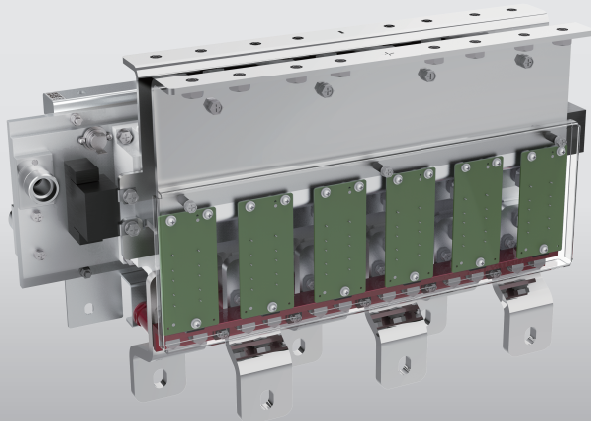




MD880LC-20M Series Basic Line Module User Guide



Industrial
Automation



Intelligent
Elevator



New Energy
Vehicle



Industrial
Robot



Rail
Transit



Data code P500005708A00

Preface

Introduction

Thank you for purchasing the MD880 series 690 VAC high-performance water-cooled multidrive product.

The MD880 series high-performance water-cooled multidrive product features high usability, power density, control performance.

Highlights:

- Wide voltage range: 525 VAC to 690 VAC
- Wide power range: 315 kW to 4200 kW
- Multiple load motors supported: AC asynchronous induction motors and permanent magnet synchronous motors
- Superior motor performance: Fast dynamic response, high control accuracy, and smooth operation.
- Flexible module structure, easy installation, easy maintenance, and easy integration into cabinet
- High power density to save installation space
- Low noise to improve user experience
- Uniform application software platform of MD880 product family to improve usability

Wide application range:

- Shield machine
Tool pan drive, slurry pump, slurry discharge pump and so on
- Petroleum
Offshore rig platform
- Vessels
Marine electric propulsion system, wind turbine installation vessels and so on
- Others
High power water-cooled test bench

The MD880LC-20M series 690 VAC high-performance water-cooled basic line module is used for AC-DC conversion. This user guide describes the installation, system structure, wiring, maintenance, and component replacement. For starters, read through this user guide. If you have any questions about product function and performance, contact Inovance for technical support.



Caution

- The drawings in the user 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.
- Drawings in the guide are for reference only and may vary with the product you purchased.
- The intellectual property rights in the guide belong to Inovance. The guide is subject to change without notice due to continuous product improvement.

More documents

Name	Data Code	Description
MD880LC-20M Series Basic Line Module Installation Guide	19011722	Describes the installation dimensions, space requirements, and wiring.
MD880LC-20M Series Basic Line Module Hardware Guide	19011723	Describes the system structure, technical specifications, and instructions for mechanical design and electrical design.
MD880LC-20M Series Basic Line Module Maintenance Guide	19011724	Describes routine maintenance and parts replacement.

Revision History

Date	Revision	Description
April 2022	A00	First release

Document acquisition

This guide is not delivered along with the product. You can download the PDF version in the following means:

Log in to Inovance's website (www.inovance.com), choose Support > Download, search by keyword, and then download the PDF file.

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Safety Instructions

Safety Precautions

- Before installing, using, and maintaining this equipment, read the safety information and precautions thoroughly, and comply with them during operations. Failure to comply may result in severe personal injuries or even death or equipment damage.
- "DANGER", "WARNING", and "CAUTION" items in the user guide do not indicate all safety precautions that need to be followed; instead, they just supplement the safety precautions.
- Use this equipment according to the designated environment requirements. Damage caused by improper usage is not covered by warranty.
- Innovent 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 severe personal injuries or even death.



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



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

Safety Instructions

- Drawings in the user guide are sometimes shown without covers or protective guards. Remember to install the without covers or protective guards as specified before using the product, and perform operations following the instructions.
- The drawings in the user guide are shown for illustration only and may be different from the product you purchased.

Unpacking



- Do not install the equipment if you find damage, rust, or indications of use on the equipment or accessories.
- Do not install the equipment if you find water seepage, component missing or damage upon unpacking.
- Do not install the equipment if you find the packing list does not conform to the equipment you received.

**CAUTION**

- Check whether the packing is intact and whether there is damage, water seepage, damp, and deformation.
- Unpack the package by following the unpacking sequence. Do not hit the package with force.
- Check whether there is damage, rust, or injuries on the surface of the equipment or equipment accessories.
- Check whether the number of packing materials is consistent with the packing list.

Storage and Transportation**WARNING**

- Use professional loading and unloading equipment to carry large-scale or heavy equipment. Failure to comply may result in personal injuries or equipment damage.
- Before hoisting the equipment, ensure the equipment components such as the front cover and terminal blocks are secured firmly with screws. Loosely-connected components may fall off and result in personal injuries or equipment damage.
- Never stand or stay below the equipment when the equipment is lifted by 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.

**CAUTION**

- Handle the equipment with care during transportation and mind your step 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 this equipment for more than three months. Long-term storage requires stricter protection and necessary inspections.
- Pack the equipment strictly before transportation. Use a sealed box for long-distance transportation.
- Never transport this equipment with other equipment or materials that may harm or have negative impacts on this equipment.

Installation**DANGER**

- Installation must be performed by only experienced personnel who have been trained with necessary electrical information.

 WARNING

- Thoroughly read the safety instructions and user guide 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 modify this equipment.
- Do not rotate the equipment components or loosen fixed bolts (especially those marked in red) on equipment components.
- When this equipment is installed in a cabinet or final equipment, protection measures such as a fireproof enclosure, electrical enclosure, or mechanical enclosure must be provided. The IP rating must meet IEC standards and local laws and regulations.
- Before installing equipment with strong electromagnetic interference, such as a transformer, install an electromagnetic shielding device for this equipment to prevent malfunctions.
- Install the equipment onto an incombustible object such as a metal. Keep the equipment away from combustible objects. Failure to comply will result in a fire.

 CAUTION

- 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 for effective ventilation and cooling.
- 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

 DANGER

- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed by only professionals.
- Before wiring, cut off all equipment power supplies. Wait as specified on the product warning sign before further operations because residual voltage exists after power-off. Measure the DC voltage of the main circuit and make sure it is below the safety voltage. Otherwise, electric shock may occur.
- Never perform wiring at power-on. Failure to comply will result in an electric shock.
- Make sure that the equipment is well grounded. Failure to comply will result in an electric shock.

**WARNING**

- Never connect the power cable to output terminals of the equipment. Failure to comply may cause equipment damage or even a fire.
- When connecting a drive with the motor, make sure that the phase sequences of the drive and motor terminals are consistent to prevent reverse motor rotation.
- Wiring cables must meet diameter and shielding requirements. The shielding layer of the shielded cable must be reliably grounded at one end.
- Fasten screw terminals with the specified tightening torque. Insufficient or excessive torque may cause overheating, damage, and even a fire.
- After wiring, make sure that no screws are fallen and cables are exposed in the equipment. Failure to comply may result in an electric shock or equipment damage.

**CAUTION**

- 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.
- In wiring the control circuit, use shielded twisted pair cable and connect the shield to the PE terminal. Otherwise, the equipment may not function properly.

Power-on**DANGER**

- Before power-on, check that the equipment is installed properly with reliable wiring and the motor can be restarted.
- Before power-on, make sure that the power supply meets equipment requirements to prevent equipment damage or even a fire.
- After power-on, do not open the cabinet door or protective cover of the equipment. Never touch any terminals, or remove any unit or part of the equipment. Failure to comply will result in an electric shock.

**WARNING**

- 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 a fire.
- Before power-on, check that no one is near the equipment, motor, or other mechanical parts. Failure to comply may result in personal injuries or even death.

Operation**DANGER**

- The equipment must be operated only by professionals. Failure to comply will result in personal injuries or even death.
- Do not touch any wiring terminals or remove any part of the equipment during operation. Failure to comply will result in an electric shock.



WARNING

- Do not touch the equipment shell, fan, or resistor for temperature detection. Failure to comply will result in heat injuries.
- Prevent metal or other objects from falling into the device during operation. Failure to comply may result in fire or equipment damage.

Maintenance



DANGER

- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed by only professionals.
- Do not maintain the equipment at power-on. Failure to comply will result in an electric shock.
- Before maintenance, cut off all equipment power supplies and wait as specified on the product warning sign.
- In case of a permanent magnet motor, do not touch the motor terminals even after power-off because there is still induced voltage generated during rotation. Failure to comply will result in an electric shock.



WARNING

- Perform daily and periodic inspection and maintenance for the equipment according to maintenance requirements and keep a maintenance record.

Repair



DANGER

- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed by only professionals.
- Do not repair the equipment at power-on. Failure to comply will result in an electric shock.
- Before inspection and repair, cut off all equipment power supplies and wait as specified on the product warning sign.



WARNING

- Require for repair services according to the product warranty agreement.
- When the fuse is blown or the circuit breaker or earth leakage circuit breaker (ELCB) trips, wait as specified on the product warning sign before power-on or further operations. Failure to comply may result in personal injuries, equipment damage or even death.
- 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 according to the replacement guide.
- Do not operate damaged equipment. Failure to comply may result in worse damage.
- After the equipment is replaced, perform wiring inspection and parameter settings again.

Disposal

- Dispose of retired equipment by following local regulations or standards. Failure to comply may result in property damage, personal injuries, or even death.
- Recycle retired equipment by following industry waste disposal standards to avoid environmental pollution.

Safety Signs

For safe equipment operation and maintenance, comply with safety signs on the equipment, and do not damage or remove the safety labels. The following table describes the safety signs.

Safety Signs	Description
	• Read through the safety instructions before operating the equipment. Failure to comply may result in death, personal injuries, or equipment damage. • Do not touch the terminals or remove the cover with power ON or within 15 min after power-off. Failure to comply will result in an electric shock.

1 Product Information

1.1 Product Model

The MD880LC-20 series is a low-voltage and liquid-cooled basic line module from Inovance. It features high power density, compact structure and high reliability. It supports 6-pulse or 12-pulse input of 690 VAC and rate power of 2273 kW. With two modules in parallel connection available, the combined rated power up to 4229 kW is sufficient for one or more inverters. The following are the designation rules.

MD880LC 20M 2000 7
① ② ③ ④

① Product platform MD880 series liquid-cooled AC drive	③ Rated current 2000 A
② Product type Basic line module	④ Voltage class 690 VAC

Note

In ③, only one current class is listed.

1.2 Nameplate

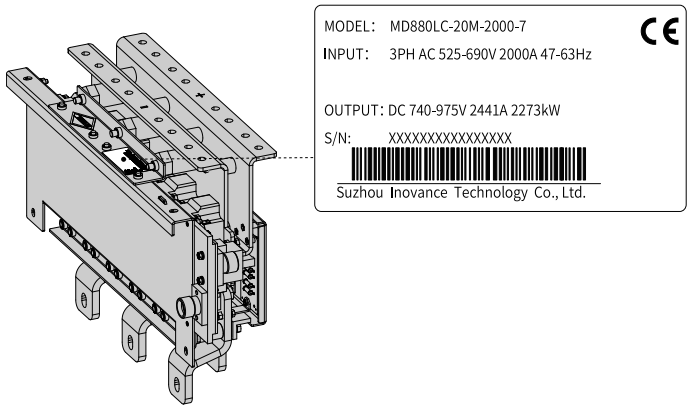


Figure 1-1 Nameplate description for the module

1.3 Technical Indicators

1.3.1 Voltage and Power Class

Table 1-1 MD880LC-20M series voltage and power class

Rated voltage	Output voltage	Rated current	Rated power	Rated power loss	Max. weight	Rated mass flow	Dimensions L × W × H	Structure
	(VDC)	(A)	(kW)	(kW)	(kg)	(L/min)	(mm)	
690 V system: 525 VAC to 690 VAC Tolerance range $\pm 10\%$ (-15%, < 1 min)	740 to 975	2000	2273	11	26.5	16	540×330×172	D3D
		3720	4229	21	53	32	(2×) 540×330×172	2 × D3D

1.3.2 Product Specifications

Table 1-2 MD880LC-20M series product specifications

MD880LC-20M	Structure	U _N = 690 V (525V to 690 V), $\pm 10\%$ (-15%, 1 min) (power level for 690 V)							
		No-overload use				Light-overload use		Heavy-overload use	
		I _{ac} :	I _{dc}	S _N	P _N	I _{LD}	P _{LD}	I _{HD}	P _{HD}
		A (AC)	A (DC)	kVA	kW	A (DC)	kW	A (DC)	kW
2000-7	D3D	2000	2441	2390	2273	2343	2182	1952	1819
3720-7	2 × D3D	3720	4540	4446	4229	4358	4059	3632	3383

Definitions:

No-overload use rating:

- I_{ac}: RMS AC input current available continuously without overload capability at 40°C (104°F) coolant temperature and 45°C (113°F) air temperature.
- I_{dc}: RMS DC output current available continuously without overload capability at 40°C (104°F) coolant temperature and 45°C (113°F) air temperature.
- S_N: Rated apparent power.
- P_N: Rated DC output power.

