Contents

Preface

Thank you for purchasing the SV820N series servo drive.

The SV820N series is a high-performance multi-axis AC servo drive developed by Inovance for small power applications. The SV820N series ranges from 100 W to 750 W. It supports CANopen and EtherCAT communication protocols via the corresponding communication port, thus allowing networking of multiple SV820N drives controlled by a host controller. The SV820N series servo drive is easy to use due to the functions of rigid table setting, inertia auto-tuning and oscillation suppression. It works together with Inovance MS1 series small/medium-inertia high-response servo motor configured with a 20-bit incremental encoder or 23-bit multi-turn absolute encoder, making the running stable and quiet. This servo drive is able to implement rapid and accurate position, speed and torque control, and is applicable for such automation equipment as semiconductor manufacturing equipment, chip mounters, PCB punching machines, transport machinery, food processing machinery, machine tools and conveying machinery.

This User Guide describes the correct use of the SV820N series servo drive, including safety information, mechanical and electrical installation, commissioning and maintenance. Read and understand this User Guide before use. If you have any problem concerning the functions or performance, contact the technical support personnel of Inovance for assistance.

The instructions are subject to change, without notice, due to servo drive upgrade, specification modification as well as efforts to increase the accuracy and convenience of the User Guide.

Unpacking and Checking the Items:

Upon unpacking, check the following items:

Check Item	Description
Whether the delivered products are consistent with your order	The box contains the equipment and the SV820N Servo Drive User Guide (brief version). Confirm the model according to the servo motor and servo drive nameplates.
Whether the product is damaged	Check the overall appearance of the product. If there is any omission or damage, contact Inovance or your supplier immediately.
Whether the rotating shaft of the servo motor rotates smoothly	It is normal if the shaft of the servo motor can be rotated manually. The servo motor is configured with a brake, but cannot be rotated manually.

Note	
	● This drive is a general industrial automation product, and is not designed for use in machinery or systems on which lives depend. ● Wiring, operation, maintenance and inspection of the product can only be conducted by a qualified person. ● When selecting the tightening torque of the screw, consider the strength of the screw and material of the installation part. Select a proper value while the screw is fixed solidly and the installation part will not be damaged. ● Install a correct safety device when this product is to be used on machinery which may cause a serious accident or loss due to trips of the product. ● Contact Inovance when this product is to be used on special applications such as atomic energy control, aerospace equipment, transport equipment, medical apparatus, safety devices and other equipment that require high cleanliness. ● Although this product has passed all QC testing, it may react unexpectedly due to trips arising from ambient noise, static interference, input power supply, wiring, optional parts, and so on. Take mechanical safety measures into full consideration to ensure safety in the application site where all possible actions of the equipment occur. ● When the motor shaft runs without being grounded, based on the actual mechanical and installation conditions, the motor bearing may suffer from electric corrosion or large noise. Please confirm it yourself. ● Trips of this product may cause rising smoke. Pay special attention to such conditions when the product is to be used in a purification workshop and similar environments. ● Note that the chip resistor disconnection or poor contact condition may occur due to a sulfuration reaction if the product is to be used in an environment with high-density sulphur or sulfuretted gas. ● Pay attention to the input voltage to the product. Inputting a voltage far larger than the rated voltage may cause damage to the internal components, thus resulting in smoke or a fire. ● The end user decides whether the servo drive matches the structure, size, service life, features, specification change of the equipment (to which the servo drive is to be installed) and its parts, and whether it complies with local laws and regulations. ● Note that use of this product beyond its specifications can be not guaranteed. ● This product is subject to change of certain components as we are dedicated to continuous improvement of the product.

Safety Information and Precautions

This User Guide is packaged together with the SV820N Servo Drive. It contains basic information for quick start of the drive.

■ Electrical Safety

Extreme care must be taken at all times when working with the Servo Drive or within the area of the Servo Drive. The voltages used in the Servo Drive can cause severe electrical shock or burns and is potentially lethal. Only authorized and qualified personnel should be allowed to work on Servo Drives.

■ Machine/System Design and Safety of Personnel

Machine/system design, installation, commissioning startups and maintenance must be carried out by personnel who have the necessary training and experience. They must read this safety information and the contents of this manual. If incorrectly installed, the Servo Drive may present a safety hazard.

The Servo Drive uses high voltages and currents (including DC), carries a high level of stored electrical energy in the DC bus capacitors even after power OFF. These high voltages are potentially lethal.

The Servo Drive is NOT intended to be used for safety related applications/functions. The electronic "STOP & START" control circuits within the Servo Drive must not be relied upon for the safety of personnel. Such control circuits isolates mains power voltages from the output of the Servo Drive. The mains power supply must be disconnected by an electrical safety isolation device before accessing the internal parts of the Servo Drive.

Safety risk assessments of the machine or process system which uses a Servo Drive must be undertaken by the user and or by their systems integrator/designer. In particular the safety assessment/design must take into consideration the consequences of the Servo Drive failing or tripping out during normal operation and whether this leads to a safe stop position without damaging machine, adjacent equipment and machine operators/users. This responsibility lies with the user or their machine/process system integrator.

System integrator/designer must ensure the complete system is safe and designed according to the relevant safety standards. Inovance Technology and Authorized Distributors can provide recommendations related to the Servo Drive to ensure long term safe operation.

The installer of the Servo Drive is responsible for complying with all relevant regulations for wiring, circuit fuse protection, earthing, accident prevention and electromagnetic (EMC regulations). In particular fault discrimination for preventing fire risk and solid earthing practices must be adhered to for electrical safety (also for good EMC practice). Within the European Union, all machinery in which this product is used must comply with required directives.

■ Electrical Installation - Safety

Electrical shock risk is always present within a Servo Drive including the output cable leading to the motor terminals. Where dynamic brake resistors are fitted external to the Servo Drive, care must be taken with regards to live contact with the brake resistors, terminals which are at high DC voltage and potentially lethal. Cables from the Servo Drive to the dynamic brake resistors should be double insulated as DC voltages are typically 600 to 700 VDC.

Mains power supply isolation switch should be fitted to the Servo Drive. The mains power supply must be disconnected via the isolation switch before any cover of the Servo Drive can be removed or before any servicing work is undertaken stored charge in the DC bus capacitors of the PWM inverter is potentially lethal after the AC supply has been disconnected. The AC supply must be isolated at least 10 minutes before any work can be undertaken as the stored charge will have been discharged through the internal bleed resistor fitted across the DC bus capacitors.

Whenever possible, it is good practice to check DC bus voltage with a VDC meter before accessing the inverter bridge. Where the Servo Drive input is connected to the mains supply with a plug and socket, then upon disconnecting the plug and socket, be aware that the plug pins may be exposed and internally connected to DC bus capacitors (via the internal bridge rectifier in reversed bias). Wait 10 minutes to allow stored charge in the DC bus capacitors to be dissipated by the bleed resistors before commencing work on the Servo Drive.

■ Electrical Shock Hazard

Ensure the protective earthing conductor complies with technical standards and local safety regulations. Because the leakage current exceeds 3.5 mA in all models, IEC 61800-5-1 states that either the power supply must be automatically disconnected in case of discontinuity of the protective earthing conductor or a protective earthing conductor with a cross-section of at least 10 mm2 (Cu) or 16 mm2 (Al) must be used. Failure to comply may result in death or serious injury.

When using an earth leakage circuit breaker, use a residual current operated protective device (RCD) of type B (breaker which can detect both AC and DC). Leakage current can cause unprotected components to operate incorrectly. If this is a problem, lower the carrier frequency, replace the components in question with parts protected against harmonic current, or increase the sensitivity amperage of the leakage breaker to at least 200 mA per drive.

Factors in determining leakage current:

- Size of the Servo Drive
- Servo drive carrier frequency
- Motor cable type and length
- EMI/RFI filter

■ Approvals

Certification marks on the product nameplate indicate compliance with the corresponding certificates and standards.

<table>
<tr><th>Certification</th><th>Mark</th><th colspan="2">Directives</th><th colspan="2">Standard</th></tr>
<tr><td rowspan="5">CE</td><td rowspan="5">CE</td><td rowspan="2">EMC directives</td><td rowspan="2">2014/30/EU</td><td>AC servo drive</td><td>EN 61800-3</td></tr>
<tr><td>AC servo motor</td><td>EN 60034-1</td></tr>
<tr><td rowspan="2">LVD directives</td><td rowspan="2">2014/35/EU</td><td>AC servo drive</td><td>EN 61800-5-1</td></tr>
<tr><td>AC servo motor</td><td>EN 60034-1</td></tr>
<tr><td>RoHS directives</td><td>2011/65/EU</td><td colspan="2">EN 50581</td></tr>
<tr><td rowspan="2">TUV</td><td rowspan="2">TÜV SÜD</td><td colspan="2" rowspan="2">-</td><td>AC servo drive</td><td>EN 61800-5-1</td></tr>
<tr><td>AC servo motor</td><td>EN 60034-1</td></tr>
<tr><td rowspan="2">cUL</td><td rowspan="2">c UL us LISTED</td><td colspan="2" rowspan="2">-</td><td>AC servo drive</td><td>UL61800-5-1
C22.2 No.14-13</td></tr>
<tr><td>AC servo motor</td><td>UL1004
C22.2 No.100</td></tr>
</table>

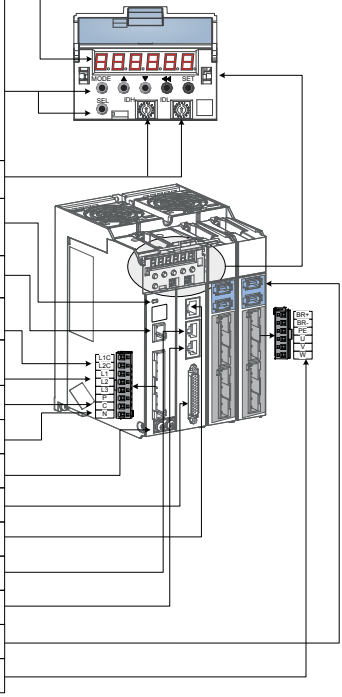
Note

- The above EMC directives are complied with only when the EMC electric installation requirements are strictly observed.
- Machines and devices used in combination with this drive must also be CE certified and marked. The integrator who integrates the drive with the CE mark into other devices has the responsibility of ensuring compliance with CE standards and verifying that conditions meet European standards.
- The installer of the drive is responsible for complying with all relevant regulations for wiring, circuit fuse protection, earthing, accident prevention and electromagnetic (EMC regulations). In particular fault discrimination for preventing fire risk and solid earthing practices must be adhered to for electrical safety (also for good EMC practice).
- For more information on certification, consult our distributor or sales representative.

Chapter 1 Servo System Selection

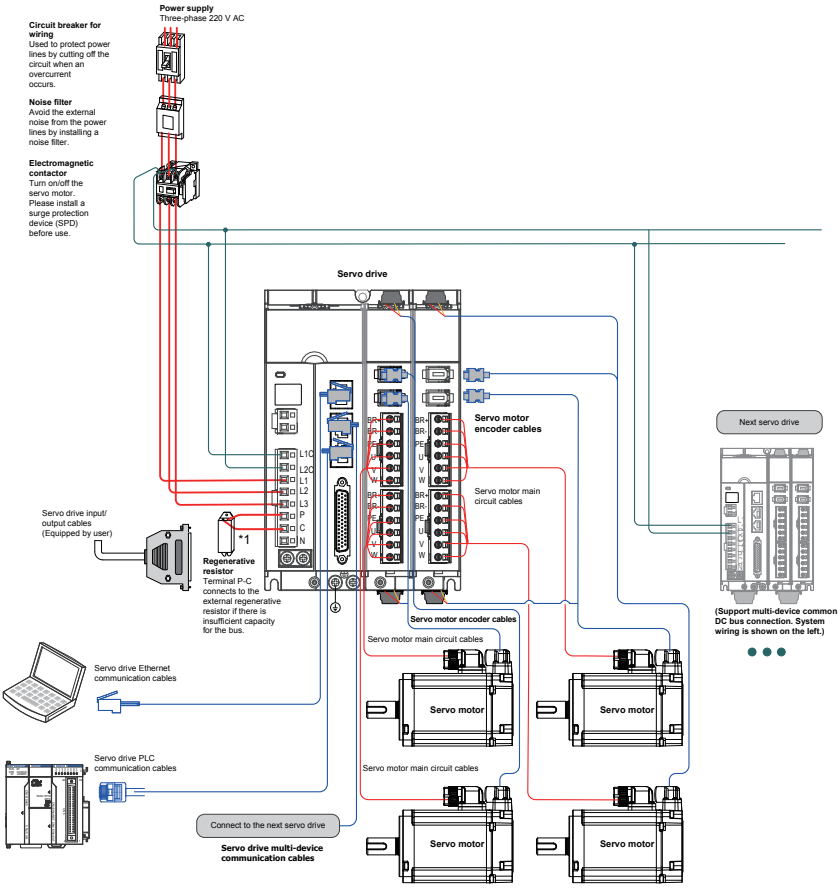
Figure 1-1 Components of servo drive

Name	Purpose
LED display	The 6-digital 7-segment LED display is used to show servo system’s running state and parameter setting
Key operator	MODE ▲ ▼ ◀◀ SET Go to the lower-level menu Execute commands such as storing parameter setting value SEL Change the value of the blinking digit for the LED View the high digits of the number consisting of more than 5 digits Decrease the value of the blinking digit for the LED Increase the value of the blinking digit for the LED Switch between all modes Return to the upper-level menu Select the specific Axis number with the key
IDH, IDL Setting the node address for the equipment	Reserved
CHARGE light Bus voltage indicator	Used to indicate the bus capacitor with charges. 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. Therefore, do not touch the power terminals to avoid electrical shock.
CN7 24 V brake power input	24 V brake power input (you must use this port to input 24 V power in order to use the brake power)
L1C, L2C Control circuit power input terminals	Control circuit 220 V AC power input.
L1, L2, L3 Main circuit power input terminals	Main circuit single-phase and three-phase 220 V power input. Terminals L1 and L2 are for single-phase power input, and terminals L1, L2 and L3 are for three-phase power input.
P, C External bleeder resistor connection terminals	External bleeder resistor is connectedbetween P and C when the servo systemis under feedbackBraking mode. Externalis under feedbackresistor needs to be purchased additionally.
P, N DC bus terminals	P, N：They are used for common DC bus connection when multiple servo drives are under parallel control.
PE Grounding terminal	Two grounding terminals of the servo drive are respectively connected to those of the power supply and the servo motor.
CN1 Control terminal	Port for digital input/output signal
CN3 Ethernet connection terminal	Ethernet connector port
CN4 EtherCAT output terminal	ErherCAT network interface, CN4 (OUT) connecting to next slave station
CN5 EtherCAT input terminal	ErherCAT network interface, CN5 (IN) connecting to master station or previous slave station
X1, X2 Terminals used to connect the encoder	Connect with the motor encoder terminals
X3, X4 Main circuit signal terminals for the drive unit	BR+, BR-: Coils of the motor with brake U, V, W: Connect the phases U, V and W of servo motor



Note	The motor with brake must be supplied with 24 V power via the CN7 terminal on the servo drive. The power must be output to the wiring terminal of the brake via BR+ and BR-.

Figure 1-2 Wiring example of three-phase 220 V/380 V system



The servo drive is directly connected to an industrial power supply, with no isolation such as transformers. In this case, a fuse or circuit breaker must be connected on the input power supply to prevent cross electric accidents in the servo system. The servo drive is not configured with the built-in protective grounding circuit. Connect a residual current device (RCD) against both overload and short-circuit or a specialized RCD combined with protective grounding.

Do not use magnetic contactors for running or stopping the servo motor. As a high-inductance device, the motor generates instantaneous high voltage, which may damage the contactor.

Pay attention to the power capacity when connecting an external control power supply or 24 V DC, especially when the power supply is for powering up multiple drives or brakes. Insufficient power supply will lead to a lack of the supply current, thus causing a failure of the drives or brakes. The brake shall be powered up by a 24 V DC power supply. The power must match the motor model and meets the brake requirements.

Observe the following precautions during wiring:

1. Provide a bleeder resistor between terminal P and C when the servo system is under feedback braking mode.
2. CN3 is an Ethernet interface, and CN4 and CN5 are for connecting EthnerCAT. CN4 is used to connect the next slave device, while CN5 is used to connect the master station or previous slave device.

1.1 Model and Nameplate Description of the Servo Drive

1.1.1 Model and Nameplate of the Servo Drive

Figure 1-3 Model description of the servo drive

SV820 N 1S 2C 2C

Mark	Serial Number
SV820	SV820 series

Mark	Control Board Type
N	Network-type

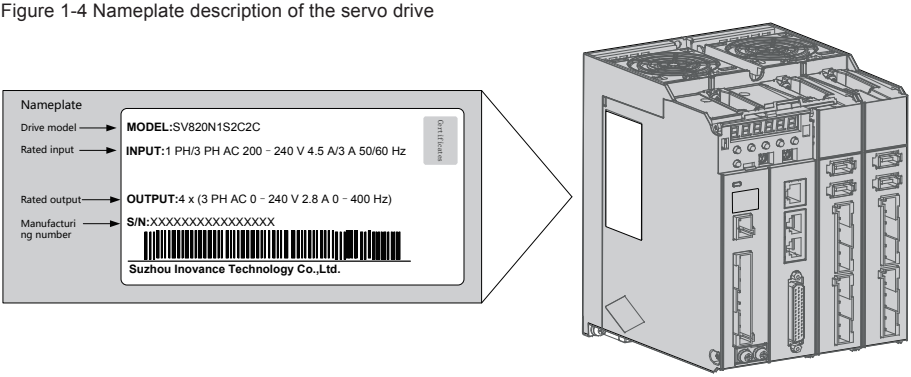
Mark	Power Supply Unit Type
1S	1 kW
2S	2 kW

Mark	Drive Unit 2

Mark	Drive Unit 1
Single axis drive unit (rated current)	
1A	1.1 A
1B	1.6 A
1C	2.8 A
1D	4.6 A
1E	7.6 A
Double axis drive unit (rated current per axis)	
2A	1.1 A
2B	1.6 A
2C	2.8 A
2D	4.6 A

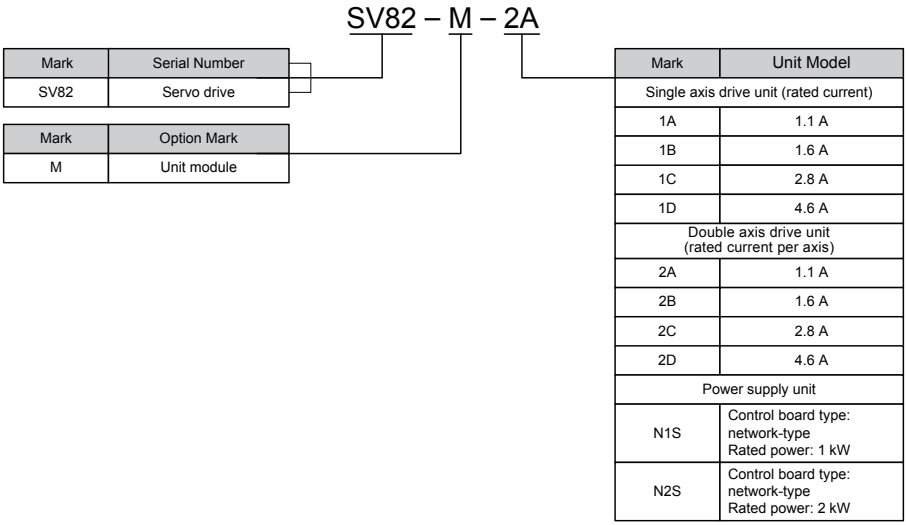
Example:
SV820N1S2C2C: SV820 series mult-axis servo system, Network-type, power supply unit 1 kW. Drive Unit 1 is 2.8A*2, Drive Unit 2 is 2.8A*2.

Figure 1-4 Nameplate description of the servo drive



1.1.2 Unit Model (Maintenance Options)

Figure 1-5 Unit model description



1

Note	Units are for the replacement of damaged ones in the original servo drive only. Contact your supplier if any unit needs replacing.

1.2 Technical Specifications

1.2.1 Basic Specifications

Item			Description
Basic specifications	Control mode		220 V single/three-phase full-bridge rectification IGBT PWM control, sine wave current drive mode
	Feedback		Serial and incremental: 23 bits or 20 bits
	Use conditions	Use/Storage temperature	0–45℃ (derating is required in case of an ambient temperature higher than 45℃)/ –40–+70℃
		Use/Storage humidity	Below 90% RH (no condensation)
		Vibration/Impact resistance	4.9 m/s^2/19.6 m/s^2
		IP rating	IP20 (except for cable entry)
		Pollution level	Level 2
		Altitude	Below 1,000 m

Item			Description
Performance	Speed and torque control performance	Speed range	1:5500 (lower limit of speed should allow the drive to run with rated torque and load)
		Speed loop bandwidth	3,000 Hz
		Torque control accuracy (repeatability)	±2%
		Soft startup time setting	0–60s (acceleration and deceleration can be set)
	Position control performance	Positioning time	1 ms–10 ms
Input/Output signal	Digital input signal	Allowing signal allocation change	24-channel DI (shared by multiple axes, with 16 channels available for high-speed probe function)
			P-OT (positive limit switch), N-OT (negative limit switch), HomeSwitch (home switch), TouchProbe1 (Probe1) TouchProbe2 (Probe2)
	Digital output signal	Allowing signal allocation change	6-channel DO (shared by multiple axes), DO load capacity 50 mA and voltage range 5 V–30 V
			S-RDY (servo ready), TGON (motor rotation output), WARN (warning), ALM (fault)
Built-in functions	Overtravel (OT) prevention		The drive slows down and stops when P-OT and N-OT act.
	Protection functions		Overcurrent, overvoltage, undervoltage, overload, main circuit detection abnormal, heatsink overheat, power supply phase loss, overspeed, encoder abnormal, CPU abnormal, parameter abnormal, etc.
	LED display		Main circuit CHARGE indicator, 6-digit LED display
	Vibration suppression		Four notches that can suppress mechanical resonance of the 50–4,000 Hz frequency are available on each axis, with 2 of them allowing adaptive setting. Both the middle-high frequency vibration suppression filter (that can suppress mechanical/system vibration of the 30–1,000 Hz frequency) and the low frequency vibration suppression filter (that can suppress machine table/end vibration of the 1–100 Hz frequency) are available.
	Communication protocol		Ethernet, EtherCAT
	Dynamic brake		Built-in dynamic brake for emergency braking in case of an abnormality
	Brake power supply		The output of built-in brake power supply must be connected to an external 24 V power supply via the CN7 port. The brake coil can be connected directly to the BR+ and BR– ports.
	Others		Gain adjustment, alarm record, jog running

Note	Check the followings when using the built-in dynamic brake. 1. As the dynamic brake has an emergency stop function, do not stop the motor via the disabling signal from the servo drive. If the servo drive starts or stops via power ON/OFF or servo ON/OFF after the command has been input, the dynamic brake circuit operates frequently and it will cause the deterioration and the failure of internal components of the servo drive. At this time, start or stop the servo motor via the speed or position command. 2. The dynamic brake is designed to meet the short-time rated specification and can only be used for an emergency stop. Coast to stop the motor or stop the motor at zero speed in normal circumstances. Perform the next step (re-power or re-run) within 3 minutes after performing the dynamic braking when the motor rotates at a high speed. 3. The dynamic brake can be used when: ① the control power is off, ② the servo is powered off, or ③ the protection feature is enabled. Parameters can be set to enable or disable the dynamic brake during the deceleration or after stopping under ① – ③ . When the control power is disconnected, the dynamic brake will act. 4. Refer to H02-08 Parameters for function setting of dynamic brake

1.2.2 EtherCAT Communication Technical Specifications

Item		Specifications
Basic performance of EtherCAT slave station	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
	Topological structure	Ring and linear
	Transmission medium	Shielded CAT 5E cable or better
	Transmission distance	Less than 100 m between two nodes (good environment and cables)
	Number of slave stations	Support 65,535 in terms of the protocol
	EtherCAT frame length	44–1,498 bytes
	Process data	Maximum 1,486 bytes per Ethernet frame
	Synchronization jitter of two slave stations	< 1 us (specific result to be determined)
	Update time	About 30 us for 1,000 digital inputs and outputs 100 servo axes about 100 us Define different update times for different interfaces
	Communication code error rate	10-10 Ethernet standard
EtherCAT Configuration unit	FMMU unit	8
	Storage synchronization management unit	8
	Process data RAM	8 KB
	Distributed clock	64 bits
	EEPROM capacity	32 Kbit Initialization data to be written in via EtherCAT master station

1.3 Specifications of the Servo Motor

1.3.1 Model and Nameplate Description of the Servo Drive

Figure 1-6 Servo motor model description

MS1 H1 – 40B 30C B – A3 3 1 Z

Mark	Serial Number
MS1	MS series servo motor

Mark	Type
H	1: Low inertia, small capacity
	2: Low inertia, medium capacity
	3: Mediuminertia, medium capacity
	4: Mediuminertia, small capacity

Mark	Rated Power (W)
Comprised of a number and a letter	
A	x1
B	x10
C	x100
D	x1000
E	x10000
Example: 40B: 400 W	

Mark	Rated Speed (RPM)
Comprised of a number and a letter	
A	x1
B	x10
C	x100
D	x1000
E	x10000
Example: 30C: 3,000 RPM	

Mark	Motor Specification
Z	Z Series Motor
Z-S	Swinging-type motor

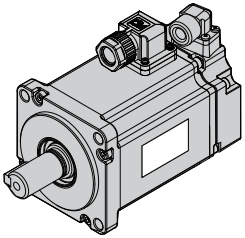
Mark	Brake, Reducer and Oil Sealing
0	None
1	Oil sealing
2	Brake
4	Oil sealing+brake

Mark	Shaft Connection Mode
1	Plain shaft
2	Solid and keyed
3	Solid, keyed and tapped holes
5	Solid and tapped holes

Mark	Encoder Type
One letter and one number	
A3	2nd generation multi-turn absolute encoder

Mark	Voltage Class
B	220 V
D	380 V

Figure 1-7 Servo motor nameplate description



Nameplate

automation

AC servo motor

MS1H Series AC Servo motor

Motor model → Model MS1H1-10B30CB

Motor parameters → Pn (W) 100 Un (V) 220 In (A) 1.3
Nn (r/min) 3000 Tn (Nm) 0.32 Duty S1
fn.(Hz) 250 Ins. F Type A330Z

Motor code → Motor Code:14101 IP67 3PHAC

Manufacturing number → S/N: 011105424FB00116

Manufacturer: Suzhou Inovance Technology Co., Ltd.

Address: No.16, Youxiang Rd, Yuexi Town, Wuzhong District, Suzhou, 215104, People's Republic of China

Note	The information above only applies to 40\60\80 bases.

1.3.2 Motor Mechanical Characteristics

Item	Description
Rated time	Continuous
Vibration level	V15
Insulation resistance	500 V DC, more than 10M Ω
Use in ambient temperature	0–40°C
Excitation mode	Permanent magnetic
Mounting Mode	Flange
Heat-resistance level	Level F
Insulation voltage	1,500 V AC, 1 minute (200 V) 1,800 V AC, 1 minute (400 V)
Housing protection mode	H1:IP67 (except for through shaft section and connectors) H4:IP67 (except for through shaft section and connectors)
Use in environment humidity	20–80% (no condensation)
Connection mode	Direct connection
Rotating direction	The motor rotates anti-clockwise viewed from the load side (CCW) at the forwarding rotation command.

1.3.3 Motor Ratings

Model	Rated Output (kW)*1	Rated Torque (N·m)	Maximum Torque (N·m)	Rated Current (Arms)	Maximum Current (Arms)	Rated Speed (RPM)	Maximum Speed (RPM)	Torque Parameter (N·m/Arms)	Rotor Inertia (10^{-4}kg·m^2)	Voltage (V)
MS1H1 (Vn=3,000 RPM, Vmax=6,000 RPM) Series Ratings										
MS1H1-05B30CB-****Z-S	0.05	0.16	0.56	1.3	4.6	3,000	6,000	0.149	0.026 (0.028)*2	220
MS1H1-10B30CB-****Z-S	0.1	0.32	1.12	1.3	4.9			0.26	0.041 (0.043)*2	
MS1H1-20B30CB-****Z-S	0.2	0.64	2.2	1.5	5.6			0.46	0.207 (0.220)*2	
MS1H1-40B30CB-****Z-S	0.4	1.27	4.5	2.8	10.8			0.51	0.376 (0.390)*2	
MS1H1-55B30CB-**** Z-S	0.55	1.75	6.13	3.8	15			0.48	1.06	
MS1H1-75B30CB-****Z-S	0.75	2.39	8.4	4.8	19			0.53	1.38 (1.43)*2	
MS1H1-10C30CB-****Z-S	1	3.18	11.13	7.6	28			0.46	1.75	
MS1H4 (Vn=3,000 RPM, Vmax=6,000 RPM) Series Ratings										
MS1H4-40B30CB-****Z-S	0.4	1.27	4.5	2.8	10.8	3,000	6,000	0.51	0.6 (0.667)*2	220
MS1H4-75B30CB-****Z-S	0.75	2.39	8.4	4.8	19			0.53	2 (2.012)*2	

Note

*1. The motor with oil seal must be derated by 20% during use.

*2. Parameters in "()" are for the brake motor.

The parameters in the preceding table are the values when the motor works together with the Inovance servo drive and the armature coil temperature is 20℃ .

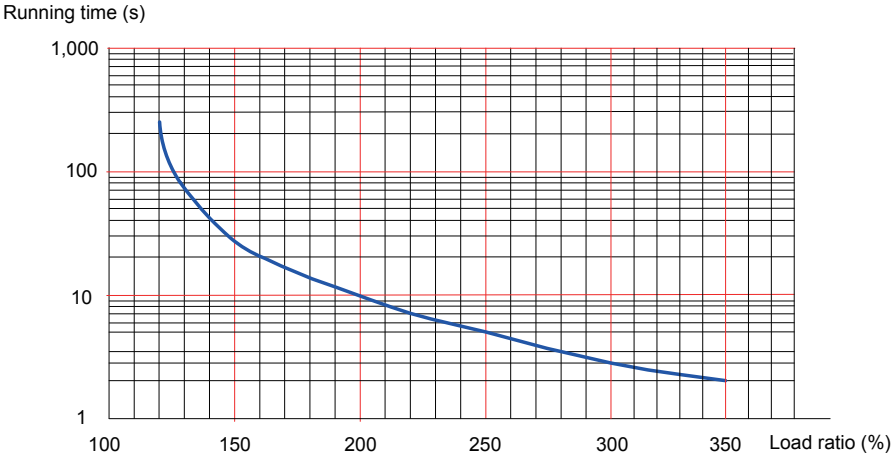
The above table shows the characteristic parameters of the motor after the heatsink below is installed for the motor.

MS1H1/MS1H4: 250 x 250 x 6 mm (aluminum)

1.3.4 Motor Overload Characteristics

Load Ratio (%)	Running Time (s)
120	230
130	80
140	40
150	30
160	20
170	17
180	15
190	12
200	10
210	8.5
220	7
230	6
240	5.5
250	5
300	3
350	2

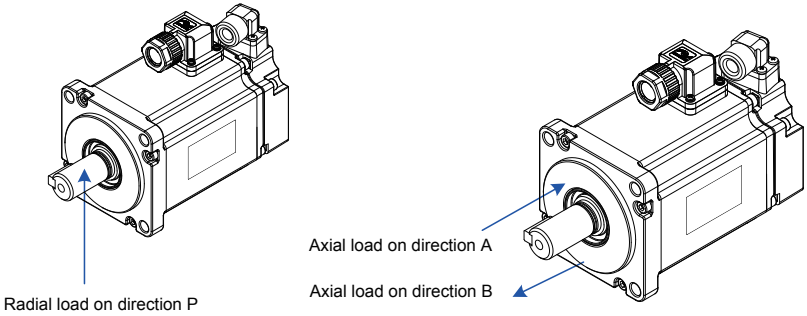
Figure 1-8 Motor overload curve



- The maximum torque of H1 and H4 is 3.5 times the rated torque.

1.3.5 Motor Allowed Radial and Axial Loads

Figure 1-9 Motor radial and axial load diagram



Motor Model	Allowed Radial Load (N)	Allowed Axial Load (N)
MS1H1-05B30CB-****Z-S	78	54
MS1H1-10B30CB-****Z-S	78	54
MS1H1-20B30CB-****Z-S	245	74
MS1H1-40B30CB-****Z-S	245	74
MS1H1-55B30CB-****Z-S	392	147
MS1H1-75B30CB-****Z-S	392	147
MS1H1-10C30CB-****Z-S	392	147
MS1H4-40B30CB-****Z-S	245	74
MS1H4-75B30CB-****Z-S	392	147

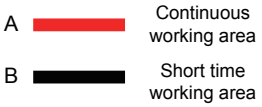
1.3.6 Electrical Specifications of the Motor Brake

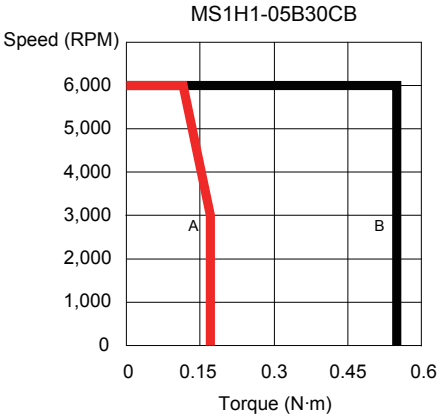
Motor Model	Holding Torque (Nm)	Power Supply Voltage (V)±10%	Resistor 20°C , (Ω)±10%	Power Supply Current Range at 20°C (A)±10%	Brake Release Time (ms)	Brake Apply Time (ms)
MS1H1-05B/10B	0.32	DC 24	94.4	0.254	≤20	≤35
MS1H1-20B/40B	1.5	DC 24	75.79	0.3	≤20	≤35
MS1H1-75B	2.5	DC 24	72	0.333	≤20	≤60
MS1H4-40B	1.5	DC 24	75.79	0.3	≤20	≤50
MS1H4-75B	2.5	DC 24	72	0.333	≤20	≤60

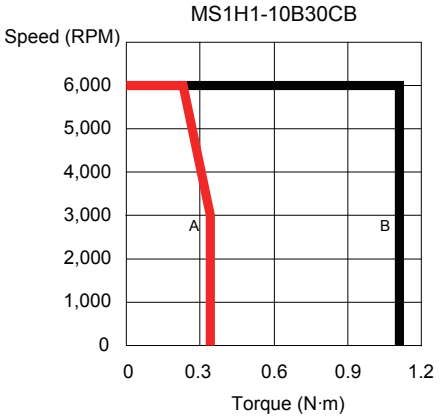
The brake must not share the power supply with other electrical devices. This is to prevent a malfunction of the brake due to a drop in the voltage or current when other electrical devices work in tandem.
Cables of 0.5 mm2 and above are recommended.

