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SV670P Series Servo Drive

Hardware Guide

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

Data code 19011854 A04

Preface

Introduction

Thank you for purchasing the SV670P series servo drive developed by Inovance.

The SV670P series servo drive is a high-end servo drive designed based on global-leading standards and high-end application needs. It is featured with high speed, high precision, high performance, and tuning-free Function.

The servo drive covers a power range from 0.05 kW to 7.5 kW and carries Modbus communication interfaces to work with the host controller for a networked operation of multiple servo drives. The drive comes with the ITune function which supports adaptive stiffness level setting, inertia auto-tuning, and vibration suppression for easy use. The servo drive, together with an MS1 series high-response servo motor (with ultra-low, low or medium inertia) equipped with a 23-bit single-turn/multi-turn absolute encoder, serve to deliver a quiet and stable operation and accurate process control through the fully closed-loop function and internal process segment function.

The drive also offers dynamic braking. The drive aims to achieve quick and accurate position control, speed control, and torque control through high-performance solutions for automation equipment in such industries as electronic manufacturing, lithium batteries, manipulators, packaging, and machine tools.

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
SV670P Series Servo Drive Selection Guide	19011852	Provides instructions on product selection, including the list of supporting components, technical data on the drive and motor, and the selection guide of cables.
SV670P Series Servo Drive installation Guide	19011868	Presents installation of the servo drive, including installation steps, , mechanical installation, and electrical installation.
SV670P Series Servo Drive Hardware Guide	19011854	Presents electrical design guidance of the equipment, description of terminals, required certificates and standards and solutions to common EMC problems.
SV670P Series Servo Drive Commissioning Guide	19011856	Presents servo commissioning, parameter descriptions, including the operating panel, commissioning software, commissioning procedure and a parameter list.

Name	Data Code	Description
SV670P Series Servo Drive Function Guide	19011866	Presents functions and parameters, including function overview, basic servo functions, adjustment and parameter list.
SV670P Series Servo Drive Communication Guide	19011871	Presents functions and parameters of the servo drive, including Modbus communication configuration, parameter descriptions, and communication application cases.
SV670P Series Servo Drive Troubleshooting Guide	19011869	Introduces faults and fault levels, the troubleshooting process, warning codes and fault codes.
SV670P Series Servo Drive Maintenance Guide	19011870	Provides instructions on maintenance and repair of the equipment.
SV670P Series Servo Drive Safety Guide	19011867	Presents the safety function and related certifications and standards, wiring, commissioning process, troubleshooting, and functions.
SV670P Series Servo Drive Manual Package	PS00005526	Provides information on selection, installation, commissioning, function, troubleshooting and parameters of the equipment.

Revision History

Date of Revision	Version	Description
2022-08	A04	Modified the recommendations for the main circuit cable.
2022-07	A03	• Updated the schematic diagram of the drive. • Deleted information on the CN8 terminal. • Modified the recommended specifications of the main circuit cable lug.
2022-05	A02	• Changed the CN3/CN4 terminals in the system connection diagram. • Modified the wiring diagram for torque control mode. • Modified the terminal layout diagram in section 4.4. • Modified the connection diagram of the CN2 absolute encoder.
2022-05	A01	Modified the analog input wiring diagram.
2022-04	A00	First release.

Document Acquisition

This manual is not delivered with the product. You can obtain the PDF version by visiting:

- http://www.inovance.com.

- Scan the QR code on the equipment to acquire more.

Table of Contents

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

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

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

Storage and Transportation

- Large-scale or heavy equipment must be transported by qualified professionals using specialized hoisting equipment. Failure to comply may result in personal 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.

- 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

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

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

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

Wiring

- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Before wiring, cut off 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.

- 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.

- 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

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

- Perform a trial run after wiring and parameter setting to ensure the equipment operates safely. Failure to comply may result in personal injuries or equipment damage.
- Before power-on, make sure that the rated voltage of the equipment is consistent with that of the power supply. Failure to comply may resulting in a fire. 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

- 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.

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

Maintenance

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

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

Repair

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

- Submit the repair request according to the warranty agreement.
- When the fuse is blown or the circuit breaker or earth leakage current breaker (ELCB) trips, wait for at least the time designated on the equipment warning label before power-on or further operations. Failure to comply may result in death, personal 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

- 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

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 structure

1.1 System Connection Diagram

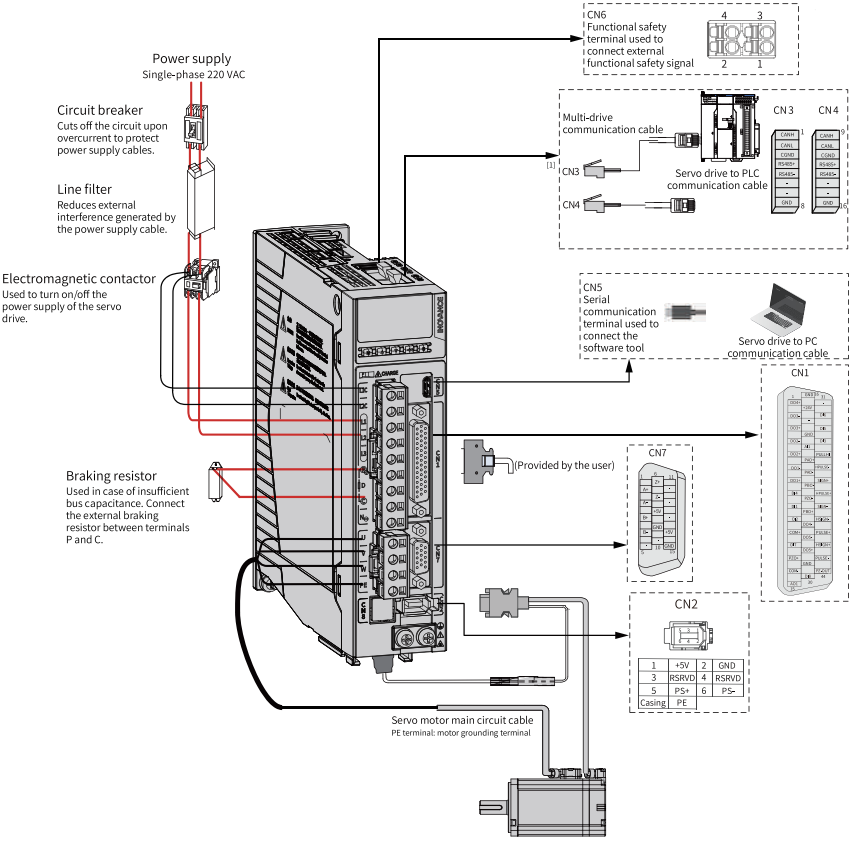


Figure 1-1 Example wiring of a single-phase 220 V system

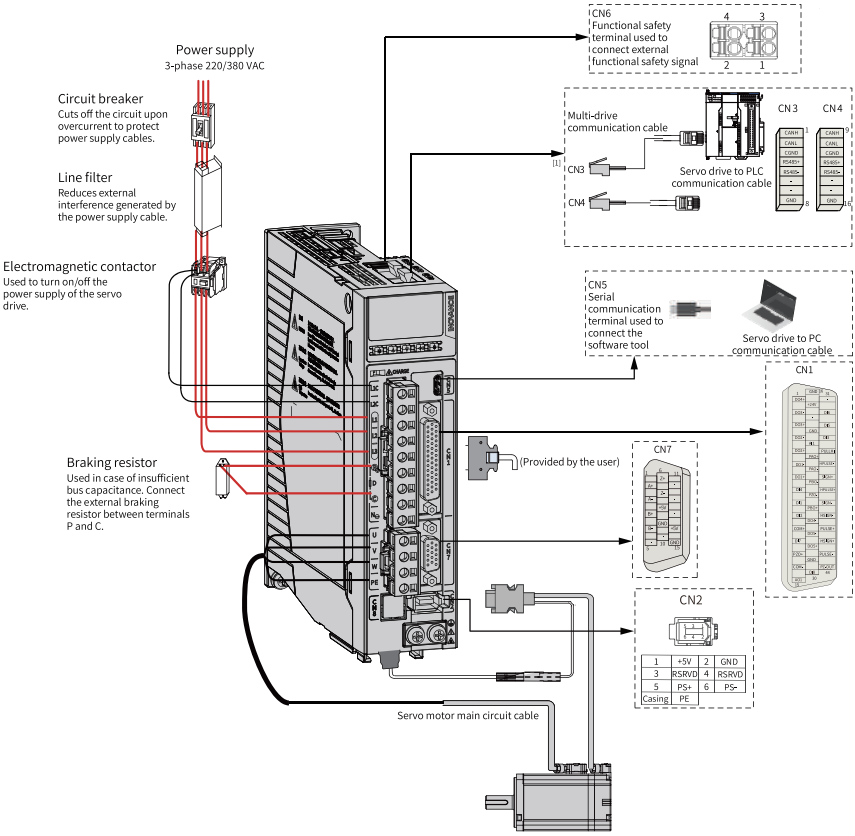


Figure 1-2 Example wiring of a three-phase 220 V or 380 V system

Note

- [1] CN3 and CN4 communication terminals can be used interchangeably. Their pin assignments are exactly the same.
- CN3 and CN4 (communication terminals) are applicable to SV670C series products for CANopen communication.
- 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 Wiring Diagrams

2.1 Wiring diagram of the Position Control Mode

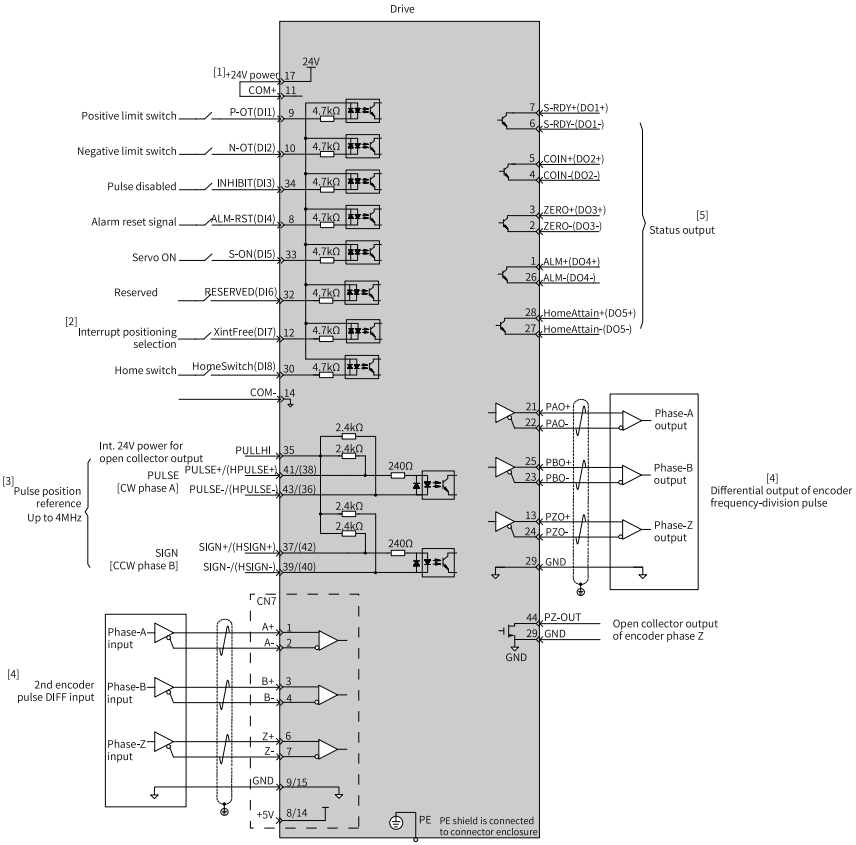


Figure 2-1 Wiring diagram of the Position Control Mode

Note

-  indicates shielded twisted pairs.
- [1] The range of the internal +24 V power supply is 20 V to 28 V, with maximum operating current being 200 mA.
- [2] DI7 and DI8 are high-speed DIs that must be used according to their functions assigned.
- [3] Use the shielded twisted pairs for pulse terminals, with both ends of the shield connected to PE. Connect GND and signal GND of the host controller properly. Pins 41, 43, 37 and 39 or 38, 36, 42, and 40 can be used for both low-speed and high-speed pulses.
- [4] Use shielded twisted pairs as frequency-division output cables and full closed-loop input cables, with both ends of the cable shield connected to PE. Connect GND to the signal ground of the host controller properly.
- [5] The DO power supply (voltage range: 5 V to 24 V) needs to be prepared by users. The DO terminals support a maximum voltage of 30 VDC and a maximum current of 50 mA.

2.2 Wiring Diagram for Torque Control Mode

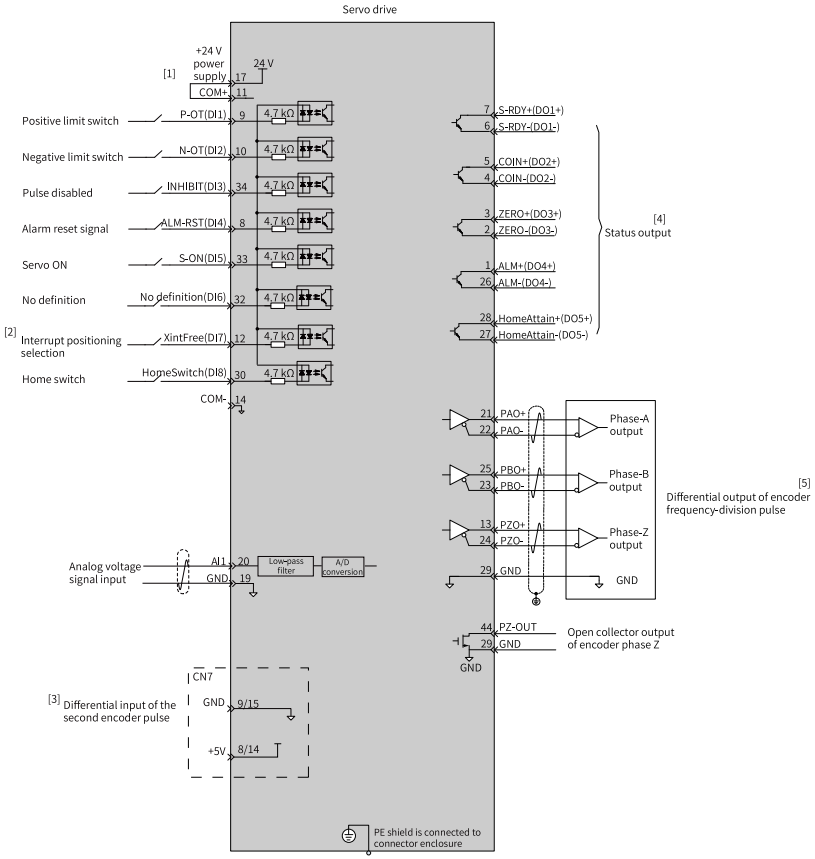


Figure 2-2 Wiring Diagram for Torque Control Mode

Note

-  indicates shielded twisted pairs.
- [1] The range of the internal +24 V power supply is 20 V to 28 V, with maximum operating current being 200 mA.
- [2] DI7 and DI8 are high-speed DIs that must be used according to their functions assigned.
- [3] The internal +5 V power supply supports a maximum current of 200 mA.
- [4] The DO power supply (voltage range: 5 V to 24 V) needs to be prepared by users. The DO terminals support a maximum voltage of 30 VDC and a maximum current of 50 mA.
- [5] Use shielded twisted pairs as frequency-division output cables and full closed-loop input cables, with both ends of the cable shield connected to PE. Connect GND to the signal ground of the host controller properly.

3 Electrical Design Guide

3.1 Design of Periphery Electrical Devices

Installing a circuit breaker

Note

For UL-compliant products, see section *"5.2 UL/cUL Certification" on page 97* for recommended fuse/circuit breaker models.

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 on the input side to prevent accidents caused by short 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

An AC input reactor is installed to eliminate the harmonics of the input current. As an optional device, the reactor can be installed externally to meet strict requirements of an application environment for harmonics.

