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SV660N Series Servo Drive

Hardware Guide

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

Data code 19011432C01

Preface

Introduction

The SV660N series high performance AC servo drive provides a power range from 0.05 kW to 7.5 kW. It supports EtherCAT communication protocol and carries Ethernet communication interfaces to work with the host controller for a networked operation of multiple servo drives.

The SV660N series servo drive supports stiffness level setting, inertia auto-tuning and vibration suppression to simplify the operation process. It allows a quiet and stable operation together with an MS1 series high-response servo motor with low or medium inertia and a 23-bit single-turn or multi-turn absolute encoder.

The drive aims to implement fast and accurate control in automation equipment such as semi-conductor manufacturing equipment, chip mounters, PCB punching machines, handling machineries, food processing machineries, machine tools, and transmission machineries.

This guide describes installation and wiring of the drive, including preparations before installation, unpacking and transportation, mechanical installation, and electrical installation.

More Documents

Name	Data code	Description
SV660N Series Servo Drive Hardware Guide	19011360	This guide describes the installation and wiring of the drive, including pre-installation preparations, unpacking and transportation,mechanical installation, and electrical installation.
SV660N Series Servo Drive Selection Guide	19011354	Presents technical data and dimensions of the servo drive, and specifications and models of optional parts (installation accessories, cables, and periphery electrical parts).
SV660N Series Servo Drive Commissioning Guide	19011362	Presents servo commissioning, parameter descriptions, including the operating panel, commissioning software, commissioning procedure and a parameter list.
SV660N Series Servo Drive Function Guide	19011361	Presents functions and parameters, including function overview, basic servo functions, adjustment and parameter list.
SV660N Series Servo Drive Communication Guide	19011395	Presents functions and parameters of the servo drive, including EtherCAT communication configuration, parameter description, and communication application cases.

Name	Data code	Description
SV660N Series Servo Drive Troubleshooting Guide	19011847	Introduces faults and fault levels, the troubleshooting process, warning codes and fault codes.
SV660N Series Servo Drive Safety Guide	19011846	Presents the safety function and related certifications and standards, wiring, commissioning process, troubleshooting, and functions.
SV660N Series Servo Drive Manual Package	PS00005512	Provides information on selection, installation, commissioning, function, troubleshooting and parameters of the equipment.

Revision History

Date	Version	Description
December 2023	C01	• Updated document acquisition channels. • Added descriptions for single-phase 220 V power supply. • Updated main circuit terminal cable specifications. • Updated main circuit terminal cable specifications. • Added the mounting instructions for the shield bracket. • Updated CN5 terminal layout. • Added DI logic level standard for DI/DO signals.
April 2023	C00	• Updated the product image on the front cover. • SIZE E does not support zero-distance installation anymore.
January 2023	B02	Modified information on recommended control terminal cable specifications.
November 2022	B01	• Added warranty information in the preface. • Added information on recommended control terminal cable specifications. • Added new content in wiring precautions: After all cables are connected, it is recommended to tie them at the point 10cm–20cm away from the connector end.
August 2022	B00	• Added information on recommended main circuit cables. • Modified the storage temperature range. • Adjusted the manual structure.
January 2022	A04	• Replaced the safety instructions • Added the table "Cable specifications and recommended models" to section 3.4.2; deleted information on the PE conductor. • Modified grounding instructions of a single device in section 3.4.6. • Modified the table "Recommended cable sizes" in section 3.6.3.

Date	Version	Description
October 2021	A03	• Optimized sections Safety Instructions, Cable Models, Cable Specifications and Recommended Models, and Wiring and Setup of the Regenerative Resistor. • Added information on unpacking weight and fan installation in section Installation. • Added a section: Precautions for Wiring Encoder Signal Cables. • Deleted the information on braking resistance selection process in section Wiring and Setup of the Regenerative Resistor. • Minor corrections.
March 2020	A02	Modified the information on the pin layout of the power cable connector at the lead wire-type motor side.
February 2020	A01	Minor corrections.
October 2020	A00	First release

Access to the guide

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

- http://www.inovance.com.
- Scan the QR code on the equipment to acquire more.
- Scan the QR code below to install the app, where you can search for and download manuals.

Warranty agreement

Inovance provides warranty service within the warranty period (as specified in your order) for faults or damage that occur during normal operation. Maintenance will be charged after the warranty period expires.

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

- Damage caused by operations not following the instructions in the user guide
- Damage caused by fire, flood, or abnormal voltage
- Damage caused by unintended use of the product
- Damage caused by use beyond the specified scope of application of the product

- Damage or secondary damage caused by force majeure (natural disaster, earthquake, and lightning strike)

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

For details, see Product Warranty Card.

Table of Contents

Preface 1
Fundamental Safety Instructions 7
1 Installation 14
1.1 Installing the Servo Drive 14
1.1.1 Unpacking and Handling 14
1.1.2 Installation Environment 16
1.1.3 Installation Clearance 17
1.1.4 Installation Dimensions 20
1.1.5 Installation Precautions 22
1.1.6 Installation Guide 24
1.2 Installing the Options 25
1.2.1 Instructions for Installing the Fuse and Circuit Breaker 25
1.2.2 Instructions for Installing the AC Input Reactor 25
1.2.3 Instructions for Installing the EMC Filter 26
1.2.4 Installation of the Magnetic Ring and Ferrite Clamp 26
1.2.5 Instructions for Installing the Shield Bracket 27
2 System Wiring Diagram 28
2.1 System Wiring Diagram 28
2.2 System Structure 31
3 Introduction to Wiring Terminals 32
3.1 Wiring Precautions 32
3.2 Terminal Pin Layout of the Servo Drive 34
3.3 Introduction To Main Circuit Terminals 38
3.3.1 Wiring Precautions 38
3.3.2 Main Circuit Wiring Requirements 40
3.3.3 Recommended Cable Specifications and Models 41
3.3.4 Main Circuit Terminal Layout 47
3.3.5 Connecting the Motor (UVW) 52
3.3.6 Wiring of External EMC Filter 55
3.3.7 Wiring of the Power Supply 56
3.3.8 Grounding and Wiring 59
3.4 Control Terminal (CN1) 63
3.4.1 Terminal Layout 65
3.4.2 DI/DO Signals 67
3.4.3 Wiring of the Brake 70
3.5 Encoder Terminal (CN2) 72
3.5.1 Terminal Layout 72
3.5.2 Connecting the Absolute Encoder 73
3.5.3 Installing Absolute Encoder Battery Box 77

3.5.4 Encoder Cable Specifications 79
3.6 Communication Terminals (CN3 and CN4) 80
3.7 Communication Terminal (CN5) 86
3.8 STO Safety Terminal (CN6) 87
3.9 Wiring and Setting of the Regenerative Resistor 91
4 Maintenance 92
4.1 Routine Maintenance Items 92
4.1.1 Routine Checklist 92
4.1.2 Routine Cleaning List 92
4.2 Regular Maintenance 93
4.2.1 Regular Checklist 93
4.2.2 Periodic Maintenance List 93
4.3 Component Replacement 94
4.3.1 Replacing the Motor Flat Key 94
4.3.2 Removing the Motor Oil Seal 95
5 Certification and Standards Compliance 97
5.1 CE Certification 97
5.1.1 Requirement for Compliance with EMC Directive 98
5.1.2 Requirements for Compliance with LVD 99
5.2 UL&cUL Certification 100
6 Solutions to Common EMC Problems 104
6.1 Malfunction of the Residual Current Device (RCD) 104
6.2 Harmonic Suppression 105
6.3 Control Circuit Interference 105
6.3.1 Common I/O Signal Interference 105
6.3.2 EtherCAT Communication Interference 107

Fundamental Safety Instructions

Safety Precautions

- This chapter presents essential safety instructions for a proper use of the equipment. Before operating the equipment, read through the guide and comprehend all the safety instructions. Failure to comply with the safety precautions may result in death, serious injury, or equipment damage.
- "CAUTION", "WARNING", and "DANGER" items in the guide only indicate some of the precautions that need to be followed; they just supplement the safety precautions.
- Use this equipment according to the designated environment requirements. Damage caused by improper use is not covered by warranty.
- Inovance shall take no responsibility for any personal injury or property damage caused by improper usage.

Safety Levels and Definitions

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

General Safety Instructions

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

Unpacking

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



- Check whether the packing is intact and whether there is damage, water seepage, dampness, and deformation before unpacking.
- Unpack the package by following the unpacking sequence. Do not strike the package violently.
- Check whether there is damage, rust, or injury on the surface of the equipment and equipment accessories before unpacking.
- Check whether the package contents are consistent with the packing list before unpacking.

Storage and Transportation



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



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

Installation



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



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



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

Wiring



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



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



- Follow the proper electrostatic discharge (ESD) procedure and wear an anti-static wrist strap to perform wiring. Failure to comply may result in damage to the equipment or to the internal circuit of the product.
- Use shielded twisted pairs for the control circuit. Connect the shield to the grounding terminal of the equipment for grounding purpose. Failure to comply will result in equipment malfunction.

Power-on



- Before power-on, check that the equipment is installed and wired properly and the motor can be restarted.
- Check that the power supply meets equipment requirements before power-on to prevent equipment damage or a fire.
- After power-on, do not open the cabinet door or protective cover of the equipment, touch any terminal, or disassemble any unit or component of the equipment. Failure to comply will result in an electric shock.



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

Operation



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



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

Maintenance



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



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

Repair



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

WARNING

- Submit the repair request according to the warranty agreement.
- When the fuse is blown or the circuit breaker or earth leakage current breaker (ELCB) trips, wait for at least the time designated on the equipment warning label before power-on or further operations. Failure to comply may result in death, personal injury or equipment damage.
- When the equipment is faulty or damaged, the troubleshooting and repair work must be performed by professionals that follow the repair instructions, with repair records kept properly.
- Replace quick-wear parts of the equipment according to the replacement instructions.
- Do not use damaged equipment. Failure to comply may result in death, personal injury, or severe equipment damage.
- After the equipment is replaced, check the wiring and set parameters again.

Disposal

WARNING

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

Additional Precautions

Cautions for the dynamic brake

- Dynamic braking can only be used for emergency stop in case of failure and sudden power failure. Do not trigger failure or power failure frequently.
- Ensure that the dynamic braking function has an operation interval of more than 5 minutes at high speed, otherwise the internal dynamic braking circuit may be damaged.
- Dynamic braking is common in rotating mechanical structures. For example, when a motor has stopped running, it keeps rotating due to the inertia of its load. In this case, this motor is in the regenerative state and short-circuit current passes through the dynamic brake. If this situation continues, the drive, and even the motor, may be burned.

Safety label

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

Safety label	Description
	• Never fail to connect the protective earth (PE) terminal. Read through the guide and follow the safety instructions before use. • Do not touch terminals within 15 minutes after disconnecting the power supply to prevent the risk of electric shock. • Do not touch the heatsink with power ON to prevent the risk of burn.

1 Installation

Read through the safety instructions in Chapter "Fundamental Safety Instructions". Failure to comply may result in serious consequence.



- Observe the installation direction described in this chapter. Failure to comply may result in equipment fault or damage.
- Do not install or operate damaged or defective equipment. Failure to comply can result in personal injury.
- Do not install the equipment in environments exposed to water splashes or corrosive gases. Failure to comply can result in equipment fault.
- Do not install the equipment near inflammable gases or combustible objects. Failure to comply can result in a fire or electric shock.
- Install the equipment inside a fire-proof cabinet that provides electrical protection. Failure to comply may result in a fire.
- Ensure the specified clearance is reserved among the servo drive, the interior surface of the control cabinet, and other machines. Failure to comply can result in a fire or equipment fault.
- Do not put heavy objects on the equipment. Failure to comply may result in personal injury or equipment damage.
- Do not subject the equipment to strong shock. Failure to comply may result in equipment damage.
- Do not block the air inlet/outlet of the equipment or allow unwanted objects to fall into the equipment. Failure to comply may result in a fire or equipment fault.

1.1 Installing the Servo Drive

1.1.1 Unpacking and Handling

Check the following items upon unpacking.

Item	Description
Check whether the delivered product is consistent with your order.	Check whether the servo drive model and specifications comply with your order. See the dimensions of the packing box in *"Table 1–1 " on page 15*. The deliverables include the product, cushion, carton box, and screw bag, as shown in *"Figure 1–1 " on page 15* .
Check whether the product is intact.	Check whether the product delivered is in good condition. If there is any missing or damage, contact Inovance or your supplier immediately.

Table 1–1 Dimensions of the outer packing box

Size	Servo drive model SV660N****I	Outer width (mm)	Outer height (mm)	Outer depth (mm)	Weight (kg)
A	S1R6, S2R8	250.0	90.0	195	0.96
B	S5R5	225.0	90	205.0	1.17
C	S7R6, T3R5, T5R4	235.0	105.0	215.0	1.48
D	S012, T8R4, T012	235.0	130.0	225.0	2.02
E	T017, T021, T026	320.0	150.0	280.0	3.94

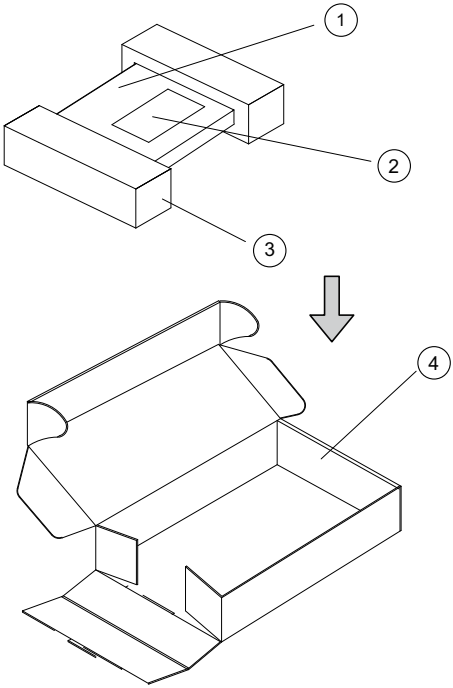


Figure 1-1 Contents inside the packing box

No.	Name
①	Product
②	Terminal accessories (varying with product models)
③	Cushion
④	Carton box

1.1.2 Installation Environment

Table 1–2 Environment requirements

Item	Requirement
Installation location	Indoors
Grid overvoltage	Overvoltage Class III (OVC III).
Altitude	The maximum altitude is 2000 m. • For altitudes not higher than 1000 m, derating is not required. • Derating is required for altitudes above 1000 m (derate 1% for every additional 100 m). • For altitudes above 2000 m, contact Inovance.
Temperature	• Mounting/Operating temperature: 0°C to 55°C For temperatures between 0°C to 45°C, derating is not required. For temperatures above 45°C, derate 2% for every additional 1°C. • Storage/Transportation temperature: -20°C to +70°C. • To improve the reliability of the machine, use the servo drive in environments without dramatic temperature change. • When installing the servo drive into an enclosed environment such as a control cabinet, use a cooling fan or air conditioner to keep the temperature of the inlet air below 45°C. Failure to comply will result in overheat or fire. • Install the servo drive on the surface of an incombustible object and leave sufficient surrounding space for heat dissipation. • Take measures to prevent the servo drive from being frozen.
Ambient humidity	Below 90% RH (no condensation)
Storage humidity	Below 90% RH (no condensation)
Vibration	Below 4.9m/s^2 • During transportation with packing box: compliant with EN 60721-3-2 Class 2M3. • During installation without packing box: compliant with ISTA 1H.
Shock	Below 19.6m/s^2

Item	Requirement
IP rating	IP20.
Environment	Pollution Degree 2 and below Install the servo drive in a place that meets the following requirements: • Free from direct sunlight, dust, corrosive gas, explosive and inflammable gas, oil mist, vapor, water drop, and salty element • Insusceptible to vibration (away from equipment that may generate strong vibration, such as a punch press) • Free from unwanted objects such as metal powder, oil, and water inside the servo drive • Free from radioactive substances, combustible materials, harmful gases and liquids, and salt corrosion • Away from combustible materials such as wood • Do not use the equipment in vacuum.

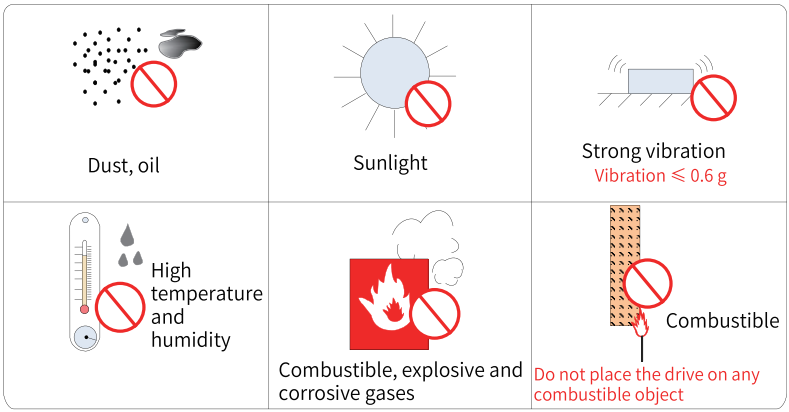


Figure 1-2 Environment requirements

1.1.3 Installation Clearance

Servo drives in different power ratings require different installation clearances. When installing multiple servo drives side by side, it is recommended to reserve a clearance of at least 10 mm (0.39 in.) between every two servo drives and a clearance of at least 50 mm (1.97 in.) above and below each servo drive for heat dissipation.

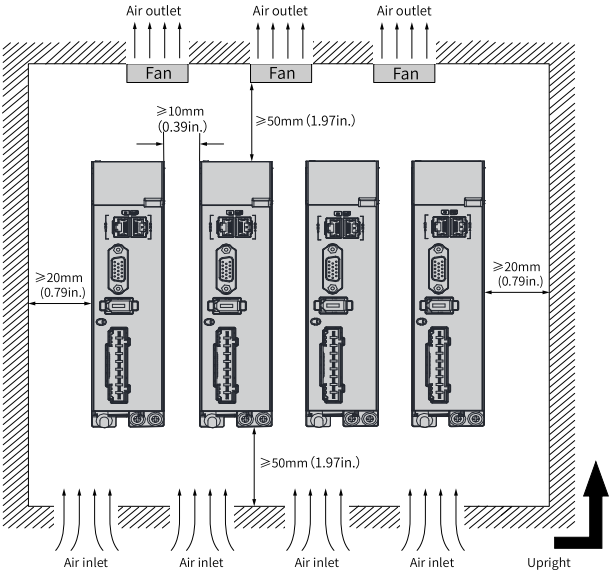


Figure 1-3 Clearance for side-by-side installation

Servo drives rated at 0.2 kW to 0.75 kW (size A and size B) support compact installation, in which a clearance of at least 1 mm (0.04 in.) must be reserved between every two servo drives. When adopting compact installation, derate the load rate to 75%.

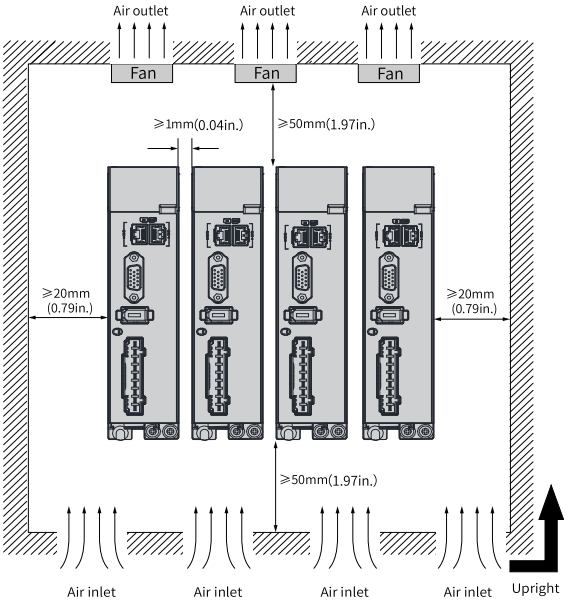


Figure 1-4 Clearance for compact installation

Servo drives in sizes C and D (rated power: 1.0 kW to 3 kW) support zero-clearance installation between every two servo drives, without the need for derating.

