



MD520 Series General-Purpose AC Drive Installation Guide



Industrial
Automation



Intelligent
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Robot



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Data code 19011714 A00

Preface

About This Guide

The MD520 series AC drive is a general-purpose high-performance current vector AC drive. It is used to control and adjust the speed and torque of three-phase AC asynchronous motors and three-phase AC permanent magnet motors. It is applicable to various automation equipment and industries such as textiles, papermaking, wire drawing, machine tools, packaging, food, fans, and water pumps.

This guide describes the composition, technical specifications, components, dimensions, options (including mounting accessories, cables, and peripheral electrical components), and extension cards of the MD520 series AC drive, as well as routine inspection and maintenance, compliance, and standards of the AC drive.

More Documents

Document Name	Document No.	Description
MD520 Series General-Purpose AC Drive Quick Installation and Commissioning Guide	19011712	Describes the installation, wiring, commissioning, troubleshooting, parameters, and fault codes of the AC drive.
MD520 Series General-Purpose AC Drive Hardware Guide	19011713	Describes the composition, technical specifications, components, dimensions, options (including mounting accessories, cables, and peripheral electrical components), and extension cards of the MD520 series AC drive, as well as routine inspection and maintenance, compliance, and standards of the AC drive.
MD520 Series General-Purpose AC Drive Installation Guide	19011714	Describes the installation dimensions, space design, specific installation steps, wiring requirements, routing requirements, and option installation requirements of the AC drive, as well as common EMC troubleshooting suggestions.
MD520 Series General-Purpose AC Drive Commissioning Guide	19011715	Describes the software tools, processes, and specific steps of debugging and commissioning of the AC drive, as well as troubleshooting, fault codes, and parameters related to the AC drive.
MD520 Series General-Purpose AC Drive Communication Guide	19011716	Describes the communication modes, networking, and communication settings of the AC drive.
MD520 Series General-Purpose AC Drive Function Guide	19011717	Describes the function application, communication, fault codes, and parameters of the AC drive.

Revision History

Date	Version	Description
2022-01	A00	First release

How to Obtain

This guide is not delivered with the AC drive, but an electronic PDF version is available. To obtain it,

log in to the official website of Inovance (www.inovance.com), choose Support > Download, search by keywords and download the file.

Table of Contents

Preface	1
Product Model List	6
Safety Precautions	7
1 Preparations for Installation.....	13
1.1 Flowcharts	13
1.2 Site Inspection	15
1.2.1 Installation Environment	15
1.2.2 Clearance	16
1.2.3 Direction	19
1.2.4 Environment	20
1.3 Tools.....	21
1.3.1 Tools for Mechanical Installation	21
1.3.2 Tools for Wiring	22
1.4 Accessories	23
1.4.1 Through-Hole Mounting Bracket	23
1.4.2 Grounding Bracket of Cable Shield	32
1.4.3 Bottom Mounting Bracket	33
1.4.4 Guide Rail	35
1.4.5 Installing the UVW Output Copper Busbar	35
2 Overall Dimensions	38
2.1 Dimensions of T1 to T9 Models	38
2.2 Dimensions of T10 to T12 Models (Without AC Output Reactor)	41
2.3 Dimensions of T10 to T12 Models (with AC Output Reactor)	42
3 Unpacking and Transportation	43
3.1 Storage	43
3.2 Transportation Before Unpacking	43
3.3 Package Check	45
3.4 Unpacking	50
3.5 Transportation and Hoisting After Unpacking	50
4 Mechanical Installation (T1 to T9 Models).....	53
4.1 Installation Method	53
4.2 Cabinet Design	53
4.2.1 Overview	53
4.2.2 Cabinet Space	53
4.2.3 Mounting Backplate	54
4.2.4 Cabinet Heat Dissipation	55

4.3	Pre-installation Precautions	62
4.4	Backplate Mounting	62
4.5	Through-Hole Mounting	64
4.6	Removing and Installing the Cover	67
4.6.1	Removing the Cover	67
4.6.2	Installing the Cover	70
4.7	Installing the Grounding Bracket of Cable Shield	72
5	Mechanical Installation (T10 to T12 Models)	76
5.1	Installation Method	76
5.2	Pre-installation Precautions	76
5.3	Heat Dissipation	77
5.4	Installation in a Cabinet	81
5.5	Removing and Installing the Cover	86
5.5.1	Removing the Cover	86
5.5.2	Installing the Cover	87
6	Checklist of Mechanical Installation	89
7	Electrical Installation	90
7.1	Electrical Wiring Diagram	90
7.2	Inspection Before Wiring	91
7.3	Main Circuit Connection	91
7.3.1	Main Circuit Terminals	91
7.3.2	Terminal Dimensions and Cable Selection	95
7.3.3	Wiring of Terminals	106
7.3.4	Requirements on Wiring of the Main Circuit	107
7.3.5	Protection Requirements	112
7.4	Control Circuit Connection	112
7.4.1	Control Circuit Terminals	112
7.4.2	Wiring of Terminals	117
7.4.3	Circuit Wiring Requirements	123
7.4.4	Cable Routing Requirements	125
7.4.5	Cable Routing Suggestions	126
7.5	Grounding	131
7.5.1	Grounding Requirements	131
7.5.2	Grounding One AC Drive Alone	132
7.5.3	Grounding Multiple AC Drives Installed Side by Side	133
7.5.4	Grounding the Cabinet System	134
7.6	Communication Connection	135
7.6.1	RS485	135
7.6.2	CAN	137
7.6.3	EtherCAT Wiring	139

7.6.4	PROFINET	140
7.7	Inspection After Wiring	140
8	Requirements on Installation of Options	142
8.1	AC Input Reactor	142
8.2	Output Reactor	142
8.3	Fuses, Contactors, and Circuit Breakers	142
8.4	EMC Filter	142
8.5	Ferrite Core and Ferrite Clamp	143
9	Troubleshooting for Common EMC Interference Problems	146
9.1	Leakage Current Suppression	146
9.2	Earth Leakage Circuit Breaker Malfunction	146
9.3	Harmonic Suppression	149
9.4	Control Circuit Interference	149
9.4.1	High-Speed Pulse Interference	149
9.4.2	Common I/O Signal Interference	149
9.5	Communication Interference	150
9.5.1	RS485 and CAN Communication Interference	150
9.5.2	EtherCAT and PROFINET Communication Interference	150
9.6	Encoder Feedback Signal Errors	151

Product Model List

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

Table –1 Mapping between product model and structure

Structure	Model (Three Phase 380–480 V)	Model (Three Phase 200–240 V)	Model (Single Phase 200-240 V)
T1	MD520-4T0.4B(S) MD520-4T0.7B(S) MD520-4T1.1B(S) MD520-4T1.5B(S) MD520-4T2.2B(S) MD520-4T3.0B(S)	MD520-2T0.4B(S) MD520-2T0.7B(S) MD520-2T1.1B(S) MD520-2T1.5B(S)	-
T2	MD520-4T3.7B(S) MD520-4T5.5B(S)	MD520-2T2.2B(S) MD520-2T3.7B(S)	MD520-2S0.4B(S) MD520-2S0.7B(S) MD520-2S1.5B(S) MD520-2S2.2B(S)
T3	MD520-4T7.5B(S) MD520-4T11B(S)	MD520-2T5.5B(S)	-
T4	MD520-4T15B(S)	MD520-2T7.5B(S)	-
T5	MD520-4T18.5(B)(S)(-T) MD520-4T22(B)(S)(-T)	MD520-2T11(B)(S)(-T)	-
T6	MD520-4T30(B)(S) MD520-4T37(B)(S)	MD520-2T15(B)(S) MD520-2T18.5(B)(S)	-
T7	MD520-4T45(B)(S) MD520-4T55(B)(S)	MD520-2T22(B)(S) MD520-2T30(B)(S)	-
T8	MD520-4T75(B)(S) MD520-4T90(S) MD520-4T110(S)	MD520-2T37(B)(S) MD520-2T45(S) MD520-2T55(S)	-
T9	MD520-4T132(S) MD520-4T160(S)	MD520-2T75(S)	-
T10	MD520-4T200(S)(-L) MD520-4T220(S)(-L)	MD520-2T90(S) MD520-2T110(S)	-
T11	MD520-4T250(S)(-L) MD520-4T280(S)(-L)	MD520-2T132(S)	-
T12	MD520-4T315(S)(-L) MD520-4T355(S)(-L) MD520-4T400(S)(-L)	MD520-2T160(S) MD520-2T200(S)	-
<p>Note:</p> <ul style="list-style-type: none"> ● (B): with the braking unit ● (S): with the safe torque off (STO) function ● (-T): with the DC reactor ● (-L): with the AC output reactor 			

Safety Precautions

Safety Disclaimer

- This chapter provides essential safety instructions for proper use of the AC drive. Before operating the AC drive, read through the user guide and comprehend all the safety instructions. Failure to comply with the safety instructions may result in damage to equipment, severe injury, or even death.
- "CAUTION", "WARNING", and "DANGER" messages in the guide are supplementary only and do not cover all safety precautions.
- Use the AC drive according to the designated environment requirements. Malfunction or damage caused by improper use is not covered by warranty.
- Inovance shall not be held liable for any safety accident or property loss caused by noncompliance with this guide or improper use of the AC drive.

Safety Categories and Definitions



indicates that failure to comply with the notice will result in severe injury or even death.



indicates that failure to comply with the notice may result in severe injury or even death.



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

Safety Precautions

- In some product drawings, covers or protective guards of the product are removed to show more details. Be sure to install the covers and protective guards before using the product and operate it in accordance with the instructions.
- Product drawings in this guide are for reference only and may be slightly different from the product you ordered.

Unpacking	
	<ul style="list-style-type: none"> • Do not install the product if you notice damage, rust, or signs of use on the product or its accessories upon unpacking. • Do not install the product if you notice water seepage or component missing or damage upon unpacking. • Do not install the product if the packing list does not match the product you received.

 CAUTION

- Before unpacking, check the package for damage, water seepage, damp, and deformation.
- Unpack the package by following the unpacking sequence. Do not strike the package with force.
- When unpacking, check the surface of the product and accessories for damage, rust, and scratches.
- Check the equipment, accessories, and materials in the package against the packing list.

Storage and Transportation

 WARNING

- Use specialized hoisting equipment and qualified staff to move large-scale or heavy equipment. Failure to comply may result in injury or damage to the product.
- Before hoisting the product, make sure that the front cover, terminal blocks, and similar parts of the product are well secured with screws. Failure to comply may cause the parts to fall off and result in injury or damage to the product.
- Never stand or stay below the product when it is lifted by hoisting equipment.
- When lifting the product with a steel wire rope, lift it steadily at a constant rate to prevent it from vibration, shock, and turnover. Do not keep the product lifted for a long time. Failure to comply may result in injury or damage to the product.

 CAUTION

- Handle the product with care and mind your steps. Failure to comply may result in injury or damage to the product.
- When handling the product with bare hands, hold the product casing firmly with care to prevent parts from falling off. Failure to comply may result in injury or damage to the product.
- Store and transport the product in strict accordance with the requirements of storage and transportation conditions. Failure to comply may result in damage to the product.
- Do not store or transport the product in environments with water splash, rain, direct sunlight, strong electric field, strong magnetic field, and strong vibration.
- Do not store the product for over three months. Take stricter prevention measures and perform necessary inspection during prolonged storage.
- Pack the product properly before road transport. For long-distance transportation, use a sealed box.
- Never transport the product together with equipment or materials that may damage or have negative impacts on it.

Installation

 DANGER

- Installation must be carried out only by qualified technicians who have received necessary electrical training and understood enough electrical knowledge.

 **WARNING**

- Read through the safety precautions and user guide before installation.
- Do not install the product in places with strong electric or magnetic fields.
- Before installation, make sure that the installation position is mechanically strong enough to bear the weight of the product. Failure to comply may result in mechanical hazards.
- Do not wear loose clothes or accessories during installation. Failure to comply may result in electric shock.
- When the product is installed in an enclosed environment (such as a cabinet or a rack), ensure adequate cooling of the environment by using cooling devices (such as a fan or an air conditioner). Failure to comply may result in product over-temperature or a fire.
- Do not modify the product.
- Do not fiddle with the bolts used to fix parts and components or the bolts marked in red.
- When the product is installed in a cabinet or terminal equipment, make sure that the enclosure of the cabinet or terminal equipment provides adequate fire prevention, electrical protection, and mechanical protection, and meets the IP rating requirements specified by relevant IEC standards and local laws and regulations.
- Before installing equipment with strong electromagnetic interference, such as a transformer, install an electromagnetic shielding device for the product to prevent malfunctions.
- Install the product on a flame-retardant object such as metal, and keep combustible materials away from the product. Failure to comply may result in a fire.

 **CAUTION**

- Cover the top of the product with cloth or paper during installation to prevent foreign objects such as metal chippings, oil, and water from falling into the product and causing faults. After installation, remove the cloth or paper to prevent over-temperature caused by poor ventilation due to blocked ventilation holes.
- Resonance may occur when a machine supposed to run at a constant speed is running at a variable speed. In this case, place anti-vibration rubber under the motor frame or use the vibration suppression function to reduce resonance.

Wiring **DANGER**

- Never allow non-qualified personnel to install, wire, inspect or maintain the equipment or replace any parts of the equipment.
- Before wiring, cut off all equipment power supplies, and wait at least a period of time specified on the product warning label before further operations because residual voltage still exists after power-off. Measure the DC voltage on the main circuit to ensure a safe voltage range. Failure to comply may result in electric shock.
- Do not carry out wiring, remove the product casing, or touch the circuit board before power is cut off. Failure to comply may result in electric shock.
- Make sure that the product and related equipment are properly grounded. Failure to comply may result in electric shock.

 WARNING

- Never connect the input power cable to output terminals of the product or equipment. Failure to comply may result in damage to equipment or even a fire.
- When connecting a drive with a motor, ensure consistency of terminal phase sequences between the drive and the motor to prevent reverse motor rotation.
- Use cables with required diameter and shield. Properly ground one end of the shield if a shielded cable is used.
- Tighten terminal screws using the tightening torque specified in this document. Insufficient or excessive tightening torque may result in over-temperature or damage to connecting parts, which may lead to a fire.
- After wiring, make sure that all cables are correctly connected, and there are no dropped screws, gaskets, or exposed cables inside the product. Failure to comply may result in electric shock or damage to the product.

 CAUTION

- During wiring, follow the electrostatic discharge (ESD) procedures and wear antistatic wrist straps. Failure to comply may result in damage to the product or its circuits.
- Use shielded twisted pair cables for the control circuit. Connect the shield to the grounding terminal of the product. Failure to comply may result in product malfunction.

Power-on

 DANGER

- Before power-on, make sure that the product is properly installed, the wiring is secure, and the motor can restart.
- Before power-on, make sure that the power supply meets requirements. Failure to comply may result in damage to the product or even fire.
- After power-on, do not open the cabinet door or protective cover, touch any wiring terminals, or disassemble any units or parts of the product. Failure to comply may result in electric shock.

 WARNING

- After wiring and parameter setting, carry out a trial run to ensure proper functioning of the product. Failure to comply may result in injury or damage to equipment.
- Before power-on, make sure that the voltage of the power supply matches the rated voltage of the product. Using an improper voltage may result in a fire.
- Before power-on, make sure that no one is near the product, motor, or machine. Failure to comply may result in injury or even death.

Operation

 DANGER

- Never allow non-qualified personnel to operate the product. Failure to comply may result in injury or even death.
- During operation, do not touch any wiring terminals or disassemble any units or parts of the product. Failure to comply may result in electric shock.

**WARNING**

- Do not touch the housing, fan, or resistor of the equipment to check temperature. Failure to comply may result in burns.
- During operation, prevent metal and other foreign objects from falling into the equipment. Failure to comply may result in fire or damage to the product.

Maintenance**DANGER**

- Never allow non-qualified personnel to install, wire, inspect or maintain the equipment or replace any parts of the equipment.
- Never carry out maintenance when power is on. Failure to comply may result in electric shock.
- Before maintenance, cut off all equipment power supplies and wait at least a period of time specified on the product warning label.
- In the case of an PM motor, do not touch motor terminals because an induced voltage is generated on the motor terminals due to the rotation of the motor even after power cut-off. Failure to comply may result in electric shock.

**WARNING**

- Carry out daily and periodic inspection and maintenance on the equipment according to maintenance requirements and retain a maintenance record.

Repair**DANGER**

- Never allow non-qualified personnel to install, wire, inspect or maintain the equipment or replace any parts of the equipment.
- Do not repair the equipment when power is on. Failure to comply may result in electric shock.
- Before inspection or repair, cut off all equipment power supplies and wait at least a period of time specified on the product warning label.

**WARNING**

- Require for repair services according to the product warranty agreement.
- When the fuse is blown or the circuit breaker or earth leakage current breaker (ELCB) trips, wait at least a period of time specified on the product warning label before power-on or further operations. Failure to comply may result in damage to equipment, injury, or even death.
- When the equipment fails or is damaged, arrange for qualified technicians to troubleshoot and repair the equipment in accordance with the maintenance instructions and retain a maintenance record.
- Replace quick-wear parts of the product according to the replacement instructions.
- Do not use damaged equipment. Failure to comply may result in worse damage, injury, or even death.
- After replacing the equipment, make sure to re-check wiring and set parameters.

Disposal
<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">  WARNING </div> <ul style="list-style-type: none"> • Dispose of retired equipment in accordance with local regulations and standards. Failure to comply may result in property damage, injury, or even death. • Recycle retired equipment in accordance with waste disposal standards of the industry to avoid environmental pollution.

Safety Signs

For safe operations, observe the safety signs on the equipment. Do not stain or remove the safety signs. See the following table for descriptions of the safety signs.

Safety Sign	Description
	<ul style="list-style-type: none"> • Read through the safety instructions before operating the product. Failure to comply may result in damage to the product, injury, or even death. • Do not touch terminals or remove the cover when power is on or within 10 minutes after power is cut off. Failure to comply may result in electric shock.

1 Preparations for Installation

1.1 Flowcharts

T1 to T9 models

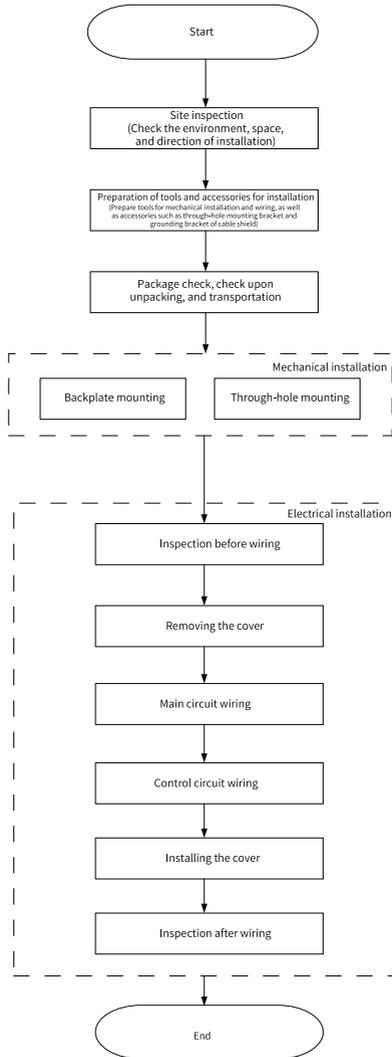


Figure 1-1 General installation process (T1 to T9 models)

T10 to T12 models

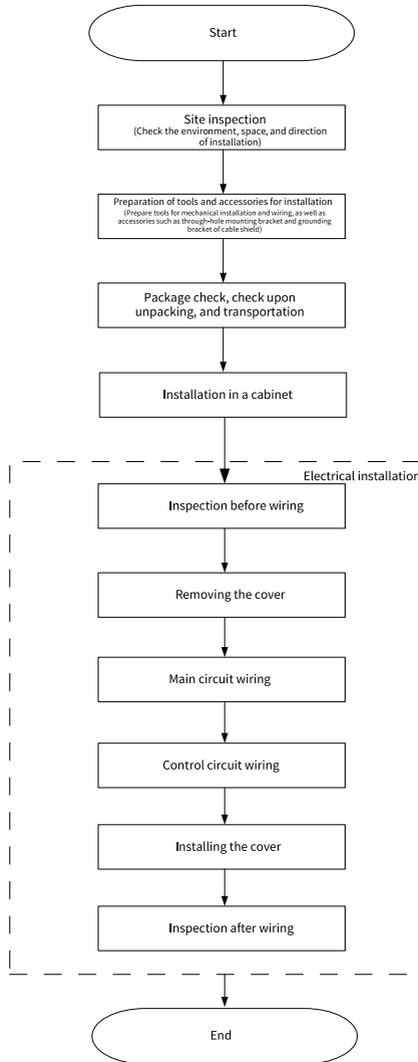


Figure 1-2 General installation process (T10 to T12 models)

1.2 Site Inspection

1.2.1 Installation Environment

To maximize performance and ensure long service life of the drive, install the drive in an environment specified as follows.

Table 1-1 Environment requirements

Item	Requirement
Installation location	Indoor
Grid overvoltage	Overvoltage category (OVC) III
Temperature	<p>Installation/Operating temperature: -10°C to $+50^{\circ}\text{C}$. When the temperature ranges from -10°C to $+40^{\circ}\text{C}$, no derating is required. For temperature above 40°C, derate 1.5% for every additional 1°C. Storage/Transportation temperature: -20°C to $+60^{\circ}\text{C}$</p> <ul style="list-style-type: none"> • For better reliability, use the AC drive in places without sharp temperature changes. • When installing the AC drive in an enclosed cabinet, use the cooling fan or air conditioner to keep the incoming air temperature below 50°C. Failure to comply may result in over-temperature of the AC drive or even a fire. • Install the AC drive on a flame-retardant surface, and ensure that sufficient space is left around it for efficient heat dissipation. • Avoid freezing the AC drive.
Humidity	< 95% RH, without condensation
Environment	<p>Pollution degree 2 or below Install the AC drive to a place meeting the following conditions:</p> <ul style="list-style-type: none"> • Free of direct sunlight, dust, corrosive gas, combustible or explosive gas, oil mist, water vapor, drip, or salt • Insusceptible to vibration (away from equipment that may generate strong vibration, such as a punch press) • No foreign objects such as metal powder, oil, and water enter the AC drive. • Free of radioactive materials, combustible materials, and hazardous gas and liquid, and salt corrosion • Away from combustible materials such as wood
Altitude	<ul style="list-style-type: none"> • No derating is required for altitudes equal to or below 1000 m. • For altitudes above 1000 m, derate 1% for every additional 100 m. <p>0.4–3 kW: The maximum altitude is 2000 m. For altitudes above 2000 m, contact Inovance. Above 3 kW: The maximum altitude is 3000 m. For altitudes above 3000 m, contact Inovance.</p>
Vibration resistance	<ul style="list-style-type: none"> • For transportation with packages: compliant with Class 2M3 requirements in EN 60721-3-2 • For installation without packages: compliant with ISTA 1H

1.2.2 Clearance

Reserve sufficient clearance as appropriate to the power rating of the AC drive.

T1 to T9 models

- Installing one alone

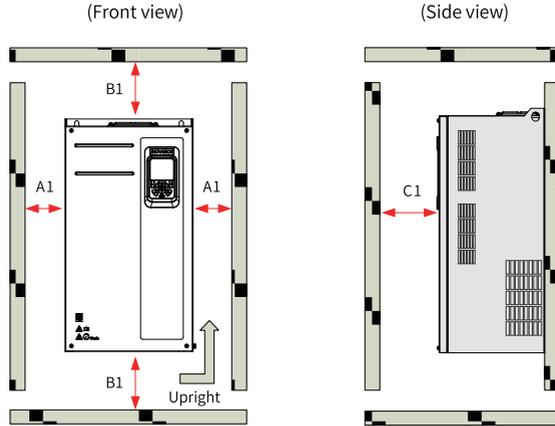


Figure 1-3 Clearance for installation of one AC drive (T1 to T9 models)

Table 1-2 Installation clearance

Power Rating	Clearance (mm)		
0.4 kW to 15 kW	$A1 \geq 10$	$B1 \geq 100$	$C1 \geq 40$
18.5 kW to 22 kW	$A1 \geq 10$	$B1 \geq 200$	$C1 \geq 40$
30 kW to 37 kW	$A1 \geq 50$	$B1 \geq 200$	$C1 \geq 40$
45 kW to 160 kW	$A1 \geq 50$	$B1 \geq 300$	$C1 \geq 40$

- Installing side by side

The AC drive dissipates heat upward. When multiple AC drives are required to work together, install them side by side. Keep their tops level with each other, especially for those of different sizes.

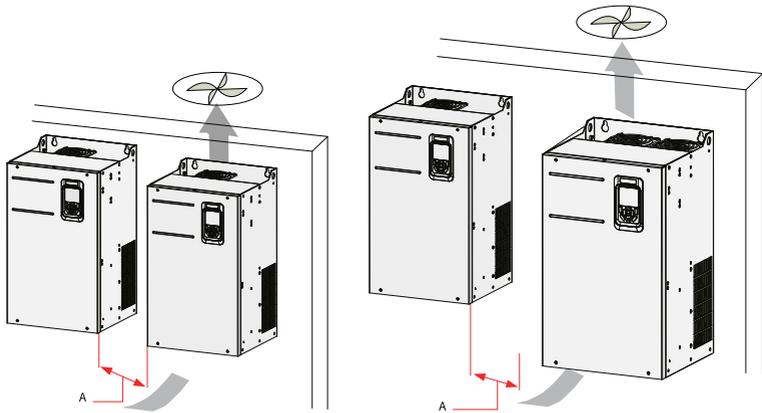


Figure 1-4 Installing multiple AC drives (T1 to T9 models) side by side

Table 1-3 Installation clearance

Power Rating	Clearance (mm)
0.4 kW to 15 kW	$A1 \geq 10$
18.5 kW to 22 kW	$A1 \geq 10$
30 kW to 37 kW	$A1 \geq 50$
45 kW to 160 kW	$A1 \geq 50$

- Installing one above another
 Where an AC drive needs to be installed above another, the heat generated by the lower AC drive may act on the upper one, causing over-temperature or overload of the upper one. In this case, install a heat insulation baffle, as shown in ["Figure 1-5 Installing one above another"](#) on page 18.

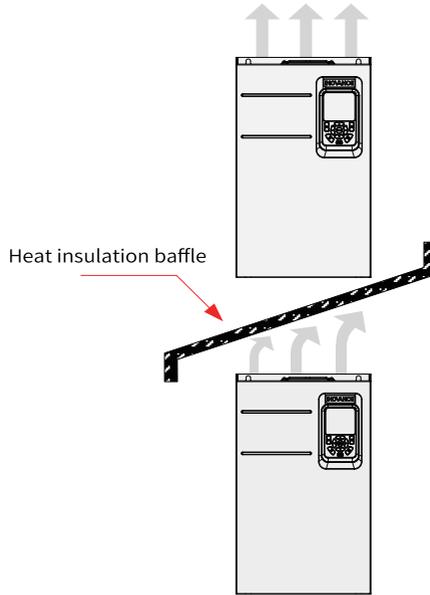


Figure 1-5 Installing one above another

T10 to T12 models

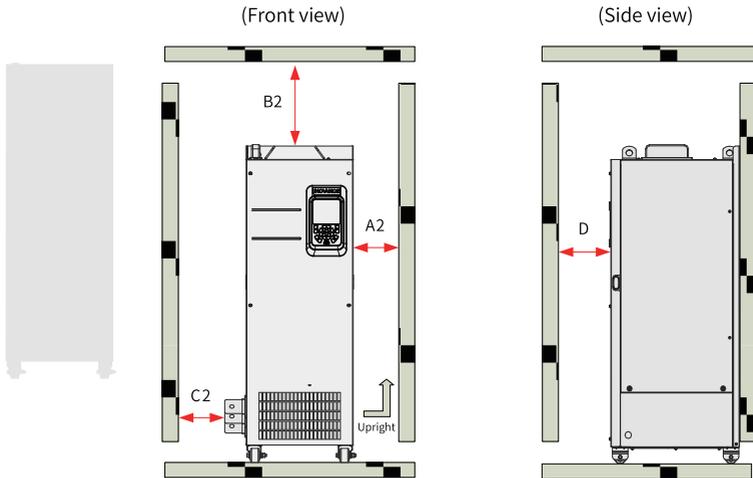


Figure 1-6 Installation clearance

Table 1-4 Installation clearance

Power Rating	Clearance (mm)			
200 kW to 400 kW	A2 \geq 10	B2 \geq 250	C2 \geq 20	D2 \geq 20

Note

T10 to T12 models can only be installed individually inside the cabinet. For installation needs, contact Inovance.

1.2.3 Direction

Install the AC drive upright only, as shown in "Figure 1-8" on page 19.

Avoid stress on any side of the AC drive or placing it on an inclined surface. The AC drive is large and heavy (close to 200 kg). If the inclination exceeds 5°, it may topple.

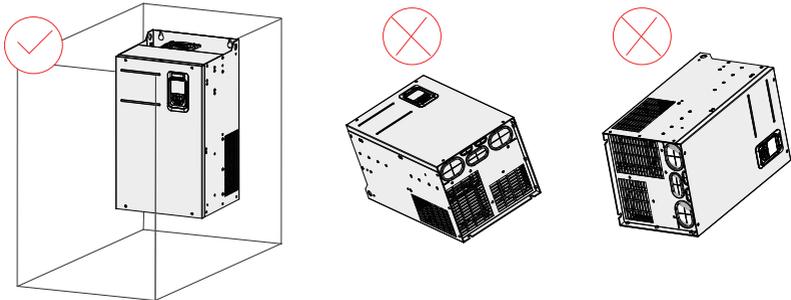


Figure 1-7 Installation direction (T1 to T9 models)

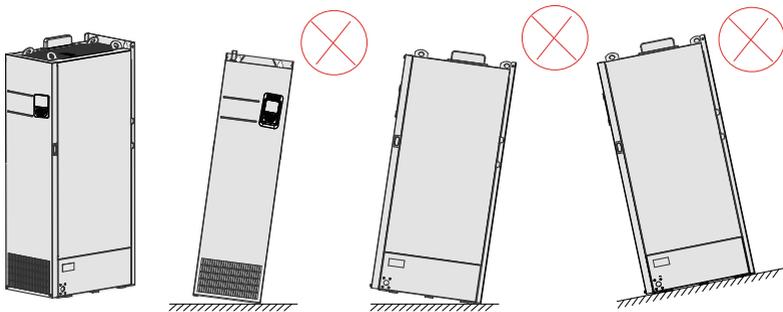


Figure 1-8 Installation direction (T10 to T12 models)

1.2.4 Environment

For optimized performance and a long service life of the AC drive, install the AC drive in an environment that meets the following requirements.

Table 1-5 Environment requirements

Item	Requirement
Location	Indoors
Grid overvoltage	Overvoltage category (OVC): III
Temperature	<p>Installation/Operation: -10°C to $+50^{\circ}\text{C}$ (-10°C to $+40^{\circ}\text{C}$: no derating; over $+40^{\circ}\text{C}$: derate 1.5% for every additional 1°C)</p> <p>Storage/Transportation: -20°C to $+60^{\circ}\text{C}$</p> <ul style="list-style-type: none"> • For better reliability, use the AC drive in places without sharp temperature changes. • For use in an enclosed space such as a control cabinet, use a cooling fan or air conditioner to keep the temperature of air taken into the AC drive below 50°C. Failure to comply may result in over-temperature or fire. • Install the AC drive on a flame retardant object, with sufficient clearance reserved for heat dissipation. • Avoid freezing of the AC drive.
Humidity	Below 95% RH, non-condensing
Environment	<p>Pollution degree: 2 or below</p> <p>Install the AC drive in a place:</p> <ul style="list-style-type: none"> • without direct sunlight, dust, corrosive gas, combustible or explosive gas, oil mist, water vapor, drip, and salt. • without vibration, especially vibration caused by equipment such as punch presses. • without foreign objects such as metal powder, oil, and water that may enter the AC drive. • without radioactive materials, combustible materials, hazardous gas and liquid, and salt corrosion. • providing a support made of materials other than combustibles such as timber. • meeting Class 3C3 requirements in IEC60721-3-3 in terms of chemically active substances.
Altitude	<ul style="list-style-type: none"> • 1000 m and below: no derating. • Above 1000 m: derate 1% for every additional 100 m. <p>0.4 kW to 3 kW models: maximum 2000 m. Consult Inovance for use above 2000 m. 3 kW models and above: maximum 3000 m. Consult Inovance for use above 3000 m.</p>
Vibration resistance	<ul style="list-style-type: none"> • Transportation with packaging: Class 2M3 requirements in EN 60721-3-2 • Installation without packaging: ISTA 1H

1.3 Tools

1.3.1 Tools for Mechanical Installation

T1 to T9 models

"[Table 1–6 Tools for mechanical installation](#)" on page 21 lists the tools for mechanical installation.

Table 1–6 Tools for mechanical installation

Tool	Description
Electric drill with an appropriate drilling bit	Used to drill mounting holes on the mounting surface.
Wrench or socket wrench	Used to tighten or loosen screws. Wrench sizes: 13, 16, and 18.
Phillips and slotted (2.5 mm to 6 mm) screwdrivers	Used to tighten or loosen screws.
Torque wrench	Used to tighten or loosen screws.
Crowbar	Used to pry off the upper access cover or cover to facilitate installation.
Crane	Used to lift the AC drive.
Tape measure	Used to measure the installation dimensions of the AC drive.
Gloves	Used to prevent static electricity.
Bottom mounting bracket (standard)	When the AC drive is installed in a cabinet, a bottom mounting bracket is used to fix it in the cabinet.
Guide rails (optional)	When the AC drive is installed in a cabinet, the guide rails are connected to the bottom mounting bracket, allowing the AC drive to be gently pushed into the cabinet along the guide rails.
Screws	Used to fix the AC drive onto the mounting surface.

