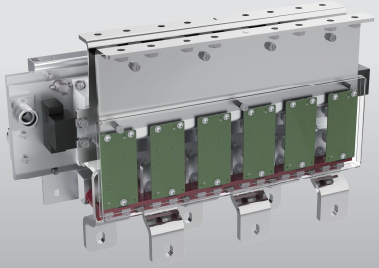
INOVANCE

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MD880LC-20M Series
Basic Rectifier Module
Hardware Guide

Industrial Automation | Intelligent Elevator | New Energy Vehicle | Industrial Robot | Rail Transit

Data code PS00004005A02

Preface

Introduction

The MD880LC-20 series product is a general low-voltage water-cooled basic rectifier developed by Inovance. It features high power density, compact structure and high reliability. The MD880LC-20 series rectifier contains two types of rectifiers, which are diode rectifier and thyristor rectifier. The most significant difference is that the thyristor rectifier supports pre-charging upon power-on, removing the need for configuring the pre-charging circuit. The input voltage class for the water-cooled thyristor rectifier is 690 V. The rated power for an individual rectifier without overload is 1689 kW. Up to four rectifier modules can be paralleled, with the total rated output power reaching 6285 kW, capable of providing power for one or more inverter modules. The water-cooled diode rectifier supports 6- or 12-pulse input and a voltage class of 690 V. The rated power of an individual rectifier is 2273 kW. For water-cooled diode rectifier, up to two rectifier modules can be paralleled, with the total rated output power reaching 4229 kW, capable of providing power for one or more inverter modules. Products are applicable to a wide range of industries, including shield machines, petroleum, and vessels.

For use with the MD880LC-50 series water-cooled inverter, the MD880LC-20 series rectifier must be configured as a 12-pulse rectifier.

More information

Data Name	Code	Description
MD880 (LC)-20 Series Basic Rectifier Function Guide	19012538	Presents function applications, and troubleshooting of the product.
MD880 (LC)-20 Series Basic Rectifier Commissioning Guide	19012539	Presents commissioning tool, commissioning flow, specific commissioning procedure, and parameters of the product.
MD880 (LC)-20 Series Basic Rectifier Parameter Guide	19012537	Presents parameters and fault codes of the product.
MD880 Series AC Drive Communication Guide	19012451	Presents specifications, networking, and communication configuration of the product.
MD880LC-20M Series Basic Rectifier Module Hardware Guide	19011639	Presents the system structure, technical specifications, components, dimensions, options (including installation accessories, cables, and electrical peripherals), certifications, and standards.

Data Name	Code	Description
MD880LC-20M Series Basic Rectifier Installation and Maintenance Guide	19011638	Presents installation preparation, unpacking and transportation, mechanical installation, electrical installation, routine maintenance, and component replacement.
MD880-20 Series Basic Rectifier Hardware User Guide	19010983	Presents technical specifications, components, dimensions, mechanical installation, electrical installation, routine maintenance, and component replacement.

Revision History

Revision date	Version	Revision
November 2024	A02	Updated the front cover and back cover.
October 2024	A01	**Added:** • Added section "Components of the Thyristor Rectifier Module" (*"1.4.2 Description of components of the thyristor rectifier module" on page 22*). • Added section "Outline Dimensions of the Thyristor Rectifier Module" (*"3.1.2 Outline dimensions of the thyristor rectifier module" on page 46*). • Added section "Recommended Installation of Thyristor Rectifier Module" (*"3.3.4 Recommended Installation Method of Thyristor Rectifier Module" on page 55*). • Added section "Thyristor Rectifier Module - Fan Fault Detection Module" (*"5.3 Thyristor Rectifier Module - Fan Fault Detection Module" on page 72*). **Revision:** • Updated section "Model and nameplate" (*"1.1 Model and Nameplate" on page 14*). • Updated section "Ordering Instructions" (*" Ordering Instructions" on page 80*).
January 2022	A00	First release

Access to the Guide

This guide is not delivered with the product. You can obtain the PDF version by the following methods:

- Do keyword search under Service and Support at *www.inovance.com*.

- Scan the QR code on the product with your smart phone.
- Scan the QR code below to install My Inovance app, where you can search for and download user guides.



Warranty disclaimer

Inovance provides warranty service within the warranty period (as specified in your order) for any fault or damage that is not caused by improper operation of the user. Maintenance will be charged after the warranty expires.

Within the warranty period, maintenance will be charged for the following damage:

- Damage caused by operations not following the instructions in the user guide
- Damage caused by fire, flood, or unusual voltage
- Damage caused by unintended use of the product
- Damage caused by use beyond the specified scope of application of the product
- Damage or secondary damage caused by force majeure (natural disaster, earthquake, and lightning strike)

The maintenance is charged according to the latest Price List of Inovance. If otherwise agreed upon, the terms and conditions in the agreement shall prevail.

For details, see Product Warranty Card.

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Fundamental Safety Instructions

Safety Precautions

- This chapter provides essential safety instructions for proper use of the equipment. Before operating the equipment, read through the guide and comprehend all the safety instructions. Failure to observe the safety precautions may result in serious injuries or death of personnel or device damage.
- "Danger", "Warning", and "Caution" items in this guide do not indicate all safety precautions that need to be followed; instead, they just supplement the safety precautions.
- Use this product according to the designated environment requirements. Damage caused by improper use is not covered by warranty.
- Inovance shall take no responsibility for any personal injuries or property damage caused by improper usage.

Safety Levels and Definitions



Indicates that failure to comply with the notice will result in death or severe personal injuries.



Indicates that failure to comply with the notice may result in death or severe personal injuries.



Indicates that failure to comply with the notice may result in minor or moderate personal injuries or equipment damage.

Fundamental safety instructions

- Drawings in the guide are sometimes shown without covers or protective guards. Remember to install the covers or protective guards as specified first, and then perform operations in accordance with the instructions.
- Product illustrations in this guide are for reference only. Actual products may vary.
- Operators must take mechanical precautions to protect personal safety and wear protective equipment, such as anti-smashing shoes, safety clothing, safety glasses, protective gloves, and protective sleeves.

Unpacking
 • Do not install the equipment if you find damage, rust, or signs of use on the equipment or accessories upon unpacking. • Do not install the equipment if you find water seepage or missing or damaged components upon unpacking. • Do not install the equipment if you find the packing list does not conform to the equipment you received.
 • Check whether the packing is intact and whether there is damage, water seepage, dampness, and deformation before unpacking. • Unpack the package in sequence. Do not hit the package violently. • Check whether there is damage, rust, or signs of bumping on the surface of the equipment and equipment accessories before unpacking. • Check whether the package contents are consistent with the packing list before unpacking.

Storage and transportation



- Large-scale or heavy equipment must be transported by qualified professionals using specialized hoisting equipment. Failure to comply may result in personal injuries or equipment damage.
- Before hoisting the equipment, ensure that components such as the front cover and terminal blocks are secured firmly with screws. Loosely-connected components may fall off and result in personal injury or equipment damage.
- Never stand or stay below the equipment when the equipment is being hoisted by the hoisting equipment.
- When hoisting the equipment with a steel rope, ensure the equipment is hoisted at a constant speed without suffering from vibration or shock. Do not turn the equipment over or let the equipment stay hanging in the air. Failure to comply may result in personal injuries or equipment damage.



- Handle the equipment with care during transportation and mind your steps to prevent personal injuries or equipment damage.
- When carrying the equipment with bare hands, hold the equipment casing firmly with care to prevent parts from falling. Failure to comply may result in personal injuries.
- Store and transport the equipment based on the storage and transportation requirements. Failure to comply will result in equipment damage.
- Avoid storing or transporting the equipment in environments with water splash, rain, direct sunlight, strong electric field, strong magnetic field, and strong vibration.
- Avoid storing the product for more than 3 months. When the product needs to be stored for an extended period, take more strict protection and necessary inspection.
- Pack the equipment strictly before transportation. Use a sealed box for long-distance transportation.
- Never transport the equipment with other equipment or materials that may harm or have negative impacts on this equipment.

Installation



- The equipment can be operated only by professionals with electrical knowledge. Non-professionals are not allowed to operate on the equipment.



- Read through the guide and safety instructions before installation.
- Do not install this equipment in places with strong electric or magnetic fields.
- Before installation, check that the mechanical strength of the installation site can bear the weight of the equipment. Failure to comply will result in mechanical hazards.
- Do not wear loose clothes or accessories during installation. Failure to comply may result in an electric shock.
- When installing the equipment in a closed environment (such as a cabinet or casing), use a cooling device (such as a fan or air conditioner) to cool the environment down to the required temperature. Failure to comply may result in equipment over-temperature or a fire.
- Do not retrofit the equipment.
- Do not fiddle with the bolts used to fix equipment components or the bolts marked in red.
- When the equipment is installed in a cabinet or final assembly, a fireproof enclosure providing both electrical and mechanical protections must be provided. The IP rating must meet IEC standards and local laws and regulations.
- Before installing devices with strong electromagnetic interference, such as a transformer, install a shielding device for the equipment to prevent malfunction.
- Install the product on an incombustible object such as metal and do not touch or attach the product to combustibles. Failure to comply can result in fire accident.



- Cover the top of the equipment with a piece of cloth or paper during installation. This is to prevent unwanted objects such as metal chippings, oil, and water from falling into the equipment and causing faults. After installation, remove the cloth or paper on top of the equipment to prevent over-temperature caused by poor ventilation due to blocked ventilation holes.
- Resonance may occur when the equipment operating at a constant speed executes variable speed operations. In this case, install the vibration-proof rubber under the motor frame or use the vibration suppression function to reduce resonance.

Wiring



- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Before wiring, disconnect all the power supplies of the equipment. Wait for at least the time designated on the equipment warning label before further operations because residual voltage still exists after power-off. Measure the DC voltage of the main circuit and make sure that it is below the safety voltage. Failure to comply will result in an electric shock.
- Do not perform wiring, remove the equipment cover, or touch the circuit board with power ON. Failure to comply will result in an electric shock.
- Check that the equipment is grounded properly. Failure to comply can result in an electric shock.



- Do not connect the input power supply to the output end of the equipment. Failure to comply will result in equipment damage or even a fire.
- When connecting a drive to the motor, check that the phase sequences of the drive and motor terminals are consistent to prevent reverse motor rotation.
- Cables used for wiring must meet cross sectional area and shielding requirements. The shield of the cable must be reliably grounded at one end.
- Fix the terminal screws with the tightening torque specified in the user guide. Improper tightening torque may overheat or damage the connecting part, resulting in a fire.
- After wiring is done, check that all cables are connected properly and no screws, washers or exposed cables are left inside the equipment. Failure to comply may result in electric shock or equipment damage.



- During wiring, follow the proper electrostatic discharge (ESD) procedures, and wear an antistatic wrist strap. Failure to comply will result in damage to internal equipment circuits.
- Use shielded twisted pairs for the control circuit. Connect the shield to the grounding terminal of the equipment for grounding purpose. Failure to comply can result in equipment malfunction.

Power-on



- Before power-on, check that the equipment is installed properly with reliable wiring and the motor can be restarted.
- Check that the power supply meets equipment requirements before power-on to prevent equipment damage or a fire.
- Do not open the cabinet door or protective cover of the product, touch any wiring terminal of the product, or remove any part of the product with power on. Failure to comply can result in an electric shock.



- Perform a trial run after wiring and parameter setting to ensure the equipment operates safely. Failure to comply may result in personal injuries or equipment damage.
- Before power-on, check that the rated voltage of the equipment is consistent with that of the power supply. Failure to comply may result in fire accident.
- Before power-on, check that no one is near the equipment, motor, or machine. Failure to comply may result in death or personal injury.

Operation



- The equipment must be operated only by professionals. Failure to comply can result in death or personal injury.
- Do not touch any connecting terminals or disassemble any unit or component of the equipment during operation. Failure to comply can result in an electric shock.



- Do not touch the equipment casing, fan, or resistor with bare hands to feel the temperature. Failure to comply may result in personal injuries.
- Prevent metal or other objects from falling into the equipment during operation. Failure to comply may result in a fire or equipment damage.

Maintenance



- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Do not maintain the equipment with power on. Failure to comply can result in electric shock.
- Before maintenance, disconnect all the power supplies of the equipment and wait for at least the time designated on the equipment warning label.
- When a permanent magnet motor is used, do not touch the motor terminals immediately after power-off because the motor terminals can generate induced voltage during rotation even after the equipment power supply is off. Failure to comply will result in an electric shock.



- Perform routine and periodic inspection and maintenance on the equipment in accordance with maintenance requirements and keep a maintenance record.

Repair



- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Do not maintain the equipment with power on. Failure to comply can result in electric shock.
- Before inspection and repair, cut off all the power supplies of the equipment and wait for at least the time designated on the equipment warning label.

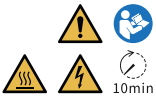


- Require for repair services in accordance with the product warranty agreement.
- When the fuse is blown or the circuit breaker or earth leakage current breaker (ELCB) trips, wait for at least the time designated on the equipment warning label before power-on or further operations. Failure to comply may result in death, personal injuries or equipment damage.
- When the equipment is faulty or damaged, require professionals to perform troubleshooting and repair by following repair instructions and keep a repair record.
- Replace quick-wear parts of the equipment in according with the replacement instructions.
- Do not operate on damaged equipment. Failure to comply may result in death, personal injury, or severe equipment damage.
- After the equipment is replaced, check the wiring and set parameters again.

Disposal
WARNING • Dispose of retired equipment in accordance with local regulations and standards. Failure to comply may result in property damage, personal injuries, or even death. • Recycle retired equipment by observing industry waste disposal standards to avoid environmental pollution.

Safety label

To ensure safe operations, comply with safety signs on the device, and do not damage or remove the safety labels. See the following table for descriptions of the safety labels.

Safety Label	Description
	• Beware of the risk of electric shock. Hazardous voltage still exists within 10 minutes after power-off. • Beware of the risk of burns and scalds. • Read the user guide before use.

1 Product Information

1.1 Model and Nameplate

Diode rectifier module

MD880LC ① - 20M ② - 2000 ③ - 7 ④

① **Product series** MD880LC water-cooled AC drive series	③ **Rated current** 2000 A
② **Product type** Basic rectifier module	④ **Voltage class** 690 VAC

Note

③: The "rated current" code indicates only one current rating.

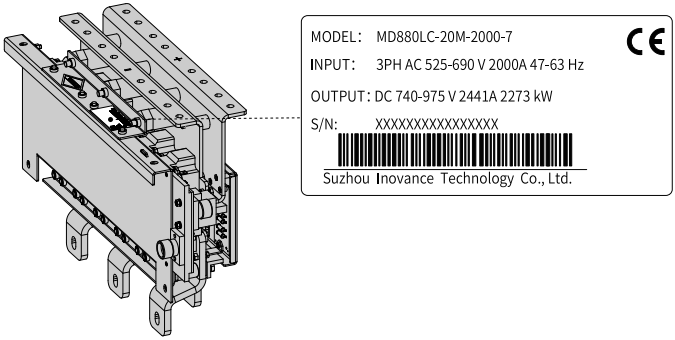


Figure 1-1 Nameplate of the diode rectifier module

Thyristor rectifier module

MD880LC ① - 20M ② - 1520 ③ - 7 ④ + SCR ⑤

① **Product series** MD880LC: MD880 water-cooled AC drive series	④ **Voltage class** 7: 690 VAC
② **Product type** 20M: Basic rectifier module	⑤ **Rectification mode** SCR: Thyristor rectifier
③ **Rated current** 1520: 1520 A	-

Note

③: Only one current rating is displayed in the rated current.

