



SV660N Series Servo Drive

Safety Guide



Industrial
Automation



Intelligent
Elevator



New Energy
Vehicle



Industrial
Robot



Rail
Transit



Data code 19011883A04

Preface

Introduction

The SV660N series high-performance AC servo drive covers a power range from 50 W to 7.5 kW. It supports EtherCAT communication protocol and carries Ethernet communication interfaces to work with the host controller to implement networked operation of multiple servo drives.

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

The SV660N series servo drive aims to implement fast and accurate control in automation equipment such as semi-conductor manufacturing equipment, chip mounters, PCB punching machines, transport machineries, food processing machineries, machine tools, and transmission machineries.

Presents the safety function and related certifications and standards, wiring, commissioning process, troubleshooting, and functions.

Note

The drawings in the manual are shown for description only and may not match the product you purchased.

The instructions are subject to change due to product upgrade, specification modification as well as efforts to increase the accuracy and convenience of the manual.

More documents

Name	Data Code	Description
SV660N Series Servo Drive Selection Guide	19011431	Presents technical data and dimensions of the servo drive, and specifications and models of optional parts (installation accessories, cables, and periphery electrical parts).
SV660N Series Servo Drive Hardware Guide	19011432	This guide describes the installation and wiring of the drive, including pre-installation preparations, unpacking and transportation, mechanical installation, and electrical installation.
SV660N Series Servo Drive Commissioning Guide	19011433	Presents servo commissioning, parameter descriptions, troubleshooting, including the operating panel, commissioning software, and commissioning process and procedure.

Name	Data Code	Description
SV660N Series Servo Drive Function Guide	19011434	Presents functions and parameters, including function overview, basic servo functions, adjustment and parameter list.
SV660N Series Servo Drive Communication Guide	19011435	Presents functions and parameters of the servo drive, including EtherCAT communication configuration, fault description, parameter description, and communication application cases.
SV660N Series Servo Drive Troubleshooting Guide	19011908	Introduces faults and fault levels, the troubleshooting process, alarm codes and fault codes.
SV660N Series Servo Drive Safety Guide	19011883	Presents the safety function and related certifications and standards, wiring, commissioning process, troubleshooting, and functions.
SV660N Series Servo Drive User Guide	PS00005512	Provides information on selection, installation, commissioning, function, troubleshooting and parameters of the equipment.

Revision History

Date	Version	Description
2025-06	A04	- Updated terms and description of T 1 . - Updated safety standards and safety parameters.
2025-01	A03	- Added Installation precautions. - Added description of vibration level, impact level, and installation environment. - Added requirements on installation space and flip angle. - Added screw tightening torques. - Updated cause and troubleshooting of displaying the x value. - Updated description of keypad monitoring display.
2024-08	A02	- Modified STO function description. - Updated UL certification requirements for servo drive power cable selection.
2024-04	A01	Updated the company address in the back cover.
2022-05	A00	First release.

Access to the Guide

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

- Do keyword search at <http://www.inovance.com>.

- Scan the QR code on the equipment to acquire more.
- Scan the QR code below to install the app, where you can search for and download manuals.



Warranty

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

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

- Damage caused by operations not following the instructions in the user guide
- Damage caused by fire, flood, or abnormal voltage
- Damage caused by unintended use of the product
- Damage caused by use beyond the specified scope of application of the product
- Damage or secondary damage caused by force majeure (natural disaster, earthquake, and lightning strike)

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

For details, see the Product Warranty Card.

Safety Instructions

Disclaimer

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

Safety Instructions

- Drawings in the guide are sometimes shown without covers or protective guards. Remember to install the covers or protective guards as specified first, and then perform operations in accordance with the instructions.
- The drawings in the guide are shown for illustration only and may be different from the product you purchased.
- Users must take mechanical precautions to protect personal safety and wear protective equipment, such as anti-smashing shoes, safety clothing, safety glasses, protective gloves, and protective sleeves.

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 package 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.

 CAUTION

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

Installation

 DANGER

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

 WARNING

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

**CAUTION**

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

Wiring**DANGER**

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

**WARNING**

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

**CAUTION**

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

Power-on

 DANGER

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

 WARNING

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

Operation

 DANGER

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

 WARNING

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

Maintenance

 DANGER

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

**WARNING**

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

Repair**DANGER**

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

**WARNING**

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

Disposal**WARNING**

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

Additional Precautions**Cautions for the dynamic brake**

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

this motor is in the regenerative state and short-circuit current passes through the dynamic brake. If this situation continues, the drive, and even the motor, may be burned.

Cautions for Motor Grounding

For applications such as welding machines, connect the PE cable of the motor to the screws of the cast component of the drive. Failure to comply may result in damage to the motor.

Effect of the electromagnetic field on implants

The motor may harm a nearby person who wears a medical implant.

The electromagnetic field may cause malfunction of the medical Implant (such as the heartbeat starter) being used.

Safety label

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

Safety label	Description
	• Never fail to connect the protective earth (PE) terminal. Read through the guide and follow the safety instructions before use. • 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.

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1 General

1.1 Terms and Abbreviations

Terms and Abbreviations	Description
Cat.	Safety category It includes B, 1, 2, 3, and 4.
CCF	Common cause failure
DCavg	Average diagnostic coverage (%)
DTI	Diagnostic test interval time
SFF	Safe failure fraction
HFT	Hardware fault tolerance
PFH	Probability of a dangerous Failure per Hour
PL	Performance Level
SC	Systematic capability
SIL	Safety integrity level
T ₁	Proof test interval
DI	Digital inputs
DO	Digital output
PCB	Printed circuit board
MCU	Micro computer unit
FPGA	Field programmable gate array
MTTFd	Mean time to dangerous failure
SRA	Safety Related Application Parameter
nSRA	Non-SRA parameters
STO	The safe torque off (STO) function brings the machine safely into a no-torque state and prevents it from unexpected start. When the STO function is activated, the servo drive stops according to the preset stop mode (H02.08).

1.2 Safety Standards

Standards compliance

- EC directives and standards
 - Low Voltage Directive 2014/35/EU Standard EN 61800-5-1
 - EMC Directive 2014/30/EU Standard EN 61800-3: 2018
 - Machinery Directive 2006/42/EC (Safety Functions) Standard IEC 61800-5-2
- Safety standard

Safety standard	Reference
Functional safety	IEC 61508: 2010 ISO 13849-1:2023 ISO 13849-2: 2012 IEC 62061: 2021 EN 61508: 2010 EN ISO 13849-1:2023 EN ISO 13849-2: 2012 EN IEC 62061: 2021 IEC 60204-1: 2016 (in extracts) EN 60204-1: 2018 (in extracts)
EMC	IEC 61800-5-2: 2016 IEC 61800-3: 2017 IEC 61326-3-1: 2017 IEC 61000-6-7: 2014 EN 61800-5-2: 2017 EN IEC 61800-3: 2018 EN 61326-3-1: 2017 EN 61000-6-7:2015
LVD	IEC 61800-5-1:2007/A1:2016 EN 61800-5-1:2007+A1:2017+A11:2021

- Safety data

Item	Safety data
SIL	SIL3, IEC61508 Maximum SIL3, EN IEC62061
PFH	$PFH \leq 2.85 \times 10^{-11} [1/h]$ (0.029% of SIL3), IEC 61508
Cat.	3, EN ISO 13849-1
PL	e, EN ISO 13849-1
MTTFd	8646 years (high)
DCavg	$\geq 90\%$ (medium)
T ₁	20 years
Mission time	20 years
HFT	1
SC	SC3
λ_s	$4.14 \times 10^{-8}/h$
λ_{DD}	$1.26 \times 10^{-8}/h$
λ_{DU}	$5.69 \times 10^{-10}/h$
MTTR	0 hour
MRT	0 hour
Application mode	High demand or continuous mode
Device type	Type B

λ_s means the failure rate of safe failure which brings the system into safe state.

λ_{DD} means the failure rate of dangerous failure but can be diagnosed by the diagnosis subsystem.

λ_{DU} means the failure rate of dangerous failure and can't be diagnosed by the diagnosis subsystem.

Note

- See ISO13849-2: 2012 for failure modes of devices.
- Failure sharing of different failure modes of each device.
- See SN29500 for failure rate of each device.

Specifications

- Electrical safety according to IEC 61800-5-1:2016, overvoltage category II
- Environment test requirement according to IEC 61800-5-1:2016
- Operating conditions are shown as follows.

Item	Description																				
Ambient/Storage temperature	0°C to +55°C/−20°C to +70°C																				
Ambient/Storage humidity	20% to 95% RH (no condensation)																				
Vibration	<table> <tr> <th>Item</th><th>Test Condition</th></tr> <tr> <td>Test reference</td><td>See IEC 60068-2-6 4.6</td></tr> <tr> <td>Condition</td><td>EUT is powered on and works normally.</td></tr> <tr> <td>Motion mode</td><td>Sinusoidal</td></tr> <tr> <td>Vibration amplitude/ Acceleration rate</td><td>-</td></tr> <tr> <td>10 Hz ≤ f ≤ 57 Hz</td><td>0.075 mm amplitude</td></tr> <tr> <td>57 Hz < f ≤ 150 Hz</td><td>1 kg</td></tr> <tr> <td>Vibration duration</td><td>10 times on each of the three mutually perpendicular axes</td></tr> <tr> <td>Axis</td><td>X, Y, Z</td></tr> <tr> <td>Installation</td><td>According to the manufacturer's specifications</td></tr> </table>	Item	Test Condition	Test reference	See IEC 60068-2-6 4.6	Condition	EUT is powered on and works normally.	Motion mode	Sinusoidal	Vibration amplitude/ Acceleration rate	-	10 Hz ≤ f ≤ 57 Hz	0.075 mm amplitude	57 Hz < f ≤ 150 Hz	1 kg	Vibration duration	10 times on each of the three mutually perpendicular axes	Axis	X, Y, Z	Installation	According to the manufacturer's specifications
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Axis	X, Y, Z																				
Installation	According to the manufacturer's specifications																				

Item	Description																
Shock resistance	<table> <tr> <th>Item</th><th>Test Condition</th></tr> <tr> <td>Test reference</td><td>See IEC 60068-2-27: 2008 Table 17</td></tr> <tr> <td>Condition</td><td>EUT is powered on and works normally.</td></tr> <tr> <td>Motion mode</td><td>Half-sine pulse</td></tr> <tr> <td>Shock amplitude/ Time</td><td>50 m/s² (5g) 30 ms</td></tr> <tr> <td>Number of shocks</td><td>3 per axis on each of three mutually perpendicular axes</td></tr> <tr> <td>Axis</td><td>±X, ±Y, ±Z</td></tr> <tr> <td>Installation</td><td>According to the manufacturer's specifications</td></tr> </table>	Item	Test Condition	Test reference	See IEC 60068-2-27: 2008 Table 17	Condition	EUT is powered on and works normally.	Motion mode	Half-sine pulse	Shock amplitude/ Time	50 m/s ² (5g) 30 ms	Number of shocks	3 per axis on each of three mutually perpendicular axes	Axis	±X, ±Y, ±Z	Installation	According to the manufacturer's specifications
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Motion mode	Half-sine pulse																
Shock amplitude/ Time	50 m/s ² (5g) 30 ms																
Number of shocks	3 per axis on each of three mutually perpendicular axes																
Axis	±X, ±Y, ±Z																
Installation	According to the manufacturer's specifications																
IP rating	IP20																
Pollution degree (PD)	PD2: free of corrosive or explosive gases; free of exposure to water, oil or chemicals; free of dust, salts or iron dust																
Altitude	2000 m or below																
Cooling method	Clean air (natural convection)																
Others	No static electricity, strong electromagnetic field, magnetic field, and radioactivity																

- The drive complies with EMC standards EN/IEC 61800-3:2017, IEC 61326-3-1, and IEC 61800-5-2
- Others

Item	Description
Applicable servo drives SV660, SV630, SV635	SV6***S1R6I-FS SV6***S2R8I-FS SV6***S5R5I-FS SV6***S7R6I-FS SV6***S012I-FS SV6***T3R5I-FS SV6***T5R4I-FS SV6***T8R4I-FS SV6***T012I-FS SV6***T017I-FS SV6***T021I-FS SV6***T026I-FS
Position	Integrated on the control board of the drive
Safety function - Inputs	Two channels: STO1/STO2

The STO subsystem elements must always be able to operate within the range of temperature, humidity, corrosion, dust, and vibration and other requirements specified above.

1.3 Precautions for Use

Safety Instructions

The chapter contains the warning symbols used in this manual and the safety instructions which you must obey when you install or connect an option module to a drive or inverter. If you ignore the safety instructions, injury, death or damage can occur. Read this chapter before you start the installation.

Any illustrations, photographs, or examples used in this manual are provided as examples only and may not apply to all products to which this manual is applicable.

The products and specifications described in this manual or the content and presentation of the manual may be changed without notice to improve the product and/or the manual.

Table 1-1 Warnings, Cautions and Notes

Icon	Signal word	Description	Consequences in case of disregard
Example:  DANGER  Hazardous voltage e.g. electric shock	DANGER	DANGER	Indicates that failure to comply with the notice will result in death or severe personal injuries
	WARNINGS	Alarm	Indicates that failure to comply with the notice may result in death or severe personal injuries
	CAUTION	Note	Indicates that failure to comply with the notice may result in minor or moderate personal injuries or equipment damage
	STOP	Prohibit	Indicates that failure to comply with the notice will result in equipment or environmental damage



- High attention is required for electrical installation and at the system design to avoid hazards either in normal operation or in the event of equipment malfunction.
- System design, installation, commissioning and maintenance must be carried out by personnel who have the necessary training and experience. They must read the operating instruction and this safety information.

It is the responsibility of the machine builder/OEM/system integrator to make sure that the essential health and safety function requirements specified in the Machinery Directive are met. Risk analysis and risk assessment is needed before using a product. Make sure that adequate measures are taken to eliminate/reduce the relating risks and components chosen must meet the safety requirements.

This section describes the information that needs to be noted before starting operation. Read the following safety precautions, risk assessment information, and limitations before starting operation.

Use the safety function STO after properly understanding all of this information. Incorrect use of safety functions or use of safety functions that are not sufficient to meet the safety requirements of the site may result in personal injury.

Safety Precautions

Carefully read the following important precautions and observe them when using the safety function.

- The STO function is not a substitute for the emergency stop (E-stop) function. If only the STO function is triggered, with no extra measures taken, the power supply cannot be cut off in emergencies and high-current parts of the motor and drive are still energized, incurring the risk of electric shock or other risks result in electric energy. Therefore maintenance work on electrical parts of the drive or motor can only be carried out after isolating the drive system from the main supply.
- Depending on the standards and requirements for a particular application, it may be possible to use STO as an integral part of an E-stop system. However, its main purpose is for use in a dedicated safety control arrangement whose purpose is to prevent any hazard from occurring, without the use of an E-stop.
- An E-stop is often provided in a machine to allow for unexpected situations where an operator sees a hazard and can take action to prevent an accident.
- The design requirement for an E-stop differs from that of a safety interlock. Generally, the E-stop is required to be independent from any complex or "intelligent" control. It may use purely electromechanical devices to either disconnect the power or initiate a controlled rapid stop using other means such as dynamic or regenerative braking.

Note

- The design of safety-related systems requires specialist knowledge. To ensure that a complete control system is safe, it is necessary for the whole system to be designed according to recognized safety principles. The use of individual sub-systems such as drives with STO function, which are intended for safety-related applications, does not in itself ensure that the complete system is safe.
 - The STO function can be used to stop the drive in emergency stop situations.
 - In processes without personnel protection, it is recommended not to stop the drive by using the STO function. If a drive running is stopped by using STO, the drive performs a coast-to-stop. If this is not acceptable, the system should be stopped using the correct mode instead of the STO function.
 - This publication is a guide to the application of Inovance SV660 series safety functions, and also on the design of safety-related systems for machinery control.
 - It is the responsibility of the designer of the end product or application to ensure that it is safe and in compliance with the relevant regulations.
-

Risk Assessment

- When using the safety functions, perform risk assessment on the servo system in advance. Make sure that the safety integrity level of the standards is met.
 - The following residual risks can be present even when the safety functions operate. Therefore, safety must always be given consideration during risk assessment.
 - If external forces (such as gravitational force with a vertical axis) are applied when the safety functions are operating, the motor will rotate due to the action of these external forces. Therefore, you must use a separate mechanical brake to secure the motor.
-

Note

- In the case of failure of multiple IGBTs, regardless of whether the STO function is enabled, the servo drive can generate an alignment torque. This torque can cause the motor shaft to rotate within a range of up to $180 \div p$ (for a synchronous reluctance motor, the range is $180 \div 2p$).
 - p : Number of motor pole pairs.
-

To ensure safety, users should decide all the risk assessments and residual risks in the entire machine equipment. A company and individual who constructed the safety related system must take full responsibility for installation and commissioning of the system. Additionally, when complying with a European machinery directive, the system must acquire safety standards certification as a whole.

