



MD600 Series Compact AC Drive

Hardware Guide



Industrial
Automation



New Energy
Vehicle



Intelligent
Elevator



Intelligent
Robot



Digital
Energy



Rail
Transit



Data code 19012234B06

Legal Information

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The storage, use, and disposal of this product (including optional accessories) must comply with local laws and regulations.

Qualified Personnel

The product/system described in this documentation may be operated only by personnel qualified for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel can identify the risks of the product/system and prevent possible dangers.

Proper Use of the Product

Proper transportation, storage, assembly, installation, commissioning, operation, and maintenance are required to ensure the safe operation of the product without any problems. The required ambient conditions must be met. All operations must follow the guidelines provided in this documentation.

Preface

Introduction

The MD600 is a compact, general-purpose, and cost-effective AC drive for small automation equipment. Supporting Modbus RTU and CAN communication protocols, it features a compact size and high-performance open-loop vector control and can drive synchronous and asynchronous motors. The MD600 is widely used in small automation equipment in fields such as silicon, lithium, woodworking, logistics, cables, packaging, and machine tools.

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

More documents

No.	Name	Data code	Description
①	MD600 Series Compact AC Drive Quick Start Guide	19012337	This guide describes the installation and operation, common faults and troubleshooting, and parameter settings of the drive.
②	MD600 Series Compact AC Drive Hardware Guide (this guide)	19012234	This guide describes product selection, mechanical design, electrical design, common EMC problems and solutions, and product certifications and standards.
③	MD600 Series Compact AC Drive Function Guide	19012238	This guide describes the basic function configuration, function application, communication configuration, troubleshooting, and parameters of the drive.
④	MD600 Series Compact 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	Revision
August 2026	B06	Added: • New content "6.5 Grounding requirements" on page 79 • Added section "Maintenance and Repair". Update: • Updated section "Safety Precautions". • Updated "Speed of three-phase AC asynchronous motor" to "Speed of three-phase AC asynchronous and synchronous motors" in "2.1 Product Overview" on page 21. • Changed "MD-BP-M External Operating Panel" to "External Operating Panel" in "System Connection" on page 26. • Updated the diagrams of DIP switches S3 and S4 in "Electrical wiring diagram" on page 28. • Moved the fan removal and installation instructions from "4.5.2.2 Fan Design" on page 43 to section "Replacing the Cooling Fan". • Modified the power supply symbol in the sink wiring diagram using the internal/external 24 V power supply in "6.3.2 Wiring Descriptions of Control Circuit Terminals" on page 72. • Added item 12 in "6.6 Post-wiring Inspection" on page 80. • Changed "AO1: 0 V to 10 V/0 mA to 20 mA" to "AO1: 0 V to 10 V" and added short-circuit rating value 5 kA in "11.4 General Specifications" on page 96. • Updated "12.7 Braking Resistor" on page 116.
March 2026	B05	Deleted the description of modifiable through parameters for the maximum output frequency from "11.3 Electrical Specifications" on page 94.

Date	Version	Revision
January 2026	B04	Update: • Updated the function descriptions of CN1 and CN2 terminals and the S4 DIP switch in "6.3.1 Descriptions of Control Circuit Terminals" on page 67. • Updated the RS485 bus connection topology structure and CAN bus connection topology structure. • Updated the selection table for braking resistors (three-phase 380 V to 480 V and single-phase 200 V to 240 V) in "12.7 Braking Resistor" on page 116. • Made minor corrections.
July 2025	B03	• Added installation environment requirements in "5.1.1 Installation Environment Requirements" on page 56. • Updated the selection table for the braking resistor in "12.7 Braking Resistor" on page 116.

Date	Version	Revision
September 2024	B02	Update: • Updated "2.3 Product Model List" on page 23. • Updated "6.3.1 Descriptions of Control Circuit Terminals" on page 67. • Updated "6.3.2 Wiring Descriptions of Control Circuit Terminals" on page 72. • Updated "11.4 General Specifications" on page 96. • Updated "12.9.1 Main circuit cable" on page 125. • Updated "12.9.2 Control Circuit Cables" on page 127. • Updated "12.3 Circuit Breaker and Fuse (CE)" on page 107. • Updated "12.7 Braking Resistor" on page 116. • Made minor corrections. Added: • Shipment Check • Power Supply Compatibility Check • Unpacking, Storage, and Transportation • AC Drive Installation • Added "AC Drive Wiring"
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 section Installation Environment. 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.

Date	Version	Revision
December 2023	B00	• Optimized the document structure. • Modified the section Installation Environment and compiled the system connection diagram and system composition table into one section. • Modified the section Installation Tool Preparations and deleted the installation of the guide rail in section Screws. • Added EMC-Compliant Control Cabinet Design. • Added the internal circuit diagram in Electrical Connection Diagram. • Modified the section Cable Preparations and compiled the cable overview and cable handling into one section. • Modified Peripheral Electrical Component Design to Basic Electrical Safety Precautions and optimized the content. • Modified Communication Cable Selection and updated the termination resistor in the CAN and RS485 communication topology diagram. • Added Application Instance. • Updated electrical specifications, technical specifications, and option specifications in Specifications. • Changed the IP rating from IP20 to IP40 (except for the power distribution wiring and capacitor ventilation) in Electrical Specifications. • Added relay specifications in Technical Specifications. • Made minor corrections.
June 2023	A00	First release.

Access to the guide

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

- Visit <https://www.inovance.com/global>, and choose Service&Support > Support > Documentation Download.
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- Scan the QR code below to install the My Inovance app, and search for the user guide in the app.



Warranty disclaimer

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

Even within the warranty period, maintenance can be charged for the following product damage:

- Damage caused by operations not following the instructions in the guide
- Damage caused by fire, flood, or abnormal voltage
- Damage caused by using the product for unintended functions
- Damage caused by using the product outside the specified scope
- Damage or secondary damage caused by force majeure (natural disaster, earthquake, and lightning strike)

When applicable, relevant maintenance fee will be charged according to the latest Price List of Inovance. If otherwise agreed upon, the agreed terms and conditions shall prevail.

For details, see the Warranty Card.

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1 Fundamental Safety Instructions

1.1 Fundamental Safety Instructions

Safety disclaimer

- This chapter provides essential safety instructions for proper use of the product. Before using this product, read through the guide and comprehend all the safety instructions. Failure to comply with the safety instructions may result in death, severe injury, or equipment damage.
- "DANGER", "WARNING", and "CAUTION" signs in this guide are only supplements to the safety instructions, and do not reflect all safety instructions to be followed.
- Use this product according to the designated environment requirements. Damage caused by improper use is not covered by warranty.
- Inovance shall take no responsibility for any personal injury or property damage caused by improper use.

Safety levels and definitions



Indicates that failure to comply with the notice can result in death or severe personal injury.



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



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

Fundamental Safety Instructions

- Drawings in the user guide are sometimes shown without covers or protective guards. Install the covers or protective guards as specified, 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 protection measures to protect their safety. For example, they must wear safety shoes, safety clothing, safety glasses, protective gloves and sleeves, or other protective equipment.

Unpacking

WARNING

- Do not install the product in the case of any damage, rust, or signs of use on the product or accessories upon unpacking.
- Do not install the product in the case of water seepage into the product or missing or damaged components upon unpacking.
- Do not install the product in the case of any discrepancy between the product you received and the product name on the packing list.

Caution

- Check whether the packing is intact and whether there is damage, water seepage, dampness, and deformation before unpacking.
- Unpack the package layer by layer. Do not strike the package violently.
- Check for damage, rust, or dents on the surfaces of the product and accessories upon unpacking.
- After unpacking, check the contents against the packing list to ensure that the equipment and accessories are in the correct quantities, and that all documentation is complete.

Storage and transportation **WARNING**

- Large or heavy equipment must be handled by qualified professionals using specialized hoisting equipment. Failure to comply could result in personal injury or equipment damage.
- Before hoisting the equipment, ensure that components such as the front cover and terminal blocks are secured firmly with screws. Loosely connected components may fall off and result in personal injury or equipment damage.
- Do not stand or stay below the product which is being hoisted.
- 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 could result in personal injury or equipment damage.

 Caution

- Handle the equipment with care and mind your step during transportation to prevent personal injury 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 could result in personal injury.
- Store and transport the equipment based on the storage and transportation requirements. Failure to comply could result in equipment damage.
- Do not store or transport the equipment in locations where the equipment may be exposed to splashing water or rain, direct sunlight, strong electric field, strong magnetic field, or strong vibration.
- Store the equipment for up to three months. Take stricter protective measures and carry out the necessary inspections for a longer storage time.
- Pack the equipment securely and properly before transportation. Use a fully enclosed container for long-distance transportation.
- Do not transport the equipment with other devices or items that may impact or cause harm to the equipment.

Installation



- Ensure peripheral power distribution requirements are met, and select air switches, fuses, cables, and cable terminals correctly.
 - Use standard torque for screw fastening, and use appropriate terminal crimping design for crimping terminals.
 - Ensure heat dissipation requirements are met and design inlet and outlet airflow duct properly.
 - Avoid environments with dripping water, conductive foreign objects (such as carbon fiber filaments, conductive metal dust, metal chips), and salt spray.
- Failure to follow the above instructions will pose a fire risk.**
- This equipment must be operated only by trained and qualified electrical personnel. Operations can be performed by professionals only.



- Read through the guide and safety instructions before installation.
 - Do not install this equipment in places with strong electric or magnetic field.
 - Before installation, check that the mechanical strength of the installation site can bear the weight of the equipment. Failure to comply may 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 an enclosed environment (such as a cabinet or case), use cooling devices (such as fans or air conditioners) to cool the space and meet the installation environment requirements. Failure to do so can result in equipment overtemperature or fire accidents.
 - Do not retrofit the equipment.
 - Do not fiddle with the bolts used to fix equipment components or the bolts marked in red.
 - When the equipment is installed in a cabinet or terminal device, appropriate guard devices (guards for fire, electrical, and mechanical protection) meeting applicable IEC standards and local laws and regulations must be provided.
 - Before installing devices with strong electromagnetic interference, such as a transformer, install a shielding device 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 may result in a fire.
- The edges of the equipment metal enclosure are sharp. Note the following precautions during installation to avoid personal injury or cable damage:**
- When performing installation, handling, or maintenance operations, always wear cut-resistant gloves.
 - Avoid direct skin contact with enclosure edges and cut surfaces during operation.

Installation

- Cover the top of the product 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 product and causing faults. After installation, remove the cloth or paper on top of the product 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, switch off all power supplies of the device. Wait for at least the time designated on the 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 can result in electric shock.
- Do not perform wiring, remove the equipment cover, or touch the circuit board and other exposed live parts with power on. Failure to comply can result in electric shock.
- Make sure that the equipment and product are grounded properly. Failure to comply can result in the risk of electric shock.

 WARNING

- Do not connect the power cable to output terminals of the equipment or product. Failure to comply may cause equipment damage or even a fire.
- When connecting a drive with the motor, make sure that the phase sequences of the drive and motor terminals are consistent to prevent reverse motor rotation.
- Cables used must comply with corresponding cross-sectional area and shielding requirements. The shield of the shielded cable must be grounded at one end properly.
- Tighten the terminal screws with the torque specified in the user guide. Insufficient or excessive torque may cause overheating and damage to the joint, which could result in fire.
- After wiring is done, ensure that all cables are connected properly and no screws, washers or exposed cables are left inside the equipment. Failure to comply could result in electric shock or equipment damage.
- Avoid direct skin contact with enclosure edges and cut surfaces during operation.
- Route cables carefully during wiring. Avoid pressing them against sharp edges, which may cause squeezing or cutting. It is recommended to use protective sleeves or route cables away from such edges.
- If the enclosure has a protective film, remove it only after installation is completed and all work involving sharp edges has been finished.

 Caution

- During wiring, follow the proper electrostatic discharge (ESD) procedures, and wear an antistatic wrist strap. Failure to comply may result in damage to the equipment or internal circuits.
- Use the shielded twisted pair cable to wire the control circuit, and connect the shield to the grounding terminal of the equipment. Failure to comply may result in equipment malfunction.

Power-on

 DANGER

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

 WARNING

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

Operation

 DANGER

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

The equipment is equipped with the automatic restart function. After power supply recovery or fault clearance, do not enable this function when the equipment is running, being inspected, or when personnel are in contact with the drive mechanism. Before enabling the automatic restart function, check the following:

- No personnel are working on the load side, and no foreign objects cause blockages.
- All safety protection devices (such as safety doors, emergency stop circuits) are properly engaged.
- Prominent "Automatic restart" safety warning signs have been posted on the equipment and the site.

 WARNING

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

Maintenance

DANGER

- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Do not perform maintenance on the equipment with power-on. Failure to comply may result in an electric shock.
- Before maintenance, disconnect all the power supplies of the equipment and wait for at least the time specified on the warning label.
- When using a permanent magnet (PM) motor, do not touch the motor terminals while the motor is rotating, because induced voltage may be present at the terminals even after the product is powered off. Failure to comply may result in electric shock.

WARNING

- Perform routine and periodic inspection and maintenance on the equipment according to maintenance requirements and keep a maintenance record.

Repair

DANGER

- 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 may result in electric shock.
- Before inspection or repair, disconnect all the power supplies of the equipment and wait for at least the time specified on the warning label.

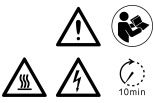
WARNING

- Submit a request for repair based on 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 specified on the warning label before power-on or other operations. Failure to comply may result in personal injury or death and equipment damage.
- Troubleshooting and repair of a faulty or damaged equipment must be performed by professionals based on the repair instructions, with the repair records kept properly.
- Replace quick-wear parts of the equipment according to the replacement instructions.
- Do not use damaged equipment. Failure to comply can result in death, personal injury, or severe equipment damage.
- Recheck the wiring and reset the parameters after equipment replacement.

Disposal	
 WARNING	• Dispose of the retired equipment in accordance with applicable national regulations and standards. Failure to comply can result in property damage, personal injury, or death. • Recycle retired equipment in accordance with industry waste disposal standards to avoid environmental pollution.

Safety Label

To ensure safe operation, comply with equipment-related safety labels. The following table describes the meanings of the safety labels.

Safety Label	Description
	• Before using the equipment, read the guide and safety precautions carefully. Failure to comply may result in personal injury, death, 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 may result in electric shock.

1.2 Industrial Information Security

The product provides interfaces for network connection and data transmission. To protect factories, systems, machines, and networks from cyberattacks, it is essential to implement proper protection mechanism for industrial security.

Customers are responsible for providing and maintaining a secure connection between the product and their network or any other network to protect their factories, systems, machines, and networks from unauthorized access. Such systems or machines can be connected to an enterprise network or the Internet only when a secure connection is established and appropriate security measures (such as using antivirus software or installing firewalls) are in place.

Inovance continuously develops and improves its products and solutions to enhance safety. It is strongly recommended that you update the product promptly and always use the latest version.



Malware (such as viruses, Trojans, and worms) can bring the device into an unsafe operating state, resulting in death, serious injury, and property damage. Observe the following precautions:

- Always use the latest software version. If the product version is no longer supported or the latest version is not used, you will be exposed to increased risk of cyber attacks.
 - Develop and maintain appropriate protective measures (including but not limited to antivirus software, firewalls, WAF, IPS/IDS, situational awareness system, identity authentication, and data encryption) to prevent the files in mobile storage devices from being damaged by malware, and to protect the products, networks, systems, and interfaces from unauthorized access, tampering, hacking, data leakage, or information theft.
 - Check all safety-related interfaces and settings after commissioning.
-

2 Product Information

2.1 Product Overview

The MD600 series is a compact, general-purpose, and cost-effective AC drive for small automation equipment. Featuring ease of use and high reliability, it is mainly used to control and adjust speed of three-phase AC asynchronous motors and synchronous motors. The drive is suitable for industries such as the crystalline silicon, lithium battery, wood working, logistics, food and beverage, cables, machine tool, and packaging.



Figure 2-1 Product appearance

The AC drive highlights the following:

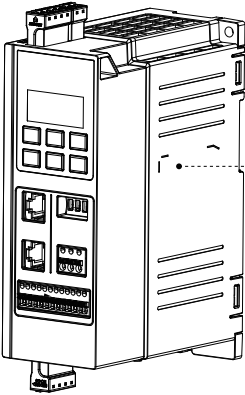
- Cost-effective: Reduces equipment life cycle costs through technical innovation and enhanced experience design.
- Compact: 38% smaller than the previous generation; heat dissipation technology of the vapor chamber; reduces cabinet costs by multi-axis installation.
- Easy to use: Crimping terminals; communication networking with dual network ports; easy speed control through the keypad, saving labor costs for equipment commissioning.
- Reliable: Independent air duct; conformal coating on the drive board; intelligent fan; anti-rotation protection; slip start; stable running, reducing losses caused by stop.

2.2 Nameplate and Model

Model Description

<u>MD600</u>	<u>S</u>	<u>- 4T</u>	<u>5R5</u>	<u>B</u>
①	②	③	④	⑤
① Product name MD600: AC drive series			④ Output current (A) 1R6: 1.6 A 5R5: 5.5 A ... 013: 13 A Note: R represents the decimal point ".".	
② Model S: RS-485 model A: CAN model			⑤ Braking unit B: With the braking unit Blank: N/A	
③ Voltage level (V) 2S: Single-phase 200 V to 240 V 4T: Three-phase 380 V to 480 V			-	

Nameplate description



MODEL: MD600S-4T5R5B

Certification

INPUT: 3PH AC 380-480V 6.7A 50/60Hz

OUTPUT: 3PH AC 0-480V 5.5A 0-590Hz 2.2kW

S/N: 0101CG364R700003

Address: No. 52, Tian'e Dang Road, Wuzhong District,
Suzhou 215104, P.R. China

Suzhou Inovance Technology Co., Ltd.

The nameplate is only for your reference.

Description of serial number

0101CG36 4 R 7 00003

① ② ③ ④ 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 R: 2023 S: 2024 Note: I/L/O/Q are skipped.	-

2.3 Product Model List

The following tables list mappings between the product model and structure.

Table 2-1 Relationship between the product model and structure (RS-485 version)

Struc ture	Three-phase 380 V to 480 V		Single-phase 200 V to 240 V	
	Power (kW)	Product model	Power (kW)	Product model
T1	0.37	MD600S-4T1R6(B)	0.37	MD600S-2S2R8(B)
	0.75	MD600S-4T2R3(B)	0.75	MD600S-2S4R6(B)
	1.5	MD600S-4T4R8(B)	1.5	MD600S-2S7R5(B)
	2.2	MD600S-4T5R5(B)		
T2	4	MD600S-4T9R5(B)	2.2	MD600S-2S010(B)
	5.5	MD600S-4T013(B)		

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

Structure	Three-phase 380 V to 480 V		Single-phase 200 V to 240 V	
	Power (kW)	Product model	Power (kW)	Product model
T1	0.37	MD600A-4T1R6(B)	0.37	MD600A-2S2R8(B)
	0.75	MD600A-4T2R3(B)	0.75	MD600A-2S4R6(B)
	1.5	MD600A-4T4R8(B)	1.5	MD600A-2S7R5(B)
	2.2	MD600A-4T5R5(B)		
T2	4	MD600A-4T9R5(B)	2.2	MD600A-2S010(B)
	5.5	MD600A-4T013(B)		

2.4 Components

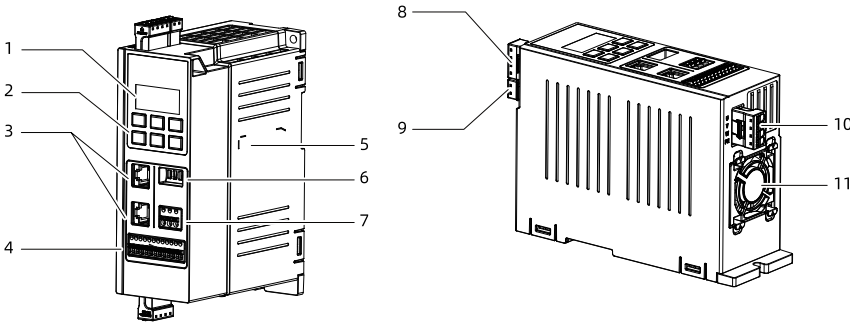


Figure 2-2 Components

No.	Name	Remarks
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.
3	Communication terminal (CN1 / CN2)	-
4	Control circuit terminal (CN4)	It integrates the Modbus RTU communication, analog input, analog output, digital input, digital output, 24 V power supply output, and 10 V power supply output signals.
5	Product nameplate	It displays the product information.
6	DIP switch for termination resistor	DIP switch for the Modbus communication termination resistor in CN1 DIP switch for the CAN communication termination resistor in CN1 and CN2

No.	Name	Remarks
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	Cooling fan	It is used for heat dissipation.

3 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.

