



SV660F Series Servo Drive Hardware Guide



Industrial
Automation



Intelligent
Elevator



New Energy
Vehicle



Industrial
Robot



Rail
Transit



Data code 19011666 A01

Preface

Introduction

The SV660F series high performance AC servo drive provides a power range from 0.05 kW to 7.5 kW. It supports Profinet 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 through cooperating with the MS1 series medium-to-small inertia high-response servo motors configured with a 23-bit multi-turn absolute encoder.

It is suitable for lithium battery PACK, printing and packaging, logistics, automobile manufacturing, tobacco and other industries to achieve fast and accurate collaborative control.

This guide presents the servo drive electrical design guidance, terminal introduction, certification and standard requirements, and suggestions for solving common EMC problems.

More documents

Name	Data Code	Description
SV660F Series Servo Drive Selection Guide	19011667	Provides instructions on product selection, including the list of supporting components, technical data on the drive and motor, and the selection guide of cables.
SV660F Series Servo Drive Hardware Guide	19011666	Presents electrical design guidance of the equipment, description of terminals, required certificates and standards and solutions to common EMC problems.
SV660F Series Servo Drive Commissioning Guide	19011668	Presents servo commissioning, parameter descriptions, including the operating panel, commissioning software, commissioning procedure and a parameter list.
SV660F Series Servo Drive Communication Guide	19011670	Presents functions and parameters of the servo drive, including Profinet communication configuration, parameter description, and communication application cases.
SV660F Series Servo Drive Function Guide	19011669	Presents functions and parameters, including function overview, basic servo functions, adjustment and parameter list.

Name	Data Code	Description
SV660F Series Servo Drive installation Guide	19012103	Presents installation of the servo drive, including installation steps, mechanical installation, and electrical installation.
SV660F Series Servo Drive Troubleshooting Guide	19012104	Introduces faults and fault levels, the troubleshooting process, warning codes and fault codes.
SV660F Series Servo Drive Maintenance Guide	19012105	Provides instructions on maintenance and repair of the equipment.
SV660F Series Servo Drive Safety Guide	19012110	Presents the safety function and related certifications and standards, wiring, commissioning process, troubleshooting, and functions.
SV660F Series Servo Drive Manual Package	PS00005951	Provides information on selection, installation, commissioning, function, troubleshooting and parameters of the equipment.

Revision History

Date of Revision	Version	Revision
2022-12	A01	- Added warranty information in the preface. - Added information on wiring of L1C and L2C in the three-phase 220 V system connection diagram. - Added information on recommended control terminal cable specifications.
2022-07	A00	First release

Access to the manual

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

- Do keyword search at <http://www.inovance.com>.
- Scan the QR code on the equipment to acquire more.

Warranty

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

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

- Damage caused by operations not following the instructions in the user guide
- Damage caused by fire, flood, or abnormal voltage

- Damage caused by unintended use of the product
- Damage caused by use beyond the specified scope of application of the product
- Damage or secondary damage caused by force majeure (natural disaster, earthquake, and lightning strike)

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

For details, see the Product Warranty Card.

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General Safety Instructions

Safety Precautions

- This section explains the safety precautions that need to be observed to use this product correctly. Before using this product, please read the instruction manual and correctly understand the relevant information of safety precautions. 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 injuries or property damage caused by improper use.

Safety Levels and Definitions



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



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



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

General Safety Instructions

- Drawings in the selection 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. Install the covers or protective guards as specified, and use the equipment in accordance with the instructions described in the user guide.
- The drawings in the guide are shown for illustration only and may be different from the product you purchased.

Unpacking **WARNING**

- 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.

 CAUTION

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

Storage and Transportation **WARNING**

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

 CAUTION

- Handle the equipment with care during transportation and mind your steps to prevent personal injuries or equipment damage.
- When carrying the equipment with bare hands, hold the equipment casing firmly with care to prevent parts from falling. Failure to comply may result in personal injuries.
- Store and transport the equipment based on the storage and transportation requirements. Failure to comply 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

 DANGER

- The equipment can be operated by well-trained and qualified professionals only. Non-professionals are not allowed.

 WARNING

- Read through the guide and safety instructions before installation.
- Do not install this equipment in places with strong electric or magnetic fields.
- Before installation, check that the mechanical strength of the installation site can bear the weight of the equipment. Failure to comply 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 devices with strong electromagnetic interference, such as a transformer, install a shielding device for the equipment to prevent malfunction.
- Install the equipment onto an incombustible object such as a metal. Keep the equipment away from combustible objects. Failure to comply will result in a fire.

 CAUTION

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

Wiring

 DANGER

- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Before wiring, cut off power connections with all equipment. Residual voltage exists after power cut-off. Therefore, wait at least the time designated on the equipment warning label before further operations. Measure the DC voltage of the main circuit and make sure it is below the safe voltage, otherwise there will be the danger of 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 will result in an electric shock.

 WARNING

- Do not connect the input power supply to the output end of the equipment. Failure to comply will 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.

 CAUTION

- During wiring, follow the proper electrostatic discharge (ESD) procedure, and wear an antistatic wrist strap. Failure to comply will damage the equipment or the internal circuits of the equipment.
- 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



DANGER

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



WARNING

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

Operation



DANGER

- The equipment must be operated only by professionals. Failure to comply will result in death or personal injuries.
- 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.



WARNING

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

Maintenance



DANGER

- 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.

**WARNING**

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

Repair**DANGER**

- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Do not repair the equipment with power ON. Failure to comply 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 injuries 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 injuries, 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 injuries, 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. See the following table for descriptions 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. • Never fail to connect Protective Earth (PE) terminal. Read the manual 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 terminals with 15 minutes after Disconnect the power. Risk of electrical shock. • Do not touch the heatsink with power ON to prevent the risk of burn. • Do not touch heatsink when power is ON. Risk of burn.

1 System Connection Diagram

1.1 System Connection Diagram

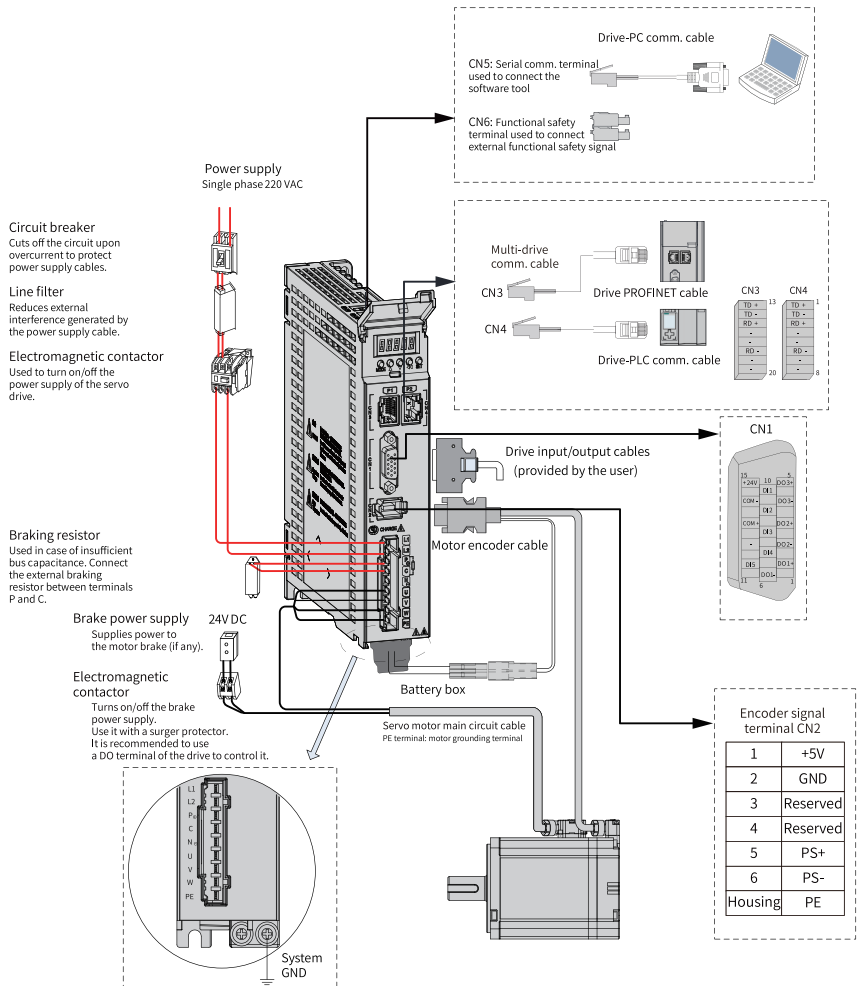


Figure 1-1 Wiring example of a single-phase 220 V system

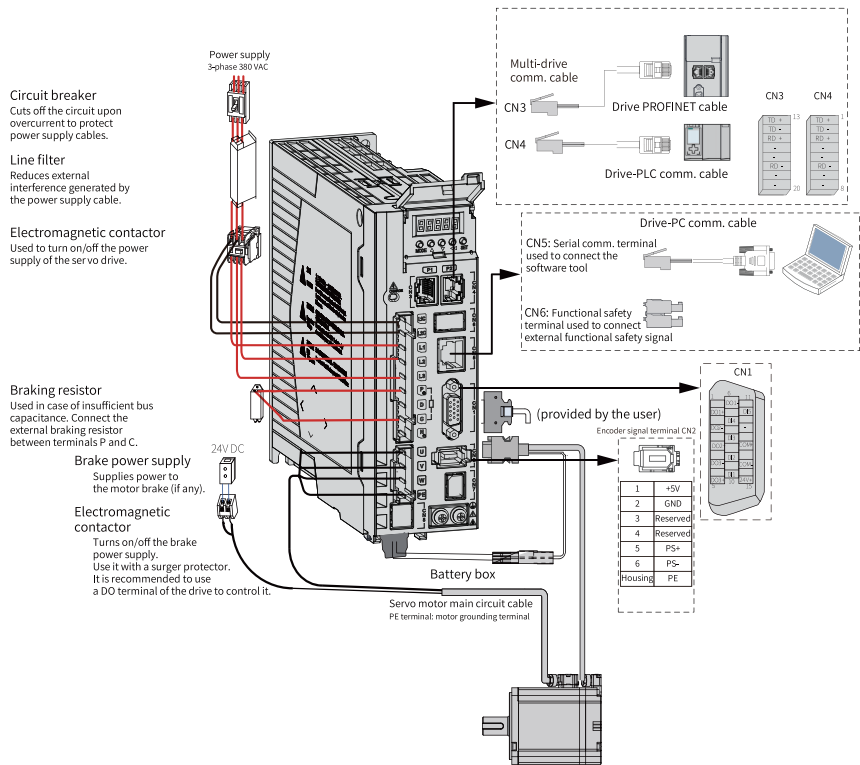


Figure 1-2 Wiring example of a three-phase 220V system

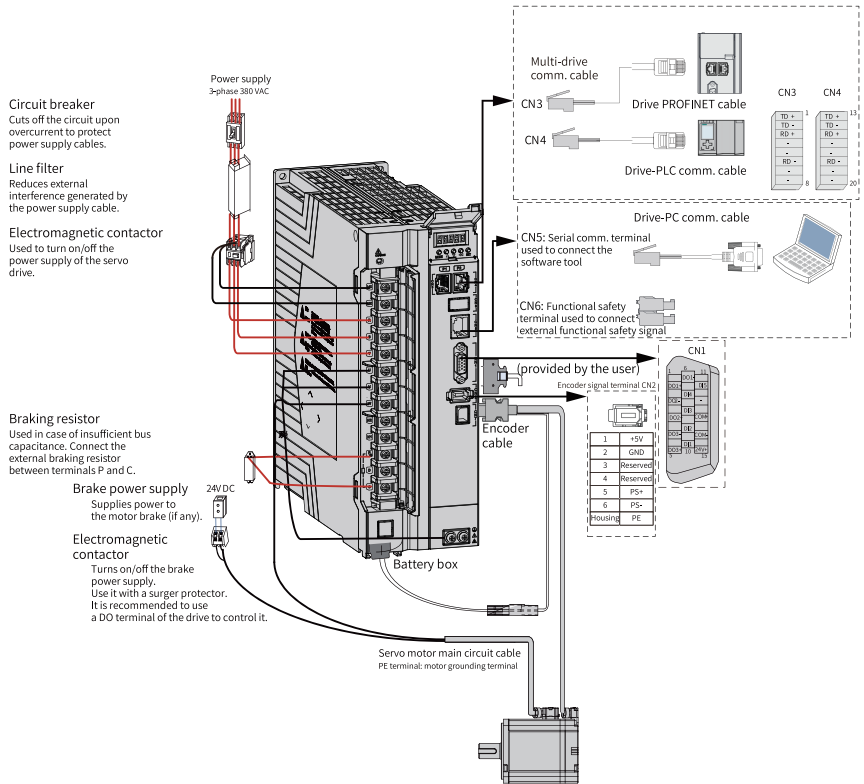


Figure 1-3 Wiring example of a three-phase 380 V system

Note

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

1.2 System Composition

- 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 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.
 - Remove the jumper between 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.
 - 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 (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.
-

2 Electrical Design Guide

2.1 Design of Periphery Electrical Devices

Installing a circuit breaker

Note

For UL-compliant products, see section ["4.2 UL&cUL Certification" on page 81](#) for recommended fuse/circuit breakers.

