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MD600 Series Basic AC Drive

Hardware Guide

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

Data code 19012234B01

Preface

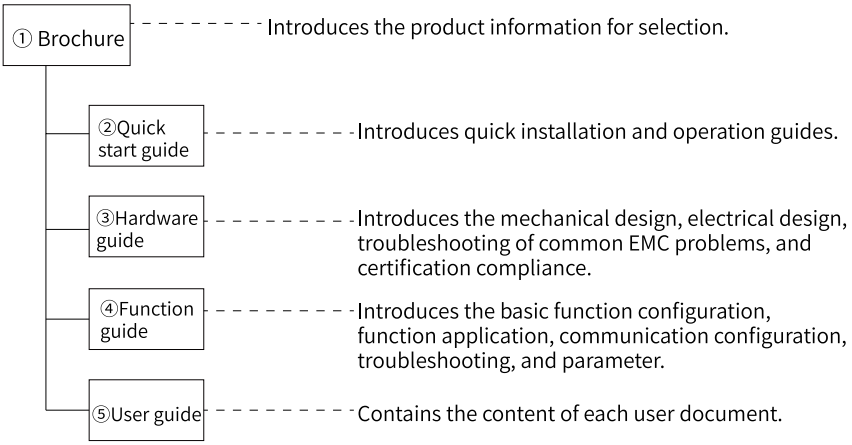
About This Guide

The MD600 series is a basic general-purpose AC drive that is compact, easy to use, energy-saving, and harsh environment resistant. It is mainly used to control and adjust speed of three-phase AC asynchronous motors. The drive is suitable for industries such as the crystalline silicon, lithium battery, carpentry, logistics, food and beverage, cable, machine tool, and packaging.

This guide describes product selection, mechanical design, electrical design, common EMC problems and solutions, and product certifications and standards.

More Data

The following figure and table describe document codes and document introduction of the drive.



No.	Name	Document Code	Description
①	MD600 Series Basic AC Drive	19120393	This guide describes the product positioning, highlights, application scenarios, and selection specifications of the drive.
②	MD600 Series Basic AC Drive Quick Start Guide	19012337	This guide describes the installation and operation, common faults and troubleshooting, and parameter settings of the drive.
③	MD600 Series Basic AC Drive Hardware Guide	19012234	This guide describes product selection, mechanical design, electrical design, common EMC problems and solutions, and product certifications and standards.

No.	Name	Document Code	Description
④	MD600 Series Basic AC Drive Function Guide	19012238	This guide describes the basic function configuration, function application, communication configuration, troubleshooting, and parameters of the drive.
⑤	MD600 Series Basic AC Drive User Guide	PS00012434	This guide describes product selection, mechanical design, electrical design, quick installation and operation, function application, communication configuration, troubleshooting, common EMC problems and solutions, and product certifications and standards.

Revision History

Date	Version	Description
March 2024	B01	Added specifications related to 5.5 kW models. Added the MD-BP-M operating panel. Optimized descriptions of the vibration and shock resistance function in *"2.1 Installation Environment" on page 21*. Made minor corrections. Note: To support the MD-BP-M operating panel, the MD600 software version must be A2-22 = 60.02/A2-23 = 61.02/A2-24 = 0.28/A2-25 = 0.31 or later. If the current MD600 software version does not support the MD-BP-M, contact the service personnel of the manufacturer to upgrade the software.
December 2023	B00	• Optimized the document structure. • Compiled the system connection diagram and system composition table into one section *"1.5 System Connection" on page 18*. • Deleted the installation of the guide rail in *"2.3 Installation Tool Preparation" on page 22*. • Added *"2.5.2 EMC-Compliant Control Cabinet Design" on page 29*. • Added the internal circuit diagram in *" Electrical Wiring Diagram" on page 38*. • Complied the cable overview and cable handling into one section *" Cable Preparation" on page 39*. • Modified "3.3 Peripheral Electrical Component Design" to "Basic Electrical Safety Precautions" and optimized the content. • Updated the termination resistor in the CAN and RS485 communication topology diagram in "3.6 Communication Cable Selection". • Added *" Application Instance" on page 62*. • Updated electrical specifications, technical specifications, and option specifications in "4 Specifications". • Changed the IP rating from IP20 to IP40 (except for the power distribution wiring and capacitor ventilation) in *"4.3 Electrical Specifications" on page 67*. • Added relay specifications in *"4.4 Technical Specifications" on page 70*. • Made minor corrections.
June 2023	A00	Initial 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 http://www.inovance.com.
- Scan the QR code on the product with your smart phone.
- Scan the QR code below to install the app, where you can search for and download manuals.

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 period expires.

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

Table of Contents

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 in an environment that complies with the design specifications. Malfunction or component damage caused by improper usage 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 can 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.

General 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.
- The drawings in the guide are shown for illustration only and may be different from the product you purchased.
- 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 by following the unpacking sequence. Do not strike the package violently.
- Check whether there is damage, rust, or injuries 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 injury 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 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.

CAUTION

- 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 can 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 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 the equipment with other equipment or materials that may harm or have negative impacts on this equipment.

Installation

DANGER

- The equipment must be operated only by professionals with electrical knowledge. Non-professionals are not allowed.

WARNING

- 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 can 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 this product is installed in a cabinet or terminal equipment, protective 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 equipments with strong electromagnetic interference, such as a transformer, install a shielding equipment for the equipment to prevent malfunction.
- 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 on the 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

DANGER

- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Before wiring, cut off all the power supplies of the equipment, and wait for at least the time designated on the equipment warning label before further operations because residual voltage still exists after power-off. After waiting for the designated time, measure the DC voltage in the main circuit to ensure the DC voltage is within the safe voltage range. 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.

WARNING

- Do not connect the input power supply to the output end of the equipment. Failure to comply can 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.
- Ensure that the cables used for wiring meet the diameter, shielding, and other relevant requirements, and that the shielding layer of the shielded cables is reliably grounded at a single terminal.
- 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 an electric shock or equipment damage.

CAUTION

- Follow the proper electrostatic discharge (ESD) procedure and wear an anti-static wrist strap to perform wiring. Failure to comply may result in damage to the equipment or to the internal circuit of the product.
- Use shielded twisted pairs for the control circuit. Connect the shield to the grounding terminal of the equipment for grounding purpose. Failure to comply will 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.
- After power-on, do not open the cabinet door or protective cover of the equipment, touch any terminal, or disassemble any unit or component of the equipment. Failure to comply will 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 will result in a fire.
- Before power-on, check that no one is near the equipment, motor, or machine. Failure to comply may result in death or personal injuries.

Operation

- The equipment must be operated only by professionals. Failure to comply will 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 will 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 will result in an electric shock.
- Before maintenance, cut off all the power supplies of the equipment and wait for at least the time designated on the equipment warning label.
- In case of a permanent magnet motor, do not touch the motor terminals immediately after power-off because the motor terminals will 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 according to maintenance requirements and keep a maintenance record.

Repair

- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Do not repair the equipment with power ON. Failure to comply will result in an 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.

- Submit the repair request according to the 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 injury or equipment damage.
- When the equipment is faulty or damaged, the troubleshooting and repair work must be performed by professionals that follow the repair instructions, with repair records kept properly.
- Replace quick-wear parts of the equipment according to the replacement instructions.
- Do not use 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

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

Safety Labels

For safe equipment operation and maintenance, comply with the safety labels on the equipment. Do not damage or remove the safety labels. See the following table for descriptions of the safety labels.

Safety Label	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 10 min after power-off. Failure to comply will result in an electric shock.

1 Hardware Description

1.1 Product Overview

The MD600 series is a basic general-purpose AC drive that is compact, easy to use, energy-saving, and harsh environment resistant. It is mainly used to control and adjust speed of three-phase AC asynchronous motors. The drive is suitable for industries such as the crystalline silicon, lithium battery, carpentry, logistics, food and beverage, cable, machine tool, and packaging.

Figure 1-1 Product appearance

The AC drive has the following features:

- The drive supports installation by guide rail, which is easy to install. With the compact size, much space can be saved.
- The main circuit wiring terminal is pluggable and can be installed without any screw, which facilitates wiring, operation, and maintenance.
- The drive is equipped with independent air ducts and highly-reliable fans. Some models is naturally ventilated, which is easy to maintain.
- RS485, CANlink, and CANopen communication modes are supported.
- The drive supports high overload capacity of operation for 60s at 150% of the rated current.
- The drive is CE certified.

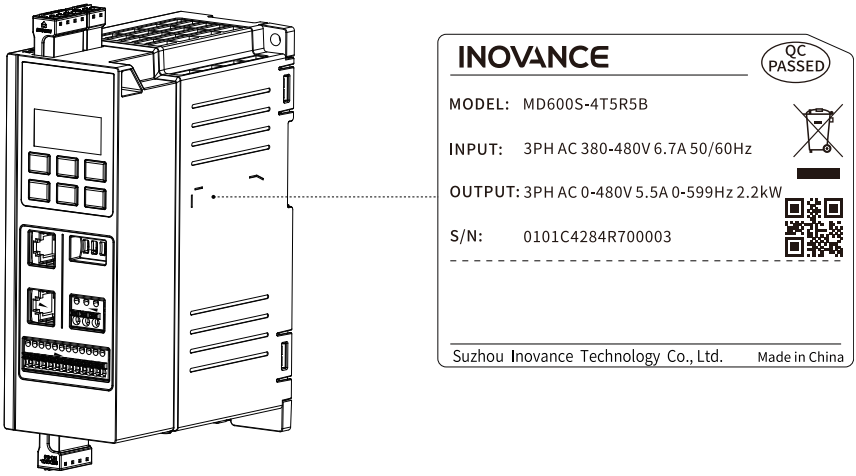
1.2 Model and Nameplate

Model description

MD600 ① S ② - 4T ③ 5R5 ④ B ⑤

①	**Product name** MD600: AC drive series	④	**Output current (A)** 1R6: 1.6 5R5: 5.5 ... 013: 13 Note: R represents the decimal point ".".
②	**Model** S: RS485 model A: CAN model	⑤	**Braking unit** B: with the braking unit Null: without the braking unit
③	**Voltage class (V)** 4T: three-phase 380 V to 480 V 2S: Single-phase 200 V to 240 V	-	

Nameplate



Serial number descriptions

0101C428 ① 4 ② R ③ 7 ④ 00003 ⑤

①	**Internal code** Product material code	④	**Month** 1: January 2: February 3: March ... C: December
②	**Manufacturer code** 4: Suzhou Inovance	⑤	**Lot number** 00001: First 00002: Second 00003: Third ... Range: 00001 to 99999
③	**Year** A: 2010 ... N: 2021 P: 2022 R: 2023 Note: I/L/O/Q is not used.	-	

1.3 Components

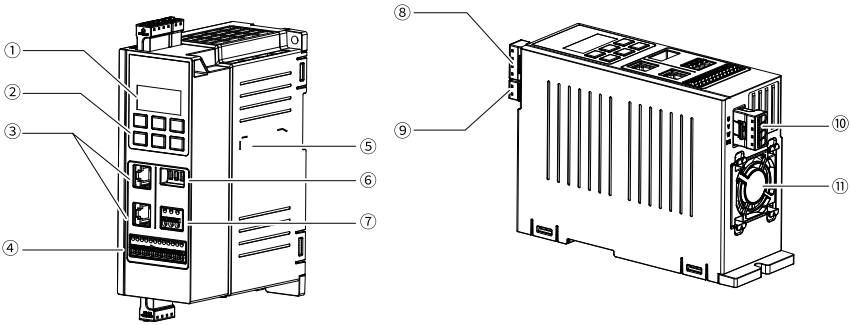


Figure 1-2 Product components

No.	Name	Description
①	LED display on the operating panel	It displays the axis number, status, unit, and data.
②	Keys on the operating panel	It is used for operations through the operating panel.

No.	Name	Description
③	Communication terminal (CN1/CN2)	-
④	Control circuit terminal (CN4)	It integrates the Modbus communication, analog input, analog output, digital input, digital output, +24 V power supply output, and +10V power supply output signals.
⑤	Nameplate	It displays the product information.
⑥	DIP switch for termination resistor	DIP switch for Modbus/CAN communication termination resistor
⑦	Relay terminal (CN3)	Relay output terminal
⑧	R (L1)/S/T (L2)/PE input terminals	It is used to connect three-phase/single-phase AC input power supplies. R/S/T terminals are used to connect the three-phase power supply. L1/L2 terminals are used to connect the single-phase power supply, and PE is the protective earthing terminal.
⑨	Braking terminal	It is used to connect the braking resistor.
⑩	U/V/W/PE output terminals	U/V/W terminals are used to connect the three-phase motor, and PE is the protective earthing terminal.
⑪	Fan	It is used for heat dissipation.

1.4 Product Model List

The following table lists mapping between the product model and structure.

Table 1–1 Relationship between the product model and structure (RS485 version)

Structure	Model (Three-Phase 380 V to 480 V)	Model (Single-Phase 200 V to 240 V)
T1	MD600S-4T1R6 MD600S-4T2R3 MD600S-4T4R8 MD600S-4T5R5B	MD600S-2S2R8 MD600S-2S4R6 MD600S-2S7R5B
T2	MD600S-4T9R5B MD600S-4T013B	MD600S-2S010B

Table 1–2 Relationship between the product model and structure (CAN version)

Structure	Model (Three-Phase 380 V to 480 V)	Model (Single-Phase 200 V to 240 V)
T1	MD600A-4T1R6 MD600A-4T2R3 MD600A-4T4R8 MD600A-4T5R5B	MD600A-2S2R8 MD600A-2S4R6 MD600A-2S7R5B
T2	MD600A-4T9R5B MD600A-4T013B	MD600A-2S010B

1.5 System Connection

When using the AC drive to drive an asynchronous motor, a variety of electrical components must be installed on both input and output sides to ensure system safety and stability. The following figure shows the system composition.

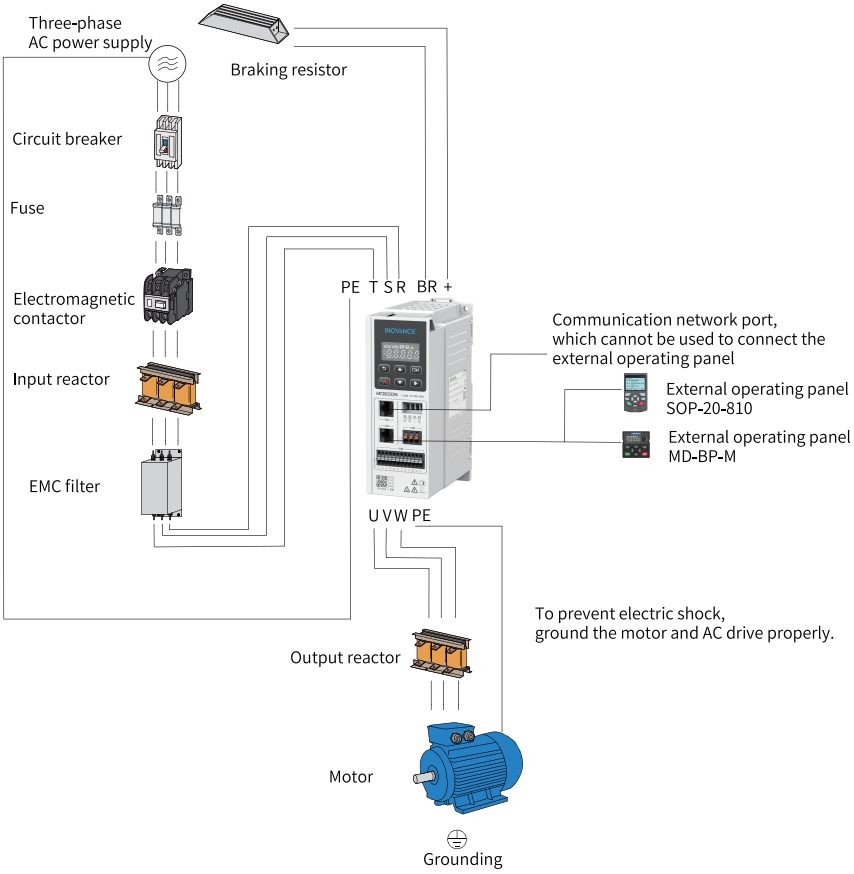


Figure 1-3 System connection

Table 1–3 Usage of peripheral electrical components

Name	Installation Position	Applicable Drive Model	Function
Circuit breaker	Input side of the drive, and between the power supply and the AC drive input side	All models	It is installed between the power supply and the AC drive input side. Circuit breaker for protection against short circuit: When overcurrent occurs on downstream devices, it cuts off the power supply to prevent incidents. Earth leakage circuit breaker (ELCB): The AC drive may generate high-frequency leakage current during running. To prevent electric shock or even a fire, install a proper ELCB based on actual applications.
Fuse	Input side of the drive	All models	It protects downstream semiconductor components in case of short circuit.

Name	Installation Position	Applicable Drive Model	Function
Electromagnetic contactor	Input side of the drive	All models	It is used to connect to or cut off the power supply of the AC drive. Do not use the contactor to power on or off the drive frequently (interval: at least one hour) or use the contactor to directly start the drive.
AC input reactor	Input side of the drive	All models	It provides the following functions: Improves the power factor on the input side. Eliminates high-order harmonics on the input side effectively and prevents damage to other devices caused by the distortion of voltage waveform. Eliminates input current unbalance caused by inter-phase unbalance.
EMC Filter	Input side of the drive	All models	It reduces the conduction and radiation interference generated by the AC drive to external devices.
Simple filter	Input side of the drive	All models	It provides the following functions: Reduces the conduction and radiation interference generated by the AC drive to external devices. Decreases conduction interference flowing from the power supply to the AC drive and improves the anti-interference capacity of the AC drive.
Braking resistor	Input side of the drive	All models	For an AC drive with the model name containing letter B, it has the built-in braking unit. After the braking resistor is connected to the braking unit, the braking resistor consumes regenerative energy during motor deceleration.
Output reactor	Output side of the drive	All models	Generally, the AC drive generates much high-order harmonics on the output side. When a motor is far away from the AC drive, much distributed capacitance exists in the circuit. Certain harmonics may cause resonance in the circuit, which brings the following adverse effects: • Degrades the motor insulation performance and damages the motor in the long run. • Generates large leakage current and causes frequent AC drive protection trips. The output reactor can protect motor insulation and reduce bearing current, prolonging the service life of the motor.
Magnetic ring and ferrite clamp	Output or input side of the drive	All models	Installing the magnetic ring on the input side can suppress the noise in the input power supply system of the drive. When it is installed on the output side, it can reduce the interference generated by the drive to external devices and lower the bearing current.
	Signal cable	All models	It improves the anti-interference performance of signals.
Motor	Output side of the drive	All models	Select an applicable motor.
External operating panel	Connect the external operating panel to the CN2 port.	All models	LCD operating panel SOP-20-810 and LED operating panel MD-BP-M.
Note: For selection of peripheral electrical devices, see "Option Specifications".			

2 Mechanical Design

2.1 Installation Environment

Table 2–1 Environmental requirements

Environment	Condition
Installation location	Indoors without direct sunlight, dust, corrosive gas, combustible gas, oil mist, water vapor, drip, or salt
Overvoltage category of the power grid	Overvoltage category III
Temperature	Installation/Ambient temperature: –10°C to +50°C. When the temperature ranges from –10°C to +40°C, no derating is required. For temperature above 40°C, derate 1.5% for every additional 1°C. Storage/Transportation temperature: -20°C to +60°C. • For better reliability, use the AC drive in places without drastic temperature changes. • When installing the drive into an enclosed environment such as a control cabinet, use a cooling fan or air conditioner to keep the temperature of the inlet air below 50°C. Failure to comply will result in overheat or fire. • Install the AC drive on a flame-retardant surface, with sufficient clearance reserved for heat dissipation. • Take measures to prevent the AC drive from being frozen.
Humidity	< 95% RH, without condensation
Environment	Pollution degree 2 or below Install the drive in a place that meets the following requirements: • Free from direct sunlight, dust, corrosive gas, combustible or explosive gas, oil mist, water vapor, drip, or salt • Not prone to vibration and away from equipment that may generate strong vibration, such as a punch press • Free from unwanted objects such as metallic dust, oil, and water that may enter the AC drive • Free from radioactive materials, combustible materials, and hazardous gas and liquid, and salt corrosion • Away from combustible materials such as wood
Altitude	• 1000 m and below: no derating. • For altitudes above 1000 m, derate 1% for every additional 100 m. The maximum altitude is 2000 m. If the altitude is higher than 2000 m, consult your Inovance agent or sales personnel.

Environment	Condition
Vibration resistance	• Usage scenario: Test according to IEC 60068-2-6. Amplitude at 5 Hz to 8.4 Hz: 3.5 mm; acceleration at 8.4 Hz to 200 Hz: 1 g; 10 cycles/axis • Transportation scenario: Test according to IEC 60068-2-64. Power spectrum density at 5 Hz to 100 Hz: 0.01 g^2/Hz; power spectrum density at 200 Hz: 0.001 g^2/Hz; Grms: 1.14 g
Shock	Usage/transportation scenario: Test according to IEC 60068-2-27. Acceleration: 15 g; pulse width; 11 ms; 18 times in directions of three axes

2.2 Installation Direction

Install the AC drive upright, as shown in the following figure. Do not lie the AC drive on its back or side, or install it in the upside-down direction.