Light-overload use rating:

- I_{LD}: Continuous RMS DC output. An overload of 10% for 1 minute every 5 minutes is allowed.
- P_{LD}: Continuous DC output power.

Heavy-overload use rating:

- I_{HD}: Continuous RMS DC output. An overload of 50% for 1 minute every 5 minutes is allowed.

- P_{HD} : Continuous DC output power.

1.3.3 Technical Data

Table 1-3 MD880LC-20M series technical data

Item		Specifications
Basics	Input AC voltage	690 V system: 525 VAC to 690 VAC, $\pm 10\%$ (-15%, < 1 min)
	Input frequency	50 Hz/60Hz ($\pm 5\%$)
	Unbalance degree	$\pm 3\%$ of rated voltage at most
	Output voltage	690 V system: 742 VDC to 976 VDC
	Overload capacity	Light overload: An overload of 10% for 1 minute every 5 minutes is allowed Heavy overload: An overload of 50% for 1 minute every 5 minutes is allowed
	Operating efficiency	More than 99.5%
Liquid-cooled system	Coolant	Pure water or mixture of pure water and ethylene glycol combined with preservative. For use in ambient temperature below +5°C, antifreeze must be added
	Maximum pressure	6 bar
	System circulated volume and flow rate	● 100% water: ≥ 16 L/min ● 80% water and 20% ethylene glycol: ≥ 18 L/min ● 60% water and 40% ethylene glycol: ≥ 21 L/min
Mechanical data	Vibration performance	In compliance with vibration level 3M4 in GB/T 4798.3 Frequency range: 2 Hz to 9 Hz; Displacement: 3 mm Frequency range: 9 Hz to 200 Hz; Acceleration rate: 10 m/s ² Shock resistance of 100 m/s ² , 11 ms
	IP rating	IP00 (module)
	Safety features	In compliance with EN 61800-5-1
Protection functions	Overtemperature protection	Overtemperature warning

	Item	Specifications
Environmental limits	Cooling mode	Liquid cooling
	Altitude	1000 to 4000 m, derated over 1000 m and isolation transformer installed over 2000 m
	Operating ambient temperature	0°C to +55°C, derated over +45°C
	Coolant temperature	0°C to +50°C, derated over +40°C
	Storage temperature	-25°C to + 55°C, coolant emptied below 0°C
	Storage humidity	5% to 95% RH, non-condensing
	Ambient humidity during transportation	Less than 95% RH at +40°C
	PH value	6 to 8
	Hardness	< 10°dH
	Conductivity	< 300 us/cm
	Chloride	< 50 mg/L
	Fluoride	< 50 mg/L
	Sulfate	< 100 mg/L
	Total dissolved solids	< 200 mg/L
	Preservative	0.5% Cortec VCI-649 (replace every two years)

Note

Water quality is necessary for normal operation of equipment.

1.3.4 Derating

Ambient Temperature Derating

When the temperature is +45 to +55°C, the rated output current must be derated by 0.5% for every 1°C increase. The output current can be calculated by multiplying the current by the derating factor (k):

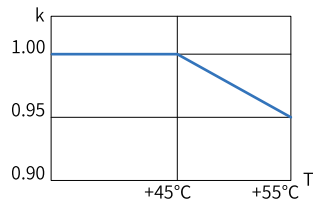


Figure 1-2 Ambient temperature derating

Altitude Derating

When the altitude is 1000 m to 4000 m, the output current of the module must be derated by 1% for every 100m increase. An isolation transformer must be installed above 2000 m. The output current can be calculated by multiplying the rated current by the derating factor (k):

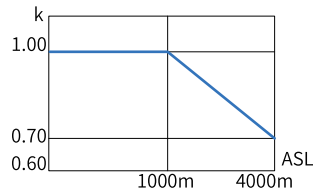


Figure 1-3 Altitude derating

Coolant Temperature Derating

When the temperature is +40 to +50°C, the rated output current must be derated by 2% for every 1°C increase. The output current can be calculated by multiplying the current by the derating factor (k):

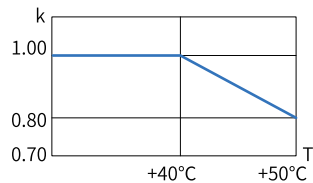


Figure 1-4 Coolant temperature derating

1.3.5 Overload Capacity

For some drive systems where overload may occur, a proper base load current is necessary for the MD880LC-20 series basic line modules. The criterion for overload is that the drive is operated with its base load current before and after the overload occurs (repeated every 300s).

The following two typical overload conditions are shown.

Curve in Light Overload Mode

Light overload duty (I_{LD}) is based on 110% base load current for 60s.

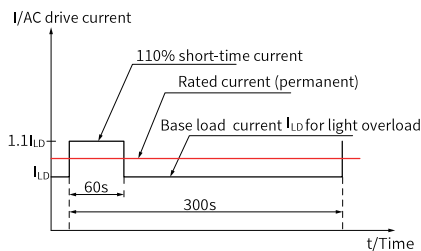


Figure 1-5 Curve in light overload mode

Curve in Heavy Overload Mode

Heavy overload duty (I_{HD}) is based on 150% base load current for 60s.

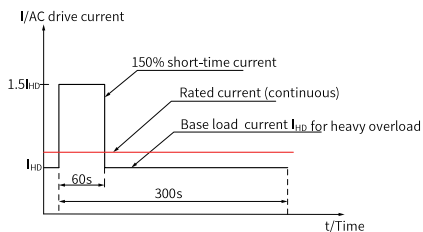


Figure 1-6 Curve in heavy overload mode

1.4 Component Description

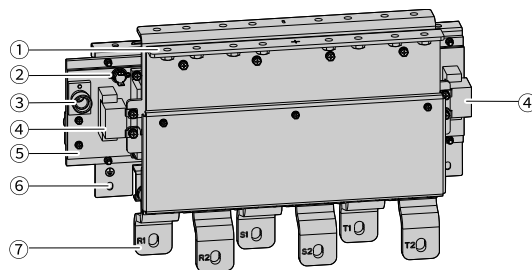


Figure 1-7 Basic line module layout 1

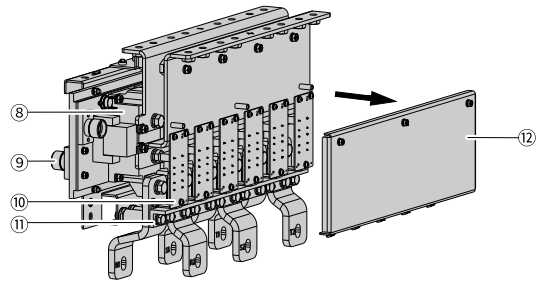


Figure 1-8 Basic line module layout 2

No.	Notes
①	DC bus terminals
②	Temperature switch
③	Coolant outlet joint, M26 × 1.5 metric external thread, 24° cone
④	Snubber capacitor
⑤	Heatsink
⑥	Sheet metal bottom
⑦	Three-phase power input terminals
⑧	Diode
⑨	Coolant inlet joint, M26 × 1.5 metric external thread, 24° cone
⑩	RC snubber board
⑪	Insulation support board
⑫	PC board

2 Electrical Design

2.1 System Structure

2.1.1 Typical System Components

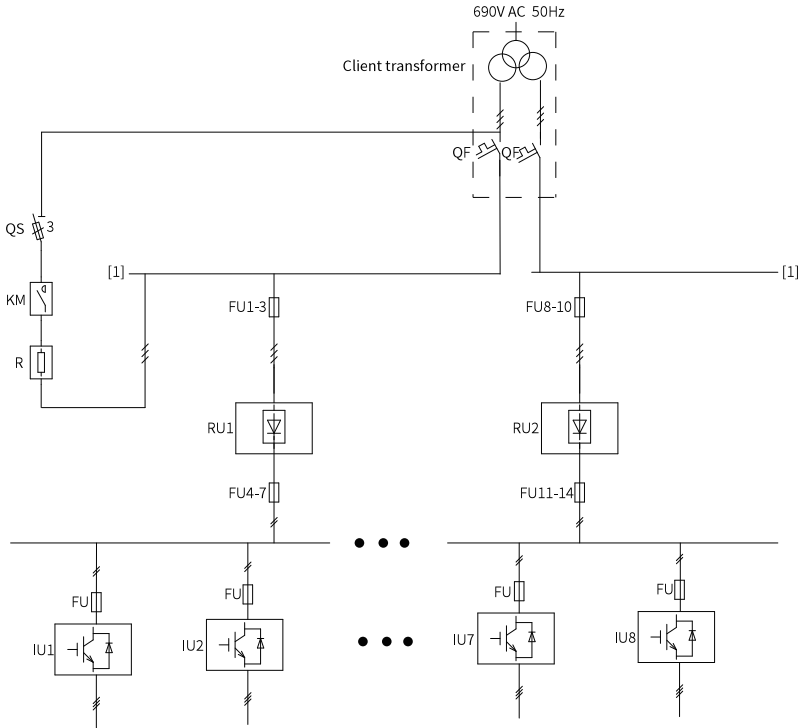


Figure 2-1 Basic line module components

Note

- [1]: The input AC cabling has to be identical (length and cross-sectional area) between all the parallel-connected modules. The input AC cable shall have a minimum length of 5 m.
- You can choose one or two rectifier modules as needed. The standard setup is a maximum of two modules.

2.1.2 Selection of Fuse

To comply with standards IEC/EN 61800-5-1 and UL61800-5-1, use fuses on the input side to prevent accidents caused by short circuit.

Table 2-1 Selection of fuse on the AC side

Module model	Fuse model (SINOFUSE)	Parameter	Quantity
MD880LC-20M-2000-7	RS306-3-S1P-1500A690V	1500 A, 690 V, SIZE: 3	6

Table 2-2 Selection of fuse on the DC side

Module model	Fuse model (BUSSMANN)	Parameter	Quantity
MD880LC-20M-2000-7	170M7595-2500A/1250 VDC	2500 A, 1250 VDC, SIZE: 4	4

2.1.3 Selection of Circuit Breaker

Table 2-3 Selection of circuit breaker

Module model	Circuit breaker model		
	Parameter	Breaking capability	Quantity
MD880LC-20M-2000-7	690 V, 2500 A	65 kA	1
MD880LC-20M-3720-7	690 V, 4000 A	100 kA	1

2.1.4 Supply Transformer

Single module supports 6-pulse or 12-pulse input. The modules do not have input reactors. Thus, the supply transformer must be dimensioned according to the supply unit apparent power S_N (BLM), supply transformer nominal power S_N (trafo) and short-circuit impedance Z_k . The supply nominal impedance Z_k must be at least 5% calculated with nominal apparent power of the supply modules. The transformer's nominal short-circuit impedance must be according to the following equation with 6-pulse system. The same impedance requirement also applies to generator, if it is used as a supply.

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

Definitions:

S_N (trafo): Transformer or generator apparent power

S_N (BLM): MD880LC-20M series apparent power

Z_k (BLM): Transformer or generator nominal short-circuit impedance

For example, the MD880LC-20M-2000-7 apparent power S_N (BLM) = 2390 kVA and the transformer apparent power S_N (trafo) is 3000 kVA, then:

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

The same rule also applies to 12-pulse transformers when the nominal values are calculated based on the total power of the 12-pulse transformer. If the nominal values are calculated per 6-pulse windings (power per winding is half of the power of the 12-pulse transformer), then half of the reactance ($\geq 2.5\%$) is sufficient. In the dimensioning example above, this can mean that 3.14% nominal impedance per winding is sufficient.

Table 2-4 12-pulse transformer selection

Item		Specifications	Notes
12-pulse supply transformer	Connection	Dy11 d0 or Dyn11 d0	Secondary side grounding is prohibited. Shielded power cables are recommended. If the necessary transformer impedance cannot be fulfilled, it is also possible to install a separate reactor.
	Phase shift between secondaries	30°	
	Voltage difference between secondaries	< 0.5%	
	Short-circuit impedance of secondaries	> 5%	
	Short-circuit impedance difference between secondaries	< 10%	

Note

In the table, the short-circuit impedance of secondaries is the equivalent impedance. For details, refer to ["2.1.4 Supply Transformer" on page 20](#).

2.2 Routing Design

2.2.1 Specifications

Signal Cables and Power Cables Routed Separately

When analog signals are used to remotely control the basic line module, route them separately from power cables and keep a distance of at least 30 cm to minimize interference. This requirement must be met even inside the control cabinet.

Requirements on the Analog Signal Cables

Use the twisted pair shielded cables as the analog control signal cables. When stripping the sheathing back of the cable, the stripped part must be as short as possible (5 mm to 7 mm), and wrap the stripped shield with the insulating tape to prevent the shielded cable from contacting other cables, eliminating interference.

Requirements on the Power Cables

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

Requirements on the Control Cables and Power Cables

If the control cable must run across the power cable, make sure they are arranged at an angle of close to 90°.