"[Table 1–7 Specifications and quantities of screws](#)" on page 22 lists the specifications and quantities of screws required for mechanical installation.

Table 1-7 Specifications and quantities of screws

Installation Method	Specification	Quantity (Pcs)	Description
Backplate Mounting	Dependent on the mounting hole diameter (provided by the user).	4	Used to fix the AC drive onto the wall.
Through-hole mounting	Dependent on the mounting hole diameter (provided by the user).	4	Used to fix the AC drive onto the backplate of the control cabinet.

T10 to T12 models

["Table 1-6 Tools for mechanical installation" on page 21](#) lists the tools for mechanical installation.

["Table 1-8 Specifications and quantities of screws" on page 22](#) lists the specifications and quantities of screws required for mechanical installation.

Table 1-8 Specifications and quantities of screws

Installation Method	Specification	Quantity (Pcs)	Description
Installation in a cabinet	M5 self-tapping screw	6	Used to fix the bottom mounting bracket to the bottom of the cabinet.
	M5x12 SEMS screw	8	Used to assemble the guide rails.
	M6 nut	2	Used to connect the guide rail assembly to the bottom mounting bracket.

1.3.2 Tools for Wiring

For wiring of main circuit terminals, use installation tools appropriate to terminal dimensions and secure the joints well. ["Table 1-9 Tools for wiring of main circuit terminals" on page 22](#) lists the tools required for wiring of the main circuit terminals.

Table 1-9 Tools for wiring of main circuit terminals

AC Drive Model	Recommended Fastener	Tool
T1 and T2	M4 SEMS screw	Phillips screwdriver (#3 slot)
T3 and T4	M5 SEMS screw	Phillips screwdriver (#3 slot)
T5 and T6	M6 SEMS screw	Phillips screwdriver (#3 slot)

AC Drive Model	Recommended Fastener	Tool
T7	M8 nut, spring washer, and flat washer	Socket wrench (#13 socket)
T8 and T9	M12 nut, spring washer, and flat washer	Socket wrench (#19 socket) and socket wrench extension bar (150 mm)
T10 and T11	M12 bolt, spring washer, and flat washer	Socket wrench (#19 socket) and socket wrench extension bar (250 mm)
T12	M16 bolt, spring washer, and flat washer	Socket wrench (#24 socket) and socket wrench extension bar (250 mm)

1.4 Accessories

1.4.1 Through-Hole Mounting Bracket

The through-hole mounting bracket is optional and can be purchased as needed.

Applicable models

Table 1-10 Models of through-hole mounting brackets

Models of through-hole mounting brackets	Structure
MD500-AZJ-A1T1	T1
MD500-AZJ-A1T2	T2
MD500-AZJ-A1T3	T3
MD500-AZJ-A1T4	T4
MD500-AZJ-A1T5	T5
MD500-AZJ-A1T6	T6
MD500-AZJ-A1T7	T7
MD500-AZJ-A1T8	T8
MD500-AZJ-A1T9	T9

Mounting-hole dimensions

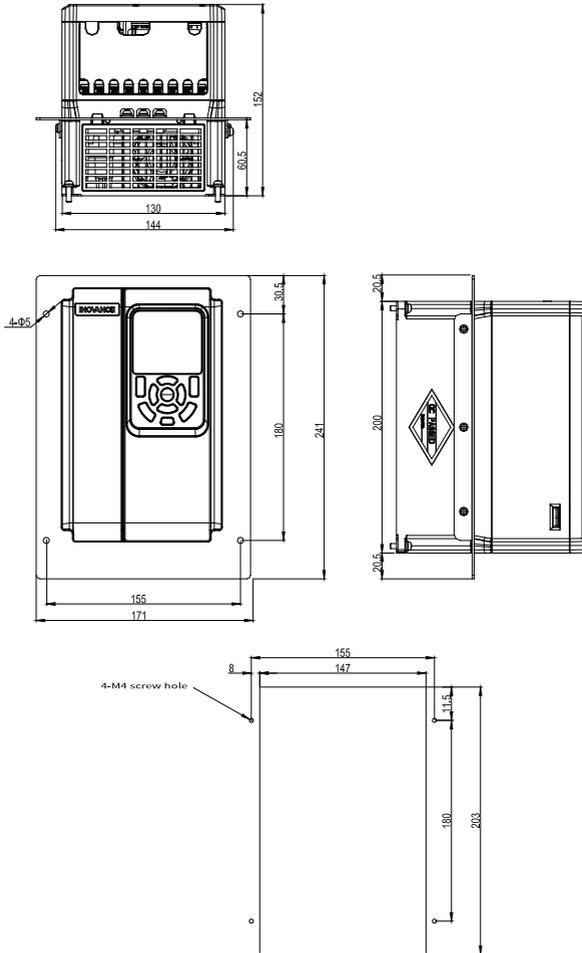


Figure 1-9 Dimensions of MD500-AZJ-A1T1 through-hole mounting bracket and holes (mm)

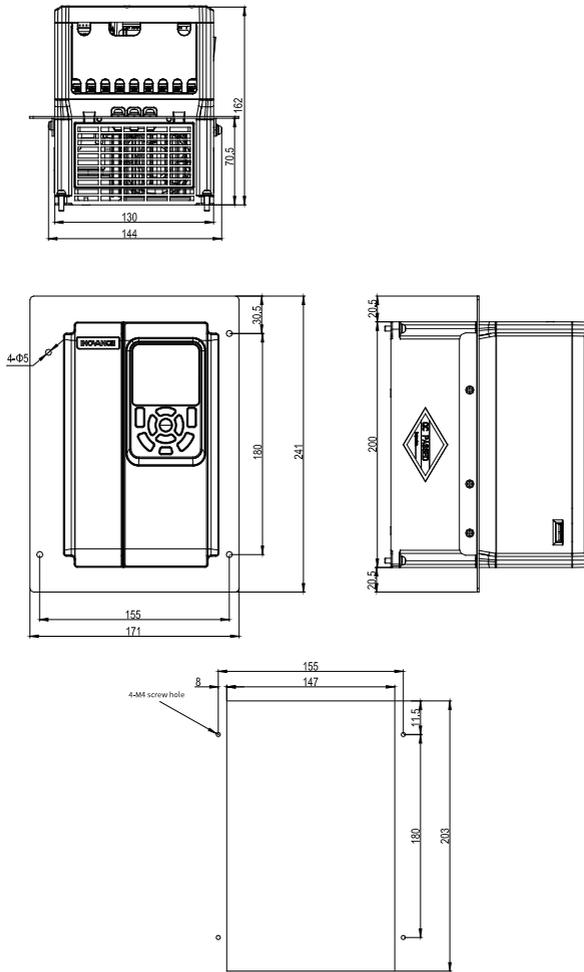


Figure 1-10 Dimensions of MD500-AZJ-A1T2 through-hole mounting bracket and holes (mm)

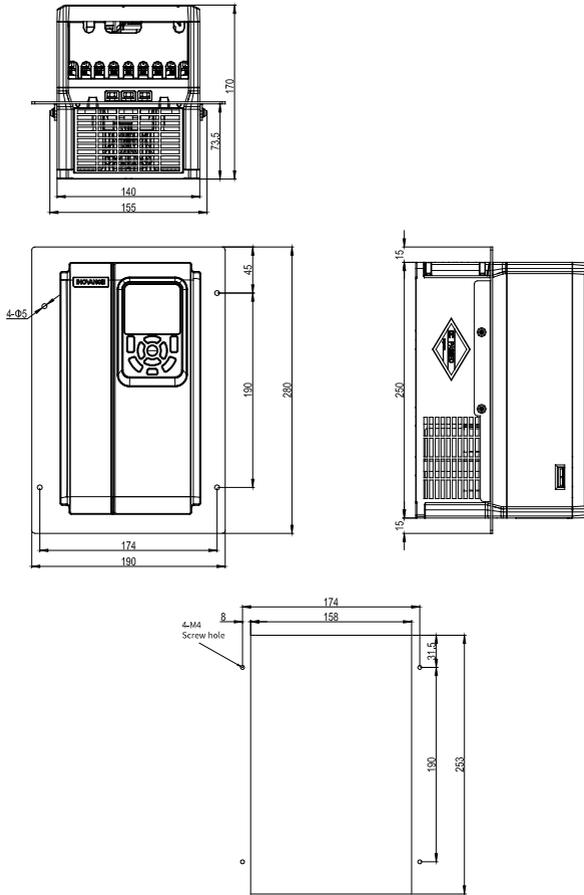


Figure 1-11 Dimensions of MD500-AZJ-A1T3 through-hole mounting bracket and holes (mm)

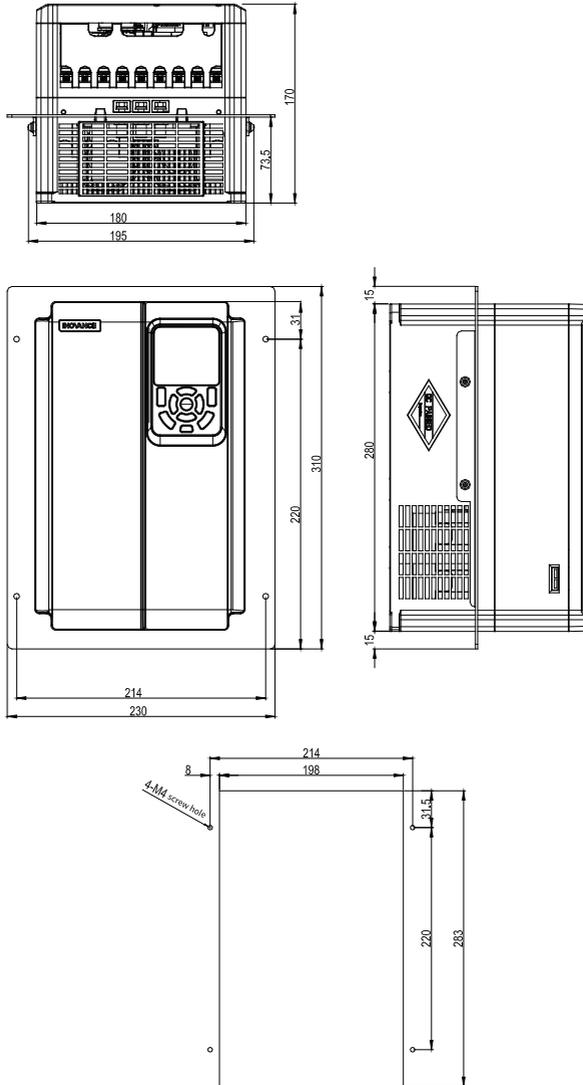


Figure 1-12 Dimensions of MD500-AZJ-A1T4 through-hole mounting bracket and holes (mm)

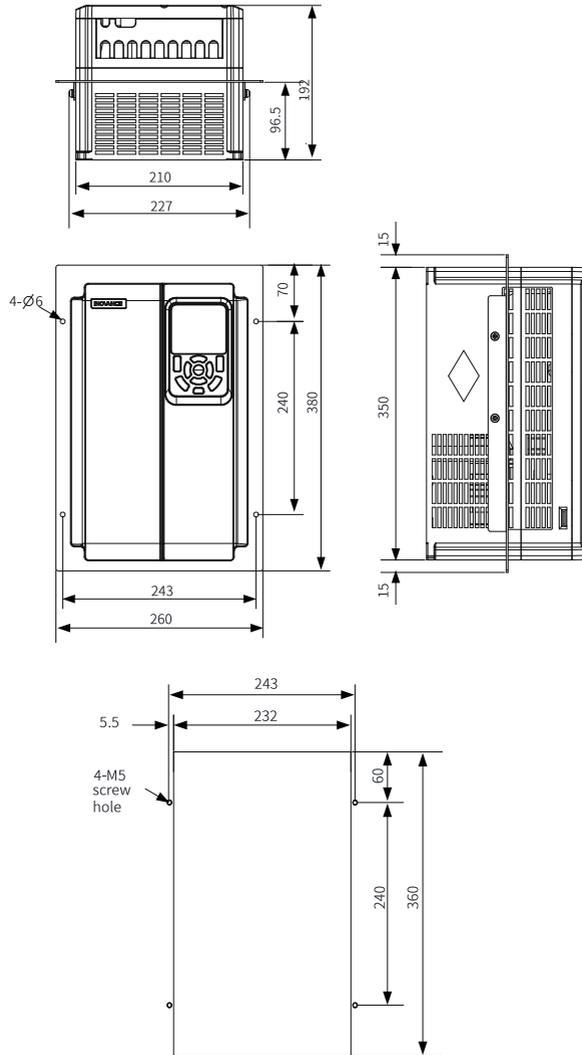


Figure 1-13 Dimensions of MD500-AZJ-A1T5 through-hole mounting bracket and holes (mm)

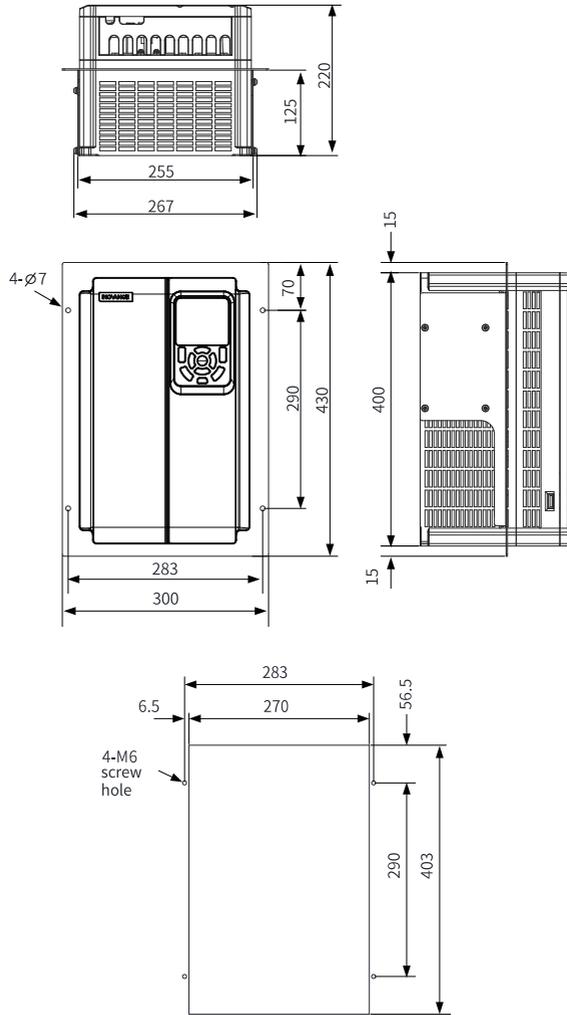


Figure 1-14 Dimensions of MD500-AZJ-A1T6 through-hole mounting bracket and holes (mm)

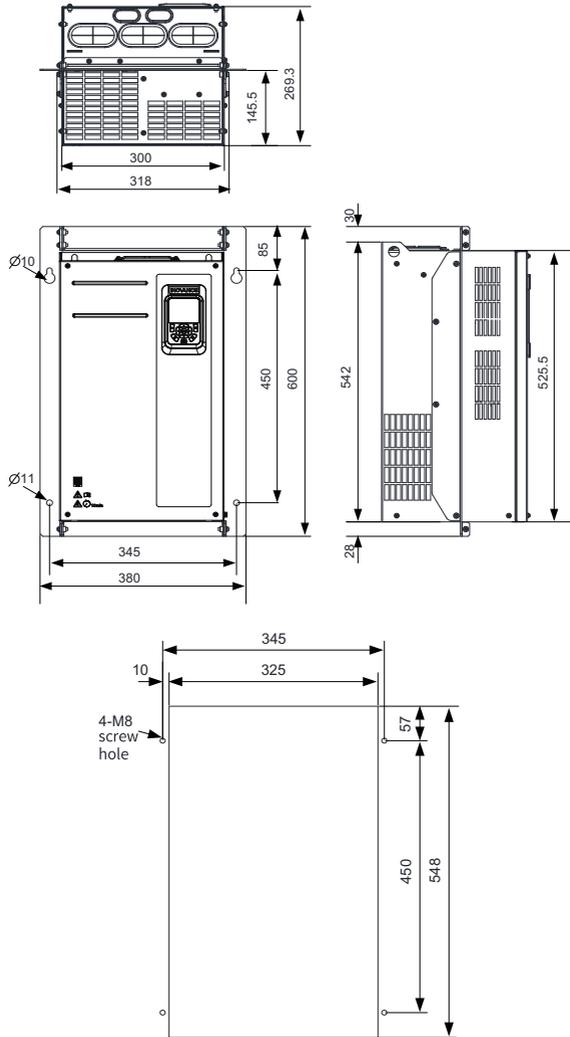


Figure 1-15 Dimensions of MD500-AZJ-A1T7 through-hole mounting bracket and holes (mm)

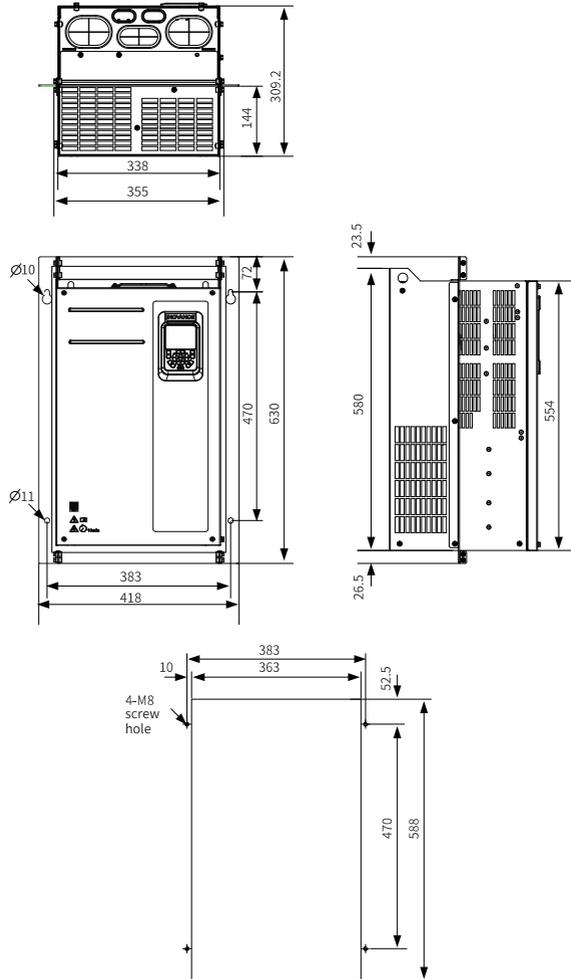


Figure 1-16 Dimensions of MD500-AZJ-A1T8 through-hole mounting bracket and holes (mm)

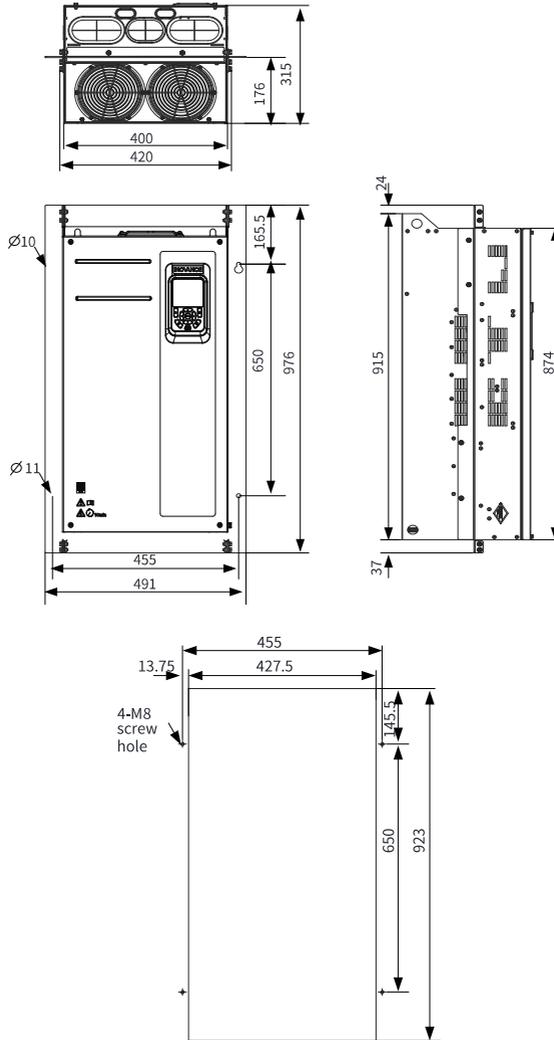


Figure 1-17 Dimensions of MD500-AZJ-A1T9 through-hole mounting bracket and holes
(mm)

1.4.2 Grounding Bracket of Cable Shield

The grounding bracket of cable shield is optional and can be purchased separately as required (applicable to T9 models and below).

1.4.3 Bottom Mounting Bracket

T10 to T12 models come with a bottom mounting bracket. When the AC drive is installed in a cabinet, the bottom mounting bracket is required for fixing the AC drive to the cabinet rack base. The dimensions of bottom mounting bracket vary with the power rating, weight, and size of the AC drive, as shown in the following figures.

The bottom mounting bracket provided with the AC drive is applicable to cabinet with a depth of 600 mm.

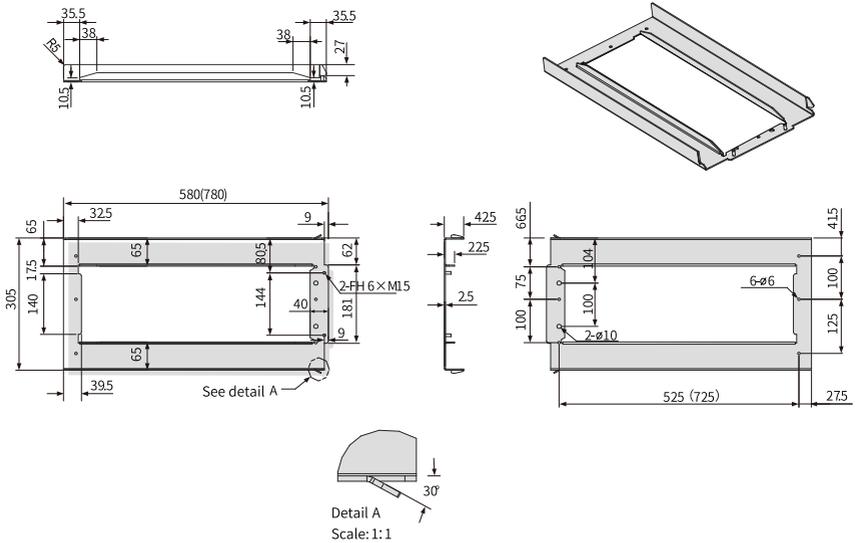


Figure 1-18 Dimensions of bottom mounting bracket for T10 models

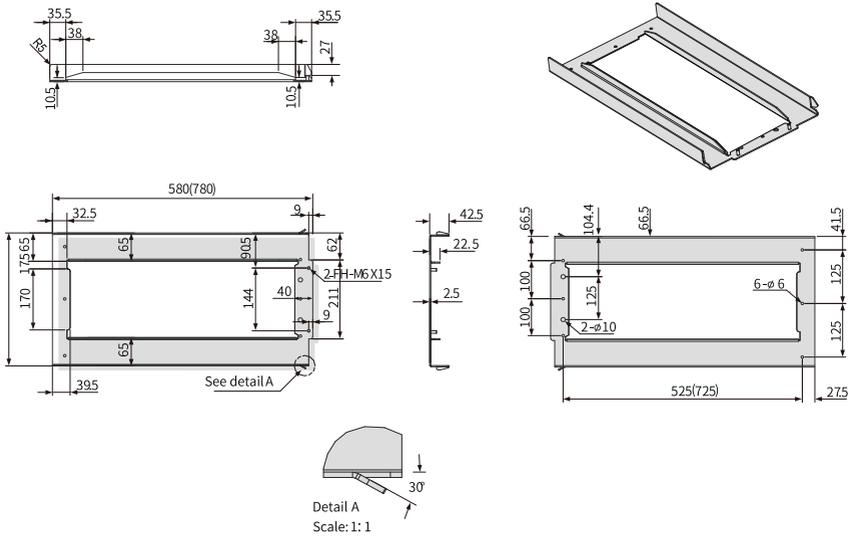


Figure 1-19 Dimensions of bottom mounting bracket for T11 models

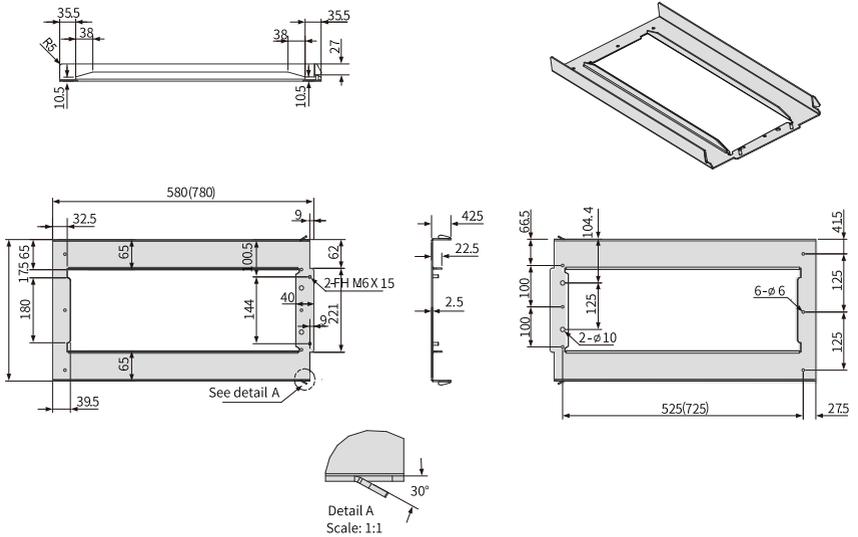


Figure 1-20 Dimensions of bottom mounting bracket for T12 models

Note

- The bottom mounting brackets shown in the preceding figures are applicable to PS standard cabinets, sized either Width 800 mm x Depth 600 mm or Width 800 mm x Depth 800 mm. Dimensions in parentheses are applicable to PS standard cabinets sized Width 800 mm x Depth 800 mm.
 - The bottom mounting brackets that come standard with T10 to T12 models are only applicable to PS standard cabinets sized Width 800 mm x Depth 600 mm.
-

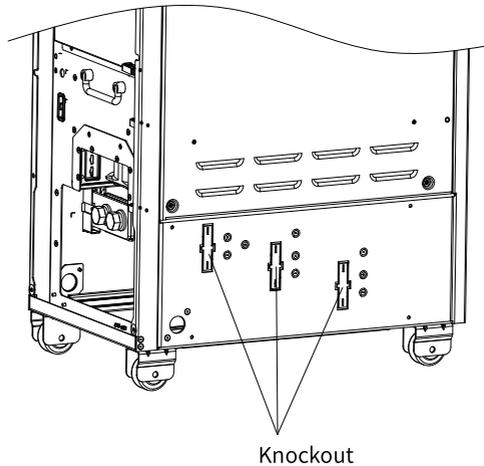
1.4.4 Guide Rail

For details of the guide rail, see *Operation Instructions for MD500-AZJ-A3T10 Guide Rail*.

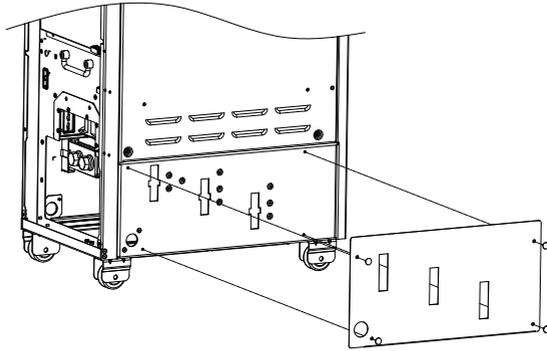
1.4.5 Installing the UVW Output Copper Busbar

All MD520 models excluding that with the base (-L) are delivered with the UVW output copper busbar. To install the UVW output copper busbar, do as follows:

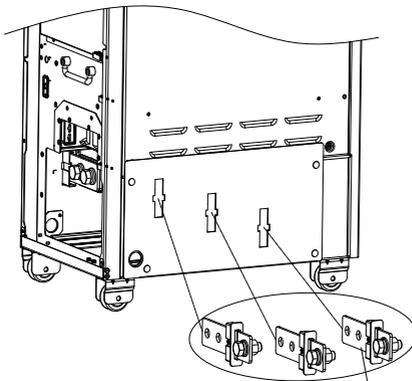
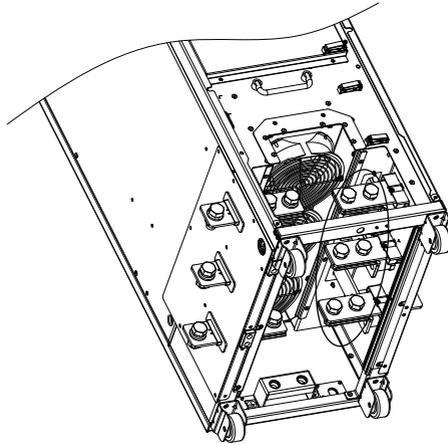
1. Use the screwdriver or cutting pliers to remove the three knockouts.



2. Use the four plastic snap-fit joints in the packing box to fasten the insulating paper to the chassis through the four holes on the paper.

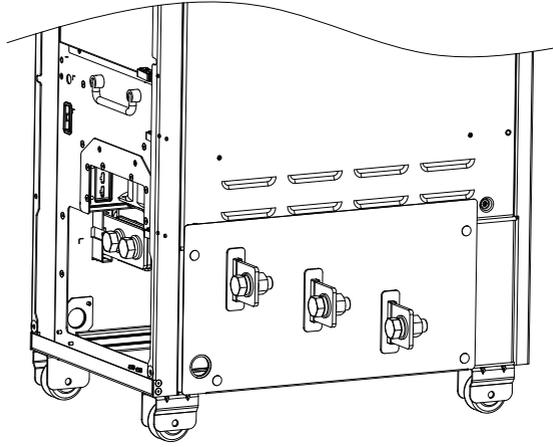


3. Remove the six screws on the drive, install the copper busbars, and then fasten the six screws.



Code of copper busbar package

The following figures shows the installed copper busbar.