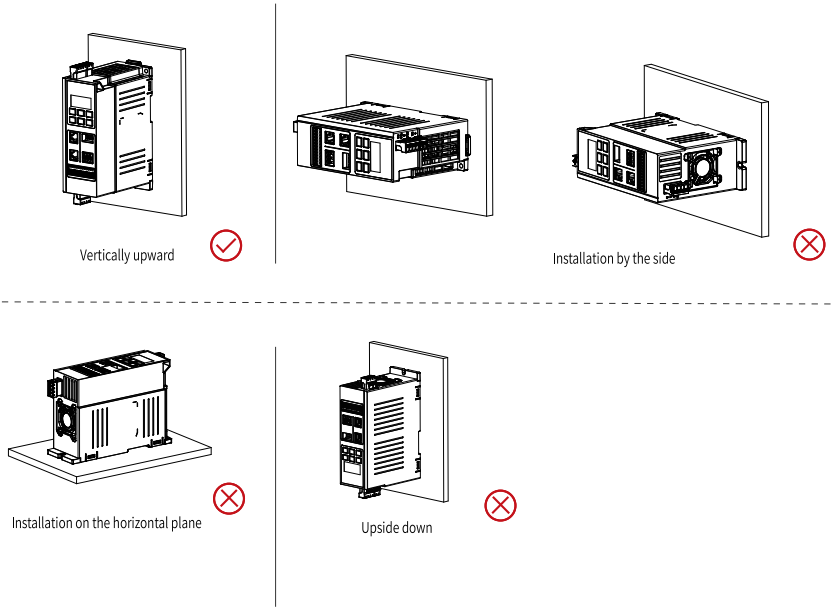


Figure 2-1 Installation direction

2.3 Installation Tool Preparation

Mechanical installation tools

"Table 2–2 Tools for mechanical installation" on page 23 lists the tools for mechanical installation.

Table 2–2 Tools for mechanical installation

Tool	Description
Electric drill with appropriate drilling bits	It is used to drill mounting holes on the mounting surface.
Phillips screwdriver and straight screwdriver (2.5 mm to 6 mm)	It is used to tighten or loosen screws.
Caliper or tape measure	It is used to measure the installation dimensions of the equipment.
Gloves	They are used to prevent static electricity during mechanical installation.
Screw	It is used to fix the equipment to the mounting surface.
Rail bracket	It is used to fix the drive onto the rail bracket.

Screw

"Table 2–3 Specifications and quantity of screws" on page 23 lists the specifications and quantity of screws required for mechanical installation.

Table 2–3 Specifications and quantity of screws

Installation Mode	Screw Specification	Quantity (Unit: PCS)	Description
Backplate mounting	M4x12 cross recessed pan head SEMS screws (with flat washer and spring washer)	2	Used to fix the drive onto the wall

Tools for wiring

When wiring the main circuit terminal, select an appropriate installation tool based on the terminal size.

Table 2–4 Wiring tools for main circuit terminals

Model	Recommended Fastener	Tool
T1 to T2	Terminal	Cable stripper and cable pliers

2.4 Cabinet Design

2.4.1 Cabinet Layout

Reserve sufficient clearance according to the power rating of the AC drive. The recommended installation methods of the MD600 include single-layer installation and multi-layer installation.

- When only a single device is installed, reserve sufficient clearance around the device, as shown in the following figure.

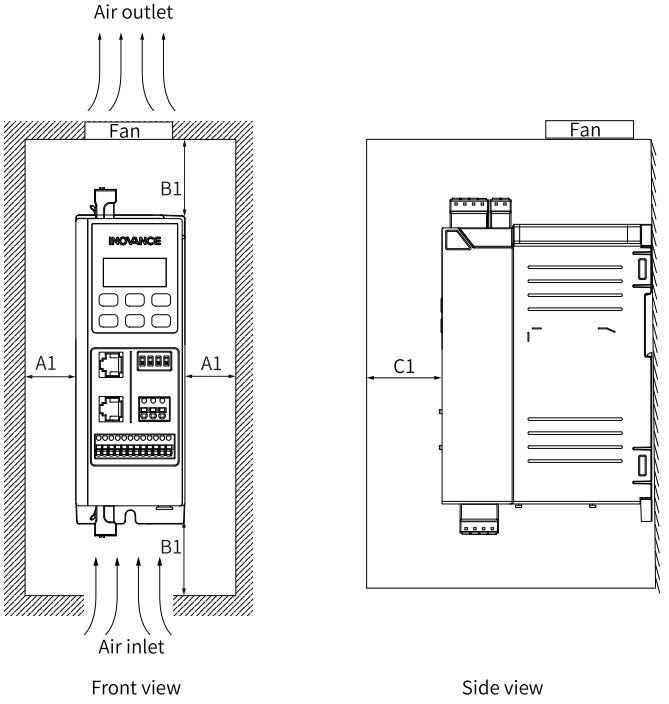


Figure 2-2 Clearance for installation of a single device

Table 2–5 Clearance for installation of a single device (three-phase 380 V to 480 V)

Power Rating	Clearance (mm)		
0.37 kW	A1 ⩾ 20	B1 ⩾ 100	C1 ⩾ 80
0.75 kW	A1 ⩾ 20	B1 ⩾ 100	C1 ⩾ 80
1.5 kW	A1 ⩾ 20	B1 ⩾ 100	C1 ⩾ 80
2.2 kW	A1 ⩾ 20	B1 ⩾ 100	C1 ⩾ 80
4 kW	A1 ⩾ 20	B1 ⩾ 120	C1 ⩾ 80
5.5 kW	A1 ⩾ 20	B1 ⩾ 120	C1 ⩾ 80

Table 2–6 Clearance for installation of a single device (single-phase 200 V to 240 V)

Power Rating	Clearance (mm)		
0.37 kW	A1 ⩾ 20	B1 ⩾ 100	C1 ⩾ 80
0.75 kW	A1 ⩾ 20	B1 ⩾ 100	C1 ⩾ 80
1.5 kW	A1 ⩾ 20	B1 ⩾ 100	C1 ⩾ 80
2.2 kW	A1 ⩾ 20	B1 ⩾ 120	C1 ⩾ 80

- When multiple devices are installed side by side, the minimum distance between two devices is shown below.

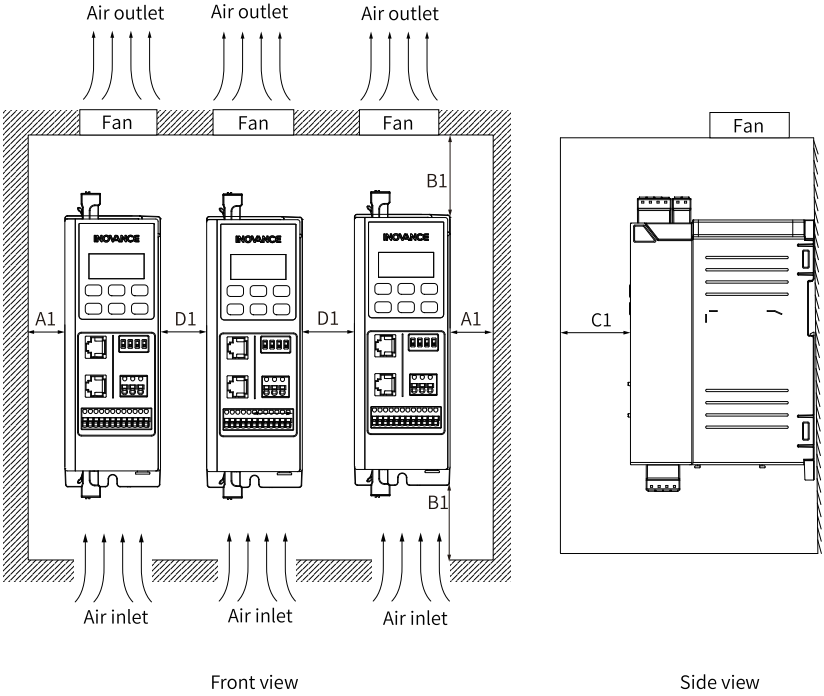


Figure 2-3 Side-by-side installation clearance

Table 2–7 Side-by-side installation clearance (three-phase 380 V to 480 V)

Power Rating	Clearance (mm)			
0.37 kW	A1 ⩾ 20	B1 ⩾ 100	C1 ⩾ 80	D1 ⩾ 30
0.75 kW	A1 ⩾ 20	B1 ⩾ 100	C1 ⩾ 80	D1 ⩾ 30
1.5 kW	A1 ⩾ 20	B1 ⩾ 100	C1 ⩾ 80	D1 ⩾ 0
2.2 kW	A1 ⩾ 20	B1 ⩾ 100	C1 ⩾ 80	D1 ⩾ 0
4 kW	A1 ⩾ 20	B1 ⩾ 120	C1 ⩾ 80	D1 ⩾ 0
5.5 kW	A1 ⩾ 20	B1 ⩾ 120	C1 ⩾ 80	D1 ⩾ 0

Table 2–8 Side-by-side installation clearance (single-phase 200 V to 240 V)

Power Rating	Clearance (mm)			
0.37 kW	A1 ⩾ 20	B1 ⩾ 100	C1 ⩾ 80	D1 ⩾ 30
0.75 kW	A1 ⩾ 20	B1 ⩾ 100	C1 ⩾ 80	D1 ⩾ 0
1.5 kW	A1 ⩾ 20	B1 ⩾ 100	C1 ⩾ 80	D1 ⩾ 0
2.2 kW	A1 ⩾ 20	B1 ⩾ 120	C1 ⩾ 80	D1 ⩾ 0

Note

- Three-phase 0.37 kW to 0.75 kW models and single-phase 0.37 kW models are naturally ventilated, whereas the rest models are air-cooled.
- For the naturally-ventilated models, if they are installed side-by-side, a distance of at least 30 mm must be reserved between two adjacent models.
- The air-cooled model supports side-by-side mounting without any space between two models.

- When devices are installed at different layers, the minimum distance between two layers is shown below.

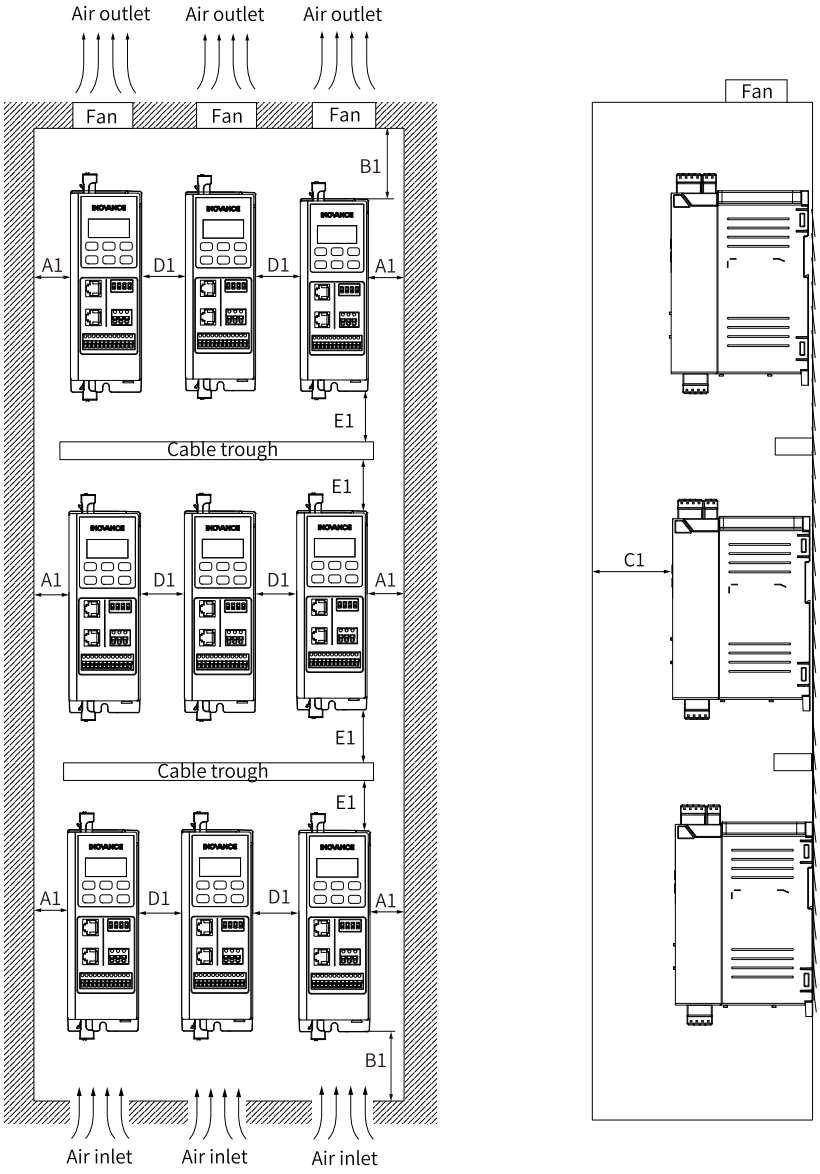


Figure 2-4 Clearance for device installation at different layers

Table 2–9 Clearance for device installation at different layers (three-phase 380 V to 480 V)

Power Rating	Clearance (mm)				
0.37 kW	A1 ⩾ 20	B1 ⩾ 100	C1 ⩾ 80	D1 ⩾ 30	E1 ⩾ 80
0.75 kW	A1 ⩾ 20	B1 ⩾ 100	C1 ⩾ 80	D1 ⩾ 30	E1 ⩾ 80
1.5 kW	A1 ⩾ 20	B1 ⩾ 100	C1 ⩾ 80	D1 ⩾ 0	E1 ⩾ 80
2.2 kW	A1 ⩾ 20	B1 ⩾ 100	C1 ⩾ 80	D1 ⩾ 0	E1 ⩾ 80
4 kW	A1 ⩾ 20	B1 ⩾ 120	C1 ⩾ 80	D1 ⩾ 0	E1 ⩾ 80
5.5 kW	A1 ⩾ 20	B1 ⩾ 120	C1 ⩾ 80	D1 ⩾ 0	E1 ⩾ 80

Table 2–10 Clearance for device installation at different layers (single-phase 200 V to 240 V)

Power Rating	Clearance (mm)				
0.37 kW	A1 ⩾ 20	B1 ⩾ 100	C1 ⩾ 80	D1 ⩾ 30	E1 ⩾ 80
0.75 kW	A1 ⩾ 20	B1 ⩾ 100	C1 ⩾ 80	D1 ⩾ 0	E1 ⩾ 80
1.5 kW	A1 ⩾ 20	B1 ⩾ 100	C1 ⩾ 80	D1 ⩾ 0	E1 ⩾ 80
2.2 kW	A1 ⩾ 20	B1 ⩾ 120	C1 ⩾ 80	D1 ⩾ 0	E1 ⩾ 80

2.4.2 Product Dimensions

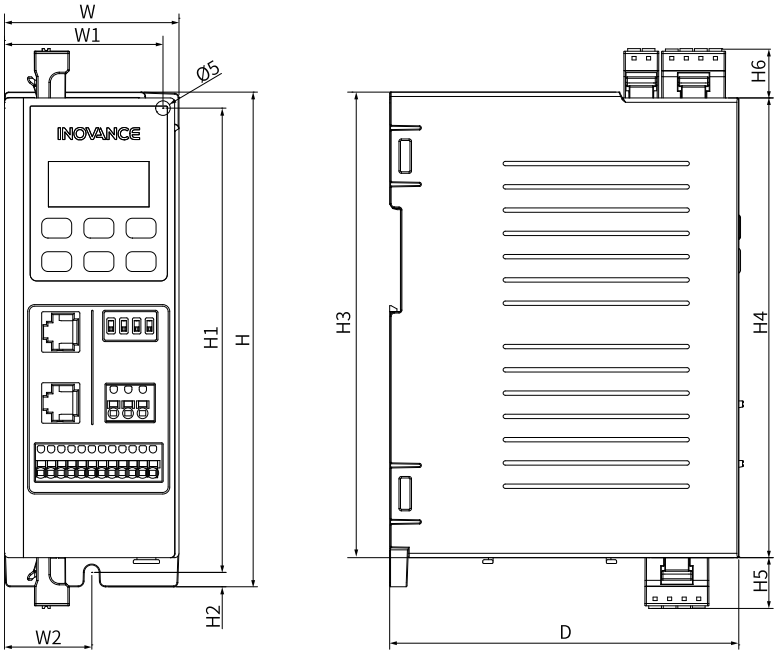


Figure 2-5 Outline dimensions and installation dimensions of T1 to T2 models

Table 2–11 Outline dimensions and mounting dimensions of T1 to T2 models

Structure	Mounting Hole (mm/inch)	Size (mm/inch)										Mounting hole diameter (mm/inch)	Weight (kg/lb)
	W1	W2	H1	H2	H	H3	H4	H5	H6	W	D		
T1	54.5 (2.15)	30 (1.18)	159.5 (6.28)	5 (0.2)	170 (6.69)	160 (6.30)	158 (6.22)	17.5 (0.69)	17 (0.67)	60 (2.36)	120 (4.72)	Ø5 (0.20)	0.8 (1.76)
T2	62.5 (2.46)	34 (1.34)	159.5 (6.28)	5 (0.2)	170 (6.69)	160 (6.30)	158 (6.22)	22 (0.87)	24 (0.95)	68 (2.68)	140 (5.51)	Ø5 (0.20)	1 (2.20)

2.5 EMC Design

2.5.1 Electromagnetic Compatibility

Overview

Electromagnetic compatibility (EMC) means that a device or system can work normally in its electromagnetic environment and the device or system does not emit electromagnetic interference (EMI) that causes abnormal operation of other devices or systems in the environment.

Type

Electromagnetic compatibility performance of the drive includes two aspects: electromagnetic emission (EMI) and electromagnetic sensitivity (EMS). EMI includes radiated emission (RE) and conducted emission (CE).

- RE: interference signal emitted by the product through the port of the housing.
- CE: interference signal transmitted by the product through the cable.

Interference and Anti-interference

Electromagnetic compatibility is a system-level concept, which indicates that the product has certain anti-interference capabilities and does not seriously interfere with other devices.

2.5.2 EMC-Compliant Control Cabinet Design

To prevent electromagnetic interference in the cabinet, isolate interference sources from devices that may be interfered during installation. Divide a cabinet into multiple EMC compartments or use multiple cabinets based on the intensity of interference sources, and install each device in accordance with the following wiring principles.

Table 2–12 Wiring requirements

No.	Wiring Requirement
1	Install the control devices and drive devices into two separate cabinets.
2	If multiple cabinets are used, use grounding cables with a cross-sectional area of at least 16 mm^2 to connect different cabinets, therefore realizing equipotential between the cabinets.
3	Place the devices in different areas in the cabinet according to the device signal strength.
4	Carry out equipotential bonding for the devices in different areas of the cabinet.
5	Shield all communication (for example, RS485) and signal cables leading from the electrical cabinet.
6	Install the power supply input filter close to the cabinet input interface.
7	Spray each grounding point in the cabinet.

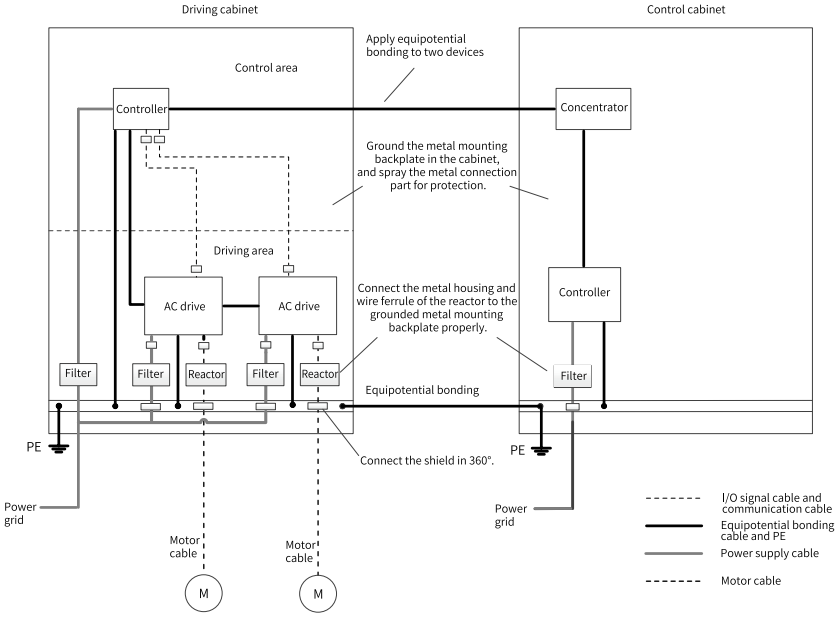


Figure 2-6 Recommended wiring for the cabinet system

2.6 Heat Dissipation Design

2.6.1 Ventilation Requirements

Common heat dissipation methods include the following:

- Natural ventilation
- Forced air cooling

2.6.1.1 Air Duct Design

Heat dissipation design of the cabinet door

The cabinet is forcibly cooled by a built-in fan. Therefore, to ensure that enough cooling air enters the cabinet, open an air inlet with an appropriate size on the cabinet door. For details on the effective area of the air inlet, see *"2.6.1.2 Air Outlet and Inlet" on page 31*. The air flows from bottom to top after being heated. Therefore, the cabinet air inlet must be at least 50 mm lower than the air inlet of the drive, as shown below.