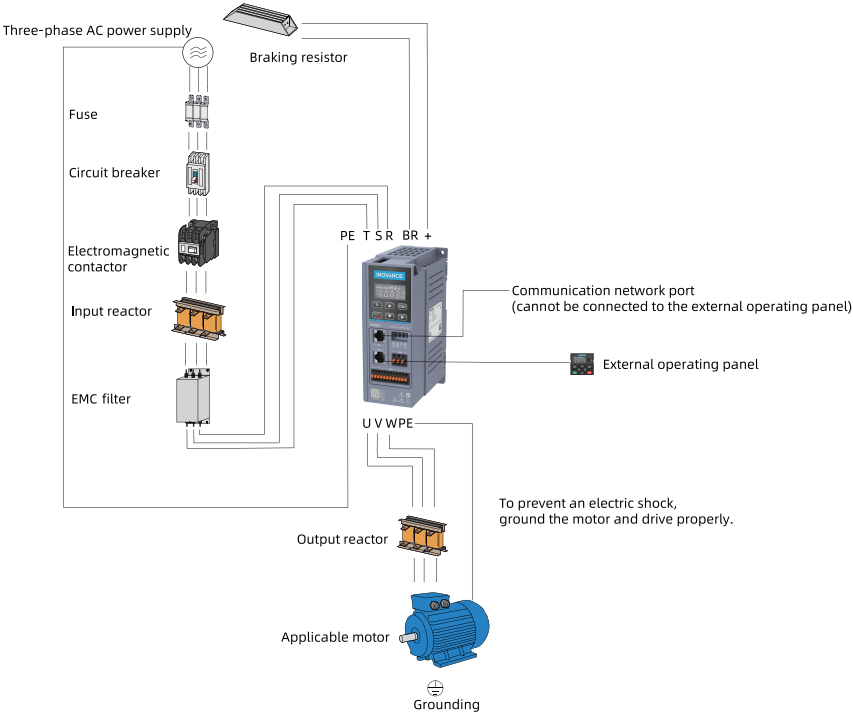


Figure 3-1 System Connection

Table 3-1 Description of electrical peripherals

Component	Installation position	Applicable model	Function overview
Circuit breaker	Input side of the drive	All models	Installed between the power supply and input side of the drive. Short circuit breaker: Cuts off the power supply when overcurrent occurs on downstream devices to prevent accidents. Residual current device (RCD): The drive may generate high-frequency leakage current during running. To prevent electric shock which may cause a fire, select a proper RCD based on actual applications.
Fuse	Input side of the drive	All models	Provides protection in case of short circuit to protect downstream semiconductors.
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.

Component	Installation position	Applicable model	Function overview
AC input reactor	Input side of the drive	All models	It provides the following functions: Improves the power factor on the input side. Eliminates harmonics on the input side and prevents other devices from being damaged due to voltage waveform distortion. Eliminates input current unbalance caused by inter-phase unbalance.
EMC 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.
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	A drive with the model name containing letter B is equipped with a 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	Harmonics are present in the output side of the drive. When motor is far from AC drive, there is excessive distributed capacitance in the circuit. Certain harmonics may cause resonance in the circuit, which can: ● Degrade the motor insulation performance and damages the motor in the long time. ● 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 magnetic buckle	AC drive input side or output side	All models	When installed on the input side, the ferrite ring can be used to suppress the noise in the input power supply system of the drive. When installed on the output side, the ferrite ring can be used to suppress interference generated by the drive to external devices and reduce the bearing current.
	Signal cable	All models	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 <i>"Accessory Specifications" on page 103.</i>			

4 Electrical Design

4.1 Electrical Wiring Diagram

Wiring diagram for the MD600 (RS485 model)

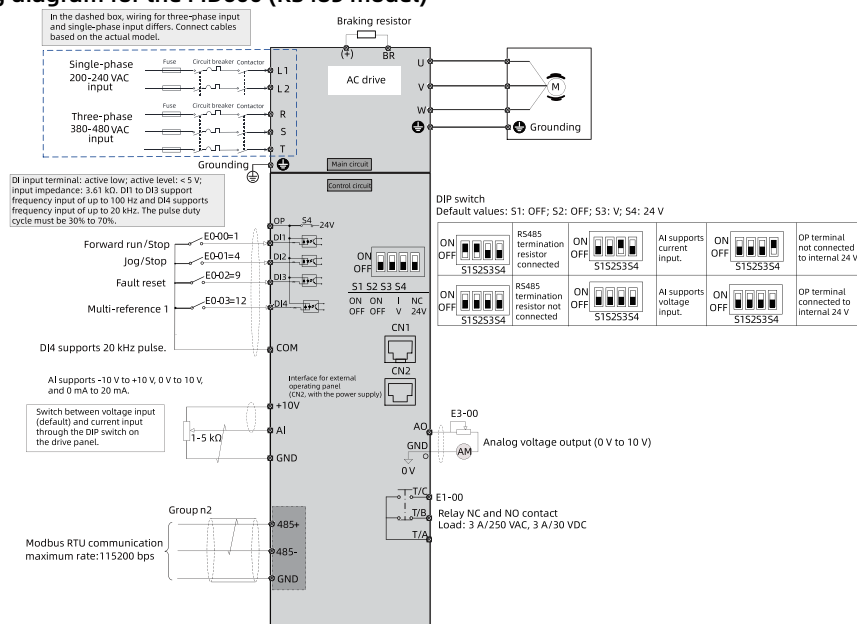


Figure 4-1 Input terminals of three-phase/single-phase power supply

Wiring diagram for the MD600 (CAN model)

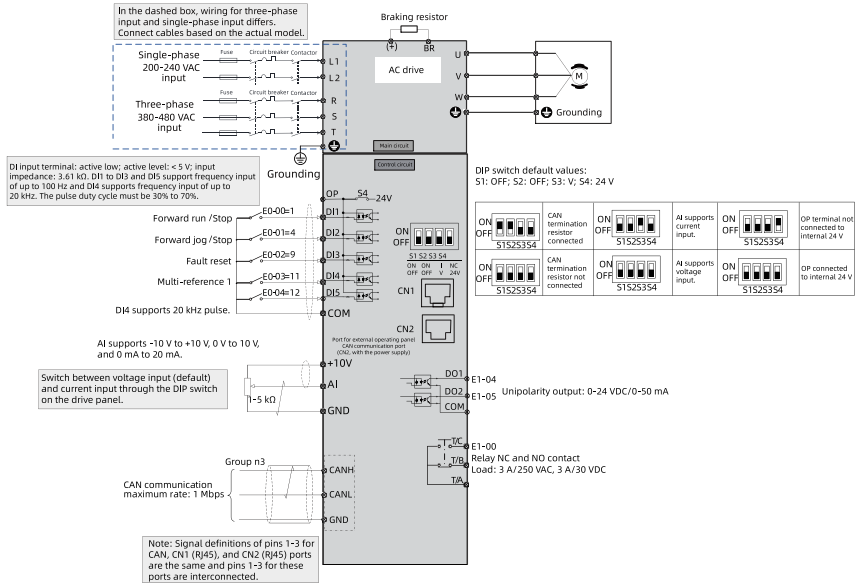


Figure 4-2 Input terminals of three-phase/single-phase power supply



- 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.

4.2 Cable Preparations

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 4–1 List of Cables

Type	Cable	Illustration	Type	Cable	Illustration
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 sheath to the length shown in the figure below.

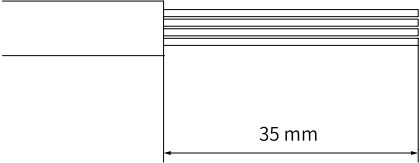


Figure 4-3 Cable preparation 1

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

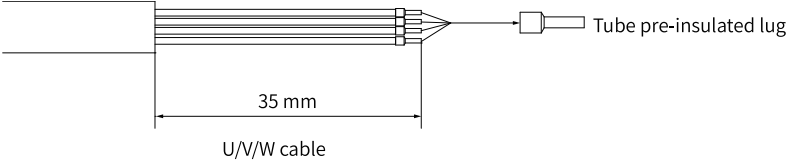


Figure 4-4 Cable preparation 2

4.3 Basic Electrical Safety Precautions

4.3.1 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.

4.3.2 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.

4.3.3 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.

4.3.4 Selecting 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.

**CAUTION**

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

4.3.5 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 ["11.3 Electrical Specifications" on page 94](#).

4.3.6 Selecting SPD 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.

4.3.7 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.

4.4 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.

Category

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).

- Radiated emission (RE): interference signal radiated by the product through the port on its housing.
- Conducted emission (CE): interference signal conducted from the product through its cable port.

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.

4.5 Cabinet Design

4.5.1 Recommended Cabinet Layout

Reserve sufficient clearance according to the power rating of the 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.

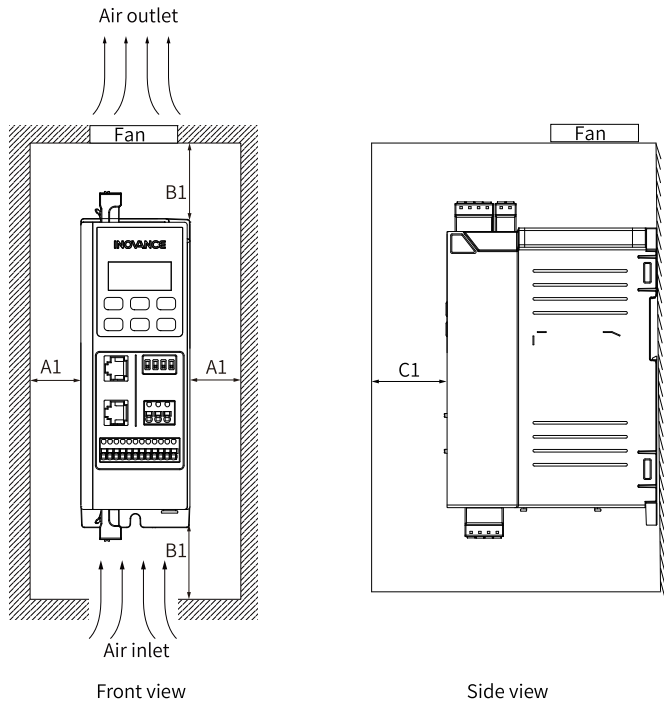


Figure 4-5 Clearance for installation of a single device

Table 4-2 Clearance for installation of a single device (single-phase 200 V to 240 V)

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

Table 4-3 Clearance for installation of a single device (three-phase 380 V to 480 V)

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

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

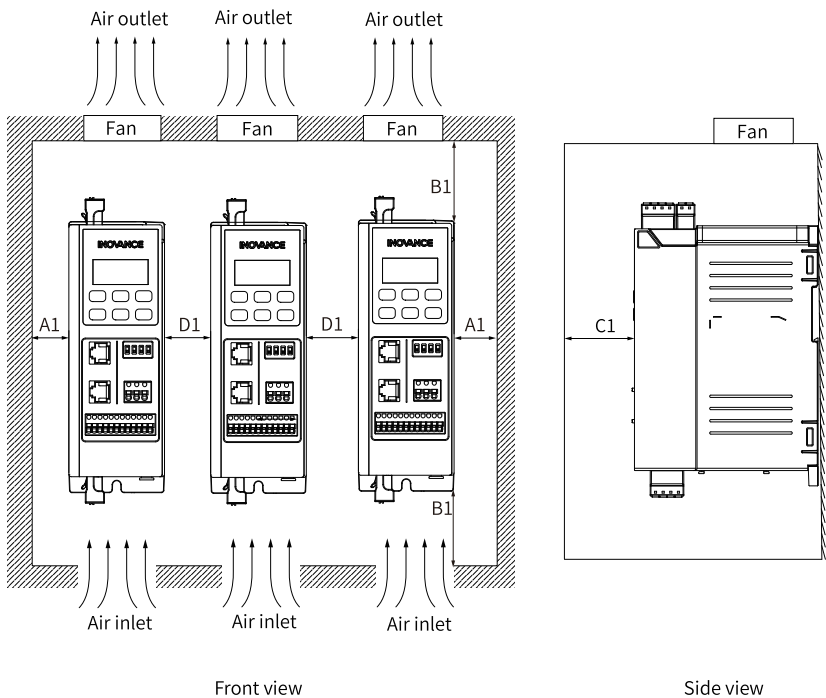


Figure 4-6 Side-by-side installation clearance

Table 4-4 Side-by-side installation clearance (single-phase 200 V to 240 V)

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

Table 4-5 Side-by-side installation clearance (three-phase 380 V to 480 V)

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

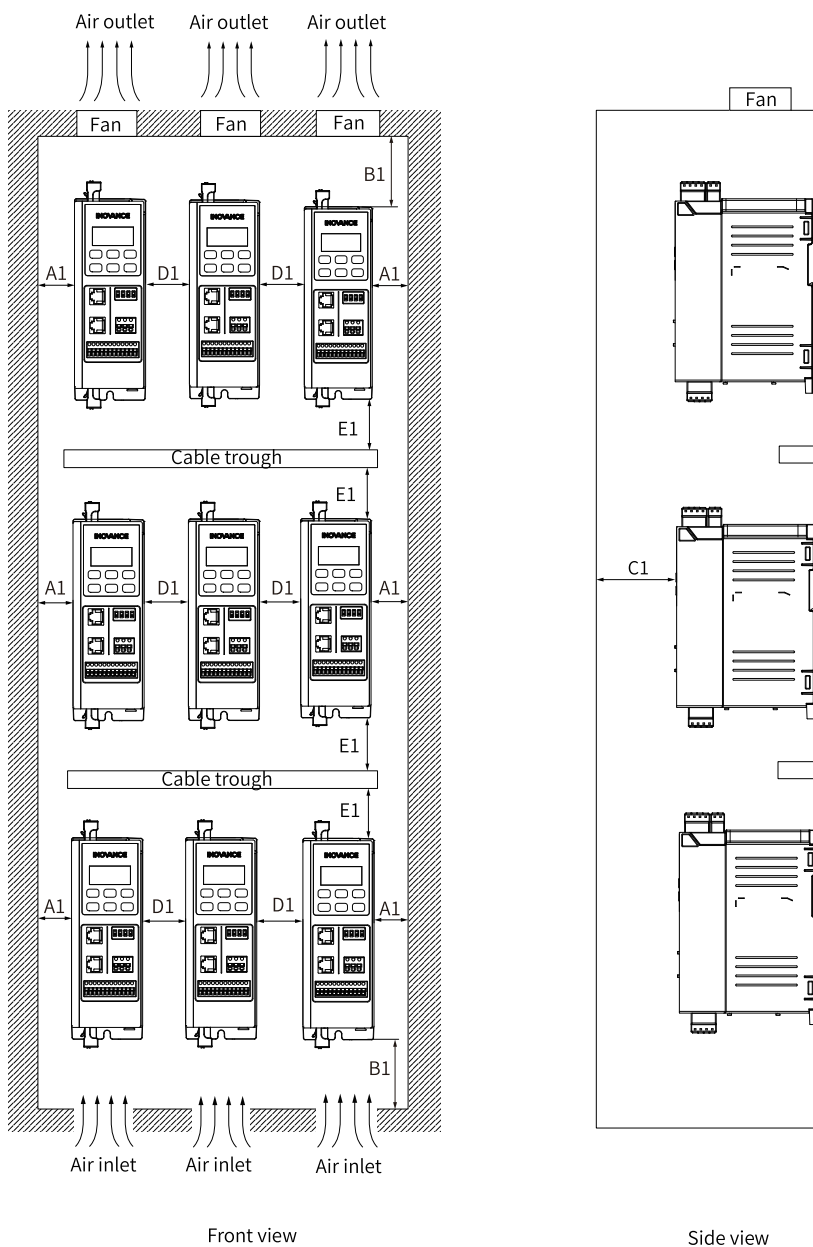


Figure 4-7 Clearance for device installation at different layers

Table 4–6 Clearance for device installation at different layers (single-phase 200 V to 240 V)

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

Table 4–7 Clearance for device installation at different layers (three-phase 380 V to 480 V)

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

4.5.2 Heat Dissipation Design

4.5.2.1 Ventilation Requirements

Common heat dissipation methods include the following:

- Natural ventilation
- Forced air cooling

4.5.2.1.1 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 ["4.5.2.1.2 Air Outlet and Inlet" on page 39](#). 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.

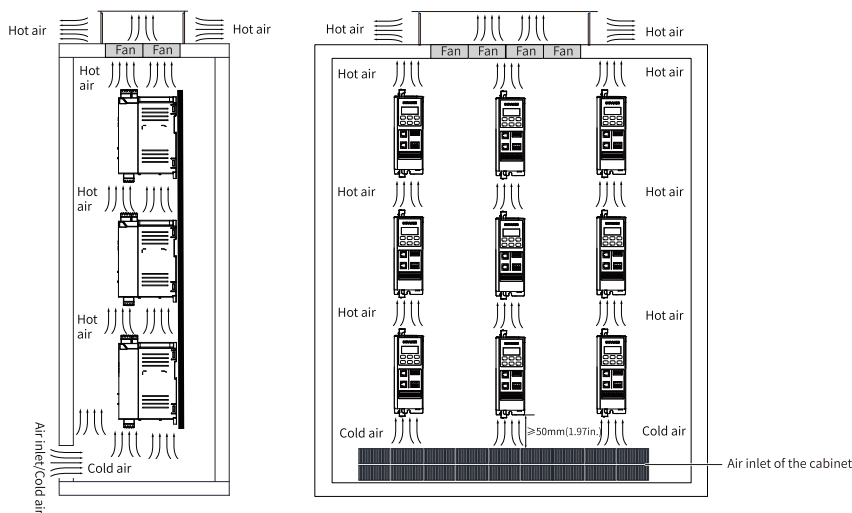


Figure 4-8 Position of the cabinet air inlet

4.5.2.1.2 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.

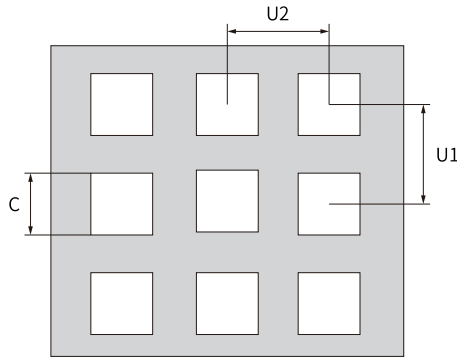
Table 4-8 Minimum ventilation area of the cabinet air inlet (single-phase 200 V to 240 V)

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

Table 4-9 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 Direct-Ventilation 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

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



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 $20.5 + 16.2 + 22 + 20.5 + 16.2 + 22 = 117.4 \text{ cm}^2$.

For air inlets 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 the opening. The ventilation area is calculated by the following: opening area $\times$ 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 4-10 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 Direct-Ventilation Cabinet (cm ²)
T1	0.37	1	32.8
	0.75	1	26
	1.5	1	26
T2	2.2	1	35.5

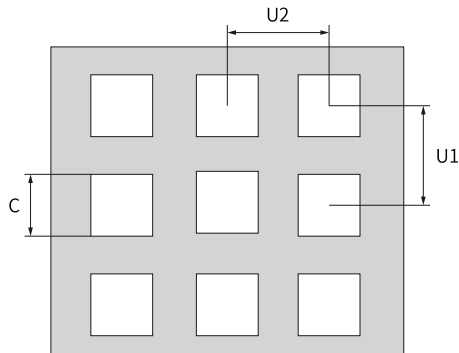
Table 4-11 Minimum ventilation area of the cabinet air outlet (three-phase 380 V to 480 V)

Structure	Power (kW)	Quantity	Min. Ventilation Area of Air Outlet for Direct-Ventilation 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

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 $C \times C$, and there are 9 holes. Therefore, the ventilation area of the air outlet is $9 \times C \times C$.



The preceding tables apply to only an individual product. When multiple drives are installed in the cabinet, the total ventilation area is the sum of all the above-mentioned ventilation areas. If the air outlet is installed with a filter screen, the air outlet resistance increases substantially. In this case, the minimum effective area of the air outlet is 1.2...1.5 x values listed in the preceding table. The ventilation area in the preceding tables refers to the actual through-hole area of the 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 $32.8 + 26 + 35.5 + 32.8 + 26 + 35.5 = 188.6 \text{ cm}^2$. In active air ventilation mode, a fan is installed at 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 following table lists the cooling air volume required by the AC drive.

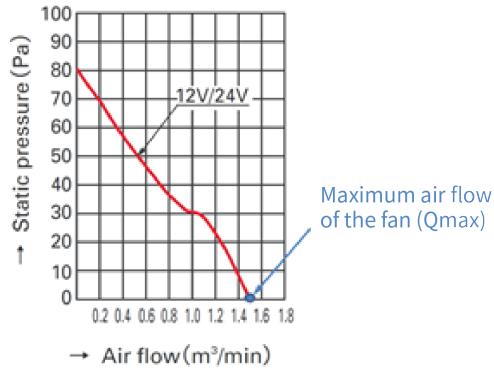
Table 4-12 Cooling air volume (single-phase 200 V to 240 V)

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

Table 4-13 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

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 an individual 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 units: 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 value of the cabinet fan should be $0 + 22 + 38 + 0 + 22 + 38 = 120$ CFM.

4.5.2.2 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 4-13](#) " on page 42 and "[Table 4-12](#) " on page 42.
2. Determine the maximum air volume value (Qmax).
3. Determine the specification and quantity of the fan based on the maximum air volume (Qmax).

Where:

$$Q_{\max} = (1.3 \text{ to } 1.5) \times \text{Sum of cooling air volume}$$

$$Q_{\max} = (1.6 \text{ to } 2.2) \times \text{Sum of cooling air volume (if a mesh filter or other components are installed at the cabinet air outlet)}$$

Note

- The air volume of the selected fan cannot be smaller than the maximum air volume Q_{max} . 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, hot air cannot be exhausted and the drive may be overheated or damaged.
-

4.5.3 EMC-Compliant 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 4-14 Wiring Principle

No.	Wiring Principle
1	Install the control devices and the drive devices in two different 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 bonding 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 (such as RS-485) signal cables leading from the cabinet.
6	Install the power supply input filter close to the cabinet input interface.
7	Spray each grounding point in the cabinet.