2.2.2 Cable Routing

Cables That Cause Interference

Cables transmitting different signals shall be routed separately. Maintain a proper distance (preferably 30 cm if space permits) between cables that cause interference and sensitive ones. Where such cables must cross, make sure they are at an angle as near to 90° as possible to prevent interference.

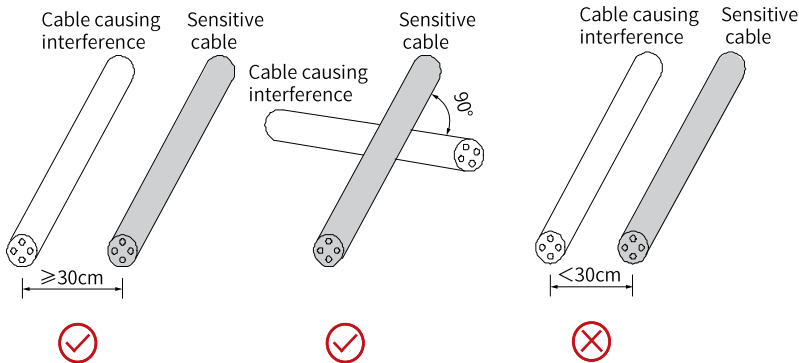


Figure 2-2 Routing of cables that cause interference and sensitive ones

Signal Cables

Route different signal cables separately and isolate them with the potential equalization cables. The following figure shows details.

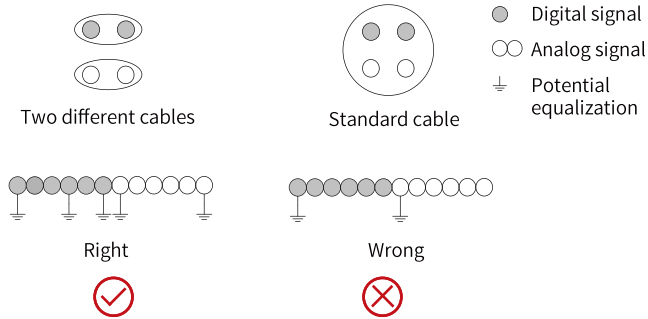


Figure 2-3 Routing of different signal cables

Multi-core Cables

For the multi-core cables, it is recommended that a cable only transmits the same type of signals. If different types of signals are to be transmitted, use shielded conducting cores, as shown in the following figure.

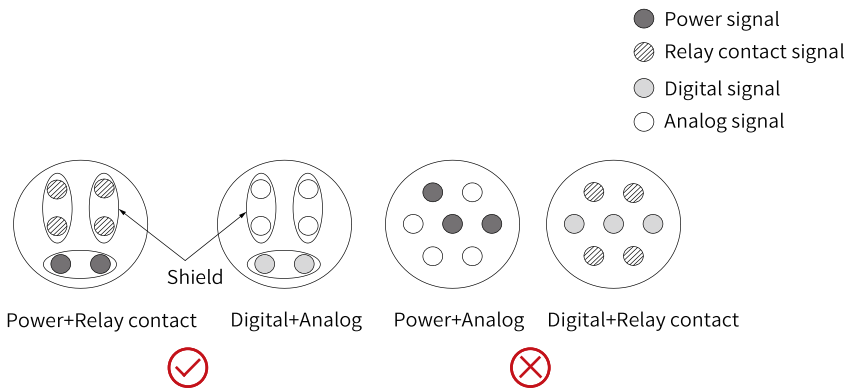


Figure 2-4 Routing of multi-core cables

For unused conducting cores in a multi-core cable, connect them to the equipotentially bonded conductors.

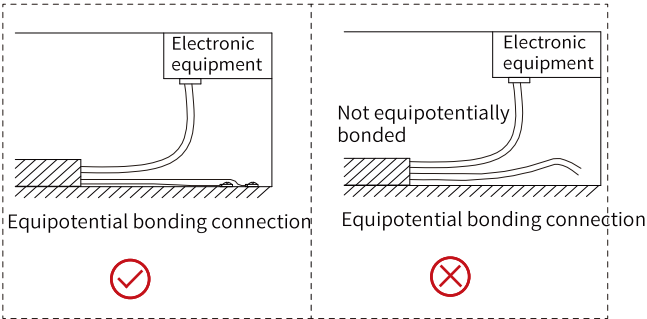


Figure 2-5 Handling of unused cores in a multi-core cable

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.

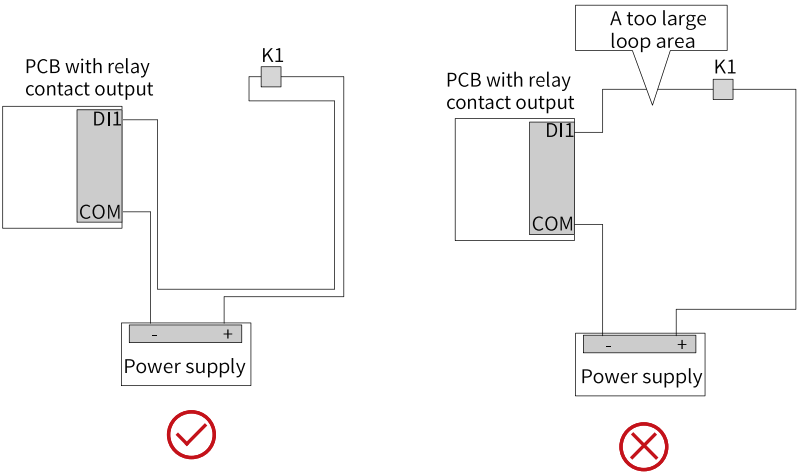


Figure 2-6 Routing for a not too large loop area

Multiple Types of Cables

Lay multiple types of cables along the equipotentially bonded metal parts and separate them to improve EMC performance. Metallic enclosures (zinc iron or stainless steel) isolated with sheet metal will deliver even better EMC performance.

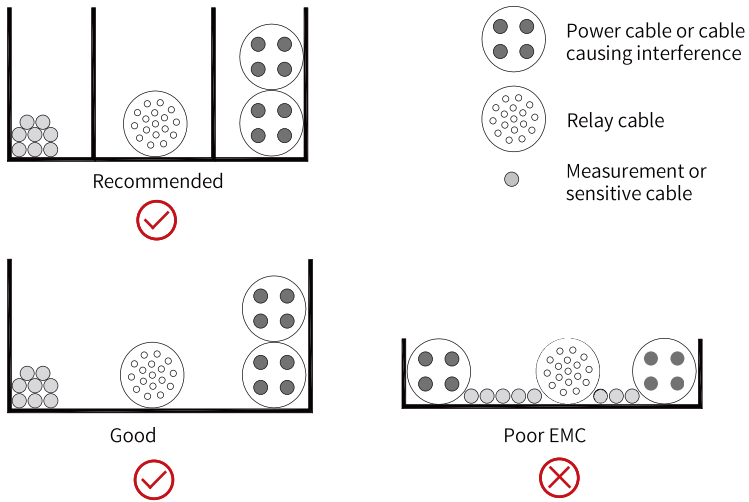


Figure 2-7 Routing of multiple types of cables

Shielded Cables

Keep the length of the unshielded cable part as short as possible, and the shield braid is tied to the nearest PE terminal. Too long a stripped part will make the cable susceptible to interference. It is especially true for encoder signals.

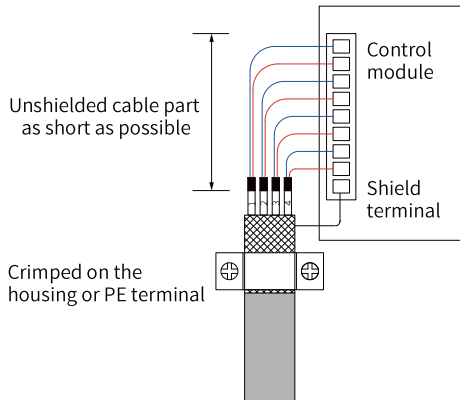


Figure 2-8 Requirements on shielded cables

The input power cable and shield must be in large-area contact with the shield plate in the cabinet modules to achieve good EMC effect. See the following figure for cable connection.

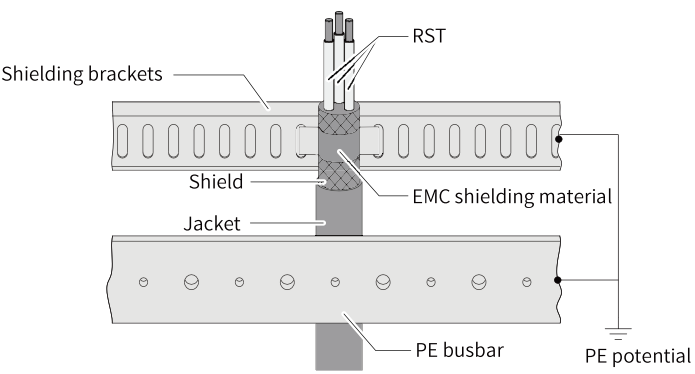


Figure 2-9 Connection of shielded power cables

2.3 Main Circuit Cable Design

2.3.1 Main Circuit Terminal Description

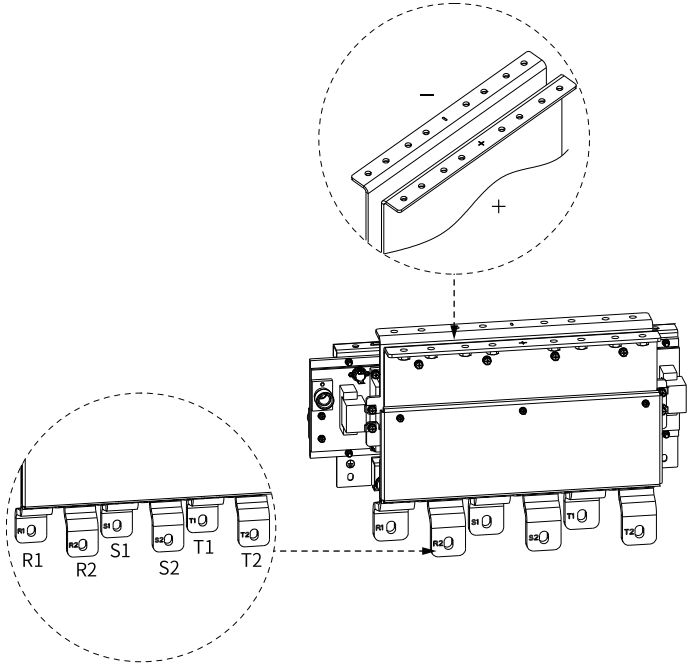


Figure 2-10 Main circuit terminal arrangement

Table 2-5 Main circuit terminal description

Terminal	Name	Function
R1, R2, S1, S2, T1 and T2	Three-phase power input terminals	Three-phase AC power input connection
+ and -	DC bus terminals	DC power output connection

2.3.2 Main Circuit Cable Selection

For cable selection, follow the requirements of the National Electrical Code (NEC), Canadian Electrical Code (CEC) Part I and relevant local regulations.

- Select proper copper cables for the main circuit as recommended
- The recommended cable is flame-retardant PVC cable with a continuous maximum permissible temperature of 105°C and nominal voltage up to 750 V. Use conditions:
 - Ambient temperature below 45°C
 - Within rated values under normal operating conditions.

If cable specifications recommended for peripherals or options are beyond the applicable cable range, contact Inovance for technical support.

Table 2-6 Cable selection

Module model	Rated input current (A)	Recommended quantity and size (mm ²)	Wiring terminal
UN: three-phase 690 VAC (range: 525 to 690 V)			
MD880-20M-2000-7	2000	6 × 185	OT/185-12
MD880-20M-3720-7	3720	8 × 240	OT/240-16

Note

- The cables recommended in the table are all symmetric 3-core shielded cables, which are connected to the three phases of the AC output busbar. The sectional area of the PE cable must fulfill the following:
 - When the sectional area of the phase line $S \leq 16 \text{ mm}^2$, the sectional area of the PE cable = S .
 - When $16 \text{ mm}^2 < S \leq 35 \text{ mm}^2$, the sectional area of the PE cable = 16 mm^2 .
 - When $S > 35 \text{ mm}^2$, the sectional area of the PE cable = $S/2$.
 - Note: $6 \times 185 \text{ mm}^2$ indicates that each phase requires 6 cables and the cross-sectional area is 185 mm^2 . It is recommended to install copper busbar. For details, please refer to ["3.3.3 Recommended Cabinet Layout" on page 36](#).
 - Note: OT/185-12 indicates a cable crimping OT terminal, with a cable sectional area of 185 mm^2 and an M12 screw hole.
 - Note the maximum size of the cable terminals listed in the following table. Use cable terminals within these limits. Otherwise, the mechanical stability and electrical clearance cannot be ensured.
 - Derating calculations are required when running multiple cables of the same specification in parallel.
-

2.3.3 Wiring Requirements on the Main Circuit

- The specification and installation method of external main circuit cables must comply with the local regulations and related IEC standards. Select proper copper cables for the main circuit as recommended.
- To protect the main circuit, any possible contact is avoided.
- Never get any foreign objects into the terminal block.
- No welding is needed when using twisted wires.
- Tighten all terminal screws to the correct tightening torque. Torque screwdriver, torque ratchet or torque wrench can be used. If you use an electric tool, make sure it is in the low speed setting. Otherwise, the screws may be damaged. Do not tighten the terminal screws at an angle in the specified range (not above 5 degrees) to prevent damage.

