Reference ground of +24V	Reference ground of +24V
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	1. 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 and J2
	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 and J2
Digital input	S1	Digital input 1	1. Input impedance: 3.3kΩ

Category	Terminal symbol	Terminal name	Description
	S2	Digital input 2	2. Voltage input range: 12–30V 3. Supporting bidirectional input of NPN and PNP
	S3	Digital input 3	
	S4	Digital input 4	
	S5	Digital input 5	
	S6	Digital input 6	
	S7	Digital input 7	
	HDI	High-speed pulse input	High-speed pulse input channel 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 functions	H1	Safety input 1	It is short connected to COM by default. If safety input is required, remove the jumpers between H1 and COM and between H2 and COM.
	H2	Safety input 2	
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	
Communication	485+	RS485 communication	RS485 communication terminals, using the Modbus protocol You can choose whether to connect the 120Ω terminal resistor through J5.
	485-		

5.4 RST signal detection card

Note:

- Models of RST signal detection board: ASY01_PA1112_DT1 (400V), ASY02_PA1112_DT1 (660V).
- Note: The RST signal detection board is applicable to Goodrive800 Pro series rectifier control units.



It is installed on the back of the control board.

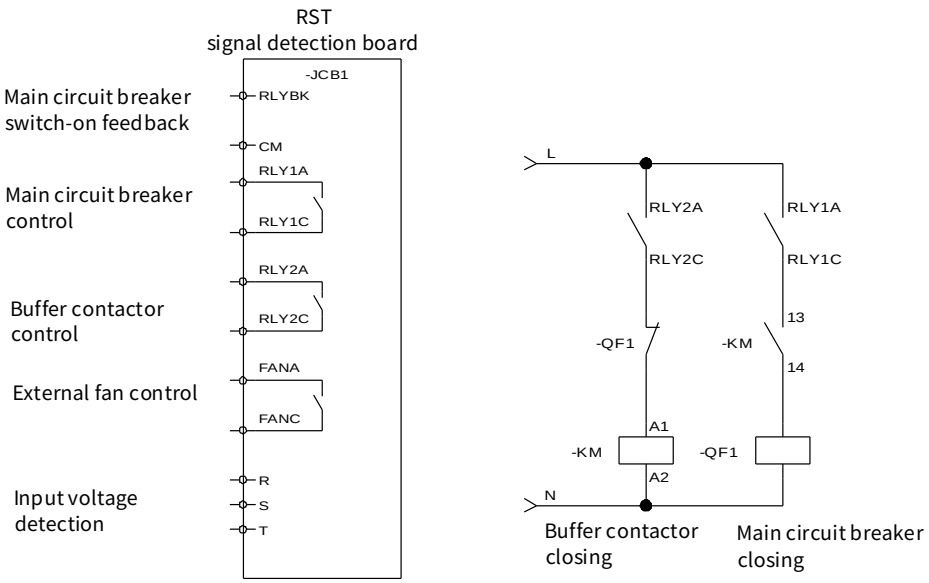
Terminal structure:

TCA	TCB	GND	PTA	PTB	PTC	PTD	FANA	FANC

Terminal description:

Terminal	Description
CM	Common terminal of main circuit breaker switch-on feedback
RLYBK	Main circuit breaker switch-on feedback signal
RLY1A	Main circuit breaker switch-on control
RLY1C	RLY1A: NO; RLY1C: common
RLY2A	Buffer contactor switch-on control
RLY2C	RLY2A: NO; RLY2C: common
FANA	External fan control
FANC	FANA is N.O. while FANC is the common terminal.
R	Input voltage R, S, T detection
S	
T	

Figure 5-7 Buffer control diagram



After power-on, system self-test is completed, and pre-charging starts after the wait time of automatic running is reached. The buffer contactor is closed by switching on the relay between RLY2A and RLY2C. After

the bus voltage pre-charging is completed, the main circuit breaker is closed and the buffer contactor is disconnected by switching on the relay between RLY1A and RLY1C, and the NO point of the main circuit breaker is closed detected by RLYBK and CM, ensuring the pre-charging is completed and waiting for the running command to start the rectifier running.

Note: The power unit needs to be connected to the 220V auxiliary power, otherwise, the optical fiber communication fault will be reported.

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 6-1Screw thread tightening torque (Fastener grade: 4.8; unit: N.m)

Screw thread specification	Copper bar connection	Metal sheet connection
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.	The requirements stated in this manual are met.
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 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 scope		Item	Method	Criterion
		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 decoloration 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 Cooling fan

6.2.1.1 Replacement of active rectifier unit cooling fan

The service life of the cooling fan of the active rectifier 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 active rectifier 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.

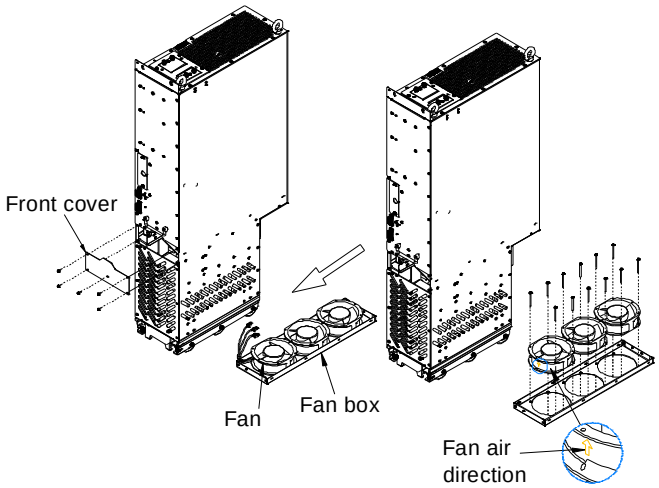
Cooling fan replacement procedures:

	Read 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.