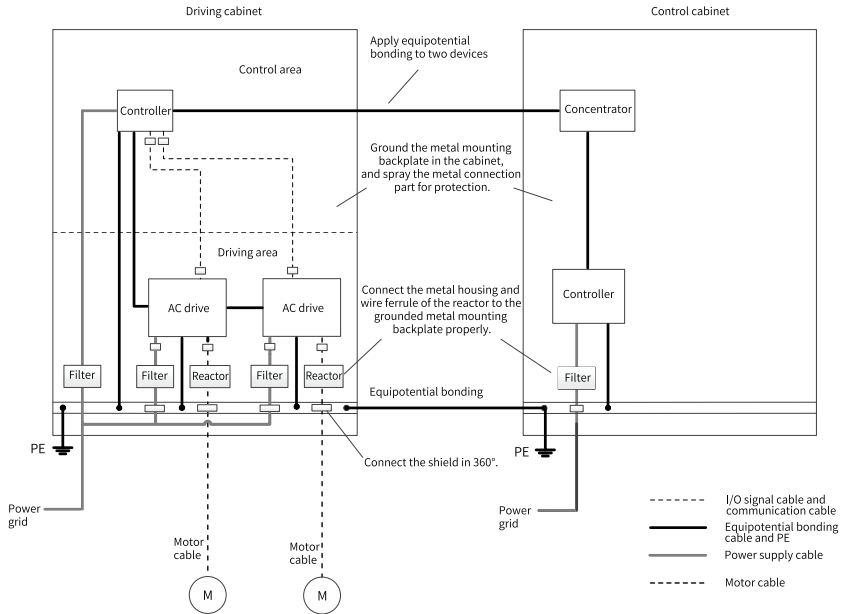


Figure 4-9 Recommended wiring of the cabinet system

Routing Precautions

- **Main circuit cabling requirements**

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, 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. Aluminum cable ducts can be used 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.

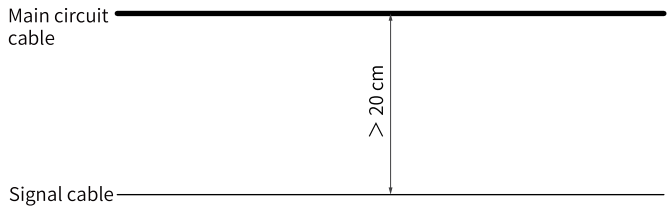


Figure 4-10 Cabling diagram

- **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/T cables and U/V/W cables) and other power cables or power supply cables.

Routing recommendations

- **Routing of disturbing cables and sensitive cables**
During routing, route cables that transmit different types of signals through different routes. Separate the disturbing cables from sensitive cables by a distance of 20 cm wherever possible. When two types of cables must be intersected, the intersection angle must be 90 degrees to avoid interference, as shown in the following figure.
-
- The figure illustrates three routing scenarios for disturbing cables (white) and sensitive cables (grey):
1. Two parallel cables with a distance between them labeled $\geq 20 \text{ cm}$. A red checkmark is below.
2. Two cables intersecting at a 90-degree angle, indicated by an arc and the label '90°'. A red checkmark is below.
3. Two parallel cables with a distance between them labeled $< 20 \text{ cm}$. A red X is below.

Figure 4-11 Routing of disturbing cables and sensitive cables

- **Routing of cables transmitting different types of signals**
Route cables that transmit different types of signals through different routes and separate them with equipotential signal cables. When routing cables that transmit the same type of signals, the equipotential signal cable stays in the outer layer and equipotential signals should stay in the middle if possible, as shown in the following figure.

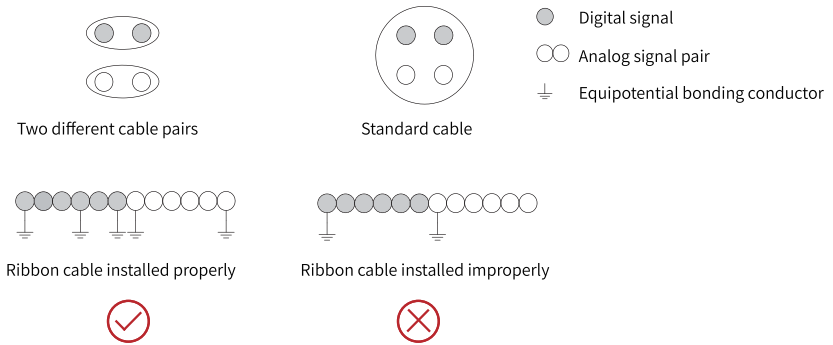


Figure 4-12 Routing different types of signal cables

● Routing of multi-conductor cables

Use one multi-conductor cable to transmit one type of signals. If you need to use one multi-conductor cable to transmit different types of signals, isolate the conductors that transmit one type of signals, as shown in the following figure.

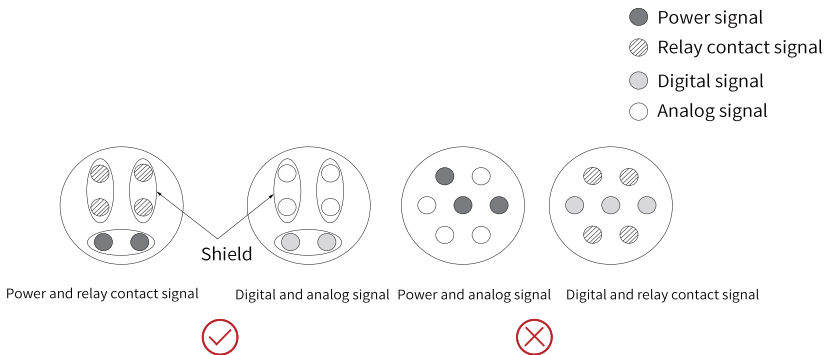


Figure 4-13 Routing of multi-conductor cables

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

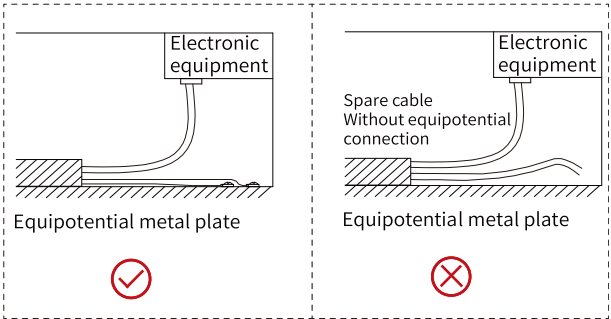


Figure 4-14 Handling of unused conductors in a multi-conductor cable

- **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 a large loop area. Use twisted pair cables for analog signals. Lay digital signal cables close to each other.

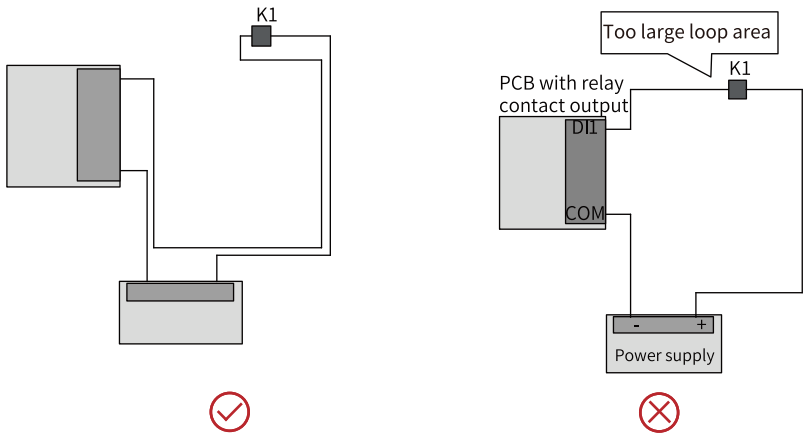


Figure 4-15 Recommended wiring loop area

- **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, as shown below.

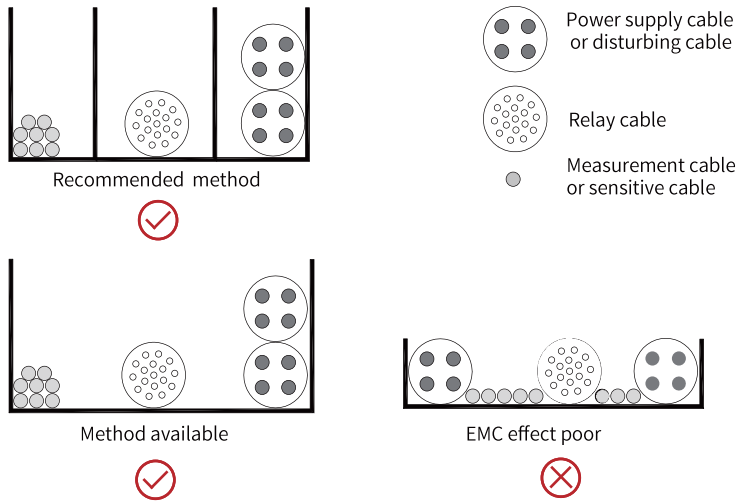


Figure 4-16 Laying multiple types of cables

- **Requirements on handling 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 drive enclosure. In this case, connect the shield to an external PE terminal, as shown below.

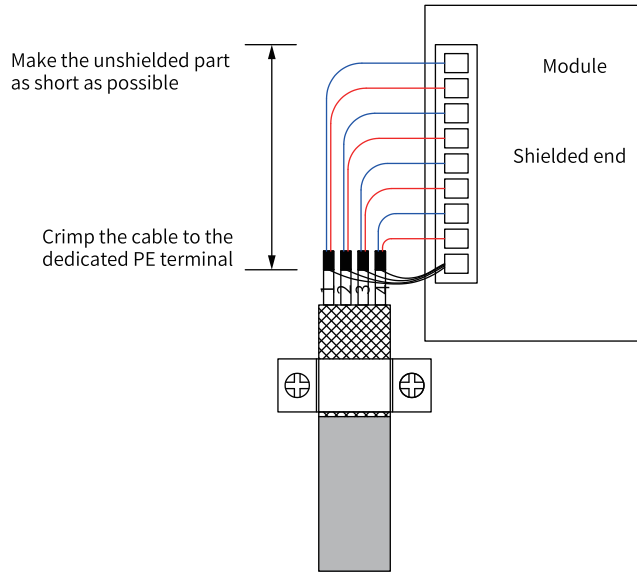


Figure 4-17 Requirements on shielded cable

4.6 Solutions to Common EMC Issues

4.6.1 Harmonic Suppression Measures

To suppress the high harmonic current of this product and improve the power factor, install an AC input reactor on the input side of the product. This will enable the product to meet standard requirements.

4.6.2 Residual Current Device Misoperation

When malfunction occurs on the residual current device (RCD), take the following measures.

Table 4-15 Troubleshooting when the ELCB malfunctions

Symptom	Possible cause	Solution
The RCD trips at the moment of power-on.	The anti-interference performance of the RCD is weak.	1. Use RCDs of recommended brands. 2. Use an RCD with a higher tripping current. 3. Move the unbalanced load to the upstream side of the residual current device.
	The tripping current of the RCD is excessively low.	
	An unbalanced load is connected to the downstream side of the RCD.	
	An excessive ground capacitance exists in the upstream side of the drive.	
The RCD trips during operation.	The anti-interference performance of the RCD is weak.	1. Use RCDs of recommended brands. 2. Install a simple filter on the input side of the drive and wind the LN and RST cables through the ferrite ring near the RCD, as shown in <i>"Figure 4-18 Installing simple filter and ferrite ring on the input side" on page 52.</i> 3. Use an RCD with a higher rated tripping current. 4. Reduce the carrier frequency without compromising the performance. 5. Use shorter motor cables.
	The tripping current of the RCD is excessively low.	
	An unbalanced load is connected to the downstream side of the RCD.	
	The distributed capacitance to ground of the motor cable and motor is excessively high.	

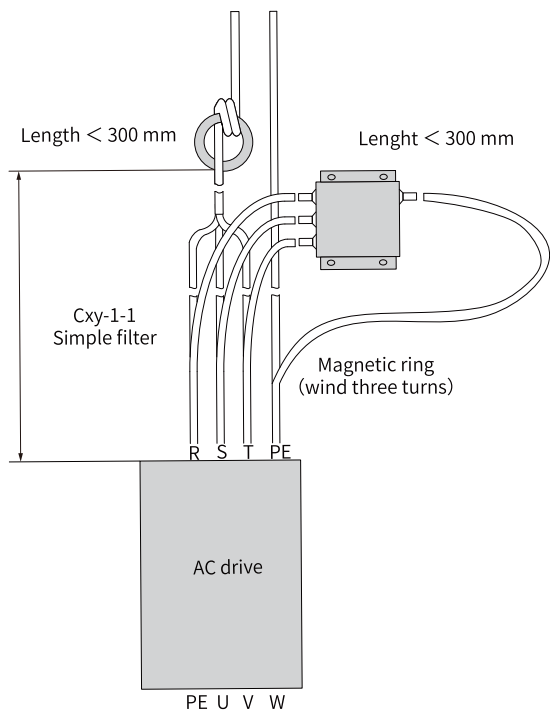


Figure 4-18 Installing simple filter and ferrite ring on the input side

4.6.3 I/O Signal Interference

4.6.3.1 High-speed Pulse Interference

Take the measures listed in the following table.

No.	Step
1	Use shielded twisted pair cables and ground both ends.
2	Connect the motor housing to the PE of the AC drive.
3	Connect the PE of the AC drive to the PE of the mains power supply.
4	Add an equipotential bonding grounding cable between the host controller and the 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.

No.	Step
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 shielded power cables with the shield grounded properly.

4.6.3.2 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 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 capacitor filtering of the low-speed DI, with a recommended maximum value of 0.1 μF .
6	Increase the filtering capacitance of the AI. The recommended maximum value is 0.22 μF .
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 shielded power cables with the shield grounded properly.

4.6.4 RS485 and CAN Communication Interference

Observe the following steps for troubleshooting.

No.	Step
1	Install a 120 Ω termination resistor at both ends of the bus.
2	Replace with multi-conductor shielded twisted pair cables and ground both ends of the shield.
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	Install extra equipotential bonding grounding cables among the nodes in case of multi-node communication.
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.

No.	Step
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 shielded power cables with the shield grounded properly.

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

Basic information

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 running; reset upon fault; speed adjustment by external potentiometer connecting to AI

Electrical cabinet schematic diagram

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

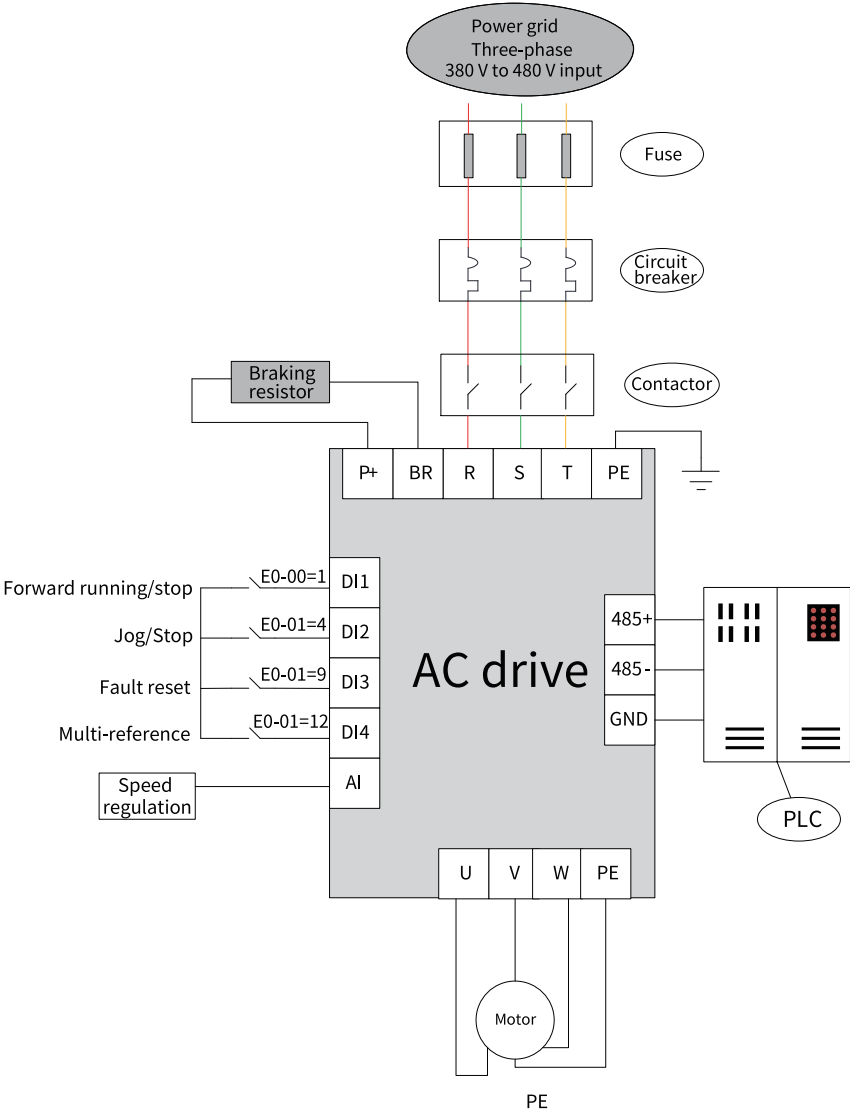


Figure 4-19 Schematic diagram of the electrical cabinet

5 Installation

5.1 Installation Preparation

5.1.1 Installation Environment Requirements

Table 5-1 Environment requirements

Environment	Conditions
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/Operating 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 product in places without drastic temperature change. • When installing the drive in an enclosed cabinet, use the cooling fan or air conditioner to keep the incoming air temperature below 50°C. Failure to comply will result in overheat or fire. • Install the drive on a flame-retardant surface, with sufficient clearance reserved for heat dissipation. • Take measures to prevent the drive from being frozen.
Humidity	Storage/Ambient humidity: <95% RH, non-condensing
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 drive • Free from radioactive materials, combustible materials, hazardous gas and liquid, and salt corrosion • Away from combustible materials such as wood • The mounting base plate must be free from oil and grease. Do not use tapping oil or liquid thread locker.

Environment	Conditions
Altitude	1000 m and below: Derating is not needed. - Derating is needed for altitudes above 1000 m (derate 1% for every additional 100 m). If the altitude is higher than 2000 m, consult your Inovance agent or sales personnel.
Vibration resistance	- Operation scenario: Tested 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: Tested according to IEC 60068-2-64. Power spectrum density at 5 Hz to 100 Hz: 0.01 g²/Hz; power spectrum density at 200 Hz: 0.001 g²/Hz; Grms: 1.14 g
Shock	Operating/Transport environment: Tested according to IEC 60068-2-27. Acceleration: 15 g; pulse width: 11 ms; 18 times in directions of three axes

5.1.2 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.

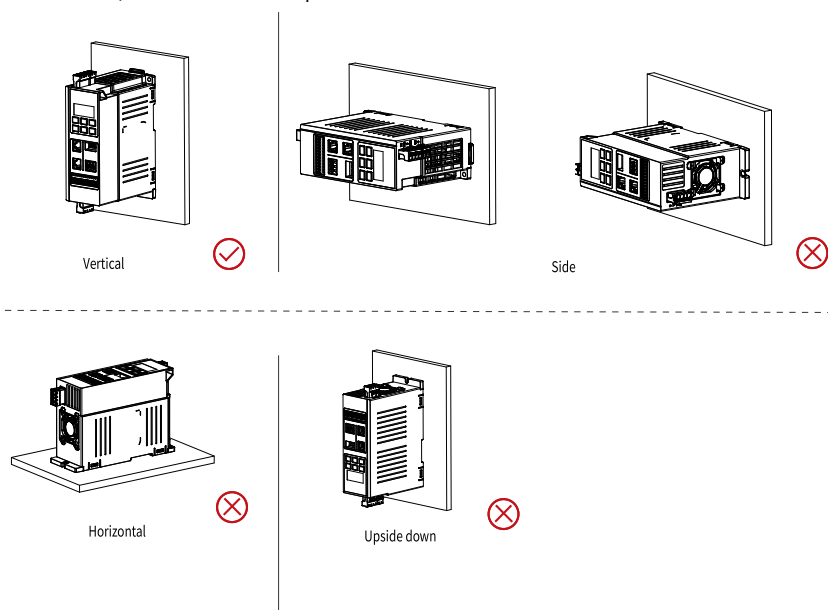


Figure 5-1 Installation direction

5.1.3 Installation Tools

Mechanical Installation Tools

For details about the tools, see ["Table 5-2 Tools for mechanical installation" on page 58.](#)

Table 5-2 Tools for mechanical installation

Tool name	Description
Electric drill and 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)	Used to tighten or loosen screws.
Caliper or tape measure	Used to measure the installation dimensions of the equipment.
Gloves	Used to prevent static electricity during 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

For screw specifications and quantity, see ["Table 5-3 Specifications and quantity of screws" on page 58.](#)

Table 5-3 Specifications and quantity of screws

Installation method	Screw Specification	Recommended tightening torque of the screw (Unit: kgf.cm)	Quantity (Unit: PCS)	Description
Back plate Mounting	M4x12 cross recessed pan head SEMS screws (with flat washer and spring washer)	12	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 5-4 Wiring tools for main circuit terminals

Structure	Recommended fastener	Tool
T1-T2	Terminal block	Cable stripper and cable pliers

5.2 Pre-installation Inspection

Complete the following inspection items before installation.

Table 5-5 Pre-installation checklist

No.	Item	Tick
1	The mechanical strength of the mounting position can bear the weight of the device.	☐
2	The environment and load-bearing capacity of the mounting position fulfill the installation requirements.	☐
3	Sufficient clearance is reserved for heat dissipation, including for heat dissipation of other devices in the cabinet.	☐
4	The mounting bracket (if needed) is made of incombustible materials.	☐
5	If the application site is exposed to metal dust, install the equipment in an enclosed cabinet to isolate the equipment from the metal dust. In this case, the space inside the cabinet needs to be as large as possible.	☐
6	Before installing the AC drive, install the bottom mounting bracket in the cabinet and guide rails (optional), and prepare mounting beams with holes reserved to fix the AC drive.	☐
7	Keep combustible and explosive materials away from the equipment.	☐

5.3 Installing the AC Drive

5.3.1 Installation Method

5.3.1.1 Backplate Mounting

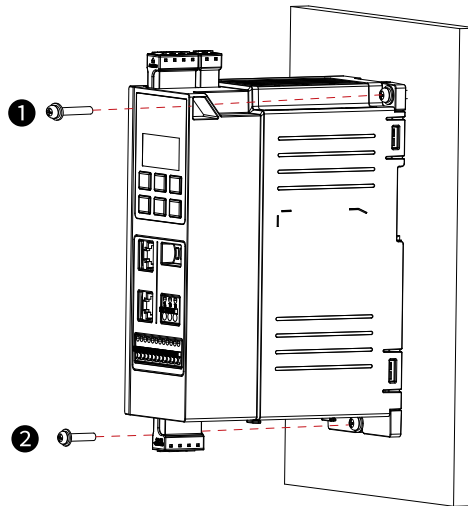
Backplate mounting is applicable to T1 (single-phase 200-240 V: 0.37-1.5 kW; three-phase 380-480 V: 0.37-2.2 kW) and T2 models (single-phase 200-240 V: 2.2 kW; three-phase 380-480 V: 4-5.5 kW).