2.4 Wiring of the Control Circuit

2.4.1 Control Circuit Terminal Description

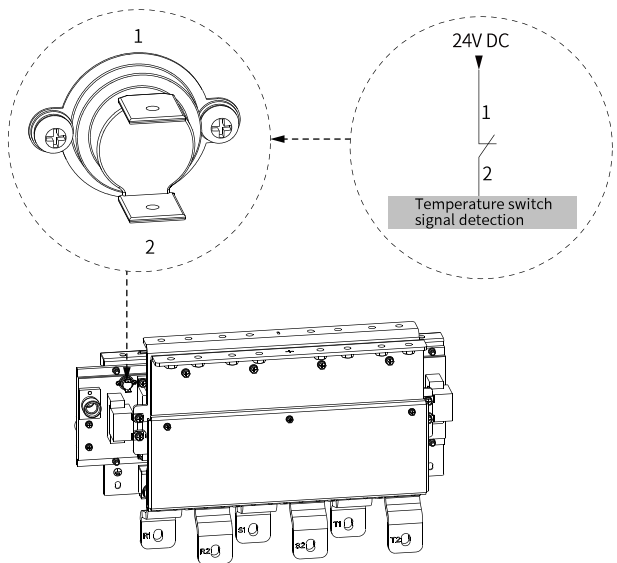


Figure 2-11 Arrangement of control circuit terminals

Table 2-7 Control circuit terminal description

Terminal	Name	Function
1	NC contact switch connection 1	Temperature signal detection 1
2	NC contact switch connection 2	Temperature signal detection 2

Note

The temperature switch is normally closed. When the module temperature reaches a predefined value, the switch opens and the control program generates a warning signal, indicating overtemperature.

2.4.2 Wiring Requirements on the Control Circuit

Note

Cable connection of the control circuit shall be carried out according to EN 60204-1.

Control Circuit Cable Selection

To ensure that the control circuit is free from strong external interference, use shielded signal cables and install shielding brackets to offer large-area 360° shielding. Send different analog signals in separate shielded cables and digital signals in shielded twisted pairs.

Model	Terminal type	Recom mended IEC cable (mm ²)	Recom mended NEC cable (AWG)	Recommended cable lug
MD880LC-20M-2000-7	Control signal terminals	0.5	20	Cord end terminal
	24V input terminal	0.5 to 1.5	22–16	

I/O Signal Cabling

- The I/O signals include analog input (AI), analog output (AO), digital input (DI), digital output (DO) and relay output types. Disconnect the main power supply circuit and ensure that the AC drive indicators are off before wiring the I/O terminals.
- Keep a distance of at least 30 cm from the main circuit and other power lines to avoid interference with I/O signals.
- Keep a distance of at least 30 cm between the relay output terminals and other I/O signal lines to avoid any malfunctions.

2.5 Grounding

2.5.1 Main Circuit Grounding Requirements



Caution

- To prevent electric shock, be sure to make the grounding wire connect to the grounding terminal. Follow the relevant electrical regulations of specific countries or regions on the grounding method.
- To prevent electric shock, make sure that the PE conductor meets the technical specifications and local safety standards. The grounding wire should be as short as possible. As the leakage current of the device typically exceeds 3.5 mA, proper PE conductor is required according to IEC 61800-5-1. Use copper wire for the conductor with a cross-sectional area of at least 10mm² or use two conductors of the same gauge.
- When using multiple devices, follow the instructions for grounding all devices. Incorrect grounding will lead to faulty operation.

Main circuit grounding requirements:

- Use a yellow/green copper cable as the PE conductor and no switch devices (eg. circuit breaker) shall be used in series connection.
- Make the grounding wire connect to the grounding terminal. Otherwise, the device may be abnormal or damaged.
- The grounding (PE) wire and neutral wire don't share a terminal in the power system.
- It is recommended that the device be installed on the conductive metal plane. Ensure that the entire conductive bottom is in good contact with the metal plane.
- Tighten the grounding screws to the correct tightening torque so that the PE conductor will not come loose or too tight.

2.5.2 Module Grounding

The basic line module is grounded through sheet metal, and tighten with screws as shown in the figure.

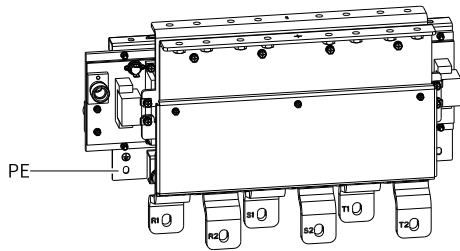


Figure 2-12 Module grounding

2.5.3 Cabinet Grounding

The most cost-effective measure to suppress interference in the cabinet during installation is to ensure that the interference source is isolated from the equipment that may be disturbed. It is necessary to divide the cabinet into multiple parts for EMC resistance based on interference intensity differences of sources. Install devices in the corresponding areas and wire according to the following table.

Table 2-8 Recommended grounding of cabinet system

No.	Wiring requirements
1	In the case of multiple cabinets, use grounding cables for connection to achieve equipotentiality.
2	In a cabinet, establish different parts based on interference intensity differences of sources.
3	Devices in different parts of the cabinet should be equipotentially connected.
4	All communication cables (eg. RS485) and signal cables from the cabinet should be shielded.
5	Place the power input filter close to the input interface of the cabinet.
6	All grounding points in the cabinet should be well coated for protection.

3 Mechanical Design

3.1 Structure Dimensions

3.1.1 Dimensions of the Basic Line Module

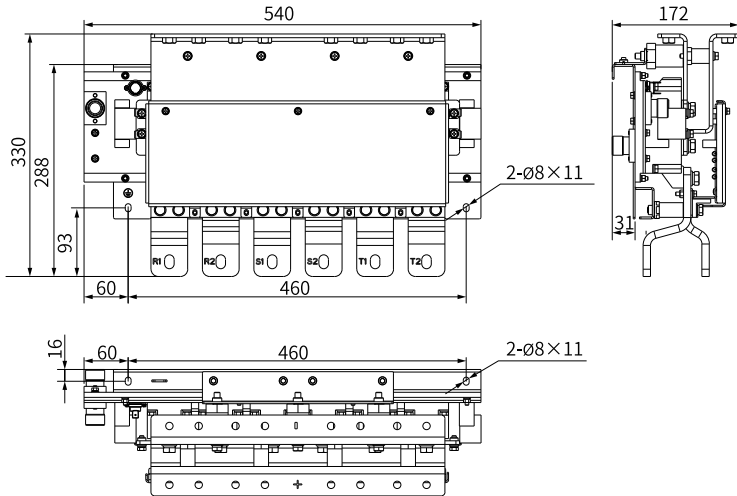


Figure 3-1 Dimensions of the basic line module (mm)

3.1.2 Mounting Dimensions of the Basic Line Module

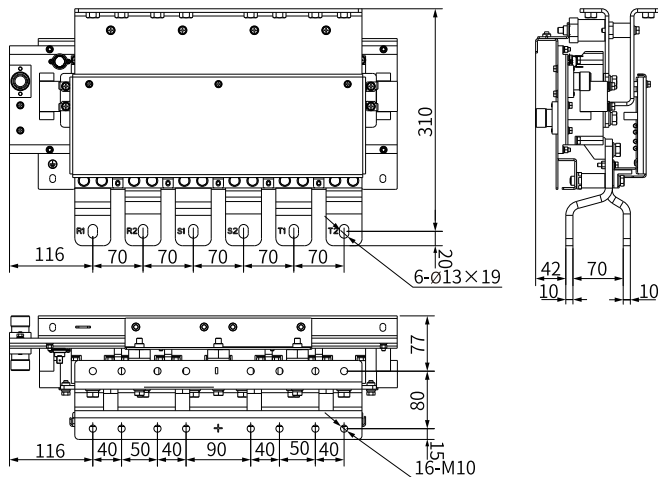


Figure 3-2 Mounting dimensions of the basic line module (mm)

3.2 Clearance Requirements

Proper clearance should be reserved for installing the module. The following figure shows the details.

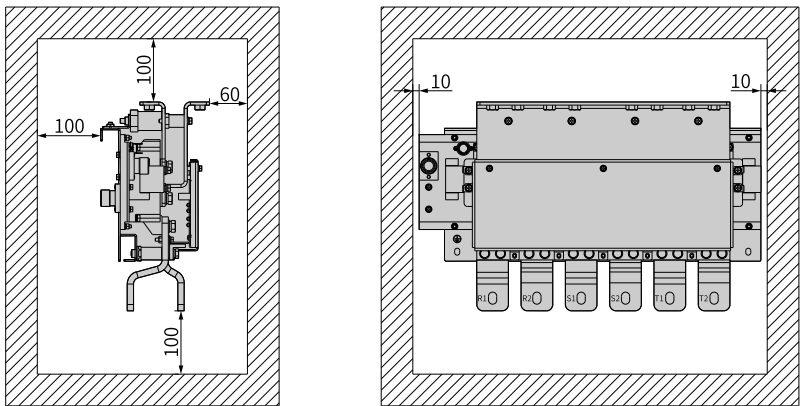


Figure 3-3 Module mounting clearance

Note

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

3.3 Cabinet Design Instructions

3.3.1 Cabinet Design Notes



Caution

- The cabinet frame must be sturdy enough to carry the weight of the drive components, control circuitry and other equipment installed in it.
- The cabinet must protect the module against contact and meet the requirements for dust and humidity.
- For easy installation, a spacious layout is recommended. Sufficient cooling air flow, obligatory clearances, cables and cable support structures all require space. The control boards must not be installed near main circuits or hot parts.
- Make sure any cross-members or shelves on which components are mounted are properly grounded and the connecting surfaces left unpainted. Ensure that the module is grounded to the PE busbar of the cabinet via its fastening screws.
- Ensure that the module is grounded to the PE busbar of the cabinet via its fastening screws.
- Nickel-plated copper is recommended.
- If there is a risk of condensation in the cabinet, use a cabinet heater. Although the primary function of the heater is to keep the air dry, it may also be required for heating at low temperatures. When placing the heater, follow the instructions provided by its manufacturer.
- Care should be taken when installing coolant pipes. Check for correct pipe installation and ensure no leaks occur.

3.3.2 EMC Requirements

The fewer and smaller the holes in the cabinet, the better the interference attenuation. The maximum diameter of a hole in galvanic metal contact in the covering cabinet structure is 100 mm. Pay special attention to the cooling air inlet and outlet grids.

The best galvanic connection between the steel panels is achieved by welding them together as no holes are necessary. If welding is not possible, leave the seams between the panels unpainted and equipped with special conductive EMC strips to provide adequate galvanic connection. Generally, reliable conductive strips are made of flexible silicon mass covered with a metal mesh. The non-tightened touch-contact of the metal surfaces is not sufficient, so a conductive gasket between the surfaces is required. The maximum distance between assembly screws is 100 mm.

Sufficient high-frequency grounding network must be constructed in the cabinet to avoid voltage differences and forming of high-impedance radiator structures. A good high-frequency grounding is made with short flat copper braids for low inductance. One-point high-frequency grounding cannot be used due to the long distances inside the cabinet.

Conductive EMC shielding gasket tapes are not sufficient for protective grounding. A sturdy low-frequency grounding structure is required for electrical safety of the parts. When designing protective grounding, please follow local regulations.

3.3.3 Recommended Cabinet Layout

Inovance can provide cabinet construction with the modules pre-assembled. The 6-pulse and 12-pulse connections use the same mechanics. AC and DC fuses are available for the basic line modules in the cabinet. The cabinet has direct cabling to the module through the bottom plate of the cabinet. Swing-out frames and internal mounting plates are there to install the control unit and other electrical equipment. The cabinet is totally sealed from the ambient air. It has installed a fan inside the cabinet to push air through a heat exchanger.

See the following for layout details.

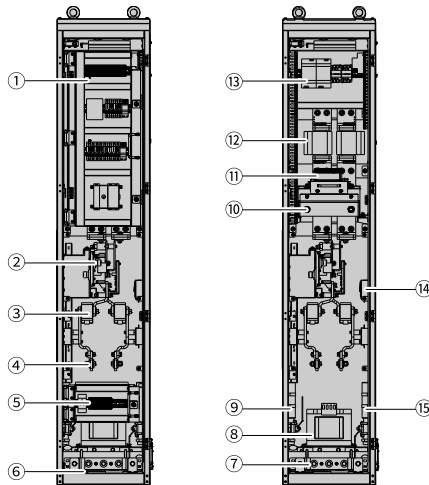


Figure 3-4 Layout in 400 mm wide cabinet

No.	Notes
①	Swing-out frame
②	Basic line module
③	AC fuse
④	AC input copper busbar

No.	Notes
⑤	Swing-out frame
⑥	Bottom cable entries
⑦	PE busbar
⑧	Transformer
⑨	Coolant inlet distribution manifold
⑩	Air-to-liquid heat exchanger
⑪	Air-to-liquid heat exchanger fan
⑫	DC fuse
⑬	Mounting plate behind the swing-out frame
⑭	Lightning protection board
⑮	Coolant outlet distribution manifold

Note

In the layout above, the left side shows the door being closed, and the right side shows the door being open.

