

Hardware Guide

MD880-20 Series Basic Rectifier Module



Preface

Thank you for purchasing the MD880 high-performance multidrive system.

The MD880 sets a new industry benchmark in terms of module structure, power density, response speed, control accuracy, and scope of application.

Highlights:

- Voltage class: 400/690 V
- Rated power range: 3.7–5600 kW
- Complete rectifier module types: basic rectifier, regenerative rectifier, and active rectifier
- Drive control of asynchronous induction motors and synchronous motors
- Excellent dynamic response and control accuracy

Scope of application:

■ Metallurgy

High-speed wire rod and continuous hot steel strip rolling equipment, wide and thick plate equipment, cold rolling mill, pickling line, annealing line, galvanizing line, color coating line, non-ferrous metal alloy manufacturing equipment, and non-ferrous metal rolling equipment

■ Papermaking

Paper machines, including continuous production lines such as headbox, wire section, press section, drying section, sizing, hard calendering, coating, supercalender, and rewinding machine

■ Harbor equipment and other large lifting equipment

Shore container bridge crane, rubber-tired (rail type) container gantry crane, grab ship unloader, grab door seat crane, large shipbuilding gantry crane, and large metallurgical casting crane

■ Ships

Marine electric propulsion engine and auxiliary machine system, and installation ships

■ Cables

Large frame stranding machine, coiling machine, and large copper/aluminum multi-motor drawing machine

■ Others

Wind power converter, unit test bench, power low-voltage control, oil and gas transportation, and mine transmission

The MD880-20 series is the basic rectifier module in the MD880 system, with stand-alone power up to 475–929 kW and maximum parallel power up to 5183 kW. Thanks to simple structure and high integration, the basic rectifier module allows for convenient assembly and maintenance, better utilization of the cabinet space, fewer cabinets, and less space occupation.

This guide describes the hardware of the MD880-20, covering safety instructions, product information, mechanical and electrical installation, control module, maintenance and inspection, and ordering guidance. Read this guide carefully before first-time use. If you have any questions about product functions or performance, consult the technical support personnel of Inovance.

Precautions
◆ The drawings in this guide sometimes show the product without covers or protective guards to display more details. Remember to install the covers or protective guards as specified first, and perform operations following the instructions. ◆ The drawings in this guide apply only to the MD880-20 series basic rectifiers. They are shown for illustration only and may not match the product you purchased. ◆ The information in this guide is subject to change without notice due to product upgrade, specification modification as well as efforts to increase the accuracy and convenience of the guide. ◆ If you have any questions about the use, contact the regional agents or customer service center of Inovance.

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1 Safety Instructions

In this guide, the safety precautions are classified based on the level of danger:

 **DANGER** : Indicates that failure to comply with the instructions will result in severe personal injuries or even death.

 **CAUTION** : Indicates that failure to comply with the instructions may result in moderate or minor personal injuries or equipment damage.

Before installing, commissioning and maintaining this system, read this chapter carefully. Observe the safety precautions specified in this chapter during operations. Inovance is not liable for any personal injuries or property damage caused by improper operations.

1.1 Safety Precautions

1) Before installation

Safety Precaution	
 DANGER	◆ Handle the basic rectifier module with care to prevent damage. ◆ Do not use the damaged basic rectifier module or basic rectifier module with missing components. Failure to comply may result in personal injury or equipment damage.
 CAUTION	◆ Do not install the basic rectifier module if you find water seepage, component missing, or damage upon unpacking. ◆ Do not install the basic rectifier module if the packing list is inconsistent with the equipment you received. ◆ Do not touch the components of the control system with your hands. Failure to comply will cause electrostatic damage.

2) Installation

Safety Precaution
 DANGER ◆ Install the basic rectifier module on flame-retardant objects such as metal, and keep it away from combustible objects. Failure to comply may result in a fire. ◆ Do not loosen the fixing bolts on the basic rectifier module randomly, especially those marked in red.
 CAUTION ◆ Do not drop conductors (such as wire ends and screws) or other foreign objects into the basic rectifier module. Failure to comply may result in damage to the module. ◆ Install the basic rectifier module in a location that can ensure good heat dissipation.

3) Wiring

Safety Precaution
 DANGER ◆ Wiring must be performed only by qualified electrical engineers under the instructions described in this guide. Failure to comply may result in severe danger. ◆ Before wiring, confirm that the basic rectifier module is de-energized. Failure to comply will result in an electric shock. ◆ Ground the basic rectifier module correctly according to the requirements. Failure to comply will result in an electric shock. ◆ Pay attention to the terminal signs to prevent incorrect wiring. Failure to comply will cause rectifier damage. ◆ Ensure that the wiring satisfies the EMC requirements and local safety standards. Use the cables with diameters recommended in this guide. Failure to comply may result in accidents. ◆ Do not connect the braking resistor between terminals (+) and (-) of the DC bus. Failure to comply will result in a fire.

4) Before power-on

Safety Precaution
 DANGER ◆ Before power-on, install the basic rectifier module in a cabinet and close the cabinet door. Failure to comply may result in an electric shock. ◆ Connect all peripherals according to the wiring instructions provided in this guide. Failure to comply will result in accidents.
 CAUTION ◆ Confirm that the voltage class of the input power supply is consistent with the rated voltage class of the basic rectifier module. ◆ Confirm that the power input terminals (R, S, T) and output terminals (+, -) are properly connected, that no short circuit occurs in peripheral circuits, and that the peripheral wiring is secured. Failure to comply will result in damage to the basic rectifier module. ◆ Do not perform the voltage withstand test for any part of the basic rectifier module because such a test has been done before delivery. Failure to comply will cause accidents.

5) After power-on

Safety Precaution
 DANGER ◆ Do not open the cover after power-on. Failure to comply will result in an electric shock. ◆ Do not touch the basic rectifier module and peripheral circuits with wet hands. Failure to comply will result in an electric shock. ◆ Do not touch any I/O terminals of the basic rectifier module. Failure to comply will result in an electric shock. ◆ The system implements a self-test when it is powered on. In this case, never touch the high-voltage circuits of the basic rectifier module. Failure to comply will result in an electric shock. ◆ Do not change the factory parameters of the basic rectifier module without permission. Failure to comply may result in equipment damage.

6) Operation

Safety Precaution	
 DANGER	◆ Only qualified personnel are allowed to perform signal detection during operation. Failure to comply may result in personal injury or equipment damage.
 CAUTION	◆ Make sure that no foreign object falls into the basic rectifier module during operation. Failure to comply may result in equipment damage.

7) Maintenance

Safety Precaution	
 DANGER	◆ Do not maintain or repair the basic rectifier module in the energized state. Failure to comply will result in an electric shock. ◆ Make sure that maintenance and repair are performed only when the rectifier voltage falls below the safe voltage (36 V). It is recommended to wait 15 minutes after power-off. Otherwise, the residual charge in the capacitor will cause personal injury. ◆ Maintenance and repair can be performed only by well-trained personnel. Failure to comply may result in personal injury or equipment damage. ◆ After replacing the basic rectifier module, check and set the parameters again. All pluggable devices must be operated in the de-energized state.

1.2 General Precautions

- 1) Do not frequently power on and then off the basic rectifier module to avoid a reduction in its service life.
- 2) Warning signs are labeled on the front side of the basic rectifier module. Be sure to observe the warning signs when using the module.
 - Only qualified personnel are allowed to perform maintenance.
 - Cut off all power supplies and wait 15 minutes before maintenance.
 - Before maintenance, read ["6 Maintenance and Servicing" on Page 69](#) thoroughly.
- 3) Application
 - If you need to use this product for special purposes such as manned mobile

equipment, medical field, aerospace, nuclear power, electric power, or submarine repeater communication equipment, contact our agents or head of sales.

- This product is manufactured under strict quality control. However, if you intend to use it in equipment where a failure of this product can cause a major accident or loss, configure a safety device.

4) Compatible loads

- Use this product together with the MD880 series inverter module.
- Select a proper basic rectifier module according to the rated current of the load.
- Perform an insulation resistance test when the load and cables are newly installed or during routine maintenance.
- During the insulation resistance test, completely disconnect the basic rectifier module from the tested parts.

5) Use outside the rated voltage

Use the basic rectifier module within the permitted operating voltage specified in this guide. Failure to comply will cause damage to the components inside the module. If required, use a corresponding voltage step-up or step-down device.

6) Altitude and de-rating

De-rate the basic rectifier module if it is used in a place higher than 1000 m where the cooling effect becomes weaker due to thin air.

7) Disposal

The electrolytic capacitors on the PCBs may explode when they are burnt, and poisonous gases will be generated when the plastic parts are burnt. Treat them as industrial waste.

2 Product Information

2.1 Overview

The MD880-20 is a general-purpose low-voltage basic rectifier module developed by Inovance. It features high power density, compact structure, and high reliability. The voltage class of this product covers 400 V and 690 V, with rated stand-alone power ranging from 475 kW to 929 kW. By paralleling multiple modules, higher rated output power (up to 5183 kW) can be achieved, which is provided to one or more inverter modules.

2.2 Model Number and Nameplate

<u>MD880</u>		-	<u>20M</u>		-	<u>0982</u>		-	<u>4</u>	
Code 1	Product Series		Code 2	Unit Type		Code 3	Rated Current		Code 4	Voltage Class
MD880	MD880 AC drive series		20 M	Basic rectifier module		0982	982 A (AC)		4	Three-phase 400 VAC
									7	Three-phase 690 VAC

Figure 2-1 Model number

Note: In "Code 3", only one current rating is listed for illustration.

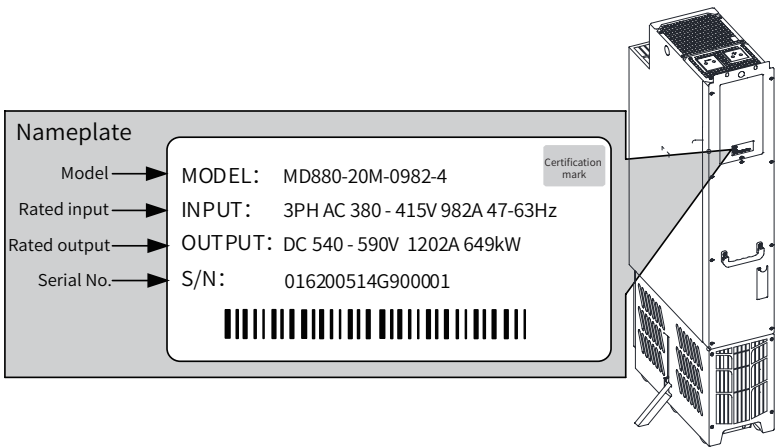


Figure 2-2 Nameplate

2.3 Voltage and Power Rating

Table 2-1 Voltage and power rating of the MD880-20 series basic rectifier module

Rated Voltage	Rated Current	Output Voltage	Rated Power	Max. Weight	Thermal Design Power	Dimensions (Width x Depth x Height))
VAC	A (AC)	VDC	kW (DC)	kg	kW	mm
400 V system: 380–415	718	540–590	475	180	3.52	230 x 602 x 1393
	982		649	182	5.12	230 x 602 x 1393
690 V system: 525–690	570	740–975	650	184	2.96	230 x 602 x 1393
	815		929	195	4.32	230 x 602 x 1393

2.4 Specifications and Model Selection

The MD880-20 is available in two voltage classes. The following table lists the specific models and specifications.

Table 2-2 Model table of the MD880-20 series basic rectifier module

Model	No Overload					Light Overload		Heavy Overload		Frame
	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	A (DC)	kW	A (DC)	kW	
UN = 400 V (380–415 V), ±10% (-15%, < 1 min), rated power: 400 V										
6-pulse										
MD880-20M-0718-4	718	879	1142	497	475	844	456	659	356	T2
MD880-20M-0982-4	982	1202	1562	680	649	1154	623	901	487	T2
MD880-20M-1336-4	1336	1635	2126	926	883	1570	848	1226	662	2 x T2
MD880-20M-1826-4	1826	2235	2905	1265	1207	2146	1159	1676	905	2 x T2
MD880-20M-2739-4	2739	3352	4358	1898	1810	3218	1738	2514	1358	3 x T2
MD880-20M-3651-4	3651	4469	5809	2529	2413	4290	2317	3351	1810	4 x T2
MD880-20M-4564-4	4564	5586	7262	3162	3016	5363	2896	4190	2262	5 x T2
MD880-20M-5477-4	5477	6704	8715	3794	3620	6435	3475	5028	2715	6 x T2
12-pulse										
MD880-20M-1336-4	1336	1635	2126	926	883	1570	848	1226	662	2 x T2
MD880-20M-1826-4	1826	2235	2905	1265	1207	2146	1159	1676	905	2 x T2
MD880-20M-2674-4	2674	3273	4255	1853	1767	3142	1697	2455	1325	4 x T2
MD880-20M-3651-4	3651	4469	5809	2529	2413	4290	2317	3351	1810	4 x T2

Model	No Overload					Light Overload		Heavy Overload		Frame
	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	A (DC)	kW	A (DC)	kW	
MD880-20M-4008-4	4008	4906	6377	2777	2649	4709	2543	3679	1987	6 x T2
MD880-20M-5477-4	5477	6704	8715	3794	3620	6435	3475	5028	2715	6 x T2
UN = 690 V (525–690 V), $\pm 10\%$ (-15%, < 1 min), rated power: 690 V										
6-pulse										
MD880-20M-0570-7	570	698	907	681	650	670	624	523	487	T2
MD880-20M-0815-7	815	998	1297	974	929	958	892	748	697	T2
MD880-20M-1061-7	1061	1299	1688	1268	1210	1247	1161	974	907	2 x T2
MD880-20M-1515-7	1515	1854	2411	1811	1727	1780	1658	1391	1295	2 x T2
MD880-20M-2273-7	2273	2782	3617	2716	2591	2671	2488	2087	1944	3 x T2
MD880-20M-3031-7	3031	3710	4823	3622	3456	3561	3317	2782	2592	4 x T2
MD880-20M-3788-7	3788	4636	6027	4527	4319	4451	4146	3477	3239	5 x T2
MD880-20M-4546-7	4546	5564	7233	5433	5183	5341	4976	4173	3887	6 x T2
12-pulse										
MD880-20M-1061-7	1061	1299	1688	1268	1210	1247	1161	974	907	2 x T2
MD880-20M-1515-7	1515	1854	2411	1811	1727	1780	1658	1391	1295	2 x T2
MD880-20M-2122-7	2122	2597	3376	2536	2419	2493	2323	1948	1814	4 x T2
MD880-20M-3031-7	3031	3710	4823	3622	3456	3561	3317	2782	2592	4 x T2
MD880-20M-4546-7	4546	5564	7233	5433	5183	5341	4976	4173	3887	6 x T2

■ Definition:

I_N : rated input (AC)/output (DC) current; I_{Max} : max. output current

S_N : rated apparent power; P_N : rated output power

I_{Ld} : continuous output current in light overload applications; P_{Ld} : output power in light overload applications

I_{Hd} : continuous output current in heavy overload applications; P_{Hd} : output power in heavy overload applications

2.5 Technical Data

Table 2-3 Technical data of the MD880-20 series basic rectifier module

Item		Specification
Basic performance	Input AC voltage	400 V system: 380–415 VAC, $\pm 10\%$ (-15%, < 1 min) 690 V system: 525–690 VAC, $\pm 10\%$ (-15%, < 1 min)
	Input frequency	47–63 Hz
	Unbalance factor	$\leq 3\%$ of rated line voltage
	Output voltage	400 V system: 540–590 VDC 690 V system: 740–975 VDC
	Overload capacity	Light overload: 110% rated load for 1 minute every 5 minutes Heavy overload: 150% rated load for 1 minute every 5 minutes
	Operating Efficiency	> 98%
Operating environment	Ambient temperature	-10°C to +40°C , derated at +40°C to +50°C
	Ambient humidity	5%–95%, no condensation
	Altitude	Max. altitude: 4000 m ≤ 1000 m: without derating > 1000 m: with derating
Storage environment	Storage temperature	-40°C to +70°C
	Storage humidity	5%–95%, no condensation
Mechanical data	Anti-vibration performance	Frequency: 5–9 Hz; Displacement: 7 mm Frequency: 9–200 Hz; Acceleration rate: 10 m/s ² Scanning speed: 1 oct/min
	IP rating	IP00 (module)
	Security performance	Compliant with EN 61800-5-1
	Cooling mode	Forced air cooling, compliant with EN 60146
Protection functions	Protection	Protection against short circuit, overcurrent, overload, overvoltage, undervoltage, phase loss, and overtemperature

2.6 Hardware Principle

2.6.1 Introduction

The thyristor bridge is the core of the MD880-20 basic rectifier module. It converts three-phase alternating current into direct current that is supplied to the intermediate DC bus of the drive system. The bus then powers up the inverter module that drives the motor. If there is only one inverter module, it is a single-drive system. If there are multiple inverter modules, it is a multi-drive system.