If a residual current device (RCD) is needed, select the RCD according to the following requirements:

- Use a B-type RCD because the drive may generate DC leakage current in the protective conductor.
- For each drive, use an RCD whose tripping current is not lower than 100 mA to prevent RCD malfunction due to high-frequency leakage current generated by the drive.
- When multiple drives are connected in parallel and share one RCD, select an RCD whose tripping current is not lower than 300 mA.
- Use Chint or Schneider RCDs (recommended).

Installing a fuse

Note

To prevent electric shocks, when the fuse is blown, wait for at least the time designated on the warning label before powering on the drive or operating peripheral devices. Failure to comply will 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.

Installing an electromagnetic contactor

Turning on or off the side electromagnetic contactor can start or stop the servo drive. However, frequent turn-on/-off may cause drive faults. Therefore, start/stop the servo drive at most once per hour. Do not use the electromagnetic contactor as the power switch of the drive. Otherwise, the lifetime of the drive may be reduced.

Installing an AC input reactor

The AC input reactor is an option used to suppress the harmonics in the input current. In applications where harmonics need to be suppressed, install an external AC input reactor.

The following figure shows the connection of the AC input reactor.

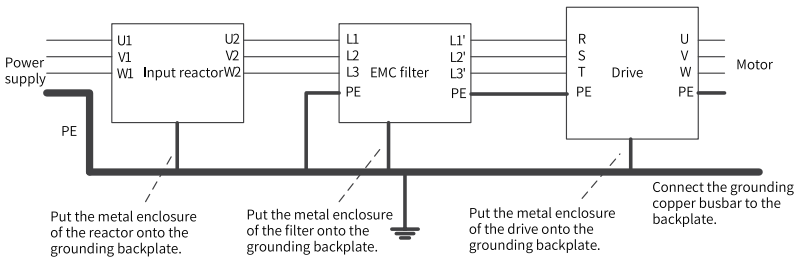


Figure 2-1 Connection of the AC input reactor

Installing an 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.

The following figure shows the connection of the EMC filter.

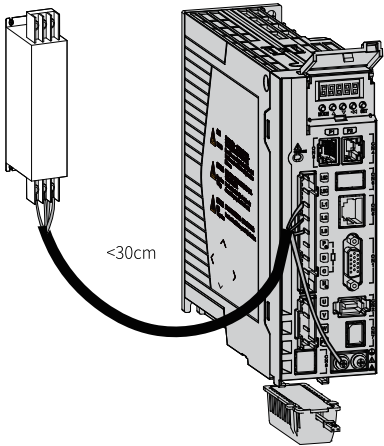


Figure 2-2 Connection of the EMC filter

Installing a magnetic ring and a magnetic buckle

The drive generates very strong interference during operation. The drive may interfere with or be interfered with by other devices due to improper routing or grounding. Wind the drive output U/V/W cable onto a magnetic ring for two to four turns. Wind the signal cable onto a magnetic buckle or magnetic ring for one to two turns.

- An amorphous magnetic ring has a high magnetic conductivity when the frequency is within 1 MHz and can efficiently suppress interference of the servo drive, but is expensive.
- A magnetic buckle has a high magnetic conductivity when the frequency is above 1 MHz and can efficiently suppress interference of various signal cables and low-power servo drives at a low cost.

The following figure shows the connection of the magnetic ring and magnetic buckle.

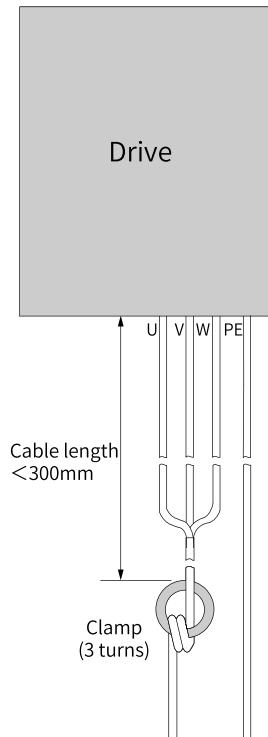


Figure 2-3 Connection of the magnetic ring

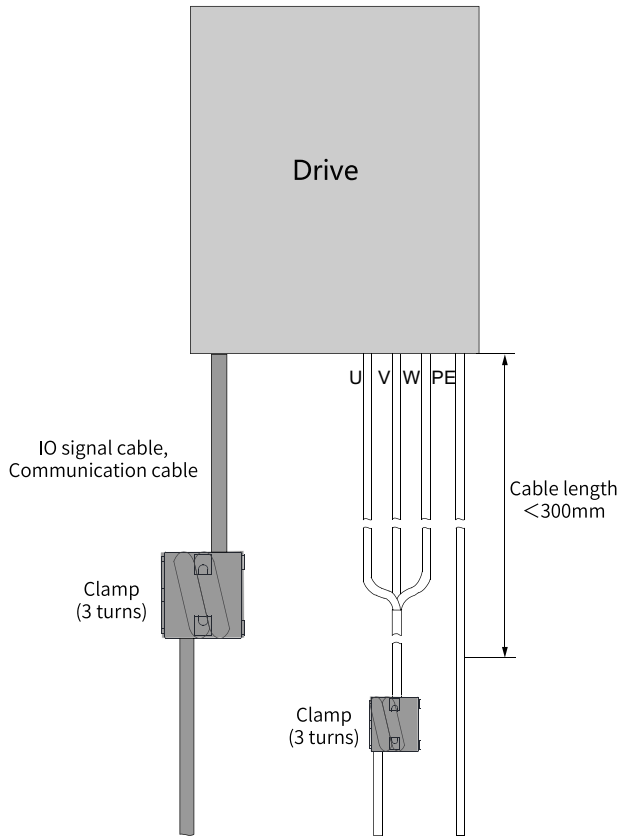


Figure 2-4 Connection of the magnetic buckle

Installing a braking resistor

When the capacitance of the bus is insufficient, the extra energy can be consumed by connecting an external braking resistor to the P $\oplus$ -C terminal.

When the motor torque direction is opposite to the direction of rotation, the energy is fed back to the servo drive from the motor side, leading to bus voltage rise. Once the bus voltage rises to the braking threshold, the excessive energy must be consumed by a regenerative resistor. Otherwise, the servo drive will be damaged. The regenerative resistor can be a built-in or an external one. The internal and built-in regenerative resistors must not be used together.

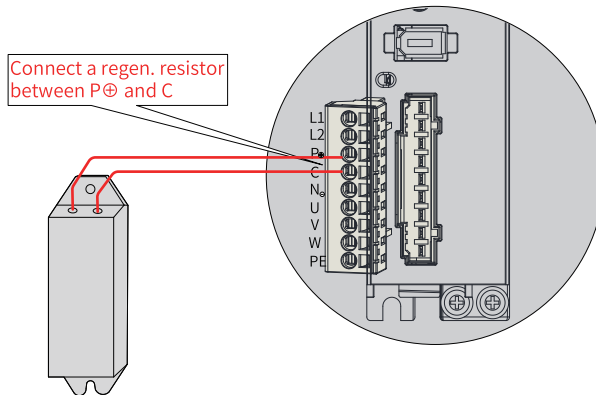


Figure 2-5 Wiring of external regenerative resistor

For cables used for terminals P+ and C, see ["2.2.1.3 Power Cable Specifications" on page 25](#).

Caution

Observe the following precautions when connecting the external regenerative resistor:

- 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.
- 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.

2.2 Power Cable Selection

2.2.1 Power Supply Cable

2.2.1.1 Rules



Caution

Read the section Rules carefully. Failure to comply may result in serious consequences.

- Do not use the power from IT system for the drive. Use the power from TN/TT system for the drive. Failure to comply may result in an electric shock.
 - Connect a electromagnetic contactor between the input power supply and the main circuit power supply of the servo drive (R, S and T) to form a structure which allows independent power cutoff on the servo drive power side. 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.
 - The main circuit cable must be away from the motor so that its insulation will not be damaged by high temperature of the motor surface.
 - 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.
 - 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 servo drive must be grounded properly. Failure to comply may result in device malfunction or damage.
-



Caution

- 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.
- 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.
- Use a power supply filter to reduce the electromagnetic interference on electronic devices surrounding the servo drive.

2.2.1.2 Power Cable Types

- The bending radius of a cable must be above 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/mm² when the total current is below 50 A, or 5 A/mm² when the total current is above 50 A. The permissible current density (A/mm²) can be adjusted based on the following formula in case of high ambient temperature or bundled cables.
Allowable current density = 8 x Reduction coefficient of current-carrying density of the conductor x Current correction coefficient

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

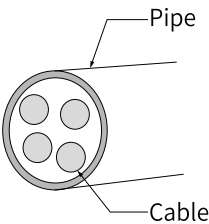


Table 2-1 Reduction coefficient of conductor current-carrying density

Number of Cables in a 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.
- 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 mm², use a grounding cable with a cross-sectional area of 2.0 mm².

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.

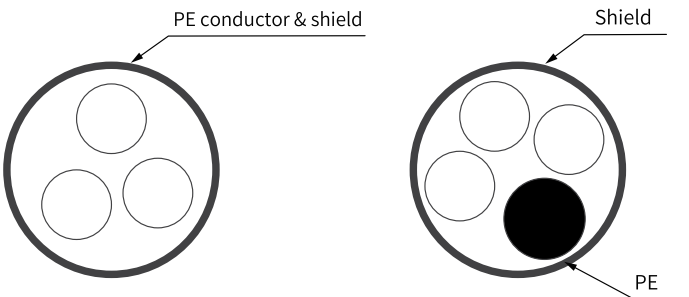


Figure 2-6 Recommended power cable

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

2.2.1.3 Power Cable Specifications

Table 2-2 Input/Output current data of the drive

Drive model SV660F****I		Rated Input Current	Rated output current (A)	Maximum Output Current (A)
Single-phase 220V				
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 220V				
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 2-3 Recommended main circuit cables

Drive model SV660F****I			L1C, L2C		L1, L2, L3/R, S, T		P⊕, D, C, N0, 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 220V												
Size A	S1R6	2.3	2 × 0.82	18	3 × 1.31	16	2 × 1.31	16	3 × 1.31	16	2.08	14
	S2R8	4	2 × 0.82	18	3 × 1.31	16	2 × 1.31	16	3 × 1.31	16	2.08	14
Size B	S5R5	7.9	2 × 0.82	18	3 × 1.31	16	2 × 1.31	16	3 × 1.31	16	2.08	14
Size C	S7R6	9.6	2 × 0.82	18	3 × 1.31	16	2 × 1.31	16	3 × 1.31 ^[1]	16	2.08	14
			2 × 0.82		3 × 1.31		2 × 1.31		3 × 2.08 ^[2]	14		14
Size D	S012	12.8	2 × 0.82	18	3 × 2.08	14	2 × 2.08	14	3 × 2.08	14	2.08	14
Three-phase 220V												
Size C	S7R6	5.1	2 × 0.82	18	3 × 1.31	16	2 × 1.31	16	3 × 1.31 ^[1]	16	1.31 ^[1]	16
									3 × 2.08 ^[2]	14	2.08 ^[2]	14
Size D	S012	8	2 × 0.82	18	3 × 2.08	14	2 × 2.08	14	3 × 2.08	14	2.08	14
Three-phase 380 V												
Size C	T3R5	2.4	2 × 0.82	18	3 × 1.31	16	2 × 1.31	16	3 × 1.31	16	2.08	14
	T5R4	3.6	2 × 0.82	18	3 × 1.31	16	2 × 1.31	16	3 × 1.31	16	2.08	14

Drive model SV660F****J			L1C, L2C		L1, L2, L3/R, S, T		P⊕, D, C, NØ, 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
Size D	T8R4	5.6	2 × 0.82	18	3 × 1.31	16	2 × 1.31	16	3 × 1.31	16	2.08	14
	T012	8	2 × 0.82	18	3 × 2.08	14	2 × 2.08	14	3 × 2.08	14	2.08	14
Size E	T017	12	2 × 0.82	18	3 × 5.27	10	2 × 5.27	10	3 × 3.33 ^[3]	12	3.33 ^[3]	12
									3 × 5.27 ^[4]	10	5.27 ^[4]	10
	T021	16	2 × 0.82	18	3 × 5.27	10	2 × 5.27	10	3 × 5.27	10	5.27	10
	T026	21	2 × 0.82	18	3 × 5.27	10	2 × 5.27	10	3 × 5.27	10	5.27	10

Note

- [1]: For MS1H1-10C30CB motors.
- [2]: For MS1H2-10C30CB/MS1H3-85B15CB motors.
- [3]: For MS1H2-40C30CD/MS1H2-50C30CD motors.
- [4]: For MS1H3-44C15CD motors.