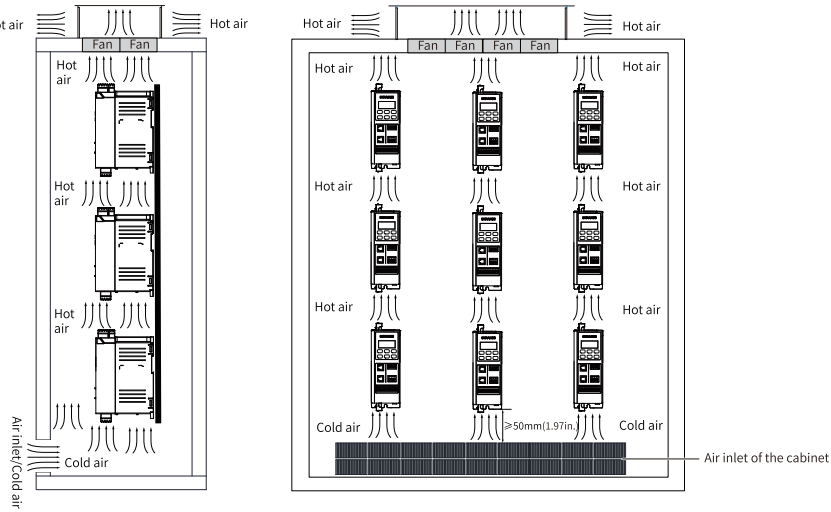


Figure 2-7 Position of the cabinet air inlet

2.6.1.2 Air Outlet and Inlet

Air inlet

The effective area of the air outlet is the actual ventilation area instead of the gross opening area. The following table describes the minimum ventilation area of the cabinet air inlet after the drive is installed in the cabinet.

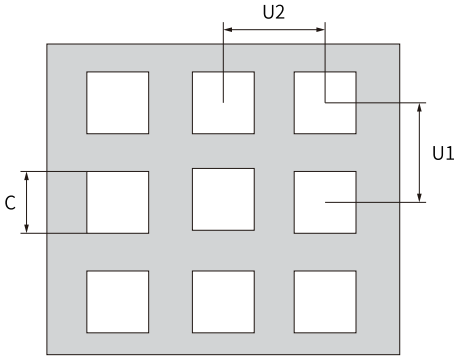
Table 2–13 Minimum ventilation area of the cabinet air inlet (three-phase 380 V to 480 V)

Structure	Power (kW)	Quantity	Min. Ventilation Area of Air Inlet for Air-Cooled Cabinet (cm^2)
T1	0.37	1	20.5
	0.75	1	20.5
	1.5	1	16.2
	2.2	1	16.2
T2	4	1	22
	5.5	1	22

Table 2–14 Minimum ventilation area of the cabinet air inlet (single-phase 200 V to 240 V)

Structure	Power (kW)	Quantity	Min. Ventilation Area of Air Inlet for Air-Cooled Cabinet (cm^2)
T1	0.37	1	20.5
	0.75	1	16.2
	1.5	1	16.2
T2	2.2	1	22

For example, on the plate shown in the following figure, the size of each hole is C x C, and there are 9 holes. Therefore, the ventilation area of the air inlet is 9 x C x C.



The preceding tables apply only to a single product. For a cabinet containing multiple products, calculate the total ventilation area by adding the ventilation area of each product.

For example, a cabinet contains the following products:

T1 model (single-phase 0.37 kW) + T1 model (single-phase 1.5 kW) + T2 model (single-phase 2.2 kW) + T1 model (three-phase 0.75 kW) + T1 model (three-phase 2.2 kW) + T2

model (three-phase 4 kW). Therefore, the minimum ventilation area of the cabinet air inlet should be 20.5 + 16.2 + 22 + 20.5 + 16.2 + 22 = 117.4 cm^2.

For the air inlet installed with a filtering net, the air inlet resistance increases substantially. In this case, the minimum ventilation area of the air inlet must be increased to 1.2 to 1.5 times the value listed in the preceding table. The ventilation area in the preceding tables refers to the actual through-hole area of an opening. The ventilation area is calculated by the following: opening area x opening rate.

Air outlet

To ensure sufficient heat dissipation of the drive, hot air in the cabinet must be exhausted to the outside. Use the active ventilation design for the cabinet.

Table 2–15 Minimum ventilation area of the cabinet air outlet (three-phase 380 V to 480 V)

Structure	Power (kW)	Quantity	Min. Ventilation Area of Air Outlet for Air-Cooled Cabinet (cm^2)
T1	0.37	1	32.8
	0.75	1	32.8
	1.5	1	26
	2.2	1	26
T2	4	1	35.5
	5.5	1	35.5

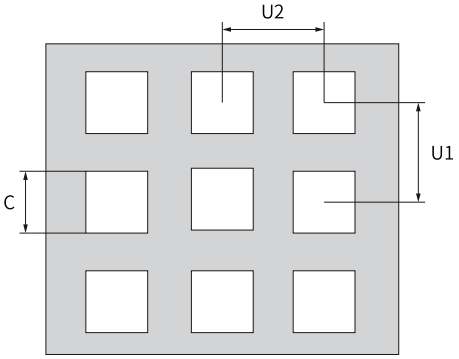
Table 2–16 Minimum ventilation area of the cabinet air outlet (single-phase 200 V to 240 V)

Structure	Power (kW)	Quantity	Min. Ventilation Area of Air Outlet for Air-Cooled Cabinet (cm^2)
T1	0.37	1	32.8
	0.75	1	26
	1.5	1	26
T2	2.2	1	35.5

Note

The effective area of the air outlet is the actual ventilation area instead of the gross opening area.

For example, on the plate shown in the following figure, the size of each hole is C x C, and there are 9 holes. Therefore, the ventilation area of the air inlet is 9 x C x C.



The preceding tables apply to only a single product. For a cabinet containing multiple products, calculate the total ventilation area by adding the ventilation area of each product. For the air outlet installed with a filtering net, the air outlet resistance increases substantially. In this case, the minimum ventilation area of the air outlet must be increased to 1.2 to 1.5 times the value listed in the preceding table. The ventilation area in the preceding tables refers to the actual through-hole area of an opening. The ventilation area is calculated by the following: opening area x opening rate.

For example, a cabinet contains the following products:

T1 model (single-phase 0.37 kW) + T1 model (single-phase 1.5 kW) + T2 model (single-phase 2.2 kW) + T1 model (three-phase 0.75 kW) + T1 model (three-phase 2.2 kW) + T2 model (three-phase 4 kW). Therefore, the minimum ventilation area of the cabinet air outlet should be 32.8 + 26 + 35.5 + 32.8 + 26 + +35.5 = 188.6 cm^2. In the active air exhaust mode, a fan is installed on the top of the cabinet to draw hot air out of the cabinet. This is a commonly used ventilation mode. To ensure that the hot air can be exhausted to the outside, the total air volume of the fan cannot be smaller than that of all drives in the cabinet.

The cooling air volume required by the MD600 is listed in the following tables.

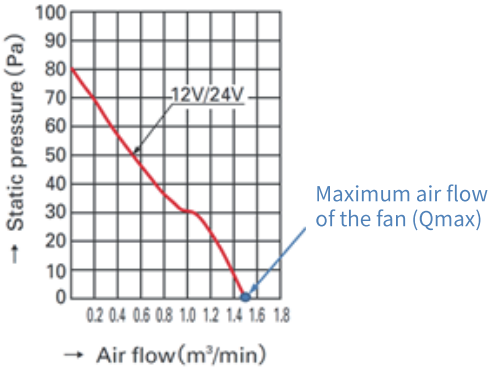
Table 2–17 Cooling air volume (three-phase 380 V to 480 V)

Structure	Power (kW)	Quantity	Max. Air Volume Qmax (CFM) of the Fan at the Top of the Cabinet
T1	0.37	1	0
	0.75	1	0
	1.5	1	22
	2.2	1	22
T2	4	1	38
	5.5	1	38

Table 2–18 Cooling air volume (single-phase 200 V to 240 V)

Structure	Power (kW)	Quantity	Max. Air Volume Qmax (CFM) of the Fan at the Top of the Cabinet
T1	0.37	1	0
	0.75	1	22
	1.5	1	22
T2	2.2	1	38

The maximum air volume Qmax is the maximum value of the point where the fan P-Q curve meets the abscissa, as shown in the following figure.



The preceding tables apply to only a single product. When multiple products are installed in the cabinet, calculate the total air volume by adding the air volume of each product.

For example, a cabinet contains the following products: T1 model (single-phase 0.37 kW) + T1 model (single-phase 1.5 kW) + T2 model (single-phase 2.2 kW) + T1 model (three-phase 0.75 kW) + T1 model (three-phase 2.2 kW) + T2 model (three-phase 4 kW). Therefore, the minimum air volume of the cabinet fan should be 0 + 22 + 38 + 0 + 22 + 38 = 120 CFM.

2.6.2 Fan Design

The MD600 fan is designed with a separate fan duct and supports forward and reverse rotation of the fan.

To select the fan, do the following:

1. Calculate the sum of cooling air volume required by all the devices based on *"Table 2–17 " on page 34* and *"Table 2–18 " on page 35*.
2. Determine the maximum air volume (Qmax) of the cabinet fan.

3. Determine the specification and quantity of the fan based on the maximum air volume (Qmax).
   Where:

   The maximum air volume of the cabinet is 1.3 to 1.5 times the sum of the cooling air volume.

   The maximum air volume of the cabinet is 1.6 to 2.2 times the sum of the cooling air volume if mesh filters, shutters, or other components are installed at the cabinet air outlet.

Note

- The air volume of the selected fan cannot be smaller than the maximum air volume Qmax. If a single fan cannot meet this requirement, multiple fans can be used.
- Install the fan in the correct air exhaust direction to ensure that air flows from inside to outside of the cabinet. Otherwise, if hot air cannot be exhausted, the drive will be overheated or damaged.

Removing the fan

The MD600 fan can be removed without any tool.

Press and hold the four snap-fit joints around the fan to pull the fan out, as shown by ①.

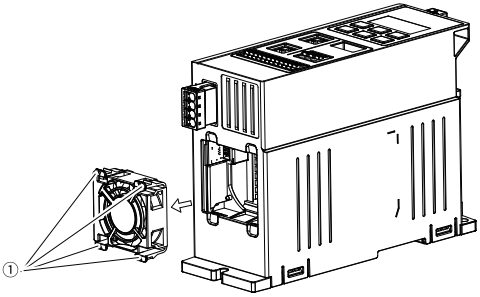


Figure 2-8 Fan removal

Installing the fan

Align the fan terminal with the slot as shown in ① and push the fan toward the drive until the snap-fit joints are in the places.

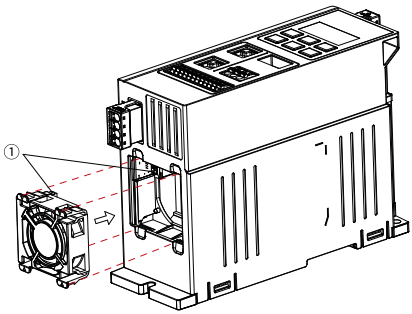


Figure 2-9 Fan installation

Note

For RS485 and CAN models, single-phase 0.75 kW, 1.5 kW, and 2.2 kW AC drives, as well as three-phase 1.5 kW, 2.2 kW, 4 kW, and 5.5 kW AC drives provide one fan.

3 Electrical Design

3.1 Electrical Wiring Diagram

Wiring diagram for the MD600 (RS485 model)

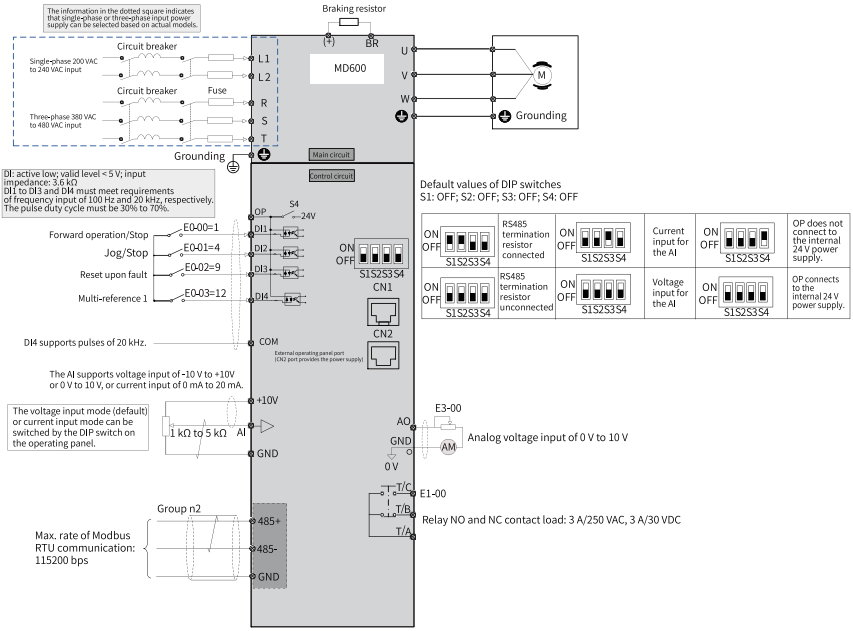


Figure 3-1 Terminal wiring for models (MD600S-4T1R6 to MD600S-4T013B and MD600S-2S2R8 to MD600S-2S010B) with single-phase/three-phase power supply input

Wiring diagram for the MD600 (CAN model)

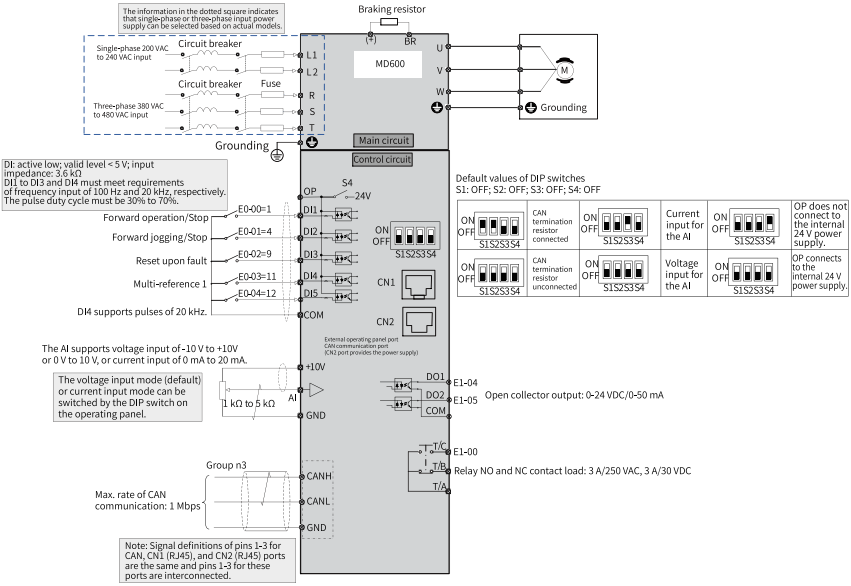


Figure 3-2 Terminal wiring for models (MD600A-4T1R6 to MD600A-4T013B and MD600A-2S2R8 to MD600A-2S010B) with single-phase/three-phase power supply input

Caution

- Signal interference may cause malfunctions. Therefore, keep the signal cable at least 20 cm away from the power cable and separately configure the input and output sides of the main circuit.
- Do not leave cuttings inside the drive while wiring. Failure to comply may result in errors, faults, and malfunctions.
- Keep the drive clean. Do not drop cuttings or dust into the drive while drilling mounting holes on the control cabinet.

3.2 Cable Preparation

During the electrical design phase, you need to prepare cables according to the cable list and cable preparation.

Cable list

The cable list mainly includes the cable type, name, and appearance, as shown in the following table.

Table 3–1 Cable list

Type	Cable Name	Appearance	Type	Cable Name	Appearance
Main circuit cable	Power cable		Control circuit cable	Signal cable	
	Grounding cable			Network cable	

Cable preparation

To prepare the cable, do as follows:

1. Strip the cable rubber jacket according to the length requirements in the following figure.

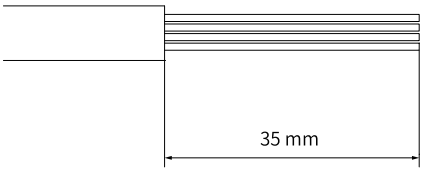


Figure 3-3 Cable preparation 1

2. Make lugs for U/V/W cable and grounding cable according to the following length requirements.

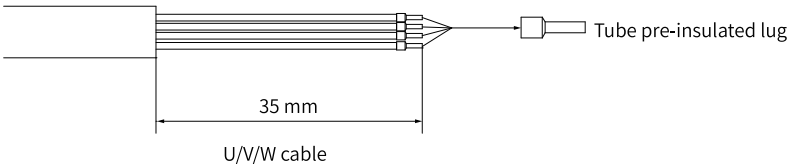


Figure 3-4 Cable preparation 2

3.3 Basic Electrical Safety Precautions

3.3.1 Selecting Power Supply Isolation Devices

Install a manually operated input isolation device between the AC power supply and the AC drive. Disconnecting the isolation device can cut off the power supply for safety during installation and maintenance.

EU

To comply with the EU guidelines, the isolation device must be one of the following types according to electrical safety standards for machinery equipment specified in EN60204-1:

- Isolation switch (EN 60947-3) of AC-23B
- Circuit breaker for isolation which complies with EN 60947-2

Other regions

The isolation device must comply with the applicable safety regulations.

3.3.2 Selecting Main Contactors

If the main contactor is used, the type (number of operation times under load) must be AC-1 and must be in accordance with IEC 60947-4. Select the contactor based on the rated voltage and current of the AC drive.

3.3.3 Short Circuit Protection

When the AC drive encounters an internal short circuit fault, the fuse used to protect the AC drive will prevent damage to the AC drive and the adjacent devices.

If the motor cable size is determined according to the rated current of the AC drive, the AC drive can protect the motor cable and motor in case of short circuit. No other protective equipment is required.

3.3.4 Selection of Motors

After power-on, the motor generates heat continuously due to thermal effect of the current. The heat is then dissipated to the surroundings. When the generated heat exceeds the dissipated heat, the motor temperature rises, which will burn the motor.

The drive provides motor overload protection, but does not provide motor overheat protection. Therefore, use a motor with the overheat detection function.

Use the dedicated motor for the MD600 series AC drive. Failure to comply will result in short circuit due to aging of insulation.

3.3.5 Checking the Compatibility of the Motor and Drive

The AC drive can be used to drive one or multiple AC asynchronous induction motors simultaneously. According to AC voltage and motor load, select the motor capacity and drive model according to *"4.3 Electrical Specifications" on page 67*.

3.3.6 Selecting Surge Protection Devices

The surge protection device (SPD) is installed on the input side of the AC drive to ensure that electrical systems and important electrical and electronic equipment are protected from damage caused by lightning overvoltage. The SPD is mainly used to limit transient overvoltage and operating overvoltage caused by lightning in power supply and signal systems. Lightning surges can be transmitted to the AC drive through the power supply or signal cable. When a lightning stroke occurs, the ground potential increases, which may damage the drive. The induced voltage can be produced in the cable and loop when a pulse electromagnetic field is generated by a lightning strike on the building (or in the vicinity). Therefore, in addition to the external lightning protection measures such as the installation of lightning rods, down conductors, and grounding devices, you need to install an SPD. This is because the lightning rod, down conductor, and grounding device cannot prevent conduction of lightning induction surge along the cable and secondary lightning strike.

3.3.7 Requirements on Power Grid System Compatibility

When the power supply distribution system of the AC drive is an asymmetric grounding system or a floating ground system (IT system), remove the ground safety capacitor for grounding applications. Any voltage to ground of the asymmetric grounding system or floating ground system (IT system) may exceed the voltage of

the built-in filter and safety capacitor. Therefore, connecting to ground in this system will damage the AC drive.

To avoid risks or accidents, it is not recommended to use the AC drive in an asymmetric grounding system or in a floating ground system (IT system).

The AC drive supports only TN and TT star-type power grids under normal conditions. Other power grids are not supported. Contact Inovance technical service personnel if necessary.