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

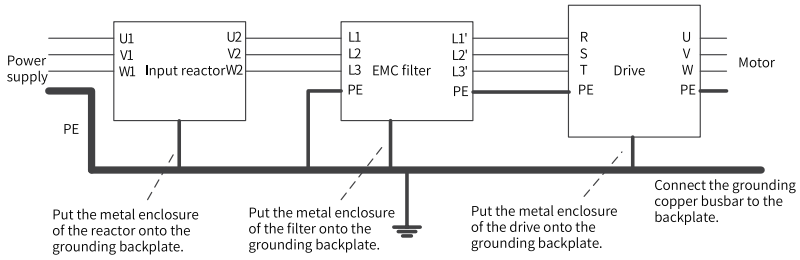


Figure 3-1 Connection of the AC input reactor

Installing an EMC filter

Note

- The connecting cable between the filter and the controller must be as short as possible (should be less than 30 cm).
- Ensure that the filter and controller are connected to the same grounding reference plane, and ensure that the filter is reliably grounded, otherwise the filtering effect of the filter cannot be achieved.

Use CE-compliant filters that comply with the emission requirements in Category C2 of EN 61800-3 and EN 12015. Properly ground the filter. Keep the cable connecting the filter to the controller shorter than 30 cm.

The following figure shows the connection of the EMC filter.

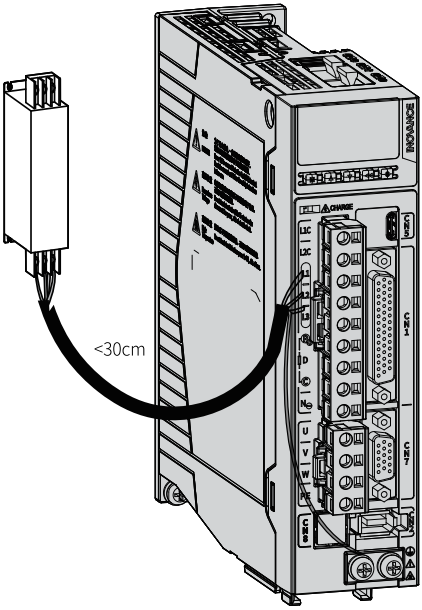


Figure 3-2 Connection of the EMC filter

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.

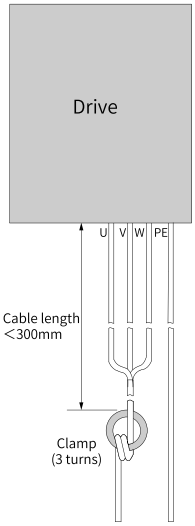


Figure 3-3 Connection of the magnetic ring

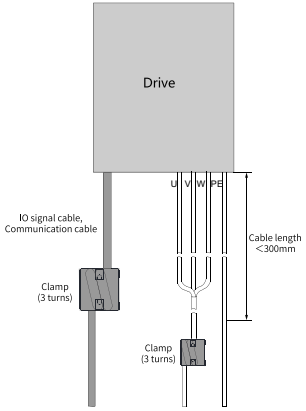


Figure 3-4 Connection of the magnetic buckle

Installing a braking resistor

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. However, a built-in regenerative resistor cannot be used together with an external one.

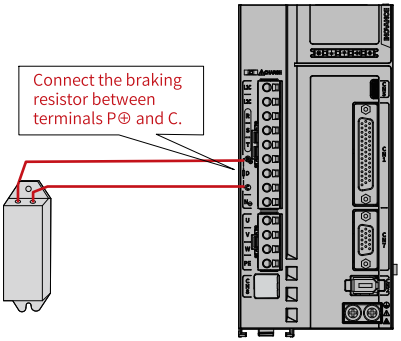


Figure 3-5 Wiring of external regenerative resistor

For cables used for terminals P⊕ and C, see *"3.2.1.3 Power Cable Specifications" on page 28*.

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.

3.2 Power Cable Selection

3.2.1 Power Supply Cable

3.2.1.1 Rules

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.

- 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.
- 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.

3.2.1.2 Power Cable Types

- The bending radius of a cable must be 10 times more than its outer diameter to prevent the internal conductor from breaking due to long-time bending.
- Use cables with a rated voltage above 600 VAC and rated temperature above 75°C. Under an ambient temperature of 30°C and normal cooling conditions, the permissible current density of the cable cannot exceed 8 A/mm^2 when the total current is below 50 A, or 5 A/mm^2 when the total current is above 50 A. The permissible current density (A/mm^2) can be adjusted based on the following formula in case of high ambient temperature or bundled cables.
  Permissible current density = 8 x Reduction coefficient of conductor current-carrying density x Current correction coefficient

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

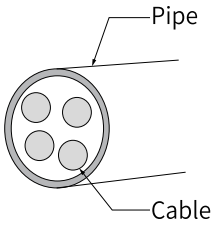


Table 3–1 Reduction coefficient of conductor current-carrying density

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

- Do not bundle power cables and signal cables together or route them through the same duct. Power cables and signal cables must be separated by at least 30 cm to prevent interference.
- Use a grounding cable with the same cross-sectional area as the main circuit cable. If the cross-sectional area of the main circuit cable is less than 1.6 mm^2, use a grounding cable with a cross-sectional area of 2.0 mm^2.

To comply with the EMC standards, use shielded cables. Shielded cables are divided into three-conductor shielded cables and four-conductor shielded cables, as shown in *"Figure 3–6 " on page 27* .

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%.

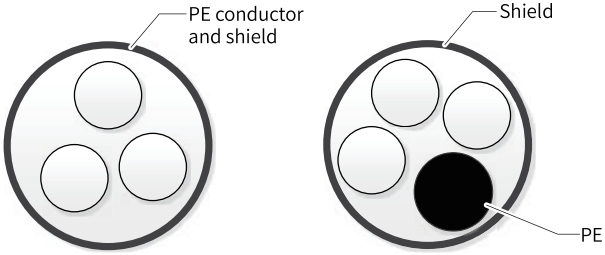


Figure 3-6 Recommended power cables

3.2.1.3 Power Cable Specifications

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

Servo drive model SV670****I		Rated Input Current	Rated output current (A)	Maximum Output Current (A)
Single-phase 220 V				
Size A	S1R6	2.3	1.6	5.8
	S2R8	4.0	2.8	10.1
Size C	S5R5	7.9	5.5	16.9
	S7R6	9.6	7.6	23.0
Size D	S012	12.8	12.0	32.0
Three-phase 220 V				
Size A	S1R6	1.1	1.6	5.8
	S2R8	2.3	2.8	10.1
Size C	S5R5	4.4	5.5	16.9
	S7R6	5.1	7.6	23.0
Size D	S012	8.0	12.0	32.0
Size E	S018	8.7	18.0	45.0
	S022	11.0	22.0	55.0
	S027	23.8	27.0	67.5
Three-phase 380 V				
Size C	T3R5	2.4	3.5	11.0
	T5R4	3.6	5.4	14.0
Size D	T8R4	5.6	8.4	20.0
	T012	8.0	12.0	30.0
Size E	T017	12.0	17.0	42.5
	T021	16.0	21.0	52.5
	T026	21.0	26.0	65.0

Table 3–3 Recommended main circuit cables

Servo drive model SV670****I			L1C, L2C		L1, L2, L3/R, S, T		P⊕, D, C, NΘ, N2, N1		U, V, W, PE		Grounding terminal	
Size	Model	Rated Input Current	(mm^2)	AWG	(mm^2)	AWG	(mm^2)	AWG	(mm^2)	AWG	(mm^2)	AWG
Single-phase 220 V												
Size A	S1R6	2.3	18	2 x 0.82	16	3 x 1.31	16	2 x 1.31	16	3 x 1.31	14	2.08
	S2R8	4	18	2 x 0.82	16	3 x 1.31	16	2 x 1.31	16	3 x 1.31	14	2.08
Size C	S5R5	7.9	18	2 x 0.82	16	3 x 1.31	16	2 x 1.31	16	3 x 1.31	14	2.08
	S7R6	9.6	18	2 x 0.82	16	3 x 1.31	16	2 x 1.31	16	3×1.31[1]	14	2.08
									14	3×2.08[2]		

Servo drive model SV670****I			L1C, L2C		L1, L2, L3/R, S, T		P⊕, D, C, NΘ, N2, N1		U, V, W, PE		Grounding terminal	
Size	Model	Rated Input Current	(mm^2)	AWG	(mm^2)	AWG	(mm^2)	AWG	(mm^2)	AWG	(mm^2)	AWG
Size D	S012	12.8	18	2 x 0.82	14	3 x 2.08	14	2 x 2.08	14	3 x 2.08	14	2.08
Three-phase 220 V												
Size A	S1R6	1.1	18	2 x 0.82	16	3 x 1.31	16	2 x 1.31	16	3 x 1.31	14	2.08
	S2R8	2.3	18	2 x 0.82	16	3 x 1.31	16	2 x 1.31	16	3 x 1.31	14	2.08
Size C	S5R5	4.4	18	2 x 0.82	16	3 x 1.31	16	2 x 1.31	16	3 x 1.31	14	2.08
	S7R6	5.1	18	2 x 0.82	16	3 x 1.31	16	2 x 1.31	16	3×1.31[1]	16	1.31[1]
									14	3×2.08[2]	14	2.08[2]
Size D	S012	8	18	2 x 0.82	14	3 x 2.08	14	2 x 2.08	14	3 x 2.08	14	2.08
Size E	S018	8.7	18	2 x 0.82	14	3 x 2.08	14	2 x 2.08	14	3 x 2.08	14	2.08
	S022	11	18	2 x 0.82	10	3 x 5.27	10	2 x 5.27	10	3 x 5.27	10	5.27
	S027	23.8	18	2 x 0.82	10	3 x 5.27	10	2 x 5.27	10	3 x 5.27	10	5.27
Three-phase 380 V												
Size C	T3R5	2.4	18	2 x 0.82	16	3 x 1.31	16	2 x 1.31	16	3 x 1.31	14	2.08
	T5R4	3.6	18	2 x 0.82	16	3 x 1.31	16	2 x 1.31	16	3 x 1.31	14	2.08
Size D	T8R4	5.6	18	2 x 0.82	16	3 x 1.31	16	2 x 1.31	16	3 x 1.31	14	2.08
	T012	8	18	2 x 0.82	14	3 x 2.08	14	2 x 2.08	14	3 x 2.08	14	2.08
Size E	T017	12	18	2 x 0.82	10	3 x 5.27	10	2 x 5.27	12	3×3.33[3]	12	3.33[3]
									10	3×5.27[4]	10	5.27[4]
	T021	16	18	2 x 0.82	10	3 x 5.27	10	2 x 5.27	10	3 x 5.27	10	5.27
	T026	21	18	2 x 0.82	10	3 x 5.27	10	2 x 5.27	10	3 x 5.27	10	5.27

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 3–4 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 3–5 Main circuit cable lug model and tightening torque

Servo drive model SV670****I			Recommended PVC Cable Model (at 40°C)			
Size	Model	Rated Input Current (A)	U, V, W, PE	Recommended Model of Brake Cable Lug	Recommended Model of Grounding Cable Lug	Tightening Torque (N·m)
Single-phase 220 V						
Size A	S1R6	2.3	GTVE10008	GTVE05008	TVR2–4	-
	S2R8	4				-
Size C	S5R5	7.9				-
	S7R6	9.6	GTVE15008	GTVE10008		-
Size D	S012	12.8				-
Three-phase 220 V						

Servo drive model SV670****I			Recommended PVC Cable Model (at 40°C)			
Size	Model	Rated Input Current (A)	U, V, W, PE	Recommended Model of Brake Cable Lug	Recommended Model of Grounding Cable Lug	Tightening Torque (N·m)
Size A	S1R6	1.1	GTVE10008	GTVE05008	TVR2–4	-
	S2R8	2.3				-
Size C	S5R5	4.4				-
	S7R6	5.1				-
Size D	S012	8.0				-
Size E	S018	8.7				-
	S022	11.0	GTVE15008	GTVE10008		-
	S027	23.8	GTVE25010	GTVE15008		-
Three-phase 380 V						
Size C	T3R5	2.4	GTVE10008	GTVE05008	TVR2–4	-
	T5R4	3.6				-
Size D	T8R4	5.6				-
	T012	8.0				-
Size E	T017	12.0	TVS1.25-4.	GTVE10008	TVR1.25-4.	1.36
	T021	16.0	TVS2–4	GTVE10008	TNR2–4	1.36
	T026	21.0	TVS3.5-4.	GTVE10008	TNR3.5-4.	1.36

The following table lists the data for recommended cable lugs (manufacturer: Suzhou Yuanli Metal Enterprise Co., Ltd) for your reference.

Table 3–6 TVR2-4 cable lug

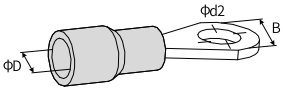
Model		D (mm)	d2 (mm)	B (mm)	Dimension Drawing
TVR	2-4	4.5	4.3	8.5	

Table 3–7 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

MS1H1/H4 05B–10C (Applicable to 0.5 kW–1 kW)			
Sheath diameter	φ6.5±0.2mm		
Internal structure and conductor colors			
Fill in "X.X" in the model number with cable length.			

Table 3–8 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)
Internal structure and conductor colors			
Fill in "X.X" in the model number with cable length.			

Table 3–9 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

MS1H3 29C–75C (Applicable to 2.9 kW–7.5 kW)			
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.			

3.2.1.4 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

3.2.2 Motor Cable

3.2.2.1 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.

3.2.2.2 Power Cable Types

For details, see *"3.2.1.2 Power Cable Types" on page 26*.

3.2.2.3 Power Cable Specifications

For details, see *"3.2.1.3 Power Cable Specifications" on page 28*.

3.2.2.4 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 3–7 Connection of the shielding layer" on page 34* 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.

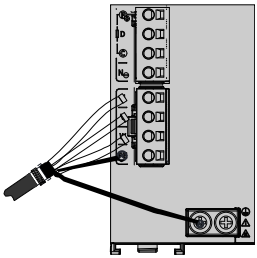


Figure 3-7 Connection of the shielding layer

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).

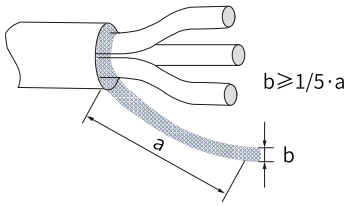


Figure 3-8 Lead-out of the motor cable shield

3.2.3 Encoder Cable

3.2.3.1 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 3–10 Recommended cables" on page 35* for details.

3.2.3.2 Encoder Cable Specifications

Table 3–10 Recommended cables

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

Note

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

3.3 Control Cable Selection

3.3.1 Rules

Observe the following requirement during control circuit wiring:

- 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.

3.3.2 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.

3.3.3 Control Cable Specifications

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

3.3.4 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.

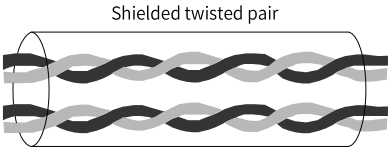


Figure 3-9 Diagram of shielded twisted pairs

3.4 Communication Cable Selection

3.4.1 CAN Communication Cable

Rules

When using CAN communication, connect the CGND terminal of the host controller device to the CGND terminal of the servo driver, as shown in the following figure.

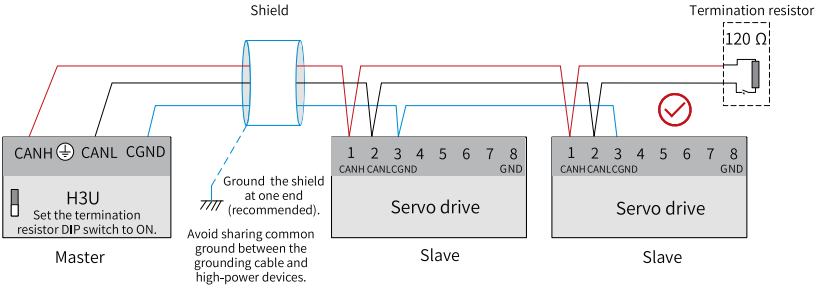


Figure 3-10 Correct CAN connection way

Caution

- A CAN communication terminal resistor is embedded in the PLC and therefore the corresponding DIP switch must be set to ON.
- It is recommended to ground the shield at single end.
- Do not connect the CGND terminal of the host controller to the GND terminal of the servo drive. Otherwise, the servo drive may be damaged.