Prerequisites

Before installation, check that the installation tools and environment have been prepared. For details, see "[Pre-installation Preparation](#)" on page 56. This section describes quick backplate mounting steps.

Procedure

1. Use a Phillips screwdriver to secure the M4x12 cross recessed pan head SEMS screw (with the flat washer and spring washer) on the upper right side of the drive, as shown in ①.
2. Repeat the previous step to fix the screw below the drive, as shown in ②.



5.3.1.2 Guide Rail Mounting

Install the guide rail for T1 models (three-phase 380-480 V: 0.37-2.2 kW; single-phase 200-240 V: 0.37-1.5 kW). For T2 models (three-phase 380-480 V: 4-5.5 kW; single-phase 200-240 V: 2.2 kW), the guide rail is not required.

Prerequisites

- To install the AC drive with a guide rail, order the DIN guide rail (option). For details, see ["12.1 List of Options" on page 102](#).
- Before installation, check that the installation tools and environment have been prepared. For details, see ["Pre-installation Preparation" on page 56](#). This section describes quick guide rail installation steps.

Procedure

1. Insert the guide rail latch into the slot at the bottom of the drive until it clicks into place, as shown in ①.
Figure ② shows that the guide rail is installed in place.

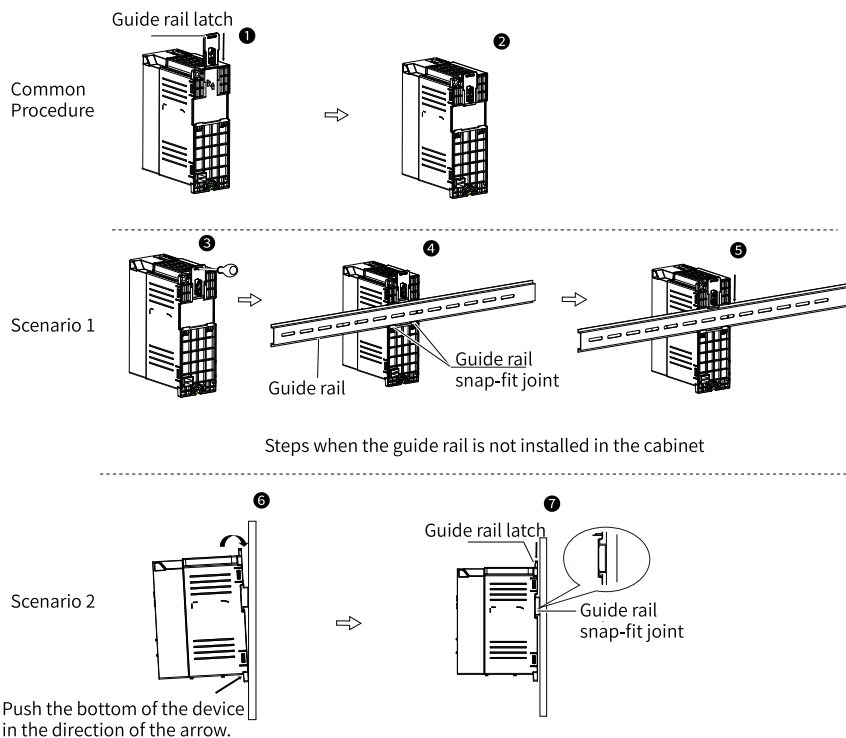
Scenario 1: The guide rail is not installed in the cabinet.

2. Use the straight screwdriver to pull the guide rail latch up slightly, as shown in ③.

3. Install the guide rail to the snap-fit joint on the drive, as shown in ④.
4. Press the guide rail latch down to the place to lock the guide rail, as shown in ⑤.

Scenario 2: The guide rail is installed in the cabinet.

5. Hold the drive at the fixing position, push the bottom of the drive in the direction of the arrow to the place to snap it to the snap-fit joint, as shown in ⑥.
6. Press the guide rail latch down to the place to lock the guide rail, as shown in ⑦.



Steps when the guide rail is not installed in the cabinet

Steps when the guide rail is installed in the cabinet.

Figure 5-2 Guide rail installation

5.4 Post-Installation Inspection

After installation is done, check the following items.

Table 5-6 Post-installation checklist

No.	Item	Tick
1	The ceiling height meets the minimum requirements for smooth ventilation. The air inlet and air outlet are free of obstruction and have sufficient space. Sufficient space is reserved for safe passing when the cabinet door is opened.	☐
2	All contact protection devices (such as the guard plate) inside and outside the cabinet are installed.	☐

6 Wiring

6.1 Pre-wiring inspection

Check the following items before wiring.

Table 6-1 Pre-wiring checklist

No.	Item	Tick
1	Cables used during wiring comply with the requirements on the cross-sectional area and the shield.	☐
2	The equipment and the drive are grounded properly.	☐
3	Take proper electrostatic discharge (ESD) measures and wear an antistatic wrist strap.	☐

6.2 Main Circuit Connection

6.2.1 Descriptions of Main Circuit Terminals

Terminal Layout

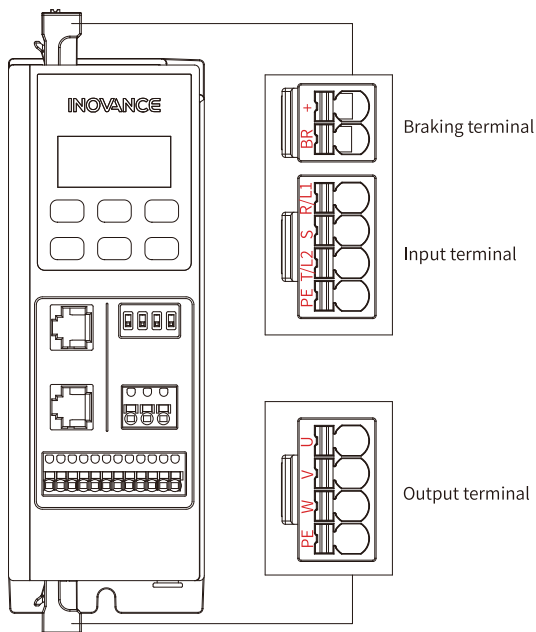


Figure 6-1 Arrangement of main circuit terminals of T1 to T2 models

Terminal description

Table 6-2 Main circuit terminals of T1 to T2 models

Terminal mark	Terminal	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 input terminals	Connected to the three-phase AC power supply.
(+), BR	Terminals for connecting the braking resistor	Used to connect the braking resistor.
U, V, W	Output terminals	Used to connect the three-phase motor.
PE	Grounding terminal (PE)	Protective grounding

Note

Terminals + and BR for the braking resistor are optional and are available only on models with the letter "B" at the end. Models without the letter "B" do not have these terminals and do not support external braking resistors.

Terminal dimensions

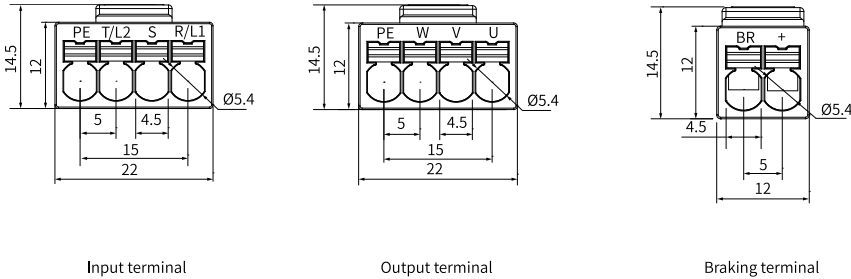


Figure 6-2 Main circuit terminal dimensions (mm) of T1 models

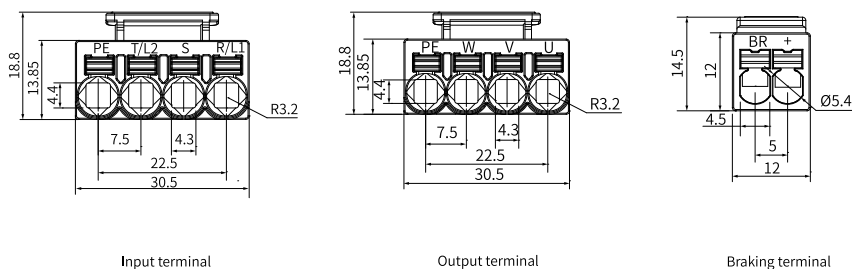


Figure 6-3 Main circuit terminal dimensions (mm) of T2 models

6.2.2 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. Do not connect these terminals to an AC power supply.
- To protect the main circuit, isolate and cover it from surfaces that may come into contact.
- 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 the external SELV circuit.
- Prevent foreign matters from entering the wiring part of the terminal block.
- Do not solder twisted conductors.

For main circuit cable specifications, see ["12.9.1 Main circuit cable" on page 125](#).

6.2.3 Main Circuit Wiring

Context

For details on main circuit terminals and control circuit terminals, see ["Electrical Design" on page 28](#). This section describes quick control circuit wiring.

Procedure

1. Ground the AC drive.
2. Check the rated value of the circuit breaker or fuse.
3. Check whether the rated motor voltage is compatible with the AC drive voltage.
4. Connect the AC drive to the motor.
5. Connect the AC drive to the mains power.

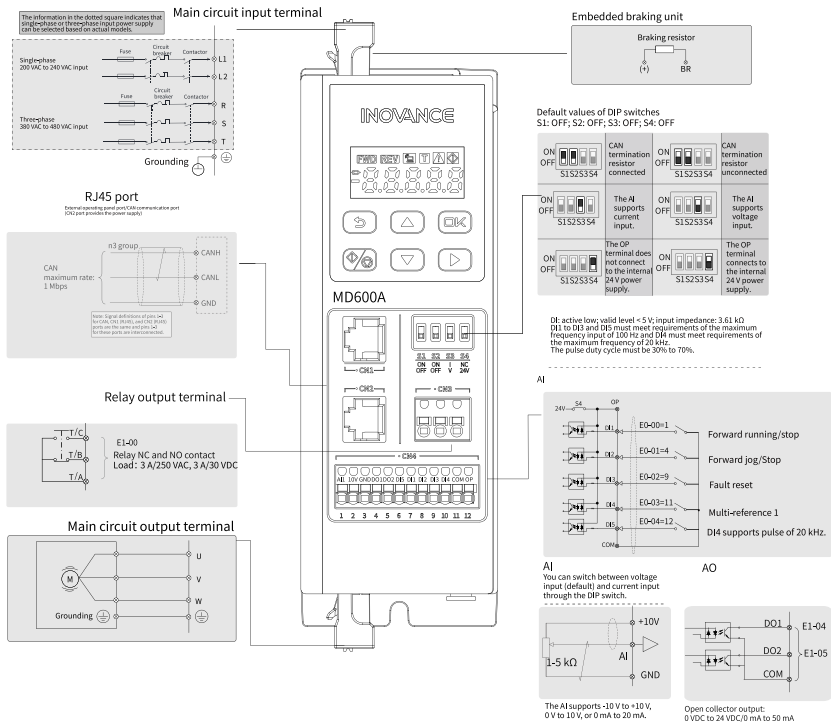


Figure 6-4 Connection diagram for CAN models

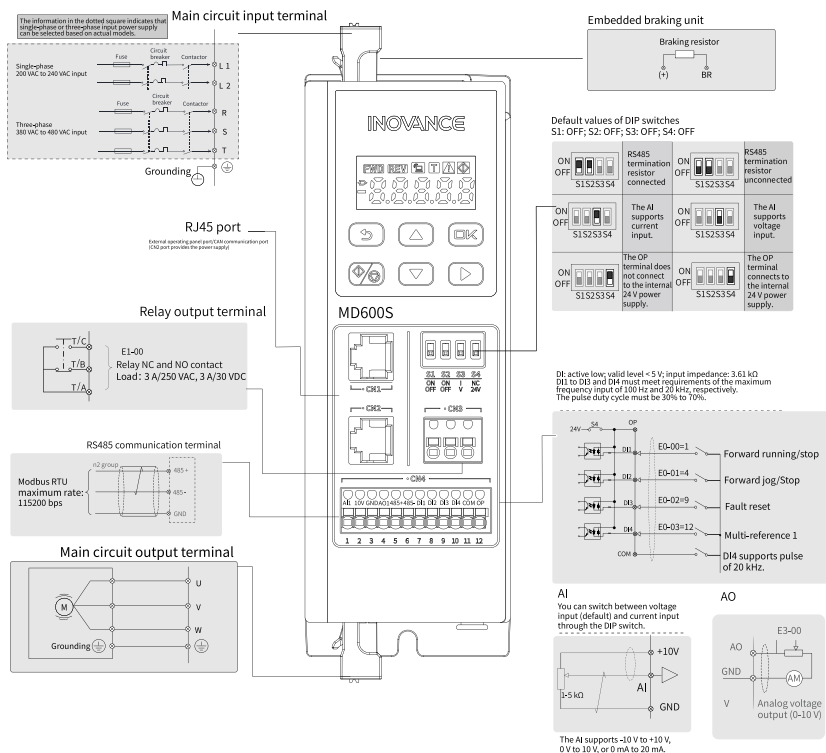


Figure 6-5 Connection diagram for RS485 models

6.3 Control Circuit Connection

6.3.1 Descriptions of Control Circuit Terminals

Terminal Layout

"Figure 6-6 " on page 68 shows the layout of control circuit terminals.

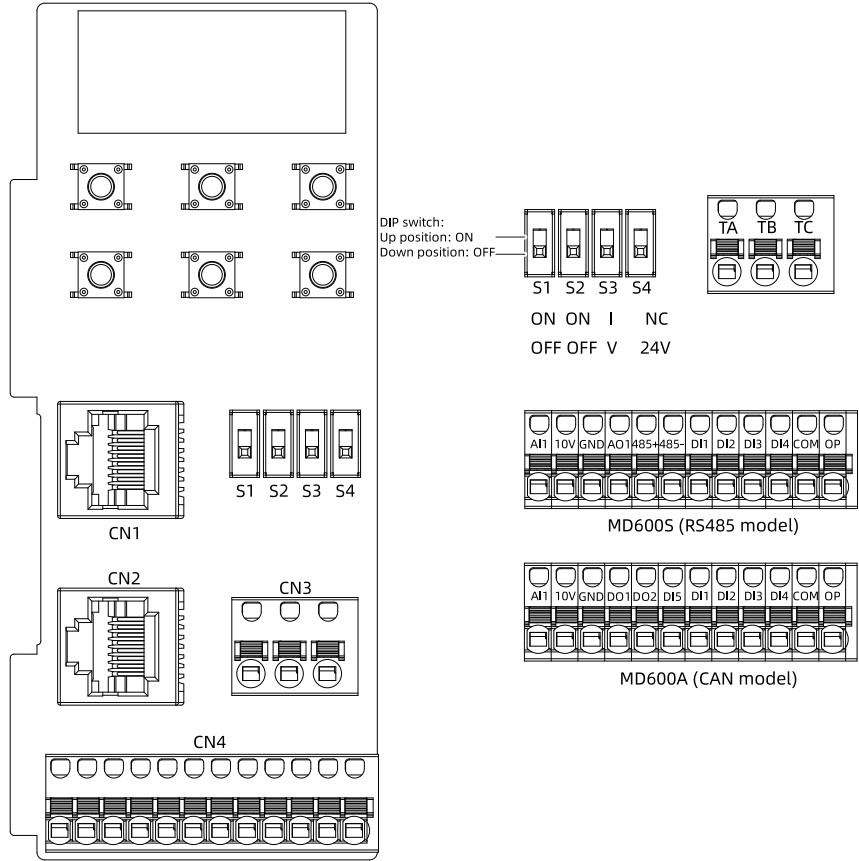


Figure 6-6 Layout of control circuit terminals

Terminal description

Table 6–3 Descriptions of Control Circuit Terminals

External terminal	Terminal type	Transmission information type	Terminal mark	Terminal name	Function
CN1	RJ45	Modbus communication	-	Communication port	The CN1 interface of the MD600S and MD600A models supports connection with the commissioning software through Modbus RTU, but does not support connection with the operating panel. The CN1 interface supports communication with the PLC.
		CAN communication			The CN1 terminal of the MD600A models supports CANopen/CANlink communication.
CN2	RJ45	Modbus communication CAN communication	-	Communication port External operating panel port	The CN2 terminal of the MD600S and MD600A models supports connection with the operating panel through the Modbus RTU and supports connection with the operating panel. The CN2 interface of the MD600A models also supports CANopen/CANlink communication.
CN3	3-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	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 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 k Ω ; input impedance in the current mode: 500 Ω
			10V	10 V analog voltage output	Output voltage range: 10 V $\pm$ 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 k Ω
			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 24 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; Transmission distance: The maximum transmission distance corresponding to the baud rate of 9.6 kbps is 1 km.
			DO2	DO2 (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 24 V Output current range: 0 mA to 50 mA

External terminal	Terminal type	Transmission information type	Terminal mark	Terminal name	Function
CN4	12-pin terminal block	DI/DO/AI/AO/RS485	485-	RS485 communication signal - (RS485 model)	Negative RS485 communication signal
			DI5	DI5 (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	DI1	See DI5 above.
			DI2	DI2	
			DI3	DI3	
CN4	12-pin terminal block	DI/DO/AI/AO/RS485	DI4	DI4	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 power supply, and disconnect OP from the internal 24V terminal by setting the S4 DIP switch to ON.
			COM	Reference ground of 24 V power supply	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 6-4 " on page 72
			S2	DIP switch for termination resistor for 485-/CANL communication	The DIP switch is disconnected by default. For details, see "Table 6-4 " on page 72
			S3	Voltage/current mode switch for AI	The voltage mode is used by default. For details, see "Table 6-4 " on page 72
			S4	24 V power supply/external power supply switch	The 24 V power supply is connected to OP by default. For details, see "Table 6-4 " on page 72

The following table describes DIP switches.

Table 6-4 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 supports the current input mode (impedance: 500 Ω). OFF: AI1 supports the voltage input mode.
S4	NC: OP unconnected 24: OP is connected to the internal 24 V power supply.

Note

- By default, the DIP switch is in the OFF position.
 - To connect the termination resistor, S1 and S2 must be set to ON at the same time.
-

6.3.2 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/T cables and U/V/W cables) and other power cables or power supply cables.

Wiring AI1

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 core at the analog signal source, as shown in *"Figure 6-7 Wiring of AI terminals" on page 73*.

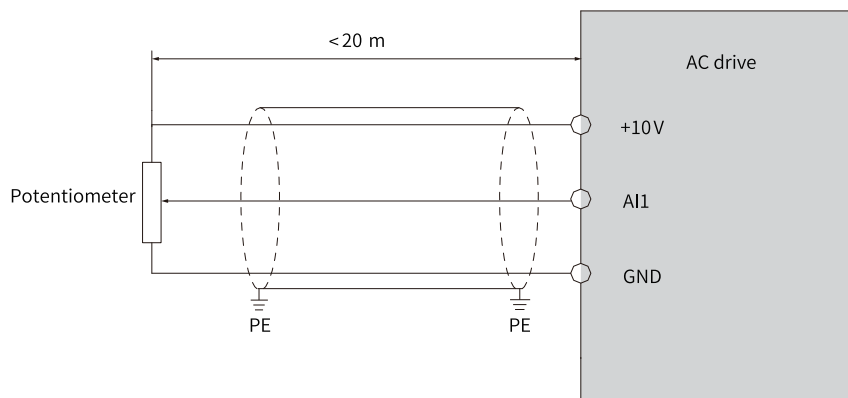


Figure 6-7 Wiring of AI terminals

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.