2 Overall Dimensions

2.1 Dimensions of T1 to T9 Models

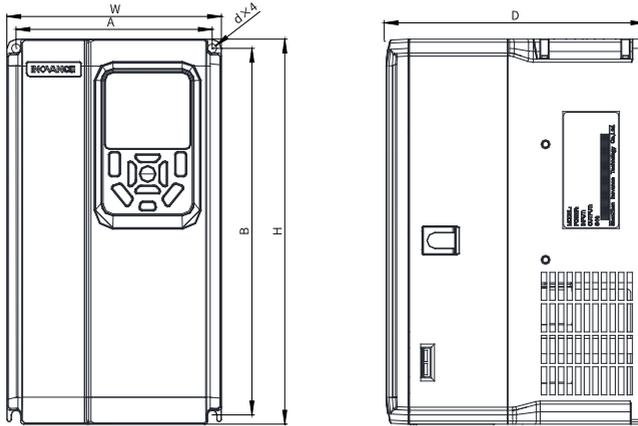


Figure 2-1 Outline dimensions and mounting dimensions of T1 to T4 models

Table 2-1 Outline dimensions and mounting dimensions of T1 to T4 models

Structure	Mounting Hole Spacing mm (in.)		Outline Dimension mm (in.)			Mounting Hole Diameter mm (in.)	Weight kg (lb)
	A	B	H	W	D		
T1	119 (4.7)	189 (7.5)	200 (7.9)	130 (5.1)	150 (6.0)	Ø5 (0.2)	1.6 (3.5)
T2	119 (4.7)	189 (7.5)	200 (7.9)	130 (5.1)	160 (6.4)	Ø5 (0.2)	2.0 (4.4)
T3	128 (5.0)	238 (9.4)	250 (9.9)	140 (5.5)	168.3 (6.7)	Ø6 (0.2)	3.3 (7.3)
T4	166 (6.5)	266 (10.5)	280 (11.0)	180 (7.1)	169 (6.7)	Ø6 (0.2)	4.3 (9.5)

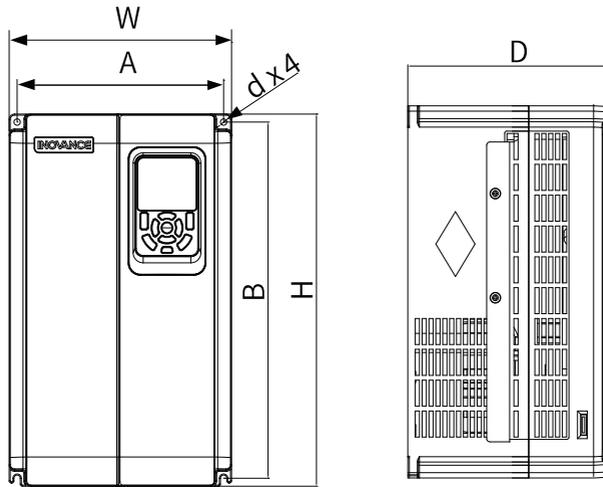


Figure 2-2 Outline dimensions and mounting dimensions of T5 to T6 models

Table 2-2 Outline dimensions and mounting dimensions of T5 to T6 models

Structure	Mounting Hole Spacing mm (in.)		Outline Dimension mm (in.)				Mounting Hole Diameter mm (in.)	Weight kg (lb)
	A	B	H	H1	W	D		
T5 (without DC reactor)	195 (7.7)	335 (13.2)	350 (13.8)	-	210 (8.3)	193.4 (7.6)	Ø6 (0.2)	7.6 (16.8)
T5 (-T, with the DC reactor)	195 (7.7)	335 (13.2)	350 (13.8)	-	210 (8.3)	193.4 (7.6)	Ø6 (0.2)	10.0 (22.0)
T6	230 (9.1)	380 (15.0)	400 (15.8)	-	250 (9.9)	220.8 (8.7)	Ø7 (0.3)	17.5 (38.6)

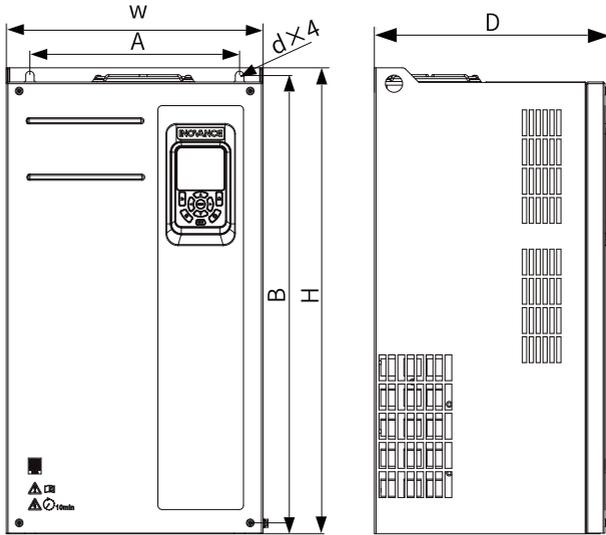


Figure 2-3 Outline dimensions and mounting dimensions of T7 to T9 models

Table 2-3 Outline dimensions and mounting dimensions of T7 to T9 models

Structure	Mounting Hole Spacing mm (in.)		Outline Dimension mm (in.)				Mounting Hole Diameter mm (in.)	Weight kg (lb)
	A	B	H	H1	W	D		
T7	245 (9.7)	523 (20.6)	525 (20.7)	542 (21.4)	300 (11.8)	275 (10.8)	Ø10 (0.4)	35 (77.2)
T8	270 (10.6)	560 (22.1)	554 (21.8)	580 (22.9)	338 (13.3)	315 (12.4)	Ø10 (0.4)	51.5 (113.5)
T9	320 (12.6)	890 (35.1)	874 (34.4)	915 (36.1)	400 (15.8)	320 (12.6)	Ø10 (0.4)	85 (187.4)

2.2 Dimensions of T10 to T12 Models (Without AC Output Reactor)

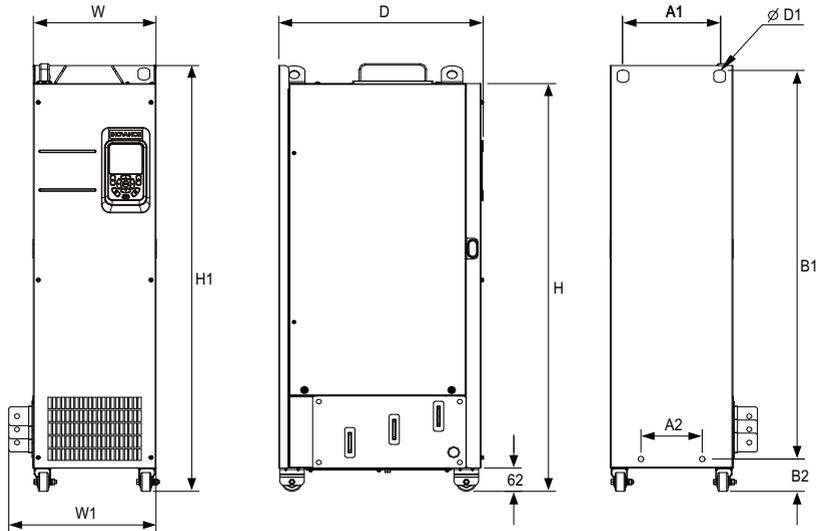


Figure 2-4 Outline dimensions and mounting dimensions of T10 to T12 models (without AC output reactor)

Table 2-4 Outline dimensions and mounting dimensions of T10 to T12 models (without AC output reactor)

Appearance Structure	Mounting Hole Spacing mm (in.)				Outline Dimension mm (in.)						Mounting Hole Diameter mm (in.)	Weight kg (lb)
	A1	A2	B1	B2	H	H1	W	W1	D	D1		
T10	240 -9.5	150 -5.9	1035 -40.8	86 -3.4	1086 -42.8	1134 -44.7	300 -11.8	360 -14.2	500 -19.7	φ13(0.5)	110 (242.5)	
T11	225 -8.9	185 -7.3	1175 -46.3	97 -3.8	1248 -49.2	1284 -50.6	330 -13	390 -15.4	545 -21.5	φ13(0.5)	155 (341.7)	
T12	240 -9.5	200 -7.9	1280 -50.4	101 -4	1355 -53.4	1405 -55.4	340 -13.4	400 -15.8	545 -21.5	φ16(0.6)	185 (407.9)	

2.3 Dimensions of T10 to T12 Models (with AC Output Reactor)

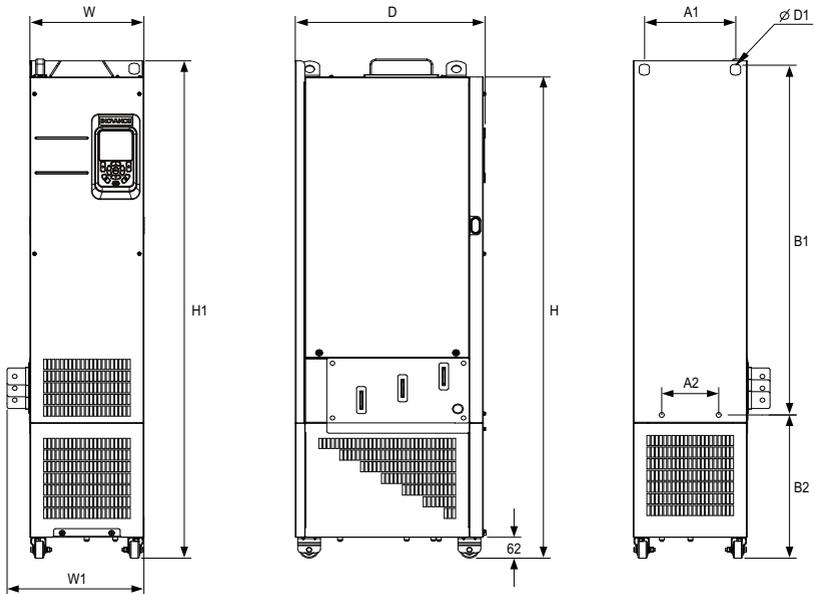


Figure 2-5 Outline dimensions and mounting dimensions of T10 to T12 models (with AC output reactor)

Table 2-5 Outline dimensions and mounting dimensions of T10 to T12 models (with AC output reactor)

Structure	Mounting Hole Spacing mm (in.)				Outline Dimension mm (in.)						Mounting Hole Diameter mm (in.)	Weight kg (lb)
	A1	A2	B1	B2	H	H1	W	W1	D	D1		
T10	240 (9.5)	150 (5.9)	1035 (40.8)	424 (16.7)	1424 (56.1)	1472 (58.0)	300 (11.8)	360 (14.2)	500 (19.7)	φ13(0.5)	160 (352.7)	
T11	225 -8.9	185 (7.3)	1175 (46.3)	435 (17.1)	1586 (62.5)	1622 (63.9)	330 (13.0)	390 (15.4)	545 (21.5)	φ13(0.5)	215 (474.0)	
T12	240 -9.5	200 (7.9)	1280 (50.4)	432 (17.0)	1683 (66.3)	1733 (68.3)	340 (13.4)	400 (15.8)	545 (21.5)	φ16(0.6)	245 (540.1)	

3 Unpacking and Transportation

3.1 Storage

- Store the AC drive in a clean and dry space, with an ambient temperature ranging from -20°C to $+60^{\circ}\text{C}$ and a temperature change rate less than $1^{\circ}\text{C}/\text{min}$.
- For long time storage, cover the AC drive or take other appropriate measures to keep it from contamination and environmental influences.
- For storage, pack the AC drive with the original packing box provided by Inovance.
- Avoid exposing the AC drive to moisture, high temperature, or outdoor direct sunlight for an extended period.
- To avoid degradation of electrolytic capacitor during long-term storage, energize the AC drive once every six months, each time lasting at least 5 hours. Use a regulator to increase the input voltage gradually to the rated value. For any doubt, contact Inovance.

3.2 Transportation Before Unpacking

T1 to T12 models

Precautions for transporting T1 to T12 models:

- T1 to T6 models are relatively small and light and therefore can be handled manually. T7 to T12 models, however, must be transported with an appropriate lifting tool.
- Fasten the AC drive onto a wooden pallet for transport on a forklift. Fasten the AC drive onto a pallet before hoisting it, as shown in the following figure.

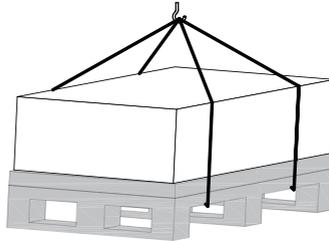
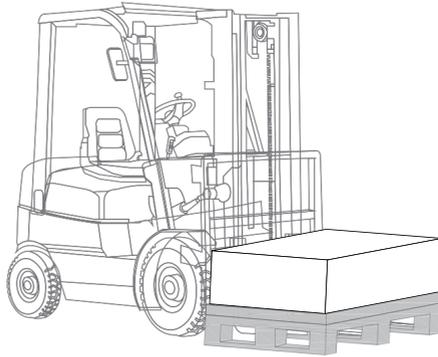


Figure 3-1 Hoisting the AC drive

- T9 to T12 models are heavy with a high center of gravity. Therefore, avoid placing them on any surface inclining greater than 5 degrees. Place the AC drive on a flat and sturdy floor capable of bearing the weight of the AC drive.
- During transportation, keep the AC drive upright as indicated on the packaging box, as shown in the following figure.

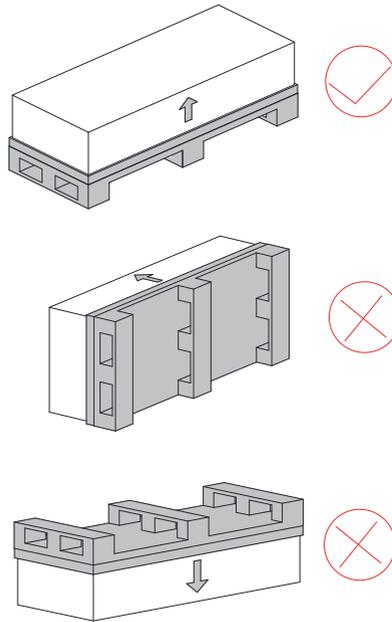


Figure 3-2 Placing the AC drive

3.3 Package Check

Upon receiving the AC drive from the transport company, check the items received against the delivery note. Notify the transport company immediately in the case of any missing or damaged items. If necessary, request support from Inovance or your local agent.

Packing method and components vary with models due to difference in structural dimensions and weight.



The electrical safety performance of the AC drive may be affected if it is damaged during transportation. Avoid connecting the AC drive without a professional high-voltage test on it.

Packing list for T1 to T9 models

- T1 to T6 models are packed using cartons.
- T7 to T9 models are packed using cartons and plywood pallets.

The following packing components are used:

- Packing list for T1 to T6 models

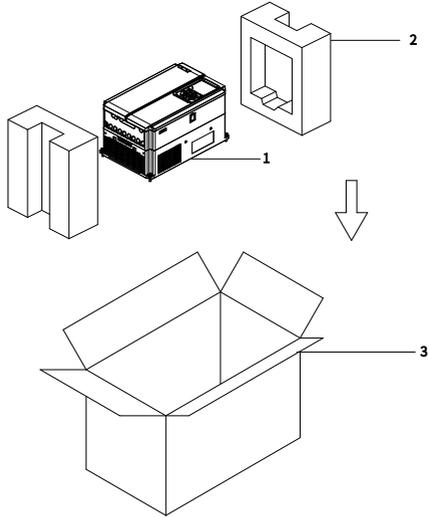


Figure 3-3 Packing list for T1 to T6 models

No.	Name
1	AC drive
2	Cushion
3	Carton

- Packing list for T7 to T9 models

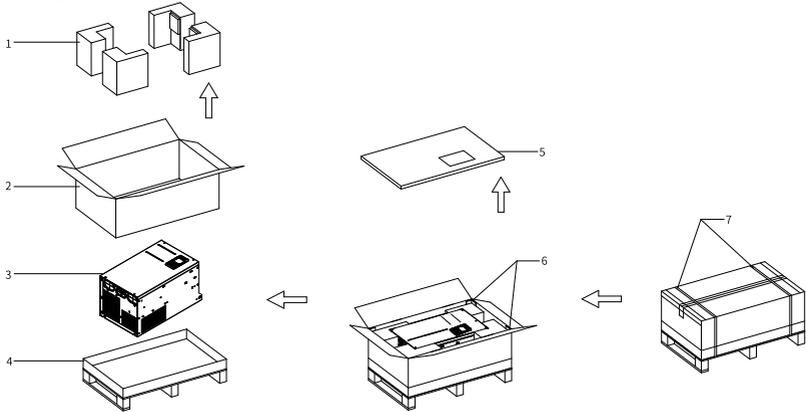


Figure 3-4 Packing list for T7 to T9 models

No.	Name
1	Cushion
2	Carton
3	AC drive
4	Plywood pallet
5	Honeycomb cardboard
6	Paper corner protector
7	Tie

Packing list for T10 to T12 models

- T10 to T11 models are packed using cartons and plywood pallets.
- T12 models are packed using wooden crates.

The following packing components are used:

- Packing list for T10 model

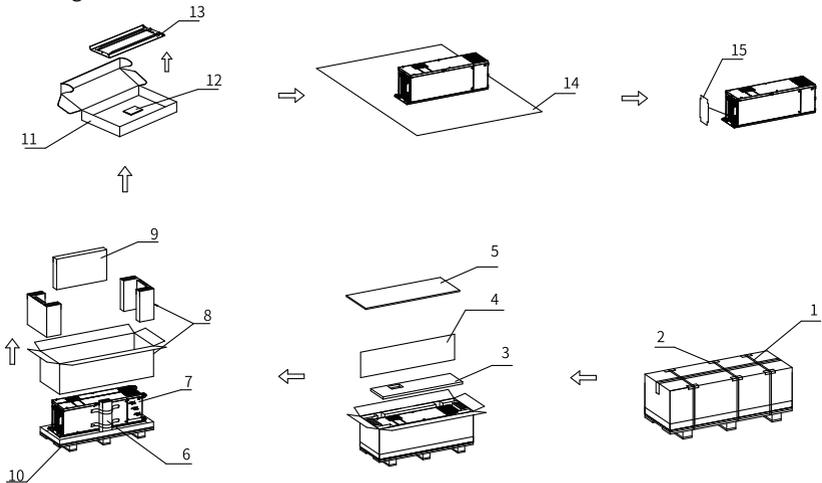


Figure 3-5 Packing list for T10 model

No.	Name
1	Packing belt
2	Paper corner protector
3	Honeycomb cardboard
4	Corrugated cardboard
5	9 mm board

No.	Name
6	Paper column
7	AC drive
8	Carton
9	Bracket box
10	Wooden pallet
11	Carton
12	User guide
13	Bracket
14	Plastic bag
15	Corrugated cardboard

- Packing list for T11 model

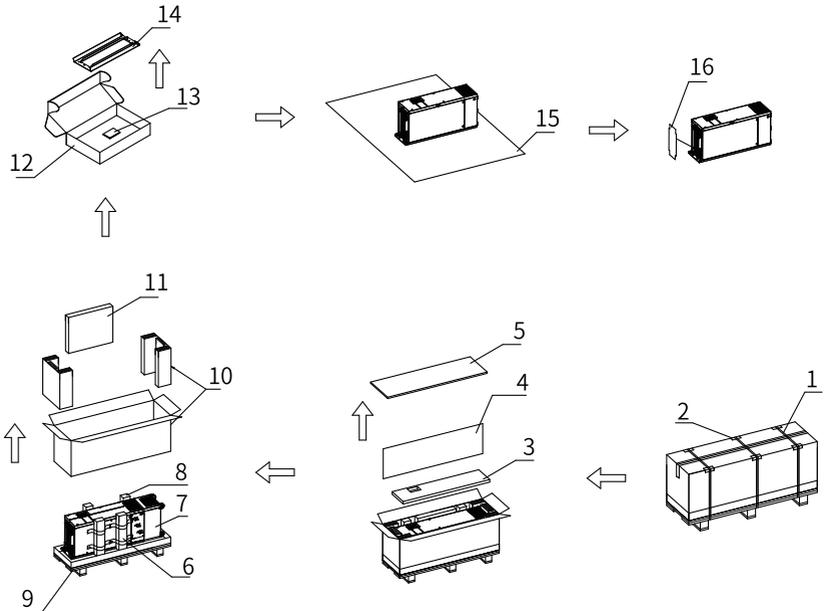


Figure 3-6 Packing list for T11 model

No.	Name
1	Packing belt
2	Paper corner protector
3	Honeycomb cardboard

No.	Name
4	Corrugated cardboard
5	9 mm board
6	Paper column
7	AC drive
8	Paper column
9	Wooden pallet
10	Carton
11	Bracket box
12	Carton
13	User guide
14	Bracket
15	Plastic bag
16	Corrugated cardboard

- Packing list for T12 model

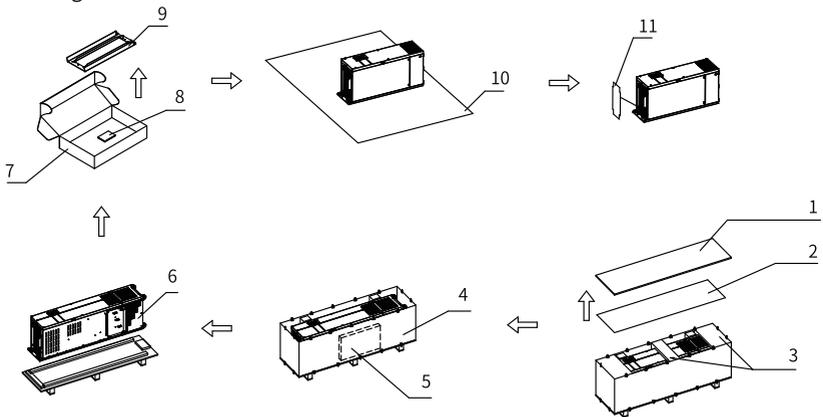


Figure 3-7 Packing list for T12 model

No.	Name
1	Cover
2	Corrugated cardboard
3	Expanded polyethylene
4	Wooden crate
5	Bracket box
6	AC drive

No.	Name
7	Carton
8	User guide
9	Bracket
10	Plastic bag
11	Corrugated cardboard

3.4 Unpacking

T1 to T12 models

Related documents and accessories are placed in different partitions in the crate. To unpack, follow these steps:

1. Remove all ties and the cover of the crate.
2. Remove all packing materials.
3. Take out the AC drive.
4. Cut and remove the plastic wrap around the AC drive.
5. Check for damage.
6. Dispose of or recycle the packaging in accordance with local regulations.

3.5 Transportation and Hoisting After Unpacking

T1 to T6 models are relatively small and light and therefore can be handled manually. T7 to T12 models, however, must be transported with an appropriate hoisting tool.

Weight of AC Drive	Persons Needed for Transporting
< 15 kg	1
≥ 15 kg	> 2; with an appropriate hoisting device

Precautions for transporting and hoisting:

- Comply with local regulations.
- Avoid handling the AC drive by directly holding its upper access cover or enclosure. Before moving it, check that all screws are tightened. Failure to comply may result in fall-off of the AC drive, causing injury.
- For T10 to T12 models, ensure that the four mounting holes on the back of the AC drive are connected to the fixing beams.
- Erect the AC drive that is lying flat before hoisting or moving it.
- Where applicable, use a crane with a capacity greater than the weight of the AC drive.

- Before vertical hoisting, make sure that all components of the AC drive, including the upper access cover and terminals, are fastened with screws. Failure to comply may result in fall-off of the AC drive, causing injury.
- When hoisting the AC drive with a sling, protect the AC drive from excessive vibration or impact. Failure to comply may result in fall-off of the AC drive, causing injury.
- When hoisting the AC drive with a sling, do not overturn the AC drive or leave it suspended for a long time. Failure to comply may result in fall-off of the AC drive, causing injury.

T1 to T9 models

To hoist T1 to T9 models, follow these steps:

1. Hook the sling to the two auxiliary eye bolts at the top of the AC drive.
Keep the hoisting angle greater than 45 degrees and the fluctuation within 0.3 m.

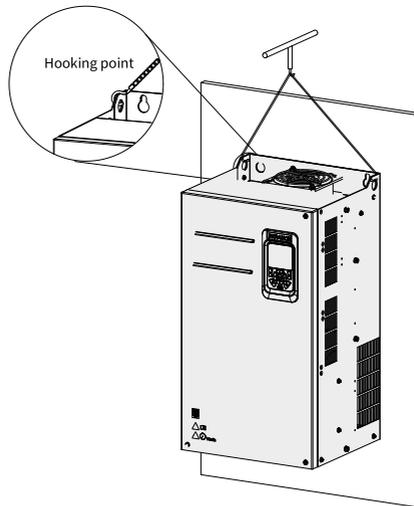


Figure 3-8 Hoisting T1 to T9 models

2. Gradually tension the sling with the crane, and then hoist the AC drive.
3. Slowly lower the AC drive to an appropriate height and suspend it until it is stable.
Then, gently place the AC drive on the floor or mounting surface for installation in the control cabinet.

T10 to T12 models

To hoist T10 to T12 models, follow these steps:

1. Hook the hoisting lug and eye bolt at the top and bottom of the AC drive, take out the AC drive from the packing box, and lay it flat on the floor.

Ensure that there is no stress on the positive and negative bus terminals.

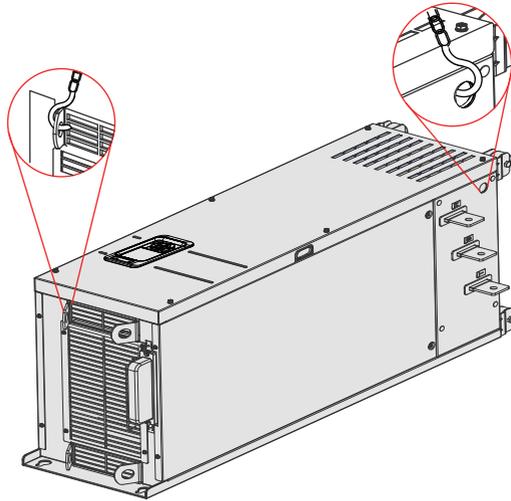


Figure 3-9 Hoisting T10 to T12 models

2. Hook the sling to the hoisting lugs diagonally placed at the top of the AC drive, slowly put the AC drive upright for installation in the cabinet.



Avoid stress on any side of the AC drive or placing it on an inclined surface. The AC drive is large and heavy (close to 200 kg). If the inclination exceeds 5°, it may topple.

4 Mechanical Installation (T1 to T9 Models)

4.1 Installation Method

T1 to T9 models support backplate mounting and through-hole mounting.

4.2 Cabinet Design

4.2.1 Overview

Before installing the AC drive in the cabinet, design the cabinet to ensure sufficient clearances for installation and heat dissipation. Take the following factors into consideration:

- Cabinet clearances
- Mounting backplate
- Cabinet heat dissipation

4.2.2 Cabinet Space

For T1 to T9 models, install AC drives one above another. The following table lists the minimum requirements for the distance between AC drives. Install a heat insulation baffle on each AC drive except for the top one.

Table 4–1 Minimum distance between upper and lower AC drives

Item	T1 to T4	T5	T6	T7 to T9
S1	≥ 100 mm	≥ 200 mm	≥ 200 mm	≥ 300 mm
S2	≥ 100 mm	≥ 200 mm	≥ 200 mm	≥ 300 mm
...	≥ 100 mm	≥ 200 mm	≥ 200 mm	≥ 300 mm
Sn	≥ 100 mm	≥ 200 mm	≥ 200 mm	≥ 300 mm

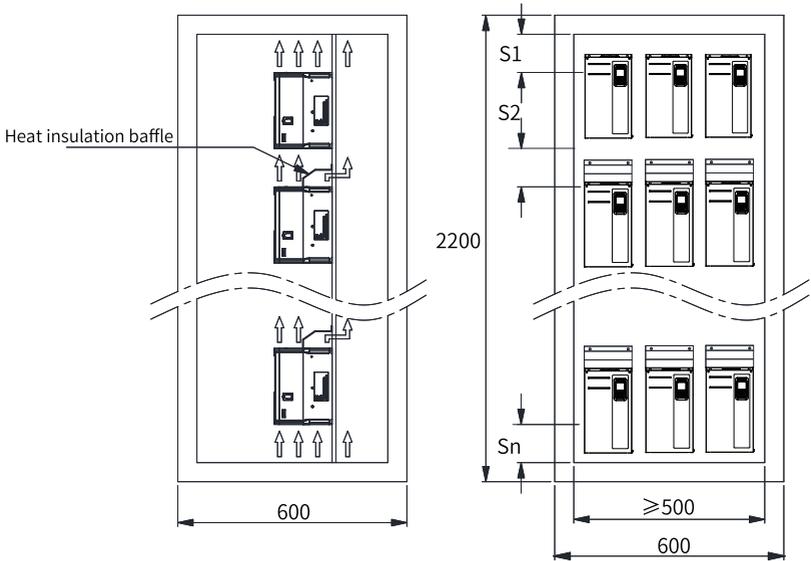


Figure 4-1 Minimum space for installing AC drives one above another

Note

Observe the ventilation direction when installing the fan to ensure smooth discharge of hot air. Failure to comply may cause failure in hot air exhaust, and over-temperature or damage to the AC drive. Ensure a distance of at least 200 mm between the air exhaust top cover and the fan outlet to avoid adverse effect on the cooling performance of the fan.

4.2.3 Mounting Backplate

Thickness and rigidity reinforcement of a mounting backplate

To avoid damage to the AC drive during transportation and ensure proper operation of the AC drive, use a mounting plate with sufficient rigidity and strength, and a thickness of at least 2 mm. Reinforce the backplate where appropriate. For example, weld a lateral reinforcing beam on the back of the backplate, as shown in the following figure.

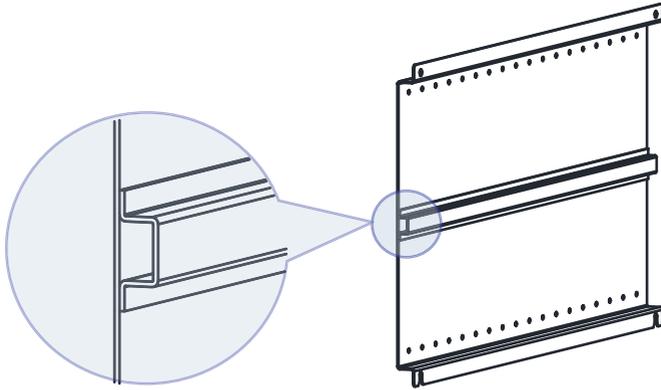


Figure 4-2 Welding a lateral reinforcing beam on the back of the backplate

Preparation of mounting holes

- Prepare mounting holes at the same time with backplate processing. For dimensions of the mounting holes, see "Overall Dimensions".
- To avoid damage to the AC drive during transportation, in addition to fixing screws, use self-clinching nuts or independent nuts on the back of the backplate to enhance screw-thread fitting and fastening effect.

4.2.4 Cabinet Heat Dissipation

Cabinet door design for heat dissipation

Forced-air cooling is implemented using the built-in fan of the AC drive. Provide an air inlet with an appropriate size on the cabinet door to ensure enough cooling air entering the cabinet.

The air flows upward due to thermal expansion. Therefore, ensure that the cabinet air inlet is at least 50 mm lower than the air inlet of the AC drive, as shown in the following figure.

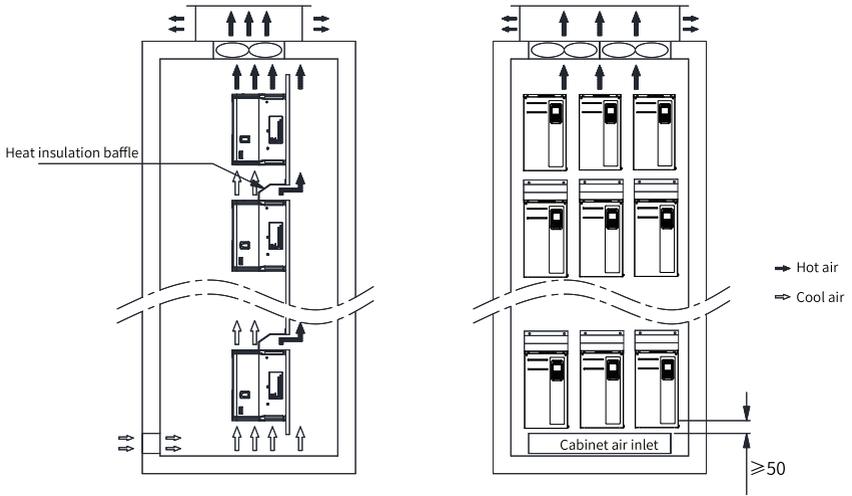


Figure 4-3 Position of the cabinet air inlet

 **Caution**

For a cabinet containing multiple AC drives, blowing air into the cabinet using a fan may disorder the air distribution in the cabinet, affecting the overall cooling effect. Therefore, do not install any fan at the cabinet air inlet.

Ensure enough effective area of the cabinet air inlet with the AC drive mounted. For minimum requirements, see ["Table 4-2 Minimum effective area of the cabinet air inlet" on page 56](#).

Table 4-2 Minimum effective area of the cabinet air inlet

AC Drive	Min. Effective Area of Cabinet Air Inlet (cm ²)
T1	20
T2	25
T3 (7.5 kW)	50
T3 (11 kW)	
T4	60
T5	
T6 and T7	102
T8	204
T9	318

"Table 4–2 Minimum effective area of the cabinet air inlet" on page 56 applies to situations where only one AC drive is mounted in the cabinet. For a cabinet containing multiple AC drives, calculate the total effective inlet area by summing each single effective area based on the table. For example, if a cabinet contains eight 7.5 kW T3 models, two T5 models, and one T9 model, the minimum effective area of the air inlet is $8 \times 25 + 2 \times 60 + 1 \times 318 = 638 \text{ cm}^2$.

If an air filter is installed at the air inlet, the air inlet resistance will rise significantly and the air inlet opening area must be increased to 1.2 to 1.5 times the value indicated in the table.

"Table 4–2 Minimum effective area of the cabinet air inlet" on page 56 refers to the actual through-hole area in the cut-out area. The effective area is calculated by multiplying the cut-out area by the cut-out rate.

Design of top ventilation

Ensure smooth discharge of hot air from the cabinet to keep sufficient heat dissipation for the AC drive. Use passive or active ventilation for the cabinet.

1. Passive ventilation (self-ventilated)

In passive ventilation, AC drive exhaust flows through the air outlet on the top of the cabinet because hot air flows upward.

In passive ventilation, hot air may accumulate and thereby cause air pressure to increase at the top of the cabinet. Meanwhile, the air pressure at the cabinet air inlet is low due to the suction of the AC drive fan. This results in an air pressure difference between the air outlet and air inlet of the cabinet, causing backflow of air. The backflow takes the hot air near the outlet back to the inlet, making the hot air be taken into the AC drive again. This significantly increases the temperature of the AC drive and impairs the performance of the AC drive.

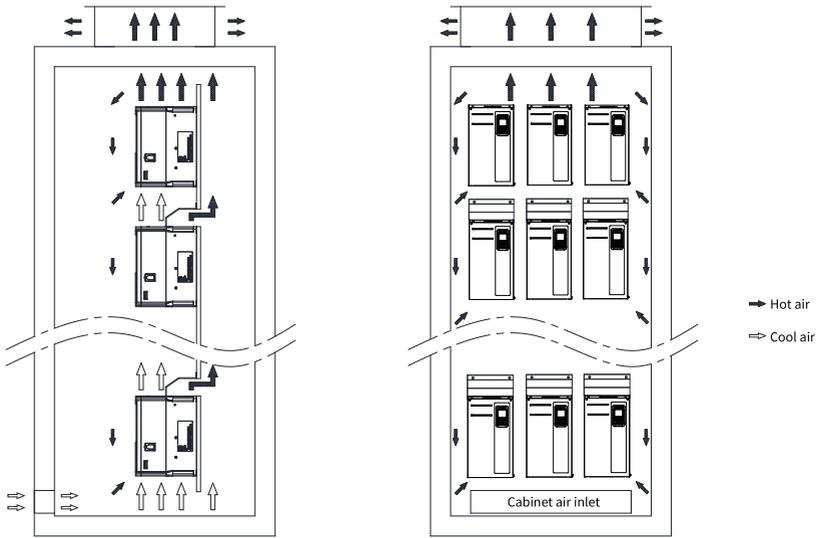


Figure 4-4 Backflow of hot air in a self-vented cabinet (without an insulating device)

To prevent backflow of hot air, use an insulating device in the self-vented cabinet. An insulating device may be a plate or an exhaust duct.