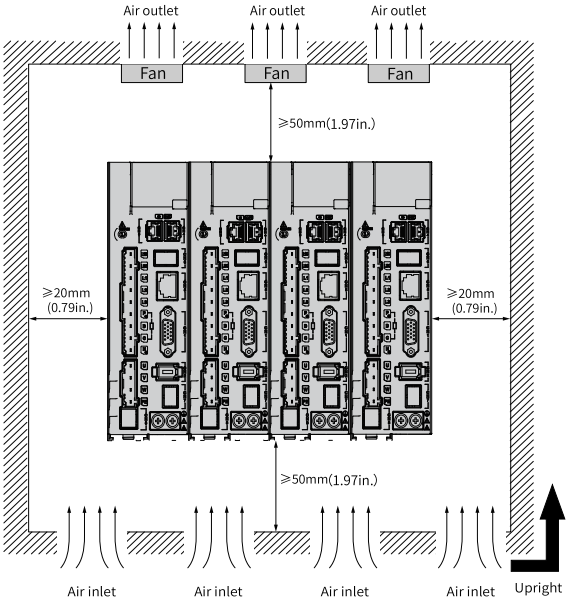


Figure 1-5 Zero-clearance installation

1.1.4 Installation Dimensions

Drives in Size A (Rated Power: (0.2 kW to 0.4 kW): SV660NS1R6I, SV660NS2R8I

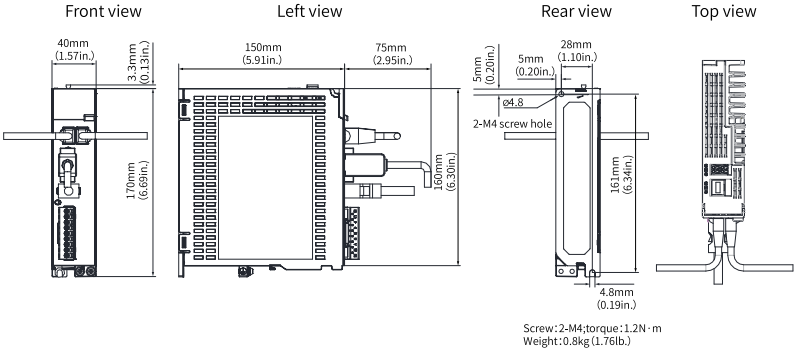


Figure 1-6 Dimension drawing of servo drives in size A

Servo drives in size B (rated power: 0.75 kW): SV660NS5R5I

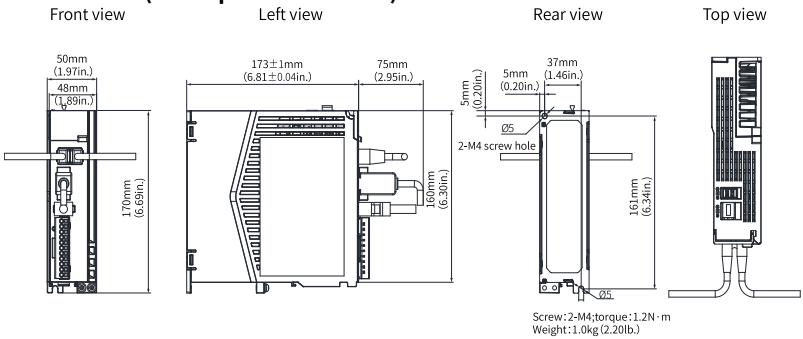


Figure 1-7 Dimension drawing of servo drives in size B

Drives in Size C (Rated Power: (1.0 kW to 1.5 kW): SV660NS7R6I, SV660NT3R5I, SV660NT5R4I

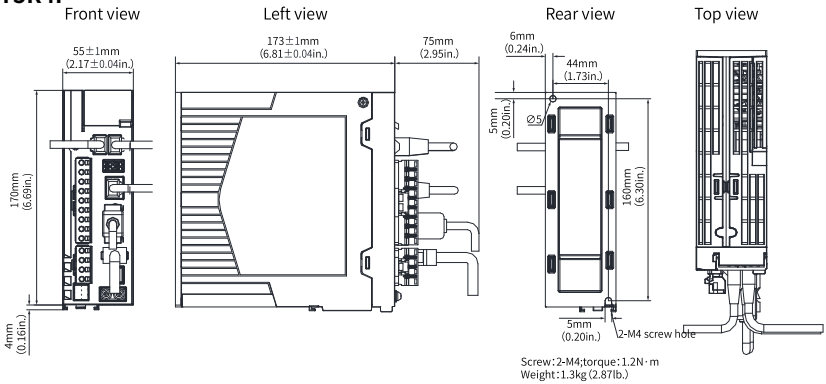


Figure 1-8 Dimension drawing of servo drives in size C

Drives in Size D (Rated Power: (1.5 kW to 3.0 kW): SV660NS012I, SV660NT8R4I, SV660NT012I

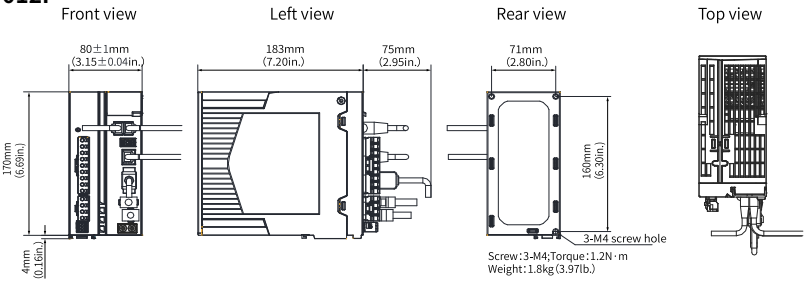


Figure 1-9 Dimension drawing of servo drives in size D

Drives in Size E (Rated Power: (5.0 kW to 7.5 kW): SV660NT017I, SV660NT021I, SV660NT026I

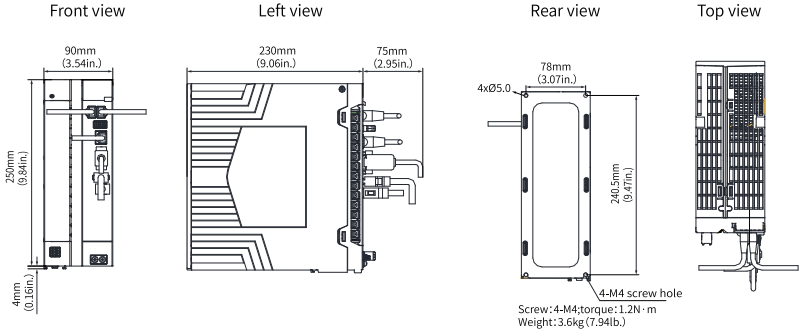
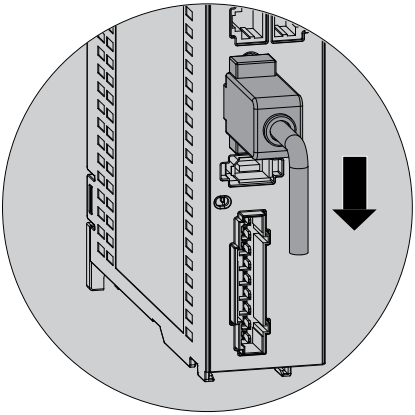
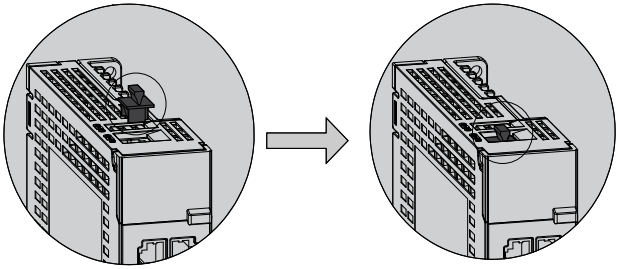


Figure 1-10 Dimension drawing of servo drives in size E

1.1.5 Installation Precautions

Table 1–3 Installation Precautions

Item	Description
Installation Method	• Install the servo drive vertically and upward to facilitate heat dissipation. For installation of multiple servo drives inside the cabinet, install them side by side. For dual-row installation, install an air guide plate. • Make sure the servo drive is installed vertically to the wall. Cool the servo drive down with natural convection or a cooling fan. Secure the servo drive to the mounting surface through two to four mounting holes (the number of mounting holes depends on the capacity of the servo drive). • Install the servo drive vertically to the wall, with its front (actual mounting face) facing the operator. • The mounting bracket (if needed) must be made of incombustible materials.
Cooling	As shown in *"1.1.4 Installation Dimensions" on page 20*, reserve sufficient space around the servo drive to ensure a good heat dissipation through the cooling fan or natural convection. Take the heat dissipated by other devices inside the cabinet into consideration. Install a cooling fan to the upper part of the servo drive to avoid excessive temperature rise in a certain area, keeping an even temperature inside the control cabinet.
Grounding	Ground the grounding terminal properly. Failure to comply may result in electric shock or malfunction due to interference.

Item	Description
Wiring requirements	As shown in the figure below, route the servo drive cables downwards to prevent liquid from flowing into the servo drive along the cables.  Route the cable in the direction of the arrow
Dust-proof cover (included in the standard configuration)	Insert the dust-proof cover into the communication port (CN5/CN6) not in use. This is to prevent unwanted objects, such as solids or liquids, from falling into the servo drive and resulting in faults. Each servo drive is delivered with two dust-proof covers inserted into the communication ports by default. You can place an order for more dust-proof covers as needed (model: NEX-02-N2B; manufacturer: PINGOOD).  **Note:** • Dust-proof cover: Prevents unwanted objects, such as solids or liquids, from falling into the servo drive and resulting in faults. • Dust-proof covers are delivered along with the servo drive. Keep the dust-proof covers in a proper place.

1.1.6 Installation Guide

The servo drive supports backplate mounting only.

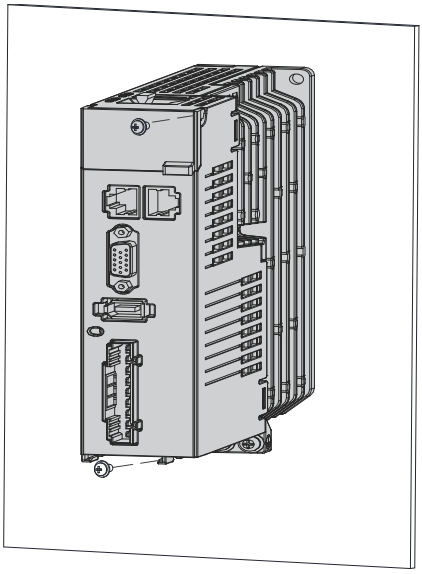


Figure 1-11 Backplate mounting

Note

- Servo drives in sizes A and C are secured by two screws, with one screw on the top and the other one at the bottom.
- Servo drives in size D are secured by three screws, with two screws on the top and another one at the bottom.
- Servo drives in size E are secured by four screws, with two screws on the top and the other two at the bottom.

1.2 Installing the Options

1.2.1 Instructions for Installing the Fuse and Circuit Breaker

Caution

To prevent electric shock, when the fuse is blown or the circuit breaker trips, wait for at least the time designated on the warning label before powering on the drive or operating peripheral devices. Failure to comply can result in death, severe personal injury, or equipment damage.

To comply with EN 61800-5-1 and UL 61800-5-1, install a fuse/circuit breaker on the input side of the servo drive to prevent accidents caused by short circuit in the internal circuit.

1.2.2 Instructions for Installing the AC Input Reactor

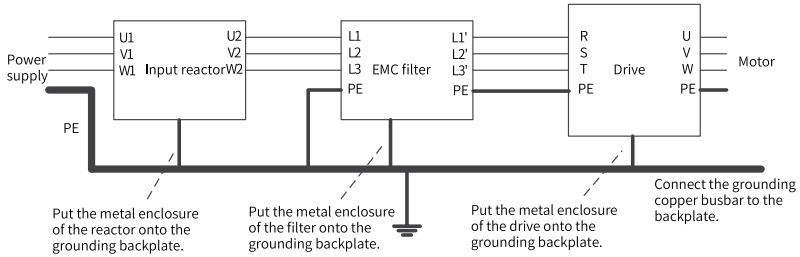


Figure 1-12 Installing the AC input reactor

1.2.3 Instructions for Installing the EMC Filter

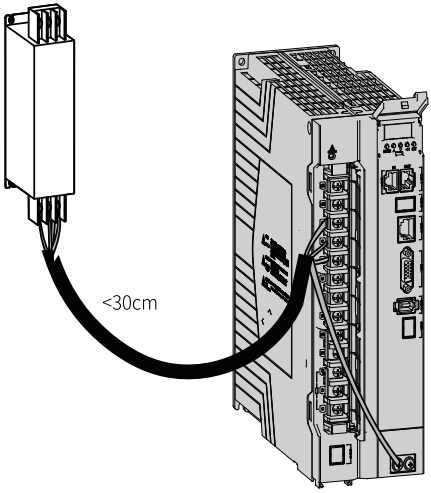


Figure 1-13 Installing the AC input reactor

1.2.4 Installation of the Magnetic Ring and Ferrite Clamp

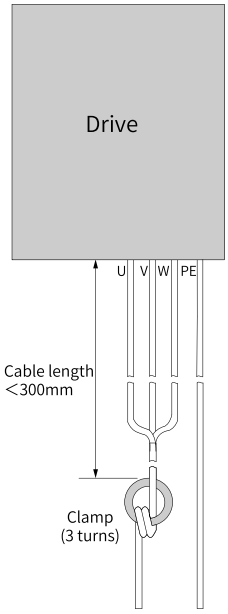


Figure 1-14 Installation of the magnetic ring

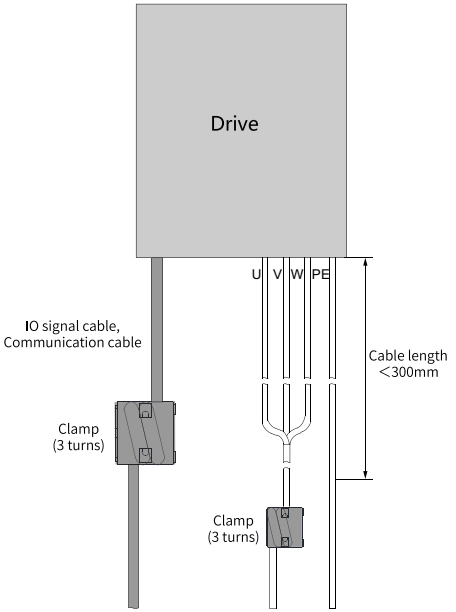


Figure 1-15 Installation of the ferrite clamp

1.2.5 Instructions for Installing the Shield Bracket

The EMC bracket needs to be used together with the matching clamp and servo cables to reduce electromagnetic interference.

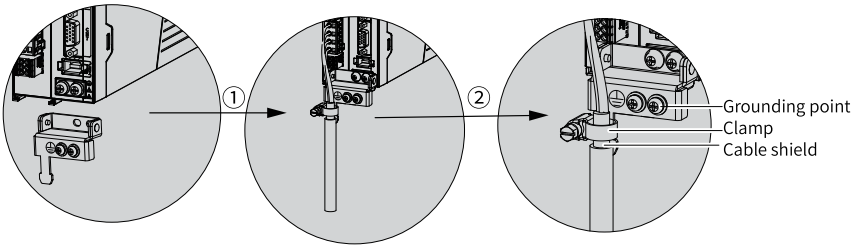


Figure 1-16 Installation of the shield bracket

- ①: Fix the shield bracket to the drive through two M4 screws with a tightening torque of 1.2 Nm.
- ②: Insert the clamp to the cable shield and shield bracket. Fix the shield to the shield bracket through screws. Connect motor power cables and brake cables according to the wiring diagram.

2 System Wiring Diagram

2.1 System Wiring Diagram

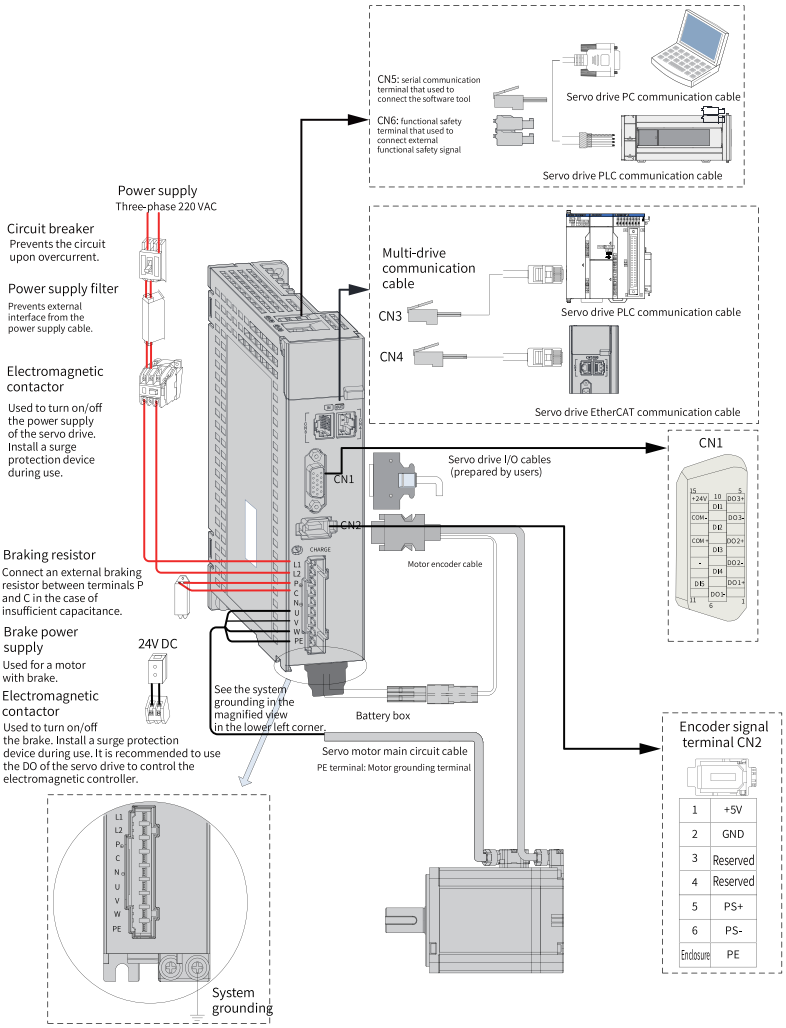


Figure 2-1 Wiring example of a single-phase 220 V system

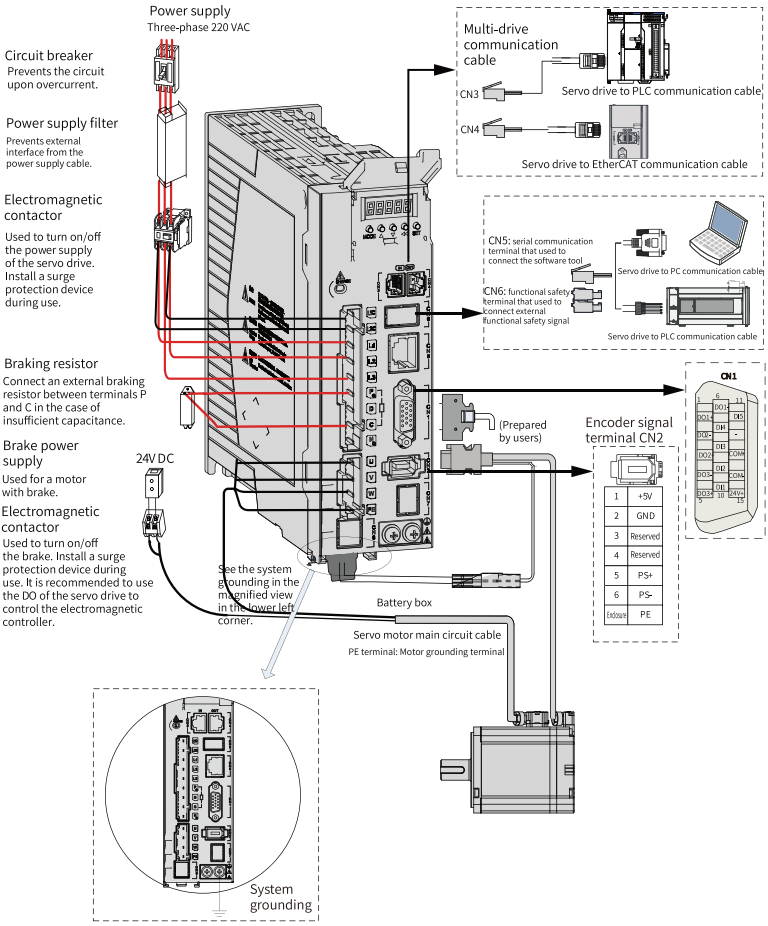


Figure 2-2 Wiring example of a three-phase 380 V system

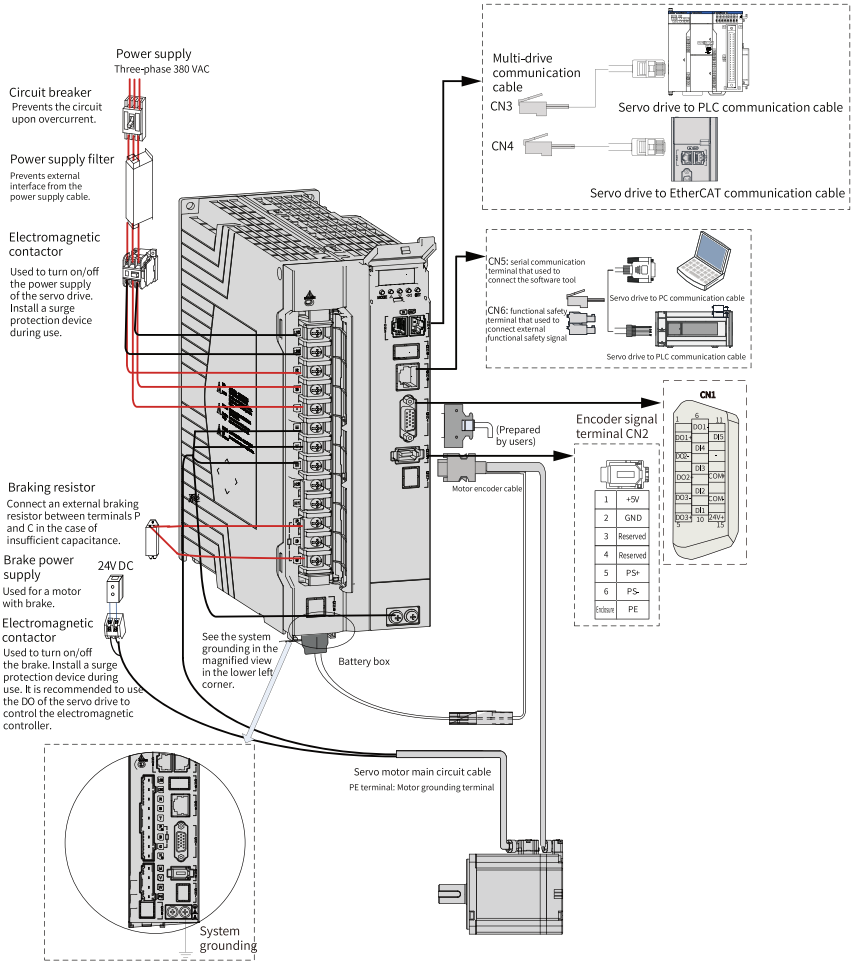


Figure 2-3 Wiring example of a three-phase 380 V system

Note

- When an external braking resistor is needed, connect it between terminals P and C (remove the jumper bar between terminals P and D). If an external braking resistor is not needed, short terminals P and D. Size A models are not equipped with built-in braking resistor or jumper bar between terminals P and D.
- CN6 (STO terminal) is only applicable to non-standard "-FS" models.