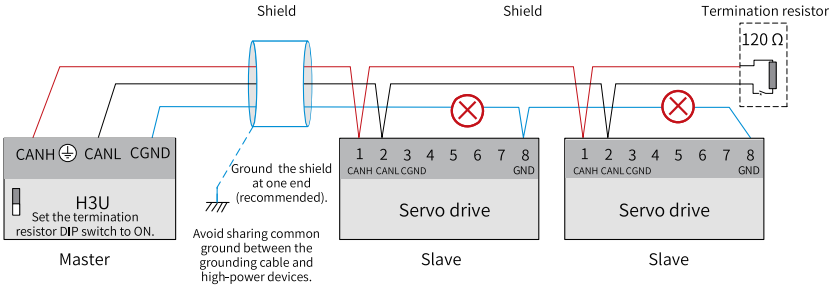


Figure 3-11 Incorrect CAN connection way

Communication cable types

Twisted pairs are recommended for CAN communication. Twisted pairs can resist high-frequency magnetic field noise and reduce radiation escaped from the cables to the outside, as shown in the following figure.

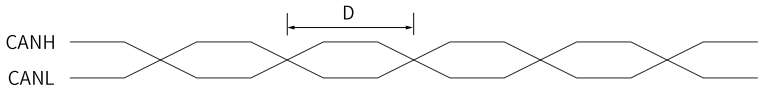


Figure 3-12 Twisted pairs

- The torque D of a twisted pair must be smaller than 2 cm. Smaller torque indicates better anti-interference effect.
- In case of short-distance low-speed communication, use shielded twisted pairs to enhance the anti-interference capability and connect both ends of the shield to the PE.
- In case of long-distance high-speed communication, shielded cables are not recommended. This is because large distributed capacitance exists between the shield and the signal cable, which may cause signal transmission delay.

Communication cable specifications

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

No.	Speed (bps)	Transmission Distance (m)	Number of Nodes	Cross-sectional Area (mm^2)
1	1M	25	64	0.205
2	500 k	95	64	0.34
3	100 k	560	64	0.5
4	50 k	1100	64	0.75

CAN communication bus and multi-node connection

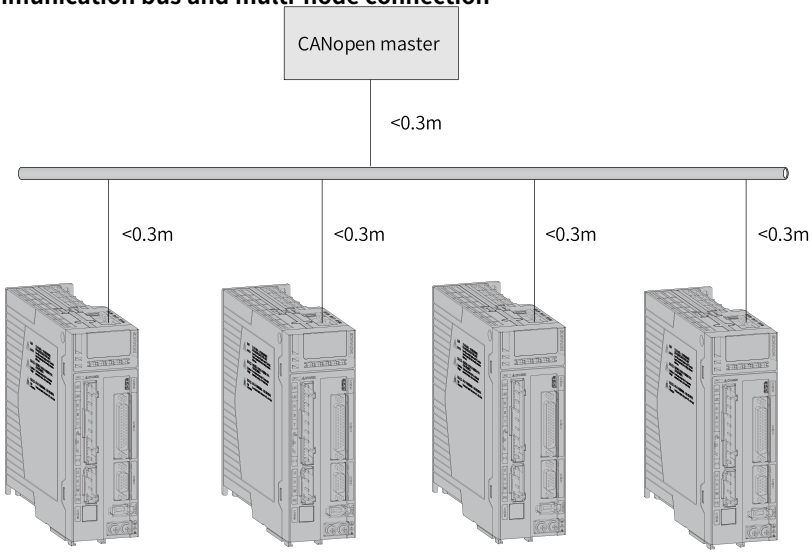


Figure 3-13 CAN communication network topology

Connect the CAN communication network in the bus topology, as shown in *"Figure 3–13 " on page 39* .

Connect each CAN transceiving device to the bus by using a branch cable shorter than 0.3 m. Otherwise, reflection may occur and cause communication problems.

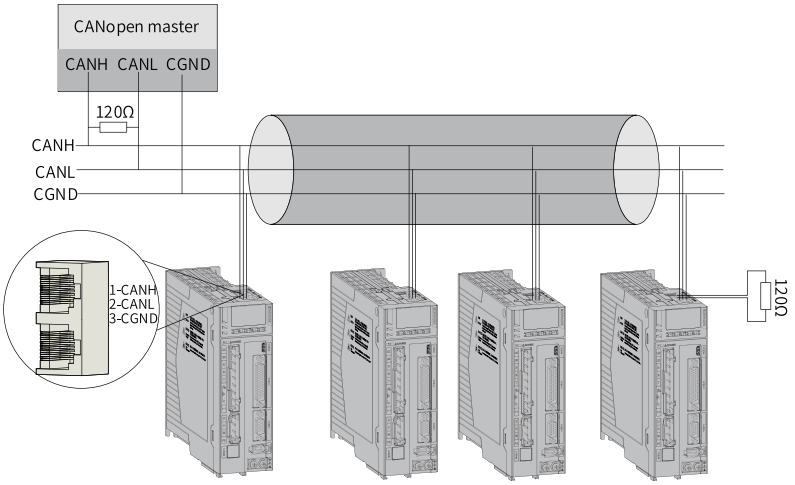


Figure 3-14 CANopen wiring diagram

It is recommended to use shielded twisted pairs. Connect two 120 Ω termination resistors at each end of the bus to prevent signal reflection. Typically, ground the shield in the single-point grounding mode. Using a multimeter to measure the resistance between CANH and CANL helps to confirm whether the junction resistance on the field is correct. The normal resistance value is about 60 Ω (with two resistors in parallel connection). Up to 64 devices can be connected.

In case of long-distance communication for CAN devices, connect the common ground CGNDs of different CAN circuits together to ensure equipotentiality between different communication devices.

Recommended Connection Modes of Different Cables

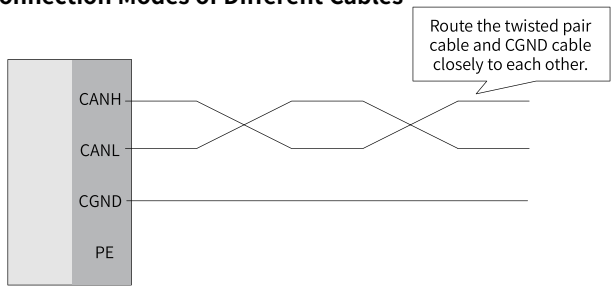


Figure 3-15 Recommended connection mode 1

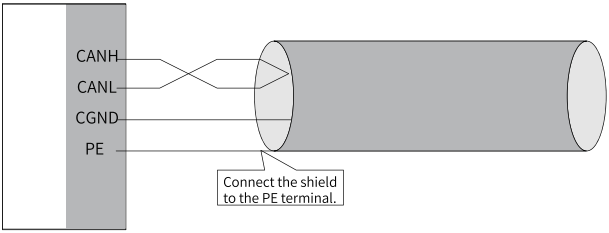


Figure 3-16 Recommended connection mode 2

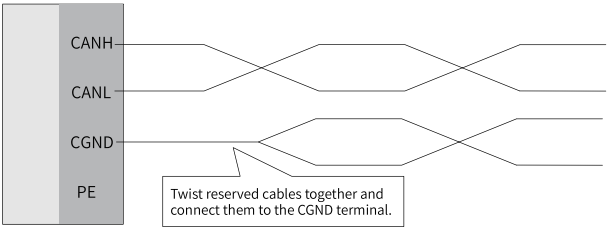


Figure 3-17 Recommended connection mode 3

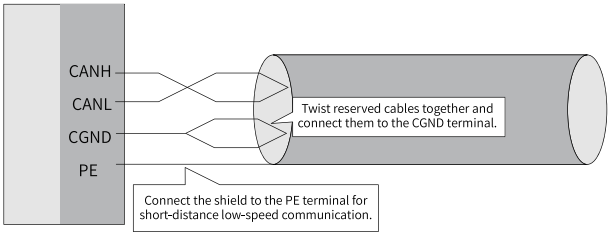


Figure 3-18 Recommended connection mode 4

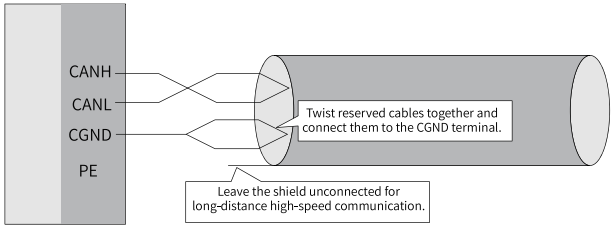


Figure 3-19 Recommended connection mode 5

Wiring for other devices without external CGND ports

- **The device is a non-isolated CAN device and shares the GND or COM port with other signals.**
  Connect the GND or COM port of the device with the CGND port of Inovance device, as shown in the following figure.

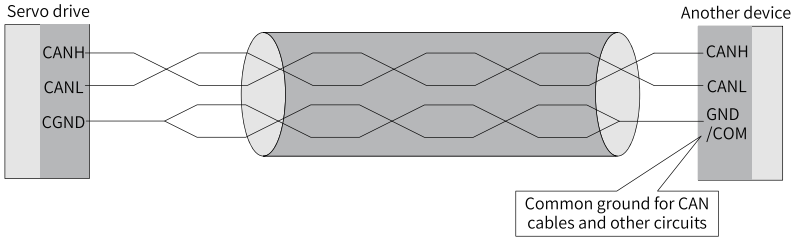


Figure 3-20 Connection mode for sharing the ground with other circuits

- **The CAN terminal of the device has no common ground with other ports.**
  Do not connect the CGND port to any cable. Use a cable of at least AWG12 to connect the PE of each device. Separate the cable from the CAN communication cable by a distance greater than 5 cm, as shown in the following figure.

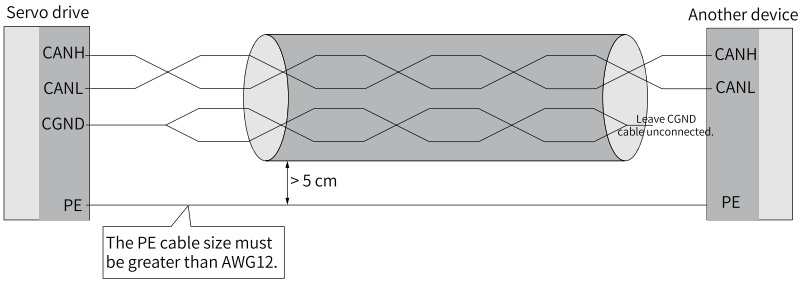


Figure 3-21 The CAN terminals of other devices have no external ground ports.

Recommended CAN communication cable layout

CAN communication devices are susceptible. If they are close to the interference source when deployed on the field, problems probably occur.

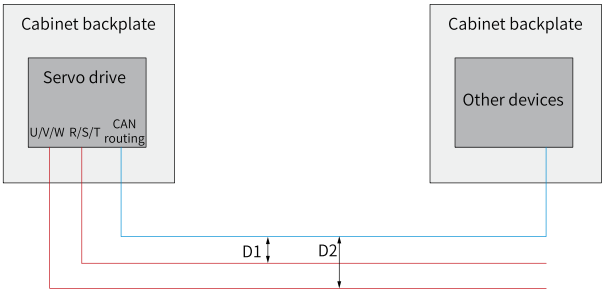


Figure 3-22 Recommended routing modes

Route the CAN cable and any interfering cable perpendicularly to each other. For parallel routing, keep a distance D1 greater than 20 cm between the CAN cable and an R/S/T cable, or keep a distance D2 greater than 50 cm between the CAN cable and a U/V/W cable. For routing near the cabinet backplate, attach the interfering cable closely onto the cabinet backplate and keep the CAN communication cable more than 1 cm away from the cabinet backplate.

Outside the cabinet, route the R/S/T power cable, U/V/W power cable, and CAN communication cable through three ducts and keep a distance (L3) greater than 20 cm between adjacent ducts. When routing the interfering cable and the CAN communication cable in one cable duct, separate the cables in accordance with the preceding principle.

3.4.2 RS485 Communication Cable

RS485 communication with PLC

The following figure shows the cable used for 485 communication between the servo drive and PLC.

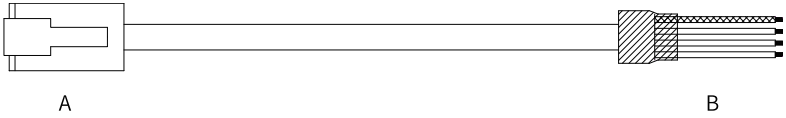


Figure 3-23 Outline drawing of cable used for CAN communication between the servo drive and PLC

Use a three-conductor shielded cable to connect the RS485 bus, with three conductors connected to 485+, 485-, and GND (GND represents non-isolated RS485 circuit) respectively. Connect RS485+ and RS485- with two conductors twisted together and connect the remaining conductor to the RS485 reference ground (GND). Connect the shield to the device ground (PE). Connect a 120Ω termination resistor on each end of the bus to prevent RS485 signal reflection.

Table 3–11 Pin connection relation of the cable used for CAN communication between the servo drive and PLC

RJ45 on the Drive Side (A)			PLC Side (B)		
Communication Type	Pin No.	Description	Communication Type	Pin No.	Description
RS485	4	485+	RS485	4	485+
	5	485-		5	485-
	8	GND		8	GND
-	Enclosure	PE (shield layer)	-	Enclosure	PE (shield layer)

Wiring of multi-drive RS485 communication

The following figure shows the cable used for multi-drive RS485 communication.

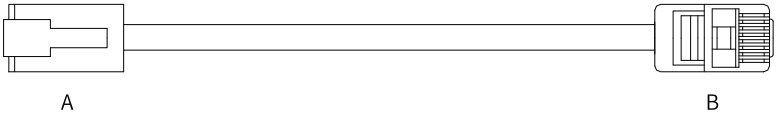


Figure 3-24 Outline drawing of the cable used for multi-drive RS485 communication

Table 3–12 Pin connection relation of the cable used for multi-drive RS485 communication (pins in 485 group used only)

RJ45 on the Drive Side (A)			RJ45 on the Drive Side (B)		
Communication Type	Pin No.	Description	Communication Type	Pin No.	Description
RS485	4	485+	RS485	4	485+
	5	485-		5	485-
	8	GND		8	GND
-	Enclosure	PE (shield layer)	-	Enclosure	PE (shield layer)

In case of a large number of nodes, use the daisy chain mode for RS485 communication. Connect the reference grounds of RS485 signals of all the nodes (up to 128 nodes) together.

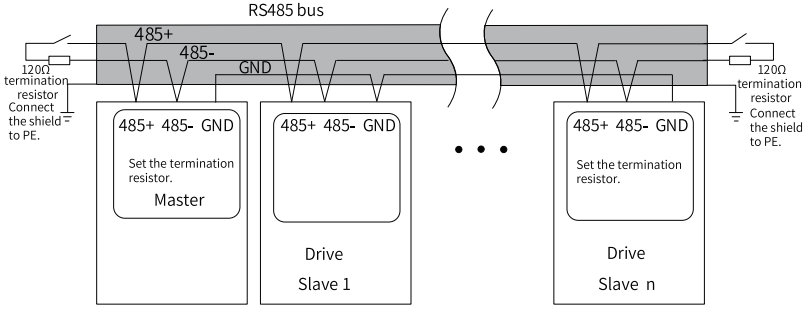


Figure 3-25 RS485 bus topology

Caution

Do not connect ⏚ (GND) terminal to the CGND terminal of the drive. Failure to comply may damage the machine.

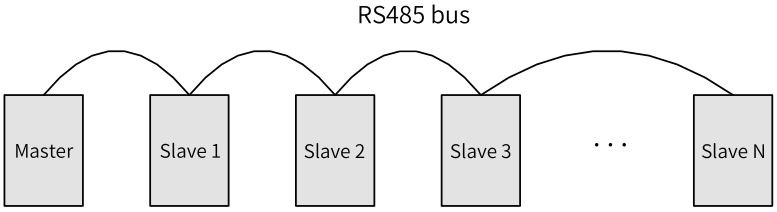


Figure 3-26 Daisy chain mode

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

Table 3–13 Transmission distance and number of nodes

No.	Transmission Rate (kbps)	Transmission Distance (m)	Number of Nodes	Cross Sectional Area
1	115.2	100	128	AWG26
2	19.2	1000	128	AWG26

3.5 Cable Routing

3.5.1 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, the cooling effect will be deteriorated. In this case, take the permissible current reduction ratio into account.
- 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 "Troubleshooting" in SV670P Series Servo Drive Commissioning Guide). In this case, power on the servo drive again after waiting for the specified ON/OFF interval. If frequent ON/OFF operation is needed, the time interval between ON and OFF must be at least 1 min.
  The servo drive carries a capacitor in the power supply part, and this capacitor will be charged with a high current for 0.2s upon power-on. Turning on/off the power supply frequently affects the performance of main circuit components inside the servo drive.
- 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.
Requirements on IEC cable selection:

- 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 98*.