Cooling pipes are arranged in the cabinet, and the air-to-liquid heat exchanger is in series connection with the basic line module. Coolant inlet and outlet distribution manifolds are configured with an inlet/outlet valve and a drain valve. See the following figure.

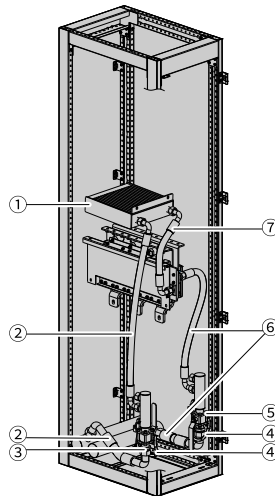


Figure 3-5 Pipe routing

No.	Notes
①	Air-to-liquid heat exchanger
②	Incoming pipes
③	Coolant inlet distribution manifold
④	Drain pipes
⑤	Coolant outlet distribution manifold
⑥	Outgoing pipes
⑦	Intermediate pipes

4 Internal Water-Cooling Circuit

4.1 Recommended Liquid-cooled System Design

Each cubicle has an inlet and outlet manifold, fitted with a stop valve and a drain valve. The stop valves can be closed to isolate all modules in the cubicle from the main cooling circuit.

The following diagram shows the coolant pipe connections in a drive system consisting of a supply unit and an inverter unit.

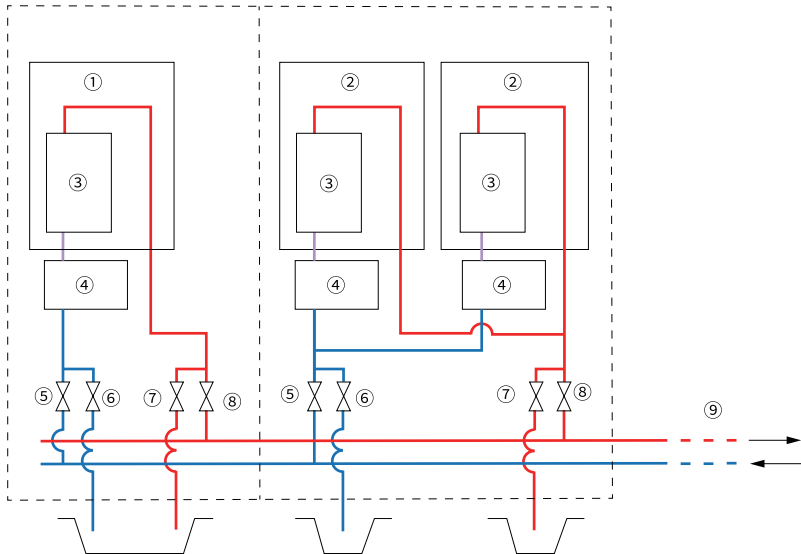


Figure 4-1 Internal liquid-cooled system

Table 4-1 Description of internal cooling system

No.	Description
①	Rectifier unit
②	Inverter unit
③	Heatsink
④	Air-to-liquid heat exchanger
⑤	Inlet valve
⑥	Inlet-side drain valve
⑦	Outlet-side drain valve
⑧	Outlet valve
⑨	Coolant main pipe

Note

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

4.2 Technical Data of Cooling Circuit

4.2.1 General Requirements

Equip the system with an expansion tank to damp pressure rise due to volume changes when the temperature varies. Equip the system with a pump that provides a nominal flow and pressure. Keep the pressure within the specified limits. Install a pressure regulator to make sure that the maximum permissible operating pressure is not exceeded. Install the bleed valve at the highest point in cooling circuit and drain valve at the lowest point.

Table 4-2 Liquid-cooled circuit parameters

Module model	Volume flow rate (L/min)			Water inlet temperature (°C)	Water inlet pressure (bar)
	100% water	Water/ethylene glycol ratio 80: 20	Water/ethylene glycol ratio 60: 40		
MD880LC-20M-2000-7	≥ 16	≥ 18	≥ 21	< 40	< 6

4.2.2 Coolant Temperature Control

The temperature of the coolant in the internal cooling circuit must be kept within the following specified limits.

- 20% ethylene glycol mixture is usable in storage temperatures down to -10 °C.
- 40% ethylene glycol mixture is usable in storage temperatures down to -25 °C.
- Note that operation below 0 °C (32°F) is not allowed regardless of the freezing point of the coolant.
- Additional ethylene glycol solution is needed at 0°C to 5°C.

Note

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

4.2.3 Temperature Limits

Freeze protection: 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 viscosity of the coolant. This results in a higher pressure loss in the system. See ["4.2.4 Pressure Limits" on page 42](#).

Coolant inlet temperature:

- 0 to 40°C (32 to 104°F): no drive output current derating required.
- 40 to 45°C (104 to 113°F): drive output current must be derated by 2 percentage points per 1°C (1.8°F) temperature increase.
- 45 to 50°C (113 to 122°F):
 - If components with a maximum operating temperature of 55°C (131°F) are installed in the same space as the drive modules, drive output current must be derated by 6 percentage points per 1°C (1.8°F) temperature increase.
 - If there are no components with a maximum operating temperature of 55°C (131°F) installed in the same space as the drive modules, drive output current must be derated by 2 percentage points per 1°C (1.8°F) temperature increase.

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

T _{air} (°C)	Min. T _{Coolant} (°C)				
	RH = 95%	RH = 80%	RH = 65%	RH = 50%	RH = 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	15.0
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 an air temperature of 5°C and relative humidity of 50%, the coolant temperature may not be below 0°C. At an air temperature of 45°C and relative humidity of 65%, the coolant temperature may not be below 36.8°C.

Maximum temperature rise: Depends on heat losses and mass flow. Typically 10 °C (18°F) with nominal losses and flow.

4.2.4 Pressure Limits

Base pressure: 100 to 150 kPa (recommended); 200 kPa (maximum). "Base pressure" denotes the pressure of the system compared with the atmospheric pressure when the cooling circuit is filled with coolant.

Air counterpressure in the expansion tank: 40 kPa

Design pressure (PS): 600 kPa.

Nominal pressure difference (between main in/out lines): 120 kPa with 25/75% (volume) coolant solution, 150 kPa with 50/50% (volume) coolant solution. This must be taken into account when determining the size of the liquid cooling circuit.

Maximum pressure difference (between main in/out lines): 200 kPa

4.2.5 Coolant Flow Rate Limits

The maximum coolant flow rate for all drive equipment is 1.3 times the nominal values. For nominal values, refer to ["Table 4-2 " on page 40](#).

4.2.6 Cooling Circuit Materials

Materials used in the internal cooling circuit are listed below. These are also the only materials that can be used in the external cooling circuit.

- Stainless steel AISI 316L (UNS 31603)
- Heavy gauge aluminum
- Plastic materials, such as PA, PEX and PTFE
- Rubber gasketing NBR (nitrile rubber).

Note

PVC hoses are not suitable for use with antifreeze.

**Caution**

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

If the plant incorporates normal iron pipes or cast iron accessories (eg. motor housings), a cooling unit with a heat exchanger must be used to separate the systems.

4.3 Filling Up and Bleeding the Internal Cooling Circuit

Both the drive and coolant must be at room temperature before filling up the cooling circuit.

**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.
 - In filling up the system, the drain valves in the line-up are 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 bleed valve, which is instead installed at the top of the cabinet.
-

The steps are as follows:

1. Open the bleed valve at the cooling unit.
2. Open the inlet valve and the outlet-side drain valve of one cubicle. keep the outlet valve and the inlet-side drain valve closed.
3. Attach a hose to the outlet-side drain valve and lead it into a suitable container.
4. Fill the circuit with coolant.

5. As the piping and modules in the cubicle fills up, 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 cubicles in the line-up.
8. Open the inlet and outlet valves in all cubicles. Let any air remaining in the system out through the bleed valve at the cooling unit.
9. Close the exhaust valve at the cooling unit.
10. Continue to fill in coolant until a base pressure of 100 to 150 kpa is achieved.
11. Open the bleed valve of the pump to let out any air.
12. Re-check the pressure and add coolant if necessary.
13. Start the coolant pump. Let any air remaining in the system out through the bleed valve at the cooling unit.
14. After one to two minutes, stop the pump or block the coolant flow with a valve.
15. Re-check the pressure and add coolant if necessary.
16. Repeat steps 13 to 15 a few times until all air is let out of the cooling circuit. Listen for a humming sound and/or feel the piping for vibration to find out if there is still air left in the circuit.

4.4 Draining the internal cooling circuit

The modules in each cubicle can be drained through the drain valves without draining the whole internal cooling circuit.



Caution

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.

Take the following steps.

1. Attach hoses to each drain valve in the cubicle to be drained. Lead the hoses into a suitable container. Make sure the ends of the hoses are not immersed in coolant at any point so that 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:
 - a. Dry the cooling circuit with air
 - b. Fill the cooling circuit with 20% or 40% ethylene glycol solution
 - c. Drain the cooling circuit again.

5 Installation Flowchart

Mechanical Installation

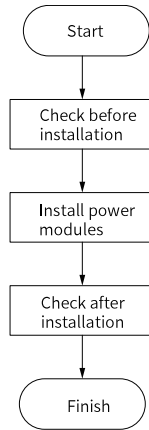


Figure 5-1 Mechanical installation flowchart

Electrical Installation

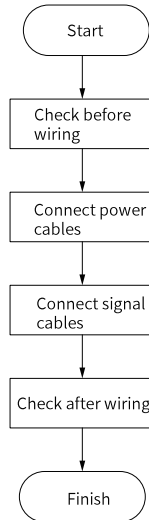


Figure 5-2 Electrical installation flowchart

6 Preparation

6.1 Installation Environment

Item	Requirements
Heat dissipation and ventilation	Install the module on flame retardant objects and screw the module on the mounting support. Reserve enough space around it to dissipate the heat generated during operation.
Installation site	Ensure the following requirements are met: • Avoid direct sunlight. • Avoid places with humidity above 95% and where condensation forms. • Avoid places with corrosive, flammable, and explosive gases. • Avoid places with greasy dirt and dust.
Vibration	Install the equipment in a place not prone to vibration. For vibration isolation performance, refer to section Technical Data in MD880LC-20M Series Basic Line Module Hardware Guide.
Ambient temperature	For derating coefficient, refer to section Derating in MD880LC-20M Series Basic Line Module Hardware Guide.
Enclosure	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.

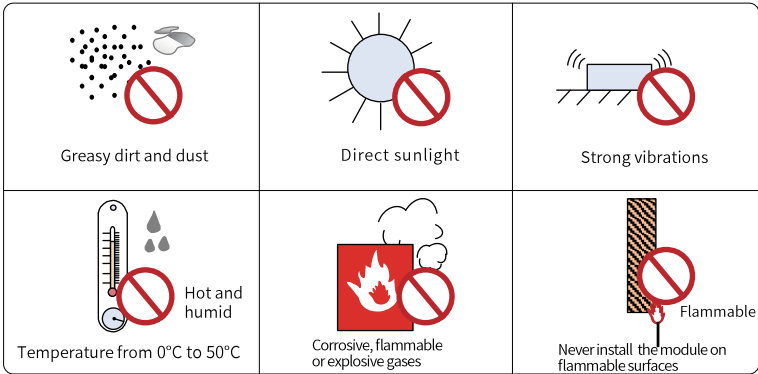


Figure 6-1 Environmental limits

6.2 Mounting Clearance

Proper clearance should be reserved for installing the module. The following figure shows the details.

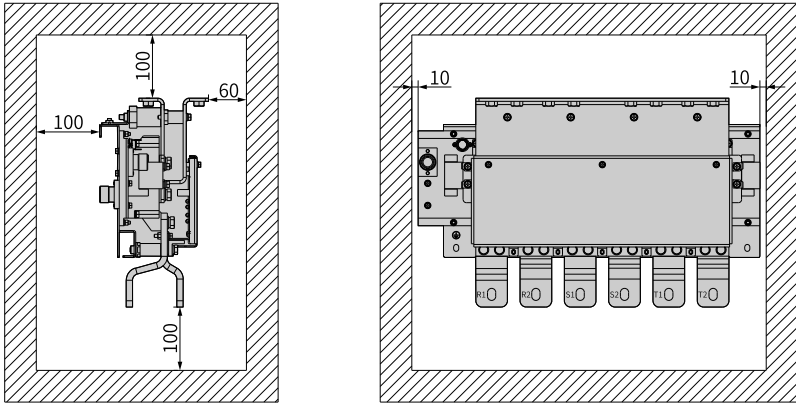


Figure 6-2 Module mounting clearance

Note

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

6.3 Installation Tools

The following tools are used for moving, attaching and fastening module.