3.4 Main Circuit Wiring

3.4.1 Introduction to Main Circuit Terminals

Terminal layout

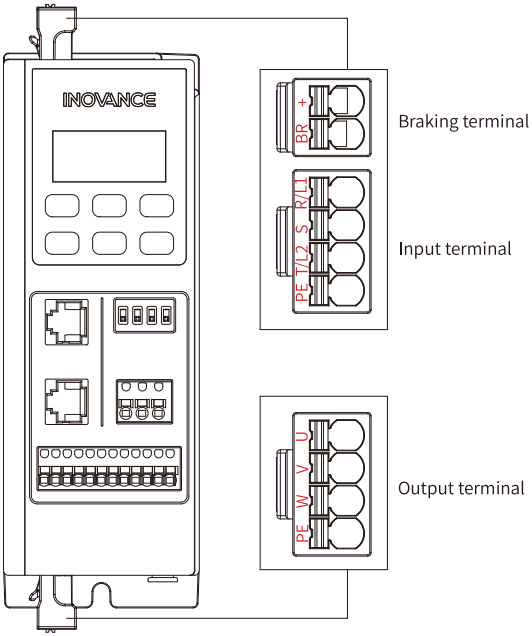


Figure 3-5 Layout of main circuit terminals for T1 to T2 models

Terminal descriptions

Table 3–2 Descriptions of main circuit terminals for T1 to T2 models

Mark	Name	Function
L1, L2	Single-phase power supply input terminals	The terminals are used to connect to the power supply. L1 is connected to the live wire and L2 is connected to the neutral wire.
R, S, T	Three-phase power supply input terminals	The terminals are used to connect the three-phase AC power supply.
(+), BR	Braking resistor connection terminals	The terminals are used to connect to the braking resistor for three-phase models with the power rating of 2.2 kW and above and single-phase models with the power rating of 1.5 kW and above.
U, V, W	Output terminals	The terminals are used to connect to a three-phase motor.
PE	Grounding terminal (PE)	It is used for protective grounding.

Terminal dimensions

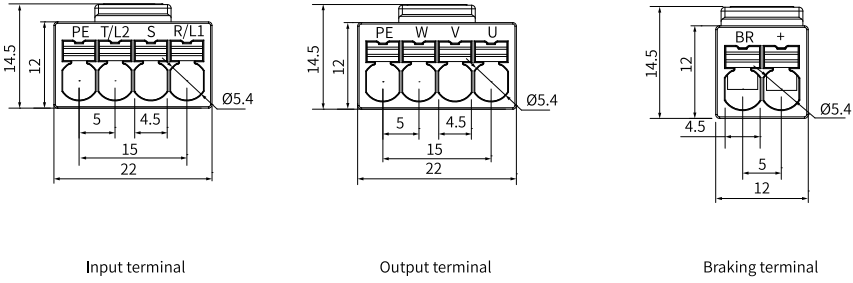


Figure 3-6 Main circuit terminal dimensions (mm) of T1 models

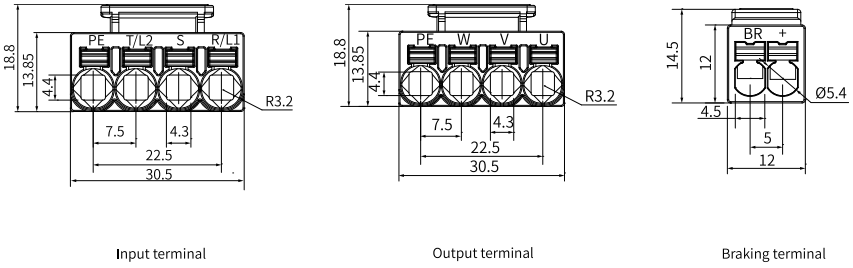


Figure 3-7 Main circuit terminal dimensions (mm) of T2 models

3.4.2 Wiring Description of Main Circuit Terminals

The following rules apply to the wiring of the main circuit:

- Terminals BR, (-), and (+) are used to connect options. Avoid connecting these terminals to an AC power supply.
- To protect the main circuit, separate it from all surfaces that may come into contact with it and provide covers as required.
- The control circuit is the internal safety extra-low voltage (SELV) circuit, which must be insulated and isolated from other circuits. Make sure that the control circuit is connected to an external SELV circuit.
- Prevent foreign matters from entering the wiring part of the terminal block.
- Do not solder the twisted conductors.

For main circuit cable specifications, see *"4.5.3.1 Main Circuit Cables" on page 77*.

3.5 Control Circuit Wiring

3.5.1 Introduction to Control Circuit Terminals

Terminal layout

"Figure 3–8 " on page 46 shows the layout of control circuit terminals.

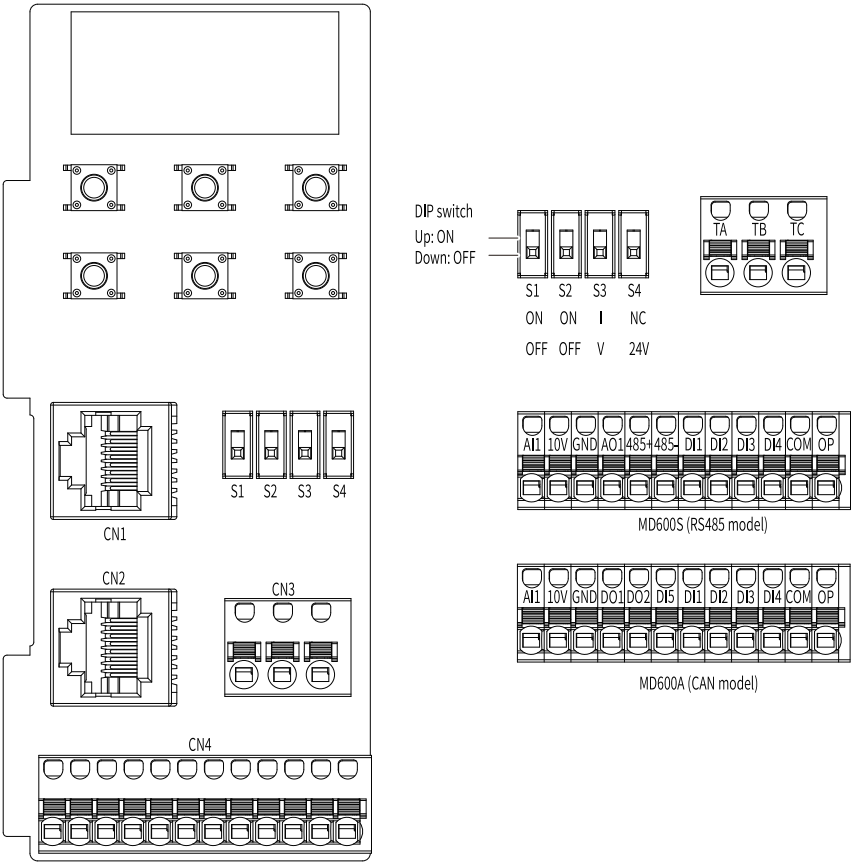


Figure 3-8 Layout of control circuit terminals

Terminal descriptions

Table 3–3 Descriptions of control circuit terminals

External	Terminal Type	Transmission Information Type	Terminal Mark	Terminal Name	Function
CN1	RJ45	Modbus communication CAN Communication	-	Communication port	485 models: The RJ45 network port supports only the RS485 communication, and the port can be used only to connect the background software connection of the AC drive through RS485. CAN models: The RJ45 network port supports CANopen/CANlink communication and can be used to connect the background software connection of the AC drive through RS485.
CN2	RJ45	Modbus communication CAN Communication	-	Communication port External operating panel port	485 models: The RJ45 network port supports only the RS485 communication, and the port can be used only to connect the background software connection of the AC drive through RS485. CAN models: The RJ45 network port supports CANopen/CANlink communication and only this port can be used to connect the external operating panel. In addition, the port can be used to connect the background software connection of the AC drive through RS485.
CN3	Three-pin terminal block	Digital output	TA	Relay output	Common terminal T/A of external relay contact
			TB	Relay output	Normally closed (NC) terminal T/B of external relay contact
			TC	Relay output	Normally open (NO) terminal T/C of external relay contact

External	Terminal Type	Transmission Information Type	Terminal Mark	Terminal Name	Function
CN4	12-pin terminal block	DI/DO/AI/AO/ RS485	AI1	Analog input terminal 1	Voltage input of -10 V to +10 V or 0 V to 10 V or current input of 0 mA to 20 mA; 12-bit resolution; accuracy after correction: 0.3%; response time: < 2 ms Input impedance in the voltage input mode: 22 kΩ; input impedance in the current mode: 500 Ω
			10V	10 V analog voltage output	Output voltage range: 10 V ± 5% Maximum output current: 10 mA
			GND	Analog ground	Internally isolated from COM
			AO1	Analog output terminal 1 (RS485 model)	Voltage output of 0 V to 10 V; 12-bit resolution; correction accuracy: 0.5%; maximum load output current in the voltage output mode: 2 mA; load impedance in the voltage output mode: 5 kΩ
			DO1	Digital output terminal 1 (CAN model)	Photocoupler isolation; unipolar open collector output; maximum output frequency: 100 Hz It cannot be connected directly to the power supply. The pull-up resistor with the resistance set according to the load must be added. Output voltage range: 0 V to 30 V Output current range: 0 mA to 50 mA
			485+	RS485 communication signal + (RS485 model)	Positive RS485 communication signal; maximum speed supported by hardware: 115.2 kbps; maximum transmission distance at the baud rate of 9.6 kbps: 1 km
			DO2	Digital output terminal 2 (CAN model)	Photocoupler isolation; unipolar open collector output; maximum output frequency: 100 Hz It cannot be connected directly to the power supply. The pull-up resistor with the resistance set according to the load must be added. Output voltage range: 0 V to 30 V Output current range: 0 mA to 50 mA
			485-	RS485 communication signal - (RS485 model)	Negative RS485 communication signal

External	Terminal Type	Transmission Information Type	Terminal Mark	Terminal Name	Function
Continued	Continued	Continued	DI5	Digital input terminal 5 (CAN model)	Isolated sink/source programmable DI; input frequency: < 100 Hz
					The operating voltage ranges from 15 V to 30 V. The voltage lower than 5 V is invalid and the voltage higher than 15 V is valid. The input impedance is 3.61 kΩ.
			DI1	Digital input terminal 1	See DI5 above.
			DI2	Digital input terminal 2	
			DI3	Digital input terminal 3	
			DI4	Digital input terminal 4	High-speed pulse input terminal (HDI); maximum input frequency: 20 kHz The working voltage ranges from 15 V to 30 V. The voltage lower than 5 V is invalid and the voltage higher than 15 V is valid. Input impedance: 3.61 kΩ
			OP	Digital input power supply common terminal	It is connected to 24V by default. When DI1 to DI5 are driven by external signals, connect OP to COM or the external 24 V, and disconnect OP from the internal 24 V by setting the S4 DIP switch to OFF.
			COM	24 V power supply reference ground	Internally isolated from GND
S	-	-	S1	DIP switch for termination resistor for 485+/ CANH communication	The DIP switch is disconnected by default. For details, see *"Table 3–4 DIP switch definitions" on page 50*
			S2	DIP switch for termination resistor for 485-/ CANL communication	The DIP switch is disconnected by default. For details, see *"Table 3–4 DIP switch definitions" on page 50*.
			S3	Voltage/current mode switch for AI	The voltage mode is used by default. For details, see *"Table 3–4 DIP switch definitions" on page 50*.
			S4	DIP switch for OP to connect the internal 24 V or external power supply	OP is connected to the internal 24 V by default. For details, see *"Table 3–4 DIP switch definitions" on page 50*.

The following table describes DIP switches.

Table 3–4 DIP switch definitions

Name	Function
S1	ON: Termination resistor connected for RS485/CAN communication OFF: Termination resistor disconnected for RS485/CAN communication
S2	ON: Termination resistor connected for RS485/CAN communication OFF: Termination resistor disconnected for RS485/CAN communication
S3	ON: AI1 is the current input mode (impedance: 500 Ω). OFF: AI1 is the voltage input mode.
S4	NC: OP is not connected. OFF: OP is connected to the internal 24 V.
Note: • By default, the DIP switch is in the OFF position. • To connect the termination resistor, set both S1 and S2 to ON.	

3.5.2 Wiring Descriptions of Control Circuit Terminals

Precautions

I/O signals include analog input (AI), analog output (AO), digital input (DI), digital output (DO) and relay output signals. To avoid interference to the I/O signals, separate the I/O signal cables at least 20 cm away from the main circuit cables (R, S, and T cables and U, V, and W cables) and other power cables or power supply cables.

AI1 wiring

Weak analog signals are easy to suffer external interference. Therefore, route the analog cable away from the interference source and keep the cable length as short as possible (no longer than 20 m). In applications where the analog signal suffers severe interference, install a filter capacitor or ferrite magnetic core at the analog signal source.

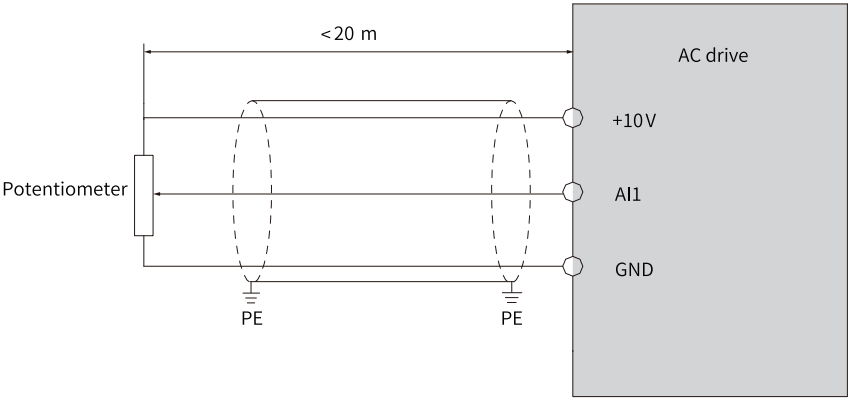


Figure 3-9 AI wiring

To select the current input mode for AI1, set S3 to ON. In this case, the input resistance is 500 Ω. The wiring is as follows.

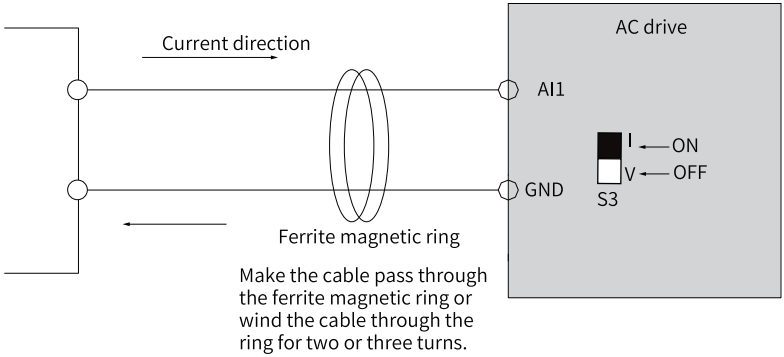


Figure 3-10 Wiring of AI1 in the current input mode

DI1 to DI5 wiring

Caution

When the OP terminal is connected to the internal 24 V (DIP switch S4 set to 24V), do not short the COM and OP terminals. Otherwise, the internal 24 V power supply will be damaged.

- Sink wiring mode

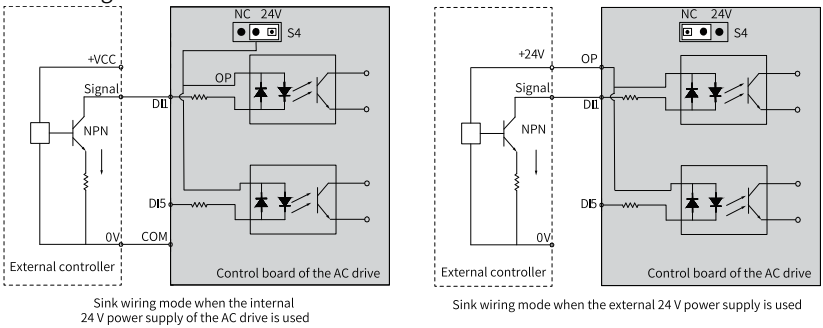


Figure 3-11 Sink wiring mode

To use the internal 24 V power supply of the drive, which is the most commonly wiring method, set the DIP switch S4 to 24V (short the OP and 24V terminals), and connect the COM terminal of the drive to the 0V terminal of the external controller.

In the mode, the DIs of different AC drives cannot be connected in parallel. Otherwise, the DI may malfunction. If DIs of different AC drives must be connected in parallel, connect the anode of a diode to the DI in series and the diode needs to satisfy the following requirement: IF > 40 mA and VR > 40 V, as shown in *"Figure 3-12 Parallel connection of DIs of multiple AC drives in the sink mode" on page 52*.

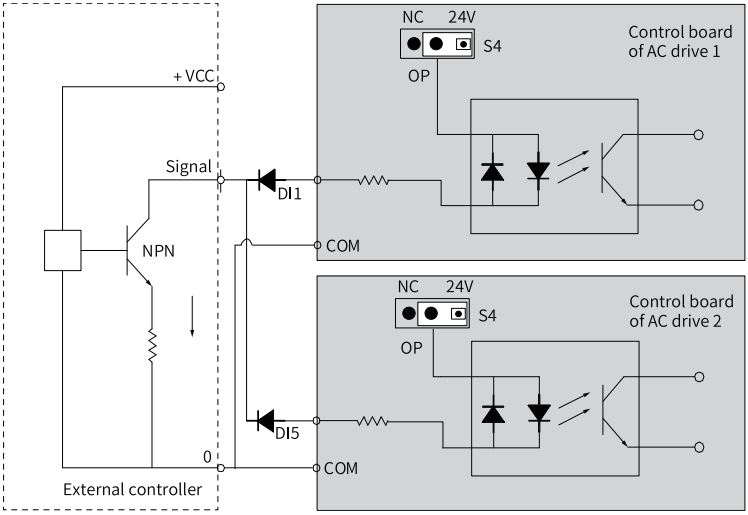
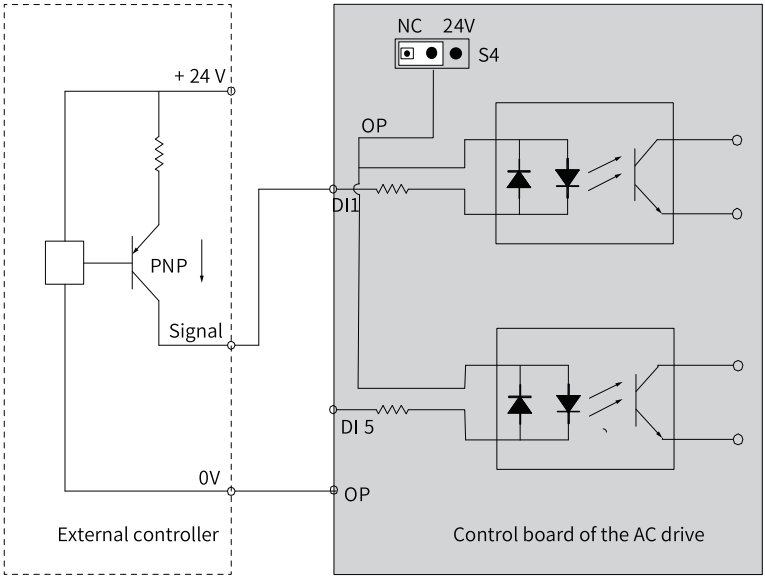


Figure 3-12 Parallel connection of DIs of multiple AC drives in the sink mode

- Source wiring mode



Source wiring mode when the external 24 V power supply is used

Figure 3-13 Source wiring mode

- In the source wiring mode, you can only use the external 24 V power supply. To use the external power supply, set the DIP switch S4 to NC (OP unconnected), connect the OP terminal of the AC drive to the 0V terminal of the external controller, and connect the anode of the 24 V external power supply to the DI through the control contact on the external controller.

DO wiring

When the DO needs to drive a relay, connect a snubber diode on both sides of the relay coil. Otherwise, the 24 VDC power supply may be damaged. Ensure that the driving capacity does not exceed 50 mA.

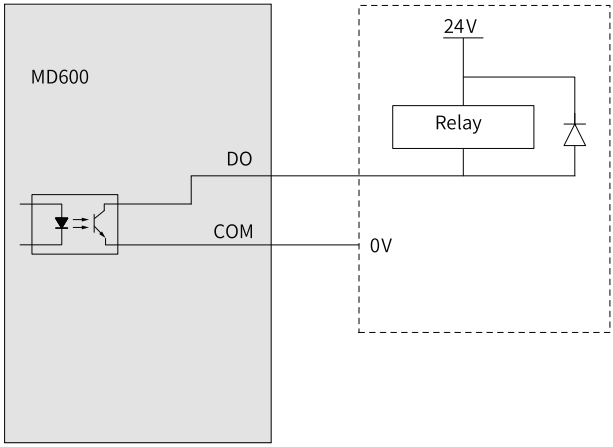


Figure 3-14 Wiring between DO and relay

Caution

Connect the snubber diode with the polarity placed correctly. Otherwise, the DO circuit will be damaged upon the DO output.