Note

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

3.5.2 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.

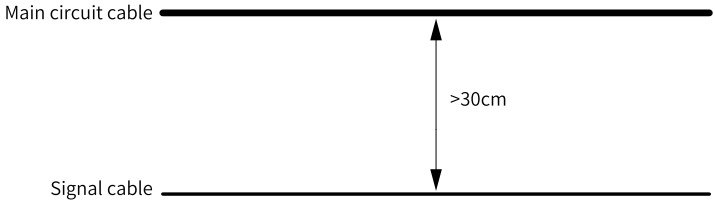


Figure 3-27 Cable layout

Wiring requirements

- Terminals P⊕, C, and NΘ are used to connect optional parts. Do not connect these terminals to an AC power supply.
- To protect the main circuit, separate and cover the surface that may come into contact with the main circuit.
- Do not allow unwanted objects to enter 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 a torque screwdriver, torque ratchet, or torque wrench to tighten terminal screws.
- When using an electric screwdriver to tighten terminal screws, set the electric screwdriver to low speed to prevent damage to the terminal screws.

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

3.5.3 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 mm^2, or use two protective grounding conductors with the same specification.
- The dimensions of the grounding cable must comply with the electrical device technical standards. Keep the length of the grounding cable as short as possible. Failure to comply will lead to unstable potential in the grounding terminals away from the grounding point due to leakage current, resulting in an electric shock.

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

Grounding requirements

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

- The protective grounding conductor must be a yellow/green cable comprised of copper conductors. Do not connect the protective grounding conductor to a switching device (such as a circuit breaker) in serial.
- Ground the grounding terminal properly. Improper grounding will lead to device malfunction or damage.
- Do not connect the grounding terminal to the N terminal of the neutral wire of the power supply.
- It is recommended to install the drive to a conductive metal surface. Ensure the whole conductive bottom of the drive is connected properly to the mounting face.
- Tighten the grounding screw with specified tightening torque to prevent the protective grounding conductor from being secured improperly.

Single-drive grounding

Installation of an individual drive:

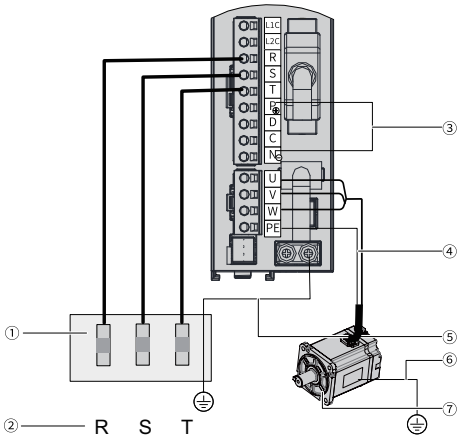


Table 3–14 Single-drive grounding

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.
⑦	Three-phase motor

Note

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

Multi-drive grounding

Side-by-side installation of multiple drives:

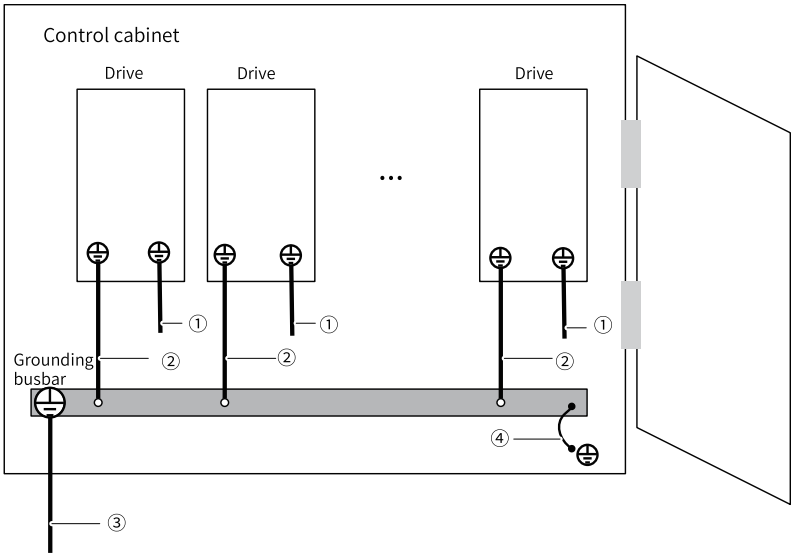


Table 3–15 Description for grounding of multiple drives installed side by side

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 3–16 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 (such as RS485) and signal cables drawn from the control cabinet.
6	Place the power input filter in a position near the input interface of the control cabinet.
7	Apply spray coating to each grounding point in the control cabinet.

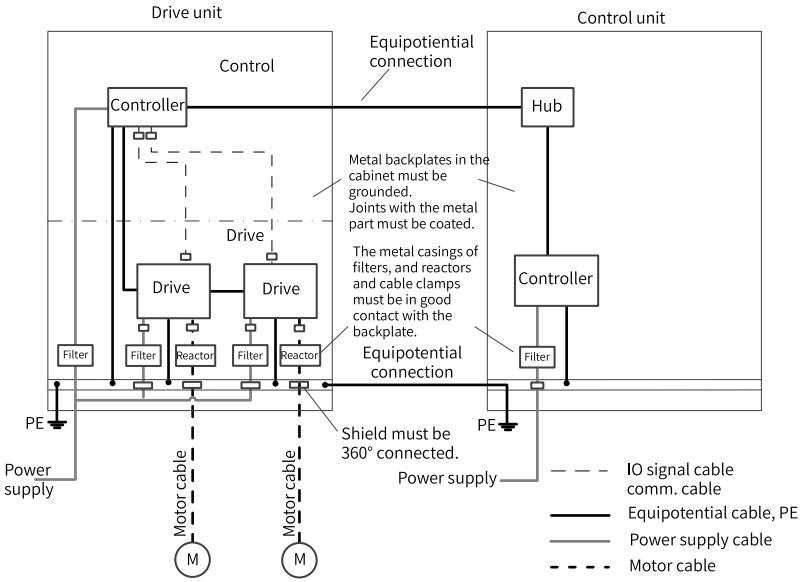


Figure 3-28 Recommended wiring for the control cabinet system

4 Terminals

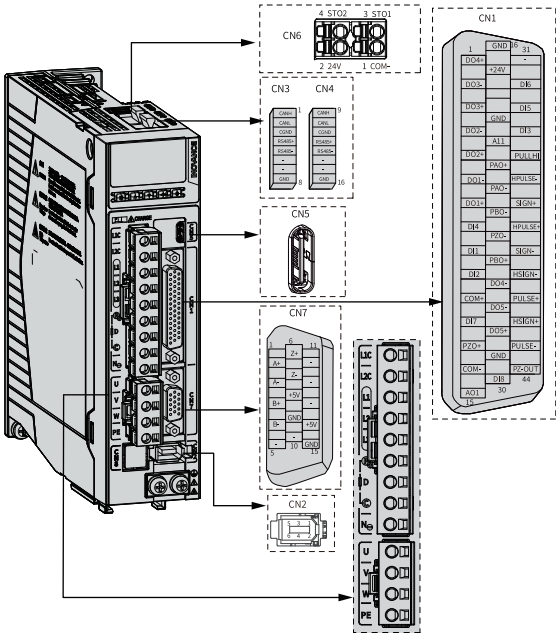


Figure 4-1 Terminal pin layout of the servo drive

- CN3 and CN4 (communication terminals) are applicable to SV670C series products for CANopen communication.
- CN6 (STO terminal) is only applicable to customized model -FS.

4.1 Pin Assignment of Main Circuit Terminal

Terminal Layout

- **Servo drives in size A/C/D (rated power: 0.2 kW to 1.5 kW): SV670PS1R6I, SV670PS2R8I, SV670PS5R5I, SV670PS7R6I, SV670PS012I, SV670PT3R5I, SV670PT5R4I, SV670PT8R4I, and SV670PT012I**

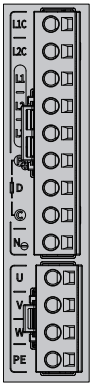


Figure 4-2 Main circuit terminal pin layout of servo drives in size A/C/D

Table 4–1 Description of main circuit terminal pins of servo drives in size A/C/D

Name	Description
L1C, L2C (control circuit power input terminals)	See the nameplate for the rated voltage class.
L1, L2, L3 (main circuit power input terminals)[1]	Power input terminals of the servo drive. See the nameplate for the rated voltage class.
P⊕, D, and C (terminals for connecting an external braking resistor)[2]	Remove the jumper bar between terminals P⊕ and C before connecting an external regenerative resistor between terminals P⊕ and D.
P⊕ and N⊖ (servo bus terminals)	Used by the common DC bus for multiple servo drives.
U, V, W (terminals for connecting the servo motor)	Connected to U, V, and W phases of the servo motor.
PE grounding terminal	Connected to the grounding terminal of the motor for grounding purpose.

Note

- [1]: The power input terminals of the 220V servo drive's main circuit are L1, L2, and L3; and the power input terminals of the 380V servo drive's main circuit are R, S, and T.
- [2] The built-in braking 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.

- **Servo drives in size E (rated power: 2.0 kW to 7.5 kW): SV670PS018I, SV670PS022I, SV670PS027I, SV670PT017I, SV670PT021I, and SV670PT026I**

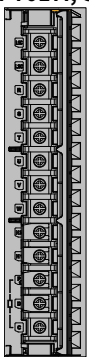


Figure 4-3 Main circuit terminal pin layout of servo drives in size E

Table 4–2 Description of main circuit terminal pins of servo drives in size E

Name	Description
L1C, L2C (control circuit power input terminals)	See the nameplate for the rated voltage class.
R, S, and T (main circuit power input terminals)[1]	Power input terminals of the servo drive. See the nameplate for the rated voltage class.
P⊕, D, and C (terminals for connecting an external braking resistor)[2]	Remove the jumper bar between terminals P⊕ and C before connecting an external regenerative resistor between terminals P⊕ and D.
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.
U, V, W (terminals for connecting the servo motor)	Connected to U, V, and W phases of the servo motor.

Note

- [1]: The power input terminals of the 220V servo drive's main circuit are L1, L2, and L3; and the power input terminals of the 380V servo drive's main circuit are R, S, and T.
- [2] The built-in braking 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.

Terminal descriptions

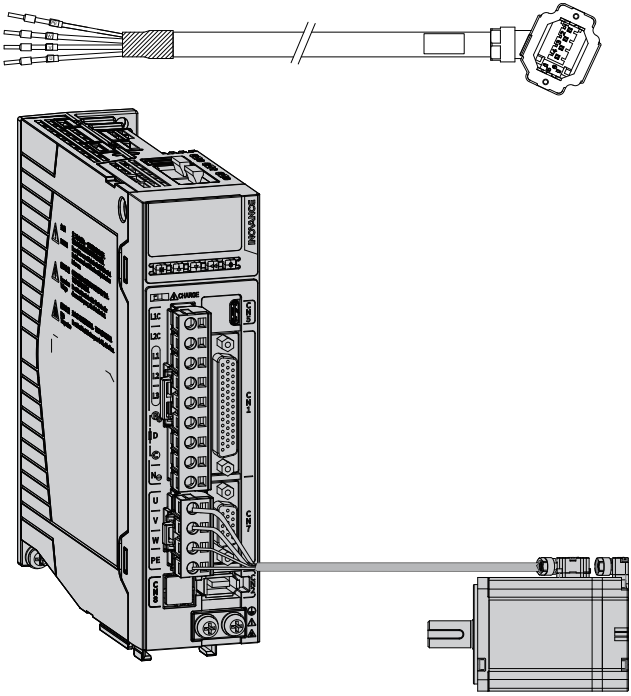
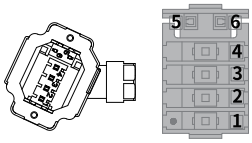


Figure 4-4 Wiring between the servo drive and terminal-type motor

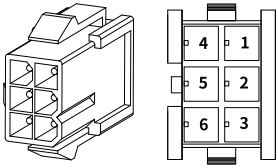
Table 4–3 Description of the power cable connector (motor side) for terminal-type motors

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

Note

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

Table 4–4 Description of the pass-through power cable connector (motor side)

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

Note

- [1] The 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 4–5 Description of the power cable connector (motor side)

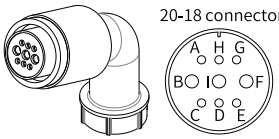
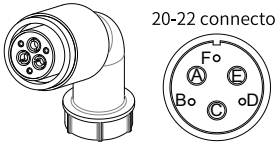
Flange Size [1]	Outline Drawing of the Connector	Terminal Pin Layout		
		Pin No.	Signal Name	Color
100 130	 MIL-DTL-5015 series 3108E20-18S military-spec connector	B	U	Blue
		I	V	Black
		F	W	Red
		G	PE	Yellow/ Green
		C	Brake (polarity insensitive)	Red
		E		Black

Table 4–6 Description of the power cable connector (motor side)

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

Note

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

4.2 Description of Control Terminal (CN1)

4.2.1 Terminal Layout

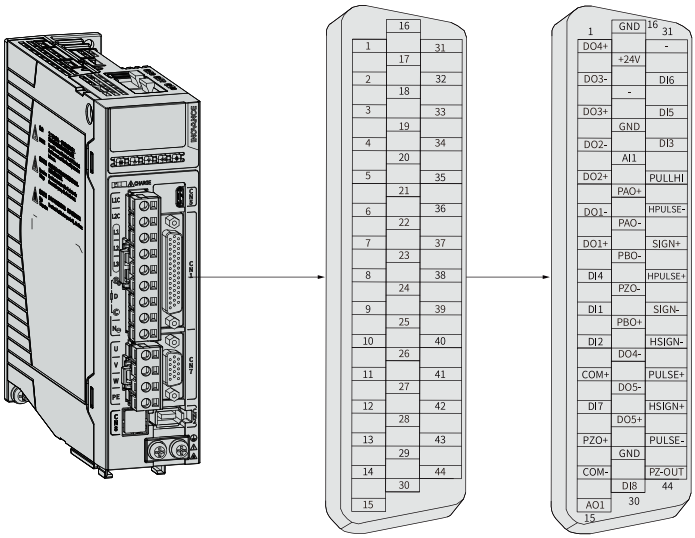


Figure 4-5 Control terminal pin layout of the servo drive

Note

- CN1: Plastic housing of plug on cable side: DB25P (manufacturer: SZTDK), black housing. Core: HDB44P male solder (manufacturer: SZTDK).
- It is recommended to use 24 AWG to 26 AWG cables.
- Use shielded cables as signal cables, with both ends of the shielded cable grounded.

Table 4–7 Description of position reference input signals

Signal Name		Pin No.	Function
Position reference	PULSE+	41	Low-speed pulse reference input mode: • Differential drive input • Open-collector Pulse input form: • Direction+Pulse • Quadrature pulse of phases A and B • CW/CCW pulse
	PULSE–	43	
	SIGN+	37	
	SIGN–	39	
	PULLHI	35	
	HPULSE+	38	High-speed pulse input reference
	HPULSE–	36	
	HSIGN+	42	High-speed position reference symbols
	HSIGN–	40	

Table 4–8 Description of DI/DO signals

Signal Name		Default Function	Pin No.	Function
General	DI1	P-OT	9	Positive limit switch
	DI2	N-OT	10	Negative limit switch
	DI3	INHIBIT	34	Position reference inhibited
	DI4	ALM-RST	8	Alarm reset (edge-triggered)
	DI5	S-ON	33	Servo ON
	DI6	-	32	-
	DI7	XintFree	12	Interrupt positioning selection
	DI8	HomeSwitch	30	Home switch
	+24 V		17	Internal 24 V power supply; voltage range: 20 V to 28 V; maximum output current: 150 mA
	COM–		14	
	COM+		11	Common terminal of DI terminals
	DO1+	S-RDY+	7	Servo ready
	DO1-	S-RDY-	6	
	DO2+	COIN+	5	Positioning completed
	DO2-	COIN–	4	
	DO3+	-	3	-
	DO3-	-	2	
	DO4+	ALM+	1	Fault output
	DO4-	ALM–	26	
	DO5+	HomeAttain+	28	Homing completed
	DO5-	HomeAttain–	27	

Table 4–9 Specifications of encoder frequency-division output signals

Signal Name		Pin No.	Function	
General	PAO+	21	Phase A frequency-division output signal	Quadrature frequency-division pulse output signals of phases A and B
	PAO–	22		
	PBO+	25	Phase B frequency-division output signal	
	PBO–	23		
	PZO+	13	Phase Z frequency-division output signal	Home pulse output signal
	PZO–	24		
	PZ-OUT	44	Phase Z frequency-division output signal	Home pulse open-collector output signal
	GND	29	Home pulse open-collector output signal ground	
	PE	Enclosure	-	

Table 4–10 Specifications of AI/AO signals

Signal Name		Pin No.	Function
General	AO1	15	Analog output
	GND	19	Common terminal of AI/AO
	AI1	20	Voltage-type AI 1 Voltage range: –10 V to +10 V
	GND	16	Power ground
	PE	Enclosure	-

4.2.2 Position Reference Input Signals

For descriptions of position reference input signals, see *"Table 4–7 " on page 58*.