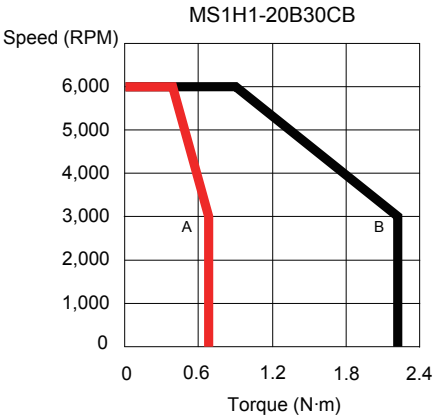
1.3.7 Motor Torque/Speed Characteristics

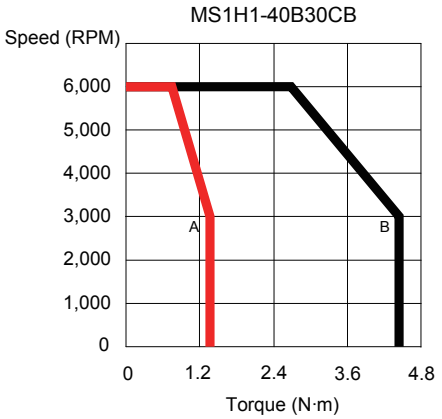
MS1H1 (low inertia, small capacity)



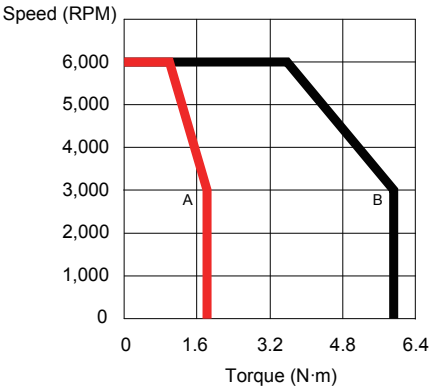




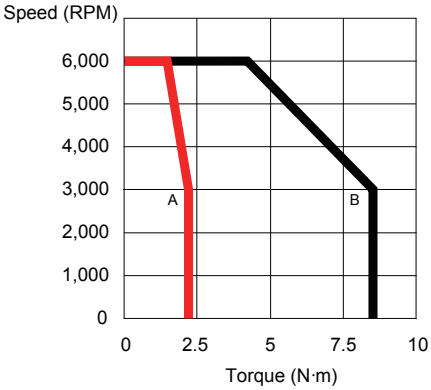




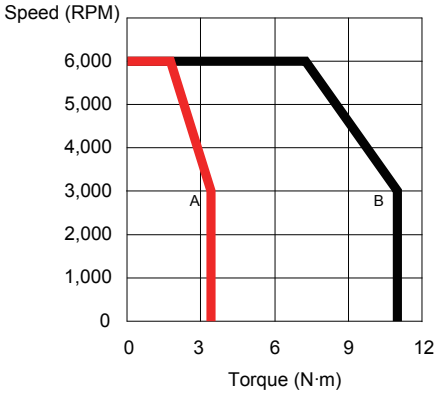
MS1H1-55B30CB



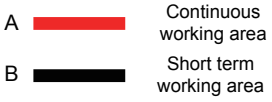
MS1H1-75B30CB

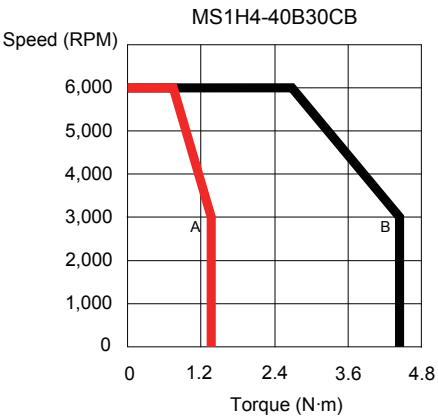


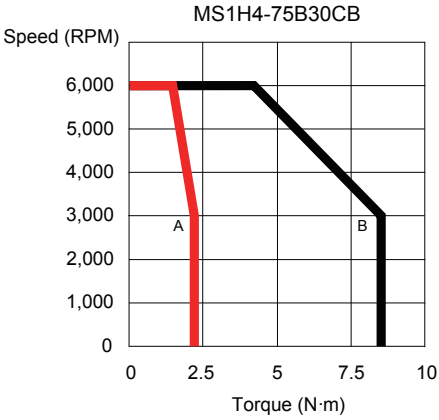
MS1H1-10C30CB



MS1H4 (medium inertia, small capacity)







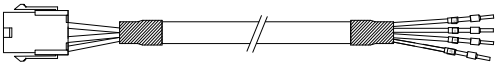
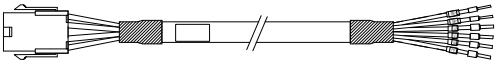
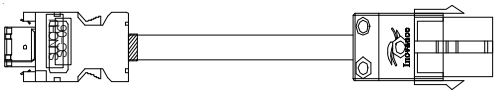
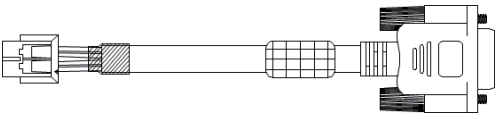
1.4 Table of Servo System Configuration Specifications

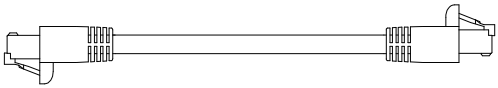
Rated Speed	Maximum Speed	Capacity	Servo Motor Model MS1H□-□□□□□□□-*****		Motor Frame Size	Drive Unit Model SV820N**□□□□
3,000 RPM	6,000 RPM	50 W	H1 (low inertia, small capacity)	05B30CB	40	1A, 2A
		100 W		10B30CB	40	1A, 2A
		200 W		20B30CB	60	1B, 2B
		400 W		40B30CB	60	1C, 2C
		550 W		55B30CB	80	1D, 2D
		750 W		75B30CB	80	1D, 2D
		1,000 W		10C30CB	80	1E
		400 W	H4 (medium inertia, small capacity)	40B30CB	60	1C, 2C
		750 W		75B30CB	80	1D, 2D

1.5 Bleeder Resistor Specification

Servo Drive Model			Minimum Allowed Resistance (Ω)	Maximum Braking Energy Absorbed by Capacitor (J)
Single/Three-phase 220 V	SV820*1S****	1 kW power supply unit	40	31
	SV820*2S****	2 kW power supply unit	40	47

1.6 Cables

Cable Name	Cable Size	L Length of Cable (mm)	Cable Appearance Diagram
Servo motor main circuit cable	SV82-L-M00-3.0	3,000	
	SV82-L-M00-5.0	5,000	
	SV82-L-M00-10.0	10,000	
	SV82-L-B00-3.0	3,000	
	SV82-L-B00-5.0	5,000	
	SV82-L-B00-10.0	10,000	
Cable for incremental encoder of the servo motor	SV82-L-P10-3.0	3,000	
	SV82-L-P10-5.0	5,000	
	SV82-L-P10-10.0	10,000	
Cable for absolute encoder of the servo motor	SV82-L-P20-3.0	3,000	
	SV82-L-P20-5.0	5,000	
	SV82-L-P20-10.0	10,000	
Servo to PC communication cable	S6N-L-T00-3.0	3,000	

Cable Name	Cable Size	L Length of Cable (mm)	Cable Appearance Diagram
Communication cable for parallel control of multiple servo motors	S6-L-T04-0.2	200	
	S6-L-T04-0.3	300	
	S6-L-T04-0.5	500	
	S6-L-T04-1.0	1,000	
	S6-L-T04-2.0	2,000	
	S6-L-T04-3.0	3,000	
	S6-L-T04-5.0	5,000	
	S6-L-T04-10.0	10,000	

1.7 Connector Kit

Item	Connector Kit
MS1 (Z-S) motor	S6-C8 (DB44 connector kit for cable sets of servo motor)
MS1 (Z-S) motor	SV82-C2 (connector kit for servo motor cables)
MS1 (Z-S) motor	SV82-C4 (connector kit for battery box of servo motor)

1.8 System Configuration

1.8.1 Configuration of the Servo Drive

Rated current of the SV820 series multi-axis drive

Model	Width	Input Current	Output Power	Number of Axes	Output Current of an Axis	Maximum Current of an Axis
SV820N1S2C2C SV820N2S2C2C	120 mm	4.6 A	1 kW	4	2.8 A	10.1 A

1.8.2 Power Supply/Drive Unit Configuration

Unit Model	Unit Category	Unit Width	Output Power or Output Current
SV82-M-N1S (1 kW network-type)	Power supply unit	62 mm	1 kW
SV82-M-N2S (2 kW network-type)	Power supply unit	62 mm	2 kW
SV82-M-2C (2*2R8)	Drive unit	30 mm	2* (2.8 A)
SV82-M-1C (2R8)	Drive unit	30 mm	2.8 A

Network-type power supply unit supports EtherCAT.

Chapter 2 Installation

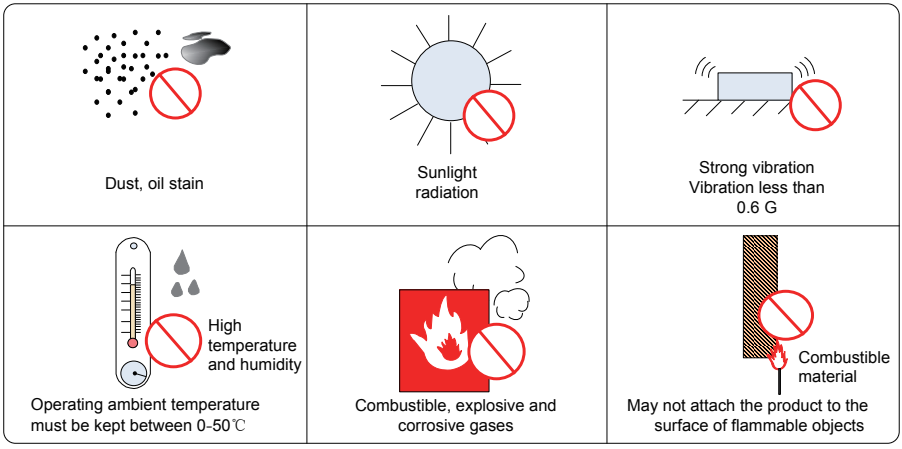
2.1 Installation of the Servo Drive

2.1.1 Installation Environment Requirements

Installation location

- Install the servo drive inside a cabinet free from sunlight and rain;
- Install the servo drive in an environment free from corrosive or inflammable gases or combustible goods, such as hydrogen sulfide, chlorine, anmonia, sulphur gas, chloridize gas, acid, soda and salt;
- Install the servo drive in an environment free from high temperature, moisture, dust and metal powder;
- Install the servo drive in a place with no vibration;
- Pollution level of the installation location: PD2.

Figure 2-1 Installation environment



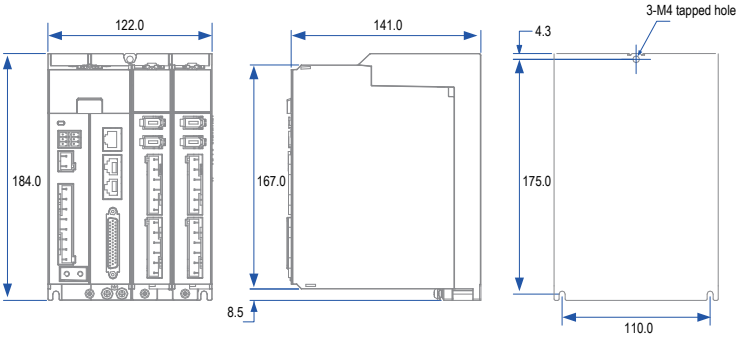
Environmental conditions

Item	Description
Use in ambient temperature	0–55°C (ambient temperature within 40°C –55°C , and average load ratio not exceeding 80%) (no freezing)
Use in environment humidity	Below 90% RH (no condensation)
Storage temperature	–20–+85°C (no freezing)
Storage humidity	Below 90% RH (no condensation)
Vibration	Below 4.9 m/s^2
Impact	Below 19.6 m/s^2
IP rating	IP20 (except for cable entry)
Altitude	Below 1,000 m

2.1.2 Requirements of the Installation Dimensions and Clearance

Product dimensions (mm)

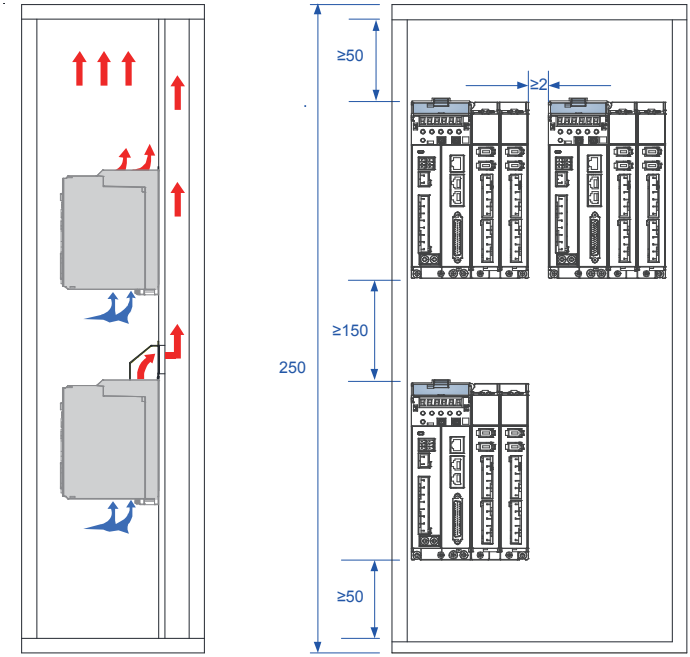
Figure 2-2 Diagram of physical dimensions



Clearance

The product can be installed side by side (with the clearance at least 2 mm) in one layer or two layers, as shown in the figure below. When the product is installed in two layers, minimum clearance is required between units.

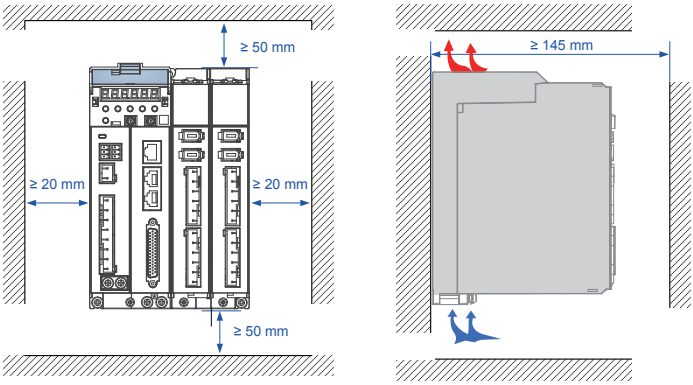
Figure 2-3 Clearance between units when the product is installed in two layers



A multi-axis system requires units to be lined up along the top.

To take the heat dissipation and cooling requirements on units Run settings into full consideration, sufficient installation clearances should be reserved by referring to data in the figure below:

Figure 2-4 Installation clearances



Installation direction: The product must only be installed vertically, not horizontally or on one side.

2.1.3 Installation Method

This product supports backplate mounting via three installation holes on the body and can be fixed to the installation surface with M4 screws.

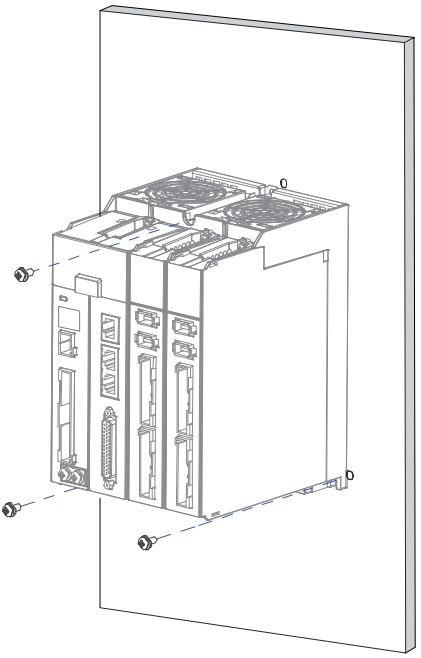
Installation method:

Mark the position of tapped holes for installation on the base plate. Drill holes for fixing the screws on the base plate.

This product must be installed on the base plate vertically.

Below is the installation diagram:

Figure 2-5 Backplate mounting diagram



Recommended torque for installation (N.M):

When the M4 screws are used to fix the product, the torque is recommended to be 1.2 N.M.

Item	M3	M4	M5	M6	M8	M10	M12
Electric connection	0.55	1.2	2.8	6	13	25	50

Cooling

Make sure the installation direction of the servo drive is vertical to the wall. Cool the servo drive with natural convection or a cooling fan.

As shown in the above figure, keep sufficient space around the drive unit to ensure cooling by fans or natural convection. Install the cooling fans above the servo drive to avoid an excessive temperature rise and maintain an even temperature inside the control cabinet.

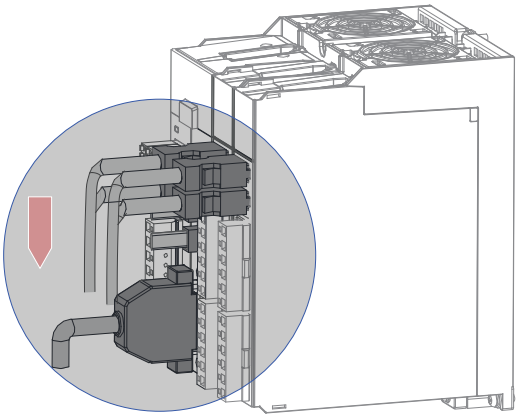
Ground

The grounding terminal must be properly grounded. Failure to comply may cause electric shock or malfunction due to interference.

Cable routing requirements

When cabling the servo drive, route the cables downward (refer to the figure below) to prevent liquid on the site from flowing into the servo drive along cables.

Figure 2-6 Cable routing diagram



2.2 Installation of the Servo Motor

2.2.1 Installation Environment Requirements

Installation location

- Install the servo drive in an environment free from corrosive or inflammable gases or combustible goods, such as hydrogen sulfide, chlorine, anmonia, sulphur gas, chloridize gas, acid, soda and salt;
- Use the servo motor with oil seal when the motor is to be used in a place with grinding fluid, oil spray, iron powder or cuttings;
- Install the servo motor away from heat sources such as a heating stove;
- Do not use the servo motor in an enclosed environment. Working in an enclosed environment will lead to a high temperature of the servo motor, which will shorten its service life;
- No foreign matter or water is allowed in the terminals in order to not influence the installation and use of the servo motor.

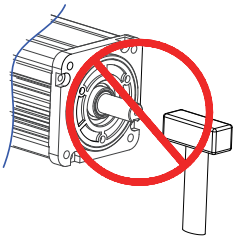
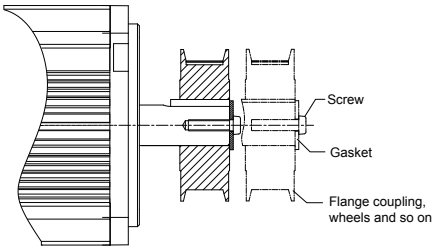
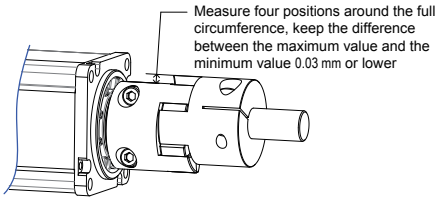
Environmental conditions

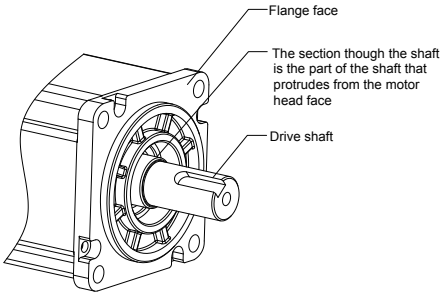
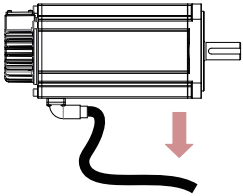
Table 2-1 Installation environment

Item	Description
Use in ambient temperature	0–40°C (no freezing)
Use in environment humidity	20%–90% RH (no condensation)
Storage temperature	–20°C –+60°C (maximum temperature guarantee: 72 hours at 80°C)
Storage humidity	20%–90% RH (no condensation)
Vibration	Below 49 m/s^2
Impact	Below 490 m/s^2
IP rating	H1 and H4: IP67 (except for the through shaft section and connection terminals of motor connectors)
Altitude	Below 1,000 m (de-rate the drive motor when the altitude is above 1,000 m)

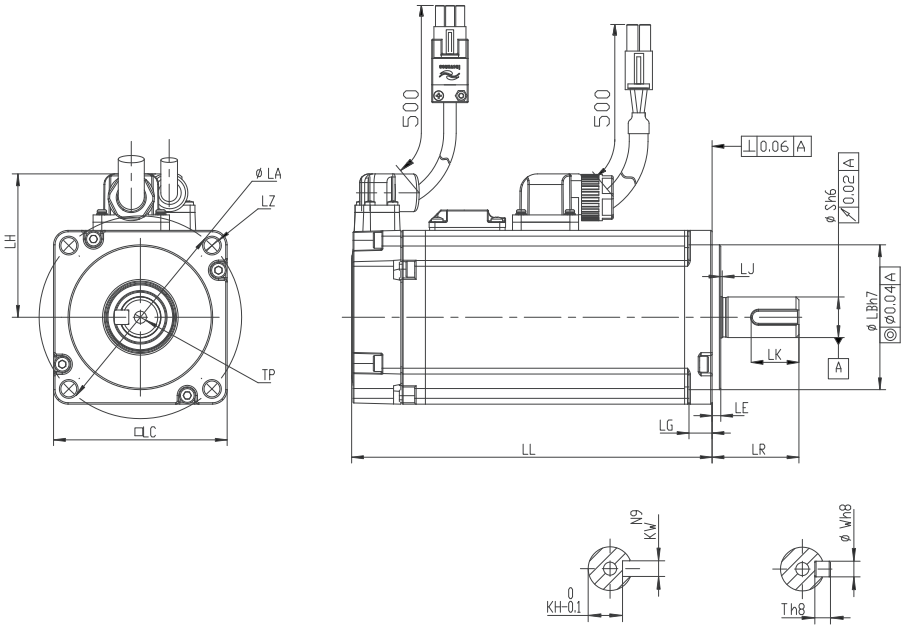
2.2.2 Installation Precautions

Table 2-2 Installation precautions

Item	Description
Rust-proof treatment	Wipe the antirust agent at the shaft extension before installing the servo motor, and then undertake rust-proof treatment.
Precautions on encoder	Do not strike the shaft extension during installation. Failure to comply will lead to damage to the internal encoder.  ● Use the screw hole at the shaft end when mounting a pulley to the servo motor shaft with a keyway. To fit the pulley, insert a double-end screw into the screw hole of the shaft, put a washer against the coupling end, and then use a nut to push the pulley in. ● If the servo motor shaft has a keyway, use the screw hole at the shaft end for installation. For a shaft without a keyway, use friction coupling or something similar. ● When removing the pulley, use a pulley remover to protect the shaft from suffering damage from the load. ● To ensure safety, install a protective cover, or a similar device, on the rotary area such as the pulley mounted on the shaft. 
Alignment	Use the coupling for mechanical connection and align the axis of the servo motor with the axis of the equipment. When installing the servo motor, make sure that alignment accuracy satisfies the requirements as described in the figure to the left. If the axes are not properly aligned, a vibration will be generated and may damage the bearings and encoder. 
Installation direction	The servo motor can be installed horizontally or vertically.

Item	Description
Oil and moisture countermeasures	● Do not immerse the servo motor and cables into oil or water during use. ● Confirm the IP rating of the servo motor when using it in a place with water droplets. (Except for the through shaft section)  ● Install the motor with its cable connection ports facing downward (as shown in the figure below) when the motor is installed in a place where there is liquid, to avoid liquid flowing along the cable to the motor body.  ● In an environment where the through shaft section is exposed to oil drops, use a servo motor with oil seal. ● Observe the following conditions when using the servo motor with oil seal: ● Make sure that the oil level is lower than the oil seal lip during use; ● Avoid oil accumulation at the oil seal lip when the motor is installed vertically upward.
Stress of cables	Do not bend the cables or the pull the cables tight. In particular, do not pull the thin signal cables during cabling and operating as the core wires are extremely fine (0.2 mm or 0.3 mm).
Connectors	● Observe the following precautions: ● When connecting the connectors, make sure that there is no foreign matter such as waste or sheet metal inside the connectors. ● Connect the connectors to the main circuit side of the servo motor first, and make sure that the grounding cable of the main circuit cables is reliably connected. If the connectors are first connected to the encoder cable side, the encoder may become faulty due to the potential differences between PEs. ● Make sure the pins are correctly arranged during wiring. ● The connectors are made up of resins. Do not strike the connectors to prevent them from being damaged. ● Hold the servo motor body during transportation when the cables are well connected, instead of catching the cables. Otherwise, the connectors may be damaged or the cables may be broken. ● Do not apply stress to the connectors during wiring if bent cables are used Failure to comply may cause damage to the connectors.

2.3 Physical Dimensions of the MS1H1 Series Motor



Shaft end diagram Keyed shaft end diagram

Motor Model	LL	LC	LR	LA	LZ	LH	LG	LE	LJ
MS1H1-05B30CB-A330Z-S	65	40	25±0.5	46	2 – φ4.5	40	5	2.5±0.5	0.5±0.35
MS1H1-05B30CB-A332Z-S	97	40	25±0.5	46	2 – φ4.5	40	5	2.5±0.5	0.5±0.35
MS1H1-10B30CB-A330Z-S	77.5	40	25±0.5	46	2 – φ4.5	40	5	2.5±0.5	0.5±0.35
MS1H1-10B30CB-A332Z-S	109	40	25±0.5	46	2 – φ4.5	40	5	2.5±0.5	0.5±0.35
MS1H1-20B30CB-A331Z-S	72.5	60	30±0.5	70	4 – φ5.5	49.5	7.5	3±0.5	0.5±0.35
MS1H1-20B30CB-A334Z-S	100	60	30±0.5	70	4 – φ5.5	49.5	7.5	3±0.5	0.5±0.35
MS1H1-40B30CB-A331Z-S	91	60	30±0.5	70	4 – φ5.5	49.5	7.5	3±0.5	0.5±0.35
MS1H1-40B30CB-A334Z-S	119	60	30±0.5	70	4 – φ5.5	49.5	7.5	3±0.5	0.5±0.35
MS1H4-40B30CB-A331Z-S	105	60	30±0.5	70	4 – φ5.5	49.5	7.5	3±0.5	0.5±0.35
MS1H4-40B30CB-A334Z-S	128	60	30±0.5	70	4 – φ5.5	49.5	7.5	3±0.5	0.5±0.35
MS1H1-55B30CB-A331Z-S	96	80	35±0.5	90	4 – φ7	59.5	7.7	3±0.5	0.5±0.35
MS1H1-75B30CB-A331Z-S	108	80	35±0.5	90	4 – φ7	59.5	7.7	3±0.5	0.5±0.35
MS1H1-75B30CB-A334Z-S	140.5	80	35±0.5	90	4 – φ7	59.5	7.7	3±0.5	0.5±0.35
MS1H1-10C30CB-A331Z-S	119	80	35±0.5	90	4 – φ7	59.5	7.7	3±0.5	0.5±0.35
MS1H4-75B30CB-A331Z-S	118.5	80	35±0.5	90	4 – φ7	59.5	7.7	3±0.5	0.5±0.35
MS1H4-75B30CB-A334Z-S	148	80	35±0.5	90	4 – φ7	59.5	7.7	3±0.5	0.5±0.35

Motor Model	S	LB	TP	LK	KH	KW	W	T	Weight (kg)
MS1H1-05B30CB-A330Z-S	8	30	M3×6	15.5	6.2 $^{0}_{-0.1}$	3	3	3	/
MS1H1-05B30CB-A332Z-S	8	30	M3×6	15.5	6.2 $^{0}_{-0.1}$	3	3	3	/
MS1H1-10B30CB-A330Z-S	8	30	M3×6	15.5	6.2 $^{0}_{-0.1}$	3	3	3	/
MS1H1-10B30CB-A332Z-S	8	30	M3×6	15.5	6.2 $^{0}_{-0.1}$	3	3	3	/
MS1H1-20B30CB-A331Z-S	14	50	M5×8	16.5	11 $^{0}_{-0.1}$	5	5	5	/
MS1H1-20B30CB-A334Z-S	14	50	M5×8	16.5	11 $^{0}_{-0.1}$	5	5	5	/
MS1H1-40B30CB-A331Z-S	14	50	M5×8	16.5	11 $^{0}_{-0.1}$	5	5	5	/
MS1H1-40B30CB-A334Z-S	14	50	M5×8	16.5	11 $^{0}_{-0.1}$	5	5	5	/
MS1H4-40B30CB-A331Z-S	14	50	M5×8	16.5	11 $^{0}_{-0.1}$	5	5	5	/
MS1H4-40B30CB-A334Z-S	14	50	M5×8	16.5	11 $^{0}_{-0.1}$	5	5	5	/
MS1H1-55B30CB-A331Z-S	19	70	M6×20	25	15.5 $^{0}_{-0.1}$	6	6	6	/
MS1H1-75B30CB-A331Z-S	19	70	M6×20	25	15.5 $^{0}_{-0.1}$	6	6	6	/
MS1H1-75B30CB-A334Z-S	19	70	M6×20	25	15.5 $^{0}_{-0.1}$	6	6	6	/
MS1H1-10C30CB-A331Z-S	19	70	M6×20	25	15.5 $^{0}_{-0.1}$	6	6	6	/
MS1H4-75B30CB-A331Z-S	19	70	M6×20	25	15.5 $^{0}_{-0.1}$	6	6	6	/
MS1H4-75B30CB-A334Z-S	19	70	M6×20	25	15.5 $^{0}_{-0.1}$	6	6	6	/

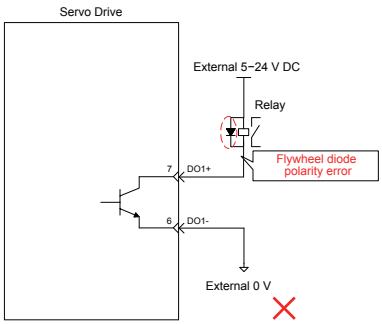
Chapter 3 Wiring

DANGER

- Wiring must be performed by professional technicians.
- To avoid the electric shock, leave the servo drive for more than five minutes after powered off, wait until the power indicator turns off completely, and check the voltage between P and N by using a multimeter. Then, disassemble or assemble the drive.
- Perform wiring after the servo drive and motor are installed properly. Failure to comply will result in electric shock.
- Do not damage the cables, lay them under large tension or pressure, or hang them. Failure to comply may result in electric shock.
- Insulate the power terminal connectors to prevent electric shock.
- The specifications and installation method of external cables must comply with the applicable local regulations.
- The cables must be copper and the grounding cable must be the yellow-green one as shown in Table 3-2.
- The entire system must be grounded.

CAUTION

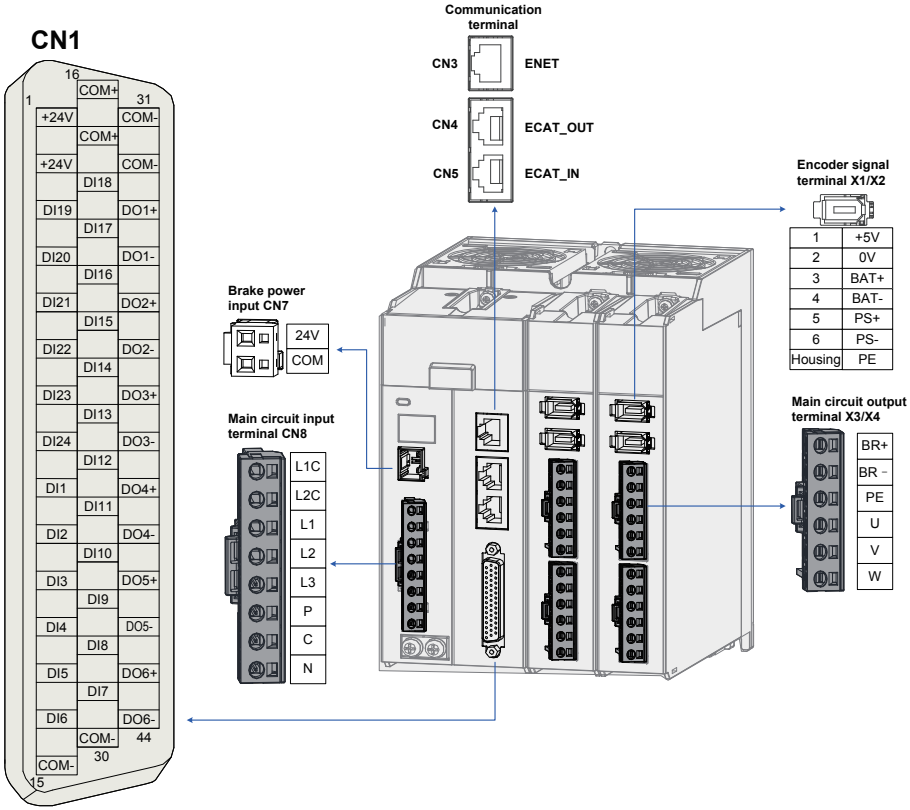
- Carry out wiring correctly. Failure to comply will result in abnormal action of the servo motor and personal injury.
- Do not mistake the terminal connection. Failure to comply may result in damage to the terminals.
- Make sure to connect the electromagnetic contactor between the power supply and main circuit of the drive (L1 and L2 for single-phase, and R, S and T for three-phase) to form a structure that can cut off the power supply at the power supply side of servo drive. If no electromagnetic contactor is connected, a fire may occur when a fault occurs and continuous large current flows through the drive.
- Use the ALM (fault signal) to cut off the main circuit power supply. If the braking transistor fails, the bleeder resistor may overheat, causing a fire.
- Before powering on, check the voltage specifications of the drive. NEVER connect the 380 V power supply to the 220 V drive. Failure to comply will damage the drive.
- Do not reverse the directions of the flywheel diode. Failure to comply will damage the drive and affect signal output.