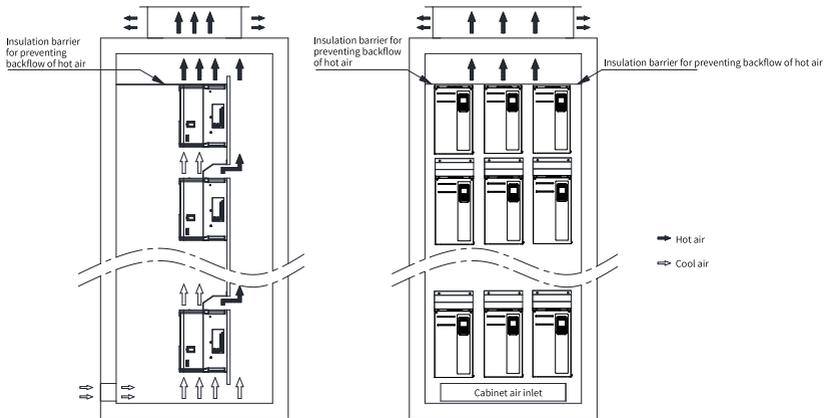


Figure 4-5 Backflow of hot air in a self-vented cabinet (with an insulating device)

Air near the air outlet of the AC drive features a higher temperature and lower density than that near the cabinet air inlet. To ensure adequate discharge of hot air in passive ventilation, observe the minimum requirements for effective area listed in ["Table 4-3 Minimum effective area of air outlet on a self-vented cabinet"](#) on [page 59](#).

Table 4–3 Minimum effective area of air outlet on a self-ventilated cabinet

AC Drive	Min. Effective Area of Air Outlet on a Self-ventilated Cabinet (cm ²)
T1	32
T2	40
T3 (7.5 kW)	
T3 (11 kW)	80
T4	
T5	96
T6 and T7	163
T8	326
T9	509

"Table 4–3 Minimum effective area of air outlet on a self-ventilated cabinet" on page 59 applies to situations where only one AC drive is mounted in the cabinet. For a cabinet containing multiple AC drives, calculate the total effective outlet area by summing each single effective area based on the table.

If an air filter is installed at the outlet, the air outlet resistance will rise significantly and the ventilation opening area must be increased to 1.2 to 1.5 times the value indicated in the table.

"Table 4–3 Minimum effective area of air outlet on a self-ventilated cabinet" on page 59 refers to the actual through-hole area in the cut-out area. The effective area is calculated by multiplying the cut-out area by the cut-out rate.

2. Active ventilation

In active ventilation, a fan is installed on the top of the cabinet to draw hot air out of the cabinet. Active ventilation is commonly used.

For smooth discharge of hot air, ensure that the total air flow of the cabinet is equal to or greater than the sum of exhaust air flow of all the AC drives in the cabinet. *"Table 4–4 Cooling air flow for the AC drive" on page 59* lists the required cooling air flow.

Table 4–4 Cooling air flow for the AC drive

AC Drive Power Rating	Cooling Air Flow (CFM)
0.4 kW to 1.1 kW	/
1.5 kW to 3.0 kW	11
3.7 kW	20
5.5 kW	24
7.5 kW	29
11 kW to 15 kW	50
18.5 kW	52
22 kW	58

AC Drive Power Rating	Cooling Air Flow (CFM)
30 kW	130
37 kW	102
45 kW to 55 kW	125
75 kW to 90 kW	225
110 kW	350
132 kW	541
160 kW	620
Note: 1 CFM = 0.02832 m ³ /min	

Design of the cabinet fan

To select a cabinet fan, follow these steps:

1. Sum the cooling air flow required by all the AC drives based on *"Table 4-4 Cooling air flow for the AC drive" on page 59*.
2. Determine the maximum air flow (Q_{max}) of the cabinet.
3. Determine the specifications and quantity of fans based on the maximum air flow (Q_{max}).

Note that:

Q_{max} of cabinet = (1.3 to 1.5) x Sum of cooling air flow

Q_{max} of cabinet = (1.6 to 2.2) x Sum of cooling air flow (if a mesh filter or other components are installed at the cabinet air outlet)

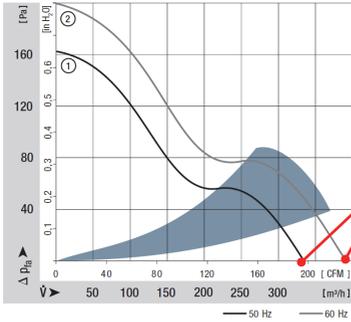
Note

Select a fan whose air volume is not smaller than the maximum air volume Q_{max} . Install multiple fans in parallel if one fan alone cannot meet the requirements.

The following figure shows typical air flows of fans.

Air flow		Nominal voltage	Frequency	Sound pressure level	Sound power level	Sinter sleeve bearings Ball bearings	Power input	Nominal speed	Temperature range	Service life L ₁₀ at 40 °C		Curve
m ³ /h	CFM									V	Hz	
320	188,3	230	50	51	6,4	■	27,0	2 800	-25...+55	60 000 / 32 000	1	
380	223,6	115	60	56	6,8	■	28,0	3 350	-25...+65	55 000 / 18 000	2	

CFM: maximum air flow of the fan (Q_{max})



Maximum air flow of the fan (Q_{max})

Figure 4-6 Q_{max} of a system fan

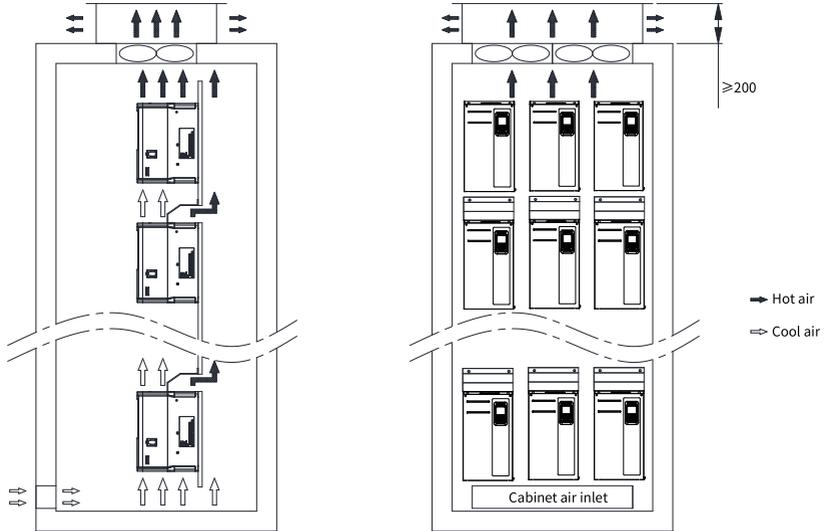


Figure 4-7 Cabinet ventilation system

Note

- When installing the fan, ensure a proper direction and smooth flow of hot air. Failure to comply may cause accumulation of hot air, leading to over-temperature or damage to the AC drive.
 - Ensure a distance of at least 200 mm between the top vent and the fan outlet to avoid adverse effect on the cooling performance of the fan.
-

4.3 Pre-installation Precautions

- Before installation, ensure that the place of installation is mechanically strong enough to bear the AC drive.
- Cover the top of the AC drive with cloth or paper during installation to prevent foreign objects, such as metal chippings, oil, and water, from entering the AC drive. Foreign objects may cause malfunction of the AC drive. Remove the cloth or paper after installation is completed. Failure to comply may degrade ventilation and result in over-temperature of the AC drive.
- Reserve sufficient clearance for heat dissipation, including heat dissipation of other equipment in the cabinet. For details, see "Installing one alone" in ["1.2.2 Clearance" on page 16](#).
- Keep the AC drive upright to facilitate upward heat dissipation. To install multiple AC drives in one cabinet, arrange them side by side. Where up and down arrangement is required, install a heat insulation baffle in between. For details, see "Installing one above another" in ["1.2.2 Clearance" on page 16](#).
- Use a mounting bracket that is flame retardant, where appropriate.
- In environments with metal dust, use an enclosed cabinet that can completely isolate the AC drive from the metal dust. In this case, ensure the maximum possible space in the cabinet and install cooling devices outside the cabinet.
- Tighten all screws using the specified torque. Failure to comply may result in electric shock or fire.
- Keep combustible and explosive materials away from the AC drive.

4.4 Backplate Mounting

For backplate mounting, fasten all retaining nuts, instead of only the two retaining nuts on the top of the AC drive. Otherwise, the connections will come loose or damaged with time due to uneven distribution of loads.

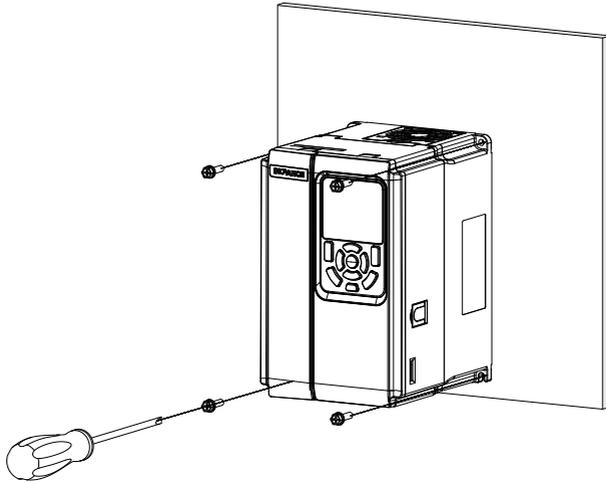


Figure 4-8 Backplate mounting (T1 to T6 models)

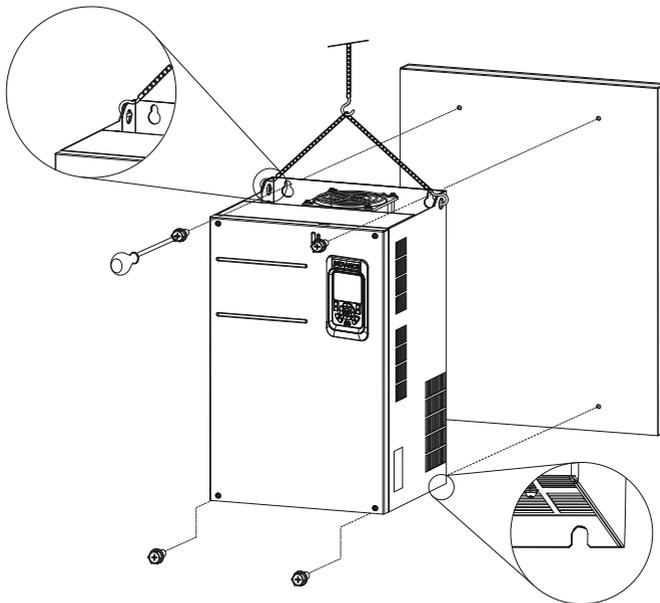
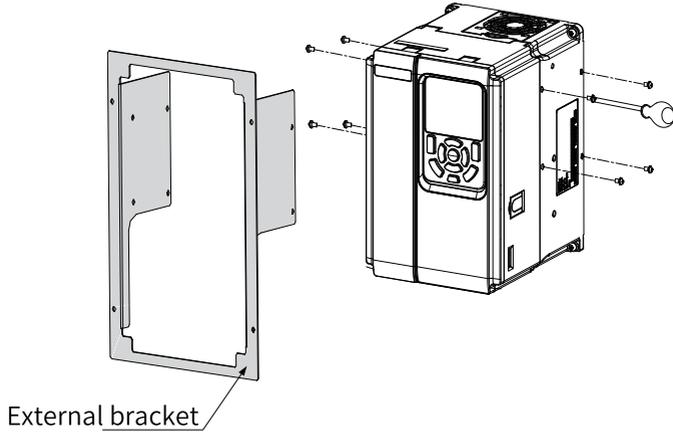


Figure 4-9 Backplate mounting (T7 to T9 models)

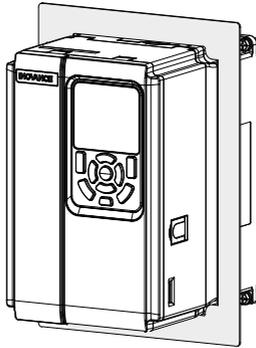
4.5 Through-Hole Mounting

T1 to T6 models

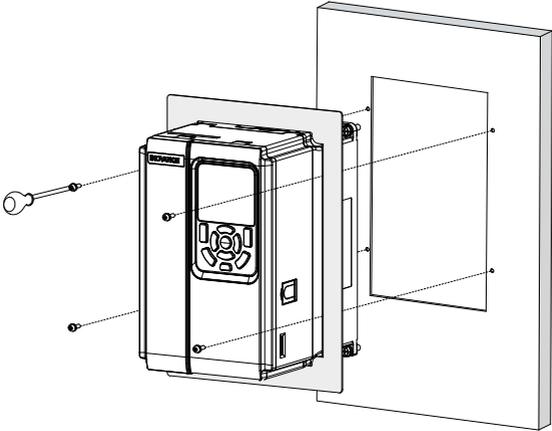
1. Frame the AC drive with the bracket and tighten the bracket fixing screws on both sides of the AC drive.



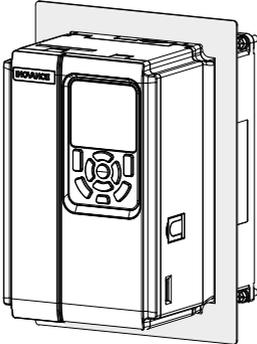
The following figure shows an AC drive with a bracket mounted.



2. Fasten the AC drive with the bracket onto the mounting backplate of the control cabinet.

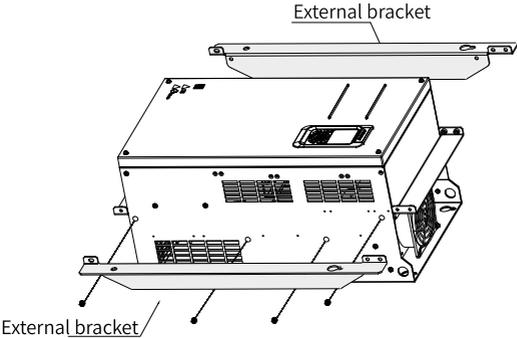


The following figure shows an AC drive that is through-hole mounted.

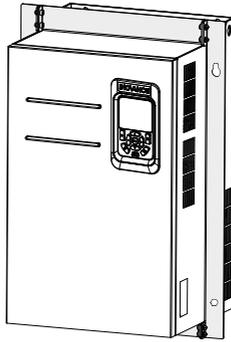


T7 to T9 models

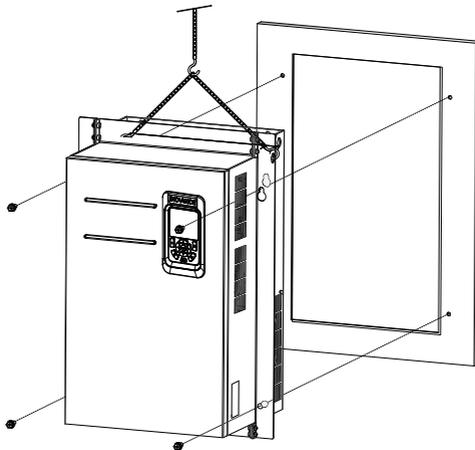
- 1. Fasten brackets from the two sides of the AC drive.



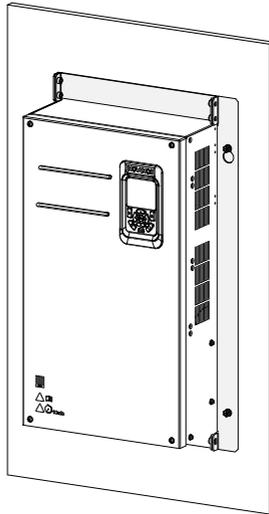
The following figure shows an AC drive with brackets mounted.



2. Fasten the AC drive onto the backplate of the control cabinet from the front of the control cabinet.



The following figure shows an AC drive that is through-hole mounted.



4.6 Removing and Installing the Cover

4.6.1 Removing the Cover

For wiring of the control circuit, remove the cover of the AC drive before connecting any jumper, PG card, or functional extension card. To remove the cover, hold it with both hands and lift up its lower part. Handle with care to prevent the cover from falling off and causing damage to equipment or injury.

Prerequisites

Power off the AC drive at least 10 minutes before removing the cover.

Context

The following figure shows the positions of the control board, jumper, and extension card with the cover removed.

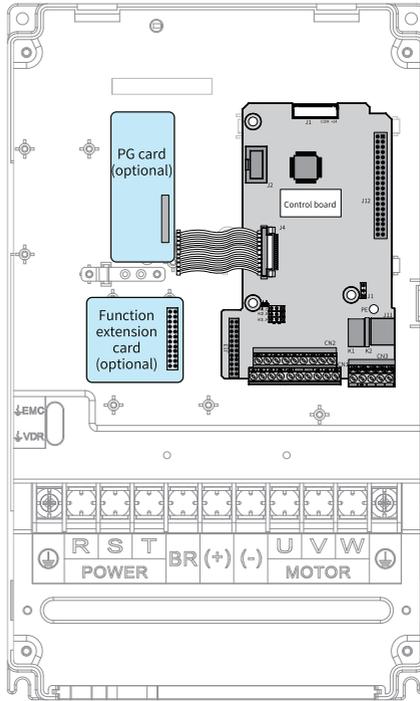
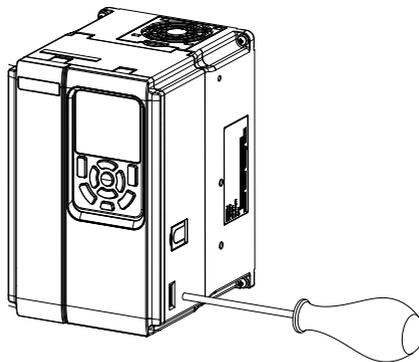


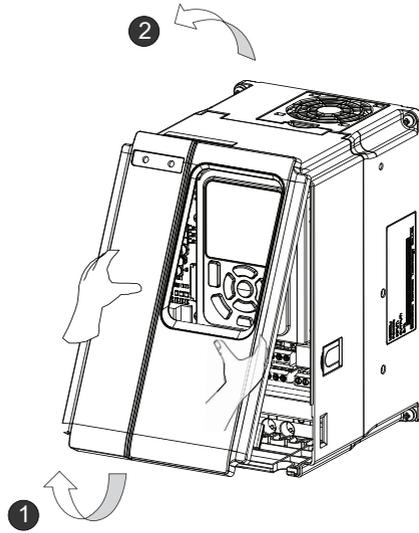
Figure 4-10 Position of the control board

1. T1 to T6 models

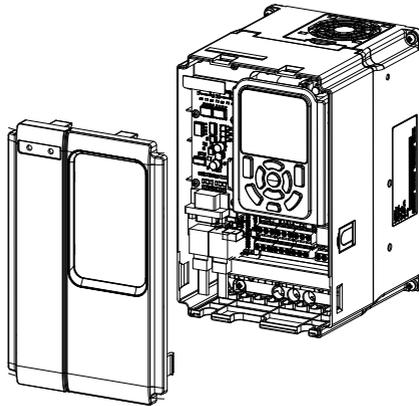
- a. Use an appropriate tool to eject the cover hooks on both sides to the inside.



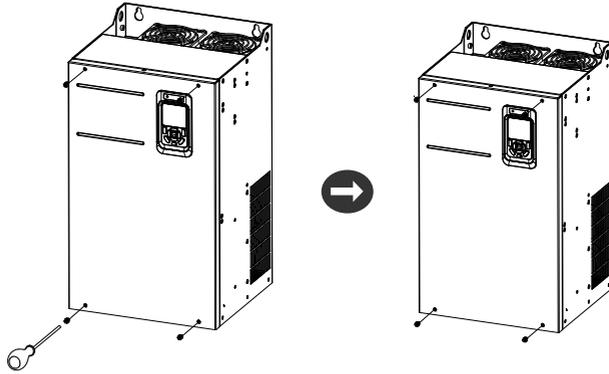
- b. Hold the cover with both hands, lift up the lower part of the cover (as shown in ①), push the cover upward, and lift up the upper part of the cover (as shown in ②).



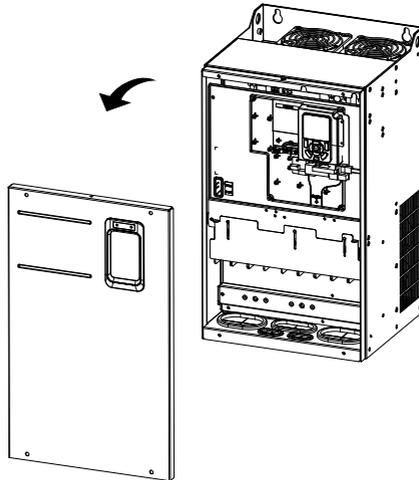
The following figure shows an AC drive with its cover removed.



2. T7 to T9 models
 - a. Use a screwdriver to unscrew the four fixing screws of the cover.



b. Hold the cover with both hands, and pull it in the arrow direction to remove it.

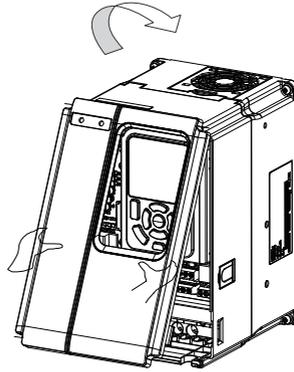


4.6.2 Installing the Cover

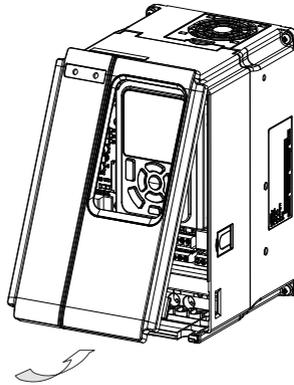
The cover of the AC drive must be removed before wiring the main circuit and control circuit. After the wiring is completed, install the cover back.

1. T1 to T6 models

a. Hold the cover with both hands and snap its upper edge snap-fit joint into the fixing hole.

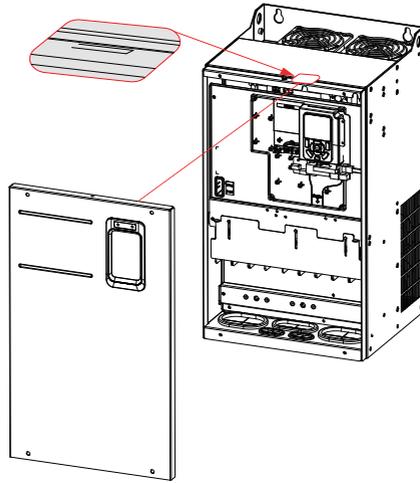


b. Align the cover, and then press the lower edge in the arrow direction.

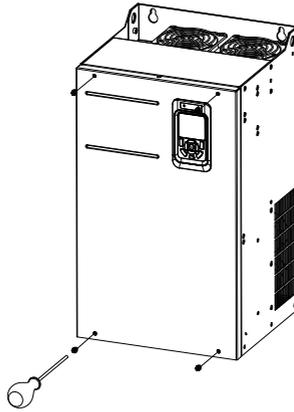


2. T7 to T9 models

a. Hold the cover with both hands, align its upper edge with the upper edge snap-fit joint on the chassis, and snap them together, as shown in the following figure.



b. Drive four fixing screws into the mounting holes with a screwdriver.

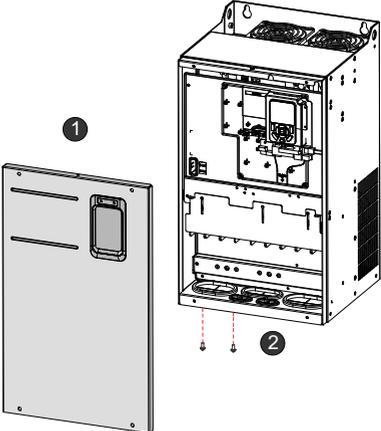
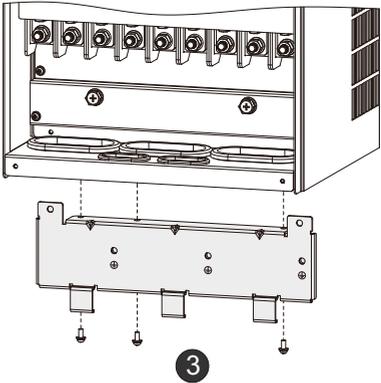


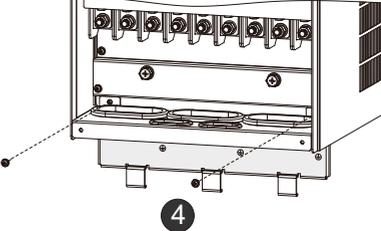
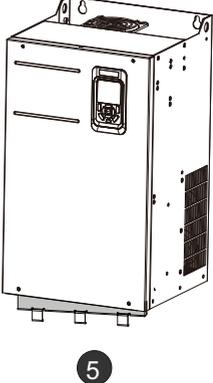
4.7 Installing the Grounding Bracket of Cable Shield

The grounding bracket of cable shield is optional and can be purchased separately (applicable to T9 models and below).

Installation

Table 4-5 Procedure of installing the grounding bracket of cable shield

Step	Description	Diagram
1	Remove the cover, as shown in ①. Remove the two M4x12 SEMS screws from the end plate of the inlet, as shown in ②.	 The diagram for Step 1 consists of two parts. On the left, a separate front cover is shown with a circular handle and a lock mechanism, labeled with a circled '1'. On the right, the main chassis is shown with the cover removed. Two screws are being removed from the bottom end plate of the inlet, labeled with a circled '2'. Red dashed lines indicate the removal path of the screws.
2	Place the grounding bracket of cable shield on the chassis, and fasten the bracket with three M4x12 SEMS screws at the three positions shown in ③.	 The diagram for Step 2 shows the chassis with the front cover removed. A grounding bracket is being positioned at the bottom of the chassis. Three screws are being inserted into the bracket, labeled with a circled '3'. Dashed lines indicate the alignment of the screws with the chassis.

Step	Description	Diagram
3	Tighten two M4x12 SEMS screws onto the two positions shown in ④.	
4	Put back the cover.	

Wiring

Use shielded cables for motor output. Use a grounding bracket of cable shield to achieve all-round connection with the shield, and crimp the drain wire of the shield to the PE terminal. The grounding bracket of cable shield comes with a wire ferrule slot. Wrap the exposed shield that protrudes the wire ferrule with insulation tape. The following figure shows the wiring.

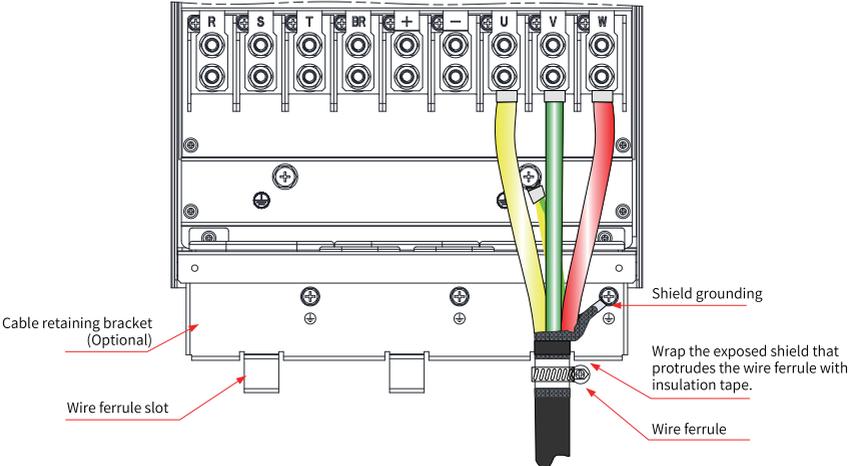


Figure 4-11 Wiring of the cable shield

5 Mechanical Installation (T10 to T12 Models)

5.1 Installation Method

T10 to T12 models can be installed in a cabinet.

5.2 Pre-installation Precautions

- Before installing the AC drive, install the bottom mounting bracket and guide rails on the cabinet, and prepare fixing beams with mounting holes for retaining the AC drive. Reserve sufficient clearance in the cabinet for connecting side copper busbars.
- The guide rails in the cabinet and the four casters of the AC drive cooperate to help the AC drive move in or out of the cabinet. Align the casters with the guide rails before a push or pull. For safety, arrange two persons to pull or push the AC drive together.
- Reserve sufficient clearance for heat dissipation, including heat dissipation of other equipment in the cabinet.
- To push the AC drive into or pull it out of the cabinet, arrange two persons to work together. After pushing the AC drive into the cabinet, remove the baffle from the air outlet of the cabinet to avoid over-temperature caused by failure to exhaust hot air.
- Install an insulation barrier at the top of the cabinet to prevent the exhaust air from flowing back into the cabinet. Provide an air intake vent on the lower part of the cabinet door.
- The cabinet is 2200 mm x 800 mm x 600 mm (including a 200 mm cabinet ventilation top cover). The cabinet needs to be installed on a base that is 100 mm in height.
- When installing the AC drive in an enclosed environment, such as a cabinet or casing box, use a cooling fan or air conditioner to keep the inlet temperature below 50°C. Failure to comply may result in over-temperature or fire.
- Cover the top of the AC drive with cloth or paper during installation to prevent foreign objects, such as metal chippings, oil, and water, from entering the AC drive. Foreign objects may cause malfunction of the AC drive. Remove the cloth or paper after installation is completed. Failure to comply may degrade ventilation and result in over-temperature of the AC drive.
- Use a mounting bracket that is flame retardant, where appropriate.
- In environments with metal dust, use an enclosed cabinet that can completely isolate the AC drive from the metal dust. In this case, ensure the maximum possible space in the cabinet and install cooling devices outside the cabinet.
- Tighten all screws using the specified torque. Failure to comply may result in electric shock or fire.

- Keep combustible and explosive materials away from the AC drive.

5.3 Heat Dissipation

Consider the space for heat dissipation for installation of T9 to T12 models in a cabinet. A self-ventilated cabinet has no fan on the top.

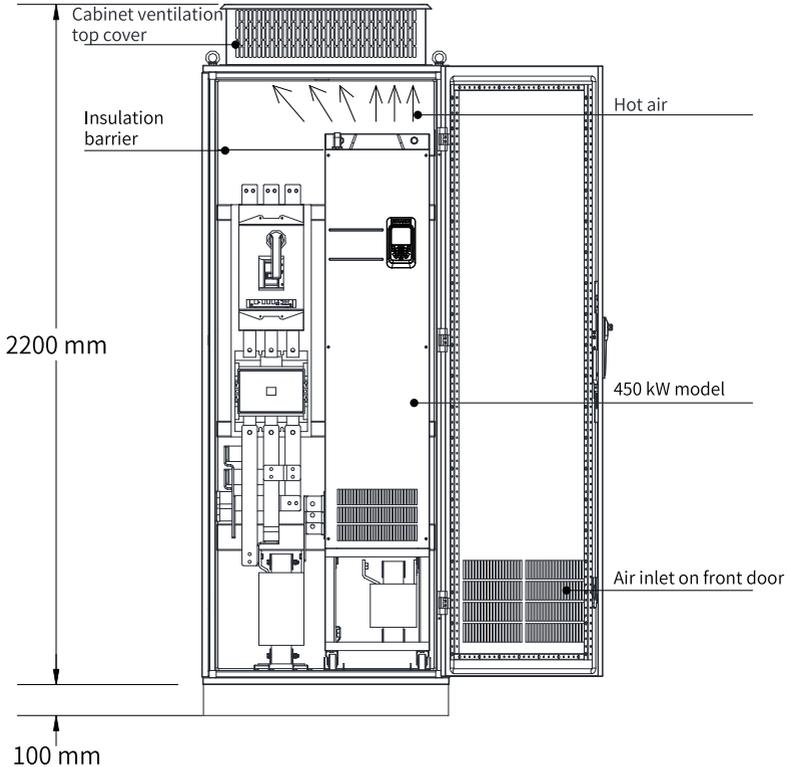


Figure 5-1 Self-ventilated cabinet

Table 5-1 Parameters of a self-ventilated cabinet

Model	Quantity of Fans	Total Airflow (CFM)	Effective Area of Cabinet Air Inlet (mm ²)	Effective Area of Cabinet Air Outlet (mm ²)
T9 (132 kW)	2	541	31809	50894
T9 (160 kW)	2	620	31809	50894
T10 (200 kW)	2	586	31809	50894
T10 (220 kW)	2	722	31809	50894

Model	Quantity of Fans	Total Airflow (CFM)	Effective Area of Cabinet Air Inlet (mm ²)	Effective Area of Cabinet Air Outlet (mm ²)
T11 (250 kW)	3	789	47713	76341
T11 (280 kW)	3	882	47713	76341
T12 (315 kW)	3	644	47713	76341
T12 (355 kW)	3	796	47713	76341
T12 (400 kW)	3	796	47713	76341

Note

- CFM = 0.0283 m³/min
- "Actual Effective Area" indicates through-hole area.