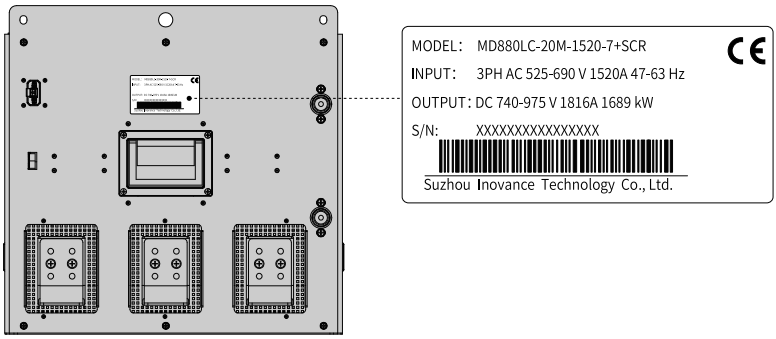


Figure 1-2 Nameplate of the thyristor rectifier module

1.2 Electrical Specifications

Item		Specification					
MD880LC-20M-		Diode XXXX-7		Thyristor XXXX-7+SCR			
		2000	3720	1520	2827	4241	5654
Frame size		D3D	2 x D3D	D3T	2 x D3T	3 x D3T	4 x D3T
Input	Rated input current I_{AC} (A)	2000	3720	1520	2827	4241	5654
	Allowable voltage fluctuation range (VAC)	525 to 690					

Item		Specification					
MD880LC-20M-		Diode XXXX-7		Thyristor XXXX-7+SCR			
		2000	3720	1520	2827	4241	5654
Output	DC bus voltage (VDC)	740 to 975					
	Apparent power S_N (kVA)	2390	4446	1776	3304	4956	6608
	Power P_N (kW)	2273	4229	1689	3142	4713	6285
	Rated output current I_{DC} (A)	2441	4540	1813	3373	5060	6747
	Power at low overload P_{LD} (kW)	2182	4059	1622	3017	4525	6033
	Output current at low overload I_{LD} (A)	2343	4358	1741	3238	4858	6477
	Power at high overload P_{HD} (kW)	1819	3383	1267	2357	3535	4713
	Output current at high overload I_{HD} (A)	1952	3632	1360	2530	3795	5060
	Overload capacity	Low overload: Operating for 1 min per every 5 min at 110% I_{LD} High overload: Operating for 1 min per every 5 min at 150% I_{HD}					
Power loss (kW)		11	21	8.5	16	24	32
Weight (kg)		26.5	53	60	120	180	240
Rated water flow (L/min)		16	32	16	32	48	64
Rated flow resistance (kPa)		40		188			
Dimensions (W x H x D) (mm)		540 x 330 x 172	(2 x) 540 x 330 x 172	473 x 460 x 322	(2 x) 473 x 460 x 322	(3 x) 473 x 460 x 322	(4 x) 473 x 460 x 322
Power consumption of auxiliary power supply		-	-	Power supply input: 24 VDC/2 A. Redundant power supply is implemented through external power supply and internal bus power supply.			

Definition:

Ratings for applications without overload:

- I_{AC} : Continuous RMS AC input current has no overload capacity when the coolant temperature is 40°C (104°F) and air temperature is 45°C (113°F).

- I_{Dc} : Continuous RMS DC output current has no overload capability when the coolant temperature is 40°C (104°F) and air temperature is 45°C (113°F).
- S_N : Rated apparent (AC) power
- P_N : Rated output (DC) power

Ratings for applications with low overload (110% of rated load):

- I_{LD} : Reference load current 110% of rated load allowed for one minute per every 5 min
- P_{LD} : Reference load power

Ratings for applications with high overload (150% of rated load):

- I_{HD} : Reference load current 150% of rated load allowed for one minute per every 5 min
- P_{HD} : Reference load power

1.3 Technical Indicators

1.3.1 Technical Data

Table 1–1 Technical data of MD880LC-20M series basic rectifier module

Item		Specification
Basic performance	AC input voltage	690 V system: 525 VAC to 690 VAC, ±10% (-15% < 1 min)
	Input frequency	47 Hz to 63 Hz (50 Hz/60 Hz±10% required in the vessel industry, with the grid side protection covered)
	Unbalance degree	Maximum value: 3% of the rated line voltage
	Output voltage	690 V model: 740 VDC to 975 VDC
	Overload capacity	Low overload: Operating for 1 min per every 5 min at 110% I_{LD} High overload: Operating for 1 min per every 5 min at 150% I_{HD}
	Operating efficiency	> 99.5% (rated working condition)
	Power factor	> 0.93
	Total harmonic distortion (THD)	THD(I) < 30% to 45% (together with an AC input reactor with 3% voltage drop)
	Noise	＜ 70 dB (noise level at 1 m outside the cabinet under rated load)
Water-cooling system	Coolant	Pure water or mixture of pure water and ethylene glycol + preservative. For use in ambient temperature below 5°C, add antifreeze.
	Maximum pressure	6 bar
	Flow requirements	• 100% water: ⩾ 16 L/min • 80% water and 20% ethylene glycol: ⩾ 18 L/min • 60% water and 40% ethylene glycol: ⩾ 21 L/min

Item		Specification
Mechanical data	Vibration	Ambient/Transportation scenario: Tested according to IEC 60068-2-6 Vibration amplitude at 5 Hz to 8.4 Hz: 3.5 mm; gravitational acceleration at 8.4 Hz to 200 Hz: 1 g, 10 cycles/axis direction
	Shock	Ambient/Transportation scenario: Tested according to IEC 60068-2-27 Gravitational acceleration: 10 g; pulse width; 11 ms, 18 times in each of X/Y/Z-axis
	IP rating	IP00 (module)
	Safety performance	Compliant with EN 61800-5-1
Protective functions	Fault protection	• Diode: Overtemperature alarm • Thyristor: Overcurrent, overvoltage, undervoltage, phase loss, three-phase unbalance, and overtemperature
Environmental requirements	Cooling method	Water-cooling
	Operating location	Indoors without direct sunlight, dust, corrosive gas, combustible gas, oil mist, water vapor, drip, or salty element
	Altitude	1000 to 4000 m (Derating is required for altitudes above 1000 m. Install an isolation transformer for altitudes above 2000 m.) *"1.3.2 Derating" on page 19*
	Ambient temperature	0°C to 55°C (Derating is required for temperatures above 45°C.) *"1.3.2 Derating" on page 19*
	Coolant temperature	0°C to 50°C (Derating is required for temperatures above 40°C.)
	Storage temperature	-40°C to +70°C (Empty the coolant of the module for storage temperatures below 0°C.)
	Storage humidity	5% RH to 95% RH (without condensation). For condensation-proof water temperature, see *"4.2.3 Temperature Limit" on page 66*
	Relative humidity during transportation	Below 95% RH at 40°C
	Pollution degree	PD2
	Power grid system	IT TT/TN (VDR and EMC screws are required for installing Inovance lightning protection board.)
	Overvoltage category	OVCIII
Water quality requirements	PH value	6–8
	Hardness	< 10.dH
	Conductivity	< 300 μs/cm
	Chloride	< 50 mg/L
	Fluoride	< 50 mg/L
	Sulfate	< 100 mg/L
	TDS	< 200 mg/L
	Preservative	0.5% Cortec VCI-649 (replacement needed every two years)
	Maximum particle size	300 μm

Note

Water quality is necessary for normal operation of equipment.

1.3.2 Derating

Temperature-based derating

When the ambient temperature is within 45°C to 55°C, the rated output current of the basic rectifier module must be derated by 0.5% for every additional 1°C. Output current = Rated current x Derating coefficient (k)

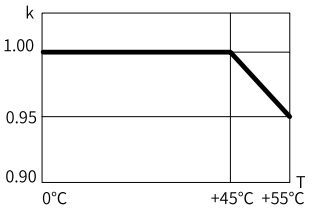


Figure 1-3 Temperature-based derating

Altitude-based derating

For altitudes of 1000 m to 4000 m, the output current of the basic rectifier must be derated by 1% for every additional 100 m. Output current = Rated current x Derating coefficient (k)

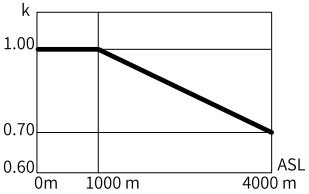


Figure 1-4 Altitude-based derating

Coolant temperature-based derating

When the coolant temperature is within 40°C to 50°C, the rated output current of the basic rectifier must be derated by 2% for every additional 1°C. Output current = Rated current x Derating coefficient (k)

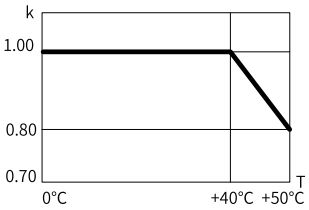


Figure 1-5 Coolant temperature-based derating

1.3.3 Overload capacity

For some drive systems where overload may occur, proper base load current is necessary for the MD880LC-20 series basic rectifier module. The criterion for overload is that the drive is operated with its base load current before and after the overload occurs in a cycle of 300s.

The following sections describe two typical overload conditions. Other conditions should conform to the overload curve.

Curve in the low overload mode

Light overload: The base load current (I_{LD}) is based on operation at 110% of the light overload current for 60s.

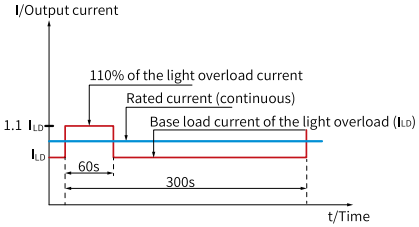


Figure 1-6 Curve in the low overload mode

Curve in the high overload mode

High overload: The base load current (I_{HD}) is based on operation at 150% of the high overload current for 60s.

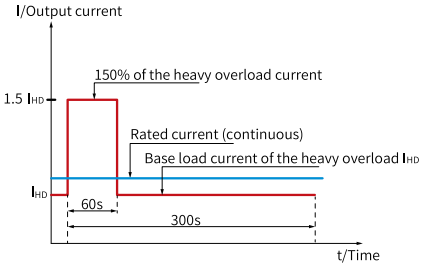


Figure 1-7 Curve in the high overload mode

1.4 Components

1.4.1 Components of the Diode Rectifier Module

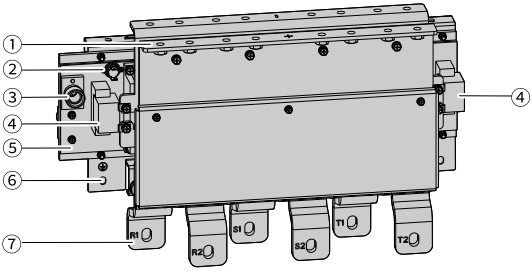


Figure 1-8 Layout 1 of the diode rectifier module

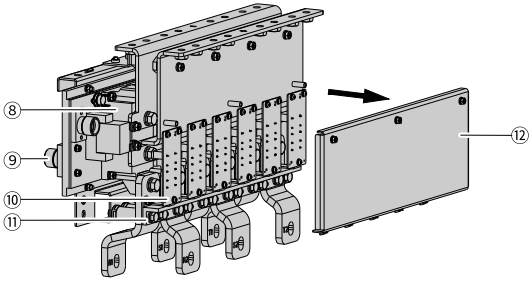


Figure 1-9 Layout 2 of the diode rectifier module

No.	Name	Description
①	DC bus terminal	-
②	Temperature switch	-
③	Water outlet joint	M26x1.5 metric external thread, with 24-degree internal taper

No.	Name	Description
④	Snubber capacitor	-
⑤	Heatsink	-
⑥	Sheet metal baseplate	-
⑦	Input terminals of three-phase power supply	-
⑧	Diode	-
⑨	Water inlet joint	M26x1.5 metric external thread, with 24-degree internal taper
⑩	RC absorption board	-
⑪	Insulation support board	-
⑫	PC board	-

1.4.2 Description of components of the thyristor rectifier module

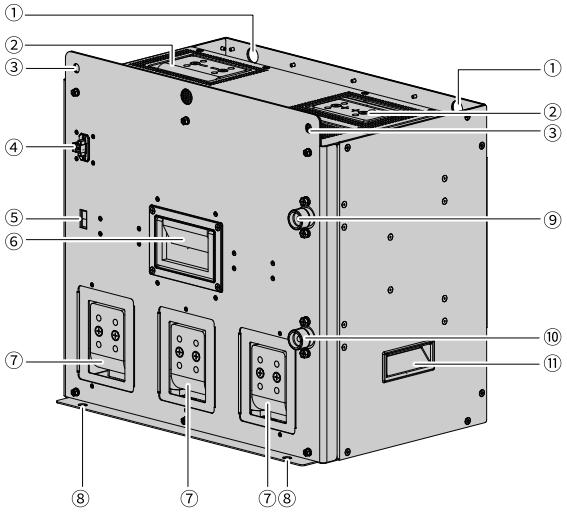


Figure 1-10 Components of the thyristor rectifier module

No.	Name	Description
①	Rear auxiliary positioning hole	-
②	DC output terminals (+) and (-)	Located on top of the module
③	Upper fixing hole	-
④	Input terminal for 24 VDC external power supply	-

No.	Name	Description
⑤	Optical fiber network terminal (VR optical fiber reception terminal, VT optical fiber transmission terminal)	-
⑥	Front handle	You can push in or out the module from the front.
⑦	AC input terminals (R, S, T)	-
⑧	Lower fixing hole	-
⑨	Water outlet joint	M26x1.5 metric external thread, with 24-degree internal taper
⑩	Water inlet joint	M26x1.5 metric external thread, with 24-degree internal taper
⑪	Side grip	-

Note

The external 24 VDC/2 A power supply can power up the thyristor module control system for commissioning. After the mains power is connected, the rectifier module is powered up by the internal auxiliary power supply, which makes the external 24 V power supply redundant.

1.4.3 Description of the Filter Module

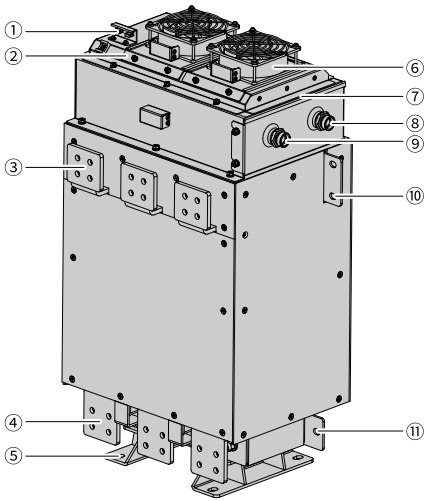


Figure 1-11 Components of the filter module for thyristor rectifier

No.	Name	Description
①	Fan cable interface (2 x)	-
②	Fan mounting plate (2 x)	-
③	Outcoming copper busbar connector of the reactor	-
④	Incoming copper bar connector of the reactor	-
⑤	Bottom fixing hole of the reactor (4 x)	-
⑥	Fan (2 x)	-
⑦	Heat exchanger box components	-
⑧	A/L, water outlet joint of the water-to-air heat exchanger	M26x1.5 metric external thread, with 24-degree internal taper
⑨	A/L, water inlet joint of the water-to-air heat exchanger	M26x1.5 metric external thread, with 24-degree internal taper
⑩	Auxiliary fixing hole on top of the reactor (2 x)	-
⑪	Auxiliary fixing hole at bottom of the reactor (2 x)	-

1.4.4 Description of Input Reactor Components

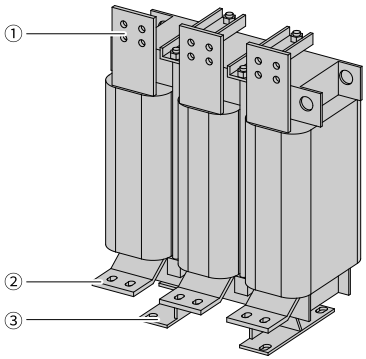


Figure 1-12 Components of the input reactor for diode rectifier

No.	Name
①	Outcoming copper busbar connector of the reactor
②	Incoming copper bar connector of the reactor
③	Bottom fixing hole of the reactor (4 x)

1.5 Selection of the Rectifier Module

Determine the rectification mode before selecting the rectifier model.

Determining the rectifier mode

Client Configuration or Requirement	Rectification mode
There is no need for energy regeneration or control.	Diode rectifier
There is no need to power on the pre-charge resistor.	Thyristor rectifier

Selecting the rectifier model

Calculate the power or current required on the inverter side when load motors are operating simultaneously at the maximum load. The calculated value is the minimum specification of the rectifier module.

2 Electrical Design

2.1 System Topology

Diode rectifier module

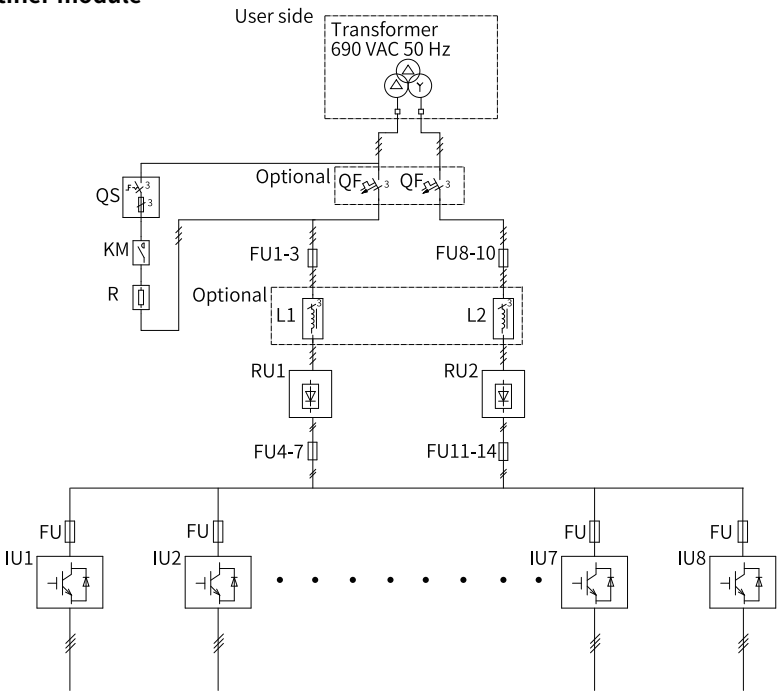


Figure 2-1 Typical system topology of the diode rectifier module

Note

- Each rectifier module must have the same input AC cable (same length and cross-sectional area) with a length of at least 5 m.
- You can choose to configure one or two rectifier modules according to different requirements.