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

2. Remove the fan module front cover from the unit housing.
3. Remove the fan module connection cable.
4. Pull out the fan box and remove the fan with a screwdriver.
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 plate. Ensure that the air direction of the fan is consistent with that of the unit, as shown in Figure 6-1.
6. Connect to the power.

Figure 6-1 Replacement of active rectifier unit fan



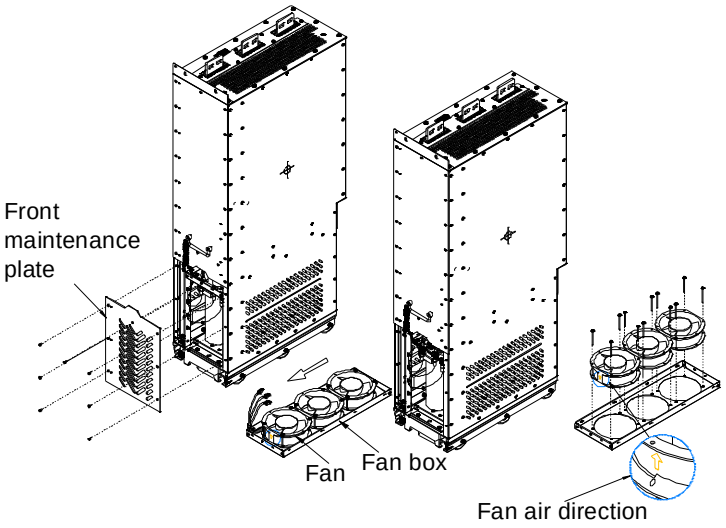
6.2.1.2 Replacement of active rectifier filter unit cooling fan

Cooling fan replacement procedures:

⚠	Read 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.

1. Stop the filter unit, disconnect the AC power supply, and wait for a time no shorter than the waiting time designated on the filter unit.
2. Remove the front maintenance plate from the unit housing.
3. Remove the fan module connection cable.
4. Pull out the fan box and remove the fan with a screwdriver.
5. Install a new fan in the fan box. Insert the fan module connection cable to the connector in reverse sequence. Install the front maintenance plate. Ensure that the air direction of the fan is consistent with that of the unit, as shown in Figure 6-2.
6. Connect to the power.

Figure 6-2 Replacement of active rectifier filter fan



6.2.2 Replacement of active rectifier filter unit filter capacitor

Filter capacitor replacement procedures:

⚠	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.

1. Stop the unit, disconnect the AC power supply, and wait for a time no shorter than the waiting time designated on the unit.
2. Remove the front maintenance plate from the unit housing.
3. Remove the 3PH cable from the front connection.
4. Remove the screws directly in front of the capacitor assembly with a screwdriver, as shown in Figure 6-3.
5. Pull out the capacitor assembly.
6. Remove the fixed copper bars and insulated PC on the capacitor assembly to replace the capacitor, as shown in Figure 6-3.
7. Install the capacitor assembly into the chassis in reverse sequence.
8. Connect to the power.

Figure 6-3 Removing front maintenance plate and cables of the active rectifier filter

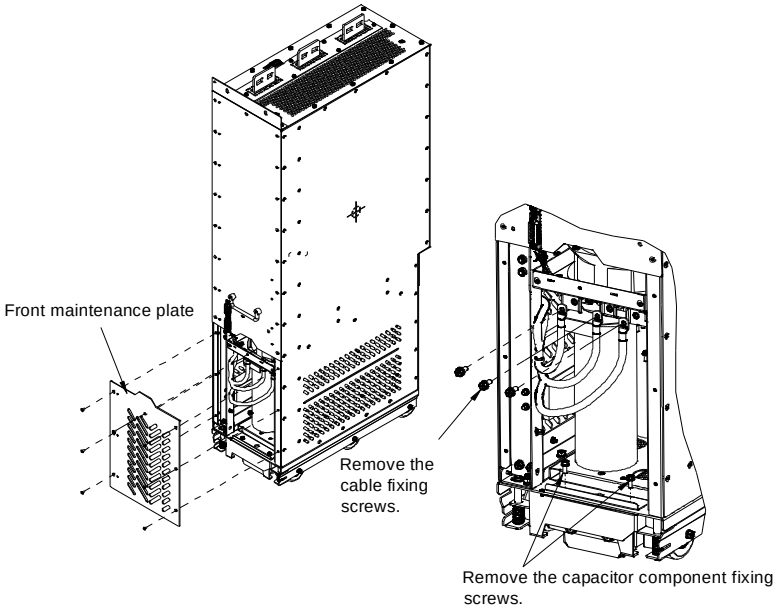
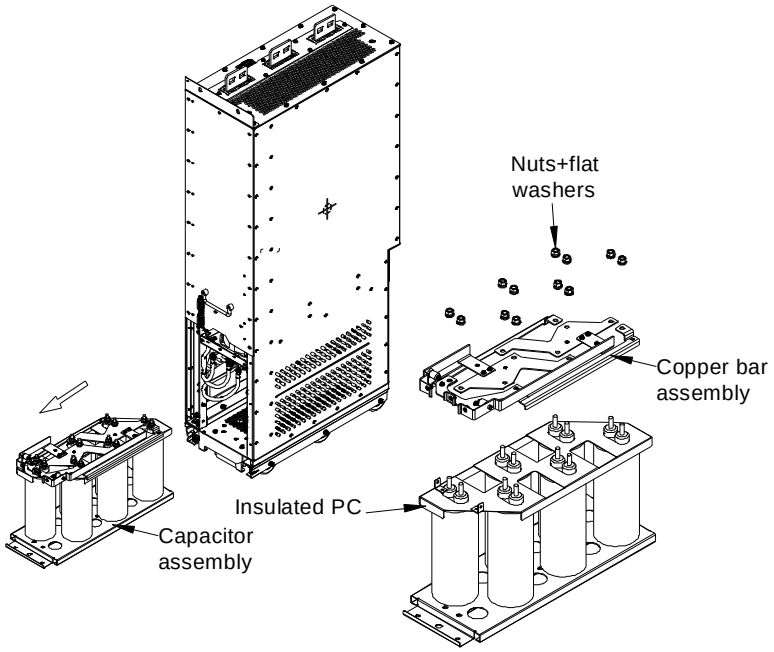