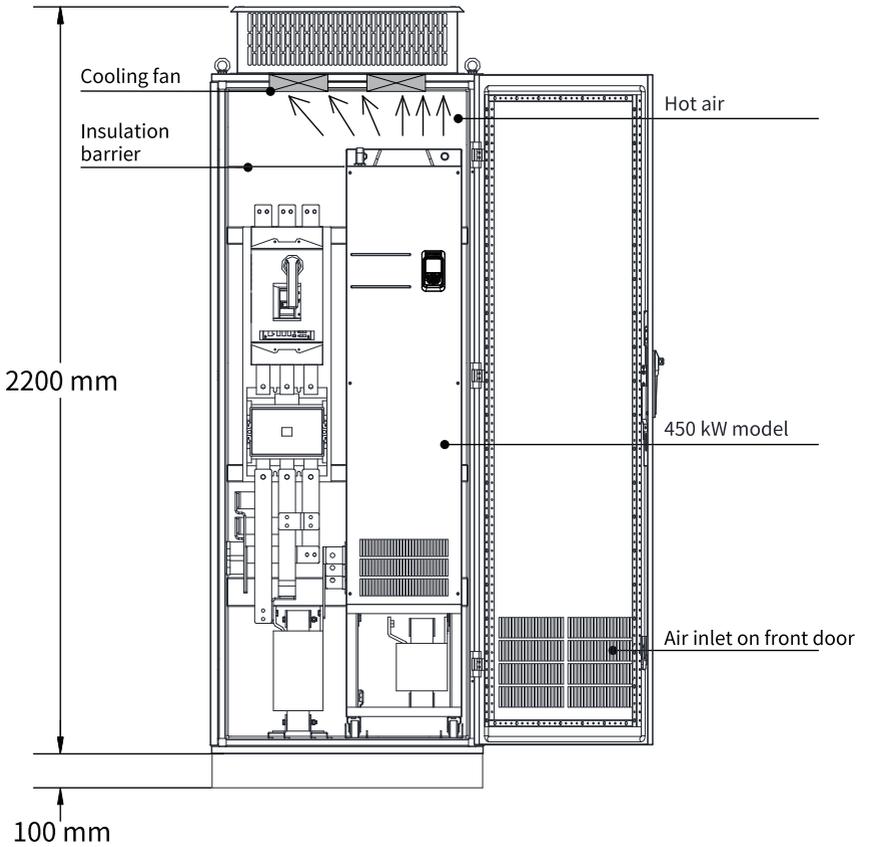


Figure 5-2 Force-ventilated cabinet (with top-mounted fans)

Table 5-2 Parameters of a force-ventilated cabinet with top-mounted fans

Model	Quantity of Fans	Total Airflow (CFM)	Effective Area of Cabinet Air Inlet (mm ²)	Max. Airflow of Fans (CFM)	Effective Area of Cabinet Air Outlet (mm ²)
T9 (132 kW)	2	541	31809	649	$S = 0.942 \times N \times (D_{out}^2 - DHUB^2)$ where, N indicates the quantity of top-mounted fans, D _{out} indicates the diameter of the fan, and DHUB indicates the diameter of the fan hub.
T9 (160 kW)	2	620	31809	744	
T10 (200 kW)	2	586	31809	703	
T10 (220 kW)	2	722	31809	866	
T11 (250 kW)	3	789	47713	947	
T11 (280 kW)	3	882	47713	1058	
T12 (315 kW)	3	644	47713	773	
T12 (355 kW)	3	796	47713	955	
T12 (400 kW)	3	796	47713	955	

Note

- CFM = 0.0283 m³/min
- "Actual Effective Area" indicates through-hole area.

As shown in the following figure, an insulation barrier is required to prevent hot air exhausted by the AC drive from flowing back into the cabinet.

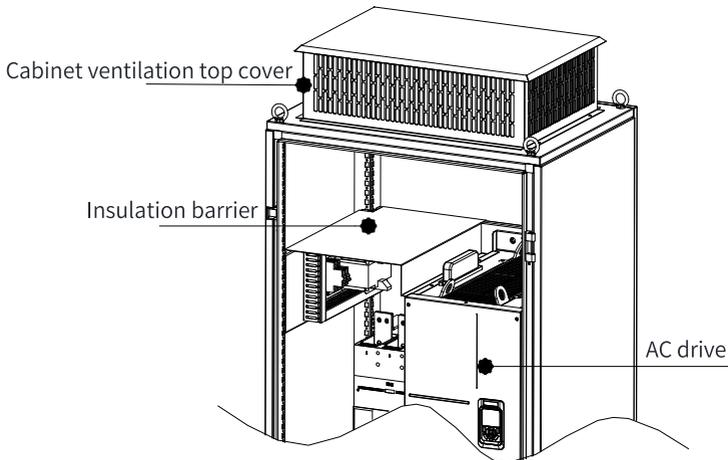


Figure 5-3 Insulation barrier in the cabinet

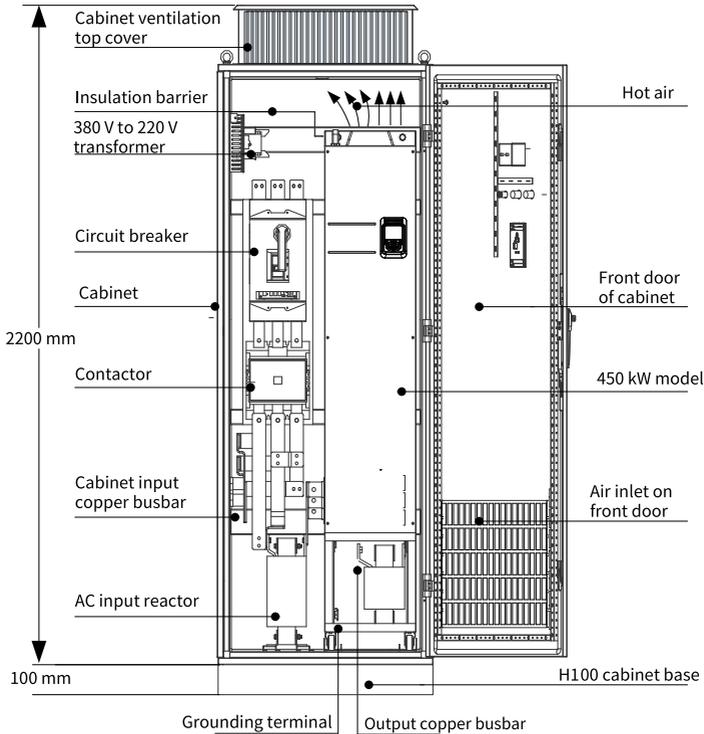


Figure 5-4 Recommended cabinet layout for T12 models

5.4 Installation in a Cabinet

Context

Use a nine-fold profile cabinet (PS cabinet) to contain the AC drive. Nine-fold profile cabinets employ assembled frames and therefore save the cost. Columns of the cabinets come with openings conforming to common standards and therefore simplify installation of fixing beams and reinforcements, making the cabinets versatile. Nine-fold profile cabinets are more reliable than standard cabinets. They are considered as the benchmark of the industry. "Figure 5-5" on page 82 shows the cross section of the nine-fold profile.

Procedure

1. Install the fixing beams in the nine-fold profile cabinet (PS cabinet) and reserve mounting holes for fastening the AC drive.

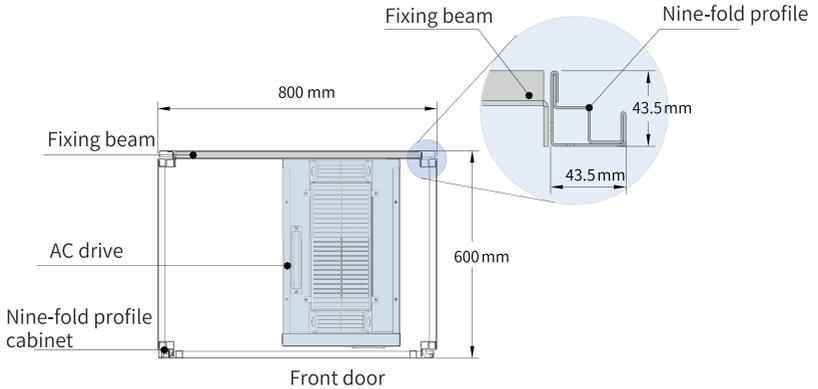


Figure 5-5 Top view of a cabinet for T11 and T12 models

To install a T11 or T12 model in a nine-fold profile cabinet 600 mm in depth, fold the back mounting plate inward, as shown in ["Figure 5-6" on page 82](#), to borrow the space of the column. (This requirement is not applicable to standard cabinets greater than 800 mm in depth.) To install a T11 or T12 model in a cabinet with access doors at both the front and the back, use a cabinet that is 800 mm in depth, instead of a 600 mm one.

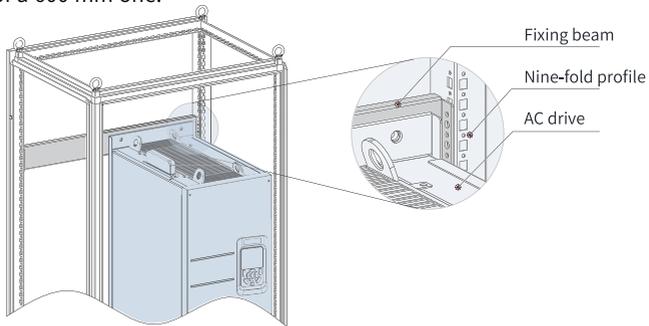


Figure 5-6 Perspective view of a cabinet for T11 and T12 models

2. Fix the bottom mounting bracket in the nine-fold profile cabinet. Use six M5 self-tapping screws to fix the mounting bracket onto the rack base of the nine-fold profile cabinet, as shown in ["Figure 5-7" on page 83](#).

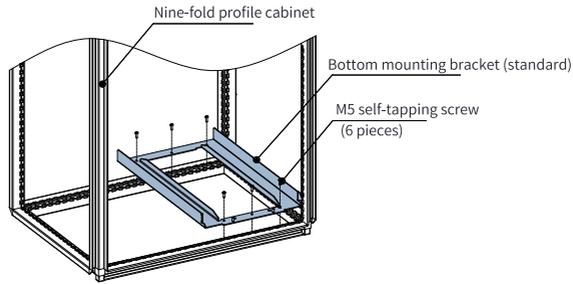


Figure 5-7 Installing the bottom mounting bracket

Drill holes for the mounting bracket and assemble the bracket on site if the cabinet is not a nine-fold profile one.

3. Assemble the guide rails (model: MD500-AZJ-A3T10) and mount them on the cabinet.

a. Assemble the guide rails, as shown in *"Figure 5-8 " on page 83 .*

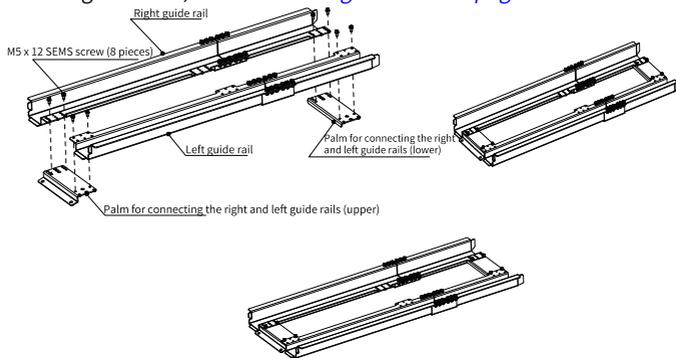


Figure 5-8 Assembling guide rails

b. Align the two round holes on the front end of the guide rails with the screws of the mounting bracket, and lock them with two M6 nuts, to mount the guide rails on the cabinet, as shown in *"Figure 5-9 " on page 84 .*

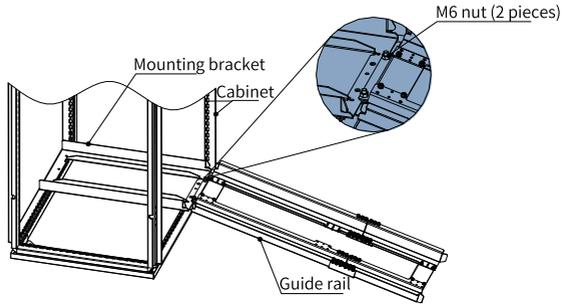


Figure 5-9 Mounting the guide rails on the cabinet

4. Remove the cover from the AC drive.
For details about how to remove the cover, see "Removing the Cover". Remove the cover to access the auxiliary handle on the AC drive.
5. Align the casters of the AC drive with the guide rails and gently push the AC drive in to the cabinet.
When pushing or pulling the AC drive, use an auxiliary strap to prevent it from toppling. It is recommended that two persons cooperate to complete this job.

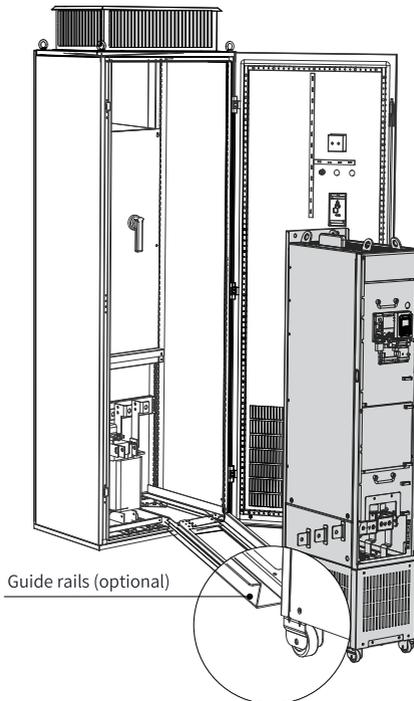


Figure 5-10 Aligning the casters with the guide rails

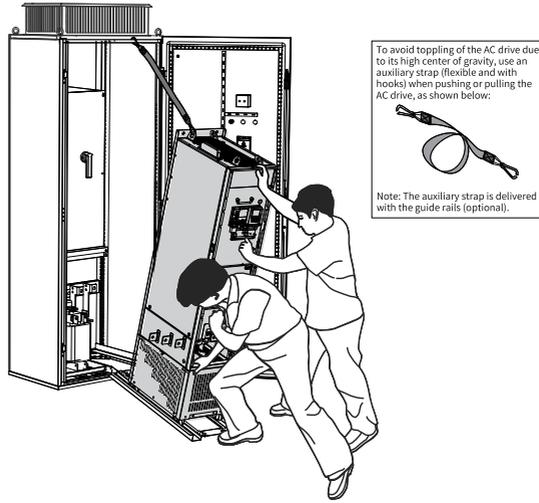


Figure 5-11 Pushing the AC drive into the cabinet

6. Remove the auxiliary strap, and drive screws into the four mounting holes on the back of the AC drive to fasten the AC drive to the fixing beams in the cabinet.

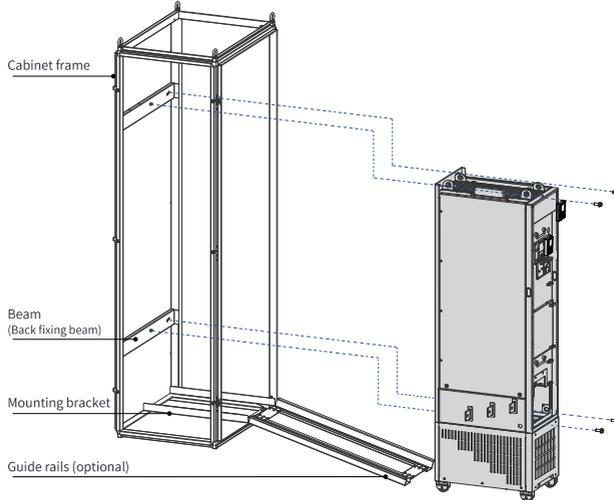


Figure 5-12 Fastening the AC drive to the fixing beams

7. Verify that the AC drive is securely installed, and remove the guide rails.
8. Remove the baffle from the top air filter of the AC drive. The baffle is used to prevent foreign objects, such as screws, from falling into the air filter during installation of the AC drive.

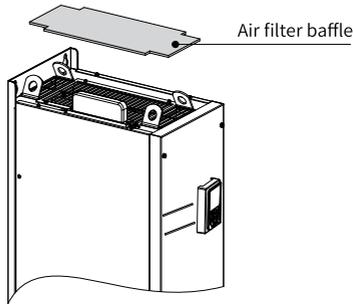


Figure 5-13 Removing the air filter baffle

5.5 Removing and Installing the Cover

5.5.1 Removing the Cover

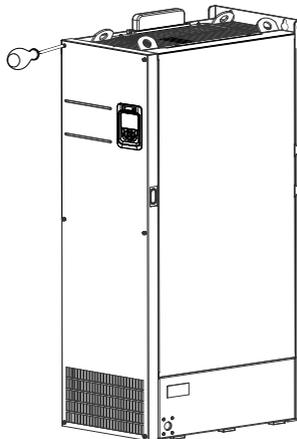
For wiring of the control circuit, remove the cover of the AC drive before connecting any jumper, PG card, or functional extension card. To remove the cover, hold it with both hands and lift up its lower part. Handle with care to prevent the cover from falling off and causing damage to equipment or injury.

Prerequisites

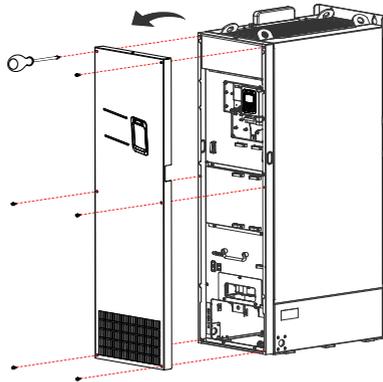
Power off the AC drive at least 10 minutes before removing the cover.

Procedure

1. Unscrew the six fixing screws on the cover with a screwdriver.



2. Hold the cover with both hands, and pull it in the arrow direction to remove it.

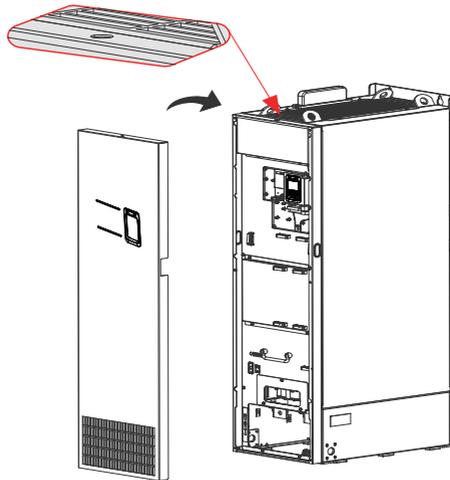


5.5.2 Installing the Cover

The cover of the AC drive must be removed before wiring the main circuit and control circuit. After the wiring is completed, install the cover back.

Procedure

1. Hold the cover with both hands, align its upper edge with the upper edge snap-fit joint on the chassis, and snap them together, as shown in the following figure. Then, align the six screw mounting holes on the cover with the cover mounting holes on the chassis and press them tightly against each other.



2. Drive six fixing screws into the holes with a screwdriver to fasten the cover.



6 Checklist of Mechanical Installation

For applicable items, tick the corresponding box on the right after installation to confirm that the work procedure has been completed.

Table 6-1 Checklist of mechanical installation

Item	Action	Applicable	Completed
1	Check the anti-tilt label.		
2	Check that the packing box is intact and free of damage and damp.		
3	Check that the environment meets the installation requirements specified in "1.2.1 Installation Environment" on page 15.		
4	Check that the ceiling height meets the minimum requirements (for smooth ventilation). Ensure sufficient clearance for the air inlet and outlet without obstruction. Reserve sufficient clearance for safe passing with the cabinet door open. For details, see "1.2.2 Clearance" on page 16.		
5	After unpacking, check that the cabinet enclosure is free of deformation, paint peeling, and cracking, and that there is no water stain in the cabinet.		
6	Check that the accessories (user guide and options) in the cabinet are complete.		
7	Remove the wooden pallet before placing the AC drive at the final installation site. For details, see "3.4 Unpacking" on page 50.		
8	Firmly attach the cabinet to the preset retaining points.		
9	Install all contact protective devices (protection plates) inside and outside the cabinet before commissioning.		

7 Electrical Installation

7.1 Electrical Wiring Diagram

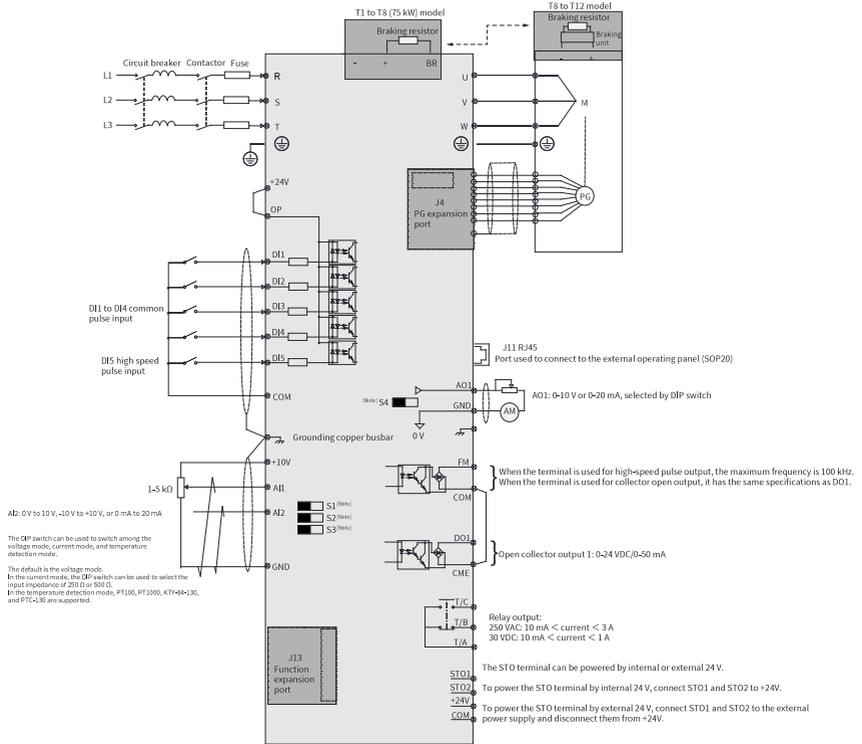


Figure 7-1 Standard wiring

Note

- For details on S1 to S4 DIP switches, see ["Table 7-16 Description of control circuit terminals" on page 114](#).
- For three-phase 380–480 VAC drives, a 0.4–75 kW model differs from a 90–450 kW model in the wiring detail marked by the double arrows in the figure.
- For three-phase 200–240 VAC drives, a 0.4–37 kW model differs from a 45–200 kW model in the wiring detail marked by the double arrows in the figure.

7.2 Inspection Before Wiring

T1 to T12 models

- Avoid wiring while the power is on. Keep all circuit breakers OFF during wiring. Failure to comply may result in electric shock.
- Cut off input and output power supplies and wait at least 10 minutes until the power indicators are completely extinct before starting wiring.
- Ensure that the motors, cabinets, and other components are installed and connected in accordance with technical regulations recognized by the country where the AC drive is installed and with other applicable regional regulations. Pay special attention to regulations on cable sizes, fuses, grounding, circuit breakers, isolation, and overcurrent protection.
- A fuse on a branch circuit may cut off fault current. To reduce the risk of fire and electric shock, check the conductive parts and related components and replace damaged ones. When a fuse trips, find and rectify the cause.

7.3 Main Circuit Connection

7.3.1 Main Circuit Terminals

T1 to T9 models

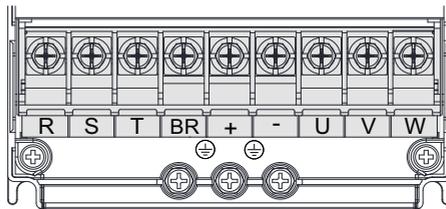


Figure 7-2 Main circuit terminals of T1 to T4 models

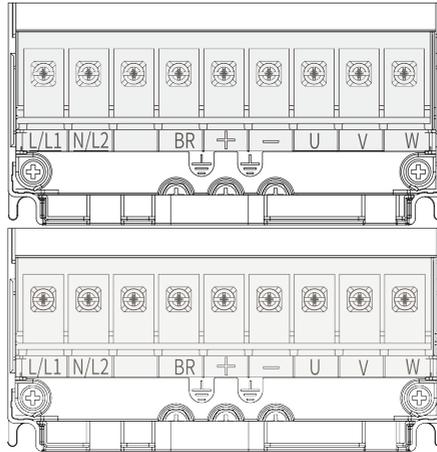


Figure 7-3 Main circuit terminals of T2 models (single phase)

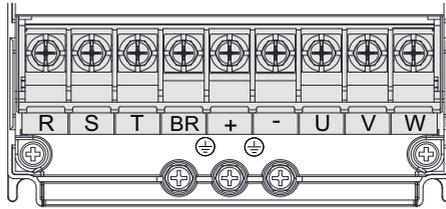


Figure 7-4 Main circuit terminals of T1 to T4 models

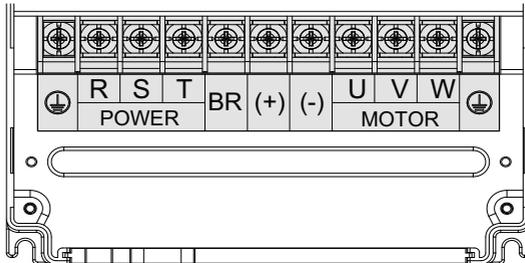


Figure 7-5 Main circuit terminals of T5 to T8 models

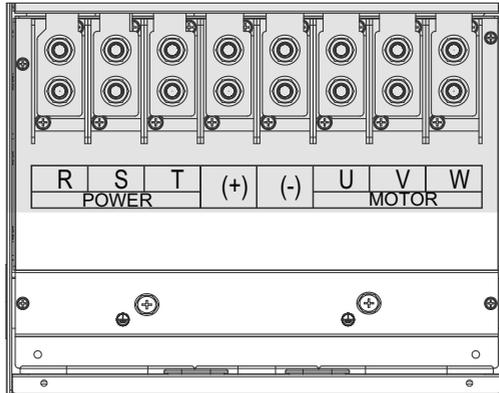


Figure 7-6 Main circuit terminals of T9 models

Table 7-1 Description of main circuit terminals

Mark	Name	Description
R, S, T	Three-phase power supply input terminals	Connected to AC input three-phase power supply.
(+), (-)	Positive and negative terminals of DC bus	Common DC busbar input, connected to the external braking unit of T9 models and above.
(+), BR-	Braking resistor connection terminals	Connected to the braking resistor of T8 models and below.
U, V, W	Output terminals	Connected to a three-phase motor.
	Grounding terminal (PE)	Used for protective grounding.

T10 to T9 models

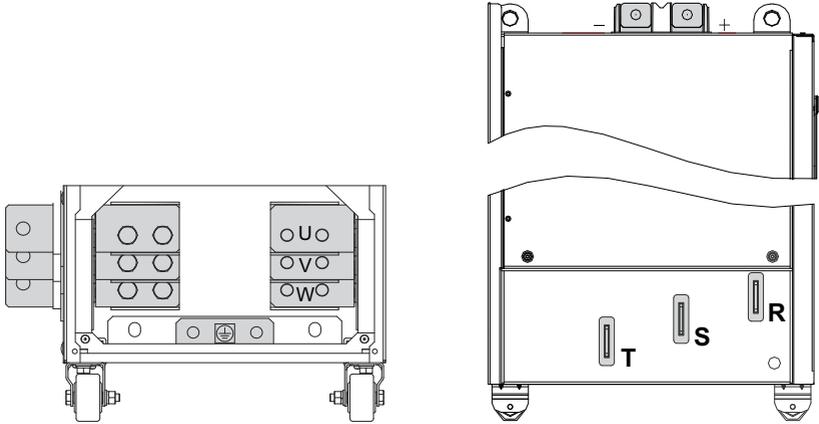


Figure 7-7 Main circuit terminals of T10 to T12 models

Table 7-2 Descriptions of main circuit terminals

Mark	Name	Description
R, S, T	Three-phase power supply input terminals	Connected to AC input three-phase power supply.
+, -	Positive and negative terminals of DC bus	Common DC busbar input, connected to an external braking unit.
U, V, W	AC drive output terminals	Connected to a three-phase motor.
	Grounding terminal (PE)	Used for protective grounding.

7.3.2 Terminal Dimensions and Cable Selection

T1 and T2

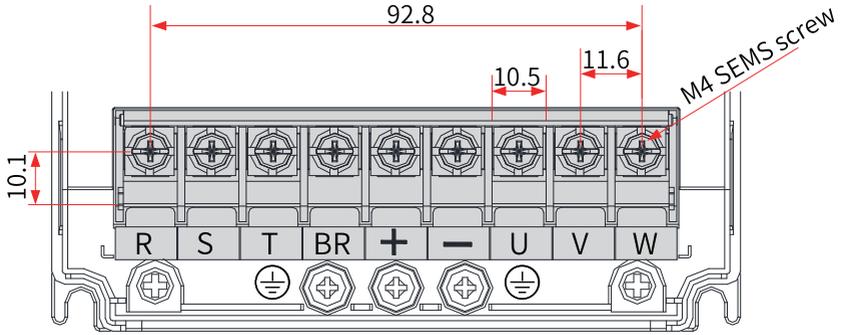


Figure 7-8 Main circuit terminal dimensions of T1 and T2 models (mm)

Table 7-3 Main circuit cable selection for T1 and T2 models

Structure	Model	Rated Input Current A	RST/UVW		Grounding Wire		Screw	Tightening Torque N · m (lb · in.)
			Cable (mm ²) ^{<1>}	Cable Lug	Cable (mm ²) ^{<1>}	Cable Lug		
T1	MD520T0.4B(S)	1.8	3 x 0.75	TNR0.75-4	0.75	TNR0.75-4	M4	1.2 (10.6)
	MD520T0.7B(S)	2.4						
	MD520T1.1B(S)	3.7						
	MD520T1.5B(S)	4.6						
	MD520T2.2B(S)	6.3						
	MD520T3.0B(S)	9.0	3 x 1	TNR1.25-4	1	TNR1.25-4		
T2	MD5203.7B(S)	11.4	3 x 1.5	TNR1.25-4	1.5	TNR1.25-4	M4	1.2 (10.6)
	MD520T5.5B(S)	16.7	3 x 2.5	TNR2-4	2.5	TNR2-4	M4	1.2 (10.6)

T3

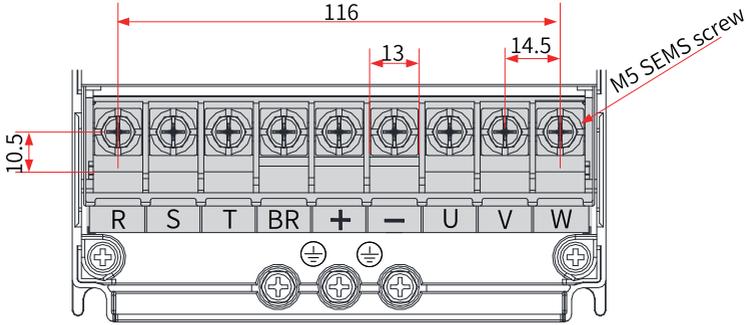


Figure 7-9 Main circuit terminal dimensions of T3 models (mm)

Table 7-4 Main circuit cable selection for T3 models

Structure	Model	Rated Input Current A	RST/UWV		Grounding Wire		Screw	Tightening Torque N · m (lb · in.)
			Cable (mm ²) ^{<1>}	Cable Lug	Cable (mm ²) ^{<1>}	Cable Lug		
T3	MD520T7.5B(S)	21.9	3 x 4	TNR3.5-5	4	TNR3.5-5	M5	2.8 (24.8)
	MD520T11B(S)	32.2	3 x 6	TNR5.5-5	6	TNR5.5-5	M5	2.8 (24.8)

T4

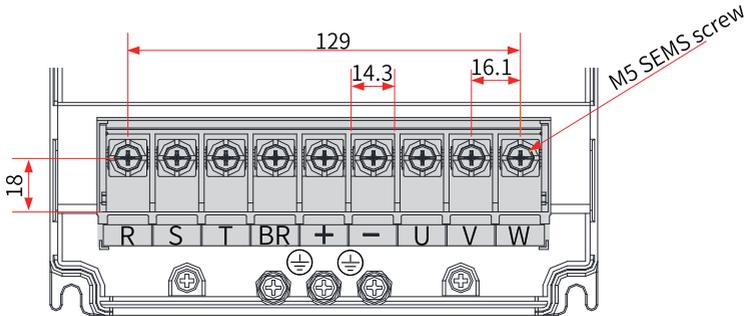


Figure 7-10 Main circuit terminal dimensions of T4 models (mm)

Table 7-5 Main circuit cable selection for T4 models

Structure	Model	Rated Input Current A	RST/UWV		Grounding Wire		Screw	Tightening Torque N · m (lb · in.)
			Cable (mm ²) ^{<1>}	Cable Lug	Cable (mm ²) ^{<1>}	Cable Lug		
T4	MD520T15B(S)	41.3	3 x 10	TNR8-5	10	TNR8-5	M5	2.8 (24.8)

T5

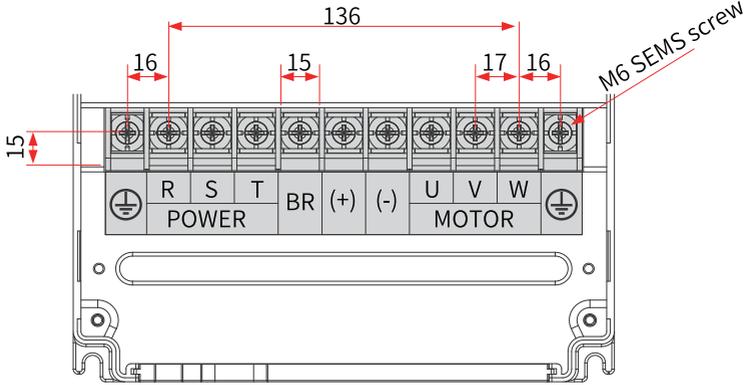


Figure 7-11 Main circuit terminal dimensions of T5 models (mm)

Table 7-6 Main circuit cable selection for T5 models

Structure	Model	Rated Input Current A	RST/UWV		Grounding Wire		Screw	Tightening Torque N · m (lb · in.)
			Cable (mm ²) ^{<1>}	Cable Lug	Cable (mm ²) ^{<1>}	Cable Lug		
T5	MD520T18.5(B)(S) MD520T18.5(B)(S)-T	49.5	3 x 10	GTNR10-6	10	GTNR10-6	M6	4.8 (45.2)
	MD520T22(B)(S) MD520T22(B)(S)-T	59.0	3 x 16	GTNR16-6	16	GTNR16-6	M6	4.8 (45.2)