DO: Optocoupler isolation, bipolarity open collector output

Output voltage range: 0 V to 24 V

Output current range: 0 mA to 50 mA

The DO is a single-polarity terminal and can only be wired in the following way.

The DO does not required thee internal 24 V power supply.

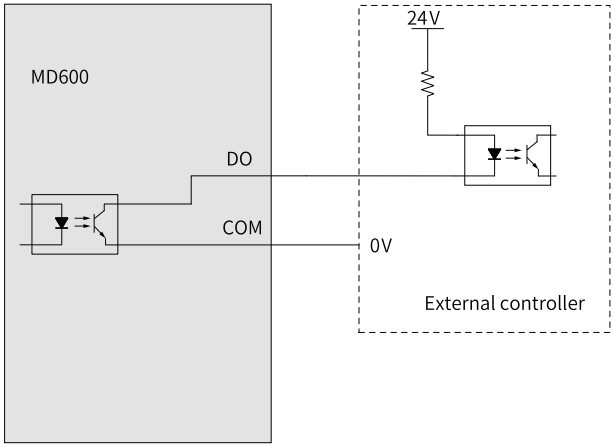


Figure 3-15 DO connecting to external controller

Relay output terminal wiring

The inductive load (relay, contactor, and motor) causes voltage peak after the current is disconnected. To minimize the interference at cutoff, use a voltage dependent resistor (VDR) at the relay contact for protection and install absorption circuits such as VDRs, RC absorption circuits, and diodes on the inductive load, as shown in *"Figure 3–16 Anti-interference treatment for relay output terminals" on page 55*.

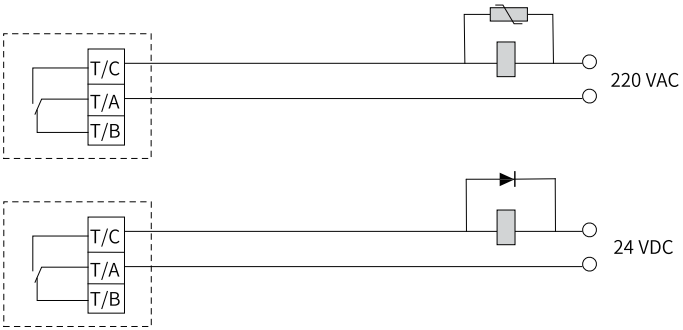


Figure 3-16 Anti-interference treatment for relay output terminals

Note

- The power supply connected with the control circuit must use class 2 power supply; otherwise, the operation performance of the AC drive will be degraded.
- For control cable specifications, see *"4.5.3.2 Control Circuit Cable" on page 79*.

3.6 Selection of Communication Cables

3.6.1 RS485 Communication Cable

Use a three-conductor shielded cable as the RS485 bus to connect to 485+, 485-, and GND terminals of the AC drive. Use the twisted pair cable to connect to the 485+ and 485- terminals and use the other cable to connect to the RS485 reference ground terminal GND. Connect the shield to the equipment ground. In the following figure, the left termination resistor is set by the DIP switch or an external termination resistor is installed. The right termination resistor is also set by the DIP switch.

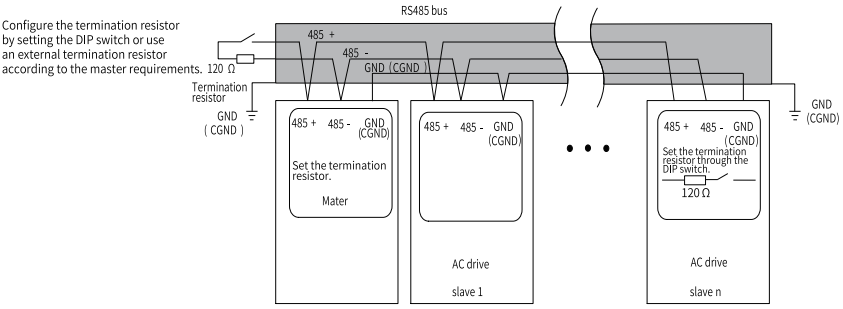


Figure 3-17 RS485 bus topology

The following table lists the maximum number of nodes and transmission distance supported by the standard RS485 circuit at different transmission rates.

Table 3–5 Transmission distance and number of nodes

Transmission Distance (m)	Rate (kbps)	Number of Nodes	Cable Specification
100	115.2	128	26AWG
1000	19.2	128	26AWG

3.6.2 CAN Communication Cable

Use the daisy chain mode for the CAN bus, as shown in the following figure. Use shielded twisted pair cables for the CAN bus, and use twisted pair cables for CANH and CANL signal cables. In the following figure, the left termination resistor is set by the DIP switch or an external termination resistor is installed. The right termination resistor is also set by the DIP switch. Connect the CAN signal reference ground of all the nodes (up to 64 nodes) together.

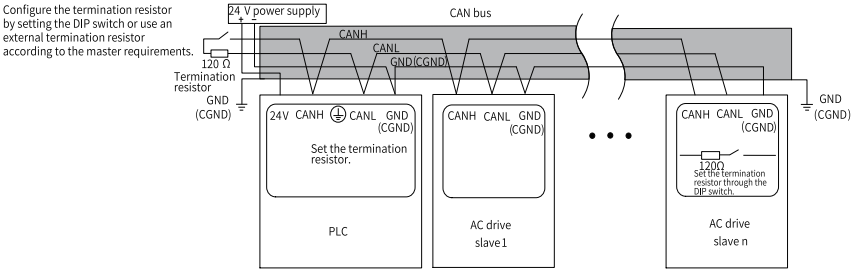


Figure 3-18 CAN bus topology

The transmission distance of the CAN bus is directly related to the baud rate and the communication cable. The following table describes the relationship between the maximum bus length and the baud rate.

Table 3–6 Transmission distance and baud rate

Transmission Distance (m)	Rate (kbps)	Number of Nodes	Cable Specification
25	1000	64	0.205 mm^2
95	500	64	0.34 mm^2
560	100	64	0.5 mm^2
1100	50	64	0.75 mm^2

3.7 Cable Routing

Routing precautions

- **Requirements on main circuit routing**
  The power supply input cable of the AC drive and motor cable can generate strong electromagnetic interference. To avoid electromagnetic interference caused by long-distance parallel coupling between the strong disturbing cable and control circuit cable, ensure a distance longer than 20 cm between main circuit cables and signal cables when cabling. Main circuit cables include the input R/S/T cable, output U/V/W cable, DC bus, and braking cable. Signal cables include the I/O signal cable and communication cable.

  Cable ducts must be in good connection and well grounded. Use aluminum cable ducts to ensure equipotentiality of the device. Connect the AC drive and motor to the system (machines or devices) properly. Protect all connections with spray coating and ensure good contact of conductive metal.

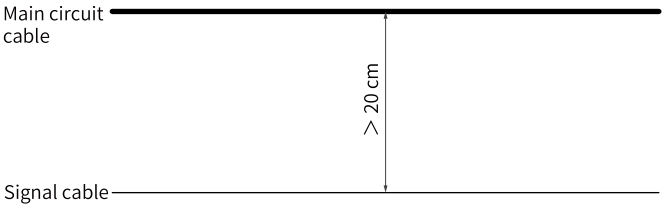


Figure 3-19 Cable layout

- **Requirements on cabling I/O signal cables**
  I/O signals include analog input (AI), analog output (AO), digital input (DI), digital output (DO) and relay output signals. To avoid interference to the I/O signals, separate the I/O signal cables at least 20 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).

Routing instructions

- **Routing disturbing cables and sensitive cables**
  Route cables that transmit different types of signals through different routes. Separate the disturbing cables from sensitive cables by a distance of at least 20 cm. When two types of cables must be intersected, the intersection angle must be 90 degrees to avoid interference, as shown in the following figure.

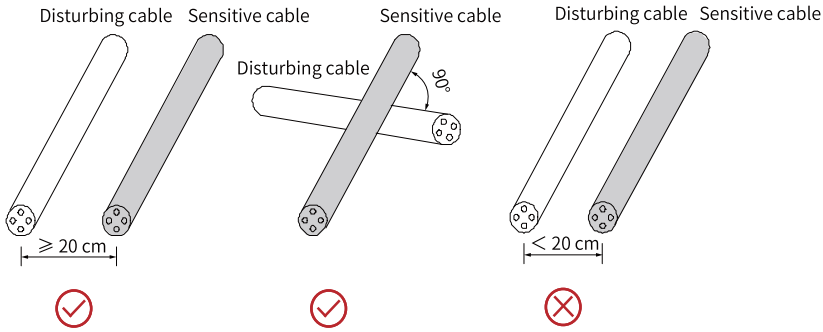


Figure 3-20 Routing disturbing cables and sensitive cables

- **Routing cables that transmit different types of signals**
  Route cables that transmit different types of signals through different routes and separate different types of signals with equipotential signals. When routing cables that transmit the same type of signals, lay equipotential signal cables to the outer layers and lay equipotential bondings as many as possible in the middle if possible, as shown in the following figure.

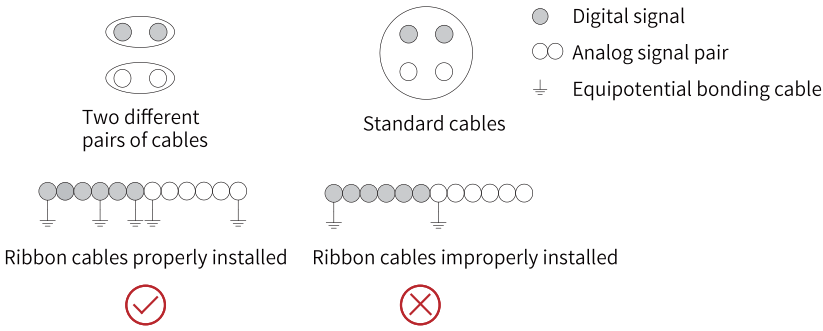


Figure 3-21 Routing cables that transmit different types of signals

- **Routing multi-conductor cables**
  For multi-conductor cables, use one cable to transmit one type of signals. To use one cable to transmit multiple types of signals, use a cable with internal conductor shields, as shown in the following figure.

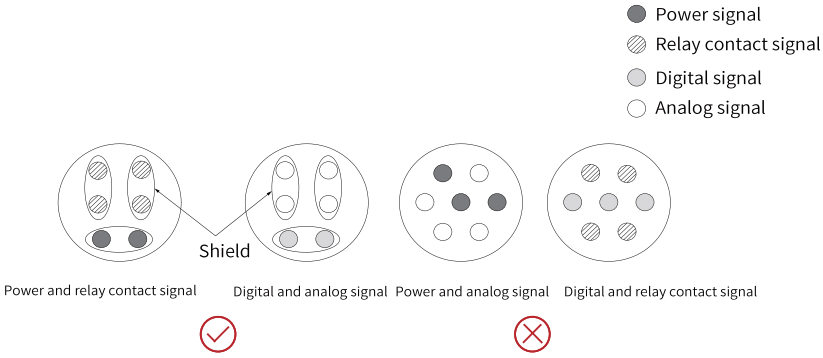


Figure 3-22 Routing multi-conductor cables

If certain conductors in a multi-conductor cable are reserved or unused, connect these conductors to the equipotential bondings, as shown below.

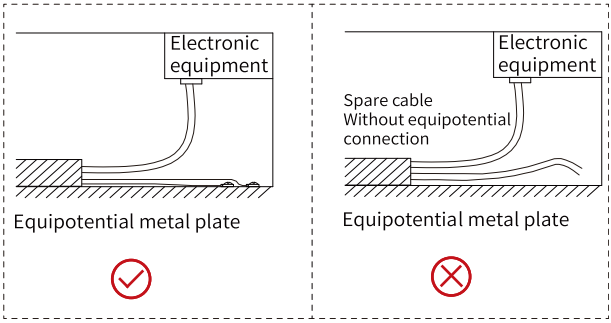


Figure 3-23 Handling reserved or unused conductors of multi-conductor cables

- **Requirements on the wiring loop area**
  For cables that transmit low-level sensor signals and shared cables that transmit relay signals, lay them close to each other to avoid the large loop area. Use twisted pair cables for analog signals. Lay digital signal cables close to each other.

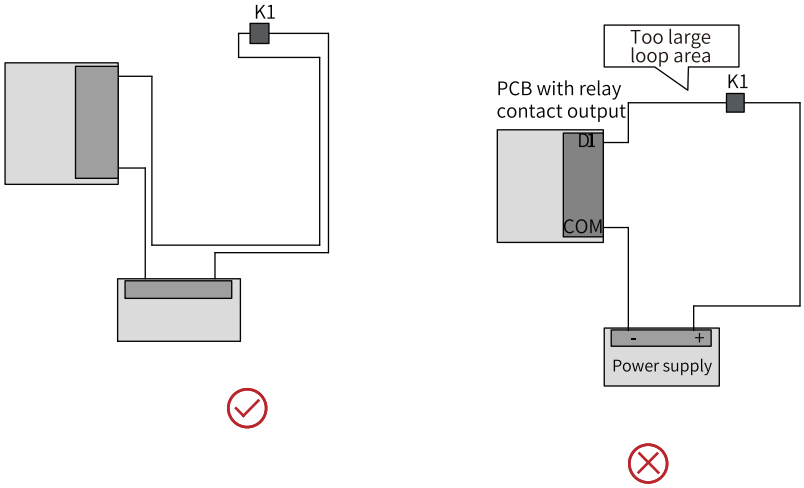


Figure 3-24 Recommended wiring loop area

- **Laying 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.

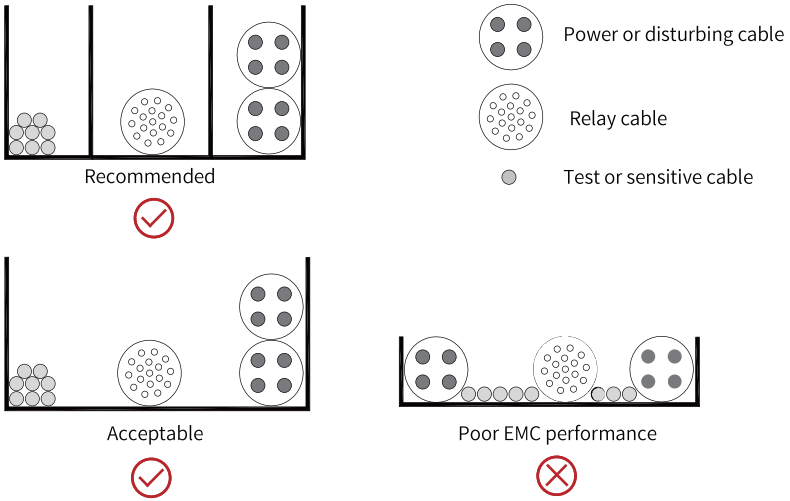


Figure 3-25 Laying multiple types of cables

- **Requirements on handing of shielded cables**
  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 is prone to signal interference. There is no dedicated PE terminal on the MD600 enclosure. In this case, connect the shield to an external PE terminal.

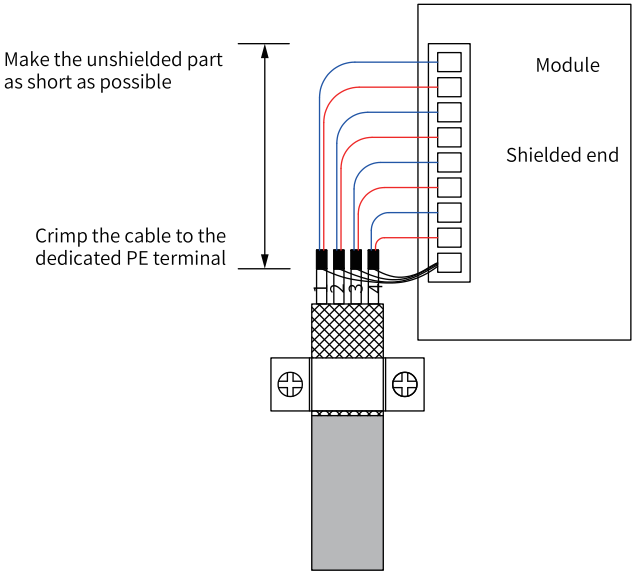


Figure 3-26 Requirements on handing of shielded cables

3.8 Application Instance

This section takes feeding of punch press as an example to describe a typical application of electrical design of the AC drive.

Background

Background information of the project is as follows:

- Basic information of the AC drive: Voltage of three-phase 380 V to 480 V; power of 2.2 kW; braking resistor required
- Application: Inovance PLC+HMI; RS485 communication
- I/O requirements: Four DIs to control start/stop, and forward/reverse rotation of the drive; reset upon fault; speed adjustment by external potentiometer connecting to AI

Schematic diagram design of electrical cabinet

The following figure shows the schematic diagram of the electrical cabinet based on the background information of the project.

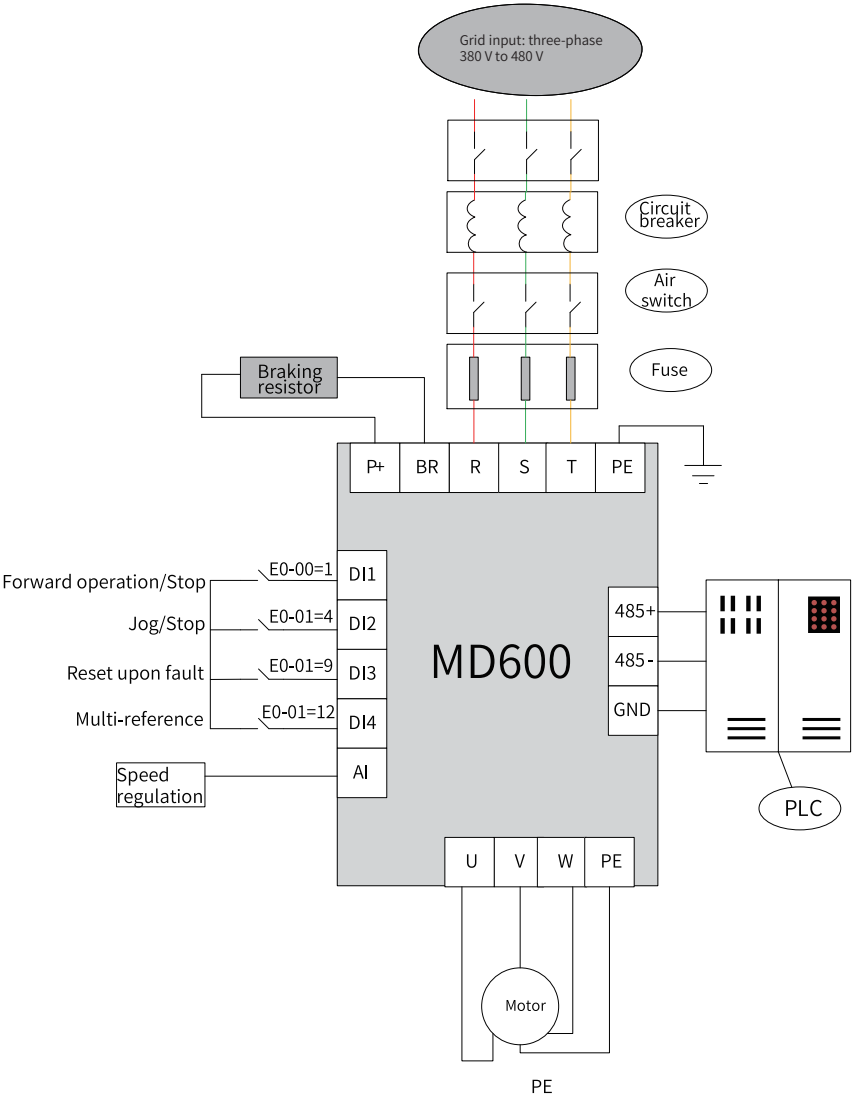


Figure 3-27 Schematic diagram

4 Specifications

4.1 Model Selection

See the following table for key specifications.