- Use a noise filter to reduce electromagnetic interference on electronic devices around the drive.
- For the power supply and the main circuit connection, make sure that the main circuit power supply is cut off and the servo ON state changes to the OFF state after the alarm signal is detected.
- Connect the U, V, W cables of the drive to the U, V, W terminals of the motor directly. Do not connect an electromagnetic contactor. Failure to comply may result in abnormalities and faults.

Drive terminal pin layout:

Figure 3-1 Terminal pin arrangement of the SV820N servo drive



The preceding figure shows the pin arrangement of the terminals in the servo drive.

3.1 Servo Drive Main Circuit Wiring

3.1.1 Main Circuit Terminals

Main circuit input terminals of the SV820N multi-axis servo drive

Figure 3-2 Main circuit terminal arrangement

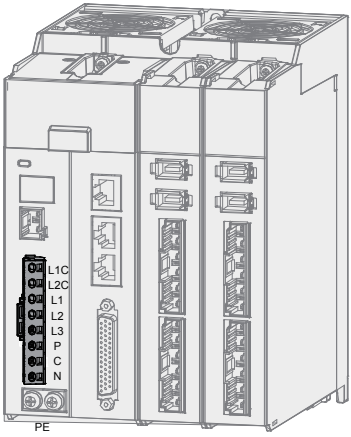
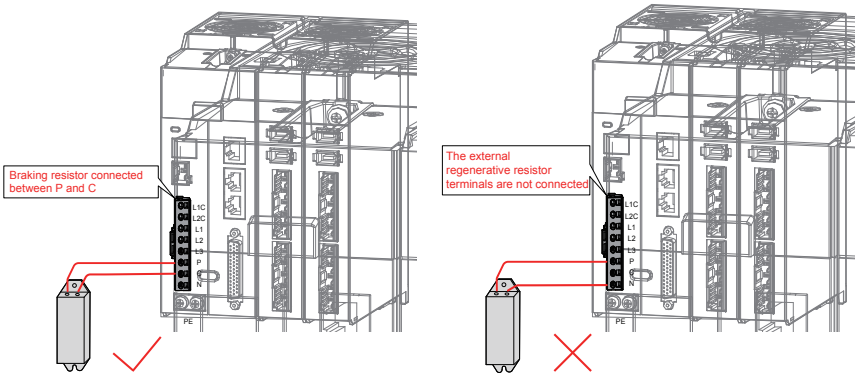


Table 3-1 Names and functions of the main circuit terminals of the SV820N servo drive

Terminal Symbol	Terminal Name	Terminal Function
L1, L2, L3	Main circuit power input terminals	Main circuit single-phase/three-phase 220 V power input. Terminals L1 and L2 are for single-phase power input, and terminals L1, L2 and L3 are for three-phase power input.
L1C, L2C	Control power input terminals	Control circuit 220 V AC power input.
P, C	Terminals for connecting external bleeder resistor	When large-inertia load needs braking for emergency stop, connect an external bleeder resistor between P and C. The external bleeder resistor needs to be purchased additionally.
P, N	Common DC bus terminal	They are used for common DC bus connection when multiple servo drives are under parallel control.
PE	Ground	Two grounding terminals of the servo drive are respectively connected to those of the power supply and the servo motor.

3.1.2 Examples of Bleeder Resistor Incorrect Wiring

Figure 3-3 Connection diagram of the external bleeder resistor



Observe the following precautions when connecting the external bleeder resistor:

1. Do not directly connect the external bleeder resistor to the bus's positive pole (P) and negative pole (N). Failure to comply will lead to damage of the servo drive or a fire.
2. Do not select any resistor lower than the minimum allowed resistance value. Failure to comply will result in Er.201 warning or damage to the drive.
3. Make sure that 2002-1Ah, 2002-1Bh and 2002-1Ch of the external bleeder resistor are accurately set before using the servo drive.
4. Install the external bleeder resistor on incombustible matters (such as a metal).

3.1.3 Recommended Models and Specifications of the Main Circuit Cables

The figure below shows the connectors of the main circuit cables. These connectors accompany the complete drive (model to be complemented at the time of producing in batches).

Figure 3-4 Figure of the main circuit cable connectors

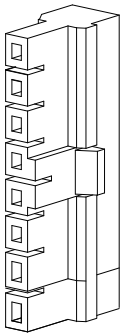


Table 3-2 Recommended main circuit cable and cable model for SV820N series servo drive

No.	Drive Model Single-phase 220 V	Rated Input Current (A)	Recommended Input Power Cable		Rated Output Current (A)	Recommended Output Power Cable		Recommended Grounding Cable	
			mm^2	AWG		mm^2	AWG	mm^2	AWG
1	SV820N1S2C2C	4.6	2 x 0.5	20	2.80	2 x 0.5	20	0.50	20

For other requirements on the main circuit cables, refer to "3.1.5 Precautions for Main Circuit Wiring" for details.

The following table describes the main circuit cables:

Table 3-3 Recommended main circuit cables

Cable Type		Allowed Temperature (℃)
Model	Name	
PVC	General PVC cable	-
IV	PVC cable rated 600 V	60
HIV	Special heat resistant PVC cable	75

The following table describes the relation between the 3-cable diameter and current. The actual value shall not exceed the value in the table.

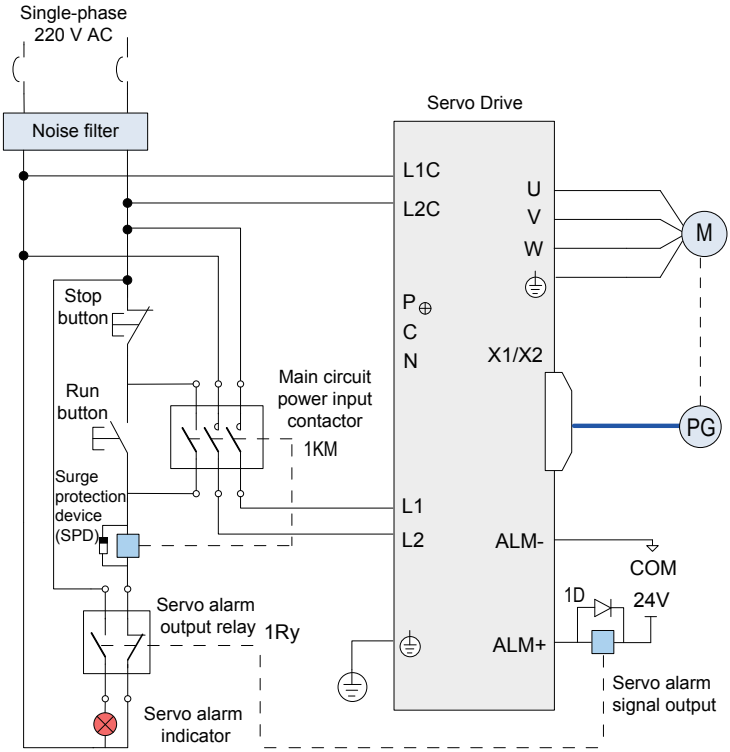
Table 3-4 3-cable specifications

AWG Specification	Nominal Sectional Area (mm^2)	Allowable Current in Different Ambient Temperatures (A)		
		30°C	40°C	50°C
20	0.519	8	7	6
19	0.653	9	8	7
18	0.823	13	11	9

3.1.4 Power Supply Wiring Example

Models using single-phase 220 V power: SV820N1S2C2C

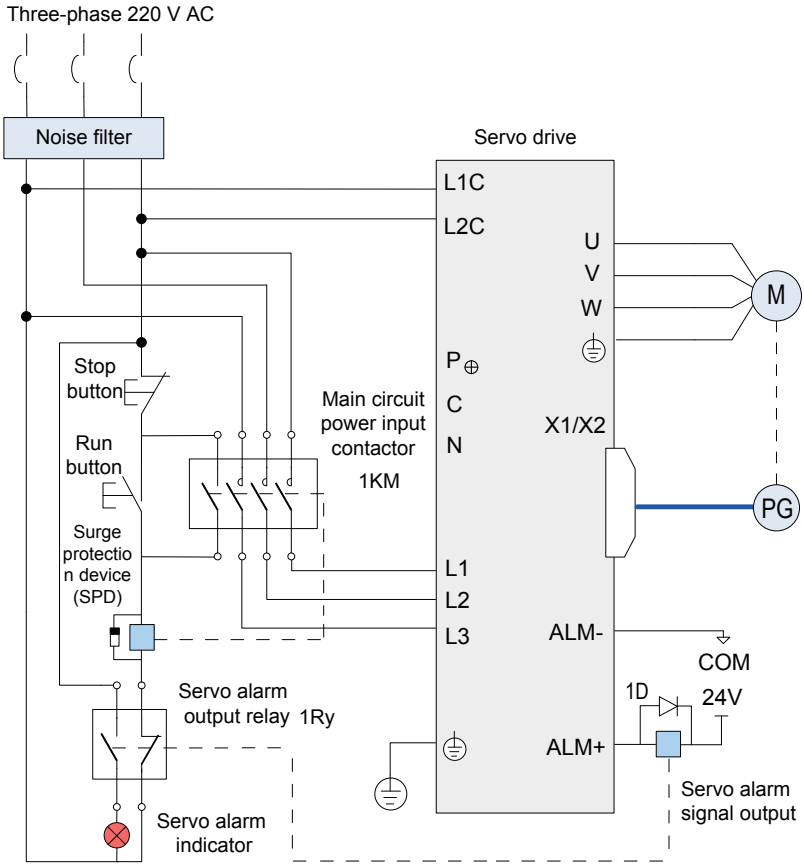
Figure 3-5 Main circuit wiring for single-phase 220 V power



Note	• 1KM: Electromagnetic contactor; 1RY: Relay; 1D: Flywheel diode; • DOs are set as fault output (ALM+/-); when the servo drive alarms, the power supply is cut off automatically. This series does not have a built-in bleeder resistor, therefore connect an external bleeder resistor between P and C if required.

Models using three-phase 220 V power: SV820N1S2C2C

Figure 3-6 Main circuit wiring for three-phase 220 V power

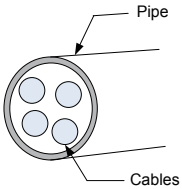


Note	• 1KM: Electromagnetic contactor; 1RY: Relay; 1D: Flywheel diode; • DOs are set as fault output (ALM+/-); when the servo drive alarms, the power supply is cut off automatically and the alarm indicator turns ON.

3.1.5 Precautions for Main Circuit Wiring

1. Do not connect the input power cables to the output terminals U, V and W. Failure to comply will cause damage to the servo drive.
2. When cables are bundled in a duct, take current reduction into consideration since the heat dissipation condition deteriorates.
3. When temperature inside the cabinet is higher than the temperature limit of the cables, select those cables with a higher temperature limit. Teflon cables are recommended. As the surface of general cables is easy to harden and break, take thermal insulation measures for cables laid in a low temperature environment.
4. The bending radius of a cable shall exceed 10 times that of its outer diameter to prevent the internal wire core from breaking due to long time bending.
5. Select and use cables with rated voltage of 600 V AC (and above) and temperature of 75°C (and above). Under the ambient temperature of 30°C and normal heat dissipation conditions, the allowable current density of the cables shall not exceed 8 A/mm^2 when the total current is below 50 A, or 5 A/mm^2 when the total current is above 50 A. This value can be adjusted when the ambient temperature is high or when the cables are bundled. The allowable current density (A/mm^2) is calculated as follow:

Allowable current density = 8 × reduction coefficient of current-carrying conductor density × current correction coefficient



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

6. The bleeder resistor cannot be connected between DC bus terminals P and C. Failure to comply may cause a fire.
7. Do not bundle power cables and signal cables together or run them through the same duct. Power and signal cables shall be separated by at least 30 cm to prevent interference.
8. High voltage may still remain in the servo drive when the power supply is cut off. Do not touch the power terminals within 5 minutes after powering off.
9. Do not frequently turn ON and OFF the power supply. If the power supply needs to be switched on or off repeatedly, make sure that the time interval is at least one minute. As the servo drive contains a capacitor in the power supply, a large charging current flows for 0.2 seconds when the power supply is turned OFF. Frequently turning ON and OFF the power supply will deteriorate performance of the main circuit components inside the servo drive.
10. Use a grounding cable with the same cross-sectional area as the main circuit cable. If the cross-sectional area of the main circuit cable is less than 1.6 mm^2, use a grounding cable with a cross-sectional area of 2.0 mm^2.
11. Ground the servo drive to the earth reliably.
12. Do not power on the servo drive if any cables become loose. Otherwise, a fire may occur.

3.1.6 Specifications of Main Circuit Peripheral Parts

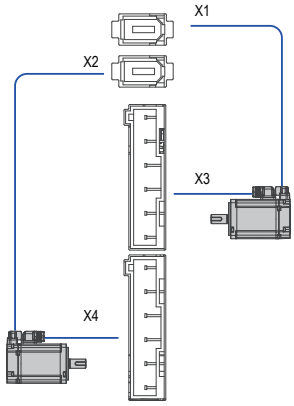
Recommended circuit breaker and electromagnetic contactor:

Table 3-5 Models of recommended circuit breaker and electromagnetic contactor

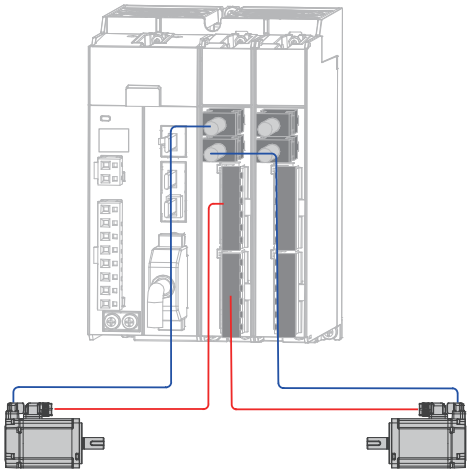
Main Circuit Power Supply	Drive Model	Recommended Circuit Breaker		Recommended Contactor	
		Current (A)	Schneider Model	Current (A)	Schneider Model
Single/Three-phase 220 V	SV820N1S**** SV820N2S****	6	OSMC32N3C6	9	LC1 D09

3.2 Wiring of Motor Cables Between Servo Drive and Servo Motor

A complete servo drive consists of two drive units with each drive unit supporting two motors. When connecting motors to the drive units, identify the terminal silk print on the drive units and use correct terminals for wiring (X1 matches with X3, and X2 matches with X4)



Actual connection diagram:



3.3 Wiring of Power Cables Between the Servo Drive and Servo Motor

3.3.1 Wiring of the Motor Power Cables with the Brake

Figure 3-7 Example of connecting the servo drive and servo motor

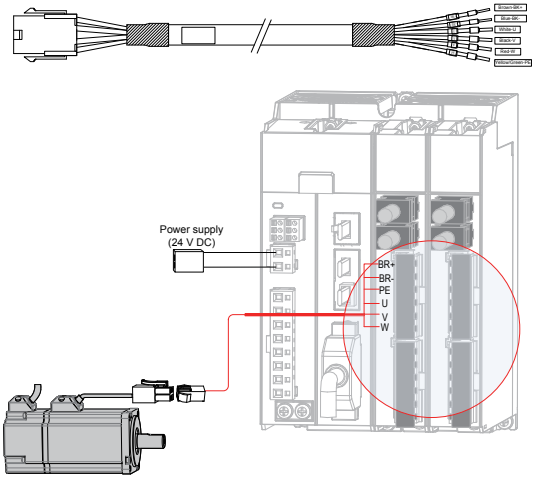
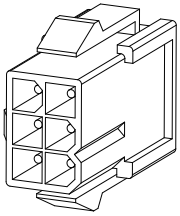
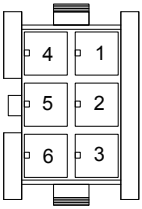


Table 3-6 Connectors of power cables on the servo motor side

Connector Appearance	Terminal Pin Layout	Frame Size of Adaptable Motor
	Black 6-pin connector 	40 (Z series) 60 (Z series) 80 (Z series)

Pin No.	Signal	Color
1	U	White
2	V	Black
4	W	Red
5	PE	Yellow/Green
3	BR+	Brown
6	BR-	Blue

Recommended:

- Plastic housing: MOLEX-50361736
- Terminal: MOLEX-39000061

Note	Frame size of the motor indicates the width of the motor flange.

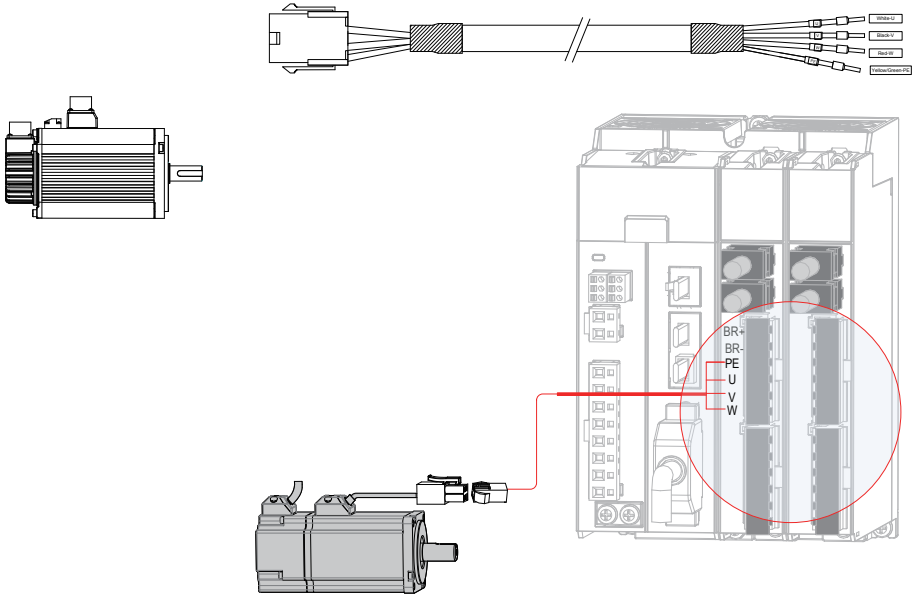
The power cable colors are subject to the actual cables. The cable colors mentioned in the guide are colors of all Inovance cables.

3.3.2 Wiring of the Motor Power Cables without the Brake

When motors without a brake are connected to the drive, it is not necessary to connect the two brake signal terminals (BR+ and BR–), as shown in the figure below.

Other connections should be performed in the same way as the motors with brake. Refer to "3.3.1 Connection of power cables of motor with a brake" for details.

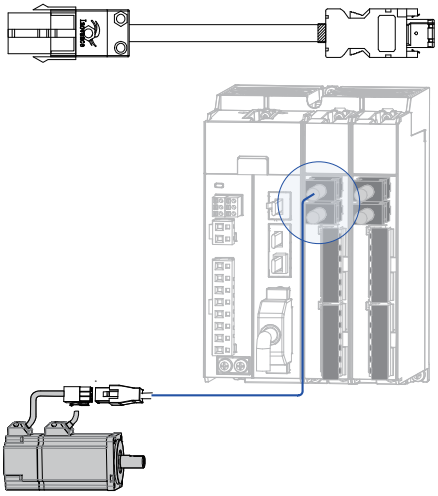
Figure 3-8 Connection diagram of power cables of a motor without a brake



3.4 Wiring of Encoder Cables

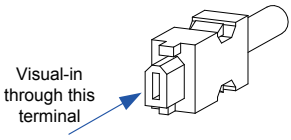
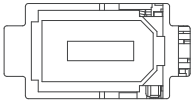
3.4.1 Connection of Series Incremental Encoder

Figure 3-9 Example of connecting encoder signal cables



The encoder cable colors are subject to the actual cables. The cable colors mentioned in the guide are colors of all Inovance cables.

Table 3-7 Connectors of SV820N series 20-bit encoder cables on servo drive side

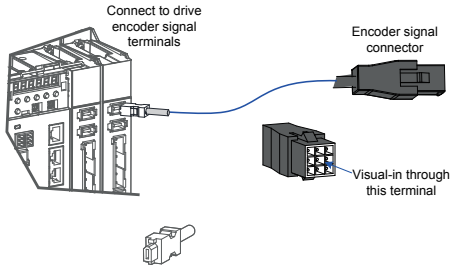
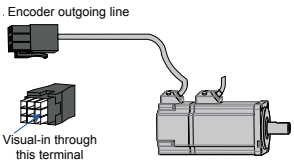
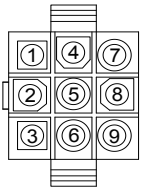
Connector Appearance	Terminal Pin Layout
	

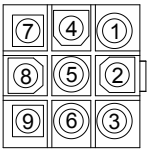
Pin No.	Signal
1	+5V
2	0V
3	Reserved
4	Reserved
5	PS+
6	PS-
Housing	PE

Recommended:

Connectors at cable side: Sunchu, IEEE 1394 (6-pin, solder type, provided with a casing)

Table 3-8 Connectors of SV820N series 20-bit encoder cables (9-pin connector)

<table>
<tr><th colspan="2">Connector Appearance and the Terminal Pin Layout</th><th>Frame Size of an Adaptable Motor [Note]</th></tr>
<tr><td> 
</td><td> 
</td><td rowspan="2">40
60
80</td></tr>
<tr><td>9-pin connector
 

<table>
<tr><th>Pin No.</th><th>Signal</th><th></th></tr>
<tr><td>3</td><td>PS+</td><td rowspan="2">Pair twisted</td></tr>
<tr><td>6</td><td>PS-</td></tr>
<tr><td>9</td><td>+5V</td><td rowspan="3"></td></tr>
<tr><td>8</td><td>GND</td></tr>
<tr><td>7</td><td>Shield</td></tr>
</table>
Recommended:
● Plastic casing: AMP 172161-1;
● Terminal: AMP 770835-1</td><td>9-pin connector
 

<table>
<tr><th>Pin No.</th><th>Signal</th><th>Color</th><th></th></tr>
<tr><td>3</td><td>PS+</td><td>Yellow</td><td rowspan="2">Pair twisted</td></tr>
<tr><td>6</td><td>PS-</td><td>Blue</td></tr>
<tr><td>9</td><td>+5V</td><td>Red</td><td rowspan="3"></td></tr>
<tr><td>8</td><td>GND</td><td>White</td></tr>
<tr><td>7</td><td>Shield</td><td></td></tr>
</table></td></tr>
</table>

Note	Frame size of the motor indicates the width of the motor flange.

Table 3-9 9-pin connection relation of 20-bit encoder cables of SV820N series

DB9 on Servo Drive Side		Function Description 9 PIN	Motor Side	
			20-29 Aviation Plug	
Signal	Pin No.		Pin No.	Pin No.
PS+	5	Serial communication signal +	3	A
PS-	6	Serial communication signal -	6	B
+5V	1	Encoder +5 V power supply	9	G
GND	2	Encoder +5 V power ground	8	H
PE	Housing	Shield	7	J

Observe the following precautions when wiring the encoder:

Correctly ground the servo drive and shield of the servo motor. Otherwise, the servo drive will report a false alarm.

Do not connect cables to the "Reserved" terminals.

To determine the length of the encoder cable, consider the voltage drop caused by the cable resistance and signal attenuation caused by the distributed capacitance. It is recommended to use a twisted-pair cable of size 26 AWG or above (as per UL2464 standard) which is 10 m long or shorter.

It is recommended that the 22–26 AWG cables and matching AMP170359-1 terminals be used for the 10B, 20B, 40B, and 75B series motors. If longer cables are required, cables of a larger diameter should be used, as described in the following table.

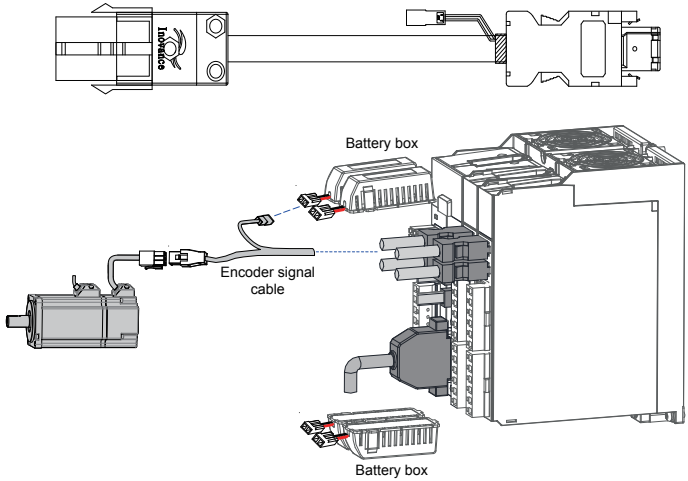
Table 3-10 Recommended cables

Diameter	Ω/km	Allowable Length (m)
26 AWG (0.13 mm^2)	143	10.0
25 AWG (0.15 mm^2)	89.4	16.0
24 AWG (0.21 mm^2)	79.6	18.0
23 AWG (0.26 mm^2)	68.5	20.9
22 AWG (0.32 mm^2)	54.3	26.4

If the cables of above 22 AWG are required, contact Inovance's sales personnel.

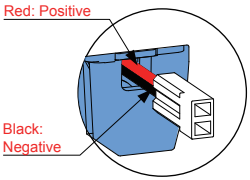
3.4.2 Connection of Absolute Encoder Cable

Figure 3-10 Example of connection of signal cable and battery box of absolute encoder



Color of battery box outer lead:

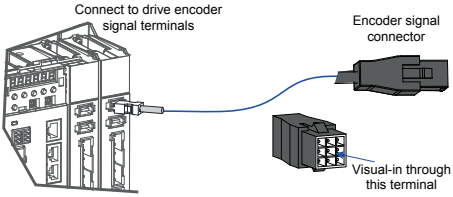
Figure 3-11 Battery box outer lead of absolute encoder

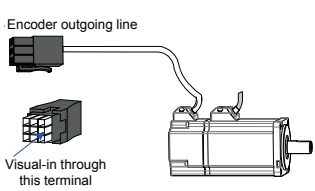


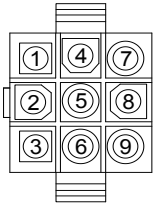
Note	Store the battery in the required ambient temperature and ensure reliable contact and sufficient electricity. Failure to comply may cause loss of the encoder position information.

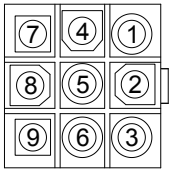
Specification of absolute encoder cables

Table 3-11 Connectors of SV820N series 20-bit encoder cables (9-pin connector)

<table>
<tr><th>Connector Appearance and the Terminal Pin Layout</th><th>Frame Size of the Adaptable Motor [Note]</th></tr>
<tr><td>




</td><td rowspan="2">40
60
80</td></tr>
<tr><td>
9-pin connector


Recommended:
Plastic casing: AMP 172161-1;
Terminal: AMP 170359
<table>
<tr><th>Pin No.</th><th>Signal</th><th></th></tr>
<tr><td>1</td><td>Battery +</td><td rowspan="2"></td></tr>
<tr><td>4</td><td>Battery -</td></tr>
<tr><td>3</td><td>PS+</td><td rowspan="2">Pair twisted</td></tr>
<tr><td>6</td><td>PS-</td></tr>
<tr><td>9</td><td>+5V</td><td rowspan="3"></td></tr>
<tr><td>8</td><td>GND</td></tr>
<tr><td>7</td><td>Shield</td></tr>
</table>
9-pin connector


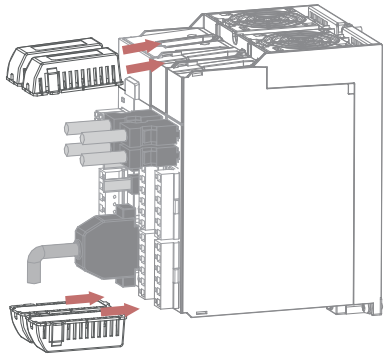
<table>
<tr><th>Pin No.</th><th>Signal</th><th>Color</th><th></th></tr>
<tr><td>1</td><td>Battery +</td><td>Blue</td><td rowspan="2"></td></tr>
<tr><td>4</td><td>Battery -</td><td>Blue and black</td></tr>
<tr><td>3</td><td>PS+</td><td>Yellow</td><td rowspan="2">Pair twisted</td></tr>
<tr><td>6</td><td>PS-</td><td>Yellow and black</td></tr>
<tr><td>9</td><td>+5V</td><td>Red</td><td rowspan="3"></td></tr>
<tr><td>8</td><td>GND</td><td>Black</td></tr>
<tr><td>7</td><td>Shield</td><td></td></tr>
</table>
</td></tr>
</table>

Note	Frame size of the motor indicates the width of the motor flange.

Installing the battery box

- Model of the battery box accessory: SV82-C4, including:
  1 plastic box
  1 battery (3.6 V, 2,600 mAh)
  Terminal block and crimping terminal
- Installation of the battery box:

Figure 3-12 Installation diagram of the battery box for the absolute encoder

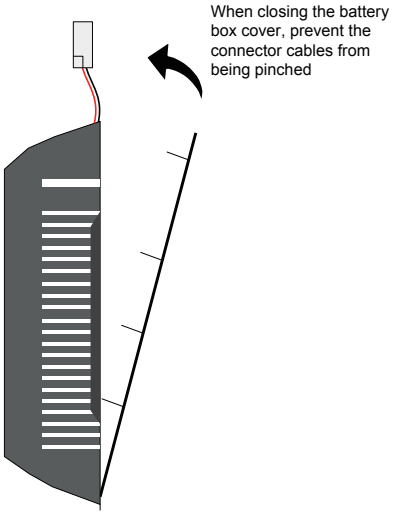


Directly insert the battery box into the corresponding slot on the drive, ensure it is inserted correctly to prevent loosening.

Removing the battery box

The battery may have leakage after a long-time use. Replace it every two years. Remove the battery box in reversed order to the steps outlined in the preceding figure.

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



Note	Improper use of battery may result in battery leakage which will corrode the components or cause the battery to explode. Observe the following precautions during use: 1. Place the battery in the correct +/– polarity; 2. If you place a battery that has been used for a long time or a dead battery in the device, battery leakage may occur, corroding surrounding components; as the battery is conductive it may cause a short circuit. Replace the battery periodically (recommended period: Every 2 years). 3. NEVER decompose the battery, so as to prevent personal injury by spraying of electrolyte. 4. NEVER put the battery in a fire. Failure to comply may result in an explosion. 5. Prevent a battery short circuit, and never strip the battery tube. Do not connect metal to the electrodes of the battery. Otherwise, a large current is produced, weakening the battery power which could result in an explosion due to severe heating. 6. This battery is not chargeable. 7. Reminder: Dispose the battery according to local regulations.

Battery selection:

Select an appropriate battery according to the following table.

Table 3-12 Battery description for the absolute encoder

Battery Specification	Item and Unit	Rated Value			Condition
		Minimum Value	Typical Value	Maximum Value	
Output: 3.6 V, 2,500 mAh Recommended manufacturer and model: Shenzhen Jieshun Science and Technology Industry Co., Ltd., LS14500	External battery voltage (V)	3.2	3.6	5	In standby mode*2
	Circuit fault voltage (V)		2.6		In standby mode
	Battery alarm voltage (V)	2.85	3	3.15	
	Current consumed by circuit (uA)		2		During normal operation*1
			10		In standby mode, axis static
			80		In standby mode, axis rotation
	Battery working ambient temperature (°C)	0		40	The same as that required by the motor
	Battery storage ambient temperature (°C)	–20		60	

The preceding data is measured in the ambient temperature of 20°C.

Note	*1: Normal operation means that the absolute encoder can count, receive and send data generated from single rotation and multiple rotations. After the absolute encoder is correctly connected , it will work normally and receive and send data after a short delay (about 5 seconds) when the servo drive is powered on. Switching the absolute encoder from standby mode to normal operation mode (power is on) requires the motor to rotate at a speed less than 10 RPM, otherwise the drive may report 740 error. In this case, power on the servo drive again. *2: Standby mode means that the servo drive is not powered on and the absolute encoder can perform multi-rotation counting by utilizing external battery power. In this mode, the absolute encoder stops receiving and sending data.

Theoretical lifetime of battery:

The calculation below only considers the current consumed by the encoder and does not cover the current consumed by the battery itself.