The reference pulses and signs on the host controller side can be outputted through the differential drive or open-collector. The following table lists the maximum input frequency and minimum pulse width.

Table 4–11 Relation between pulse input frequency and pulse width

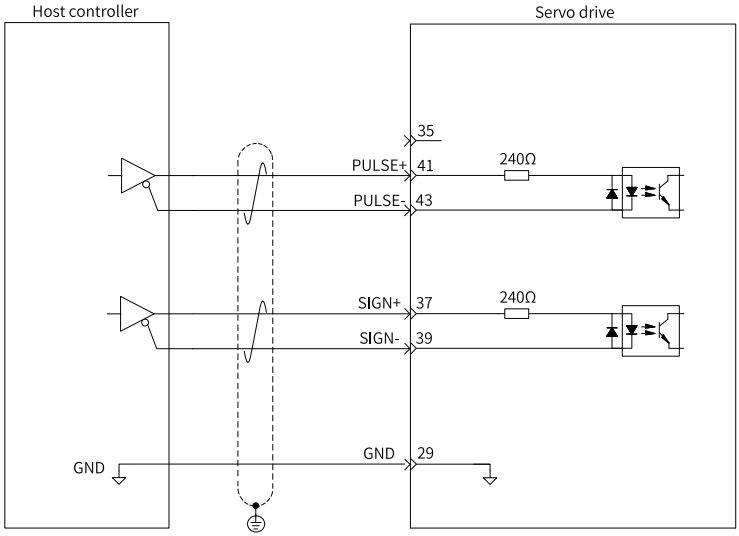
Pulse Mode		Maximum Frequency (pps)	Minimum Pulse Width (us)
Low-speed	Differential	500 k	1
	Open-collector	200 k	2.5
High-speed differential		4 M	0.125

Note

- You can either use high-speed pulses or low-speed pulses, but not both of them together.
- If the output pulse width of the host controller is smaller than the minimum pulse width, a pulse receiving error will occur on the drive.
- The symbol ∫ represents shielded twisted pairs.

Low-speed pulse reference input

- Differential mode



- Open-collector mode

  ① For use of the internal 24 V power supply of the servo drive:

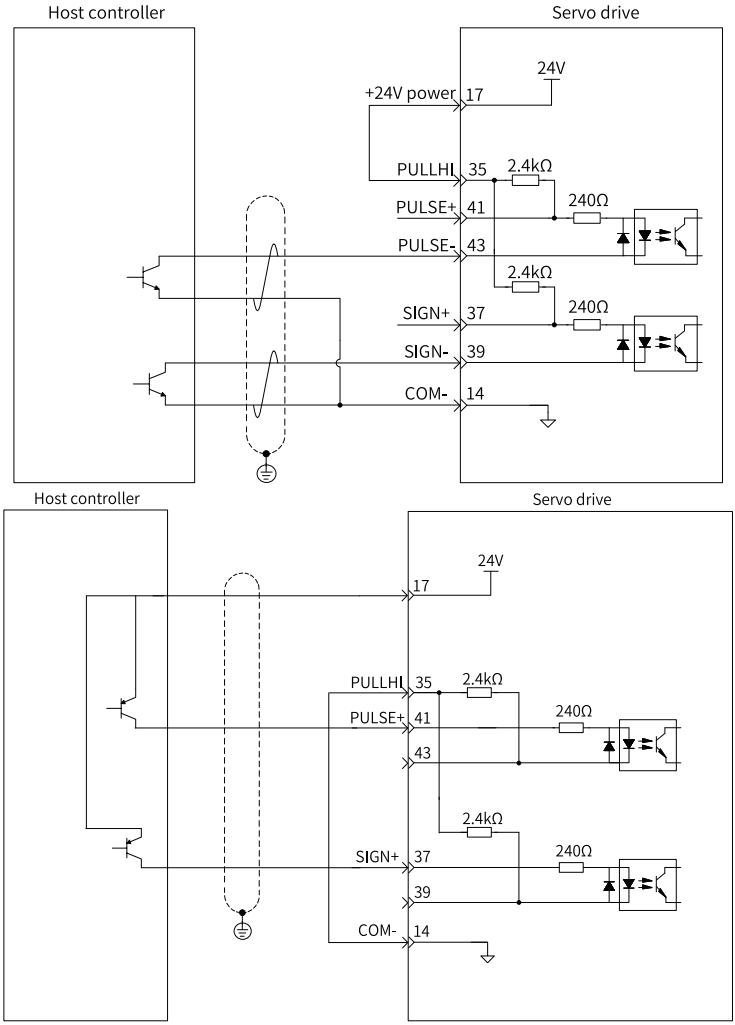


Figure 4-6 Correct: The internal 24 V power supply of the servo drive is used.

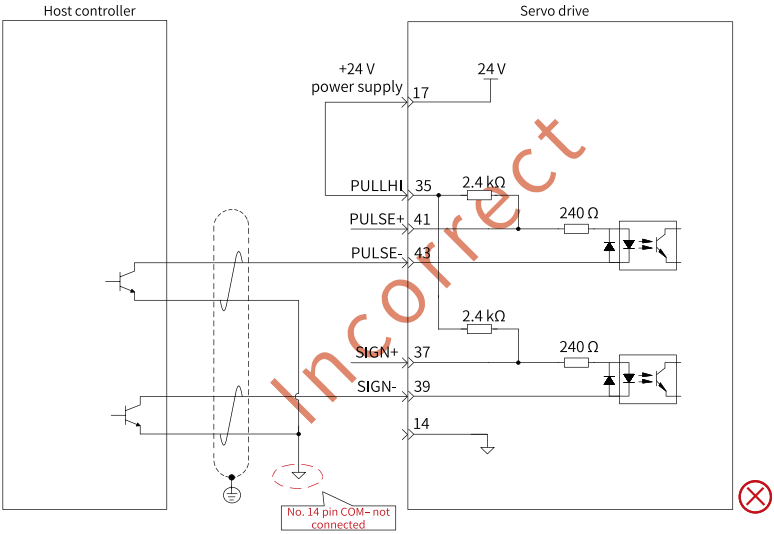
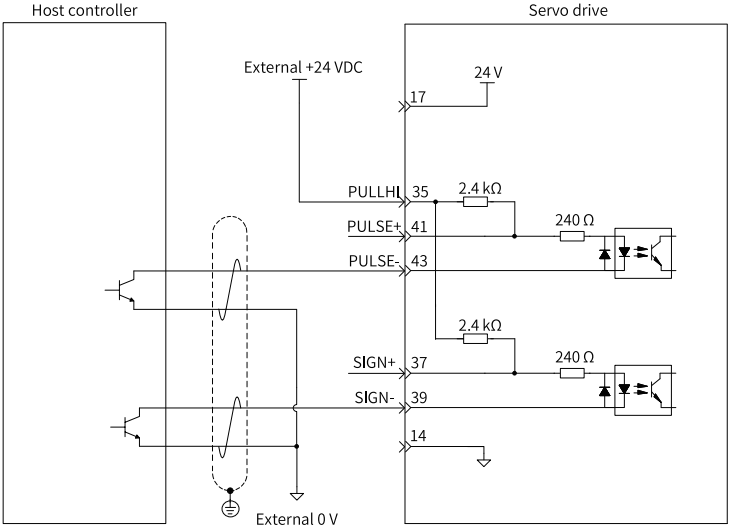
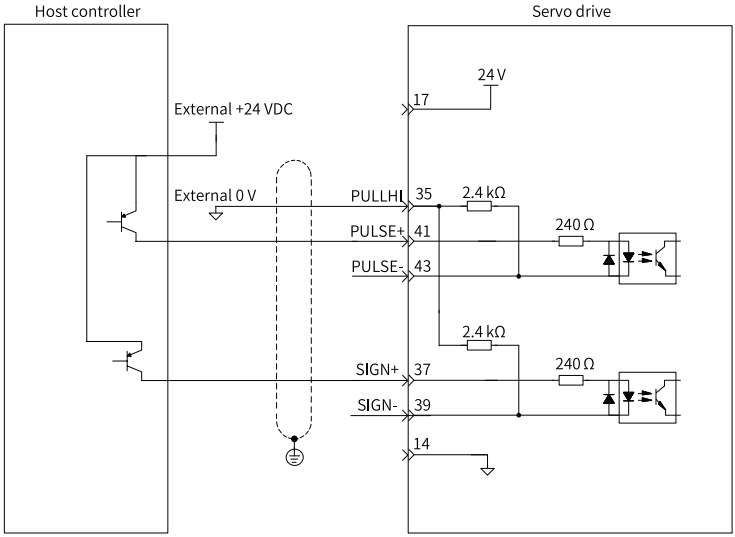


Figure 4-7 Incorrect: Pin 14 (COM–) is not connected, leading to failure in forming a closed-loop circuit.

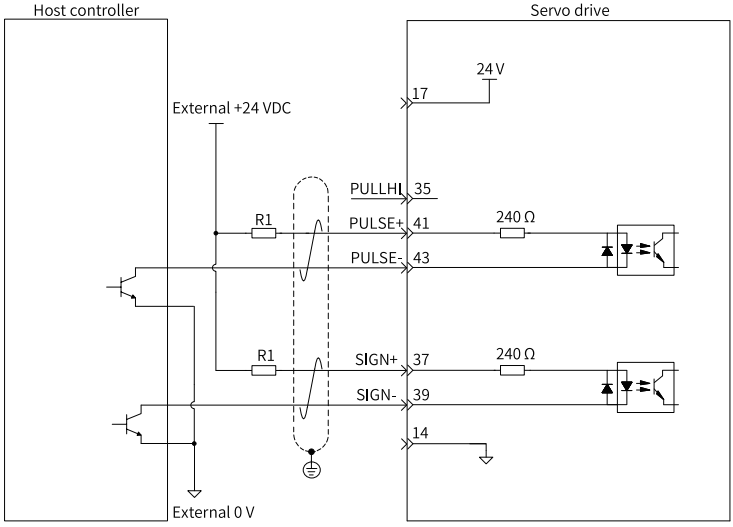
② For use of an external power supply:

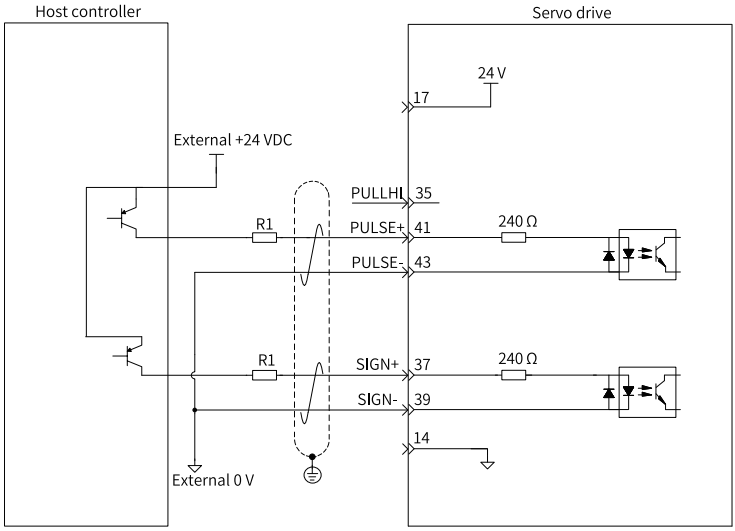
- Scheme 1: Using the built-in resistor (recommended)





- Scheme 2: Using the external resistor





Select resistor R1 based on the following formula.

$$\frac{V_{CC} - 1.5}{R1 + 240} = 10\ mA$$

Table 4–12 Recommended resistance of R1

V_{CC} Voltage (V)	R1 Resistance (kΩ)	R1 Power (W)
24	2.4	0.5
12	1.5	0.5

- The following figures show examples of improper wiring.
- 1: The current limiting resistor is not connected, resulting in terminal burnout.

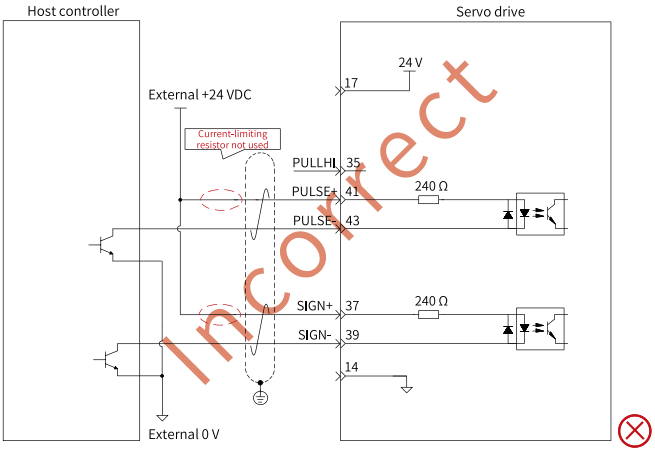


Figure 4-8 Incorrect wiring example 1: The current limiting resistor is not connected, resulting in terminal burnout.

- 2: Multiple terminals share the same current limiting resistor, resulting in pulse receiving error.

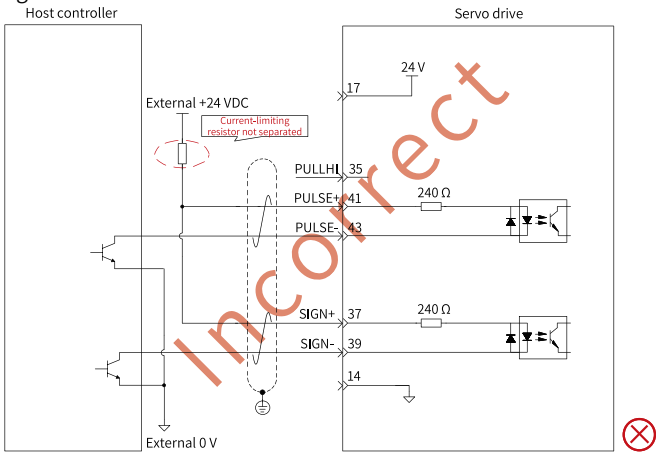


Figure 4-9 Incorrect wiring example 2: Multiple terminals share the same current limiting resistor, resulting in pulse receiving error.

- Incorrect wiring 3: The SIGN port is not connected, preventing these two ports from receiving pulses.

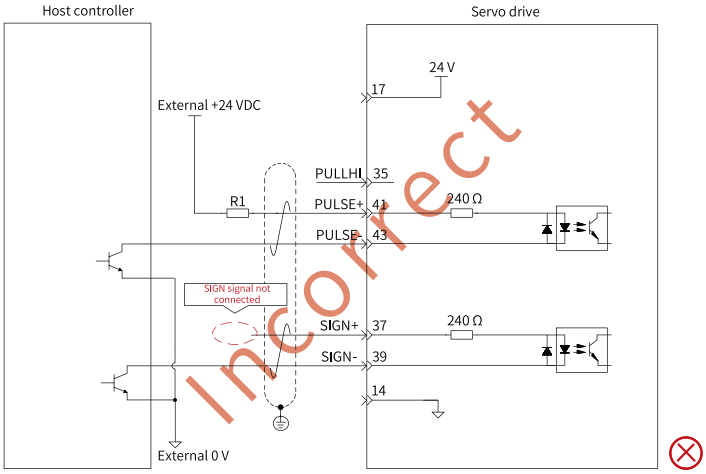


Figure 4-10 Incorrect wiring example 3: The SIGN port is not connected, preventing these two ports from receiving pulses.

- Wrong wiring 4: Terminals are connected incorrectly, resulting in terminal burnout.