- The forklift and pallet truck for moving the module around.
- The wrench or socket wrench with width across flats 10 for attaching the module.
- The wrench or socket wrench with width across flats 16/18 for cable or busbar connection.
- The slotted screw for signal wire connection.
- The open-end torque wrench with width across flats 32 for coolant pipe connection.

7 Unpacking and Transportation

7.1 Unpacking

7.1.1 Unpacking Precautions



- Upon receipt of the product, a thorough inspection shall be done.
 - Check that you have received all the items specified on the delivery note. Notify the shipping company of any missing components or damage. If you have any problems, contact Inovance office or the local agent for technical support.
-



- If product damage occurs during transportation, the electrical safety hazards may be created. Do not connect the equipment to any power sources before the high voltage test is performed.
 - Failure to comply with this warning may result in severe personal injury or death and/or property damage.
-

7.1.2 Unpacking Steps

1. Cut off the plastic straps or undo the screws of the box.
2. Lift off the box cover and sides.

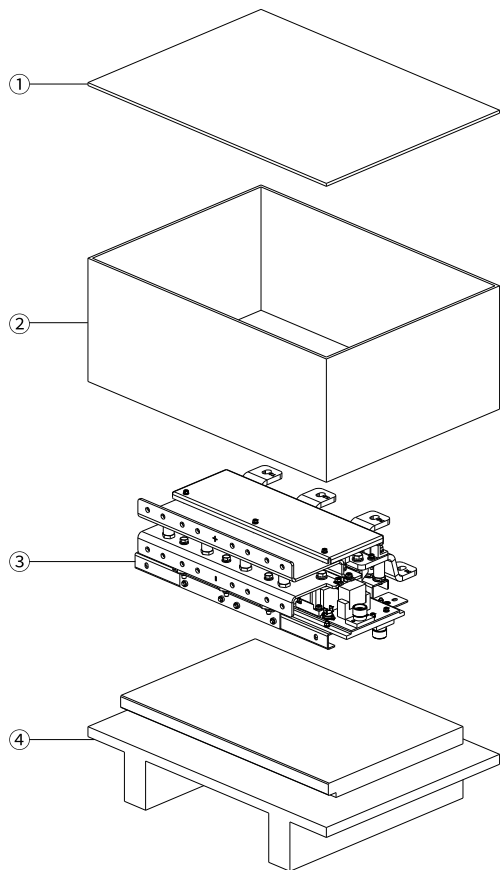


Figure 7-1 Transport package layout

No.	Notes
①	Box cover
②	Side plate
③	Basic line module
④	Wooden pallet

3. Cut open the plastic wrapping of the module.
4. Undo the four screws with which the module is attached to the plywood support.

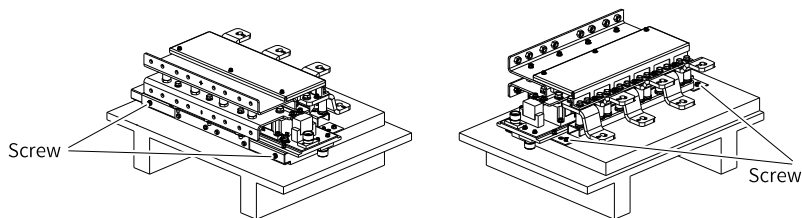


Figure 7-2 Module fixing screw

5. Lift off the module.
6. Check that there are no signs of damage.

7.1.3 Unpacking Checklist

Check that the model number is the same as your order. Examine the following items upon unpacking the module.

Table 7-1 Unpacking checklist

No.	Item	Yes
1	Outside surface shall be free from scratches, dents or any sign of damage.	☐
2	All optional parts are included in the delivery.	☐
3	The nameplate is consistent with your order.	☐
4	The warning label is free from blurs, scratches or any sign of damage.	☐

The module is well packed for storage or installation.

7.2 Storage Precautions

Store the module in a clean and dry place with the temperature kept between -40°C and $+70^{\circ}\text{C}$ and variation less than $1^{\circ}\text{C}/\text{min}$. For long-term storage, appropriate measures (cover the product, for example) shall be taken to ensure the module is free from contamination and environmental factors.

For storage of the equipment, pay attention to the following two aspects:



- Never place the module in an area of damp, high temperature or excess sunlight exposure.
- If the storage temperature is lower than 0°C , drain the internal coolant.

7.3 Transportation

7.3.1 Handling Precautions



Caution

- Move the transport crate on a wooden pallet to the installation site by trained personnel.
- All handling equipment must have a load capacity that is greater than the combined weight of the module.

7.3.2 Handling Before Unpacking

Move the transport crate with a forklift to the installation site.

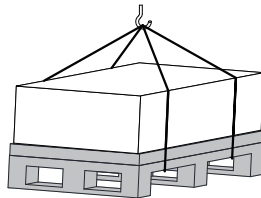
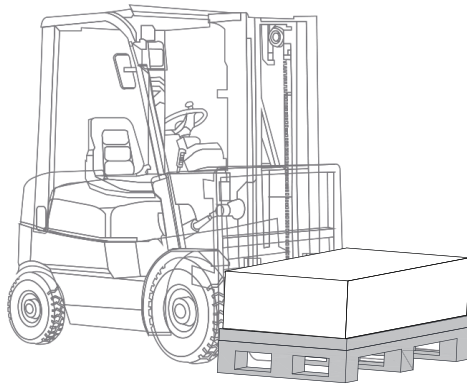


Figure 7-3 Handling before unpacking

7.3.3 Handling After Unpacking

The module is of light weight and you can move it by hand after unpacking.

8 Mechanical Installation

8.1 Safety Information



Danger

- To ensure the equipment is reliable and safe to use, it must be properly installed and operated by qualified personnel in accordance with all the warning notices and safety instructions.
 - Failure to comply with this warning may result in severe personal injury or death and/or property damage.
-



Caution

- The cabinet frame must be sturdy enough to carry the weight of the drive components, control circuitry and other equipment installed in it.
 - The cabinet must protect the module against contact and meet the requirements for dust and humidity.
 - For easy installation, a spacious layout is recommended. Sufficient cooling air flow, obligatory clearances, cables and cable support structures all require space. The control boards must not be installed near main circuits or hot parts.
 - Make sure any cross-members or shelves on which components are mounted are properly grounded and the connecting surfaces left unpainted. Ensure that the module is grounded to the PE busbar of the cabinet via its fastening screws.
 - Ensure that the module is grounded to the PE busbar of the cabinet via its fastening screws.
 - Nickel-plated copper is recommended.
 - If there is a risk of condensation in the cabinet, use a cabinet heater. Although the primary function of the heater is to keep the air dry, it may also be required for heating at low temperatures. When placing the heater, follow the instructions provided by its manufacturer.
 - Care should be taken when installing coolant pipes. Check for correct pipe installation and ensure no leaks occur.
-

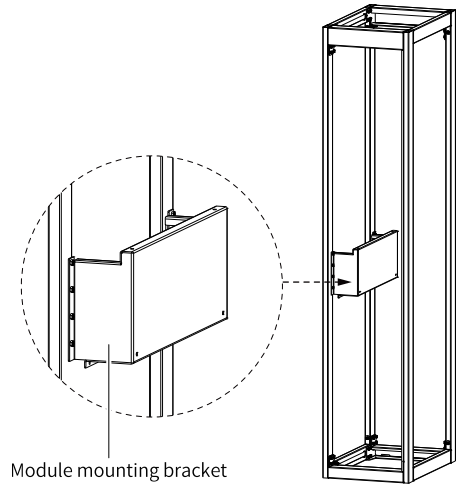
8.2 Checklist Before Installation

If any items in the checklist below are within the scope of supply, please tick the corresponding columns on the right. After the installation is completed, please tick each work step for confirmation.

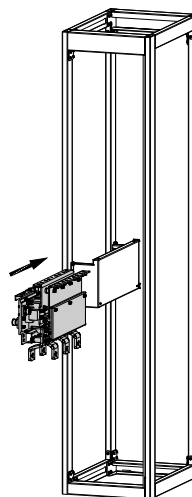
No.	Item	Yes
1	Check to ensure the packaging holding the device is not damaged or wet.	☐
2	After unpacking, check that the module enclosure is free from peculiarities, such as deformation, flaking paint, cracks and signs of damp.	☐
3	Check for complete accessories and items inside.	☐
4	The space around the module shall meet the minimum requirements for installation and easy flow of cooling air.	☐
5	Before commissioning, ensure that appropriate measures are taken to protect the module.	☐

8.3 Installing the Power Module

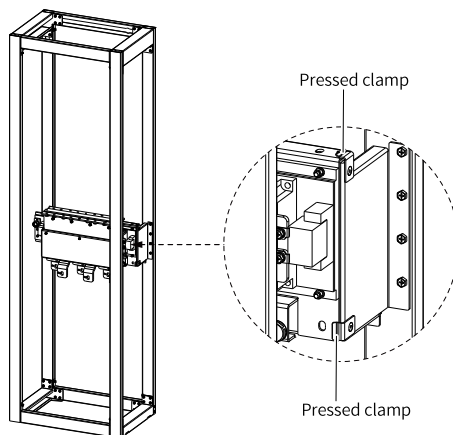
1. Design the module mounting bracket in the cabinet.



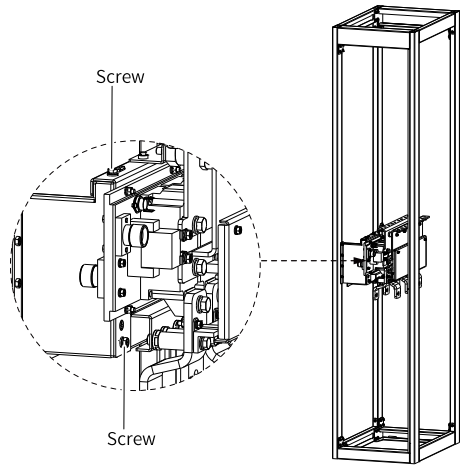
2. Push the module carefully into the cabinet along the metal guide rail.
-



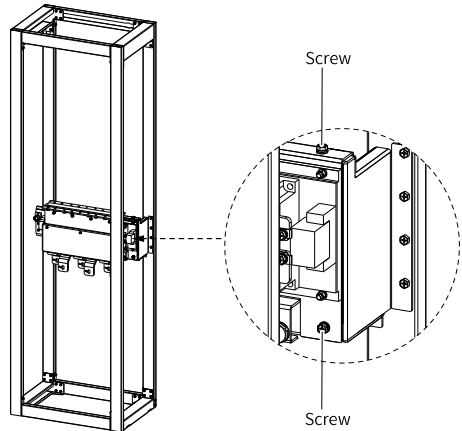
3. Use pressed clamps on the back side of the module.
-



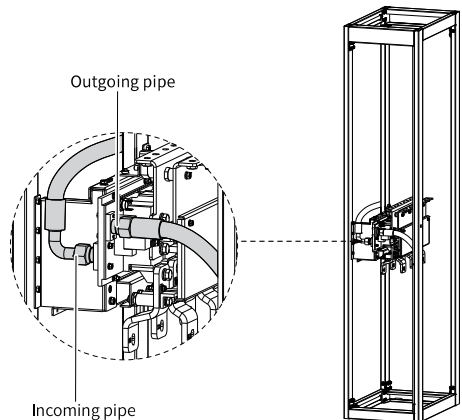
4. Use screws on the front side.
-



5. With spacious layout, the back side can also be fixed with screws.
-



6. Install incoming and outgoing pipes.
-



8.4 Checklist After Installation

After installation, you must go through the following items to avoid equipment damage or property loss.

Table 8–1 Checklist after installation

No.	Item	Yes
1	The drive cabinet is attached to the floor. For vibration and other considerations, it can be fastened to the wall or roof if necessary.	☐
2	The drive module is fastened properly to the cabinet.	☐
3	There are no tools, foreign objects or dust from drilling inside the cabinet.	☐
4	The coolant connections between cubicles (if any) are tight.	☐
5	Cabinet shrouds are in place and doors are closed.	☐

9 Electrical Installation

9.1 Safety Information



Caution

- The product is often used in high-voltage industrial applications. It contains live and rotating components. Therefore, there is a risk of severe injury or significant property damage if covers are removed without authorization during operation, if it is used or operated incorrectly, or if it has not been properly maintained.
 - When carrying out electrical work, the following five safety rules must always be observed:
 - Disconnect the equipment from power supply.
 - Make sure that reconnection is not possible.
 - Ensure that there is no voltage on the drive power terminals.
 - Make sure that the equipment is properly grounded.
 - Cover adjacent live parts or isolate them before starting work.
-

9.2 Checks Before Wiring

Take necessary measures when performing electrical installation to ensure safety. Be sure to obey the following rules.