Assume that the drive works normally for T1 in a day, the motor rotates for T2 after the drive is powered off, and the motor stops rotating for T3 after power off [unit: hour (H)]

Example:

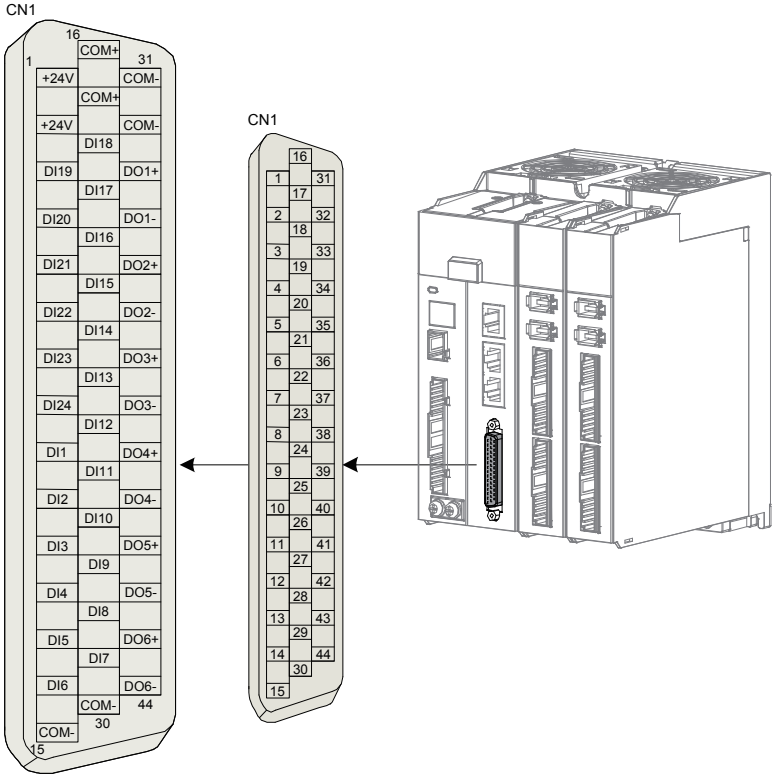
Table 3-13 Theory lifetime of absolute encoder battery

Item	Working Time 1	Working Time 2
Number of days the battery works under different working conditions (day) in 1 year	313	52
T1 (H)	8	0
T2 (H)	0.1	0
T3 (H)	15.9	24

- Battery power consumed in 1 year = (8 H *2 uA + 0.1 H*80 uA + 15.9 H*10 uA)*313 + (0 H *2 uA + 0 H*80 uA +24 H*10 uA)*52 ≈ 70 mAH
- Battery theory lifetime = Battery capacity/Battery power consumed in 1 year = 2,600 mAH/70 mAH = 37.1 years

3.5 Wiring to Control Signal Terminal CN1 of Servo Drive (DI/DO)

Figure 3-13 Pin layout of control circuit terminal connector of servo drive



Plastic casing of plug on cable side: DB25P (SZTDK), black casing; Core: HDB44P (SZTDK).

It is recommended to use 24–26 AWG cables.

Table 3-14 DI/DO signal description

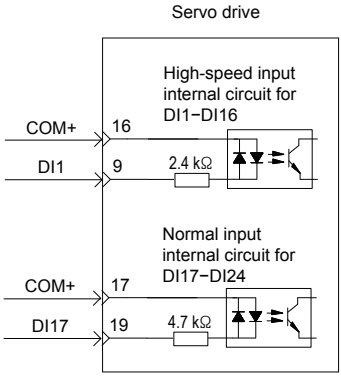
Signal	Pin No.	Function Description	Signal	Pin No.	Function Description
DI1	9	High-speed digital input signal 1	DO1+	33	Digital output signal 1 (positive terminal)
DI2	10	High-speed digital input signal 2	DO1-	34	Digital output signal 1 (negative terminal)
DI3	11	High-speed digital input signal 3	DO2+	35	Digital output signal 2 (positive terminal)
DI4	12	High-speed digital input signal 4	DO2-	36	Digital output signal 2 (negative terminal)
DI5	13	High-speed digital input signal 5	DO3+	37	Digital output signal 3 (positive terminal)
DI6	14	High-speed digital input signal 6	DO3-	38	Digital output signal 3 (negative terminal)
DI7	29	High-speed digital input signal 7	DO4+	39	Digital output signal 4 (positive terminal)
DI8	28	High-speed digital input signal 8	DO4-	40	Digital output signal 4 (negative terminal)
DI9	27	High-speed digital input signal 9	DO5+	41	Digital output signal 5 (positive terminal)
DI10	26	High-speed digital input signal 10	DO5-	42	Digital output signal 5 (negative terminal)
DI11	25	High-speed digital input signal 11	DO6+	43	Digital output signal 6 (positive terminal)
DI12	24	High-speed digital input signal 12	DO6-	44	Digital output signal 6 (negative terminal)
DI13	23	High-speed digital input signal 13			
DI14	22	High-speed digital input signal 14			
DI15	21	High-speed digital input signal 15			
DI16	20	High-speed digital input signal 16			
DI17	19	General digital input signal 17			
DI18	18	General digital input signal 18			
DI19	3	General digital input signal 19			
DI20	4	General digital input signal 20			
DI21	5	General digital input signal 21			
DI22	6	General digital input signal 22			
DI23	7	General digital input signal 23			
DI24	8	General digital input signal 24			

Note

- DI1–DI16 are high-speed DIs.
- DI17–DI24 are general DIs.

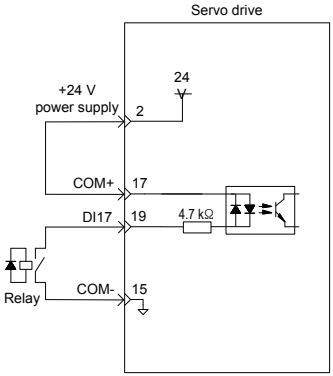
3.5.1 DI Circuit

DI1 – DI24 interface circuits are the same, in which the input current limiting resistor for DI1–DI16 is 2.4 kΩ. The following takes DI17 interface circuit as an example.

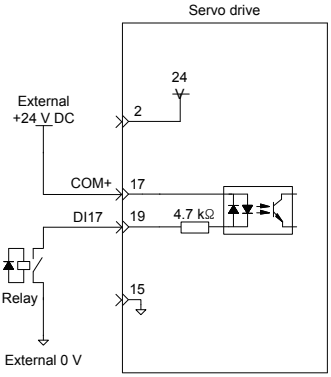


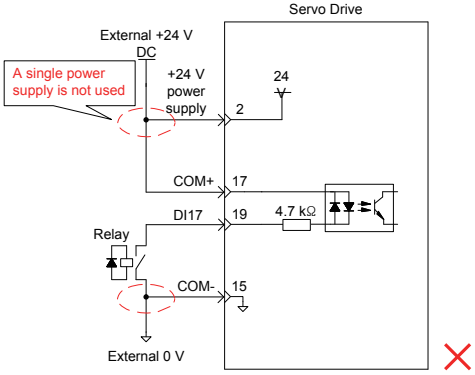
When the host controller provides relay output:

- When the internal 24 V power supply of the servo drive is used:



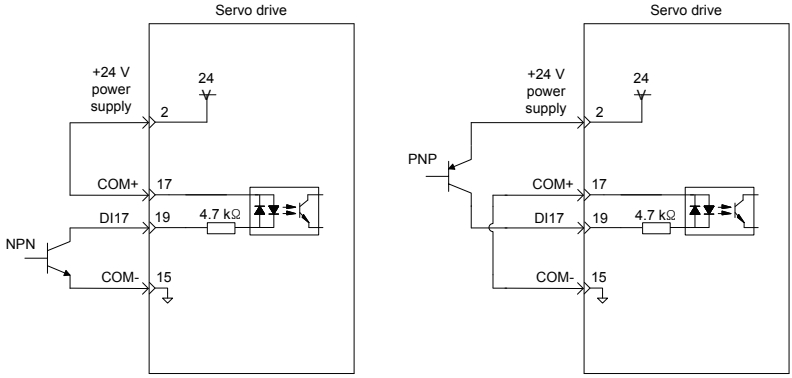
- When the external power supply is used:



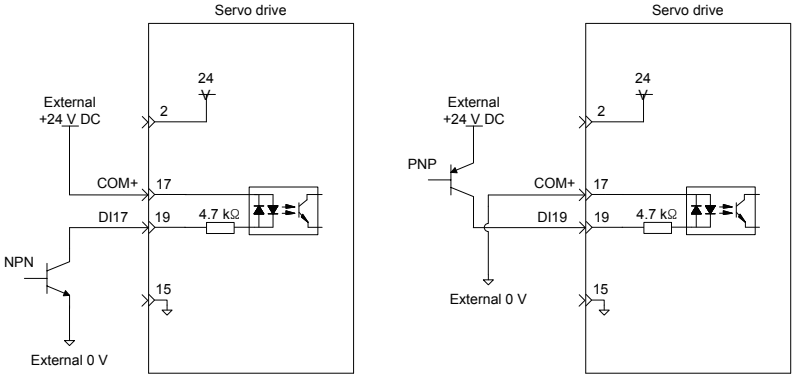


When the host controller provides OC output:

- When the internal 24 V power supply of the servo drive is used:



- When the external power supply is used:

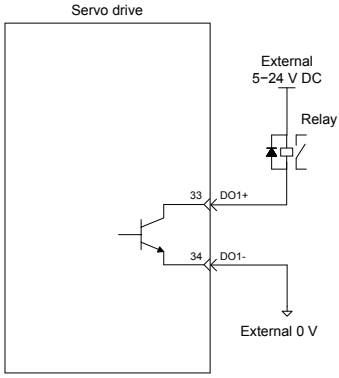


Note	PNP and NPN input cannot be applied in the same circuit.

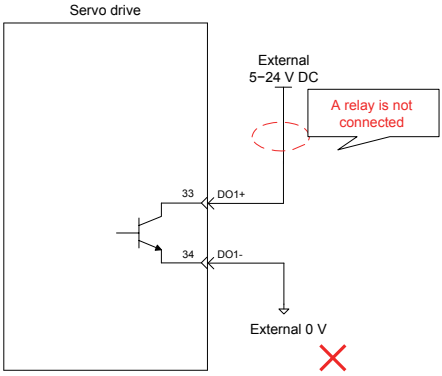
3.5.2 DO Circuit

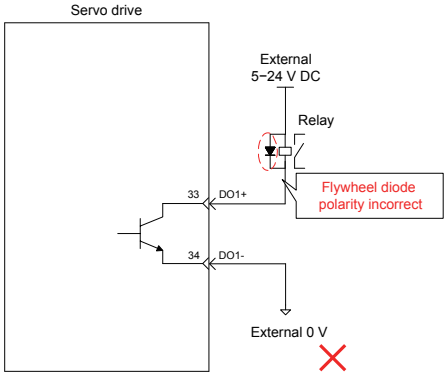
DO1–DO6 interface circuits are the same. The following takes DO1 interface circuit as an example.

When the host controller provides relay input:

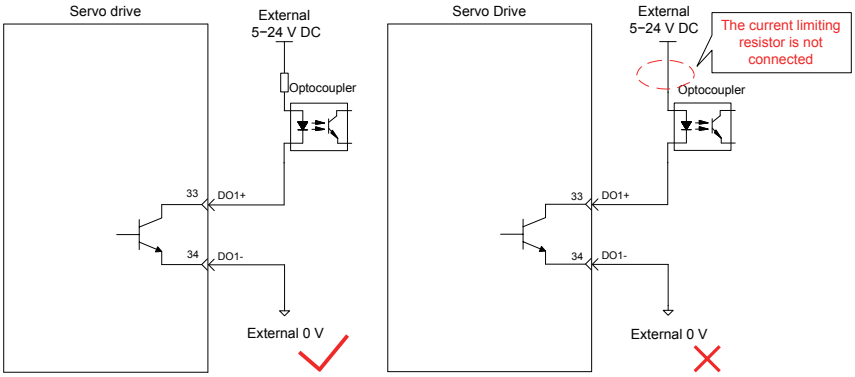


Note	When the host controller provides relay input, a flywheel diode must be installed, otherwise, the DO ports may be damaged.





When the host controller provides optocoupler input:



Note	The maximum allowable voltage and current of the optocoupler output circuit inside the servo drive are as follows: • Maximum voltage: 30 V DC • Maximum current: DC 50 mA

3.6 Wiring to Communication Signal Connectors (CN4/CN5)

3.6.1 Wiring Diagram

Figure 3-14 Network topology of communication group

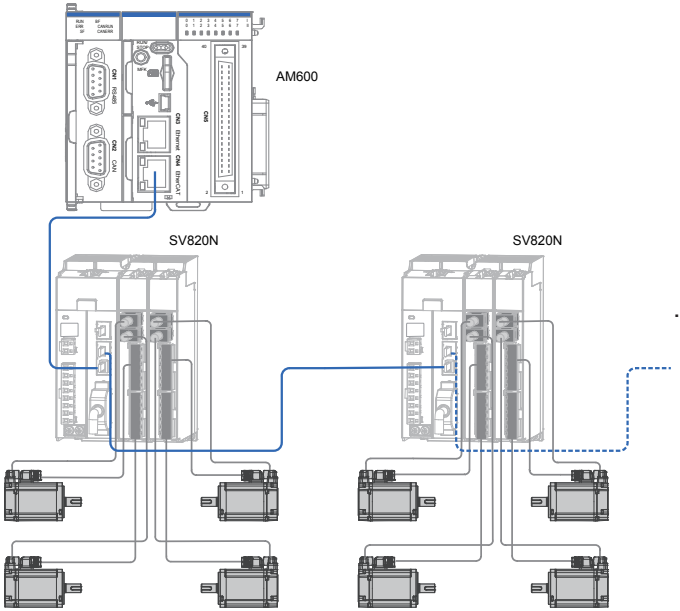
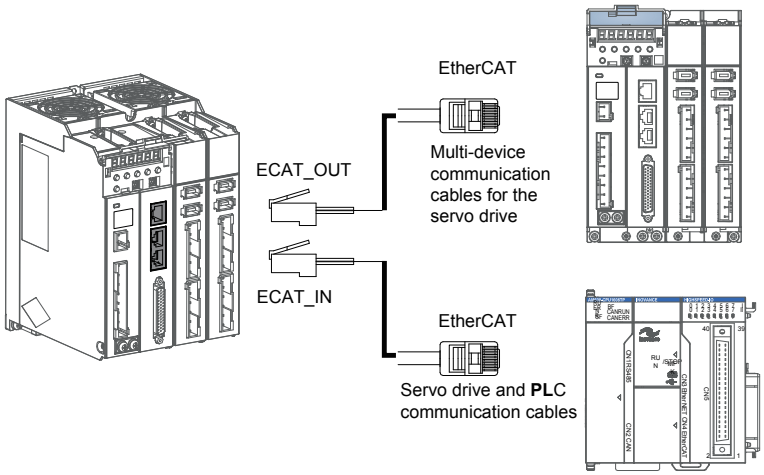
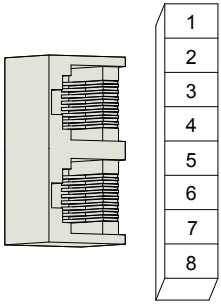


Figure 3-15 Communication wiring diagram



Communication signal connectors (CN4 and CN5) are EtherCAT interface connectors. The interface line from the master station is connected to CN5 (IN), and CN4 (OUT) is connected to the next slave device.

Table 3-15 Pin definition of communication signal terminal connectors

Pin No.	Signal	Function Description	Terminal Pin Layout
1	TX+	Data transmit+	
2	TX-	Data transmit-	
3	RX+	Data receive+	
4	-	-	
5	-	-	
6	RX-	Data receive–	
7	-	-	
8	-	-	
Housing	PE	Shield	

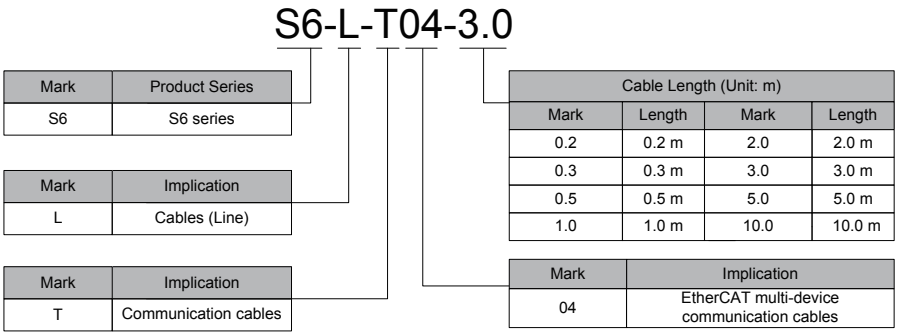
3.6.2 Selection of Communication Cables

Selection principle

Specification	Supplier
0.2 m–10 m	Inovance
More than 10 m	Haituo

Basic information about EtherCAT communication cables of Inovance

Cable models are as follows:



Cable ordering information:

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

Cables of 10 m long or shorter: must be purchased from Inovance;

Cables longer than 10 m: to be purchased from Haituo

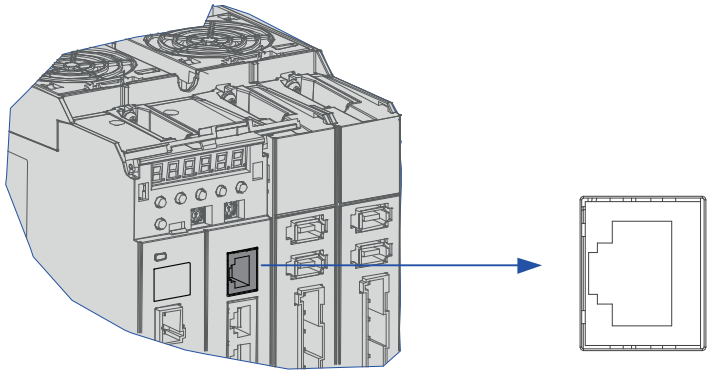
Specification and characteristics:

Item	Detailed Description
UL certification	Comply with UL certification
CAT.5E cable	CAT.5E cable
Double shield	Braided shield (coverage 85%), aluminum foil shield (coverage 100%)
Environmental adaptability	Working ambient temperature: –30–+60°C ; resistant to industrial oil and corrosive acid and alkali.
EMC testing standard	GB/T 24808-2009

3.7 Wiring of Signal Connector Between Background Communication and Online Upgrade (CN3)

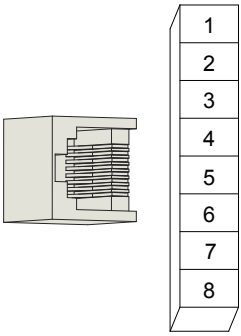
Arrangement of Ethernet(CN3) terminals:

Figure 3-16 Ethernet connector terminal



Pin definition of CN3 (Ethernet connector terminal) is the same as that of CN4/CN5. Refer to Table 4-27 for details.

Table 3-16 Pin definition of communication signal terminal connectors

Pin No.	Signal	Function Description	Terminal Pin Layout
1	TX+	Data transmit+	
2	TX-	Data transmit-	
3	RX+	Data receive+	
4	-	-	
5	-	-	
6	RX-	Data receive–	
7	-	-	
8	-	-	
Housing	PE	Shield	

Note	Communication cables are the same as cables for multi-device communication (S6-L-T04).

3.8 Anti-interference Measures for Electrical Wiring

Take the following measures to suppress interference:

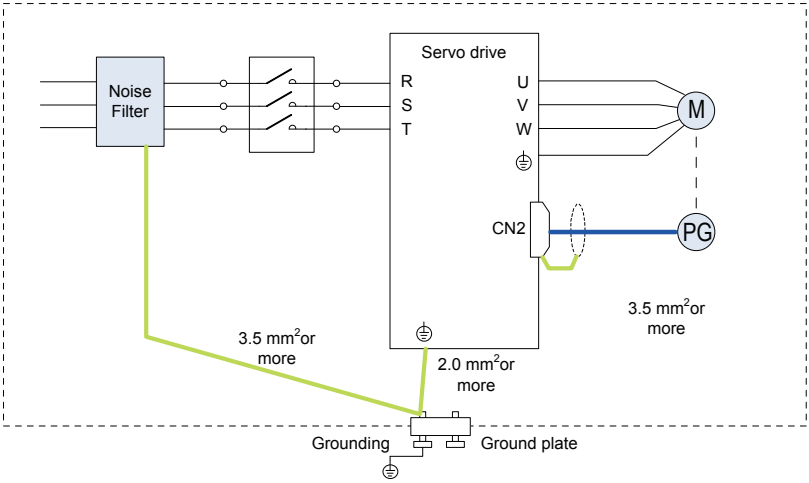
1. Ensure that the reference input cable is shorter than 3 m, and the encoder cable is shorter than 20 m and both types of cables are shielded twisted pair.
2. Use a thick cable as the grounding cable. (Recommended to be more than 2.0 mm^2)
3. D class (or higher class) grounding is recommended (grounding resistance is below 100 Ω).
4. Use one-point grounding.
5. Use a noise filter to prevent radio frequency interference. For a home application or an application with noise interference, install the noise filter on the input side of the power supply line.
6. To prevent malfunction due to electromagnetic interference, take the following measures:
   a. Install the host controller and noise filter as close to the servo drive as possible.
   b. Install a surge protection device (SPD) on the relay, solenoid and electromagnetic contactor coils.
   c. The distance between a strong-current cable and a weak-current cable must be at least 30 cm. Do not put these cables in the same duct or bundle them together.
   d. Do not share the power supply with an electric welder or electrical discharge machine. When the servo drive is placed near a high-frequency generator, install a noise filter on the input side of the power supply line.

3.8.1 Anti-interference Wiring Example and Grounding

As the servo drive's main circuit uses "high-speed switch elements", the difference between the peripheral wiring and grounding may result in noise from the switch, influencing the system's normal operation. Thus, the servo drive must be properly wired and grounded. A noise filter can be added if necessary.

Anti-interference wiring example

Figure 3-17 Anti-interference wiring example



Note	• For the grounding cable connected to the casing, use a thick cable with an area of at least 3.5 mm^2. Braided copper wires are recommended. • If a noise filter is used, observe the precautions as described in the "Using a Noise Filter" section.

Grounding

To prevent potential magnetic interference, conduct grounding correctly according to the following instructions.

■ **Grounding the servo motor housing**

Connect the grounding terminal of the servo motor to the PE terminal of the servo drive and correctly ground the PE terminal, to reduce potential magnetic interference.

■ **Grounding the shield of the encoder cable**

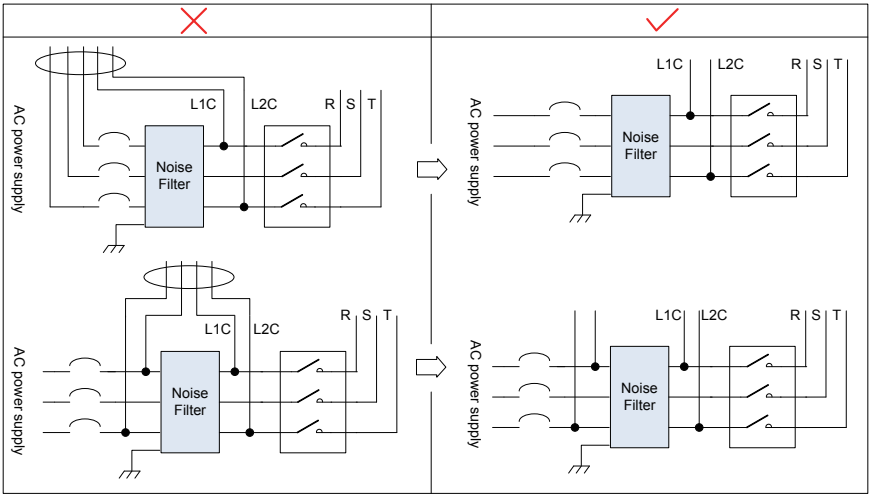
Tie the shield of the motor encoder cable to ground at both ends.

3.8.2 Using a Noise Filter

To prevent interference from power cables and reduce impact of the servo drive to other sensitive devices, install a noise filter on the input side of the power supply according to the input current. In addition, install a noise filter on the power supply line of peripheral devices if necessary. Observe the following precautions when installing and wiring the noise filter to avoid influencing its actual effect.

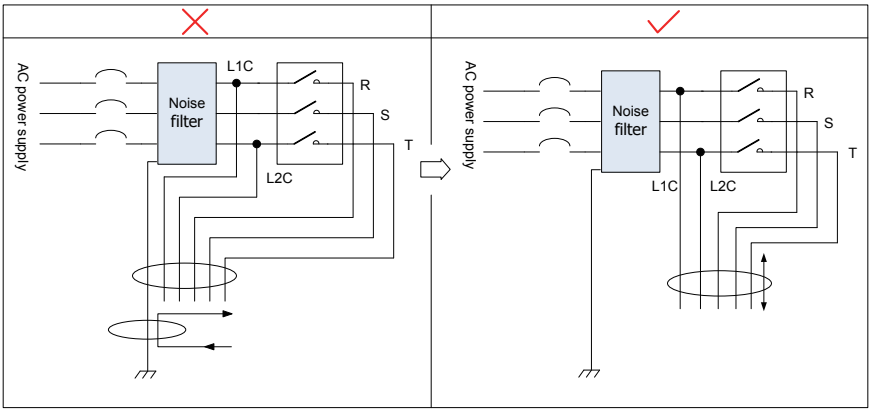
- Do not put the input and output wires of the noise filer in the same duct or bundle them together.

Figure 3-18 Diagram for noise filter input and output cable wiring



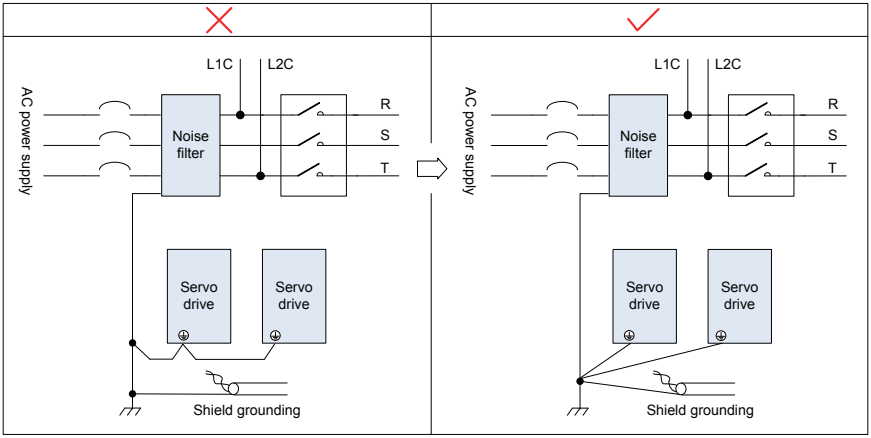
- Separate the grounding cable and output power supply lines of the noise filter.

Figure 3-19 Diagram for separated cabling of noise filter grounding cable and output cable



- Use a separate grounding cable as short and thick as possible for the noise filter. Do not share the grounding cable with other grounding devices.

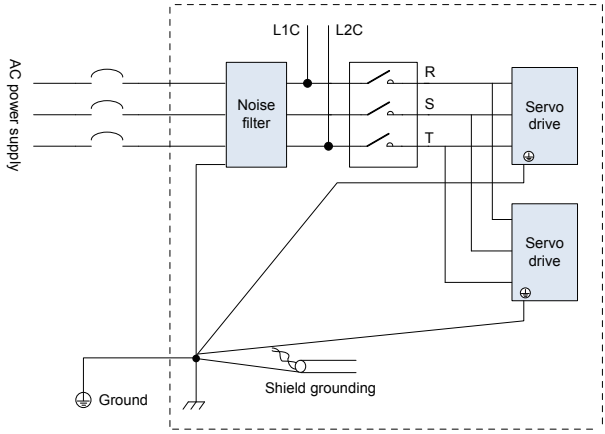
Figure 3-20 Single point grounding diagram



- Grounding the noise filter inside the cabinet

If the noise filter and the servo drive are installed in the same cabinet, fix the noise filter and the servo drive on the same metal plate. Make sure the contact part is in good conductive condition, and ground the metal plate properly.

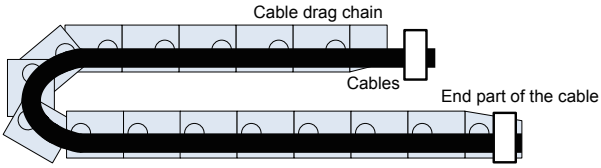
Figure 3-21 Diagram for noise filter grounding



3.9 Precautions of Using Cables

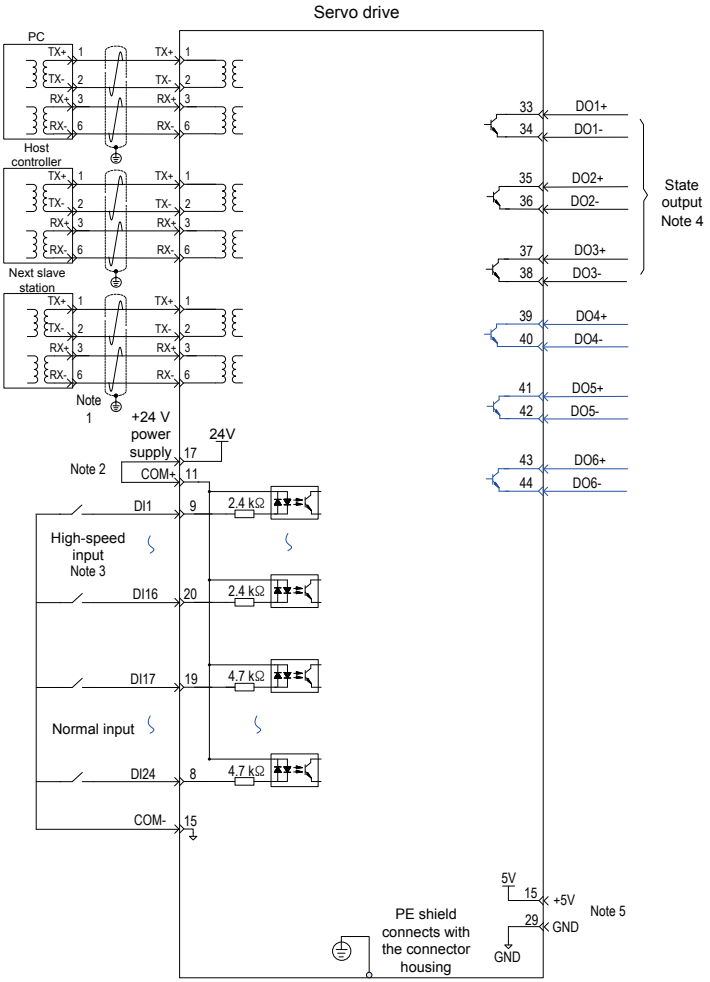
1. Do not bend or apply tension to cables. The core wire of a signal cable is only 0.2 or 0.3 mm in diameter and easily broken. Handle the cables carefully.
2. In scenarios where cables need to be moved, use flexible cables. Common cables are easily damaged after being bent for a long time. Cables configured together with low power servo motors cannot be used for movement.
3. If cable protection chain is used, make sure that:
   - the bending radius of the cable must be at least 10 times the diameter of the cable;
   - do not fix or bundle the cables inside the cable protection chain. You can bundle them at both ends of the cable protection chain;
   - cables must not be wound or warped;
   - space factor inside the cable protection chain must not exceed 60%;
   - do not mix cables of great difference in size together as thick cables may crush thin cables. If you need to use them together, place a spacer plate to separate them.

Figure 3-22 Cable protection chain diagram



3.10 Overall Wiring

Figure 3-23 Overall wiring diagram

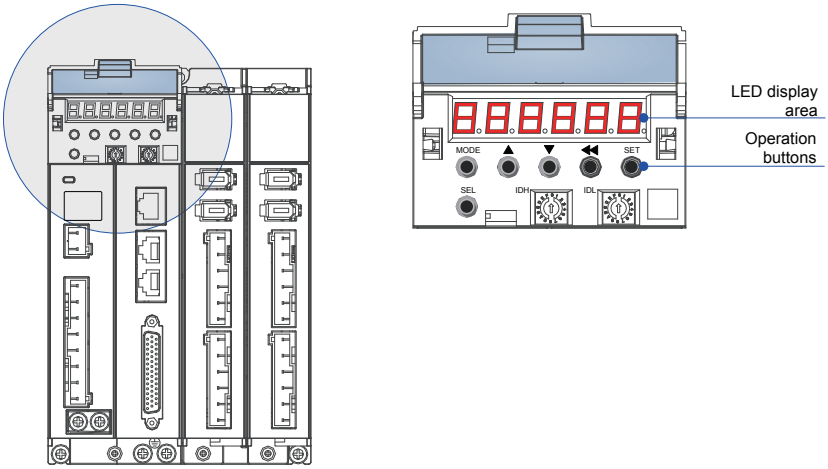


Note	
	• Note 1: Use CAT.5E double-shielded cable for network interfaces. Straight-through and crossover Ethernet cables are acceptable. • Note 2: Internal +24 V power supply, voltage range: 20 V to 28 V, maximum working current: 200 mA. • Note 3: As DI1–DI16 are high-speed DIs, please use them according to the functions. If they are used in low speed circumstances, the internal filtering parameters may be increased according to the function code to enhance the anti-interference capacity. • Note 4: Customers need to prepare the power supply for DOs, with voltage ranging from 5 V to 24 V. The DO terminals support 30 V DC voltage and 50 mA current to the maximum. • Note 5: The internal +5 V power supply supports a maximum of 200 mA output current.

Chapter 4 Operation Panel

4.1 Operation Panel Composition

Figure 4-1 Appearance of the LED operation panel



The operation panel of the SV820N servo drive consists of an LED (6-digit, 7 segments) and 6 buttons. The operation panel is used for the servo drive display, parameter setting, user password setting and general functions operations. When the operation panel is used for parameter setting, the functions of the buttons are described as follows.

LED display area

There are 6 digits on the LED. The LED displays common states, parameters and the axis number currently operated.

Operation buttons

Table 4-1 Functions of buttons

Button	Button Name	Button Function
MODE	MODE	Switch between all modes. Return to upper-level menu.
▲	INCREMENT	Increase the value of the blinking digit for the LED.
▼	DECREMENT	Decrease the value of the blinking digit for the LED.
◀◀	SHIFT	Shift the blinking digit for the LED. View the high digits of the number consisting of more than 5 digits.
SET	SET	Switch to the lower-level menu. Execute commands such as storing parameter setting value.
SEL	SEL	Select specific axis number and operate corresponding parameters of current axis number.