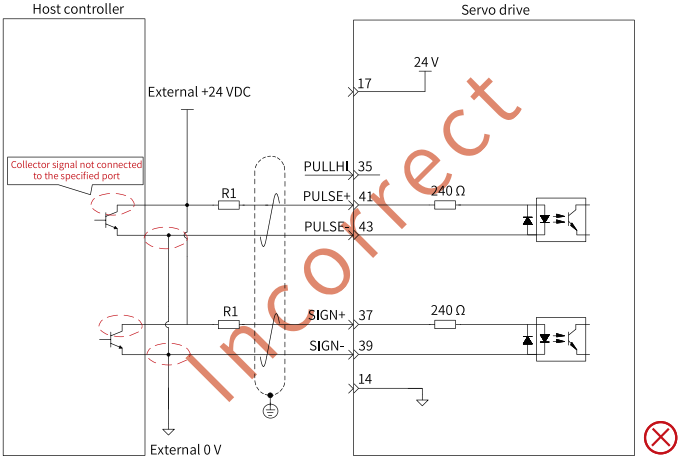


Figure 4-11 Incorrect wiring example 4: Terminals are connected incorrectly, resulting in terminal burnout.

- Wrong wiring 5: Multiple terminals share the same current limiting resistor, resulting in pulse receiving error.

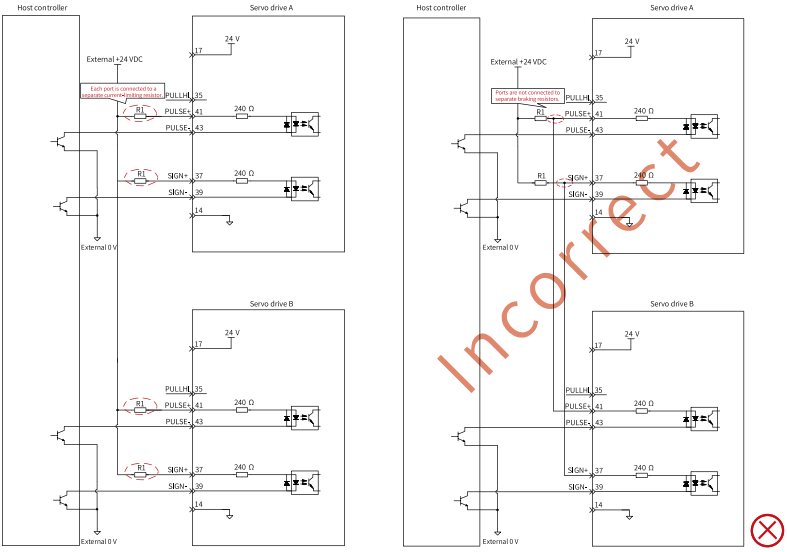
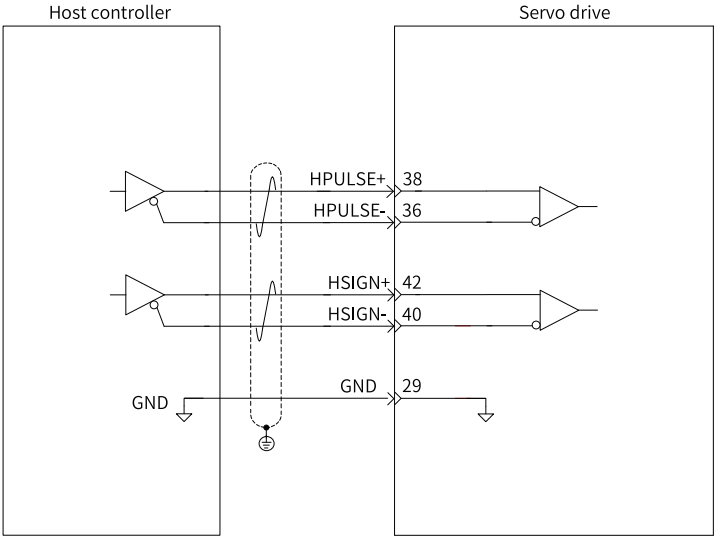


Figure 4-12 Incorrect wiring example 5: Multiple terminals share one current limiting resistor, resulting in a pulse receiving error.

High-speed pulse reference input

High-speed reference pulses and signs on the host controller side can be outputted to the servo drive through the differential drive only.



Caution

The differential input must be 5 V. Otherwise, unstable pulse input will occur on the servo drive, resulting in the following situations:

- Pulse loss during pulse input
- Reference inverted during reference direction input
- Connect 5 V GND of the host controller to the GND of the servo drive to reduce noise interference.

4.2.3 AI/AO Signals

Table 4–13 Specifications of AI/AO signals

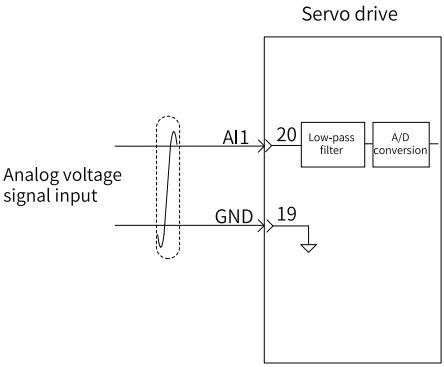
Signal Name	Default Function	Pin No.	Function
General	AO1	15	AO signal Voltage range: –10 V to +10 V
	GND	19	Common terminal of AI/AO
	AI1	20	Voltage-type AI 1 Voltage range: –10 V to +10 V
	GND	16	Power supply ground
	PE	Enclosure	-

Analog input signal

The input terminal for analog speed and torque signals is AI1.

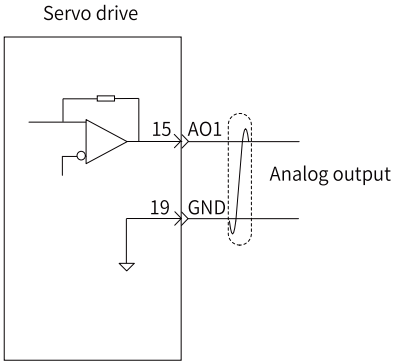
AI1 is a voltage-type analog input terminal with a resolution of 12 bits. The voltage value is set in group H03.

- Voltage-type input specification: –10 V to +10 V; maximum permissible voltage: ±12 V
- Input impedance: 10 kΩ



Analog output signal

The output terminal for analog speed and torque signals is AO1, supporting a voltage range of –10 V to +10 V. The voltage value is set in group H04.



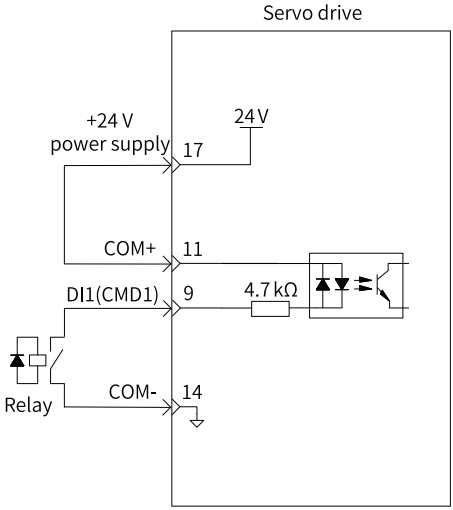
4.2.4 DI/DO Signals

For description of DI/DO signals, see *"Table 4–8 " on page 59*.

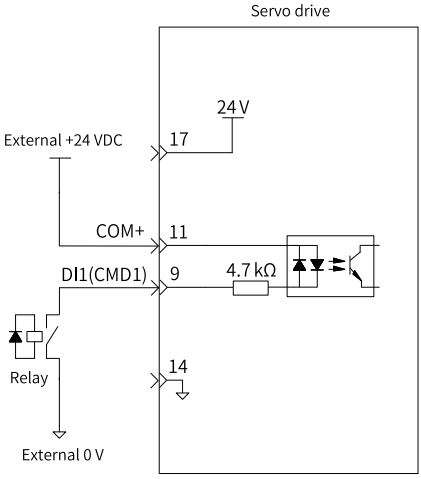
DI circuit

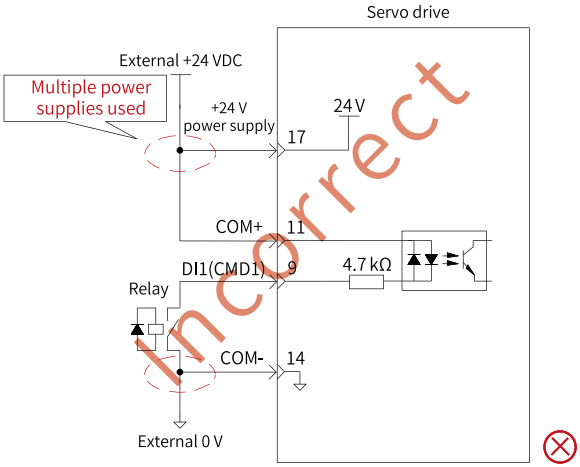
The circuits for DI1 to DI8 are the same. The following takes the DI1 circuit as an example.

- The host controller provides relay output.
  - For use of the internal 24 V power supply of the servo drive:

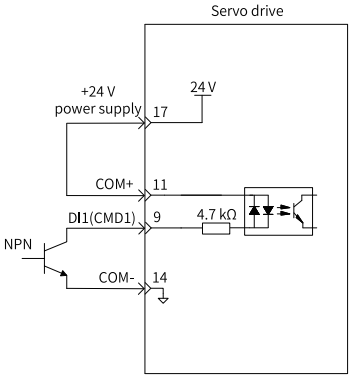


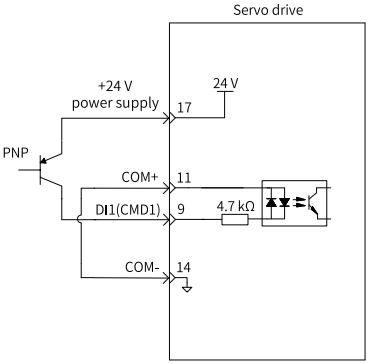
- When the external power supply is used:



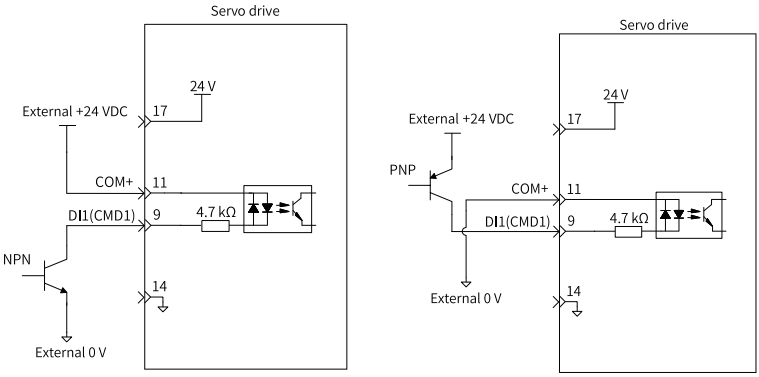


- The host controller provides open-collector output.
  - For use of the internal 24 V power supply of the servo drive:





  - When the external power supply is used:



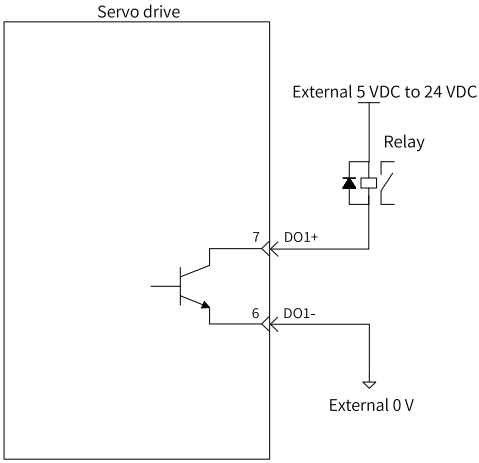
Note

PNP and NPN input cannot be used together in the same circuit.

DO circuit

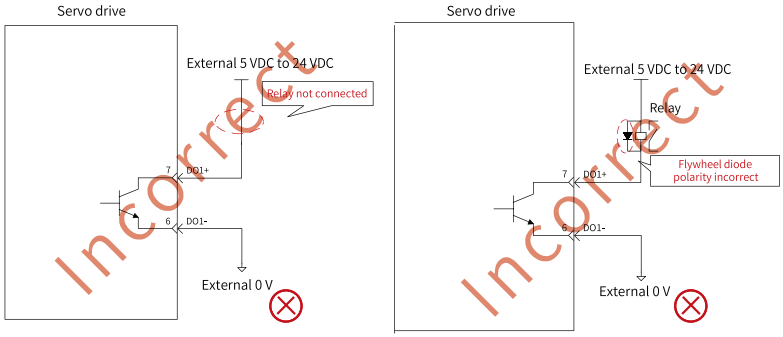
The circuits for DO1 to DO5 are the same. The following takes the DO1 circuit as an example.

- When the host controller provides relay input:

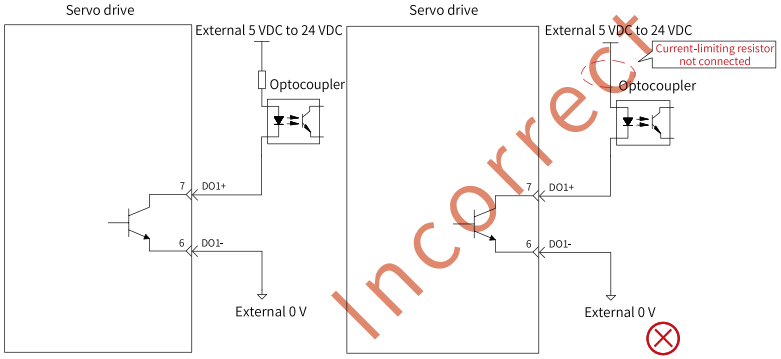


Note

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



- The host controller provides optocoupler input.



Note

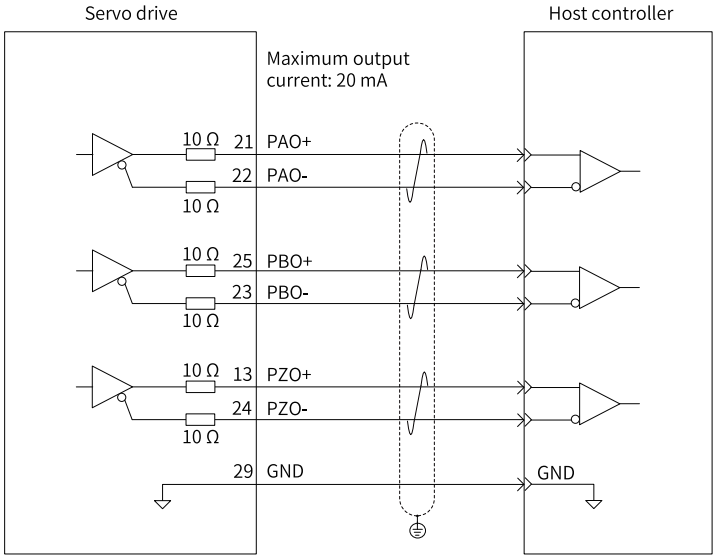
The maximum permissible voltage and current capacity of the optocoupler output circuit inside the servo drive are as follows:

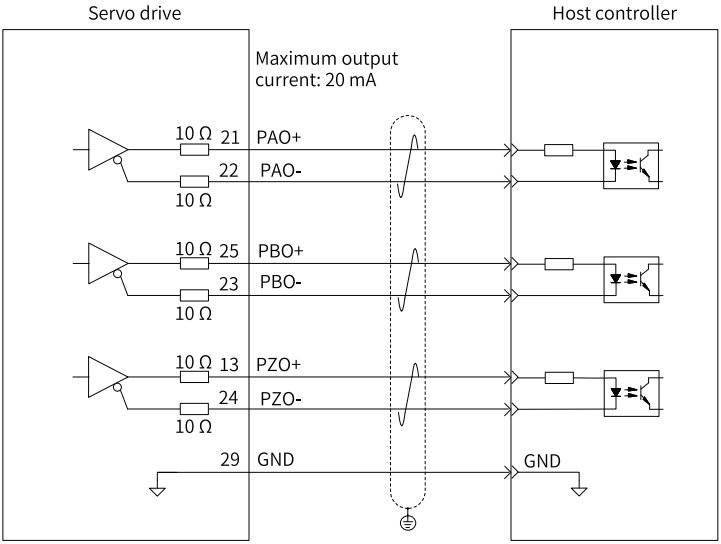
- Maximum voltage: 30 VDC
- Maximum current: DC 50 mA

4.2.5 Encoder Frequency-Division Output Signals

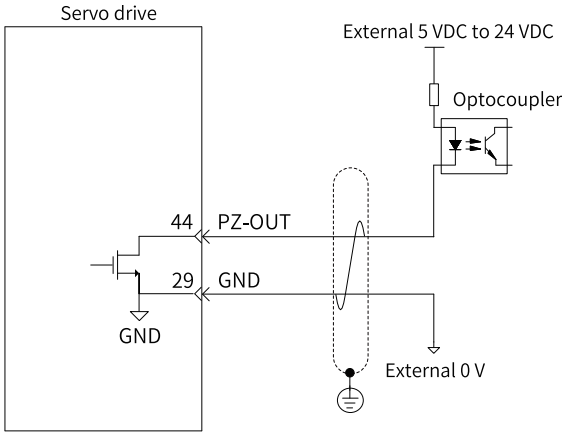
For details on encoder frequency-division output signals, see *"Table 4–10 " on page 60*.