- The equipment is operated with high voltages. All connection work must be carried out in a no-voltage condition.
- All work on the device must be carried out by qualified personnel only.
- Work on a disconnected device must be carried out with extreme caution because external supply voltages may be present. The power and control terminals may be live even when the equipment is not running.
- Dangerously high voltage levels are still present in the device up to 15 minutes after it has been disconnected due to the DC-link capacitors. For this reason, the unit should not be opened until the voltage is close to 0 V.
- The operator is responsible for ensuring that the motor, cabinet, and other components are installed and connected in accordance with the recognized technical rules in the country of installation and with applicable regional guidelines. Special attention should be paid to cable dimensioning, fuses, grounding, shutdown, disconnection, and overcurrent protection.
- If a protective device trips in a branch circuit, a fault current may have been interrupted. To reduce the risk of fire or an electric shock, the current-conducting parts and other components in the unit should be inspected and damaged parts

replaced. When a protective device trips, the cause of the trip must be identified and rectified.

9.3 Cable Connection of the Module

Terminals

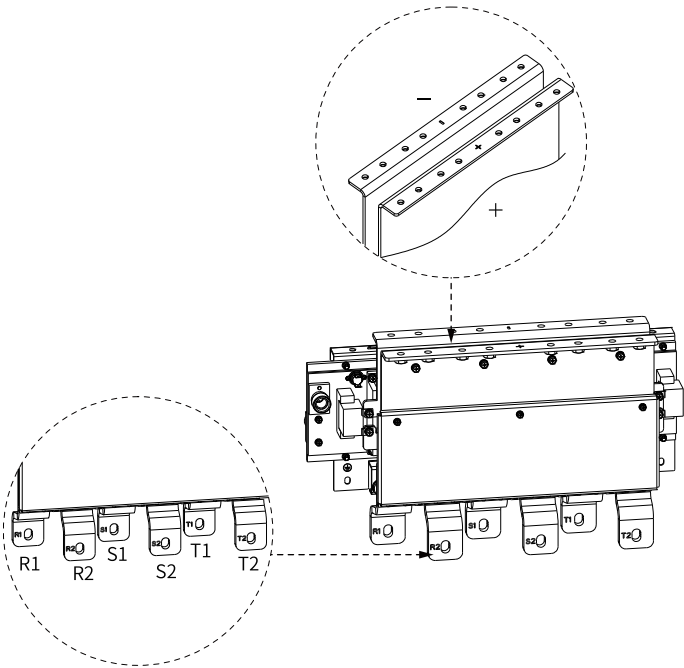


Figure 9-1 Main circuit terminal arrangement

No.	Terminal	Function
R1, R2, S1, S2, T1 and T2	Three-phase power input terminals	Three-phase AC power input connection
+ and -	DC bus terminals	DC power output connection

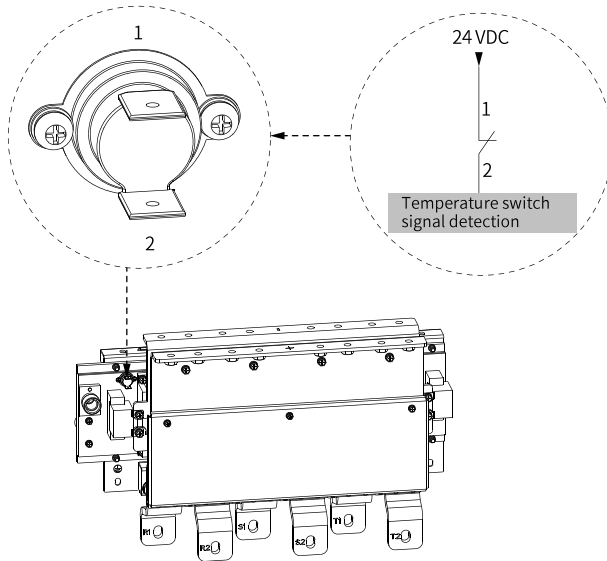


Figure 9-2 Arrangement of control circuit terminals

Table 9-1 Control circuit terminal description

Terminal	Name	Function
1	NC contact switch connection 1	Temperature signal detection 1
2	NC contact switch connection 2	Temperature signal detection 2

Wiring Steps

1. Temperature detection terminal: Connect one end of basic line module terminals 1 and 2 to the specialized crimped cables with the other end connecting 24 VDC power supply and the temperature detection module.
2. Connect the cable to the output terminals. Ensure that you connect conducting wires in the right sequence of R1, R2, S1, S2, T1 and T2.
3. Select proper power cables according to the load and fix them on the cable rack.
4. When shielded power cables are used, the shield must be secured to the shielding plate in an EMC-compliant manner.

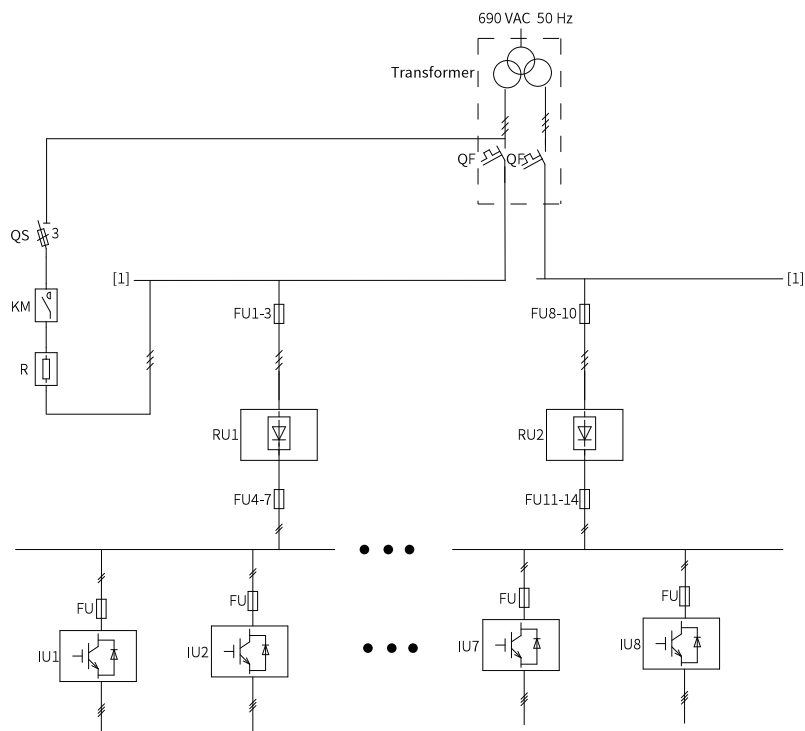


Figure 9-3 Basic line module components

Note

[1]: The input AC cabling has to be identical (length and cross-sectional area) between all the parallel-connected modules. The input AC cable shall have a minimum length of 5 m.

9.4 Tightening Torque of Fasteners

Table 9-2 Electrical connections

Size	Strength class	Max. torque (N · m)
M3	4.8	0.5
M4	4.8	1.2
M5	4.8	2.8
M6	4.8	4.8
M8	8.8	20
M10	8.8	40

Size	Strength class	Max. torque (N·m)
M12	8.8	70
M16	8.8	180

Table 9-3 Cable lugs

Size	Strength class	Max. torque (N·m)
M8	8.8	15
M10	8.8	32
M12	8.8	50

9.5 Wiring Checklist

After the completion of electrical installation work, check the key items listed in the following table. Read ["9.1 Safety Information" on page 57](#) and ["9.2 Checks Before Wiring" on page 57](#) before carrying out any work on the unit.

No.	Item	Completion or not
1	The input power and motor cables are connected and the correct voltage is supplied.	☐
2	The auxiliary power provides the correct voltage.	☐
3	For strain relief, the cables must be clamped on the cable rack.	☐
4	The cables are properly connected with the required torque to the terminals provided.	☐
5	When EMC shielded cables are used, the cable shield must be secured to the shielding plate to ensure EMC compliance.	☐
6	For the modules in parallel output connection with the DC bus, ensure that the connection is correct.	☐
7	The control cables must be shielded and connected properly. To prevent interference, the control cables must be laid out separately from the power cables. Cabling and connections must always comply with the relevant EMC directives.	☐

10 Parts Replacement

10.1 Overview

For the cabinet design, refer to MD880LC-20M Series Basic Line Module Hardware Guide. This section describes the components that need to be replaced during maintenance and repair. The other components are not subject to wear normally and thus are not described here.

10.2 Maintenance Tools

The following tools may be required during maintenance and part replacement.

- Wrench or socket wrench with width across flats 6.
- Wrench or socket wrench with width across flats 8.
- Wrench or socket wrench with width across flats 10.
- Wrench or socket wrench with width across flats 12.
- Wrench or socket wrench with width across flats 16.
- Wrench or socket wrench with width across flats 18.
- Open-end wrench with width across flats 32.
- Torque wrench
- Phillips screwdriver size 1/2.
- A socket wrench kit with two extension rods is recommended.

10.3 Safety Information

These electrical safety precautions are for all personnel who do maintenance and repair work.

1. Ask the person in control of the electrical installation work for a permit to work.
2. Clearly identify the work location and equipment.
3. Disconnect all possible voltage sources. Make sure that re-connection is not possible. Lock out and tag out.
 - a. Open the main disconnecting device of the drive.
 - b. Open the disconnecter of the supply transformer.
 - c. If you have a permanent magnet synchronous motor connected to the drive, disconnect the motor from the drive with a safety switch or by other means.
 - d. Disconnect any dangerous external voltages from the control circuits.
 - e. After you disconnect power from drive, always wait at least 15 minutes to let the DC bus voltage be close to 0 V before you continue.
4. Protect any other energized parts in the work location against contact.
5. Take special precautions when working near bare wires.
6. Measure that the installation is de-energized. Measure that the installation is de-energized. If the measurement requires removal or disassembly of shrouding or

other cabinet structures, obey the local laws and regulations applicable to live working (including – but not limited to – electric shock and arc protection).

- Make sure that the voltage between the drive input power terminals (R, S, T) and the grounding (PE) busbar is close to 0 V.
- Make sure that the voltage between the drive output terminals (U, V, W) and the grounding (PE) busbar is close to 0 V.
- Make sure that the voltage between the drive DC busbar (+ and -) and the grounding (PE) busbar is close to 0 V.

7. Install temporary grounding as required by the local regulations.



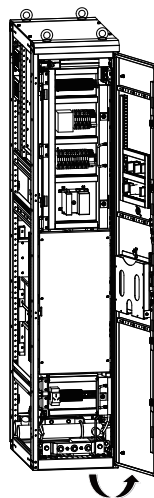
Danger

- Be aware that the basic line module is operated with high voltage.
 - All maintenance and repair must be done only after the module is de-energized.
 - Only trained personnel can perform the work. Failure to comply may result in severe injury, death, or property damage.
 - Because voltage of external power supply may exist, be careful when maintaining and inspecting the open cabinets. Even when the motor does not rotate, the power supply and terminals may be energized.
-

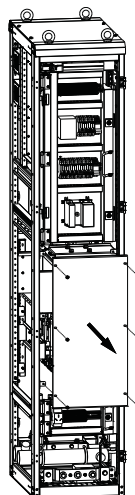
10.4 Replacing the AC Fuse

1. See ["10.3 Safety Information" on page 62](#) and follow the electrical safety precautions before you start the work.
-

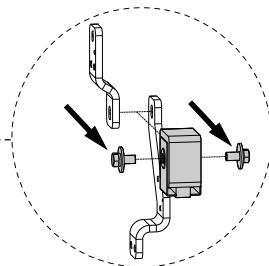
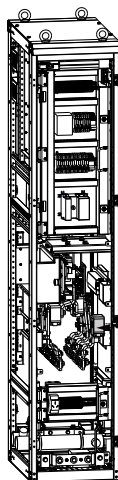
2. Open the cabinet door.
-



3. Undo the six M6 screws and remove the shroud.
-

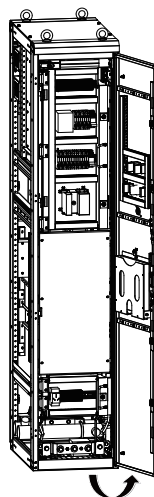


4. Undo the two M12 screws and pull out the AC fuse.
5. Check the condition of the fuse. If the fuse burns out, replace all fuses and tighten the screw with $40\text{N} \cdot \text{m}$.
6. Install the shroud in the reverse order and close the cabinet door.