4.2 Display of the Operation Panel

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

  The following mapping relation exists between the function code (decimal) for the panel display and the operation object dictionary of the host controller (hexadecimal, "Index" and "Sub-index"), and should be noted in use:

  Object dictionary index = 0 x 2000 + function code group No.;

  Object dictionary sub-index = hexadecimal of offset in function code group + 1, for example:

Operation Panel Display	Object Dictionary Operated by the Host Controller
H00-00	2000-01h
H00-01	2000-02h
……	……
H01-09	2001-0Ah
H01-10	2001-0Bh
……	……
H02-15	2002-10h

Note	The following section describes content displayed on the operation panel side (decimal) about operation panel display and parameter setting. The parameters are different from the those viewed on the host controller background (hexadecimal). Please make the conversion by referring to the above table when needed.

- The operation panel can display the running state, parameter, faults, and monitored information Run settings of the servo drive.

  State display: Displays the current servo drive state, such as servo ready or running;

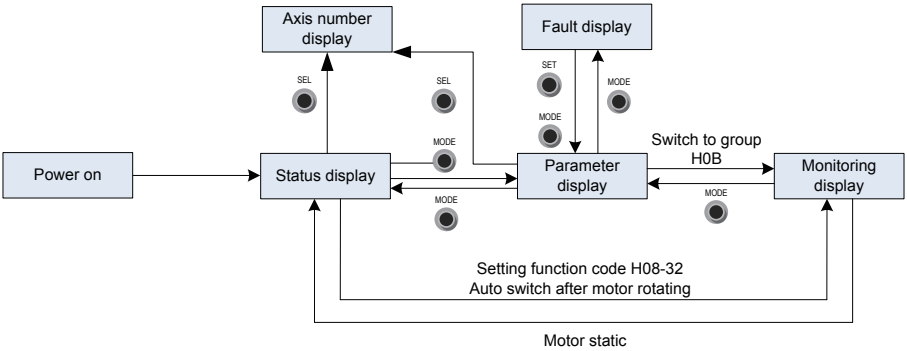
  Parameter display: Displays the function codes and their setting values;

  Fault display: Displays the fault and warnings occurring in the servo drive;

  Monitoring display: Displays the current running parameters of the servo drive.

  Axis No. display: Displays the axis number currently operated and displayed.

Figure 4-2 Diagram for switching between different display

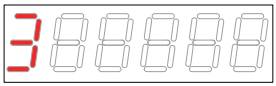
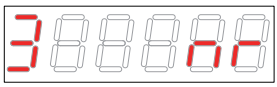
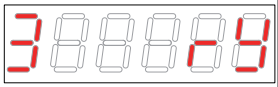
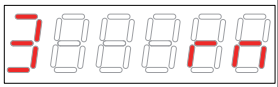
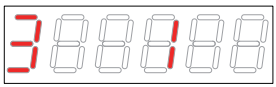
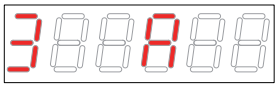


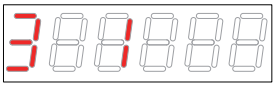
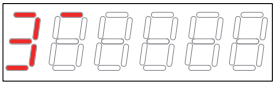
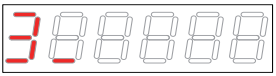
- After the power is on, the operation panel enters the state display mode.
- Press the MODE key to switch over between different modes, as shown in the preceding figure.
- In state display mode, set H02-32 and select the monitored parameters. When the motor rotates, the operation panel automatically switches over to monitoring display. After the motor stops, the panel automatically restores to the state display.

- In parameter display mode, set H02-32 and select the parameters to be pre-monitored, and the operation panel switches to the monitoring display mode.
- Once a fault occurs, the operation panel immediately enters the fault display mode, and all 5-digit LEDs blink. Press the SET key to stop the LED blinking, and then press the MODE key to switch over the parameter display mode.

4.2.1 State Display

In this section, the current operation axis 3 is taken as an example.

Display	Name	Situation	Meaning
	3 Axis number currently operated (as example only)	The axis number is selected and parameters are displayed (axis number is not displayed on specific parameter setting interface).	Parameters displayed on the operation panel currently are parameters of axis 3
 (Axis number is not displayed in reset state)	reset Servo initialization	Moment at servo power-on.	The servo drive is in initialization or reset state. After initialization or reset is completed, the servo drive automatically switches over to another state.
	nr Servo is not ready (Not ready)	Initialization is completed, but the servo drive is not ready.	The servo cannot operate as the power-on of main circuit fails to meet the specifications.
	ry Servo is ready (Ready)	The servo drive is ready.	The servo drive is ready for running, and waits for the servo enable signal from the host controller.
	rn Servo being running (run)	The servo enable signal is active.	The servo drive is in running state.
 	1–A Control mode		It displays the current 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

Display	Name	Situation	Meaning
 	1–8 Communication state		It displays the state of EtherCAT state machine in the slave station in character form. 1: Initialization state 2: Pre-operation state 4: Safe operation state 8: Operation state
	- CN4 connection indication	CN4 is connected successfully when EtherCAT is output	Segment off: No communication layer is detected in the physical layer. Segment on: Communication connection is set up in the physical layer.
	- CN5 connection indication	CN5 is connected successfully when EtherCAT is output	

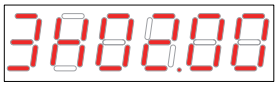
4.2.2 Parameter Display

The SV820N series has 14 groups of function codes based on parameter functions. The function codes can be located quickly based on the group it belongs to. Refer to the appendix to view the function code table. In this section, the current operation axis 3 is taken as an example.

Parameter group display

Display	Name	Content
HXX.YY	Function code group	XX: Function code group number YY: Offset in function code group

For example, function code H02-00 is displayed as follows:

Display	Name	Content
	Function code H02-00	02: Function code group number 00: Offset in function code group

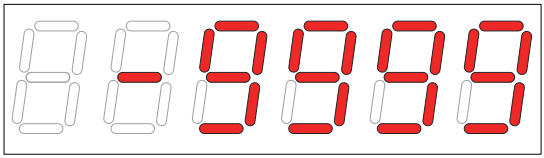
4

Display of data of different lengths and negative number

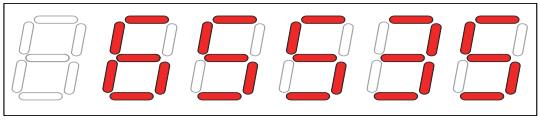
■ **With-symbol number of 4 digits and below and without-symbol number of 5 digits and below**

Such a number is display with 5-digit 7-segment LED display. The highest digit "-" indicates the negative symbol.

For example, –9999 is displayed as follows:



For example, 65535 is displayed as follows:

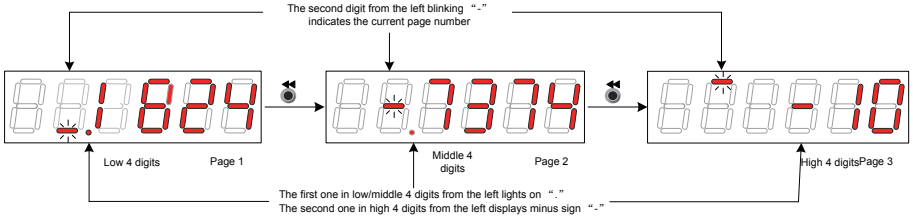


■ **With-symbol number of above 4 digits and without-symbol number of above 5 digits**

The number is displayed in digits from low to high in pages. Each 5 digits are displayed in a page. The display method is: current page + value of current page. As shown in the following figure, hold down "SHIFT" for more than 2 seconds to switch to the next page.

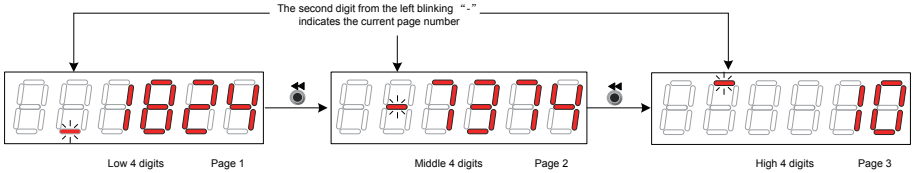
For example, –1073741824 is displayed as follows:

Figure 4-3 –1073741824 display operation diagram



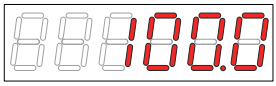
Example: For example, 1073741824 is displayed as follows:

Figure 4-4 1073741824 display operation diagram

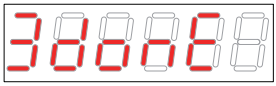
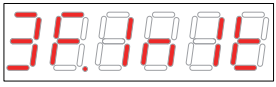
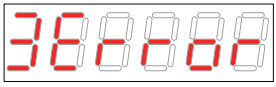


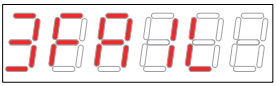
Points of decimal display

"." of the unit's position displayed on the LED indicates the decimal point, and this segment "." does not blink.

Display	Name	Content
	Decimal point	100.0

Parameter setting display

Display	Name	Situation	Meaning
	Done Parameter setting completed	Parameter setting is successful.	The parameter setting is completed and stored in the servo drive (Done). The servo drive can then execute other operations
	F.InIt Parameter restored to default setting	The parameter initialization function is used (H02-31=1).	The servo drive is restoring parameters to default setting (Function Code Initialize). After initialization is completed, the control power is on again.
	Error Password incorrect	Use the User Password function (H02-30), the password entered is incorrect.	The servo drive prompts the password error (Error), and you need to enter the correct password.

Display	Name	Situation	Meaning
	TunE	Use One-key Self-adjustment function.	One-key Self-adjustment is in progress.
	FAIL	Use One-key Self-adjustment function.	One-key Self-adjustment has failed.

Fault display (taking the current operation axis 3 as an example)

- The keypad displays the current or history faults and warning codes. For analysis and rectification of faults and warnings, refer to Chapter 5.
- When a single fault or warning occurs, the keypad displays the fault or warning code. When multiple faults or warnings occur, the keypad displays the fault code of the highest level.
- Set the number of history faults that can be viewed in H0B-33. View H0B-34 to display the selected fault or warning codes.
- Set H02-31=2 to clear information about the latest ten faults or warnings stored in the servo drive.

For example, fault E3.941 is displayed as follows:

Display	Name	Content
	Current warning code	E3.: Fault or warning in the servo drive 941: Warning code

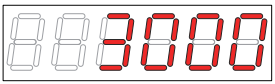
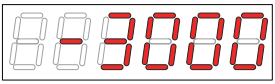
Monitoring display

Group H0B of the servo drive: Displays the parameters for monitoring the running status of the servo drive.

Set H02-32 (Default keypad display). After the servo motor runs properly, the keypad switches over from "servo status display mode" to "parameter display mode". The function code group number for the parameter is H0B, and the offset is the setting value of H02-32.

For example, if H02-32=00, the keypad displays the corresponding parameter value of H0B-00 if the servo motor speed is not 0.

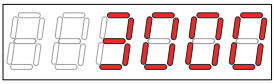
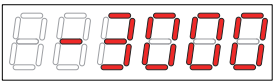
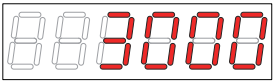
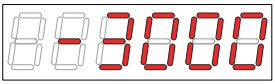
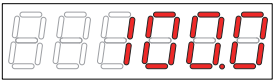
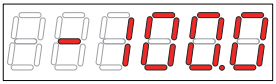
4

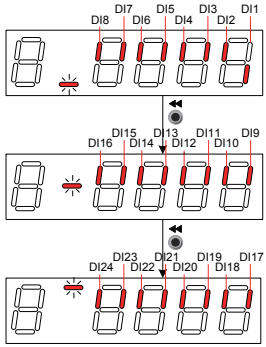
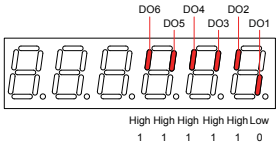
Function Code	Name	Unit	Meaning	Display Examples
H0B-00	Actual motor speed	RPM	The actual servo motor speed after round-off is displayed, in unit of 1 RPM.	3,000 RPM is displayed as follows:  –3,000 RPM is displayed as follows: 

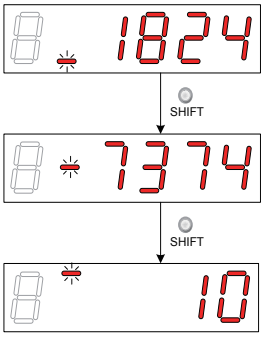
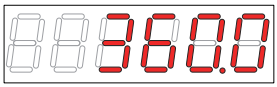
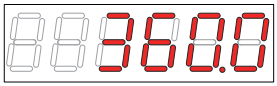
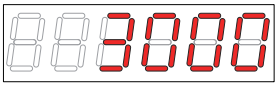
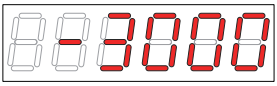
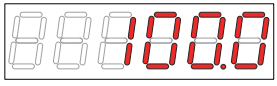
4.3 Parameter Monitoring

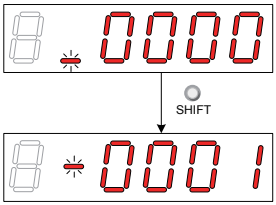
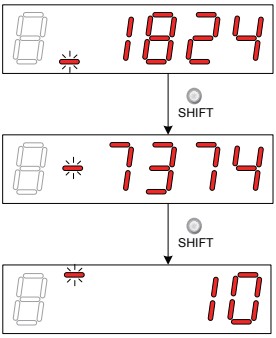
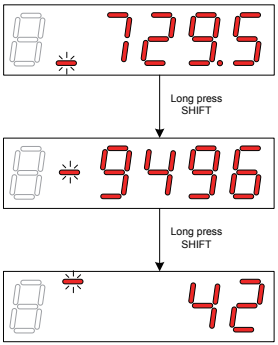
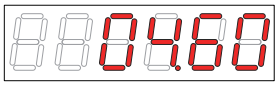
Group H0B of the servo drive: Displays the parameters for monitoring the running status of the servo drive.

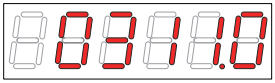
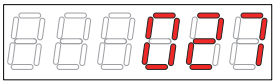
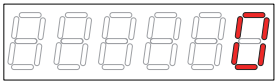
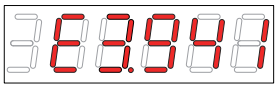
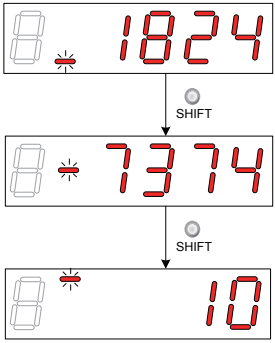
The display of H0B monitoring is described as follows:

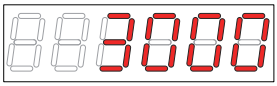
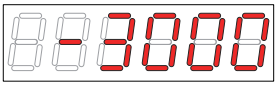
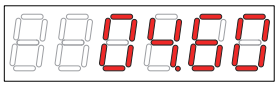
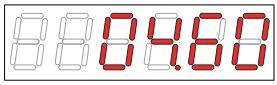
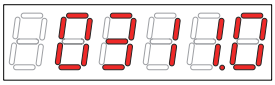
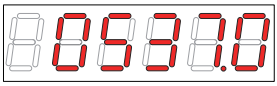
Function Code	Name	Unit	Meaning	Display Examples
H0B-00	Actual motor speed	RPM	The actual servo motor speed after round-off is displayed, in unit of 1 RPM.	3,000 RPM is displayed as follows:  –3,000 RPM is displayed as follows: 
H0B-01	Speed reference	RPM	The current speed reference of the servo drive is displayed.	3,000 RPM is displayed as follows:  –3,000 RPM is displayed as follows: 
H0B-02	Internal torque reference	0.1%	It is the percentage of the actual servo motor output torque to the rated motor torque.	100.0% is displayed as follows:  –100.0% is displayed as follows: 

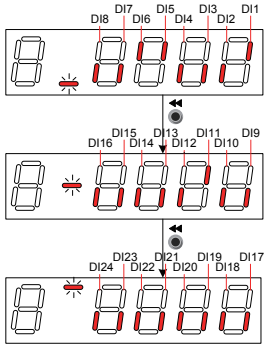
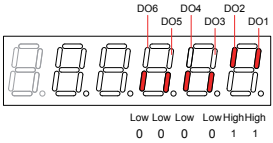
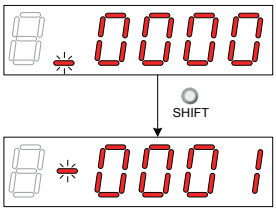
Function Code	Name	Unit	Meaning	Display Examples
H0B-03	Input signal (DI signal) monitoring	-	It indicates the corresponding optocoupler status of 24 DI terminals: The upper LED segment ON indicates the optocoupler is OFF: (Indicated with "1") The lower LED segment ON indicates the optocoupler is ON: (Indicated with "0") H0B-03 value read by the commissioning software is a hexadecimal number.	For example, when the optocoupler of terminal DI1 is ON and that of DI2–DI24 is OFF: The corresponding binary value is "11111111 11111111 11111110" The value of H0B-03 read by the commissioning software is 0xFFFFFE. The keypad display is as follows: 
H0B-05	Output signal (DO signal) monitoring	-	It indicates the corresponding optocoupler status of 6 DO terminals: The upper LED segment ON indicates the optocoupler is OFF: (Indicated with "1") The lower LED segment ON indicates the optocoupler is ON: (Indicated with "0") H0B-05 value read by the commissioning software is a hexadecimal number.	For example, when optocoupler of terminal DO1 is ON and that of terminal DO2–DO6 is OFF: The corresponding binary value is "111110"; The value of H0B-05 read by the commissioning software is 0x3E. The keypad display is as follows: 

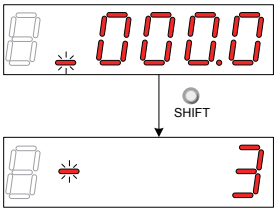
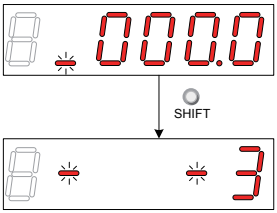
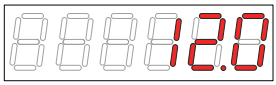
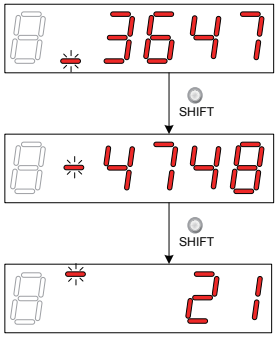
Function Code	Name	Unit	Meaning	Display Examples
H0B-07	Absolute position counter (32-bit decimal display)	Reference unit	It indicates the current absolute position of the motor (reference unit).	1073741824 referent units display: 
H0B-09	Mechanical angle	0.1°	It indicates the current mechanical angle of the motor.	360.0° is displayed as follows: 
H0B-10	Rotation angle (electric angle)	0.1°	It indicates the current electric angle of the motor.	360.0° is displayed as follows: 
H0B-11	Speed corresponding to input position reference	RPM	It indicates the servo drive speed corresponding to the position reference in a single control period.	3,000 RPM is displayed as follows:  –3,000 RPM is displayed as follows: 
H0B-12	Average load ratio	0.1%	It indicates the percentage of the average load torque to the rated motor torque.	The keypad display of 100.0% is as follows: 

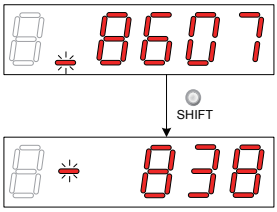
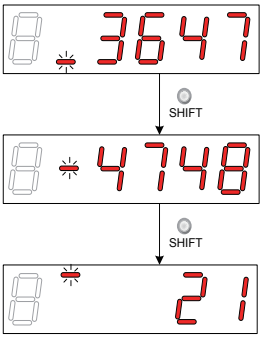
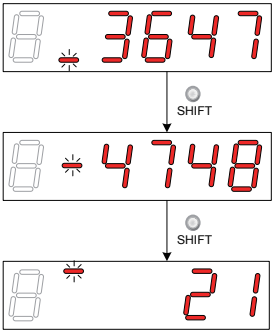
Function Code	Name	Unit	Meaning	Display Examples
H0B-15	Encoder position deviation counter (32-bit decimal display)	Encoder unit	Deviation of the encoder position = Total input position references (encoder unit) - Total encoder feedback pulses (encoder unit)	10,000 encoder units is displayed as follows: 
H0B-17	Feedback pulse counter (32-bit decimal display)	Encoder unit	The system counts and displays the position feedback from the servo motor encoder (encoder unit). Note: When an absolute encoder motor is used, H0B-17 displays only the low 32-bit data of motor position feedback. The actual motor position feedback can be obtained in H0B-77 (absolute position low 32 bits of absolute encoder) and H0B-79 (absolute position high 32 bits of absolute encoder).	1,073,741,824 encoder units is displayed as follows: 
H0B-19	Total power-on time (32-bit decimal display)	0.1s	The system counts and displays the total servo drive power-on time.	429,496,729.5s is displayed as follows: 
H0B-24	Phase current effective value	0.01 A	It indicates the phase current effective value of the servo motor.	4.60 A is displayed as follows: 

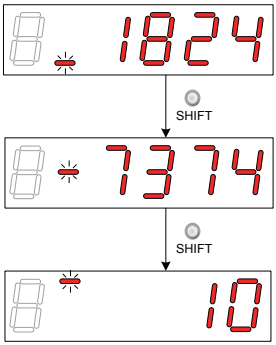
Function Code	Name	Unit	Meaning	Display Examples
H0B-26	Bus voltage	0.1 V	DC bus voltage of main circuit	After 220 V AC rectification, 311.0 V is displayed as follows: 
H0B-27	Module temperature	℃	It indicates the temperature of the power module inside the servo drive.	27°C is displayed as follows: 
H0B-33	Fault record	-	It sets the number of history faults to be viewed. 0: Current fault 1: Latest fault 2: Last 2nd fault …… 9: last 9th fault	0: current fault is displayed as follows: 
H0B-34	Fault code of the selected fault record	-	It indicates the fault code selected by H0B-33. When there is no fault, H0B-34 display is "E+Axis No.000."	For example, when the axis number is 3: If H0B-33=0, H0B-34=E3.941, the current fault code is 941. Display: 
H0B-35	Time stamp upon displayed fault	s	It indicates the total servo running time when the fault displayed in H0B-34 occurs. When there is no fault, H0B-35 display is "0."	If H0B-34=Er.941, H0B-35=107374182.4, the current fault code is 941 and the total servo running time is 107,374,182.4s when this fault occurs. 

Function Code	Name	Unit	Meaning	Display Examples
H0B-37	Motor speed upon displayed fault	RPM	It indicates the servo motor speed when the fault displayed in H0B-34 occurs. When there is no fault, H0B-37 display is "0."	3,000 RPM is displayed as follows:  –3,000 RPM is displayed as follows: 
H0B-38	Motor phase U current upon displayed fault	0.01 A	It indicates the winding current effective value of the servo motor phase U when the fault displayed in H0B-34 occurs. When there is no fault, H0B-38 display is "0."	4.60 A is displayed as follows: 
H0B-39	Motor phase V current upon displayed fault	0.01 A	It indicates the winding current effective value of the servo motor phase V when the fault displayed in H0B-34 occurs. When there is no fault, H0B-39 display is "0."	4.60 A is displayed as follows: 
H0B-40	Bus voltage upon displayed fault	0.1 V	It indicates the DC bus voltage of the main circuit when the fault displayed in H0B-34 occurs. When there is no fault, H0B-40 display is "0."	After 220 V AC rectification, 311.0 V is displayed as follows:  After 380 V AC rectification, 537.0 V is displayed as follows: 

Function Code	Name	Unit	Meaning	Display Examples
H0B-41	Input terminal state upon displayed fault	-	It indicates the high/low level state of the 24 DI terminals when the fault displayed in H0B-34 occurs. The viewing method is the same as that of H0B-03. When there is no fault, H0B-41 displays that all DI terminals are low, and the corresponding decimal value is "0."	For example, the value of H0B-41=0x431 read by the commissioning software is: The corresponding binary value is "00000000 00000100 00110001." The keypad display is as follows: 
H0B-43	Output terminal state upon displayed fault	-	It indicates the high/low level state of the 6 DO terminals when the fault displayed in H0B-34 occurs. The viewing method is the same as that of H0B-05. When there is no fault, H0B-42 displays that all DO terminals are low, and the corresponding decimal value is "0."	H0B-43=3 is displayed as follows: 
H0B-53	Position deviation counter (32-bit decimal display)	Reference unit	Position deviation = Total input position references (reference unit) - Total encoder feedback pulses (reference unit)	10,000 reference units is displayed as follows: 

Function Code	Name	Unit	Meaning	Display Examples
H0B-55	Actual motor speed	0.1 RPM	It indicates the actual servo motor speed, precision to 0.1 RPM.	3,000.0 RPM is displayed as follows:  –3,000.0 RPM is displayed as follows: 
H0B-57	Control power voltage	0.1 V	It indicates the control power DC voltage.	12.0 V is displayed as follows: 
H0B-58	Mechanical absolute position (low 32 bits)	Encoder unit	It displays mechanical absolute position (low 32 bits) when the absolute encoder is used.	Example: 2147483647 encoder unit 
H0B-60	Mechanical absolute position (high 32 bits)	Encoder unit	It displays mechanical absolute position (high 32 bits) when the absolute encoder is used.	Example: –1 encoder unit 
H0B-70	Number of the absolute encoder turns	Rev	It displays the current number of the absolute encoder turns.	Example: 32767 

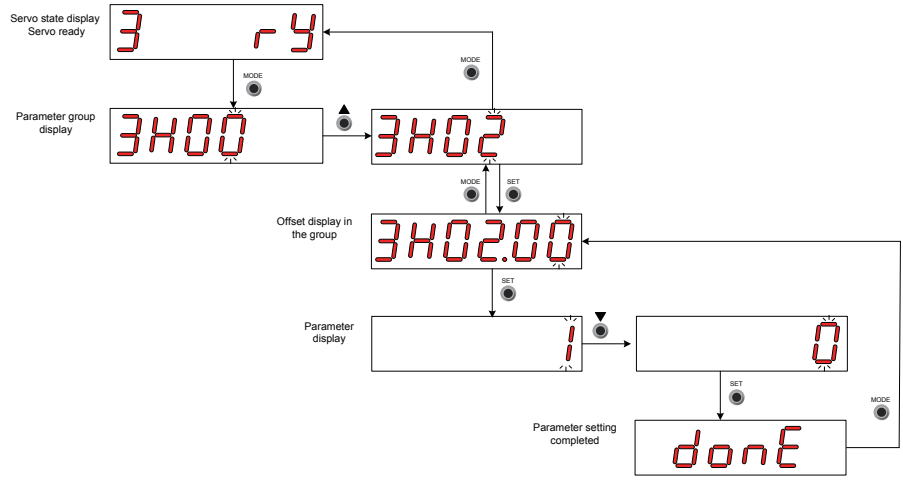
Function Code	Name	Unit	Meaning	Display Examples
H0B-71	Absolute encoder single-turn position feedback	Encoder unit	It displays the single-turn position feedback of the absolute encoder.	Example: 8388607 Encoder unit 
H0B-77	Position (low 32 bits) of the absolute encoder	Encoder unit	It displays the absolute position (low 32 bits) of the motor when the absolute encoder is used.	Example: 2147483647 encoder unit 
H0B-79	Position (high 32 bits) of the absolute encoder	Encoder unit	It displays the absolute position (low 32 bits) of the motor when the absolute encoder is used.	Example: –1 encoder unit 
H0B-81	Rotating load single-turn position feedback (low 32 bits)	Encoder unit	It displays mechanical load position feedback (low 32 bits) when the absolute system works in rotating mode.	Example: 2147483647 encoder units 
H0B-83	Rotating load single-turn position feedback (high 32 bits)	Encoder unit	It displays mechanical load position feedback (high 32 bits) when the absolute system works in rotating mode.	Example: 1 Encoder unit 

Function Code	Name	Unit	Meaning	Display Examples
H0B-85	Rotating load single-turn position	Reference unit	It displays the mechanical absolute position when the absolute system works in rotating mode.	Example: 1073741824 referent unit 

4.4 Parameter Setting

Parameter setting can be performed on the keypad of servo drive. For details on the parameters, refer to Chapter 8. The following figure shows the keypad operation of switching the position control mode to the speed control mode after the power is on.

Figure 4-5 Diagram for keypad operation of parameter setting



- MODE: Switch the display mode and return to the upper-level menu.
- ▲/▼: Increase or decrease the value of the current blinking digit.
- ◀◀: Change the current blinking digit.
- SET: Store the current setting value or switch to the next-level menu.

When the "Done" screen is displayed after parameter setting is completed, press the MODE key to return to the parameter group display (the "H02-00" screen).

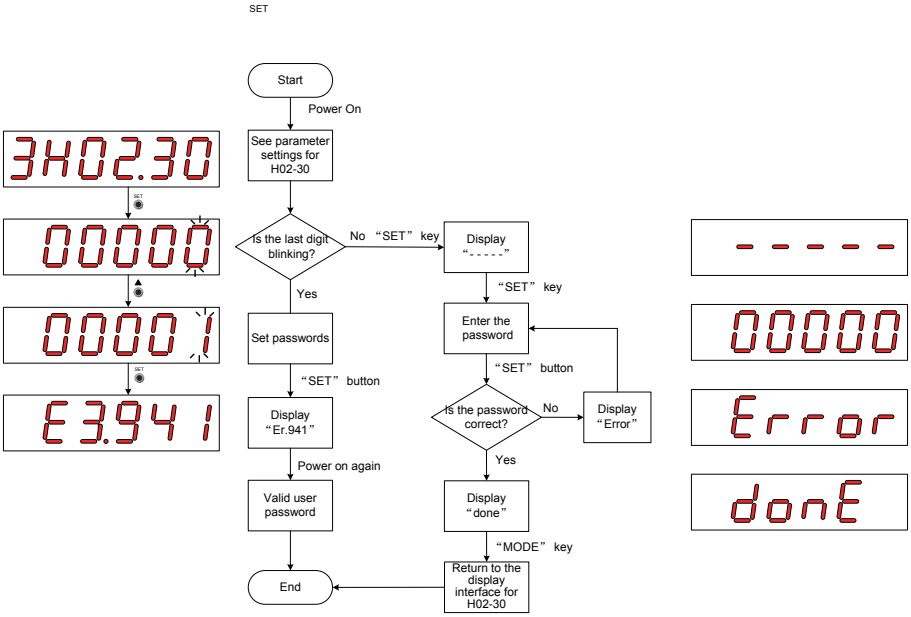
4.5 User Password

After the user password function (H02-30) is enabled, only the authorized user has the parameter setting rights; other operators can only view the parameters.

4.5.1 Setting User Password

The following takes the operation of setting the password to "00001" for example.

Figure 4-6 Diagram for keypad operation of user password setting



4

Note	
	• *1: If the last digit does not blink, password protection is enabled. If the last digit blinks, password protection is disabled or the correct password has been entered. • When modifying the user password, enter the current password so that you enable the parameter setting rights. Enter H02-30 again, and you can set a new password, according to the method described in the preceding figure.

4.5.2 Canceling User Password

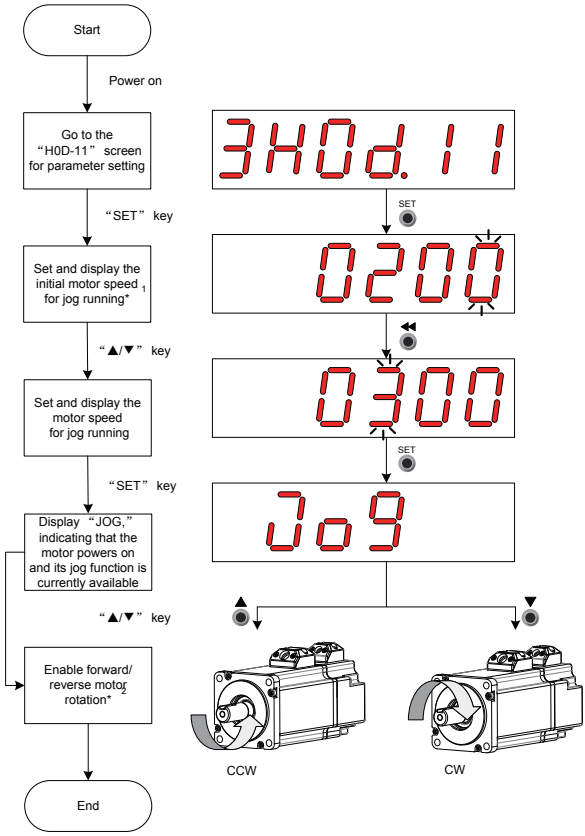
Enter the existing user password, and set H02-30 to "00000". Then, the user password is canceled.

4.6 Jog Running

Note	• When using the jog running function, set the S-ON signal inactive. Otherwise, this function cannot be used. • Use the jog running function to perform trial running on the servo motor and drive.

4.6.1 Operation Method

Figure 4-7 Diagram for keypad operation of jog running setting



Note	• *1: Press the ▲ or ▼ key to increase or decrease the motor speed for the jog running. If this jog running ends, the motor speed restores to the initial value. • *2: Press the ▲ or ▼ key to make the servo motor rotate in the forward or reverse direction. If you release the key, the servo motor stops running immediately.

4.6.2 Exiting Jog Running

Press the MODE key to exit the jog running and return to the upper-level menu.

4.7 DI/DO Function

There are 24 DI signals and 6 DO signals on terminal CN1 of SV820N. H03 (terminal DI function allocation and logic selection) and H04 (terminal DO function allocation and logic selection) can be used by multiple axes. On any axis, setting and modifying functions of DI and DO terminals can be performed on keypad.