Thyristor rectifier module

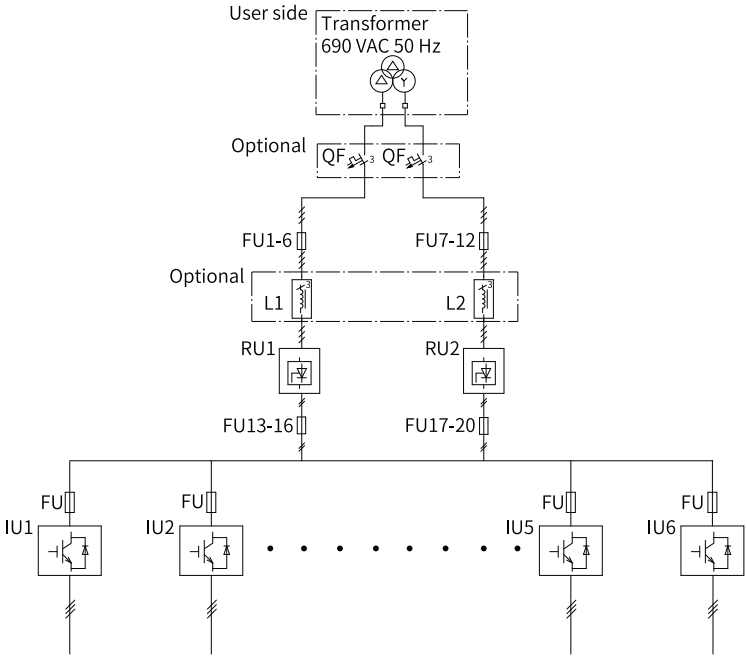


Figure 2-2 Typical system topology of the thyristor rectifier module

2.2 Models of Options

2.2.1 Fuse Selection

To comply with IEC/EN 61800-5-1 standards, install a fuse on the input side to prevent accidents caused by short circuit in the internal circuit.

Table 2–1 Fuse on the AC Side

Module model	Fuse on the AC side (medium current fuse)	Specifications	Quantity
MD880LC-20M-2000-7	RS306-3-S1P-1500A690V	1500 A, 690 V, size: 3	6
MD880LC-20M-1520-7+SCR	RS306-3-S1P-1250A690V	1250 A, 690 V	6

Table 2–2 Fuse selection on the DC side

Module model	Fuse model on the DC side (medium current fuse)	Specifications	Quantity
MD880LC-20M-2000-7	170M7595-2500 A/1250V DC	2500 A, 125 VDC, size 4	4
MD880LC-20M-1520-7+SCR	RSZ307-5-W7P-1800A1200V	1800 A, 1200 V	4

2.2.2 Circuit Breaker Model Selection

Table 2–3 Selection of the circuit breaker

Module model	Recommended circuit breaker model		
	Specification	Breaking capacity	Quantity
MD880LC-20M-2000-7	690 V, 2500 A	65 kA	1
MD880LC-20M-3720-7	690 V, 4000 A	100 kA	1
MD880LC-20M-1520-7+SCR	690 V, 2000 A	65 kA	1

2.2.3 Power Supply Transformer

The rectifier module does not contain an input reactor. Therefore, the short circuit impedance Z_k of the power supply transformer is determined by the apparent power S_N (BLM) of the rectifier unit and the capacity of the power supply transformer S_N (trafo). The rated impedance of the power supply calculated using the rated apparent power of the rectifier module must be at least 5%. The rated short circuit impedance of the transformer must comply with the following formula for a 6-pulse system. If the generator is used as the power supply, the same impedance requirements also apply to the generator.

$$Z_k(\text{BLM}) \geqslant 5\% \times \frac{S_N(\text{trafo})}{S_N(\text{BLM})}$$

Definition:

S_N (trafo): Apparent power of the transformer or generator

S_N (BLM): Apparent power of the basic rectifier module

Z_k (BLM): Rated short-circuit impedance of the transformer or generator

For example, the apparent power S_N (BLM) of the basic rectifier module MD880LC-20M-2000-7 is 2390 kVA. Assume that the apparent power S_N (trafo) of the transformer is 3000 kVA, then the following formula applies.

$$Z_k(\text{BLM}) \geqslant 5\% \times \frac{3000}{2390} = 6.28\%$$

When 12-pulse rectifier is applied, S_N (BLM) takes the total rectifier capacity. S_N (trafo) takes half of the total transformer capacity. That is, the calculated short circuit impedance of each winding in the 12-pulse transformer cannot be lower than 2.5%. In the preceding

model selection example, the rated impedance of each winding on the secondary side is calculated as 3.14%.

Table 2–4 12-pulse transformer model selection requirements

Item		Specification	Remark
12-pulse power transformer	Connection	Dy11 d0 or Dyn11 d0	• Grounding on the secondary side is inhibited. Shielded power cables are recommended. If the above model selection requirements cannot be met, an input reactor must be installed. • When the rated impedance of the transformer is not met, an input reactor must be installed.
	Phase shift between secondary sides	30°	
	Voltage difference between secondary sides	< 0.5%	
	Short-circuit impedance of secondary side	＞ 5%	
	Short-circuit impedance difference between secondary sides	< 10%	

Note

In the table, the short-circuit impedance of secondaries is the equivalent impedance. For details, refer to *"2.2.3 Power Supply Transformer" on page 28*.

2.3 Terminal Layout

2.3.1 Descriptions of Main Circuit Terminals

Main circuit terminal of diode rectifier module

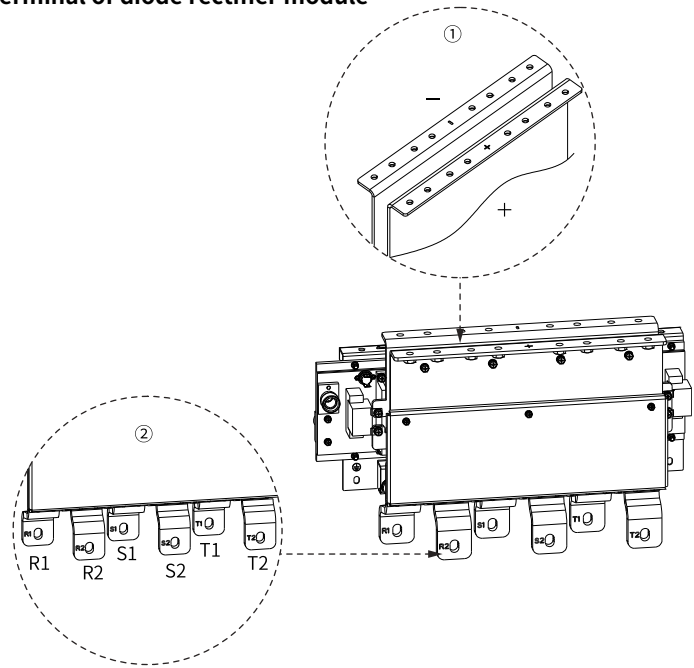


Figure 2-3 Main circuit terminal layout of the diode rectifier module

No.	Name	Description
①	DC bus terminal (+) and (-)	Select the appropriate cable and tightening torque for the positive and negative output copper busbar terminals.
②	R1, R2, S1, S2, T1, and T2 three-phase power input terminals	Select the proper cable and tightening torque.

Main circuit terminal of thyristor rectifier module

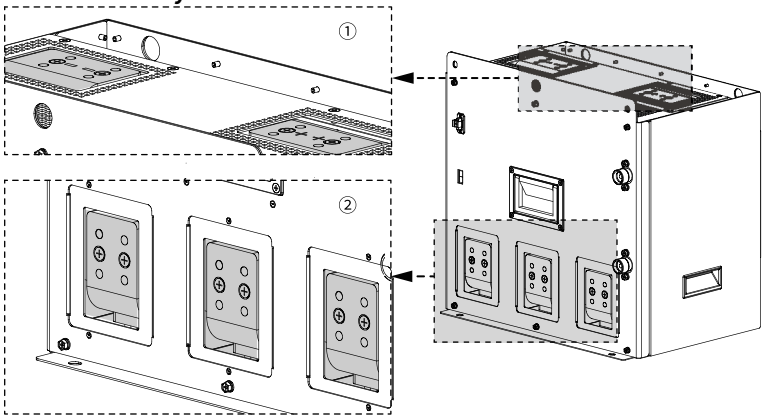


Figure 2-4 Main circuit terminal layout of the thyristor rectifier module

No.	Name	Description
①	Bus terminals (+) and (-)	Select the appropriate cable and tightening torque for the positive and negative output copper busbar terminals.
②	R, S, T (AC input terminals)	Select the proper cable and tightening torque.

2.3.2 Descriptions of Control Circuit Terminals

Description of the control circuit terminals of the diode rectifier module

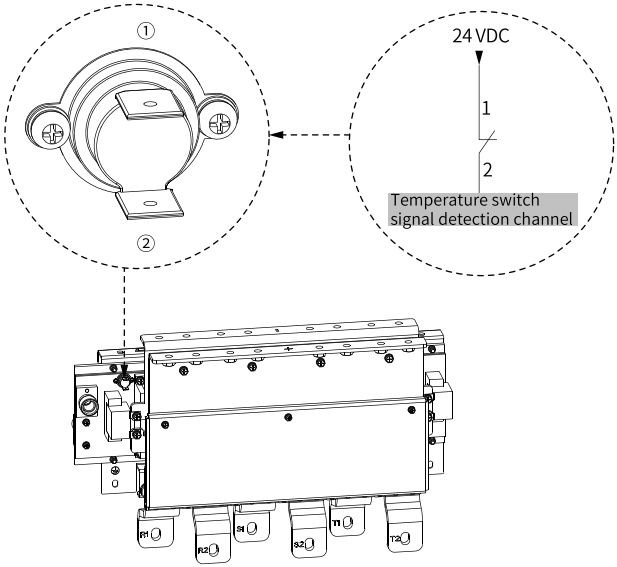


Figure 2-5 Control circuit terminal layout of the diode rectifier module

Terminal	Name	Description
①	NC contact switch wiring 1	Temperature detection signal point 1. Select a proper cable and tightening torque.
②	NC contact switch wiring 2	Temperature detection signal point 2. Select a proper cable and tightening torque.

Note

By default, the temperature switch is a NC contact. When the temperature of the module reaches the preset value, the temperature switch changes to NO to trigger the overtemperature signal sent to the control module.

Description of the control circuit terminals of the thyristor rectifier module

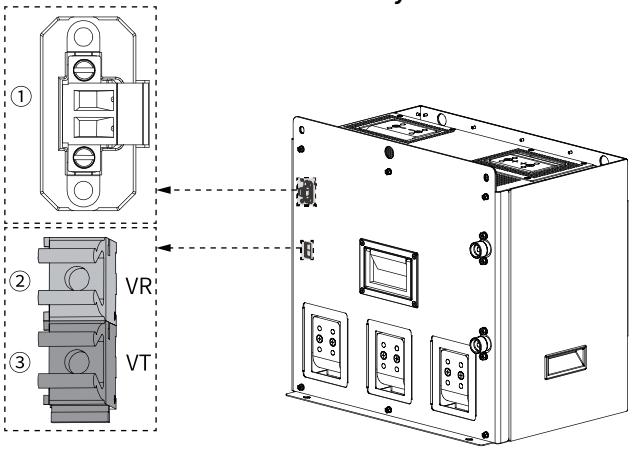


Figure 2-6 Control circuit terminal layout of the thyristor rectifier module

No.	Name	Description
①	Input terminal for 24 VDC external power supply	2-conductor twisted pair, single-conductor cable, cross-sectional area: 0.5 mm^2 to 2.5 mm^2
②	VR optical fiber reception terminal	Connected to HCU or HPCU through optical fiber
③	VT optical fiber transmission terminal	

2.4 Selection of Power Cables

Precautions

- Select a cable that can carry the rated current of the basic rectifier module.
- Select a cable whose maximum rated temperature is higher than or equal to 70°C (158° F) under continuous operation.
- For a maximum voltage of 500 VAC, select a cable rated at 600 VAC. For a maximum voltage of 600 VAC, select a cable rated at 750 VAC. For devices rated at 690 VAC, the rated voltage between cable conductors must be at least 1 kV.
- The specification and installation method of external main circuit cables must comply with local regulations and related IEC standards. Use proper copper conductors for main circuit cables according to the recommended values.
- Do not solder the twisted conductors.

Power cable types

Use symmetrical three-conductor shielded cables, which are connected to the three phases of the AC copper busbars at the bottom. The PE cable must be wired separately.

Power cable specifications

Table 2–5 Cable selection

Module model	Rated input current (A)	Recommended cable quantity and cross-sectional area (mm^2)	Terminal
UN: Three-phase 690 V (range: 525 V to 690 V)			
MD880-20M-2000-7	2000	6 x 185	OT/185-12
MD880-20M-3720-7	3720	8 x 240	OT/240-16
MD880LC-20M-1520-7+SCR	1520	5 x 185	OT/185-12

Note

- The recommended cables in the table are shielded cables with three conductors and one PE wire. The three power cables are connected to the three-phase AC copper busbar at the bottom, and the PE wire is connected to the grounding copper busbar. If a three-conductor shielded cable without the PE wire is used, the PE wire needs to be wired separately. Requirements on the PE wire cross-sectional area are as follows:
  - When the cross-sectional area S $\leqslant$ 16 mm^2, the cross-sectional area of the PE wire = S.
  - When 16 mm^2 < cross-sectional area S $\leqslant$ 35 mm^2, the cross-sectional area of the PE wire = 16 mm^2.
  - When the cross-sectional area S > 35 mm^2, the cross sectional area of the PE wire = S/2.
- 2x150 mm^2 indicates that each phase requires two cables and sectional area is 150 mm^2.
- OT/150-12 indicates that the cable is crimped to the OT terminal, the cable cross-sectional area is 150 mm^2, and the screw hole is M12.
- Observe the maximum size of the wiring terminal listed in the preceding table. Use terminals within the maximum size. Otherwise, the mechanical stability and specified electrical clearance cannot be ensured.
- Derating calculation is required when multiple cables of the same specification are connected in parallel.

Power cable shield

For the input and output shielded power cables inside the basic rectifier module, the shield must come into contact with the shield plate inside the cabinet through a large surface area to achieve a proper EMC shielding effect. See the figure below for the connection method.

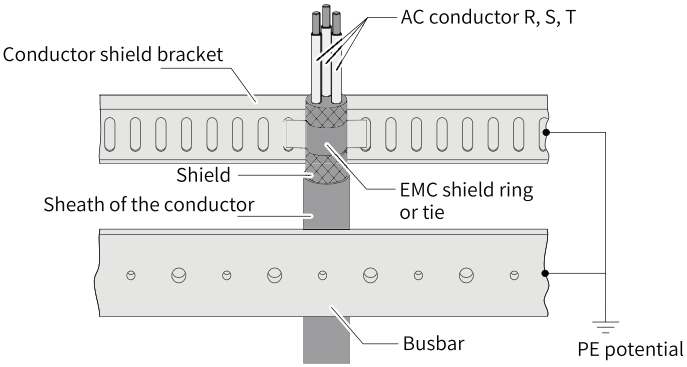


Figure 2-7 Connection of shielded power cables

2.5 Selecting Control Cables

Precautions

- Use shielded twisted pair cables as analog control signal cables. When stripping the sheath of the cable, keep the stripped part as short as possible (5 mm to 7 mm), and wrap the stripped shield with the insulating tape to prevent the shielded cable from touching other devices, which may result in interference.
- I/O signals include analog input (AI) signals, analog output (AO) signals, digital input (DI) signals, digital output (DO) signals, and relay output signals. Before wiring the I/O terminal, disconnect the main power supply and ensure that the danger indicator on the AC drive is off.
- To avoid interference to the I/O signals, separate the I/O signal cables at least 30 cm from the main circuit cables (R, S, and T cables and U, V, and W cables) and other power cables (or power supply cables).
- To avoid malfunction of the equipment, separate the relay output cables at least 30 cm away from other I/O signal cables.

Control cable types

To ensure that the control circuit is not affected by strong external interference, it is recommended to use the shielded cable with the shield for the signal cable. Use the signal shield brackets at both ends of the shield to connect the shield to the device in 360°. Use

separate shielded cables for different analog signals. It is recommended to use shielded twisted pair (STP) cables for digital signals.