The encoder frequency-division output circuit outputs differential signals through the differential drive. Typically, this circuit provides feedback signals to the host controller in a position control system. Use a differential or optocoupler receiving circuit on the host controller side to receive feedback signals. The maximum output current is 20 mA.





The encoder phase Z frequency-division output circuit supports open-collector signal output. Typically, this circuit provides feedback signals to the host controller in a position control system. Use an optocoupler circuit, relay circuit, or bus receiver circuit on the host controller side to receive feedback signals.



Caution

To reduce noise interference, use shielded twisted pairs to connect the 5V GND of the host controller to the GND of the servo drive.

4.2.6 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.

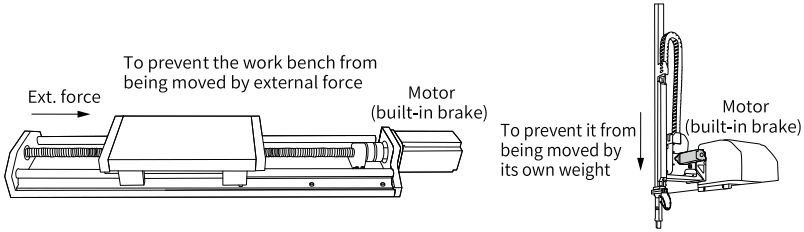


Figure 4-13 Application of the brake

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.

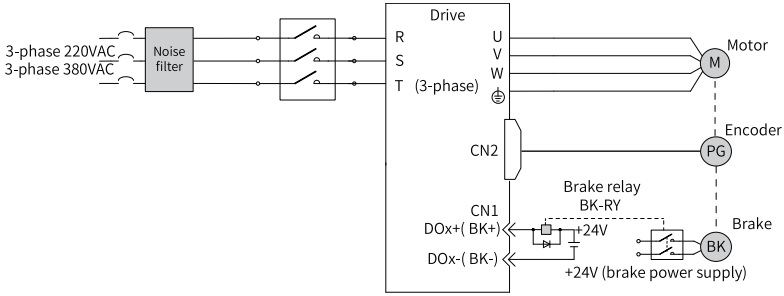


Figure 4-14 Wiring of the brake

Pay attention to the following precautions during wiring:

When determining the length of the motor brake cable, take full account the voltage drop caused by cable resistance. 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 4–14 Brake specifications

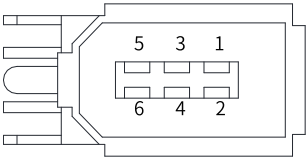
Motor Model	Holding Torque (N·m)	Supply Voltage (VDC) ±10%	Coil Resistance (Ω)±7%	Exciting Current (A)	Release Time (ms)	Apply Time (ms)	Backlash (°)
MS1H1-05B/10B	0.32	24	94.4	0.25	⩽ 20	⩽ 40	⩽ 1.5
MS1H1-20B/40B MS1H4-40B	1.5		75.79	0.32	⩽ 20	⩽ 60	⩽ 1.5
MS1H1-75B/ MS1H4-75B	3.2		57.6	0.42	⩽ 40	⩽ 60	⩽ 1
MS1H2-10C/15C/ 20C/25C	8		25	0.96	⩽ 30	⩽ 85	⩽ 0.5
MS1H2-30C/40C/ 50C	16		21.3	1.13	⩽ 60	⩽ 100	⩽ 0.5
MS1H3-85B/13C/ 18C	12		29.7	0.81	⩽ 60	⩽ 120	⩽ 0.5
MS1H3-29C/44C/ 55C/75C	50		14.4	1.67	⩽ 100	⩽ 200	⩽ 0.5

Note

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

4.3 Description of Encoder Terminal (CN2)

Terminal Layout



Encoder signal terminal CN2

Figure 4-15 Encoder terminal pin layout

Table 4–15 Description of encoder terminal pins

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

Terminal descriptions

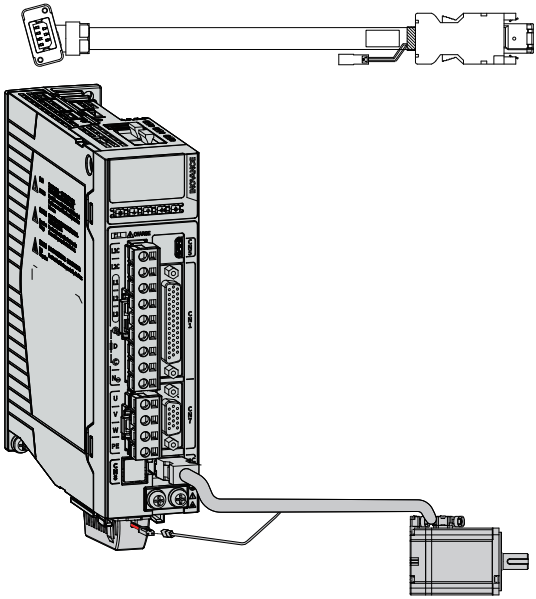


Figure 4-16 Wiring example of absolute encoder signals [1]

Note

- [1] The preceding figure shows the wiring of a 23-bit multi-turn absolute encoder.
- The encoder cable color is subject to the color of the actual product. Cable colors mentioned in this guide all refer to Inovance cables.

Lead wires of the battery box:

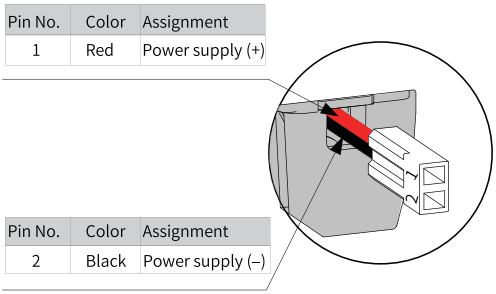
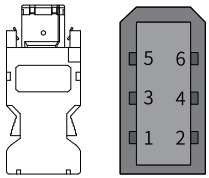
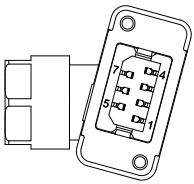


Figure 4-17 Description of the lead wire color of the battery box

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

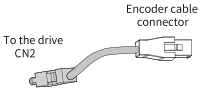
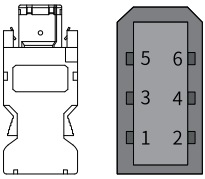
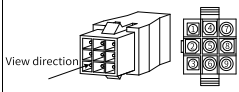
Table 4–16 Terminal-type motor encoder cable connector

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

Note

[1] The flange size refers to the width of the mounting flange.

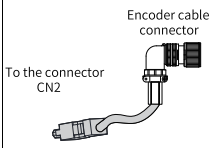
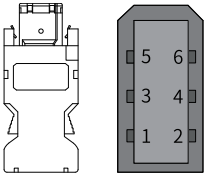
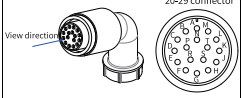
Table 4–17 Encoder cable connector of lead-type motors

<table>
<tr><th rowspan="2">Applicable Motor Flange Size [1]</th><th colspan="2" rowspan="2">Outline Drawing of the Connector</th><th colspan="4">Terminal Pin Layout</th></tr>
<tr><th>Pin No.</th><th>Signal Name</th><th>Color</th><th>Type</th></tr>
<tr><td rowspan="10">Pass-through type:
40
60
80</td><td rowspan="10">  </td><td rowspan="4">Servo drive side</td><td rowspan="4"> 
6-pin male (right side as the connecting side)</td><td>1</td><td>+5 V</td><td>Red</td><td rowspan="2">Twisted pair</td></tr>
<tr><td>2</td><td>GND</td><td>Orange</td></tr>
<tr><td>5</td><td>PS+</td><td>Blue</td><td rowspan="2">Twisted pair</td></tr>
<tr><td>6</td><td>PS–</td><td>Purple</td></tr>
<tr><td>Enclosure</td><td>PE</td><td>-</td><td>-</td></tr>
<tr><td rowspan="6">Motor side</td><td rowspan="6"> 
9-pin connector
Recommended: Plastic enclosure: AMP 172161-1;
Terminal: AMP 770835-1</td><td>1</td><td>Battery (+)</td><td>Brown</td><td rowspan="4">Twisted pair</td></tr>
<tr><td>4</td><td>Battery (-)</td><td>Black</td></tr>
<tr><td>3</td><td>PS+</td><td>Blue</td></tr>
<tr><td>6</td><td>PS–</td><td>Purple</td></tr>
<tr><td>9</td><td>+5 V</td><td>Red</td><td rowspan="3">-</td></tr>
<tr><td>8</td><td>GND</td><td>Orange</td></tr>
<tr><td>7</td><td>Shield</td><td>-</td></tr>
</table>

Note

[1] The flange size refers to the width of the mounting flange.

Table 4–18 Encoder cable connector of motors

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

Note

[1] The flange size refers to the width of the mounting flange (in mm).

4.4 Description of Communication Terminals (CN3/CN4)

Note

CN3 and CN4 (communication terminals) of the CANopen type are only applicable to SV670C.

Terminal Layout

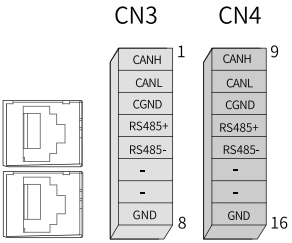


Figure 4-18 Communication Terminal pin layout of the servo drive

Table 4–19 Description of communication terminal pins

Pin No.	Description	Description
1 and 9	CANH	CAN communication port
2 and 10	CANL	
3 and 11	CGND	CAN communication GND
4 and 12	RS485+	RS485 communication port
5 and 13	RS485-	
6 and 14	-	-
7 and 15	-	-
8 and 16	GND	Grounding
Enclosure	PE	Shield

Terminal descriptions

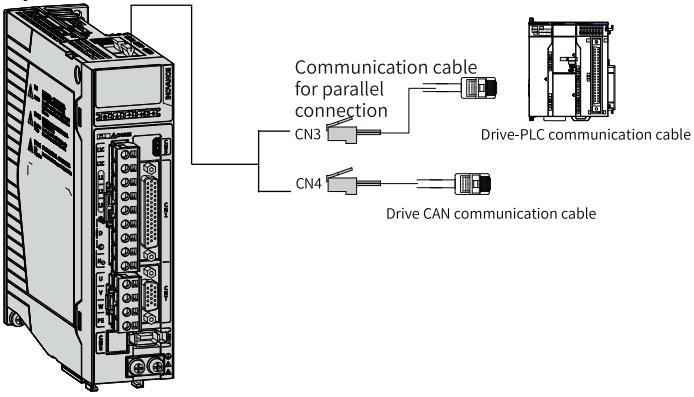


Figure 4-19 Wiring of communication cables

CN3 and CN4 are identical communication terminals connected in parallel internally.

CN3 and CN4 terminals are used for communication with the PC, PLC, and other drives. For pin assignment of CN3/CN4, see *"Figure 4–18 Communication Terminal pin layout of the servo drive" on page 83*.

- **CAN communication with PLC**
  The following figure shows the cable used for the communication between the servo drive and PLC in CAN communication networking.

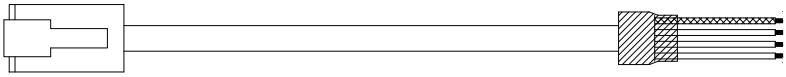


Figure 4-20 Outline drawing of cable used for CAN communication between the servo drive and PLC

Use a three-conductor shielded cable to connect the CAN bus, with the three conductors connected to CANH, CANL, and CGND (CGND represents isolated RS485 circuit) respectively. Connect CANH and CANL with twisted pairs. Connect CGND to the CAN reference ground. Connect the shield to the device ground. Connect a 120Ω termination resistor on each end of the bus to prevent CAN signal reflection.

Table 4–20 Pin connection relation of the cable used for CAN communication between the servo drive and PLC

RJ45 on the Drive Side (A)			PLC Side (B)		
Communication Type	Pin No.	Description	Communication Type	Pin No.	Description
CAN	1	CANH	CAN	1	CANH
	2	CANL		2	CANL
	3	CGND		3	CGND
-	Enclosure	PE (shield layer)	-	Enclosure	PE (shield layer)

- **CAN communication connection for multi-CAN applications**
  The following figure shows the cable used for parallel connection of multiple servo drives during CAN communication.

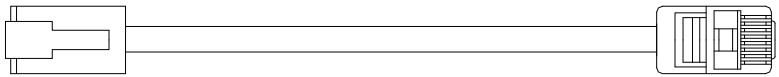


Figure 4-21 Outline drawing of multi-drive communication cable

Table 4–21 Pin connection relation of multi-drive communication cable (pins in CAN group used only)

RJ45 on the Drive Side (A)			RJ45 on the Drive Side (B)		
Communication Type	Pin No.	Description	Communication Type	Pin No.	Description
CAN	1	CANH	CAN	1	CANH
	2	CANL		2	CANL
	3	CGND		3	CGND
-	Enclosure	PE (shield layer)	-	Enclosure	PE (shield layer)

Use the daisy chain mode for CAN bus, as shown in the following figure.

- Shielded twisted pair cables are recommended for connecting the CAN bus. Twisted pairs are recommended for connecting CANH and CANL.
- Connect a 120Ω termination resistor on each end of the bus to prevent signal reflection.
- Connect the reference grounds of CAN signals of all the nodes together.
- Up to 64 nodes can be connected.

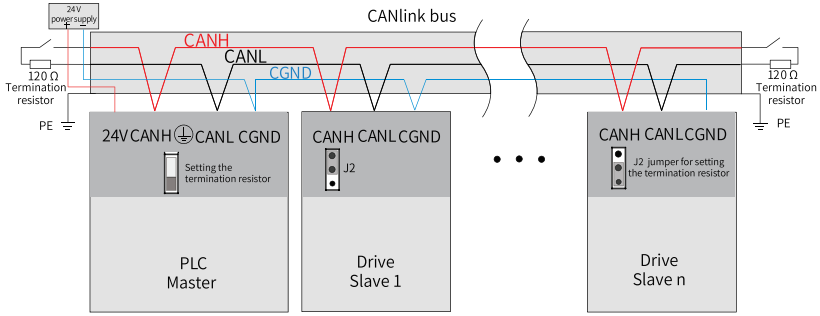


Figure 4-22 CAN bus topology

Caution

Do not connect the CGND terminal of the host controller to the GND terminal of the servo drive. Otherwise, the servo drive may be damaged.

4.5 Description of Communication Terminal (CN5)

Terminal Layout

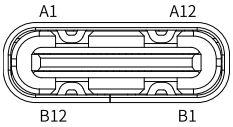


Table 4–22 Pin Description of Communication Terminals (CN5)

Pin No.	Description	Description
A1 B1	GND	Ground
A4 B4	VBUS	USB power supply
A5 B5	-	-
A6 B6	DP	Differential data transmission
A7 B7	DN	Differential data transmission
A8 B8	-	-
A9 B9	VBUS	USB power supply
A12 B12	GND	Ground

Terminal descriptions

This terminal is a commissioning port connected with the PC. The communication cable must be of fast-charging Type-C with a magnetic ring. It must be equipped with a grounding wire, aluminum foil and metal shielding layer. Its length can be up to 3 m.