4.7.1 DI/DO Function Definition

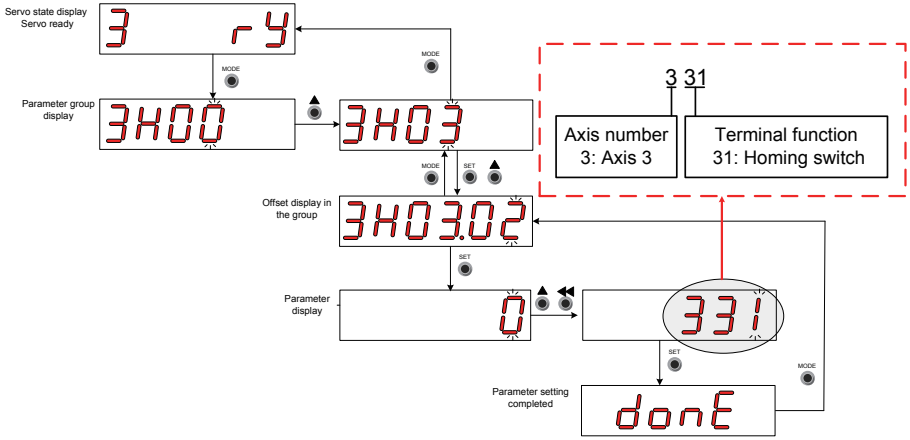
Code	Name	Function Name	Description	Remark
Description: It consists of three digits, the first one (from left to right) indicates axis number and last two digits indicate terminal function.				
Input Signal Function Description				
01	S-ON	Servo enabled	Invalid - In local mode, servo motor disabled. Valid - In local mode, servo motor enabled.	S-ON function is only valid in non-bus control mode. The logic of the corresponding terminal needs to be set to level valid.
14	P-OT	Positive limit switch	Valid - Forward drive inhibited; Invalid - Forward drive permitted.	When the mechanical movement is outside the movable range, the overtravel prevention function is implemented. It is recommended that the logic of the corresponding terminal be set to level valid.
15	N-OT	Negative limit switch	Valid - Reverse drive inhibited; Invalid - Reverse drive permitted.	When the mechanical movement is outside the movable range, the overtravel prevention function is implemented. It is recommended that the logic of the corresponding terminal be set to level valid.
31	HomeSwitch	Home switch	Invalid - Mechanical load is outside Home switch range; Valid - Mechanical load is within Home switch range.	The logic of the corresponding terminal needs to be set to level valid. If the logic is set to 2 (rising edge valid), the servo drive forcibly changes it to 1 (high level valid). If the logic is set to 3 (falling edge valid), the servo drive forcibly changes it to 0 (low level valid). If the logic is set to 4 (both rising edge and falling edge valid), the servo drive forcibly changes it to 0 (low level valid).
38	TouchProbe1	Probe 1	Invalid - Probe is not triggered; Valid - Probe can be triggered.	The logic of probe is only relevant to the probe function (60B8h) regardless of the logic selection of terminal.
39	TouchProbe2	Probe 2	Invalid - Probe is not triggered; Valid - Probe can be triggered.	The logic of probe is only relevant to the probe function (60B8h) regardless of the logic selection of terminal.
Output Signal Function Description				
01	S-RDY	Servo ready	Valid - Servo ready; Invalid - Servo not ready.	Servo ready, running is permitted

Code	Name	Function Name	Description	Remark
02	TGON	Motor rotation	Invalid - The absolute value of motor speed after filter is smaller than the setting value of function code H06-16; Valid - The absolute value of motor speed after filter reaches the setting value of function code H06-16	-
10	WARN	Warning	Valid - Servo drive reports warning; Invalid - Servo drive reports no warning or warning is reset.	-
11	ALM	Fault	Valid - A fault occurs in the servo drive; Invalid - Servo drive suffers no fault or fault is already reset.	-

4.7.2 DI Function Setting

In this section, function setting of H03-02 is taken as an example. Function setting of H03 group consists of three digits. The first digit is for setting axis No. and last two digits are for specific terminal functions. Diagram is shown in red dotted box below:

Figure 4-8 Diagram for keypad operation of DI function setting



Example: Set DI1, DI2, DI3 and DI4 as the home signals of 4 modules respectively. Corresponding parameters can be set as the following values via commissioning software or the keypad.

H0302=131

H0304=231

H0306=331

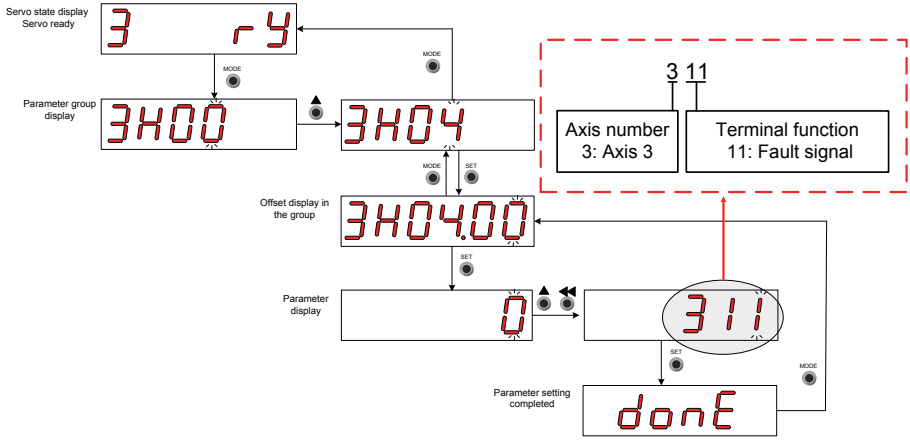
H0308=431

Note	Hardware switch setting can be adopted by the logic of terminal DI based on an actual situation.

4.7.3 DO Function Setting

In this section, function setting of H04-00 is taken as an example. Function number setting of H04 consists of three decimal digits. The first digit is for the setting axis No. and last two digits are for specific terminal functions. The diagram is shown in the red dotted box below:

Figure 4-9 Diagram for keypad operation of DO function setting



Example: Set DO1, DO2, DO3 and DO4 as the fault signals of 4 modules respectively. Corresponding parameters can be set as the following values via commissioning software or the keypad.

H0400=111

H0402=211

H0404=311

H0406=411

Note	The hardware switch setting can be adopted by the logic of terminal DO based on the actual situation.

Chapter 5 Troubleshooting

5.1 Fault and Warning Grading

Fault and warning grading

Faults and alarms are graded into the following three levels based on degree of severity: NO.1 > NO.2 > NO.3.

NO.1 non-resettable fault

NO.1 resettable fault

NO.2 resettable fault

NO.3 resettable warning

"Resettable" means that the keypad stops displays of faults/warnings once the "reset signal" is input.

To reset a fault/warning, use one of the following two methods:

Set 200D-02h=1 (fault reset enabled).

Enable the rising edge of the control word 0x6040 bit7 on the host controller.

To reset a NO.1 fault and a NO.2 fault, turn off the S-ON signal and input the fault reset signal.

To reset a NO.3 warning, directly input the fault reset signal.

■ **Relevant function code:**

Function Code	Name	Setting Range	Function	Setting Mode	Effective Time	Default
200Dh-02h	Fault reset	0: no operation 1: fault/warning reset	The keypad stops display for the resettable faults and warnings. After reset, the value restores to "0: no operation."	At stop	Immediate	0

5.2 Communication Fault and Warning Code List

When communication or the servo drive is abnormal, the SV820 servo drive sends an emergency message to the network as a producer, or sends a response abort message when the SDO transmission is abnormal.

Fault code list (take the current operation axis 3 as an example):

Display	Fault Name	Fault Type	Resettable or Not	Fault Range
E3.101	System parameter abnormal	NO.1	No	Equipment fault
E3.102	Abnormal communication initialization of coprocessor	NO.1	No	Equipment fault
E3.104	Abnormal communication or interrupt timeout of the coprocessor	NO.1	No	Equipment fault
E3.105	Internal program abnormal	NO.1	No	Equipment fault
E3.106	Abnormal communication of the main processor	NO.1	No	Equipment fault
E3.107	Communication loss of the main processor	NO.1	No	Equipment fault
E3.108	Parameter storage fault (read/write)	NO.1	No	Equipment fault
E3.111	Group 2000h/2001h parameter abnormal	NO.1	No	Equipment fault
E3.120	Product model matching fault (No corresponding motor No corresponding driver Absolute position parameter not matching 2nd-generation encoder parameter not matching)	NO.1	No	Shaft fault
E3.121	Invalid S-ON command	NO.2	Yes	Shaft fault
E3.122	Absolute position function and encoder matching fault (Motor model not matching 2nd-generation encoder parameter not matching)	NO.1	No	Shaft fault
E3.130	Different DIs allocated with the same function	NO.1	Yes	Shaft fault
E3.136	Data check error or no parameter stored in the motor ROM	NO.1	No	Shaft fault
E3.150	STO signal input protection	NO.1	Yes	Equipment fault
E3.201	Hardware overcurrent (Phase P overcurrent Phase N overcurrent Phase U overcurrent Phase V overcurrent Bus discharge overcurrent)	NO.1	No	Shaft or equipment fault
E3.202	Soft-start relay fault	NO.1	No	Equipment fault
E3.208	FPGA sampling operation timeout Encoder communication timeout Sigma_Dleta modulation fault	NO.1	No	Shaft or equipment fault
E3.210	Output short-circuit to ground	NO.1	No	Shaft fault
E3.220	UVW phase sequence error	NO.1	No	Shaft fault
E3.234	Runaway	NO.1	No	Shaft fault
E3.400	Main circuit overvoltage	NO.1	Yes	Equipment fault
E3.410	Main circuit undervoltage	NO.1	Yes	Equipment fault

Display	Fault Name	Fault Type	Resettable or Not	Fault Range
E3.420	Main circuit phase loss	NO.2	Yes	Equipment fault
E3.430	Control power undervoltage	NO.1	No	Equipment fault
E3.500	Motor overspeed	NO.1	Yes	Shaft fault
E3.602	Angle auto-tuning failure	NO.1	Yes	Shaft fault
E3.610	Servo drive overload	NO.2	Yes	Shaft fault
E3.620	Overload motor	NO.2	Yes	Shaft fault
E3.630	Motor rotor locked	NO.2	Yes	Shaft fault
E3.650	Heatsink overheat	NO.2	Yes	Shaft fault
E3.731	Encoder battery failed	NO.2	Yes	Shaft fault
E3.733	Encoder multi-turn counting error	NO.2	Yes	Shaft fault
E3.735	Encoder multi-turn counting overflow	NO.2	Yes	Shaft fault
E3.740	Encoder interference	NO.1	No	Shaft fault
E3.A33	Encoder data reading/writing abnormal	NO.1	No	Shaft fault
E3.B00	Position deviation excess	NO.2	Yes	Shaft fault
E3.B01	Position reference increment abnormal	NO.2	Yes	Shaft fault
E3.B03	Electronic gear ratio setting exceeding limit	NO.2	Yes	Shaft fault
E3.D09	Software position setting error	NO.2	Yes	Shaft fault
E3.D10	Home position setting error	NO.2	Yes	Shaft fault
E3.E07	Network state switching abnormal	NO.2	Yes	Equipment fault
E3.E08	Synchronization loss*	NO.2	Yes	Equipment fault
E3.E11	ESI configuration file not burnt*	NO.2	Yes	Equipment fault
E3.E13	Synchronization cycle setting error*	NO.2	Yes	Equipment fault
E3.E15	Synchronization cycle error is too large*	NO.2	Yes	Equipment fault

Warning code list (take the current operation axis 3 as an example)

Display	Name	Fault Type	Resettable or Not	Fault Range
E3.601	Home attaining warning	NO.3	Yes	Shaft fault
E3.730	Encoder battery warning	NO.3	Yes	Shaft fault
E3.760	Encoder overheat	NO.3	Yes	Shaft fault
E3.909	Motor overload warning	NO.3	Yes	Shaft fault
E3.920	Regenerative bleeder resistor overload	NO.3	Yes	Equipment fault
E3.922	External regenerative bleeder resistor resistance value is too small	NO.3	Yes	Equipment fault
E3.939	The motor power cables break.	NO.3	Yes	Shaft fault
E3.941	Parameter modification taking effect only after re-power	NO.3	Yes	Equipment fault
E3.942	Parameter storage too frequent	NO.3	Yes	Equipment fault
E3.950	Positive limit switch warning	NO.3	Yes	Shaft fault
E3.952	Negative limit switch warning	NO.3	Yes	Shaft fault
E3.980	Encoder algorithm abnormal	NO.3	Yes	Shaft fault
E3.990	Main circuit power input phase loss warning	NO.3	Yes	Equipment fault
E3.998	Homing object dictionary error	NO.3	Yes	Shaft fault
E3.E20	Ethernet hardware error	NO.3	Yes	Equipment fault
E3.E21	MAC address of the driver not burnt.	NO.3	Yes	Equipment fault

5.3 Troubleshooting of Faults

Note	Take the current operation axis 3 as an example.

■ **E3.101: system parameter abnormal**

Cause:

The total number of parameters changes, which generally occurs after software updates.

The actual parameter values of group 2002h and later exceed the limit, which generally occurs after software updates.

Probable Cause	Confirming Method	Corrective Action
1. The control power voltage drops instantaneously.	Check whether the control power (L1C, L2C) is cut off or whether an instantaneous power failure occurs.	Restore the default setting (2002-20h=1), and rewrite the parameters.
	Measure whether the control power voltage on the non-drive side is within the following specifications: 220 V drive: Effective value: 220 V to 240 V Allowed error: –10% to +10% (198 V to 264 V) 380 V drive: Effective value: 380 V–440 V Allowed error: –10% to +10% (342 V to 484 V)	Increase the power capacity or replace with a large-capacitance power supply. Restore the default setting (2002-20h=1), and rewrite the parameters.
2. Instantaneous power failure occurs during parameter storage.	Check whether instantaneous power failure occurs during parameter storage.	Power on the system again, restore the default setting (2002-20h=1), and rewrite the parameters.
3. The times of parameter writing within a certain period exceeds the limit.	Check whether the parameter update is performed frequently from the host controller.	Change the parameter writing method and rewrite parameters. If the servo drive is faulty, replace it.
4. The software is upgraded.	Check whether the software is upgraded.	Reset the servo drive model and the servo motor model, and restore the default setting (2002-20h=1).
5. The servo drive is faulty.	If the servo drive is powered off and powered on several times and the default setting is restored, but the fault persists, it indicates that the servo drive is faulty.	Replace the servo drive.

■ **E3.102: Abnormal communication initialization of coprocessor**

Cause:

Multi-core communication initialization fault or software version of cores not matching

Probable Cause	Confirming Method	Corrective Action
1. The FPGA software version and the software version of CPU cores do not match.	View the FPGA software version (2001-03h) and the CUP0 software version (2001-04h) and the CUP1 software version (2001-05h) via the keypad or the Inovance servo commissioning software. Check whether the non-zero value of the most significant bit is the same in the two versions.	Contact Inovance for technical support. Update the software to make them match.
2. The FPGA is faulty.	The fault persists after the servo drive is powered off and on for several times.	Replace the servo drive.

■ **E3.104: Abnormal communication or interrupt timeout of coprocessor**

Cause:

Coprocessor or FPGA interrupt timeout, cyclic access among coprocessors timeout

Probable Cause	Confirming Method	Corrective Action
1. The FPGA is faulty.	The fault persists after the servo drive is powered off and on several times.	Replace the servo drive.
2. The communication handshake between the FPGA and the MCU is abnormal.		
3. MCU interrupt times out.		

■ **E3.105: Internal program abnormal**

Cause:

The total number of parameters is abnormal at EEPROM reading/writing operation.

The data range of parameters is abnormal, which generally occurs after software updates.

Probable Cause	Confirming Method	Corrective Action
1. An EEPROM fault occurs.	Check the causes according to the method of E3.101.	Restore the default setting (2002-20h=1), and power on the system again.
2. The servo drive is faulty.	The fault persists after the servo drive is powered off and on several times.	Replace the servo drive.

■ **E3.106: abnormal communication of the main processor**

To distinguish the fault symptom, the servo drive displays different internal fault codes under the same fault code. You can view these internal fault codes in 200B-2Eh.

Cause:

Access between HOST and FPGA or between Host and coprocessor times out during power-on initialization.

Probable Cause	Confirming Method	Corrective Action
1. The FPGA is faulty.	The fault persists after the servo drive is powered off and on several times.	Replace the servo drive.
2. The communication handshake between the FPGA and the HOST is abnormal.		
3. Access between HOST and coprocessor times out.		

■ **E3.107: communication loss of main processor**

Cause:

Cyclic handshake communication between main processor and coprocessor is lost.

Probable Cause	Confirming Method	Corrective Action
Internal communication failure	The fault persists after the servo drive is powered off and on several times.	Replace the servo drive.

■ **E3.108: parameter storage fault**

Cause:

Parameter values cannot be written to EEPROM.

Parameter values cannot be read from EEPROM.

Probable Cause	Confirming Method	Corrective Action
1. Parameter writing is abnormal.	Modify a parameter, power on the servo drive again and check whether the modification is saved.	If the modification is not saved and the fault persists after the servo drive is powered off and on several times, replace the servo drive.
2. Parameter reading is abnormal.		

■ **E3.111: group 2000h/2001h parameter abnormal**

Cause:

The total number of parameters changes, which generally occurs after software updates.

The actual parameter values of group 2000 or 2001 exceed the limit, which generally occurs after software updates.

Probable Cause	Confirming Method	Corrective Action
1. Instantaneous power failure occurs during parameter storage.	Check whether instantaneous power failure occurs during parameter storage.	Set drive model (2001-0Bh) incorrectly, and power on the system, then correctly set the drive model and power on the system again.
2. Instantaneous power failure occurs during serial encoder motor parameter writing.	Check whether instantaneous power failure occurs during serial encoder motor parameter writing.	Write the parameters of serial encoder motor by using Inovance commissioning software.
3. The software is upgraded.	Check whether the software is upgraded.	Set drive model (2001-0Bh) incorrectly, and power on the system, then correctly set the drive model and power on the system again.
4. The servo drive is faulty.	If the fault persists after the servo drive is powered off and on again, and step 1 and 2 are repeated for several times, it indicates that the servo drive is faulty.	Replace the servo drive.

■ E3.120: product model matching fault

Cause:

The motor model and drive model do not match or the parameter setting is incorrect, or the inverter module recognition is incorrect.

Probable Cause	Confirming Method	Corrective Action
1. The product (encoder, motor or servo drive) SN does not exist.	Internal fault code 200B-2Eh=1120 View the motor nameplate to check whether the motor is suitable. Check whether 2000-01h setting is correct.	Set 2000-01h (Motor SN) correctly according to the motor nameplate or use a matching motor.
	Internal fault code 200B-2Eh=2120 To view the drive model (2001-0Bh), please refer to the "1.1 Model and Nameplate Description of the Servo Drive" section on page 9 to check whether this drive model exists.	If the drive SN does not exist, set it correctly by referring to the "1.1 Model and Nameplate Description of the Servo Drive" section on page 9.
2. The power rating of the servo motor and does not match that of the servo drive.	Internal fault code 200B-2Eh=3120 Check whether drive model (2001-0Bh) matches serial bus motor model (2000-06h) by referring to the "1.1 Model and Nameplate Description of the Servo Drive" section on page 9 and the "1.3 Specifications of the Servo Motor" section on page 13.	Replace products that are not matching by referring to the "1.4 Table of Servo System Configuration Specifications" section on page 21.
3. Settings of inverter model do not match auto recognition results.	Check whether faulty axis 2001-10h and 2001-62h are the same.	Set 2001-10h the same as 2001-62h. Replace the inverter module.

■ E3.121: invalid S-ON command

Cause:

When some auxiliary functions are used, a redundant S-ON signal is given.

Probable Cause	Confirming Method	Corrective Action
1. When the servo drive is enabled internally, the S-ON signal is turned on via communication.	Check whether the S-ON signal is sent from the host controller when the auxiliary functions (200D-03h, 200D-04h, 200D-0Ch) are used.	Turn off the S-ON signal from the host controller.

■ E3.122: product matching fault in the absolute position mode

Cause:

The motor does not match in the absolute position mode or the motor SN is set incorrectly.

Probable Cause	Confirming Method	Corrective Action
1. The motor does not match in absolute position mode or the motor SN is set incorrectly.	View the motor nameplate to check whether the motor is a multi-turn absolute encoder motor. Check whether H0000 (Motor SN) is correct.	Set H0000 (Motor SN) correctly according to the motor nameplate or use a matching motor.

■ **E3.130: different DIs allocated with the same function**

Cause:

The same function is allocated to different DIs

Probable Cause	Confirming Method	Corrective Action
1. The same function is allocated to different DIs.	View 2003-03h, 2003-05h, 2003-07h to 2003-31h to check whether they are allocated with the same non-zero DI function No.	Allocate parameters that have been allocated with the same non-zero DI function No. with different DI functions. Then turn on the control power again to allow the modifications to take effect. You can also turn the S-ON signal OFF and give the reset signal to make the modification take effect.

■ **E3.136: Data check error or no parameter stored in the motor ROM**

Cause:

When reading parameters from the encoder ROM memory, the servo drive detects that no parameters are saved there or parameter values are inconsistent with the agreed value.

Probable Cause	Confirming Method	Corrective Action
1. The servo drive model and the motor model do not match.	View the servo drive and servo motor nameplates to check that the equipment used is the Inovance SV820 series, servo drive and matching servo motor.	Replace the matching servo drive and servo motor.
2. A parameter check error occurs or no parameter is stored in the serial increment encoder ROM memory.	Check whether the encoder cable is used according to the standard configuration. For cable specification, refer to the "1.6 Cables" section on page 21. The cable must be connected reliably without scratching, breaking or poor contact. Measure signals PS+, PS-, +5V and GND at both ends of the encoder cable and observe whether signals at both ends are consistent. For the definition of signals, refer to Hardware wiring.	Use the recommended encoder cable. Ensure that the cable is connected to the motor securely and tighten the screws on the drive side. If necessary, use a new encoder cable. Never bundle encoder cable and power cables (RST, UVW) together.
3. The encoder wiring is incorrect or disconnected.	Check the encoder wiring. Check whether the on-site vibration is too large, resulting in encoder cable loosening and potential damage to the encoder.	Connect the encoder cable correctly. Re-connect the encoder cable securely.
4. The servo drive is faulty.	The fault persists after the servo drive is powered on again.	Replace the servo drive.

■ **E3.150: STO input protection**

Cause:

STO input protection

■ **E3.201: Overcurrent**

Cause:

Hardware overcurrent is detected.

Probable Cause	Confirming Method	Corrective Action
1. References are input simultaneously at the servo drive startup or the reference input is too early.	Check whether an reference is input before the keypad displays "ry."	Reference sequence: After the keypad displays "ry", turn on S-ON signal and input reference. If allowed, add reference filter time constant or increase acceleration/ deceleration time.
2. The motor cables are in poor contact.	Check whether the servo drive power cables and motor UVW cables are loose.	Tighten the cables that are loose or are disconnected.
3. The motor cables are grounded.	After ensuring the servo drive power cables and motor cables are connected securely, measure whether the insulation resistance between the servo drive UVW cables and ground cable (PE) is MΩ-level.	Replace the motor if the insulation is poor.
4. The motor UVW cables are short circuited.	Disconnect the motor cables and check whether they are short circuited and whether burrs exist.	Connect the motor cables correctly.
5. The motor is damaged.	Disconnect the motor cables and measure whether the resistance between motor cables UVW is balanced.	Replace the motor if the resistance is unbalanced.
6. The gain setting is improper and the motor oscillates.	Check whether the motor oscillates or generates a shrill noise during motor startup and running. You can view "current feedback" by using the drive Inovance servo commissioning software.	Carry out gain adjustment.
7. The encoder cable is incorrectly wired, corrosive, or inserted loosely.	Check whether the encoder cable is used according to the standard configuration. Check whether the cable is aging, corrosive or loose. Turn off the S-ON signal, rotate the motor shaft manually, and check whether 200B-12h (Electrical angle) changes as the motor rotates.	Re-weld, fasten or replace the encoder cable.
8. The servo drive is faulty.	The fault persists after the motor cables are disconnected and the servo drive is powered on again.	Replace the servo drive.
9. Bleeder resistor overcurrent	Check whether external bleeder resistor resistance value is small or the bleeder resistor is short-circuited (P and C ends at main circuit input terminal).	Select new resistance value and model of the bleeder resistor. Perform the wiring again.

■ **E3.202: Soft-start relay wire-breaking**

Cause:

Soft-start relay is wire-breaking.

E3.208: FPGA sampling operation timeout

Cause:

Find th e cause through the internal fault code (200B-2Eh) when E3.208 occurs.

Probable Cause	Confirming Method	Corrective Action
1. Communication with the encoder times out.	Internal fault code 200B-2Eh=2208 Encoder wiring is incorrect. Connection of the encoder cable becomes loose. The encoder cable is too long. Communication interference exists. The encoder is faulty.	Use the recommended encoder cable. If a non-standard cable is used, check that it complies with the specifications and is a shielded twisted pair cable. Check whether the connectors at both ends of the encoder are in good contact. Contact the manufacturer. Do not bundle motor cables and encoder cables together. Ensure the servo motor and servo drive are well grounded. Replace the servo motor.
2. Current sampling times out.	Internal fault code 200B-2Eh=3208: Check whether there is large equipment generating interference on-site and whether there are interference sources such as various variable-frequency devices inside the cabinet. The internal current sampling chip is damaged.	Separate the heavy current from the light current. Replace the servo drive.
3. FPGA operation times out.	Internal fault code 200B-2Eh=0208: Determine causes 1/2/3/4.	Remove the preceding causes 1/2/3/4.

■ **E3.210: Output to-ground short-circuit**

Cause:

The servo drive detects motor phase current or bus voltage abnormal during self-check at power-on.

Probable Cause	Confirming Method	Corrective Action
1. The servo drive power cables (UVW) are short-circuited to ground.	Disconnect the motor cables, and measure whether the servo drive power cables (UVW) are short-circuited to ground (PE).	Re-connect these cables or replace them.
2. The motor is short-circuited to ground.	After ensuring the servo drive power cables and motor cables are connected securely, measure whether the insulation resistance between the servo drive UVW cables and ground cable (PE) is MΩ-level.	Replace the motor.
3. The servo drive is faulty.	Remove the power cables from the servo drive. The fault persists after the drive is powered off and on for several times.	Replace the servo drive.

■ **E3.220: UVW phase sequence incorrect**

Cause:

Incorrect UVW phase sequence is detected during angle auto-tuning.

Probable Cause	Confirming Method	Corrective Action
1. Power cable sequences are incorrect.	Check whether power cable sequence are correct.	Change any two phase sequences for angle auto-tuning again.

■ E3.234: Runaway

Cause:

The torque reference direction is reversed to the speed feedback direction in the torque control mode.

The speed feedback direction is reversed to the speed reference direction in the position or speed control mode.

Probable Cause	Confirming Method	Corrective Action
1. UVW phase sequence is incorrect.	Check whether the servo drive power cables are in the same phase sequence as the servo drive UVW cables and motor UVW cables.	Connect the UVW cables according to the correct sequence.
2. When the power is turned on, the interference signal causes the motor rotor to detect the initial phase error.	The UVW phase sequence is correct, but E3.234 occurs when the servo drive is turned on.	Power on the servo drive again.
3. The encoder model is set incorrectly or the wiring is incorrect.	View the servo drive and servo motor nameplates to check that the equipment used is the Inovance SV820 series servo drive and 20-bit servo motor (-U2***).	Use the matching servo drive and servo motor. If you use the Inovance SV820 series servo drive and 20-bit servo motor, ensure that 2000-01h=14000. Correct the motor model, encoder type, and encoder wiring.
4. The encoder cable is incorrectly wired, corrosive, or inserted loosely.	Check whether the encoder cable is used according to the standard configuration. Check whether the cable is aging, corrosive or loose. Turn off the S-ON signal, rotate the motor shaft manually, and check whether 200B-12h (electrical angle) changes as the motor rotates.	Re-weld, fasten or replace the encoder cable.

■ E3.400: Main circuit overvoltage

Cause:

The DC bus voltage between P and N exceeds overvoltage threshold.

220 V drive: Normal value: 310 V, overvoltage threshold: 420 V.

Probable Cause	Confirming Method	Corrective Action
1. The main circuit input voltage is too high.	Measure whether the input voltage of the servo drive main circuit (RST) is within the following specifications: 220 V drive: Effective value: 220 V–240 V Allowed error: –10% to +10% (198 V to 264 V)	Replace or adjust the power supply according to the specifications.
2. The power supply is instable or affected by lightning.	Check whether the power supply is unstable, affected by lightning or satisfies the preceding specifications.	Connect a surge suppressor and then the power supply. If the fault persists, replace the servo drive.

Probable Cause	Confirming Method	Corrective Action
3. Bleeder resistor failure	If an external bleeder resistor is used (2002-1Ah=1/2), measure resistance between P and C. For bleeder resistor specification, refer to the "1.5 Bleeder Resistor Specification" section on page 21.	If resistance is "∞", wire breaking occurs in the bleeder resistor. If an external bleeder resistor is used, replace it with a new one between P and C. Set 2002-1Bh (power of external bleeder resistor) and 2002-1Ch (resistance of external bleeder resistor) correctly according to the specifications of the used bleeder resistor.
4. The resistance of the bleeder resistor is too large, and energy absorption during braking is insufficient.	Measure the resistance of the external bleeder resistor between P and C. Compare the measured value with the recommended value.	Connect a new external bleeder resistor of recommended resistance between P and C. Set 2002-1Bh (power of external bleeder resistor) and 2002-1Ch (resistance of external bleeder resistor) correctly according to the specifications of the used bleeder resistor.
5. The motor is in abrupt acceleration/deceleration status. The maximum braking energy exceeds the energy absorption value.	Confirm the acceleration/deceleration time during running and measure the DC bus voltage between P and C to check whether the voltage exceeds the fault threshold during deceleration.	Ensure that the input voltage of main circuit is within the specifications. Then increase the acceleration/deceleration time within the allowed range.
6. The bus voltage sampling value has a large deviation from the actually measured value.	Check whether 200B-1 Bh (bus voltage) is within the following specifications: 220 V drive: 200B-1Bh > 420 V Measure the DC bus voltage between P and C and check whether the DC bus voltage is normal and smaller than 200B-1 Bh.	Contact Inovance for technical support.
7. The servo drive is faulty.	The fault persists after the main circuit is powered off and on several times.	Replace the servo drive.

■ E3.410: Main circuit undervoltage

Cause:

The DC bus voltage between P and N is lower than the overvoltage threshold.

220 V drive: Normal value: 310 V, overvoltage threshold: 200 V.

Probable Cause	Confirming Method	Corrective Action
1. The power supply of main circuit is unstable or power failure occurs.	Measure whether the input voltage of the main circuit (RST) on non-drive side and drive side is within the following specifications: 220 V drive: Effective value: 220 V–240 V Allowed error: –10% to +10% (198 V to 264 V) The voltages of all three phases need to be measured.	Improve the power capacity.
2. Instantaneous power failure occurs.		
3. The power voltage drops during running.	Check the power input voltage and check whether main power is applied to other devices, resulting in insufficient power capacity and a voltage dip.	

Probable Cause	Confirming Method	Corrective Action
4. Phase loss exists: Single-phase power supply is used for the 3-phase servo drive.	Check whether the main circuit wiring is correct and reliable, and whether the phase loss fault detection (200A-01h) is shielded.	Replace the cables and wire the power cables correctly: Three-phase: R, S, T Single-phase: L1, L2
5. The servo drive is faulty.	Check whether 200B-1Bh (Bus voltage) is within the following specifications: 220 V drive: 200B-1Bh < 200V The fault persists after the main circuit (RST) is powered off and on for several times.	Replace the servo drive.

■ **E3.420: Main circuit phase loss**

Cause:

1 or 2 phase(s) loss occurs on the three-phase servo drive.

Probable Cause	Confirming Method	Corrective Action
1. The three-phase power cables are not connected well.	Check whether the power cables (RST) on servo drive side and non-servo drive side are in good condition and connected securely.	Replace the cables and wire the power cables correctly:
2. The single-phase power supply is used for the three-phase servo drive. 3. The three-phase power supply is unbalanced or the voltages of three phases are too low.	Confirm the power input specification of the servo drive and the actual input voltage. Check whether the input voltage of the main circuit satisfies the following specifications: 220 V drive: Effective value: 220 V to 240 V Allowed error: –10% to +10% (198 V to 264 V) 380 V drive: Effective value: 380 V to 440 V Allowed error: –10% to +10% (342 V to 484 V) The voltages of all three phases need to be measured.	For three-phase servo drive of 0.75 kW (H01-10=5), single-phase power supply is allowed. If the input voltage satisfies the specifications on the left, set H0A-00=2 (inhibit faults and warnings). If the input voltage does not satisfy the specifications, replace or adjust the power capacity according to the specifications on the left.
4. The servo drive is faulty.	The fault persists after the main circuit (RST) is powered off and on several times.	Replace the servo drive.

■ **E3.430: Control power undervoltage**

Cause:

AC input phase loss of control power exists.

Probable Cause	Confirming Method	Corrective Action
Control power input is unstable.	Check whether the control power cables are well connected and whether the AC input voltage of control power satisfies specifications.	Connect the motor power cables again or replace them.

■ **E3.500: Motor overspeed**

Cause:

The actual speed of the servo motor exceeds the overspeed threshold.