Control cable specifications

Model	Terminal type	Recommended IEC Cable Specification (mm^2)	Recommended NEC Cable Specification (AWG)	Recommended Lug Specification
MD880LC-20M-2000-7	Control signal terminal	0.5	20	Tubular terminal
	24 V input terminal	0.5 to 1.5	16 to 22	
MD880LC-20M-1520-7+SCR	Temperature detection terminal	0.5 to 1.5	16 to 22	Tubular terminal

Control cable shield

Minimize the length of the unshielded part of a shielded cable, and connect the shield to the nearest PE terminal. If the unshielded part is too long, the cable conductor may be easily disturbed by signals.

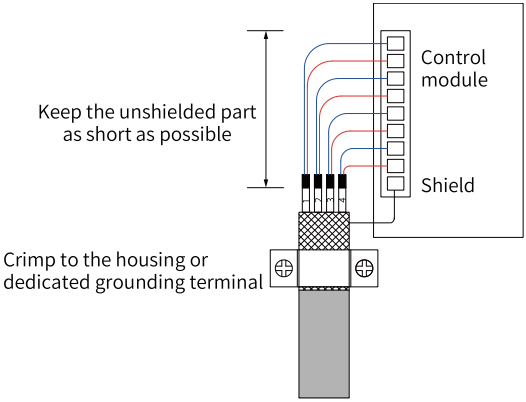


Figure 2-8 Handling shielded cables

2.6 Cable Layout

2.6.1 Wiring Requirements

Routing signals cables and power cables through different routes

When analog signals are used to control the basic rectifier module remotely, route the signal cables and high-current cables (such as power supply input cables, rectifier output cables, and braking resistor connection cables) through different routes at a clearance

larger than 30 cm. This is to reduce interference generated by the rectifier and other devices. This requirement must be observed for wiring inside the control cabinet.

Requirements on analog control signal cables

Use shielded twisted pair cables as analog control signal cables. When stripping the sheath of the cable, keep the stripped part as short as possible (5 mm to 7 mm), and wrap the stripped shield with the insulating tape to prevent the shielded cable from touching other devices, which may result in interference.

Requirement on power cables

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

Requirements on control cables and power supply cables

If the power supply cables and control cables must be cross-connected, ensure that they are cross-connected at 90 degrees.

2.6.2 Routing Recommendations

Disturbing cables

Cables transmitting different signals must be routed separately. Maintain a proper distance (preferably 30cm if space permits) between disturbing cables and disturbed cables. Where such cables must be cross-connected, make sure they are cross-connected at an angle as near to 90° as possible to prevent disturbance.

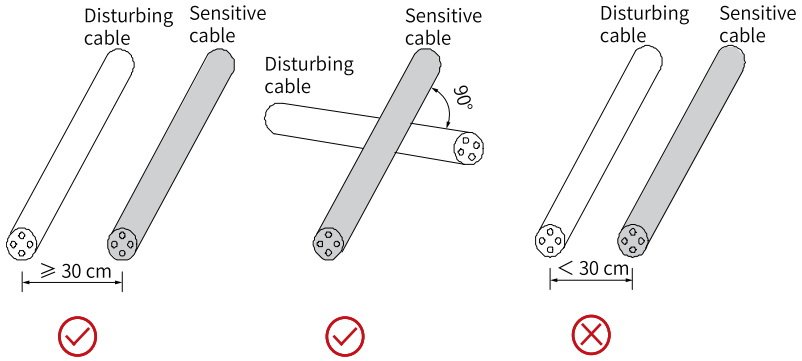


Figure 2-9 Routing of disturbing cables and disturbed cables

Signal cable

Route different signal cables separately and isolate them with the potential equalization cables. See the following figure as reference.

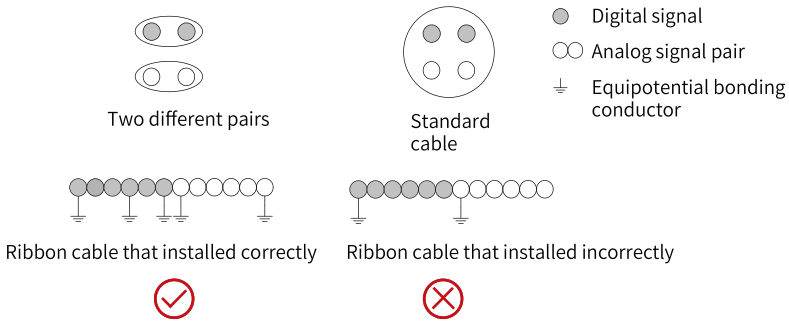


Figure 2-10 Routing of different types of signal cables

Multi-core Cables

For multi-conductor cables, it is recommended that one cable transmits one type of signals. If one cable is used to transmit different types of signals, use the cable with conductors shielded, as shown in the following figure.

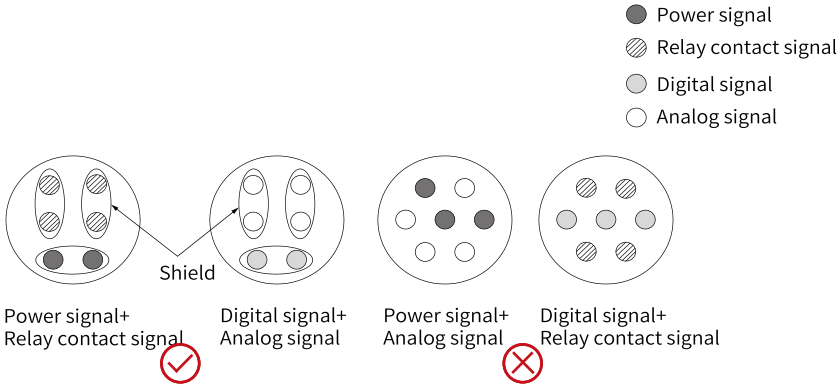


Figure 2-11 Routing of multi-core cables

For unused conductors in a multi-conductor cable, connect the unused (or reserved) conductors to the equipotential connection point.

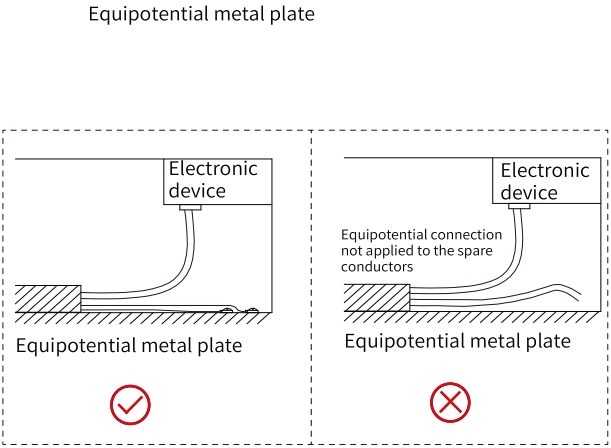


Figure 2-12 Handling of unused cores in a multi-core cable

Wiring loop

For the cables transmitting low-level sensor signals and relay signals, lay the two cable types close to each other for a not too large loop area. Make sure to use twisted pair cables for the analog signals. Route the digital signal cables close to each other.

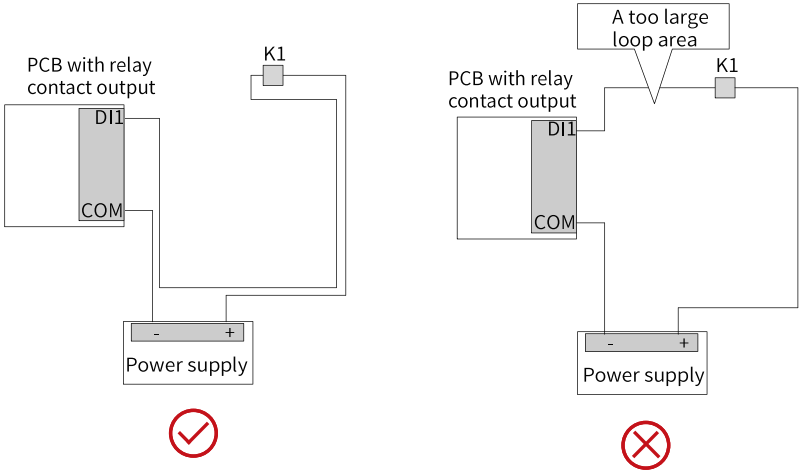


Figure 2-13 Recommended wiring loop area

Multiple types of cables

For cables of different types, route the cables along the equipotential metal plate. To enhance the internal EMC performance, separate different types of cables or separate cables with metal separators (recommended) in the same metal (zinc-iron or stainless steel) duct.

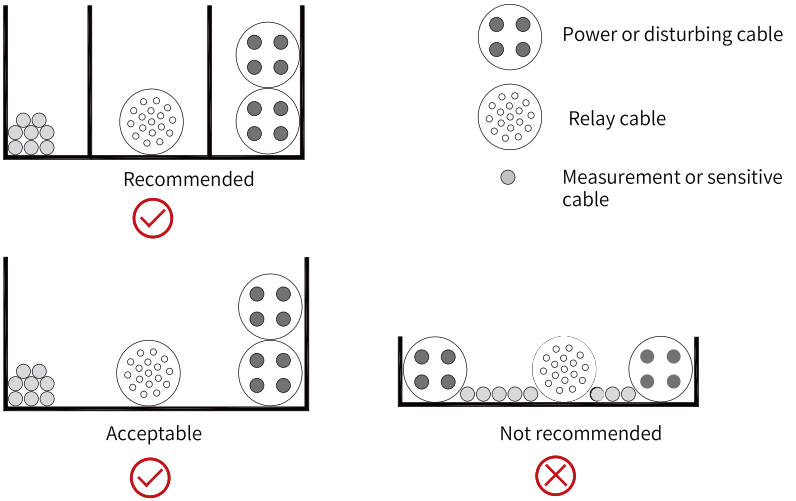


Figure 2-14 Routing of multiple types of cables

Shielded Cables

Minimize the unshielded part of the shielded cable, and connect the shield to the nearest PE terminal. If the unshielded part is excessively long, the conductor may be easily disturbed by other signals, especially the encoder signals.

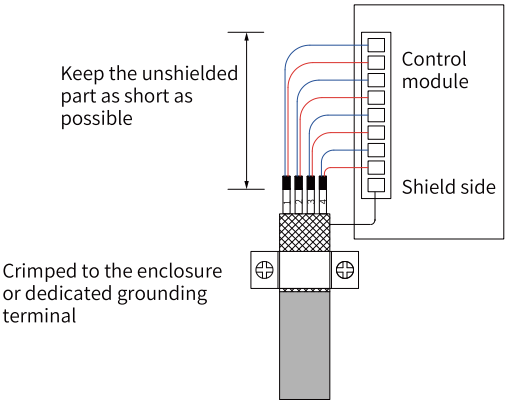


Figure 2-15 Handling shielded cables

The power input cables and shield of the basic rectifier module must come into contact with the shield plate inside the cabinet through a large surface area to achieve a proper EMC shielding effect. See the figure below for the connection method.

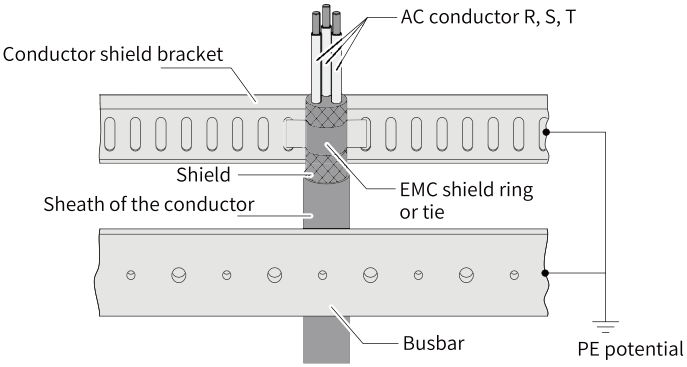


Figure 2-16 Connection of shielded power cables

2.7 Grounding

Caution

- Ground the grounding terminal to avoid electric shock. Follow the relevant electrical regulations of specific countries or regions on the grounding method.
- To prevent electric shock, ensure the protective grounding conductor complies with technical specifications and local safety standards. Keep the grounding cable as short as possible. The leakage current of the product can exceed 3.5 mA. Therefore, the cross-sectional area of the protective grounding conductor must be at least 10 mm^2 or two protective grounding conductors of the same specification must be connected according to EN 61800-5-1.
- When using multiple devices, follow the instructions for grounding all devices. Incorrect grounding can result in malfunction of devices.

Grounding requirement

- Use a yellow-green cable with copper conductors for protective grounding. Do not connect the protective grounding conductor to switching devices such as circuit breakers in series.
- Ground the grounding terminal properly. Improper grounding can lead to device malfunction or damage.
- Do not connect the grounding terminal to the N terminal of the neutral wire of the power supply.
- Install the device on a conductive metal mounting surface. Ensure that the whole conductive bottom of the drive is attached properly to the mounting surface.
- Fasten the grounding screws using the recommended tightening torque.

Grounding the diode rectifier module

The basic rectifier module is grounded through the sheet metal. Tighten with screws as shown in the figure.

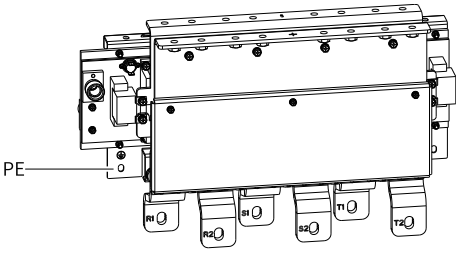


Figure 2-17 Grounding the diode rectifier module

Grounding the thyristor rectifier module

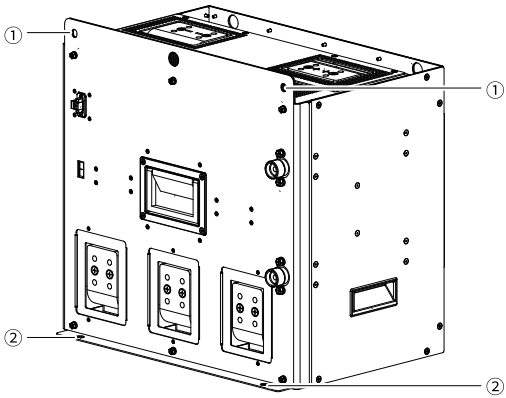


Figure 2-18 Grounding the thyristor rectifier module

No.	Description
①	Ground the enclosure of the module through the sheet metal of the cabinet.
②	Ground the enclosure of the module through the sheet metal of the cabinet.

Recommended cabinet grounding

To suppress interference in a cabinet properly, isolate the interference source from the equipment that may be disturbed during installation. It is necessary to divide the cabinet into multiple EMC areas or sub-cabinets based on intensity of the interference source. Install devices in the corresponding areas and wire according to the following table.

Table 2–6 Recommended grounding of cabinet system

No.	Wiring Requirement
1	In the case of multiple cabinets, use grounding cables for connection to achieve equipotentiality.
2	Place the devices in different areas in the cabinet according to the device signal strength.
3	Carry out equipotential bonding for the devices in different areas of the cabinet.
4	Shield all communication (for example, RS485) and signal cables that routed out from the cabinet.
5	Install the power supply input filter inside the cabinet to a place near the input interface of the cabinet.
6	Apply spray coating to each grounding point in the cabinet.

2.8 Anti-interference Design

To suppress interference in a cabinet properly, isolate the interference source from the equipment that may be disturbed during installation. It is necessary to divide the cabinet into multiple parts for EMC resistance based on interference source intensity. Install devices in the corresponding areas and wire according to the following table.