Table 4–1 Model selection

Type	Model	Structure	Power	Rated Input Current	Rated Output Current	Product Code	Protocol	Cooling Method	Built-in Braking Unit
RS485 models	**Three-phase 380 V to 480 V**								
	MD600S-4T1R6	T1	0.37	1.9	1.6	0101C431	RS485 communication	Natural ventilation	Not supported
	MD600S-4T2R3	T1	0.75	2.8	2.3	0101C432	RS485 communication	Natural ventilation	Not supported
	MD600S-4T4R8	T1	1.5	5.9	4.8	0101C522	RS485 communication	Air cooling	Not supported
	MD600S-4T5R5B	T1	2.2	6.7	5.5	0101C428	RS485 communication	Air cooling	Supported
	MD600S-4T9R5B	T2	4	11.6	9.5	0101C520	RS485 communication	Air cooling	Supported
	MD600S-4T013B	T2	5.5	15.8	13	0101C429	RS485 communication	Air cooling	Supported
	Single-phase 200 V to 240 V								
	MD600S-2S2R8	T1	0.37	6.2	2.8	0101C427	RS485 communication	Natural ventilation	Not supported
	MD600S-2S4R6	T1	0.75	10.2	4.6	0101C523	RS485 communication	Air cooling	Not supported
	MD600S-2S7R5B	T1	1.5	16.6	7.5	0101C524	RS485 communication	Air cooling	Supported
	MD600S-2S010B	T2	2.2	22.2	10	0101C521	RS485 communication	Air cooling	Supported

Type	Model	Structure	Power	Rated Input Current	Rated Output Current	Product Code	Protocol	Cooling Method	Built-in Braking Unit
CAN models	**Three-phase 380 V to 480 V**								
	MD600A-4T1R6	T1	0.37	1.9	1.6	0101C552	CAN Communication	Natural ventilation	Not supported
	MD600A-4T2R3	T1	0.75	2.8	2.3	0101C554	CAN Communication	Natural ventilation	Not supported
	MD600A-4T4R8	T1	1.5	5.9	4.8	0101C557	CAN Communication	Air cooling	Not supported
	MD600A-4T5R5B	T1	2.2	6.7	5.5	0101C558	CAN Communication	Air cooling	Supported
	MD600A-4T9R5B	T2	4	11.6	9.5	0101C560	CAN Communication	Air cooling	Supported
	MD600A-4T013B	T2	5.5	15.8	13	0101C553	CAN Communication	Air cooling	Supported
	Single-phase 200 V to 240 V								
	MD600A-2S2R8	T1	0.37	6.2	2.8	0101C551	CAN Communication	Natural ventilation	Not supported
	MD600A-2S4R6	T1	0.75	10.2	4.6	0101C555	CAN Communication	Air cooling	Not supported
	MD600A-2S7R5B	T1	1.5	16.6	7.5	0101C556	CAN Communication	Air cooling	Supported
	MD600A-2S010B	T2	2.2	22.2	10	0101C559	CAN Communication	Air cooling	Supported

4.2 Selection Instance

Selection Flow

The following figure shows the AC drive selection flow.

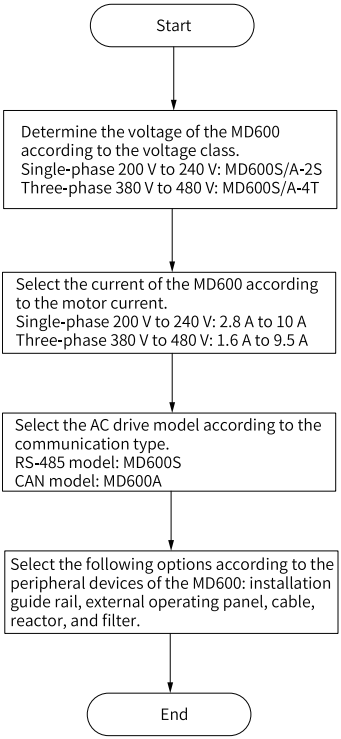


Figure 4-1 Selection flow

Example

The following procedure takes the MD600S-4T1R6 as an example.

1. The voltage range of the MD600S-4T1R6 is three-phase 380 V to 480 V.
2. The current of the MD600S-4T1R6 is 1.6 A.
3. The MD600S-4T1R6 supports RS485 communication.
4. The models of the peripheral devices of the MD600S-4T1R6, such as the AC input reactor, output reactor, and EMC filter are MD-ACL-10-5-4T, MD-OCL-5-1.44, and FN 3287-10-44-C28-R65, respectively.

4.3 Electrical Specifications

In the following tables, the rated power of the AC drive is measured under the following conditions:

- For three-phase 380 V to 480 V models, the rated power is measured at the input voltage of 400 VAC.
- For single-phase 200 V to 240 V models, the rated power is measured at the input voltage of 230 VAC.

Three-phase 380 V to 480 V

Table 4–2 Electrical specifications for T1 to T2 models (three-phase 380 V to 480 V)

Item		Specification					
Model: MD600S/A-4Txxxxx		1R6	2R3	4R8	5R5B	9R5B	013B
Structure		T1				T2	
Input	Rated input current (A)	1.9	2.8	5.9	6.7	11.6	15.8
	Rated voltage/frequency	Three-phase 380 VAC to 480 VAC, 50/60 Hz					
	Allowable voltage fluctuation range	-15% to +10%, or 323 VAC to 528 VAC					
	Allowable frequency fluctuation range	±5%, or 47.5 Hz to 63 Hz					
	Capacity of power supply (kVA)	1.6	2.3	4.9	5.6	9.6	13.1
Output	Power (kW)	0.37	0.75	1.5	2.2	4	5.5
	Rated output current (A)	1.6	2.3	4.8	5.5	9.5	13
	Output voltage	Three-phase 0 V to input voltage					
	Maximum output frequency	599 Hz (edited by parameter)					
	Carrier frequency	0.5 kHz to 16.0 kHz (automatically adjusted according to the load characteristics)					
	Overload capacity	Heavy load: 60s at 150% of the rated current					
Heat dissipation design	Thermal loss (W)	25	31	57	65	100	149
	Air exhaust volume (CFM)	-	-	12	12	19	19
Overvoltage class	OVCIII						
Pollution degree	PD2						
IP rating	IP40 (IP20 for power supply distribution wiring and capacitor vent)						

Single-phase 200 V to 240 V

Table 4–3 Electrical specifications for T1 to T2 models (single-phase 200 V to 240 V)

Item		Specification			
Model: MD600S/A-2Sxxxxx		2R8	4R6	7R5B	010B
Structure		T1			T2
Input	Rated input current (A)	6.2	10.2	16.6	22.2
	Rated voltage/frequency	Single-phase 200 VAC to 240 VAC, 50/60 Hz			
	Allowable voltage fluctuation range	-15% to +10%, or 170 VAC to 264 VAC			
	Allowable frequency fluctuation range	±5%, or 47.5 Hz to 63 Hz			
	Capacity of power supply (kVA)	1.5	2.4	4	5.3

Item		Specification			
Model: MD600S/A-2Sxxxxx		2R8	4R6	7R5B	010B
Output	Power (kW)	0.37	0.75	1.5	2.2
	Rated output current (A)	2.8	4.6	7.5	10
	Output voltage	Three-phase 0 V to input voltage			
	Maximum output frequency	599 Hz (edited by parameter)			
	Carrier frequency	0.5 kHz to 16.0 kHz (automatically adjusted according to the load characteristics)			
	Overload capacity	Heavy load: 60s at 150% of the rated current			
Heat dissipation design	Thermal loss (W)	22	36	55	77
	Air exhaust volume (CFM)	-	12	12	19
Overvoltage class	OVCIII				
Pollution degree	PD2				
IP rating	IP40 (IP20 for power supply distribution wiring and capacitor vent)				

4.4 Technical Specifications

Table 4–4 Technical specifications

Item		Specification
Basic functions	Input frequency resolution	Digital setting: 0.01 Hz Analog setting: maximum frequency x 0.025%
	Control mode	Voltage/frequency (V/f) control
	Torque boost	Automatic torque boost; manual torque boost: 0.1 % to 100.0%
	V/f curve	Straight-line type, multi-point type, and V/f separation
	Acceleration/ deceleration curve	Straight-line or S-curve acceleration/deceleration Four types of straight-line acceleration and deceleration time are supported. The first two types range from 0.0s to 6500.0s, and the last two types range from 0.00s to 650.00s. The S-curve acceleration/deceleration time ranges from 0.00s to 650.00s
	DC braking	Start frequency of DC braking: 0.00 Hz to 599 Hz Braking time: 0.0s to 100.0s Braking current: 0.0% to 100.0%
	Jog control	Frequency range: -50.00 Hz to +50.00 Hz Acceleration/deceleration time: 0.00s to 650.00s
	Simple PLC, multi-speed running	The AC drive can implement up to 16 speeds by using the simple PLC function or control terminals.
	Built-in PID	The PID function facilitates the implementation of the closed-loop process control system.
	Automatic voltage regulation (AVR)	When the mains voltage changes, the output voltage keeps constant automatically.
	Overvoltage and overcurrent suppression control	This function limits the current and voltage automatically during operation to prevent frequent tripping caused by overvoltage/overcurrent.
	Quick current limit	The function minimizes the occurrence of overcurrent to ensure normal operation of the AC drive.
Customized functions	Undervoltage suppression	The load feedback energy compensates for any voltage reduction upon an instantaneous power failure, allowing the AC drive to continue to operate for a short period.
	Virtual DI/DO	Five groups of virtual DIs/DOs are supported to implement simple logic control.
	Timing control	Time range: 0.0 minute to 6500.0 minutes
	Multiple field buses	Modbus (Modbus RTU), CANlink, and CANopen buses are supported.
	Powerful software	The software allows you to upload and download AC drive parameters and supports the virtual oscilloscope function. You can monitor the internal state of the AC drive through the virtual oscilloscope.

Item		Specification
Operation	Operation command source	Operating panel, control terminal, and serial communication port (switchable in multiple ways)
	Frequency source	The drive supports 10 frequency reference sources, including digital setting, analog voltage, analog current, pulse setting, and serial communication ports (switchable in multiple ways).
	Auxiliary frequency	The drive supports 10 auxiliary frequency reference sources. The auxiliary frequency reference can be used together with the main frequency reference to implement fine adjustment and frequency superposition.
	Input terminal	RS485 models: Four DIs, among which DI1 to DI3 are normal terminals and DI4 is a high-speed terminal (max. frequency of signal: 20 kHz); one AI, which supports voltage input of –10 V to +10 V or current input of 0 mA to 20 mA (switched via the DIP switch) CAN models: Five DIs, among which DI1 to DI3 and DI5 are normal terminals and DI4 is a high-speed terminal (max. frequency of signal: 20 kHz); one AI, which supports voltage input of -10 V to +10 V or current input of 0 mA to 20 mA (switched via the DIP switch).
	Output terminal	RS485 models: One dual-contact relay output terminal; contact driving capability: 250 VAC, 3 A, COSØ=0.4; one AO, which supports current output of 0 mA to 20 mA or voltage output of 0 V to 10 V CAN models: Two normal DOs; one dual-contact relay output terminal; contact driving capability: 250 VAC, 3 A, COSØ=0.4
Operating panel and display	LED display	The LED displays parameters.
	LCD display	Optional and two languages (Chinese or English) available
	Parameter copy	It allows quick parameter copy through the LCD operating panel (optional).
	Key locking and function selection	The function can be used to lock the keys partially or completely and limit the availability of some keys to prevent accidental operation.

Item		Specification
Protective functions	Phase loss protection	Input/output phase loss protection
	Instantaneous overcurrent protection	The drive stops when the output current reaches the overcurrent protection point.
	Overvoltage protection	The drive stops when the DC voltage of the main circuit is above 820 V (applicable to three-phase 380 V models). The drive stops when the DC voltage of the main circuit is above 410 V (applicable to single-phase 220 V models).
	Undervoltage protection	The drive stops when the DC voltage of the main circuit is lower than 350 V (applicable to three-phase 380 V models). The drive stops when the DC voltage of the main circuit is lower than 190 V (applicable to single-phase 220 V models).
	Overtemperature protection	Protection is triggered when the inverter bridge gets overheated.
	Overload protection	The drive stops 60s after operating at 150% of the rated current.
	Short circuit protection	Protection against output inter-phase short circuit and output short-circuited to ground
Environment	Operating location	Indoors without direct sunlight, dust, corrosive gas, combustible gas, oil mist, water vapor, drip, or salt
	Altitude	Below or equal to 1000 m: derating not required; 1000 m < altitude ⩽ 2000 m: de-rated by 1% for every additional 100 m; maximum altitude: 2000 m If the altitude is higher than 2000 m, consult your Inovance agent or sales personnel.
	Ambient temperature	-10°C to +50°C. 40°C to 50°C: de-rated by 1.5% for every additional 1°C.
	Humidity	Less than 95% RH, non-condensing
	Vibration resistance	• Usage scenario: Test according to IEC 60068-2-6. Amplitude at 5 Hz to 8.4 Hz: 3.5 mm; acceleration at 8.4 Hz to 200 Hz: 1 g; 10 cycles/axis • Transportation scenario: Test according to IEC 60068-2-64. Power spectrum density at 5 Hz to 100 Hz: 0.01 g^2/Hz; power spectrum density at 200 Hz: 0.001 g^2/Hz; Grms: 1.14 g
	Shock	Usage/transportation scenario: Test according to IEC 60068-2-27. Acceleration: 15 g; pulse width; 11 ms; 18 times in directions of three axes
	Storage temperature	-20°C to +60°C

4.5 Option Specifications

4.5.1 List of Options

Optional peripherals include braking units and external operating panels, as listed in the following table. For use of each option, see its user guide. If any option is required, specify it in your order.

Table 4–5 Option list

Type	Name	Option Model	Ordering Code	Applicable Drive Model	Function
Operating panel	Hand-held LCD operating panel	SOP-20-810	01040028	All models	External LCD operation panel, which supports Chinese and English display, parameter copying, and connection to the background.
	Smart operating panel	MD-BP-M	01040264	All models	The external LED operating panel supports digital and English display, parameter setting, and status monitoring.
Cable	Main circuit cable	The recommended cable lug manufacturer is Zhejiang Kise. For details of recommended lugs, see "4.5.3.3 Cable Lug" on page 80.			It is recommended that the input and output main circuit cables use symmetrical shielded cables. Compared with four-conductor cables, symmetrical shielded cables can reduce electromagnetic radiation in the whole transmission system. It is recommended that power cables also use symmetrical shielded cables.
	Control circuit cables	All control circuit cables must be shielded cables. Use a separate shielded cable for each type of analog signal. It is recommended that digital signal cables use shielded twisted pair (STP) cables.			
	Extension cable	MDCAB	01013008	All models	The standard 8-conductor network cable can be used to connect to the SOP-20-810 through the network port or connect to the software installed on the computer through the relay mode of the SOP-20-810.
Option	DIN rail	MD600-DGJ1	01040265	Applicable only to T1 models	It is used to install the T1 model.
	SOP-20-810 mounting base	CP600–BASE1	01040022	All models	It is used to install the SOP-20-810 to the cabinet door.

Note

For the list of peripheral electrical devices, see "1.5 System Connection" on page 18.

4.5.2 Operating Panel

Model	Description	Appearance
SOP-20-810	It is an optional LCD operating panel that supports parameter copy, download, and modification and supports English and Chinese. For dimensions, see *"Figure 4–2 Dimensions (unit: mm) of the SOP-20-810" on page 75* and *"Figure 4–3 Mounting bracket dimensions and hole sizes (mm) of the SOP-20-810" on page 75*.	
MD-BP-M	It is an optional LED operating panel that supports parameter setting, parameter modification, and status monitoring. It can display digits and English letters for easy operation. For dimensions, see *"Figure 4–5 Dimensions (unit: mm) of the cabinet door opening for mounting the MD-BP-M through the snap-fit joint" on page 76* and *"Figure 4–6 Dimensions (unit: mm) of the cabinet door opening for mounting the MD-BP-M with screws" on page 77*.	

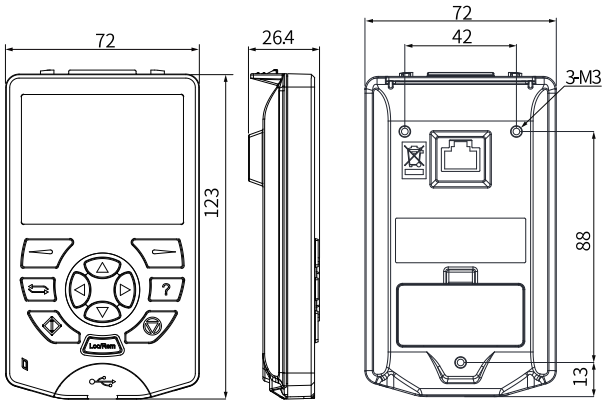


Figure 4-2 Dimensions (unit: mm) of the SOP-20-810

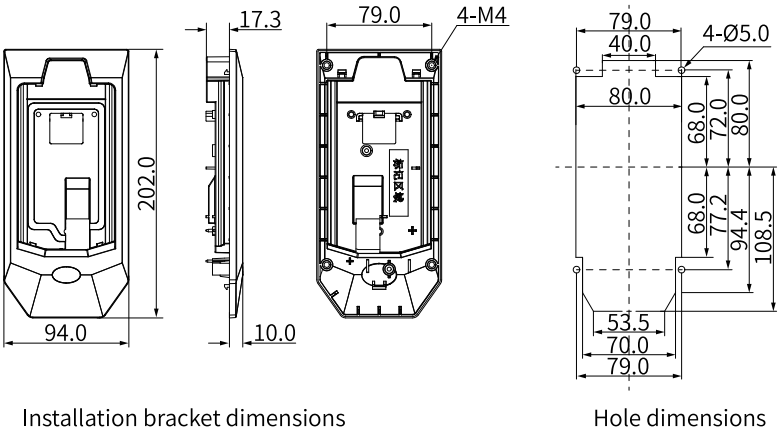


Figure 4-3 Mounting bracket dimensions and hole sizes (mm) of the SOP-20-810

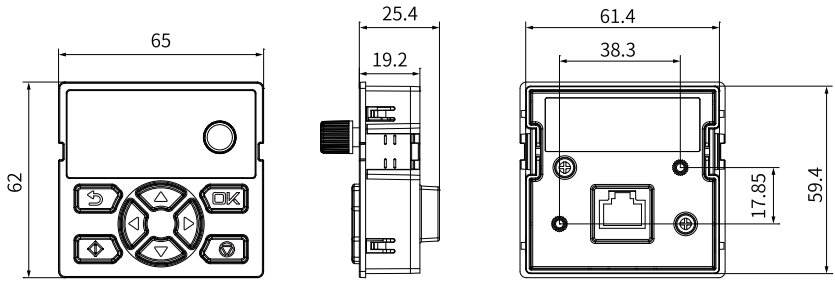


Figure 4-4 Dimensions (unit: mm) of the MD-BP-M

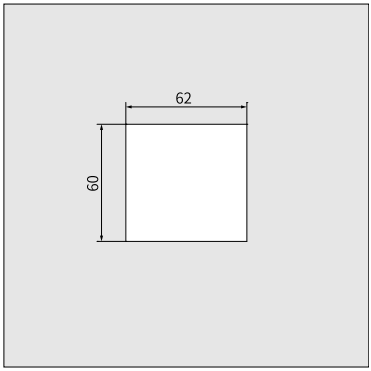


Figure 4-5 Dimensions (unit: mm) of the cabinet door opening for mounting the MD-BP-M through the snap-fit joint

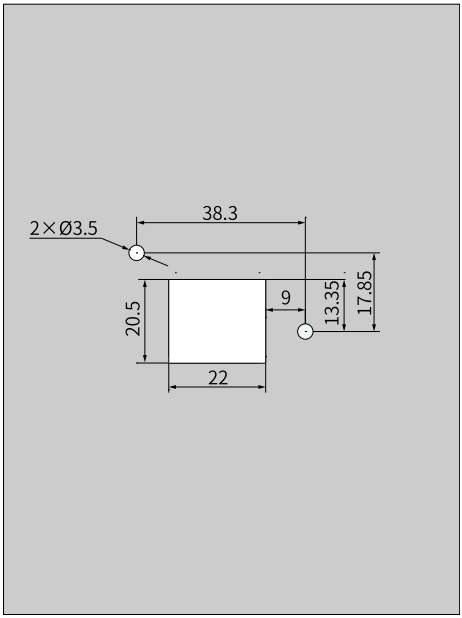


Figure 4-6 Dimensions (unit: mm) of the cabinet door opening for mounting the MD-BP-M with screws

4.5.3 Cables

4.5.3.1 Main Circuit Cables

Power cable selection requirements

For the selection of power cables, follow national or regional regulations. Select IEC cables based on the following requirements:

- Compliant with IEC 60204-1 and IEC 60364-5-52 standards
- PVC insulated cables with copper conductors
- Heat resistance: ambient temperature of 40°C and cable surface temperature of 70°C (Note: When the ambient temperature exceeds 40°C, contact Inovance.)
- Symmetrical cable with copper-braided shield

If specifications of recommended cables for peripheral devices or options are outside the specification range of the cables applicable to the product, contact Inovance.

To meet the EMC requirements, the cable with the shield must be used. The shielded cables are divided into three-conductor cables and four-conductor cables, as shown below. If the conductivity of the three-conductor cable shield cannot meet requirements, add an independent PE cable. Alternatively, use a four-conductor cable with one conductor as the PE wire. The shield of the shielded cable is comprised of

coaxial cooper braids to suppress radio frequency interference. To enhance the shielding performance and conductivity, the braided density of the shield must be greater than 90%.