Perform all risk assessments and safe level certification to the machine or the system as a whole. It is recommended that a Certification Body final safety certification of the system be used.

The following shows residual risks concerning the safety function of this product.

Common residual risks

- At the shipment to end-users, check the settings of safety related components with programming tools and monitored/displayed contents on display and record and save the setting data concerning the safety observation function and the programming tools you used. Perform them using a check sheet, etc.
- The safety will not be ensured such as in assembling machine until installing, wiring, and adjustment are completed properly. Install, wire, and adjust your system referring to Section "Installation" for each unit.
- Only qualified personnel are authorized to install, start-up, repair or adjust the machines in which these components are installed. Only trained engineers should install and operate the equipment.
- Separate the wiring for safety observation function from other signal wiring.
- Protect the cables with appropriate ways (routing them in a cabinet, using a cable guard, etc.).
- We recommend using a switch, relay, sensor, etc. which comply with safety standards. When using a switch, relay, sensor, etc. which do not comply with safety standards, perform a safety confirmation.
- Keep the required clearance/creepage distance depending on voltage you use.
- The time to a safety observation error depends on parameter settings.

Safe torque off (STO)

This function only cuts off the torque of the motor, and does not cut off the power supply of the servo/inverter. Before servicing the servo/inverter, cut off the power supply and ensure that the servo/inverter are not energized.

2 Product Information

2.1 Nameplate and Model Number of the Servo Drive

Description of the Model

SV660 N S 2R8 I - FH
① ② ③ ④ ⑤ ⑥

1 Series SV660: SV660 series servo drive	4 Rated output current		5 Installation Mode I: Base plate-mounted
2 Product Type N: EtherCAT	S: 220 V	1R6: 1.6 A 2R8: 2.8 A 5R5: 5.5 A 7R6: 7.6 A 012: 11.6 A	6 Non-standard Features Blank: standard FS: STO NS: Upgraded FH ^[1] : High protection INT ^[2] : global version
3 Voltage class S: 220 V T: 380 V	T: 380 V	3R5: 3.5 A 5R4: 5.4 A 8R4: 8.4 A 012: 11.9 A 017: 16.5 A 021: 20.8 A 026: 25.7 A	

Note

- [1] -FH: High-protection models with enhanced stability, special for environments prone to cutting fluid and dust.
- [2] -INT: -INT products are covered by our global warranty system.

Nameplate

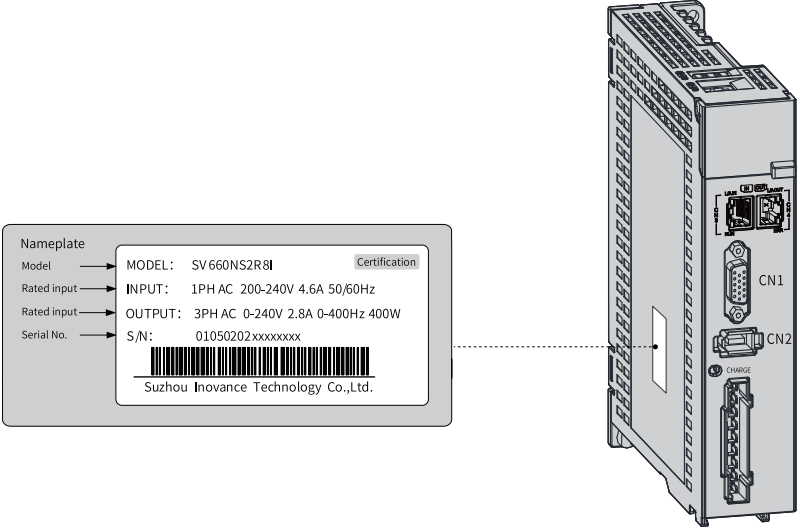


Figure 2-1 Nameplate

Encryption of the production serial number

01050202 4 S 7 00001
① ② ③ ④ ⑤

1 Internal code Equipment material code	3 Year 9: 2009 A: 2010 ... S: 2024 ... Note: I/L/O/Q is not used.	5 Lot number 00001: 1st in current month 00002: 2nd in current month 00003: 3rd in current month ... Range: 00001 to 99999
2 Manufacturer code 4: Suzhou Inovance	4 Month 1: January 2: February ... A: October B: November C: December	

Example: The S/N 010502024H700001 indicates the drive is manufactured in July, 2017.

2.2 Components

2.2.1 Servo drives in size A (rated power: 0.2 kW to 0.4 kW)

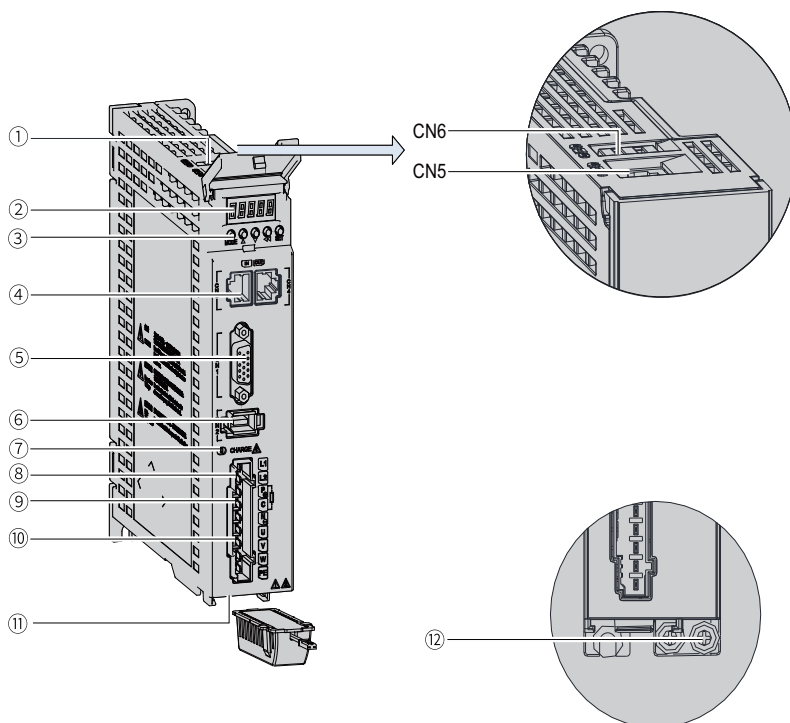


Figure 2-2 Components (SV660NS1R6I, SV660NS2R8I)

Table 2-1 Description of components (SV660NS1R6I, SV660NS2R8I)

No.	Name	Description
1	CN6 (STO safety function terminal)	Connected to external functional safety signal for functional safety purpose.
	CN5 (communication terminals)	Connected to RS232C communication instruction device.
2	LED display	The 5-digit 8-segment LED display is used to show servo system's running state and parameter setting.

No.	Name	Description
3	Keys	MODE: Used to switch parameters in sequence. △: Used to increase the value of the blinking bit. ▽: Used to decrease the value of the blinking bit. ◁: Used to shift the blinking bit leftwards. (Hold down: Turning to the next page when the displayed number exceeds five digits) SET: Used to save modifications and enter the next menu.
4	CN3, CN4 (EtherCAT communication terminals)	CN3 (IN): Connected to the master or the last slave device CN4 (OUT): Connected to the next slave device
5	CN1 (control terminal)	Used by reference input signals and other I/O signals.
6	CN2 (terminal for connecting the encoder)	Connected to the motor encoder terminal.
7	CHARGE (bus voltage indicator)	Indicates the electric charge is present in the bus capacitor. When the indicator turns on, charges possibly still exist in the internal capacitor of the servo unit, even if the power supply of the main circuit is OFF. To prevent electric shock, do not touch the power terminals when this indicator lights up.
8	L1, L2 (power input terminals)	See the nameplate for the rated voltage class.
9	P ⊕ , N ⊖ (servo bus terminals)	Used by the common DC bus for multiple servo drives. For use of the common DC busbar, contact Inovance technicians.
	P ⊕ , C (terminals for connecting external braking resistor)	If an external braking resistor is needed, connect it between terminals P ⊕ and C.
10	U, V, W (terminals for connecting the servo motor)	Connected to U, V, and W phases of the servo motor.
11	Battery location	Used to hold the battery box of the absolute encoder.
12	Grounding terminal	Connected to the grounding terminal of the motor/power supply for grounding purpose.

Note

- Built-in braking resistors or jumper bars are not included in S1R6 and S2R8 models. Connect an external braking resistor between terminals P ⊕ and C if needed.
- The CN6 STO safety function terminal is only suitable for non-standard models (-FS).

2.2.2 Size B drive (rated power: 0.75 kW)

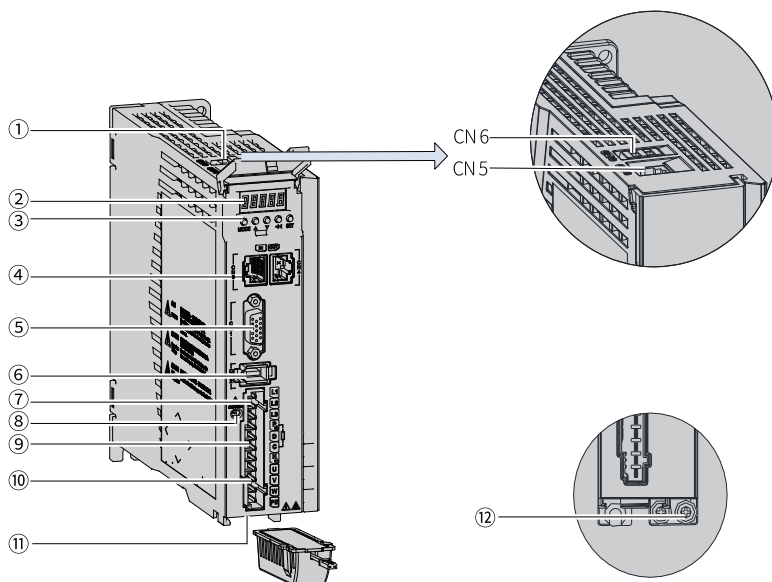


Figure 2-3 Components (SV660NS5R51)

Table 2-2 Description of components (SV660NS5R5I)

No.	Name	Description
1	CN6 (STO safety function terminal)	Connected to external functional safety signal for functional safety purpose.
	CN5 (communication terminals)	Connected to RS232 communication instruction device.
2	LED display	The 5-digit 8-segment LED display is used to show servo system's running state and parameter setting.
3	Keys	MODE: Used to switch parameters in sequence. △: Used to increase the value of the blinking bit. ▽: Used to decrease the value of the blinking bit. ◁: Used to shift the blinking bit leftwards. (Hold down: Turning to the next page when the displayed number exceeds five digits) SET: Used to save modifications and enter the next menu.
4	CN3, CN4 (EtherCAT communication terminals)	CN3 (IN): Connected to the master or the last slave device CN4 (OUT): Connected to the next slave device
5	CN1 (control terminal)	Used by reference input signals and other I/O signals.
6	CN2 (terminal for connecting the encoder)	Connected to the motor encoder terminal.
7	L1, L2, L3 (power input terminals)	See the nameplate for the rated voltage class. Note: S5R5 (0.75 kW) models support single-phase 220 V input only, with a 220 V power supply connected between terminals L1 and L2.
8	CHARGE (bus voltage indicator)	Indicates the electric charge is present in the bus capacitor. When the indicator turns on, charges possibly still exist in the internal capacitor of the servo unit, even if the power supply of the main circuit is OFF. To prevent electric shock, do not touch the power terminals when this indicator lights up.
9	P ⊕, N ⊖ (servo bus terminals)	Used by the common DC bus for multiple servo drives. For use of the common DC busbar, contact Inovance technicians.
	P ⊕, D, C (terminals for connecting external braking resistor)	Remove the jumper bar between terminals P ⊕ and D before connecting an external braking resistor between terminals P ⊕ and C. If no external braking resistor is required, keep the jumper between terminals P ⊕ and D. Only Size A provides no built-in braking resistor or PD jumper.

No.	Name	Description
10	U, V, W (terminals for connecting the servo motor)	Connected to U, V, and W phases of the servo motor.
11	Battery location	Used to hold the battery box of the absolute encoder.
12	Grounding terminal	Connected to the grounding terminal of the motor/power supply for grounding purpose.

Note

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

2.2.3 Servo Drives in Size C and Size D (Rated Power 1.0 kW to 3.0 kW)

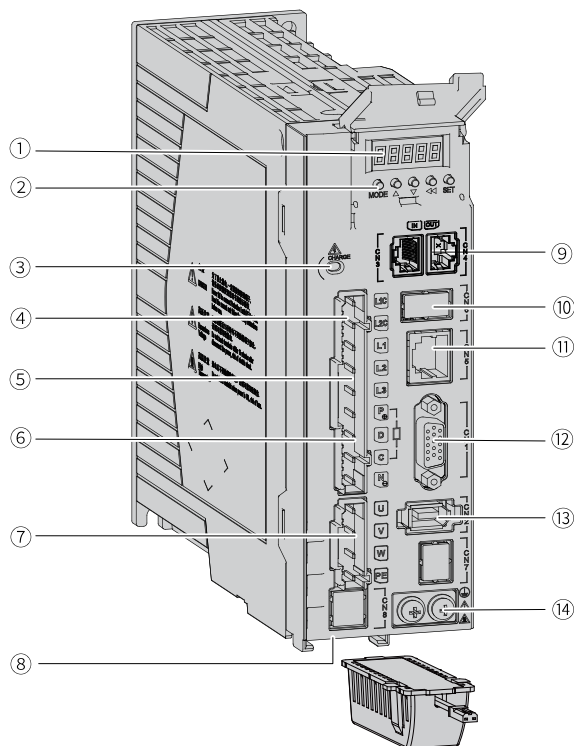


Figure 2-4 Components (Size C: SV660NS7R6I/Size D: SV660NS012I)

Table 2–3 Description of Components (Size C: SV660NS7R6I/Size D: SV660NS012I)

No.	Name	Description
1	LED display	The 5-digit 8-segment LED display is used to show servo system's running state and parameter setting.
2	Keys	MODE: Used to switch parameters in sequence. △: Used to increase the value of the blinking bit. ▽: Used to decrease the value of the blinking bit. ◁: Used to shift the blinking bit leftwards. (Hold down: Turning to the next page when the displayed number exceeds five digits) SET: Used to save modifications and enter the next menu.
3	CHARGE (bus voltage indicator)	Indicates the electric charge is present in the bus capacitor. When the indicator turns on, charges possibly still exist in the internal capacitor of the servo unit, even if the power supply of the main circuit is OFF. To prevent electric shock, do not touch the power terminals when this indicator lights up.
4	L1C, L2C (control circuit power input terminals)	See the nameplate for the rated voltage class.
5	L1, L2, L3 (main circuit power input terminals)	Used as the power input terminals for a three-phase 220 V servo drive. See the nameplate for the rated voltage class.
6	P ⊕, D, C (terminals for connecting external braking resistor)	Remove the jumper bar between terminals P ⊕ and D before connecting an external braking resistor between terminals P ⊕ and C. If no external braking resistor is required, keep the jumper between terminals P ⊕ and D. Only Size A provides no built-in braking resistor or PD jumper.
	P ⊕, N ⊖ (servo bus terminals)	Used by the common DC bus for multiple servo drives. For use of the common DC busbar, contact Inovance technicians.
7	U, V, W (terminals for connecting the servo motor)	Connected to U, V, and W phases of the servo motor.
8	Battery location	Used to hold the battery box of the absolute encoder.
9	CN3, CN4 (EtherCAT communication terminals)	CN3 (IN): Connected to the master or the last slave device CN4 (OUT): Connected to the next slave device
10	CN6 (STO safety function terminal)	Connected to external functional safety signal for functional safety purpose.
11	CN5 (communication terminals)	Connected to RS232 communication instruction device.
12	CN1 (control terminal)	Used by reference input signals and other I/O signals.