3 Mechanical Design

3.1 Structure Dimensions

3.1.1 Outline Dimensions of the Diode Rectifier Module

Dimensions of the diode rectifier module

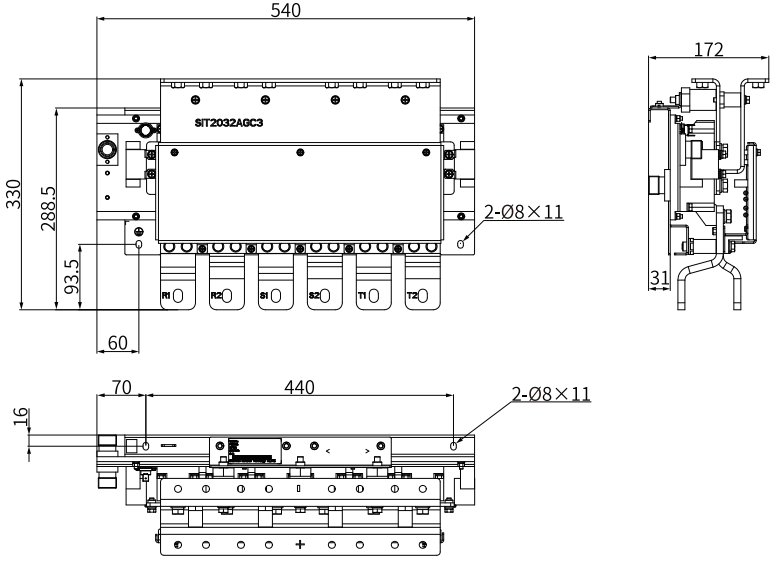


Figure 3-1 Dimensions of the diode rectifier module (mm)

Mounting dimensions of the diode rectifier module

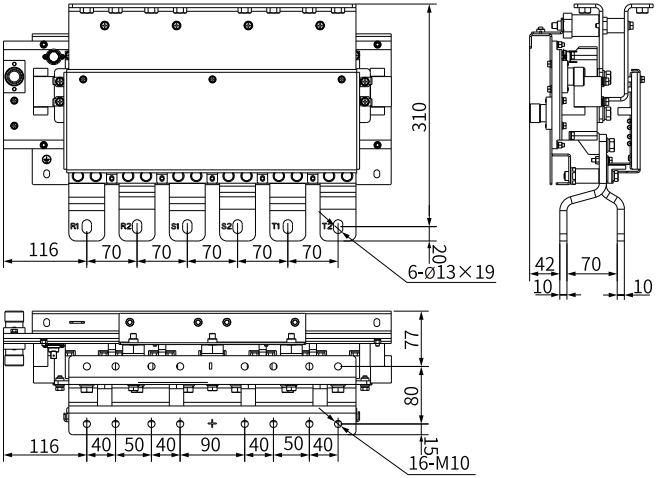


Figure 3-2 Mounting dimensions of the diode rectifier module (mm)

3.1.2 Outline dimensions of the thyristor rectifier module

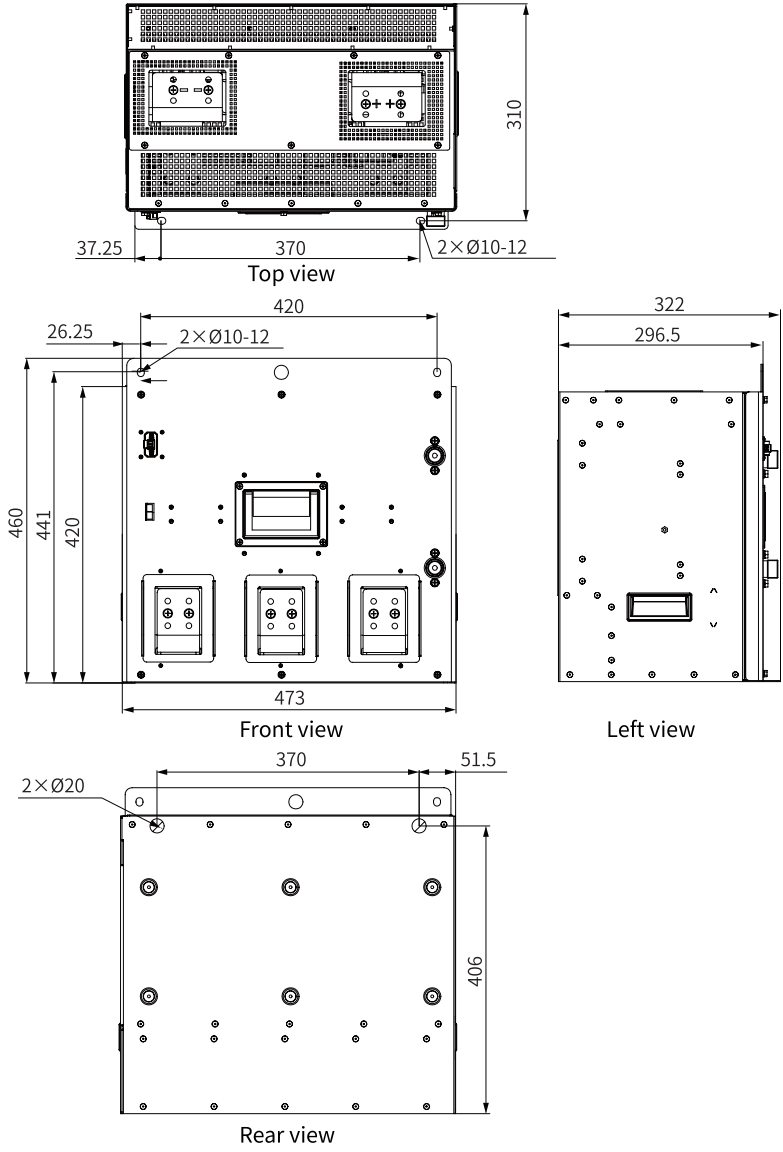


Figure 3-3 Dimensions of the thyristor rectifier module (mm)

3.1.3 Dimensions of Filter Module

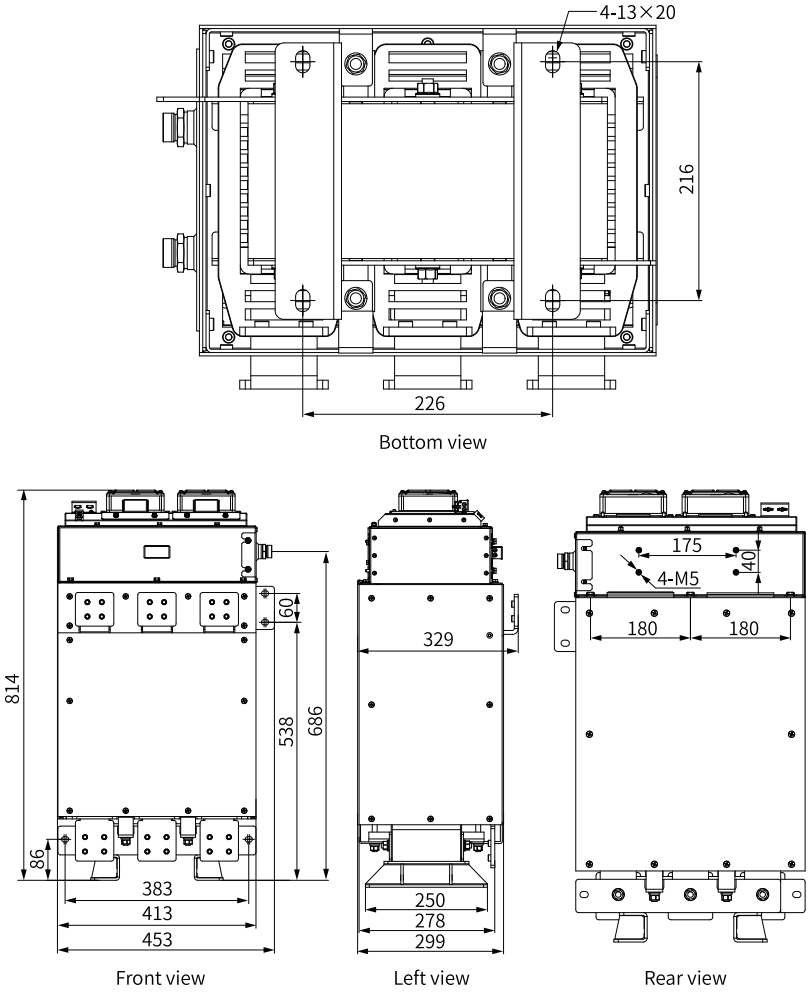
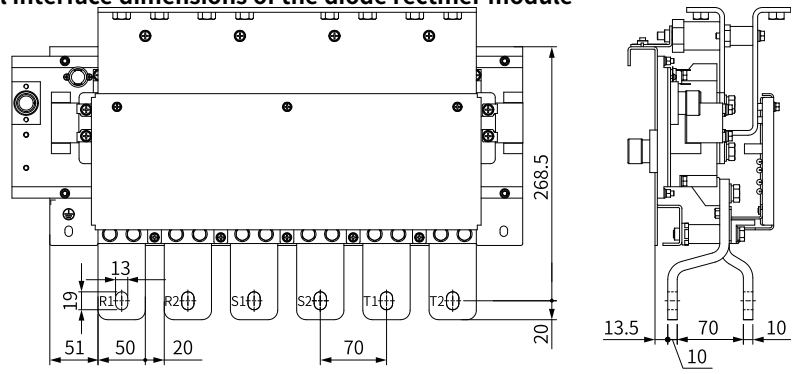


Figure 3-4 Outline dimensions of the filter module (mm)

3.1.4 Dimensions of Module Electrical Interfaces

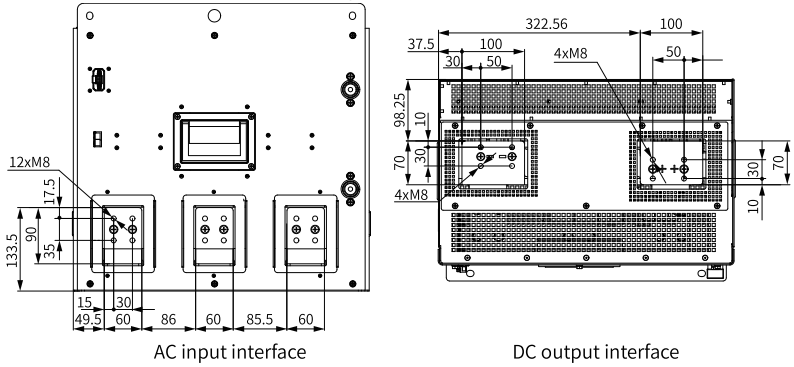
Electrical interface dimensions of the diode rectifier module



Front view　　Left view

Figure 3-5 Electrical interface dimensions of diode rectifier module (mm)

Electrical interface dimensions of the thyristor rectifier module



AC input interface　　DC output interface

Figure 3-6 Electrical interface dimensions of the thyristor rectifier module (mm)

3.1.5 Electrical interface dimensions of the reactor module

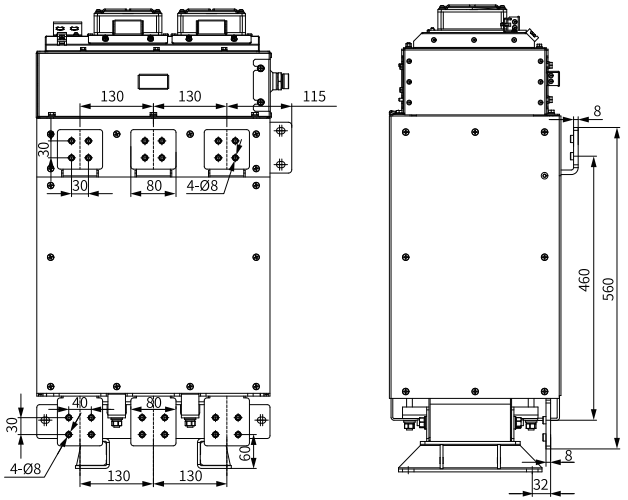


Figure 3-7 Electrical interface dimensions of the reactor module (mm)

3.1.6 Dimensions of Module Water Joint

Dimensions of the water joint of the diode rectifier module

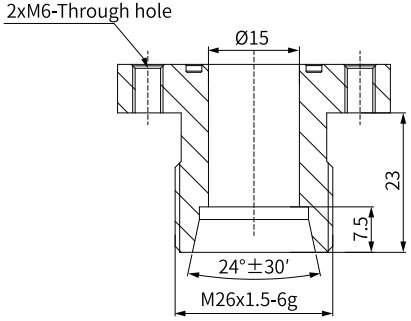


Figure 3-8 Dimensions of the water joint of the diode rectifier module (mm)

Dimensions of the water joint of the thyristor rectifier module

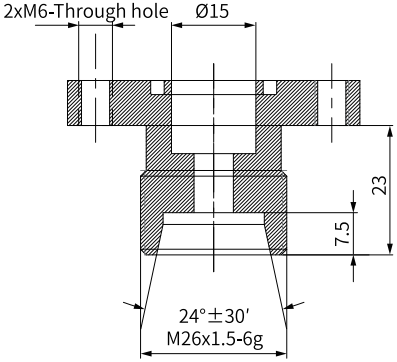


Figure 3-9 Dimensions of the water joint of the thyristor rectifier module (mm)

Note

The water nozzle joint of the thyristor rectifier module has M26 x 1.5 external metric thread, with 24-degree internal taper.

3.1.7 Dimensions of the water circuit joint of the heat exchanger module

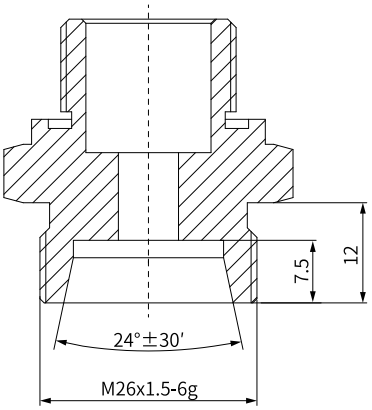


Figure 3-10 Dimensions of the water circuit joint of the heat exchanger module (mm)

3.2 Installation Clearance

Installation clearance of the diode rectifier module

The installation clearance around the rectifier module must be reserved, as shown below.

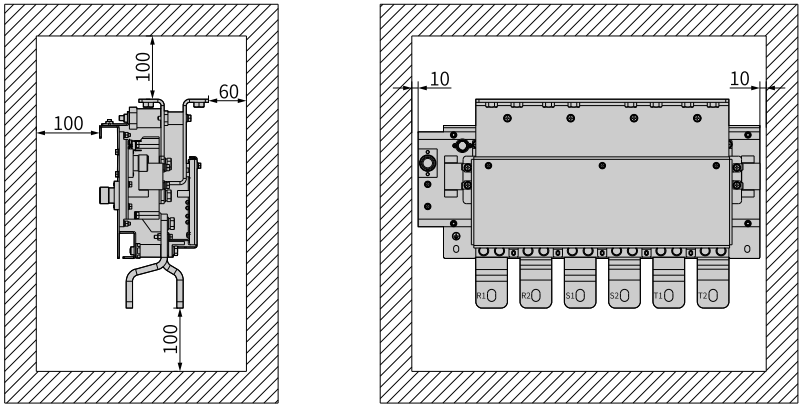


Figure 3-11 Installation clearance of the diode rectifier module

Note

The dimensions above represent the minimum space requirements (unit: mm).

Installation clearance of thyristor rectifier module

The installation clearance around the rectifier module must be reserved, as shown below.

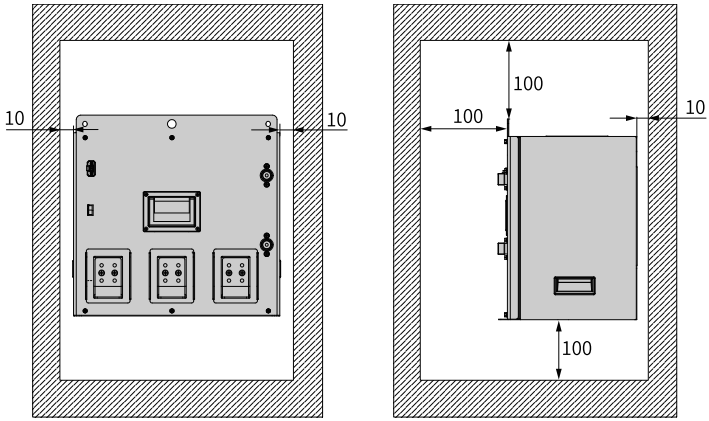


Figure 3-12 Installation clearance of thyristor rectifier module

Note

The dimensions above represent the minimum space requirements (unit: mm).

3.3 Cabinet Design Instructions

3.3.1 Cabinet Design Precautions

Note

As the capacitor lifetime of MD880LC-50 series water-cooled inverter products is designed based on 12-pulse rectifier input, the MD880LC-20 series rectifier products need to be configured based on 12-pulse rectification during integration.

- The cabinet frame must be sturdy enough to carry the weight of the components, control circuitry and other devices installed in the cabinet.
- The cabinet must protect the rectifier module against contact and meet the requirements for dust and humidity.
- To facilitate installation, it is recommended to leave enough space around the equipment to allow adequate cooling air flow, necessary clearance, and space required for holding cables and cable supports. Do not install the control board near the main circuit or high-temperature parts.
- Make sure that all cross members or shelves on which components are mounted are properly grounded and the connecting surfaces are uncoated. Ensure that the rectifier module is grounded properly through the fixing points on the mounting baseplate.
- Ensure that the rectifier module is grounded properly through the fixing points on the mounting baseplate.
- It is recommended to use nickel plated copper.
- If there is a risk of condensation in the cabinet, use a cabinet heater. Although the heater is mainly used to keep the air dry, it can also be used for heating at low temperatures. When placing the heater, follow the instructions provided by the manufacturer.
- Take care when installing coolant pipes. Ensure the pipe machineries are installed correctly without leakage.