Probable Cause	Confirming Method	Corrective Action
1. UVW phase sequence of the motor cables is incorrect.	Check whether the servo drive power cables are in the same phase sequence as the servo drive UVW cables and the motor UVW cables.	Connect the UVW cables according to the correct sequence.
2. The setting of 200A-09h is incorrect.	Check whether the overspeed threshold is smaller than the actual maximum motor speed. Overspeed threshold=1.2 times maximum motor speed (200A-09h=0). Overspeed threshold=200A-09h (200A-09h≠0, and 200A-09h < 1.2 times maximum motor speed).	Re-set the overspeed threshold according to the actual mechanical requirement.
3. The input reference is higher than the overspeed threshold.	Check whether the motor speed corresponding to the input reference exceeds the overspeed threshold. Position control mode: In CSP mode, view the gear ratio 6091-01h/6091-02h to check the position reference increment for a single synchronous cycle and convert it to speed. In PP mode, view the gear ratio 6091-01h/6091-02h and check the value of 6081h (profile velocity). In HM mode, view the gear ratio 6091-01h/6091-02h, and determine 6099-01h and 6099-02h. In speed control mode, view the gear ratio 6091 h, and the values of 60 FFh (target velocity), 2006-07h to 2006-0Ah, and 607 Fh (max profile velocity). Torque control mode: In torque control mode, view the value of 2007-12h (speed limit source) and the corresponding speed limit value.	Position control mode: CSP: Decrease the position reference increment for a single synchronous cycle, and the host controller needs to increase the position ramp additionally when generating references. PP: Decrease the value of 6081h, or increase the acceleration/deceleration ramp (6083h, 6084h). HM: Decrease 6099-01h and 6099-02h, or increase the acceleration/deceleration ramp (609 Ah). Decrease the gear ratio according to the actual conditions. Speed mode: Decrease the target velocity, speed limit value, gear ratio. In PV mode, increase the speed ramp 6083h and 6084h; in CSV mode, the host controller needs to increase speed ramp additionally. Torque control mode: Set the speed limit value smaller than the overspeed threshold.
4. The motor speed overshoots.	Check whether the "speed feedback" exceeds the overspeed threshold through the Inovance servo commissioning software.	Adjust the gain or mechanical running conditions.
5. The servo drive is faulty.	The fault persists after the servo drive is powered on again.	Replace the servo drive.

■ **E3.602: Angle auto-tuning failure**

Cause:

Abnormal jitter is reported by the encoder during the angle auto-tuning.

Probable Cause	Confirming Method	Corrective Action
Encoder feedback data abnormal	Check if the encoder communication is disturbed.	Check the encoder hardware wiring.

■ **E3.610: Servo drive overload**

Cause:

Heat accumulation of the servo drive reaches the fault level.

■ **E3.620: Motor overload**

Cause:

Heat accumulation of the motor reaches the fault level.

Probable Cause	Confirming Method	Corrective Action
1. Wiring of the motor and encoder is incorrect or in poor contact.	Check wirings between the servo drive, the servo motor and the encoder according to the correct "wiring diagram."	Connect the wirings according to the correct wiring diagram. Preferably use the cables recommended by Inovance. When self-made cables are used, prepare and connect the cables according to the hardware wiring instructions.
2. The load is too heavy. The motor keeps output of effective torque higher than the rated torque for a continuous operation.	Confirm the overload characteristics of the servo drive or motor. Check whether the average load ratio (200B-0DH) is larger than 100% for a long time.	Use a servo drive of larger capacity and matching servo motor. Reduce the load and increase the acceleration/deceleration time.
3. Acceleration/deceleration is too frequent or the load inertia is too large.	Calculate the mechanical inertia ratio or perform the inertia auto-tuning. Then view 2008-10h (load inertia ratio). Check the single running cycle when the servo motor runs circularly.	Increase acceleration/ deceleration time during single running.
4. The gain adjustment is improper, or the stiffness is too high.	Check whether the motor vibrates and produces abnormal noise during running.	Re-adjust the gain.
5. The servo drive or motor model is set incorrectly.	View the bus motor model in 2000-06h and servo drive model in 2001-0Bh.	View the servo drive nameplate and set the servo drive model in 2001-0Bh correctly and use a matching servo motor according to Section 2.3.

Probable Cause	Confirming Method	Corrective Action
6. Locked-rotor occurs due to mechanical factors, resulting in very heavy load during running.	Check the running reference and motor speed (200B-01h) through Inovance servo commissioning software or the keypad: Running reference in position control: 200B-0Eh (Input position reference counter) Running reference in speed mode: 200B-02h (Speed reference) Running reference in torque mode: 200B-03h (Internal torque reference) Check that the running reference is not 0 but the motor speed is 0 in the corresponding mode.	Eliminate mechanical factors.
7. The servo drive is faulty.	The fault persists after the servo drive is powered on again.	Replace the servo drive.

■ **E3.630: Overheat protection for locked-rotors**

Cause:

The actual motor speed is lower than 10 RPM but the torque reference reaches the limit. The duration reaches the value set in 200A-21h.

Probable Cause	Confirming Method	Corrective Action
1. Power output (UVW) phase loss or incorrect phase sequence occurs in the servo drive.	Perform motor trial running when there is no load and check the motor wirings.	Correct the wiring or replace the cables.
2. The servo drive UVW cable or the encoder cable breaks.	Check wirings.	Correct the wiring or replace the cables.
3. Locked-rotor occurs due to mechanical factors.	Check the running reference and motor speed (200B-01h) through Inovance servo commissioning software or the keypad: Running reference in position control: 200B-0Eh (Input position reference counter) Running reference in speed mode: 200B-02h (Speed reference) Running reference in torque mode: 200B-03h (Internal torque reference) Check that the running reference is not 0 but the motor speed is 0 in the corresponding mode.	Eliminate mechanical factors.

■ **E3.650: Heatsink overheat**

Cause:

The temperature of the servo drive power module is higher than the over-temperature protection threshold.

Probable Cause	Confirming Method	Corrective Action
1. The ambient temperature is too high.	Measure the ambient temperature	Improve the cooling conditions for the servo drive to reduce the ambient temperature.
2. The servo drive is powered off and powered on several times to reset the overload fault.	View the fault records (set 200B-22h and view 200B-23h) and check whether an overload fault/warning (E3.610, E3.620, E3.630, E3.650) occurs.	Change the fault reset method. After overload occurs, wait 30s and then perform the reset operation. Increase the capacity of the servo drive and servo motor, increase acceleration/deceleration time, and reduce the load.
3. The fan is damaged.	Observe whether the fan works during running.	Replace the servo drive.
4. The installation direction and clearance away from other servo drives are improper.	Check whether installation of the servo drive is proper.	Install the servo drive according to the requirements.
5. The servo drive is faulty.	The fault persists after restart and 5 minutes after powering off.	Replace the servo drive.

■ **E3.731: Encoder battery failed**

Cause:

The battery voltage of the absolute encoder is lower than 3.0 V.

Probable Cause	Confirming Method	Corrective Action
The battery is not connected during power-off.	Check whether the battery is connected during power-off.	Set 200D-15h=1 to remove the fault.
The battery voltage of the encoder is too low.	Measure the battery voltage.	Use a new battery of matching voltage.

■ **E3.733: Encoder multi-turn counting error**

Cause:

Encoder multi-turn counting error

Probable Cause	Confirming Method	Corrective Action
The encoder is faulty.	Set 200D-15h=2 to remove the fault. E3.733 persists after power-on again.	Replace the motor.

■ **E3.735: Encoder multi-turn counting overflow**

■ **E3.740: Encoder interference**

Cause:

The encoder communication has been disturbed, resulting in an error in the communication process.

Probable Cause	Confirming Method	Corrective Action
1. The encoder wiring is incorrect.	Check the encoder wiring.	Reconnect cables according to the correct wiring diagram.

Probable Cause	Confirming Method	Corrective Action
2. Connection of the encoder cable becomes loose.	Check whether the on-site vibration is too large, resulting in encoder cable loosening and potential damage to the encoder.	Re-connect the encoder cable securely.
3. Interference on Z signal of the encoder exists.	Check on-site wirings: Check whether large equipment is generating an interference on-site and whether there are interference sources such as various variable-frequency devices inside the cabinet. Set the servo in "Rdy" state, then manually rotate the motor shaft anti-clockwise, and monitor whether the 200B-12h (electrical angle) increases or decreases smoothly while number of 0-360° within one revolution is 5. (This is for Z series motors, and for X series motors the number should be 4.) If 200B-12h changes abnormally during rotation, it indicates that a fault occurs on encoder. If there is no alarm during rotation but the system alarms during servo running, it is likely that interference exists.	Preferably use the cables recommended by Inovance. If a non-standard cable is used, check whether the cable meets the requirements and is an STP cable. Do not bundle motor cables and encoder cables together. Ensure the servo motor and servo drive are well grounded. Check that the connectors at both ends of the encoder are in good contact.
4. The encoder is faulty.	Use a new encoder cable. If the fault no longer occurs after replacement, it indicates that the original encoder cable is damaged. Place motor at the same position, power on the system several times and observe change of 200B-12h. The electrical angle must be within ±30°.	Use a new encoder cable. Replace the servo motor if the encoder is faulty.

■ E3.A33: Encoder reads and writes data abnormally

Cause:

Internal parameters of the encoder are abnormal.

Probable Cause	Confirming Method	Corrective Action
1. The serial incremental encoder cable breaks or becomes loose.	Check wirings.	Check the connection of the encoder cable to see whether there is an incorrect connection, broken wiring, or a poor contact. If motor cables and encoder cables are bundled together, separate them.
2. Reading and writing of the series incremental encoder parameters are abnormal.	If the servo drive is powered off and on several times but the fault persists, it indicates that the encoder is faulty.	Replace the servo motor.

■ E3.B00: Position deviation excess

Cause:

The position deviation is larger than the setting of 6065h in position control mode.

Probable Cause	Confirming Method	Corrective Action
1. Power output (UVW) phase loss or incorrect phase sequence occurs in the servo drive.	Perform motor trial running when there is no load and check the motor wirings.	Correct the wiring or replace the cables.

Probable Cause	Confirming Method	Corrective Action
2. The servo drive UVW cable or the encoder cable breaks.	Check wirings.	Reconnect the UVW cables. The servo motor UVW cables must be connected to the servo drive UVW cables correspondingly. If necessary, replace all cables and ensure a reliable connection.
3. Locked-rotor occurs due to mechanical factors.	Check the running reference and motor speed (200B-01h) through Inovance servo commissioning software or the keypad: Running reference in position control: 200B-0 Eh (Input position reference counter) Running reference in speed mode: 200B-02h (Speed reference) Running reference in torque mode: 200B-03h (Internal torque reference) Check that the running reference is not 0 but the motor speed is 0 in the corresponding mode.	Eliminate mechanical factors.
4. The servo drive gain is too low.	Check the position loop gain and speed loop gain of the servo drive. 1st gain: 2008-01h to 2008-03h 2nd gain: 2008-04h to 2008-06h	Adjust the gain manually or perform gain auto-tuning.
5. The position reference increment is too large.	Position control mode: In CSP mode, view the gear ratio 6091-01h/6091-02h to check the speed reference increment for a single synchronous cycle and convert it to speed. In PP mode, view the gear ratio 6091-01h/6091-02h and check the value of 6081h (profile velocity). In HM mode, view the gear ratio 6091-01h/6091-02h, and determine 6099-01h and 6099-02h.	CSP: Decrease the position reference increment for a single synchronous cycle, and the host controller needs to increase the position ramp additionally when generating references. PP: Decrease the value of 6081h, or decrease the acceleration/deceleration ramp (6083h, 6084h). HM: Decrease 6099-01h and 6099-02h, or decrease the acceleration/deceleration ramp (609Ah). Decrease the gear ratio according to the actual conditions.
6. Relative to the running condition, 6065h (following error window) is too small.	Check whether the setting of 6065h is too small.	Increase the value of 6065h.
7. The servo drive or motor is faulty.	Monitor the running curve through the oscilloscope function in Inovance servo commissioning software: Position reference, position feedback, speed reference, torque reference	If the position reference is not 0, but the position feedback is always 0, replace the servo drive or motor.

■ E3.B01: Position reference suffers abnormal increment

Cause:

Target position increment in CSP mode is too large.

Probable Cause	Confirming Method	Corrective Action
1. The position reference increment is too large.	Check the target position increment of the adjacent synchronous cycles.	Decrease the position reference speed, or set a certain acceleration/ deceleration curve when the host controller plans the target position.
2. Before switching modes, the target position is not aligned with the current position.	Check whether mode switching happened in the controller software.	Before mode switching, assign the value of the current position to the target position.
3. When the servo is enabled, the target position is not aligned with the current position.	Check whether the operation of enabling the servo happened in the controller software.	When the servo is enabled, assign the value of the current position to the target position.
4. The gear ratio setting is unreasonable.	Check whether the 6091-01h and 6091-02h are set incorrectly. Check whether scaling factors of the host controller associated with machine and motor encoder are set incorrectly.	Modify gear ratio and host controller related scaling factors according to practical applications.
5. Motor selection is unreasonable.	Check that the maximum motor speed is less than the maximum operating speed that satisfies on-site demand.	Re-select the motor or reduce the maximum operating speed on site.

■ E3.B03: Electronic gear ratio setting exceeds limit

Cause:

Electronic gear ratio exceeds limit: (0.001 x encoder resolution/10,000, 4,000 x encoder resolution/10,000).

Probable Cause	Confirming Method	Corrective Action
1. The electronic gear ratio setting exceeds the preceding range.	Check whether the ratio value of 6091-01h/6091-02h exceeds the preceding range.	Set the gear ratio within the required range.

■ E3.D09: Software position setting incorrect

Cause:

The lower limit of the software position is larger than the upper limit.

Probable Cause	Confirming Method	Corrective Action
1. The lower limit of the software position is larger than the upper limit.	The lower limit (607D-01) of the parameter soft limit is greater than the upper limit (607D-02).	Reset the parameters.

■ E3.D10: Origin position setting incorrect

Cause:

The origin offset is outside the soft limit.

Probable Cause	Confirming Method	Corrective Action
1. The origin offset is outside the soft limit.	The value of the parameter (607Ch) is outside the soft limit 607D-01 and the upper limit (607D-02) of the soft limit.	Reset the parameters.

5.4 Troubleshooting of Warnings

■ E3.601: Home attaining warning

Cause:

When using the homing function, home is not found within the time set in 2005-24h.

Probable Cause	Confirming Method	Corrective Action
1. The home switch fails.	There is only high-speed searching and no low-speed searching during the homing operation. After high-speed searching of homing, the drive keeps reverse low-speed searching.	If a hardware DI is used, check whether the DI function has been allocated to a DI in group 2003h and then check the wiring of the DI. Manually change the DI logic and observe whether the servo drive receives DI level change in 200B-04h. If the home signal is Z but it cannot be found at all times, check the Z signal status.
2. The search time is too short.	Check whether the time for homing set in 2005-24h is too short.	Increase 2005-24h.
3. The speed for searching for the home switch signal at high speed is too small.	Check the distance from the initial position of homing to the home switch. Then check whether 6099-01h (speed during search for the home switch) is too small, resulting in a delay in finding the home switch.	Increase 6099-01h.
4. The setting of the home switch is improper.	Check whether the limit signals at two sides are active simultaneously. Check whether a limit signal is active simultaneously with the home signal.	Set the position of the hardware switch properly.

■ E3.730: Encoder battery warning

Cause:

The battery voltage of the absolute encoder is lower than 3.0 V.

Probable Cause	Confirming Method	Corrective Action
1. The battery voltage of the absolute encoder is lower than 3.0 V.	Measure the battery voltage.	Use a new battery of matching voltage.

■ E3.909: Motor overload warning

Cause:

Accumulative heat of 60Z series 200 W and 400 W motors reaches the warning threshold.

Probable Cause	Confirming Method	Corrective Action
1. Wiring of the motor and encoder is incorrect or in poor contact.	Check the wiring between the servo drive, servo motor and the encoder according to the correct wiring diagram.	Connect the wirings according to the correct wiring diagram. Preferably use the cables recommended by Inovance. When self-made cables are used, prepare and connect the cables according to the hardware wiring instructions.
2. The load is too heavy. The motor keeps output of effective torque higher than the rated torque for a continuous operation.	Confirm the overload characteristics of the servo drive or motor. Check whether the average load ratio (2008-0Dh) is larger than 100% for a long time.	Use a servo drive of larger capacity and matching servo motor. Reduce the load and increase the acceleration/deceleration time.

Probable Cause	Confirming Method	Corrective Action
3. Acceleration/deceleration is too frequent or the load inertia is too large.	Check the mechanical inertia ratio or perform the inertia auto-tuning. Then view 2008-10h (load inertia ratio). Check the single running cycle when the servo motor runs circularly.	Increase the acceleration/deceleration time.
4. The gain is improper, or the stiffness is too high.	Check whether the motor vibrates and produces abnormal noise during running.	Re-adjust the gain.
5. The servo drive or motor model is set incorrectly.	View the bus motor model in 2000-06h and servo drive model in 2001-0Bh.	View the servo drive nameplate and set the servo drive model in 2001-0Bh correctly and use a matching servo motor according to Section 2.3.
6. Locked-rotor occurs due to mechanical factors, resulting in very heavy load during running.	Check the running reference and motor speed (200B-01h) through Inovance servo commissioning software or keypad: Running reference in position control: 200B-0Eh (Input position reference counter) Running reference in speed mode: 200B-02h (Speed reference) Running reference in torque mode: 200B-03h (Internal torque reference) Check that the running reference is not 0 or very large but the motor speed is 0 in corresponding mode.	Eliminate mechanical factors.
7. The servo drive is faulty.	Power off and on the servo drive.	Replace the servo drive if the fault persists after the servo drive is powered on again.

■ **E3.920: Bleeder resistor overload**

Cause:

The accumulative heat of the bleeder resistor exceeds the setting value.

Probable Cause	Confirming Method	Corrective Action
1. The cable of the external bleeder resistor is in poor connection, becomes loose or breaks.	Disconnect the external bleeder resistor and measure whether the resistance is "∞". Measure whether the resistance between P and C is "∞".	Use a new external bleeder resistor. If the resistance measured is the same as the nominal value, connect the bleeder resistor between P and C.
		Connect the external bleeder resistor between P and C with a new cable.

Probable Cause	Confirming Method	Corrective Action
2. The setting of H02-25 is incorrect when the external bleeder resistor is used.	View the setting value of H02-25. Measure the resistance of the external resistor between P and C, and compare it with the bleeder resistor specification table in Section 6.1.7. Check whether the setting value of H02-27 is larger than the resistance of the bleeder resistor between P and C.	Set H02-25 correctly: H02-25=1 (external, naturally ventilated) H02-25=2 (external, forcible cooling)
3. The resistance of the external bleeder resistor used is too large.		Select a proper bleeder resistor according to the bleeder resistor specification table in Section 6.1.7.
4. H02-27 (resistance of external bleeder resistor) is larger than the resistance of the external bleeder resistor actually used.		Set H02-27 according to the resistance of the external bleeder resistor actually used.
5. The input voltage of the main circuit exceeds the specifications.	Check whether the input voltage of the main circuit satisfies the following specifications: 220 V drive: Effective value: 220 V to 240 V Allowed error: –10% to +10% (198 V to 264 V) 380 V drive: Effective value: 380 V–440 V Allowed error: –10% to +10% (342 V to 484 V)	Replace or adjust the power supply according to the specifications on the left.
6. The load rotor inertia is too large.	Perform inertia auto-tuning according to "inertia auto-tuning," or calculate the total inertia of the machine manually according to the mechanical parameters. Check whether the actual load inertia ratio exceeds 30.	Select a large external bleeder resistor and set H02–26 consistent with the actual value. Select a larger servo drive. If allowed, reduce the load. If allowed, increase the acceleration/deceleration time. If allowed, increase the motor running cycle.
7. The motor speed is very high, resulting in an incomplete deceleration within the required time. The motor is in continuous deceleration status in cyclic running.	View the motor speed curve in cycle running and check whether the motor is in the deceleration status for a long period.	
8. The capacity of the servo drive or bleeder resistor is insufficient.	View the motor's single cycle speed curve and calculate whether the maximum braking energy can be absorbed completely.	
9. The servo drive is faulty.	-	Replace the servo drive.

■ **E3.922: External bleeder resistor is too small.**

Cause:

H02-27 (resistance of external bleeder resistor) is smaller than H02-21 (permissible minimum resistance of external bleeder resistor).

Probable Cause	Confirming Method	Corrective Action
When the external bleeder resistor (H02-25=1 or 2) is used, its resistance is smaller than the permissible minimum resistance required by the servo drive.	Measure the resistance of the external bleeder resistor between P and C and check whether it is smaller than H02-21.	If yes, connect an external bleeder resistor matching the servo drive between P and C and set H02-27 (resistance of external bleeder resistor) to the actual value. If not, set H02-27 to the actual value of the external bleeder resistor.

■ E3.939: Motor power cable breaking

Cause:

The actual phase current of the motor is smaller than 10% of the rated motor current, and the actual motor speed is small but the internal torque reference is very large.

Probable Cause	Confirming Method	Corrective Action
The motor power cables break.	Check whether the difference between 200B-19h (phase current effective value) and 200B-03h (internal torque reference) reaches over 500%, and whether 200B-01h (actual motor speed) is smaller than 1/4 of the rated motor speed.	Reconnect the motor power cables. Use new cables if necessary.

■ E3.941: Parameter modification taking effect only after powering on again

Cause:

After the function code property "effective time" as "power-on again" is modified, the servo drive prompts the user to power on again.

Probable Cause	Confirming Method	Corrective Action
Function codes with changes immediately in effective are modified.after powering on again	check whether function codes with "effective time" as "power-on again" are modified.	Power on the servo drive again.

■ E3.942: Parameter storage too frequent

Cause:

The number of function codes that are modified once exceeds 200.

Probable Cause	Confirming Method	Corrective Action
A great number of function code parameters are modified and stored frequently to EEPROM (200C-0Eh=1)	Check whether the host controller performs frequent and fast function code parameter modification on the servo drive.	Check the running mode. For parameters that need not be stored in EEPROM, set 200C-0 Eh to 0 before the writing operation of the host controller.

■ E3.950: Positive limit switch warning

Cause:

The logic of the DI allocated with FunIN.14: P-OT (positive limit switch) is valid.

Probable Cause	Confirming Method	Corrective Action
The logic of the DI allocated with FunIN.14: P-OT (positive limit switch inhibited) is valid.	Check whether a DI is allocated with FunIN.14 (P-OT) in group 2003h. View whether the DI logic is valid in 200B-04h (monitored DI states).	Check the running mode. On the prerequisite of ensuring safety, send a reverse reference or rotate the motor to make the logic of DI with the positive limit switch function become invalid.

■ E3.952: Negative limit switch warning

Cause:

The logic of the DI allocated with FunIN.15: N-OT (negative limit switch) is valid.

Probable Cause	Confirming Method	Corrective Action
The logic of the DI allocated with FunIN.15: N-OT (negative limit switch inhibited) is valid.	Check whether a DI is allocated with FunIN.15 (N-OT) in group 2003h. View whether the DI logic is valid in 200B-04h (monitored DI states).	Check the running mode. On the prerequisite of ensuring safety, send a reverse reference or rotate the motor to make the logic of DI with the negative limit switch function become invalid.

■ **E3.980: Encoder internal fault**

Cause:

An encoder algorithm error occurs.

Probable Cause	Confirming Method	Corrective Action
An encoder internal fault occurs.	If the servo drive is powered off and on several times but the warning is still reported, it indicates that the encoder is faulty.	Replace the servo motor.

■ **E3.990: Power input phase loss warning**

Cause:

The three-phase servo drive of 1 kW is allowed to run under single-phase power but the fault and warning of power input phase loss (H0A-00) is enabled.

Probable Cause	Confirming Method	Corrective Action
When H0A-00=1 (enable faults and warnings), the 0.75 kW three-phase servo drive (H01-02=5) can run under single-phase power, but this warning is reported when single-phase power is applied.	Check whether the three-phase servo drive allows running under single-phase power.	If the warning persists when a three-phase servo drive is connected to three-phase power, rectify this warning as Er.420 (power cable phase loss). If the warning persists when a three-phase servo drive allows single-phase power input, set H0A-00 to 0.

■ **E3.998: Homing object dictionary is set incorrectly.**

Cause:

Homing mode (6098h) sets a value outside the specification.

Probable Cause	Confirming Method	Corrective Action
The setting value of object 6098h is not supported.	Check the setting value of object 6098h.	Set parameters according to the specifications.

■ **E3.E20: Ethernet hardware error**

Cause:

Ethernet hardware fault

Probable Cause	Confirming Method	Corrective Action
Ethernet hardware error	If the servo drive is powered off and on several times but the warning is still reported, it indicates that the Ethernet is faulty.	Replace the servo drive.

■ **E3.E21: The MAC address is not burned.**

Cause:

MAC address of the driver not burnt.

Probable Cause	Confirming Method	Corrective Action
The MAC address is not burned.	If the servo drive is powered off and on several times but the fault persists, it indicates that the servo drive does not burn the MAC address.	Please consult the manufacturer's technical service personnel.

5.5 Troubleshooting of Communication Faults

The above provides the details for rectifying faults of the SV820 series servo drive. This part describes how to rectify communication faults.

■ **E3.E07: Network state switching abnormal**

Cause:

When the servo is enabled, the network switches from OP to non-OP.

Probable Cause	Confirming Method	Corrective Action
1. When the servo is enabled, the network switches from OP to non-OP.	Check whether the network state has switched from OP to non-Op.	Check the host computer network status switch program.

■ **E3.E08: Synchronization loss**

Cause:

The master station's synchronization signal is abnormal during communication.

Probable Cause	Confirming Method	Corrective Action
1. The slave station's receipt signal is abnormal during synchronous communication.	Check whether the shielded twisted pair is used as the communication cable. Check whether the servo drive is well grounded. Check whether drive's Ethernet port is damaged.	Use the shielded twisted pair. Connect the cable according to the wiring instructions. Check the network connection status via the first LED on the left.
2. The master station's sending signal is abnormal during synchronous communication.	The synchronization clock of the host controller is not valid. The synchronization clock error of the host controller is too large.	Measure the synchronization cycle by background oscilloscope or actual oscilloscope: If the synchronization cycle is 0, it indicates that the synchronization clock of the host controller is not valid. Firstly, check whether the network cable connects all slave stations in accordance with entering from the IN port and going out from the OUT port; then restart the network. But if the network cable connection sequence is correct, restart the network directly. If it is not 0 and within the permissible fluctuation range (2us) of the servo drive, increase the permissible interruption loss times (200E-21h) of the slave station.

■ **E3.E11: ESI configuration file is not burned.**

Cause:

ESI configuration file is not burned.

Probable Cause	Confirming Method	Corrective Action
1. The equipment configuration file is not burnt.	When the host computer scans the slave station, its ID is empty.	Burn the equipment configuration file.
2. The servo drive is faulty.	Servo drive failure	Replace the servo drive.

■ E3.E13: The synchronization cycle setting error

Cause:

After the system switches over to the running mode, the synchronization cycle is an integer multiple of reference scheduling cycles.

Probable Cause	Confirming Method	Corrective Action
1. The synchronization cycle is an integer multiple of reference scheduling cycles.	Check the setting of the synchronization cycle.	Modify the setting of the synchronization cycle to the integer multiples of the reference scheduling cycle. Remark: The reference scheduling cycle can be calculated by factory parameters (H0160 and H0161).

■ E3.E15: Synchronization cycle error is too large

Cause:

The synchronization cycle error exceeds the threshold.

Probable Cause	Confirming Method	Corrective Action
1. The controller has a large synchronization cycle error.	Measure the synchronization cycle of the controller. Measure the synchronization cycle through a digital oscilloscope or the oscilloscope function in the Inovance servo commissioning software.	Increase the factory parameter (200E-21h).

Chapter 6 Trial Running

6.1 Check Before Running

Check the items in the following table before running the servo drive and motor.

Checklist before running

Record	No.	Content
Wiring		
□	1	The servo drive's main circuit power input terminals are connected correctly.
□	2	The main circuit output terminals U, V, W of the servo drive are properly connected to the power cables U, V, W of the servo motor in the correct phase sequence.
□	3	No short circuit exists in the main circuit power input terminals R, S, T and the output terminals U, V, W of the servo drive.
□	4	The signal wires of the servo drive are connected correctly. The external signal wires such as the brake and the limit switch are connected reliably.
□	5	The servo drive and motor are grounded reliably.
□	6	The cable tension is within the permissible range.
□	7	The wiring terminals have been insulated.
Environment and Mechanical Conditions		
□	1	No foreign objects, such as wire heads or metal powder, which may cause short circuit of the signal wire and power cables, exist inside and outside of the servo drive.
□	2	The servo drive or external regenerative resistor is not placed on flammable objects.
□	3	Installation, shaft and mechanical connection of the servo motor are reliable.
□	4	The servo motor and connected machine are in conditions running order.

6.2 Power Supply Connection

After connecting the power supply of the control circuit and main circuit, if the bus voltage indicator is in normal display and the keypad displays "reset", "nr", and "ry" in sequence, it indicates that the servo drive is ready for running and waiting for the S-ON signal from the host controller.

6.3 Jog Running via the Keypad

SV820N supports setting parameters and performing jog running via the keypad. For details on the commissioning procedures, please see the "4.6 Jog Running" section in Chapter 4.

6.4 Jog Running via Commissioning Software

Note: When performing background jog running, the current control mode of the corresponding shaft shall not be in the EtherCAT control mode.

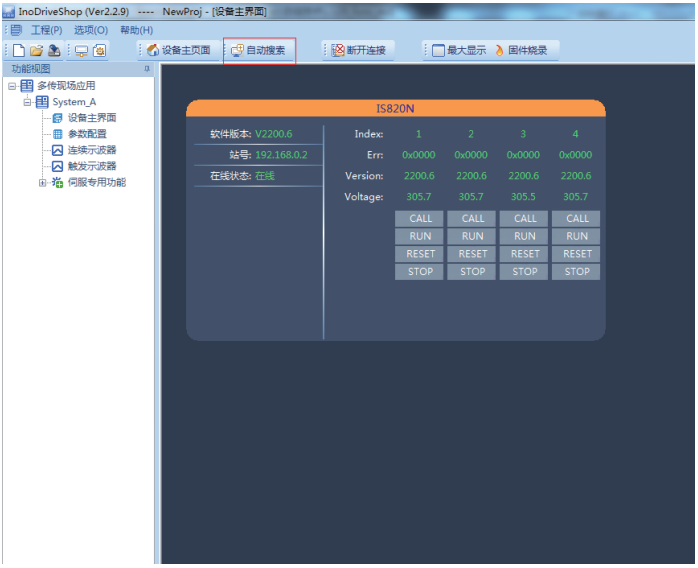
6.4.1 Communication Setting

First open the commissioning software InoDriveShop.exe of SV820N. Then with InoDriveShop (background commissioning software), various functions can be performed on thePC, such as real-time monitoring, parameter configuration, real-time sampling, triggering single sampling and an emergency stop. The software icon is as follows:

Select the corresponding serial number and baud rate from the Communication Wizard.

Double click the icon to open the software, then directly load connected devices:

The current device can also be identified by automatic search function:



6.4.2 Jog Running

Enter Speed JOG mode operation interface, and complete jog running on 4 shafts respectively.

Function description: The Speed JOG function is mainly used for motor speed mode commissioning. Select the corresponding axis number in the axis drop-down box, set the commissioning speed in JOG speed, set the servo status as servo On, then the motor will be enabled. At this point, click and hold the left arrow button and the motor will run forward at the set JOG speed and will stop upon release. Similarly, press and hold the right arrow button which will cause the reverse running. Set the servo status as servo Off, then the motor will be disabled.

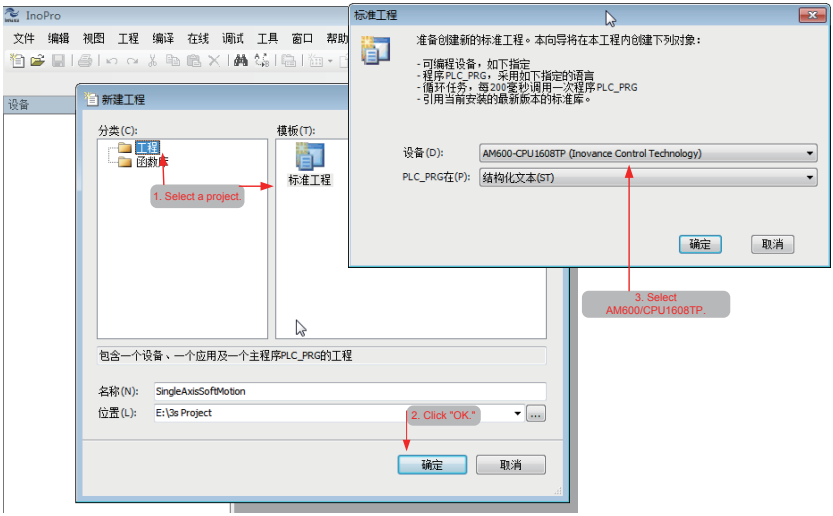
6.5 Cyclic Synchronous Position (CSP) Mode of SV820N with AM600 Controller

The following will introduce the communication settings of SV820N by taking Inovance's AM600 controller as the master station.

Note	To better fit for SV820, it is recommended to use Version 1.10 or higher version for AM600 background.

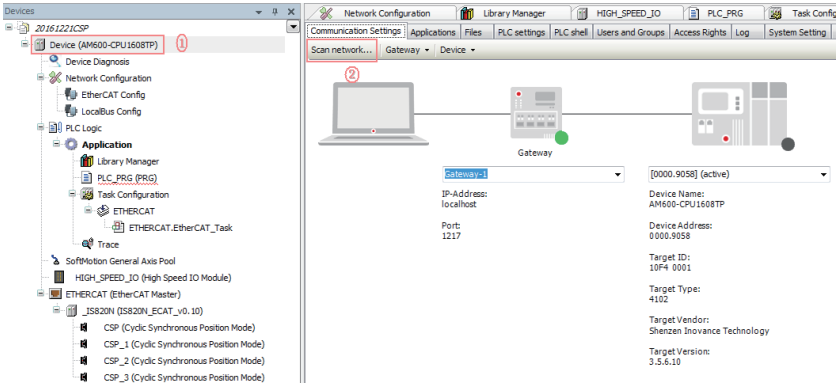
6.5.1 Creating a Project

Create an AM600 project. Select "AM600-CPU1608TP," as shown in the following image.