Table 2–4 Recommended Cable Specifications and Models

Cable Type	Cable Size	OD (mm)
Power cable	4 × 12AWG	12.2 ± 0.4
	4 × 14AWG	10.5 ± 0.3
	4 × 16AWG	9.5 ± 0.4
	4 × 18AWG	7.8 ± 0.2
	4 × 20AWG	6.5 ± 0.2
Power cable shield	4 × 12AWG	12.9 ± 0.4
	4 × 14AWG	11.2 ± 0.4
	4 × 16AWG	10.1 ± 0.4
	4 × 18AWG	8.3 ± 0.2
	4 × 20AWG	6.5 ± 0.2
Power cable + brake cable	4 × 20AWG + 2 × 24AWG	6.5 ± 0.2
Brake cable	2 × 18AWG	5.8 ± 0.2
	2 × 20AWG	5.0 ± 0.2

Table 2-5 Main circuit cable lug and tightening torque

Servo drive model SV660F****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 220V						
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 220V						
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 2-6 TVR2-4 cable lug

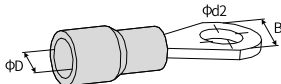
Lug Model		D (mm)	d2 (mm)	B (mm)	Dimension Drawing
TVR	2-4	4.5	4.3	8.5	

Table 2-7 Recommended terminal blocks

Servo drive model SV660F****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 SV660F****I		Terminal Block	
Size E	T017	-	
	T021		
	T026		

Table 2-8 Specifications of motor output cables

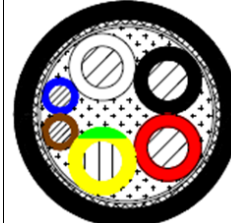
MS1H1/H4 05B-10C (Applicable to 0.5 kW-1 kW)			
Cable type	Regular cable	Flexible cable	Oil-resistant shielded flexible cable
Cable model	S6-L-M/B***-X.X	S6-L-M/B***-X.X-T	S6-L-M/B***-X.X-TS
Cable specifications	UL2517 (rated temperature: 105°C) 4Ex20AWG+2Cx24AWG	UL2517 (rated temperature: 105°C) 4Ex20AWG+2Cx24AWG	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 diameter	6.5±0.2 mm		
Internal structure and conductor colors			
Fill in "X.X" in the model number with cable length.			

Table 2-9 Specifications of motor output cables

MS1H2 10C-50C (Applicable to 1 kW-5 kW)/MS1H3 85B-18C (Applicable to 850 W-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 diameter	9.5±0.3 mm (main circuit)	10.0±0.3 mm (main circuit)	10.5±0.3 mm (main circuit)

MS1H2 10C–50C (Applicable to 1 kW–5 kW)/MS1H3 85B–18C (Applicable to 850 W–1.8 kW)			
Internal structure and conductor colors			
Fill in "X.X" in the model number with cable length.			

Table 2–10 Specifications of motor output cables

MS1H3 29C–75C (Applicable to 2.9 kW–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 diameter	12.2±0.4 mm (main circuit)	12.5±0.4 mm (main circuit)	13.2±0.4 mm (main circuit)
Internal structure and conductor colors			
Fill in "X.X" in the model number with cable length.			

2.2.1.4 Power Cable Shield

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

2.2.2 Motor Cable

2.2.2.1 Rules



Danger

- 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.
 - The main circuit cable must be away from the motor so that its insulation will not be damaged by high temperature of the motor surface.
 - Connect the servo drive to the motor directly. Do not use an electromagnetic contactor during wiring. Failure to comply may result in equipment fault.
-

2.2.2.2 Power Cable Types

For details, see ["2.2.1.2 Power Cable Types" on page 23](#).

2.2.2.3 Power Cable Specifications

For details, see ["2.2.1.3 Power Cable Specifications" on page 25](#).

2.2.2.4 Power Cable Shield

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

It is recommended to use the shielded cable as the motor output cable. Perform a 360° connection on the shield structure by using the shield grounding bracket, and crimp the drain wire of the shield to the PE terminal. Connect the shielded cable with shielded iron plate at the grounding end of the equipment for 360°, and avoid connecting the shielding layer to the casing in the form of "pig tail", otherwise, it will become high impedance for high frequency noise. If the shielding must be disconnected to install the motor contactor, the shielding must be kept continuous and its high frequency impedance as low as possible.

See ["Figure 2-7 Connection of the shielding layer" on page 31](#) for the correct connection of the shielding layer. Connect the shielding wire to the drive for 360° and avoid pig tail connection as possible. In the figure, the red line is the power line shielding layer, and the yellow line and blue line are the IO signal line shielding layer.

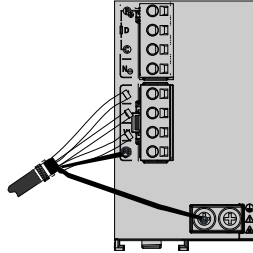


Figure 2-7 Connection of the shielding layer

Grounding bracket of the power cable shield.

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).

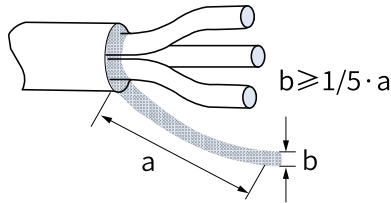


Figure 2-8 Lead-out of the motor cable shield

2.2.3 Encoder Cable

2.2.3.1 Rules

- 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 2-11 " on page 32 for details.

2.2.3.2 Encoder Cable Specifications

Table 2-11 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.

2.3 Control Cable Selection

2.3.1 Rules

Observe the following requirement during control circuit wiring:



Caution

- 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. Otherwise equipment may malfunction due to disturbed I/O signals.
- 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.

2.3.2 Control Cable Types

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.

2.3.3 Control Cable Specifications

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

Table 2-12 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).

2.3.4 Control Cable Shield

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.

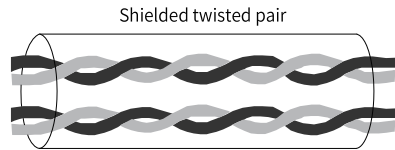


Figure 2-9 Diagram of shielded twisted pairs

2.4 Communication Cable Selection

Rules

This servo drive complies with the latest international EMC standard: IEC 61800-3:2004/A1:2011 (Adjustable speed electrical power drive systems—part 3: EMC requirements and specific test methods)

Communication cable specifications

Table 2-13 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

Cable shield

The PROFINET communication cable must be Ethernet Category 5 (100BASE-TX) network cable or high-strength shielded network cable. The cable for the servo drive must be the shielded network cable with the length no longer than 100 m. The shielded network cable enhances the anti-interference capacity of the system.

2.5 Cable Routing

2.5.1 Routing 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 into consideration since the cooling condition becomes poor.

- 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, E740.0/E136.0/E430.0 may occur (see the Troubleshooting Guide for details). 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.
- Do not power on the servo drive if terminal screws or cables are loose. Failure to comply may lead to a fire.

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

- EN 60204-1 and IEC 60364-5-52 standards
- Copper conductors with PVC insulation
- Heat resistance: 40°C ambient temperature and 70°C cable surface temperature (Contact the manufacturer if the ambient temperature exceeds 40°C.)

For details about requirements on UL cable selection, see "[Cable requirements](#)" on [page 82](#).

Note

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

- Do not bend or apply stress to cables. The conductor of a signal cable is only 0.2 mm or 0.3 mm in diameter. Handle the cables carefully to prevent fracture.
- In scenarios where cables need to be moved, use flexible cables. Ordinary cables are easily damaged after being bent for a long time. Cables of low-power servo motors cannot be used for movement.
- If the cable drag chain is used, ensure the following requirements are met.
 - The bending radius of the cable is at least 10 times its outer diameter.
 - Do not fix or bundle the cables inside the cable carrier. The cables can be bundled and fixed only at two unmovable ends of the cable carrier.
 - Cables cannot be wound or twisted.
 - The space factor inside the cable drag chain cannot exceed 60%.

- Do not use cables with different sizes together; otherwise, the thick cable may crush the thin cable. If thick and thin cables need to be used together, use a spacer plate to separate them.

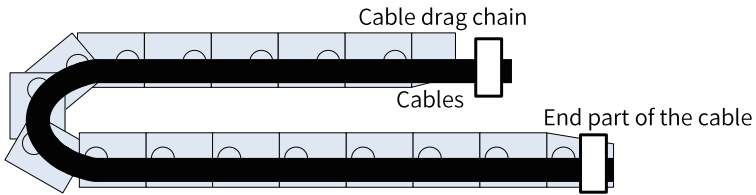


Figure 2-10 Cable drag chain

2.5.2 Routing Recommendations

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.

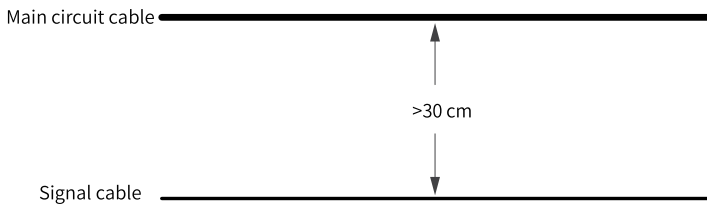


Figure 2-11 Cable layout

Wiring requirements

- Terminals P $\oplus$, C, and N0 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 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 with an angle not higher than 5°. Failure to comply may damage the terminal screws.

2.5.3 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 mm², 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:

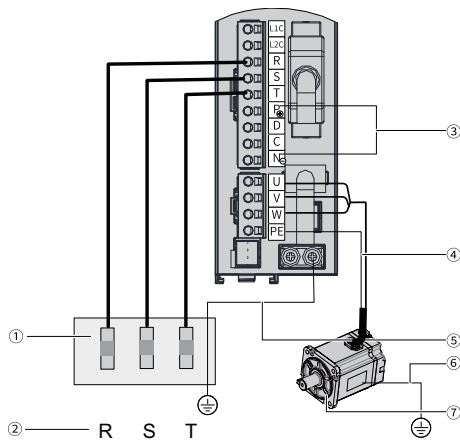


Table 2-14 Single-drive grounding

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.

No.	Description
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:

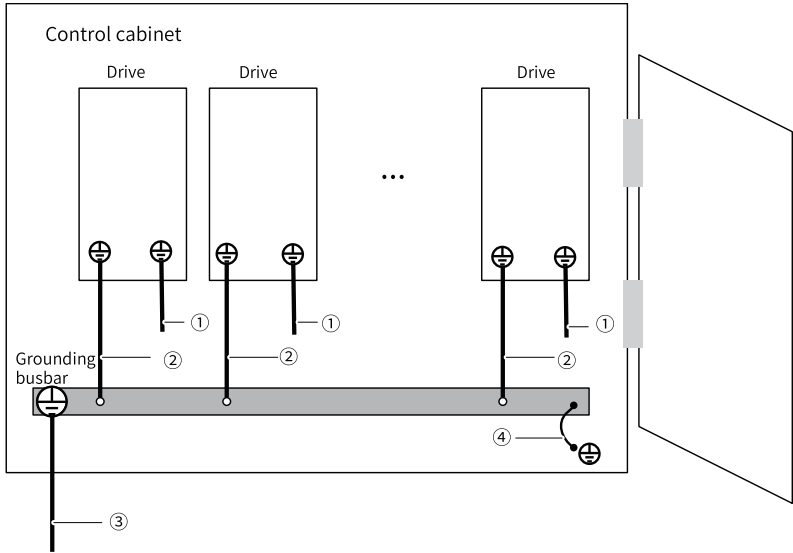


Table 2-15 Description for grounding of multiple drives installed side by side

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 2-16 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 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.