3.3.2 Cabinet EMC Requirements

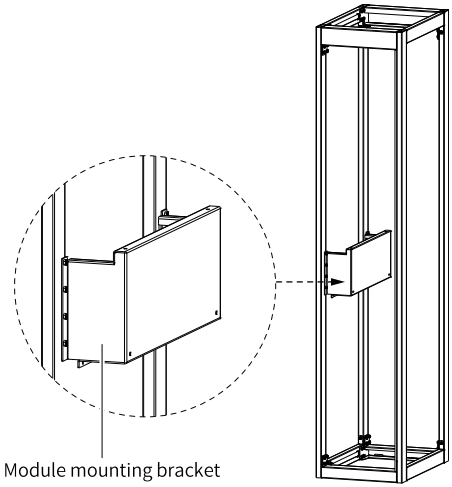
- The fewer and smaller the holes in the cabinet, the better the anti-interference and anti-attenuation performance. The maximum diameter of a hole on the galvanic metal contact surface in the cabinet is 100 mm. Pay special attention to the size of the grid holes at the cold air inlet and air outlet.
- The best galvanic connection between the steel panels is achieved by welding them together as no holes are necessary. If welding is not possible, do not paint the gap between panels and install special conductive EMC bars to realize galvanic connection. Generally, reliable conductive bars are made of flexible silicon with the surface covered

by a metal mesh. Additional conductive gaskets are needed between metal surfaces to enhance the contact between them. The maximum distance between assembly screws is 100 mm.

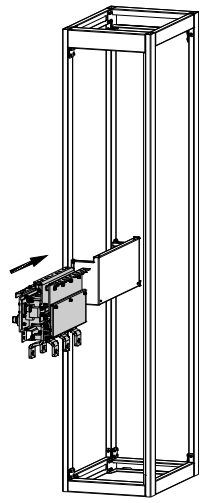
- Make sure that a high-frequency grounding system has been established in the cabinet. This is to prevent voltage difference and form structures that can shield against radiation. Use short and flat low-inductance copper braids to improve the performance of high-frequency grounding system. High-frequency single-point grounding cannot be used due to the long distance in the cabinet.
- Use of only conductive EMC shield gaskets is not enough to achieve protective grounding. To ensure electrical safety of the parts, a low-frequency grounding system is required. Follow local regulations to design protective grounding.

3.3.3 Recommended Installation Method for Diode Rectifier Module

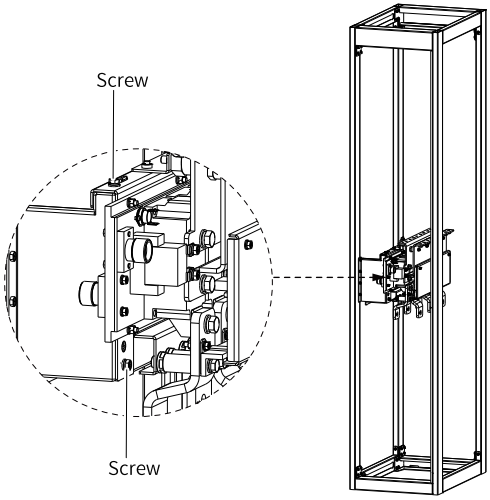
1. Design the module mounting bracket in the cabinet.



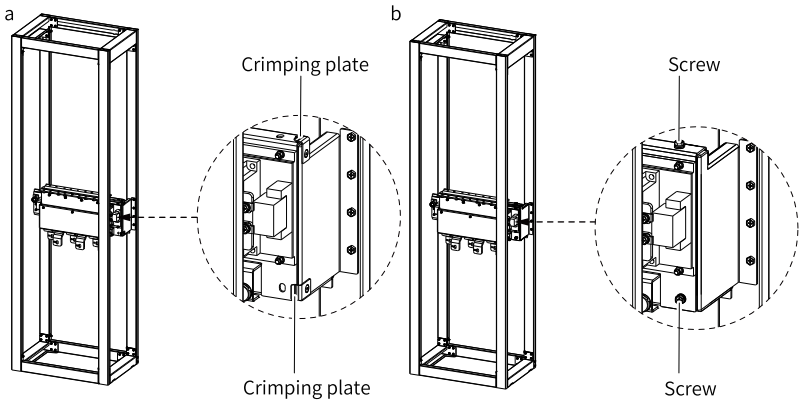
2. Push the diode rectifier module into the cabinet along the sheet metal guide rail.



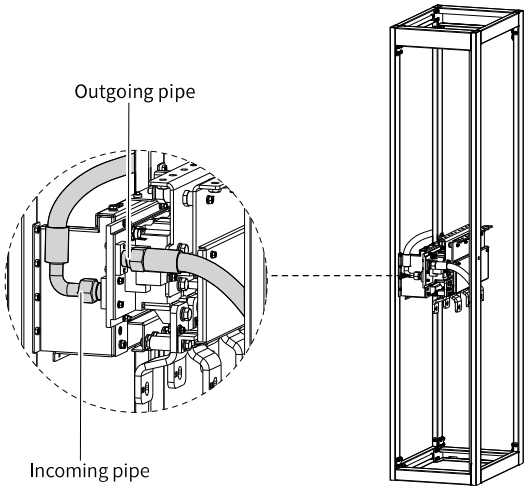
3. The front side of the module is secured with screws.



4. The rear side of the module is fixed in the following two ways:
   a. When the operating space inside the cabinet is limited, crimp the rear side of the module by a crimping plate.
   b. When the operating space inside the cabinet is sufficient, fix the rear side of the module with screws.

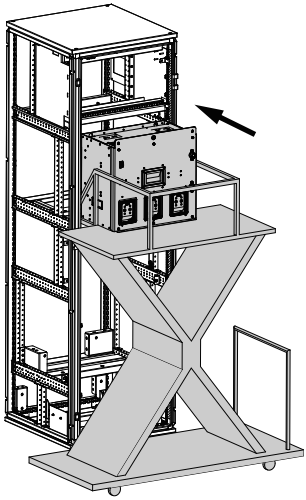


5. Install the inlet and outlet pipes.

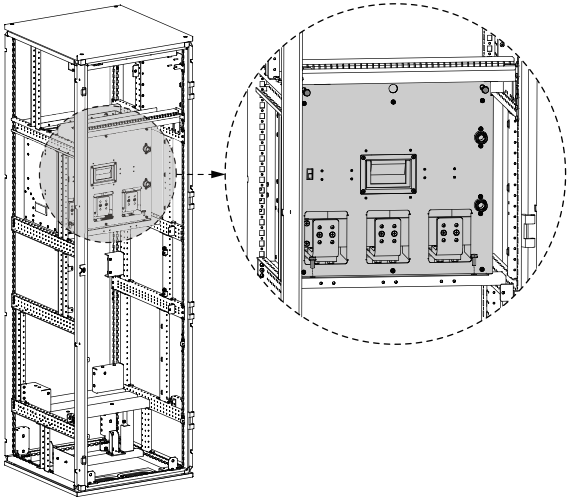


3.3.4 Recommended Installation Method of Thyristor Rectifier Module

1. Place the unit on the bracket, raise the bracket to level with the mounting base of the unit in the cabinet, and push the module along the deep support beam onto the mounting base of the module.



2. Installing the module: Push the module inward until the front face of the unit is firmly connected to the front fixing beam. Tighten the four M8x20 screws with a socket (wrench opening size 13). The screw installation direction is shown in the figure.
   Note:
   - The socket can be used with an extension rod for easy installation.
   - The tightening direction is clockwise.

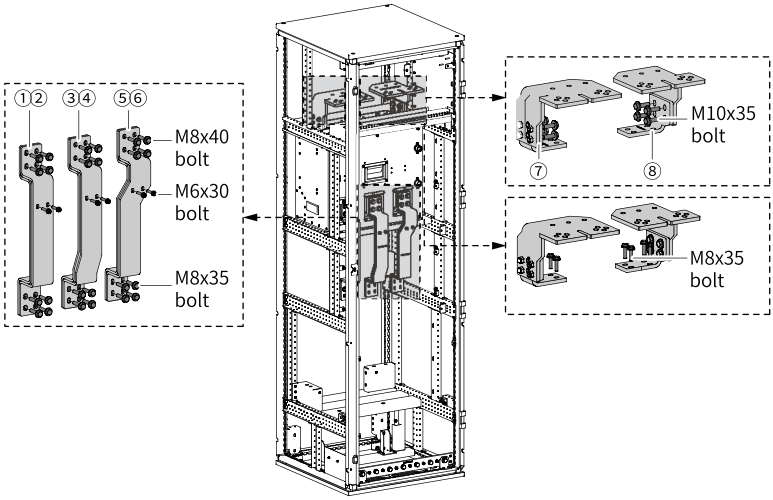


3. Installing the copper busbar:
   a. Installing copper busbars ① to ⑥: Place the copper busbars ① to ⑥. Ensure that the copper busbar is connected to the RST bus terminal of the module properly. Secure the copper busbars with 30 bolts. Fasten the twelve M8 x 40 bolts and twelve M8 x 35

bolts with a socket of wrench opening size 13. Fasten the six M6 x 30 bolts with a socket of wrench opening size 10.

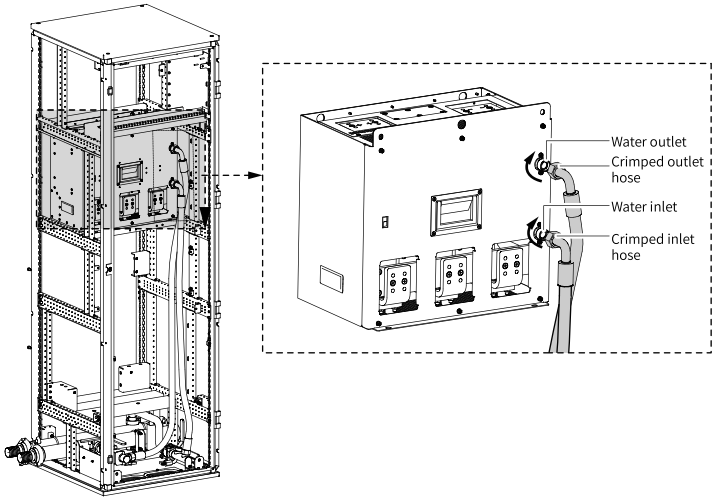
b. Install copper busbars ⑦ and ⑧. Place the copper busbars ⑦ and ⑧ in the proper position. Ensure that the copper busbar is connected to the DC bus terminal of the module properly. Secure the copper busbar with 16 bolts. Fasten the eight M10x35 bolts with a socket of wrench opening size 16. Fasten the eight M8x35 bolts with a socket of wrench opening size 13.

Note: The socket can be used with an extension rod for easy installation.



4. For main circuit terminal information, see *"Figure 2–4 Main circuit terminal layout of the thyristor rectifier module" on page 31*.
5. Installing the inlet and outlet pipes: Install the inlet and outlet pipes separately into the inlet nozzle and outlet nozzle of the module, as shown in the following figure. Lock the pipes with a 32 mm open-end wrench clockwise. The recommended tightening torque is 35 N · m.

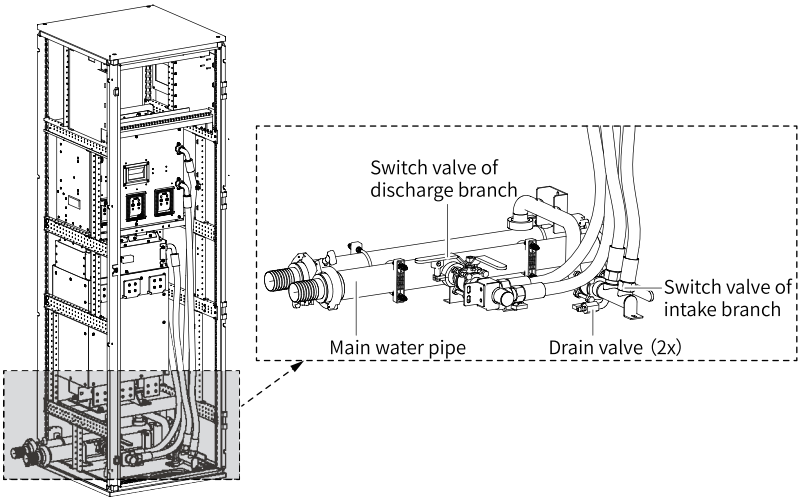
   Description: The water nozzle connector is M26 x 1.5, with 24-degree internal taper.



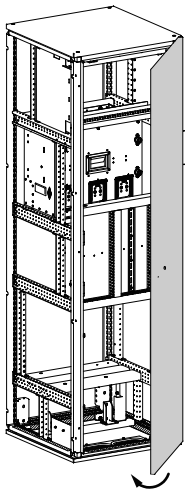
6. After installing the inlet and outlet pipes, close the two drain valves and open the inlet/outlet branch switch valve. Ensure that the water circuit inside the cabinet is connected to the main water pipe. The handle state is shown in the following figure after the valve commissioning is done.

   Note:

   - When the handles of the switch valve and drain valve are in parallel with the water pipe, the switch valve and drain valve are opened. When the switch valve and drain valve are vertical to the water pipe, they are closed.
   - For water-cooled system, check the water first upon overtemperature.



7. Close the cabinet door in the direction shown below.



3.3.5 Recommended Cabinet Layout (Diode Rectifier Module)

Rectifier module

Note

- Inovance can provide cabinet products. The same structure is used for 6-/12- pulse rectifiers.
- In the layout diagram for the rectifier module in a 400-mm wide cabinet, the left side shows a closed swing door and the right side shows an open swing door.

The following figure shows the recommended installation of the basic rectifier module.

- The cabinet is equipped with an AC fuse and a DC fuse for the rectifier module. The cable inlet is located at the bottom of the cabinet.
- The cabinet is equipped with two swing doors and internal mounting plates to meet the installation needs of auxiliary control components and pre-charging circuit components.
- The cabinet is completely sealed. Therefore, the cabinet is equipped with heat exchanger and fan to meet the heat dissipation requirements in the cabinet.

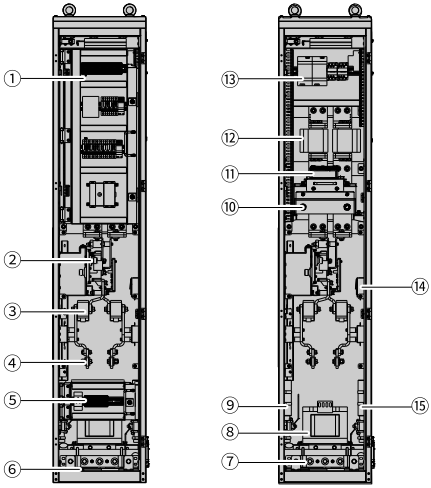


Figure 3-13 Layout of the rectifier module in a cabinet with a width of 400 mm

No.	Description	No.	Description
①	Swing door	⑨	Water separator (water inlet)
②	Rectifier module	⑩	Water-to-air heat exchanger
③	AC fuse	⑪	Fan of the water-to-air heat exchanger
④	AC input copper busbar	⑫	DC fuse
⑤	Swing door	13	Device mounting plate behind the swing door
⑥	Bottom cable inlet hole	⑭	Surge protection board
⑦	PE busbar	⑮	Water separator (water outlet)
⑧	Transformer	-	-

Piping layout

- The cabinet is equipped with a cooling duct. The water-air heat exchanger is connected in series with the rectifier module.
- The water inlet and outlet pass through two water separators, which are equipped with an inlet/drain valve and a drain valve.

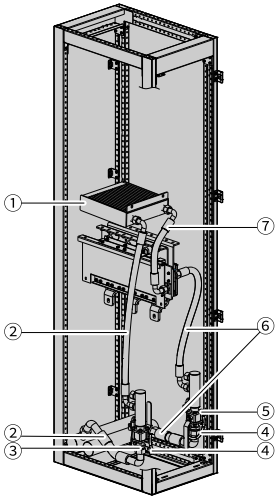


Figure 3-14 Layout of the cabinet piping

No.	Description	No.	Description
①	Water-to-air heat exchanger	⑤	Water separator (water outlet)
②	Water inlet pipe	⑥	Water outlet pipe
③	Water separator (water inlet)	⑦	Intermediate pipe
④	Drain pipe	-	-

3.3.6 Recommended Cabinet Layout (Thyristor Rectifier Module)

Note

In the layout of the basic rectifier cabinet, the left image shows a closed swing door, and the right image shows an open swing door.

The following figure shows the recommended installation of the basic rectifier module.

- The lower part of the cabinet is the AC inlet cable, and the AC fuse is installed. The upper part is the DC bus area, and the DC fuse is installed.
- The control plate, which can be switched on/off is positioned in the middle front part of the cabinet.
- The filter reactor module of the basic rectifier module is installed behind the control panel.
- The filter reactor module is installed in the lower part of the basic rectifier module.

- An water-to-air heat exchanger is integrated into the reactor module, which ensures that the air entering the basic rectifier module has been cooled by the heat exchanger.
- The cabinet main water pipe is located at the bottom near the back of the cabinet.
- The water inlet and outlet branches are placed on the left and right sides of the lower part of the cabinet. The water pipes are arranged on the right side of the cabinet.