No.	Name	Description
13	CN2 (terminal for connecting the encoder)	Connected to the motor encoder terminal.
14	Grounding terminal	Connected to the grounding terminal of the motor/power supply for grounding purpose.

Note

- The main circuits of models S7R6 and S012 can be connected to a single-phase or a three-phase power supply, depending on which one is available on site. For models S7R6 and S012, no derating is required when a single-phase power supply is connect to L1 or L2.
 - The CN6 STO safety function terminal is only suitable for non-standard models (-FS).
-

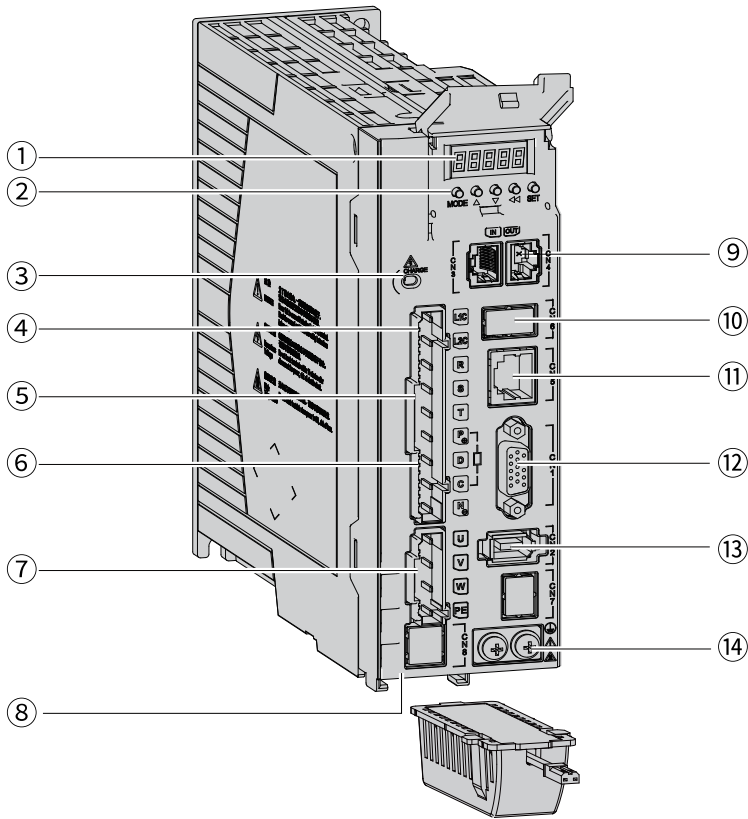


Figure 2-5 Components (Size C: SV660NT3R5I, SV660NT5R4I/Size D: SV660NT8R4I, SV660NT012I)

Table 2-4 Components (Size C: SV660NT3R5I, SV660NT5R4I/Size D: SV660NT8R4I, SV660NT012I)

No.	Name	Description
1	LED display	The 5-digit 8-segment LED display is used to show servo system's running state and parameter setting.
2	Keys	MODE: Used to switch parameters in sequence. △: Used to increase the value of the blinking bit. ▽: Used to decrease the value of the blinking bit. ◁: Used to shift the blinking bit leftwards. (Hold down: Turning to the next page when the displayed number exceeds five digits) SET: Used to save modifications and enter the next menu.

No.	Name	Description
3	CHARGE (bus voltage indicator)	Indicates the electric charge is present in the bus capacitor. When the indicator turns on, charges possibly still exist in the internal capacitor of the servo unit, even if the power supply of the main circuit is OFF. To prevent electric shock, do not touch the power terminals when this indicator lights up.
4	L1C, L2C (control circuit power input terminals)	See the nameplate for the rated voltage class.
5	R, S, T (main circuit power input terminals)	See the nameplate for the rated voltage class.
6	P [⊕] , D, C (terminals for connecting external braking resistor)	Remove the jumper bar between terminals P [⊕] and D before connecting an external braking resistor between terminals P [⊕] and C. If no external braking resistor is required, keep the jumper between terminals P [⊕] and D. Only Size A provides no built-in braking resistor or PD jumper.
	P [⊕] , N [⊖] (servo bus terminals)	Used by the common DC bus for multiple servo drives. For use of the common DC busbar, contact Inovance technicians.
7	U, V, W (terminals for connecting the servo motor)	Connected to U, V, and W phases of the servo motor.
8	Battery location	Used to hold the battery box of the absolute encoder.
9	CN3, CN4 (EtherCAT communication terminals)	CN3 (IN): Connected to the master or the last slave device CN4 (OUT): Connected to the next slave device
10	CN6 (STO safety function terminal)	Connected to external functional safety signal for functional safety purpose.
11	CN5 (communication terminals)	Connected to RS232 communication instruction device.
12	CN1 (control terminal)	Used by reference input signals and other I/O signals.
13	CN2 (terminal for connecting the encoder)	Connected to the motor encoder terminal.
14	Grounding terminal	Connected to the grounding terminal of the motor/power supply for grounding purpose.

Note

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

2.2.4 Servo Drive in Size E (Rated Power 5.0 kW to 7.5 kW)

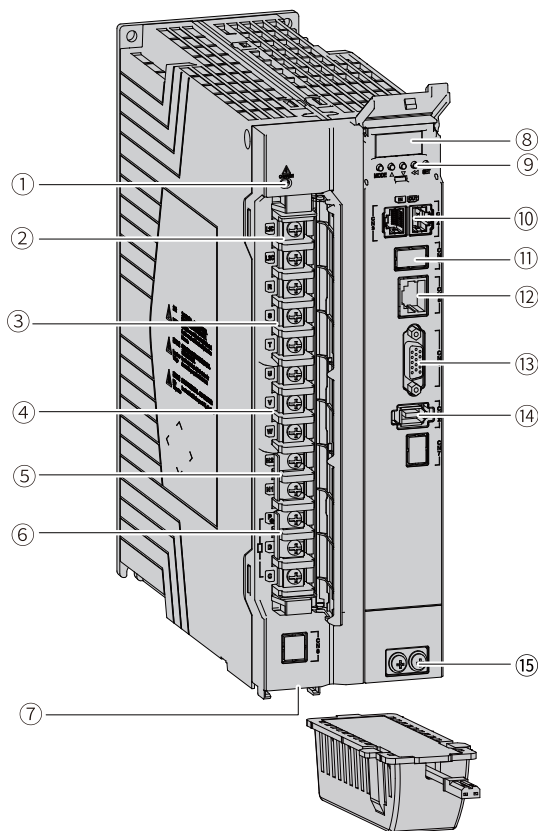


Figure 2-6 Components of servo drives in size E (SV660NT017I, SV660NT021I, SV660NT026I)

Table 2-5 Components (SV660NT017I, SV660NT021I, SV660NT026I)

No.	Name	Description
1	CHARGE (bus voltage indicator)	Indicates the electric charge is present in the bus capacitor. When the indicator turns on, charges possibly still exist in the internal capacitor of the servo unit, even if the power supply of the main circuit is OFF. To prevent electric shock, do not touch the power terminals when this indicator lights up.
2	L1C, L2C (control circuit power input terminals)	See the nameplate for the rated voltage class.
3	R, S, T (main circuit power input terminals)	See the nameplate for the rated voltage class.
4	U, V, W (terminals for connecting the servo motor)	Connected to U, V, and W phases of the servo motor.
5	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.
6	P ⊕, D, C (terminals for connecting external braking resistor)	Remove the jumper bar between terminals P ⊕ and D before connecting an external braking resistor between terminals P ⊕ and C. If no external braking resistor is required, keep the jumper between terminals P ⊕ and D. Only Size A provides no built-in braking resistor or PD jumper.
7	Battery location	Used to hold the battery box of the absolute encoder.
8	LED display	The 5-digit 8-segment LED display is used to show servo system's running state and parameter setting.
9	Keys	MODE: Used to switch parameters in sequence. △: Used to increase the value of the blinking bit. ▽: Used to decrease the value of the blinking bit. ◁: Used to shift the blinking bit leftwards. (Hold down: Turning to the next page when the displayed number exceeds five digits) SET: Used to save modifications and enter the next menu.
10	CN3, CN4 (EtherCAT communication terminals)	CN3 (IN): Connected to the master or the last slave device CN4 (OUT): Connected to the next slave device
11	CN6 (STO safety function terminal)	Connected to external functional safety signal for functional safety purpose.
12	CN5 (communication terminals)	Connected to RS232 communication instruction device.

No.	Name	Description
13	CN1 (control terminal)	Used by reference input signals and other I/O signals.
14	CN2 (terminal for connecting the encoder)	Connected to the motor encoder terminal.
15	Grounding terminal	Connected to the grounding terminals of the power supply and the motor.

Note

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

2.3 Electrical Specifications

- Single-phase 220 V drive

Item		Size A		Size B	Size C	Size D
Servo Drive Model		S1R6	S2R8	S5R5	S7R6	S012
Power of the Drive (kW)		0.2	0.4	0.75	1	1.5
Max. applicable motor capacity (kW)		0.2	0.4	0.75	1	1.5
Power supply equipment capacity (kVA)		1.4	2.8	4.6	6.0	8.0
Continuous output current (Arms)		1.6	2.8	5.5	7.6	11.6
Max. output current (Arms)		5.8	10.1	16.9	23.0	32.0
Main circuit ^[1]	Continuous input current (Arms)	2.3	4.0	7.9	9.6	12.8
	Main circuit power supply	Single-phase 200 VAC~240 VAC, -10% to +10%, 50 Hz/60 Hz				
	Energy Loss (W) ^[2]	10.21	23.8	38.2	47.32	69.84
	Inrush current (A)	17.0	17.0	17.0	11.3	11.3
Control circuit	Control circuit power supply	Powered up by the bus, sharing the same power supply and rectification part with the main circuit				
	Energy Loss (W) ^[3]	16				
Braking resistor	Resistance (Ω)	-	-	50	25	
	Resistor power (W)	-	-	50	80	
	Min resistance of external resistor (Ω)	40	40	40	20	15
	Max. braking energy absorbed by capacitor (J)	7.86	15.72	22.39	32.39	32.39
	Braking resistor	All models in the series support built-in and external braking resistors. But Size A does not come with a built-in braking resistor as standard				
Cooling mode		Self-cooling		Air cooling		
Overvoltage class		III				

Item	Size A		Size B	Size C	Size D
Max. Input Surge Current (A)	18.65	18.65	18.65	12.44	12.44
3 τ (ms) (3 x RC time constant)	19.8	39.6	56.4	122.4	180

- Three-phase 220 V drive

Item		Size C	Size D
Servo Drive Model		S7R6	S012
Power of the Drive (kW)		1	1.5
Max. applicable motor capacity (kW)		1	1.5
Power supply equipment capacity (kVA)		5.05	6.68
Continuous output current (Arms)		7.6	11.6
Max. output current (Arms)		23	32
Main circuit ^[1]	Continuous input current (Arms)	5.1	8.0
	Main circuit power supply	3-phase 200 VAC–240 VAC, -10% to +10%, 50 Hz/60 Hz	
	Energy Loss (W) ^[2]	47.32	69.84
	Inrush current (A)	11.3	11.3
Control circuit	Control circuit power supply	Single-phase 200 VAC–240 VAC, -10% to +10%, 50 Hz/60 Hz	
	Energy Loss (W) ^[3]	16	
Braking resistor	Resistance (Ω)	25	
	Resistor power (W)	80	
	Min resistance of external resistor (Ω)	20	15
	Max. braking energy absorbed by capacitor (J)	32.39	32.39
	Braking resistor	Built-in and external resistor is supported	
Cooling mode		Air cooling	
Overvoltage class		III	
Max. Input Surge Current (A)		12.44	12.44
3 τ (ms) (3 x RC time constant)		122.4	180

- Three-phase 380 V drive

Item	Size C		Size D		Size E		
Servo Drive Model	T3R5	T5R4	T8R4	T012	T017	T021	T026
Power of the Drive (kW)	1	1.5	2	3	5	6	7.5
Max. applicable motor capacity (kW)	1	1.5	2	3	5	6	7.5
Power supply equipment capacity (kVA)	6.05	9.08	10.23	15.15	22.25	25.0	31.25
Continuous output current (Arms)	3.5	5.4	8.4	11.9	16.5	20.8	25.7
Max. output current (Arms)	11	14	20	29.75	42	55	65

Item		Size C		Size D		Size E		
Main circuit ^[1]	Continuous input current (Arms)	2.4	3.6	5.6	8.0	12.0	16.0	21.0
	Main circuit power supply	3-phase 380 VAC–440 VAC, -10% to +10%, 50 Hz/60 Hz						
	Energy Loss (W) ^[2]	39.5	63.25	94.82	135.47	187.62	228.28	258.63
	Inrush current (A)	20.7	20.7	20.7	20.7	20.7	20.7	20.7
Control circuit	Control circuit power supply	Single-phase 380 VAC–440 VAC, -10% to +10%, 50 Hz/60 Hz						
	Energy Loss (W) ^[3]	16						
Braking resistor	Resistance (Ω)	100	100	50	50	35	35	35
	Resistor power (W)	80	80	80	80	100	100	100
	Min resistance of external resistor (Ω)	80	60	45	40	35	25	25
	Max. braking energy absorbed by capacitor (J)	28.18	34.22	50.32	50.32	100.64	100.64	100.64
	Braking resistor	Built-in and external resistor is supported						
Cooling mode		Air cooling						
Overvoltage class		III						
Max. Input Surge Current (A)		24.89	24.89	24.89	24.89	24.89	24.89	24.89
3 τ (ms) (3 x RC time constant)		30.6	30.6	45	45	73.8	90	90

Note

- [1]: The main circuits of the S7R6 and S012 models support single-phase 220 V power supplies without derating.
- [2]: Main circuit energy loss refers to the energy loss under rated output current of the servo drive.
- [3]: Control circuit energy loss refers to the energy loss under rated input current of the servo drive.
- Select the external braking resistor according to actual operating conditions.