2.2 System Structure

- The servo drive is directly connected to an industrial power supply, with no isolation such as a transformer. A fuse or circuit breaker therefore must be connected to the input power supply to prevent electric shock in the servo system. For the sake of safety, install a residual current device (RCD) to provide protections against overload and short circuit or a specialized RCD to protect the grounding cable.
- Do not start or stop the motor by using the electromagnetic contactor. As a high-inductance device, the motor may generate high voltages instantaneously, which may break down the contactor.
- When connecting an external power supply to the control circuit or a 24 VDC power supply, pay attention to the power capacity as insufficient power capacity will lead to insufficient supply current, resulting in failure of the servo drive or the brake. This is especially true when the power supply is used to power up multiple servo drives or brakes. The brake must be powered up by a 24 VDC power supply that matches the motor model and meets the brake power requirements.

Note

- The built-in braking resistor or jumper bar is not available in models S1R6 and S2R8. If an external braking resistor is needed for these models, connect it between terminals P⊕ and C.
- Remove the jumper between P⊕ and D before using the external braking resistor. Failure to comply will result in overcurrent and damage the braking transistor.
- Do not connect the external braking resistor to the positive or negative pole of the bus directly. Failure to comply will damage the servo drive and result in a fire.
- Do not select any resistor lower than the minimum allowed resistance value. Failure to comply will result in E201.0 (Hardware overcurrent) or damage the servo drive.
- Make sure parameters H02.25 (Braking resistor setting), H02.26 (Power of external braking resistor) and H02.27 (Resistance of external braking resistor) are set properly before operating the servo drive.
- Install the external braking resistor on an incombustible object such as a metal.

---

3 Introduction to Wiring Terminals

3.1 Wiring Precautions



Read through the safety instructions in Chapter "Fundamental Safety Instructions". Failure to comply may result in serious consequences.

- Do not use the power from IT system for the servo drive. Use the power from TN/ TT system for the drive. Failure to comply may result in an electric shock.
- Connect an electromagnetic contactor between the input power supply and the main circuit power supply of the drive (L1, L2 for single-phase; L1, L2, L3/R, S, T for three-phase) to form a structure allowing independent power cutoff on the power supply side of the drive. This is to prevent fire accident caused by continuous high current generated upon fault.
- Check that the input power supply of the drive is within the specified voltage range. Failure to comply may result in faults.
- Do not connect the output terminals U, V, and W of the drive to a three-phase power supply. Failure to comply may result in physical injury or a fire.
- Do not connect the motor terminals U, V, and W to a mains power supply. Failure to comply may result in physical injury or a fire.
- Use the ALM (fault) signal to cut off the main circuit power supply. A faulty braking transistor may overheat the regenerative resistor and lead to a fire.
- Connect the PE terminal of the drive to the PE terminal of the control cabinet. Failure to comply may result in an electric shock.
- Ground the entire system properly. Failure to comply may result in equipment malfunction.
- After the power supply is cut off, residual voltage is still present in the internal capacitor of the drive, wait for at least 15 min before further operations. Failure to comply may result in an electric shock.



- The specification and installation of external cables must comply with applicable local regulations.
- Observe the following requirements when the servo drive is used on a vertical axis.
  - Set the safety device properly to prevent the workpiece from falling upon warning or overtravel.
  - Ensure the positive/negative polarity of the 24 V power supply is correct. Otherwise, the axis may fall and cause personal injury or equipment damage.
- Observe the following requirements during wiring of the power supply and main circuit:
  - When the main circuit terminal is a connector, remove the connector from the servo drive before wiring.
  - Insert one cable into one cable terminal of the connector. Do not insert multiple cables into one cable terminal.
  - When inserting cables, take enough care to prevent the cable conductor burrs from being short circuited to the neighboring cable.
  - Insulate the connecting part of the power supply terminals to prevent electric shock.
  - Do not connect a 220 V servo drive to a 380 V power supply directly.
  - Install safety devices such as a circuit breaker to prevent short circuit in external circuits. Failure to comply may result in a fire.
  - Cut off the main circuit power supply and switch off the S-ON signal after an alarm signal is detected.
  - After all cables are connected, it is recommended to tie them at the point 10cm–20cm away from the connector end.
- Connect the servo drive to the motor directly. Do not use an electromagnetic contactor during wiring. Failure to comply may result in equipment fault.
- Do not put heavy objects onto cables or pull cables with excessive force. Failure to comply may result in cable damage, leading to an electric shock.
- When connecting DO terminals to relays, ensure the polarity of the flywheel diode is correct. Wrong polarity will result in equipment damage or signal output failure.
- Keep a distance of at least 30 cm between main circuit cables and I/O signal cables/encoder cables. Failure to comply may result in equipment malfunction.
- Use twisted pairs or multi-conductor shielded twisted pairs as the I/O signal cable or encoder cable. Failure to comply may result in equipment malfunction.
- The maximum wiring lengths of the I/O signal cable and the encoder cable are 3 m and 10 m respectively.
- Use a power supply filter to reduce the electromagnetic interference on electronic devices surrounding the servo drive.
- Take proper shielding measures in the following locations to prevent equipment damage:

- Locations with interference caused by static electricity
- Locations with strong electric field or magnetic field
- Locations with radioactive rays

3.2 Terminal Pin Layout of the Servo Drive

Servo drives in size A (rated power: 0.2 kW to 0.4 kW): SV660NS1R6I and SV660NS2R8I

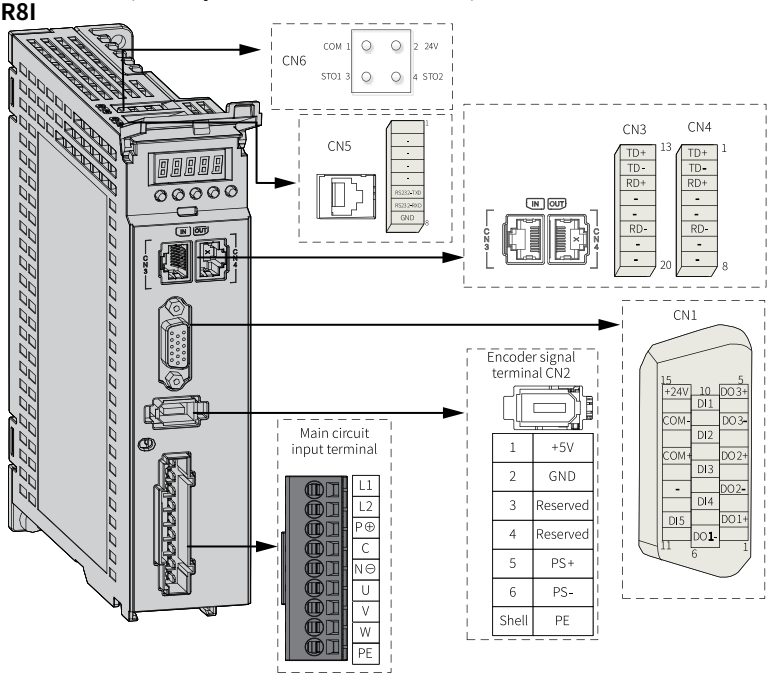


Figure 3-1 Terminal pin layout of servo drives in size A

Size B (rated power: 0.75 kW): SV660NS5R5I

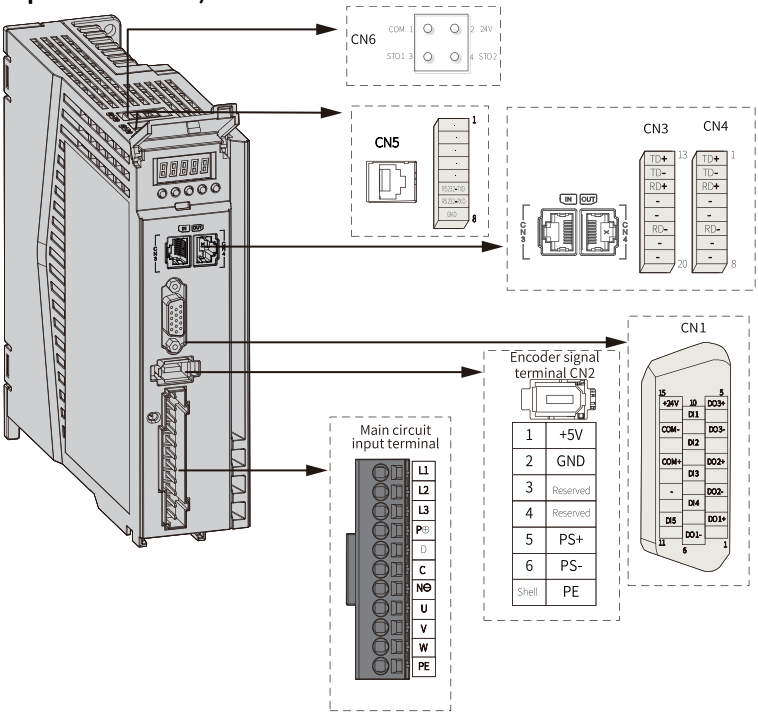


Figure 3-2 Terminal pin layout of servo drives in size B

Sizes C and D (rated power: 1.0 kW to 3.0 kW): size C: SV660NS7R6I/D: SV660NS012I

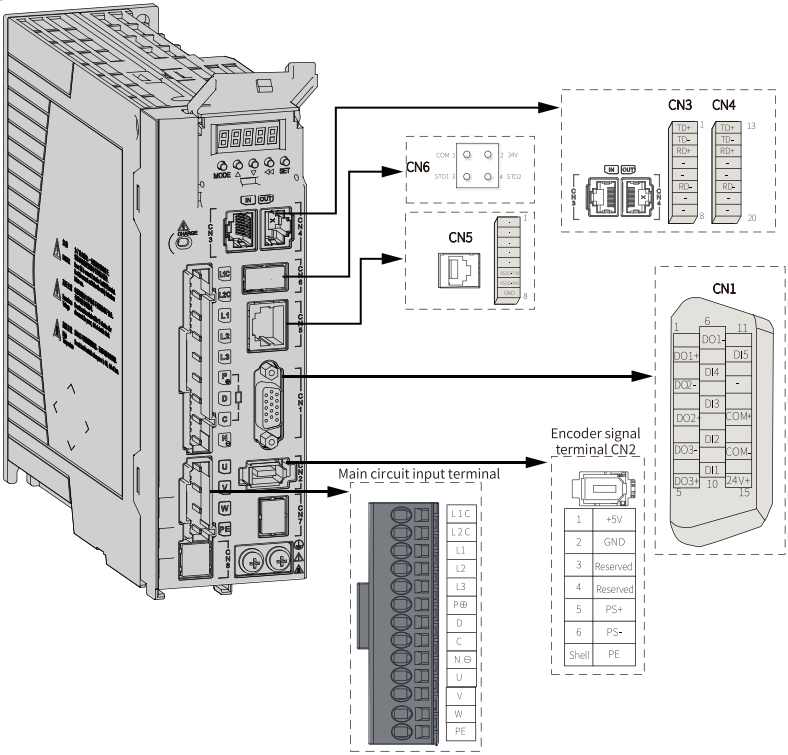


Figure 3-3 Terminal pin layout of servo drives in size C and size D (220V)

Sizes C and D (rated power: 1.0 kW to 3.0 kW): size C: SV660NT3R5I and SV660NT5R4I; size D: SV660NT8R4I, SV660NT012I

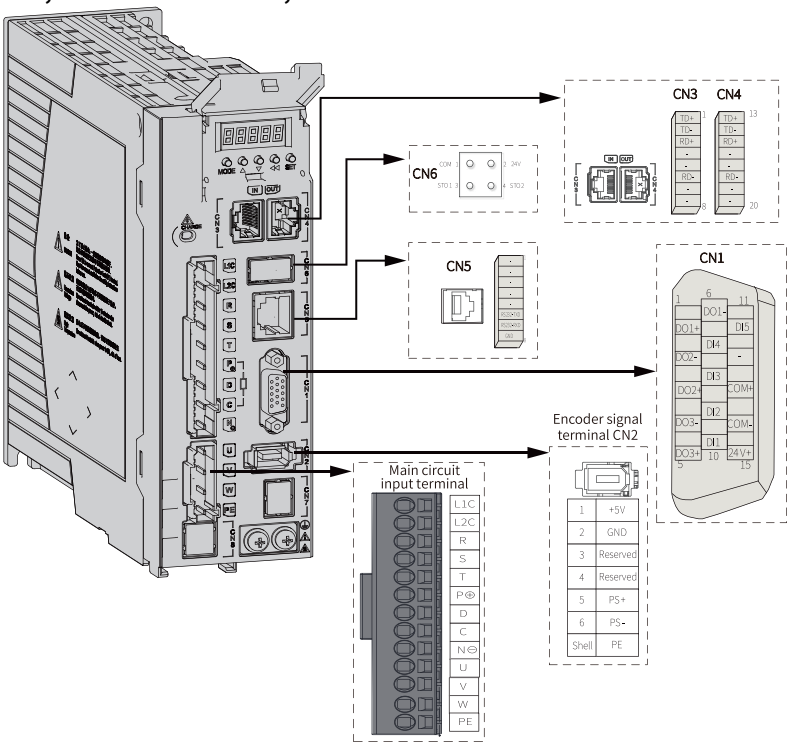


Figure 3-4 Terminal pin layout of servo drives in size C and size D (380V)

Size E (rated power: 5.0 kW to 7.5 kW): SV660NT017I, SV660NT021I, and SV660NT026I

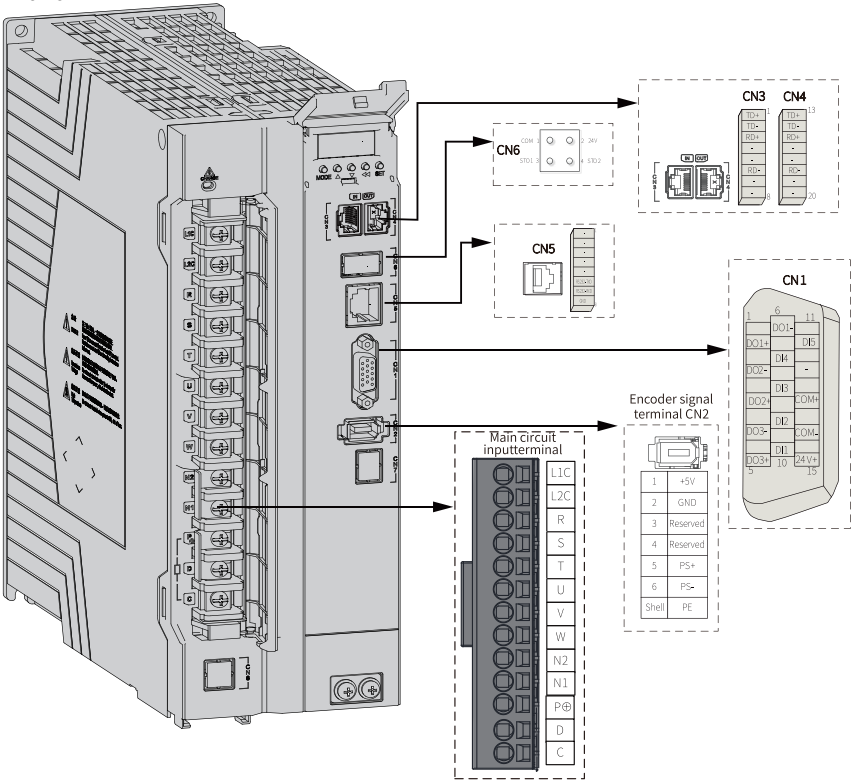


Figure 3-5 Terminal pin layout of servo drives in size E

Note

CN6 (STO terminal) is only applicable to customized model -FS.

3.3 Introduction To Main Circuit Terminals

3.3.1 Wiring Precautions

- Do not connect the input power supply cables to the output terminals U, V, and W. Failure to comply will damage the servo drive.
- When cables are bundled in a duct, take current reduction ratio into consideration because of the poor cooling condition.

- It is recommended to use Teflon cables featuring a higher temperature limit when the temperature inside the cabinet exceeds the temperature limit of regular cables. As the surface of regular cables may be easily hardened and cracked under low temperature, take thermal insulation measures for cables laid in environments with low temperature.
- The bending radius of a cable must be more than 10 times its outer diameter to prevent the internal conductor from breaking due to long-time bending.
- Use cables with a rated voltage above 600 VAC and rated temperature above 75°C. Under an ambient temperature of 30°C and normal cooling conditions, the permissible current density of the cable cannot exceed 8 A/mm^2 when the total current is below 50 A, or 5 A/mm^2 when the total current is above 50 A. The permissible current density (A/mm^2) can be adjusted based on the following formula in case of high ambient temperature or bundled Cable.
  Permissible current density = 8 x Reduction coefficient of conductor current-carrying density x Current correction coefficient

$$\text{Current correction coefficient} = \sqrt{(\text{Cable max. allowable temp.} - \text{Ambient temp.}) \div 30}$$

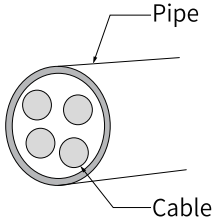


Table 3–1 Reduction coefficient of conductor current-carrying density

Number of Cables in the Same Duct	Current Reduction Coefficient
< 3	0.7
4	0.63
5–6	0.56
7–15	0.49

- Do not bundle power cables and signal cables together or route them through the same duct. Power cables and signal cables must be separated by at least 30 cm to prevent interference.
- High voltage may be still present in the servo drive after the power supply is switched off. Do not touch the power supply terminals within 5 minutes after power-off.
- Do not switch on/off the power supply frequently. If the power supply is switched on or off frequently within 1s, E740/E136/E430 may occur (see section Description of Error Codes in SV660N Series Servo Drive Troubleshooting Guide). In this case, power on the servo drive again after waiting for the specified ON/OFF interval. If

frequent ON/OFF operation is needed, the time interval between ON and OFF must be at least 1 min.
The servo drive carries a capacitor in the power supply part, and this capacitor will be charged with a high current for 0.2s upon power-on. Turning on/off the power supply frequently affects the performance of main circuit components inside the servo drive.

- Use a grounding cable with the same cross-sectional area as the main circuit cable. If the cross-sectional area of the main circuit cable is less than 1.6 mm^2, use a grounding cable with a cross-sectional area of 2.0 mm^2.
- The servo drive must be grounded properly. Failure to comply may result in device malfunction or damage.
- Do not power on the servo drive if terminal screws or cables are loose. Failure to comply may lead to a fire.

3.3.2 Main Circuit Wiring Requirements

Servo drive power input cables and motor cables may generate strong electromagnetic interference. To prevent the electromagnetic interference incurred by long-distance parallel routing and coupling between disturbing cables and control cables, keep a clearance of at least 30 cm between main circuit cables and signal cables. Main circuit cables include the RST cable, UVW cable, DC bus, and braking cable. Signal cables include the I/O signal cable, communication cable, and encoder cable.

Cable ducts must be connected and grounded properly. Aluminum cable ducts can be used to ensure equipotentiality of the device. The filter, servo drive, and motor must be properly connected to systems (machines or devices), with spraying protection applied at the installation part and the conductive metal kept in full contact.

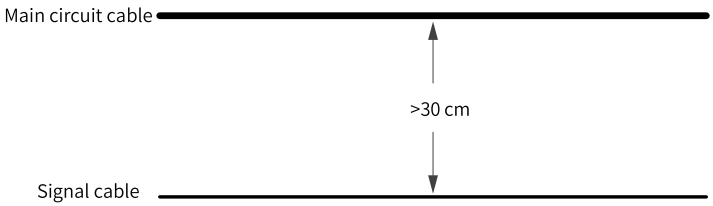


Figure 3-6 Cable layout

Wiring requirements

The wiring mode compliant with the Low Voltage Directive is supported.

- Terminals P⊕, C, and N⊖ are used to connect optional parts. Do not connect these terminals to an AC power supply.