The basic rectifier module is supplied with an AC reactor to smooth the line current waveform and the DC bus voltage. Different from a diode rectifier bridge, the thyristor rectifier bridge is controllable. You can turn on/off the thyristor by controlling the conduction angle. In this case, it is unnecessary to add a precharging circuit to the basic rectifier module or inverter module.

The basic rectifier module supports two control modes: charging mode and normal running mode.

Charging mode: After the main power supply is switched on, the control program gradually increases the thyristor conduction angle to precharge the intermediate capacitor and other components in the inverter module connected to the bus. The basic rectifier module switches to the normal running mode when the preset bus voltage is reached.

Normal running mode: The thyristor runs in a similar way to a diode.

The following figure shows the simplified main circuit of the basic rectifier module.

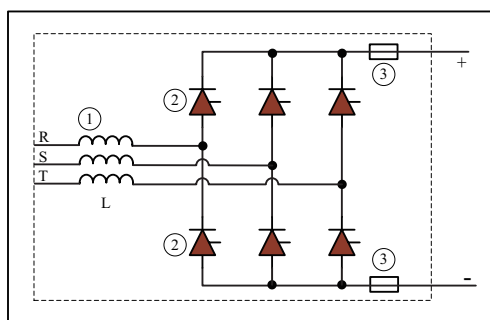


Figure 2-3 Main circuit of the basic rectifier module

No.	Component	Function
1	Input AC reactor	Improves the harmonic wave on the grid side.
2	Thyristor	Converts the alternating current to the direct current.
3	DC fuse	Prevents device damage due to a short circuit of back-end equipment.

2.6.2 6-/12-Pulse Basic Rectifier

The 6-pulse basic rectifier can meet the rectification needs of general applications, and the 12-pulse basic rectifier is mostly used in applications with high requirements for harmonics.

1) 6-pulse basic rectifier

The 6-pulse mode supports a maximum of six parallel basic rectifier modules. The following figure shows the parallel wiring.

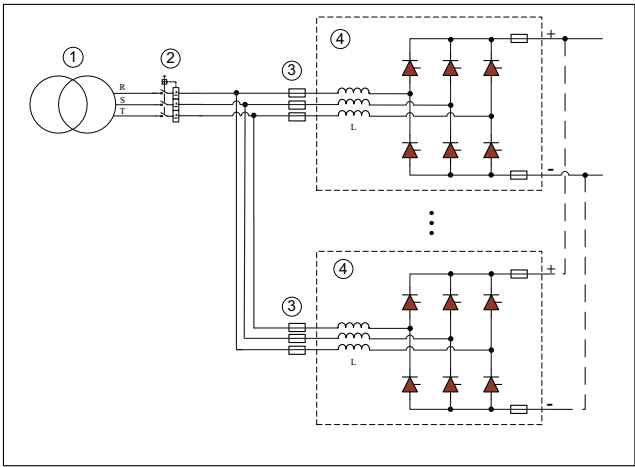


Figure 2-4 Wiring of parallel 6-pulse basic rectifiers

No.	Component
1	Grid transformer
2	Air circuit breaker
3	AC fuse
4	Basic rectifier module

2) 12-pulse basic rectifier

The 12-pulse basic rectifier eliminates the fifth and seventh harmonics, which remarkably reduces the harmonic distortion of the line current and the conducted emissions. The 12-pulse basic rectifier system requires a phase-shifting transformer or two separate transformers. The primary and secondary sides have the same transformation ratio, and there is a phase difference of 30° between the windings on the secondary side.

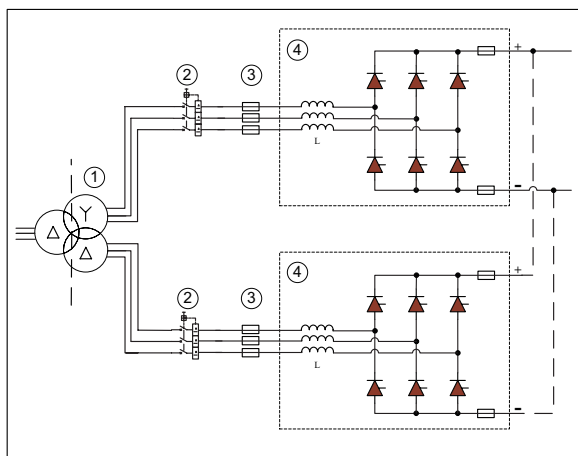


Figure 2-5 Wiring of 12-pulse basic rectifiers

No.	Component
1	Phase-shifting transformer (for details, see "2.11 Selection of the Phase-Shifting Transformer" on Page 23)
2	Air circuit breaker
3	AC fuse
4	Basic rectifier module

2.6.3 Electrical Diagram of a Typical Drive System

The following figure shows a typical drive system where a basic rectifier module is connected to three inverter modules.

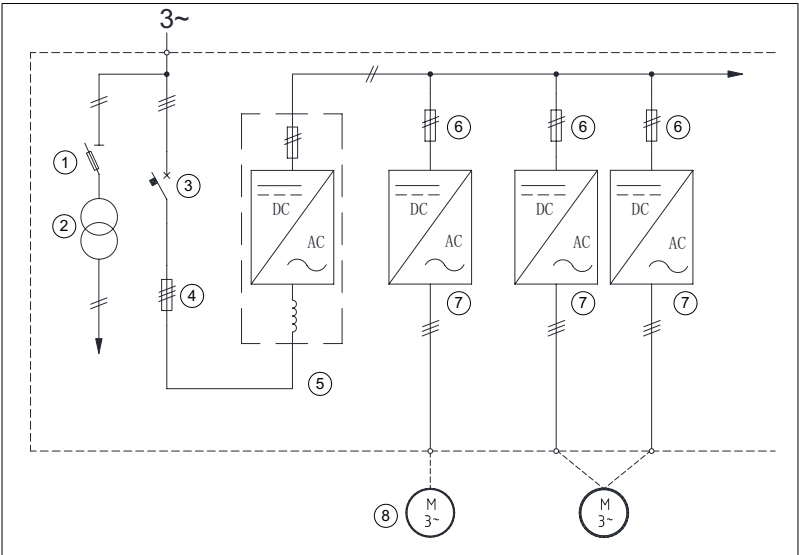


Figure 2-6 Electrical connections of the basic rectifier and drive system

No.	Component
1	Auxiliary power switch
2	Auxiliary power transformer
3	Air circuit breaker
4	AC fuse
5	Basic rectifier module
6	Inverter DC fuse
7	Inverter module
8	Motor

2.7 Module Layout

2.7.1 Structural Layout of the Basic Rectifier Module

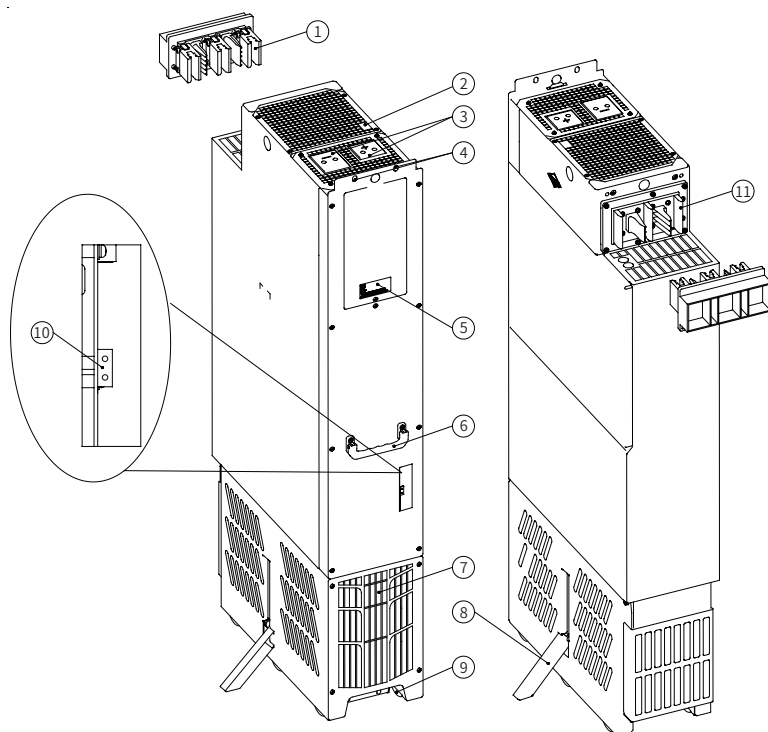


Figure 2-7 Structural layout of the basic rectifier module

No.	Description
1	Quick connector socket (included in the options of the T2 mounting kit or in the cabinet)
2	24 V external power supply
3	DC output terminal
4	Module fixing hole with grounding protection
5	Nameplate label
6	Handle
7	Cooling fan
8	Anti-tip bracket
9	Pulley
10	Fiber-optic interface
11	Quick connector plug

2.7.2 Outline Dimensions of the Basic Rectifier Module

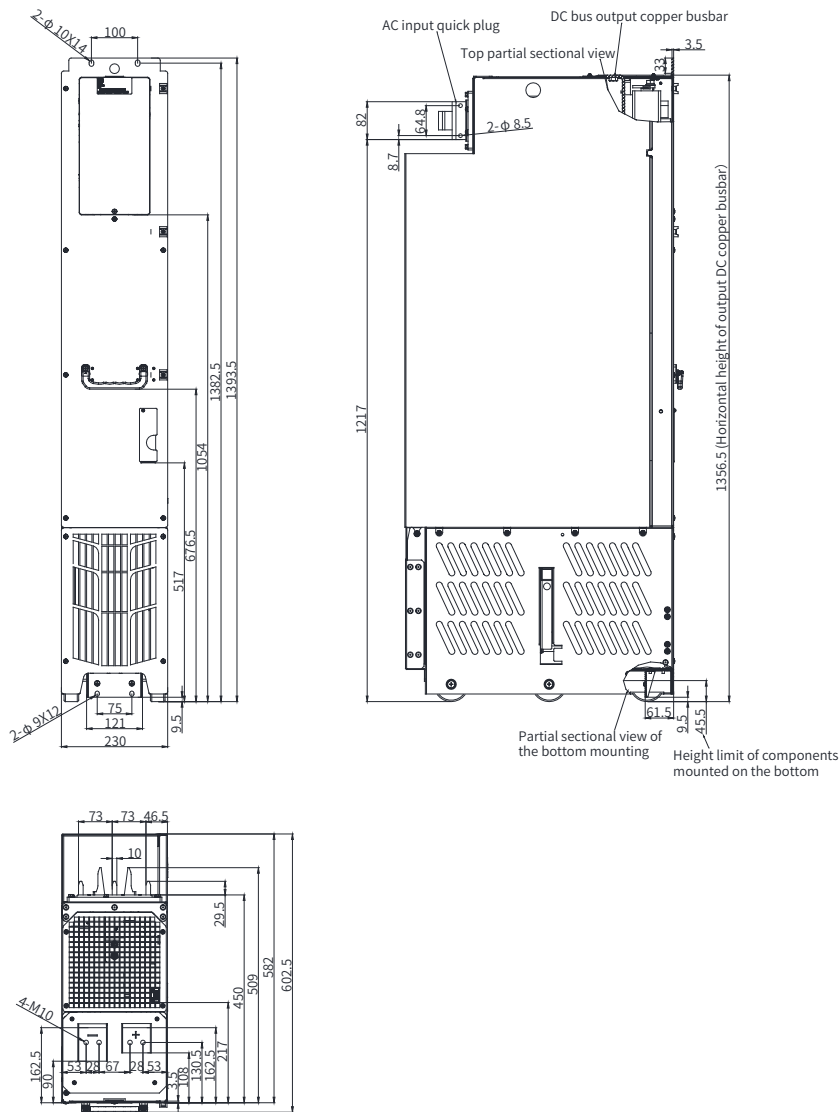


Figure 2-8 Outline dimensions of the basic rectifier module (unit: mm)

2.8 Derating

1) Temperature derating

In the temperature range from +40°C to +50°C, the rated output current of the basic rectifier module is decreased by 1% for every added 1°C. Calculate the output current by multiplying the rated current by the derating factor (k).

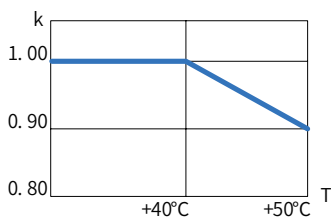


Figure 2-9 Temperature derating curve

2) Altitude derating

At altitudes from 1000 m to 4000 m above sea level, the output current of the basic rectifier module is derated by 1% for every 100 m increase in altitude.

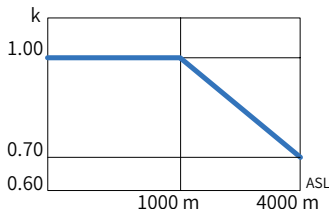


Figure 2-10 Altitude derating curve

2.9 Overload Capability

When using the basic rectifier module in a drive system requiring overload, set a proper reference load current. An overload occurs when the drive system runs at the reference load current (load cycle: 300s).

1) Curve in light overload mode

The reference load current in the light overload mode (I_L) is based on 110% rated load, 60s overload every 300s (load cycle).

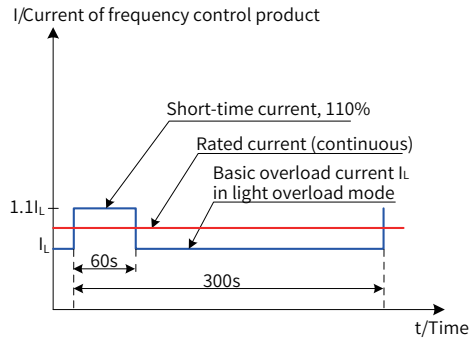


Figure 2-11 Curve in light overload mode

2) Curve in heavy overload mode

The reference load current in the heavy overload mode (I_H) is based on 150% rated load, 60s overload every 300s (load cycle).