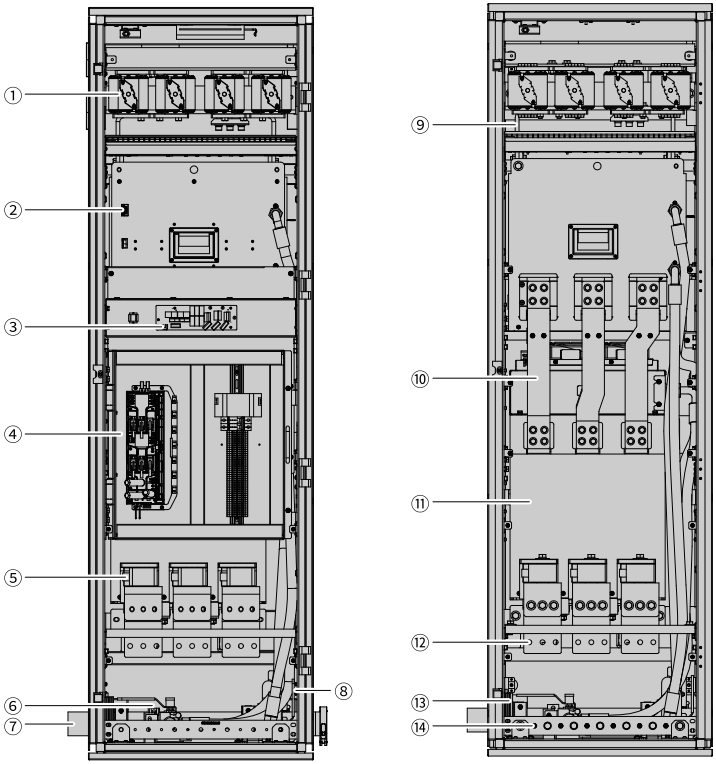


Figure 3-15 Layout of the rectifier module in the cabinet

No.	Description	No.	Description
①	DC fuse	⑧	Inlet valve
②	Rectifier module	⑨	DC copper busbar
③	Surge protection board	⑩	AC copper busbar
④	Control panel (swing door)	⑪	AC input reactor
⑤	AC fuse	⑫	Incoming AC terminal block
⑥	Drain valve	13	Heater
⑦	Main water pipe	⑭	PE busbar

4 Internal Water-cooled Circuit

4.1 Recommended Water-cooled System Design

Note

The coolant used with MD880 liquid-cooled drive system is pure water or ethylene glycol mixed with pure water.

Each cabinet is equipped with a water inlet pipe and outlet pipe respectively, together with a water inlet valve and drain valve. The water inlet valve can be closed to isolate all modules in the cabinet from the main cooling circuit.

Diode rectifier module

The following diagram shows the coolant pipe connection in a drive system consisting of the diode rectifier module and inverter module.

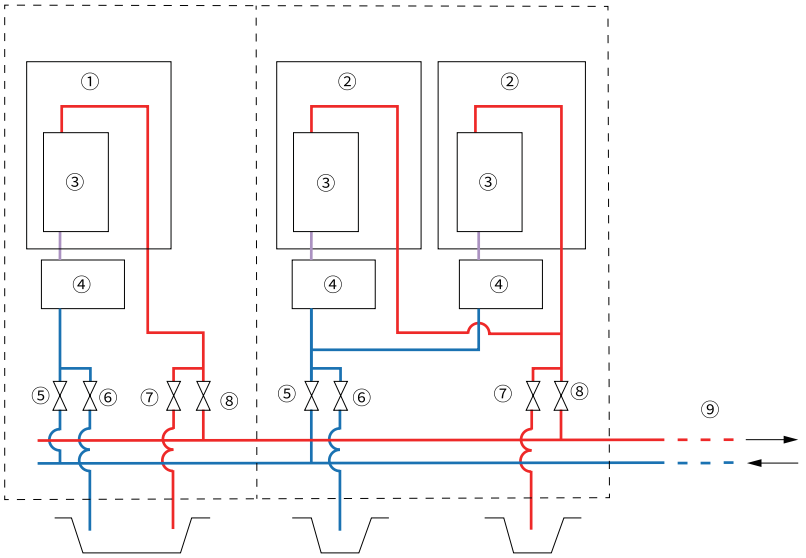


Figure 4-1 Internal water-cooled system

Table 4–1 Description of internal cooling system

No.	Description
①	Diode rectifier module
②	Inverter unit
③	Heatsink

No.	Description
④	Water-to-air heat exchanger
⑤	Inlet valve
⑥	Inlet-side drain valve
⑦	Outlet-side drain valve
⑧	Drain valve
⑨	Coolant main pipe

Thyristor rectifier module

The following diagram shows the coolant pipe connection in a drive system consisting of the thyristor rectifier module and inverter module.

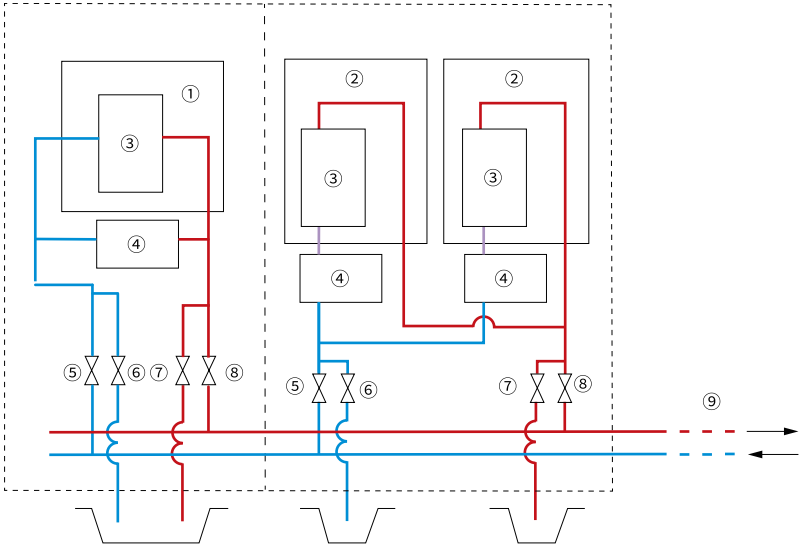


Figure 4-2 Internal water-cooled system

No.	Description
①	Thyristor rectifier module
②	Inverter module
③	Heatsink
④	Water-to-air heat exchanger
⑤	Inlet valve
⑥	Inlet-side drain valve
⑦	Outlet-side drain valve
⑧	Drain valve
⑨	Coolant main pipe

4.2 Technical Data of Cooling Circuit

4.2.1 Installation Requirements

Reserve at least a distance of 100 mm above and below the module thyristor rectifier module respectively to ensure effective air ventilation. Install an water-to-air heat exchanger to take away the heat generated by the reactor, module and other components in the cabinet.

The system is equipped with an expansion tank to suppress pressure rise caused by volume changes when the temperature changes. The system is equipped with a pump that provides the rated flow and pressure. Keep the pressure within the specified limit. Install a pressure regulator to ensure that the maximum allowable working pressure is not exceeded. Install an exhaust valve at the highest point of the cooling circuit and a drain valve at the lowest point.

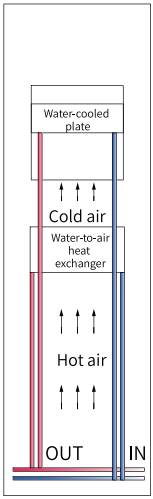


Figure 4-3 Cooling circuit in the module cabinet

Table 4–2 Technical data of internal water-cooled circuit

Module model	Air inlet temperature of the basic rectifier module (°C)	Air volume of the basic rectifier module (CFM)	Flow of rectifier module (L/min)			Water inlet temperature of the rectifier module (°C)	Water inlet pressure of the rectifier module (bar)
			100% water	Water/ ethylene glycol ratio: 80:20	Water/ ethylene glycol ratio: 60:40		
MD880LC-20M-2000-7	-	-	⩾ 16	⩾ 18	⩾ 21	< 40	< 6
MD880LC-20M-1520-7+SCR	< 50	360	⩾ 16	⩾ 18	⩾ 21	< 40	< 6

4.2.2 Coolant Temperature Control

The temperature of the coolant in the internal cooling circuit must be within the range specified below.

- 20% ethylene glycol solution can be used for storage temperatures of -10°C.
- 40% ethylene glycol solution can be used for storage temperatures of -25°C.
- Regardless of the freezing point of the coolant, the module is not allowed to run at the temperature below 0°C (32°F).
- If the coolant temperature is within the range of 0°C to 5°C, it is recommended to add ethylene glycol solution to prevent freezing.

Note

The minimum coolant temperature is dependent on ambient temperature and relative humidity.

4.2.3 Temperature Limit

Anti-freezing: The freezing point of the coolant is determined by the concentration of heat transfer fluid in the mixture.

The higher the concentration of heat transfer fluid, the higher the concentration of the coolant. This results in higher pressure loss in the system. For details, see *"4.2.4 Pressure Limit" on page 67*.

Input coolant temperature:

- 0°C to 40°C (32°F to 104°F): Derating is not required for the drive output current.
- 40°C to 45°C (104°F to 113°F): The drive output current is derated by 2% for every additional 1°C (1.8°F).
- 45°C to 50°C (113°F to 122°F):
  - If a component with the maximum ambient temperature of 55°C (131°F) is installed with the drive module, the drive output current is derated by 6% for every additional 1°C (1.8°F).
  - If no such component is installed with the drive module, the drive output current is derated by 2% for every additional 1°C (1.8°F).

Condensation is not allowed. The minimum coolant temperature to avoid condensation (at the atmospheric pressure of 1 bar) is shown below as a function of the relative humidity (RH) and the ambient temperature.

Table 4–3 Minimum coolant temperature

Ambient Temperature (°C)	Minimum Coolant Temperature (°C)				
	Relative Humidity = 95%	Relative Humidity = 80%	Relative Humidity = 65%	Relative Humidity = 50%	Relative Humidity = 40%
5	4.3	1.9	-0.9	-4.5	-7.4
10	9.2	6.7	3.7	-0.1	-3.0
15	14.2	11.5	8.4	4.6	1.5
20	19.2	16.5	13.2	9.4	6.0
25	24.1	21.4	17.9	13.8	10.5
30	29.1	26.2	22.7	18.4	156.0
35	34.1	31.1	27.4	23.0	19.4
40	39.0	35.9	32.2	27.6	23.8
45	44.0	40.8	36.8	32.1	28.2
50	49.0	45.6	41.6	36.7	32.8
55	53.9	50.4	46.3	42.2	37.1

Note

The coolant temperature must be 0°C (32°F) or above under all conditions. For example, at the temperature of 5°C and relative humidity of 50%, the coolant temperature cannot be below 0°C. At the temperature of 45°C and relative humidity of 65%, the coolant temperature cannot be below 36.8°C.

4.2.4 Pressure Limit

- Flow resistance at rated flow (between main input/output pipelines): 200 kPa (16 L/min) for pure water; 300 kPa (18 L/min) for 20% ethylene glycol water solution (volume concentration); 400 kPa (21 L/min) for 40% ethylene glycol water solution (mass concentration)
- Rated water supply pressure: 600 kPa
- Maximum transient water supply pressure: 900 kPa

Note

Take the rated pressure difference into account when determining the dimension of the liquid-cooling circuit.

4.2.5 Coolant Flow Limit

The maximum coolant flow of all drive devices is 1.3 x rated value. For the rated coolant flow, see *"Table 4–2 " on page 65*.

4.2.6 Cooling circuit material

The internal cooling circuit and the external cooling circuit must use the same materials, as described below.

- 304 stainless steel
- Aluminum alloy
- EPDM rubber



When connecting external pipes to the internal cooling circuit, use materials specified above only. Copper, brass, or bronze cannot be used under any circumstances. Even minor dissolution of copper can cause copper precipitation on aluminum and subsequent galvanic corrosion. The liquid cooling system cannot contain any zinc (eg. galvanized pipes).

If ordinary iron pipes or cast iron accessories (such as motor housing) are used on the site, a cooling unit with a heat exchanger must be used to separate the system.

4.3 Refilling and Discharging the Internal Cooling Circuit

Both the drive and coolant must be at room temperature before refilling.

Caution

- Make sure that the maximum permissible operating pressure is not exceeded. When necessary regulate the pressure to appropriate level by draining excess coolant out of the system.
- Bleeding of the cooling circuit is very important and has to be done with great care. Air bubbles in the cooling circuit may reduce or completely block coolant flow and lead to overheating. Let the air out of the cooling system while filling in coolant and, eg. after any power module replacements.
- During system filling up, the drain valve is used only to vent the air from the circuit so that it can be displaced by the coolant. The actual bleeding of the circuit must be done via an external bleed valve installed at the highest point of the cooling circuit. The most practical position of the valve is usually close to or located at the cooling device.
- The rectifier module has no drain valve. The drain valve is installed at the top of the cabinet system.

Follow the following steps.

1. Open the exhaust valve of the cabinet system.
2. Attach a hose to the drain valve on the outlet side and lead it into a suitable container.
3. Open the inlet valve and the drain valve on the outlet side of the cabinet. Keep the drain valve and the drain valve on the inlet side closed.
4. Fill the circuit with coolant.
5. When the cooling circuit and module in the cabinet are filled up with coolant, the coolant starts to flow from the hose. Let some coolant flow out, then close the drain valve.
6. Close the inlet valve.
7. Repeat steps 2 to 6 for all cabinet.
8. Open the water inlet and outlet valves of all cabinets. Discharge all the air in the system through the exhaust valve of the cabinet.
9. Close the exhaust valve of the cabinet.
10. Open the exhaust valve of the pump to discharge all the air.
11. Re-check the pressure and fill the coolant if necessary.
12. Start the coolant pump. Discharge all the air in the system through the exhaust valve of the cabinet.
13. After one to two minutes, stop the coolant pump or block the coolant flow with a valve.
14. Re-check the pressure and fill the coolant if necessary.
15. Repeat steps 12 to 14 a few times until all the air is discharged. Listen for a humming sound or observe whether the pipe vibrates to find out if there is still air left in the circuit.

4.4 Discharging internal cooling circuit

You can drain the water out of the module through the drain valve, without the need for discharging the whole internal cooling circuit.



Hot, pressurized coolant can be present in the cooling circuit. Do not work on the cooling circuit before the pressure is released by stopping the pumps and draining coolant.

To discharge the internal cooling circuit, do as follows:

1. Attach the hose to the drain valve in the cabinet to be discharged. Lead the hose into a suitable container. Make sure the ends of the hose are not immersed in the coolant at any position so that the air can displace the coolant in the system.
2. Open the drain valves. Wait until all coolant has drained.
3. If the drive is to be stored in temperatures below 0°C, do as follows:
   a. Dry the cooling circuit with air.
   b. Fill the cooling circuit with 20% or 40% ethylene glycol solution.
   c. Discharge the cooling circuit again.

5 Options

5.1 List of Options

No.	Name	Remark
1	Function expansion module	Applicable only to thyristor rectifier module.
2	AC input reactor	Applicable to diode rectifier modules and thyristor rectifier modules. For details, see *"5.4 AC Input Reactor" on page 73*
3	Fan fault detection module	Applicable only to thyristor rectifier module.
4	Water-to-air heat exchanger	Applicable to diode rectifier modules and thyristor rectifier modules. For details, see *"5.5 Water-to-Air Heat Exchanger" on page 74*

5.2 Function Expansion Module

See the following table for the specific description of the expansion modules, and see the user guide of each module for details.

No.	Name	Model	Function	Connection with HCU	Dimension (mm)
1	I/O module	HIO-10	Two AIs Two AOs Two DIOs One relay output	SLOT	105 x 73 x 24
2	PROFIBUS-DP module	HDP-10	PROFIBUS-DP bus adaption	SLOT	75 x 73 x 24
3	CAN bus module	HCAN-10	CANopen bus adaptation	SLOT	75 x 73 x 24
		HCAN-30	CAN 2.0 bus adaption	SLOT	75 x 73 x 24
4	Modbus-RTU module	HMBA-10	Modbus-RTU bus adaption	SLOT	75 x 73 x 24
5	EtherCAT Module	HETC-10	EtherCAT bus adaption	SLOT	75 x 73 x 24
6	EtherNet module	HETN-10	EtherNet commissioning module	SLOT	75 x 73 x 24

No.	Name	Model	Function	Connection with HCU	Dimension (mm)
7	PROFINET I/O module	HPFN-10	PROFINET I/O industrial Ethernet adaption	SLOT	75 x 73 x 24
		HPFN-20	PROFINET IRT industrial Ethernet adaption	SLOT	75 x 73 x 24
8	Modbus TCP module	HMBT-10	Modbus TCP industrial Ethernet adaption	SLOT	75 x 73 x 24
9	Parallel control module	HPCU-40	Supports two to four paralleled modules	Optical fiber	232 x 86 x 40
10	Function expansion module	HESD-10	One expansion slot	Optical fiber	105 x 75 x 70
11	Optical fiber expansion module	HOFM-10	One pair of optical fibers	SLOT	75 x 73 x 24
		HOFM-30	Three pairs of optical fibers	SLOT	75 x 73 x 24
12	Smart operating panel	SOP-20-880	HMI operating panel	Network cable	73 x 125 x 25
13	Optical fiber routing control module	HOFR-50	Supports data exchange among two to five HCU control modules	Optical fiber	232 x 86 x 40

5.3 Thyristor Rectifier Module - Fan Fault Detection Module

The HFAN-10 fan fault detection module is used to detect the operating state of the fan, including the fan feedback signal detection and digital output function.