T6

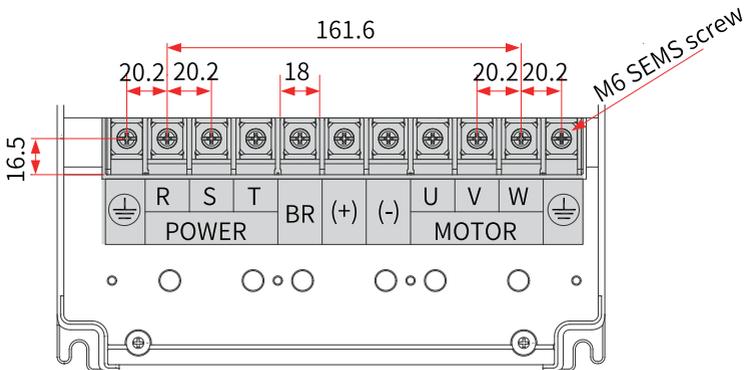


Figure 7-12 Main circuit terminal dimensions of T6 models (mm)

Table 7-7 Main circuit cable selection for T6 models

Structure	Model	Rated Input Current A	RST/UVW		Grounding Wire		Screw	Tightening Torque N · m (lb · in.)
			Cable (mm ²) ^{<1>}	Cable Lug	Cable (mm ²) ^{<1>}	Cable Lug		
T6	MD520T30(B)(S)	57.0	3 x 16	GTNR16-6	16	GTNR16-6	M6	4.8 (45.2)
	MD520T37(B)(S)	69.0	3 x 25	GTNR25-6	16	GTNR16-6	M6	4.8 (45.2)

T7

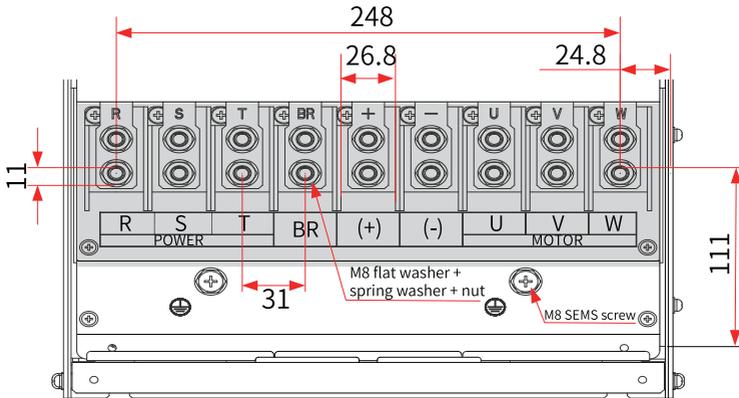


Figure 7-13 Main circuit terminal dimensions of T7 models (mm)

Table 7-8 Main circuit cable selection for T7 models

Structure	Model	Rated Input Current A	RST/UVW		Grounding Wire		Screw	Tightening Torque N · m (lb · in.)
			Cable (mm ²) ^{<1>}	Cable Lug	Cable (mm ²) ^{<1>}	Cable Lug		
T7	MD520T45(B)(S)	89.0	3 x 35	GTNR35-8	16	GTNR16-8	M8	13.0 (115.2)
	MD520T55(B)(S)	106.0	3 x 50	GTNR50-8	25	GTNR25-8	M8	13.0 (115.2)

T8

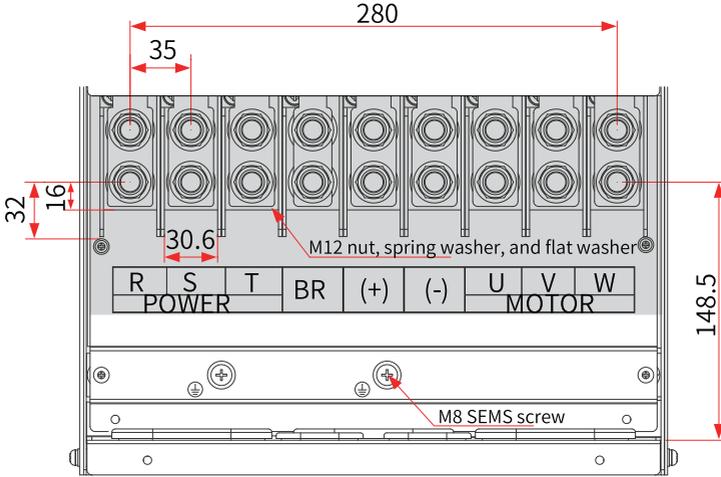


Figure 7-14 Main circuit terminal dimensions of T8 models (mm)

Table 7-9 Main circuit cable selection for T8 models

Structure	Model	Rated Input Current A	RST/UVW		Grounding Wire		Screw	Tightening Torque N · m (lb · in.)
			Cable (mm ²) ^{<1>}	Cable Lug	Cable (mm ²) ^{<1>}	Cable Lug		
T8	MD520T75(B)(S)	139.0	3 x 70	GTNR70-12	35	GTNR35-12	M12	35.0 (310.1)
	MD520T90(S)	164.0	3 x 95	GTNR95-12	50	GTNR50-12	M12	35.0 (310.1)
	MD520T110(S)	196.0	3 x 120	GTNR120-12	70	GTNR70-12	M12	35.0 (310.1)

T9

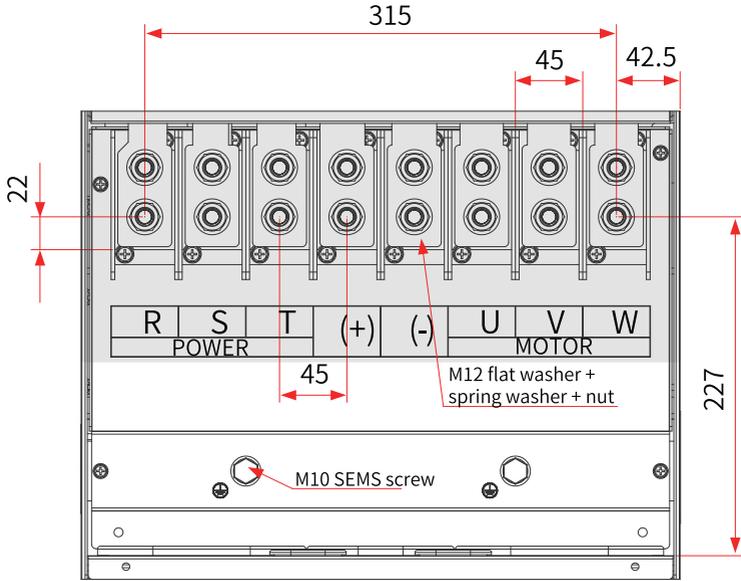


Figure 7-15 Main circuit terminal dimensions of T9 models (mm)

Table 7-10 Main circuit cable selection for T9 models

Structure	Model	Rated Input Current A	RST/UWV		Grounding Wire		Screw	Tightening Torque N · m (lb · in.)
			Cable (mm ²) ^{<1>}	Cable Lug	Cable (mm ²) ^{<1>}	Cable Lug		
T9	MD520T132(S)	240.0	3 x 150	BC150-12	95	BC95-12	M12	35.0 (310.1)
	MD520T160(S)	287.0	3 x 185	BC185-12	95	BC95-12	M12	35.0 (310.1)

T10

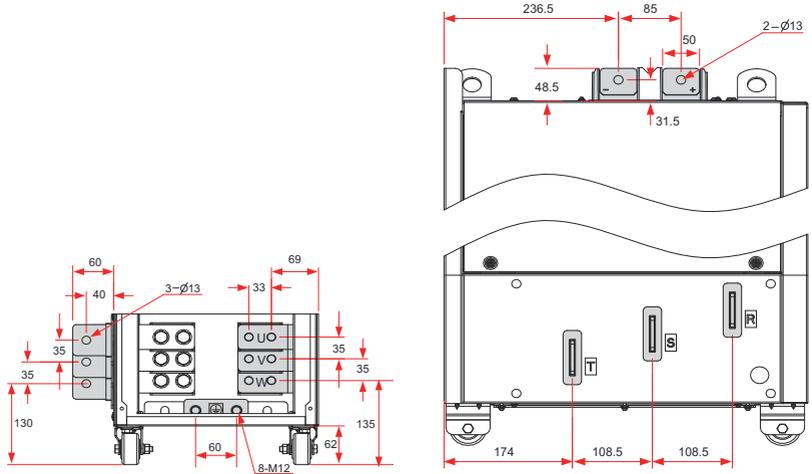


Figure 7-16 Main circuit terminal dimensions of T10 models (without output reactors) (mm)

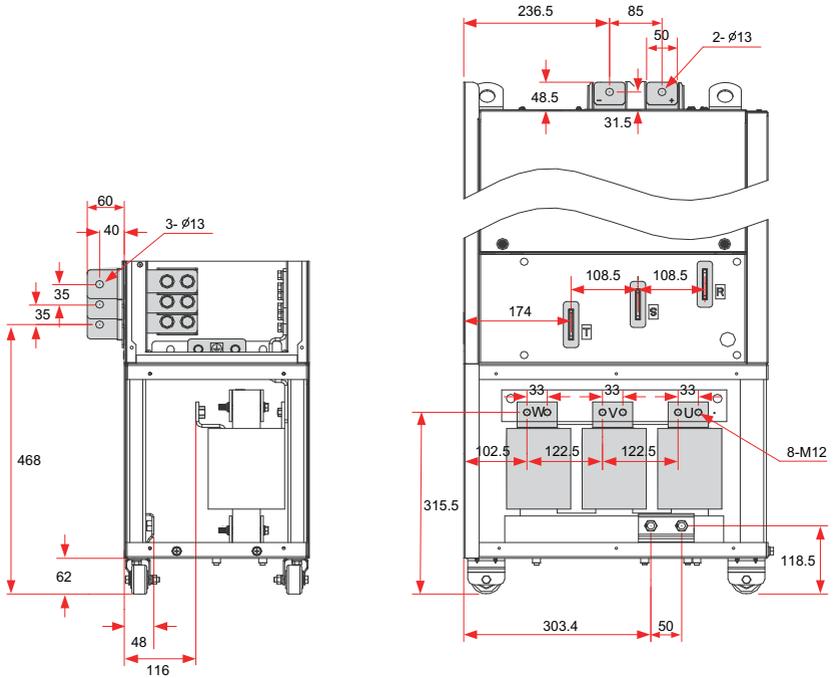


Figure 7-17 Main circuit terminal dimensions of T10 models (with output reactors) (mm)

The side copper busbars in the preceding figures can be removed if necessary. The following figure shows the dimensions of the main circuit terminals without the side copper busbars.

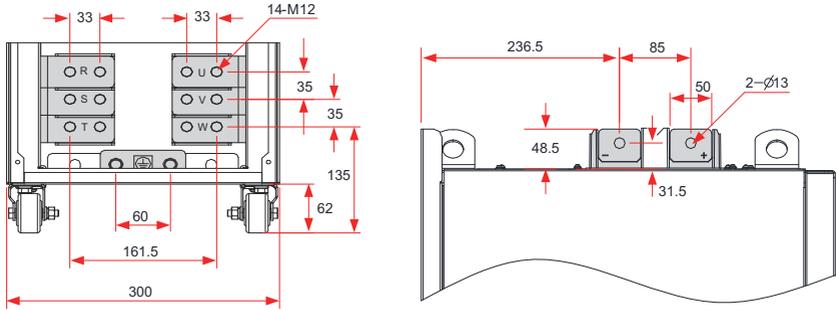


Figure 7-18 Main circuit terminal dimensions of T10 models (without side copper busbars and output reactors) (mm)

Table 7-11 Main circuit cable selection for T10 models

Structure	Model	Rated Input Current A	RST/UWV		Grounding Wire		Screw	Tightening Torque N · m (lb · in.)
			Cable (mm ²) ^{<1>}	Cable Lug	Cable (mm ²) ^{<1>}	Cable Lug		
T10	MD520T200(S) MD520T200(S)-L	365.0	2 x (3 x 95)	BC95-12	95	BC95-12	M12	35.0 (310.1)
	MD520T220(S) MD520T220(S)-L	410.0	2 x (3 x 120)	BC120-12	120	BC120-12	M12	35.0 (310.1)

T11

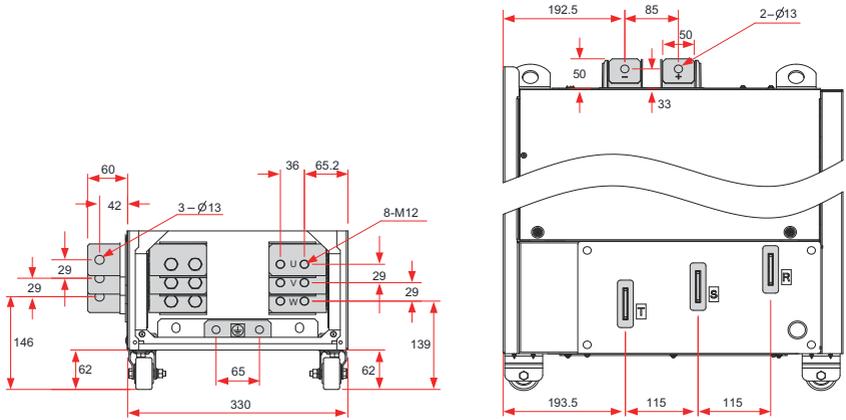


Figure 7-19 Main circuit terminal dimensions of T11 models (without output reactors) (mm)

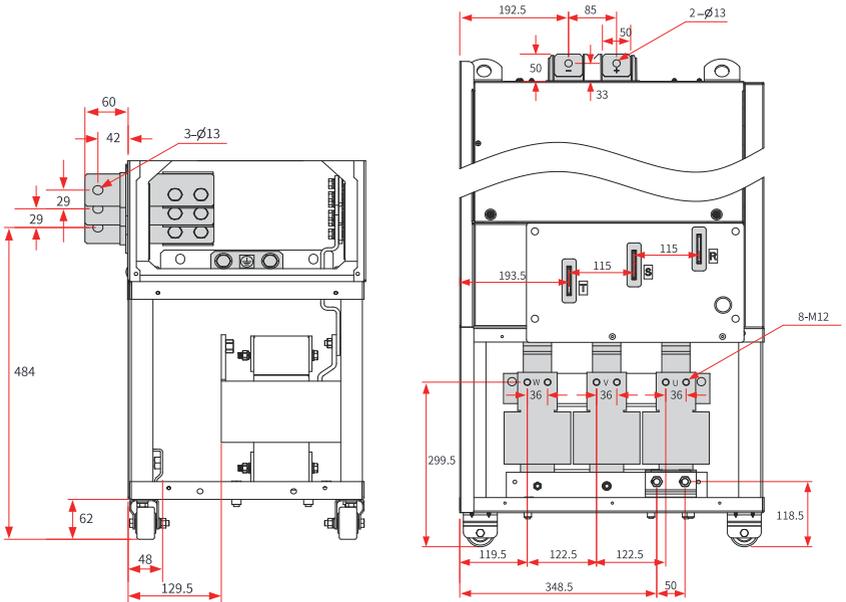


Figure 7-20 Main circuit terminal dimensions of T11 models (with output reactors) (mm)

The side copper busbars in the preceding figures can be removed if necessary. The following figure shows the dimensions of the main circuit terminals without the side copper busbars.

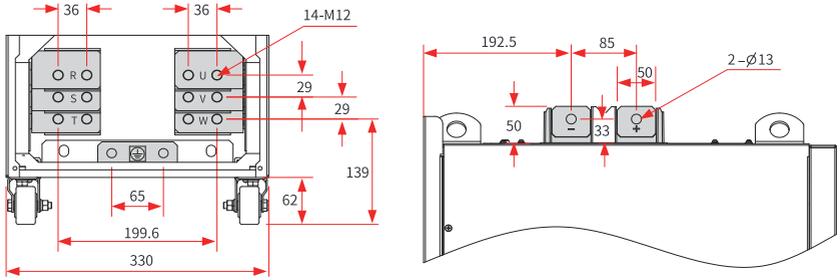


Figure 7-21 Main circuit terminal dimensions of T11 models (without side copper busbars and output reactors) (mm)

Table 7-12 Main circuit cable selection for T11 models

Structure	Model	Rated Input Current A	RST/UVW		Grounding Wire		Screw	Tightening Torque N · m (lb · in.)
			Cable (mm ²) ^{<1>}	Cable Lug	Cable (mm ²) ^{<1>}	Cable Lug		
T11	MD520T250(S) MD520T250(S)-L	441.0	2 x (3 x 120)	BC120-12	120	BC120-12	M12	35.0 (310.1)
	MD520T280(S) MD520T280(S)-L	495.0	2 x (3 x 150)	BC150-12	150	BC150-12	M12	35.0 (310.1)

T12

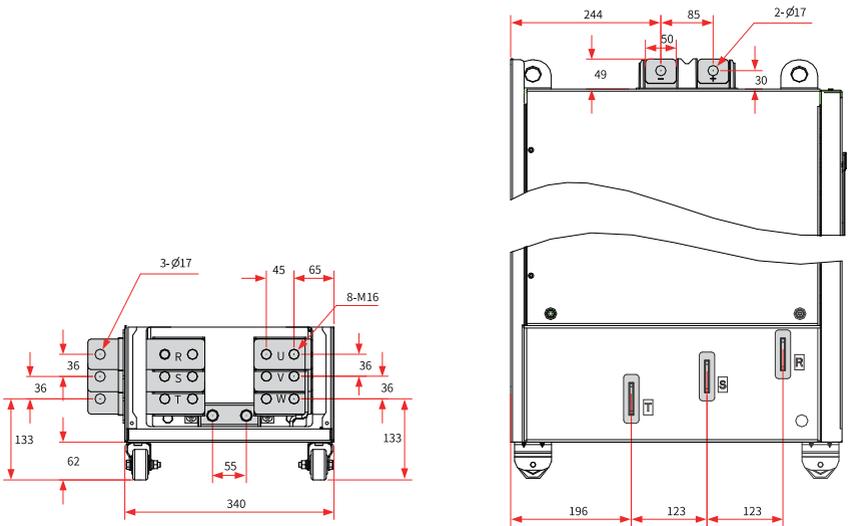


Figure 7-22 Main circuit terminal dimensions of T12 models (without output reactors) (mm)

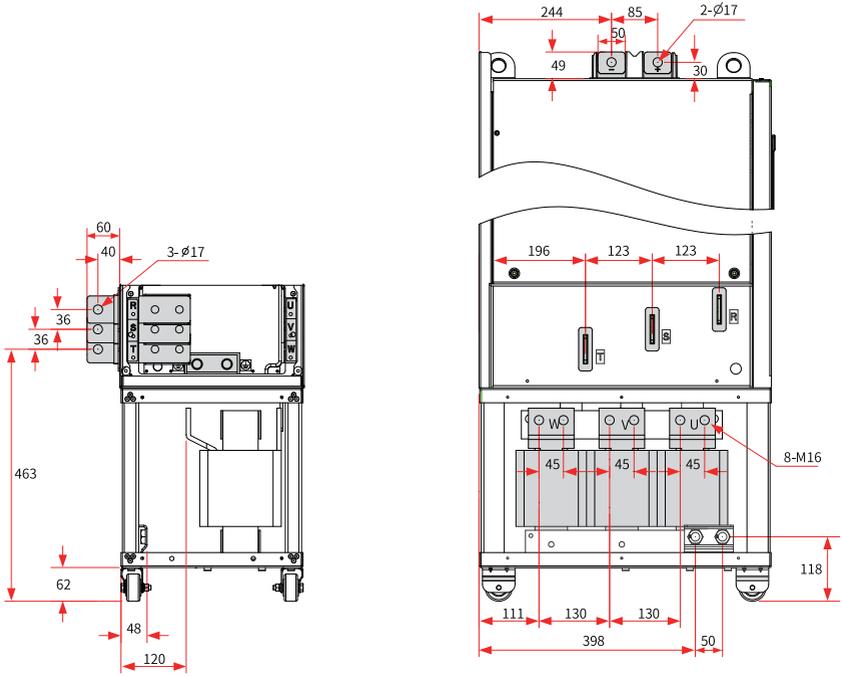


Figure 7-23 Main circuit terminal dimensions of T12 models (with output reactors) (mm)

The side copper busbars in the preceding figures can be removed if necessary. The following figure shows the dimensions of the main circuit terminals without the side copper busbars.

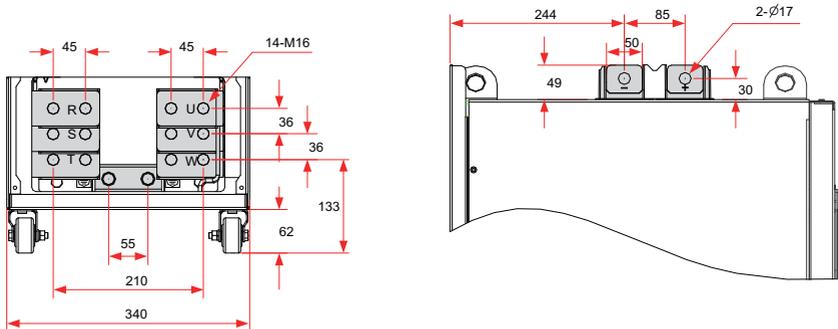


Figure 7-24 Main circuit terminal dimensions of T12 models (without side copper busbars and output reactors) (mm)

Table 7–13 Main circuit cable selection for T12 models

Structure	Model	Rated Input Current A	RST/UVW		Grounding Wire		Screw	Tightening Torque N · m (lb · in.)
			Cable (mm ²) ^{<1>}	Cable Lug	Cable (mm ²) ^{<1>}	Cable Lug		
T12	MD520T315(S) MD520T315(S)-L	565.0	2 x (3 x 185)	BC185-16	185	BC185-16	M16	85.0 (753.1)
	MD520T355(S) MD520T355(S)-L	617.0						
	MD520T400(S) MD520T400(S)-L	687.0	2 x (3 x 240)	BC240-16	240	BC240-16	M16	85.0 (753.1)

7.3.3 Wiring of Terminals

This section specifies requirements for wiring of main circuit terminals. For requirements for selection, routing, and wiring of main circuit cables, see ["7.3.4 Requirements on Wiring of the Main Circuit" on page 107](#).

To avoid accidents due to short circuits, install fuses at the input side. For requirements and selection of fuses at the input side, see "Conditions for Compliance with the LVD" in the *MD520 Series General-Purpose AC Drive Hardware Guide*.

Power input R/S/T

- Wiring at the input side is independent of phase sequence requirements.
- Sizes and wiring of external main circuit cables must comply with local regulations and related IEC requirements.
- Select properly sized copper conductors for the main circuit, as recommended in the sections of main circuit cable selection in this guide.

DC bus (+)/(-)

- The DC bus (+)/(-) terminals carry a residual voltage for a period after the AC drive is powered off. Therefore, after the CHARGE indicator turns off, wait at least 10 minutes before proceeding with wiring. Failure to comply may result in electric shock.
- When wiring an optional external braking component for a model rated at 90 kW or above, ensure correct polarity (+)/(-). Failure to comply may result in damage to the AC drive and braking component or even fire.
- To wire a braking unit, use twisted pair cables or tight pair cables each within 10 m in length for parallel wiring.
- Do not connect a braking resistor directly to the DC bus. Failure to comply may result in damage to the AC drive or even fire.

Output U/V/W

- Sizes and wiring of external main circuit cables must comply with local regulations and related IEC requirements.
- Select properly sized copper conductors for the main circuit.
- Do not connect any capacitor or surge protection device at the output side. Failure to comply may result in frequent triggering of the protection mechanism or even damage to the AC drive.
- An excessively long motor cable may result in electrical resonance due to the distributed capacitance. The electrical resonance may in turn lead to damage to motor insulation or high leakage current, triggering the overcurrent protection mechanism of the AC drive. When using a motor cable longer than 100 m, install an AC output reactor close to the AC drive.

Grounding (PE) terminal

For grounding requirements, see "7.5 Grounding".

7.3.4 Requirements on Wiring of the Main Circuit

Requirements on wiring of the main circuit

- Terminals BR, (-), and (+) are optional. Avoid connecting them to the AC power supply.
- To protect the main circuit, separate and cover the surface that may come into contact with the main circuit.
- The control circuit is a 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 SELV circuit.
- Prevent foreign objects from entering the wiring part of the terminal block.
- Avoid welding when using stranded wires.
- Tightening torque required by terminals may vary. Tighten the screws in accordance with applicable requirements. Use screwdrivers, ratchets, or wrenches as appropriate.
- When using an electric tool to tighten the terminal screws, set the tool to a low speed to avoid damage to the terminal screws.
- Avoid tightening the terminal screws at an angle of greater than 5 degrees. Failure to comply may result in damage to the terminal screws.

Requirements on power cable selection

Follow national or regional regulations when selecting power cables. Selection of IEC cables is based on:

- EN 60204-1 and IEC 60364-5-52 standards
- Copper wires with PVC insulation

- 40°C ambient temperature and 70°C cable surface temperature (Note: Contact the manufacturer if the ambient temperature exceeds 40°C.)
- Symmetrical cable with copper mesh shield

Note

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

Shielded cables must be used to satisfy the EMC requirements. A shielded cable is either a three-core cable or a four-core cable, as shown in the following figure. If the shield of three-core cable cannot provide sufficient conductivity, add an independent PE cable, or use a four-core cable that contains a PE core. To suppress radio frequency interference effectively, use coaxial copper braid as the shielding layer of cable. The braided density of cooper braid should be greater than 90% to enhance the shielding efficiency and conductivity.

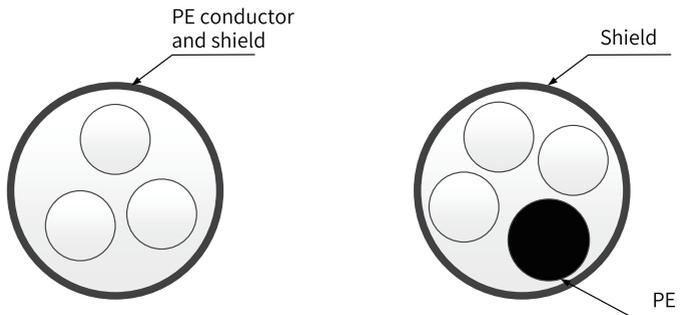


Figure 7-25 Recommended power cable types

Requirements on routing of the main circuit

The power input cable of the AC drive and the motor cable can generate strong electromagnetic interference. To avoid electromagnetic interference caused by long-distance parallel coupling between the strong interference cable and the control circuit, ensure a distance greater than 30 cm between main circuit cables and signal cables. Common main circuit cables include input R/S/T cables, output U/V/W cables, DC buses, and braking cables. Signal cables include I/O signal cables, communication cables, and encoder cables.

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

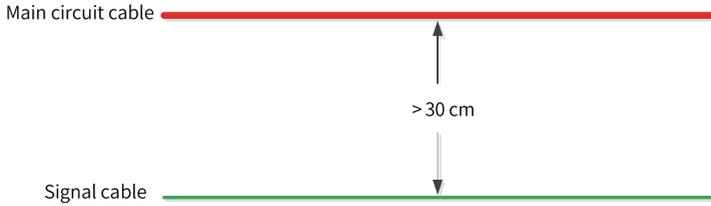


Figure 7-26 Routing of cables

Wiring in an IT or angular grid system

Before wiring in an IT or angular grid system, disconnect the optional EMS grounding screw. Failure to comply may result in damage to the AC drive or injury.

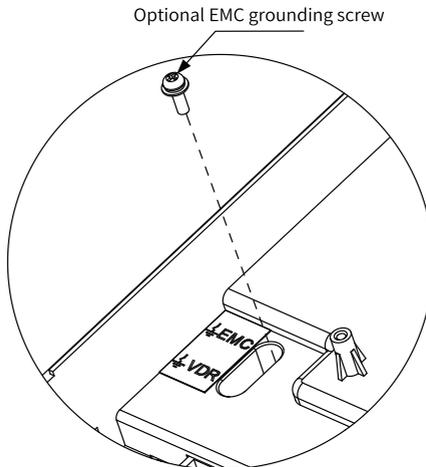


Figure 7-27 Disconnecting the optional EMC grounding screw

Motor cable shield requirements

Use shielded cables for motor output. Use a grounding bracket to achieve all-round connection with the shield, and crimp the lead wire of the shield to the PE terminal. The following figure shows the shield wiring.

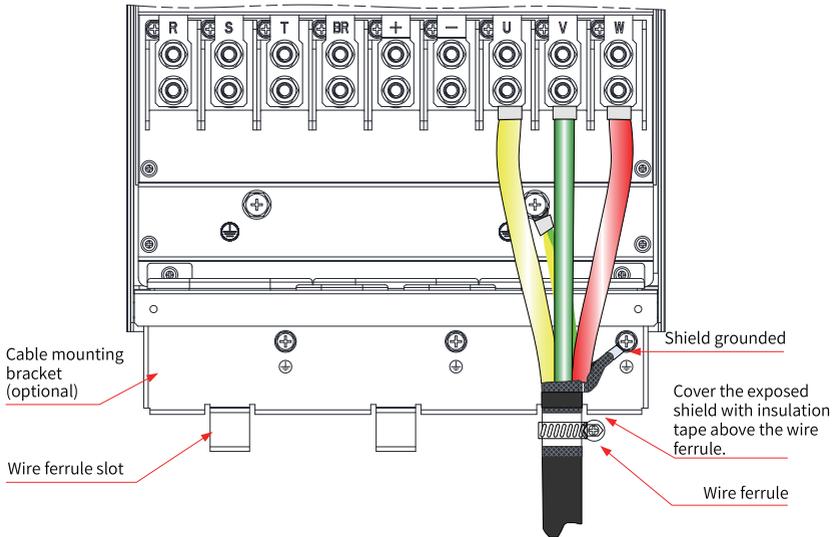


Figure 7-28 Shield wiring

For the motor cable shield, use a shortest possible lead wire with a width no less than one-fifth of the length.

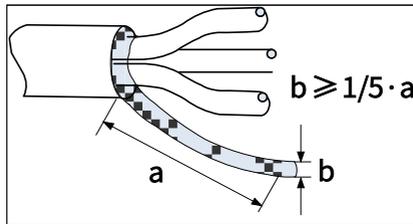


Figure 7-29 Lead wire of the motor cable shield

Motor cable length requirements

During operation of the AC drive, the quick on-off of the power switching tube can lead to excessively large dU/dt on the output side. A long motor cable may result in excessive voltage stress on the motor winding, causing insulation breakdown. Use motors that comply with IEC60034-25 IVIC B or motors with high insulation and withstand voltage. In addition, when the cable length increases, the distributed capacitance of the cable increases linearly, resulting in harmonic current.

When using a motor cable longer than the maximum length indicated in the following table, install an output reactor on the output side of the AC drive, or use a motor conforming to IEC60034-25 IVIC B. The output reactor can reduce the voltage stress on the motor winding.

Table 7-14 Requirement for output reactor based on cable length and motor types

AC Drive Rated Power (kW)	Maximum Cable Length of the Common Asynchronous Motor (m)	IEC60034-25 IVIC B Compliant	Common Asynchronous Induction Motor
0.4-3.7	50 m	Not required	Required
5.5	70 m	Not required	Required
7.5	100 m	Not required	Required
11	110 m	Not required	Required
15	125	Not required	Required
18.5	135	Not required	Required
22	150	Not required	Required
≥ 30	150	Not required	Required

Recommended cable lugs

Cable lugs recommended in the following table are GTNR series, TNR series, and BC series made by Suzhou Yuanli Metal Enterprise Co., Ltd.

Table 7-15 Appearance of cable lugs

Series	Appearance
GTNR	
TNR	
BC	

7.3.5 Protection Requirements

Main circuit cable protection requirements

Apply heat-shrink tubing to the copper lug and conductors of the cable, and ensure all conducting parts of the cable are properly wrapped, as shown in ["Figure 7-30 Applying heat-shrink tubing to conducting parts of the main circuit cable" on page 112](#).

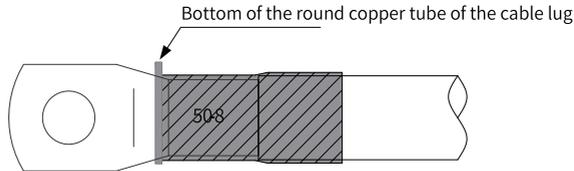


Figure 7-30 Applying heat-shrink tubing to conducting parts of the main circuit cable

Requirements for upstream protective devices

- Install appropriate protective devices on the power input side to provide overcurrent, short-circuit, and isolation protections.
- When selecting protective devices, take the following factors into consideration: current capacity of the main circuit cable, required system overload capacity, and short-circuit capacity of the upstream power input. Generally, select those recommended in the selection guide for peripheral electrical components.

7.4 Control Circuit Connection

7.4.1 Control Circuit Terminals

["Table 7-17" on page 116](#) describes control circuit terminals.