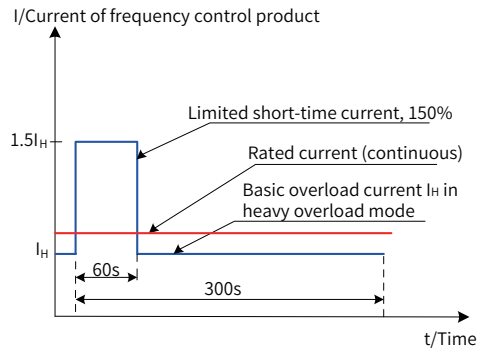


Figure 2-12 Curve in heavy overload mode

2.10 Tightening Torque

Table 2-4 Electrical connection

Screw/Bolt	Strength Grade	Max. Torque (N · m)
M3	4.8–8.8	0.5
M4	4.8–8.8	1
M5	8.8	4
M6	8.8	9
M8	8.8	22
M10	8.8	42
M12	8.8	70

Table 2-5 Mechanical connection

Screw/Bolt	Strength Grade	Max. Torque (N · m)
M5	8.8	6
M6	8.8	10
M8	8.8	24

Table 2-6 Insulator connection

Screw/Bolt	Strength Grade	Max. Torque (N · m)
M6	8.8	5
M8	8.8	9
M10	8.8	18
M12	8.8	31

Table 2-7 Cable connector

Screw/Bolt	Strength Grade	Max. Torque (N · m)
M8	8.8	15
M10	8.8	32
M12	8.8	50

2.11 Selection of the Phase-Shifting Transformer

Table 2-8 Requirements for phase-shifting transformer selection

No.	Type	Description	Remarks
1	Connection group	Dy11d0 or Dy5d0	Grounding on the secondary side is prohibited. Shielded power cables are recommended. If the preceding requirements cannot be met, derate the product.
2	Phase shift between secondary sides	30° electrical angle	
3	Voltage difference between secondary sides	< 0.5%	
4	Short circuit impedance on the secondary sides	> 5%	
5	Short circuit impedance difference between secondary sides	≤ 5%	

2.12 Selection of the DC Fuse

Table 2-9 Model selection of the DC fuse

Product Model	Recommended DC Fuse Model				
	Model (Bussmann)	Model (Sinofuse)	UN (V)	IN (A)	Quantity
MD880-20M-0718-4	170M5499	RS306-3-S1P-1100A690V	1100	900	4
MD880-20M-0982-4	170M5499	RS306-3-S1P-1500A690V	1100	900	4
MD880-20M-0570-7	170M5499	RS306-3-S1P-900A690V	1100	900	2
MD880-20M-0815-7	170M5499	RS306-3-S1P-1250A690V	1100	900	4

3 Mechanical Installation

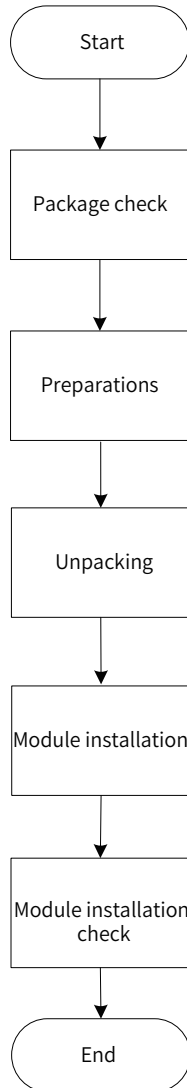


Figure 3-1 Mechanical installation flowchart

3.1 Notes on Installation

3.1.1 Transportation

1) Transportation

- Suitable hoisting gear operated by trained personnel is required due to the weight of the basic rectifier module.
- Ensure that the ground at the installation location is flat and strong enough to bear the weight of the basic rectifier module.
- The basic rectifier module is heavy with a high center of gravity. Therefore, do not place the module on a slope of more than 5° .
- The basic rectifier module must always be transported in the upright position indicated. Never turn it upside down or place it on its side.

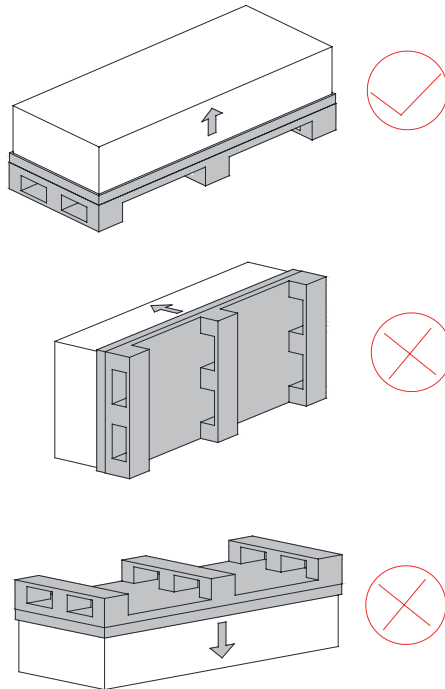


Figure 3-2 Mode of transportation

- The basic rectifier module must be carried on a wooden pallet when transported with a forklift. Do not disassemble the module while it is still on the wooden pallet and awaiting transportation.

- The basic rectifier module must be carried on a wooden pallet when transported with a crane.

2) Acceptance

Carry out a thorough visual inspection of the basic rectifier module before accepting the delivery from the shipping company.

Check that you have received all the items specified on the delivery note. Notify the shipping company immediately of any missing components or damage. If necessary, request the support of Inovance office or your local agent.

 DANGER	
	◆ If the basic rectifier module is damaged during transportation, the electrical safety of the module can no longer be ensured. Do not connect the module until a thorough high-voltage test has been performed. ◆ Personal injury or substantial material damage may occur if the preceding notice is not observed.

3) Storage

The basic rectifier module must be stored in a clean and dry room, with temperatures between -40°C and +70°C and temperature variations smaller than 1°C/min. If the module is stored for a prolonged period once it has been unpacked, cover it or take other appropriate measures to ensure that it does not become dirty and that it is protected against environmental influences.

3.1.2 Installation Checklist

 DANGER	
	◆ To ensure safe and reliable running, the basic rectifier module must be properly installed and commissioned by qualified personnel, taking into account all the warning notices provided. ◆ In particular, the general and national installation and safety guidelines for high-voltage installations as well as the guidelines relating to the proper use of tools and personal protective equipment must be observed. ◆ Personal injury or substantial material damage may occur if the preceding notices are not observed.

Check the boxes accordingly in the right-hand columns if the activity applies to the module in your scope of delivery. In the same way, check the boxes once you have finished the installation procedure to confirm that the activities are complete.

Table 3-1 Installation checklist for the basic rectifier module

Item	Activity	Applicable?	Completed?
1	Check that the packing box is free of loss, damage, and dampness.	☐	☐
2	The minimum clearances around the basic rectifier module (for unhindered air discharge) must be observed. Sufficient space must be reserved to ensure that the cooling air supply and exhaust are not obstructed.	☐	☐
3	After unpacking, check that the module housing is intact without distortion, peeling or crack, and there is no water stain.	☐	☐
4	The accessories (user guide, optional parts, and so on) inside the packing box are complete.	☐	☐
5	Before commissioning, make sure that the protection around the basic rectifier module has been handled properly.	☐	☐

3.2 Installation Preparations

3.2.1 Preparations

All basic rectifier modules must be installed according to the drawings. Allow sufficient space around the modules for airflow, door open/close, and maintenance.

The installation location must be dry and free of dust. The air supplied cannot contain any electrically conductive gases, vapors, or dust, which could impair operation. If necessary, filter the air supplied to the installation room.

 CAUTION	
	◆ The allowed climatic ambient conditions must be taken into account. Derating is required for ambient temperatures greater than 40°C and installation altitudes above 1000 m.

1) Requirements for mounting clearances

The following figure shows the requirements for the mounting clearances of the basic

rectifier module.

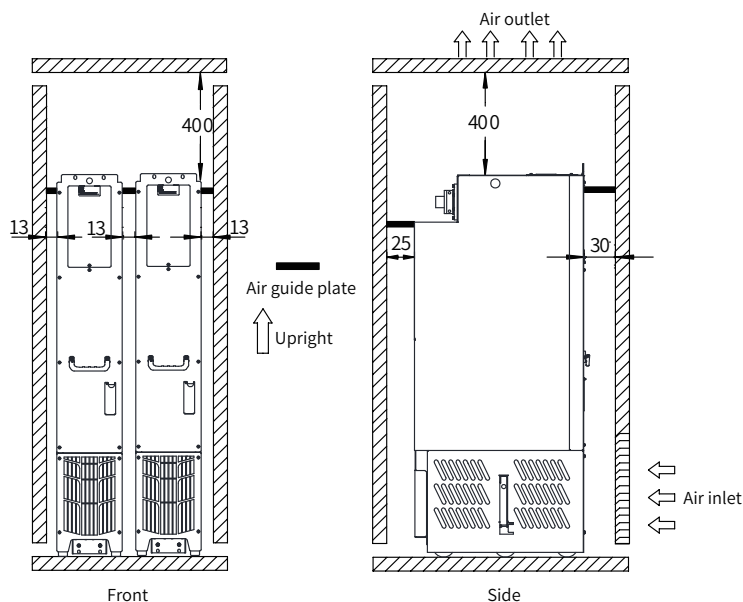


Figure 3-3 Clearance requirements

2) Area of the air inlet/outlet

The minimum ventilation space required must be reserved above and below the basic rectifier module, in which no wiring or installation of any components is allowed to ensure smooth supply/exhaust of cooling air. This notice must be observed, especially when cable ducts are used.

Requirements for the area of the air inlet/outlet:

The area of the air inlet should be: $S_{\text{Inlet}} = (1.5 \text{ to } 2.0) \times (S_{\text{Module } 1} + S_{\text{Module } 2} + S_{\text{Module } 3} + \dots + S_{\text{Module } N})$

In this formula:

S_{Inlet} : Air inlet area (unit: cm^2)

S_{Module} : Air inlet area of each module (unit: cm^2)

The area of the air outlet should be: $S_{\text{Outlet}} = (1.2 \text{ to } 1.5) \times S_{\text{Inlet}}$

Ventilation area of the T2 series basic rectifier module is as follows:

Table 3-2 Ventilation area table

Structure	Ventilation Area (S_{inlet}) of the Basic Rectifier Module (cm^2)
T2	1400



NOTE

◆ Failure to observe the installation rules will significantly reduce the service life of the basic rectifier module and may cause the fault or premature failure of the module.

3.2.2 Transportation Before Unpacking

- Transport the packed basic rectifier module with a pallet.
- The basic rectifier module can be transported with a forklift or crane. The transportation equipment must have a load capacity larger than the weight of the basic rectifier module.
- Adjust the distance between forklift feet (larger than half of the module length).
- The hoist rope of the crane must pass through the pallet under the basic rectifier module, with the height change not larger than 0.3 m.
- Hydraulic vehicles are prohibited from moving for a long distance or on a slop road.

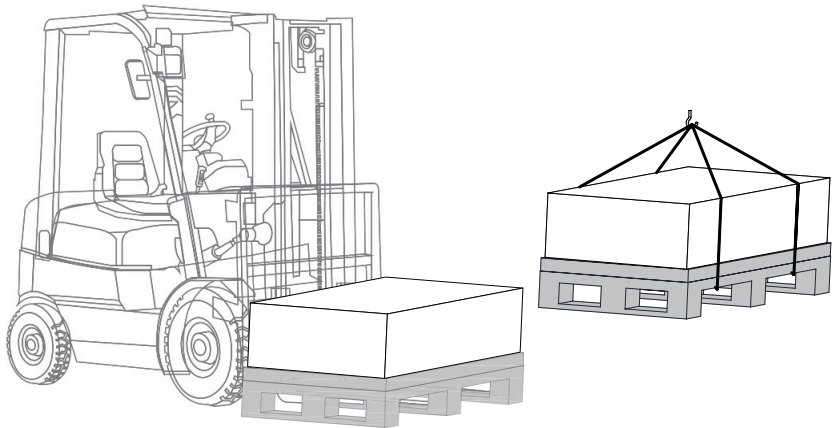


Figure 3-4 Transporting the basic rectifier module before unpacking

3.2.3 Unpacking

The basic rectifier module is delivered in a corrugated cardboard box. The cardboard box is tied to a wooden base with PET bands.

Unpacking steps:

- ① Cut off the bands and lift the box cover off.
- ② Remove any filling material.
- ③ Take out the basic rectifier module.
- ④ Cut open the plastic wrapping of the module.
- ⑤ Check that there are no signs of damage.

Dispose of or recycle the packaging according to the local regulations.

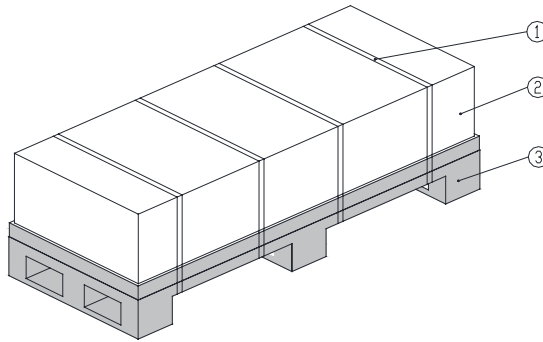


Figure 3-5 Package of the basic rectifier module

No.	Component
1	Bands
2	Box cover
3	Pallet

3.3 Cabinet Layout

1) Layout of 1xT2 basic rectifier module in a 400 mm wide cabinet

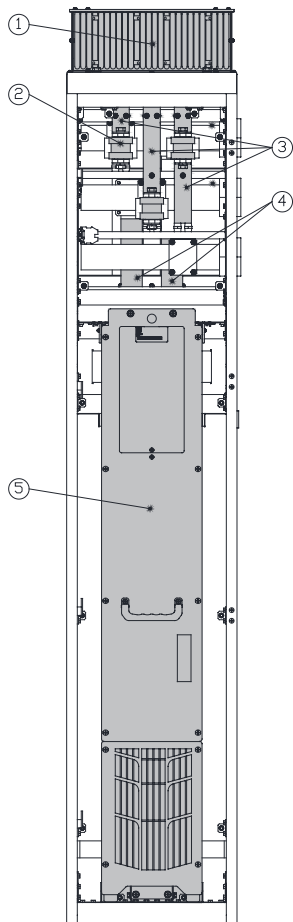


Figure 3-6 T2 - 400 mm wide cabinet

No.	Component
1	Protective cover at the top of the cabinet
2	AC fuse
3	R/S/T AC input copper busbar
4	(+)/(-) DC output copper busbar
5	Basic rectifier module

2) Layout of 2xT2 basic rectifier module in a 600 mm wide cabinet

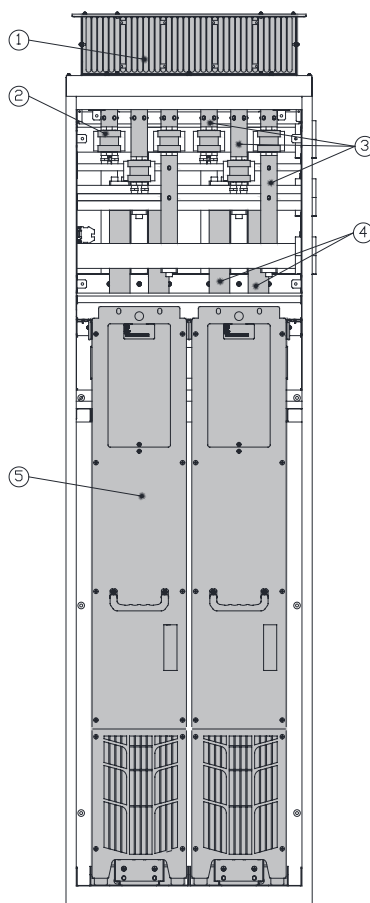


Figure 3-7 T2 - 600 mm wide cabinet

No.	Component
1	Protective cover at the top of the cabinet
2	AC fuse
3	R/S/T AC input copper busbar
4	(+)/(-) DC output copper busbar
5	Basic rectifier module

3) Layout of 3xT2 basic rectifier module in an 800 mm wide cabinet

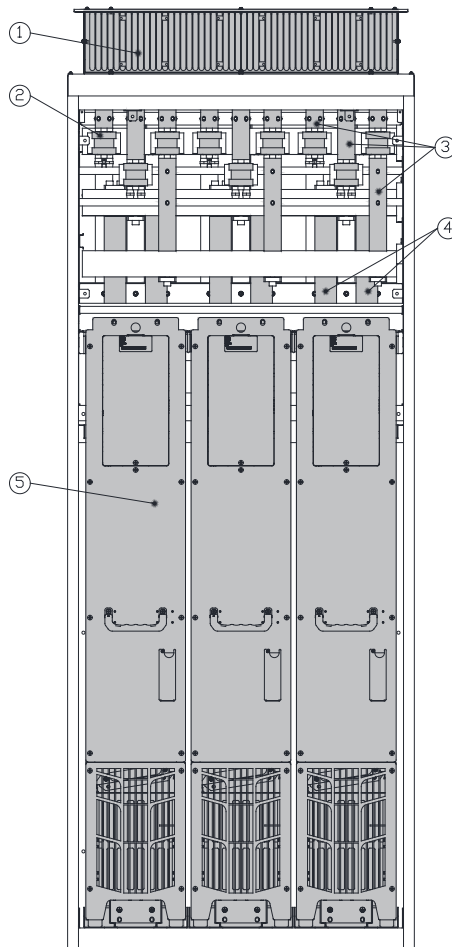


Figure 3-8 T2 - 800 mm wide cabinet

No.	Component
1	Protective cover at the top of the cabinet
2	AC fuse
3	R/S/T AC input copper busbar
4	(+)/(-) DC output copper busbar
5	Basic rectifier module

4) Component installation of 1xT2 basic rectifier module in a 400 mm wide cabinet

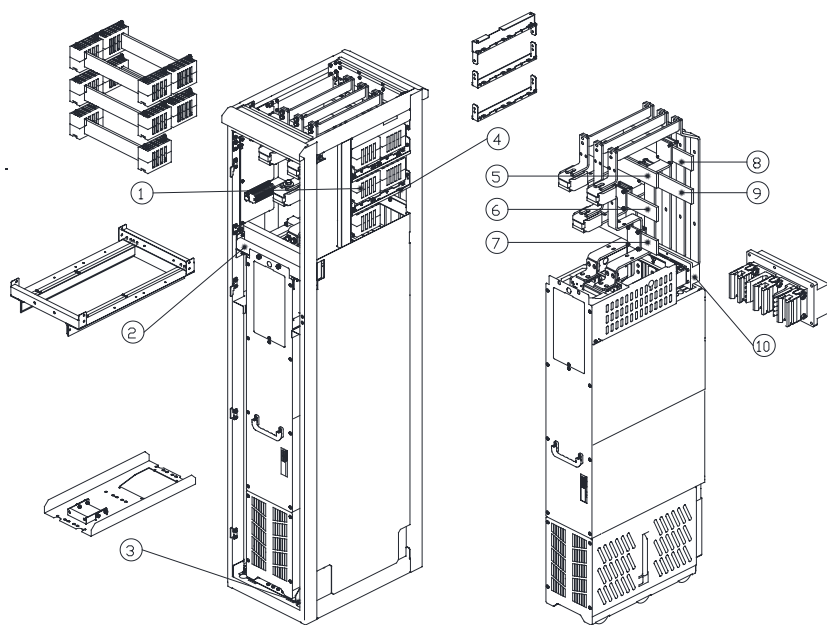


Figure 3-9 T2 - Component installation in a 400 mm wide cabinet

No.	Component
1	Bus and busbar clamp
2	Upper fixing bracket
3	Lower mounting plate
4	Busbar clamp fixing bracket
5	R copper busbar
6	S copper busbar
7	T copper busbar
8	(+) copper busbar
9	(-) copper busbar
10	Quick connector socket

3.4 Dimensions and Installation of T2 Quick Mounting Kit

T2 quick mounting kit, an option installed in the cabinet, is used to secure the quick connector socket (fixed inside the cabinet). This allows the users to assemble a cabinet themselves.