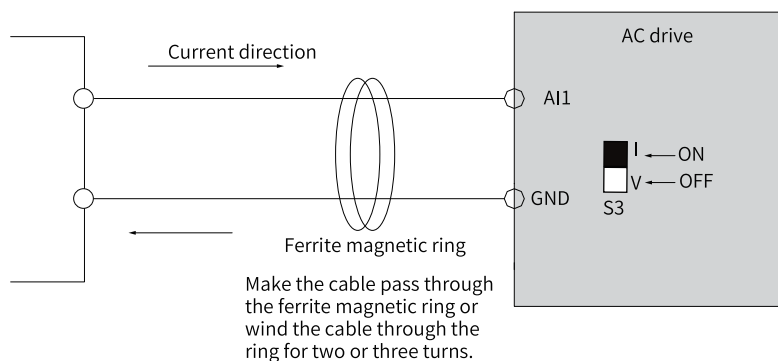


Figure 6-8 Wiring of AI1 in the current input mode

Wiring DI1 to DI5



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

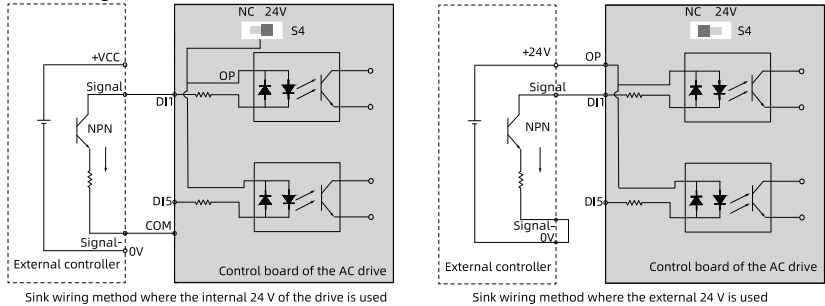


Figure 6-9 Sink wiring

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 requirement: $IF > 40\text{ mA}$ and $VR > 40\text{ V}$, as shown in ["Figure 6-10 Parallel connection of DIs of different AC drives in sink wiring mode" on page 74.](#)

Control board of the AC drive

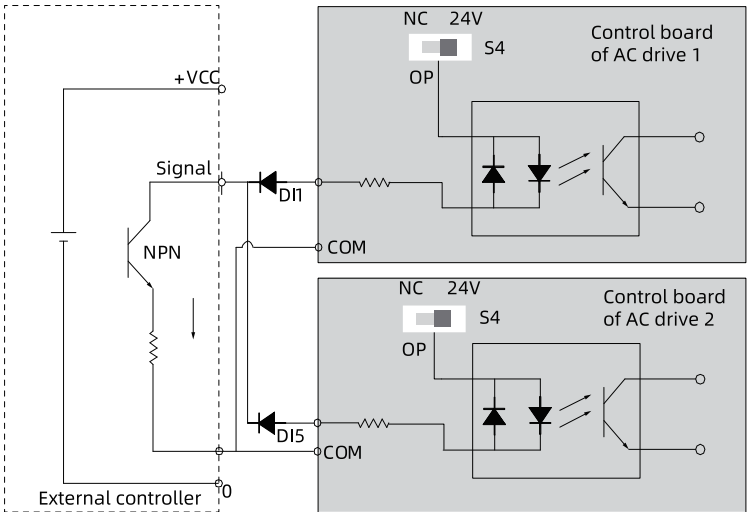


Figure 6-10 Parallel connection of DIs of different AC drives in sink wiring mode

- Source wiring

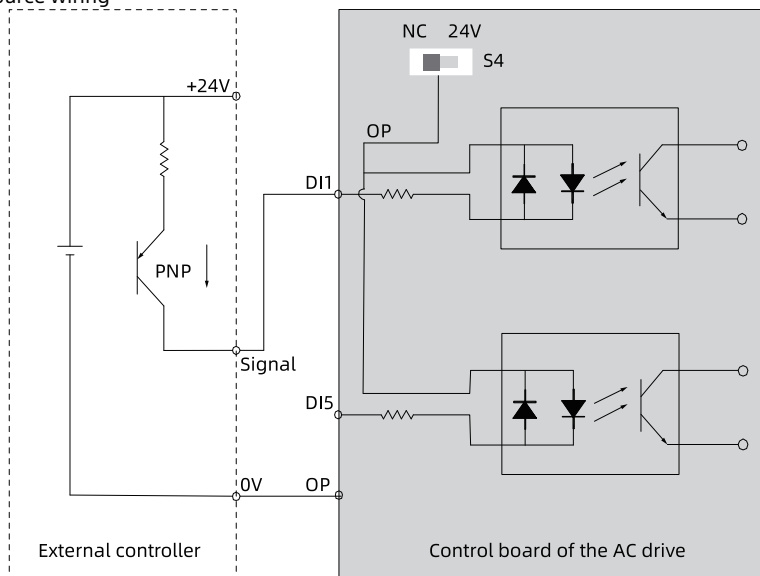


Figure 6-11 Source wiring

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

To use the DO terminal to drive a relay, connect a snubber diode to both ends of the relay coil. Otherwise, it may cause damage to the 24 VDC power supply. Ensure that the driving capacity does not exceed 50 mA.

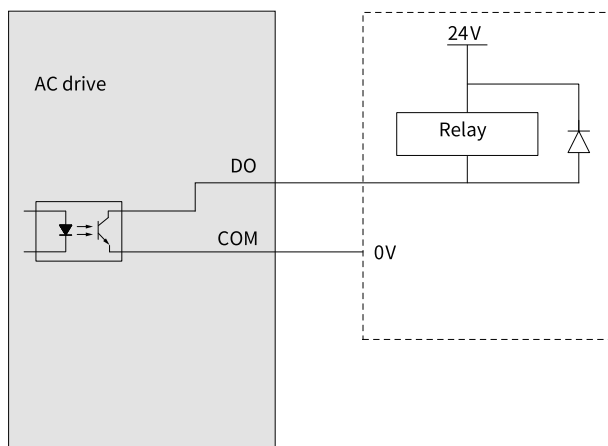


Figure 6-12 Wiring between DO and relay



CAUTION

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

DO: Optocoupler isolation; unipolarity 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 be wired only in the following way.

The DO does not require the internal 24 V power supply.

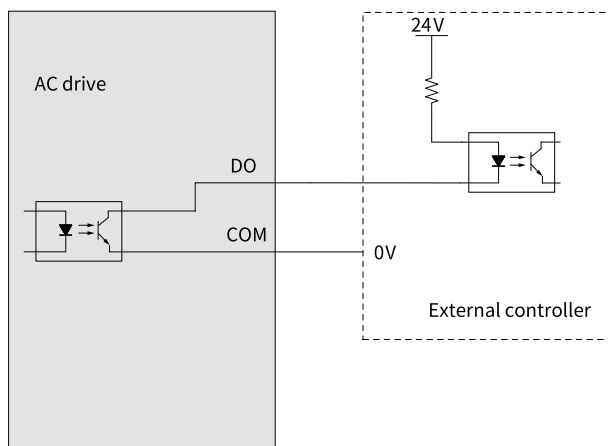


Figure 6-13 DO connecting to external controller

Wiring of Relay Output Terminals

The inductive load (relay, contactor, and motor) causes voltage peak after the current is removed. To minimize the interference at cutoff, connect a voltage dependent resistor to the relay contact and connect absorption circuits, such as voltage dependent resistors, RC absorption circuits, and diodes, to other inductive loads, as shown in ["Figure 6-14 Anti-interference treatment for relay output terminals" on page 77](#).

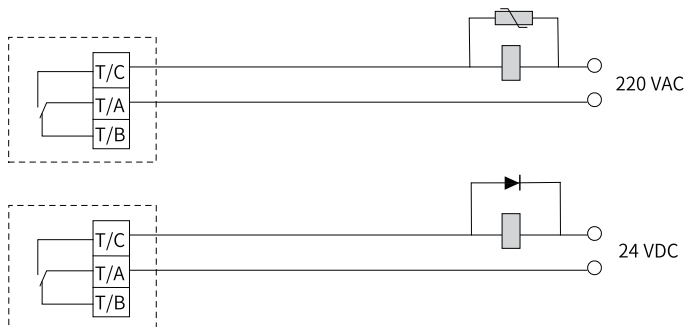


Figure 6-14 Anti-interference treatment for relay output terminals

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 "Control Circuit Cable" in MD600 Series Compact AC Drive User Guide.

6.4 Communication Wiring

6.4.1 RS485 Communication Wiring

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 on the master. If the master does not have a built-in termination resistor, install an external termination resistor. The right termination resistor is also set by the DIP switch.

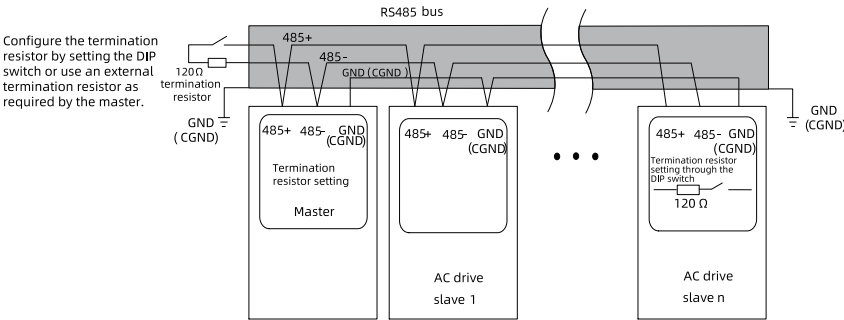


Figure 6-15 RS485 bus topology

The maximum number of nodes and transmission distance of a standard RS485 circuit vary with the transmission rate, as listed in the following table.

Table 6-5 Transmission distance and number of nodes

Transmission distance (m)	Transmission Rate (kbps)	Number of Nodes	Cross-Sectional Area
100	115.2	128	26 AWG
1000	19.2	128	26 AWG

6.4.2 CAN Wiring

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 reference grounds for CAN signals of all the nodes (up to 64 nodes) together.

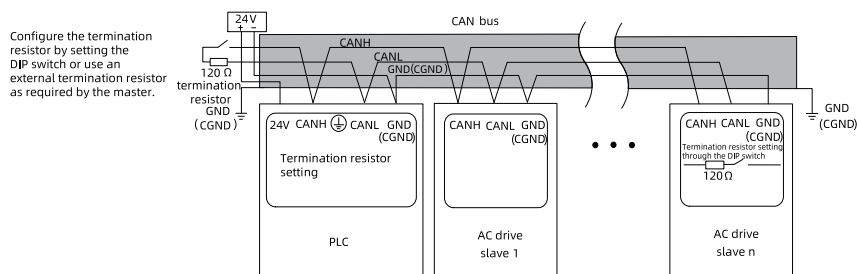


Figure 6-16 CAN bus topology

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 6-6 Transmission distance and baud rate

Transmission distance (m)	Transmission Rate (kbps)	Number of Nodes	Cross Sectional Area (mm ²)
25	1000	64	0.205
95	500	64	0.34
560	100	64	0.5
1100	50	64	0.75

6.5 Grounding requirements

To properly ground the servo drive, observe the following requirements:

Note

- To prevent electric shock, ground the grounding terminal properly. Observe related national or regional regulations during grounding.
- To prevent electric shocks, ensure that the protective grounding conductor meets the technical specifications and local safety standards, and shorten the grounding cable length as much as possible.
- The leakage current of a single drive does not exceed 3.5 mA AC or 10 mA DC. You only need to configure one protective grounding conductor with the same specifications as the phase cable.
- When using multiple devices, follow the instructions for grounding all devices. Incorrect grounding can result in misoperation of devices.

6.6 Post-wiring Inspection

After wiring is done, check the following items and tick compliant items.

Table 6-7 Post-wiring inspection checklist

No.	Item	Tick
1	The power supply input cables are connected to the R, S, and T terminals (three-phase 380 V) or L1 and L2 terminals (single-phase 220 V).	☐
2	Motor input cables are connected to the U, V, and W terminals.	☐
3	The cross-sectional area of the main circuit cables meet the requirements.	☐
4	The heat-shrink tubing has been applied to the copper barrel of the main circuit lug and cable conductors, with the tubing fully covering all exposed conductors.	☐
5	The motor output cable does not exceed 50 m. Otherwise, the carrier frequency needs to be reduced through A5-01.	☐
6	The grounding cable is connected properly.	☐
7	The output terminals and control cable terminals are connected properly.	☐
8	The braking resistor and braking unit with proper resistance are wired properly.	☐
9	The control circuit signal cables are shielded twisted pair cables.	☐
10	Control circuit cables and main circuit cables are routed through different routes.	☐
11	There are no screws, gaskets, or exposed cables left inside the product.	☐
12	When wiring multiple motors, ensure the connections are correct and avoid cross-wiring between the motors and the drive. Cross-wiring may cause abnormal motor operation.	☐

7 Shipment Check

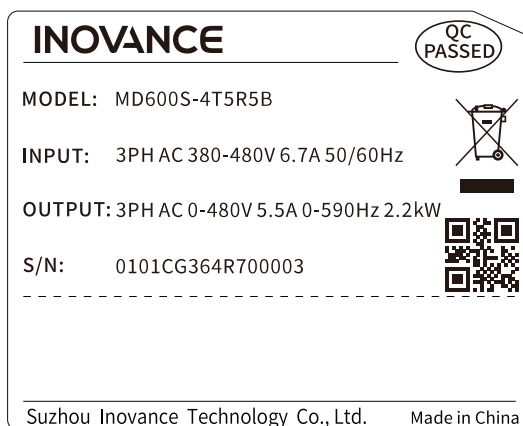
Procedure

1. Open the package and check whether the drive is intact.



If the AC drive or other accessories are damaged, do not operate or install the damaged device.

2. Check whether the drive model is consistent with that on the delivery order.



3. Record the model and serial No.

8 Power Supply Compatibility Check

Check and ensure that the voltage of the mains power is compatible with the voltage of the AC drive power supply.

The following table describes the AC drive models and power supply voltage.

Table 8–1 AC drive models and power supply voltage

Rated voltage	AC drive model
Single-phase 200 V to 240 V	MD600S/A-2S2R8 MD600S/A-2S4R6 MD600S/A-2S7R5B MD600S/A-2S010B
Three-phase 380 V to 480 V	MD600S/A-4T1R6 MD600S/A-4T2R3 MD600S/A-4T4R8 MD600S/A-4T5R5B MD600S/A-4T9R5B MD600S/A-4T013B

Note

MD600S indicates the RS485 model, and MD600A indicates the CAN model.

9 Unpacking and Handling

Unpacking

1. Open the package of the AC drive (①).
2. Take out the cushion (②).
3. Take out the AC drive (③) and the accessory kit (④).

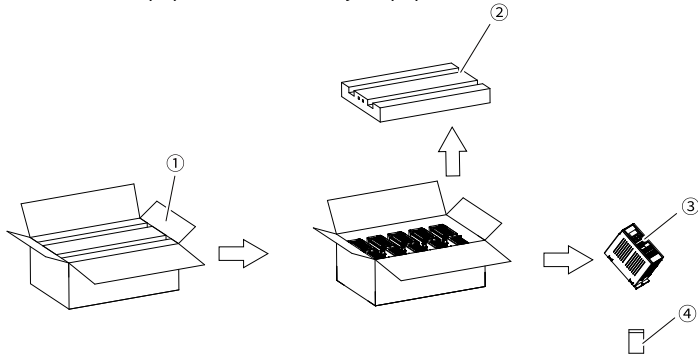


Figure 9-1 Unpacking
Table 9-1 Unpacking list

No.	Name
①	AC drive package
②	Cushion
③	AC drive
④	Accessory Kit

Storage



Store and transport the equipment as required to prevent damage.

- The drive must be stored in a clean and dry room, where the temperature ranges from -20°C and +60°C and temperature change rate is smaller than 1°C/min.
- Do not store or transport the equipment in locations where the equipment may be exposed to splashing water or rain, direct sunlight, strong electric field, strong magnetic field, or strong vibration.
- Do not expose the drive to environments with moisture, high temperature, or strong sunlight for a long time.

- If the drive needs to be stored for a long period of time, cover it or take other appropriate measures to keep it from contamination and adverse environmental impacts.
- Pack the drive with the original packing box provided by Inovance.
- Store the equipment for up to three months. Take stricter protective measures and carry out the necessary inspections for a longer storage time.
- The electrolytic capacitor will deteriorate after long-term storage. Therefore, switch on the drive once for at least 5 hours every 6 months. Increase the input voltage slowly to the rated value by using a voltage regulator. Contact Inovance for technical support if necessary.
- Pack the equipment securely and properly before transportation. Use a fully enclosed container for long-distance transportation.
- Never transport the drive with other device or materials that may harm or have negative impacts on the drive.

Handling

Note

- Large-scale or heavy equipment must be transported by qualified professionals using specialized hoisting equipment. Failure to comply may result in personal injuries or equipment damage.
 - Before hoisting the equipment, ensure the components such as the front cover and terminal block 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.
 - 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.
 - Handle the equipment with care during transportation and mind your steps to prevent personal injuries or equipment damage.
-

10 Maintenance and Repair

10.1 Routine Maintenance and Repair

10.1.1 Routine checklist

The ambient temperature, humidity, dust, and vibration will cause aging of components inside the drive, which leads to potential faults and shortens the service life of the drive. Therefore, routine maintenance on the device is required. The maintenance interval must be shortened when the drive is used in environments suffering from high ambient temperature, frequent startup and stop, violent fluctuation in the AC power supply and the load, strong vibration or shock, and intrusive and corrosive substances such as dust, metal dust, and hydrochloric acid.

Check the following items daily to ensure a proper operation of the product. It is recommended to make a copy of this checklist and sign the "Checked" column after each inspection.

Item	Description	Solution	Result
Motor	No unusual vibration or noise occurs during operation of the motor.	• Ensure normal mechanical connection. • Check the motor for phase loss. • Check whether motor screws are tightened.	
Cooling fan	The cooling fans of the drive and the motor operate properly without exception.	• Ensure the fan on the device side operates normally. • Ensure the fan on the device side operates normally. • Ensure that the air duct is not clogged. • Ensure that the ambient temperature is within the allowable range.	
Installation environment	The control cabinet and cable ducts are normal.	• Ensure the insulation of the cables at the inlet and outlet is not damaged. • Ensure that the mounting bracket does not vibrate. • Ensure that the copper busbar and cable terminals are connected properly or are not corroded.	

Item	Description	Solution	Result
Load	The operating current of the drive is within the allowable range of the rated current of the drive and that of the motor.	• Ensure motor parameters are set properly. • Ensure that the motor is not overloaded. • Ensure that the mechanical vibration is within the allowable range, that is, lower than 0.6 g.	
Input voltage	The power supply voltage between the main circuit and the control circuit is normal and stable.	• Ensure that the input voltage is within the allowable range. • Check that no heavy load is started around the drive.	
Brake	The brake circuit is normal.	• Check that the control wiring is secure and free from discoloration, melting, or other abnormalities. • Ensure that the brake acts properly. Perform the brake action test separately.	

10.1.2Regular checklist

The following shows items to be checked every one or two years. Determine the actual inspection cycle based on actual application and operating environment. Regular maintenance helps detect product function deterioration and damage.

Make a copy of the following checklist and sign the "Checked" column after each inspection.



Do not perform inspection or connection work with power on. Failure to do so may result in an electric shock. Cut off the power supplies of all equipment before wiring or repair. 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 safety voltage range. Failure to do so may result in an electric shock.

Item	Description	Solution	Checked
Drive	There are no waste, dirt, or dust on the surface.	● Ensure that the power supply of the controller cabinet is connected. ● Use a vacuum cleaner to suck up waste and dust to prevent direct contact with the parts. ● For stubborn surface dirt, wipe up the dirt with a piece of soft cloth immersed in alcohol.	
Cable	● Power cables and connections are not discolored. ● The insulation is not aged or cracked.	● Replace the cracked cables. ● Replace the damaged terminal.	
Peripherals of the electromagnetic contactor	● The contact can be closed without abnormal noise. ● There are no short circuit, water seepage, swelling, or cracking occurs on peripheral devices.	Replace such defective peripherals.	
Air duct	● The air duct and heatsink are not clogged. ● The fan is operating normally.	● Clean the air duct. ● Replace the fan.	
Control circuit	● Control components are in good contact. ● Terminal screws are tightened. ● The insulation of the control cable is not cracked.	● Clean the surface of control circuit cables and terminals. ● Replace control circuit cables that are damaged or corroded.	

10.2 Components Replacement

10.2.1 Service Life of Maintainable Components

The quick-wear parts of the AC drive include the cooling fan and filter electrolytic capacitor. The service life of such devices is closely related to the operating environment and maintenance conditions. Generally, the lifespan is as follows.

Part	Service Life ^[Note]
Fan	≥ Five years
Electrolytic capacitor	≥ Five years
Note: The standard lifetime indicates the lifetime when the parts are used in the following conditions. You can determine when to replace these parts according to the actual operating time. Ambient temperature: 40°C Load rate: 80% Operating rate: 24 hours per day	

10.2.2 Replacing the Fan

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.

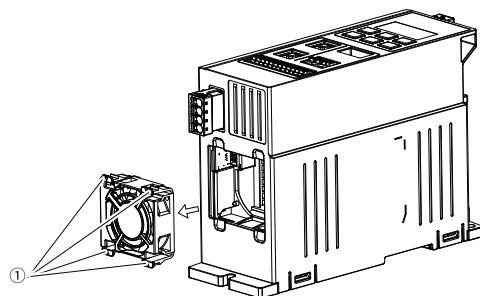


Figure 10-1 Fan removal

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.

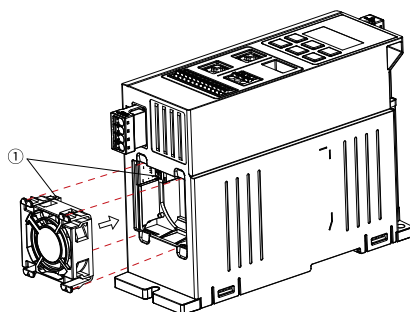


Figure 10-2 Fan installation

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.

11 Technical Data

11.1 Model Selection List

See the following table for key specifications.