- To protect the main circuit, separate and cover the surface that may come into contact with the main circuit.
- Prevent foreign objects from entering the wiring area of the terminal block.
- Do not solder the twisted conductors.
- The tightening torque may vary with terminals. Tighten terminal screws with the specified tightening torque. You can use a torque screwdriver, torque ratchet, or torque wrench to tighten terminal screws.
- When using an electric screwdriver to tighten terminal screws, set the electric screwdriver to low speed to prevent damage to the terminal screws.
- Tighten the terminal screws with an angle not greater than 5°. Failure to comply may damage the terminal screws.

3.3.3 Recommended Cable Specifications and Models

Table 3–2 Input/Output current specifications of the servo drive

Drive model SV660N****I		Rated input current (A)	Rated output current (A)	Maximum output current (A)
Single-phase 220 V				
Size A	S1R6	2.3	1.6	5.8
	S2R8	4	2.8	10.1
Size B	S5R5	7.9	5.5	16.9
Size C	S7R6	9.6	7.6	23
Size D	S012	12.8	11.6	32
Three-phase 220 V				
Size C	S7R6	5.1	7.6	23
Size D	S012	8	11.6	32
Three-phase 380 V				
Size C	T3R5	2.4	3.5	11
	T5R4	3.6	5.4	14
Size D	T8R4	5.6	8.4	20
	T012	8	11.9	29.75
Size E	T017	12	16.5	41.25
	T021	16	20.8	52.12
	T026	21	25.7	64.25

Table 3–3 Recommended main circuit cables

Drive model SV660N****I			L1C, L2C		L1, L2, L3/R, S, T		P⊕, D, C, NΘ, N2, N1		U, V, W, PE		Grounding terminal	
Size	Model	Rated input current (A)	(mm^2)	(AWG)	(mm^2)	(AWG)	(mm^2)	(AWG)	(mm^2)	(AWG)	(mm^2)	(AWG)
Single-phase 220 V												
Size A	S1R6	2.3	2x0.52	20	3x0.52	20	2x0.52	20	3x0.52	20	0.52	20
	S2R8	4	2x0.52	20	3x0.52	20	2x0.52	20	3x0.52	20	0.52	20
Size B	S5R5	7.9	2x0.52	20	3x0.52	20	2x0.52	20	3x0.52	20	0.52	20
Size C	S7R6	9.6	2x0.82	18	3x0.82	18	2x0.82	18	3x0.82	18	0.82	18
Size D	S012	12.8	2x1.31	16	3x1.31	16	2x1.31	16	3x1.31	16	1.31	16
Three-phase 220 V												
Size C	S7R6	5.1	2x0.52	20	3x0.52	20	2x0.52	20	3x0.52	20	0.52	20
Size D	S012	8	2x1.31	16	3x1.31	16	2x1.31	16	3x1.31	16	1.31	16
Three-phase 380 V												
Size C	T3R5	2.4	2x0.52	20	3x0.52	20	2x0.52	20	3x0.52	20	0.52	20
	T5R4	3.6	2x0.52	20	3x0.52	20	2x0.52	20	3x0.52	20	0.52	20
Size D	T8R4	5.6	2x0.52	20	3x0.52	20	2x0.52	20	3x0.52	20	0.52	20
	T012	8	2x1.31	16	3x1.31	16	2x1.31	16	3x1.31	16	1.31	16
Size E	T017	12	2x2.08	14	3x2.08	14	2x2.08	14	3x2.08	14	2.08	14
	T021	16	2x2.08	14	3x2.08	14	2x2.08	14	3x2.08	14	2.08	14
	T026	21	2x3.33	12	3x3.33	12	2x3.33	12	3x3.33	12	3.33	12

Table 3–4 Recommended cable specifications and models

Cable type	Cable specification	Outer diameter (mm)
Power cable	4x12AWG	12.2±0.4
	4x14AWG	10.5±0.3
	4x16AWG	9.5±0.4
	4x18AWG	7.8±0.2
	4x20AWG	6.5±0.2
Shielded power cable	4x12AWG	12.9±0.4
	4x14AWG	11.2±0.4
	4x16AWG	10.1±0.4
	4x18AWG	8.3±0.2
	4x20AWG	6.5±0.2
Power cable + brake cable	4×20AWG + 2×24AWG	6.5±0.2
Brake cable	2x18AWG	5.8±0.2
	2x20AWG	5.0±0.2

Table 3–5 Main circuit cable lug and tightening torque

Servo drive model SV660N****I			Recommended PVC cable model (at 40°C)			
Size	Model	Rated input current (A)	U, V, W, PE cable lug	Brake cable lug	Grounding cable lug	Tightening torque (N·m)
Single-phase 220 V						
Size A	S1R6	2.3	GTVE10008	GTVE05008	TVR2-4	-
	S2R8	4			TVR2-4	-
Size B	S5R5	7.9			TVR2-4	-
Size C	S7R6	9.6			TVR2-4	-
Size D	S012	12.8	GTVE15008	GTVE10008	TVR2-4	-
Three-phase 220 V						
Size C	S7R6	5.1	GTVE10008	GTVE05008	TVR2-4	-
Size D	S012	8	GTVE15008	GTVE10008	TVR2-4	-
Three-phase 380 V						
Size C	T3R5	2.4	GTVE10008	GTVE05008	TVR2-4	-
	T5R4	3.6			TVR2-4	-
Size D	T8R4	5.6			TVR2-4	-
	T012	8	GTVE15008	GTVE10008	TVR2-4	-
Size E	T017	12	TVS1.25-4	GTVE10008	TVR1.25-4	1.36
	T021	16	TVS2-4	GTVE10008	TNR2-4	1.36
	T026	21	TVS3.5-4	GTVE10008	TNR3.5-4	1.36

Table 3–6 Dimensions and appearance of TVR2-4 cable lug

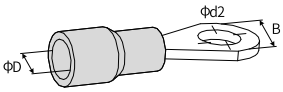
Lug model		D (mm)	d2 (mm)	B (mm)	Appearance
TVR	2-4	4.5	4.3	8.5	

Table 3–7 Recommended terminal blocks

Servo drive model SV660N****I		Terminal block
Size A	S1R6	9EDGK-5.0-09P-13-01AH & Gaozheng & B/BBB1
	S2R8	
Size B	S5R5	9EDGK-5.0-11P-13-05AH & Gaozheng & B/BBA2
Size C	S7R6	9EDGK-7.5-09P-13-1014A(H) & Gaozheng & B/BAB1+9EDGK-7.5-04P-13-1015A_H & Gaozheng & B/BAA2
	T3R5	
	T5R4	
Size D	S012	
	T8R4	
	T012	

Servo drive model SV660N****I		Terminal block
Size E	T017	-
	T021	
	T026	

Table 3–8 Specifications of motor output cables

MS1H1/H4 05B–10C (0.05 kW to 1 kW)			
Cable type	Regular cable	Flexible cable	Oil-resistant shielded flexible cable
Cable model	S6-L-M/B***-X.X	S6-L-M/B***-X.X-T	S6-L-M/B***-X.X-TS
Cable specifications	UL2517 (rated temperature: 105°C) 4Ex20AWG+2Cx24AWG	UL2517 (rated temperature: 105°C) 4Ex20AWG+2Cx24AWG	UL2517 (rated temperature: 105°C) 4Ex20AWG+2Cx24AWG
	Power cable: 20AWG (0.52 mm^2) OD of insulation: 1.7 mm	Power cable: 20AWG (0.52 mm^2) OD of insulation: 1.7 mm	Power cable: 20AWG (0.52 mm^2) OD of insulation: 1.7 mm
	Brake cable: 24AWG (0.205 mm^2) OD of insulation: 1.1 mm	Brake cable: 24AWG (0.205 mm^2) OD of insulation: 1.1 mm	Brake cable: 24AWG (0.205 mm^2) OD of insulation: 1.1 mm
Sheath outer diameter	ϕ6.5 (0.2 mm)		
Internal structure and conductor colors			
Fill in "X.X" of the model number with cable length.			

Table 3–9 Specifications of motor output cables

MS1H2 10C–50C (1 kW to 5 kW)/MS1H3 85B–18C (0.85 kW to 1.8 kW)			
Cable type	Regular cable	Flexible cable	Oil-resistant shielded flexible cable
Cable model	S6-L-M/B***-X.X	S6-L-M/B***-X.X-T	S6-L-M/B***-X.X-TS
Cable specifications	UL2586 (rated temperature: 105°C) 4Ex16AWG, 2Cx18AWG	UL2586 (rated temperature: 105°C) 4Ex16AWG, 2Cx18AWG	UL2586 (rated temperature: 105°C) 4Ex16AWG, 2Cx18AWG
	Power cable: 16AWG (1.31 mm^2) OD of insulation: 3.1 mm	Power cable: 16AWG (1.31 mm^2) OD of insulation: 3.25 mm	Power cable: 16AWG (1.31 mm^2) OD of insulation: 3.25 mm
	Brake cable: 18AWG (0.823 mm^2) OD of insulation: 2.0 mm	Brake cable: 18AWG (0.823 mm^2) OD of insulation: 2.15 mm	Brake cable: 18AWG (0.823 mm^2) OD of insulation: 2.15 mm
Sheath outer diameter	ϕ9.5±0.3 mm (main circuit)	ϕ10.0±0.3 mm (main circuit)	ϕ10.5±0.3 mm (main circuit)

MS1H2 10C–50C (1 kW to 5 kW)/MS1H3 85B–18C (0.85 kW to 1.8 kW)			
Internal structure and conductor colors			
Fill in "X.X" of the model number with cable length.			

Table 3–10 Specifications of motor output cables

MS1H3 29C–75C (2.9 kW to 7.5 kW)			
Cable type	Regular cable	Flexible cable	Oil-resistant shielded flexible cable
Cable model	S6-L-M/B***-X.X	S6-L-M/B***-X.X-T	S6-L-M/B***-X.X-TS
Cable specifications	UL2586 (rated temperature: 105°C) 4Ex12AWG, 2Cx18AWG	UL2586 (rated temperature: 105°C) 4Ex12AWG, 2Cx18AWG	UL2586 (rated temperature: 105°C) 4Ex12AWG, 2Cx18AWG
	Power cable: 12AWG (3.31 mm^2) OD of insulation: 4.1 mm	Power cable: 12AWG (3.31 mm^2) OD of insulation: 4.2 mm	Power cable: 12AWG (3.31 mm^2) OD of insulation: 4.2 mm
	Brake cable: 18AWG (0.823 mm^2) OD of insulation: 2.0 mm	Brake cable: 18AWG (0.823 mm^2) OD of insulation: 2.15 mm	Brake cable: 18AWG (0.823 mm^2) OD of insulation: 2.15 mm
Sheath outer diameter	ϕ12.2±0.4 mm (main circuit)	ϕ12.5±0.4 mm (main circuit)	ϕ13.2±0.4 mm (main circuit)
Internal structure and conductor colors			
Fill in "X.X" of the model number with cable length.			

Cable selection

To comply with the EMC standards, use shielded cables. You can use shield-less cables if EMC is not a concern.

Shielded cables are divided into three-conductor shielded cables and four-conductor shielded cables, as shown in the following figure.

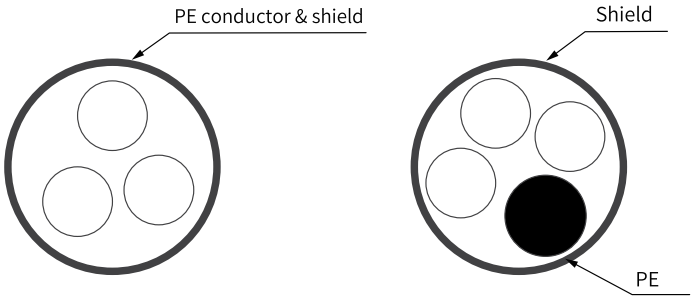


Figure 3-7 Recommended power cable

If the conductivity of the three-conductor cable shield is insufficient, add an extra PE cable. Or use a four-core shielded cable, with one core being the PE wire. The shield of the shielded cable is comprised of coaxial cooper braids to suppress radio frequency interference. To enhance the shielding performance and conductivity, the braided density of the shield must be greater than 90%.

Observe national or regional regulations when selecting cable dimensions. The IEC cable must meet the following requirements:

- Compliant with IEC 60204-1 and IEC 60364-5-52 standards
- PVC insulated cables with copper conductors
- Heat resistance: ambient temperature of 40°C and cable surface temperature of 70°C (Contact the manufacturer if the ambient temperature exceeds 40°C.)

Requirements for UL cable selection are described in *" Cable requirements" on page 101*.

Note

If the recommended cable specifications for peripheral devices or optional parts exceed the applicable cable specification range, contact Inovance.

3.3.4 Main Circuit Terminal Layout

Size A (rated power: 0.2 kW to 0.4 kW): SV660NS1R6I, SV660NS2R8I

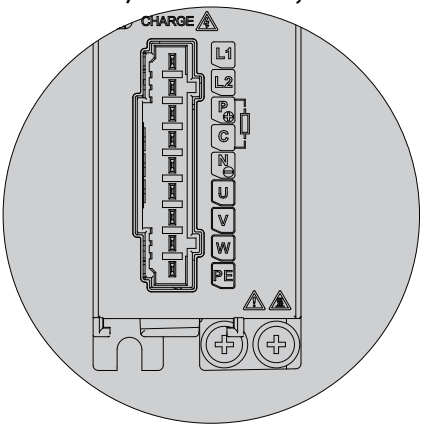


Figure 3-8 Main circuit terminal pins of size A drive

Table 3–11 Description of main circuit terminal pins of servo drives in size A

No.	Name	Description
1	L1, L2 (power input terminals)	See the nameplate for the rated voltage class.
2	P⊕, N⊖ (DC bus terminals)	Used by the common DC bus for multiple servo drives. Contact Inovance for technical support.
	P⊕, C Terminals for connecting external braking resistor	If an external braking resistor is needed, connect it between terminals P⊕ and C.
3	U, V, W (terminals for connecting the servo motor)	Connected to U, V, and W phases of the servo motor.
4	Motor grounding terminal	Connected to the grounding terminal of the motor for grounding purpose.

Rated power: (size B: 0.75 kW): SV660NS5R5I

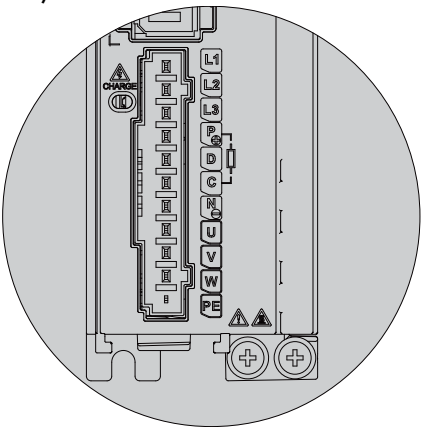


Figure 3-9 Pin assignment of main circuit terminal of servo drives in size B

Table 3–12 Description of main circuit terminal pins of servo drives in size B

No.	Name	Description
1	L1, L2, L3 (power input terminals)	See the nameplate for the rated voltage class. Note: S5R5 (750 W) models support single-phase 220 V input only, with a 220 V power supply connected between terminals L1 and L2.
2	P⊕, N⊖ (DC bus terminals)	Used by the common DC bus for multiple servo drives. Contact Inovance for technical support.
	P⊕, D, C Terminals for connecting external braking resistor	Remove the jumper bar between terminals P⊕ and C before connecting an external braking resistor between terminals P⊕ and D. When an external braking resistor is needed, connect it between terminals P and C. If an external braking resistor is not needed, short terminals P and D. Size A models are not equipped with built-in braking resistor or jumper bar between terminals P and D.
3	U, V, W (terminals for connecting the servo motor)	Connected to U, V, and W phases of the servo motor.
4	Motor grounding terminal	Connected to the grounding terminal of the motor for grounding purpose.

Rated power (size C/D: 1.0 kW to 3.0 kW): SV660NS7R6I, SV660NS012I

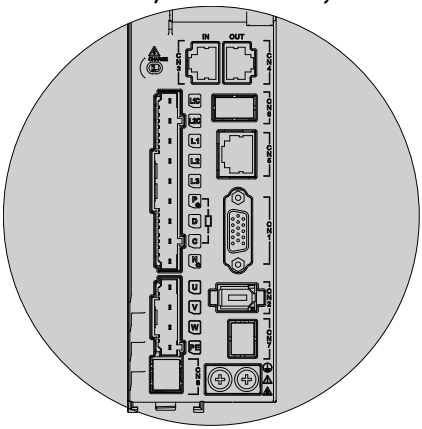


Figure 3-10 Pin assignment of main circuit terminal of servo drives in size C and D (220 V)

Table 3–13 Description of main circuit terminal pins of servo drives in size C and D (220 V)

No.	Name	Description
1	L1C, L2C Control circuit power input terminals	See the nameplate for the rated voltage class.
2	L1, L2, L3 Main circuit power input terminals	See the nameplate for the rated voltage class. Note: The drive supports single-phase/three-phase 220 V input, with the 220 V power supply connected between L1 and L2.
3	P⊕, N⊖ (DC bus terminals)	Used by the common DC bus for multiple servo drives. Contact Inovance for technical support.
	P⊕, D, C Terminals for connecting external braking resistor	Remove the jumper bar between terminals P⊕ and C before connecting an external braking resistor between terminals P⊕ and D. When an external braking resistor is needed, connect it between terminals P and C. If an external braking resistor is not needed, short terminals P and D. Size A models are not equipped with built-in braking resistor or jumper bar between terminals P and D.
4	U, V, W (terminals for connecting the servo motor)	Connected to U, V, and W phases of the servo motor.
5	Motor grounding terminal	Connected to the grounding terminal of the motor for grounding purpose.

Rated power (size C/D: 1.0 kW to 3.0 kW): SV660NT3R5I, SV660NT5R4I, SV660NT8R4I, SV660NT012I

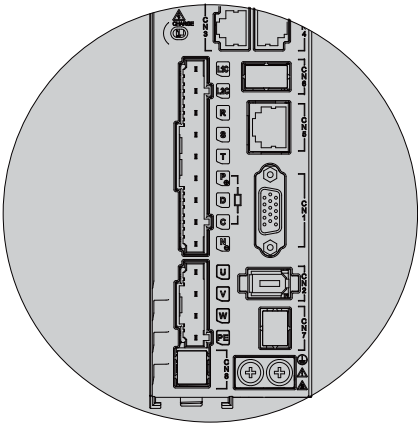


Figure 3-11 Pin assignment of main circuit terminal of servo drives in size C and D (380 V)

Table 3–14 Description of main circuit terminal pins of servo drives in size C and D (380 V)

No.	Name	Description
1	L1C, L2C Control circuit power input terminals	See the nameplate for the rated voltage class.
2	R, S, T Main circuit power input terminals	See the nameplate for the rated voltage class.
3	P⊕, N⊖ (DC bus terminals)	Used by the common DC bus for multiple servo drives. Contact Inovance for technical support.
	P⊕, D, C Terminals for connecting external braking resistor	Remove the jumper bar between terminals P⊕ and C before connecting an external braking resistor between terminals P⊕ and D. When an external braking resistor is needed, connect it between terminals P and C. If an external braking resistor is not needed, short terminals P and D. Size A models are not equipped with built-in braking resistor or jumper bar between terminals P and D.
4	U, V, W (terminals for connecting the servo motor)	Connected to U, V, and W phases of the servo motor.
5	Motor grounding terminal	Connected to the grounding terminal of the motor for grounding purpose.

Size E (rated power: 5.0 kW to 7.5 kW): SV660NT017I, SV660NT021I, and SV660NT026I

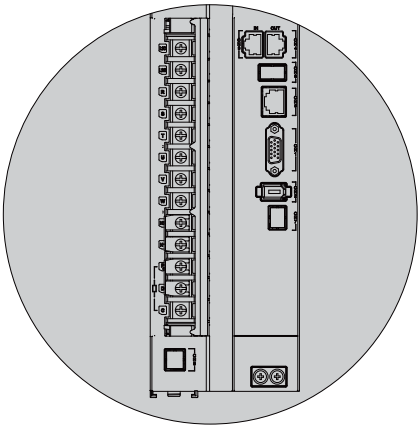


Figure 3-12 Pin assignment of main circuit terminal of servo drives in size E

Table 3–15 Description of main circuit terminal pins of servo drives in size E

No.	Name	Description
1	L1C, L2C Control circuit power input terminals	See the nameplate for the rated voltage class.
2	R, S, T Main circuit power input terminals	See the nameplate for the rated voltage class.
3	U, V, W (terminals for connecting the servo motor)	Connected to U, V, and W phases of the servo motor.
4	N2, N1 Terminals for connecting external reactor	Terminals N1 and N2 are jumpered by default. To suppress harmonics in the power supply, remove the jumper between terminals N1 and N2 first and connect an external DC reactor between terminals N1 and N2.
5	P⊕, D, C Terminals for connecting external braking resistor	Remove the jumper bar between terminals P⊕ and C before connecting an external braking resistor between terminals P⊕ and D. When an external braking resistor is needed, connect it between terminals P and C. If an external braking resistor is not needed, short terminals P and D. Size A models are not equipped with built-in braking resistor or jumper bar between terminals P and D.