Features:

- Supports the detection on the operating state of the fan with voltage signal feedback through FAN_DI1 to FAN_DI6.
- Supports DO1 and DO2.
- DIL is reserved for normal DI input, which does not support fan operating state detection.

- Powered by the HCU control module without the need for an external power supply.

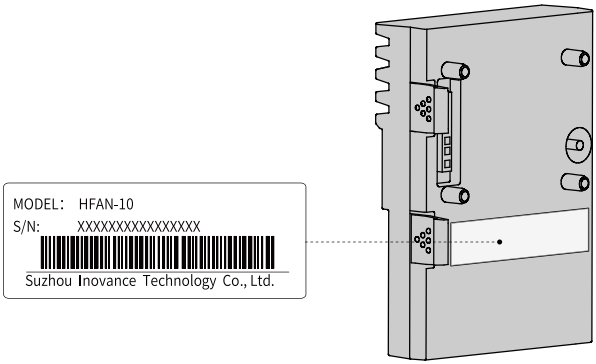


Figure 5-1 Nameplate and model

HFAN-10
① ②

①	**Product series** HFAN: Fan fault detection module	③	**Product type** 10: Voltage feedback fan fault detection module

For details about the fan fault detection module, see *HFAN-10 Fan Fault Detection Module User Guide*.

5.4 AC Input Reactor

The following table lists the input reactor model of the rectifier module.

Module model	Inductance	Reactor model	Insulation class	Cooling method	Rated Loss at 20°C	Weight
MD880LC-20M-2000-7	27 μH	LD-HE300-110-1000-7-L1	H	Forced air cooling	550 W	105 kg
MD880LC-20M-1520-7+SCR	24 μH	YF-MD880LC-20M-1520-7-L1	H	Forced-air cooling	1720 W	180 kg

Note

The MD880LC-20M-2000-7 diode rectifier module requires two 1000 A reactors.

5.5 Water-to-Air Heat Exchanger

When the MD880LC-20 thyristor module is used, water-to-air heat exchanger is needed to ensure that the bottom air inlet temperature of the rectifier module does not exceed 50°C. To achieve this, add a water-to-air heat exchanger at the bottom. The heat exchange capacity of the heat exchanger must be higher than the sum of the heat generated by rectifier and other heating components in the cabinet.

See the following table for water-to-air heat exchanger selection.

Module model	Water-to-Air heat exchanger model	Heat exchange power	Rated flow	Weight
MD880LC-20M-2000-7	MD880LC-WAHE-1.8 kW	1.8 kW	16 L/min	< 5.5 kg
MD880LC-20M-1520-7+SCR	MD880LC-WAHE-3.4 kW	3.4 kW	16 L/min	< 8 kg

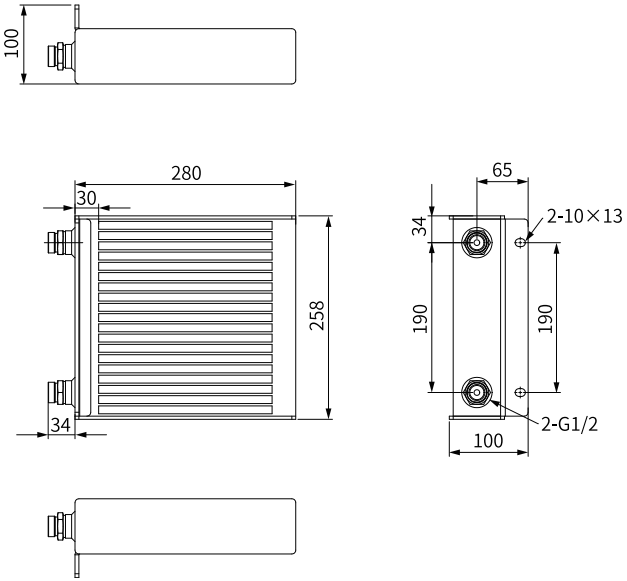


Figure 5-2 Dimensions of 1.8 kW water-to-air heat exchanger (mm)

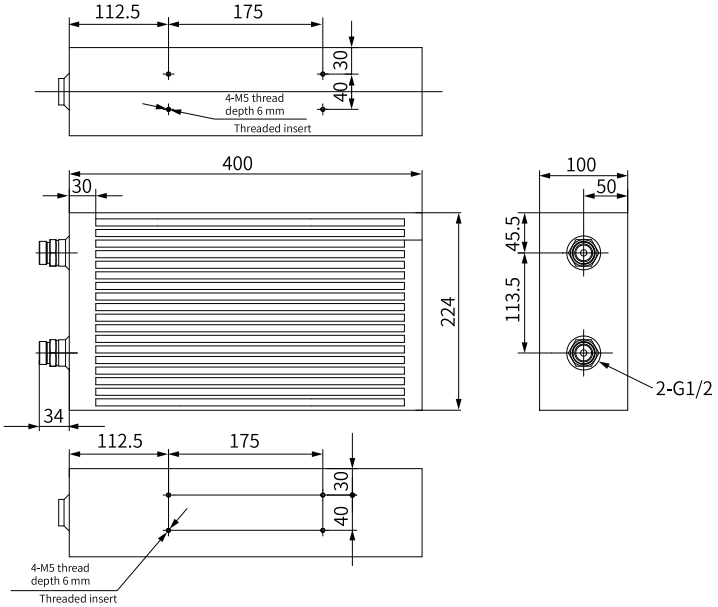


Figure 5-3 Dimensions of 3.4 kW water-to-air heat exchanger (mm)

6 Certification and Standards Requirements

6.1 Compliance List

The following table lists the certifications, directives, and standards that the product may comply with. For details about the certificates acquired, see the certification marks on the product nameplate.

Certification	Directive		Standards compliance
CE certification	EMC directive	2014/30/EU	EN IEC 61800-3
	LVD	2014/35/EU	EN 61800-5–1
	RoHS directive	2011/65/EU	EN IEC 63000

Note

The product meets the requirements of the latest version of instructions and standards of the CE certification.

6.2 CE Certification

6.2.1 Precautions for Compliance with European Standards

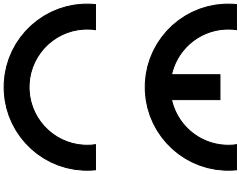


Figure 6-1 CE mark

- The CE mark indicates compliance with the Low Voltage Directive (LVD), Electromagnetic Compatibility (EMC), and Restriction of Hazardous Substances (RoHS) directives for commercial trades (production, import, and sales) in Europe.
- The CE mark is mandatory for engaging in commercial business (production, importation, and distribution) in Europe.
- The product complies with the LVD, EMC, and RoHS directives and is labeled with the CE mark.
- Machines and devices integrated with this drive must also comply with CE requirements for distribution in Europe.

- The integrator who integrates this product into other products and attaches the CE mark to the final assembly has the responsibility of ensuring compliance with CE certification.

6.2.2 Requirements for Compliance with EMC

This product is applicable to the first environment and second environment and complies with EMC directive 2014/30/EU and standard EN IEC 61800-3.



When applied in First Environment, this product may generate radio interference. Besides the CE compliance described in this chapter, take measures to avoid the radio interference if required.

As required by EMC directives and standards, install an EMC filter on the input side and shielded cables on the output side. Ensure that the filter is grounded properly and the shield of the output cable is grounded 360 degrees.



The integrator of the system installed with the inverter is responsible for compliance of the system with the European EMC Directive and standard EN IEC 61800-3 according to the system application environment.

EMC specifications

The drive complies with EN IEC 61800-3. The maximum length of the motor cable allowed by the conducted and radiated emission is shown in the following table.

Table 6–1 Maximum motor cable length allowed by conducted and radiated emission

Product model	Maximum cable length allowed by conducted emission				Maximum cable length allowed by radiated emission			
	Category C1		Category C2		Category C1		Category C2	
	Built-in Filter	External EMC Filter	Built-in Filter	External EMC Filter	Built-in Filter	External EMC Filter	Built-in Filter	External EMC Filter
Single-phase model	-	10 m	-	25 m	-	-	-	25 m
Three-phase model	-	-	-	50 m	-	-	-	50 m

Introduction to EMC standards

Electromagnetic compatibility (EMC) means that a device is compatible with (i.e., no interference is caused by) its electromagnetic (EM) environment and it does not emit levels of EM energy that cause electromagnetic interference (EMI) in other devices in the vicinity. EMC includes the following requirements:

- The electromagnetic interference generated by a device during normal operation must be restricted within a certain limit.
- The equipment has certain grade of immunity (EMS) to the presence of electromagnetic interference in its operation environment.

EN IEC 61800-3 defines the following two environments:

- First Environment: Environment that includes domestic premises and establishments directly connected without intermediate transformers to a low-voltage power supply network which supplies buildings used for domestic purposes.
- Second environment: Environment that includes all establishments other than those directly connected to a low-voltage power supply network which supplies buildings used for domestic purposes.

Devices are divided into the following four categories based on the intended application environment.

- Category C1 equipment: Power drive system (PDS) with the rated voltage lower than 1000 V, which is intended for use in the first environment
- Category C2 equipment: PDS of rated voltage less than 1000 V, which is hardwired and, when used in the First Environment, is intended to be installed and commissioned only by a professional.
- Category C3 equipment: PDS of rated voltage less than 1000 V, intended for use in the Second Environment only and not the First Environment.
- Category C4 equipment: PDS of rated voltage greater than or equal to 1000 V, or rated current greater than or equal to 400 A, or intended for use in complex systems in the Second Environment.

6.2.3 Requirements for Compliance with LVD

The product has been tested in accordance with EN61800-5-1 and complies with the LVD. To ensure machines or devices that the product is installed in as a whole comply with the LVD, be sure to meet these requirements as described below.

Installation location

Install the product in a place with overvoltage category III and pollution degree 2 or below as specified by IEC 60664-1.

Installation environment

For installation environment requirements, see section "Installation Environment Requirements" in MD880–20M Series Basic Rectifier Module Installation and Maintenance Guide.

Installation protection requirements

- The product is intended for cabinet assembly for systems operating in the end-user environment. The end-user system shall provide enclosures for fireproof and electrical and mechanical protection in line with local laws and regulations and relevant IEC standards.
- For IP20 products, install them in structures where foreign objects cannot enter from the top or front.

Wiring requirements of the main circuit

Refer to *"2.5 Selecting Control Cables" on page 35*.

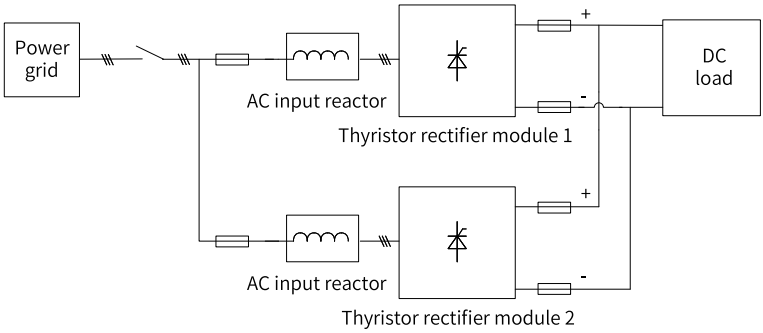
Requirements for protective devices

To comply with EN 61800-5-1 standards, install a fuse/circuit breaker on the input side to prevent accidents caused by short circuit in the internal circuit. See *"2.2.1 Fuse Selection" on page 27* for recommended fuse/circuit breaker selection.

7 Ordering Instructions

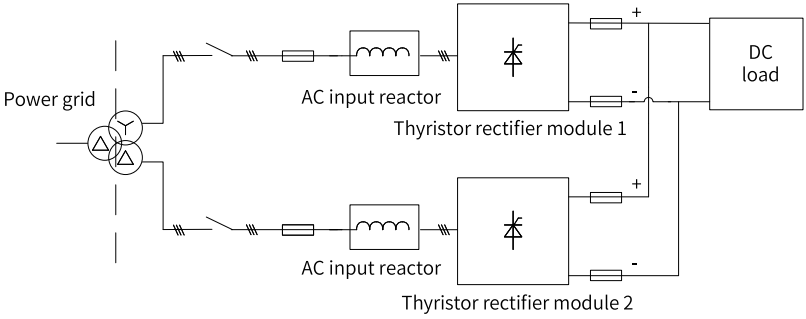
Two paralleled 6-pulse thyristor rectifiers

The derating coefficient for two paralleled 6-pulse thyristor rectifiers of 1520 A/690 V is 0.93. After derating, overload current threshold is 2827 A. The system topology is shown in the following figure.



Two paralleled 12-pulse thyristor rectifiers

The derating coefficient for two paralleled 12-pulse thyristor rectifiers of 1520 A/690 V is 0.93. After derating, overload current threshold is 2827 A. A 12-pulse rectifier can eliminate the 5th and 7th harmonics of the power grid, thus greatly reducing harmonic distortion and conducted emission in the line current. A 12-pulse rectifier system requires a phase-shifting transformer or two independent transformers with the same primary-to-secondary transformation ratio. A phase difference of 30° must be present between windings on the secondary side. The system topology is shown in the following figure.



List of ordering numbers

The following table describes the product models and ordering numbers of the MD880 series 690 VAC high-performance water-cooled basic rectifier module.

Table 7–1 Ordering instructions

Model MD880LC-20M-⋯	Frame	Part No.	Quantity	Remark
2000-7	D3D	1. MD880LC-20M-2000-7	1	Basic rectifier module
		2. MD880LC-WAHE-1.8 kW	1	Water-to-air heat exchanger assembly with fan (optional)
		3. HE300-110-1000-7-L1	2	AC input reactor (optional)
3720-7	2 x D3D	1. MD880LC-20M-2000-7	2	Basic rectifier module
		2. MD880LC-WAHE-1.8 kW	2	Water-to-air heat exchanger assembly with fan (optional)
		3. HE300-110-1000-7-L1	4	AC input reactor (optional)
1520-7+SCR	D3T	1. MD880LC-20M-2827-7+SCR	1	Basic rectifier module
		2. HCU-20	1	Basic rectifier control module
		3. HFAN-10	1	Fan fault detection module (optional)
		4. MD880LC-20M-1520-7-L1	2	AC input reactor (optional)
		5. MD880LC-WAHE-3.4 kW	2	Water-to-air heat exchanger assembly with fan (optional)
2827-7+SCR	2 x D3T	1. MD880LC-20M-1520-7+SCR	2	Basic rectifier module
		2. HCU-20	1	Basic rectifier control module
		3. HPCU-40	1	Parallel control module
		4. HFAN-10	2	Fan fault detection module (optional)
		5. MD880LC-20M-1520-7-L1	2	AC input reactor (optional)
		6. MD880LC-WAHE-3.4 kW	2	Water-to-air heat exchanger assembly with fan (optional)
4241-7+SCR	3 x D3T	1. MD880LC-20M-1520-7-SCR	3	Basic rectifier module
		2. HCU-20	1	Basic rectifier control module
		3. HPCU-40	1	Parallel control module
		4. HFAN-10	2	Fan fault detection module (optional)
		5. MD880LC-20M-1520-7-L1	3	AC input reactor (optional)
		6. MD880LC-WAHE-3.4 kW	3	Water-to-air heat exchanger assembly with fan (optional)

Model MD880LC-20M-⋯	Frame	Part No.	Quantity	Remark
5654-7+SCR	4 x D3T	1. MD880LC-20M-1520-7-SCR	4	Basic rectifier module
		2. HCU-20	1	Basic rectifier control module
		3. HPCU-40	1	Parallel control module
		4. HFAN-10	3	Fan fault detection module (optional)
		5. MD880LC-20M-1520-7-L1	4	AC input reactor (optional)
		6. MD880LC-WAHE-3.4 kW	4	Water-to-air heat exchanger assembly with fan (optional)

Note

When four parallel units are configured with three fan fault detection modules, three slots on the HCU will be occupied. If additional function modules are needed, slot expansion can be achieved by using an optical fiber expansion module (HOFM-10 or HOFM-30) and a function expansion module (HESD-10) in combination. For specific model selection and usage instructions, see the *HCU Control Module Hardware Guide*.

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www.inovance.com

Add.: Inovance Headquarters Tower, High-tech Industrial Park,
Guanlan Street, Longhua New District,
Shenzhen 518000, P.R. China
Tel: (0755) 2979 9595 Fax: (0755) 2961 9897

Suzhou Inovance Technology Co., Ltd.

www.inovance.com

Add.: No. 52, Tian E Dang Road, Wuzhong District, 215104,
Suzhou City, Jiangsu Province, P.R. China
Tel: (0512) 6637 6666 Fax: (0512) 6285 6720