Figure 6-4 Removing capacitor assembly of the active rectifier filter



6.2.3 Fuse replacement

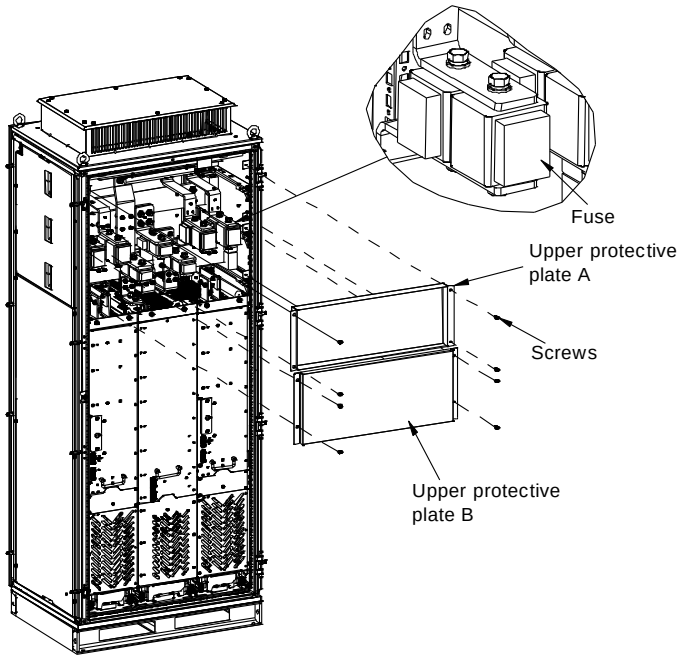
Fuse replacement procedures:

⚠	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.

1. Stop the unit, disconnect the AC power supply, and wait for a time no shorter than the waiting time designated on the unit.
2. Open the cabinet door and check to ensure there is no voltage in the machine.
3. Unscrew four screws of the upper protective plate and remove the upper protective plate.

4. Remove the upper and lower screws of the fuse. Be careful not to fall the flat washer into the cabinet. It is shown as Figure 6-5.
5. Install a new fuse into the cabinet in reverse sequence.
6. Close the cabinet door and connect to the power.

Figure 6-5 Replacing the fuse of the active rectifier filter



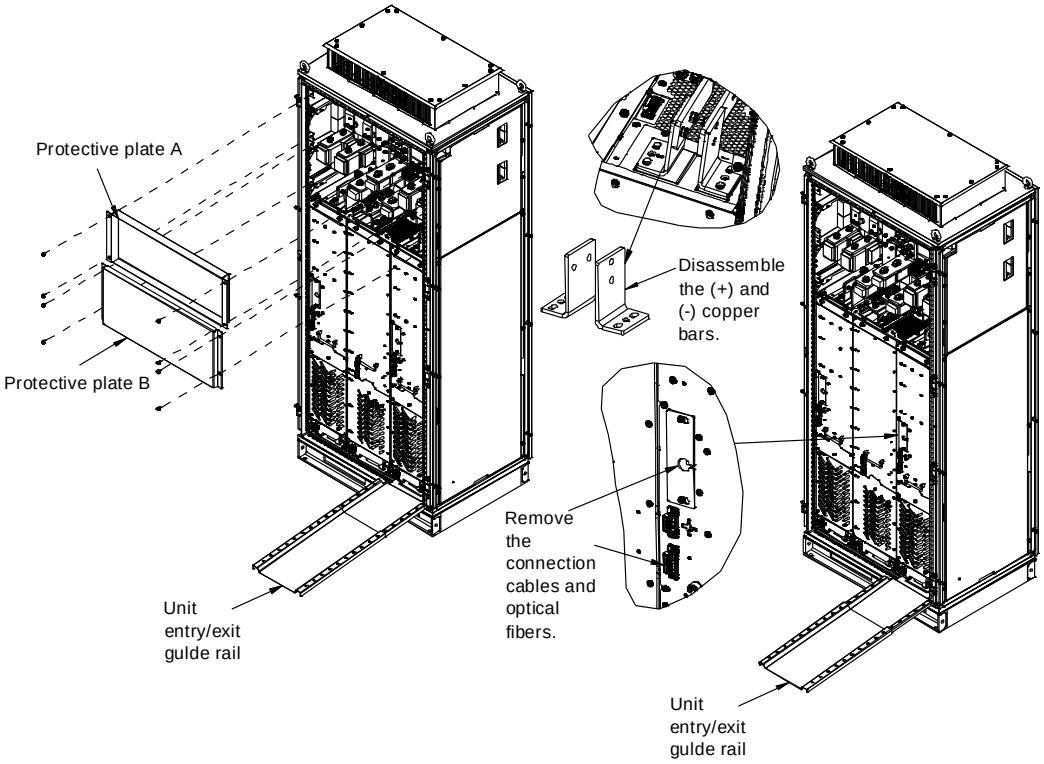
6.2. 5 Active rectifier unit

Active rectifier unit replacement procedures:

⚠	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.