3.3.5 Connecting the Motor (UVW)

Keep the lead wire of the motor cable shield as short as possible, with its width (b in the following figure) not shorter than 1/5 of its length (a in the following figure).

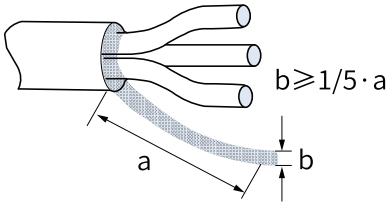


Figure 3-13 Lead-out of the motor cable shield

- The following figure shows the wiring diagram for a terminal-type motor.

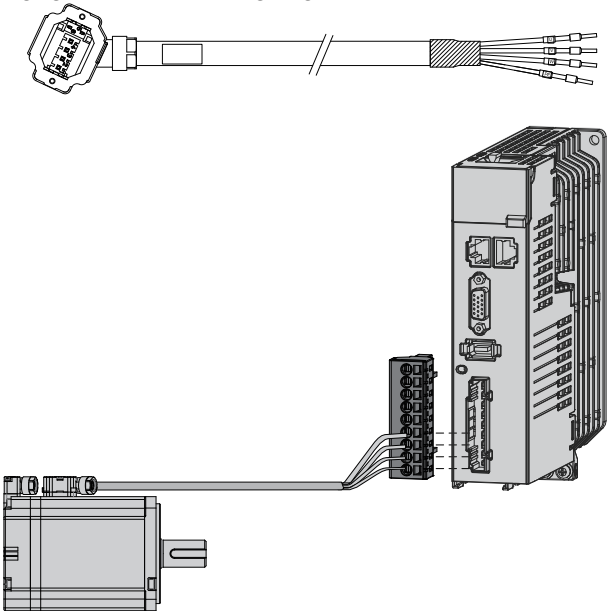
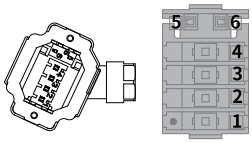


Figure 3-14 Wiring between the servo drive and terminal-type motor

Table 3–16 Description of the power cable connector (motor side) for terminal-type motors

Flange Size [1]	Outline Drawing of the Connector	Terminal Pin Layout		
		Pin No.	Signal Name	Color
Terminal-type: 40 60 80	 Black 6-pin connector	1	PE	Yellow/ Green
		2	W	Red
		3	V	Black
		4	U	White
		5	Brake (polarity insensitive)	Brown
		6		Blue

Note

- [1] The flange size refers to the width of the mounting flange.
- Power cable colors are subject to the actual product. All cable colors mentioned in this guide refer to Inovance cable colors.

- The connection diagram for a flying leads type motor is shown in the following figure.

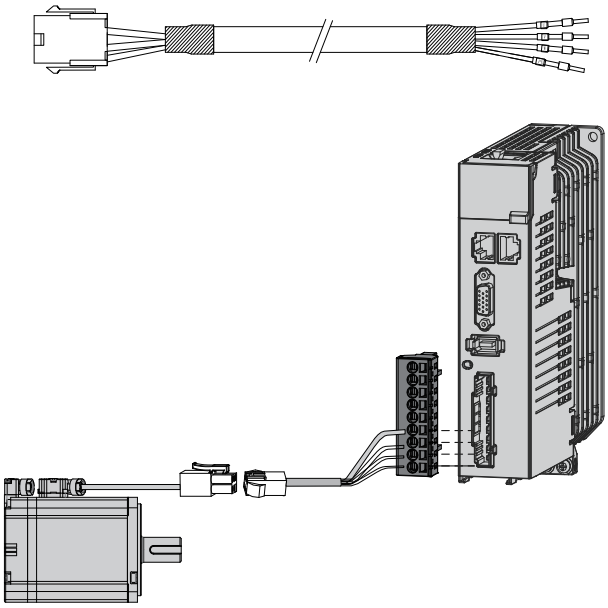
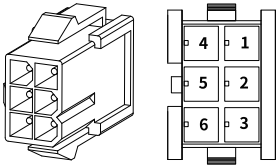


Figure 3-15 Wiring between the servo drive and terminal-type motor

Table 3–17 Description of the flying leads power cable connector (motor side)

Flange Size [1]	Outline Drawing of the Connector	Terminal Pin Layout		
		Pin No.	Signal Name	Color
Flying leads type: 40 60 80	 Black 6-pin connector Recommendation: Plastic housing: MOLEX-50361736 Terminal: MOLEX-39000061	1	U	White
		2	V	Black
		4	W	Red
		5	PE	Yellow/ Green
		3	Brake (polarity insensitive)	Brown
		6		Blue

Note

- [1]: The motor flame size indicates the width for installing the flange.
- Power cable colors are subject to the actual product. All cable colors mentioned in this guide refer to Inovance cable colors.

- The following table describes the connector for high-power motor power cables.

Table 3–18 Description of the power cable connector (motor side)

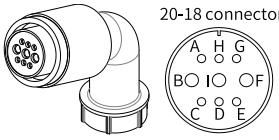
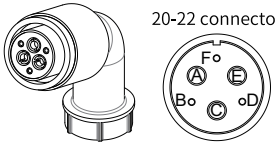
Flange Size [1]	Outline Drawing of the Connector	Terminal Pin Layout		
		Pin No.	Signal Name	Color
100 130	 MIL-DTL-5015 series 3108E20-18S aviation connector	B	U	Blue
		I	V	Black
		F	W	Red
		G	PE	Yellow/ Green
		C	Brake (polarity insensitive)	Red
		E		Black

Table 3–19 Description of the power cable connector (motor side)

Flange Size [1]	Outline Drawing of the Connector	Terminal Pin Layout		
		Pin No.	Signal Name	Color
180	 MIL-DTL-5015 series 3108E20-22S military-spec connector	A	U	Blue
		C	V	Black
		E	W	Red
		F	PE	Yellow/ Green
		B	Brake (polarity insensitive)	Red
		D		Black

Note

- [1] The flange size refers to the width of the mounting flange.
- Power cable colors are subject to the actual product. All cable colors mentioned in this guide refer to Inovance cable colors.

3.3.6 Wiring of External EMC Filter

Install the filter near the input terminals of the drive. The cable between the filter and the drive must be shorter than 30 cm. Connect the grounding terminal of the filter together with the grounding terminal of the drive. Ensure the filter and the drive are installed onto the same conductive mounting surface that is connected to the main grounding of the control cabinet.

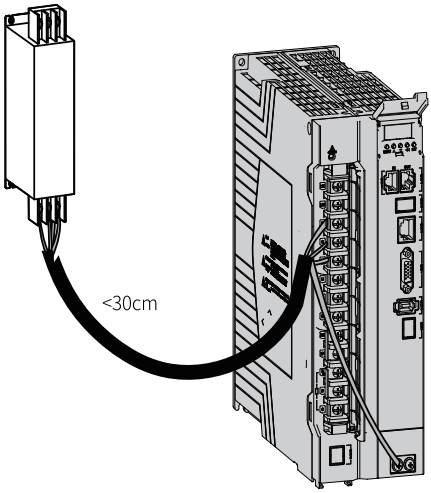


Figure 3-16 Installing the filter

3.3.7 Wiring of the Power Supply

- Single-phase 220 V models: SV660NS1R6I, SV660NS2R8I, SV660NS5R5I, SV660NS7R6I and SV660NS012I

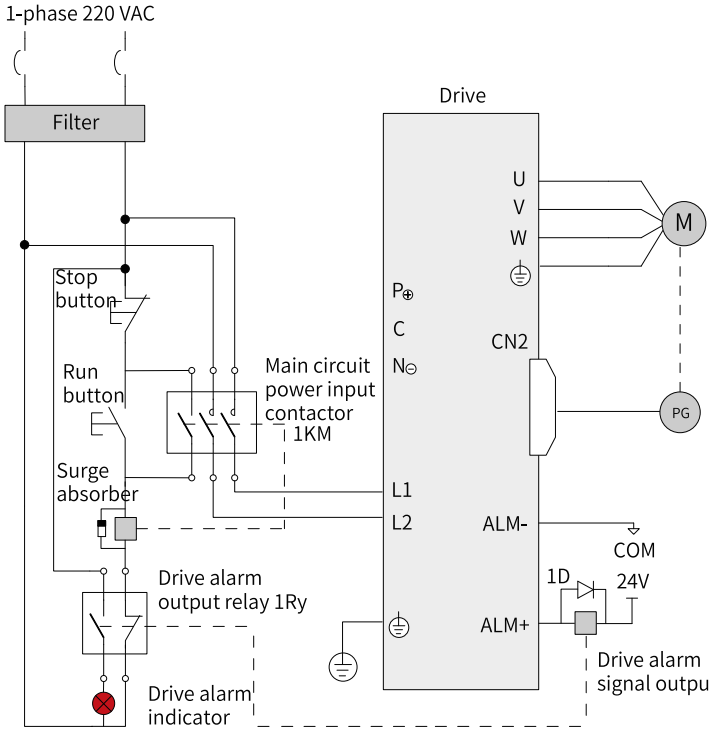


Figure 3-17 Main circuit wiring

Note

- 1KM: Electromagnetic contactor; 1Ry: Relay; 1D: Flywheel diode
- DO is set as alarm output (ALM+/-). When the servo drive alarms, the power supply will be cut off automatically. SV660NS1R6I and SV660NS2R8I are not configured with built-in regenerative resistors, if the regenerative resistor is needed, connect an external regenerative resistor between P⊕ and C.

- Three-phase 220 V models: SV660NS7R6I, SV660NS012I

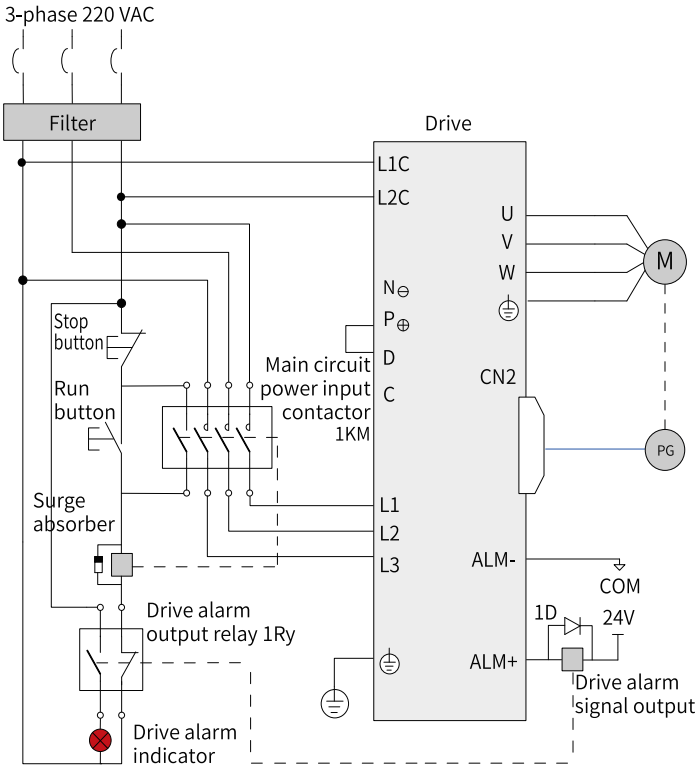


Figure 3-18 Main circuit wiring of three-phase 220 V models

Note

- 1KM: Electromagnetic contactor; 1Ry: Relay; 1D: Flywheel diode
- The DO is set as alarm output (ALM+/-). When the servo drive alarms, the power supply is cut off automatically and the alarm indicator lights up.

- Three-phase 380 V models: SV660NT3R5I, SV660NT5R4I, SV660NT8R4I, SV660NT012I, SV660NT021I, SV660NT026I

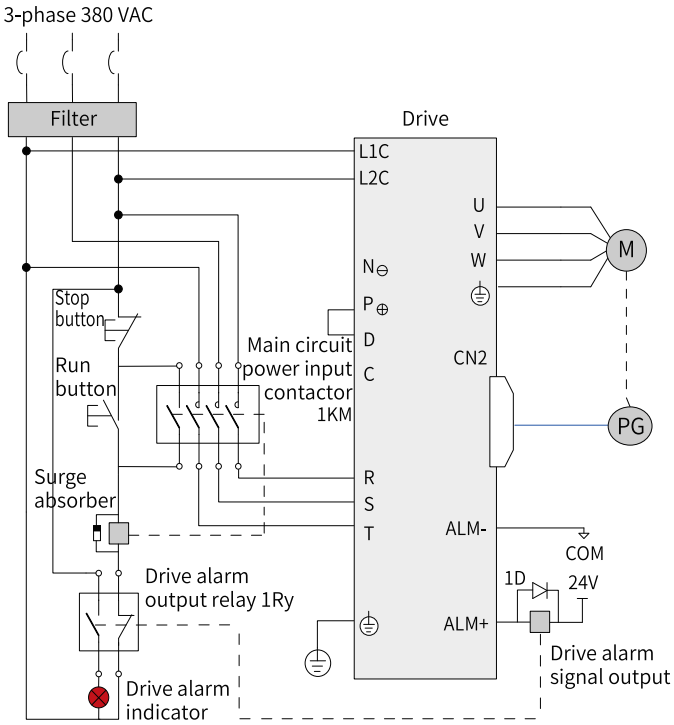


Figure 3-19 Main circuit wiring of three-phase 380 V models

Note

- 1KM: Electromagnetic contactor; 1Ry: Relay; 1D: Flywheel diode
- The DO is set as alarm output (ALM+/-). When the servo drive alarms, the power supply is cut off automatically and the alarm indicator lights up.

3.3.8 Grounding and Wiring

Observe the following requirements to ensure a proper grounding of the servo drive.



- To prevent electric shocks, ground the grounding terminal properly. Observe related national or regional regulations during grounding.
- To prevent electric shocks, ensure the protective grounding conductor complies with technical specifications and local safety standards. Keep the length of the grounding cable as short as possible. As the leakage current of the equipment may exceed 3.5 mA, it is recommended to use a copper protective grounding conductor with a cross-sectional area of at least 10 mm^2, or use two protective grounding conductors with the same specification.
- The dimensions of the grounding cable must comply with the electrical device technical standards. Keep the length of the grounding cable as short as possible. Failure to comply will lead to unstable potential in the grounding terminals away from the grounding point due to leakage current, resulting in an electric shock.



- For use of multiple servo drives, observe all the grounding instructions for the drive. Improper grounding of the device will lead to malfunction of the drive and the device.
- Do not share the same grounding cable with other devices (such as welding machines or high-current electrical devices). Improper grounding of the device will lead to drive or device faults caused by electrical interference.
- For use of multiple servo drives, observe all the grounding instructions for the drive. Improper grounding of the device will lead to malfunction of the drive and the device.
- For drives equipped with optional VDR and insulation resistor grounding screws, remove the grounding screw before voltage resistance test. Failure to comply may cause the drive to fail the test.

Grounding requirements

Observe the following requirements to ensure a proper grounding of the drive.

- The protective grounding conductor must be a yellow/green cable comprised of copper conductors. Do not connect the protective grounding conductor to a switching device (such as a circuit breaker) in serial.
- Ground the grounding terminal properly. Improper grounding will lead to device malfunction or damage.
- Do not connect the grounding terminal to the N terminal of the neutral wire of the power supply.

- It is recommended to install the drive to a conductive metal surface. Ensure the whole conductive bottom of the drive is connected properly to the mounting face.
- Tighten the grounding screw with specified tightening torque to prevent the protective grounding conductor from being secured improperly.

Single-drive grounding

Installation of an individual drive:

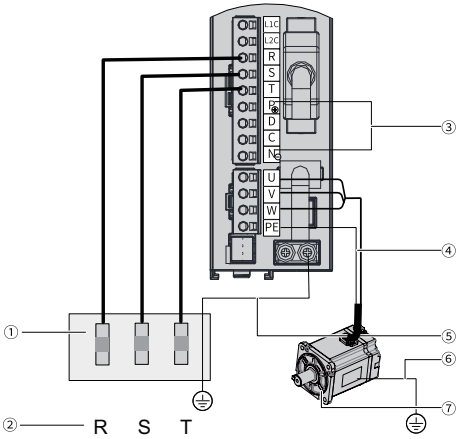


Table 3–20 Single-drive grounding

No.	Description
①	Input protection (fuse or circuit breaker) Connect the lower end of the fuse to the filter.
②	Input power supply
③	Do not ground the DC bus terminal or the regenerative resistor terminal.
④	Connect the output PE terminal of the servo drive to the motor output cable shield.
⑤	Connect the PE cable on the input power supply side to the input PE terminal of the servo drive.
⑥	Ground the motor enclosure.
⑦	Three-phase motor

Note

The main circuit terminal layout varies with different models and is subject to the physical product.

Multi-drive grounding

Side-by-side installation of multiple drives:

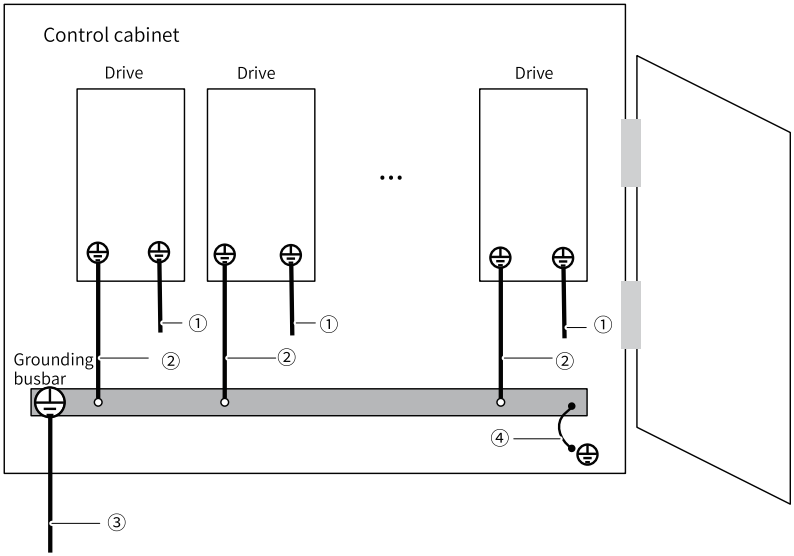


Table 3–21 Description for grounding of multiple drives installed side by side

No.	Description
①	Connect the motor output cable shield to the output PE terminal of the servo drive.
②	Connect the main circuit input PE terminal of the servo drive to the grounding copper busbar of the control cabinet through a protective grounding conductor.
③	Connect the PE cable on the input power supply side to the grounding copper busbar of the control cabinet.
④	Connect the grounding copper busbar of the control cabinet to the metal enclosure of the control cabinet through the protective grounding conductor.

Grounding the control cabinet system

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

Table 3–22 Wiring requirements

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

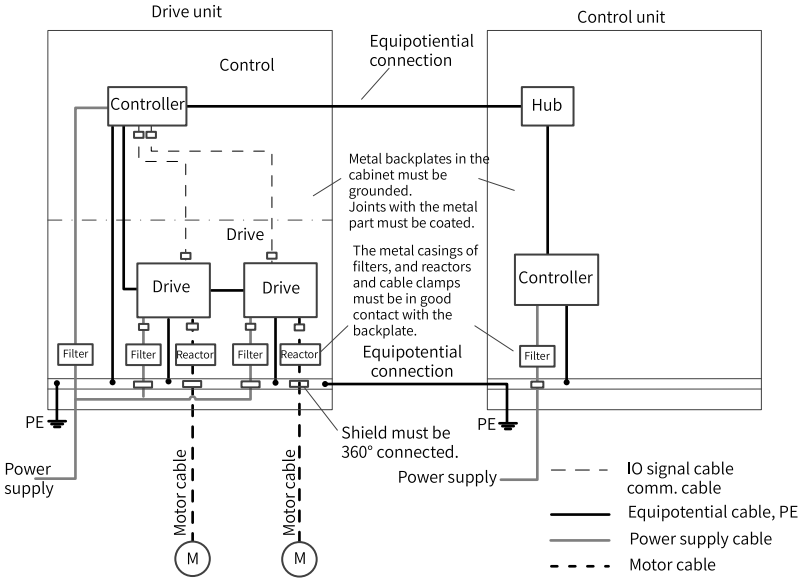


Figure 3-20 Recommended wiring for the control cabinet system

3.4 Control Terminal (CN1)

Observe the requirements in standard EN 60204-1 during connecting control circuit cables.

I/O signal cable selection

It is recommended to use shielded signal cables to prevent I/O signal circuit from being disturbed by external noise. Use separate shielded cables for different analog signals. It is recommended to use shielded twisted pairs for digital signals.

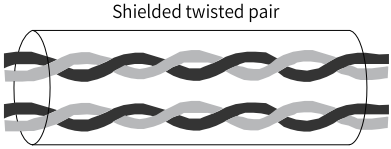


Figure 3-21 Diagram of shielded twisted pairs

Control Cable Specifications

Table 3–23 Recommended Control Cable Specifications

Control terminal	Connector Kit/Material No.	AWG
CN1	DB15	24 to 30
CN6	15120648	24 to 20

Note

The CN6 terminal is only applicable to customized models (-FS).

I/O signal layout

I/O signals include DI/DO signals and relay output signals.

Observe the following requirement during control circuit wiring:

Route the control circuit cables and main circuit cables or other power cables through different routes with a distance of at least 30 cm. Failure to comply may result in disturbed I/O signals.