2.4 Technical Specifications

Item			Description
General Specifications	Control mode		IGBT PWM control, sine wave current drive mode
			220 V, 380 V: Single-phase/Three-phase full bridge rectification
	Encoder feedback		23-bit multi-turn absolute encoder, which can be used as an incremental encoder in absence of the battery
	Conditions for use	Operating/Storage temperature ^[1]	0°C to +55°C (If the ambient temperature exceeds 45°C, derate by 10% for every additional 5°C)/ -20°C to +70°C
		Operating/Storage humidity	Below 90% RH (no condensation)
		Vibration resistance	4.9 m/s ²
		Impact resistance	19.6 m/s ²
		IP rating	IP20 (excluding terminals (IP00))
		Pollution degree	PD2
		Altitude	Max. 2000 m For altitudes not higher than 1000 m, derating is not required For altitude above 1000 m, derate 1% for every additional 100 m. For altitude above 2000m, contact Inovance.
Speed/torque control mode	Performance	Load change ratio	Below 0.5% at 0–100% load (under rated speed)
		Voltage change ratio	0.5% at rated voltage $\pm$ 10% (under rated speed)
		Speed control range	1–6000 (The lower limit of the speed control range is that the load can be rotated under rated motor torque)
	Input signal	Speed Reference Input	CSV/PV mode
		Torque Reference	CST/PT mode
Position Control Mode	Performance	Feedforward compensation	0% to 100.0% (resolution: 0.1%)
		Timing window	1–65535 encoder unit
	Input signal	EtherCAT communication mode	CSP mode/PP mode/HM mode
Input/Output signal	DI signal	DI signal function assignment ^[2]	5 DIs
			DI1–DI3: normal DI (rising edge (24 V input low to high) input delay: 50 μ s, falling edge (24 V input high to low) input delay: 200 μ s, voltage range: 20 V–30 V)
			DI4–DI5: fast DI (rising edge (24 V input low to high) input delay: 10 μ s, falling edge (24 V input high to low) input delay: 50 μ s, voltage range: 20 V–30 V)
			The DI functions are as follows: servo enable, alarm reset, forward overtravel, reverse overtravel, home switch, emergency stop, probe
	Digital output signal	Output signal function selection	3 DOs
			With-load capacity: 50 mA Voltage range: 5 V to 30 V
			The DO functions are as follows: servo ready, motor rotation output, comparison output, brake output, forced communication output, EDM output, fault, and warning

Item		Description
Built-in functions	Stop at limit switch	The servo drive stops immediately when P-OT or N-OT is active
	Electronic gear ratio	$0.001 \leq B/A \leq 3355443.2$
	Protective functions	Including protections against overcurrent, overvoltage, undervoltage, overload, main circuit detection error, heatsink overheat, power phase loss, overspeed, encoder error, CPU error, and parameter error
	Safety Function	DI signal function assignment
		output
		Applicable standard
	LED display	Main circuit CHARGE indicator, 5-digit LED display
	Vibration suppression	5 notches (including two adaptive notches) available, 50 Hz to 8000 Hz
	Usability functions	One-key parameter tuning, adaptive parameter tuning, speed observer, and model tracking
	Communication function	Software commissioning
		Multi-station communication
		Number of multi-station communication axes
		Axis address setting
		Function
	Others	Gain tuning, alarm record, JOG

Note

- [1] Install the servo drive within the allowable ambient temperature range. When it is installed inside a control cabinet, the temperature inside the cabinet must also be within this range.
- [2] DI logic level: "0" < 3 V; "1" > 18 V

2.5 Technical Data of EtherCAT Communication

Item		Specification
EtherCAT Basic performance of slave	Communication protocol	EtherCAT protocol
	Service supported	CoE (PDO, SDO)
	Synchronization mode	DC - Distributed clock
	Physical layer	100Base-TX
	Baud rate	100 Mbit/s (100Base-TX)
	Duplex mode	Full duplex
	Topology	Linear, star, tree
	Transmission medium	Shielded Cat5e 4-core cables or cables of Cat6 or higher
	Transmission distance	Less than 100 m between two nodes (with proper environment and cables)
	Number of slaves	65535 by protocol
	EtherCAT frame length	44 bytes to 1498 bytes
	Process Data	Max. 1,486 bytes per Ethernet frame
	Synchronous jitter of two slaves	< 1 μ s
	Communication code error rate	10^{-10} Ethernet standard
EtherCAT configuration unit	Number of storage synchronization management units	8
	Process data RAM	8 KB
	Distributed clock	64-bit
	EEPROM capacity	32 kbit

2.6 Product Dimensions

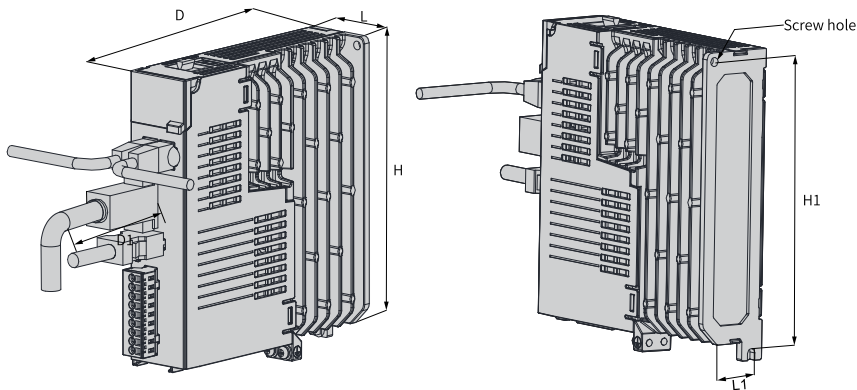


Figure 2-7 Product dimensions

Size	L	H	D	L1	H1	D1	Screw Hole	Tightening Torque	Mass
	Unit: mm (in.)							Unit: N · m	Unit: kg (lb.)
A	40 (1.57)	170 (6.69)	150 (5.91)	28 (1.10)	161 (6.34)	75 (2.95)	2×M4	0.6 to 1.2	0.8 (1.76)
B	50 (1.97)	170 (6.69)	173 (6.81)	37 (1.46)	161 (6.34)	75 (2.95)	2×M4	0.6 to 1.2	1.0 (2.20)
C	55±1 (2.17±0.04)	170 (6.69)	173±1 (6.81±0.04)	44 (1.73)	160 (6.30)	75 (2.95)	2×M4	0.6 to 1.2	1.2 (2.65)
D	80±1 (3.15±0.04)	170 (6.69)	183 (7.20)	71 (2.80)	160 (6.30)	75 (2.95)	3×M4	0.6 to 1.2	1.8 (3.97)
E	90 (3.54)	250 (9.84)	230 (9.06)	78 (3.07)	240.5 (9.47)	75 (2.95)	4×M4	0.6 to 1.2	3.6 (7.94)

3 Installation

3.1 Installation

Note

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

The service life of the drive depends to a large extent on the use manner and installation environment. A favorable use manner and installation environment prolong the service life of the drive. Install and use the drive in a place that complies with the installation environment requirements. For details, see ["3.3 Installation Environment Requirements" on page 40](#)



Caution

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

3.2 Unpacking Inspection

Check the following items upon unpacking.

Item	Description
Check whether the delivered product is consistent with your order.	Check whether the servo drive model and specifications comply with your order. See the dimensions of the packing box in "Table 3-1 " on page 39 . The deliverables include the product, cushion, carton box, and screw bag, as shown in "Figure 3-1 " on page 39 .
Check whether the product is intact.	Check whether the product delivered is in good condition. If there is any missing or damage, contact Inovance or your supplier immediately.

Table 3-1 Dimensions of the outer packing box

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

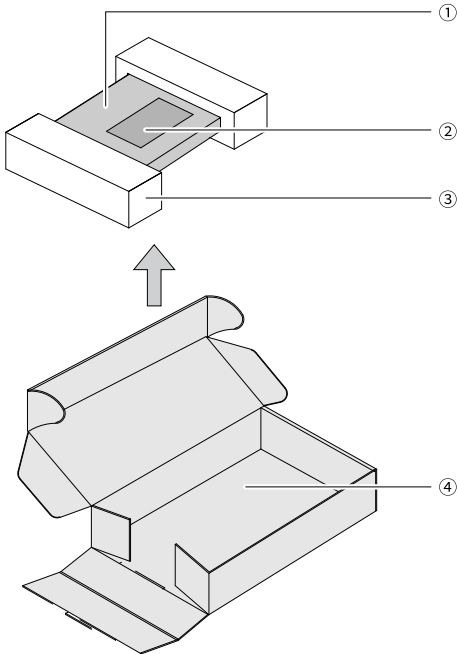


Figure 3-1 Contents inside the packing box

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

3.3 Installation Environment Requirements

Table 3-2 Environment requirements

Item	Requirement
Installation location	Indoor
Grid overvoltage	Overvoltage category (OVC) III
Altitude	The maximum altitude is 2000 m. • For altitudes not higher than 1000 m, derating is not required • Derating is required for altitudes above 1000 m (derate 1% for every additional 100 m) • For altitudes above 2000 m, contact Inovance.
Temperature	• Installation/operation temperature: 0°C to 55°C When the temperature exceeds 45°C, 2% derating is required for every additional 1°C Class: 3K3 (IEC 60721-3-3) • Storage/transportation temperature: -20°C to +70°C Class: 1K2 (IEC 60721-3-1)/Level: 2K2 (IEC 60721-3-2) • To improve the reliability of the machine, use the servo drive in environments without dramatic temperature change. • When installing the servo drive into an enclosed environment such as a control cabinet, use a cooling fan or air conditioner to keep the temperature of the inlet air below 45°C. Failure to comply will shorten the service life of the servo drive or lead to overheat or fire. • Install the drive on the surface of an incombustible object and leave sufficient surrounding space for heat dissipation. • Take measures to prevent the servo drive from being frozen.
Environment humidity	Below 90% RH (no condensation)
Storage humidity	Below 90% RH (no condensation)

Item	Requirement	
Vibration	Below 4.9 m/s ² • Vibration condition during package transportation: vibration must comply with IEC60721-3-2:1997 Class 2M3 • Vibration condition during operation: vibration must comply with IEC60721-3-3:2019 Class 3M2 • For installation with the package removed: compliant with ISTA 1H	
	Item	Test Condition
	Vibration test Test according to IEC 60068-2-6 (Fc) (sine waveform)	5 Hz to 8.4 Hz, 3.5 mm deviation vibration amplitude
		8.4 Hz to 200 Hz, 1g acceleration vibration amplitude
		10 frequency cycles per axis
Shock	< 19.6 m/s ² The permissible impact must comply with IEC 60721-3-3:2002 Level 3M2.	
	Item	Test Condition
	Shock test Test according to IEC 60068-2-27 Ea (semi-sine waveform)	5 g acceleration peak value
		30 ms duration
		Three impacts on all three axes in both directions
IP rating	IP20	
Environment	Pollution Degree 2 and below Install the servo drive in a place that meets the following requirements: • Free from direct sunlight and rain. • Free from corrosive matters like hydrogen sulfide, sulphurous acid, chlorine and chlorination, ammonia gas, acid, alkali, and salt, and combustible gases, combustible materials, and radioactive materials. • Free from vibration. Keep the drive away from punch presses. • Free from cutting fluid, oil mist, iron powder, and iron chip. • Free from risk of ingress of unwanted objects such as metal powder, conductive filaments, oil, and water in the servo drive. • Away from combustible materials such as wood. • Do not use it in the vacuum environment. It is recommended to use it in air pressure above 89.9 kPa (altitude 1000 m). • Convenient for inspection and cleaning.	

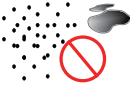
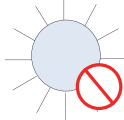
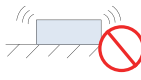
 Dust, oil dirt	 Direct sunlight	 Strong vibration Vibration ≤ 0.6 g
 High temperature and humidity Operating ambient temperature must be kept between 0°C–55°C	 Combustible, explosive and corrosive gas	 Combustible material Do not mount the drive on the surface of any flammable object

Figure 3-2 Environment requirements

3.4 Installation Clearance



To prevent condensation and conductive objects from affecting the functions and performance of the drive, install the drive into an IP54 control cabinet compliant with EN60529. If you can ensure that there is no condensation or conductive objects on the installation site, use a control cabinet with lower protection rating.

Servo drives in different power classes require different installation clearances. It is recommended to reserve a clearance of at least 10 mm (0.39 in.) between two drives, and a horizontal clearance of at least 20 mm (0.79 in.) and a vertical clearance of 50 mm (1.97 in.) between the drive and cabinet for heat dissipation.

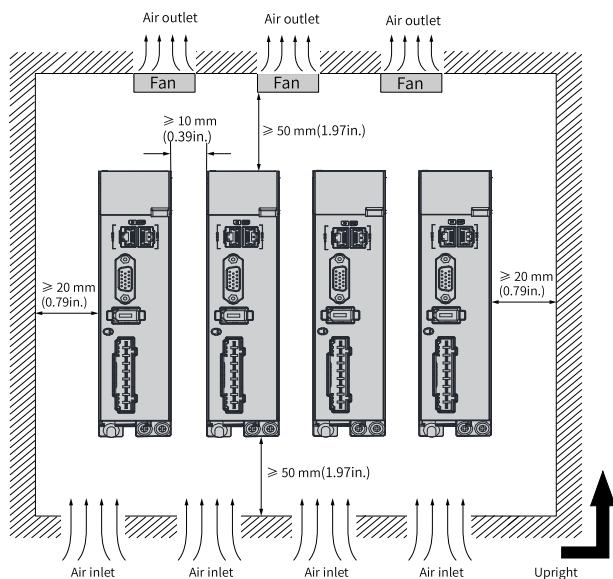


Figure 3-3 Clearance for side-by-side installation

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

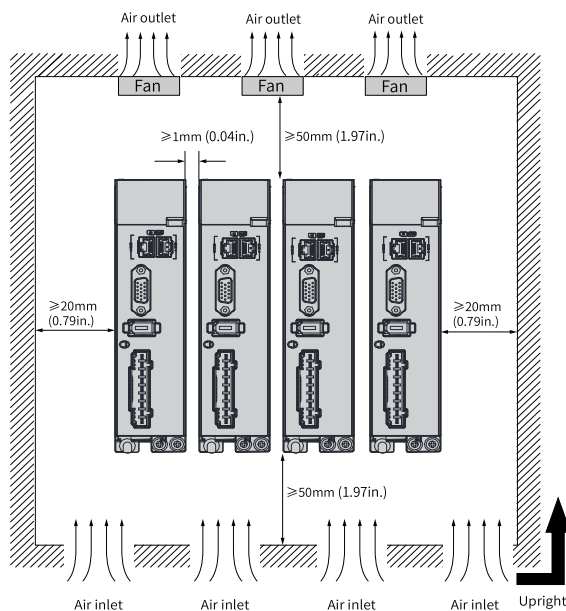


Figure 3-4 Clearance for compact installation

Servo drives in sizes C and D (rated power: 1.0 kW to 3.0 kW) support zero-clearance installation between every two servo drives, without the need for derating.

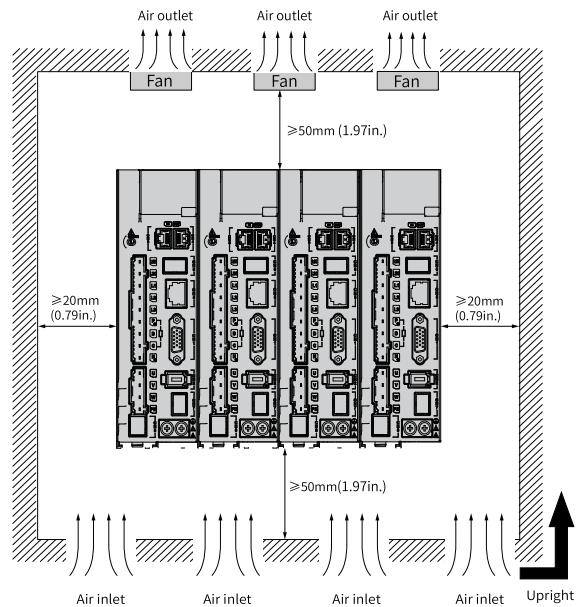


Figure 3-5 Zero-clearance installation

Note

Air volume of cooling fan > $n \times 5$ cfm. Air inlet area > $n \times 1580\text{mm}^2$ n is the number of parallel drives.