1. Stop the machine and disconnect the AC power.
2. Open the cabinet door and check to ensure there is no voltage in the machine.
3. Disconnect the external connection cables of the active rectifier unit.
4. Unscrew four screws of the front protective plate and remove the front protective plate.
5. Disconnect the (+) and (-) DC output copper bars. See Figure 6-6.
6. Install the unit guide rail.
7. Remove the (four M8) fixing screws from the top and bottom of the unit.
8. Pull the unit and unfold the anti-tipping stand. See Figure 3-9.
9. Install a new active rectifier unit according to section 3.3.6.6 Unit installation and replacement.

Figure 6-6 Replacing the active rectifier unit



Appendix A Technical data

A.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.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 100kA. 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

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 environments except those in Category I.

VFD categories:

Category C1: VFD of rated voltage lower than 1000V, applied to the first environment.

Category 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.

Category C3: VFD of rated voltage lower than 1000V, applied to the second environment. They cannot be applied to the first environment.

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

A.4.1 VFD category of C2

The induction disturbance limit meets the following stipulations:

1. Select the motor and control cables according to the description in the manual.
2. Install the VFD according to the description in the manual.
3. For the maximum length of the motor cable, see section 4.3 EMC requirements.

	• The product 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:

1. Select the motor and control cables according to the description in the manual.
2. Install the VFD according to the description in the manual.
3. For the maximum length of the motor cable, see section 4.3 EMC requirements.

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

Appendix B Expansion card

B.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.2 Naming rule

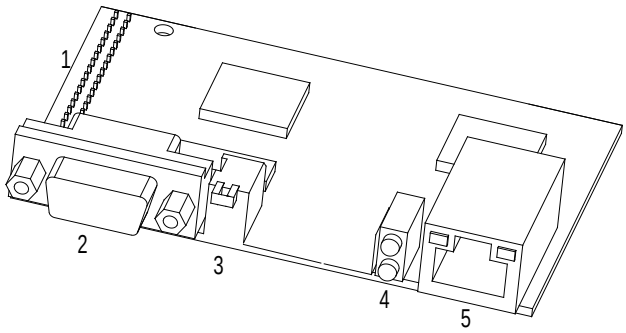
EC – TX 1 03

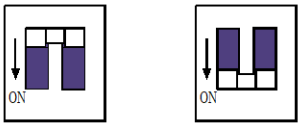
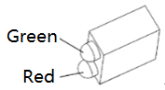
① ② ③ ④

Symbol	Illustration	Description
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.
④	Card type identification	03: PROFIBUS+ Ethernet communication card 05: CANopen+ Ethernet communication card 09: PROFINET+ Ethernet communication card

B.3 Function

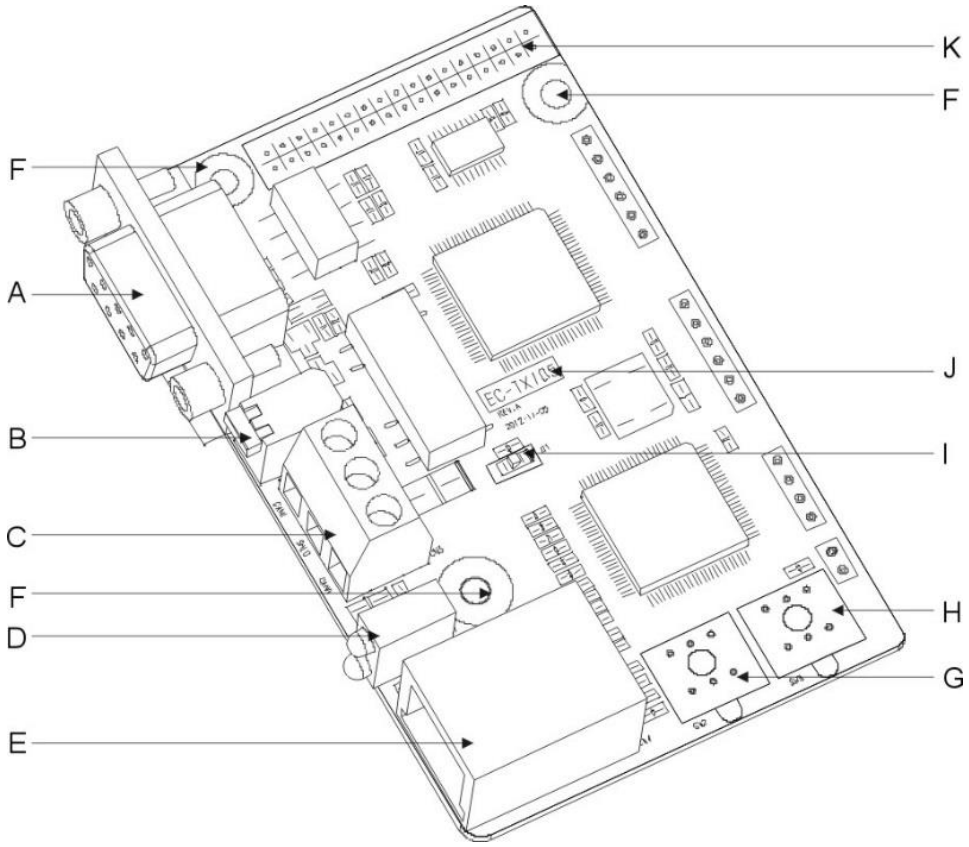
Figure B-4 EC-TX103 communication card outline