3.4.1 Terminal Layout

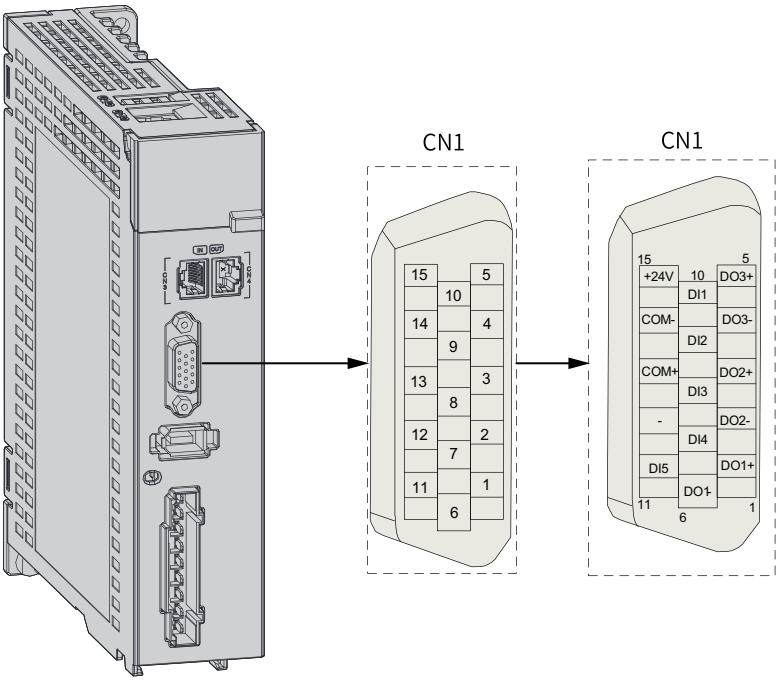


Figure 3-22 Control terminal pin layout of servo drives in sizes A and B

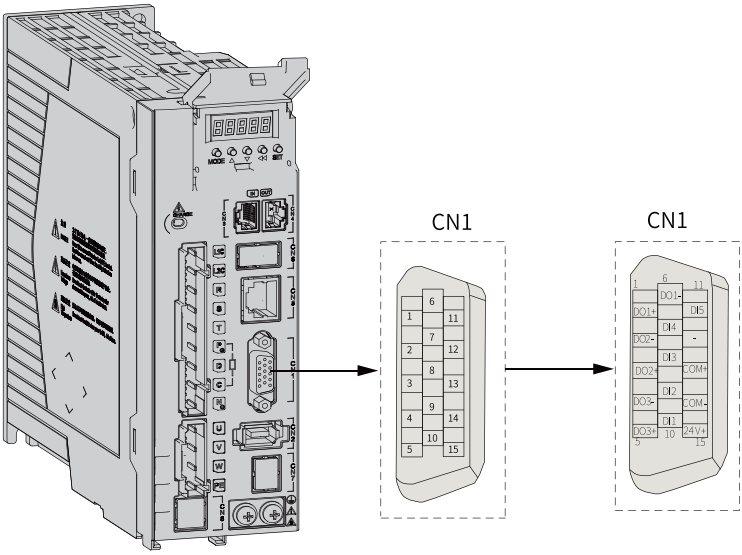


Figure 3-23 Control terminal pin layout of servo drives in sizes C, D and E

Note

Use shielded cables as signal cables, with both ends of the shielded cable grounded.

Table 3–24 Description of DI/DO signals

Signal		Default function	Pin No.	Description
General	DI1	P-OT	10	Positive limit switch
	DI2	N-OT	9	Negative limit switch
	DI3	HomeSwitch	8	Home switch
	DI4	TouchProbe2	7	Touch probe 2
	DI5	TouchProbe1	11	Touch probe 1
	+24V		15	Internal 24 V power supply: 20 to 28 V; maximum output current: 200 mA
	COM-		14	
	COM+		13	Common terminal of DI terminals.
	DO1+	S-RDY+	1	Ready to switch on
	DO1-	S-RDY-	6	
	DO2+	ALM+	3	Fault
	DO2-	ALM-	2	
	DO3+	BK+	5	Brake
	DO3-	BK-	4	

Note

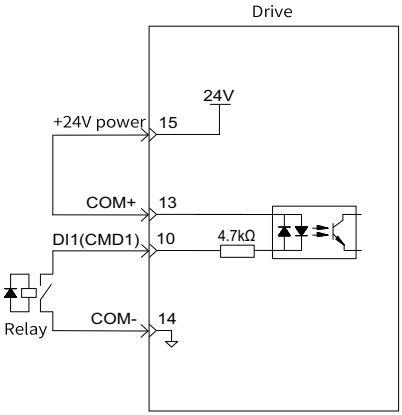
DI logic level: "0" < 3 V; "1" > 20 V.

3.4.2 DI/DO Signals

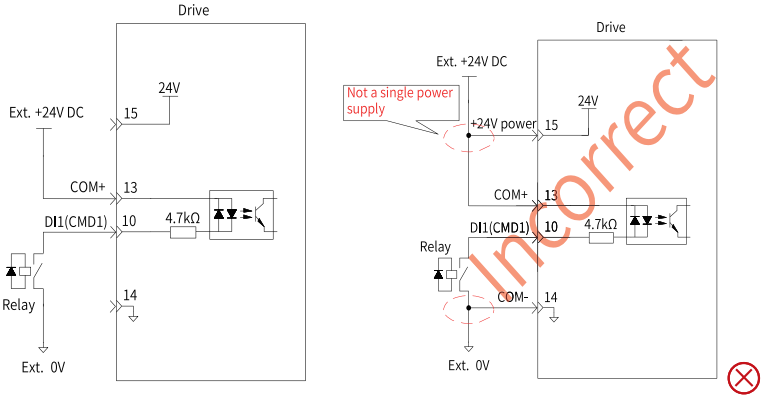
DI circuit

The circuits for DI1 to DI5 are the same. The following takes the DI1 circuit as an example.

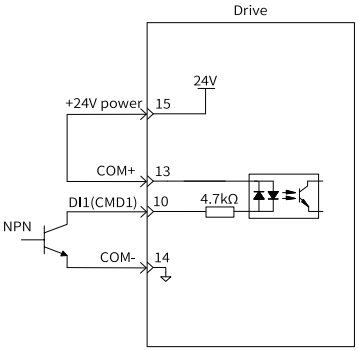
- The host controller provides relay output:
  - When you use the internal 24 V power supply:

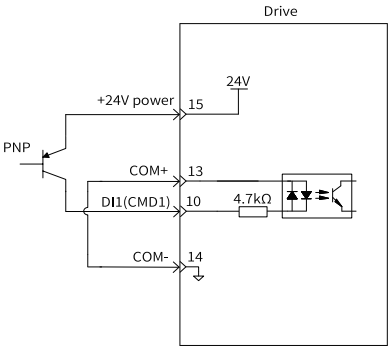


  - When you use an external power supply:

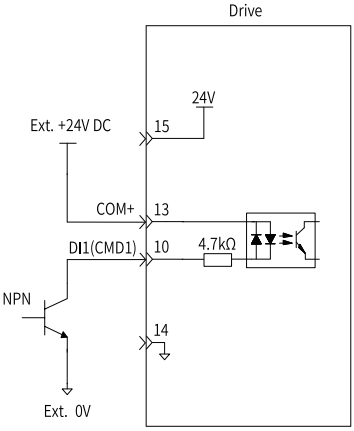


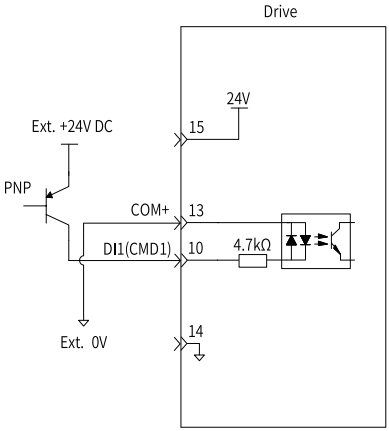
- The host controller provides open-collector output.
  - When you use the internal 24 V power supply:





  - When you use an external power supply:





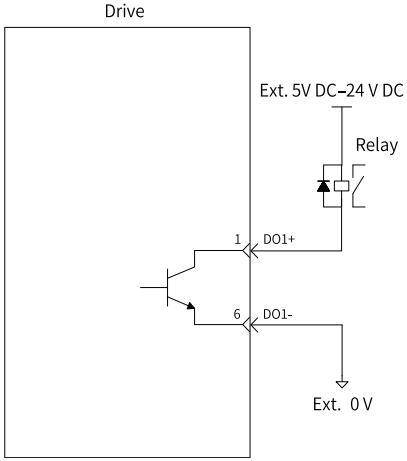
Note

PNP and NPN input cannot be applied in the same circuit.

DO circuit

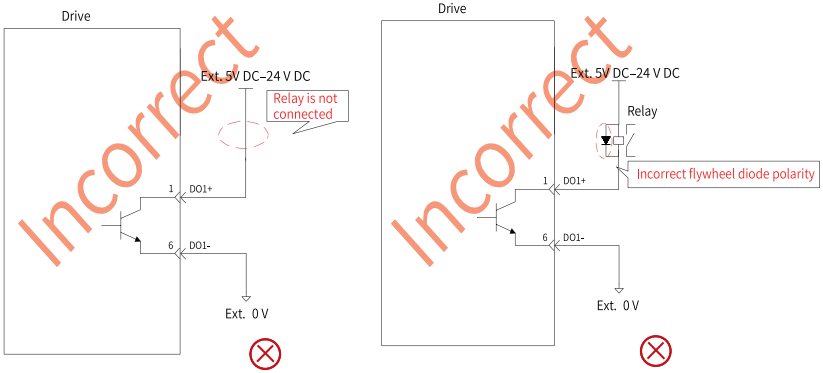
The circuits for DO1 to DO3 are the same. The following description takes DO1 circuit as an example.

- The host controller provides relay input.

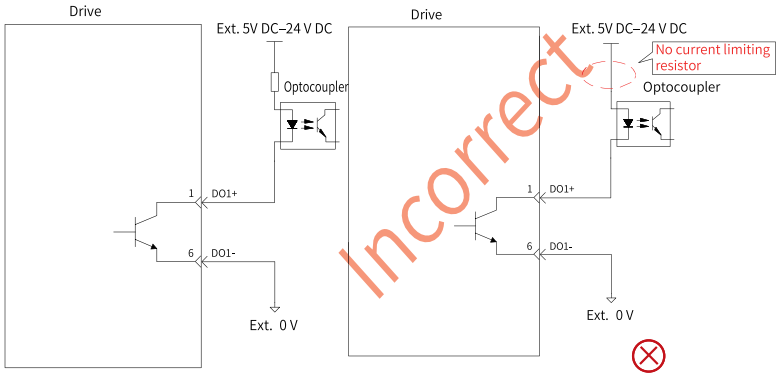


Note

When the host controller provides relay input, a flywheeling diode must be installed. Otherwise, the DO may be damaged.



- The host controller provides optocoupler input.



Note

The maximum permissible voltage and current capacity of the optocoupler output circuit inside the servo drive are as follows:

- Max. voltage: 30 VDC
- Max. current: DC 50 mA

3.4.3 Wiring of the Brake

The brake is used to prevent the motor shaft from moving and lock the position of the motor and the motion part when the drive is in the non-operational status.

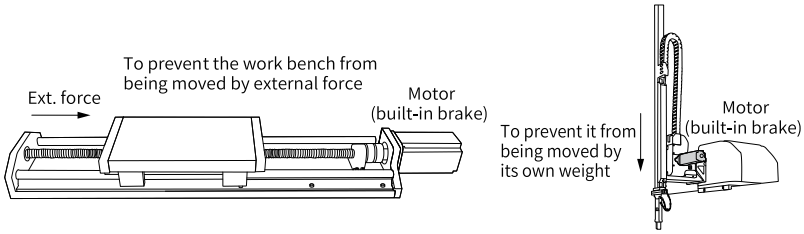


Figure 3-24 Application of the brake

Caution

- Use the built-in brake for position-lock purpose only. Do not use this brake for any other purposes (such as braking) other than position-lock in the stop state.
- The brake coil has no polarity.
- Switch off the S-ON signal after the motor stops.
- When the motor with brake runs, the brake may generate a click sound, which does not affect its function.
- When brake coils are energized (the brake is released), flux leakage may occur on the shaft end. Pay special attention when using magnetic sensors around the motor.

The brake input signal of the brake is polarity-insensitive. Prepare a 24 V power supply. The following figure shows the standard wiring of the brake signals (BK) and the brake power supply.

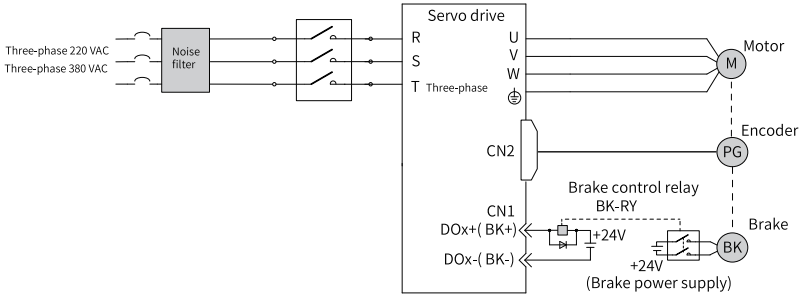


Figure 3-25 Wiring of the brake

Pay attention to the following precautions during wiring:

When determining the length of the motor brake cable, take the voltage drop caused by cable resistance into account. The input voltage must be at least 21.6 V to enable the brake to work properly. The following table lists brake specifications of Inovance MS1 series servo motors.

Table 3–25 Brake specifications

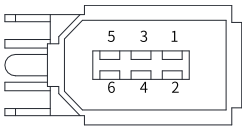
Motor model	Holding torque (N·m)	Supply voltage (VDC) ±10%	Coil resistance (Ω) (±7%)	Exciting current (A)	Release time (ms)	Apply time (ms)	Backlash (°)
MS1H1-05B/10B MS1H4-10B	0.32	24	94.4	0.25	⩽ 20	⩽ 40	⩽ 1.5
MS1H1-20B/40B MS1H4-20B/40B	1.5		75.79	0.32	⩽ 20	⩽ 60	⩽ 1.5
MS1H1-75B/10C MS1H4-75B/10C	3.2		57.6	0.42	⩽ 40	⩽ 60	⩽ 1
MS1H2-10C/15C/ 20C/25C	8		32.73	0.73	⩽ 40	⩽ 100	⩽ 1
MS1H2-30C/40C/ 50C MS1H3-85B/13C/ 18C	16		24	1	⩽ 60	⩽ 120	⩽ 1
MS1H3-29C/44C/ 55C/75C	50		18.58	1.29	⩽ 100	⩽ 200	⩽ 1

Note

- The brake cannot share the same power supply with other electrical devices. This is to prevent malfunction of the brake due to voltage or current drop caused by other working devices.
- Use cables with a cross-sectional area above 0.5 mm^2.

3.5 Encoder Terminal (CN2)

3.5.1 Terminal Layout



Encoder signal terminal CN2

Figure 3-26 Encoder terminal pin layout

Table 3–26 Description of encoder terminal pins

No.	Name	Description
1	+5 V	5 V power supply
2	0 V	-
3	Reserved	-
4	Reserved	-
5	PS+	Encoder signal
6	PS-	
Enclosure	PE	Shield

3.5.2 Connecting the Absolute Encoder

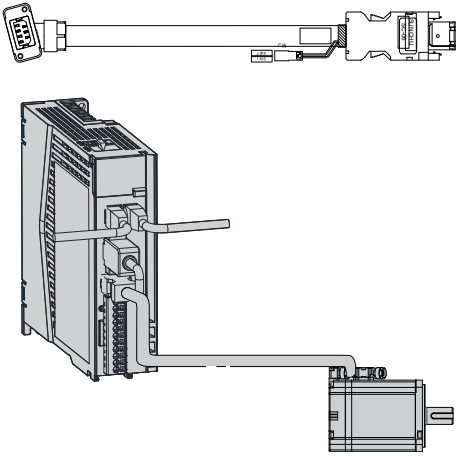


Figure 3-27 Terminal-type signal cable wiring [1]

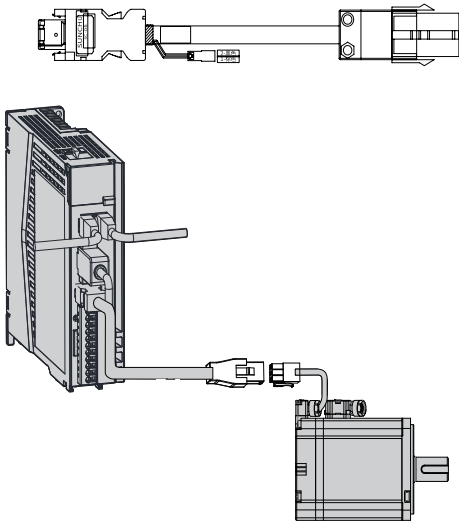


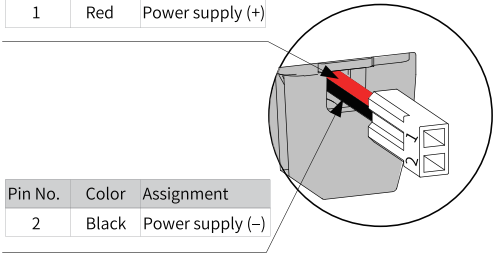
Figure 3-28 Flying leads-type signal cable wiring [1]

Note

- [1] The preceding figure shows the wiring diagram of the absolute encoder cable, which is similar to that of the incremental encoder (without a battery box). The cable for the incremental encoder needs to be purchased separately.
- The encoder cable color is subject to the color of the actual product. Cable colors mentioned in this guide all refer to Inovance cables.

Lead wires of the battery box:

Pin No.	Color	Assignment
1	Red	Power supply (+)

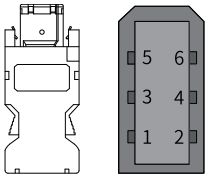
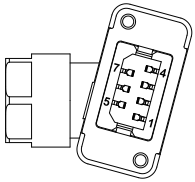


Pin No.	Color	Assignment
2	Black	Power supply (–)

Figure 3-29 Description of the lead wire color of the battery box

- Keep the battery in environments within the required ambient temperature range and ensure the battery is in reliable contact and carries sufficient power capacity. Otherwise, encoder data loss may occur.
- Model of the battery box (battery included): S6-C4A

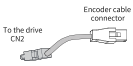
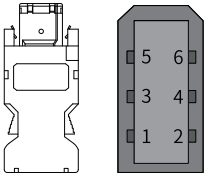
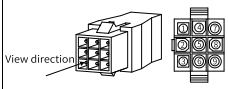
Table 3–27 Terminal-type motor encoder cable connector

Applicable Motor Flange Size [1]	Outline Drawing of the Connector		Terminal Pin Layout			
			Pin No.	Signal Name	Color	Type
Terminal-type: 40 60 80	Servo drive side	 6-pin male	1	+5 V	Red	Twisted pair
			2	GND	Orange	
			5	PS+	Blue	Twisted pair
			6	PS-	Purple	
			Enclosure	PE	-	-
	Motor side	 7-pin connector	1	PS+	Blue	Twisted pair
			2	PS-	Purple	
			3	DC+	Brown	Twisted pair
			4	DC-	Black	
			5	+5 V	Red	Twisted pair
			6	GND	Orange	
			7	PE	-	-

Note

[1]: The motor frame size indicates the width for installing the flange.

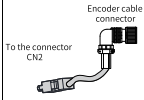
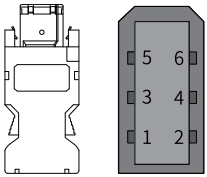
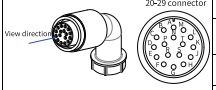
Table 3–28 Flying leads type motor encoder cable connector (9-pin)

Applicable Motor Flange Size [1]	Outline Drawing of the Connector			Terminal Pin Layout			
				Pin No.	Signal Name	Color	Type
Flying leads type: 40 60 80		Servo drive side	 6-pin male	1	+5 V	Red	Twisted pair
				2	GND	Orange	
				5	PS+	Blue	Twisted pair
				6	PS-	Purple	
				Enclosure	PE	-	-
		Motor side	 9-pin connector Recommended: Plastic enclosure: AMP 172161-1; terminal: AMP 770835-1	1	Battery (+)	Brown	Twisted pair
				4	Battery (-)	Black	
				3	PS+	Blue	Twisted pair
				6	PS-	Purple	
				9	+5 V	Red	Twisted pair
				8	GND	Orange	
				7	Shield	-	-

Note

[1]: The motor frame size indicates the width for installing the flange.

Table 3–29 Absolute encoder cable connector (MIL-DTL-5015 series 3108E20-29S aviation connector)

Applicable Motor Flange Size [1]	Outline Drawing of the Connector			Terminal Pin Layout			
				Pin No.	Signal Name	Color	Type
100 130 180		Servo drive side	 6-pin male	1	+5 V	Red	Twisted pair
				2	GND	Orange	
				5	PS+	Blue	Twisted pair
				6	PS-	Purple	
				Enclosure	PE	-	-
		Motor side		A	PS+	Blue	Twisted pair
				B	PS-	Purple	
				E	Battery (+)	Brown	Twisted pair
				F	Battery (-)	Black	
				G	+5 V	Red	Twisted pair
				H	GND	Orange	
				J	Shield	-	-

Note

[1]: The motor frame size indicates the width for installing the flange.