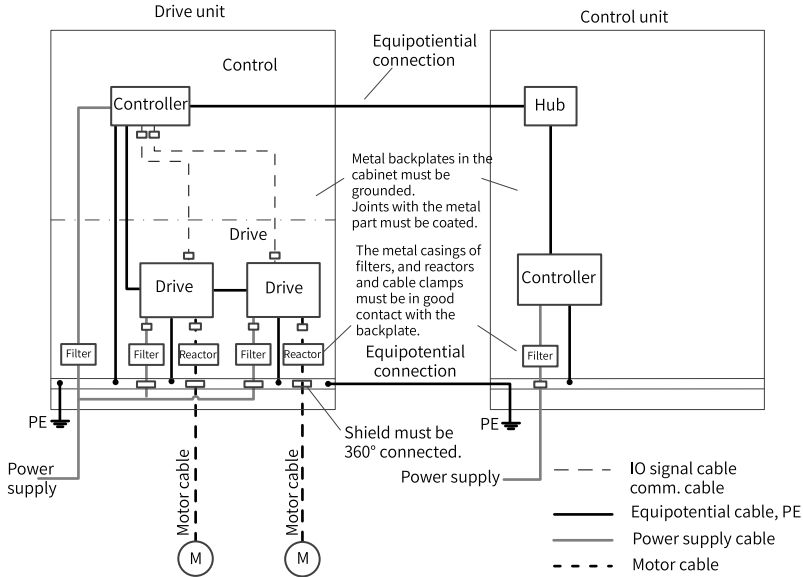


Figure 2-12 Recommended wiring for the control cabinet system

3 Wiring Terminals

3.1 Terminal Pin Layout of the Drive

Size A (rated power: 0.2 kW–0.4 kW): SV660FS1R6I, SV660FS2R8I

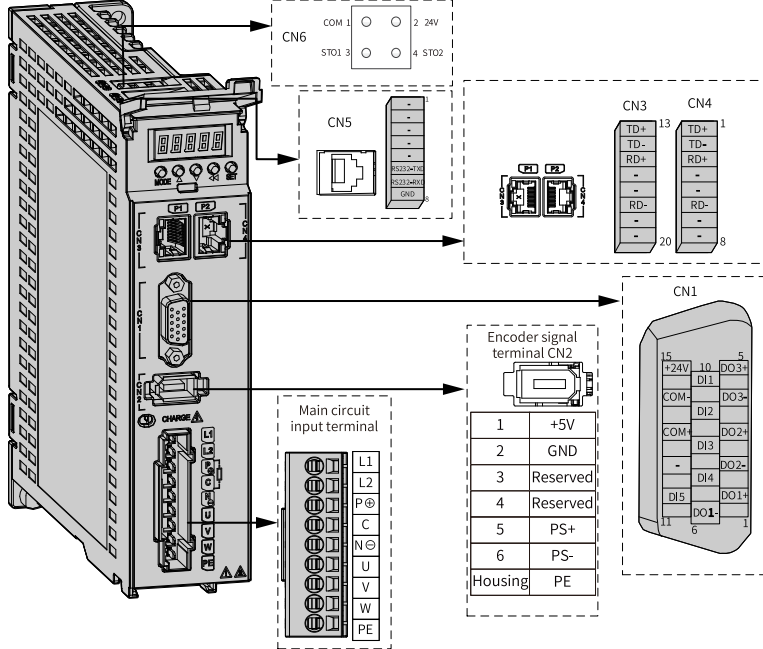


Figure 3-1 Terminal pin layout of servo drives in size A

Rated power: (SIZE B: 0.75 kW): SV660FS5R5I

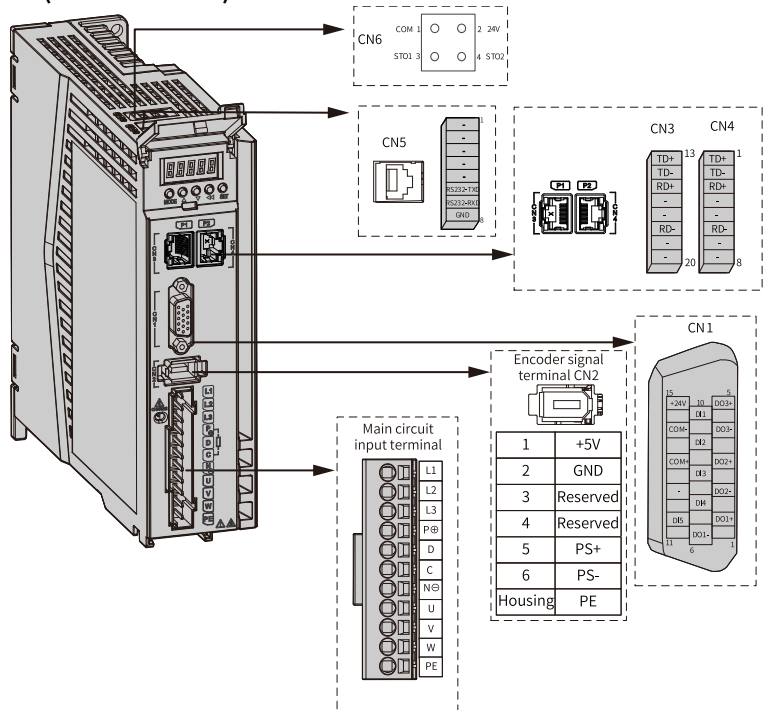


Figure 3-2 Terminal pin layout of servo drives in size B

Sizes C and D (rated power: 1.0 kW to 3.0 kW): size C: SV660FS7R6I/D: SV660FS012I

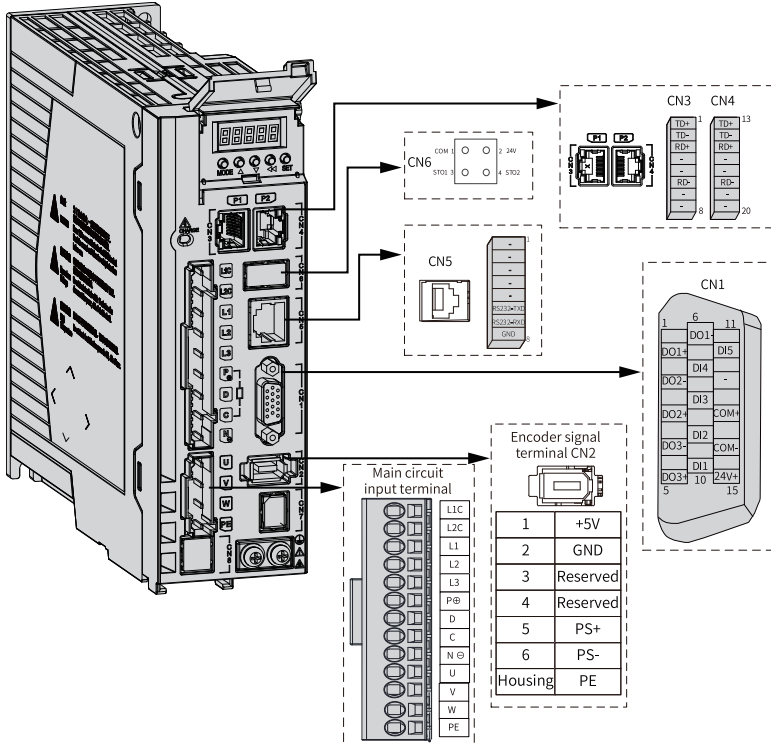


Figure 3-3 Terminal pin layout of servo drives in size C and size D (220V)

Sizes C and D (rated power: 1.0 kW to 3.0 kW): size C: SV660FT3R5I and SV660FT5R4I; size D: SV660FT8R4I, SV660FT012I

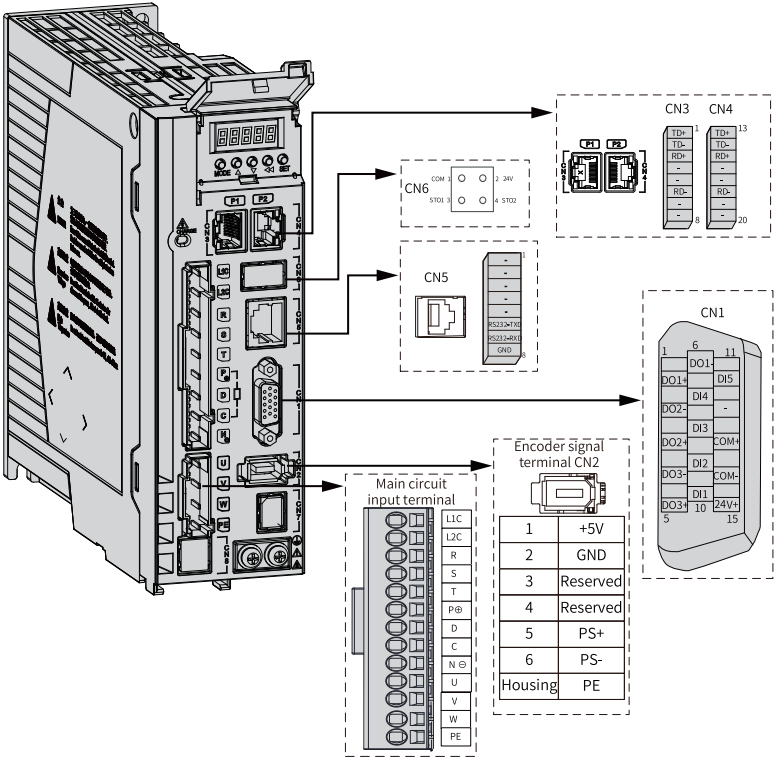


Figure 3-4 Terminal pin layout of servo drives in size C and size D (380V)

Size E (rated power: 5.0 kW to 7.5 kW): SV660FT017I, SV660FT021I, and SV660FT026I

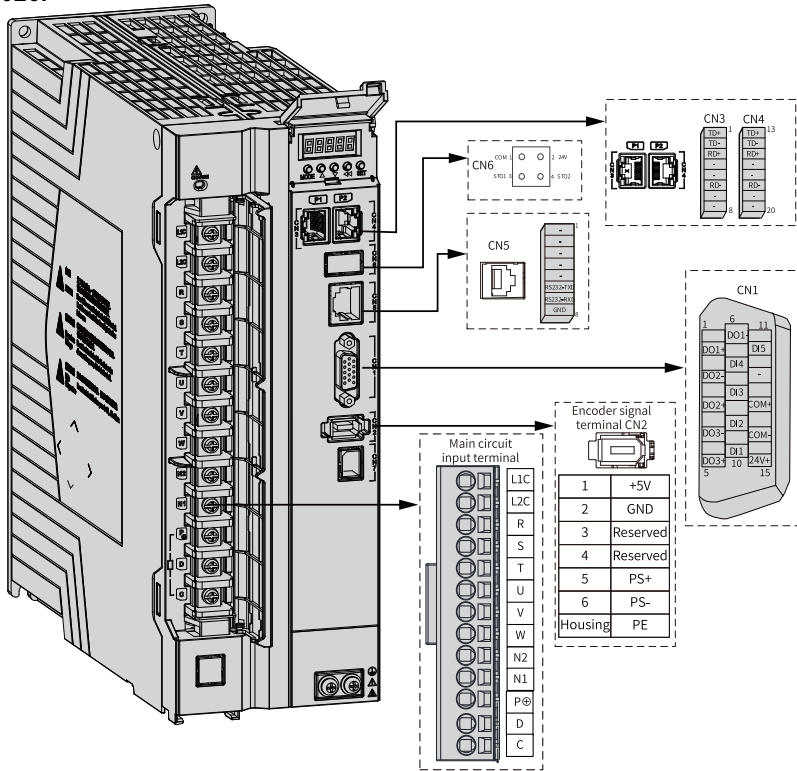


Figure 3-5 Terminal pin layout of servo drives in size E

Note

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

3.2 Main circuit terminal layout

Size A (rated power: 0.2 kW–0.4 kW): SV660FS1R6I, SV660FS2R8I

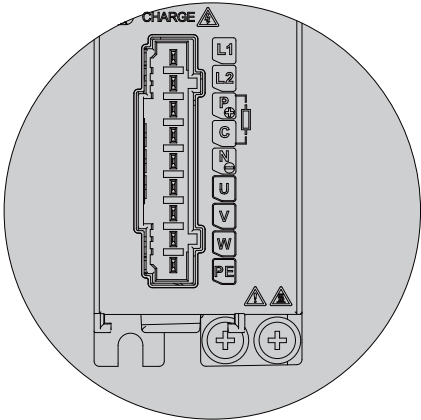


Figure 3-6 Main circuit terminal pins of size A drive

Table 3–1 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.
	P⊕, C Terminals for connecting external braking resistor	If an external regenerative 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): SV660FS5R5I