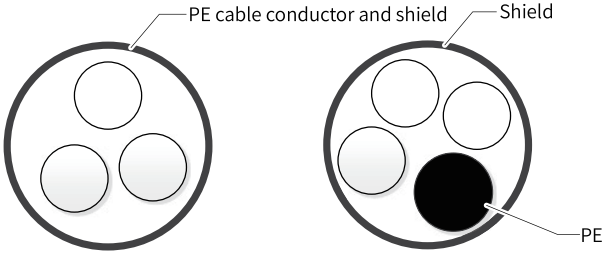


Figure 4-7 Recommended power cable

Recommended cable

Table 4–6 Cable selection (three-phase 380 V to 480 V)

Structure	Model	Power (kW)	Braking Current (A)	Input/Output Terminal		Braking Terminal		Input/output Grounding	
				Recommended Cable Specification (mm^2)	Recommended Lug Specification	Recommended Cable Specification (mm^2)	Recommended Lug Specification	Recommended Cable Specification (mm^2)	Recommended Lug Specification
T1	MD600S/A-4T1R6	0.37	No braking	0.75	E7510	-	-	0.75	E7510
	MD600S/A-4T2R3	0.75	No braking	0.75	E7510	-	-	0.75	E7510
	MD600S/A-4T4R8	1.5	No braking	0.75	E7510	-	-	0.75	E7510
	MD600S/A-4T5R5B	2.2	3.3	1	E1010	1	E1010	1	E1010
T2	MD600S/A-4T9R5B	4	6.4	2.5	E2512	1.5	E1510	2.5	E2512
	MD600S/A-4T013B	5.5	8.5	2.5	E2512	1.5	E1510	2.5	E2512

Table 4–7 Cable selection (single-phase 200 V to 240 V)

Structure	Model	Power (kW)	Braking Current	Input/Output Terminal		Braking terminal		Input/output Grounding	
				Recommended Cable Specification (mm^2)	Recommended Lug Specification	Recommended Cable Specification (mm^2)	Recommended Lug Specification	Recommended Cable Specification (mm^2)	Recommended Lug Specification
T1	MD600S/A-2S2R8	0.37	No braking	1	E1010	-	-	1	E1010
	MD600S/A-2S4R6	0.75	No braking	2.5	E2510	-	-	2.5	E2510
	MD600S/A-2S7R5B	1.5	4.6	2.5	E2510	1	E1010	2.5	E2510
T2	MD600S/A-2S010B	2.2	6.9	4	E4012	1.5	E1510	4	E4012

4.5.3.2 Control Circuit Cable

Note

Wire the control circuit cable according to EN 60204-1.

To ensure that I/O signal cables are not affected by peripheral interference and noise, use shielded cables with the shield for signal cables. Install the signal shield bracket at each end of the shield to reliably connect the shield to the AC drive in 360°. Use separate shielded cables for different analog signals. It is recommended to use shielded twisted pair (STP) cables for digital signals.

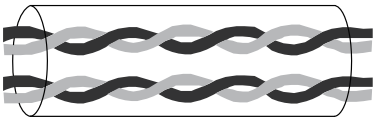


Figure 4-8 STP cable

Table 4–8 Specifications of the control circuit cable

Structure	Terminal Type	Recommended IEC Cable Specification (mm^2)	Recommended Lug Specification
T1	Control signal terminal	0.5 to 0.75	IEC: • 0.5 mm^2 (E0510) • 0.75 mm^2 (E7510) • 1 mm^2 (E1010) • 1.5 mm^2 (E1510)
	Relay terminal	0.5 to 1.5	
T2	Control signal terminal	0.5 to 0.75	
	Relay terminal	0.5 to 1.5	

4.5.3.3 Cable Lug

It is recommended to use the tube pre-insulated lugs (TG-JT type) produced by Zhejiang KISE Terminal Co., Ltd.

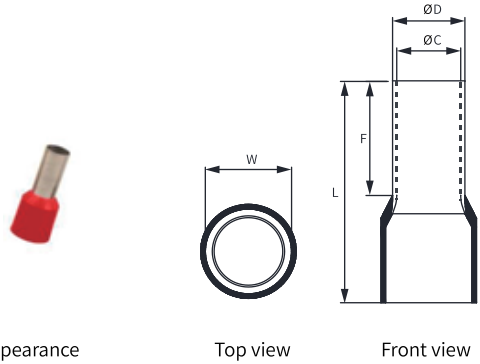


Figure 4-9 Appearance and dimensions of the tube pre-insulated lug (TG-JT type)

Table 4–9 Specifications and dimensions of the tube pre-insulated lugs (TG-JT type)

Cross Sectional Area	Model	Dimensions (mm)					Insulation Sheath Color (1) For Germany (2) For France	Crimping Tool
		F	L	W	Dφ	Cφ		
22AWG 0.5 mm^2	E0510	10.0	16.0	2.7	1.3	1.0	(1) Orange (2) White	OPT AN-04WF
20AWG 0.75 mm^2	E7510	10.0	16.0	2.8	1.5	1.2	(1) White (2) Blue	OPT AN-04WF
18AWG 1.0 mm^2	E1010	10.0	16.5	2.9	1.7	1.4	(1) Yellow (2) Red	OPT AN-04WF
16AWG 1.5 mm^2	E1510	10.0	16.5	3.5	2	1.7	(1) Red (2) Black	OPT AN-04WF

Cross Sectional Area	Model	Dimensions (mm)					Insulation Sheath Color (1) For Germany (2) For France	Crimping Tool
		F	L	W	Dϕ	Cϕ		
14AWG 2.5 mm^2	E2510	10.0	17.5	4.1	2.6	2.3	(1) Blue (2) Gray	OPT AN-04WF
	E2512	12.0	19.5	4.1	2.6	2.3	(1) Blue (2) Gray	OPT AN-04WF
12AWG 4.0 mm^2	E4012	12.0	19.5	4.5	3.15	2.8	(1) Gray (2) Orange	OPT AN-10WF

4.5.4 Peripheral Electrical Components

4.5.4.1 Circuit Breaker, Fuse, and Electromagnetic Contactor

The following tables list recommended circuit breakers, fuses, and contactors.

Table 4–10 Circuit breaker, fuse, and electromagnetic contactor (three-phase 380 V to 480 V)

Structure	Model	Specification of Recommended Semiconductor Fuse	Specification of Recommended Contactor	Minimum Specification of Recommended D-Type Circuit Breaker
		Rated Current (A)	Rated Current (A)	Rated Current (A)
T1	MD600S/A-4T1R6	5	9	3
	MD600S/A–4T2R3	5	9	4
	MD600S/A–4T4R8	10	9	10
	MD600S/A–4T5R5B	15	9	10
T2	MD600S/A–4T9R5B	20	16	16
	MD600S/A-4T013B	32	25	20

Table 4–11 Circuit breaker, fuse, and electromagnetic contactor (single-phase 200 V to 240 V)

Structure	Model	Specification of Recommended Semiconductor Fuse	Specification of Recommended Contactor	Minimum Specification of Recommended D-Type Circuit Breaker
		Rated Current (A)	Rated Current (A)	Rated Current (A)
T1	MD600S/A-2S2R8	10	9	10
	MD600S/A–2S4R6	20	16	16
	MD600S/A–2S7R5B	32	25	20
T2	MD600S/A-2S010B	40	32	32

4.5.4.2 AC Input Reactor

An AC input reactor is mainly used to reduce harmonics in the input current. In applications where harmonics need to be suppressed, install an optional AC input reactor.

Inovance AC input reactor

Recommended AC input reactor manufacturers and models are listed in the following tables.

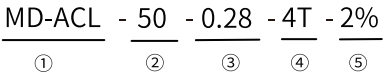


Figure 4-10 AC input reactor model

①	**Internal code** MD-ACL: Inovance AC input reactor	④	**Rated voltage** 4T: 380 V
②	**Rated current** 50: 50 A	⑤	**Voltage drop percentage** 2%: 2%
③	**Inductance** 0.28: 0.28 mH	-	

Table 4–12 Selection of AC input reactors (three-phase 380 V to 480 V)

Structure	AC Drive Model	Reactor Model	Inductance (mH)	Loss (W)
T1	MD600S/A-4T1R6	MD-ACL-10-5-4T	5	-
	MD600S/A-4T2R3	MD-ACL-10-5-4T	5	-
	MD600S/A-4T4R8	MD-ACL-10-5-4T	5	-
	MD600S/A-4T5R5B	MD-ACL-10-5-4T	5	-
T2	MD600S/A-4T9R5B	MD-ACL-15-3-4T	3	-
	MD600S/A-4T013B	MD-ACL-15-3-4T	3	-

Dimensions

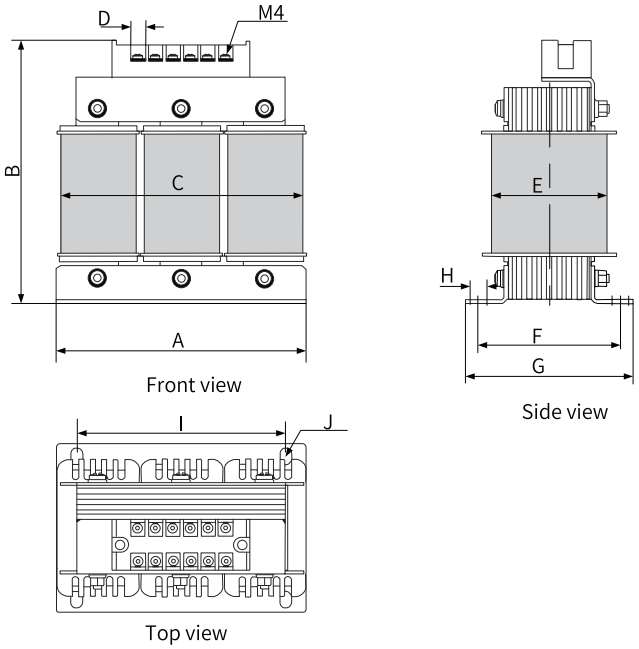


Figure 4-11 Dimensions of AC input reactors (10 A/15 A)

Table 4–13 Dimensions of AC input reactors (10 A/15 A) (unit: mm)

Model	A	B	C	D	E	F	G	H	I	J
MD-ACL-10-5-4T	150±2	160	155	8	80	85±2	100±2	10	125±2	Φ7x10
MD-ACL-15-3-4T	150±2	160	155	8	80	85±2	100±2	10	125±2	Φ7x10

4.5.4.3 Output Reactors

With an output reactor installed on the output side of the drive, the excessive dV/dt can be reduced, lowering the voltage stress on the motor winding. This protects the motor winding, lowers the motor temperature, and prolongs the service life of the motor. Whether to install an output reactor on the output side of the AC drive is dependent on the actual situation. The cable connecting the AC drive and motor cannot be too long. Otherwise, large distributed capacitance and high harmonics current will be caused. When the application environment has high requirements on grid harmonics suppression, you can choose an optional reactor as required.

Inovance AC output reactor

Models and dimensions of the recommended Inovance AC output reactors are as follows.

MD-OCL - 50 - 0.14 - 4T - 1%
① ② ③ ④ ⑤

Figure 4-12 AC output reactor model

①	**Internal code** MD-OCL: Inovance AC output reactor	④	**Rated voltage** 4T: 380 V
②	**Rated current** 50: 50 A	⑤	**Voltage drop percentage** 1%: 1%
③	**Inductance** 0.14: 0.14 mH	-	

Table 4–14 Recommended models of the AC output reactor (three-phase 380–480 V)

Structure	AC Drive Model	Rated Current (A)	Rated Power (kW)	Reactor Model	Inductance (mH)
T1	MD600S/A-4T1R6	1.6	0.37	MD-OCL-5-1.4-4T-1%	1.4
	MD600S/A-4T2R3	2.3	0.75	MD-OCL-5-1.4-4T-1%	1.4
	MD600S/A-4T4R8	4.8	1.5	MD-OCL-7-1.0-4T-1%	1.0
	MD600S/A-4T5R5B	5.5	2.2	MD-OCL-10-0.7-4T-1%	0.7
T2	MD600S/A-4T9R5B	9.5	4	MD-OCL-15-0.47-4T-1%	0.47
	MD600S/A-4T013B	13	5.5	MD-OCL-15-0.47-4T-1%	0.47

Table 4–15 Recommended models of the AC output reactor (single-phase 200–240 V)

Structure	AC Drive Model	Rated Current (A)	Rated Power (kW)	Reactor Model	Inductance (mH)
T1	MD600S/A-2S2R8	2.8	0.37	MD-OCL-5-1.4-4T-1%	1.4
	MD600S/A-2S4R6	4.6	0.75	MD-OCL-7-1.0-4T-1%	1.0
	MD600S/A-2S7R5B	7.5	1.5	MD-OCL-10-0.7-4T-1%	0.7
T2	MD600S/A-2S010B	10	2.2	MD-OCL-15-0.47-4T-1%	0.47

Dimensions

The following figures describe dimensions of the AC output reactor.

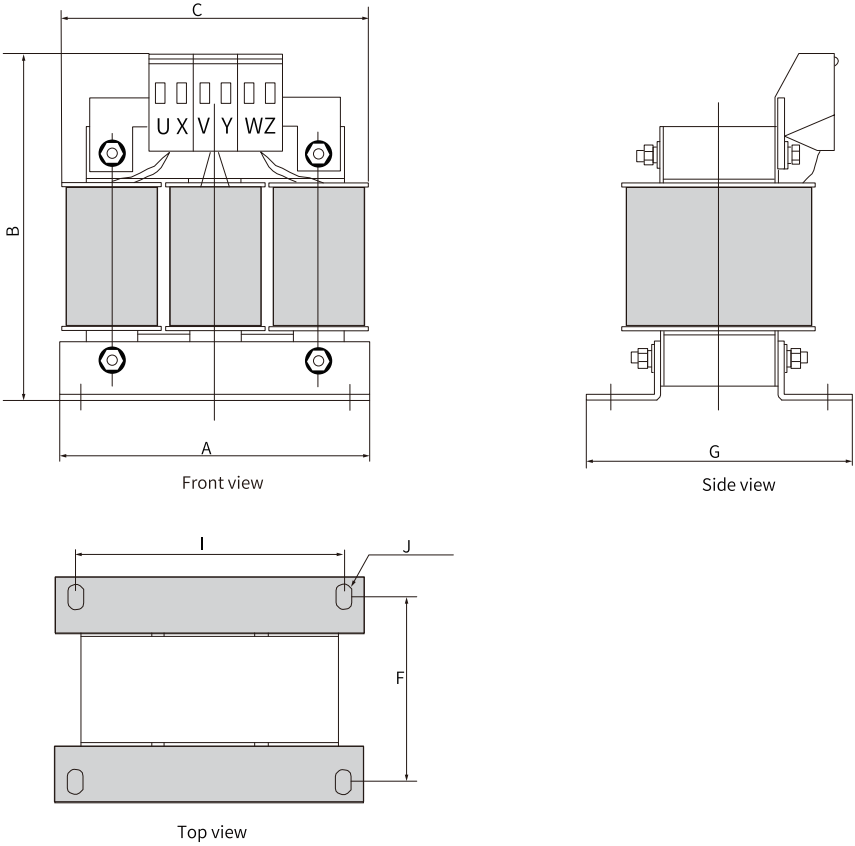


Figure 4-13 Dimensions of AC output reactors (5-10 A)

Table 4–16 Dimensions of AC output reactor (5-10 A, unit: mm)

Model	A	B	C	G	F	I	J
MD-OCL-5-1.4-4T-1%	105±1	130	110	84±2	65±2	91±1	Φ6*11
MD-OCL-7-1.0-4T-1%	105±1	130	110	84±2	65±2	91±1	Φ6*11
MD-OCL-10-0.7-4T-1%	105±1	130	110	84±2	65±2	91±1	Φ6*11

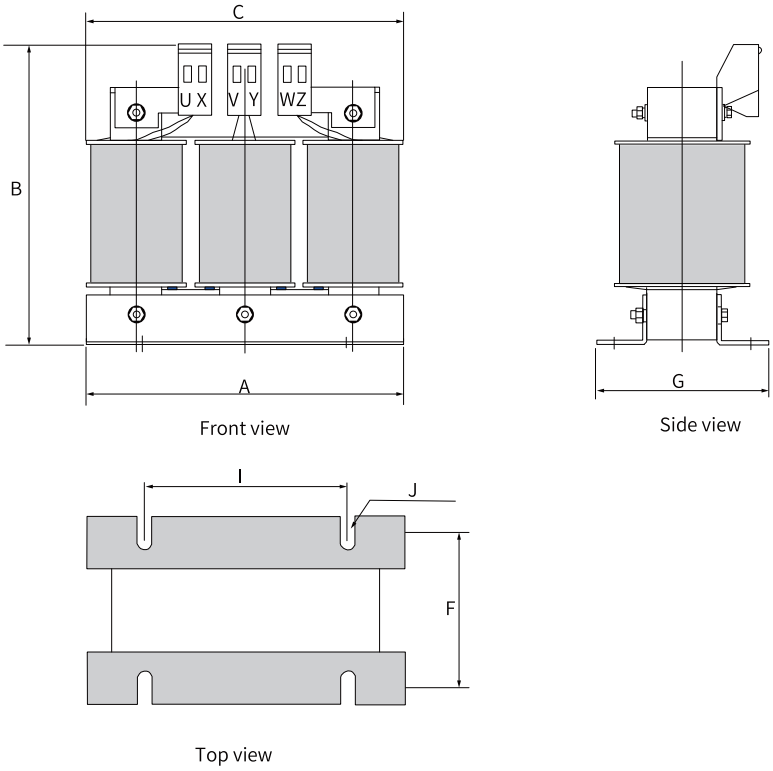


Figure 4-14 Dimensions of AC output reactors (15 A)

Table 4–17 Dimensions of AC output reactors (15 A, unit: mm)

Model	A	B	C	G	F	I	J
MD-OCL-15-0.47-4T-1%	148±1	140	155	76±2	61±2	95±1	Φ6*15

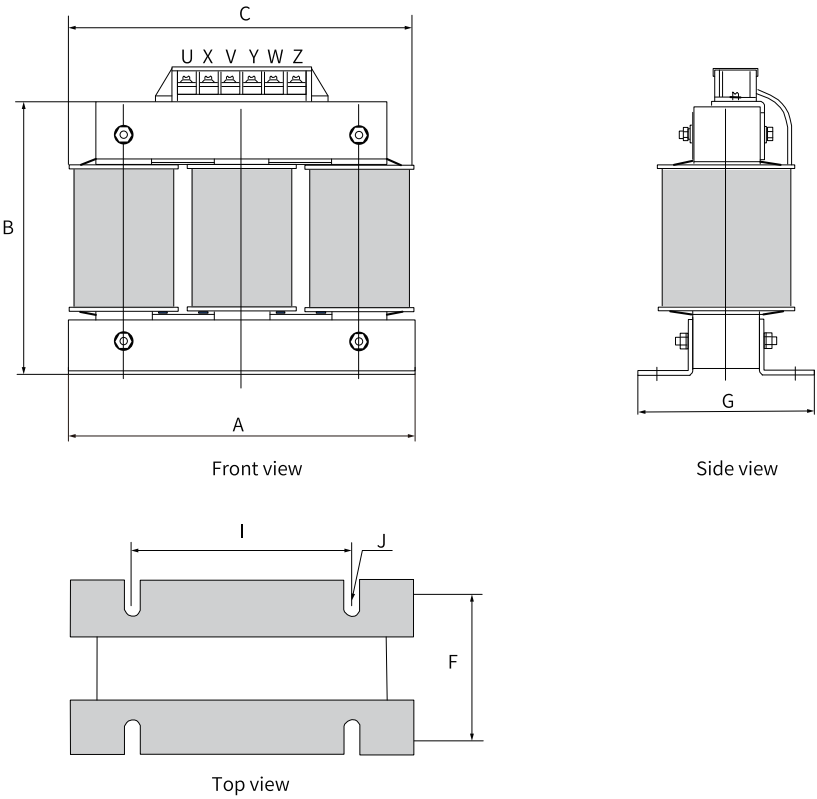


Figure 4-15 Dimensions of AC output reactors (20 A)

Table 4–18 Dimensions of AC output reactors (20 A, unit: mm)

Model	A	B	C	G	F	I	J
MD-OCL-20-0.35-4T-1%	148±1	165	155	76±2	61±2	95±1	Φ6*15

4.5.4.4 EMC Filter

To comply with the requirements of EN IEC 61800-3, install an external EMC filter listed in the following table. You can select FN 2090 and FN 3287 series EMC filters manufactured by Schaffner. Select the EMC filter according to the rated input current of the drive, as shown in the following table.

Note

If you need a filter of Schaffner, you can purchase it from the manufacturer.