3.5.3 Installing Absolute Encoder Battery Box

The optional S6-C4A battery box contains the following items:

- One plastic case.
- One battery (3.6 V, 2,600 mAh).
- Terminal block and crimping terminal.

Installing the battery box

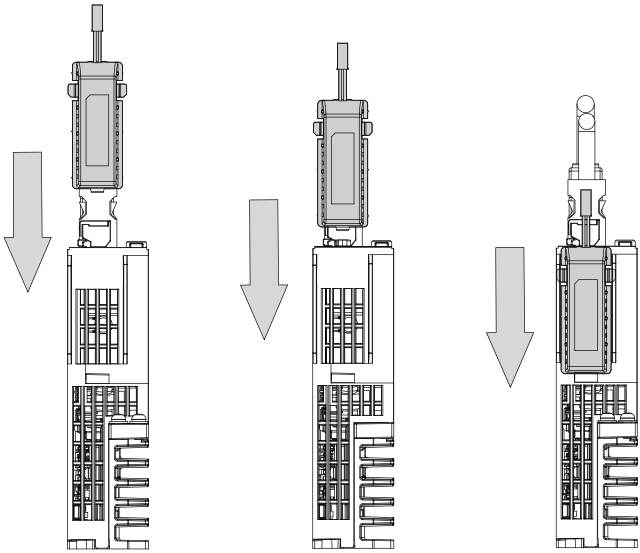
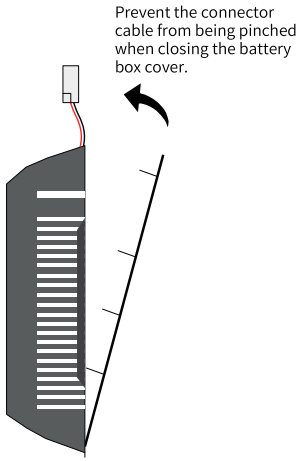


Figure 3-30 Installing the battery box (bottom view)

Removing the battery box

The battery may generate leakage liquid after long-term use. Replace it every two years. Remove the battery box in steps shown in the preceding figure, but in the reverse order.

When closing the battery box cover, prevent the connector cable from being pinched.



Improper use of the battery may result in liquid leakage which corrodes the components or leads to battery explosion. Observe the following precautions during use:



- Insert the battery with polarity (+/-) placed correctly.
- Leaving an idled or retired battery inside the device may lead to electrolyte leakage. The electrolyte inside the battery is highly corrosive, not only corroding surrounding components but also incurring the risk of short circuit. It is recommended to replace the battery every 2 years.
- Do not disassemble the battery because the internal electrolyte may spread out and result in personal injury.
- Do not throw a battery into the fire. Failure to comply may result in an explosion.
- Do not short-circuit the battery or strip off the battery case. Prevent terminals (+) and (-) of the battery from coming into contact with the metal. Contact with the metal can result in a high current, not only weakening the battery power, but also incurring the risk of explosion due to severe heating.
- This battery is not rechargeable.
- Dispose of the retired battery according to local regulations.

3.5.4 Encoder Cable Specifications

- Ground the shielded layers on both the servo drive side and the motor side. Otherwise, the servo drive will report a false alarm.
- Do not connect cables to the "reserved" terminals.
- Given the voltage drop caused by cable resistance and signal attenuation caused by distributed capacitance, it is recommended to use twisted-pair cables of 26AWG or above (as per UL2464 standard) with length no longer than 10 m as the encoder cable.

Note

It is recommended to use 22AWG to 26AWG cables and a matching terminal AMP170359-1 for 10B, 20B, 40B, and 75B series motors. If a longer cable is required, increase the cable diameter properly. See *"Table 3–30 Recommended cables" on page 80* for details.

Table 3–30 Recommended cables

Cable Size	Cable Size (mm^2)	Ω/km	Allowable Length (m)	OD (mm)
3P×26AWG	0.13	143	10.0	6.0±0.2
3P×25AWG	0.16	89.4	16.0	6.2±0.2
3P×24AWG	0.2	79.6	18.0	6.5±0.2
3P×23AWG	0.26	68.5	20.9	6.8±0.2
3P×22AWG	0.32	54.3	26.4	7.0±0.2
3P×21AWG	0.41	42.7	33.5	7.3±0.2
3P×20AWG	0.52	33.9	42.2	7.6±0.3
3P×19AWG	0.57	26.9	53.2	8.5±0.3
3P×18AWG	0.81	21.4	66.8	8.8±0.3
3P×17AWG	1.03	16.3	87.7	9.7±0.3
3P×16AWG	1.31	13.5	105.0	11.4±0.3

Note

If the cables of above 16AWG are required, contact the sales personnel of Inovance.

3.6 Communication Terminals (CN3 and CN4)

Terminal layout

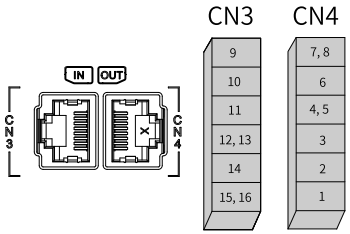


Figure 3-31 Communication terminal pin layout (sizes A and B)

Table 3–31 EtherCAT communication terminal pin assignment (sizes A and B)

Pin No.	Name	Description
9	TD+	Transmitting data (+)
10	TD-	Transmitting data (-)
11	RD+	Receiving data (+)
12 and 13	-	-
14	RD-	Receiving data (-)

Pin No.	Name	Description
15 and 16	-	-
1	TD+	Transmitting data (+)
2	TD-	Transmitting data (-)
3	RD+	Receiving data (+)
4 and 5	-	-
6	RD-	Receiving data (-)
7 and 8	-	-

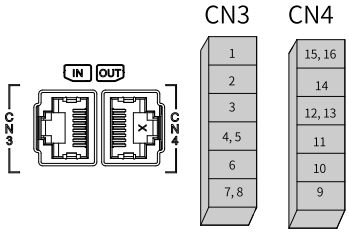


Figure 3-32 Communication terminal pin layout (sizes C, D and E)

Table 3–32 EtherCAT communication terminal pin assignment (sizes C, D and E)

Pin No.	Name	Description
1	TD+	Transmitting data (+)
2	TD-	Transmitting data (-)
3	RD+	Receiving data (+)
4 and 5	-	-
6	RD-	Receiving data (-)
7 and 8	-	-
9	TD+	Transmitting data (+)
10	TD-	Transmitting data (-)
11	RD+	Receiving data (+)
12 and 13	-	-
14	RD-	Receiving data (-)
15 and 16	-	-

Terminal description

CN3 and CN4 are EtherCAT connectors. Connect CN3 (IN) to the communication port of the master and CN4 (OUT) to the next slave. For assignment of CN3/CN4 terminal pins, see *" Communication Terminals CN3 and CN4" on page 80*

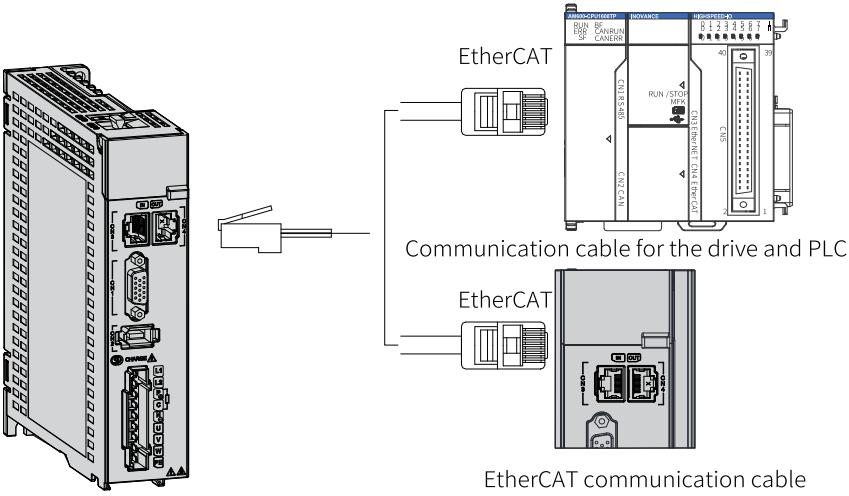


Figure 3-33 Wiring of communication cables

Terminal connection

- Topology
  The communication topology of EtherCAT is flexible without any limit. The SV660N series servo drive carries IN and OUT ports.

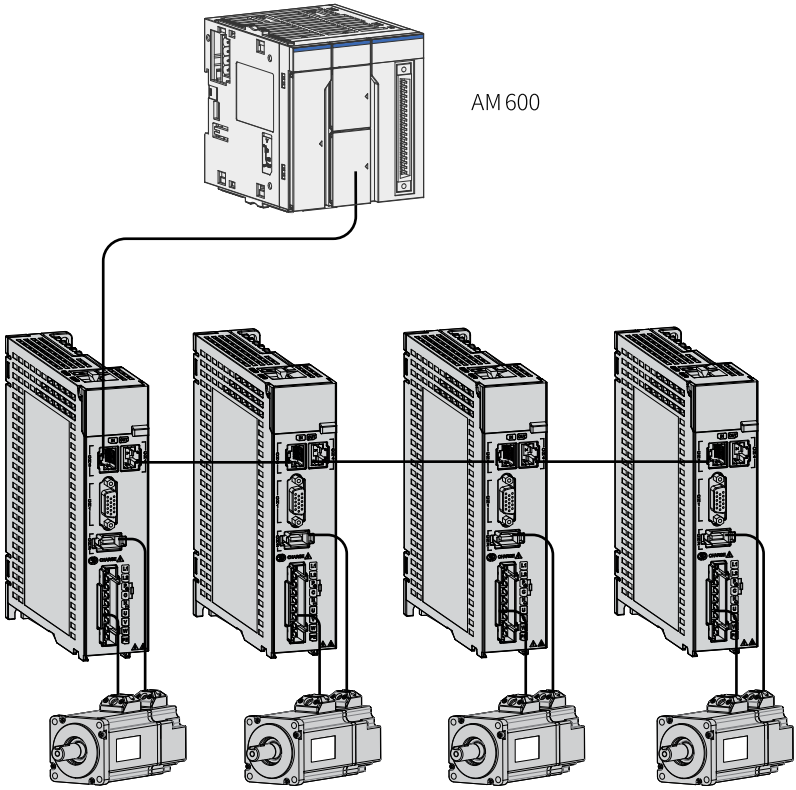
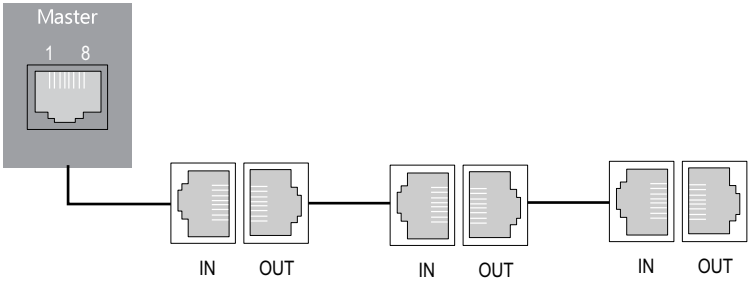


Figure 3-34 Communication network topology

- Linear topology



Communication cable selection

The EtherCAT communication cable must be Ethernet Category 5 (100BASE-TX) network cable or high-strength shielded network cable. The cables used for the servo

drive must also be network cable, with length shorter than 100 m. The shielded network cable enhances the anti-interference capacity of the system.

EMC standards

This servo drive complies with the latest international EMC standard: IEC 618003:2004/A1:2011 (Adjustable speed electrical power drive systems—part 3: EMC requirements and specific test methods

Interface information

EtherCAT cables are connected to the network ports (IN and OUT) equipped with metal shield. The electrical characteristics comply with standards IEEE 802.3 and ISO 8877.

Table 3–33 Instructions for communication cable selection

Cable Length	Price	Supplier
0.2 m to 10 m	See *"Table 3–34 Information for ordering the communication cable" on page 84"Cable Ordering"* .	Inovance, Haituo and others
More than 10 m	The cable price is added by RMB 5 for every additional 1 m based on the price of S6-L-T04-10.0. The cable price is also related to the magnitude of the order.	

Note

Cable selection is subject to the instructions provided by the cable supplier. See "Instructions for purchasing servo encoder cables/power cables" in Inovance business system.

Table 3–34 Information for ordering the communication cable

Material code	Cable model	Length (m)
15040261	S6-L-T04-0.3	0.3
15040262	S6-L-T04-3.0	3.0
15041960	S6-L-T04-0.2	0.2
15041961	S6-L-T04-0.5	0.5
15041962	S6-L-T04-1.0	1.0
15041963	S6-L-T04-2.0	2.0
15041964	S6-L-T04-5.0	5.0
15041965	S6-L-T04-10.0	10.0

Cables are ordered from suppliers including Haituo (the cable price is added by RMB 5 for every additional 1 m based on the price of S6-L-T04-10.0. The cable price is also related to the magnitude of the order). The order quantity will also affect the pricing.

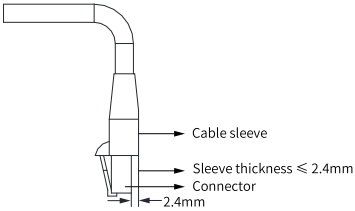


Figure 3-35 Network port connector

Note

The head of the dual-port network terminal cannot be too thick, otherwise, interference may occur. The recommended thickness is 2.4 mm. See *"Figure 3–35 Network port connector" on page 85*.

Table 3–35 Specifications

Item	Detailed Description
UL Certification	Compliant with UL certification
Cat.5e cable	Cat.5e cable
Double shield	Braided shield (coverage: 85%), aluminum foil shield (coverage: 100%)
Environmental worthiness	Ambient temperature: -30°C to +60°C, resistant to industrial oil, corrosive acid and alkali
EMC test standard	GB/T 24808-2009

3.7 Communication Terminal (CN5)

Terminal layout

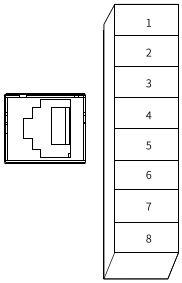


Figure 3-36 Layout of terminals

Table 3–36 Pin assignment

Pin No.	Definition
1–5	-
6	RS232-TXD
7	RS232-RXD
8	GND

Description

You can connect the servo drive to PC with a PC communication cable through the CN5 terminal. The outline drawing of the cable is shown in the following figure.

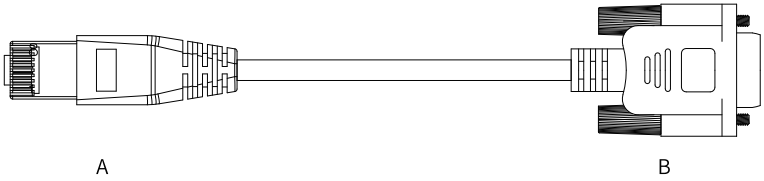


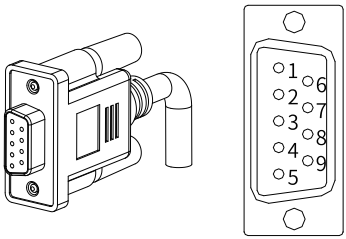
Figure 3-37 PC communication cable

Table 3–37 Pin connection relation between the servo drive and PC communication cable

RJ45 on the drive side (A)		DB9 on the PC side (B)	
Signal	Pin No.	Signal	Pin No.
RS232-TXD	6	PC-RXD	2
RS232-RXD	7	PC-TXD	3
GND	8	GND	5
PE (shield)	Enclosure	PE (shield)	Enclosure

Pin assignment of DB9 terminal on the PC side is shown in the following table.

Table 3–38 Pin assignment of DB9 terminal on the PC side

Pin No.	Assignment	Description	Pin layout
2	PC-RXD	PC receiving end	
3	PC-TXD	PC transmitting end	
5	GND	Ground	
Enclosure	PE	Shield	

If the host controller supports USB interface only, use the serial-to-USB cable.

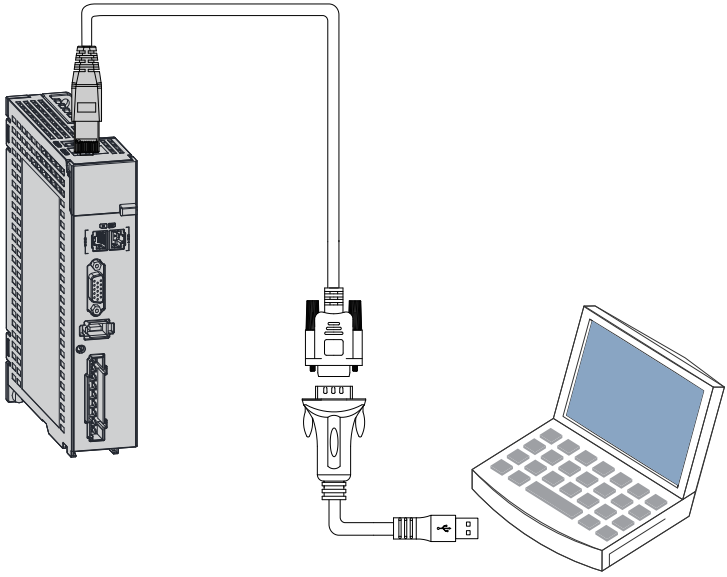


Figure 3-38 Serial-to-USB conversion

Recommendations: Manufacture: Z-TEK Model: ZE551A, equipped with a 0.8 m USB extension cable Chip model: FT232

3.8 STO Safety Terminal (CN6)

Note

The CN6 STO safety function terminal is only suitable for non-standard models (-FS).

Terminal layout

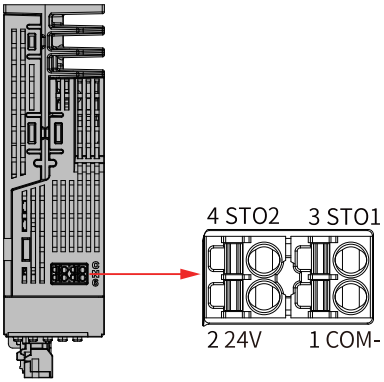


Table 3–39 Pin assignment of STO safety terminal

Pin No.	Assignment	Description
1	COM-	STO reference GND
2	24V	Internal 24 V power supply
3	STO1	Control input of STO1
4	STO2	Control input of STO2

Two isolated inputs are configured to dual-channel inputs of the STO function: STO1/ STO2.

To facilitate commissioning, additional pin with supply voltage (+24V) is integrated. The bridging of the 24 V terminal to STO1/STO2 is needed in case the safety circuit is installed but no STO function is needed.

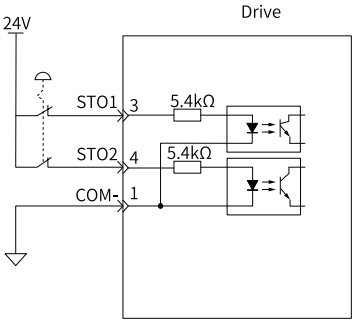
Description

- **Electrical specifications and connection of the input circuit**
  This section describes the characteristics of the input signals assigned to the CN6 connectors.
  - Specifications
    The servo drive operates normally only when the input states of STO1 and STO2 are both "High" ("1" or "H").

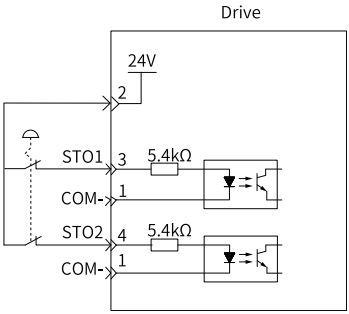
    The servo drive does not operate when the input states of STO1 or STO2 are different or are both "Low" ("0" or "L").
  - Electrical characteristics of Safety Request Input Signal are as follows:

Item	Characteristics	Description
Voltage range	24 VDC (±15%)	-
Input current	3.6 mA (Typ.)	This is the value per channel.
Standards of logic levels	"0" < 5 V, "1" > 15 V	-
Digital input impedance	5.4 kΩ	-

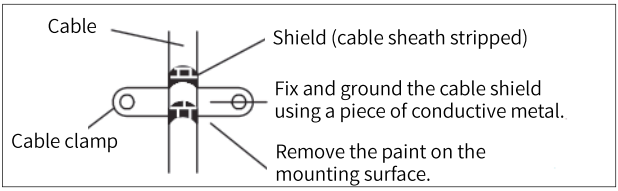
- Wiring example for an external 24 V



- Wiring example for an internal 24 V



- **EMC requirements**
  - To avoid short circuit between two adjacent conductors, either use cable with shield connected to the protective bonding circuit on each separate conductor, or use flat cables with one earthed conductor between each signal conductor.
  - Double-shielded or single-shielded twisted multi-pair cable is strongly recommended.
  - Fix and ground the cable shield using a piece of conductive metal.
    Example of cable clamp:



- The maximum allowable cable length between the drive and the safety switch is 30 m.

- **Other requirements**
  - All wiring must be well protected, routed and clamped where practicable.
  - It must be assured that there is no pulling or pinching on the cable when installing.
  - Route the two STO DI channels through different routes to prevent possible fault. If impossible, protect the cable with double shields.