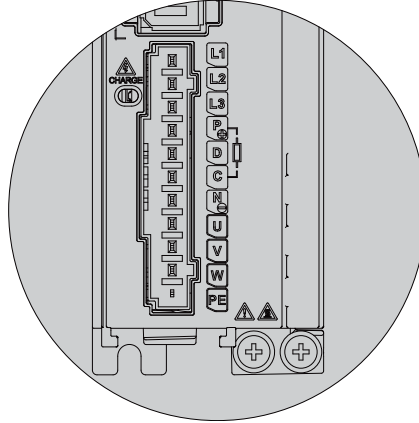


Figure 3-7 Pin assignment of main circuit terminal of servo drives in SIZE B

Table 3-2 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 $\oplus$, N $\ominus$ (DC bus terminals)	Used by the common DC bus for multiple servo drives.
	P $\oplus$, D, C Terminals for connecting external braking resistor	If an external regenerative resistor is needed, connect it between terminals P $\oplus$ and C. Size B drives come with a built-in regenerative resistor, with terminals P $\oplus$ and D jumped. Note: Remove the jumper between terminals P $\oplus$ and D before using the external regenerative resistor. Failure to comply will result in overcurrent and damage the braking transistor.
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.

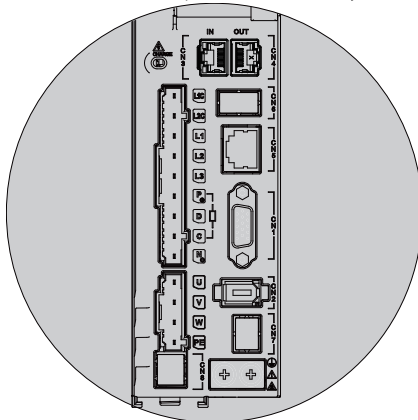
Rated power (SIZE C/SIZE D: 1.0kW–3.0kW): SV660FS7R6I, SV660FS012I

Figure 3-8 Pin assignment of main circuit terminal of servo drives in SIZE C and D (220 V)

Table 3–3 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.
3	P⊕, N⊖ (DC bus terminals)	Used by the common DC bus for multiple servo drives.
	P⊕, D, C Terminals for connecting external braking resistor	If an external regenerative resistor is needed, connect it between terminals P⊕ and C. SIZE C and SIZE D use a built-in regenerative resistor, with terminals P⊕ and D jumped. Note: 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.
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/SIZE D: 1.0 kW–3.0 kW): SV660FT3R5I, SV660FT5R4I, SV660FT8R4I, SV660FT012I

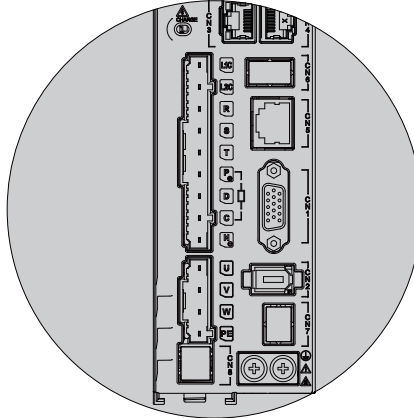


Figure 3-9 Pin assignment of main circuit terminal of servo drives in SIZE C and D (380V)

Table 3–4 Description of main circuit terminal pins of servo drives in SIZE C and D (380V)

No.	Name	Description
1	L1C, L2C Control circuit power input terminals	See the nameplate for the rated voltage class.
2	R, S, and T Main circuit power input terminals	See the nameplate for the rated voltage class.
3	P $\oplus$, N $\ominus$ (DC bus terminals)	Used by the common DC bus for multiple servo drives.
	P $\oplus$, D, C Terminals for connecting external braking resistor	If an external regenerative resistor is needed, connect it between terminals P $\oplus$ and C. SIZE C and SIZE D use a built-in regenerative resistor, with terminals P $\oplus$ and D jumped. Note: Remove the jumper between terminals P $\oplus$ and D before using the external regenerative resistor. Failure to comply will result in overcurrent and damage the braking transistor.
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 E: 5.0 kW–7.5 kW): SV660FT017I, SV660FT021I, SV660FT026I

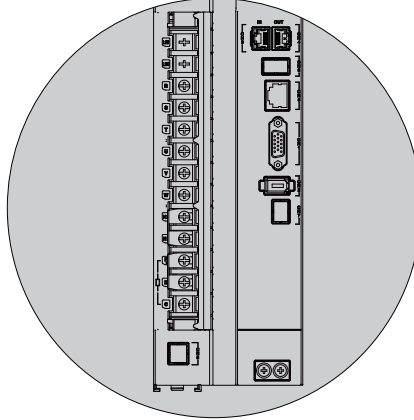


Figure 3-10 Pin assignment of main circuit terminal of servo drives in size E

Table 3-5 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, and 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	If an external regenerative resistor is needed, connect it between terminals P⊕ and C. SIZE E use a built-in regenerative resistor, with terminals P⊕ and D jumped. Note: 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.

Description

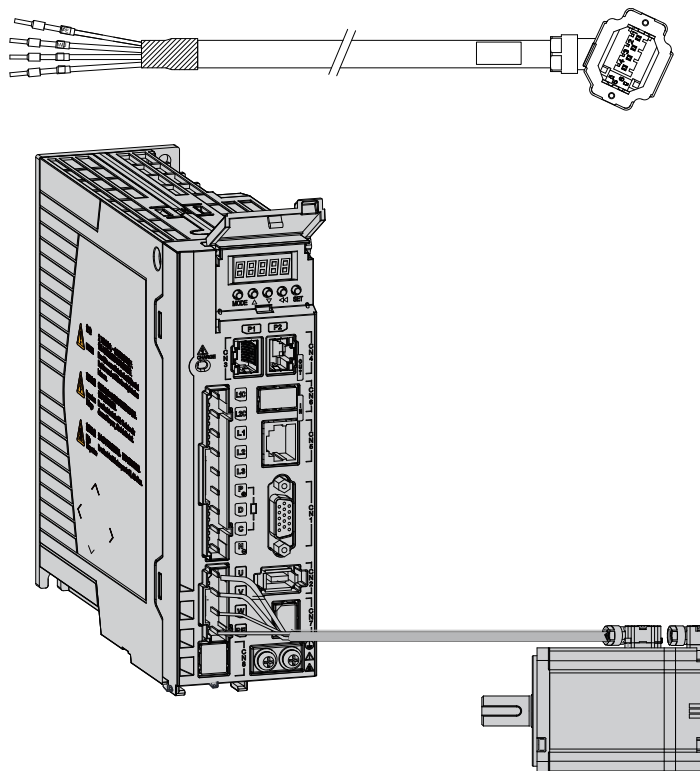
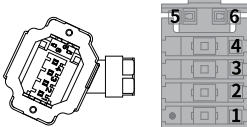


Figure 3-11 Wiring between the servo drive and terminal-type motor

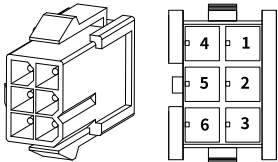
Table 3-6 Description of the power cable connector (motor side) for terminal-type motors

Flange Size [1]	Illustration	Pin		
		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.

Table 3-7 Description of the flying leads power cable connector (motor side)

Flange Size [1]	Illustration	Pin		
		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		Brown
		6	Brake (polarity insensitive)	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.

Table 3-8 Description of the power cable connector (motor side)

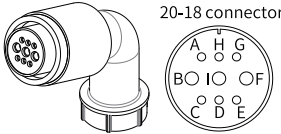
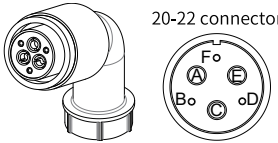
Flange Size [1]	Illustration	Pin		
		Pin No.	Signal Name	Color
100 130	 20-18 connector MIL-DTL-5015 series 3108E20- 18S aviation connector	B	U	Blue
		I	V	Black
		F	W	Red
		G	PE	Yellow/ Green
		C	Brake (polarity insensitive)	Red
		E		Black

Table 3-9 Description of the power cable connector (motor side)

Flange Size [1]	Illustration	Pin		
		Pin No.	Signal Name	Color
180	 20-22 connector 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 Control Terminal CN1

3.3.1 Terminal Layout

Terminal Layout

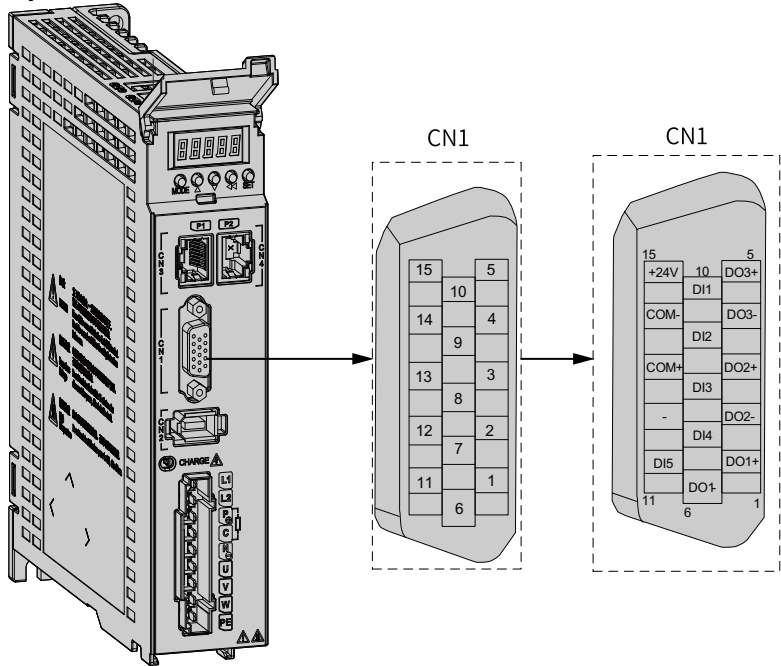


Figure 3-12 Control terminal pin layout of servo drives in sizes A and B

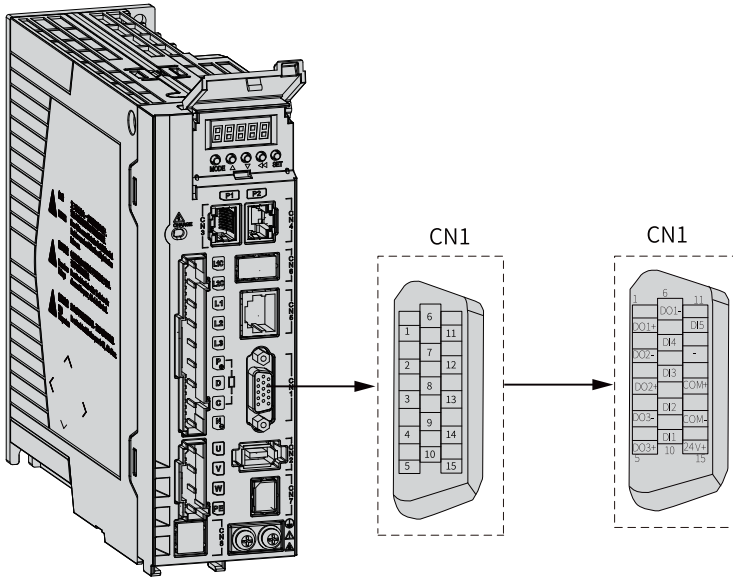


Figure 3-13 Control terminal pin layout of servo drives in sizes C, D and E

Note

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

Description

Table 3-10 Description of DI/DO signals

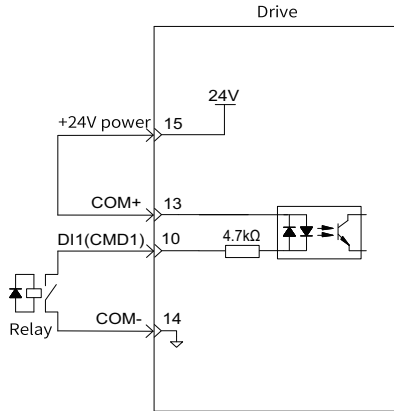
Signal Name		Default Function	Pin No.	Function
General	DI1	P-OT	10	Positive limit switch
	DI2	N-OT	9	Negative limit switch
	DI3	HomeSwitch	8	Home switch
	DI4	Emergence Stop	7	Emergency stop
	DI5	TouchProbe1	11	Touch probe 1
	+24V		15	Internal 24 V power supply, voltage range: 20 to 28 V, maximum output 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	