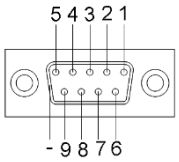
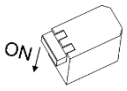
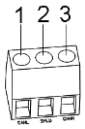
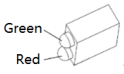


<table>
<tr><th>No.</th><th>Name</th><th>Description</th></tr>
<tr><td>1</td><td>Interface with the control board</td><td>Used to connect to the control board</td></tr>
<tr><td>2</td><td>Bus communication interface</td><td>Shielded twisted copper wire transmission is one of the most common PROFIBUS transmission means.
The connection pins are described as follows when PROFIBUS is used.
<table>
<tr><th colspan="2">Connector pin</th><th>Description</th><th colspan="2">Connector 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.
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, you must disconnect the EC-TX series communication card terminator.
Bus terminator OFF Bus terminator ON
 
</td></tr>
<tr><td>4</td><td>Status indicator</td><td>An EC-TX series module is equipped with two fault indicators.
<table>
<tr><th>Status indicator</th><th>Name</th><th>Color</th><th>Function</th></tr>
<tr><td> 
</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>
</table></td></tr>
</table>

No.	Name	Description			
			Offline/Fault	Red	On-- The module is offline and data exchange cannot be performed. Off-- The module is not in the offline state. Blinking at the frequency of 1Hz: A configuration error occurs: The length of the user parameter data set during the initialization of the module is different from that during the network configuration. Blinks at the frequency of 2 Hz: User parameter data is incorrect. The length or content of the user parameter data set during the initialization of the module is different from that during the network configuration. Blinking at 4 Hz-- An error occurs in the ASIC initialization of communication.
5	Ethernet interface	Used to access the Ethernet			

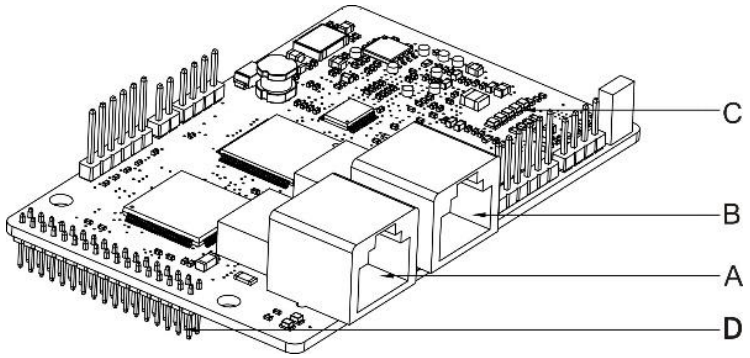
Figure B-5 EC-TX105 communication card outline

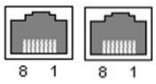


<table>
<tr><th>No.</th><th>Name</th><th>Description</th></tr>
<tr><td>A</td><td>CANopen communication interface (DB9 female end)</td><td>There are two CANopen communication interfaces, a DB9 female connector (A) and a 3-pin open interface terminal (C), either of which you can choose to use.
<table>
<tr><th>CANopen communication interface (DB9 female end)</th><th>Pin</th><th>Function</th><th>Description</th></tr>
<tr><td rowspan="9"> 
</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>CANopenterminal resistor switch</td><td>Terminal resistor switch function description.
<table>
<tr><th>Terminal resistor switch</th><th>Position value</th><th>Function</th><th>Description</th></tr>
<tr><td rowspan="2"> 
</td><td>Upward</td><td>OFF</td><td>CAN_H and CAN_L are not connected to a terminal resistor.</td></tr>
<tr><td>Downward</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
<table>
<tr><th>Status indicator</th><th>Name</th><th>Color</th><th>Indication</th><th>State</th><th>Description</th></tr>
<tr><td> 
</td><td>Run indicator (RUN)</td><td>Green</td><td>Blinking once and then off</td><td>Stop</td><td>Component in stopped state</td></tr>
</table></td></tr>
</table>

No.	Name	Description					
					Blinking	Pre-operation	Component in pre-operation state
					On	Operation	Component in operating state
					Dark	Fault	Check whether the communication card reset pin and power supply connection.
			Error indicator (ERROR)	Red	Dark	No fault	Component in operating state
					On	Bus off or VFD fault	The CAN controller bus is off or a fault occurs on the VFD.
					Blinking	Initialization error	Incorrect address setting.
					Blinking once	Frame fault	Received frame lost or incorrect.
E	Ethernet interface	Used to access the Ethernet					
F	CANopen high address knob (Reserved)	**Note:** The two address knobs are not installed, and communication addresses are set through function codes.					
G	CANopen low address knob (Reserved)						
H	Communication card power indicator	-					
I	Interface with the control board	Used to connect to the control board					