Table 11-1 Model Selection List

Model	Model	Structure	Power (kW)	Rated input current (A)	Rated output current (A)	Product code	Function	Cooling method	Built-in Braking Unit
Single-phase 200 V to 240 V									
RS-485	MD600S-2S2R8	T1	0.37	6.2	2.8	0101C427	RS485 Communication	Natural ly-ventilated	None
	MD600S-2S2R8B	T1				0101CR67	RS485 Communication	Natural ly-ventilated	Yes
	MD600S-2S4R6	T1	0.75	10.2	4.6	0101C523	RS485 Communication	Air cooling	None
	MD600S-2S4R6B	T1				0101CR68	RS485 Communication	Air cooling	Yes
	MD600S-2S7R5	T1	1.5	16.6	7.5	0101CR63	RS485 Communication	Air cooling	None
	MD600S-2S7R5B	T1				0101C524	RS485 Communication	Air cooling	Yes
	MD600S-2S010	T2	2.2	22.2	10	0101CR87	RS485 Communication	Air cooling	None
	MD600S-2S010B	T2				0101C521	RS485 Communication	Air cooling	Yes
Three-phase 380 V to 480 V									

Model	Model	Structure	Power (kW)	Rated input current (A)	Rated output current (A)	Product code	Function	Cooling method	Built-in Braking Unit
RS-485	MD600S-4T1R6	T1	0.37	1.9	1.6	0101C431	RS485 Communication	Natural ly-ventilated	None
	MD600S-4T1R6B	T1				0101CR53	RS485 Communication	Natural ly-ventilated	Yes
	MD600S-4T2R3	T1	0.75	2.8	2.3	0101C432	RS485 Communication	Natural ly-ventilated	None
	MD600S-4T2R3B	T1				0101CR55	RS485 Communication	Natural ly-ventilated	Yes
	MD600S-4T4R8	T1	1.5	5.9	4.8	0101C522	RS485 Communication	Air cooling	None
	MD600S-4T4R8B	T1				0101CR56	RS485 Communication	Air cooling	Yes
	MD600S-4T5R5	T1	2.2	6.7	5.5	0101CR57	RS485 Communication	Air cooling	None
	MD600S-4T5R5B	T1				0101C428	RS485 Communication	Air cooling	Yes
	MD600S-4T9R5	T2	4	11.6	9.5	0101CR91	RS485 Communication	Air cooling	None
	MD600S-4T9R5B	T2				0101C520	RS485 Communication	Air cooling	Yes
	MD600S-4T013	T2	5.5	15.8	13	0101CR52	RS485 Communication	Air cooling	None
	MD600S-4T013B	T2				0101C429	RS485 Communication	Air cooling	Yes
Single-phase 200 V to 240 V									

Model	Model	Structure	Power (kW)	Rated input current (A)	Rated output current (A)	Product code	Function	Cooling method	Built-in Braking Unit
CAN	MD600A-2S2R8	T1	0.37	6.2	2.8	0101C551	CAN communication	Natural ly-ventilated	None
	MD600A-2S2R8B	T1				0101CR69	CAN communication	Natural ly-ventilated	Yes
	MD600A-2S4R6	T1	0.75	10.2	4.6	0101C555	CAN communication	Air cooling	None
	MD600A-2S4R6B	T1				0101CR70	CAN communication	Air cooling	Yes
	MD600A-2S7R5	T1	1.5	16.6	7.5	0101CR62	CAN communication	Air cooling	None
	MD600A-2S7R5B	T1				0101C556	CAN communication	Air cooling	Yes
	MD600A-2S010	T2	2.2	22.2	10	0101CR88	CAN communication	Air cooling	None
	MD600A-2S010B	T2				0101C559	CAN communication	Air cooling	Yes
Three-phase 380 V to 480 V									

Model	Model	Structure	Power (kW)	Rated input current (A)	Rated output current (A)	Product code	Function	Cooling method	Built-in Braking Unit
CAN	MD600A-4T1R6	T1	0.37	1.9	1.6	0101C552	CAN communication	Natural ly-ventilated	None
	MD600A-4T1R6 B	T1				0101C R66	CAN communication	Natural ly-ventilated	Yes
	MD600A-4T2R3	T1	0.75	2.8	2.3	0101C554	CAN communication	Natural ly-ventilated	None
	MD600A-4T2R3 B	T1				0101C R58	CAN communication	Natural ly-ventilated	Yes
	MD600A-4T4R8	T1	1.5	5.9	4.8	0101C557	CAN communication	Air cooling	None
	MD600A-4T4R8 B	T1				0101C R60	CAN communication	Air cooling	Yes
	MD600A-4T5R5	T1	2.2	6.7	5.5	0101C R61	CAN communication	Air cooling	None
	MD600A-4T5R5 B	T1				0101C558	CAN communication	Air cooling	Yes
	MD600A-4T9R5	T2	4	11.6	9.5	0101C R92	CAN communication	Air cooling	None
	MD600A-4T9R5 B	T2				0101C560	CAN communication	Air cooling	Yes
	MD600A-4T013	T2	5.5	15.8	13	0101C R64	CAN communication	Air cooling	None
	MD600A-4T013 B	T2				0101C553	CAN communication	Air cooling	Yes

11.2 Selection Instance

Selection flow

The following figure shows the AC drive selection flow.

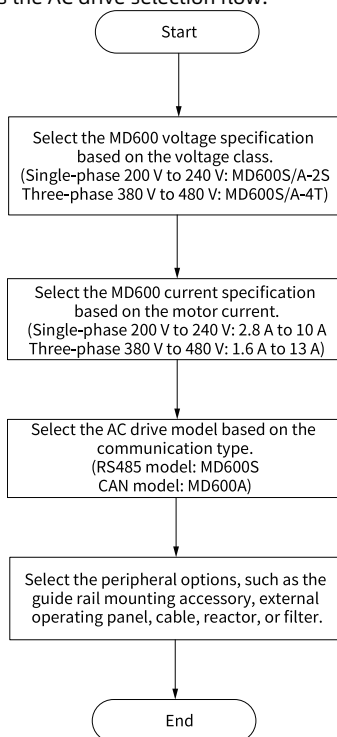


Figure 11-1 Selection flow

Example

The following part takes MD600S-4T1R6 as an example.

1. The voltage of 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 peripheral devices of the MD600S-4T1R6 include the AC input reactor MD-ACL-10-5-4T, output reactor MD-OCL-5-1.44, and EMC filter FN 3287-10-44-C28-R65.

11.3 Electrical Specifications

Note

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

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

Single-phase 200 V to 240 V

Table 11-2 Electrical specifications for T1 to T2 models (single-phase 200 V to 240 V)

Item		Specification			
Model: MD600S/A-2Sxxxx(B)		2R8	4R6	7R5B	010 B
Structure		T1			T2
Input	Rated input current (A)	6.2	10.2	16.6	22.2
	Rated voltage/Rated 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%; actual allowable range: 47.5 Hz to 63 Hz			
	Power capacity (kVA)	1.5	2.4	4	5.3
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			
	Carrier frequency	0.5 kHz to 16.0 kHz (automatically adjusted according to the load)			
Thermal design	Overload capacity	overload: 60s at 150% of the rated current continuously			
	Thermal Loss (W)	22	36	55	77
	Exhaust flow (CFM)	-	12	12	19

Three-phase 380 V to 480 V

Table 11-3 Electrical specifications for T1 to T2 models (three-phase 380 V to 480 V)

Item		Specification					
Model: MD600S/A-4Txxxx(B)		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/Rated frequency	Three-phase 380 VAC to 480 VAC, 50/60 Hz					
	Allowable voltage fluctuation range	-15% to +10%; allowed voltage range: 323 VAC to 528 VAC					
	Allowable frequency fluctuation range	±5%; actual allowable range: 47.5 Hz to 63 Hz					
	Power capacity (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					
	Carrier frequency	0.5 kHz to 16.0 kHz (automatically adjusted according to the load)					
Thermal design	Overload capacity	overload: 60s at 150% of the rated current continuously					
	Thermal Loss (W)	25	31	57	65	100	149
	Exhaust flow (CFM)	-	-	12	12	19	19

11.4 General Specifications

Item			Technical specifications
Motor control performance	Applicable motor type		Asynchronous induction motor (IM) and permanent magnet synchronous motor (PMSM)
	Control mode		Sensorless vector control (SVC), and voltage/frequency (V/f) control
	Asynchronous motor (V/f)	Functions available	Energy-saving control, overvoltage suppression, overcurrent suppression, undervoltage suppression (voltage dip suppression), oscillation suppression, torque boost, slip compensation, V/f curve selection, decoupled V/f, DC braking, random PWM, fast deceleration upon over-excitation, and droop control
	Asynchronous motor (SVC)	Functions available	Energy-saving control, inertia auto-tuning, acceleration feedforward, adaptive speed loop parameters, droop control, free programming and self-adaption of speed loop parameters, load observer, overvoltage suppression, undervoltage suppression (voltage dip suppression), over-excitation fast deceleration, automatic voltage adjustment, flying start, and DC braking
		Speed regulation range	1:500
		Starting torque	200%
		Torque step response	Within 2 ms
		Torque control accuracy	±3% at frequencies above 5 Hz
		Speed stability accuracy	Within 10% of the rated slip value
		Field weakening ratio	6 x field weakening
	Permanent magnet synchronous motor	Functions available	Speed tracking, electronic star connection, fast deceleration upon over-excitation, MTPA maximum torque-to-current ratio control, inertia auto-tuning and acceleration feedforward, droop control, adaptive speed loop parameter programming, overvoltage suppression, undervoltage suppression, DC braking, I/F control in SVC
		Speed regulation range	1:200
		Starting torque	200%
		Torque step response	Within 2 ms
		Speed stability accuracy	0.05% (without motor defects)
		Torque control accuracy	±3% at frequencies above 5 Hz

Item			Technical specifications
Basic functions	Resolution of input frequency		Digital setting: 0.01 Hz Analog setting: maximum frequency x 0.025%
	Operation	Operation command	Independent dual channel and dual channel, which can be switched freely Provides different start/stop sources (terminal, operating panel, communication, custom, connector). Provides standard control word.
		Frequency reference	Independent dual channel and dual channel, which can be switched freely Provides various sources (communication, operating panel, analog, connector, and so on). Supports main frequency, auxiliary frequency, and various operations (addition, subtraction, multiplication, Max., and Min.). Supports additional frequency. Supports multi-level frequency limits.
		Auxiliary frequency reference	Supports various auxiliary frequency references and allows fine-tuning of the auxiliary frequencies and frequency synthesis.
		Standard command word	Normal start/stop (OFF1) Emergency stop (OFF2) Quick stop, stop with maximum capability (OFF3) Operation enable, operation pause
		Torque reference	Multiple torque reference sources: digital reference, analog voltage reference, analog current reference, pulse reference, multi-reference, PID, simple PLC, and communication, which can be switched through multiple ways
		Start/Stop mode	Dual channel, which can be switched freely Supports six different start/stop modes (single-wire mode, two-wire mode 1, two-wire mode 2, two-wire mode 3, three-wire mode 1, three-wire mode 2)
		Acceleration/Deceleration time	Linear acceleration/deceleration and S-curve acceleration/deceleration 4 sets of acceleration/deceleration time 7-segment S-curve can be independently configured. Automatic switchover between acceleration/deceleration
	Multi-speed		Supports up to 16 multi-speed references. Supports different unit settings (Hz, rpm, rated %, maximum speed %). Supports free per-unit conversion. Supports custom limit.
	Ramp transition function		When speed references are sent through communication cyclically, automatic interpolation is supported to rectify command discontinuity caused by communication intervals, ensuring smooth operation.
	Output limit		Torque limit, power limit, current limit, maximum/minimum torque limit, and speed limit

Item			Technical specifications
MD600S commissioning and configuration (human machine interface)	Control Interfaces	Analog input	One analog input: AI1: -10 V to +10 V/0 mA to 20 mA Voltage and current: calibration accuracy 0.3%, response time shorter than 2 ms
		Analog output	MD600S: one analog output; AO1: 0 V to 10 V; calibration accuracy: 100 mV; resolution: 12-bit; calibration accuracy: 0.5% MD600A: no analog output
		Digital input.	MD600A: four common inputs; one high-speed input; NPN/PNP input wiring method; DI4 used as high-speed pulse input; 20 kHz frequency MD600S: four common inputs, NPN/PNP input wiring method
		Digital output	Relay output: two contacts, 3 A/250 VAC, 3 A/30 VDC, with normally open and normally closed functions supported: MD600A: two common digital outputs; frequency: 100 Hz, output voltage range: 0 V to 24 V; output current range: 0 mA to 50 mA
	Display and operations on the operating panel	LED operating panel	Used to display and change parameters and display drive status (forward run, reverse run, stop, operating panel/terminal/communication control, speed/torque control).
		Key lock and function	To prevent inadvertent operations, keys on the operating panel can be locked partially, and functions with limited availability range can be assigned to some keys.
	Commissioning software tool		The commissioning software (iFA Drive/InoDriverShop) supports uploading and downloading drive parameters and oscilloscope functions. You can monitor internal status of the drive through the oscilloscope. Function logic is presented using data flow diagrams, enabling manual-free commissioning. This helps reduce the learning cost and shorten commissioning time.
	Parameter protection		Supports parameter access write protection to prevent inadvertent parameter modification.
	User password (parameter lock)		Supports user-defined passwords to protect parameter accessibility.
	Parameter access levels		Standard: default level with access to commonly used function parameters Extended: Extended with non-frequent function parameters Expert: Parameters for experts, which can be set with a password

Item			Technical specifications
		Custom user parameter set	You can recombine and generate new parameter sets. 1. Used to view or set parameters quickly. 2. Used for quick access to single command through communication.
		Auxiliary functions	Timed period arrival, operating time arrival, forward/reverse run dead zone time, frequency reference arrival, current reference arrival, and load speed conversion
		Configurable startup protection	Startup protection modes for different command sources can be configured flexibly.
		Automatic carrier frequency adjustment	Used to improve the overload capacity and allow the carrier frequency to be adjusted with the output frequency.
	Standard process	Process PID	Provides two sets of PID parameters, which can be switched automatically. PID initial value, PID pause, limit amplitude, PID feedback reference filtering, dead zone, integral saturation, forced PID, and PID feedback loss detection
		Free function module	Supports custom needs through different free function blocks. Supports function blocks such as arithmetic operation and logic operation
		Simple PLC	Supports 16 operational instructions. Supports custom acceleration/deceleration time, speed, and operating time. Supports custom cycle mode. Supports value retention upon power failure. Supports pause and reset.
		Jump frequency	Allows the drive to avoid mechanical resonance points of the load. Supports up to 4 jump frequency points.
	Energy efficiency	Energy conservation statistics	The energy conservation statistics function converts energy savings into quantifiable metrics (kWh, CO2 emissions, monetary equivalents) for visual evaluation. These values can be read by the host controller directly.
		Sleep and wake-up	Used to switch the drive to the sleep or standby mode when continuous operation is not needed, and restart the drive when necessary to save energy.
Communications	Supports two communication modes		MD600A: CAN communication protocol MD600S: Modbus RTU communication protocol
	Communication command word		Single-word control mode Bit control mode Free mode

Item		Technical specifications
Faults and Protection	Custom fault	Supports custom faults, alarms, and prompts.
	Historical fault log	Supports up to six fault logs. Fault code, fault subcode, operation data, and fault time
	Load monitoring	You can configure the normal operation range of the drive based on actual operating conditions. When the corresponding range is exceeded, you can define faults and alarms as needed.
	Automatic Fault Reset	The fault can be reset automatically. If the number of automatic resets is exhausted, the fault cannot be reset. The fault whitelist and blacklist can be configured as needed.
	Automatic restart upon fault	After a fault occurs, automatic fault reset and restart are supported. When the number of automatic resets is exhausted, the fault can no longer be reset. The fault whitelist and blacklist can be configured freely.
	Fault protection	Ground fault upon power-on, drive overcurrent, drive overload, motor overload, drive overvoltage, drive undervoltage, drive overtemperature, input phase loss, output phase loss, communication fault, current detection fault, motor load loss, motor step loss, motor stall, motor overspeed, motor overtemperature, current loop error, excessive speed deviation, demagnetization protection, overspeed protection, excessive zero drift, EEPROM read fault, motor parameter auto-tuning fault, ground fault, and stall in SVC
	Automatic Check	Supports self-test on the drive and motor, IGBT shoot-through, current sensor sampling error, ground fault, phase loss, and phase-to-phase short circuit.
Environment	Operating location	Indoors and free from direct sunlight, conductive dust, oil mist, corrosive gas, flammable gas, vapors, water drips, and salty elements
	Altitude	For altitudes equal to or below 1000 m, derating is not required. For altitude ranging from 1000 m to 3000 m, derate 1% for every additional 100 m. For altitude above 3000 m, contact Inovance.
	Ambient temperature	Storage temperature: -40°C to +60°C Transportation temperature: -20°C to +60°C Operating temperature: -20°C to +60°C. For temperatures above 50°C, derate 2.5% for every additional 1°C. The maximum temperature is 60°C.
	Humidity	< 95% RH, without condensation
	Overvoltage category	OVCIII
	Pollution degree	PD2
	IP rating	IP40 (IP20 for power supply distribution wiring and capacitor vent)
	Protection class	Class I
	Grid type	TN, TT, star type

11.5 Product dimensions

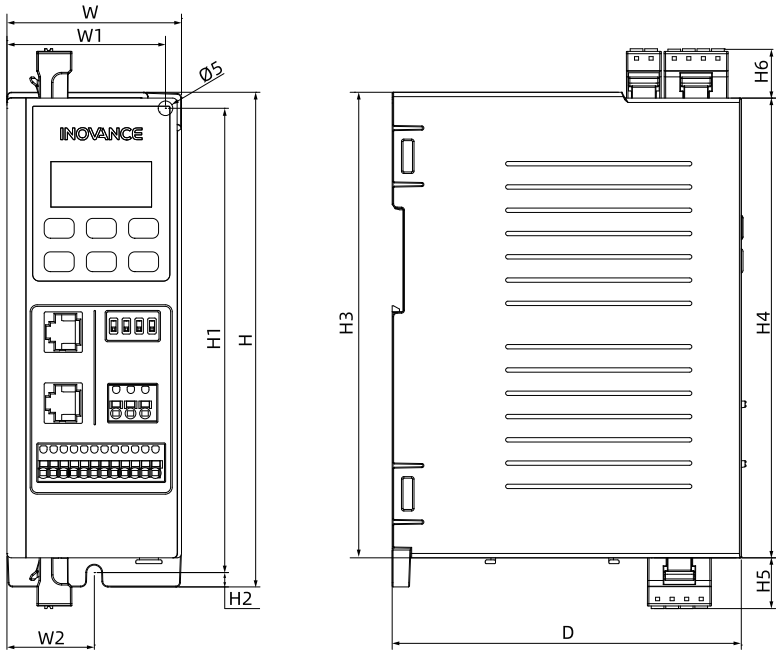


Figure 11-2 Outline dimensions and mounting dimensions of T1 to T2 models

Table 11-4 Outline dimensions and mounting dimensions of T1 to T2 models

St- r- u- c- t- u- re	Mou- nting hole mm (in.)	Outline dimension mm (in.)										Mounting Hole Di- ameter (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 (6.6- 9)	160 (6.3- 0)	158 (6.22)	17.5 (0.69)	17 (0.67)	60 (2.36)	120 (4.72)	Φ5 (0.20)	0.8 (1.76)
T2	62.5 (2.46)	34 (1.34)	159.5 (6.28)	5 (0.2)	170 (6.6- 9)	160 (6.3- 0)	158 (6.22)	22 (0.87)	24 (0.95)	68 (2.68)	140 (5.51)	Φ5 (0.20)	1 (2.20)

12 Option

12.1 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 optional part is required, specify it in your order.

Table 12–1 List of Options

Category	Name	Option model	Ordering no.	Applicable Model	Function
External operating panel	Hand-held LCD operating panel	SOP-20-810	01040028	All models	The external LCD operation panel supports Chinese and English display, parameter copying, and connection to the commissioning software.
	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 "12.9.3 Terminal" on page 128 .			It is recommended to use symmetrical shielded cables as input and output main circuit cables. Compared with four-core cables, symmetrical shielded cables can reduce electromagnetic radiation in the whole drive system. It is recommended that power cables also use symmetrical shielded cables.
	Control circuit cable	All control circuit cables must be shielded cables. Use separate shielded cables for different analog signals. It is recommended to use shielded twisted pair (STP) cables as digital signal 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 commissioning software installed on the computer through the relay mode of the SOP-20-810.

Category	Name	Option model	Ordering no.	Applicable Model	Function
Accessories	Guide rail installation accessory	MD600-DGJ1	01040265	Applicable only to T1 models (three-phase 380 V to 480 V: 0.37 kW to 2.2 kW; single-phase 200 V to 240 V: 0.37 kW to 1.5 kW)	Guide rail installation accessory
	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 related section.

12.2 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 12-1 Dimensions (unit: mm) of the SOP-20-810" on page 105 and "Figure 12-2 Mounting bracket dimensions and hole sizes (mm) of the SOP-20-810" on page 105.	 The SOP-20-810 is a handheld LCD device with a black casing. The screen displays a menu titled '1: Inverter' with four options: '01 Parameters', '02 Fault Records', '03 Shortcut', and '04 Authority'. At the bottom of the screen, it shows 'Back Loc 10:00:00 Select'. The device features a circular navigation pad with four arrow keys and a central button, surrounded by several function buttons including a green diamond-shaped button, a red circle-with-slash button, and a 'Loc/Rem' button. A USB port is visible at the bottom.
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 12-3 Dimensions (unit: mm) of the MD-BP-M" on page 106, "Figure 12-4 Dimensions (unit: mm) of the cabinet door opening for mounting the MD-BP-M through the snap-fit joint" on page 106, and "Figure 12-5 Dimensions (unit: mm) of the cabinet door opening for mounting the MD-BP-M with screws" on page 107.	 The MD-BP-M is a smaller, rectangular LED display panel. The screen shows 'INVOICE' at the top, followed by a grid of icons and numerical data. Below the screen is a circular knob and a set of navigation buttons similar to the SOP-20-810, including a green diamond button and a red circle-with-slash button.