3.3.2 DI/DO Signals

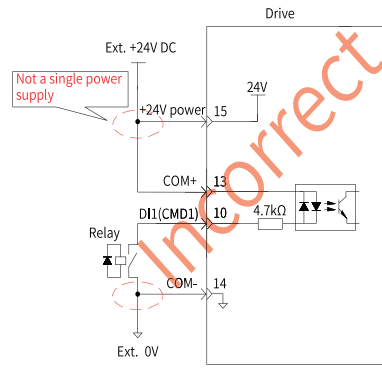
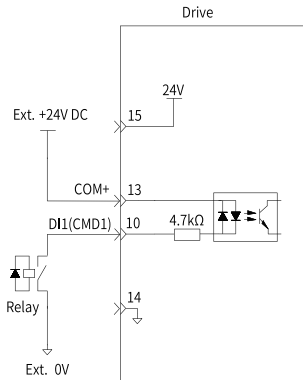
DI circuit

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

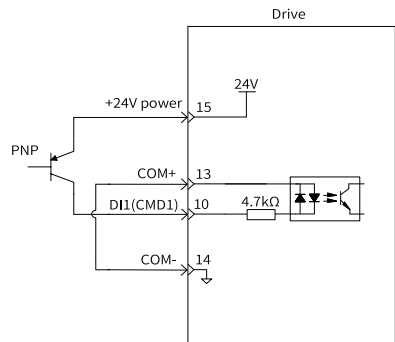
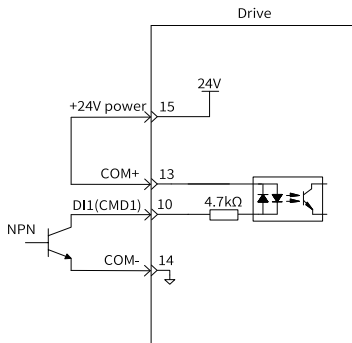
- The host controller provides relay output:
 - When you use the internal 24 V power supply:



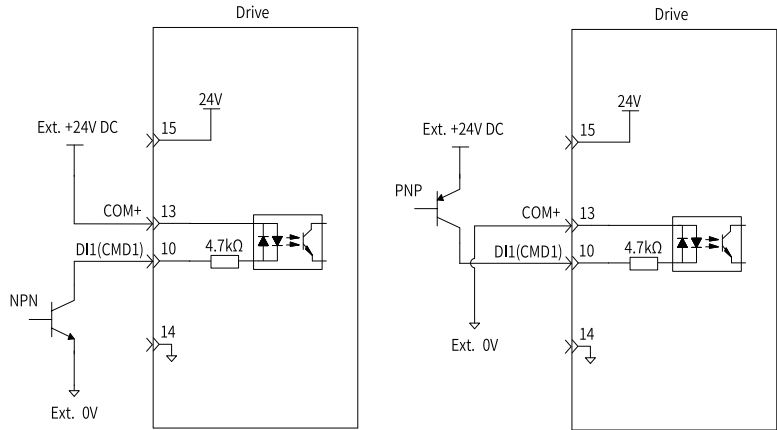
- When you use an external power supply:



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



- When you use an external power supply:



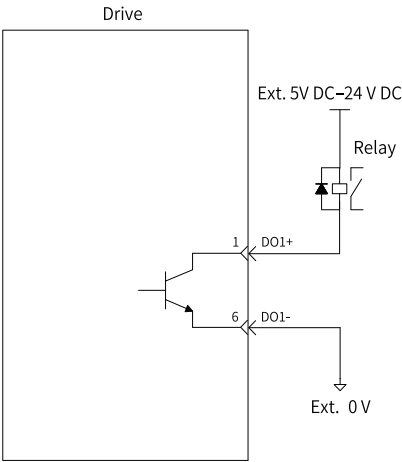
Note

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

DO circuit

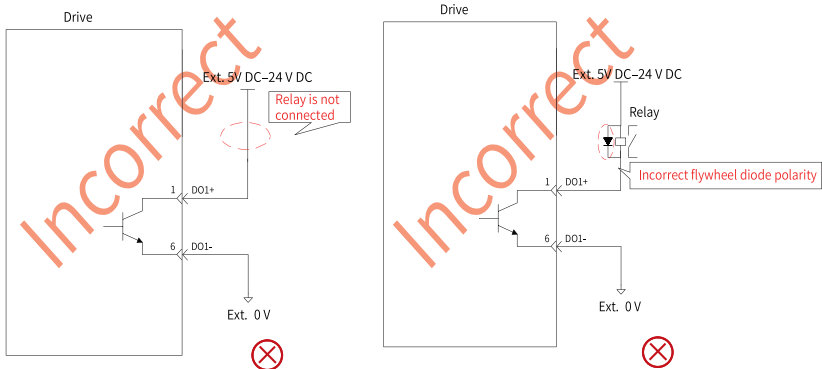
The circuits for DO1 to DO3 are the same. The following description takes DO1 circuit as an example.

- The host controller provides relay input.

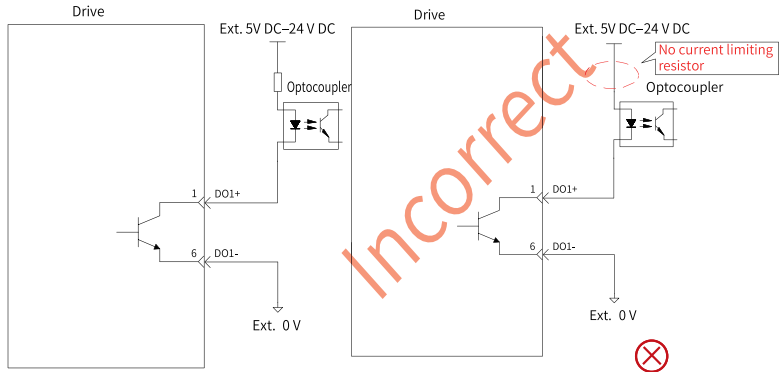


Note

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

3.3.3 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.

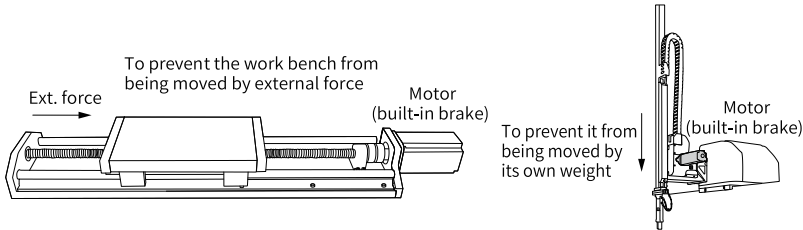


Figure 3-14 Application of the brake



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 connection of brake input signals is polarity-insensitive. Users need to prepare a 24 V power supply. The following figure shows the standard wiring of the brake signals (BK) and the brake power supply.

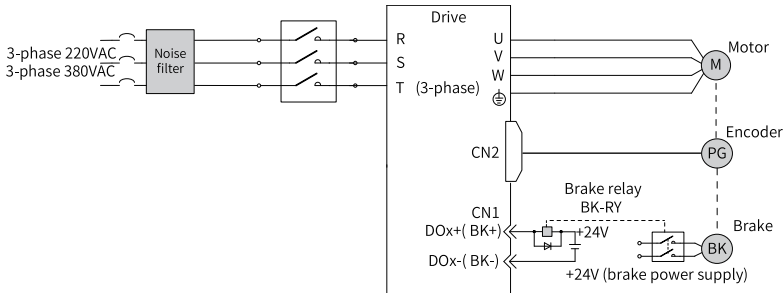


Figure 3-15 Wiring of the brake

Pay attention to the following precautions during wiring:

When deciding the length of the motor brake cable, take the voltage drop caused by cable resistance into consideration. 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 3–11 Brake specifications

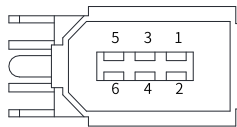
Motor Model	Holding Torque (N·m)	Supply Voltage (VDC) $\pm 10\%$	Coil Resistance (Ω) $\pm 7\%$	Exciting Current (A)	Release Time (ms)	Apply Time (ms)	Backlash (°)
MS1H1-05B/10B MS1H4-10B	0.32	24	94.4	0.25	≤ 20	≤ 40	≤ 1.5
MS1H1-20B/40B MS1H4-20B/40B	1.5		75.79	0.32	≤ 20	≤ 60	≤ 1.5
MS1H1-75B/10C MS1H4-75B/10C	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 mm².

3.4 Encoder Terminal CN2

Terminal Layout



Encoder signal terminal CN2

Figure 3-16 Terminal pin layout of the encoder

Table 3-12 Pin assignment

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

Description

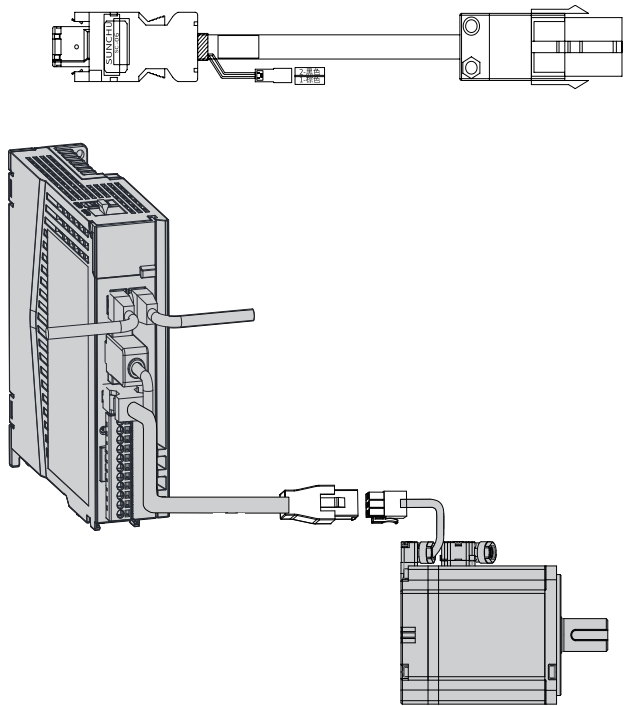


Figure 3-17 Signal wiring example of the absolute encoder^[1]

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.

The following figure describes the lead wire color of the battery box.