Model selection

Table 4–19 Standard EMC filter model and appearance

Filter Model		Appearance
Schaffner	FN2090 series	
	FN3287 series	

Table 4–20 Selection of EMC filters (three-phase 380 V to 480 V)

Structure	AC Drive Model	Rated Current (A)	Applicable Filter
T1	MD600S/A-4T1R6	1.6	FN 3287-10-44-C28-R65
	MD600S/A-4T2R3	2.3	FN 3287-10-44-C28-R65
	MD600S/A-4T4R8	4.8	FN 3287-10-44-C28-R65
	MD600S/A-4T5R5B	5.5	FN 3287-10-44-C28-R65
T2	MD600S/A-4T9R5B	9.5	FN 3287-16-44-C33-R65
	MD600S/A-4T013B	13	FN 3287-16-44-C33-R65

Table 4–21 Selection of EMC filters (single-phase 200-240 V)

Structure	AC Drive Model	Rated Current (A)	Applicable Filter
T1	MD600S/A-2S2R8	2.8	FN 2090-8-06
	MD600S/A-2S4R6	4.6	FN 2090-10-06
	MD600S/A-2S7R5B	7.5	FN 2090-16-06
T2	MD600S/A-2S010B	10	FN 2090-22-06

Dimensions

- Dimensions of Schaffner FN 2090 series filters

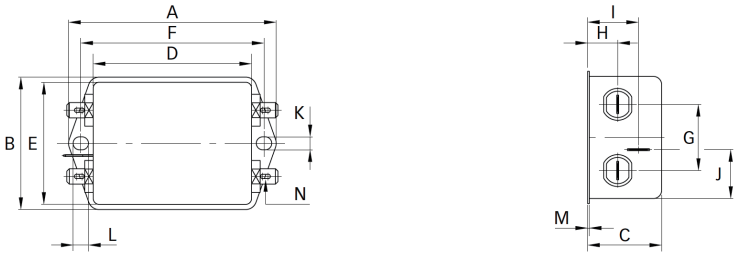


Figure 4-16 Dimensions of FN 2090 series filters (unit: mm)

Table 4–22 Dimensions of FN 2090 series filters (unit: mm)

Rated Current (A)	A	B	C	D	E	F	G	H	I	J	K	L	M	N
3	85	54	30.3	64.8	49.8	75	27	12.3	20.8	19.9	5.3	6.3	0.7	6.3 x 0.8
4														
6														
8	113.5±1	57.5±1	45.4±1	94±1	56	103	25	12.4	32.4	15.5	4.4	6	1	6.3 x 0.8

- Dimensions of Schaffner FN 3287 series filters

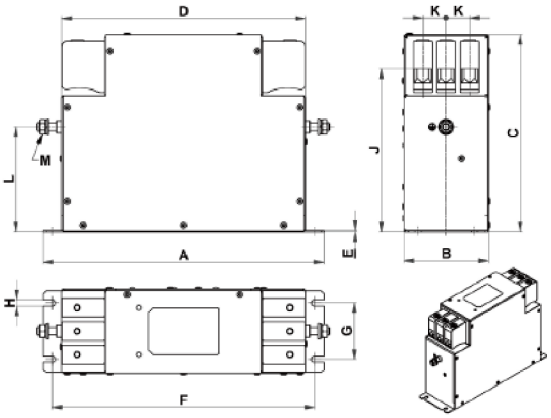


Figure 4-17 Dimensions of FN 3287 series filters (unit: mm)

Table 4–23 Dimensions of FN 3287 series filters (unit: mm)

Rated Current (A)	A	B	C	D	E	F	G	H	J±2	K	L±1	M
10	180	40	112	153	0.8	170	20	4.5	94	11	68	M5
16	200	45	112	170	0.8	185	25	5.4	102	11	76	M5
25	205	45	132	173	0.8	190	25	5.4	113	13	83	M5

Note

If you need an EMC filter of Schaffner, you can purchase it from the manufacturer.

4.5.4.5 Magnetic Ring and Ferrite Clamp

Model selection

The magnetic ring can be installed on the input or output side of the drive. Install the magnetic ring as close to the drive as possible. Installing the magnetic ring on the input side can suppress the noise in the input power supply system of the drive. When it is installed on the output side, it can reduce the interference generated by the drive to external devices and can reduce the bearing current.

In applications with leakage current and signal cable interference, install a magnetic ring or a ferrite clamp.

- Amorphous magnetic ring: featuring high permeability when the frequency is within 1 MHz and excellent anti-interference performance, but not as low-cost as the ferrite clamp.

- Ferrite clamp: featuring high permeability when the frequency is above 1 MHz and excellent suppression performance on interference generated by low-power drives and signal cables

DY644020H, DY805020H, and DY1207030H are all amorphous magnetic rings.

Table 4–24 Appearance and models of the magnetic ring and ferrite clamp

Type	Model	Appearance
Magnetic ring	DY644020H	
	DY805020H	
	DY1207030H	
Ferrite clamp	DYR-130-B	

Dimensions

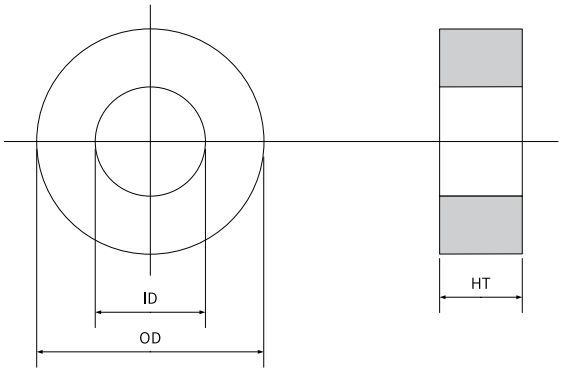


Figure 4-18 Dimensions of the magnetic ring

Table 4–25 Dimensions of the magnetic ring

Model	Dimension (OD x ID x HT) (mm)
DY644020H	64 x 40 x 20
DY805020H	80 x 50 x 20
DY1207030H	120 x 70 x 30

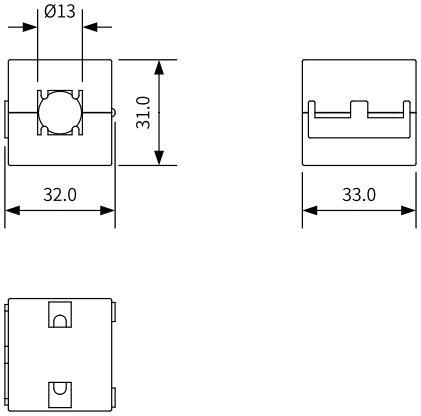


Figure 4-19 Ferrite clamp dimensions (unit: mm)

4.5.4.6 Braking Resistor

Resistance of braking resistors

The internal braking unit of the AC drive processes the regenerative energy generated by the motor during deceleration. When the voltage of the DC bus exceeds the limit

set by the software, the braking unit automatically turns on and connects the braking resistor to the DC bus. The braking resistor consumes the regenerative energy to keep the bus voltage within the safe range. The braking resistor is disconnected until the bus voltage drops below a certain range. The resistance of the braking resistor is calculated by the following formula:

$$R = \frac{U_{BR}^2}{P_{BR}} = \frac{U_{BR}^2}{P_N * k * \eta_{motor} * \eta_{inverter}}$$

Note

When the braking power is fed back from the motor to the U/V/W cable, and then fed back from the U/V/W cable to the DC bus of the drive, the braking power will be derated by the motor efficiency and the drive efficiency, respectively. Therefore, the braking power actually consumed by the braking resistor will be lower. The conversion coefficient is roughly estimated to be from 0.8 to 0.9.

R: Resistance of the braking resistor

U_{BR}: AC drive starting braking voltage (three-phase 380 V to 480 V models: 760 V by default; single-phase 200 V to 240 V models: 370 V by default; the default values can be modified.)

P_{BR}: Braking power that needs to be consumed by the braking resistor on the DC bus of the drive

P_n: Rated power of the AC drive

k: Multiple of the braking torque to the rated torque. Generally, it is set to 1.25 or around. The k value can be adjusted according to the actual situation.

n_{motor}: Motor efficiency. It is generally set to 0.85 or around or the actual motor efficiency. It can also be estimated by reference to the efficiency of the four-pole motor energy efficiency class IE3 specified in the IEC 60034-30-2 standard.

$n^{Inverter}$: It is generally set to 0.98 or around.

Power of braking resistors

In theory, the power of the braking resistor and the braking power are the same. However, because the braking resistor is naturally ventilated in the power supply distribution cabinet, power derating must be applied. Assume that the derating coefficient is α. You can select the rated power of the braking resistor according to the following formula:

$$P = \frac{P_{BR} * D}{\alpha}$$

P: Rated power of the braking resistor

α: Power derating value of the braking resistor. It is generally about 50%. Depending on the type and the actual cooling conditions of the resistor, a higher derating value is required if the temperature of the resistor rises. Otherwise, a fire caused by overheating of the resistor may occur. Therefore, select the power according to the actual situation.

D: Braking frequency, that is, percentage of the regenerative process to the whole working process.

Braking frequency (D) is determined by application. The following table lists the typical braking frequency in different applications.

Common Application	Elevator	Winding/ Unwinding Machine	Centrifuge	Occasional Braking Load	Regular Applications
Braking frequency	20% to 30%	20% to 30%	50% to 60%	5%	10%

Table 4–26 Selection of braking resistors (three-phase 380-480 V)

Structure	AC Drive Model	Applicable Motor (kW)	Braking Unit	Recommended Braking Resistor Specification (125% of Braking Torque, ED: 10% ; Max. 10s)	Quantity of Braking Resistors	Minimum Braking Resistance (Ω)	Remarks
T1	MD600S/A-4T1R6	0.37	N/A	-	-	-	Without built-in braking unit
	MD600S/A-4T2R3	0.75		-	-	-	
	MD600S/A-4T4R8	1.5		-	-	-	
	MD600S/A-4T5R5B	2.2	Built-in	440 W/250 Ω	1	69	AC drive model with the model name containing B
T2	MD600S/A-4T9R5B	4		800 W/130 Ω	1	41	
	MD600S/A-4T013B	5.5	Built-in	1100 W/100 Ω	1	41	

Table 4–27 Selection of braking resistors (single-phase 200-240 V)

Structure	AC Drive Model	Applicable Motor (kW)	Braking Unit	Recommended Braking Resistor Specification (125% of Braking Torque, ED: 10% ; Max. 10s)	Quantity of Braking Resistors	Minimum Braking Resistance (Ω)	Remarks
T1	MD600S/A-2S2R8	0.37	N/A	-	-	-	Without built-in braking unit
	MD600S/A-2S4R6	0.75		-	-	-	
	MD600S/A-2S7R5B	1.5	Built-in	300 W/90 Ω	1	52	AC drive model with the model name containing B
T2	MD600S/A-2S010B	2.2		440 W/60 Ω	1	26	

Note

- The braking resistance in the preceding table is calculated based on the braking usage rate (ED) of 10% and the longest time for single braking of 10s.
- The default initial braking voltages of built-in braking units for the 380-480 V models and 200-240 V models are 760 V and 370 V, respectively.
- The data in the preceding table is only for reference. You can select the resistance and power of the braking resistor as required. (Note that the resistance cannot be lower than the recommended minimum value, whereas the power can exceed the recommended value.) Select the braking resistor based on the generation power of the motor in the actual system, system inertia, deceleration time, and potential energy load.
- Larger system inertia requires shorter deceleration time and more frequent braking. In this case, select a braking resistor with a higher power rating and lower resistance.

5 Solutions to Common EMC Problems

5.1 Earth Leakage Circuit Breaker Malfunction

When the earth leakage circuit breaker (ELCB) malfunctions, perform troubleshooting according to the following table.

Table 5–1 Troubleshooting when the ELCB malfunctions

Trip	Possible Cause	Solution
Trip upon power-on	The anti-interference performance of the ELCB is poor.	1. Use an ELCB from a recommended manufacturer. 2. Use an ELCB with a higher tripping current. 3. Move the unbalanced load to the front end of the ELCB.
	The action current of the ELCB is too low.	
	Unbalanced load is connected to the back end of the ELCB.	
	The capacitance to the ground at the front end of the AC drive is large.	
Trip during operation	The anti-interference performance of the ELCB is poor.	1. Use an ELCB from a recommended manufacturer. 2. Install a simple filter on the input side of the drive, and wind the LN/RST cables through a magnetic ring near the ELCB, as shown in *"Figure 5–1 Installing a simple filter and magnetic ring on the input side" on page 97*. 3. Replace with an ELCB with a higher rated tripping current. 4. Reduce the carrier frequency while ensuring performance. 5. Use shorter motor cables.
	The action current of the ELCB is too low.	
	Unbalanced load is connected to the back end of the ELCB.	
	For motor cables and the motor, the distributed capacitance to ground is too high.	

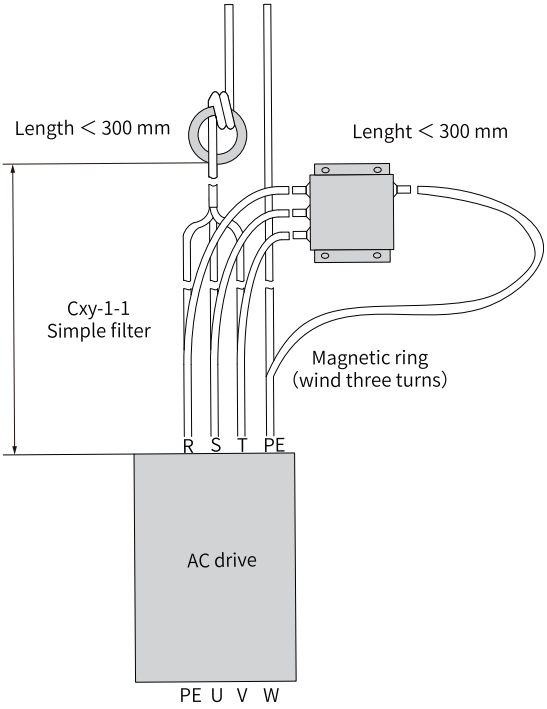


Figure 5-1 Installing a simple filter and magnetic ring on the input side

5.2 Harmonic Suppression

To suppress high-order harmonics of the AC drive and improve the power factor, install an AC input reactor on the input side of the AC drive to meet standard requirements.

5.3 I/O Signal Interference

5.3.1 High-Speed Pulse Interference

Take the measures listed in the following table.

No.	Step
1	Use shielded twisted pair cables and ground the cables at both ends.
2	Connect the motor housing to the PE terminal of the AC drive.
3	Connect the PE terminal of the AC drive to that of the power grid.

No.	Step
4	Add an equipotential bonding grounding cable between the host controller and the AC drive.
5	Separate signal cables from power cables with a distance of at least 20 cm.
6	Add a ferrite clamp to the signal cable, or add a magnetic ring and wind the signal cable through the magnetic ring for one to two turns.
7	Install a magnetic ring to the U, V, and W output cables at the drive side and wind the cables through the magnetic ring for two to four turns.
8	Use a shielded power cable and properly ground its shield.

5.3.2 Common I/O Signal Interference

Refer to the following table to rectify the fault.

No.	Step
1	Use shielded cables as the I/O signal cables and connect both ends of the shield to the PE terminal.
2	Connect the PE terminal of the motor to that of the drive, and connect the PE terminal of the drive to that of the power grid.
3	Add an equipotential bonding grounding cable between the host controller and the AC drive.
4	Install a magnetic ring to the U, V, and W output cables at the drive side and wind the cables through the magnetic ring for two to four turns.
5	Increase the filtering capacitance of the low-speed DI. The recommended maximum value is 0.1 uF.
6	Increase the capacitance of the AI. The recommended maximum value is 0.22 uF.
7	Install a ferrite clamp or a magnetic ring to the signal cable and wind the signal cable through the magnetic ring for one to two turns.
8	Use a shielded power cable and properly ground its shield.

5.4 RS485 and CAN Communication Interference

Obverse the following steps for troubleshooting.

No.	Step
1	Install a 120 Ω termination resistor at both ends of the bus.
2	Use multi-conductor shielded twisted pair cables and ground the shield at both ends.

No.	Step
3	Separate communication cables from power cables with a distance of at least 20 cm.
4	Adopt the daisy chain mode for multi-node communication.
5	For multi-node communication, add an equipotential bonding grounding cable between nodes.
6	Add a ferrite clamp at both ends of the communication cable or add a magnetic ring at both ends of the communication cable and wind the communication cable through the magnetic ring for one to two turns.
7	Install a magnetic ring to the U, V, and W output cables at the drive side and wind the cables through the magnetic ring for two to four turns.
8	Use a shielded power cable and properly ground its shield.

6 Certification and Standard Compliance

6.1 Compliance List

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

Certification Name	Directive		Standard
CE Certification	EMC Directive	2014/30/EU	EN IEC 61800-3
	LVD	2014/35/EU	EN 61800-5-1
	RoHS Directive	2011/65/EU	/

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 drive complies with the LVD, EMC, and RoHS directives and is labeled with the CE mark.
- The machinery and devices equipped with this product must also meet CE requirements when sold in Europe.
- The integrator who integrates this drive into other products and attaches CE mark to the final assembly has the responsibility of ensuring compliance with CE certification.

6.2.2 Requirements for Compliance with EMC

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

If the product is used in the first environment, it may generate radio interference. In addition to CE compliance requirements, measures should be taken to prevent interference when necessary.

- To enable the drive to comply with the EMC directive and standards, install an EMC filter on the input side and use shielded cables on the output side. Ensure the filter is grounded properly and the shield of the output cable is grounded 360 degrees.

The manufacturer of the system with the product installed must ensure that the system meets the requirements of the European EMC Directive, and ensure that the system meets the requirements of the standard EN IEC 61800-3 according to the application environment of the system.

Introduction to EMC standards

Electromagnetic compatibility (EMC) describes the ability of electrical and electronic devices to work properly in the electromagnetic environment without introducing electromagnetic interferences that disturb the operation of other local devices or systems. Therefore, EMC includes the following requirements:

- The electromagnetic interference generated by a device during normal operation must be restricted within a certain limit.
- The device must have sufficient immunity to electromagnetic interference in the environment and can work properly in the environment with electromagnetic interference, which is described as electromagnetic sensitivity.

EN IEC 61800-3 defines the following two environments:

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

Based on the expected environment, the products are divided into the following four categories:

- C1 equipment: power drive system (PDS) with the rated voltage lower than 1000 V, which is intended for use in the first environment
- C2 equipment: PDS with the rated voltage lower than 1000 V, which is neither a plug-in device nor a movable device and and is intended to be installed and commissioned only by professionals when used in the first environment.
- C3 equipment: PDS with the rated voltage lower than 1000 V, which is intended for use in the second environment and not intended for use in the first environment
- C4 equipment: PDS with the rated voltage equal to or higher than 1000 V or rated current equal to or higher than 400 A, or intended for use in complex systems in the second environment

6.2.3 Requirements for Compliance with the LVD

The drive has been tested in accordance with EN61800-5-1 and has complied with the LVD. Observe the following requirements to enable machines and devices integrated with this drive to comply with the LVD.

Installation location

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

Installation environment

For requirements of the installation environment, see *"2.1 Installation Environment" on page 21*.

Installation protection requirements

- The drive serves as a part of a final system. Install the drive as the system component in a fireproof cabinet that provides effective electrical and mechanical protection, and install it in accordance with local laws and regulations and relevant IEC standards.
- For IP40-certified products, install them in structures where foreign objects cannot enter from the top or front sides.

Wiring of main circuit terminals

For details about the main circuit terminal wiring requirements, see *"3.4.2 Wiring Description of Main Circuit Terminals" on page 45*.

Requirements for protective devices

To comply with EN 61800-5-1 standards, install a fuse/circuit breaker on the input side of the drive to prevent accidents caused by short circuit in the internal circuit. Use a fuse that matches the maximum input current of the AC drive. For selection of fuses, see *"4.5.4.1 Circuit Breaker, Fuse, and Electromagnetic Contactor" on page 81*.

7 Service and Support

Documentation download

Product manuals, brochures, certificates, 2D/3D drawings and other information can be downloaded in the following way:

Go to our official website *https://www.inovance.com*, choose **Service and Support** > **Download**, enter keywords, and download the documentation.

Pre-sales consulting

We are honored to have you as our client. You can submit basic information to us in the following way, so that we can reach you as soon as possible. We are committed to your privacy. We will never share your information with any third party.

Go to our official website (*https://www.inovance.com*), choose **Service and Support** > **Contact Us**, and submit your information.

After-sales service

If you have product quality problems and need after-sales service, or you need to purchase spare parts, you can get the after-sales service person in your region through the following way.

Go to our official website (*https://www.inovance.com*), choose **Service and Support > After-sales Service**, and submit the product category and your region.

Repair service

If a product is faulty and needs to be repaired, you can check the maintenance instructions, submit the service request and check the service record in the following way.

Go to our official website (*https://www.inovance.com*), choose **Service and Support** > **Repair**, and submit the repair request.

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You can authenticate Inovance products in the following way:

Go to our official website (*https://www.inovance.com*), choose **Service and Support** > **Authentication**, and enter the 16-digit serial number.

FAQ

You can go through frequently asked questions about Inovance products in the following way:

Go to our official website (*https://www.inovance.com*) and choose **Service and Support** > **FAQ**.

Feedback

You can submit your feedback in the following way:

Go to our official website *https://www.inovance.com*, choose **Service and Support** > **Feedback**, and submit your feedback.

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