3.4.1 Kit Dimensions

1) Lower dimensions of T2 quick mounting kit

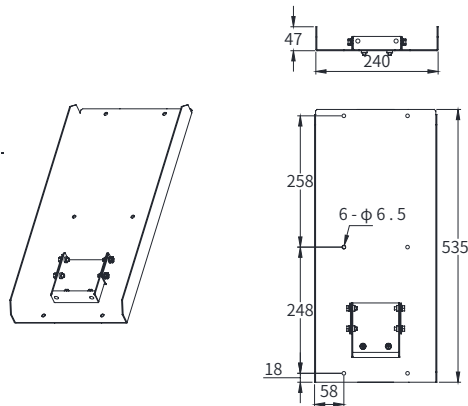


Figure 3-10 Lower dimensions of T2 quick mounting kit (unit: mm)

2) Upper dimensions of T2 quick mounting kit

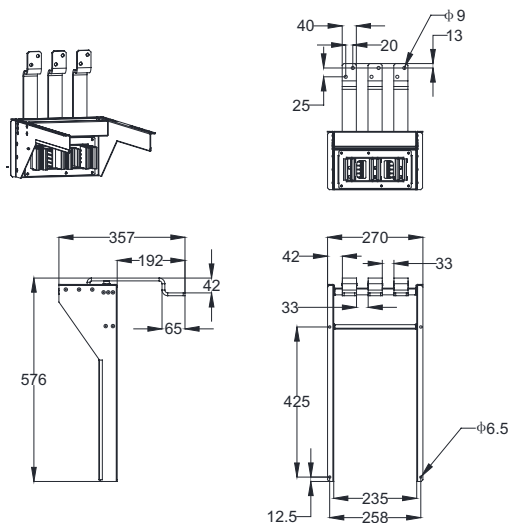


Figure 3-11 Upper dimensions of T2 quick mounting kit (unit: mm)

3) Recommendation on fixing the upper part of T2 quick mounting kit

It is recommended to make two beams (A, B) to fix the upper part of the T2 quick mounting kit. These beams are fixed on the left and right sides of the cabinet, with beam A placed before beam B. Beam B is used for fixing both the frame kit and the basic rectifier module. You can design the two beams at the same time. The beam dimensions and mounting holes are as follows.

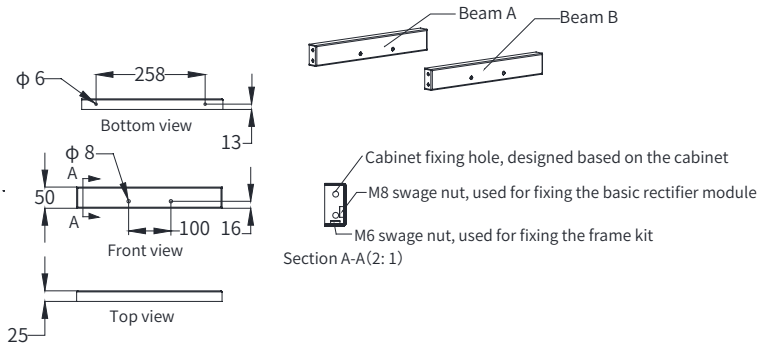


Figure 3-12 Dimensions of beams (unit: mm)

4) Relative positions of the upper and lower parts of T2 quick mounting kit

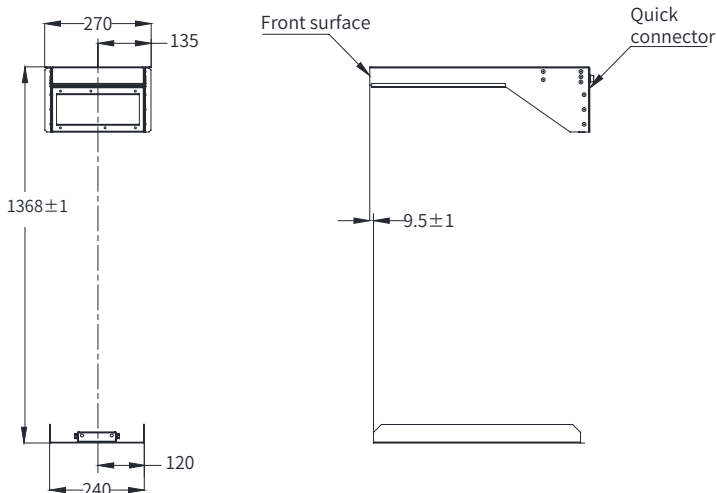


Figure 3-13 Clearance requirements for the relative positions of the upper and lower parts of T2 quick mounting kit (unit: mm)

3.4.2 Requirements for Cabinet Dimensions

- 1) The following figure shows the requirements for the cabinet dimensions.

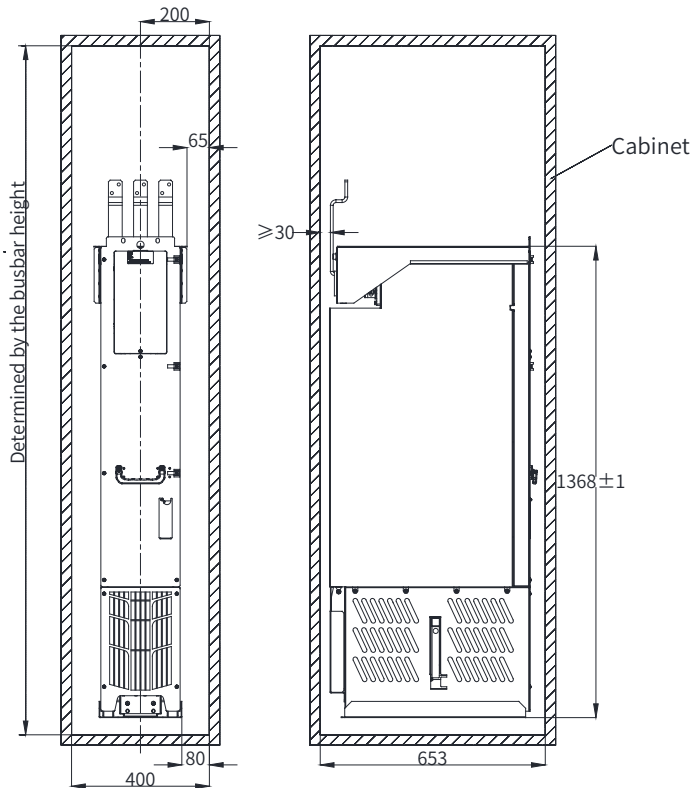


Figure 3-14 Requirements for the cabinet dimensions (unit: mm)

- 2) Cut two grooves on the front bottom beam of the cabinet for placing the module guide rail. The dimensions of the holes are shown in the following figure.

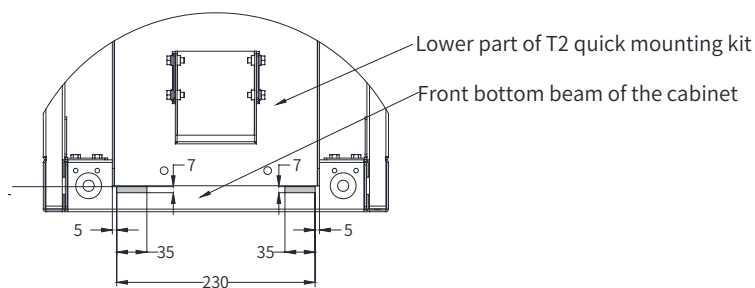


Figure 3-15 Dimensions of holes on the front bottom beam of the cabinet (unit: mm)

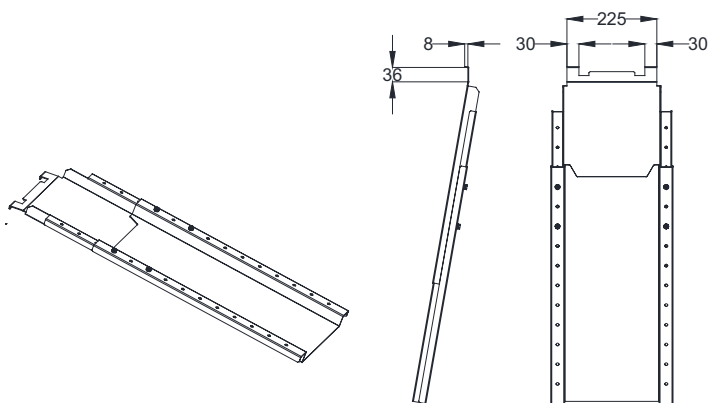


Figure 3-16 Dimensions of the guide rail (unit: mm)

3.4.3 Mounting of the T2 Quick Mounting Kit

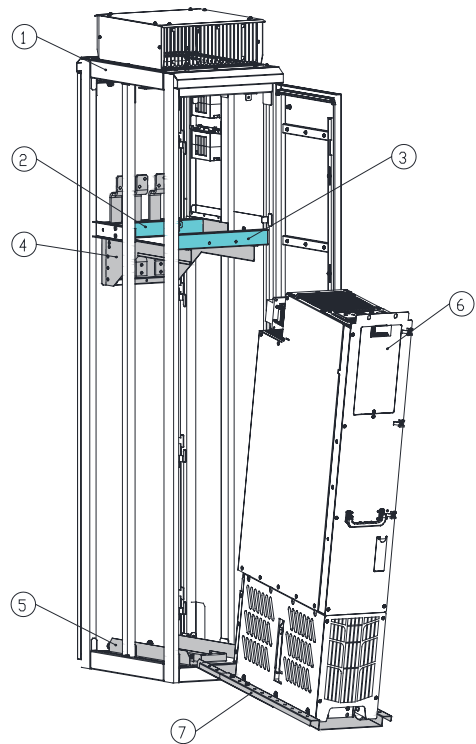


Figure 3-17 Mounting of the T2 quick mounting kit

No.	Component
1	Cabinet
2	Beam A
3	Beam B
4	Upper part of T2 quick mounting kit
5	Lower part of T2 quick mounting kit
6	Basic rectifier module
7	Guide rail

Mounting procedure:

- ① Fix the upper part of the T2 quick mounting kit to the cabinet with four M6 bolts through beams A and B.

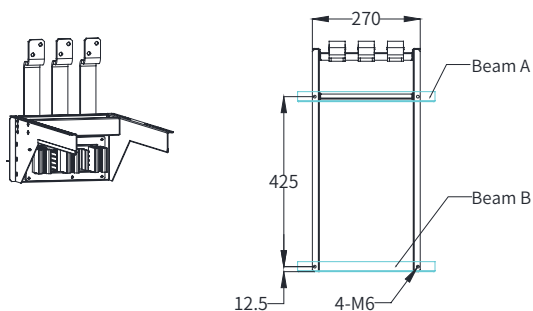


Figure 3-18 Mounting the upper part of the T2 quick mounting kit

- ② Attach the lower part of the quick mounting kit to the bottom of the cabinet with six M6 bolts.
- ③ Insert the guide rail into the two grooves on the front bottom beam of the cabinet.

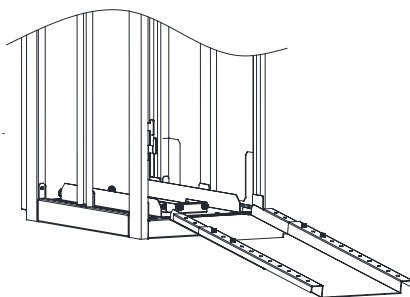


Figure 3-19 Mounting the guide rail

- ④ Push the basic rectifier module into the cabinet and attach it to the upper and lower parts of the quick mounting kit through four M8 bolts.

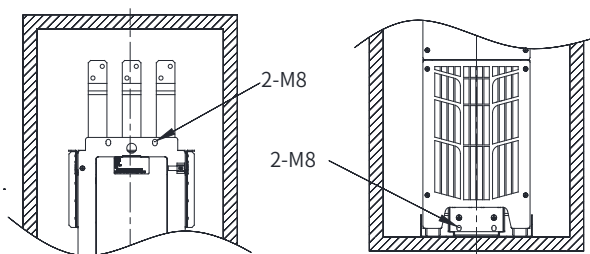


Figure 3-20 Attaching the basic rectifier module to the quick mounting kit

4 Electrical Installation

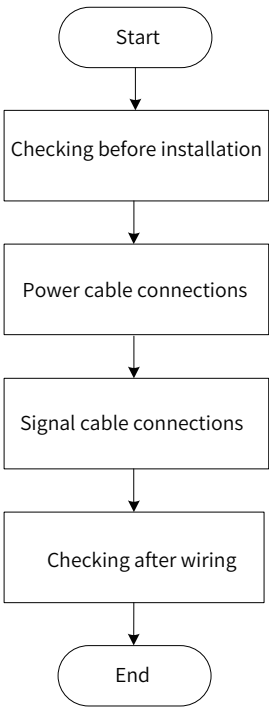


Figure 4-1 Electrical installation flowchart

4.1 Safety Information

4.1.1 Required Safety Precautions Before Installation

 DANGER	
	◆ The module must be operated only by qualified personnel who read and comply with the safety information provided in this guide. ◆ When carrying out any kind of work on electrical equipment, always observe the following five safety rules: 1) Disconnect the equipment from the power supply. 2) Protect the equipment against reconnection. 3) Make sure that the equipment is de-energized. 4) Make sure that the equipment is well grounded. 5) Cover or enclose adjacent components that are still live.

4.1.2 Installation Inspections

 DANGER	
	◆ The basic rectifier module is operated with high voltages. All connection work must be carried out when the module is de-energized.
	◆ Only qualified personnel are allowed to work on the basic rectifier module.
	◆ Take caution when working on disconnected equipment because external supply voltages may be present. The power and control terminals may still be live even when the load is not running.
	◆ Due to the capacitor in the inverter module, dangerously high voltage levels are still present in the basic rectifier module up to 15 minutes after the rectifier module has been disconnected. For this reason, the rectifier module should not be opened until the voltage is below 36 V.
	◆ The user is responsible for ensuring that the basic rectifier module, cabinets, and other components are installed and connected in accordance with the recognized technical rules in the country of installation and with other applicable regional regulations. Special attention should be paid to cable dimensions, fuses, grounding, shutdown, disconnection, and overcurrent protection.
	◆ If an item of protective gear trips in a branch circuit, a leakage current may have been disconnected. To reduce the risk of fire or an electric shock, you should inspect the current-carrying parts and other components in the basic rectifier module and replace the damaged parts. When an item of protective gear trips, the cause of the trip must be identified and rectified.