3.5 Installation Dimensions

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

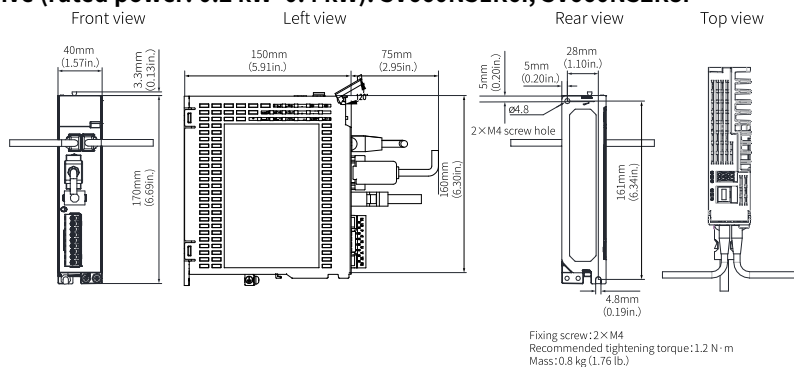


Figure 3-6 Dimensions of Size A

Size B drive (rated power: 0.75 kW): SV660NS5R5I

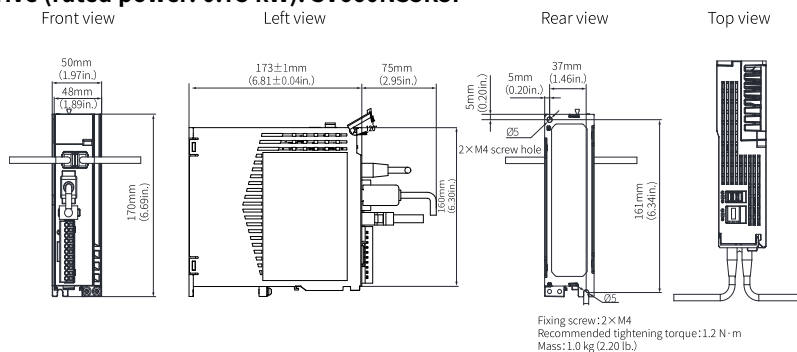


Figure 3-7 Dimensions of Size B

Size C drive (rated power: 1.0 kW–1.5 kW): SV660NS7R6I, SV660NT3R5I, SV660NT5R4I

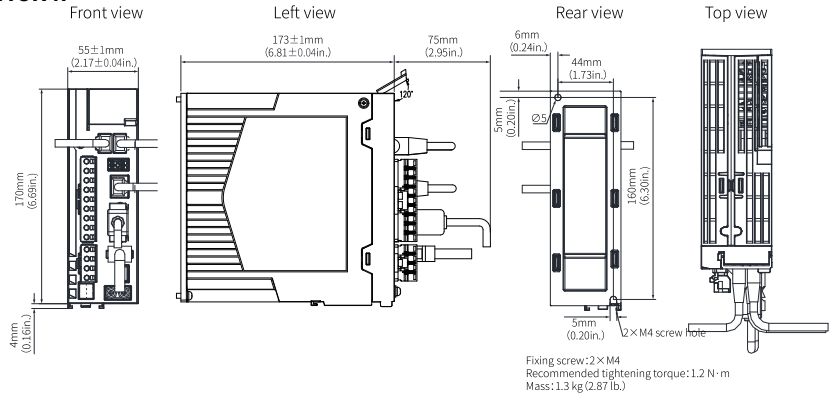


Figure 3-8 Dimensions of Size C

Size D drive (rated power: 1.5 kW–3.0 kW): SV660NS012I, SV660NT8R4I, SV660NT012I

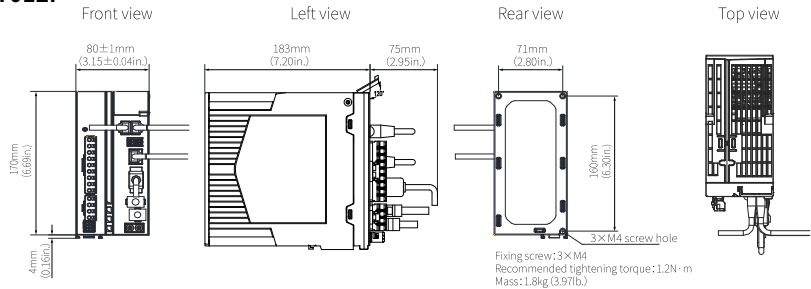


Figure 3-9 Dimensions of Size D

Size E drive (rated power: 5.0 kW–7.5 kW): SV660NT017I, SV660NT021I, SV660NT026I

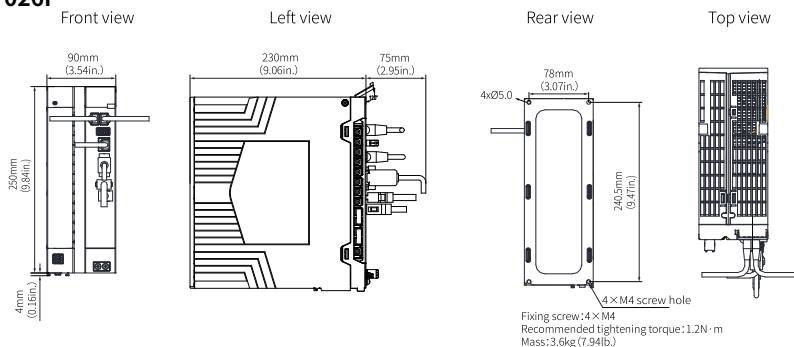
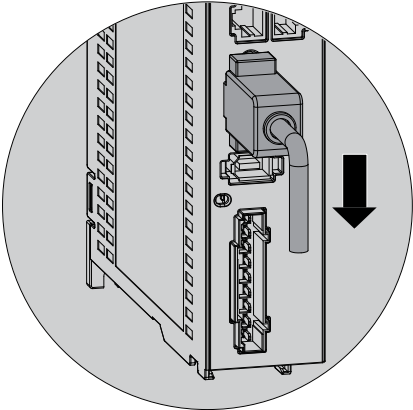
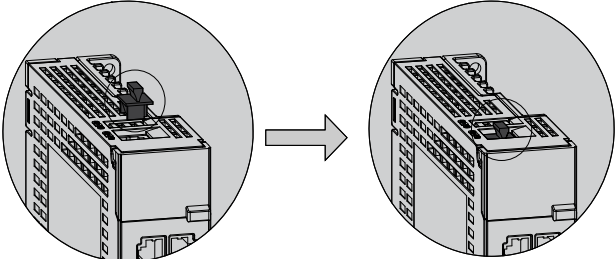


Figure 3-10 Dimensions of Size E

Table 3-3 Installation Precautions

Item	Description
Installation Method	• Install the servo drive vertically and upward to facilitate heat dissipation. For installation of multiple servo drives inside the cabinet, install them side by side. For dual-row installation, install an air guide plate. • Make sure the servo drive is installed vertically to the wall. Cool the servo drive down with natural convection or a cooling fan. Secure the servo drive to the mounting surface through two to four mounting holes (the number of mounting holes depends on the capacity of the servo drive). • Install the servo drive vertically to the wall, with its front (actual mounting face) facing the operator. • The mounting bracket (if needed) must be made of incombustible materials.
Cooling	As shown in "3.5 Installation Dimensions" on page 46 , reserve sufficient space around the servo drive to ensure a good heat dissipation through the cooling fan or natural convection. Take the heat dissipated by other devices inside the cabinet into consideration. Install a cooling fan to the upper part of the servo drive to avoid excessive temperature rise in a certain area, keeping an even temperature inside the control cabinet.
Grounding	Ground the grounding terminal properly. Failure to comply may result in electric shock or malfunction due to interference.

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

3.6 Installation Instructions

The servo drive supports backplate mounting only.

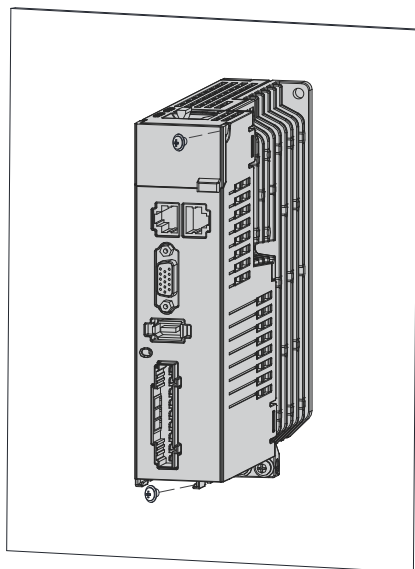


Figure 3-11 Backplate mounting

Note

- Servo drives in Sizes A and C are secured by two screws, with one screw on the top and the other one at the bottom.
 - Servo drives in Size D are secured by three screws, with two screws on the top and another one at the bottom.
 - Servo drives in Size E are secured by four screws, with two screws on the top and the other two at the bottom.
 - M4 screw, tightening torque: $1.2 \text{ N} \cdot \text{m}$
-

4 Wiring

4.1 Rules



Caution

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

- Do not use the power from IT system for the servo drive. Use the power from TN/TT system for the drive. Failure to comply may result in an electric shock.
 - Connect an electromagnetic contactor between the input power supply and the main circuit power supply of the drive (L1, L2 for single-phase; L1, L2, L3/R, S, T for three-phase) to form a structure allowing independent power cutoff on the power supply side of the drive. This is to prevent fire accident caused by continuous high current generated upon fault.
 - Check that the input power supply of the drive is within the specified voltage range. Failure to comply may result in faults.
 - Do not connect the output terminals U, V, and W of the drive to a three-phase power supply. Failure to comply may result in physical injury or a fire.
 - Do not connect the motor terminals U, V, and W to a mains power supply. Failure to comply may result in physical injury or a fire.
 - Use the ALM (fault) signal to cut off the main circuit power supply. A faulty braking transistor may overheat the braking 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.
-



Caution

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

- Locations with radioactive rays

4.2 Main Circuit Cable Requirements

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

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

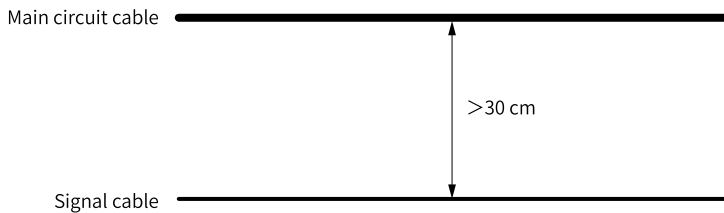


Figure 4-1 Cable layout

Wiring requirements

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

- Terminals P ⊕ , C, and N ⊖ are used to connect optional parts. Do not connect these terminals to an AC power supply.
- To protect the main circuit, separate and cover the surface that may come into contact with the main circuit.
- Prevent foreign matters from entering the wiring part of the terminal block.
- Do not solder the twisted conductors.
- The tightening torque may vary with terminals. Tighten terminal screws with the specified tightening torque. You can use the torque screwdriver, ratchet, or wrench.
- When using an electric screwdriver to tighten terminal screws, set a low speed to prevent damage to the terminal screws.
- Tighten the terminal screws with an angle not higher than 5°. Failure to comply may damage the terminal screws.

4.3 CN6 STO Safety Terminal

Note

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

Terminal Arrangement

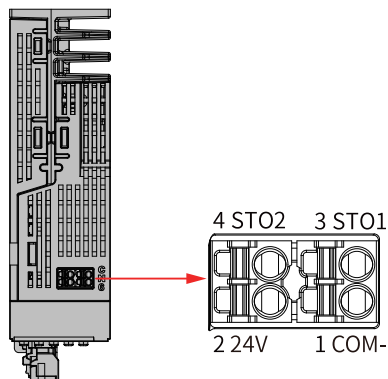


Table 4-1 Pin assignment

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

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

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

Description

- **Electrical specifications and connection of the input circuit**

This section describes the characteristics of the input signals assigned to the CN6 connectors.

- **Specifications**

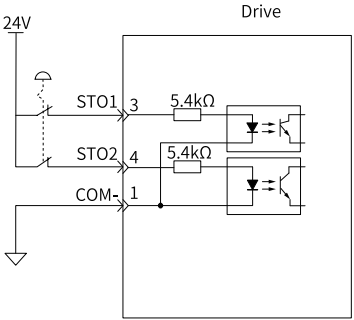
The servo drive operates normally only when the input states of STO1 and STO2 are both "High" ("1" or "H").

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

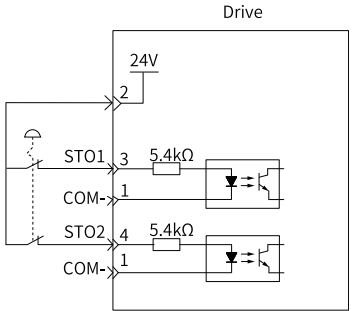
- Electrical characteristics of Safety Request Input Signal are as follows:

Item	Characteristics	Description
Voltage range	24 VDC ($\pm 15\%$)	-
Input current	3.6 mA (Typ.)	The input current of STO1 and STO2.
Standards of logic levels	"0" < 5 V, "1" > 15 V	-
Digital input impedance	5.4k Ω	-

- External 24 V

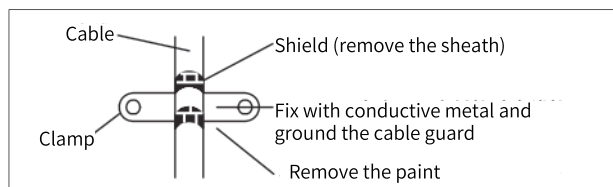


- Internal 24 V



● EMC requirements

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



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

● Other requirements

- All wiring must be well protected, routed and clamped where practicable.
- It must be assured that there is no pulling or pinching on the cable when installing.
- For cabling the DI inputs of the STO, to avoid common cause failure in the cables, the two channels must be routed through two well-apart routes, or the cable must be protected with double-shielded methods.

Cable	Description
Category	Low voltage, double-shielded or single-shielded twisted multi-pair cable
Maximum size	0.8 mm ² (18 AWG)
Minimum size	0.3 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 (kW)	Structure	W×H×D (mm ³)
A	0.2 to 0.4	Integrated structure	40 x 170 x 150
B	0.75	Integrated structure	50 x 170 x 173
C	1 to 1.5	Split-type structure	55 x 170 x 173
D	1.5 to 3	Split-type structure	80 x 170 x 183
E	5 to 7.5	Split-type structure	90 x 250 x 230

5 Operating Panel

5.1 Panel Components

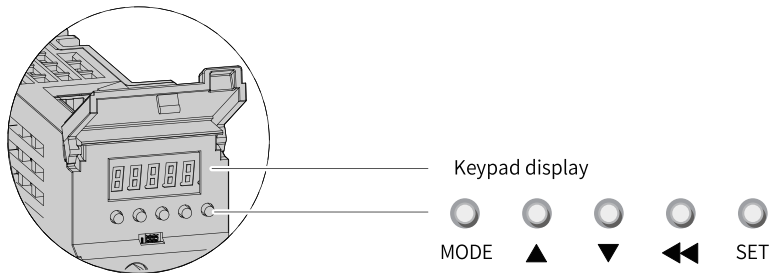


Figure 5-1 Magnified view of the operating panel

The operating panel of the SV660N series servo drive consists of an LED display (5-digit, 8-segment) and five keys. The operating panel is used for value display, parameter setting, user password setting, and general function execution. The following table takes parameter setting as an example to describe the general functions of the keys.

Table 5-1 General functions of keys

Name	Diagram	Description
MODE		Switches among different modes. Returns to the previous menu.
UP		Increases the value of the blinking digit for the LED.
DOWN		Decreases the value of the blinking digit for the LED.
SHIFT		Shifts the blinking digit for the LED. You can view the high digits of the number consisting of more than 5 digits.
SET		Switches to the lower-level menu. Executes commands such as saving parameter settings.

5.2 Panel Display

Table 5-2 Physical numbers of the displayed content

Display	Equiva lent	Display	Equiva lent	Display	Equiva lent	Display	Equiva lent
0	0	9	9	h	h	r	r
1	1	A	A	c	c	t	t
2	2	b	B	J	J	U	U
3	3	C	C	L	L	y	y
4	4	d	D	n	n	r	T
5	5	E	E	N	N	u	u
6	6	F	F	o	o	-	-
7	7	H	H	P	P	-	-
8	8	G	G	q	q	-	-

The operating panel can display the running status, parameter, faults, and monitoring information during running of the servo drive.

- Status display: Displays current servo drive status, such as servo ready or servo running.
- Parameter display: Displays parameters and their setpoints
- Fault display: Displays faults and alarms that occurred on the servo drive.
- Monitored value display: Displays values of monitoring parameters.

Transition relation between the panel display and the operation object of the host controller

The mapping relation between the parameter displayed on the keypad (in decimal) and the object dictionary operated by the host controller (in hexadecimal, "Index" and "Sub-index") is as follows.

Object dictionary index = 0x2000 + Parameter group number

Object dictionary sub-index = Hexadecimal offset within the parameter group + 1 For example:

Panel Display	Object dictionary operated by the host controller
H02.15	2002-10h

Note

The following section only describes the display and parameter settings on the keypad side (in decimal), which are different from those displayed in the software tool (in hexadecimal). Make necessary value conversions during use.

Display mode switchover

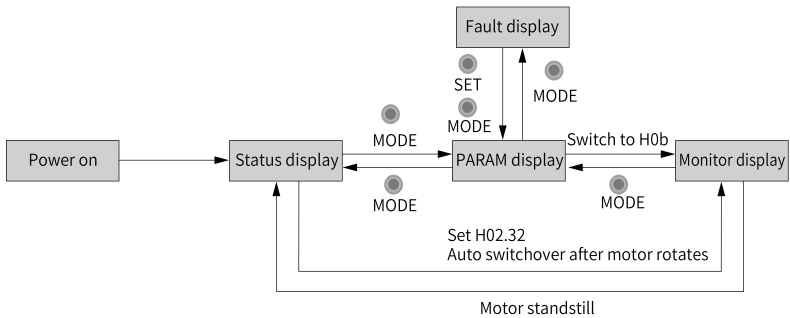
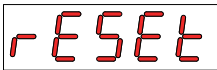


Figure 5-2 Switchover among different display modes

- The keypad enters status display immediately upon power-on.
- Press MODE to switch among different display modes based on the conditions shown in "Figure 5-2 " on page 59 .
- In status display, set H02.32 to select the parameter to be monitored. When the motor rotates, the keypad automatically switches to monitored value display. After the motor stops, the keypad automatically returns to status display.
- In the parameter display mode, after you select the parameter to be monitored in group H0b, the keypad switches to monitored value display.