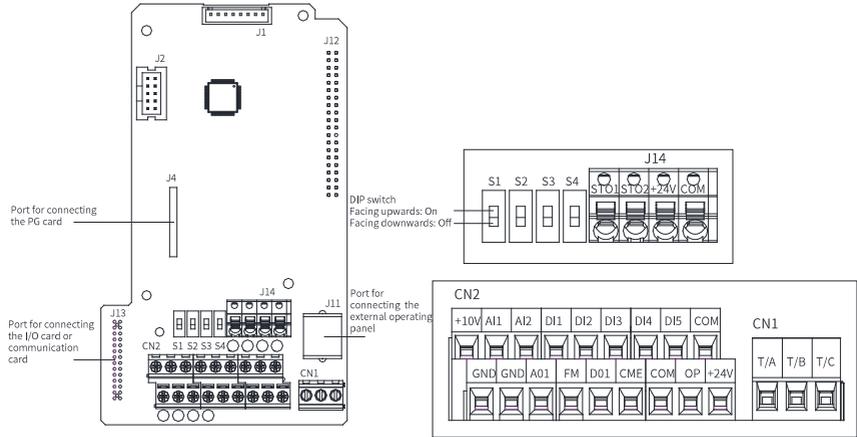


Figure 7-31 Control circuit terminals

Table 7–16 Description of control circuit terminals

Type	Mark	Name	Function Description
Power supply	+10V-GND	External +10 V power supply	The terminal is used to provide +10 V power supply to an external unit with the maximum output current 10 mA. Generally, it is used to power an external potentiometer with resistance ranging from 1 kΩ to 5 kΩ.
	+24V-COM	External +24 V power supply	The terminal is used to provide +24 V power supply to an external unit. Generally, it is used to power DI/DO terminals and external sensors. The maximum output current is 200 mA ^[Note 1] .
	OP	Input terminal for external power supply	It is connected to +24V by default. To use an external signal to drive terminals DI1 to DI5, disconnect OP from +24V and connect it to an external power supply.
Analog input	AI1-GND	Analog input terminal 1	Input voltage range: –10 VDC to +10 VDC Input impedance: 22 kΩ
	AI2-GND	Analog input terminal 2	The terminal supports voltage input (default), current input, and temperature input. When used as voltage/current input, the terminal supports 0 V to 10 V, -10 V to +10 V, or 0 mA to 20 mA with the resolution 12-bit and the correction accuracy 0.3%. The input impedance is 22 kΩ for voltage input and 500 Ω or 250 Ω for current input, which is set by S2 and S3 DIP switches ^{Note [2]} .

Type	Mark	Name	Function Description
Digital input	DI1-OP	Digital input 1	Photocoupler isolation and bipolar input Input impedance: 1.72 k Ω Voltage range for effective level input: 9 V to 30 V
	DI2-OP	Digital input 2	
	DI3-OP	Digital input 3	
	DI4-OP	Digital input 4	
	DI5-OP	Digital input 5	Besides features of DI1 to DI4, DI5 can also be used for high-speed pulse input. Input impedance: 1.16 k Ω Maximum input frequency: 100 kHz Operating voltage range: 15 V to 30 V
Analog output	AO1-GND	Analog output 1	The DIP switch on the control board is used to determine voltage output (default) or current output. Output voltage range: 0–10 V Output current range: 0–20 mA
Digital output	DO1-CME	Digital output 1	Photocoupler isolation and bipolar open collector output Output voltage range: 0–24 V Output current range: 0–50 mA Note that CME and COM are internally insulated, but are shorted externally by jumper as the factory settings. In this case, DO1 is driven by +24V. To drive DO1 by external power supply, remove the jumper between CME and COM.
	FM-COM	High-speed pulse output	The terminal is set by F5-00 (FM terminal output selection). When the terminal is used for high-speed pulse output, the maximum frequency is 100 kHz. When the terminal is used for collector open output, it has the same specifications as DO1.
Relay output	T/A	Common terminal	Contact driving capacity: 250 VAC, 3 A, COS ϕ = 0.4 30 VDC, 1 A
	T/B	Normally closed terminal	
	T/C	Normally open terminal	

Type	Mark	Name	Function Description
Auxiliary ports	J13	Expansion card terminal	It is a 28-conductor terminal used to connect optional cards, such as bus cards
	J4	PG card terminal	It is used to connect the resolver, differential, and 23-bit encoders.
	J11	Port for external operating panel	It is used to connect the LCD operating panel (SOP-20) and the LED operating panel (MDKE-10).
DIP switches	S1		For details, see "Table 7-17 Description of control circuit terminals 2" on page 116.
	S2		For details, see "Table 7-17 Description of control circuit terminals 2" on page 116.
	S3		For details, see "Table 7-17 Description of control circuit terminals 2" on page 116.
	S4		It is used to determine whether AO1 supports the current mode. If S4 is closed, AO1 supports the current mode.

Table 7-17 Description of control circuit terminals 2

Mark	DIP Switch			Description
	S1	S2	S3	
Name	OFF	OFF	OFF	Voltage mode for AI2
	ON	OFF	OFF	Temperature mode for AI2. The temperature sensor type can be set by F9-57.
	OFF	ON	OFF	Current mode for AI2 with the input impedance 500 Ω
	OFF	ON	ON	Current mode for AI2 with the input impedance 250 Ω

Note

- [Note 1] If the ambient temperature exceeds 23°C, the output current must be derated by 1.8 mA for every additional 1°C. The maximum output current is 170 mA at 40°C. When OP and 24V are shorted, the maximum output current is calculated by the following formula: 170 mA minus current over the DI.
- [Note 2] Based on the maximum output voltage of the signal source, select 500 Ω or 250 Ω impedance. For example, if 500 Ω is selected, the maximum output voltage cannot be lower than 10 V so that AI2 can measure 20 mA current.

7.4.2 Wiring of Terminals

Analog input terminal AI1

Weak analog voltage signals are susceptible to external interference. Therefore, a shielded cable is typically required, and the wiring distance should be as short as possible (within 20 m), as shown in ["Figure 7-32 Wiring analog input terminal AI1" on page 117](#). In scenarios where analog signals experience severe external interference, install a filter capacitor or a ferrite core on the analog signal source, as shown in ["Figure 7-33 Grounding the shield of analog input cable" on page 118](#). Connect the drain wire of the shield of the analog input cable to the PE terminal of the AC drive.

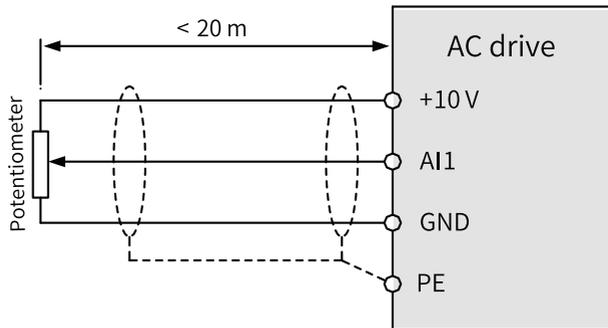


Figure 7-32 Wiring analog input terminal AI1

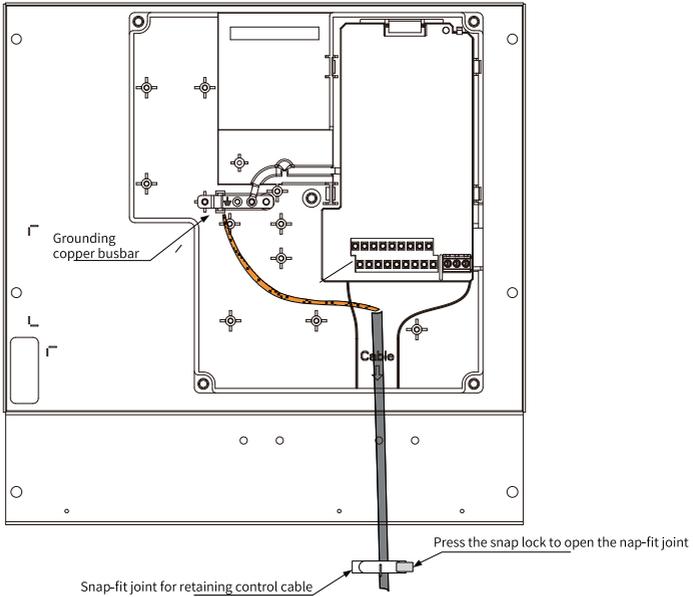


Figure 7-33 Grounding the shield of analog input cable

Analog input terminal AI2

- If AI2 is to be used for voltage signal input, wire it in the same way as that for AI1.
- If AI2 is to be used for current signal input, connect the current input wire to AI2 and current output wire to GND, and toggle S2 (or S2 and S3) to ON. If only S2 is toggled to ON, the impedance is 500 Ω. If both S2 and S3 are toggled to ON, the impedance is 250 Ω.

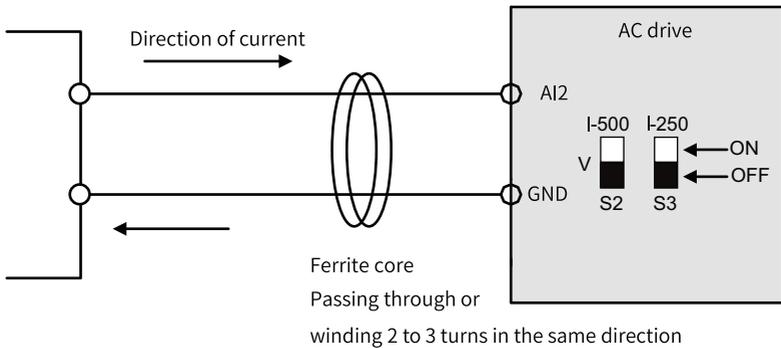
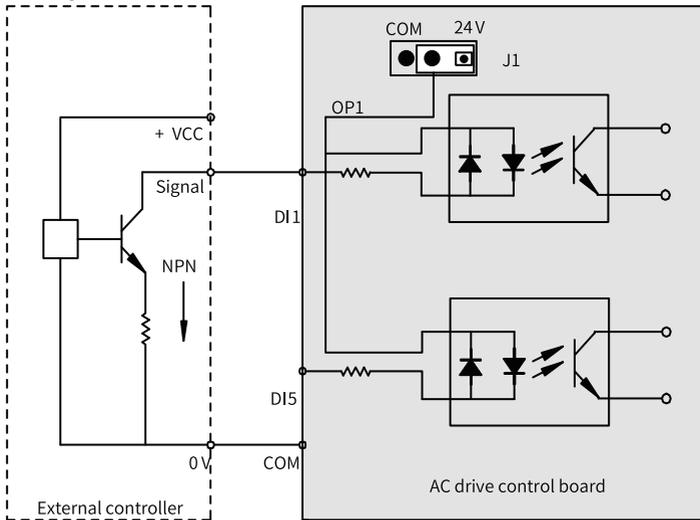


Figure 7-34 Wiring analog input terminal AI2/AI3

Digital input terminals DI1 to DI5

- Sink wiring



Sink wiring where the 24 V power supply of the AC drive is used

Figure 7-35 Sink wiring

The most commonly used wiring mode is using the internal 24 V power supply of the AC drive. In this case, short pins 1 and 2 of jumper J1 on the control board of the AC drive (to short OP1 to 24V), and connect COM of the AC drive to 0V of the external controller.

This wiring method does not allow DI terminals of different AC drives to be connected in parallel because parallel connection may cause malfunction of the DI terminals. If parallel connection is needed, connect a diode in series to each DI terminal (connect the anode to DI). The diode must meet the following requirements: $I_F > 40 \text{ mA}$, $V_R > 40 \text{ V}$. "[Figure 7-36 Wiring for parallel connection of DI terminals of multiple AC drives in sink mode](#)" on page 120 shows such parallel connection.

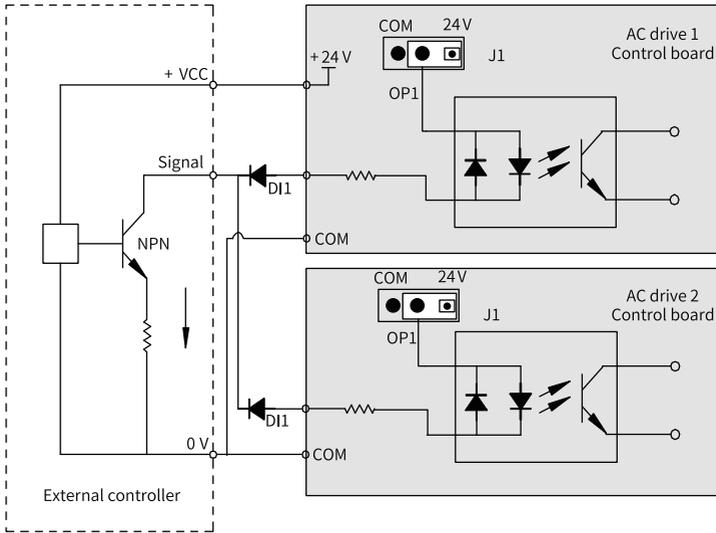
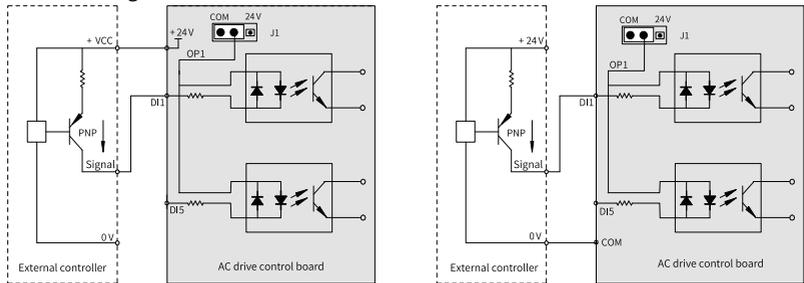


Figure 7-36 Wiring for parallel connection of DI terminals of multiple AC drives in sink mode

● Source wiring



Source wiring where the 24 V power supply of the AC drive is used

Source wiring where the external 24 V power supply is used

Figure 7-37 Source wiring

- To use the internal 24 V power supply of the AC drive, short pins 2 and 3 of jumper J1 on the control board of the AC drive (to short OP1 to COM), and connect +24V of the AC drive to the power terminal of the external controller.
- To use an external power supply, short pins 2 and 3 of jumper J1 on the control board of the AC drive (to short OP1 to COM), and connect COM of the AC drive to 0V of the external controller. Connect +24V of the external power supply to the applicable DI terminal through the control contact on the external controller.

Digital output (DO) terminals

To use a DO terminal to drive a relay, connect a snubber diode across the relay coil. Otherwise, the 24 VDC power supply may be damaged. Ensure that the driving capacity does not exceed 50 mA.

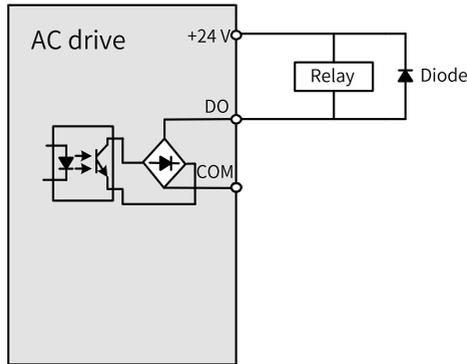


Figure 7-38 Wiring a DO terminal

Note

Ensure correct direction of electrodes when installing the snubber diode. Failure to comply may result in burnout of the 24 VDC power supply upon output from the digital output terminal.

Relay output terminals

Inductive loads (relays, contactors, and motors) cause voltage spikes at cutoff of current. 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 7-39 Anti-interference treatment for relay output terminals" on page 122.](#)

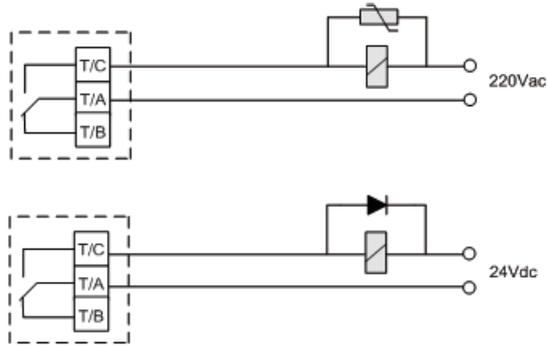


Figure 7-39 Anti-interference treatment for relay output terminals

Note

Use a category 2 power supply for the control circuit. Failure to comply may degrade the operating performance of the AC drive.

Requirements on tubular terminals

Use tubular terminals with insulating sleeves. Where applicable, keep the exposed conductor of a single wire or stranded wire no longer than 6 mm, as shown in "Figure 7-40 Requirements on the tubular terminal of a control cable" on page 122.

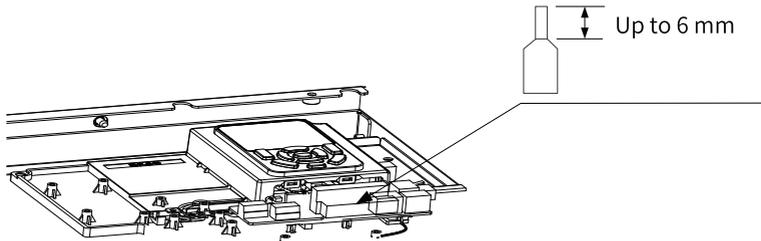


Figure 7-40 Requirements on the tubular terminal of a control cable

Table 7-18 Control cable specifications

Single Wire mm ² (AWG)	Stranded Wire mm ² (AWG)	Tightening Torque (N · m)
0.2 to 0.75 (AWG 24 to 18)	0.75 mm	0.565

Wiring for connecting an external operating panel

To use an external operating panel, connect one end of the connecting cable to the RJ45 port of the AC drive, and lead the other end of the cable through either side of

the AC drive to the operating panel, as shown in "Figure 7-41 Wiring for connecting an external operating panel" on page 123.

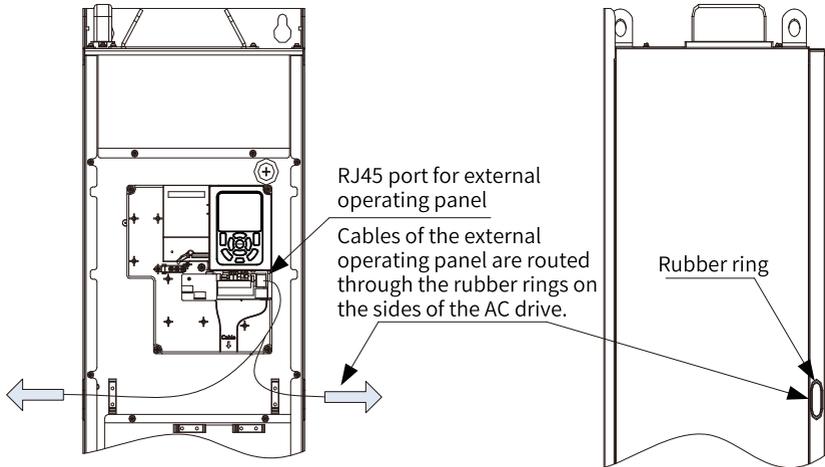


Figure 7-41 Wiring for connecting an external operating panel

7.4.3 Circuit Wiring Requirements

Note

Connect the control circuit cables according to EN 60204-1.

Selection requirements

To prevent peripheral interference and noise, use shielded cables for the control circuit. Install a shielding bracket at each end of the shield layer to reliably connect the cable to the AC drive. Use a separate shielded cable for each type of analog signal. Use shielded twisted pair cables for digital signals.

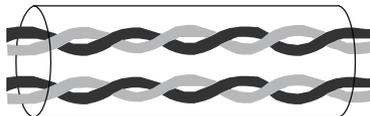


Figure 7-42 Shielded twisted pair

Requirements on shield grounding for analog terminals

Weak analog voltage signals are susceptible to external interference. Therefore, a shielded cable is typically required, and the wiring distance should be as short as

possible (within 20 m). In scenarios where analog signals experience severe external interference, install a filter capacitor or a ferrite core on the analog signal source.

- Use shielded cables together with a shield grounding bracket (optional) to achieve all-round grounding of the cable shield.
- Minimize the length of the drain wire of the shield. Fasten the drain wire to the standard grounding copper busbar of the AC drive by using screws. The following figure shows the grounding.

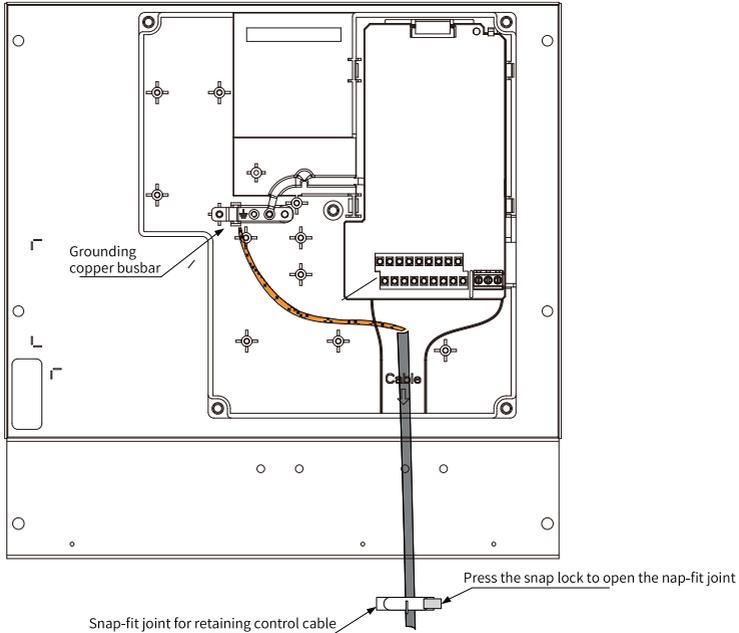


Figure 7-43 Grounding the shield of analog input cable

Requirements on wiring of encoder signal cables

Before inserting a PG card, remove the screws shown in the enlarged area in the following figure, align the PG card with the three fixing studs (to the upper left of the enlarged area), and fix the PG card with M3x8 screws.

The AC drive is grounded as a whole in structure. When wiring the encoder after PG card installation, connect the encoder signal cable shield to the PE terminal of the PG card to complete shield grounding. Wire the encoder in accordance with the following requirements:

1. During on-site installation and commissioning, route the encoder cable and power cable in different cable ducts. Failure to comply may result in encoder interference.
2. Use shielded twisted pair cables. For differential encoders, connect the shield of the twisted pair cable to the grounding (PE) terminal of the AC drive.

3. In some scenarios with large-scale equipment, where the AC driver is far away from the motor (the motor cable may be as long as 10 m), the grounding impedance of the encoder cable shield is increased due to parasitic inductance of the cable. In this case, you can disconnect the encoder shield from the grounding (PE) terminal of the driver.

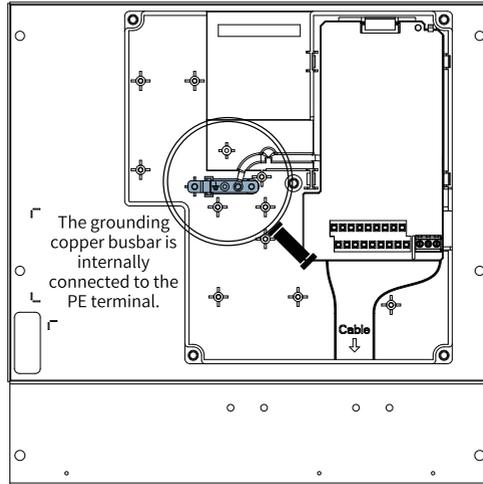


Figure 7-44 PG card installation screws

Requirements on wiring of I/O signal cables

- I/O signals include analog input (AI) signals, analog output (AO) signals, digital input (DI) signals, digital output (DO) signals, and relay output signals. Before wiring the I/O terminals, disconnect the main power supply and ensure that the danger indicator of the AC drive is off.
- Separate I/O signal cables from the main circuit cables (RST and UVW) and other power cables (or electric power cables) by at least 30 cm. Failure to comply may result in interference to I/O signals.
- Separate the cable connecting the relay output terminal from other I/O signal cables by a distance greater than 30 cm. Failure to comply may result in malfunction of the AC drive and equipment.

7.4.4 Cable Routing Requirements

1. Separated routing of signal cables and power cables

When analog signals are used for remote control on the cabinet module, separate signal cables from high-voltage circuits (power input, inverter output, and braking resistor connection cables) by a distance above 50 cm to reduce interference from the AC drive and other equipment to analog signals. Comply with this requirement for cable routing even inside the control cabinet.

2. Analog control signal cables

Use shielded twisted pair cables. Minimize the length of unshielded part of the cable (about 5 mm to 7 mm) and wrap the exposed part with insulation tape to prevent the shielded cable from coming into contact with other equipment and incurring interference.

3. Motor cables

Use shielded cables. Minimize the distance between the cabinet module and the motor, and route the motor cables separately from other cables. Also, avoid long-distance parallel routing of the motor cables and other cables to reduce electromagnetic interference caused by rapid changes in the output voltage of the AC drive.

4. Power cables

Use shielded cables, or shield all the cables from the cabinet module to the motor by using conduits.

5. Control cables and power cables

If a control cable must run across a power cable, arrange them at an angle close to 90°.

7.4.5 Cable Routing Suggestions

Routing interfering cables and sensitive cables

Separate cables that transmit different types of signals. Separate interfering cables from sensitive cables by 30 cm wherever possible. When two types of cables must run across each other, arrange them at an angle of 90°, as shown in the following figure.

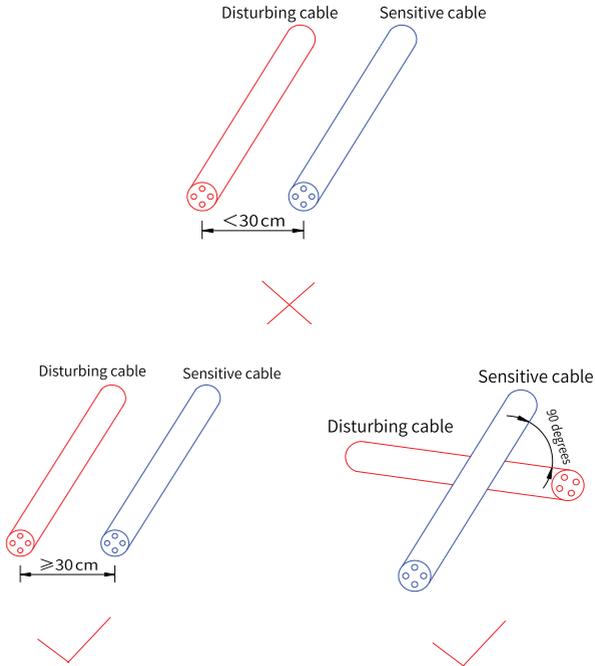


Figure 7-45 Routing interfering cables and sensitive cables

Routing cables that transmit different types of signals

Arrange cables that transmit different types of signals through different routes and separate different types of signals with equipotential signals. When routing cables that transmit the same type of signals, 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.

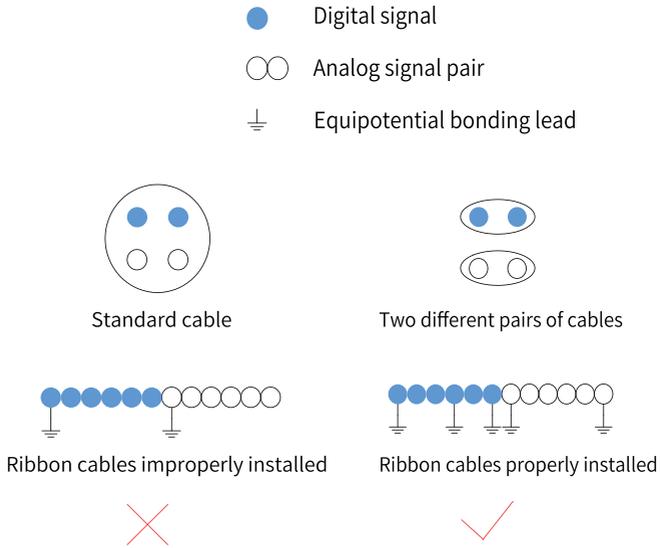


Figure 7-46 Routing cables that transmit different types of signals

Routing multi-conductor cables

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

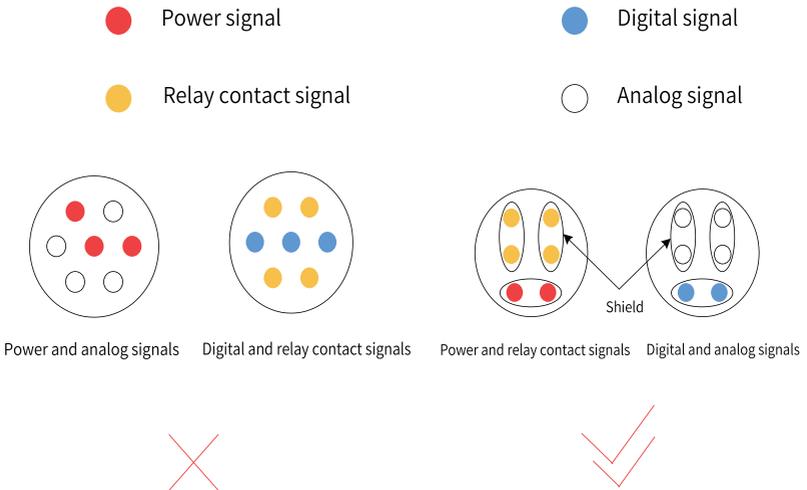


Figure 7-47 Routing multi-conductor cables

If a multi-conductor cable used to connect the equipment has any idle core wires, connect all the idle (or reserved) wires to the equipotential bonding point, as shown in the following figure.

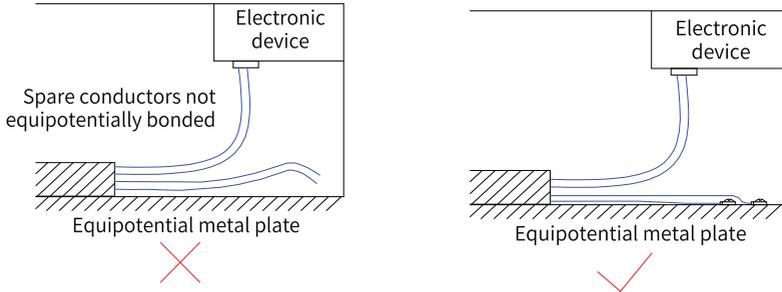


Figure 7-48 Handling reserved core wires of multi-conductor cables

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

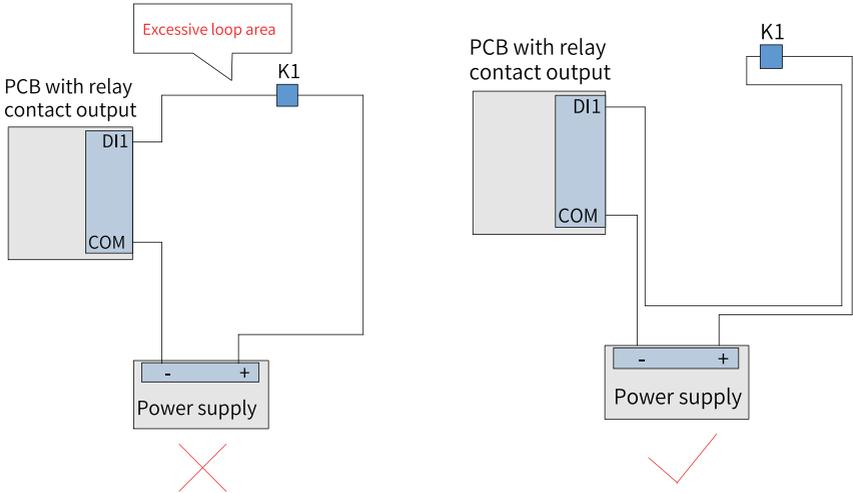


Figure 7-49 Avoiding large loop area

Laying multiple types of cables

Lay multiple types of cables along the metal block with equipotential connection and separate the cables by types to improve internal EMC. Separate cables in the same metal (zinc-iron or stainless steel) cable duct with metal spacers for better effect.

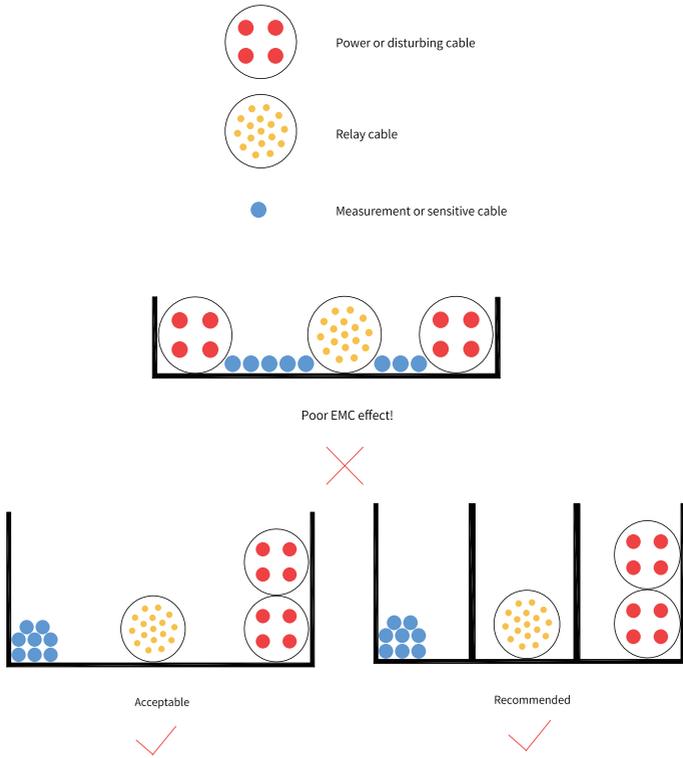


Figure 7-50 Laying multiple types of cables

Handling shielded cables

Minimize the length of the unshielded part of a shielded cable, and connect the shield to the nearest PE terminal. A long unshielded part makes signals, especially encoder signals, susceptible to interference.