4.1.3 General Notes

1) Static electricity

The PCBs contain components sensitive to electrostatic discharge. Wear a grounding wrist band when operating the PCBs. Do not touch the PCBs unless necessary.

2) Optical components

Move the fiber-optic cables with care. When unplugging the fiber-optic cables, always hold the terminals rather than the cable itself. Do not touch the ends of fiber-optic cables with bare hands because the ends are extremely sensitive to dirt.

4.1.4 Insulation test

The basic rectifier module has been insulation tested between the main circuit and the housing at the factory. Therefore, do not perform any voltage withstand and insulation resistance tests on them again.

4.2 General Information

 DANGER	
	◆ The following are operations carried out inside the cabinet. The cabinet is used in industrial high-voltage equipment and contains live and rotating components. For this reason, severe injury or significant material damage may result if the required covers are removed without authorization, if the equipment is used or operated incorrectly, or if the equipment has not been properly maintained. ◆ You must read and observe the safety information and application notes provided in this guide.

1) Basic rules for cable routing

Follow the basic rules below when connecting the basic rectifier module in the cabinet.

- Observe EMC guidelines.
- Use existing routing for cable assemblies.
- Always use the shield plates provided.
- Use existing cabling paths.
- Take cable protection measures at cabinet corners or in places with sharp objects.
- Refit any covers removed during cable routing before completing the work and before commissioning.

2) Preparations

Before starting any cabling or connection work in the basic rectifier module, ensure that the following measures are performed:

- Disconnect the cabinet unit from the power supply.
- Observe the "five safety rules".
- Remove all covers that may obstruct the cabling or connections of the basic rectifier module.

3) Safety and EMC

 DANGER	
	◆ All covers removed during cable routing must be replaced before the basic rectifier module starts running.
 CAUTION	
	◆ The power cable shields must be secured to the shielding plate and the PE cables to the PE bus.

4.3 EMC-Compliant Cable Routing

4.3.1 Requirements

- 1) Separate routing for the signal cables and power cables

When analog signals are used for the remote control of the basic rectifier module, the signal cables and high-voltage circuit cables (power input, rectifier output, and braking resistor connecting cables) must be routed separately with a distance larger than 30 cm, to reduce the interference on the analog generated by the basic rectifier module and other devices. This requirement must be met even inside the control cabinet.

- 2) Requirements for the analog control signal cables

The analog control signal cables must be shielded twisted pair cables. For stripped cables, the stripped part must be as short as possible (5–7 mm), and the shield must be wrapped with the insulating tape to prevent interference caused by the contact between the shielded cable and other devices.

- 3) Requirements for the power cables

Use the shielded cables as the power cables, or shield all cables with cable ducts.

- 4) Requirements for the control cables and power supply cables

If the control cables run across the power cables, ensure a crossing angle of 90° as possible as you can.

4.3.2 Routing Suggestions

- 1) Route the cables that carry different signals separately. Reserve a proper distance between interfering cables and sensitive cables (30 cm is recommended if the routing space is large enough). If the two types of cables must cross, arrange them at an angle of 90° to prevent interference.

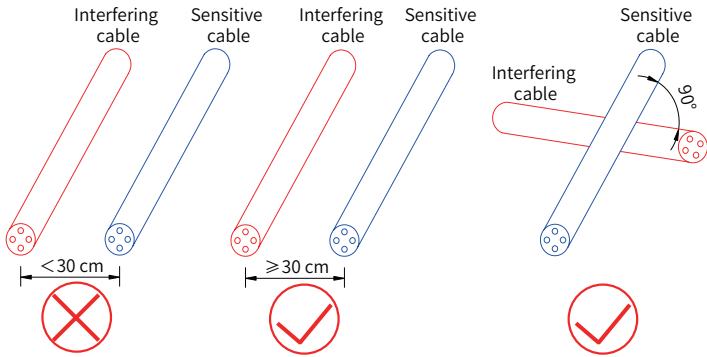


Figure 4-2 Routing of interfering cables and sensitive cables

- 2) Route the signal cables of different types separately and isolate them with equipotential signal cables. When routing the cables of the same signal type, lay the equipotential signal cables at the outer layer, and arrange as many equipotential signal cables as possible in the middle. The following figure is for your reference.

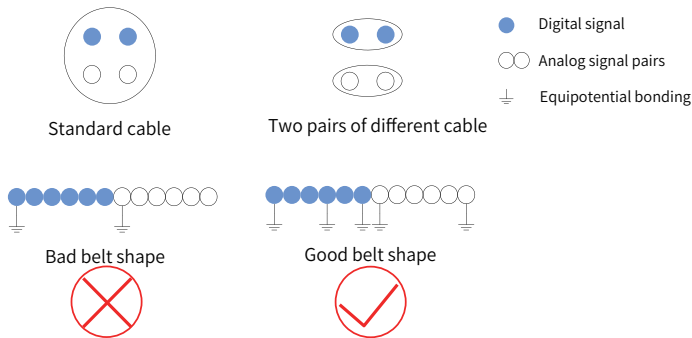


Figure 4-3 Routing of different types of signal cables

- 3) For multicore cables, it is recommended that one cable transmit only one type of signal. If different types of signals are transmitted via one cable, the cable cores must be shielded, as shown in the following figure.

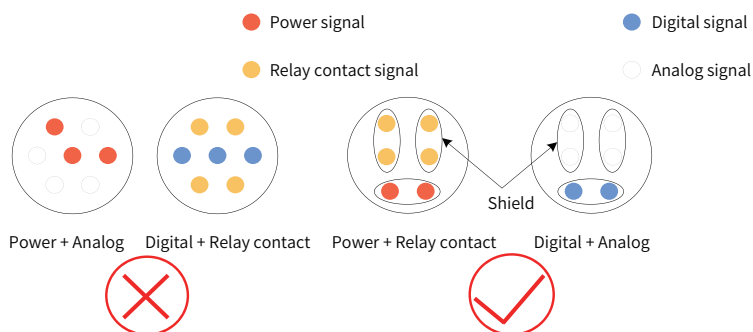


Figure 4-4 Routing of multicore cables

- 4) When some cores in a multicore cable are not used, connect all unused (or reserved) conductors to the equipotential connecting point.

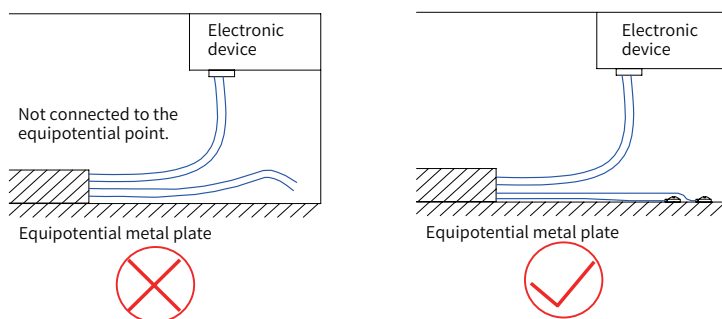


Figure 4-5 Handling of unused cores in a multicore cable

- 5) The low-level sensor signal cables and relay signal cables with a common line should be laid as close to each other as possible to avoid too large loop area. The analog signal cables must be twisted pairs, and the digital signal cables must be laid closely.

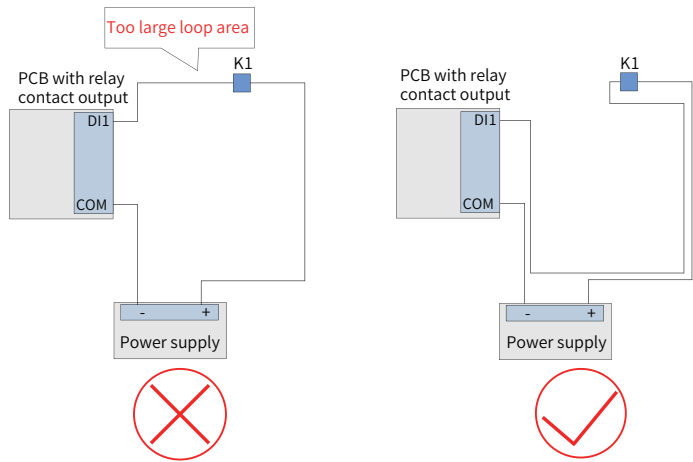


Figure 4-6 Routing for preventing too large loop area

- 6) When there are multiple types of cables, lay them along the metal block with an equipotential bonding and reserve a distance as large as possible between them to improve internal EMC. If the cables in the same metal (zinc-iron or stainless steel) duct are separated by metal plates, the EMC will be better.

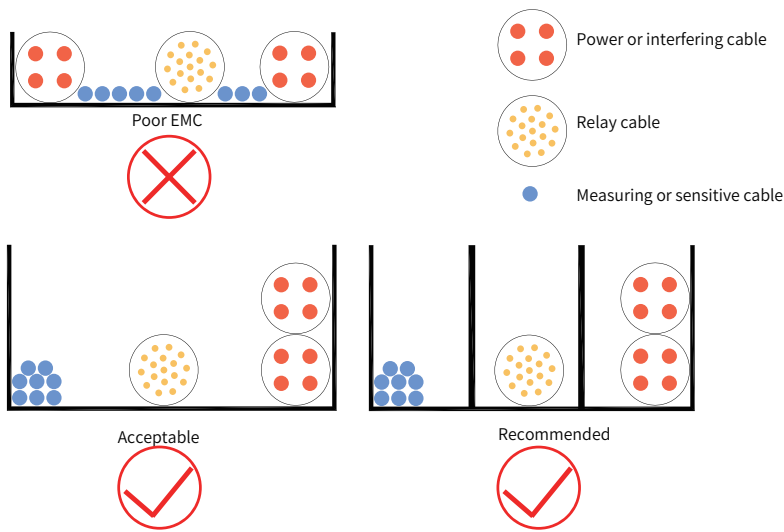


Figure 4-7 Routing of multiple types of cables

- 7) The unshielded part of shielded cables must be as short as possible, and the shield braid is connected to the nearest PE end. If the stripped part of a cable is too long, the cable is prone to interference, especially for encoder signals.

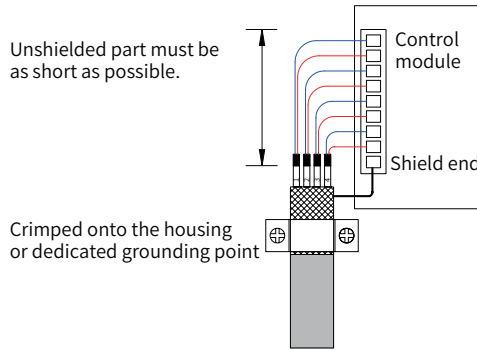


Figure 4-8 Requirements for shielded cables

4.3.3 Connection of Shielded Power Cables

Ensure that the input power cables of the basic rectifier module and the shields have a large-area contact with the shield plate in the installation cabinet to achieve good EMC. The following figure shows the connections.

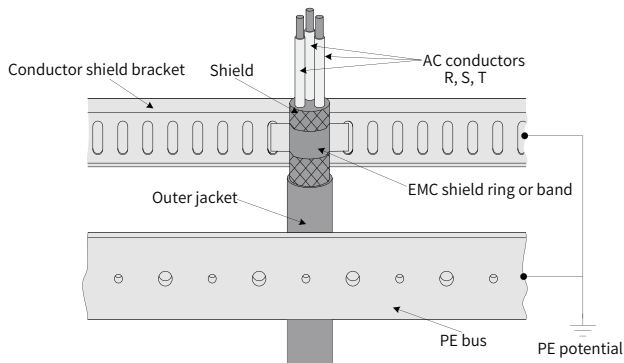


Figure 4-9 Connection requirements for shielded power cables

4.4 Connections

Preparatory steps:

- Disconnect the cabinet unit from the power supply.
- Make sure that all the necessary safety measures have been taken at the installation location.
- Observe the "five safety rules".

4.4.1 Connecting the Basic Rectifier Module

1) Terminal assignment on the basic rectifier module

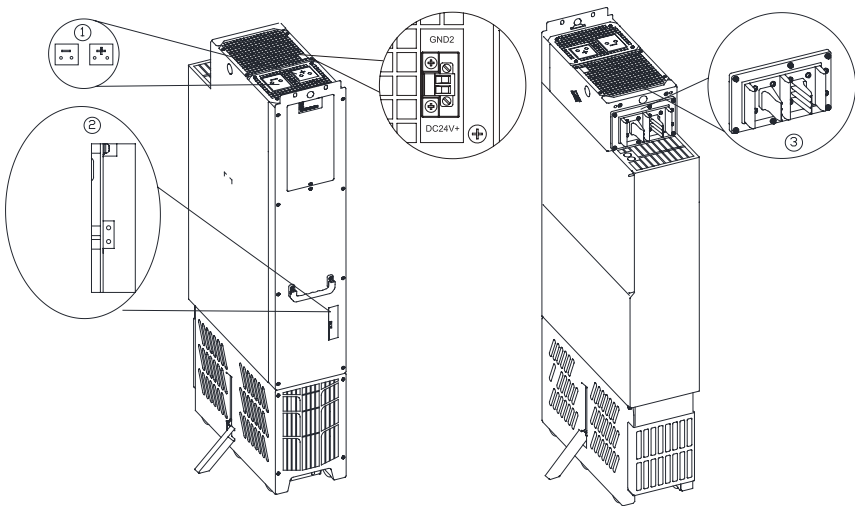


Figure 4-10 Terminal assignment on the basic rectifier module

Table 4-1 Terminal connection parameters of the basic rectifier module

No.	Terminal	Description
1	(+)/(-) DC output	400 V system: 540–590 VDC 690 V system: 740–975 VDC Connected to the M10/42 N · m copper busbar
2	Fiber-optic terminal	Fiber-optic terminal: for fiber-optic cable connection
3	R/S/T AC input	Quick connector

2) Procedure for connecting the basic rectifier module:

- ① Check that the quick connector socket or T2 quick mounting kit has been properly

installed in the cabinet and that the AC input copper busbar and DC bus copper busbar are connected reliably.

- ② Install the basic rectifier module into the cabinet following ["3 Mechanical Installation" on Page 25](#).
- ③ In the line connection module, connect the power supply cables to the input terminals. Ensure that the connections are in this sequence: R, S, and then T.



NOTE

◆ Tighten the screws to the specified torque. If the torque is too small, the connector will overheat during running; if the torque is too large, the equipment will be damaged.

4.4.2 Operating the Basic Rectifier Module in Grounding Systems (TT/TN)

When the basic rectifier module is used in the TT and TN systems, it is strongly recommended to install the two grounding screws on the voltage dependent resistor (VDR) board. Figure 4-11 shows the installation procedure. After the grounding screws are installed, reinstall the removed cover onto the basic rectifier module.

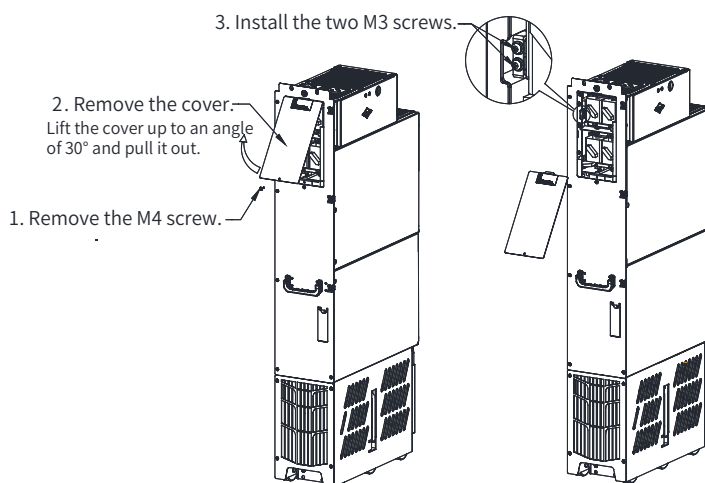


Figure 4-11 Installing the two M3 screws on the VDR board



NOTE

◆ When the basic rectifier module is operated in an isolated supply system (IT system), do not install the two grounding screws which have been removed before delivery.