- Once a fault occurs, the keypad switches to fault display immediately, with all the five LEDs blinking. Press SET to stop the LEDs from blinking, and then press MODE to switch to parameter display.

Status display

Display	Name	Applicable Occasion	Meaning
	reset Servo drive initializing	Upon power-on	The servo drive is in the initialization or reset status. After initialization or reset is done, the servo drive automatically switches to other status.
	nr Servo not ready	Initialization done, but servo drive not ready.	The servo drive cannot run as the main circuit is not powered on.
	nr.x ^[1] Servo not ready		Meaning of "x" For specific reasons and troubleshooting methods, see "Table 5-3 Cause and troubleshooting" on page 62. • 1: Control power (L1C, L2C) undervoltage • 2: Main circuit power input error • 3: Bus undervoltage • 4: Pre-charge resistor not bypassed • 5: Encoder initialization not done • 6: Short-circuited to ground detection not done • 7: Other uncompleted initialization items exist
	ry Servo ready	Servo drive ready	The servo drive is ready to run and waits for the enabling signal from the host controller.
	rn Servo running	Servo ON (S-ON) signal activated (S-ON signal switched on)	The servo drive is running.

Display	Name	Applicable Occasion	Meaning
	1-A: Control modes	-	Displays present operation mode of the servo drive in hexadecimal digits. 1: Profile position control 3: Profile velocity mode 4: Profile torque mode 6: Homing mode 8: Cyclic synchronous position mode 9: Cyclic synchronous velocity mode A: Cyclic synchronous torque mode
	1-8: communication statuses	-	Displays the status of the slave EtherCAT state machine in characters. 1: Initialization 2: Pre-operational 4: Safe-operational 8: Running
	- CN4 connection indication	EtherCAT output connected successfully	OFF: no communication connection is detected in the physical layer. ON: communication connection is detected in the physical layer.
	- CN3 connection indication	EtherCAT input connected successfully	
	STO STO function display selection	-	Check if the 24V input for the STO terminal is disconnected.

Note

[1] Only -NS models can display nr.x.

Table 5-3 Cause and troubleshooting

nr.x	Cause	Troubleshooting
nr.1	The control voltage H0b.57 is less than the undervoltage threshold H01.78 (the input 220V threshold is 190V, and the input 380V threshold is 380V).	1. Measure if the L1C and L2C inputs meet the input specifications. 2. If yes, read H0b.57. If H0b.57 is close to 0, the hardware circuit may be damaged.
nr.2	L1–L3 input is abnormal.	1. Use a multimeter to check whether there is voltage input in L1–L3. 2. Use an oscilloscope to test L1–L3 inputs for phase loss.
nr.3	The bus voltage H0b.26 is less than the undervoltage threshold H01.42 (the input 220V threshold is about 200V, and the input 380V threshold is about 380V).	1. Check if input L1-L3 meet the input specifications. 2. If yes, and H0b.26 is close to 0, the hardware circuit may be damaged.
nr.4	Servo soft start resistor not bypassed.	Check if bus voltage H0b.26 is in the normal range (input 220V: 235V–378V, input 380V: 451V–689V).
nr.5	Encoder initialization not done.	Contact Inovance.
nr.6	Short-circuit to ground detection not done.	Check the value of H0b-57.
nr.7	There are other uncompleted initialization items.	Check whether there are other uncompleted initialization items, such as the safety board initialization.

Parameter Display

Parameters are divided into 14 groups based on their functions. A parameter can be located quickly based on the parameter group it belongs to. For details on parameters, See section Description of Parameters.

- Display of parameter groups

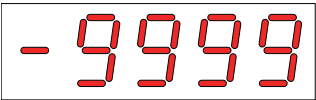
Display	Name	Description
HXX.YY	Parameter group	XX: Parameter group No. (Hexadecimal) YY: Offset within the parameter group (decimal)

For example, "H02.00" is displayed as follows.

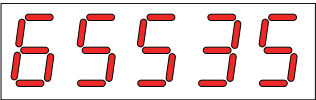
Display	Name	Description
	H02.00	02: Parameter group No. 00: Offset within the parameter group

- Display of negative numbers and numbers with different lengths
 - Signed number with 4 digits and below or unsigned number with 5 digits and below
Such numbers are displayed in a single page (five digits). For signed numbers, the highest bit "-" represents the negative symbol.

For example, "-9999" is displayed as follows:



For example, "65535" is displayed as follows:



- Signed number with more than 4 digits or unsigned number with more than 5 digits
Such numbers are displayed from low to high bits in several pages (5 digits per page): current page + values on current page, as shown in the following figure. Hold down SHIFT for more than 2s to switch to the next page.

For example, "-1073741824" is displayed as follows:

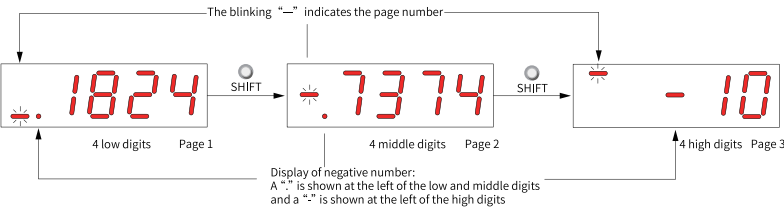


Figure 5-3 Display of "-1073741824"

Example: "1073741824" is displayed as follows:

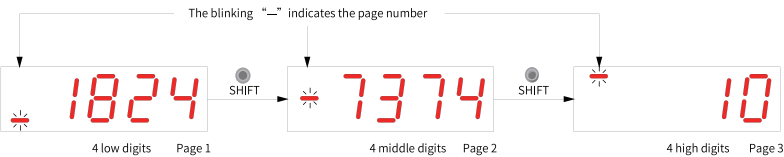


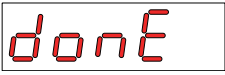
Figure 5-4 Display of "1073741824"

- Display of the decimal point

The segment "." of the ones indicates the decimal point, which does not blink.

Display	Name	Description
	Decimal point	100.0

- Display of parameter setting status

Display	Name	Applicable Occasion	Meaning
	Done Parameter setting completed	The parameter is set successfully.	The parameter is set and saved to the servo drive (Done). The servo drive can execute other operations.
	F.InIt (Restored to default settings)	Parameter initialization is in progress (H02.31 = 1).	The servo drive is in the process of parameter initialization. After parameter initialization is done, switch on the control power supply again.
	Error (wrong password)	The user password (H02.30) is activated and the password entered is wrong.	A wrong password is entered. You need to enter the password again.
	TunE	Auto-tuning with one-key enabled	The function of auto-tuning with one-key is in progress.
	FAIL	Auto-tuning with one-key enabled	The function of auto-tuning with one-key fails.

Fault Display

- The panel displays the active or history faults and warning codes. For troubleshooting, see the Troubleshooting Guide.
- When a fault or alarm occurs, the operating panel displays the corresponding fault or alarm code immediately. When multiple faults or errors occur, the keypad displays the fault or error code of the highest fault level.
- You can select the previous fault/alarm to be viewed through H0b.33 and view the code of the selected fault/alarm in H0b.34.

- You can clear the latest 10 faults or alarms saved in the servo drive by setting H02.31 to 2.

For example, "E941.0" is displayed as following:

Display	Name	Description
	E941.0 Alarm code	E: A fault or alarm occurs on the servo drive. 941.0: Alarm code

Note

- If the panel displays Hault/Fault, a system fault has occurred.
- The possible causes include bugs of the program, external interference like static electricity or electromagnetic interference, extreme operating temperature or radiation.
- In this case, record the values of H16.00–H16.19, and consult with our R&D engineers.

Monitored value display

- H0b (200b) parameters monitor the operating state of the servo drive. The keypad monitoring display function can be enabled by setting H02.32 (2002.21h). The parameter group number displayed is H0b (200b) and the group offset is the value of H02.32 (2002.21h).
- When the valid offset is set in H02.32, the keypad enters the "state display" mode if the motor was in the static state, or the "parameter display" mode if the motor was in the rotating state. Mode switchover is not related to whether the servo drive is enabled.
V09XXX software version: The motor is in the static state when the speed feedback is 0; otherwise, the motor is in the rotating state.

V102XX software version: The motor is in the static state when the zero speed signal is active (speed feedback < threshold 606Fh and duration 6070h). Otherwise, the motor is in the rotating state.

- For example, if you set H02.32 (2002.21h) to 00 and the motor changes from the static state to the rotating state, the keypad switches from the "state display" mode to "parameter display" mode and displays the value of H0b.00 (200b.00h).

The following table describes the monitoring parameters in H0b.00.

Parameter	Name	Unit	Meaning	Example
H0b.00	Motor speed actual value	rpm	Displays the actual value of the motor speed after round-off, which can be accurate to 1 rpm.	Display of 3000 rpm:  -3000 rpm: 

5.3 Parameter Settings

Example of parameter settings

You can set parameters through the keypad. For details on parameters, see section Description of Parameters. The following figure shows how to switch from position control mode to speed control mode using the keypad after power-on.

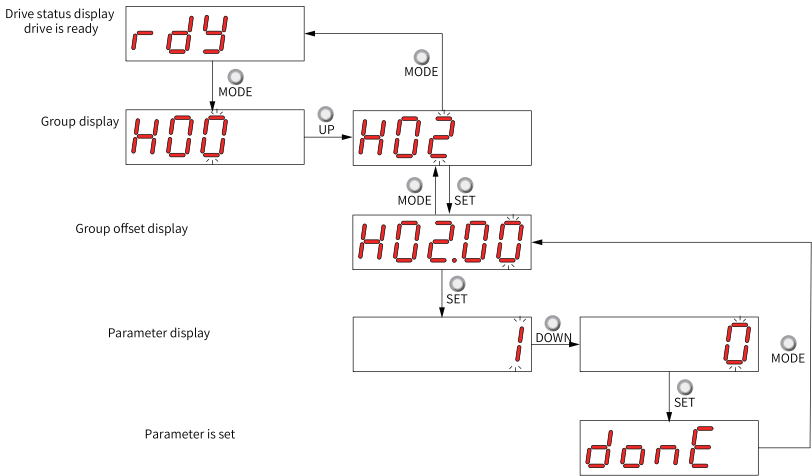


Figure 5-5 Example of parameter setting

- **MODE:** Used to switch the keypad display mode and return to the previous interface.
- **UP/DOWN:** Used to increase or decrease the value of the blinking digit.
- **SHIFT:** Used to shift the blinking digit.
- **SET:** Used to save the present setpoint or switch to the next interface.

After parameter setting is done, that is, "donE" is displayed on the keypad, press MODE to return to the parameter group interface (interface of "H02.00").

Forced DI/DO signals

There are five DI and 3 DO signals on the CN1 terminal.

Users can allocate the DI/DO function and terminal logic to parameters in group H03/H04 by using the keypad (or host controller communication), so that the host controller can control corresponding servo functions through the DI or use the DO signal output by the servo drive.

The servo drive also provides forced DI/DO functions. The forced DIs can be used to test the DI functions of the servo drive, and the forced DOs can be used to check the DO signal connection between the host controller and the servo drive.

- **Forced DI signal input**

After this function is enabled, all DI signal levels are controlled by the forced DI setting (H0d.18), independent of external DI signal status.

- **Steps:**

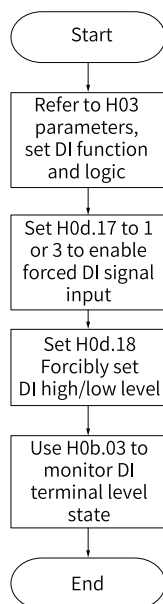


Figure 5-6 Procedure for setting forced DI function

Set the DI logic through parameters in group H03. H0d.18 is used to set the DI forced input, which is displayed in hexadecimal on the keypad. H0b.03 is used to monitor the DI terminal level state.

- **Example:**

As shown in the figure below, when the terminal logic is set to active low by H03, assume that the function of terminal DI1 is effective, while the functions of terminals DI2 to DI5 are ineffective. Since the binary number "11110" is "1E" in hexadecimal, the value of H0d.18 can be set to "1E". At this point, the keypad displays that the DI1 terminal is in low level, while terminals DI2 to DI5 are in high level. If the DI function

is normal, and the display value of H0b.03 is the same as the value of H0d.18, the value of H0b.03 read by InoDriverShop is 30 in decimal.

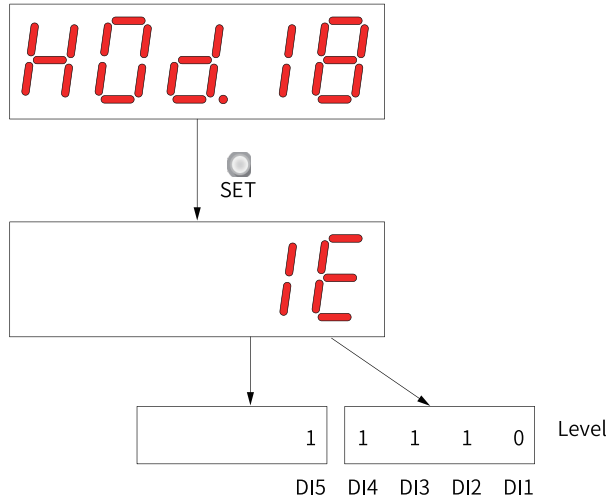


Figure 5-7 Meaning of the H0d.18 setpoint

Monitoring the DI level status through H0b.03. Display on the operating panel:

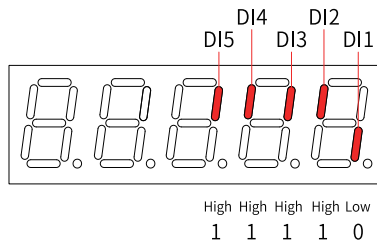


Figure 5-8 DI level status corresponding to H0b.03

Note

Upper LED segments ON: high level (indicated by "1") Lower LED segments ON: low level (indicated by "0")

- Exit
The forced DI signal function is not retentive upon power-off. Normal DIs apply after restart, or you can set H0d.17 to 0 (No operation) to return to the normal DI mode.
- Forced DO function

After this function is enabled, all DO signal levels are controlled by H0d.19 (Forced DO value), regardless of the internal DO status of the servo drive.



If the motor is used in vertical motion, when the brake output signal is set to Enabled, the brake will open and the load may fall. Take protective measures on the machine to prevent the risk of falling.

■ Operating process

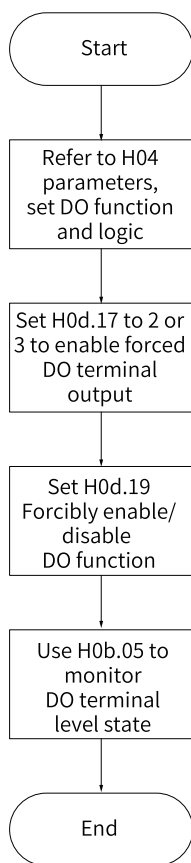


Figure 5-9 Procedure for setting forced DO function

Set the DO logic through parameters in group H04. H0d.19 is used to set the DO forced output, which is displayed in hexadecimal on the keypad. H0b.05 is used to monitor the DO terminal level state.

■ Example:

As shown in the figure below, when the DO function level logic is set to active high by H04, the functions of terminals DO2–DO3 are effective, while the functions of terminal DO1 are ineffective. Since the binary number "110" is "6" in hexadecimal, the value of H0d.19 can be set to "6". At this point, the keypad displays terminals DO2–DO3 as high level, while terminal DO1 as low level. If the DO function is normal, and the value read from H0b.05 is the same as the value of H0d.19, the value of H0b.05 read by InoDriverShop is 6 in decimal.