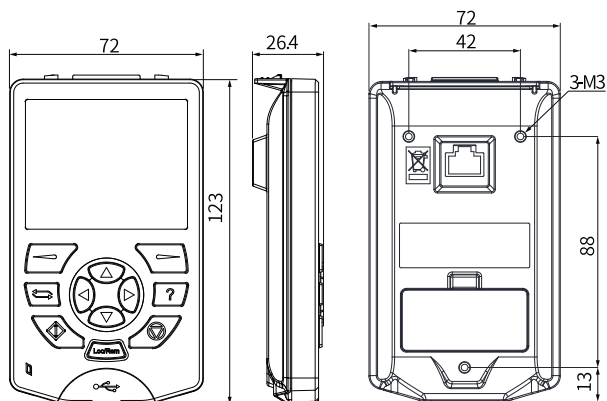
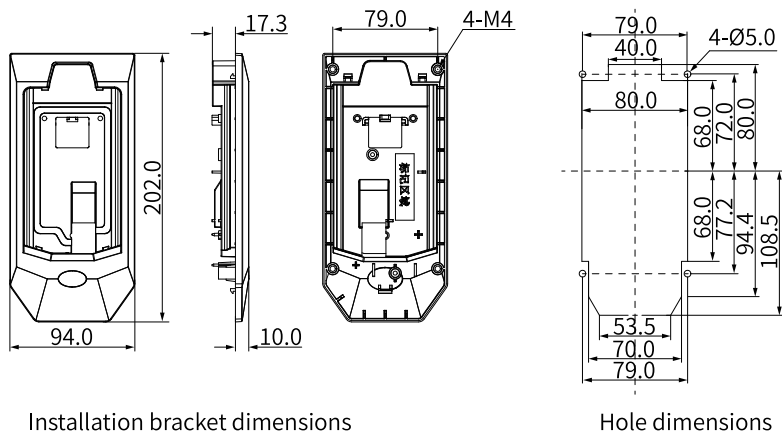


Figure 12-1 Dimensions (unit: mm) of the SOP-20-810



Installation bracket dimensions

Hole dimensions

Figure 12-2 Mounting bracket dimensions and hole sizes (mm) of the SOP-20-810

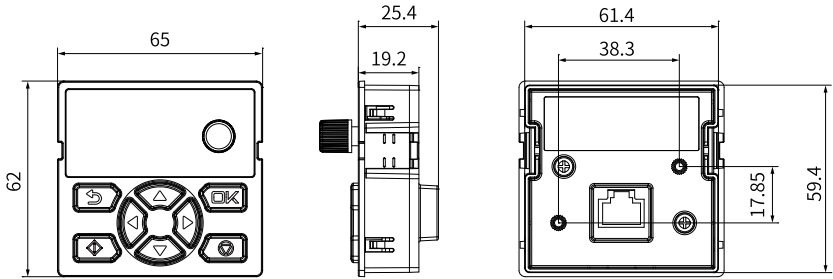


Figure 12-3 Dimensions (unit: mm) of the MD-BP-M

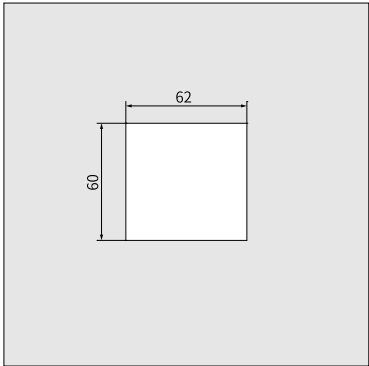


Figure 12-4 Dimensions (unit: mm) of the cabinet door opening for mounting the MD-BP-M through the snap-fit joint

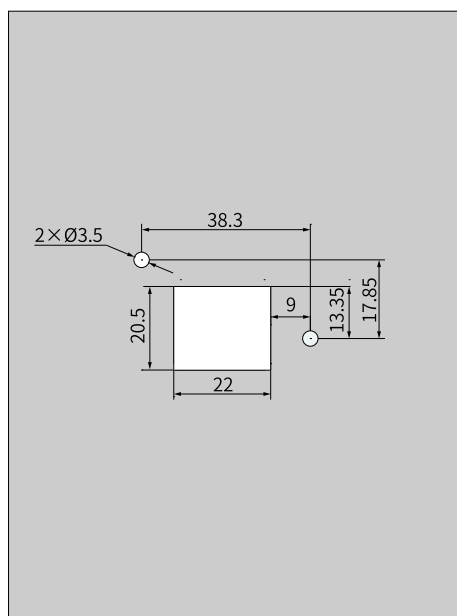


Figure 12-5 Dimensions (unit: mm) of the cabinet door opening for mounting the MD-BP-M with screws

12.3 Circuit Breaker and Fuse (CE)

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

Table 12-2 Circuit breaker, fuse, and electromagnetic contactor (single-phase 200 V to 240 V, compliance with CE)

Structure	Model	Recommended Semiconductor Fuse Specification (Bussmann)	Recommended Contactor Specification (Schneider)	Minimum Specification of Recommended D-Type Circuit Breaker (Schneider)
		Rated current (A)	Rated current (A)	Rated current (A)
T1	MD600S/A-2S2R8(B)	10	9	10
	MD600S/A-2S4R6(B)	15	12	16
	MD600S/A-2S7R5(B)	25	18	25
T2	MD600S/A-2S010(B)	35	25	32

The recommended values in the preceding table are based on the following prerequisites:

1. The ambient temperature of the device is 40°C and there is no forced air cooling method. The altitude is 2000 m. Only a single drive is installed. The current-carrying density of the conductor is 1.3 A/mm².
2. If the conditions vary, select the model according to actual conditions.

Table 12-3 Circuit breaker, fuse, and electromagnetic contactor (three-phase 380 V to 480 V, compliance with CE)

Structure	Model	Recommended Semiconductor Fuse Specification (Bussmann)	Recommended Contactor Specification (Schneider)	Minimum Specification of Recommended D- Type Circuit Breaker (Schneider)
		Rated current (A)	Rated current (A)	Rated current (A)
T1	MD600S/A-4T1R6(B)	5	9	3
	MD600S/A-4T2R3(B)	5	9	4
	MD600S/A-4T4R8(B)	10	9	10
	MD600S/A-4T5R5(B)	15	9	10
T2	MD600S/A-4T9R5(B)	20	12	16
	MD600S/A-4T013(B)	25	18	25
The recommended values in the preceding table are based on the following prerequisites:				
1. The ambient temperature of the device is 40°C and there is no forced air cooling method. The altitude is 2000 m. Only a single drive is installed. The current-carrying density of the conductor is 1.3 A/mm².				
2. If the conditions vary, select the model according to actual conditions.				

12.4 AC input reactor

The AC input reactor is mainly used to reduce harmonics in the input current. As an option, installing the input reactor on the input side of the AC drive can improve the input power factor, suppress the high harmonics of the input current of the AC drive, and reduce external conduction and radiation interference. When the application environment has high requirements on grid harmonics suppression, you can choose an optional reactor as required.

Inovance AC output reactor

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

MD-ACL

-

50

-

0.28

-

4T

-

2%

①

②

③

④

⑤

Figure 12-6 AC input reactor model

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

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

Structure	Model	Applicable reactor model	Inductance (mH)	Power consumption (W)
T1	MD600S/A-4T1R6(B)	MD-ACL-10-5-4T	5	-
	MD600S/A-4T2R3(B)	MD-ACL-10-5-4T	5	-
	MD600S/A-4T4R8(B)	MD-ACL-10-5-4T	5	-
	MD600S/A-4T5R5(B)	MD-ACL-10-5-4T	5	-
T2	MD600S/A-4T9R5(B)	MD-ACL-15-3-4T	3	-
	MD600S/A-4T013(B)	MD-ACL-15-3-4T	3	-

Dimensions

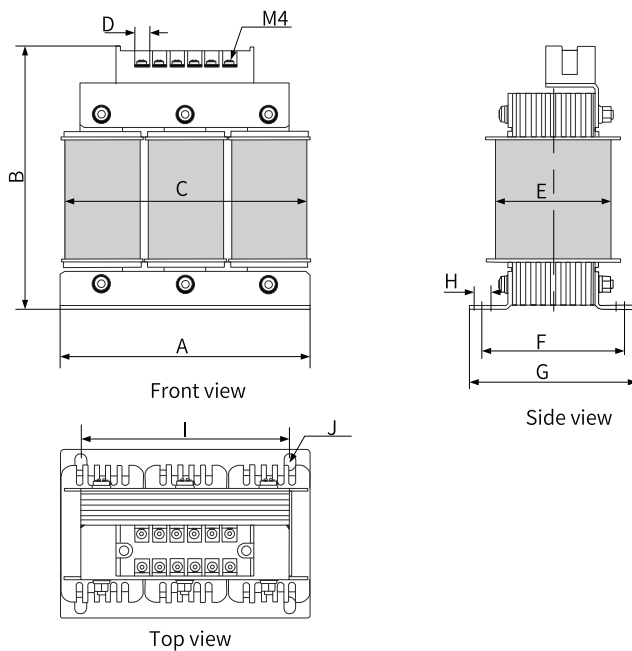


Figure 12-7 Dimensions of AC input reactors (10 A/15 A)

Table 12-5 Dimensions of 10/15 A AC input reactor (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	Φ7×10
MD-ACL-15-3-4T	150±2	160	155	8	80	85±2	100±2	10	125± 2	Φ7×10

12.5 Output Reactors

With an output reactor installed on the output side of the drive, the excessive dV/dt can be reduced. This can reduce the voltage stress on the motor winding to protect it, lower the motor temperature, and prolong 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.

$$\frac{\text{MD-OCL}}{\text{①}} - \frac{50}{\text{②}} - \frac{0.14}{\text{③}} - \frac{4T}{\text{④}} - \frac{1\%}{\text{⑤}}$$

Figure 12-8 AC output reactor model

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

Table 12-6 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-252R8(B)	2.8	0.37	MD-OCL-5-1.4-4T-1%	1.4
	MD600S/A-254R6(B)	4.6	0.75	MD-OCL-7-1.0-4T-1%	1.0
	MD600S/A-257R5(B)	7.5	1.5	MD-OCL-10-0.7-4T-1%	0.7
T2	MD600S/A-25010(B)	10	2.2	MD-OCL-15-0.47-4T-1%	0.47

Table 12-7 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(B)	1.6	0.37	MD-OCL-5-1.4-4T-1%	1.4
	MD600S/A-4T2R3(B)	2.3	0.75	MD-OCL-5-1.4-4T-1%	1.4
	MD600S/A-4T4R8(B)	4.8	1.5	MD-OCL-7-1.0-4T-1%	1.0
	MD600S/A-4T5R5(B)	5.5	2.2	MD-OCL-10-0.7-4T-1%	0.7
T2	MD600S/A-4T9R5(B)	9.5	4	MD-OCL-15-0.47-4T-1%	0.47
	MD600S/A-4T013(B)	13	5.5	MD-OCL-15-0.47-4T-1%	0.47

Dimensions

Dimensions of the AC output reactor:

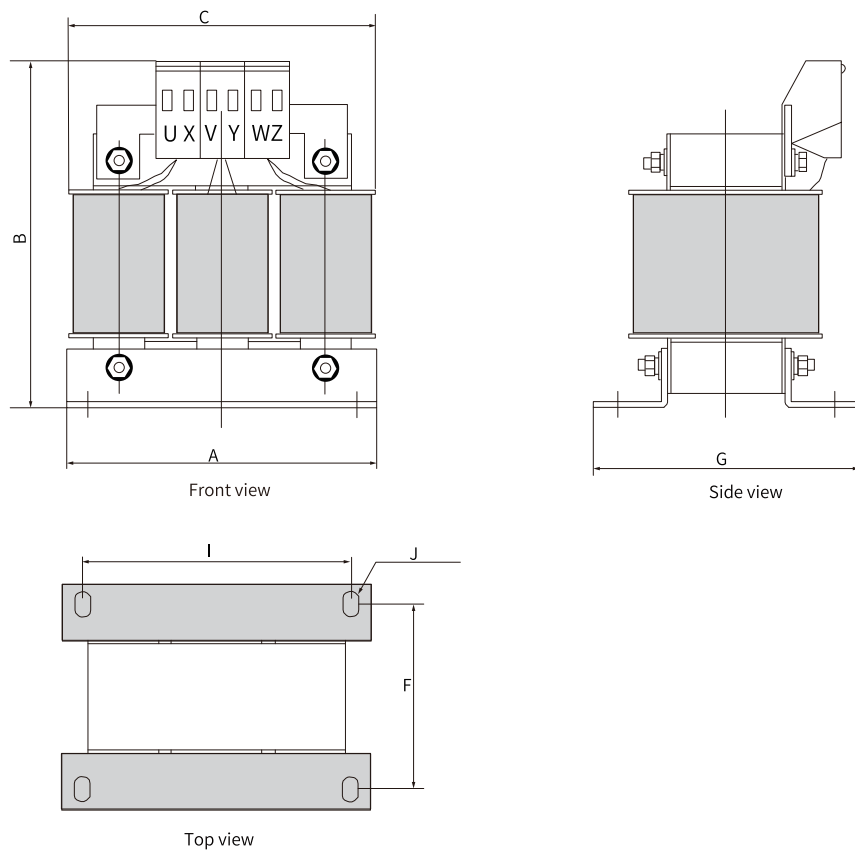


Figure 12-9 Dimensions of the AC output reactor (5-10 A)

Table 12-8 Dimensions of the AC output reactor (5-15 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	Φ6x11
MD-OCL-7-1.0-4T-1%	105 ± 1	130	110	84 ± 2	65 ± 2	91 ± 1	Φ6x11
MD-OCL-10-0.7-4T-1%	105 ± 1	130	110	84 ± 2	65 ± 2	91 ± 1	Φ6x11

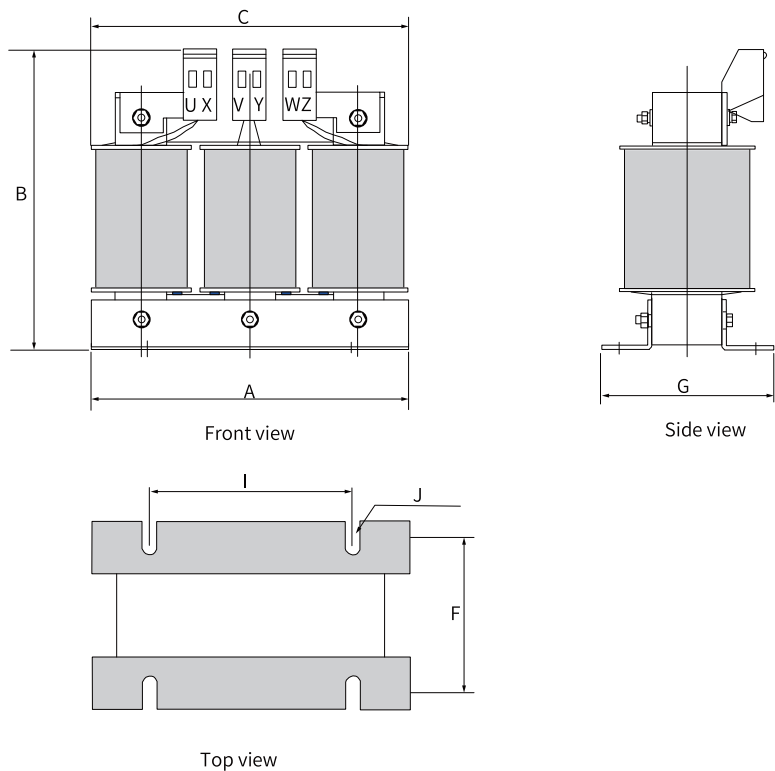


Figure 12-10 Dimensions of AC output reactors (15 A)

Table 12-9 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	Φ6x15

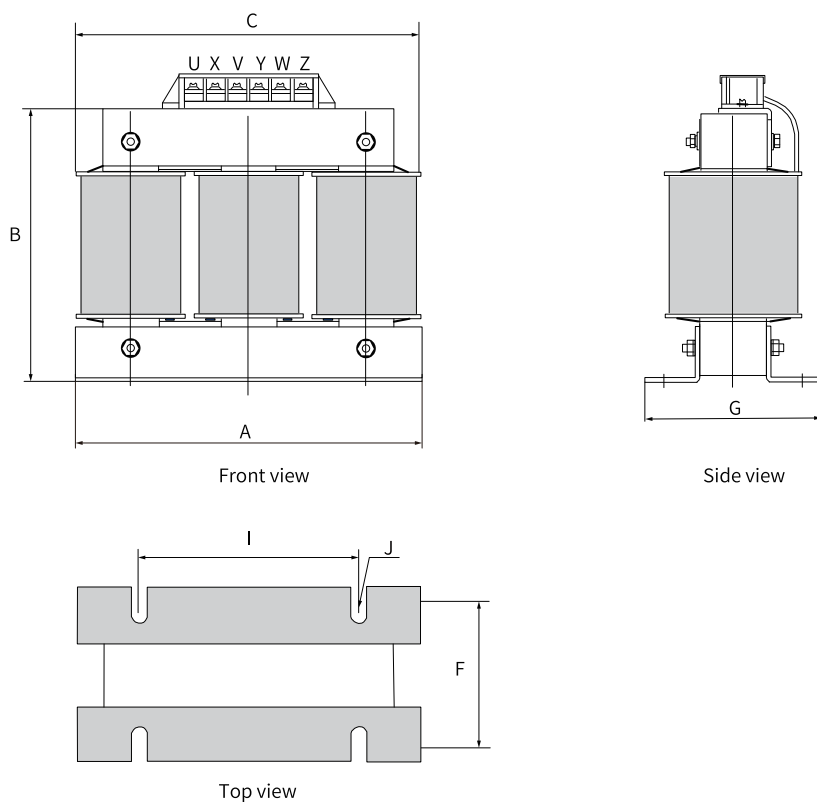


Figure 12-11 Dimensions of 20 A AC output reactors

Table 12-10 Dimensions of the AC output reactor (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	Φ6x15

12.6 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 12-11 Standard EMC filter model and appearance

Filter model		Appearance
Schaffner	FN2090	
	FN3287	

Table 12-12 Selection of EMC filters (single-phase 200-240 V)

Structure	Model	Rated Current (A)	Applicable filter
T1	MD600S/A-2S2R8(B)	6.2	FN2090-8-06
	MD600S/A-2S4R6(B)	10.2	FN 2090-12-06
	MD600S/A-2S7R5(B)	16.6	FN 2090-20-06
T2	MD600S/A-2S010(B)	22.2	FN 2090-30-08

Table 12-13 Selection of EMC filters (three-phase 380-480 V)

Structure	Model	Rated Current (A)	Applicable filter
T1	MD600S/A-4T1R6(B)	1.9	FN3287-10-44-C28-R65
	MD600S/A-4T2R3(B)	2.8	FN3287-10-44-C28-R65
	MD600S/A-4T4R8(B)	5.9	FN3287-10-44-C28-R65
	MD600S/A-4T5R5(B)	6.7	FN3287-10-44-C28-R65
T2	MD600S/A-4T9R5(B)	11.6	FN3287-16-44-C33-R65
	MD600S/A-4T013(B)	15.8	FN3287-16-44-C33-R65

Dimensions

- Dimensions of Schaffner FN2090 filters:

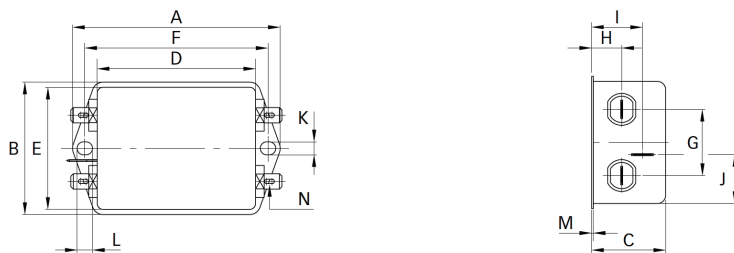


Figure 12-12 Dimensions of FN2090 filters (unit: mm)

Table 12-14 Dimensions of FN2090 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 × 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 × 0.8

- Dimensions of Schaffner FN3287 filters:

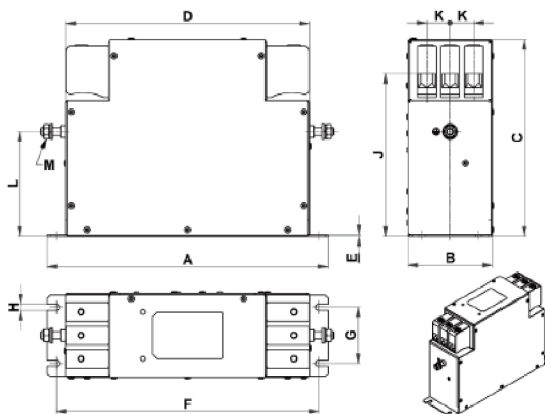


Figure 12-13 Dimensions of FN3287 filters (unit: mm)

Table 12–15 Dimensions of FN3287 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

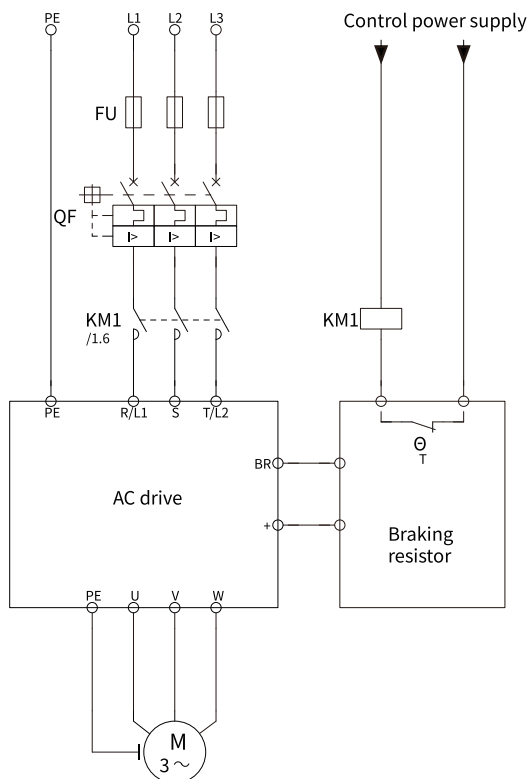
Note

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

12.7 Braking Resistor

Braking resistor protection

In applications where a braking resistor is installed, it is recommended to use a resistor with a temperature switch to ensure safety and avoid overheating and burning of the braking resistor. Connect the temperature switch output to the electromagnetic contactor control circuit on the front end of the drive (as shown in the following figure) to implement the interlock protection function. When the resistor overheats, a tripping fault occurs, avoiding the resistor to be burned.



Selecting the resistance of the braking resistor

The built-in braking unit of the drive processes the regenerative energy generated by the motor during deceleration. When the DC bus voltage 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 based on the following formula.