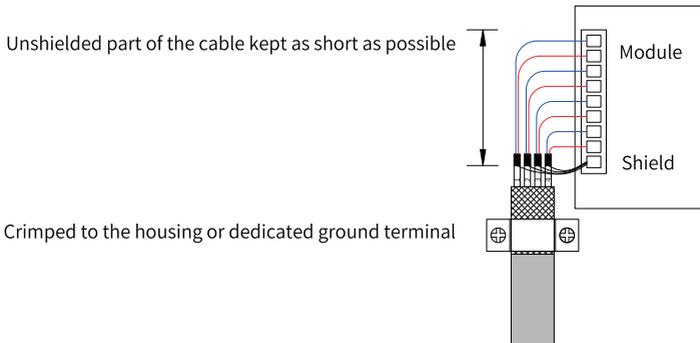


Figure 7-51 Handling shielded cables

7.5 Grounding

7.5.1 Grounding Requirements

To correctly ground the AC drive, observe the following requirements:



- Ground the grounding terminal to avoid electric shock. Comply with the relevant local electrical regulations for grounding.
 - To prevent electric shocks, check that the protective grounding conductor meets the technical specifications and local safety standards, and use a shortest possible grounding cable. The leakage current of the AC drive can be over 3.5 mA. Use a copper wire with a cross-sectional area of at least 10 mm² for the protective grounding, or use two protective grounding conductors of the same specifications for connection according to EN 61800-5-1.
 - Follow the instructions for grounding every AC drive when multiple AC drives are installed. Incorrect grounding may lead to malfunction of AC drives.
 - Disconnect the optional grounding screw of VDR (available on the AC drive) before the voltage resistance test. Failure to comply may fail the test.
-
- Use a proper yellow-green copper cable for the protective grounding conductor, and avoid connecting it to switchgears such as circuit breakers in series.
 - Reliably ground the grounding terminal. Failure to comply may result in abnormal operation of the AC drive and even damage.
 - Avoid connecting the grounding (PE) terminal to the N terminal of the neutral wire of the power supply.
 - Mount the equipment onto a conductive metal surface (recommended) to ensure well connection between the entire conductive bottom of the equipment and the mounting surface.
 - Fasten the grounding screws using the recommended tightening torque to avoid loose or excessively tight fixing of the protective grounding conductor.

7.5.2 Grounding One AC Drive Alone

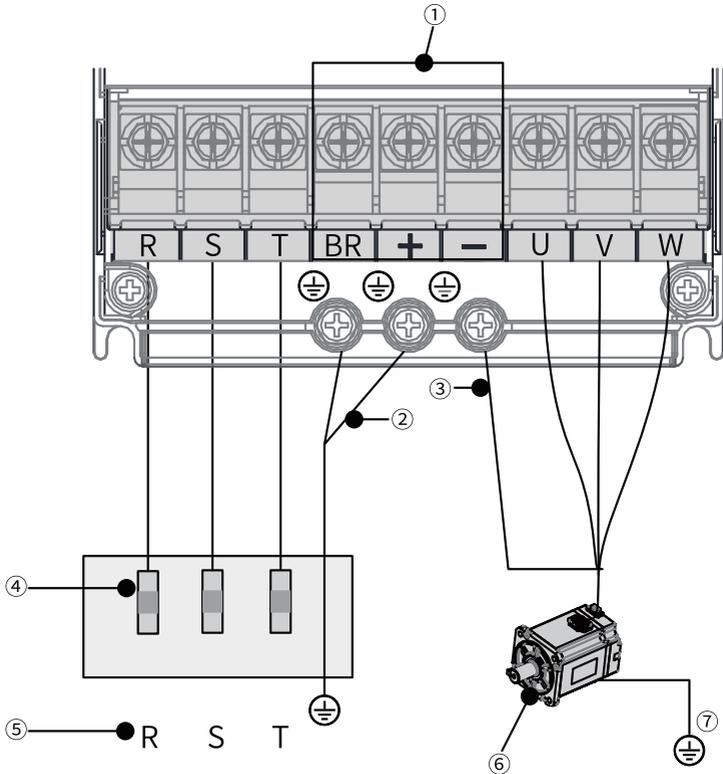


Figure 7-52 Main circuit grounding

Table 7-19 Main circuit grounding

No.	Wiring Description
①	Avoid grounding the DC bus terminal and braking resistor terminal.
②	Connect the PE terminal on the power supply side to the PE terminal on the input side of the AC drive.
③	Connect the PE terminal on the output side of the AC drive to the motor output cable shield.
④	Input protection (fuse with its lower part connected to the filter)
⑤	Power supply

No.	Wiring Description
⑥	Three-phase motor
⑦	Ground the motor enclosure.

Note

Arrangement of the main circuit terminals varies with models.

7.5.3 Grounding Multiple AC Drives Installed Side by Side

The following figure shows the grounding when multiple AC drives are installed in the cabinet side by side.

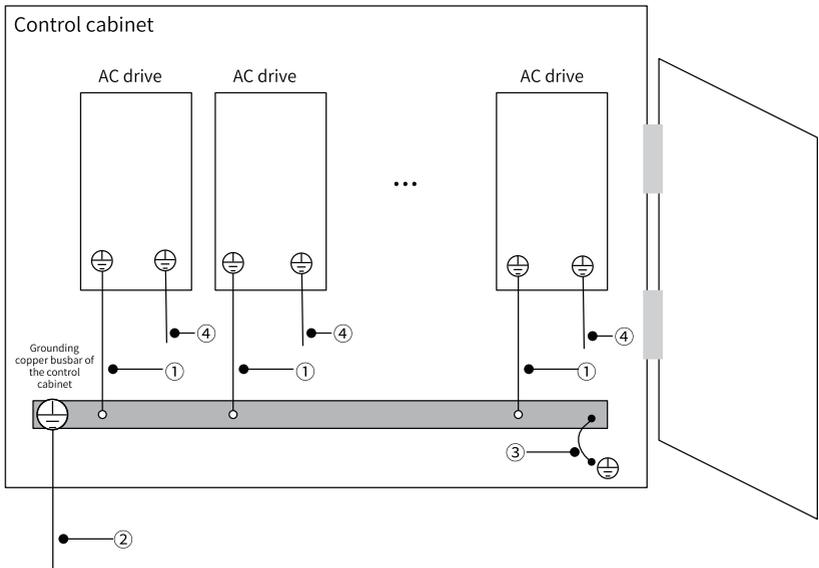


Figure 7-53 Grounding multiple AC drives installed side by side

Table 7-20 Grounding multiple AC drives installed side by side

No.	Wiring Description
①	Connect the PE terminal on the input side of the main circuit to the grounding copper busbar of the control cabinet through a protective grounding conductor.
②	Connect the PE terminal on the power supply side to the grounding copper busbar of the control cabinet.

No.	Wiring Description
③	Connect the grounding copper busbar of the control cabinet to the metal housing through a protective grounding conductor.
④	Connect the motor output cable shield to the PE terminal on the output side of the product.

7.5.4 Grounding the Cabinet System

The most cost-effective method of suppressing interference in a cabinet is to isolate the interference source from the equipment that may be interfered with. Divide a cabinet into multiple EMC compartments or use multiple cabinets based on the intensity interference sources, and install each device in accordance with the following wiring principles.

Table 7-21 Wiring principles

No.	Wiring principles
1	Place the control unit and the drive unit in two separate cabinets.
2	If multiple cabinets are used, connect the cabinets by using a PE cable with a cross-sectional area of at least 16 mm ² for equipotentiality between the cabinets.
3	If only one cabinet is used, place the devices in different compartments of the cabinet based on signal intensity.
4	Perform equipotential bonding for devices in different compartments of the cabinet.
5	Shield all communication (such as RS485) and signal cables drawn from the electric cabinet.
6	Place the power input filter in a position near the input interface of the cabinet.
7	Provide spray coating protection for all grounding points in the cabinet.

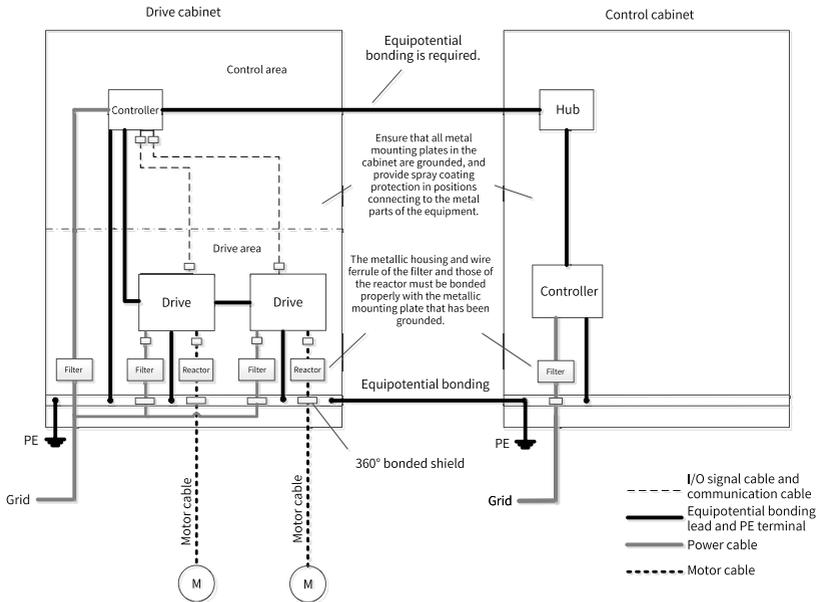


Figure 7-54 Recommended wiring for the cabinet system

7.6 Communication Connection

7.6.1 RS485

RS485 communication connection with PLC

Use a three-conductor shielded cable as the RS485 bus. The AC drive comes with three cables for connection to the RS485+, RS485–, and CGND terminals. The cables for RS485+ and RS485– connection are twisted pair cables. For the third cable, the conductor is connected to the RS485 reference ground CGND, and the shield is connected to the equipment ground. Connect 120 Ω termination resistors only at the head and tail ends of the bus to prevent RS485 signal reflection. The following table specifies the cable pin connections for the communication between PLC and the AC drive.

Table 7–22 Cable pin connections for communication between PLC and the AC drive

AC Drive			PLC		
Communication Type	Signal	Description	Communication Type	Signal	Description
RS485	RS485+	RS485 signal (positive)	RS485	RS485+	RS485 signal (positive)
	RS485–	RS485 signal (negative)		RS485–	RS485 signal (negative)
	CGND	Signal reference ground		CGND	Signal reference ground
-	GND (CGND)	Housing	-	GND (CGND)	Housing

RS485 communication connection for multiple AC drives in parallel

The following table specifies the cable pin connections for multiple AC drives in parallel in RS485 communication networking.

Table 7–23 Cable pin connections for parallel communication of multiple AC drives

AC Drive (Side A)			AC Drive (Side B)		
Communication Type	Signal	Description	Communication Type	Signal	Description
RS485	RS485+	RS485 signal (positive)	RS485	RS485+	RS485 signal (positive)
	RS485–	RS485 signal (negative)		RS485–	RS485 signal (negative)
	CGND	Signal reference ground		CGND	Signal reference ground
-	GND (CGND)	Housing	-	GND (CGND)	Housing

Communication networking

Use the daisy chain connection for the RS485 bus in the case of a large number of nodes, as shown in the following figure. Ensure that the RS485 signal reference ground of all nodes are connected together. A maximum of 128 nodes can be connected.

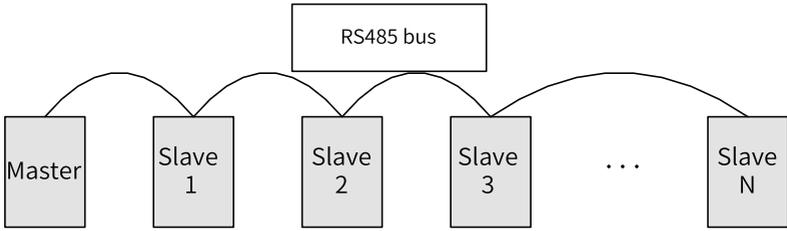


Figure 7-55 Daisy chain connection

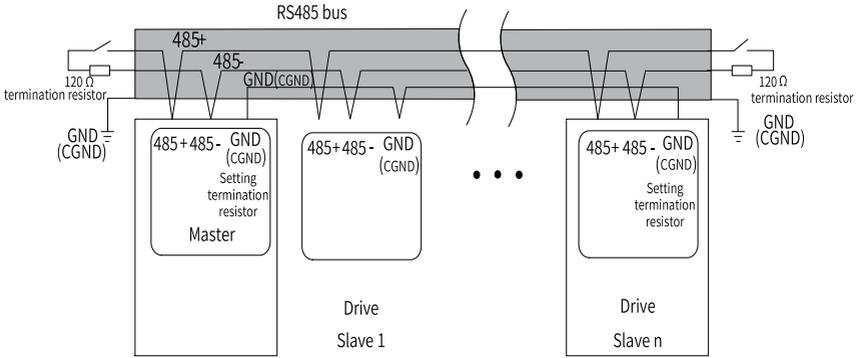


Figure 7-56 RS485 bus topology

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

Table 7-24 Transmission distance and number of nodes

Transmission Distance (m)	Rate (kbit/s)	Number of Nodes	Cable Diameter
100	115.2	128	AWG 26
1000	19.2	128	AWG 26

7.6.2 CAN

CAN communication connection with PLC

Use a three-conductor shielded cable as the CAN bus. The AC drive comes with three cables for connection to the CANH, CANL, and CGND terminals. The cables for CANH and CANL connection are twisted pair cables. For the third cable, the conductor is connected to the CAN reference ground CGND, and the shield is connected to the equipment ground. Connect 120 Ω termination resistors only at the head and tail ends of the bus to prevent CAN signal reflection.

The following table specifies the cable pin connections for the communication between the AC drive and PLC in CAN communication networking.

Table 7-25 Cable pin connections for communication between PLC and the AC drive

AC Drive			PLC		
Communication Type	Signal	Description	Communication Type	Signal	Description
CAN	CANH	CAN signal (positive)	CAN	CANH	CAN signal (positive)
	CANL	CAN signal (negative)		CANL	CAN signal (negative)
	CGND	Signal reference ground		CGND	Signal reference ground
-	GND (CGND)	Housing	-	GND (CGND)	Housing

CAN communication connection for multiple AC drives in parallel

The following table specifies the cable pin connections for multiple AC drives in parallel in CAN communication networking.

Table 7-26 Cable pin connections for parallel communication of multiple AC drives

AC Drive (Side A)			AC Drive (Side B)		
Communication Type	Signal	Description	Communication Type	Signal	Description
CAN	CANH	CAN signal (positive)	CAN	CANH	CAN signal (positive)
	CANL	CAN signal (negative)		CANL	CAN signal (negative)
	CGND	Signal reference ground		CGND	Signal reference ground
-	GND (CGND)	Housing	-	GND (CGND)	Housing

Communication networking

Use the daisy chain topology for the CAN bus. The following figure shows the CAN bus topology. Use shielded twisted pair cables for the CAN bus and twisted pair cables for CANH and CANL. Connect 120 Ω termination resistors only at both ends of the bus to prevent signal reflection. Ensure that the CAN signal reference ground of all nodes are connected together. A maximum of 64 nodes can be connected.

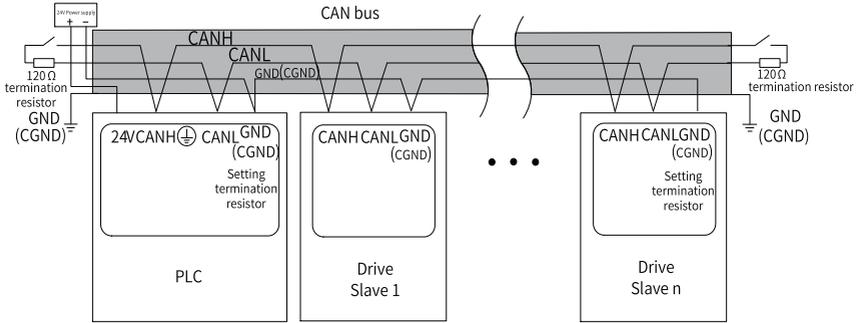


Figure 7-57 CAN bus topology

The transmission distance of CAN bus is directly dependent on the baud rate and communication cable. The following table shows the mapping between the maximum transmission distance of CAN bus and the baud rate.

Table 7-27 Transmission distance and rate

Transmission Distance (m)	Rate (kbit/s)	Number of Nodes	Cable Diameter
25	1024	64	0.205 mm ²
95	500	64	0.34 mm ²
560	100	64	0.5 mm ²
1100	50	64	0.75 mm ²

7.6.3 EtherCAT Wiring

Use standard RJ45 network ports and standard registered jacks for the EtherCAT bus. Use Cat 5e shielded twisted pair cables and injection molding wires with iron shells. As verified by FastEthernet technology, when the EtherCAT bus is used, the cable between equipment shall not exceed 100 m. Failure to comply may result in signal attenuation, affecting normal communication.

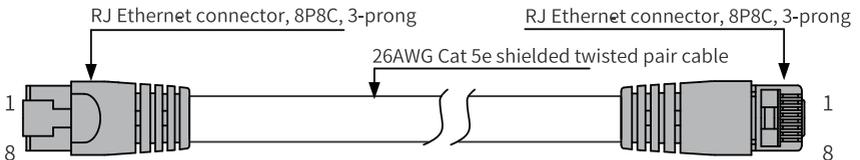


Figure 7-58 Requirements on fabrication of EtherCAT network cables

Use shielded cables for network data transmission for the EtherCAT bus. Network cables of the specifications specified in the following table are recommended.

Table 7-28 EtherCAT cable specifications

Item	Specifications
Cable type	Elastic crossover cable, S-FTP, Cat 5e
Standard compliance	EIA/TIA568A, EN50173, ISO/IEC11801 EIA/TI Abulletin TSB, EIA/TIA SB40-A&TSB36
Lead wire cross section	AWG 26
Lead wire type	Twisted pair cable
Pair	4

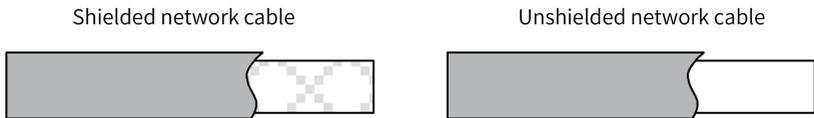


Figure 7-59 Shielded network cables

During wiring, hold the registered jack of the RJ45 network cable and insert it in the RJ45 port of the communication module until you hear a click sound. To remove the RJ45 network cable, press and hold the tail of the registered jack, and pull it out along the direction parallel with the module.

To avoid the influence of other stress on the communication cable and ensure the stability of communication, fasten the cable near the equipment before starting EtherCAT communication.

7.6.4 PROFINET

After communication between the MD500-PN1 card and the AC drive is implemented, connect the AC drive to the PROFINET master station and configure related parameters to implement communication between the MD500-PN1 card and the PROFINET master station, thereby implementing AC drive networking.

PROFINET supports a variety of topologies, including bus, star, and tree topologies. Different networking modes can be implemented by using switches.

A ring or linear topology can be implemented by using two ports on the AC drive. In this case, connect the head and tail of the cable to only one of the two ports. The cable between two nodes can be up to 100 m.

7.7 Inspection After Wiring

After the wiring is completed, check the items in the following checklist one by one and put a tick for compliance.

Table 7-29 Wiring checklist

No.	Checklist	Compliance
1	The power input is connected to the R, S, and T terminals properly.	
2	The motor input cable is connected to the U, V, and W terminals properly.	
3	The diameter of the main circuit cable meets the requirement.	
4	Heat-shrink tubing is applied to the copper lug and conductors of the main circuit cable and the tubing completely wraps the conducting parts of the cable.	
5	Motor output cable does not exceed 50 m, or the carrier frequency (F0-15) is reduced for a motor output cable exceeding 50 m.	
6	The AC drive is properly grounded.	
7	The output terminals and control cable terminals are connected securely and reliably.	
8	Where applicable, the braking resistor and braking unit used are wired properly with proper resistance values.	
9	Shielded twisted pair cables are used as control circuit signal cables.	
10	Optional cards are properly connected.	
11	The control circuit cable and main circuit power cable are routed separately.	

8 Requirements on Installation of Options

8.1 AC Input Reactor

An AC input reactor is used to suppress harmonic waves in the input current. Install an AC reactor for applications with strict requirements on harmonic suppression to meet the requirements in IEC/EN 61000-3-2/12.

To install an AC input reactor, ensure sufficient space in the cabinet.

8.2 Output Reactor

An output reactor installed on the output side of the AC drive can reduce dV/dt and voltage stress on the motor winding, protecting the motor winding, reducing the motor temperature, and prolonging the motor service life.

8.3 Fuses, Contactors, and Circuit Breakers



If the fuse is blown or the circuit breaker trips, wait for at least a period of time specified on the equipment warning label before energizing the AC drive or operating any peripheral equipment. Failure to comply may result in equipment damage, personal injury, or even death.

To meet the requirements in IEC/EN 61800-5-1 and UL61800-5-1, install a fuse or circuit breaker on the input side to prevent accidents caused by internal short circuits.

8.4 EMC Filter

Use an optional EMC filter to meet category C2 emission requirements in EN 61800-3 of CE certification. For details about models and dimensions, see the *MD520 Series AC Drive Selection Guide*. Install the EMC filter according to the following requirements:

- Install the EMC filter close to the input terminals of the AC drive by using a cable shorter than 30 cm.
- Connect the grounding (PE) terminal of the EMC filter to that of the AC drive, and install the filter and the AC drive on the same conductive mounting surface, which is connected to the main grounding wire of the cabinet.
- Connect the LINE terminal of the EMC filter to the grid, and the LOAD terminal to the AC drive.

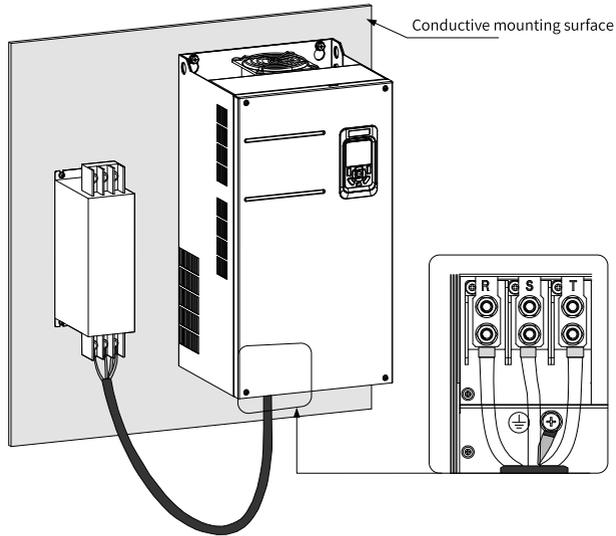


Figure 8-1 Installing an EMC filter

8.5 Ferrite Core and Ferrite Clamp

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

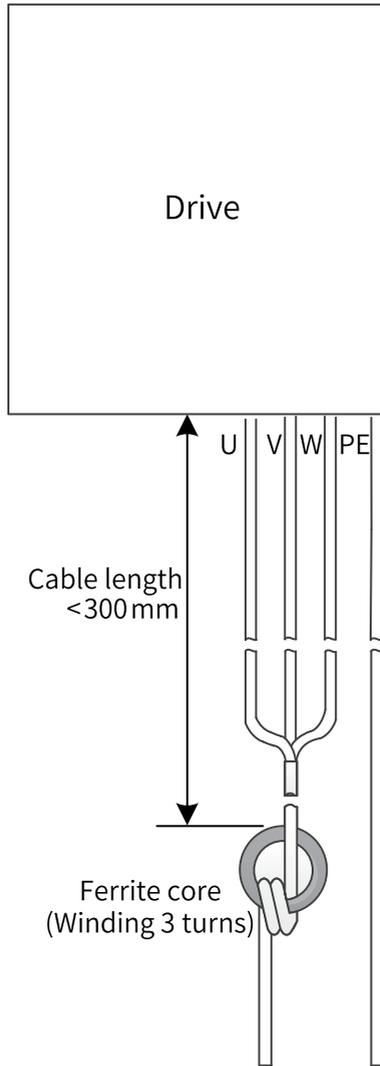


Figure 8-2 Installing a ferrite core

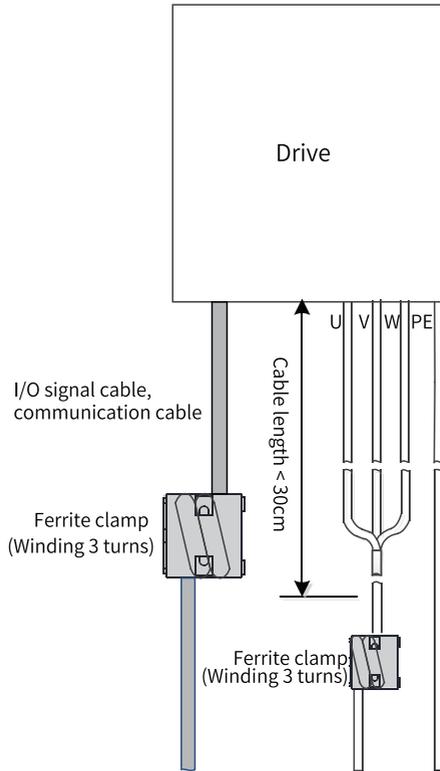


Figure 8-3 Installing a ferrite clamp

Note

The R/S/T or U/V/W cables must pass through the same ferrite core to suppress the common mode noise.

9 Troubleshooting for Common EMC Interference

Problems

9.1 Leakage Current Suppression

The drive outputs high-speed pulse voltage, which may easily incur high-frequency leakage current. The leakage current generated by each drive is higher than 100 mA. The rated action current of the earth leakage circuit breaker (ELCB) therefore must be above 100 mA. The drive may generate DC leakage current in the protective conductor, a B-type (delay-time) ELCB therefore must be used.

If multiple drives are used, install an ELCB to each drive. The factors that affect the leakage current are as follows:

- AC drive capacity
- Carrier frequency
- Type and length of the motor cable
- EMI filter

When leakage current causes the circuit breaker to trip, you should:

- Increase the rated operating current of the circuit breaker.
- Replace the circuit breaker with a new one with high-frequency suppression.
- Reduce the carrier frequency.
- Shorten the output drive cable.
- Install a current leakage suppression device.
- Use a circuit breaker from recommended manufacturers such as Chint Electric and Schneider.

9.2 Earth Leakage Circuit Breaker Malfunction

When an earth leakage circuit breaker malfunctions, perform troubleshooting according to the following table.

Table 9-1 Troubleshooting for leakage current

Trip	Possible Cause	Action
<p>Trip upon power-on</p>	<p>The anti-interference performance of the earth leakage circuit breaker is poor.</p>	<ol style="list-style-type: none"> 1. Use an earth leakage circuit breaker from a recommended manufacturer. 2. Use an earth leakage circuit breaker with greater rated operating current. 3. Move the unbalanced load to the front end of the earth leakage circuit breaker. 4. Remove the EMC screw or disconnect the grounding terminal of the external EMC filter to reduce the capacitance of the input end to the ground.
	<p>The operating current of the earth leakage circuit breaker is too low.</p>	
	<p>Unbalanced load is connected to the back end of the earth leakage circuit breaker.</p>	
	<p>The capacitance to the ground at the front end of the AC drive is large.</p>	
<p>Trip during operation</p>	<p>The anti-interference performance of the earth leakage circuit breaker is poor.</p>	<ol style="list-style-type: none"> 1. Use an earth leakage circuit breaker from a recommended manufacturer. 2. For an individual AC drive, tighten the EMC screw. For multiple AD drives, disconnect the optional EMC grounding screw, as shown in <i>"Figure 9-1 Disconnecting the optional EMC grounding screw" on page 148.</i> 3. Install a simple filter on the input side of the AC drive, and wind the LN/RST cable on a ferrite core near the earth leakage circuit breaker, as shown in <i>"Figure 9-2 Installing a simple filter and ferrite core on the input side" on page 148.</i> 4. Use an earth leakage circuit breaker with greater rated operating current. 5. Reduce the carrier frequency while ensuring performance. 6. Use shorter motor cables.
	<p>The operating current of the earth leakage circuit breaker is too low.</p>	
	<p>Unbalanced load is connected to the back end of the earth leakage circuit breaker.</p>	
	<p>The capacitance to ground of the motor cables and motors is too high.</p>	

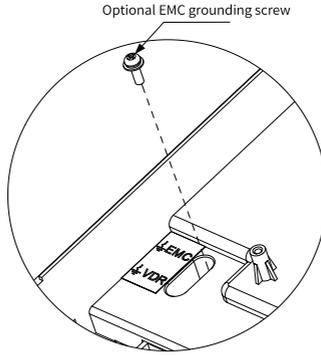


Figure 9-1 Disconnecting the optional EMC grounding screw

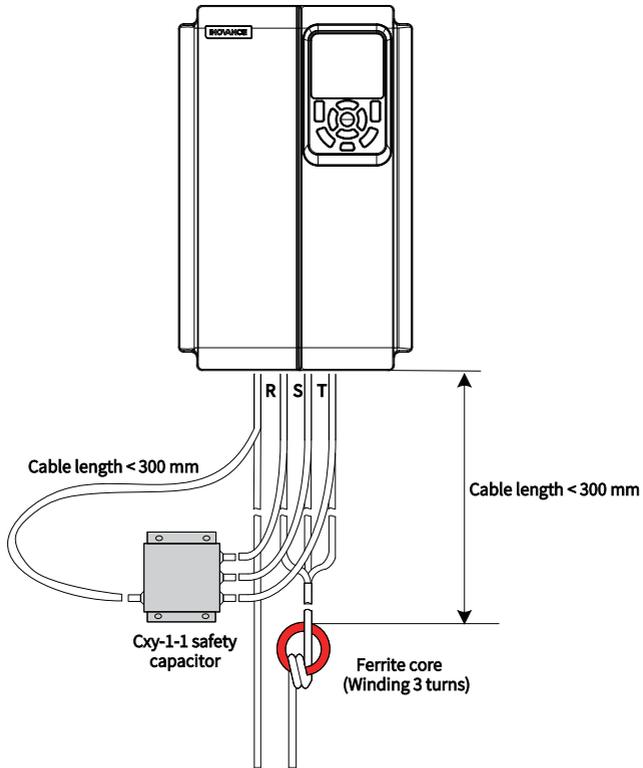


Figure 9-2 Installing a simple filter and ferrite core on the input side

9.3 Harmonic Suppression

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

9.4 Control Circuit Interference

9.4.1 High-Speed Pulse Interference

Follow the following table for troubleshooting.

Step	Action
1	Use a shielded twisted-pair cable and ground it at both ends.
2	Connect the motor enclosure to the PE terminal of the AC drive.
3	Connect the PE terminal of the AC drive to the PE terminal of the grid.
4	Add an equipotential bonding grounding wire between the host controller and the AC drive.
5	Separate the signal cable from the power cable by a distance of at least 30 cm.
6	Add a ferrite clamp to the signal cable, or wind the signal cable on a magnetic ring for one to two turns.
7	Wind the output U/V/W cables of the AC drive on a magnetic ring for two to four turns.
8	Use a shielded power cable and ensure that the shield is well-grounded.

9.4.2 Common I/O Signal Interference

The AC drive generates very strong interference. Despite EMC measures taken, the interference may still exist due to improper routing or grounding. When the AC drive interferes with other equipment, follow the following table for troubleshooting.

Step	Action
1	Use shielded cables as the I/O signal cables, with the shield connected to the PE terminal.
2	Reliably connect the PE terminal of the motor to the PE terminal of the AC drive, and connect the PE terminal of the AC drive to the PE terminal of the grid.
3	Add an equipotential bonding grounding wire between the host controller and the AC drive.
4	Wind the output U/V/W cables of the AC drive on a magnetic ring for two to four turns.

Step	Action
5	Increase capacitance at low-speed DI. The upper limit of capacitance is 0.1 μ F.
6	Increase capacitance at AI. The upper limit of capacitance is 0.22 μ F.
7	Add a ferrite clamp to the signal cable, or wind the signal cable on a magnetic ring for one to two turns.
8	Use a shielded power cable and ensure that the shield is well-grounded.

9.5 Communication Interference

9.5.1 RS485 and CAN Communication Interference

Follow the following table for troubleshooting.

Step	Action
1	Add a 120 Ω termination resistor at each end of the bus.
2	Use a multi-core shielded twisted pair cable instead, and ground the shield at both ends.
3	Separate the communication cable from the power cable by a distance of at least 30 cm.
4	For multi-node communication, adopt the daisy chain topology for routing.
5	For multi-node communication, add an equipotential bonding grounding wire between nodes.
6	Add a ferrite clamp at each end of the communication cable, or wind the communication cable on a magnetic ring for one to two turns.
7	Wind the output U/V/W cables of the AC drive on a magnetic ring for two to four turns.
8	Use a shielded power cable and ensure that the shield is well-grounded.

9.5.2 EtherCAT and PROFINET Communication Interference

Follow the following table for troubleshooting.

Step	Action
1	Check that the communication network cables meet the specification requirements for Cat 5e shielded cables.
2	Check that the communication port is not loose or in poor contact.

Step	Action
3	Separate the communication cable from the power cable by a distance of at least 30 cm.
4	For multi-node communication, add an equipotential bonding grounding wire between nodes.
5	Check that any cable between two nodes is within 100 m in length.
6	Add a ferrite clamp at each end of the communication cable and wind the communication cable for one to two turns.
7	Wind the output U/V/W cables of the AC drive on a magnetic ring for two to four turns.
8	Use a shielded power cable and ensure that the shield is well-grounded.

9.6 Encoder Feedback Signal Errors

Follow the following table for troubleshooting.

Step	Action
1	Route the encoder cable and power cable in different cable ducts.
2	When the AC drive is far away from the motor (the motor cable is as long as 10 m), disconnect the grounding (PE) terminal from the encoder shield on the AC drive side.
3	Add a magnetic ring or ferrite clamp for the encoder signal cable close to the AC drive.
4	Wind the output U/V/W cables of the AC drive on a magnetic ring for two to four turns.
5	Use a shielded power cable and ensure that the shield is well-grounded.



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Shenzhen Inovance Technology Co., Ltd.

www.inovance.com

Add.: Inovance Headquarters Tower, High-tech Industrial Park,
Guanlan Street, Longhua New District, Shenzhen

Tel: (0755) 2979 9595

Fax: (0755) 2961 9897

Customer service: 4000-300124

Suzhou Inovance Technology Co., Ltd.

www.inovance.com

Add.: No. 16 Youxiang Road, Yuexi Town,
Wuzhong District, Suzhou 215104, P.R. China

Tel: (0512) 6637 6666

Fax: (0512) 6285 6720

Customer service: 4000-300124