4.4.3 Connecting the HCU-20 Control Module

For the installation of the HCU-20 control module and connections of the control cables, see ["5 Control Module" on Page 56](#).

4.5 Connecting Power Cables to the Busbar

This section provides schematic diagrams showing the connections between power cables and the busbar, without details such as terminal marks. These diagrams cannot be used for electrical installation. See the final electrical wiring diagrams for electrical installation.

4.5.1 Wiring of a Single 6-Pulse Basic Rectifier

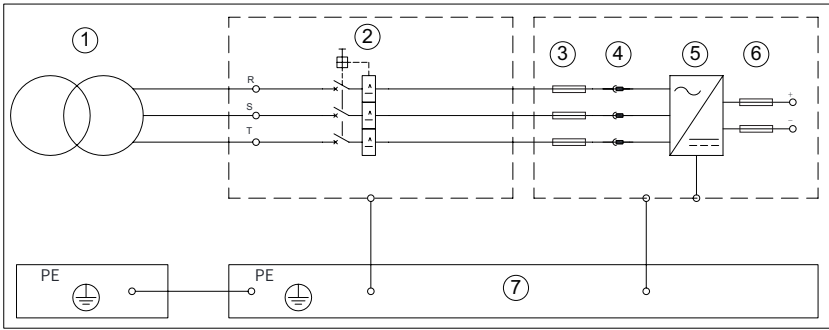


Figure 4-12 Wiring of a single 6-pulse basic rectifier

No.	Component
1	Transformer
2	Air circuit breaker
3	AC fuse
4	Quick connector
5	Basic rectifier module
6	DC fuse
7	Grounding copper busbar

4.5.2 Wiring of Two Parallel 6-Pulse Basic Rectifiers

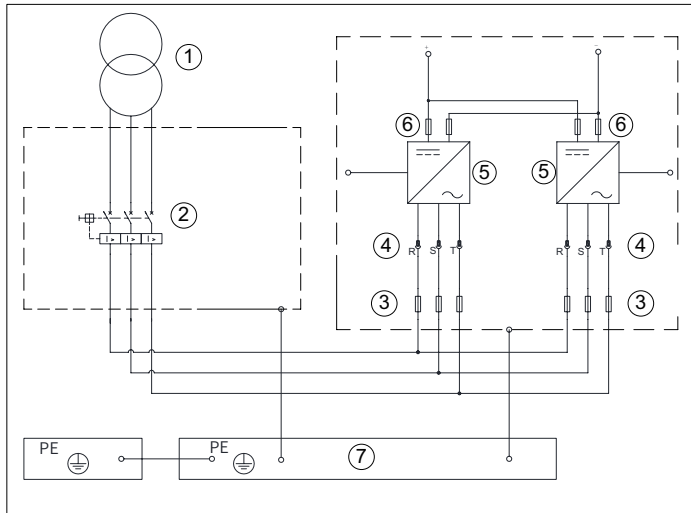


Figure 4-13 Wiring of two parallel 6-pulse basic rectifiers

No.	Component
1	Transformer
2	Air circuit breaker
3	AC fuse
4	Quick connector
5	Basic rectifier module
6	DC fuse
7	Grounding copper busbar

4.5.3 Wiring of 12-Pulse Basic Rectifier

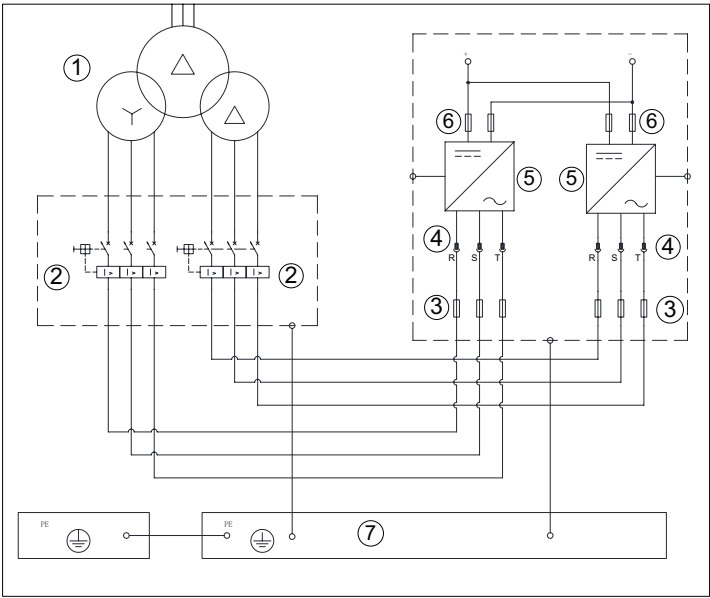


Figure 4-14 Wiring of 12-pulse basic rectifier

No.	Component
1	Phase-shifting transformer (for details, see "2.11 Selection of the Phase-Shifting Transformer" on Page 23)
2	Air circuit breaker
3	AC fuse
4	Quick connector
5	Basic rectifier module
6	DC fuse
7	Grounding copper busbar

4.6 Installation Checklist

Use the following checklist to guide you through the electrical installation procedure for the basic rectifier module. Read all the safety precautions in ["1 Safety Instructions" on Page 6](#) before carrying out any work on the module.

No.	Activity	Applicable?	Completed?
1	Ensure that the connections and voltages of the input power supply and DC output bus are correct.	☐	☐
2	Ensure that the auxiliary power supply is supplied with correct voltage.	☐	☐
3	For strain relief, the I/O power cables must be clamped on the cable clamp plates.	☐	☐
4	The cables must be properly connected with the required torque to the terminals provided.	☐	☐
5	When EMC-shielded cables are used, the cable shields must be secured to the shield plates to ensure proper EMC.	☐	☐
6	When the parallel outputs of the basic rectifier module are connected to the DC bus, ensure that the connections are correct.	☐	☐
7	The control cables must be connected in accordance with the interface assignment and the shield applied. To prevent interference, the control cables must be laid separately from the power cables. Cabling and connections must always comply with the relevant EMC guidelines.	☐	☐

5 Control Modules

The HCU-20 control module, normally installed in the auxiliary control cabinet, controls the basic rectifier module through high-speed optical fibers.

The control module requires an external 24 VDC power supply, but it is also internally equipped with multiple isolated power supplies, including 24 VDC isolated digital power supply, InoLink communication RS485 isolated power supply, SOP-20-880 power supply, as well as power supplies for the function modules connected to the expansion slots of the HCU-20.

You can upgrade the control module software through a PC or SOP-20-880.

5.1 HCU-20 Control Module

5.1.1 Module Components

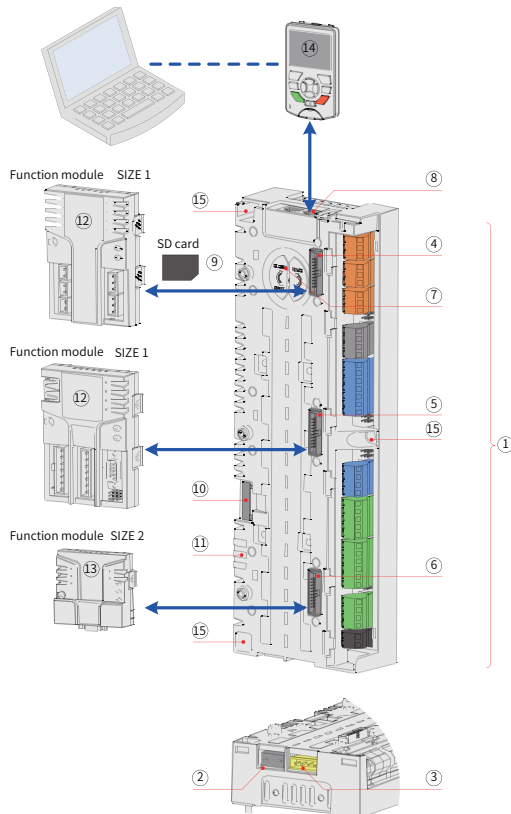


Figure 5-1 Components of the HCU-20 control module

Table 5-1 Function descriptions of HCU-20 components

No.	Component	Function Description
1	User terminals	Standard user I/O terminals
2	Fiber-optic communication interface	Interface for fiber-optic communication between the HCU-20 and the basic rectifier module
3	Reserved	-
4	SLOT1	Function module interface
5	SLOT2	Function module interface
6	SLOT3	Function module interface
7	Battery cover	Spare RTC battery cover. The RTC battery is a non-rechargeable lithium battery that must be replaced regularly.
8	Smart operating panel interface	Interface connecting the HCU-20 and the SOP-20-880. The two RJ45 interfaces are identical and easy to be cascaded.
9	SD card	Standard 8 GB micro SD card, which can be flexibly inserted and removed.
10	Reserved	-
11	Indicators	Power, Run and Fault indicators
12	Function module SIZE 1	105 x 73 x 24 (unit: mm) function module
13	Function module SIZE 2	75 x 73 x 24 (unit: mm) function module
14	Smart operating panel	Smart operating panel SOP-20-880
15	Fixing holes	Three holes for fixing the HCU-20

5.1.2 Standard Terminals

Table 5-2 Standard terminals of the HCU-20 control module

Category	Terminal	Function Description
Input power supply	XPWR: 24VI	HCU-20 power supply
Digital power output	XDPR: 24VD	Digital output power isolated from XPWR
Digital input	XDI: DI1–DI6, DIL	Input type: relay contact, NPN or PNP
High-speed digital input	XHDIO: HDI1, HDI2	Input type: NPN or PNP
High-speed digital output	XHDIO: HDO1, HDO2	Output type: open collector
Analog output	XAO: AO1, AO2	Output type: current or voltage, selected by jumper

Category	Terminal	Function Description
Analog input	XAI: AI1, AI2	Input type: current or voltage, selected by jumper
Relay output	XRO1, XRO2, XRO3	Relay output: NO, NC, and COM
InoLink communication	XCOMM	High-speed RS485, bus termination resistor selected by jumper
RJ45 interface	X11, X12	For communication with the SOP-20-880. The two RJ45 interfaces are identical for cascading multiple HCU-20. Connection cable: < 3 m
Inodrive communication	VR, VT	For communication with the basic rectifier module

5.1.3 Optional Function Modules

The HCU-20 can be used with other function modules connected to its slots to expand its functions. The following table shows the details.

Table 5-3 List of optional function modules

No.	Module	Model	Function Description	Connection Method	Dimensions (Unit: mm)
1	I/O module	HIO-10	2 AIs 2 AOs 2 DIOs 1 relay output	SLOT	105 x 73 x 24
2	PROFIBUS-DP module	HDP-10	PROFIBUS-DP bus adaptation	SLOT	75 x 73 x 24
3	CAN bus module	HCAN-10	CANopen bus adaptation	SLOT	75 x 73 x 24
4	MODBUS RTU module	HMBA-10	MODBUS RTU bus adaptation	SLOT	75 x 73 x 24
5	Ethernet module	HETN-10	Ethernet commissioning module	SLOT	75 x 73 x 24
6	PROFINET I/O module	HPFN-10	PROFINET I/O industrial Ethernet	SLOT	75 x 73 x 24
7	Modbus TCP module	HMBT-10	Modbus TCP industrial Ethernet	SLOT	75 x 73 x 24

No.	Module	Model	Function Description	Connection Method	Dimensions (Unit: mm)
8	Fiber-optic expansion module	HOFM-10	One pair of 50 M fiber-optic cables	SLOT	75 x 73 x 24
		HOFM-30	Three pairs of 50 M fiber-optic cables	SLOT	75 x 73 x 24
9	Parallel control module	HPCU-40	Supports 2 to 4 parallel modules	Optical fiber	232 x 86 x 40
		HPCU-60	Support 2 to 6 parallel modules	Optical fiber	232 x 86 x 40
		HPCU-A0	Support 2 to 10 parallel modules	Optical fiber	232 x 86 x 40
10	Function expansion module	HESD-10	Expands one SLOT expansion slot	Optical fiber	105 x 75 x 70
11	Synchronous voltage detection module	HSVM-10	AC voltage detection	Optical fiber	150 x 100 x 30
		HSVM-20	DC voltage detection	Optical fiber	150 x 100 x 30
12	Smart operating panel	SOP-20-880	Human-machine interaction	RS485	150 x 100 x 30
13	Fiber-optic routing control module	HOFR-50	Supports the data exchange between five HCU control modules	Optical fiber	232 x 86 x 40
14	Pulse-by-pulse current limit module	HCBC-A0	Pulse-by-pulse current limit control of parallel power modules	Optical fiber	232 x 86 x 40

5.1.4 LED Indicators

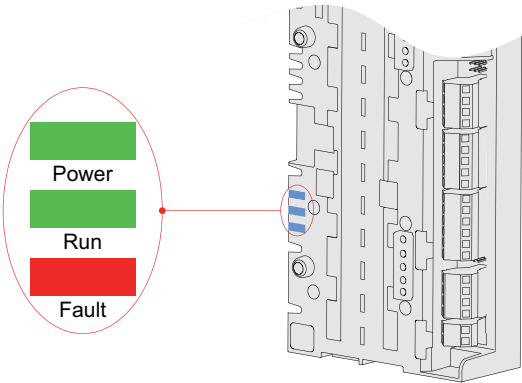


Figure 5-2 Location and definition of LED indicators

Table 5-4 Function description of LED indicators

No.	Indicator	State	Function Description
1	Power	Solid green	The HCU-20 power supply is normal.
		OFF	The HCU-20 is de-energized or the power supply has failed.
2	Run	Solid green	The basic rectifier module is running.
		OFF	The basic rectifier module stops.
3	Fault	Solid red	The system is faulty.
		OFF	The system is normal.

5.1.5 SD Memory Card

The HCU-20 is internally equipped with an SD card for storing the real-time data from all stages of the control module to assist in monitoring and analyzing the basic rectifier module. The data is stored on a micro SD card and analyzed by Inovance maintenance personnel.

5.1.6 Terminals

1) Overall terminal diagram

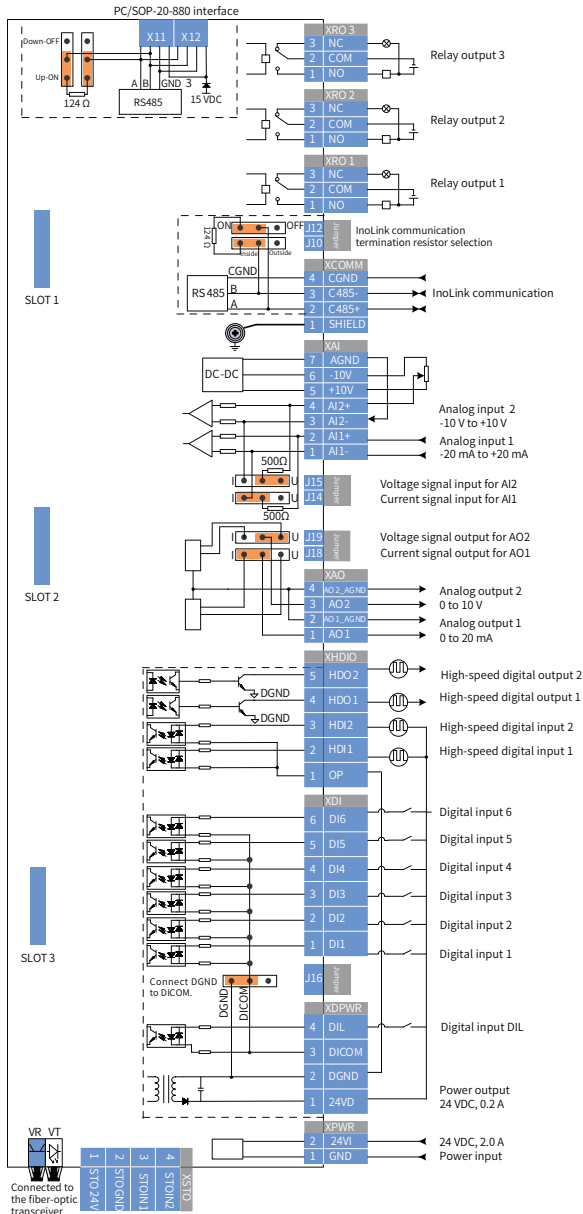


Figure 5-3 Overview of HCU-20 control module terminals

2) I/O terminals

Table 5-5 Default I/O terminal configuration of the HCU-20 control module

No.	Terminal	Function Description
1	XRO1	Main circuit contactor control signal
2	XRO2	Fault output signal
3	XRO3	Backup
4	DI1	Backup
5	DI2	Start/Switch-on signal
6	DI3	Main contactor close feedback signal
7	DI4	Backup
8	DI5	Switch-off signal
9	DI6	Backup

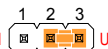


NOTE

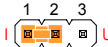
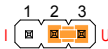
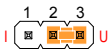
◆ If you need to modify the pin assignment, see the *MD880-20 Series Basic Rectifier Software Guide*.