Figure 4-23 Recommended cables

Note

- Supports online upgrade and background commissioning when the drive is powered on.
- In USB mode, the terminal only supports download and upload of parameters, and driver firmware update.
- The terminal uses USB power supply. If there is a fault that cannot be completely reset, disconnect the USB power supply and drive control power, and then power on again.

4.6 CN6 STO safety Terminal

Note

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

Terminal Layout

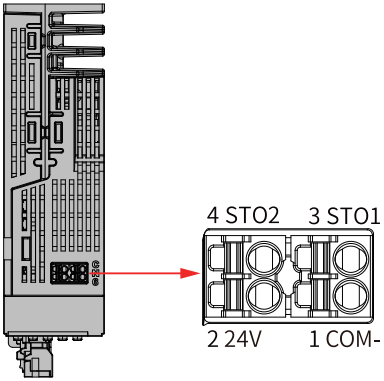
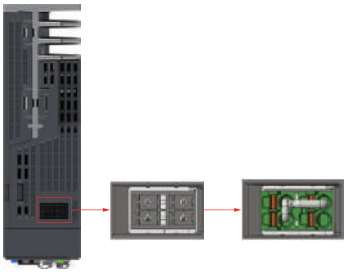


Table 4–23 Pin assignment

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

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.



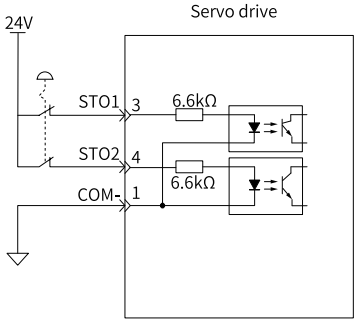
Terminal descriptions

- **Electrical specifications and connections of 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").

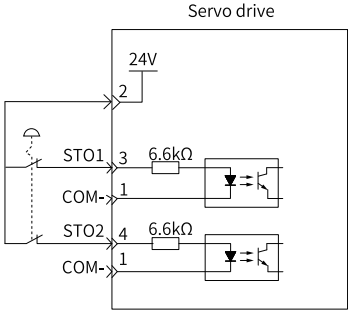
    The servo drive does not operate when the input states of STO1 or STO2 are different or are both "Low" ("0" or "L").
  - Electrical characteristics of Safety Request Input Signal are as follows:

Item	Characteristics	Description
Voltage range	24V DC (±15%)	-
Input current	3.6mA(Typ.)	This is the value per channel.
Standards of logic levels	"0" < 3 V, "1" > 15 V	-
Digital input impedance	6.6 kΩ	-

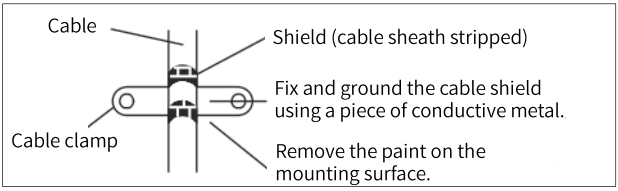
  - Connection example of external 24 V



- Connection example of 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.
- **Additional 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)

Cable	Description
Minimum size	0.3 mm^2(28 AWG)
Maximum length	The max. distance between STO input and the operating contact is 30 m

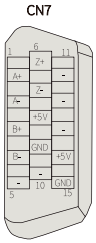
Applicable servo drives

STO applies to the following -FS servo drives:

Size	Power Range	Structure	W×H×D (mm^3)
A	0.2 kW–0.4 kW	Split-type structure	40 x 170 x 150
C	0.75 kW–1.5 kW	Split-type structure	55 x 170 x 173
D	1.8 kW–3 kW	Split-type structure	75 x 170 x 183
E	5 kW–7.5 kW	Split-type structure	90 x 250 x 230

4.7 Description of the 2nd Encoder Terminal (CN7)

Terminal Layout



Pin No.	Description	Description	Pin No.	Description	Description
1	A+	Encoder pulse phase A input+	9	GND	Power supply reference ground
2	A–	Encoder pulse phase A input–	10	-	-
3	B+	Encoder pulse phase B input+	11	-	-
4	B–	Encoder pulse phase B input–	12	-	-
5	-	-	13	-	-
6	Z+	Encoder pulse phase Z input+	14	+5 V	5 V power supply (load current lower than 200 mA)

Pin No.	Description	Description	Pin No.	Description	Description
7	Z-	Encoder pulse phase Z input–	15	GND	5 V power supply reference ground
8	+5 V	Encoder 5 V power supply (load current lower than 200 mA)	Enclosure	PE	Shield

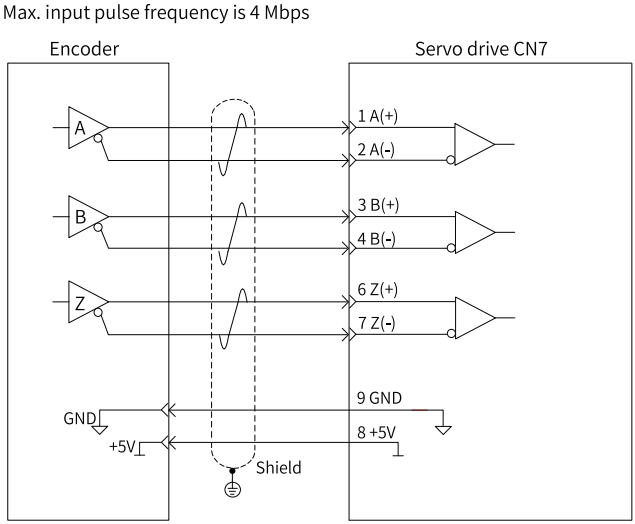
Note

The total load current cannot exceed 200 mA when No. 8 and No. 14 pins are used together.

Terminal descriptions

Encoder pulse input

Use shielded twisted pairs to match the high input frequency.



- To reduce noise interference, connect the reference ground of the external encoder to the GND of the drive. Use shielded cables and connect the shield to the CN7 terminal enclosure.
- The input mode of the external encoder is differential input.
- The maximum pulse frequency supported by a phase A/B linear encoder is 4 Mbps.
- The pulse input terminal of a phase A/B encoder supports open circuit detection.

Suppose the current consumed by the motor encoder is 200 mA, you can select the cable based on the following recommendations.

Table 4–24 Recommended cable between the servo drive and linear motor encoder

Cable Size	Ω/km	Allowable Length (m)
26 AWG (0.13 mm^2)	143	8.0
25 AWG (0.15 mm^2)	89.4	14.0
24 AWG (0.21 mm^2)	79.6	15.0
23 AWG (0.26 mm^2)	68.5	18.0
22 AWG (0.32 mm^2)	54.3	23.0
21 AWG (0.41 mm^2)	42.7	29.0

Suppose the current consumed by the motor encoder is higher than 200 mA, you can select the cable based on the following formula.

$$L2=\frac{\triangle U_{max2}}{I_{encoder} x 2 R_{unit}}$$

Where, △U is 0.5 V, $I_{encoder}$ represents the current consumed by the encoder (see the encoder user guide for details), and R_{unit} represents the unit resistance (Ω/km) of the cable.

4.8 Wiring of the External Regenerative Resistor

Connecting the regenerative resistor

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. However, a built-in regenerative resistor cannot be used together with an external one.

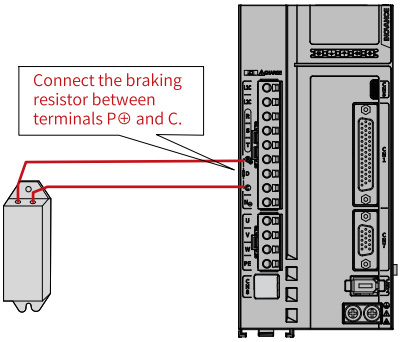


Figure 4-24 Wiring of external regenerative resistor

For cables used for terminals P⊕ and C, see *"3.2.1.3 Power Cable Specifications" on page 28*.

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.

5 Certification and Standard Requirements

CE Certification

Command	Standard	
EMC directive 2014/30/EU	Servo drive	EN 61800-3 EN 61800-6-2 EN 61800-6-4 EN 55011
	Servo Motor	
Low Voltage Directive 2014/35/EU	Servo drive	EN 61800-5-1
	Servo Motor	EN 60034-1 EN 60034-5
RoHS 2011/65/EU	Servo drive	EN 50581
	Servo Motor	

UL/cUL certification

Certification	Standard	
UL/cUL certification	Servo drive	UL61800-5-1 C22.2 No.274-17
	Servo Motor	UL 1004-1 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.

KC Certification

SV670 series servo drives are KC-certified.

5.1 CE Certification

Figure 5-1 CE Marking

- The CE mark indicates compliance with the Low Voltage Directive LVD), Electromagnetic Compatibility (EMC), and Restriction of Hazardous Substances (RoHS) directives.

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

5.1.1 Requirements for Compliance with EMC

The drive is applicable to the first environment and second environment and complies with EMC directive 2014/30/EU and standard EN 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 or systems 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 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 equipment: Power drive system (PDS) with rated voltage less than 1000 V, intended for use in the first environment.
- Category C2 equipment: 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 equipment: 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 equipment: PDS with rated voltage equal to or above 1000 V, or rated current equal to or above 400 A, or intended for use in complex systems in the second environment.

5.1.2 Requirements for Compliance with LVD

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

Installation location

Install the drive in a place with overvoltage category III and pollution degree 1 or 2 as specified by EN61800-5-1.

Installation environment

For requirements of the installation environment, see SV670P 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.

IP20-rated drives 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 *"4.1 Pin Assignment of Main Circuit Terminal" on page 52*.

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 SV670P Series Servo Drive Selection Guide.

5.2 UL/cUL Certification

Figure 5-2 UL/cUL marking

The UL/cUL mark is commonly applied to products sold in United States and Canada. It indicates that UL has performed product tests and evaluation, and determined that their stringent standards have been met. For a product to receive UL/cUL certification, the main components inside the product must also be UL certificated.

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

Keep the ambient temperature within the following range based on the IP rating:

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

Installation requirements

Installation requirements for open-type drives:

SV670P 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

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

- Terminals P⊕, C, and NΘ are used to connect optional parts. Do not connect these terminals to an AC power supply.
- To protect the main circuit, separate and cover the surface that may come into contact with the main circuit.
- The control circuit is the internal safety extra-low voltage (SELV) circuit that must be strictly insulated and isolated from other circuits. Make sure that the control circuit is connected to the external SELV circuit.
- Do not allow unwanted objects to enter 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 a torque screwdriver, torque ratchet, or torque wrench to tighten terminal screws.
- When using an electric screwdriver to tighten terminal screws, set the electric screwdriver to low speed to prevent damage to the terminal screws.
- Tighten the terminal screws with an angle not higher than 5°. Failure to comply may damage the terminal screws.

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

Cable selection

To comply with UL61800-5-1 and CSA C22.2 No. 274-17, power cables used for SV670P 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 5KA and 65 KA and a maximum voltage of 480 VAC (class 400 V).

Note

All breaker protective devices must be UL-certified.

For the SV670 drive applied in North America, the recommended protective devices are as follows:

Servo drive model SV670P****I		Circuit breaker (A)	Class J fuse (A)	Recommended inverse time lag breaker[1] (A)
Single-phase 220 V				
Size A	S1R6	15	6	40
	S2R8	15	6	40
Size C	S5R5	15	10	40
	S7R6	15	10	100
Size D	S012	20	20	100
Three-phase 220 V				
Size A	S1R6	15	6	40
	S2R8	15	6	40
Size C	S5R5	15	10	40
	S7R6	15	10	100
Size D	S012	20	20	100

Servo drive model SV670P****I		Circuit breaker (A)	Class J fuse (A)	Recommended inverse time lag breaker[1] (A)
Size E	S018	40	40	100
	S022	40	40	100
	S027	40	40	100
Three-phase 380 V				
Size C	3R5	15	10	100
	5R4	15	10	100
Size D	T8R4	20	20	100
	T012	20	20	100
Size E	T017	40	40	100
	T021	40	40	100
	T026	40	40	100

Note

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

5.3 KC Certification

Appllicant Suzhou Inovance Technology Co., Ltd.
AC Servo Drive
Model SV670 series
Made In China
Manufacturer
Suzhou Inovance Technology Co.,Ltd.

A급기기 (업무용 방송통신기자재)
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Adjustment of drive parameters

The default setting of the drive shall enable the user to get started and check the basic mechanical operation condition quickly. The user can later perform fine tuning to optimize the operation/performance.

Parameter adjustment shall be completed by qualified personnel trained on servo drives. Some parameter settings may cause failures if you operate improperly, especially during commissioning start-up. Prevent any person from touching the equipment.

This manual provides a complete list of parameters and functional descriptions, which should always be adjusted with care during field start-up. If in doubt, please contact Inovance and authorized distributors for technical support.

6 Solutions to Common EMC Interference Problems

6.1 Malfunction of the Residual Current Device (RCD)

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 150 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.
- It is recommended to use Chint or Schneider RCDs.

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

Table 6–1 Measures against leakage current

Symptom	Possible Cause	Measure
The RCD trips at the moment of power-on.	The anti-interference performance of the RCD is weak.	• It is recommended to use Siemens or Schneider RCDs. • It is recommended to use a 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 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 a RCD with a higher tripping current. • Install a simple filter on the input side of the drive and wind the magnetic ring on the LN and RST cables near the RCD, as shown in *"Figure 6–1 Magnetic ring on the input side" on page 103*. • 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.	
	For motor cables and the motor, the distributed capacitance to ground is too high.	

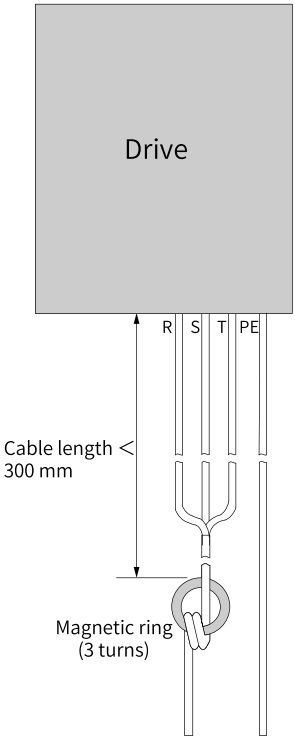

Figure 6-1 Magnetic ring on the input side

6.2 Harmonic Suppression

To suppress harmonics and improve the power factor to allow the drive to fulfill the standards, install an AC input reactor on the input side of the drive. For details about reactor models, see the "SV670P Series Servo Drive Selection Guide." For details about the installation method, see *" Installing an AC input reactor" on page 21*.

6.3 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 *"3.3.4 Control Cable Shield" on page 36*.
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 wire between the host controller and the servo drive.
4	At the drive output side, wind the output U/V/W cable onto a magnetic ring for two to four turns. For details, see *" Installing a magnetic ring and a magnetic buckle" on page 22*.
5	Increase the filter capacitance for low-speed DIs. A capacitance up to 0.1 μF is recommended, as shown in *"Figure 6–2 I/O signal cables with capacitance increased" on page 104*.
6	Increase the filter capacitance between AI and GND. A capacitance up to 0.22 μF is recommended.
7	Wind the signal cable onto a magnetic buckle or magnetic ring for one to two turns. For details, see *" Installing a magnetic ring and a magnetic buckle" on page 22*.
8	Use shielded power cables and ground the shield properly.

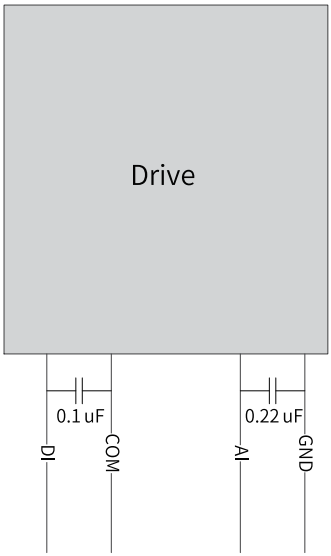

Figure 6-2 I/O signal cables with capacitance increased

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Shenzhen Inovance Technology Co., Ltd.

www.inovance.com

Add.: Inovance Headquarters Tower, High-tech Industrial Park, Guanlan Street, Longhua New District, Shenzhen
Tel: (0755) 2979 9595 Fax: (0755) 2961 9897

Suzhou Inovance Technology Co., Ltd.

www.inovance.com

Add.: No. 16 Youxiang Road, Yuexi Town, Wuzhong District, Suzhou 215104, P.R. China
Tel: (0512) 6637 6666 Fax: (0512) 6285 6720