Figure B-6 EC-TX109 communication card outline



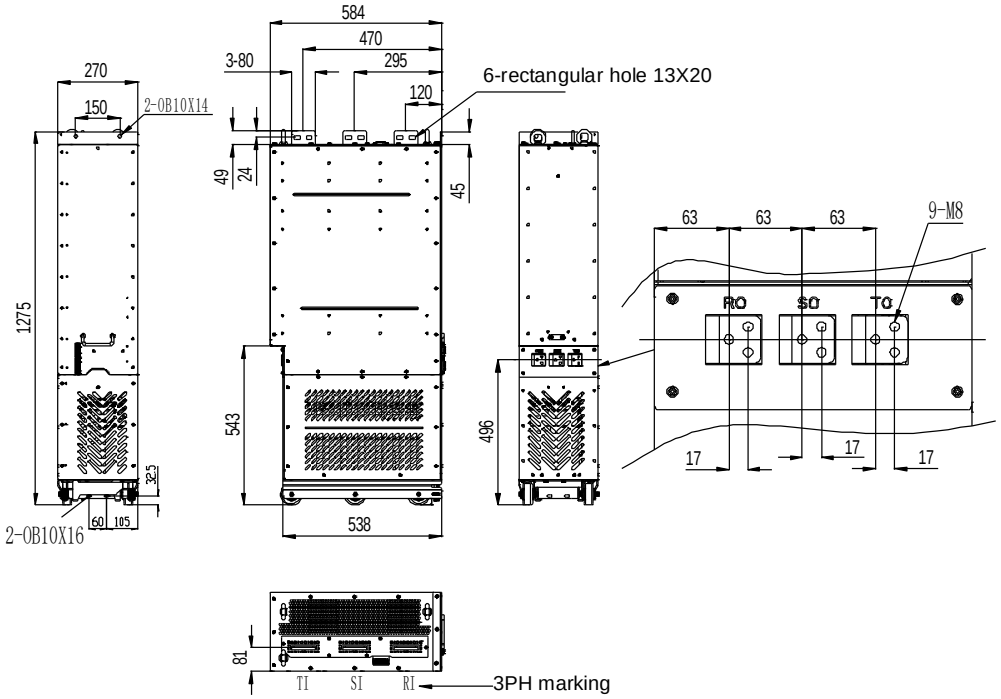
<table>
<tr><th>No.</th><th>Name</th><th>Description</th></tr>
<tr><td>A</td><td>Ethernet interface 1 for PROFINET communication</td><td rowspan="2">The PROFINET communication card uses two standard RJ45 interfaces, which do not distinguish the direction and can be swappable.
 

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>State</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 connection to the network cable 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>
<tr><td>D</td><td>PROFINET communication card interface pins</td><td>Used for hard connection with the main control box</td></tr>
</table>

Appendix C Dimension drawings

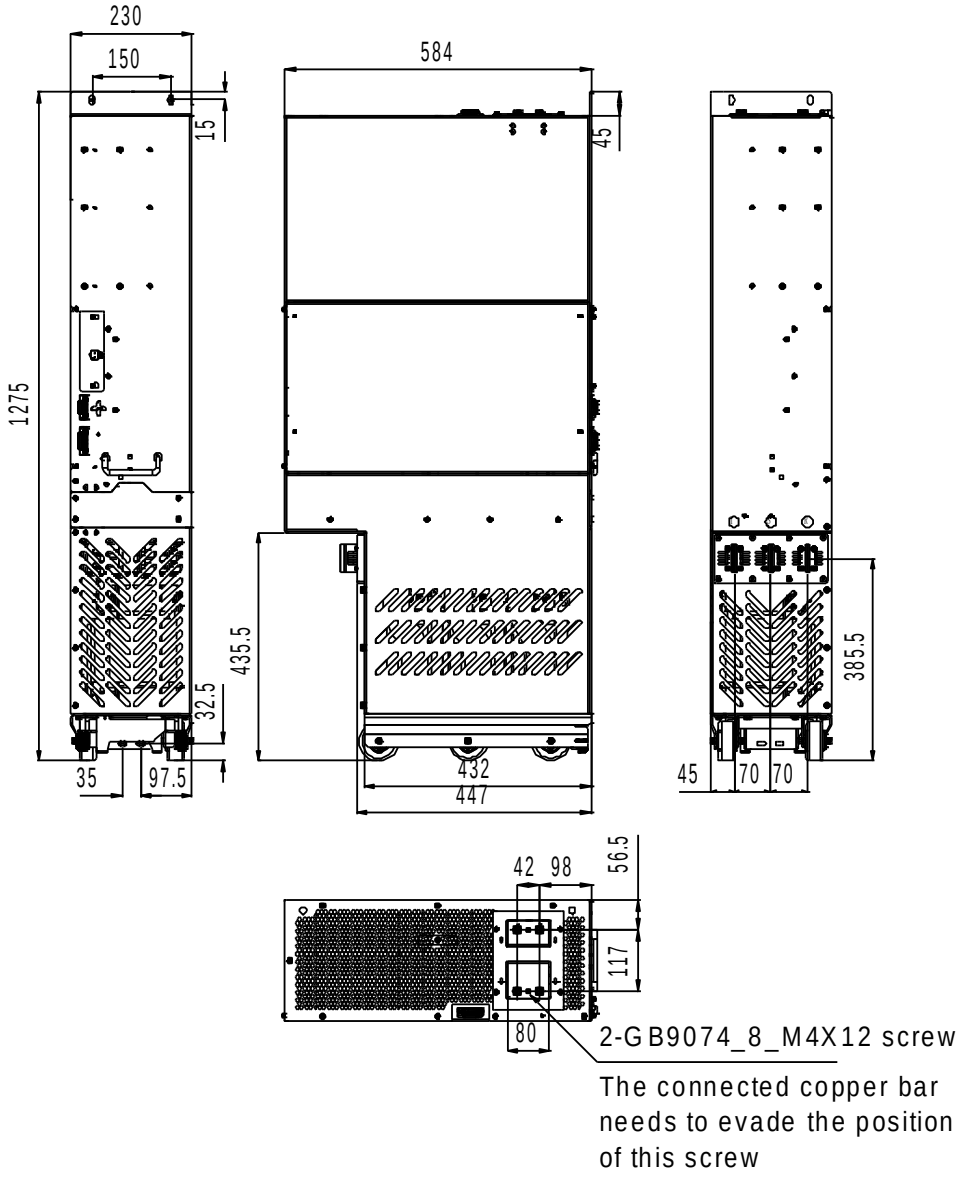
The following figure shows the dimension drawings of the active rectifier filter unit.