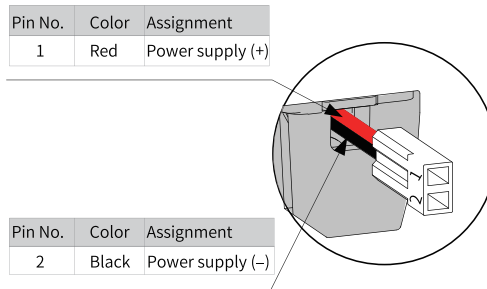
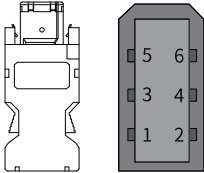
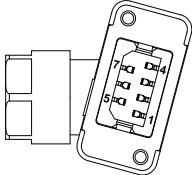


Figure 3-18 Lead wire color of the battery box

Note

- 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

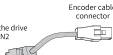
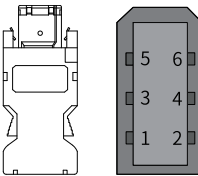
Table 3-13 Terminal-type motor encoder cable connector

Motor Frame Size ^[1]	Illustration		Pin			
			Pin No.	Signal Name	Color	Type
Terminal- type: 40 60 80	Ser- vo drive side		1	+5V	Red	Twisted pair
			2	GND	Orange	
			5	PS+	Blue	Twisted pair
			6	PS-	Purple	
			Enclosure	PE	-	-
			6-pin male			
	Mo- tor side		1	PS+	Blue	Twisted pair
			2	PS-	Purple	
			3	DC+	Brown	Twisted pair
			4	DC-	Black	
			5	+5V	Red	Twisted pair
			6	GND	Orange	
			7	PE	-	-
		7-pin connector				

Note

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

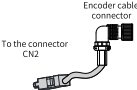
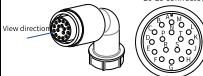
Table 3-14 Flying leads type motor encoder cable connector (9-pin)

Motor Frame Size ^[1]	Illustration		Pin			
			Pin No.	Signal Name	Color	Type
Flying leads type: 40 60 80	 Encoder cable connector To the drive CPU	 6-pin male	1	+5V	Red	Twisted pair
			2	GND	Orange	
			5	PS+	Blue	Twisted pair
			6	PS-	Purple	
			Enclo sure	PE	-	-
	 9-pin connector Recommended: Plastic enclosure: AMP 172161- 1; terminal: AMP 770835-1	M o t o r s i d e	1	Battery (+)	Brown	Twisted pair
			4	Battery (-)	Black	
			3	PS+	Blue	Twisted pair
			6	PS-	Purple	
			9	+5V	Red	Twisted pair
			8	GND	Orange	
			7	Shield	-	-

Note

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

Table 3-15 Absolute encoder cable connector (MIL-DTL-5015 series 3108E20-29S aviation connector)

Motor Frame Size ^[1]	Illustration		Pin			
			Pin No.	Signal Name	Color	Type
100 130 180	 Servo motor side 6-pin male	1	+5V	Red	Twisted pair	
		2	GND	Orange		
		5	PS+	Blue	Twisted pair	
		6	PS-	Purple		
		Enclosure	PE	-	-	
		 Motor side 20-25 connector	A	PS+	Blue	Twisted pair
	B		PS-	Purple		
	E		Battery (+)	Brown	Twisted pair	
	F		Battery (-)	Black		
	G		+5V	Red	Twisted pair	
	H		GND	Orange		
	J		Shield	-	-	

Note

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

3.5 Communication Terminals CN3 and CN4

Terminal Layout

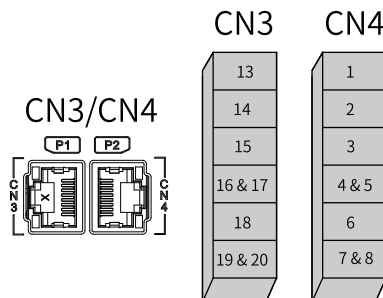


Figure 3-19 Communication terminal pin layout (sizes A and B)

Table 3–16 PROFINET communication terminal pin assignment (sizes A and B)

Pin No.	Name	Description
13	TD+	Data transmit positive
14	TD-	Data transmit negative
15	RD+	Data reception+
16 and 17	-	-
18	RD-	Data reception–
19 and 20	-	-
1	TD+	Data transmit positive
2	TD-	Data transmit negative
3	RD+	Data reception+
4 and 5	-	-
6	RD-	Data reception–
7 and 8	-	-

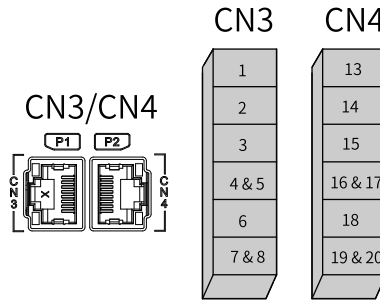


Figure 3-20 Communication terminal pin layout (sizes C, D and E)

Table 3–17 PROFINET communication terminal pin assignment (sizes C, D and E)

Pin No.	Name	Description
1	TD+	Data transmit positive
2	TD-	Data transmit negative
3	RD+	Data reception+
4 and 5	-	-
6	RD-	Data reception–
7 and 8	-	-
13	TD+	Data transmit positive
14	TD-	Data transmit negative
15	RD+	Data reception+
16 and 17	-	-
18	RD-	Data reception–
19 and 20	-	-

Description

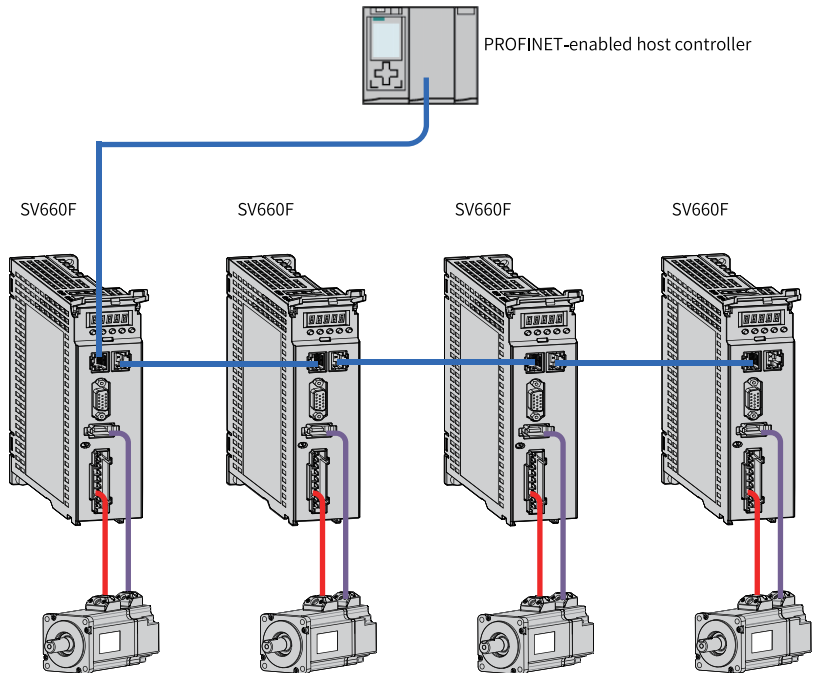


Figure 3-21 Communication network topology

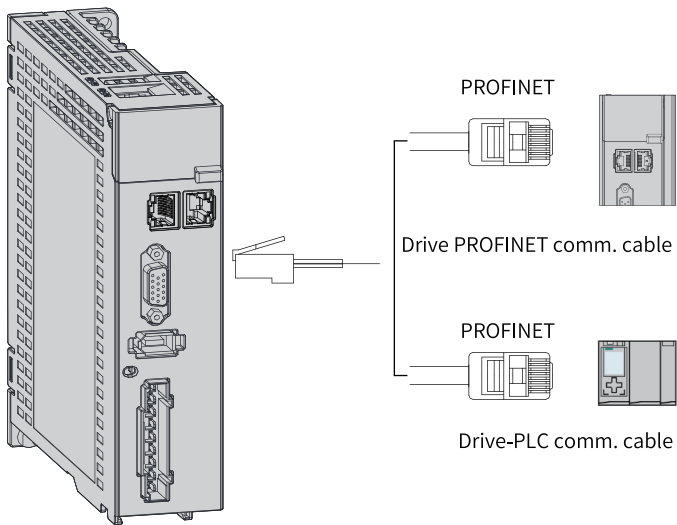


Figure 3-22 Wiring of communication cables

CN3 and CN4 are PROFINET communication port connectors. CN3(P1) is connected to the host controller, and CN4(P2) is connected to a slave. For assignment of CN3/CN4 terminal pins, see ["3.5 Communication Terminals CN3 and CN4" on page 66](#).

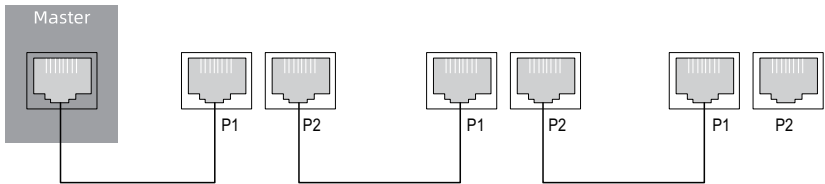
Terminal Wiring

- Topology

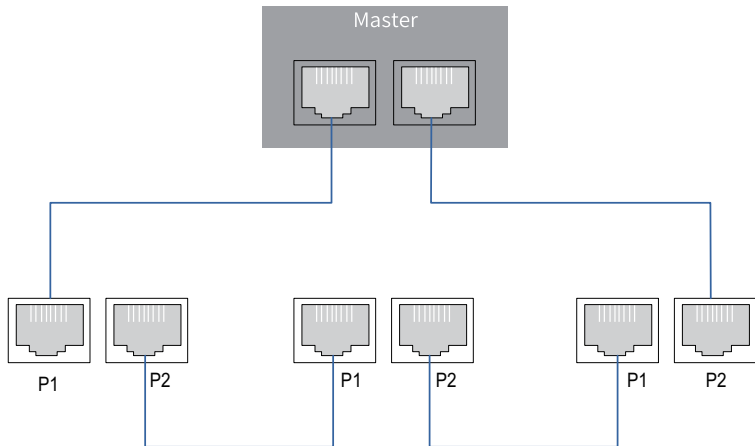
Profinet communication topology is flexible and basically has no restrictions.

However, in IRT communication mode, the actual physical topology connection sequence must be consistent with the topology connection sequence configured by the PLC.

- Linear



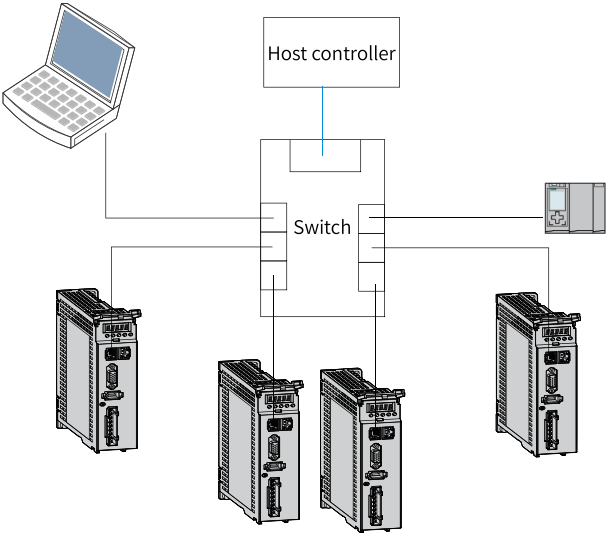
- Redundant ring



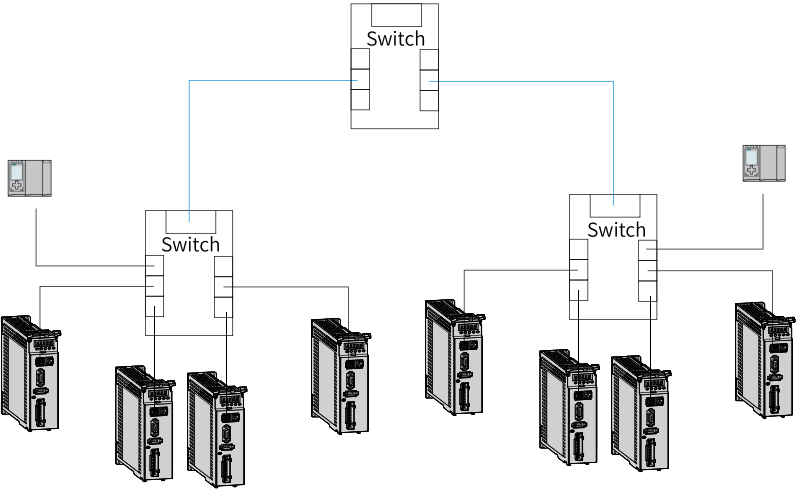
Note

When using the redundant ring, set H0E.36 (EtherCAT AL enhanced link) to 1 (Enabled), then power on the servo drive again.