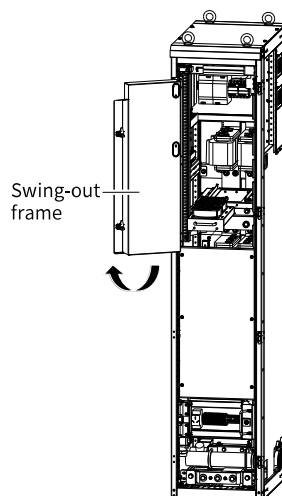


10.5 Replacing the Cabinet Fan

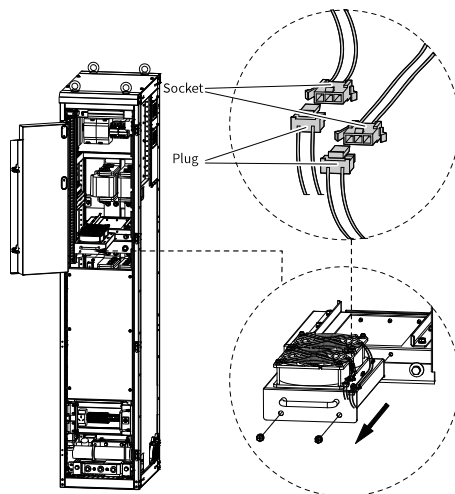
1. See ["10.3 Safety Information" on page 62](#) and follow the electrical safety precautions before you start the work.
2. Open the cabinet door.



3. Open the swing-out frame.
-

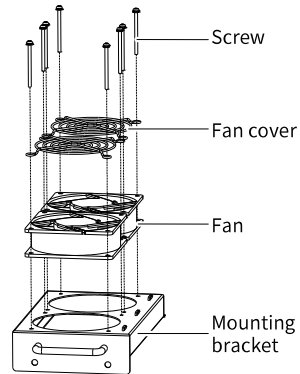


4. Disconnect the fan wiring, undo the two M6 screws and pull the fan out in the direction indicated by the arrow.
-



5. Undo the eight M4 screws.
-

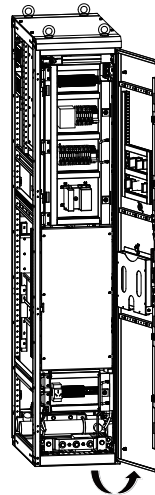
6. Replace the fan and install in reverse order.
-



10.6 Replacing the DC Fuse

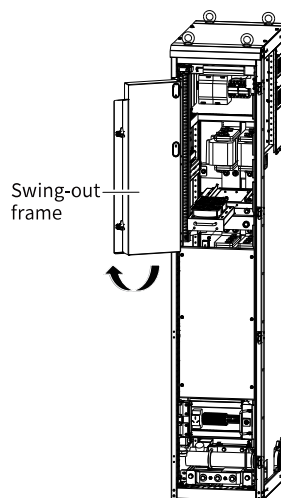
1. See ["10.3 Safety Information" on page 62](#) and follow the electrical safety precautions before you start the work.
-

2. Open the cabinet door.
-



3. Open the swing-out frame.
-

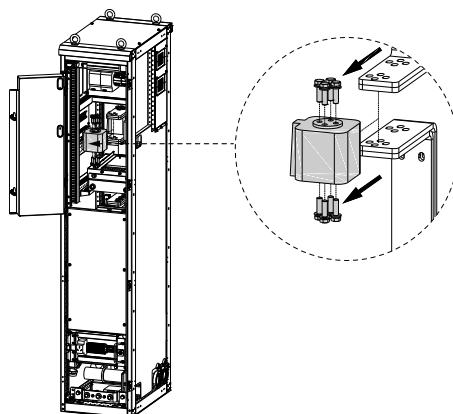
4. Pull out the fan and see ["10.5 Replacing the Cabinet Fan" on page 65](#).
-



5. Undo the 8 M10 screws and pull out the DC fuse in the direction indicated by the arrow.
-

6. Check the condition of the fuse. If the fuse burns out, replace all fuses and tighten the screws with $20\text{N} \cdot \text{m}$.
-

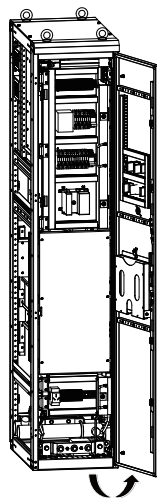
7. Install the fan and close the swing-out frame and cabinet door.
-



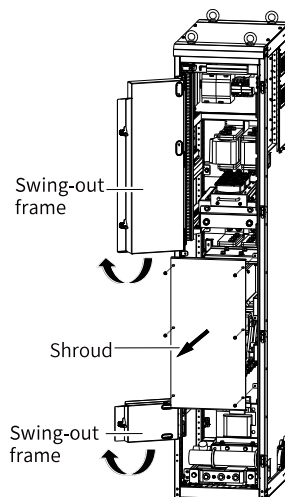
10.7 Replacing the Basic Line Module

1. See ["10.3 Safety Information" on page 62](#) and follow the electrical safety precautions before you start the work.
-

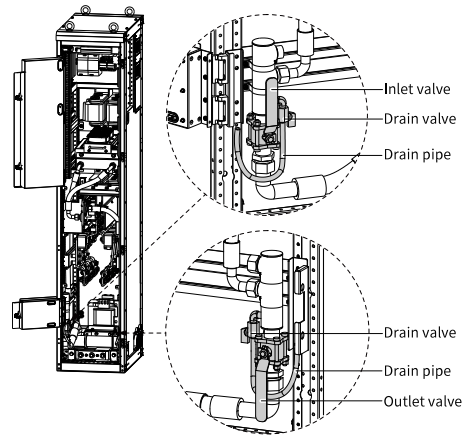
2. Open the cabinet door.
-



3. Undo the six M6 screws of the swing-out frame, open the swing-out frame and remove the shroud.
-

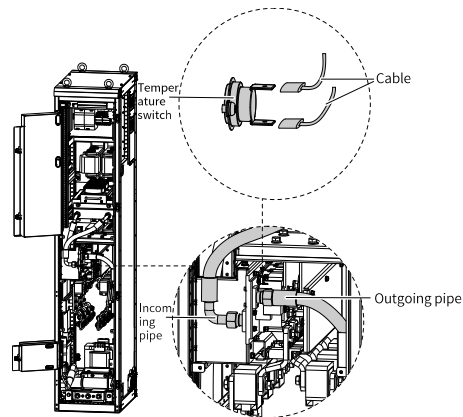


4. Close the inlet and outlet valves. Attach a hose to the drain valve and lead the hose into a suitable container.
-

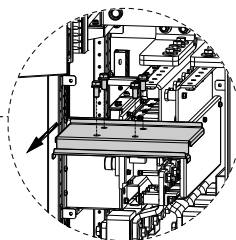
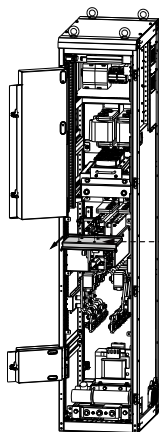


5. Open the drain valves located behind the inlet and outlet valves. Make sure the ends of the hose are not immersed in coolant at any point so that air can displace the coolant in the system. Wait until all coolant has drained.
-

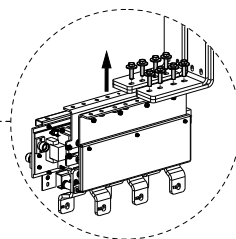
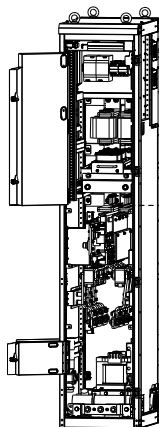
6. Disconnect the coolant pipes of the module to be removed. Disconnect the wiring of the temperature switch.
-



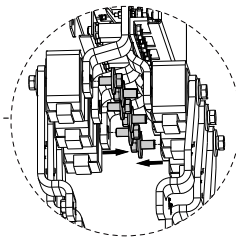
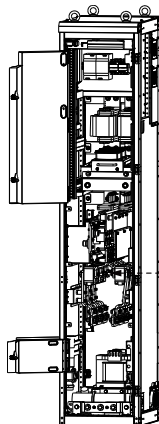
7. Undo the four M10 screws of the module and remove the shroud.
-



8. Undo the eight M10 screws of the module DC copper busbar.
-

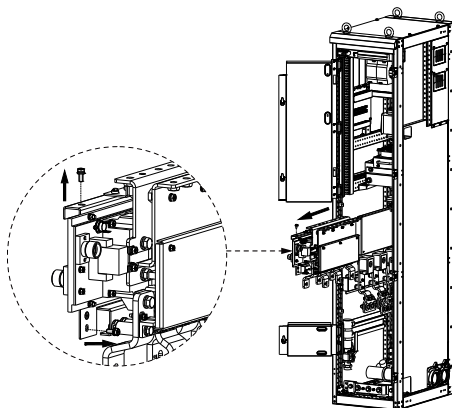


9. Undo the six M12 screws of the module AC copper busbar.
-



10. Undo the two M6 screws of the module that are located in the front and remove the module.
-

11. Install the new module in reverse order.
-



11 Maintenance and Inspection

11.1 Daily Inspection

No other available electrical components need to be inspected for possible wear or damage except the cabinet fan.

11.2 Precautions on Cleaning

The purpose of cleaning is to keep the device in the specified running state. Thus remove the dust and contamination periodically.



- Dust buildup inside the module must be cleaned by authorized personnel regularly in compliance with the safety regulations. Clean up the interior of the module at least annually. Increase the frequency of cleaning if necessary.
 - Use a vacuum cleaner and a soft brush. For areas that cannot be easily reached, use dry compressed air (max. 1 bar) for cleaning.
-

11.3 Precautions Before Maintenance and Repair



- After you disconnect power from drive, always wait at least 15 minutes to let the DC bus voltage be close to 0 V before you continue. Otherwise, the residual charge on the capacitor will cause injury.
 - When external power supply is connected, hazardous voltage is still present even if the main circuit breaker is open.
 - The fan has a tendency to continue its circular motion even after it is switched off due to the inertia of motion.
-

11.4 Precautions During Maintenance and Repair



- Carry out the work only after you de-energize and cool off the module.
 - Follow standard safety precautions and local codes during installation and wiring. The tools you use must meet the voltage withstand requirements and the housing must be well grounded.
 - Residual voltage is still present in the cabinet even after you switch off the input circuit breaker. Check that no voltage exists before maintenance or repair.
 - Be careful with measurement inside the cabinet. Never touch the multimeter probes together or touch the other terminals by the probes.
 - Only qualified personnel can inspect and maintain the module.
-

12 CE Certification

12.1 Important Notes on EU Standards Compliance



Figure 12-1 CE marking

- The CE marking certifies that a product has met EU health, safety and environment requirements, which ensure consumer safety. Manufacturers in the European Union (EU) and abroad must meet CE marking requirements where applicable in order to market their products in Europe.
- It is required for products manufactured anywhere in the world that are then marketed in the EU .
- This product is labeled with CE mark, compliant with Low Voltage Directive (LVD), Electromagnetic Compatibility (EMC) Directive and Environmental Protection (RoHS) Directive.
- Machines and devices integrated with this product must also meet CE requirements when sold in Europe.
- It is the responsibility of the end user of the product to ensure the machines the product to be used for comply with the CE standard and to affix the CE marking.

12.2 EMC Directive Compliance

This product complies with European EMC Directive 2014/30/EU and can be used for First Environment and Second Environment defined in 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.

For better EMC performance, install input EMC filter and use output shielded cable. Ensure the filter is well grounded and that the cable has large-area 360° shielding.



Caution

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.

Specification

See the following table for the maximum length of motor cable allowed by conducted and radiated interference.

Table 12-1 Maximum motor cable length allowed for conducted and radiated interference

Product model	Maximum cable length allowed for conducted interference				Maximum cable length allowed for radiated interference			
	C1		C2		C1		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 type	-	10 m	-	25 m	-	-	-	25 m
Three-phase type	-	-	-	50 m	-	-	-	50 m

EMC Standard

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 two requirements:

- The electromagnetic interference produced by the equipment during a normal operation in its environment shall not exceed 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 two types of 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.

Four categories fit within the two environments:

- Category C1 equipment: Power drive system (PDS) of rated voltage less than 1000 V, 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.

12.3 CE LVD Low Voltage Directive Compliance

This product has been tested according to EN61800-5-1, and it complies with the Low Voltage Directive. To ensure machines or devices that the product is installed in as a whole comply with the Low Voltage Directive, be sure to meet these requirements as described below.

Installation Site

Install this product in line with the IEC 60664-1 overvoltage level III and pollution degrees 2/3/4.

Installation Environment

Refer to MD880-20M Series Basic Line Module Installation Guide.

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 sides.

Wiring Requirements on the Main Circuit

Refer to ["2.3.3 Wiring Requirements on the Main Circuit" on page 28](#).

Protective Devices

To comply with EN 61800-5-1, use fuse/circuit breaker on the input side to prevent accidents caused by short circuit. See ["2.1.2 Selection of Fuse" on page 20](#) for recommended fuse/circuit breaker selection.

13 Ordering Instructions

This chapter lists the model and order No. of the basic line module.

Table 13-1 Ordering Instructions

Model	Frame	Order No.	Notes
MD880LC-20M-2000-7	D3D	MD880LC-20M-2000-7	Basic line module
MD880LC-20M-3720-7	2 x D3D	MD880LC-20M-3720-7	Basic line module



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