Figure C-1 Installation dimensions (unit: mm)



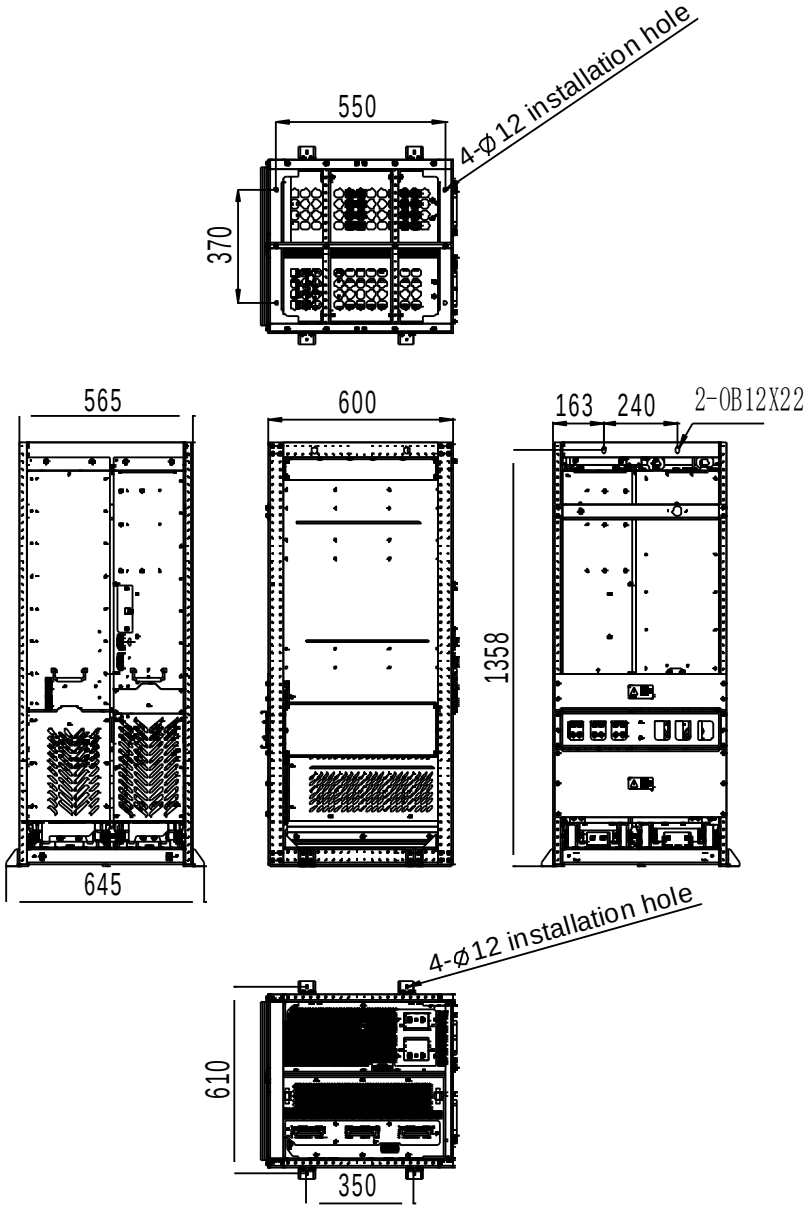
The following figure shows the dimension drawings of the active rectifier unit.

Figure C-2 Installation dimensions (unit: mm)



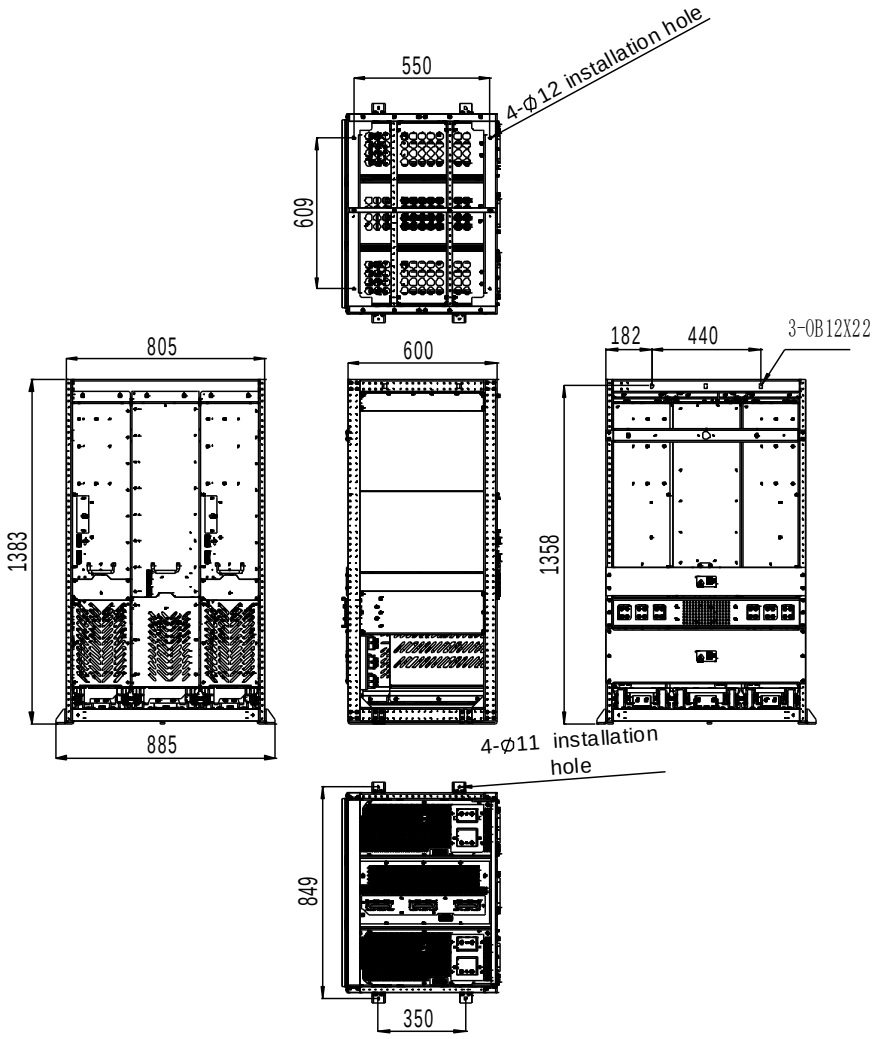
The following figure shows the dimension drawings of the active rectifier frame (LCL+*A8).