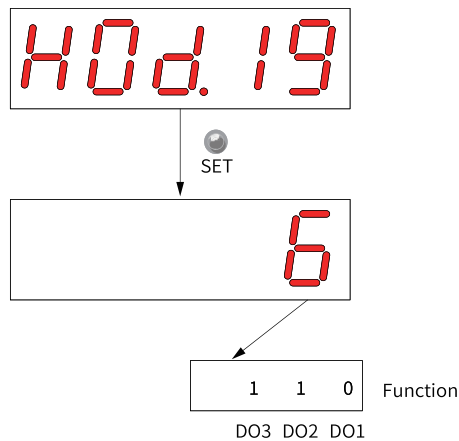


Figure 5-10 Meaning of the H0d.19 setpoint

Monitoring the DO level status through H0b.05. Display on the operating panel:

If the logic of all the three DO terminals are "active high", the DO1 terminal is low level and DO2 to DO3 terminals are high level, and the corresponding binary number is "110". In this case, the value of H0b.05 (Monitored DO signal) read by the software tool is 6 (decimal). Display on the operating panel:

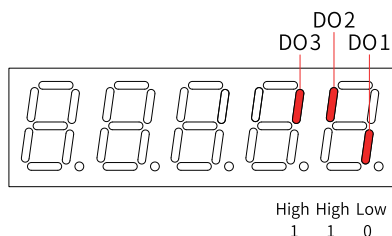


Figure 5-11 Display H0b.05 when all DO are "active high"

- Exit

The forced DO signal function is not retentive upon power-off. Normal DOs apply after restart, or you can set H0d.17 to 0 (No operation) to return to the normal DO mode.

- Forced EtherCAT DO

After this function is enabled, all DO signal levels are controlled by 60FE.01h (Physical output) and are unrelated to the internal DO signal status.

If the motor is used in vertical motion, when the brake output signal is set to Enabled, the brake will open and the load may fall. Take protective measures on the machine to prevent the risk of falling.

- Operating process

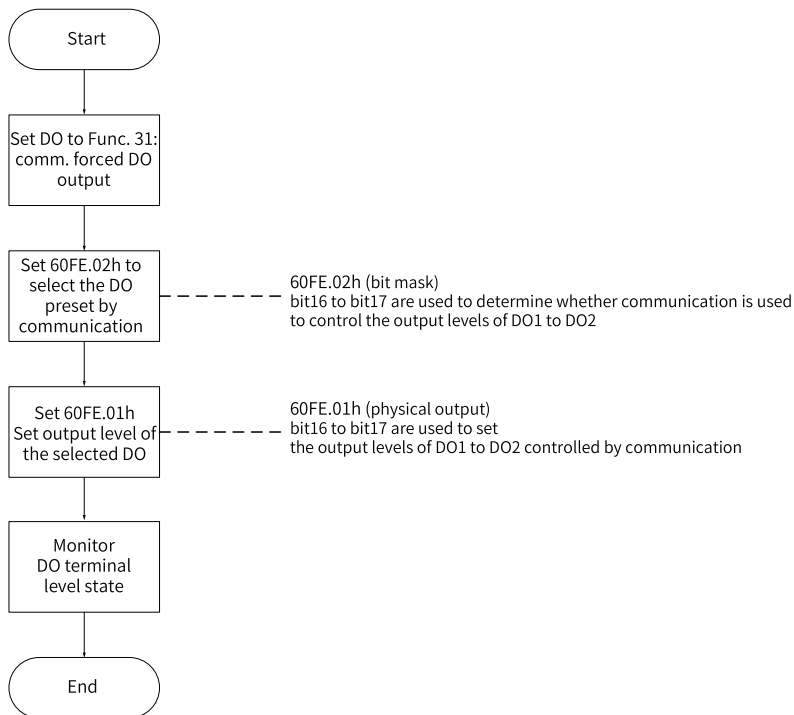


Figure 5-12 Procedure for setting EtherCAT forced DO

When H0d.17 is set to 4, 60FE (Digital output) can be used to forcibly set the DO terminal level through EtherCAT communication, regardless of the internal DO status of the drive.

bit	Related DO	Output mask: 60FE.02h	Physical output: 60FE.01h
16	DO1	1: DO1 forced output enabled	DO1 forced output (0: OFF, 1: ON)
17	DO2	1: DO2 forced output enabled	DO2 forced output (0: OFF, 1: ON)
18	DO3	1: DO3 forced output enabled	DO3 forced output (0: OFF, 1: ON)

When H0d.17 is set to 4 and any bit among bit16...bit18 of 60FE.02h is set to 1, the corresponding forced DO is OFF.

H0b.05 is used to monitor the DO level status. The keypad displays the level, and the value of H0b.05 (monitored DO signal) read in the software tool is hexadecimal.

Example: To make the output levels of DO1...DO3 be forcibly set by the bus, in which DO1 outputs low level and DO2 to DO3 output high level, set as follows:

Set H0d.17 to 4, 60FE.02h to 0x00070000, and 60FE.01h to 0x00060000. Monitor the DO level status through H0b.05 (Monitored DO signal). The keypad displays as follows.

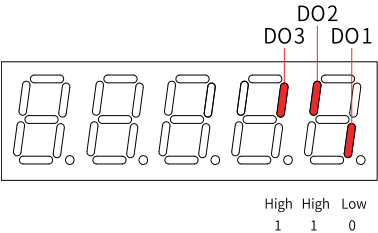


Figure 5-13 Display of H0b.05 when DO signals are controlled by EtherCAT

- Exit
The forced DO output is not retentive upon power-off. Normal DO functions are restored after restart, or you can set H0d.17 (200d.12h) to 0 to return to the normal DO mode.

User password

After the user password (H02.30) is activated, only authorized operators can set parameters.

Set bit5 of H0A. 71 to 1. After setting the user password, you can't view and change the parameters after H02 group through the panel and Inovance servo commissioning platform.

- Setting the user password
The following figure shows how to set the user password to "00001".

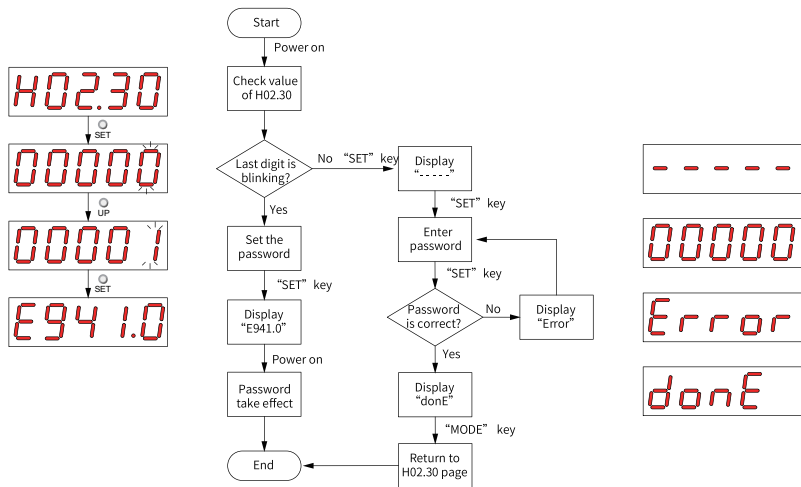


Figure 5-14 Procedure for setting the user password

To change the user password, input current password first to authorize the access to parameter setting. Next, enter H02.30 again to set a new password based on the procedure shown in the preceding figure.

Note

If the last bit does not blink, the access to parameters is password protected. If the last bit blinks, password is not needed or the password entered is correct.

- Canceling the user password
Enter the set user password, and set H02.30 to "00000" to cancel the user password.

6 STO

6.1 Overview

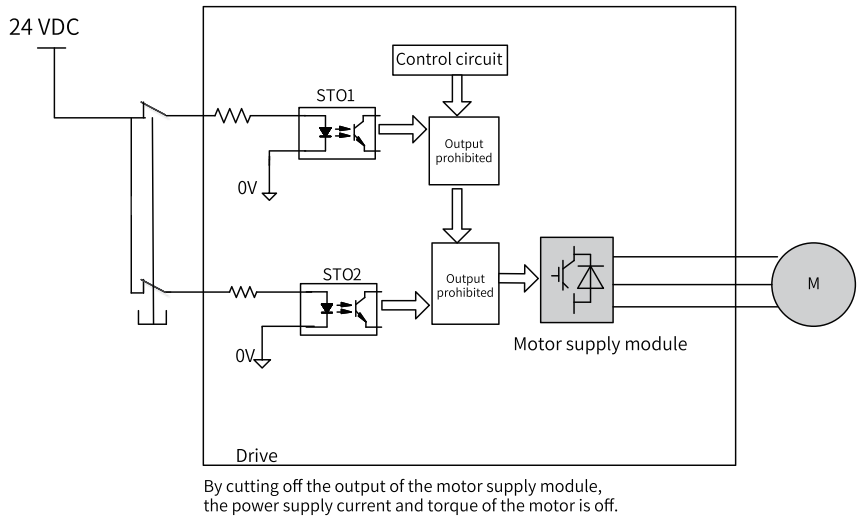


Figure 6-1 Schematics of the STO function

Safe Torque Off (STO) is a safety function that complies with IEC 61800-5-2:2016. It is built into Inovance SV680 series servo drives.

The STO function inhibits the control signal of the power semiconductors on the drive output end, preventing the drive from generating torque at the motor shaft end.

The STO function prevents movement of the motor by two redundant external hardware signals (STO1 and STO2) that block the PWM signals from being outputted to the power layer of the servo drive. STO1 and STO2 input signals must be both active to allow the servo drive to operate normally.

See the following table for the STO function.

STO1 Input	STO2 Input	PWM Signal
H	H	Normal
L	H	Prohibit
H	L	Prohibit
L	L	Prohibit

STO (safe torque)	
Description	Cuts off the power of the motor.
Description	The safe torque off (STO) function brings the machine safely into a no-torque state and prevents it from unexpected start. When the STO function is activated, the servo drive stops according to the preset stop mode (H02.08).
Safe state	Disables the PWM gating signal of the drive.
Operation mode	High demand mode or continuous mode

6.2 Function Use and Monitoring

Function Use

The keypad displays the STO function state and error information.

See the following table to identify the cause of a fault and the action to be taken. Contact Inovance technical support if the fault persists after corrective actions listed in the following table are taken.

Fault codes related to the STO function are listed in the following table:

Fault Code	state	Description	Cause	Corrective Action
E150.1	Status of STO1 and STO2 inconsistent	Only one of STO1 and STO2 is in "Low" state, status of STO1 and STO2 are inconsistent.	The input states of STO1 and STO2 are inconsistent.	1. Ensure the requests for disconnecting the voltage of STO1 and STO2 are triggered simultaneously. 2. The input circuit is abnormal and a certain STO input signal is still in the "H" state after the 24 V signal is disconnected. Contact Inovance for technical support.
E150.2	STO activated	OV/UV of the 5V power supply is detected.	OV/UV of the 5V power supply.	Restore the 5 V power supply to normal state. Contact Inovance for technical support.
E150.3	STO activated	The input circuit of STO works improperly.	The input circuit of STO works improperly.	Fix the input circuit fault. Contact Inovance for technical support.
E150.4	STO activated	The buffer circuit of STO works improperly.	The buffer circuit of STO works improperly.	Fix the buffer circuit fault. Contact Inovance for technical support.

Note

- For a motor with brake, if either STO1 or STO2 closes, the drive will be disabled within 30 ms (STO response time).
- For a motor without brake, if either STO1 or STO2 closes, the drive will be disabled within 5 ms (STO response time).

EDM DO signal

When STO1 and STO2 input 24V voltage are cut off, the EDM DO signal is active, otherwise the EDM DO signal is inactive.

At this time, STO1 and STO2 are filtered signals. When EDM is active, the servo drive blocks the PWM signal.

Signal Name	Mark	Photo coupler logic			
Safety input	STO1	ON	ON	OFF	OFF
	STO2	ON	OFF	ON	OFF
EDM output	EDM	OFF	OFF	OFF	ON

Note

The DO output of this EDM is only a monitoring signal to detect whether a safety function is triggered, not a safety signal output.

The EDM state of the integrated STO can only be output through the non-safe DO output of the drive, not through the DO output on the safety module.

EDM DO output wiring diagram

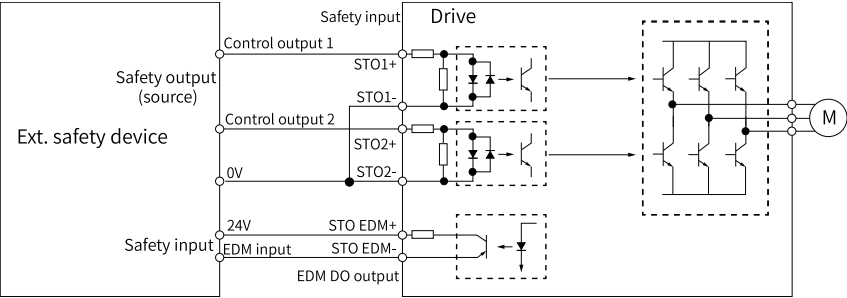


Figure 6-2 Wiring of external safety device to the drive (single axis)

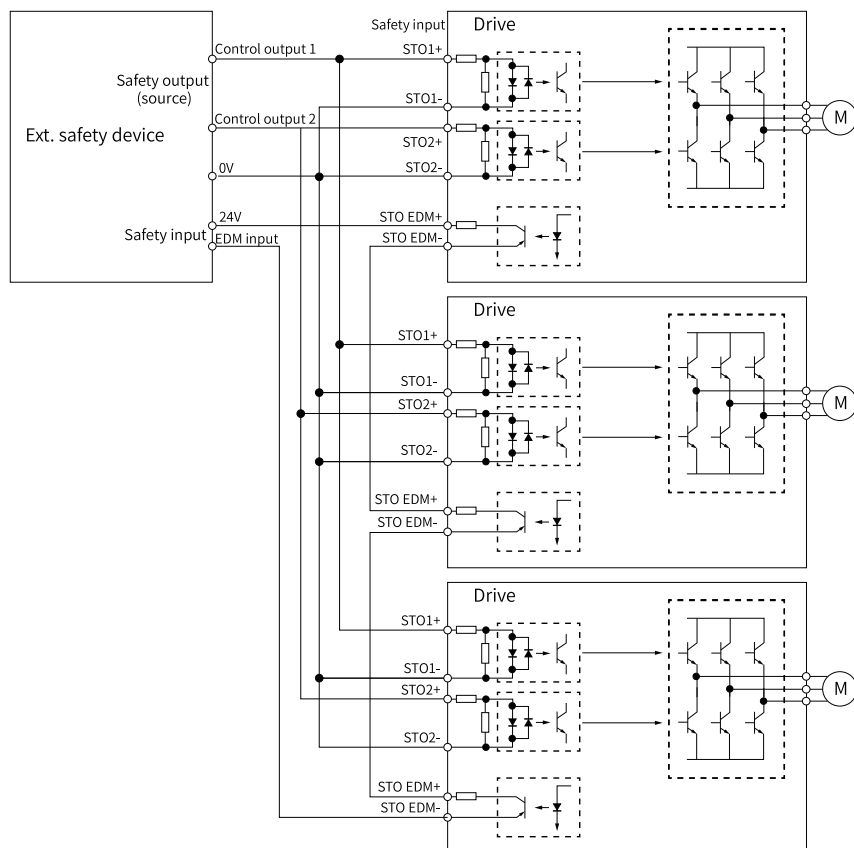
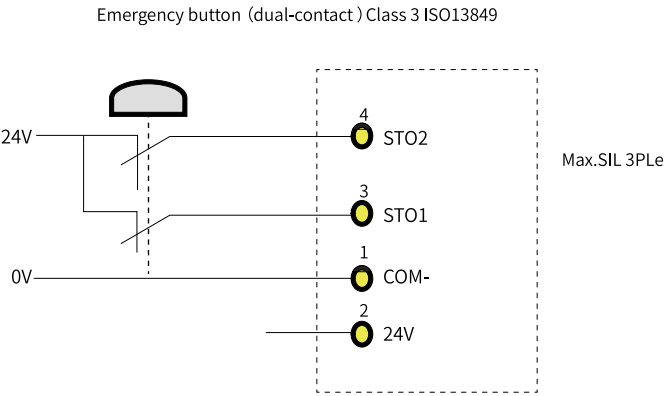


Figure 6-3 Wiring of external safety device to the drive (multi-axis)

Application Example of Safety Function

Example:



6.3 Fault reset

The exceptional operation refers to the durations of power-on and initialization, and how to return from the STO state.

- The PWM buffer is disabled as the enable terminal is pulled up during power-on, so the PWM signal is inhibited.
- The PWM buffer is disabled as the enable terminal is pulled up during initialization of the MCU, so the PWM signal is inhibited. Such condition is cleared and servo drive works normally after initialization is done.
- When all of the following conditions are met, the servo system that enters the safe state through the STO function can be back to normal with the safe state cleared after auto-reset of the drive.
 - The input state of the STO request must be "high".
 - The servo ON or servo RUN command must be inactive.
 - No dangerous faults exist.