3) Detailed terminal description

Table 5-6 Detailed description of the HCU-20 terminals

No.	Terminal	Function Description	Cable Specification
XPWR: input power terminal			
1	GND	24.0 VDC $\pm$ 5%, 2.0 A	2-core twisted pair cable is recommended. Cross sectional area: 0.5–2.5 mm ²
2	24VI		
XDPWR: DIL connection terminal			
1	24VD	Provides power for DI, HDI, and HDO 24.0 VDC $\pm$ 5%, 0.2 A	Twisted pair or single-core cable Cross sectional area: 0.5–2.5 mm ²
2	DGND	24 VD ground	
3	DICOM	DI common output, connected to DGND through jumper J11	
4	DIL	Digital interlock or common DI; technical parameters are the same as common DIs	
Jumper J16: power supply selection			
 By shorting 1 and 2, the 24 VDC internal power supply is used to power up DIs.			
 By shorting 2 and 3, the external power supply is used to power up DIs.			

No.	Terminal	Function Description	Cable Specification
XDI: DI terminal			
1	DI1	24V logic level: "0" < 5 V; "1" > 15 V; Rin: 2.0 kΩ Input type: NPN/PNP, relay contact Hardware filter: 0.04 ms Imax: 15 mA	Single-core cable Cross sectional area: 0.5–2.5 mm ²
2	DI2		
3	DI3		
4	DI4		
5	DI5		
6	DI6		
XHDIO: HDIO terminal			
1	OP	HDI common terminal	Cross sectional area: 0.5–2.5 mm ² Shielded twisted pair cable is recommended. HDO and DGND are twisted together. HDI and OP are twisted together.
2	HDI1	Input type: NPN, PNP	
3	HDI2	24 V logic level: "0" < 5 V; "1" > 15 V; Rin: 2.0 kΩ Input voltage range: 0–30 VDC Input frequency range: 0–100 kHz Max. HDI load (Imax): 15 mA	
4	HDO1	Output type: OC	
5	HDO2	Output frequency range: 0–100 kHz Max. HDO load (Imax): 20 mA Output voltage range: 0–26.4 VDC	
XAO: AO terminal			
1	AO1	AO1 output range: 0–20 mA, Rload ≤ 500 Ω; 0–10 V, Rload ≥ 10 kΩ AO2 output range: 0–20 mA, Rload ≤ 500 Ω; 0–10 V, Rload ≥ 10 kΩ Resolution: 11 bit + sign bit Accuracy: 2% full scale	Cross sectional area: 0.5–2.5 mm ² Shielded twisted pair cable is recommended. AO1 and AO1_AGND are twisted together. AO2 and AO2_AGND are twisted together.
2	AO1_AGND		
3	AO2		
4	AO2_AGND		
Jumper J19: AO1 signal type selection			
1 2 3 When 1 and 2 are shorted, current signal is selected for AO1.			
1 2 3 When 2 and 3 are shorted, voltage signal is selected for AO1.			
Jumper J18: AO2 signal type selection			
1 2 3 When 1 and 2 are shorted, current signal is selected for AO2.			
1 2 3 When 2 and 3 are shorted, voltage signal is selected for AO2.			

No.	Terminal	Function Description	Cable Specification	
XAI: AI terminal				
1	AI1-	Current input: -20 mA to +20 mA, Rin: 500 Ω	Cross sectional area: 0.5–2.5 mm ² Use two 2-core shielded twisted pair cables in the case of two AIs. If HCU-20 is used as the power supply, use one 4-core shielded twisted pair cable in the case of one AI.	
2	AI1+			
3	AI2-			
4	AI2+	Differential input, input range: ±30 V Sampling interval per channel: 0.25 ms Hardware filter: 0.25 ms Resolution: 11 bit + sign bit Accuracy: 1% full scale		
5	+10V	+10 V: +10 V ± 1%		
6	-10V	-10 V: -10 V ± 1%		
7	AGND	Rload: 1–10 kΩ		
Jumper J14: AI1 signal type selection				
				When 1 and 2 are shorted, current signal is selected for AI1.
				When 2 and 3 are shorted, voltage signal is selected for AI1.
Jumper J15: AI2 signal type selection				
				When 1 and 2 are shorted, current signal is selected for AI2.
				When 2 and 3 are shorted, voltage signal is selected for AI2.
XCOMM: InoLink communication RS485 terminal				
1	SHIELD	RS485 bus, 5 V standard level	4-core shielded twisted pair cable Cross sectional area: 0.5–2.5 mm ²	
2	C485+	Bus termination resistor: 124 Ω		
3	C485-	Max. communication baud rate: 5 Mbps		
4	CGND	Max. number of nodes: 32 (without repeater) Max. transmission distance: 10 m		
Jumpers J10 and J12: RS485 bus termination resistor selection (J10 and J12 must be in the same state to ensure matching termination resistor.)				
			The termination resistor is connected when 1 and 2 are shorted.	
			The termination resistor is disconnected when 2 and 3 are shorted.	

No.	Terminal	Function Description	Cable Specification
XRO1: relay 1 output terminal			
1	RO1_NO	Output type: passive NO and NC contacts Contact parameters: 250 VAC/30 VDC, 2 A	Single-core cable
2	RO1_COM		Cross sectional area:
3	RO1_NC		0.5–2.5 mm ²
XRO2: relay 2 output terminal			
1	RO2_NO	Output type: passive NO and NC contacts Contact parameters: 250 VAC/30 VDC, 2 A	Single-core cable
2	RO2_COM		Cross sectional area:
3	RO2_NC		0.5–2.5 mm ²
XRO3: relay 3 output terminal			
1	RO3_NO	Output type: passive NO and NC contacts Contact parameters: 250 VAC/30 VDC, 2 A	Single-core cable
2	RO3_COM		Cross sectional area:
3	RO3_NC		0.5–2.5 mm ²
VR, VT: fiber-optic transceiver			
1	VR	Receives fiber-optic communication signals	Optical fiber type: plastic optical fiber (POF)
2	VT	Transmits fiber-optic communication signals	
X11, X12: SOP-20-880 communication RS485 terminal			
1, 2, 7	NC	RS485 bus, 5 V standard level	Standard LAN cable
3, 8	GND3	Bus termination resistor: 124 Ω	
4	A	Max. communication baud rate: 4 Mbps	
5	B	Max. number of nodes: 32 (without repeater) Max. transmission distance: 100 m	
6	15V3	15V3: 15 V ± 15%	
Jumper J12, J15: bus termination resistor selection (J12 and J15 are active only when they are in the same state)			
1 2 3 Connect the termination resistor by shorting 1 and 2.			
1 2 3 Disconnect the termination resistor by shorting 2 and 3.			

5.2 HPCU Parallel Control Module

The HPCU is a parallel control module in the system. It receives the driving and control signals sent by the HCU-20 and synchronously transmits these signals to each power module. Meanwhile, it quickly collects and uploads the current, voltage, status, and other information reported by each power module to the HCU-20. Additionally, it also controls the synchronization, current sharing, reset, and start/stop of parallel power modules.

According to the system requirements, you can select HPCU-40 (four parallel modules) or HPCU-60 (six parallel modules).

5.2.1 Standard Interfaces

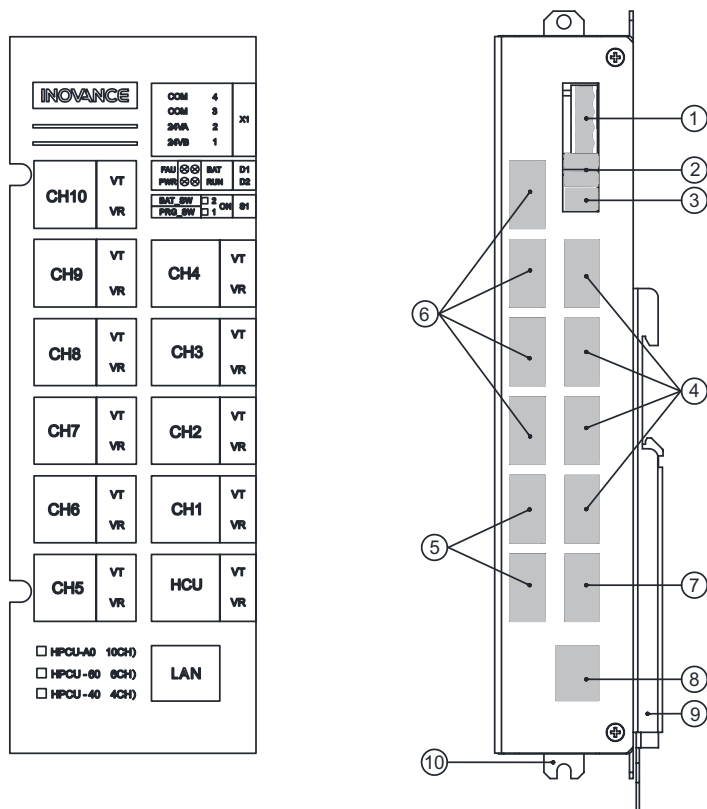


Figure 5-4 HPCU control module

Table 5-7 Function description of HPCU interfaces

No.	Name	Interface	Description	Remarks
①	Power supply X1	COM 4	24V ground	External power supply for HPCU X1 terminal: 5.08 mm pitch, 4-pin black pluggable terminal Twisted pair cable Cross sectional area: 0.5–2.5 mm ²
		COM 3	24V ground	
		24VA 2	24 V+	
		24VB 1	24 V+	
②	LED indicator	PWR	Solid green	The HPCU power supply is normal.
			OFF	The HPCU is de-energized or the power supply has failed.
		RUN	Solid green	The power module is running.
			OFF	The power module is not running.
		FAU	Solid red	The system is faulty.
			OFF	The system is normal.
		BAT	Reserved	-
			Reserved	-
③	DIP switch S1	BAT_SW	Reserved	-
		PRG_SW	Reserved	-
④	Fiber-optic transceiver	CH1 to CH4	Parallel module channels 1 to 4	VT: 50 M, transmits fiber-optic communication signals VR: 50 M, receives fiber-optic communication signals Optical fiber type: POF HPCU-40 channels: CH1 to CH4 HPCU-60 channels: CH1 to CH6 HPCU-A0 channels: CH1 to CH10
⑤		CH5 to CH6	Parallel module channels 5 to 6	
⑥		CH7 to CH10	Parallel module channels 7 to 10	
⑦		HCU	Communication between HPCU and HCU	
⑧	-	LAN	Commissioning interface	Connected to PC
⑨	Guide rail groove	-	Used for guide rail installation	-
⑩	Mounting hole	-	Four holes for securing the installation	-

5.2.2 LED Indicators

Table 5-8 Function description of LED indicators

No.	Indicator	State	Function Description
1	PWR	Solid green	The HPCU power supply is normal.
		OFF	The HPCU is de-energized or the power supply has failed.
2	RUN	Solid green	The basic rectifier module is running.
		Off	The basic rectifier module is not running.
3	FAU	Flashing red	The system is faulty.
		OFF	The system is normal.
4	BAT	Solid red	Battery undervoltage occurs.
		OFF	The battery is normal.

5.2.3 Electrical Connection of the HPCU

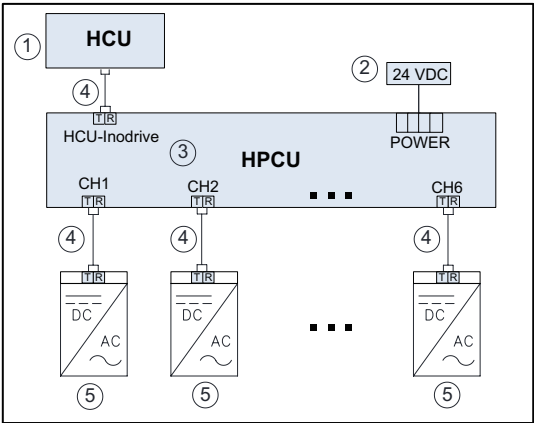


Figure 5-5 Electrical connection of the HPCU

Table 5-9 Description of HPCU electrical connection

No.	Component
1	HCU-20 control module
2	External 24 VDC power supply
3	HPCU parallel control module
4	Communication optical fiber
5	Basic rectifier module

6 Maintenance and Inspection

6.1 Overview

This chapter describes:

- Precautions on maintenance and inspection of the basic rectifier module and mounting cabinet
- Regular maintenance and inspection of components
- Component replacement during maintenance and inspection

 DANGER	
	◆ Before carrying out maintenance or inspection on the basic rectifier module and mounting cabinet, switch off all power supplies and wait for 15 minutes.
	◆ Before starting maintenance, measure the DC bus voltage using a multimeter after the 15 minutes have elapsed. This is to make sure that the bus voltage is below the harmless level ($< 36\text{ V}$).
	◆ When an external power supply is connected, hazardous voltages are still present in the basic rectifier module and mounting cabinet even when the main circuit breaker is open.
	◆ Beware of any residual rotation of the fan.

6.2 Precautions on Cleaning

The basic rectifier module comprises mostly electronic components. Apart from the fans, therefore, it contains hardly any components that are subject to wear or that require maintenance or inspection. To ensure normal operation of the module, remove the dirt and contamination regularly.

The following points must generally be observed:

1) Dust deposits

Dust deposits inside the basic rectifier module must be removed at regular intervals (or at least once a year) by qualified personnel in line with the relevant safety regulations. Determine the cleaning frequency according to the operating environment. The module must be cleaned using a brush and vacuum cleaner, along with dry compressed air (max. 1 bar) for areas that cannot be easily reached.

2) Ventilation

The ventilation openings in the cabinet and the cooling fan circuit must never be obstructed. The fans must be checked to make sure that they are functioning properly.

6.3 Precautions on Inspection

- Inspection involves activities and procedures for maintaining the normal operation of the equipment and eliminating the equipment faults.
- Before starting any maintenance or inspection work, operate in strict compliance with correct operating instructions.
- Maintain and inspect the basic rectifier module only after it has become de-energized and cooled down.
- Mount and connect the basic rectifier module according to the national standards, industry standards, and local safety rules.
- Residual voltages are still present in the cabinet after you turn off the input breaker switch. Check and confirm that no voltage exists before operations.
- Use only instruments that comply with the voltage withstand requirements for testing. Ensure that the housing of the instruments is well grounded.
- Be careful when measuring the components inside the cabinet. Never let the two probes of the multimeter touch or let them touch other terminals.
- The basic rectifier module can be installed, inspected, and maintained only by qualified personnel.

1) Required tools

The following tools are required for inspecting and replacing the components.

- Spanner or socket spanner (width across flats 6)
- Spanner or socket spanner (width across flats 8)
- Spanner or socket spanner (width across flats 10)
- Spanner or socket spanner (width across flats 12)
- Torque wrench
- Phillips screwdriver (size 1/2)
- A socket-spanner kit with two long extensions is recommended.

2) Service life of components

To ensure long-term normal operation of the module, maintain the electronic

components inside the module regularly according to their service life. The service life of these components is influenced by the operating environment and conditions. The following table lists the replacement intervals for your reference.