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

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}: Braking start voltage of the AC drive. The default braking start voltage of three-phase 380 V to 480 V models and single-phase 200 V to 240 V models are 760 V and 370 V, respectively, which can be changed via parameters.

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 drive

k: Multiple of the braking torque to the rated torque, which is set to 1.25 generally. The k value can be adjusted as needed.

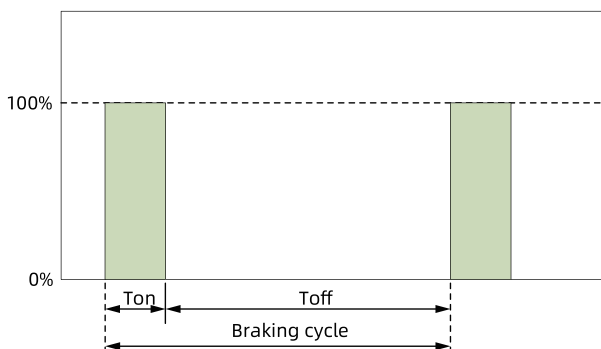
n_{motor}: Motor efficiency, which is generally set to 0.85 set based on the actual motor efficiency. It can also be estimated based on the efficiency of the four-pole motor energy efficiency class IE3 specified in the IEC 60034-30-2 standard.

n_{inverter}: Between 0.9 to 0.98 generally

Selecting the power of the braking resistor

In theory, the power of the braking resistor is the same as the average power consumption of the braking resistor on the bus. However, given that the braking resistor is naturally ventilated in the power 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:

$$P_{N_BR} = \frac{P_{BR} \times ED\%}{\alpha}$$
$$ED\% = \frac{T_{on}}{T_{on} + T_{off}}$$



P_{N_BR} : Rated power of the braking resistor

α : Power derating value of the braking resistor, which is 50% generally. Depending on the motor 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. Select the power according to the actual application conditions.

ED%: Braking duty cycle

T_{on} : Indicates the time during which the braking resistor is turned on within one braking cycle.

T_{off} : Indicates the time during which the braking resistor is turned off within one braking cycle.

Note

1. Braking resistor temperature rise: It is affected by various factors, such as the braking on time T_{on} , braking duty cycle ED%, actual heat dissipation conditions, and braking resistor type (such as aluminum-housed resistors, corrugated resistors, and braking resistor cabinets with different designed thermal time constants). If the resistor temperature rise is excessive, a higher power derating is required; otherwise, the risk of fire can be incurred due to overtemperature of the braking resistor. Therefore, select the braking resistor with a proper power class according to actual conditions.
2. Braking duty cycle (ED%): It must be determined based on the actual braking conditions. Typical ED% values for common applications are listed in the following table.

Common applications	Elevator	Winding/Unwinding	Centrifuge	Occasional braking load	General application
ED%	20% to 30%	20% to 30%	50% to 60%	5.0%	10%

Recommendation for typical braking resistor

Assuming the braking torque of 125%, braking resistor ON time (T_{on}) of 10s per braking cycle, and braking duty cycle (ED%) of 10%, the resistance and power ratings of the braking resistor are shown in the table below.

Table 12-16 Selection of braking resistors (single-phase 200-240 V)

Structure	Model	Applicable motor (kW)	Braking unit	Specifications of the recommended braking resistor (125% braking torque, 10% ED, max. 10s)	Actual braking resistor selection (Inovance model)				Minimum braking resistance (Ω)
					Braking resistor model	Resistance of a single resistor (Ω)	Power of a single motor (W)	Number of parallel resistors (PCS)	
T1	MD600S/A-2S2R8(B)	0.37	Built-in unit (optional)	60 W/370 Ω	RXLG-200W-380RJ-XZ1000-OE-B	380	200	1	52
	MD600S/A-2S4R6(B)	0.75		110 W/180 Ω	RXLG-400W-190RJ-XZ1000-OE-B	190	400	1	52
	MD600S/A-2S7R5(B)	1.5		230 W/90 Ω	RXLG-800W-100RJ-XZ1000-OE-B	100	800	1	35
T2	MD600S/A-2S010(B)	2.2		330 W/60 Ω	RXLG-1500W-62RJ-XZ1000-OT-B	62	1500	1	26

Table 12–17 Selection of braking resistors (three-phase 380 V to 480 V)

Structure	Drive model	Applicable motor (kW)	Braking unit	Specifications of the recommended braking resistor (125% braking torque, 10% ED, max. 10s)	Actual braking resistor selection (Inovance model)				Minimum braking resistance (Ω)
					Braking resistor model	Resistance of a single resistor (Ω)	Power of a single motor (W)	Number of parallel resistors (PCS)	
T1	MD600S/A-4T1R6(B)	0.37	Built-in unit (optional)	60 W/1560 Ω	RXLG-50W-1560RJ-XZ1000-OE-B	1560	50	1	69
	MD600S/A-4T2R3(B)	0.75		110 W/770 Ω	RXLG-100W-770RJ-XZ1000-OE-B	770	100	1	69
	MD600S/A-4T4R8(B)	1.5		230 W/380 Ω	RXLG-200W-380RJ-XZ1000-OE-B	380	200	1	69
	MD600S/A-4T5R5(B)	2.2		330 W/260 Ω	RXLG-300W-260RJ-XZ1000-OE-B	260	300	1	69
T2	MD600S/A-4T9R5(B)	4		600 W/140 Ω	RXLG-600W-140RJ-XZ1000-OE-B	140	600	1	41
	MD600S/A-4T013(B)	5.5		830 W/100 Ω	RXLG-800W-100RJ-XZ1000-OE-B	100	800	1	41

Note

- The braking resistance in the above table is under the condition of 125% braking torque, 10s braking on-time (Ton), and 10% braking duty cycle (ED%).
- For single-phase 200 V to 240 V, the default initial braking voltage of the built-in braking unit is 370 V. For three-phase 380 V to 480 V, the default initial braking voltage of the built-in braking unit is 760 V.
- 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 or be equal to 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.
- For systems featuring large inertia frequent braking and requiring short deceleration time, select a braking resistor with high power and low resistance.

Recommended braking resistor power under different braking conditions

The braking resistor power in the above table is recommended under the condition of 125% braking torque, 10s braking on-time (Ton), and 10% braking duty cycle (ED%). However, in actual applications, braking conditions vary and cannot be fully summarized by a single typical condition. The following lists the recommended braking resistor power for different braking duty cycles and different braking on-time (Ton) at 125% braking torque for your reference.

Braking condition	Braking condition			Braking resistor power (at 125% braking torque) (kW)					
	Braking on-time Ton/s	Braking off-time Toff/s	Braking duty cycle ED%	0.37	0.75	1.5	2.2	4	5.5
3s, 10% ED	3	27	10%	40	90	170	250	460	630
3s, 15% ED		17	15%	60	120	240	360	650	900
3s, 25% ED		9	25%	100	200	390	570	1050	1440
3s, 40% ED		4.5	40%	150	310	610	900	1640	2250
10s, 10% ED	10	90	10%	60	110	230	330	600	830
10s, 15% ED		56.7	15%	70	150	290	430	780	1080
10s, 25% ED		30	25%	110	220	430	640	1150	1590
10s, 40% ED		15	40%	160	320	650	950	1720	2370
20s, 10% ED	20	180	10%	80	160	310	460	840	1150
20s, 15% ED		113.3	15%	90	180	370	540	980	1350
20s, 25% ED		60	25%	120	250	490	720	1320	1810
20s, 40% ED		30	40%	170	350	690	1010	1840	2530
30s, 10% ED	30	270	10%	100	200	410	600	1090	1500
30s, 15% ED		170	15%	110	220	450	660	1200	1650
30s, 25% ED		90	25%	140	280	560	820	1480	2040
30s, 40% ED		45	40%	180	370	740	1080	1960	2700
60s, 10% ED	60	540	10%	170	340	680	1000	1810	2490
60s, 15% ED		340	15%	170	340	690	1010	1840	2530
60s, 25% ED		180	25%	180	370	740	1090	1980	2730
60s, 40% ED		90	40%	210	440	870	1280	2320	3190

Note

1. The thermal time constant τ of the braking resistor must be larger than or equal to 100s.
 2. The recommended power of the braking resistor in the preceding table is based on the assumption that the braking torque is 125%. If T_{on} and ED% remain unchanged but the braking torque changes, the power of the braking resistor changes linearly with the braking torque. For example, the recommended power of the braking resistor for a 5.5 kW AC drive under the condition of "braking torque 125%, ED 10%, and 10s" is 830 W. If the actual braking torque is 150% (1.2 times the braking torque 125%), the recommended power of the braking resistor under the condition of "braking torque 150%, ED 10%, 10s" is 996 W (830 W x 1.2).
 3. The temperature rise of the braking resistor varies with different heat dissipation conditions. Therefore, the heat dissipation conditions of the resistor can also affect the power selection of the braking resistor.
-

12.8 Ferrite Ring and Ferrite Clamp

Model selection

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

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

- The amorphous magnetic ring has a high magnetic conductivity when the frequency is within 1 MHz and can efficiently suppress interference of the servo drive at a high cost.
- 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 12-18 Appearance and model of the magnetic ring and ferrite clamp

Category	Manufacturer model	Appearance
Magnetic ring	DY644020H	
	DY805020H	
	DY1207030H	
Ferrite clamp	DYR-130-B	

Dimensions

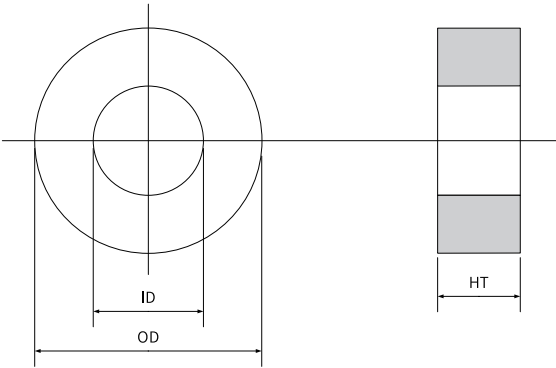


Figure 12-14 Dimensions of the magnetic ring

Table 12-19 Dimensions of the magnetic ring

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

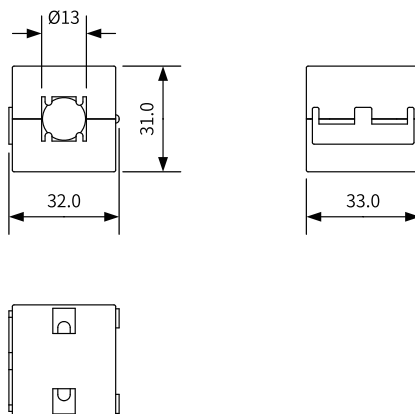


Figure 12-15 Dimensions of the ferrite clamp (unit: mm)

12.9 Cable

12.9.1 Main circuit cable

Power cable selection requirements

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

- Compliant with EN 60204-1 and IEC 60364-5-52 standards
- PVC insulated cables with copper conductors
- Heat resistance: maximum cable surface temperature not exceeding 70°C at an ambient temperature of 40°C (Note: Contact the manufacturer when the ambient temperature exceeds 40°C.)
- Symmetric cable with copper-braided shield

If the recommended cables for peripheral equipment or options are not suitable for the product, contact Inovance.

To comply with the EMC standards, use shielded cables. Shielded cables are classified into the three-conductor cables and four-conductor cables, as shown in the following figure. If a three-conductor cable is used but its shield cannot provide sufficient conductivity, add an independent PE cable. Alternatively, use a four-conductor cable

containing a PE conductor. The shield of the shielded cable consists of coaxial cooper braids to suppress radio frequency interference. The braided density of the cooper braid should be greater than 90% to enhance the shielding efficiency and conductivity.

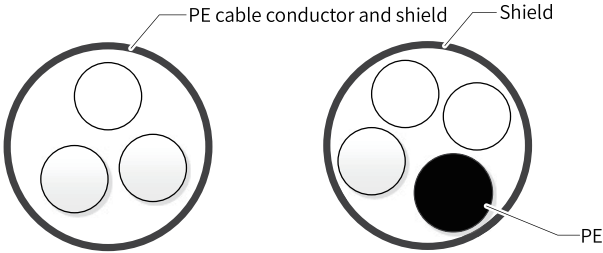


Figure 12-16 Recommended power cable types

Recommended cable

Table 12-20 Cable selection (single-phase 200 V to 240 V, compliant with CE certification)

Single-phase 200 V to 240 V										
AC drive model	Power (kW)	Rated input current (A)	Rated output current	Braking current (A)	RST/UVW		Grounding cable		Braking terminal	
					Recom mended cable type (mm ²) ^[1]	Rec om mend ed termi nal model	Recom mended cable type (mm ²) ^[1]	Recom mended termi nal model	Recom mended cable type (mm ²) ^[1]	Recom mended terminal model
MD600S/A-2S2R8(B)	0.37	6.2	2.8	0.71	3x0.75	E7510	0.75	E7510	0.75	E7510
MD600S/A-2S2R8	0.37	6.2	2.8	No braking	3x0.75	E7510	0.75	E7510	/	/
MD600S/A-2S4R6(B)	0.75	10.2	4.6	1.43	3x1	E1010	1	E1010	0.75	E7510
MD600S/A-2S4R6	0.75	10.2	4.6	No braking	3x1	E1010	1	E1010	/	/
MD600S/A-2S7R5(B)	1.5	16.6	7.5	2.87	3x2.5	E2510	2.5	E2510	0.75	E7510
MD600S/A-2S7R5	1.5	16.6	7.5	No braking	3x2.5	E2510	2.5	E2510	/	/
MD600S/A-2S010(B)	2.2	22.2	10	4.2	3x4	E4012	4	E4012	0.75	E7510
MD600S/A-2S010	2.2	22.2	10	No braking	3x4	E4012	4	E4012	/	/
Notes: [1]: Chinese standards applicable; 3 x 4: one three-conductor cable with a cross sectional area of 4 mm². It is recommended to use the tube pre-insulated lugs (TG-JT type) produced by Zhejiang KISE Terminal Co., Ltd. 1. Observe the local regulations during selection. The cables recommended in the preceding table meet the following conditions:PVC insulation and copper conductor. Heat resistance: maximum cable surface temperature not exceeding 70°C at an ambient temperature of 40°C (Remark: When the ambient temperature exceeds 40°C, contact Inovance.) Cable layout type E is adopted (see IEC 60204-1). 2. If the conditions vary, select the model according to actual conditions.										

Table 12-21 Cable selection (three-phase 380 V to 480 V, compliant with CE certification)

Three-phase 380 V to 480 V										
AC drive model	Power (kW)	Rated input current (A)	Rated output current	Braking current (A)	RST/UVW		Grounding cable		Braking terminal	
					Recommended cable type (mm ²) ^[1]	Recommended terminal model	Recommended cable type (mm ²) ^[1]	Recommended terminal model	Recommended cable type (mm ²) ^[1]	Recommended terminal model
MD600S/A-4T1R6(B)	0.37	1.9	1.6	0.34	3x0.75	E7510	0.75	E7510	0.75	E7510
MD600S/A-4T1R6	0.37	1.9	1.6	No braking	3x0.75	E7510	0.75	E7510	/	/
MD600S/A-4T2R3(B)	0.75	2.8	2.3	0.7	3x0.75	E7510	0.75	E7510	0.75	E7510
MD600S/A-4T2R3	0.75	2.8	2.3	No braking	3x0.75	E7510	0.75	E7510	/	/
MD600S/A-4T4R8(B)	1.5	5.9	4.8	1.4	3x0.75	E7510	0.75	E7510	0.75	E7510
MD600S/A-4T4R8	1.5	5.9	4.8	No braking	3x0.75	E7510	0.75	E7510	/	/
MD600S/A-4T5R5(B)	2.2	6.7	5.5	2.05	3x0.75	E7510	0.75	E7510	0.75	E7510
MD600S/A-4T5R5	2.2	6.7	5.5	No braking	3x0.75	E7510	0.75	E7510	/	/
MD600S/A-4T9R5(B)	4	11.6	9.5	3.72	3x1.5	E1512	1.5	E1512	0.75	E7510
MD600S/A-4T9R5	4	11.6	9.5	No braking	3x1.5	E1512	1.5	E1512	/	/
MD600S/A-4T013(B)	5.5	15.8	13	5.12	3x2.5	E2512	2.5	E2512	0.75	E7510
MD600S/A-4T013	5.5	15.8	13	No braking	3x2.5	E2512	2.5	E2512	/	/
Notes: [1]: Chinese standards applicable; 3 x 4: one three-conductor cable with a cross sectional area of 4 mm². It is recommended to use the tube pre-insulated lugs (TG-JT type) produced by Zhejiang KISE Terminal Co., Ltd. 1. Observe the local regulations during selection. The cables recommended in the preceding table meet the following conditions: PVC insulation and copper conductor. Heat resistance: maximum cable surface temperature not exceeding 70°C at an ambient temperature of 40°C (Remark: When the ambient temperature exceeds 40°C, contact Inovance.) Cable layout type E is adopted (see IEC 60204-1). 2. If the conditions vary, select the model according to actual conditions.										

12.9.2 Control Circuit Cables

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 as signal cables. Install the signal shield bracket at each end of the shield to bond the shield to the drive 360 degrees. Use separate shielded cables for different analog signals. It is recommended to use shielded twisted pair (STP) cables for digital signals.

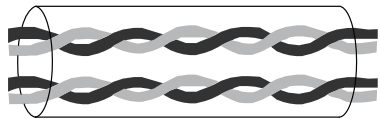


Figure 12-17 Shielded twisted pair cables

Table 12-22 Specifications of the control circuit cable

Structure	Type	Recommended IEC Cable Specification (mm ²)	Recommended cable lug specifications
T1	Control signal terminal	0.5-1.0	IEC: • 0.5 mm ² (E0510) • 0.75 mm ² (E7510) • 1 mm ² (E1010)
	Relay terminal	0.5-1.0	
T2	Control signal terminal	0.5-1.0	
	Relay terminal	0.5-1.0	

12.9.3Terminal

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

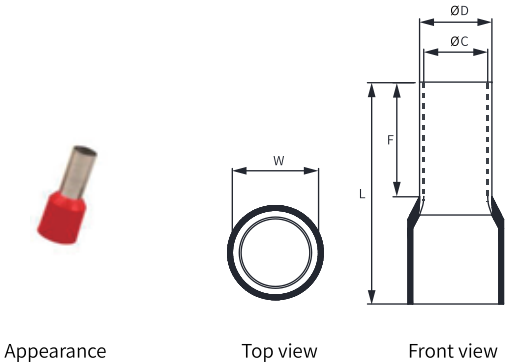


Figure 12-18 Appearance and dimensions of the tube-type pre-insulated terminal (TG-JT)

Table 12-23 Specifications and dimensions of the tube-type pre-insulated terminal (TG-JT)

Cross-sectional area	Model	Dimension (mm)					Insulation sheath color (1) For Germany (2) For France	Crimping tool
		F	L	W	DØ	CØ		
A.W.G.22 0.5 mm ²	E0510	10.0	16.0	2.7	1.3	1.0	(1) Orange (2) White	OPT AN-04WF
A.W.G.20 0.75 mm ²	E7510	10.0	16.0	2.8	1.5	1.2	(1) White (2) Blue	OPT AN-04WF
A.W.G.18 1.0 mm ²	E1010	10.0	16.5	2.9	1.7	1.4	(1) Yellow (2) Red	OPT AN-04WF
A.W.G.16 1.5 mm ²	E1510	10.0	16.5	3.5	2.0	1.7	(1) Red (2) Black	OPT AN-04WF
	E1512	12.0	18.5	3.5	2.0	1.7	(1) Red (2) Black	OPT AN-04WF
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

13 Requirements for Certification and Standards

Compliance

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

13.2 CE Certification

13.2.1Precautions for Compliance with EU Standards



Figure 13-1 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 the EU.
- The CE mark is mandatory for engaging in commercial business (production, importation, and distribution) in the EU.
- The drive complies with LVD, EMC, and RoHS directives and carries the CE mark.
- Machines and devices integrated with this drive must also comply with CE requirements for distribution in EU.
- 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.

13.2.2Requirements for Compliance with EMC Directive

- This drive, which is applicable to the First environment and Second environment, 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.

- As required by EMC Directive and standard, 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 or systems 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 the device or system during normal operation must be within a certain limit.
- The device or system must have sufficient immunity to the electromagnetic interference in the environment.

EN IEC 61800-3 defines the following two types of environments.

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

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

- Category C1: Power drive systems with the rated voltage less than 1000 V, intended for use in the first environment.

- Category C2: Power drive systems with the rated voltage lower than 1000 V, which is neither a plug-in device nor a movable device and is intended to be installed and commissioned only by professionals when used in the first environment.
- Category C3: Power drive systems 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
- Category C4: Power drive systems 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

13.2.3 Requirements for Compliance with LVD

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

Installation location

Install the product 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 ["5.1.1 Installation Environment Requirements" on page 56](#).

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 requirements for main circuit terminals

For details about the main circuit terminal wiring requirements, see ["6.2.2 Wiring Description of Main Circuit Terminals" on page 65](#).

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 ["12.3 Circuit Breaker and Fuse \(CE\)" on page 107](#).

Service and Support

Should you encounter a safety accident during the use or operation of the product, or face challenges in operating and maintaining the equipment, which remain unresolved after the relevant documentation is consulted, we provide multiple channels to ensure prompt resolution:

- Channel #1: Contact service@inovance.com.
- Channel #2: Visit <https://www.inovance.com/global> to access document downloads, after-sales support, spare parts ordering, repair applications, and authenticity verification services.
- Channel #3: Download My Inovance app (<https://zshc-eu.inovance.com/download-pc/>) where you can access products info and documentation, and query product parameters.

We are committed to providing you with quick and professional technical support, and we look forward to your satisfaction and trust.



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