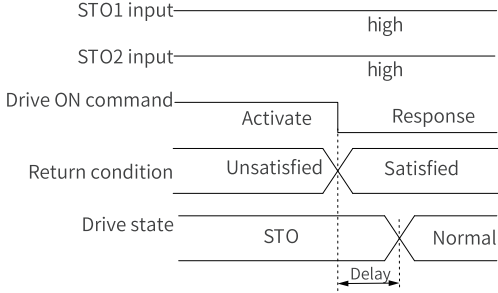


Figure 6-4 Return condition of servo ON/RUN command

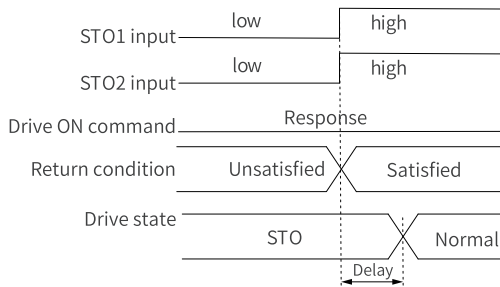


Figure 6-5 Return condition of external STO request state

- When STO_IN (STO1 or STO2 input) is restored to 24 V, the EDM and servo ready signals are immediately reset to 0. After 200 milliseconds, the servo operation signal is activated (when STO_IN keeps at 24 V). Servo operation is PWM drive signal output.

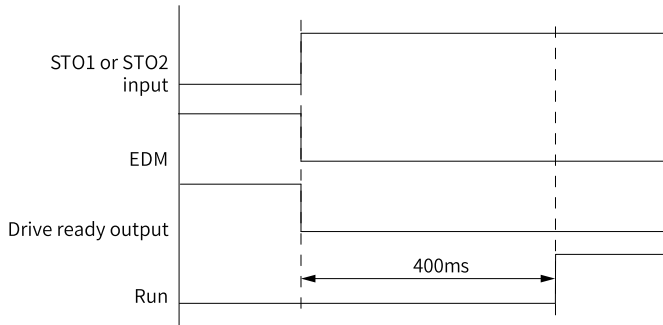
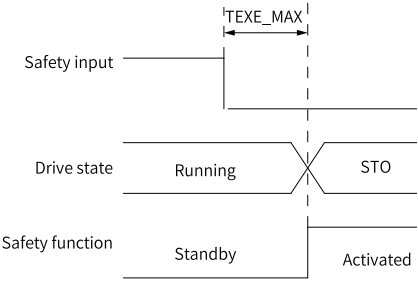


Figure 6-6 Servo drive reset timing diagram

6.4 Safety Function Response Time

STO function prevents the movement of the motor by two redundant external hardware signals: STO1 and STO2 that block the PWM signals to the power layer of the servo drive. STO1 and STO2 input signals must be both active to allow the servo drive to operate normally.

If either or both of them are at low level simultaneously, the PWM signal will be blocked in the next 30 ms.



7 Commissioning and Operation

7.1 Commissioning Flowchart

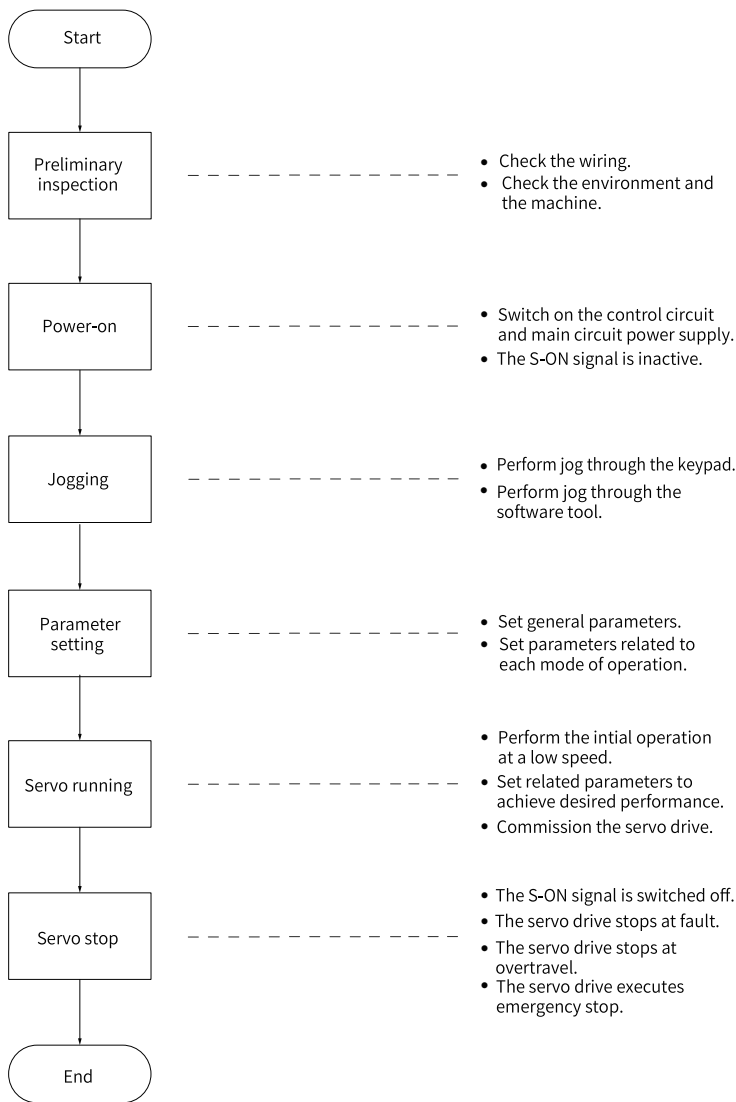


Figure 7-1 Commissioning flowchart of the drive

7.2 Commissioning Steps

See SV660N Series Servo Commissioning Guide.

7.3 Acceptance

Basic requirements

- Technical staff must be trained to understand the requirements and principles of designing and operating safety-related systems.
- Person performing the maintenance must be trained to understand the requirements and principles of designing and operating safety-related systems.
- Operators must be trained to understand the requirements and principles of designing and operating safety-related systems.
- The safety-related circuit on the control board that fails to operate must be replaced with a new one as it is not repairable.

Commissioning Checklist

- Start-up test and validation
IEC 61508, EN/IEC 62061 and EN ISO 13849 require the final assembler of the equipment to verify the operation of the safety function through acceptance testing. This acceptance test is described in the drive manual. The testing of optional safety features is described in the corresponding manuals.

The acceptance test must be performed:

- at initial start-up of the safety function
- After any changes related to safety functions (wiring, assembly, settings, or other related operations)
- after any maintenance work related to the safety function.

The acceptance test of the safety function must be carried out by an authorized person with expertise and knowledge of the safety function. The test must be documented and signed by the test staff.

Signed acceptance test reports must be stored in the logbook of the machine. The report shall include documentation of start-up activities and test results, fault reports, and troubleshooting records. Any new acceptance tests performed due to changes or maintenance need to be logged into the logbook.

- Checklist of integrated STO functions

Step	Action	Result
1	Ensure that the drive runs and stops freely during commissioning.	
2	Stop the drive (if running), switch the input power supply off and isolate the drive from the power line by a disconnecter.	

Step	Action	Result
3	Check the STO circuit connections against the circuit diagram.	
4	Check that the shield of the STO input cable is grounded to the drive frame.	
5	Close the disconnector and switch the power supply on.	
5.1	Test the STO signal #1 when the motor is stopped: Set STO1 and STO2 to H. Send a stop command to the drive (if running) and wait until the motor shaft is at standstill. Awake the STO function by de-energizing (low state or open-circuit) the STO input signal #1 and send a start command to the drive. Ensure that the motor stays at a standstill and the keypad of the drive displays "E150.1".	
5.2	Set STO1 to "H" and disable the ON/RUN command of the drive. Then, reset the drive automatically and enable ON/RUN command of the drive. Finally, check whether the motor runs normally.	
5.3	Test the STO signal #2 when the motor is stopped: Set STO1 and STO2 to H. Send a stop command to the drive (if running) and wait until the motor shaft is at standstill. Awake the STO function by de-energizing (low state or open-circuit) the STO input signal #2 and give a start command for the drive. Ensure that the motor stays at a standstill and the keypad of the drive displays "E150.1".	
5.4	Set STO2 to "H" and disable the ON/RUN command of the drive. Then, reset the drive automatically and enable ON/RUN command of the drive. Finally, check whether the motor runs normally.	
6.1	Test the STO channel 1 when the motor is running: Set STO1 and STO2 to H. Start the drive and ensure the motor is running. Awake the STO function by de-energizing (low state or open-circuit) the STO input signal 1. Ensure that the motor stops and the drive trips. Reset the fault and try to start the drive. Ensure that the motor stays at a standstill and the keypad of the drive displays "E150.1".	
6.2	Set STO1 to "H" and disable the ON/RUN command of the drive. Then, reset the drive automatically and enable ON/RUN command of the drive. Finally, check whether the motor runs normally.	

Step	Action	Result
6.3	Test the STO channel 2 when the motor is running: Set STO1 and STO2 to H. Start the drive and ensure the motor is running. Awake the STO function by de-energizing (low state or open-circuit) the STO input signal 2. Ensure that the motor stops and the drive trips. Reset the fault and try to start the drive. Ensure that the motor stays at a standstill and the keypad of the drive displays "E150.1".	
6.4	Set STO2 to "H" and disable the ON/RUN command of the drive. Then, reset the drive automatically and enable ON/RUN command of the drive. Finally, check whether the motor runs normally.	
7	Document and sign the acceptance test report which verifies that the safety function is safe and acceptable for operation.	

Special requirements

You must conduct STO diagnosis every three month by powering off and powering on the drive once, or running the STO function once.

Note

There are two ways to perform STO diagnosis:

- Power off and restart;
- Trigger and then cancel STO.

You can use either of them.

8 Inspection and Maintenance

8.1 Routine Maintenance Items

Standard operating conditions:

The annual average ambient temperature is 30 °C, the average load rate is less than 80%, and the daily operating time is less than 20h.

8.1.1 Routine Inspection

Check the following items during routine inspection.

Table 8–1 Routine checklist

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

8.1.2 Routine Cleaning

Check the following items during routine cleaning.

Table 8–2 Routine cleaning list

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

Note

- Before cleaning, switch off the power supply and clean with an air gun or a piece of dry cloth.
- Do not use gasoline, dilutes, alcohol, or acid or alkaline detergent to prevent enclosure discolor or damage.

8.2 Regular Maintenance

8.2.1 Periodic Inspection Items

Table 8-3 Periodic checklist

No.	Item	Yes
1	The screws used to fix the couplings between devices are in place.	☐
2	Check the equipment for signs of overheating.	☐
3	Terminal blocks are in good condition without any sign of damage.	☐
4	The clamping units of terminal blocks are in place.	☐
5	Check and clean the heatsink (every 6-12 months).	☐

The heatsink tends to accumulate dust on its fins. Clean the dust to prevent over-temperature and shortening of the drive service life. In normal environment, inspect the heatsink yearly. In dirty environment (prone to cutting fluid, textile wool, oil dirt, dense dust, and so on), you must clean the heatsink more frequently.

Clean the heatsink as follows (if necessary):

1. Remove the cooling fan (for air-cooled devices only).
2. While blowing compressed air (dry) from the bottom to the top, use a vacuum cleaner to collect dust at the air outlet.

Note

If there is a danger of dust entering adjacent equipment, clean it in another room.

3. Replace the cooling fan (for air-cooled devices only).

8.2.2 Periodic Maintenance

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

Object	Type	Standard Replacement Interval	Remarks
Drive	Bus filter capacitor	About 8 years (ambient temperature: 30°C; load rate: 80%; uptime per day: 20 hours; standard environment ^[1])	The standard replacement interval is for reference only. If any device/ component works improperly before the replacement interval expires, replace it immediately.
	Fan	5 years (ambient temperature: 30°C; load rate: 80%; uptime per day: 20 hours; standard environment)	
	Control circuit aluminum electrolytic capacitor	About 10 years (ambient temperature: 30°C; load rate: 80%; uptime per day: 20 hours; standard environment ^[1])	
	Pre-charge relay	100000 operations (depending on the operating conditions)	
	Pre-charge resistor	20000 operations (depending on the operating conditions)	
	Dynamic brake relay	About 1000 times (rated motor speed; interval: 5 min; inertia: 20 times)	
	Dynamic brake resistor		
Motor	Bearing	3 to 5 years (20,000 h to 30,000 h)	
	Oil seal	5000 h	
	Encoder	3 to 5 years (20,000 h to 30,000 h)	
	Absolute encoder battery	Depends on the operating condition See the operation instructions for the encoder battery for details.	

Note

[1]: For details on the standard environment, see ["3.3 Installation Environment Requirements" on page 40](#).

9 Certification and Standard Compliance

Table 9-1 Compliance list

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

9.1 CE Certification



Figure 9-1 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.

9.1.1 Requirements for Compliance with EMC

The MD800 series AC drive, which is applicable to the First environment and Second environment, complies with EMC Directive 2014/30/EU and standard EN IEC 61800-3.

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



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

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

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

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

- Category C1: a Power drive system (PDS) with the 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.

9.1.2 Requirements for Compliance with LVD

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

Installation location

Install the drive in a place with overvoltage category III and pollution degree 1 or 2 as specified by IEC 606641-1.

Installation Environment

For requirements of the installation environment, see ["3.3 Installation Environment Requirements" on page 40](#).

Protection

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

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

Main Circuit Cable Requirements

For wiring requirements of the main circuit terminals, see section related to wiring of the main circuit in the hardware guide.

Requirements of protective devices

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

For recommended fuse/circuit breaker models, see the selection table of fuses and circuit breakers in the Selection Guide.

9.2 UL&cUL Certification



Figure 9-2 UL/cUL marking

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

The drive has been tested in accordance with UL 61800–5–1 and CSA C22.2 No. 274-17 to determine compliance with UL/cUL standards. Observe the following requirements to enable machines and devices integrated with this drive to comply with UL/cUL standards.

Installation location

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

Ambient temperature

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

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

Installation requirements

Installation requirements for open-type drives:

SV660 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 Cable Requirements



Warning: It is not allowed to connect output terminals (such as P ⊕ , C, and N ⊖) in the field.

- Terminals P ⊕ , C, and N ⊖ are used to connect optional parts. Do not connect these terminals to an AC power supply.
- To protect the main circuit, separate and cover the surface that may come into contact with the main circuit.
- The control circuit is the internal safety extra-low voltage (SELV) circuit, which must be insulated and isolated from other circuits. Make sure that the control circuit is connected to the external SELV circuit.
- Prevent foreign matters from entering the wiring part of the terminal block.
- Do not solder the twisted conductors.
- The tightening torque may vary with terminals. Tighten terminal screws with the specified tightening torque. You can use the torque screwdriver, ratchet, or wrench.
- When using an electric screwdriver to tighten terminal screws, set a low speed to prevent damage to the terminal screws.
- Tighten the terminal screws with an angle not higher than 5°. Failure to comply may damage the terminal screws.

Wiring requirements of the control circuit

Observe the requirements in UL508 during wiring.

Cable requirements

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

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

If the recommended 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 the drive must meet the following requirements:

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

Requirements of protective devices

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

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

Note

All breaker protective devices must be UL-certified.

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

Drive Model SV660 Series Servo Drive			Circuit breaker (A)	Bussmann semiconduc tor fuse (A)	Inverse time lag breaker ^[1] (A)
Size	Model	Rated Input Current (A)			
Single-phase 220 V					
Size A	S1R6	2.3	15	-	40
	S2R8	4.0	15	-	40
Size B	S5R5	7.9	15	-	40
Size C	S7R6	9.6	15	-	100
Size D	S012	12.8	20	-	100
Three-phase 220 V					
Size C	S7R6	5.1	15	-	100
Size D	S012	8.0	20	-	100
Three-phase 380 V					
Size C	T3R5	2.4	15	-	100
	T5R4	3.6	15	-	100
Size D	T8R4	5.6	20	-	100
	T012	8.0	20	-	100
Size E	T017	12.0	40	40	100
	T021	16.0	40	40	100
	T026	21.0	40	40	100

Note

[1]: It is recommended to use an inverse time circuit breaker for a parallel multi-drive system.

9.3 FSoE Conformance



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10 Troubleshooting

See SV660N Series Servo Drive Troubleshooting Guide.

11 Parameter Table

See SV660N Series Servo Commissioning Guide.



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