Figure C-3 Installation dimensions (unit: mm)

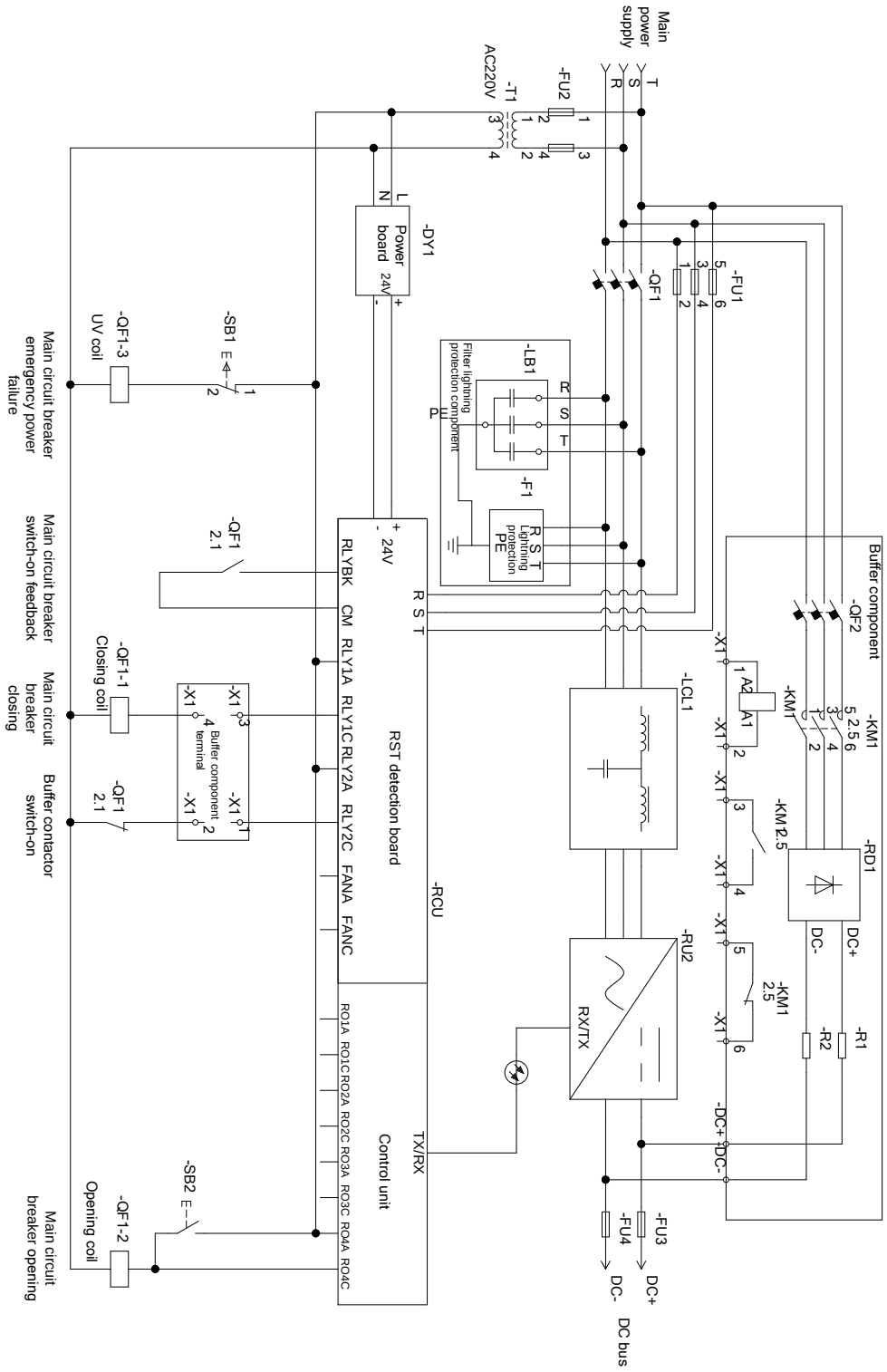


The following figure shows the dimension drawings of the active rectifier frame (LCL+2*A8).

Figure C-4 Installation dimensions (unit: mm)



Appendix D System electrical drawing



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