- Star



- Tree



Ordering

Table 3–18 Instructions for communication cable selection

Cable Length	Price	Supplier
0.2 m to 10 m	See <i>"Table 3–19 Information for ordering the communication cable" on page 71 "Cable Ordering"</i> .	Inovance
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.	Haituo

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 3–19 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

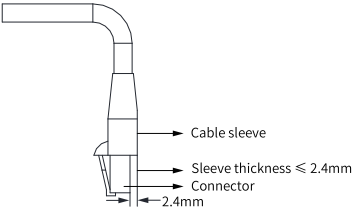
Ordering:

Purchase cables shorter than or equal to 10 m from Inovance.

Cables longer than 10 m: Purchase them 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 order quantity will also affect the pricing.

Note

The head of the dual-port network terminal cannot be too thick, otherwise, interference may occur. The recommended thickness is 2.4 mm, as shown below.



3.6 Description of Communication Terminal (CN5)

Terminal Layout

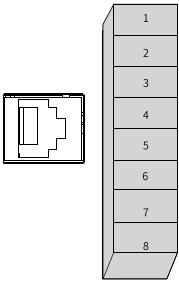


Table 3-20 Pin assignment

Pin No.	Description
1 to 5	-
6	RS232-TXD
7	RS232-RXD
8	GND

Communication with PC

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

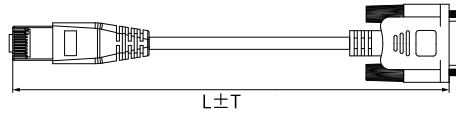


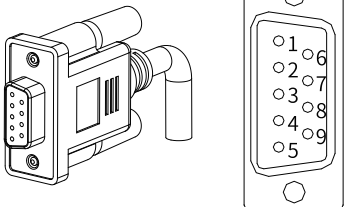
Figure 3-23 PC communication cable

Table 3-21 Pin connection relation between the servo drive and PC communication cable

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

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

Table 3-22 Pin assignment of DB9 terminal on the PC

Pin No.	Description	Description	
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.

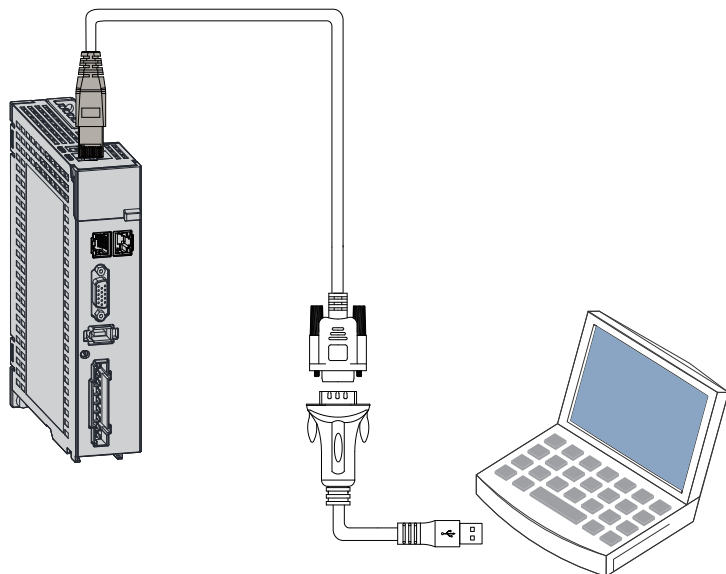


Figure 3-24 Serial-to-USB conversion

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

3.7 CN6 STO Safety Terminal

Note

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

Terminal Layout

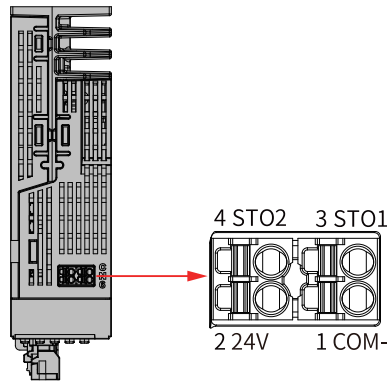
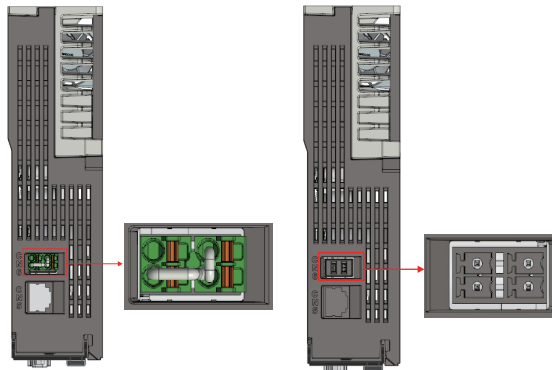


Table 3-23 Pin assignment

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

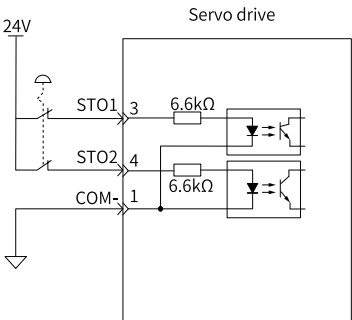
The servo drive operates normally only when the input states of STO1 and STO2 are both "High" ("1" or "H").

The servo drive does not operate when the input states of STO1 or STO2 are different or are both "Low" ("0" or "L").

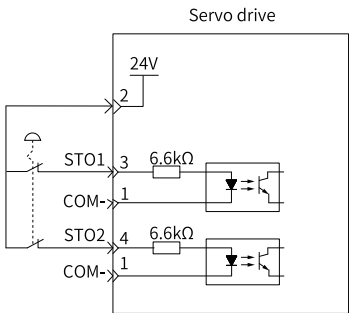
- Electrical characteristics of Safety Request Input Signal are as follows:

Item	Characteristics	Description
Voltage range	24 VDC ($\pm 15\%$)	-
Input current	3.6 mA (Typ.)	This is the value per channel.
Standards of logic levels	"0" < 5V, "1" > 15 V	-
Digital input impedance	6.6 k Ω	-

- External 24 V

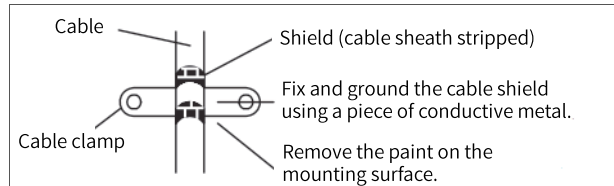


- Internal 24 V



- 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 activation 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.
 - For cabling the DI inputs of the STO, to avoid common cause failure in the cables, the two channels must be routed through two well-apart routes, or the cable must be protected with double-shielded methods.

Cable	Description
Category	Low voltage, double-shielded or single-shielded twisted multi-pair cable
Maximum size	0.8 mm ² (18 AWG)
Minimum size	0.3mm ² (28 AWG)
Maximum length	The max. distance between STO input and the operating contact is 30 m

Applicable servo drives

STO applies to the following -FS servo drives:

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

4 Certification and Standard Requirements

Table 4-1 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 drive complies with the latest version of directives and standards for CE and UL/cUL certifications.

4.1 CE Certification



Figure 4-1 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.

4.1.1 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

4.1.2 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 SV660F Series Servo Installation Guide.

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 main circuit terminals, see ["3.2 Main circuit terminal layout" on page 46](#).

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 SV660F Series Servo Drive Selection Guide.

4.2 UL&cUL Certification



Figure 4-2 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 61800–5–1 and CSA C22.2 No. 274-17 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.

Installation 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:

SV660F series servo drives are open-type drives that must be installed in a fireproof cabinet with the housing that provides effective electrical and mechanical protection. The installation must conform to local laws and regulations and related NEC requirements.

Main circuit wiring requirements



Warning

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

- 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.
- 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 with an angle not higher than 5°. Failure to comply may damage the terminal screws.

Wiring requirements of the control circuit

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.

Cable selection

To comply with UL61800-5-1 and CSA C22.2 No. 274-17, power cables used for SV660P 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)
- Cable size must be 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 of 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:

Fuse type: Semiconductor Fuse						
Servo drive model SV660F****I			Recommended Fuse UL-compliant FWH series			
Size	Model	Rated Input Current	Manufacturer	Model	Rated Voltage	Rated current (A)
Three-phase 380 V						
Size E	T017	12	COOPER BUSSMANN LLC	FWH-50B	500	50
	T021	16		FWH-70B	500	70
	T026	21		FWH-125B	500	125

Circuit Breaker Type: Inverse Time Circuit Breaker						
Servo drive model SV660F****I			Recommended Fuse UL-compliant 3VA6 series			
Size	Model	Rated Input Current	Manufacturer	Model	Rated Voltage	Rated current (A)
Single-phase 220 V						
Size A	S1R6	2.3	Siemens SIEMENS AG	3VA6140-6HL31	480	40
	S2R8	4.0		3VA6140-6HL31	480	40
Size B	S5R5	7.9		3VA6140-6HL31	480	40
Size C	S7R6	9.6		3VA6210-6HL31	480	100
Size D	S012	12.8		3VA6210-6HL31	480	100
Three-phase 220 V						
Size C	S7R6	5.1	Siemens	3VA6210-6HL31	480	100
Size D	S012	8.0	SIEMENS AG	3VA6210-6HL31	480	100
Three-phase 380 V						
Size C	T3R5	2.4	Siemens SIEMENS AG	3VA6210-6HL31	480	100
	T5R4	3.6		3VA6210-6HL31	480	100
Size D	T8R4	5.6		3VA6210-6HL31	480	100
	T012	8.0		3VA6210-6HL31	480	100

5 Solutions to Common EMC Problems

5.1 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 5-1 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 5-1 Magnetic ring on the input side" on page 86. • 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.	

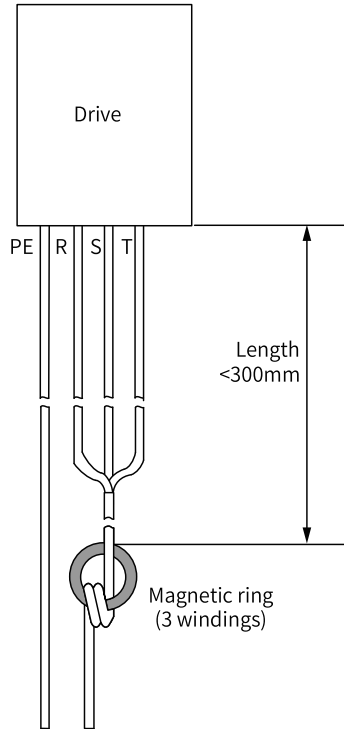


Figure 5-1 Magnetic ring on the input side

5.2 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 details about reactor models and installation, see the Installation Guide.

5.3 Noise Prevention

To prevent noise interference caused by switching on and off the IGBT, you can install a magnetic ring on the output UVW cables. For details, see the Installation Guide.

Tightly secure the back of the enclosure to the drive grounding metal housing.

Use shielded power cables and ground the shield properly.

5.4 Control Circuit 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 "2.3.4 Control Cable Shield" on page 33 .
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 39).
4	Install the magnetic ring on the output side (UVW) of the drive by two to four turns (see "Installing a magnetic ring and a magnetic buckle" on page 19).
5	Increase the filter capacitance for low-speed DIs. A capacitance up to 0.1 μF is recommended, as shown in "Figure 5-2 I/O signal cables with capacitance increased" on page 88 .
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 "Installing a magnetic ring and a magnetic buckle" on page 19).
8	Use shielded power cables and ground the shield properly.

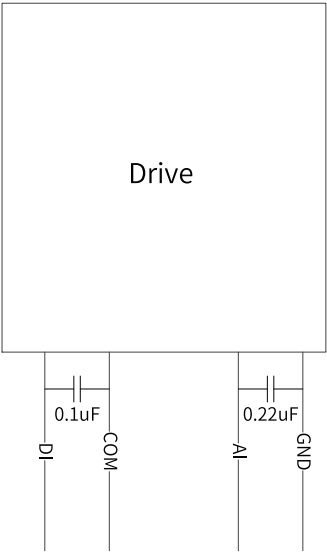


Figure 5-2 I/O signal cables with capacitance increased



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