Cables	Description
Category	Low voltage, double-shielded or single-shielded twisted multi-pair cable
Maximum size	0.8 mm^2 (18AWG)
Minimum size	0.8 mm^2 (28AWG)
Maximum length	The maximum length between the STO input terminal and the operation contact is 30 m.

Applicable servo drives

The STO function applies to the following servo drives (-FS models):

Size	Power range	Structure	W x H x D (mm^3)
A	0.2 kW to 0.4 kW	Integrated structure	40 x 170 x 150
B	0.75 kW	Integrated structure	50 x 170 x 173
C	1 kW to 1.5 kW	Split-type structure	55 x 170 x 173
D	1.5 kW to 3 kW	Split-type structure	80 x 170 x 183
E	5 kW to 7.5 kW	Split-type structure	90 x 250 x 230

3.9 Wiring and Setting of the Regenerative Resistor

Connecting the regenerative resistor

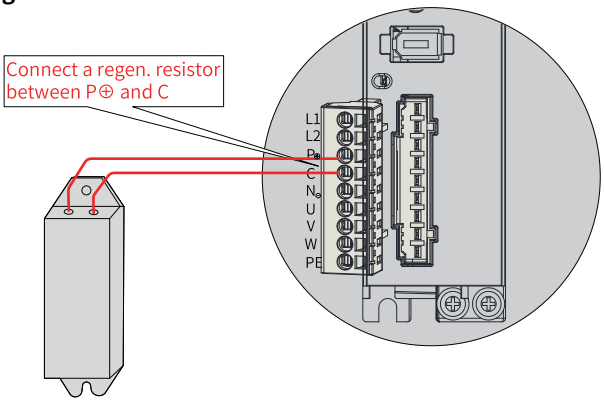


Figure 3-39 Wiring of external regenerative resistor

For cables used for terminals P⊕ and C, see *"3.3.3 Recommended Cable Specifications and Models" on page 41*.

Caution

Observe the following precautions when connecting the external regenerative resistor:

- Remove the jumper between terminals P⊕ and D before using the external regenerative resistor. Failure to comply will result in overcurrent and damage the braking transistor.
- Do not connect the external regenerative resistor to the positive or negative pole of the bus directly. Failure to comply will damage the servo drive and result in a fire.
- Select a resistor with resistance higher than or equal to the minimum permissible value. Failure to comply will result in Er.201 (Overcurrent) or damage the servo drive.
- Make sure parameters H02.25 (Regenerative resistor setting), H02.26 (Power of external regenerative resistor) and H02.27 (Resistance of external regenerative resistor) are set properly before operating the servo drive.
- Install the external regenerative resistor on an incombustible object such as a metal.
- The built-in regenerative resistor or jumper bar is not available in models S1R6 and S2R8. If an external regenerative resistor is needed for these models, connect it between terminals P⊕ and C.

4 Maintenance

4.1 Routine Maintenance Items

Standard operating conditions:

Average annual ambient temperature: 30°C Average load rate: ＜ 80% Daily operating time: ＜ 20 h

4.1.1 Routine Checklist

Check the following items during routine inspection.

Table 4–1 Routine checklist

No.	Routine Checklist	Checked
1	The ambient temperature and humidity are normal. There is no dust or unwanted objects in the servo drive.	☐
2	There is no abnormal vibration or noise.	☐
3	The voltage of the power supply is normal.	☐
4	There is no strange smell.	☐
5	There are no fibers adhered to the air inlet.	☐
6	There is no intrusion of unwanted object on the load end.	☐

4.1.2 Routine Cleaning List

Check the following items during routine cleaning.

Table 4–2 Routine cleaning list

No.	Routine Cleaning List	Checked
1	Clean the dust on the equipment surface, especially the metallic dust.	☐
2	Keep the front end of the servo drive and the connectors clean.	☐

Note

- Switch off the power supply before cleaning the equipment. Clean the equipment with a blower gun or a piece of dry cloth.
- To prevent equipment discoloration or damage, do not use gasoline, diluents, alcohol, or acidic/alkaline detergent for cleaning.

4.2 Regular Maintenance

4.2.1 Regular Checklist

Table 4–3 Regular checklist

No.	Item	Checked
1	The screws used to fix the couplings between devices are in place.	☐
2	There is no sign of overheating.	☐
3	Terminal blocks are in good condition without any sign of damage.	☐
4	The clamping units of terminal blocks are in place.	☐

4.2.2 Periodic Maintenance List

The electrical and electronic parts inside the servo drive may be mechanically worn out and degraded. To keep the servo drive and servo motor in good condition, perform parts replacement based on the replacement cycles listed in the following table. Contact Inovance or Inovance agent before replacement to double check whether the part needs to be replaced.

Equipment	Components	Standard Replacement Interval	Remarks
Servo drive	Bus filter capacitor	About five years	The standard replacement interval is for reference only. If any device/ component works improperly within the replacement interval, replace it immediately.
	Cooling fan	2 to 3 years (10000 h to 30000 h)	
	Aluminum electrolytic capacitor on the PCB	About five years	
	Pre-charge relay	100,000 operations (depending on the operating conditions)	
	Pre-charge resistor	20,000 operations (depending on the operating conditions)	
Motor	Bearing	3 to 5 years (20,000 h to 30,000 h)	
	Oil seal	5000 h	
	Encoder	3 to 5 years (20,000 h to 30,000 h)	
	Absolute encoder battery	Depends on the operating condition. See the operation instructions for the encoder battery for details.	

4.3 Component Replacement

4.3.1 Replacing the Motor Flat Key

Caution

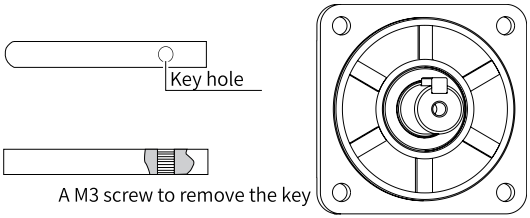
- Observe all the requirements presented in this chapter. Failure to comply may result in equipment fault or damage.
- Violent disassembly is not allowed. Take enough care during disassembly to prevent personal injury.

Standard MS1 series motors in flange sizes 60, 80, and 130 adopt C-type flat key that carries the disassembly hole. To disassemble the flat key, select a proper disassembly bolt (inner hexagon bolt recommended) based on the following table.

Specification of the key disassembly bolt		
Motor Size	Dimensions of the Flat Key	Specifications of the Disassembly Bolt (Inner Hexagon Bolt)
Size 40	Type-A flat key—A3×3×14	No disassembly hole
Size 60	Type-C flat key—C5×5×16.5	M3 x 10 and above
Size 80	Type-C flat key—C6×6×25	M3 x 15 and above
Size 100	Type-C flat key—C8×7×35	M3 x 20 and above
Size 130	Type-C flat key—C8×7×35	M3 x 20 and above
Size 180	Type-C flat key—C10×8×64	M3 x 20 and above

- Tool needed: an Allen wrench
- Disassembly procedure:

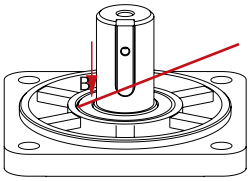
  1. Select a proper disassembly bolt (inner hexagon bolt recommended) based on the motor model.
  2. Use an Allen wrench to screw down the screw until the A-A end of the flat key is detached from the keyway, as shown below. See the following figure.



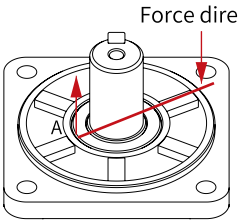
4.3.2 Removing the Motor Oil Seal

- Tools needed: a pair of needle-nose pliers, a pair of slip-proof gloves, and a piece of cotton cloth.
- Disassembly procedure:

  1. Put the cotton cloth onto the supporting point B to avoid the end cover from being scratched during disassembly.
  2. Secure the motor and use the needle-nose pliers to hold point A of the oil seal lip.
  3. Pry the oil seal out gradually against the supporting point B.



(Support point B is at the step of the extension)



(Support point A is at the outer lip of the oil seal)

5 Certification and Standards Compliance

Table 5–1 Compliance list

Certification	Directive Name		Standard
CE certification	EMC directive	2014/30/EU	EN IEC 61800-3
	LVD directive	2014/35/EU	EN 61800-5-1 EN 60034
	RoHS directive	2011/65/EU	EN 50581
UL/cUL certification	-		UL61800-5-1 C22.2 No.274-17 UL 1004-6 CSA C22.2 No. 100-14

Note

The product complies with the latest directives and standards of CE, UL/cUL certifications.

5.1 CE Certification

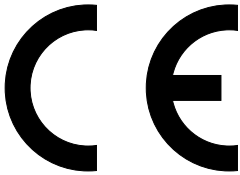


Figure 5-1 CE mark

- The CE mark indicates compliance with the Low Voltage Directive (LVD), Electromagnetic Compatibility (EMC), and Restriction of Hazardous Substances (RoHS) directives.
- The CE mark is required for engaging in commercial business (production, importation, and distribution) in Europe.
- The drive complies with LVD, EMC, and RoHS directives and carries the CE mark.
- Machines and devices integrated with this drive must also comply with CE requirements for distribution in Europe.
- The integrator who integrates this drive into other products and attaches CE mark to the final assembly has the responsibility of ensuring compliance with CE certification.

5.1.1 Requirement for Compliance with EMC Directive

The SV660P series servo drive, which is applicable to the first environment and second environment, complies with EMC Directive 2014/30/EU and standard EN IEC 61800-3.

As required by EMC Directive 2014/30/EU and standard EN IEC 61800-3, install an EMC filter on the input side of the drive and use shielded cables on the output side. Ensure the filter is grounded properly and the shield of the output cable is grounded 360 degrees.



- When applied in the first environment, the drive may generate radio interference. In addition to the CE compliance requirements described in this chapter, take additional measures, if necessary, to prevent the radio interference generated by the drive.

Introduction to EMC standards

Electromagnetic compatibility (EMC) describes the ability of electrical and electronic devices to work properly in the electromagnetic environment without introducing electromagnetic interferences that disturb the operation of other local devices or systems. In other words, EMC includes two aspects: 1) The electromagnetic interference generated by a device during normal operation cannot exceed a certain limit. 2) The device must have sufficient immunity to the electromagnetic interference in the environment.

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

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

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

- Category C1 drive: Power drive system (PDS) with rated voltage less than 1000 V, intended for use in the first environment

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

5.1.2 Requirements for Compliance with LVD

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

Installation location

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

Installation environment

For requirements of the installation environment, see *"1.1.2 Installation Environment" on page 16*.

Protective Requirements of Installation

The drive must be installed in a fireproof cabinet with doors that provide effective electrical and mechanical protection. The installation must conform to local and regional laws and regulations and relevant IEC standards.

Drives (IP20) intended to be installed inside the cabinet must be installed in a structure that prevents intrusion of unwanted objects from the top and the front.

Main circuit wiring requirements

For wiring requirements of the main circuit terminals, see SV660N Series Servo Drive Hardware Guide.

Requirements of protective devices

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

For recommended fuse/circuit breaker models, see Chapter "Optional Parts" in SV660N Series Servo Drive Selection Guide.

5.2 UL&cUL Certification



Figure 5-2 UL/cUL marking

The UL/cUL mark commonly applies to products sold in the United States and Canada. Products with UL/cUL mark have been inspected and assessed by the UL organization. To pass UL/cUL certification, main built-in components of electrical products must also be UL certified.

The drive has been tested in accordance with UL 6180051 and CSA C22.2 No. 27417 to determine compliance with UL/cUL standards. Observe the following requirements to enable machines and devices integrated with this drive to comply with UL/cUL standards.

Mounting location

Install the drive in a place with overvoltage category III and pollution degree 1 or 2 as specified by UL61800–5–1.

Ambient temperature

According to the protection level, the ambient temperature must be maintained within the following range:

Ambient temperature for open-type drives: 0°C to 50°C

Installation requirements

Installation requirements for open-type drives:

SV660N series servo drives are open-type drives that must be installed in a fireproof cabinet with the enclosure that provides effective electrical and mechanical protection. The installation must conform to local laws and regulations and related NEC requirements.

Main circuit wiring requirements



On-site installation of output terminals (such as P⊕, C, and NΘ) is not allowed.

- Terminals P⊕, C, and NΘ are used to connect optional parts. Do not connect these terminals to an 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 the internal safety extra-low voltage (SELV) circuit, which must be insulated and isolated from other circuits. Make sure that the control circuit is connected to the external SELV circuit.
- Prevent foreign matters from entering the wiring part of the terminal block.
- Do not solder the twisted conductors.
- The tightening torque may vary with terminals. Tighten terminal screws with the specified tightening torque. You can use the torque screwdriver, ratchet, or wrench.
- When using an electric screwdriver to tighten terminal screws, set a low speed to prevent damage to the terminal screws.
- Tighten the terminal screws at an angle within 5 degrees. Failure to comply may result in screw damage.

Control circuit wiring requirements

Observe the requirements in UL508 during wiring.

Cable requirements

Cable dimensions must be compliant with requirements in NEC (National Electric Code) and CEC (Canadian Electrical Code) Part I and local regulations.

- Use cables with copper conductors.
- The recommended cable for the main circuit is a class 2 600V indoor heat-resistant PVC cable with continuous maximum allowable temperature of 75°C. The following conditions are used as premises:
  - Ambient temperature: < 40°C
  - Normal operating ratings

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

Terminal cable selection

To comply with UL61800-5-1 and CSA C22.2 No. 274-17, power cables used for SV660 series servo drives must meet the following requirements:

- Compliant with NEC, Table 310-16 of NFPA70.
- Comprised of copper conductors with a rated temperature not lower than 75°C (167°F)
- Compliant with 14AWG or higher.
- With a rated voltage not lower than the rated voltage of the servo drive
- It is recommended to use cables compliant with UL758 Style 2517 and Style 2586 as motor main circuit cables.

Requirements for protective devices

To comply with UL61800-5-1, install a fuse/circuit breaker on the input side of the drive to prevent accidents caused by short circuit in the internal circuit.

Install sufficient protective devices against short circuit in branch circuits according to applicable regulations and this guide. The drive is applicable to circuits with a rated breaking capacity lower than 5000 A and a maximum voltage of 480 VAC (class 400 V).

Note

All breaker protective devices must be UL-certified.

For the SV660 drive applied in North America, the recommended protective devices are as follows:

Drive model SV660 series servo drive			Circuit breaker (A)	Bussmann conductor fuse (A)	Recommended inverse time lag breaker [1] (A)
Size	Model	Rated input current (A)			
Single-phase 220 V					
Size A	S1R6	2.3	15	-	40
	S2R8	4.0	15	-	40
Size B	S5R5	7.9	15	-	40
Size C	S7R6	9.6	15	-	100
Size D	S012	12.8	20	-	100
Three-phase 220 V					
Size C	S7R6	5.1	15	-	100
Size D	S012	8.0	20	-	100
Three-phase 380 V					
Size C	T3R5	2.4	15	-	100
	T5R4	3.6	15	-	100

Drive model SV660 series servo drive			Circuit breaker (A)	Bussmann conductor fuse (A)	Recommended inverse time lag breaker [1] (A)
Size	Model	Rated input current (A)			
Size D	T8R4	5.6	20	-	100
	T012	8.0	20	-	100
Size E	T017	12.0	-	40	-
	T021	16.0	-	40	-
	T026	21.0	-	40	-

Note

[1]: It is recommended to use the inverse time circuit breaker for multiple servo drives connected in parallel.

6 Solutions to Common EMC Problems

6.1 Malfunction of the Residual Current Device (RCD)

If an RCD is needed, select the RCD according to the following requirements:

- The drive may generate DC leakage current in the protective conductor, a B-type RCD therefore must be used.
- The drive may generate high-frequency leakage current during operation. To prevent malfunction of the RCD, install an RCD with tripping current not lower than 100 mA for each servo drive.
- When multiple drives connected in parallel share one RCD, select an RCD with tripping current not lower than 300 mA.
- Recommended RCD manufacturers are Siemens and Schneider.

When malfunction occurs on the RCD, take the following measures.

Table 6–1 Measures against leakage current

Symptom	Possible Cause	Measure
The RCD trips at the moment of power-on.	The anti-interference performance of the RCD is weak.	• It is recommended to use Siemens or Schneider RCDs. • It is recommended to use an RCD with a higher tripping current. • Move the unbalanced load to the front end of the RCD.
	The tripping current of the RCD is too low.	
	An unbalanced load is connected to the rear end of the RCD.	
	The capacitance of the front end of the servo drive against the ground is too high.	
The RCD trips during operation.	The anti-interference performance of the RCD is weak.	• It is recommended to use Siemens or Schneider RCDs. • It is recommended to use an RCD with a higher tripping current. • Install a simple filter on the input side of the servo drive and wind magnetic rings on the LN and RST cables near the RCD, as shown in *"Figure 6–1 Magnetic ring on the input side" on page 105*. • Reduce the carrier frequency without compromising the performance. • Reduce the length of motor cables.
	The tripping current of the RCD is too low.	
	An unbalanced load is connected to the rear end of the RCD.	
	The distributed capacitance of the motor cable or motor against the ground is too high.	

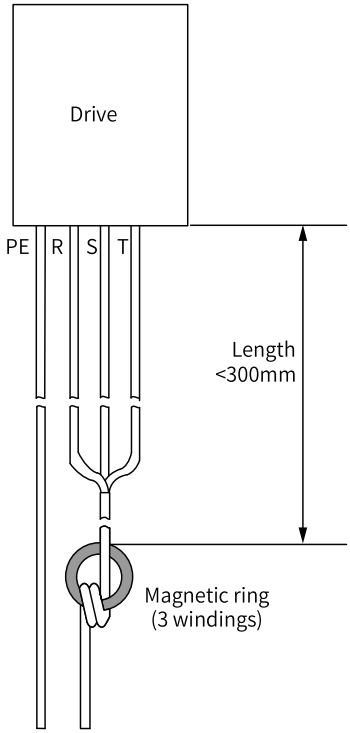


Figure 6-1 Magnetic ring on the input side

6.2 Harmonic Suppression

To suppress harmonics and improve the power factor to allow the drive to fulfill the standards, install an AC input reactor on the input side of the drive. For the reactor model and installation mode, see *"1.2.2 Instructions for Installing the AC Input Reactor" on page 25*.

6.3 Control Circuit Interference

6.3.1 Common I/O Signal Interference

The drive generates strong interference during operation. Although EMC measures are taken, interference may still exist due to improper wiring or grounding during use. When the drive disturbs or is disturbed by other devices, adopt the following measures.

Step	Measure
1	Use shielded cables as the I/O signal cables and connect the shield to the PE terminal. For details, see *" Connecting Control Signals" on page 63*.
2	Reliably connect the PE terminal of the motor to the PE terminal of the servo drive, and connect the PE terminal of the servo drive to the PE terminal of the grid.
3	Add an equipotential bonding grounding cable between the host controller and drive (see *" Grounding the control cabinet system" on page 62*).
4	Install the magnetic ring on the output side (UVW) of the drive by two to four turns (see *"1.2.4 Installation of the Magnetic Ring and Ferrite Clamp" on page 26*).
5	Increase the filter capacitance for low-speed DIs. A capacitance up to 0.1 μF is recommended, as shown in *"Figure 6–2 I/O signal cables with capacitance increased" on page 106*.
6	Increase the filter capacitance between AI and GND. A capacitance up to 0.22 μF is recommended.
7	Install a ferrite clamp or wind a magnetic ring on the signal cable by one or two turns. (see *"1.2.4 Installation of the Magnetic Ring and Ferrite Clamp" on page 26*).
8	Use shielded power cables and ground the shield properly.

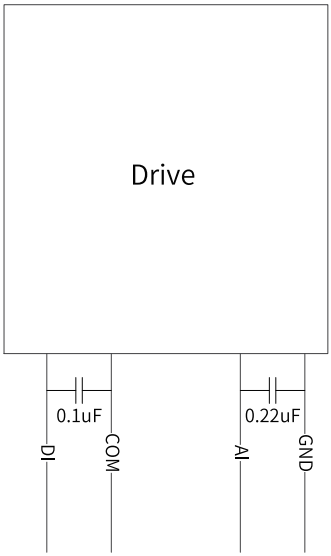


Figure 6-2 I/O signal cables with capacitance increased

6.3.2 EtherCAT Communication Interference

Take the measures listed in the following table to suppress interference.

No.	Step
1	The communication cable must be shielded Cat 5e.
2	The communication port is tight and secure without the risk of poor contact.
3	Separate communication cables from power cables with a distance of at least 30 cm.
4	Add an equipotential bonding grounding cable among the nodes during multi-node communication (see *" Grounding the control cabinet system" on page 62*)
5	The maximum allowable cable length between two nodes is 100 m.
6	Install ferrite clamps on both sides of the communication cable and wind the magnetic ring by one or two turns (see *"1.2.4 Installation of the Magnetic Ring and Ferrite Clamp" on page 26*).
7	Install the magnetic ring on the output side (UVW) of the drive by two to four turns (see *"1.2.4 Installation of the Magnetic Ring and Ferrite Clamp" on page 26*).
8	Use shielded power cables and ground the shield properly.

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