Table 6-1 Service life of the components inside the basic rectifier module

Component	Standard Service Life
DC fan	3 to 5 years
PCB	8 to 10 years

3) Tightening torques for screw connections

The following tightening torques apply when tightening the current-conducting connections (power input connections, DC bus connections, copper busbar connections), non-current-conducting connections (grounding terminals and protective grounding terminals), and general steel threaded connections.

Table 6-2 Tightening torques for current-carrying components

Screw/Bolt	Grounding/Protective Grounding/ Steel Threaded Connections (N · m) (Fault Current-Conducting)	Plastic, Busbars (N · m) (Operating Current-Conducting)
M2.5	0.8	0.6
M3	1.25	0.8
M4	2.9	1.8
M5	5.5	2.5
M6	9.5	5.5
M8	20	10.5
M10	45	20
M12	80	45

4) Cable terminals and fasteners

Check the cable and screw terminals regularly to ensure that they are securely in position and, if necessary, retightened. Cabling must be checked for defects. Defective parts must be replaced immediately.



NOTE

◆ The actual maintenance intervals depend on the installation environment and operating conditions of the equipment.

6.4 Replacement of Components

6.4.1 General Information

This section deals with the replacement of components that may need to be exchanged during maintenance or inspection. Other components are not normally subject to wear and are, therefore, not covered in this part.

6.4.2 Safety Information

Required safety precautions before carrying out maintenance and inspection:

- The basic rectifier module is operated with high voltages.
- All connection work must be carried out when the basic rectifier module is de-energized.
- Due to the capacitor in the circuits, hazardous voltages are still present inside the basic rectifier module up to 15 minutes after the module has been disconnected. Therefore, do not open the module until a reasonable period has elapsed (residual voltage < 36 V).
- The basic rectifier module can be maintained and inspected only by trained personnel. Failure to comply may result in severe personal injury or even death, or substantial property loss.
- Some of the devices are heavy or top heavy. Due to their weight, the devices must be handled with care by trained personnel. Severe injury or even death or substantial property loss can occur if the devices are not lifted or transported properly.

6.4.3 Replacing the Filter Screen

1) Preparatory steps

- Observe the "five safety rules".
- Disconnect the cabinet from the power supply (do not forget the external power supplies).
- Ensure that the window blind in the cabinet door is not damaged.
- The cabinet must be powered off to prevent the fan from drawing in contaminated external air. If an external power supply for the fan is used, beware of the residual rotation of the fan or switch off the power supply.
- If you do not replace the dirty filter screen regularly, the cabinet may stop due to overtemperature.

2) Removing the filter screen

If an IP42 air inlet kit is used by the cabinet, clean the air inlet as follows:

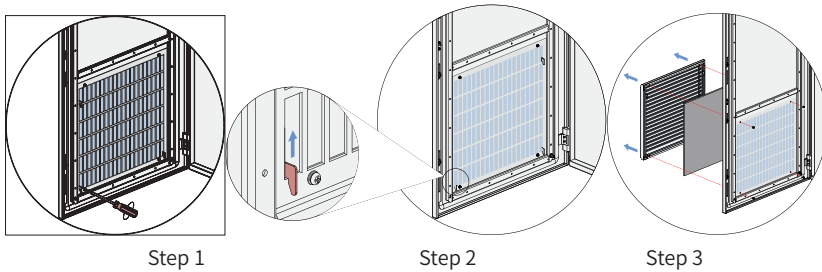


Figure 6-1 Removing the filter screen

- ① Open the front cabinet door and remove the four M4 screws from the window blind, as shown in Step 1.
- ② Lift the window blind and remove it, as shown in Step 2.
- ③ Remove and clean (or replace) the filter screen, as shown in Step 3.

3) Installing the filter screen

Perform the preceding procedure in reverse order:

- ① Insert the cleaned or a new filter screen into the window blind.
- ② Snap the window blind back into the preset position.
- ③ Fix the window blind with the four M4 screws from the inside of the front cabinet door.

Repeat the preceding actions for all filter screens that need to be replaced.

6.4.4 Replacing the DC Fans

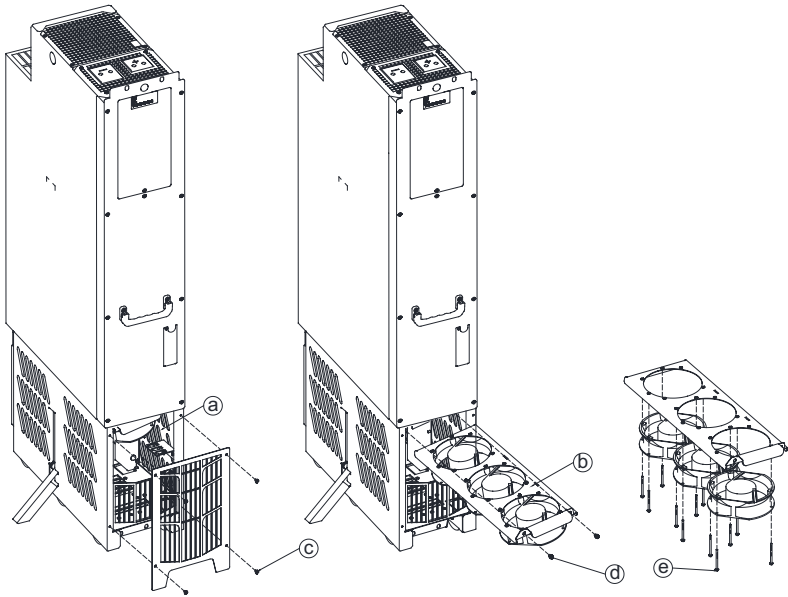


Figure 6-2 Replacing the DC fans of the basic rectifier module

The DC fans have two specifications. Replace the fans with proper ones according to the model of the basic rectifier module. The replacement steps are as follows:

- ① Disconnect the drive system from the AC power supply and ensure that the equipment is voltage-free.
- ② Open the cabinet door, unscrew the four M4 screws (c) fixing the front cover with a screwdriver, and remove the cover.
- ③ Disconnect the connections between the fans and the supply module (a).
- ④ Unscrew the two M5 screws (d) from the fan assembly and pull out the fan assembly (b).
- ⑤ Unscrew the twelve M4 screws (e, four for each fan) from the fan assembly and remove the fans.
- ⑥ Install the new fans and fan assembly in an order reverse to preceding actions.
- ⑦ Connect the fans to the supply module.

6.4.5 Replacing the Basic Rectifier Module

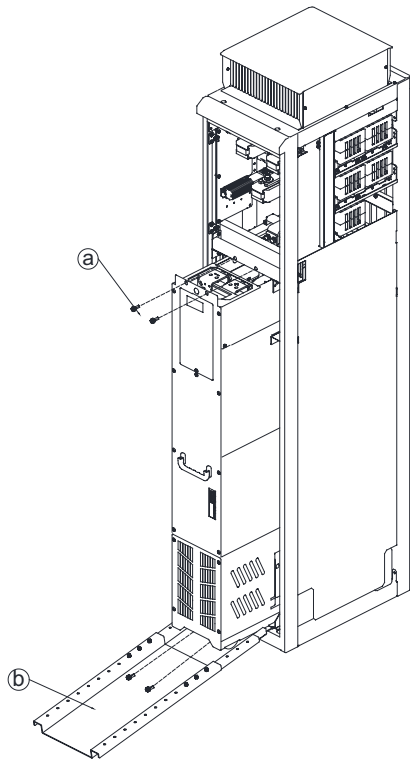


Figure 6-3 Replacing the basic rectifier module

- 1) Perform the following steps to replace the basic rectifier module:
 - ① Disconnect the drive system from the AC power supply and ensure that the equipment is voltage-free.
 - ② Open the cabinet door.
 - ③ Disconnect the fiber-optic connections.
 - ④ Disconnect the output DC bus.
 - ⑤ Fix the guide rail (b) for installing the basic rectifier module.
 - ⑥ Remove the M8 retaining screws (a) at the top and bottom (two for each side) of the basic rectifier module.
 - ⑦ Pull out the basic rectifier module and unfold the anti-tip bracket.
 - ⑧ Install the basic rectifier module by carrying out the preceding steps in reverse order.

**NOTE**

- ◆ It is recommended that the height of the cabinet base be ≤ 10 mm to avoid excessive inclination of the guide rail.

2) Fold and unfold the anti-tip bracket as follows:

- ① Unfold the bracket by pulling it down in the direction of the arrow shown in the following figure.

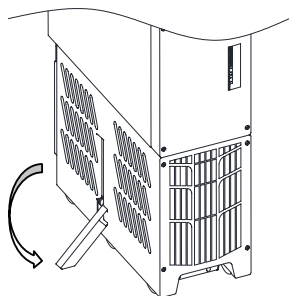


Figure 6-4 Unfolding the anti-tip bracket

- ② Press the anti-tip bracket spring to the left until the bracket aligns with the bracket slot.
- ③ Gently swing the anti-tip bracket up into the slot to fold it.

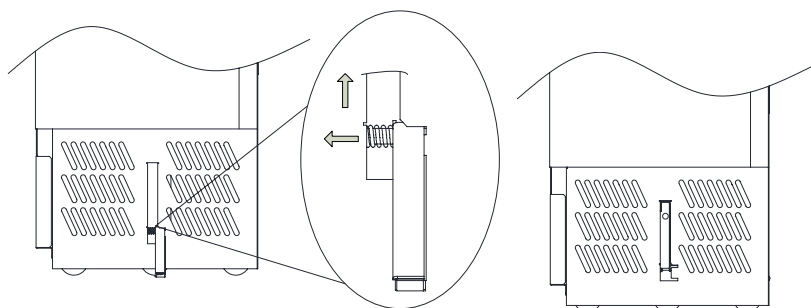


Figure 6-5 Folding the anti-tip bracket

6.4.6 Replacing the Fuse

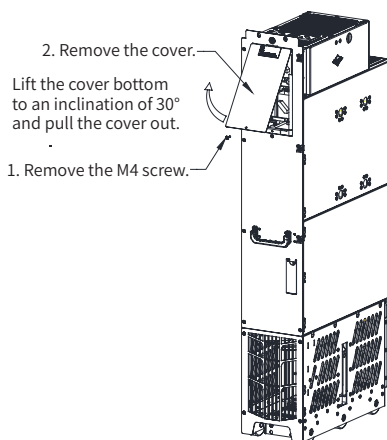


Figure 6-6 Removing the cover

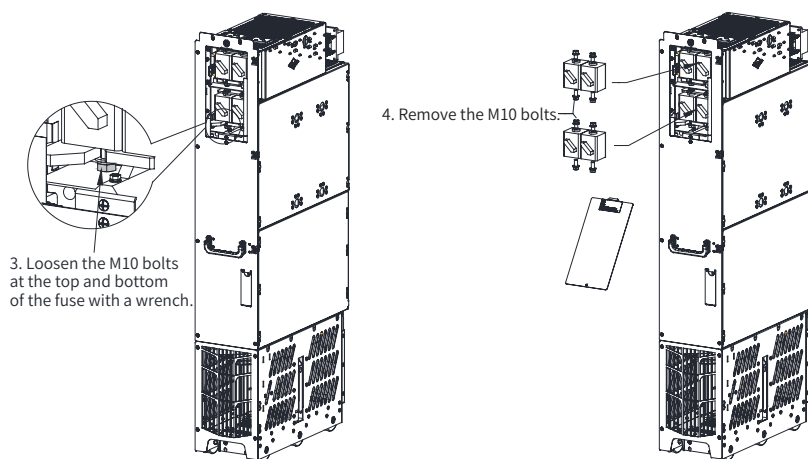


Figure 6-7 Removing the fuse

- ① Unscrew the M4 screw on the cover and remove the cover, as shown in Figure 6-6;
- ② Loosen the M10 bolts at the top and bottom of the fuse with a wrench and take out the fuse.
- ③ Remove the M10 bolts.



◆ It is recommended that the height of the cabinet base be ≤ 10 mm to avoid excessive inclination of the guide rail.

Ordering Guidance

This chapter lists the model numbers and order numbers of the basic rectifier modules.

Rectifier Model MD880-20M-...	Frame	Order No.	Quantity	Remarks
0718-4	T2	1. MD880-20M-0718-4	1	Basic rectifier module
		2. HCU-20	1	Basic rectifier control module
		3. T2-quick-kit	1	T2 quick mounting kit (optional)
0982-4	T2	1. MD880-20M-0982-4	1	Basic rectifier module
		2. HCU-20	1	Basic rectifier control module
		3. T2-quick-kit	1	T2 quick mounting kit (optional)
1336-4	2 x T2	1. MD880-20M-0718-4	2	Basic rectifier module
		2. HCU-20	1	Basic rectifier control module
		3. HPCU-40	1	Parallel control module
		4. T2-quick-kit	2	T2 quick mounting kit (optional)
1826-4	2 x T2	1. MD880-20M-0982-4	2	Basic rectifier module
		2. HCU-20	1	Basic rectifier control module
		3. HPCU-40	1	Parallel control module
		4. T2-quick-kit	2	T2 quick mounting kit (optional)
2739-4	3 x T2	1. MD880-20M-0982-4	3	Basic rectifier module
		2. HCU-20	1	Basic rectifier control module
		3. HPCU-40	1	Parallel control module
		4. T2-quick-kit	3	T2 quick mounting kit (optional)
3651-4	4 x T2	1. MD880-20M-0982-4	4	Basic rectifier module
		2. HCU-20	1	Basic rectifier control module
		3. HPCU-40	1	Parallel control module
		4. T2-quick-kit	4	T2 quick mounting kit (optional)
4564-4	5 x T2	1. MD880-20M-0982-4	5	Basic rectifier module
		2. HCU-20	1	Basic rectifier control module
		3. HPCU-60	1	Parallel control module
		4. T2-quick-kit	5	T2 quick mounting kit (optional)

Rectifier Model MD880-20M-...	Frame	Order No.	Quantity	Remarks
5477-4	6 x T2	1. MD880-20M-0982-4	6	Basic rectifier module
		2. HCU-20	1	Basic rectifier control module
		3. HPCU-60	1	Parallel control module
		4. T2-quick-kit	6	T2 quick mounting kit (optional)
0570-7	T2	1. MD880-20M-0570-7	1	Basic rectifier module
		2. HCU-20	1	Basic rectifier control module
		3. T2-quick-kit	1	T2 quick mounting kit (optional)
0815-7	T2	1. MD880-20M-0815-7	1	Basic rectifier module
		2. HCU-20	1	Basic rectifier control module
		3. T2-quick-kit	1	T2 quick mounting kit (optional)
1061-7	2 x T2	1. MD880-20M-0570-7	2	Basic rectifier module
		2. HCU-20	1	Basic rectifier control module
		3. HPCU-40	1	Parallel control module
		4. T2-quick-kit	2	T2 quick mounting kit (optional)
1515-7	2 x T2	1. MD880-20M-0815-7	2	Basic rectifier module
		2. HCU-20	1	Basic rectifier control module
		3. HPCU-40	1	Parallel control module
		4. T2-quick-kit	2	T2 quick mounting kit (optional)
2273-7	3 x T2	1. MD880-20M-0815-7	3	Basic rectifier module
		2. HCU-20	1	Basic rectifier control module
		3. HPCU-40	1	Parallel control module
		4. T2-quick-kit	3	T2 quick mounting kit (optional)
3031-7	4 x T2	1. MD880-20M-0815-7	4	Basic rectifier module
		2. HCU-20	1	Basic rectifier control module
		3. HPCU-40	1	Parallel control module
		4. T2-quick-kit	4	T2 quick mounting kit (optional)

Rectifier Model MD880-20M-...	Frame	Order No.	Quantity	Remarks
3788-7	5 x T2	1. MD880-20M-0815-7	5	Basic rectifier module
		2. HCU-20	1	Basic rectifier control module
		3. HPCU-60	1	Parallel control module
		4. T2-quick-kit	5	T2 quick mounting kit (optional)
4546-7	6 x T2	1. MD880-20M-0815-7	6	Basic rectifier module
		2. HCU-20	1	Basic rectifier control module
		3. HPCU-60	1	Parallel control module
		4. T2-quick-kit	6	T2 quick mounting kit (optional)

Revision History

Date	Version	Change Description
May 2021	A00	First release.

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