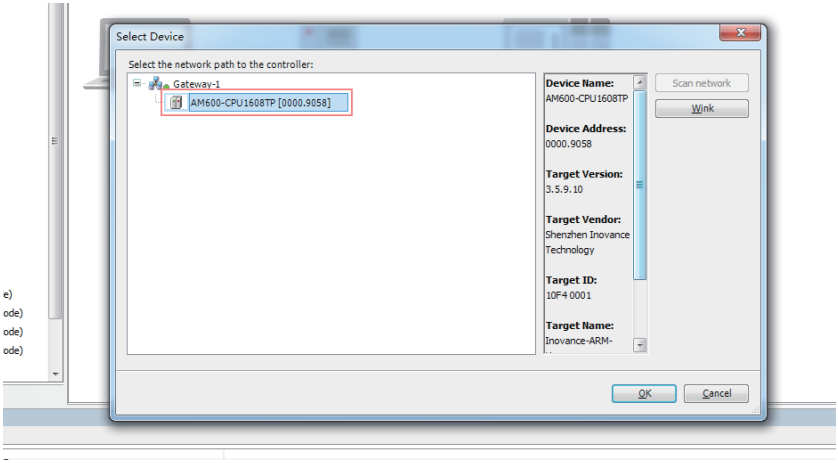


6.5.2 Communication Setting

Correctly connect the communication cables. To have a normal communication connection, set the IP address of the PC to the same network segment (192.168.1.xxx) as AM600.

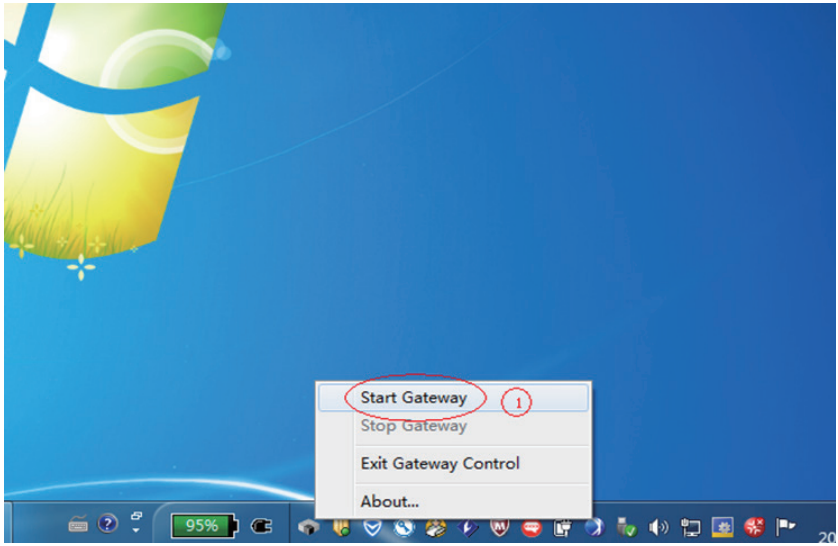


Click Scan Network.



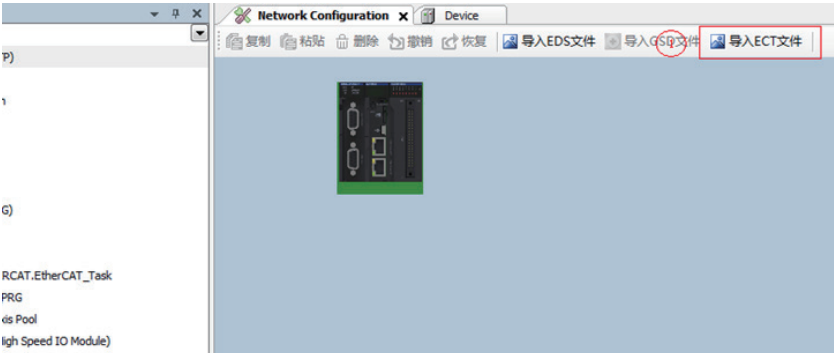
Select the scanned AM600 device. Now the communication connection between PLC and PC is completed. Next, perform the device configuration.

Note	When the AM600 device cannot be scanned in InoPro: The CoDeSys gateway is not turned on. Please check and start it, and then scan. Check whether the CoDeSys gateway is turned on (shown in color). If it is in STOP state, please click it to start.



6.5.3 Adding Devices for the Configuration

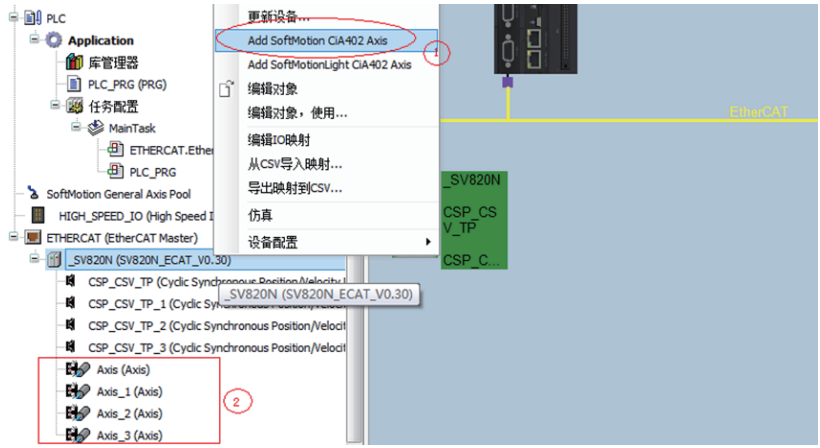
1. Add the XML file of SV820N: Click Import ECT File in Network Configuration to add XML files (please download XML files from Inovance's official website).



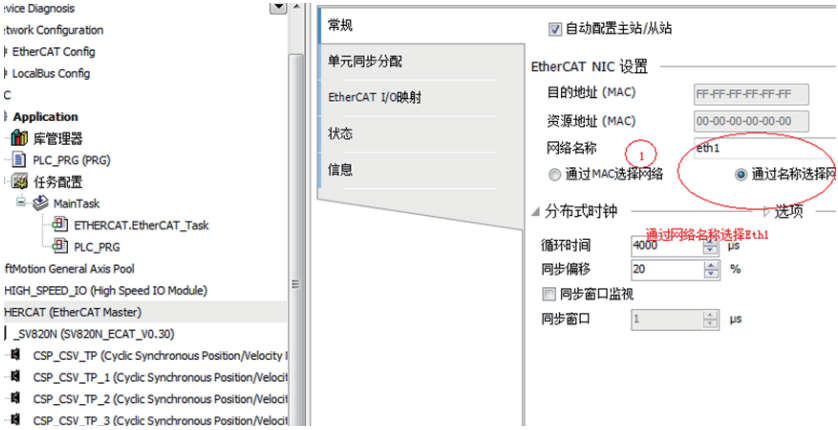
2. Perform device configuration for the system: First add the EtherCAT bus, then add the SV820N device. (Directly drag the SV820N_ECAT_V0.10 into the configuration interface.)

3. If AM600 background is lower than V1.10, please manually add 4 motor shafts.

   Right-click the SV820N device option to add 4 rotating motor shafts.

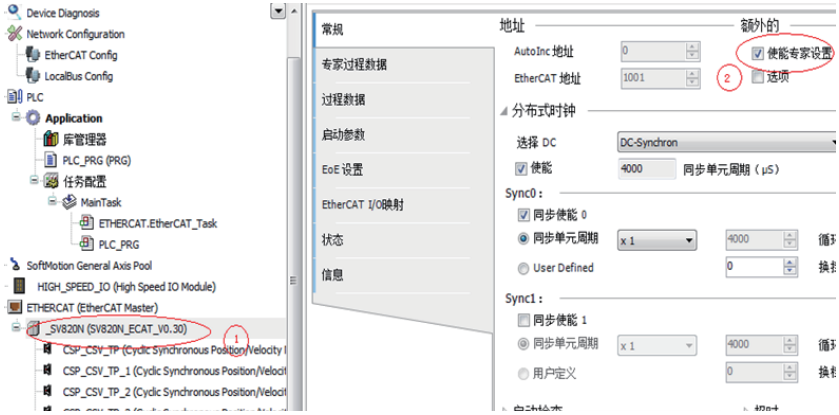


4. Configure master station communication parameters for EtherCAT: Just use the default value, and select eth1 for the network.

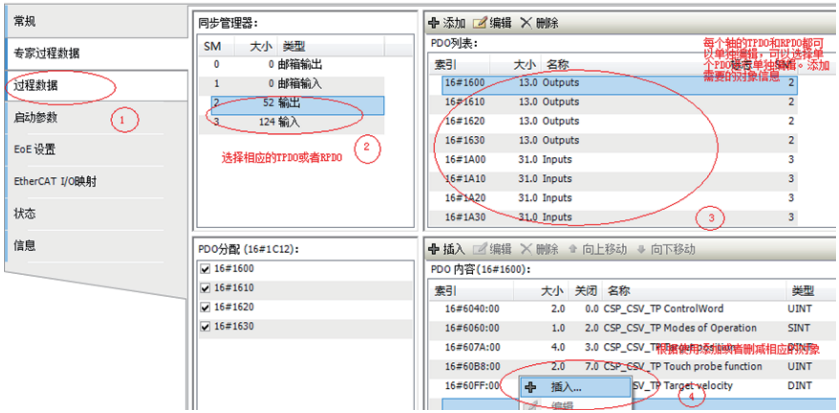


6.5.4 Configuring the PDO Mapping for the Slave Station

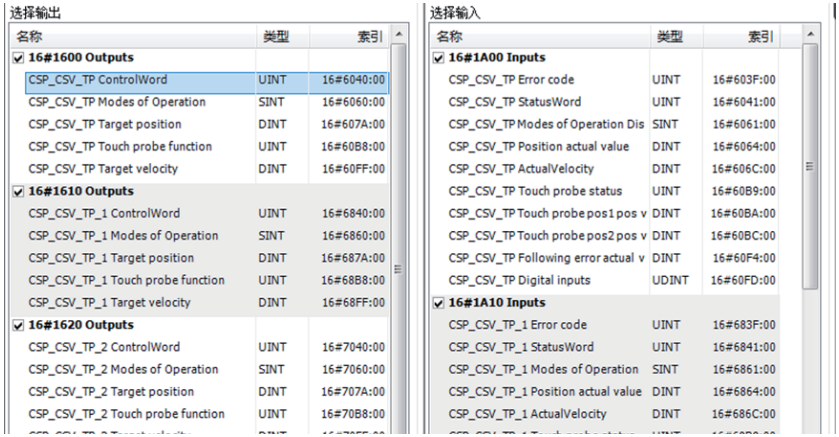
1. Enable expert settings



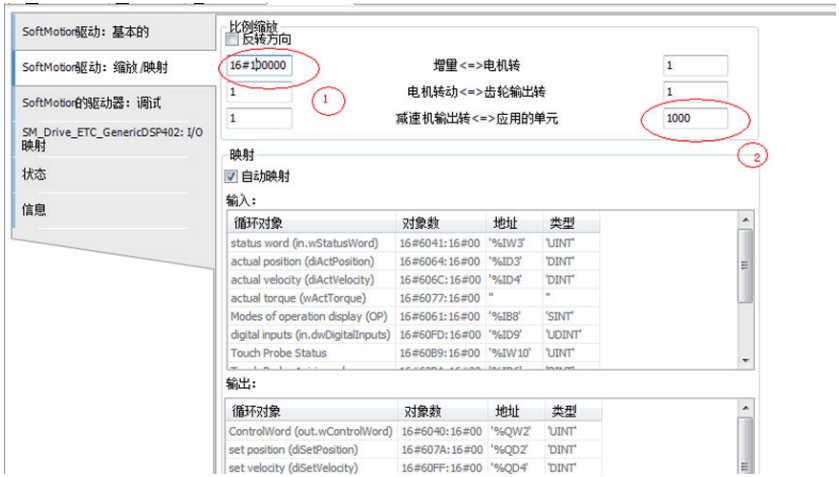
2. Check the corresponding PDO list. On PDO configuration interface, process data required by 4-axis CSP mode can be configured. Click SV820N (SV820N_ECAT_v0.10) list.



The PDO list configured according to the CSP (Location) + CSV (Speed) + TP (Probe) mode is as follows.

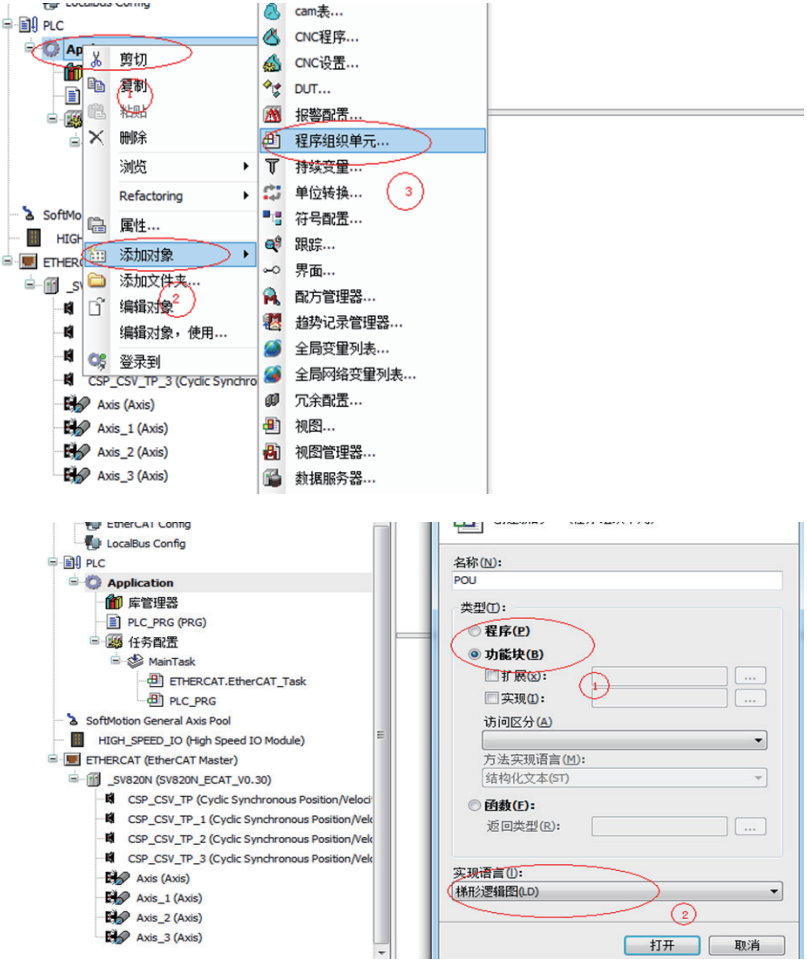


6.5.5 Axis Scaling Settings



6.5.6 PLC Program

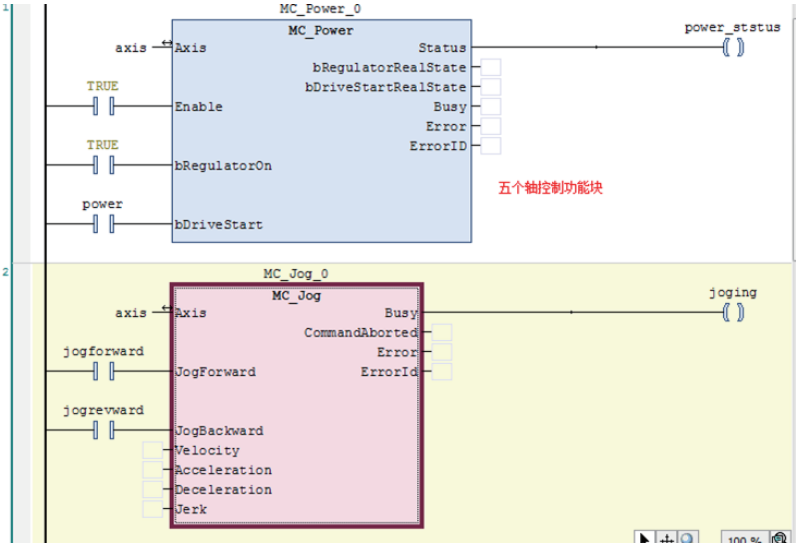
1. Add an FB file that edits the function block in the application.



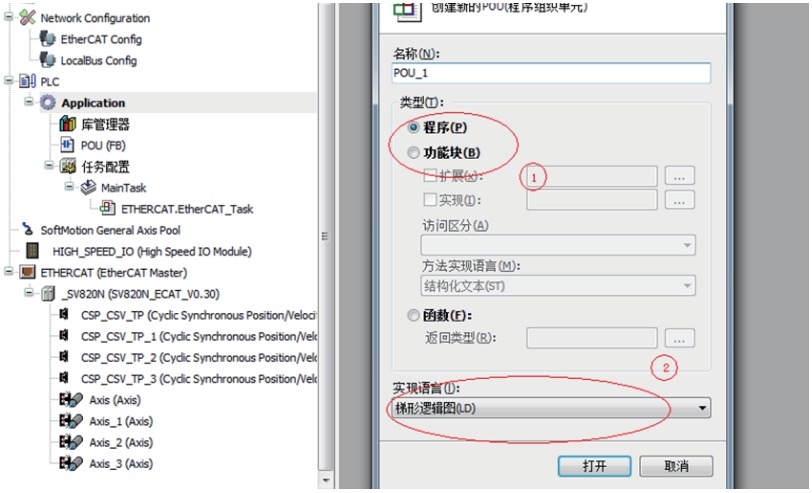
2. The definition part of FB

```
FUNCTION_BLOCK POU
VAR_IN_OUT
    axis:AXIS_REF_SM3;
END_VAR
VAR_INPUT
    power: BOOL;
    jogforward: BOOL;
    jogrevward: BOOL;
    home: BOOL;                    定义区
    moveabsolute: BOOL;
    reset: BOOL;
    pos:LREAL;
    vel:LREAL;
    acc:LREAL;
    dcc:LREAL;
END_VAR
VAR_OUTPUT
        power_ststus: BOOL;
    joging: BOOL;
    home_done: BOOL;
    absmove_done: BOOL;
    reset_done: BOOL;
END_VAR
VAR
```

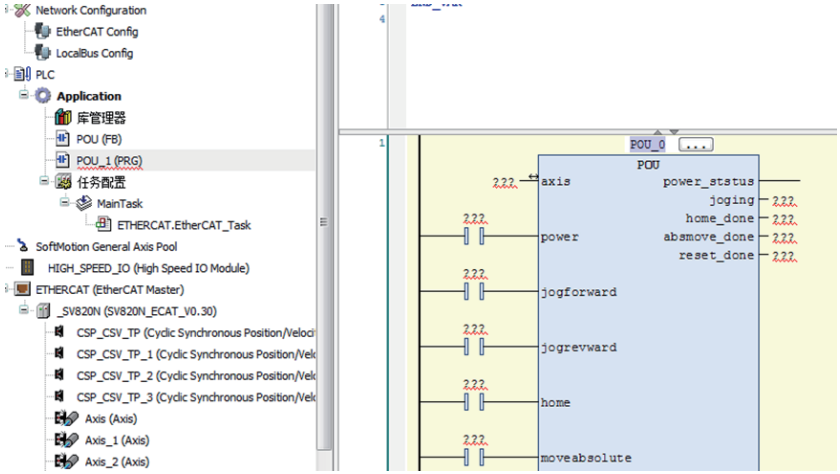
3. Five function blocks in FB



4. Add another POU as shown in step 1.

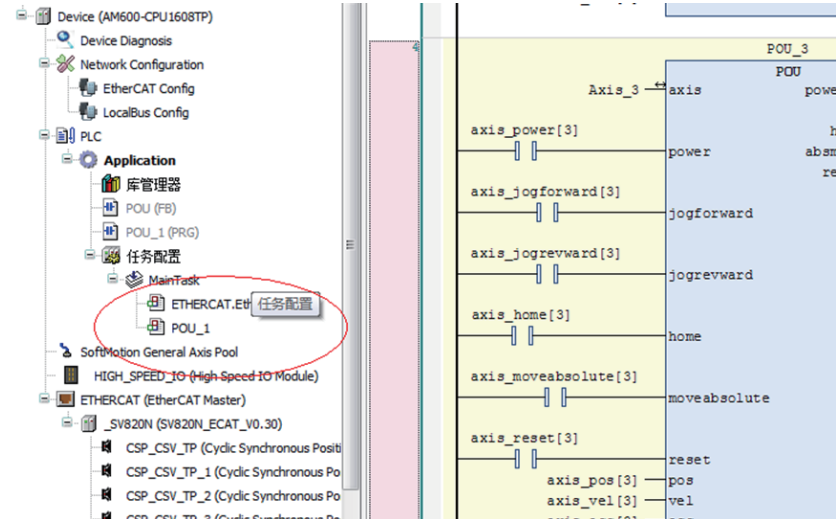


5. Add the FB function block to the newly created POU. Codes are as follows:

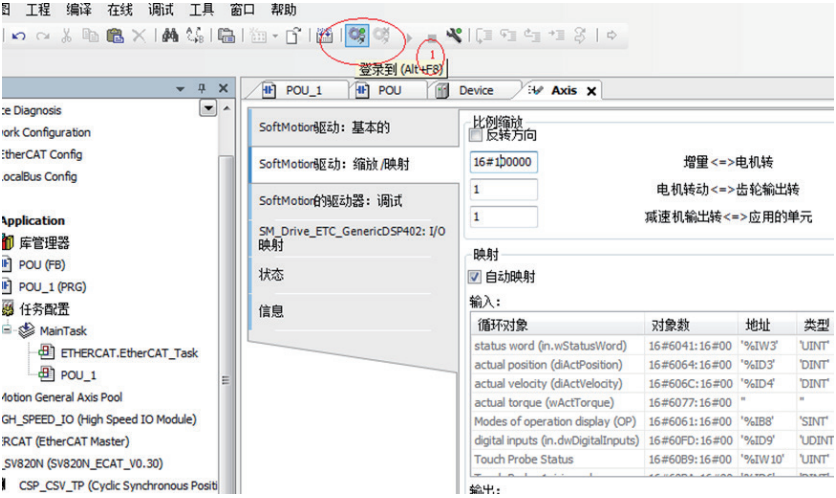


6. Instantiate this FB into four function blocks, and assign to four axes respectively.

7. After calling this program in the Ethercat task, simple enabling, jog, homing, absolute position operation can be perfomed.



Log in to the PLC to operate the bus manually.

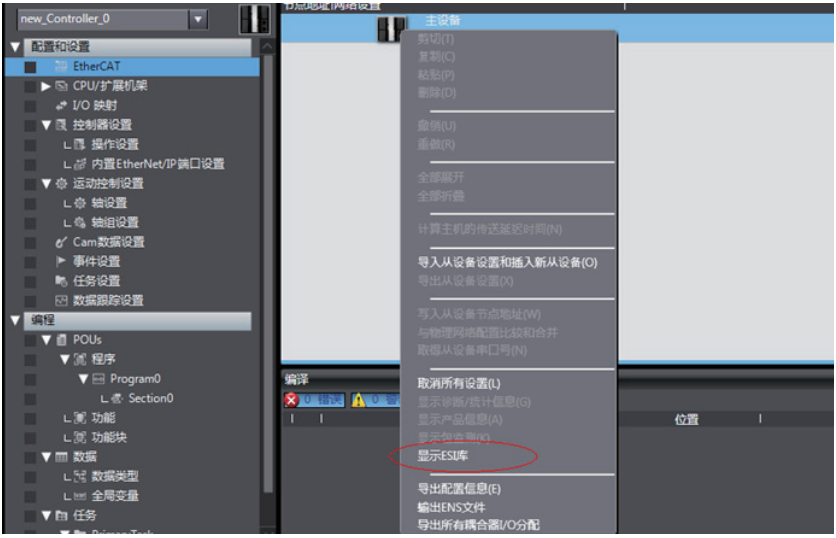


6.6 Commissioning SV820N with Omron NJ Series Controller

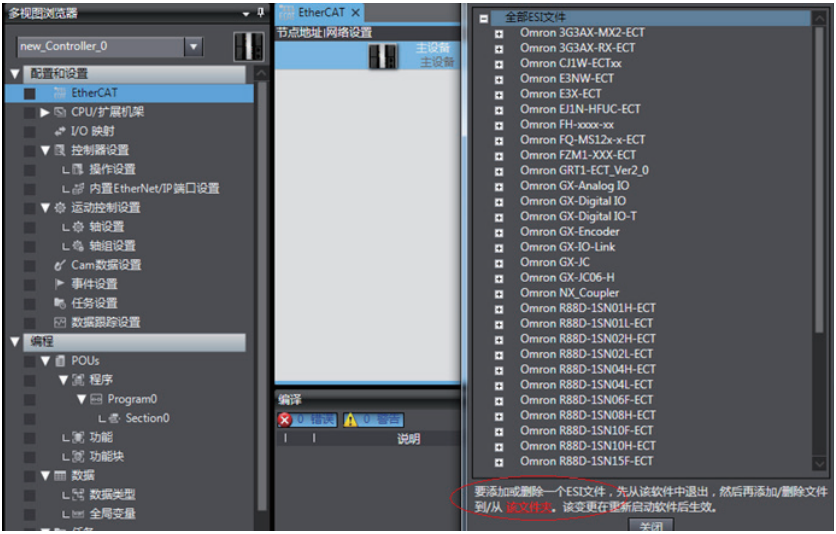
6.6.1 Network Configuration Settings

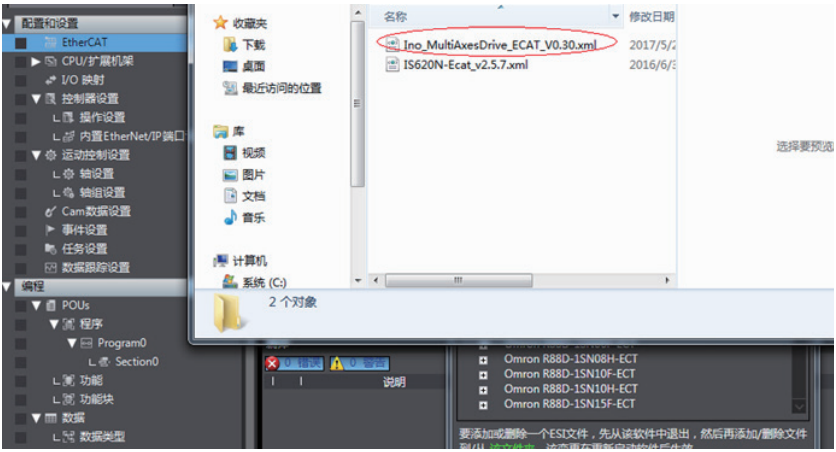
1. After creating a new project, on EtherCAT device interface, select the master station icon and right-click to open the menu bar, then click "Show ESI Library."

Note	Add the XML file of SV820N (please download XML files from Inovance's official website).

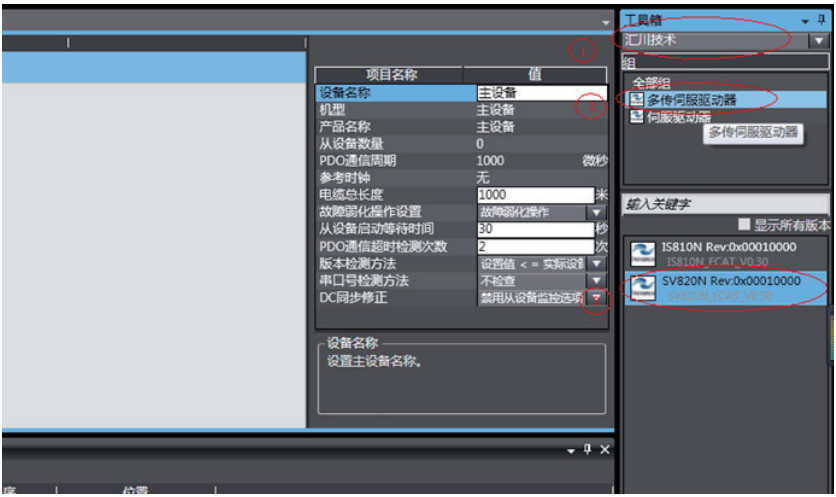


2. In the ESI Library list, open the link below ("The folder") and put the ".xml document" corresponding to the SV820N into the folder. Then exit and reopen the Sysmac Studio software to make it effective.

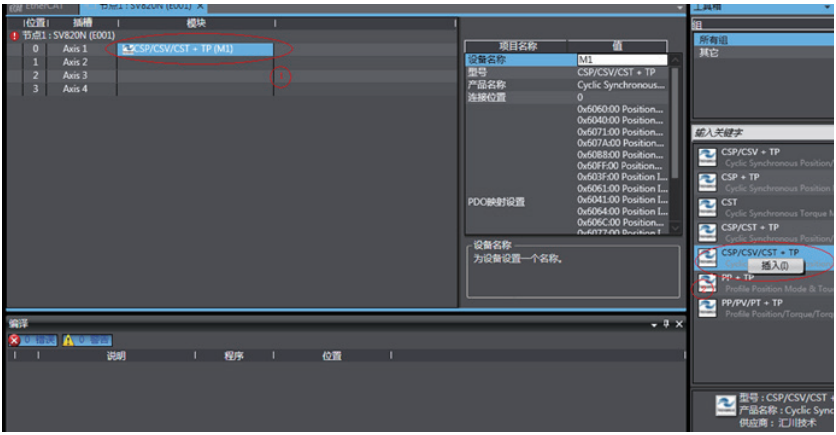


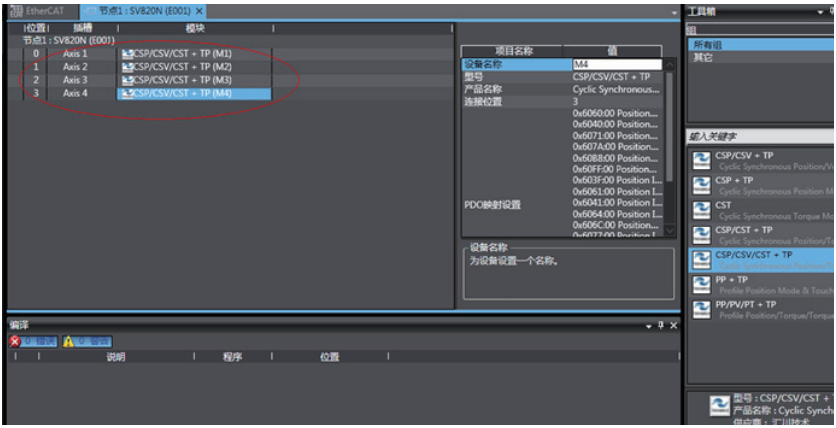


3. On the upper right of the software, click on all suppliers, then select Inovance in the drop-down menu. Then double-click SV820N in the device list below to add the device to the configuration list. (If the network is already configured, skip to step 4 and use the online upload configuration.)

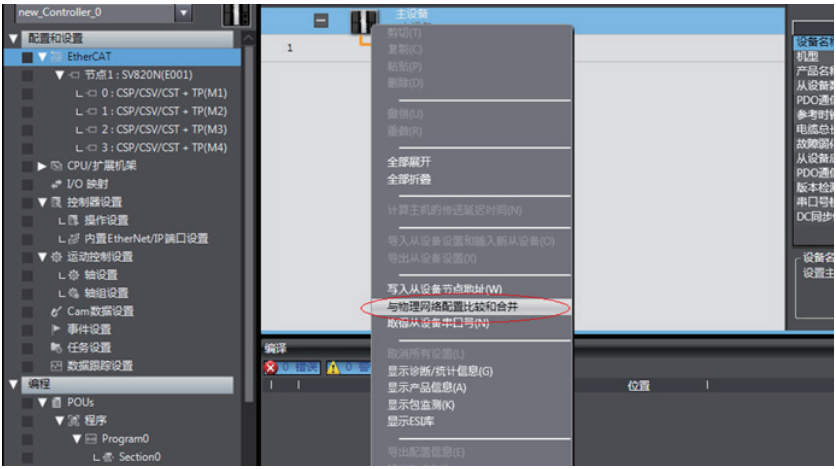


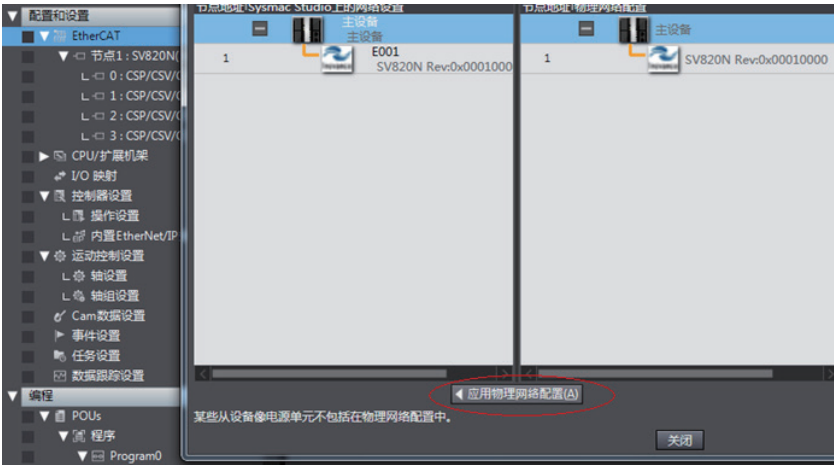
The SV820N is a 4-in-1 drive and plans the usability for the PDO list of each axis. Select the mode you want to run from "CSP/CSV+TP, CSP+TP, CST, CSP/CST+TP, CSP/CST/CSV+TP, PP+TP, PP\PV\PT+TP." In conjunction with the controller, the XML file will select the PDO list needed by the current mode. In this example, select CSP/CST/CSV+TP mode for all axes.





4. Set the EtherCAT communication site address through H0E-21 (currently available only for NJ, and there is no need to configure Beckhoff Twincat). Power on again after setting. For easier configuration management , it is recommended to set the address according to the actual physical connection order.
5. Set the master station modification as online mode, and compare and merge with the physical network configuration in the menu bar. Set the actual physical network configuration to Sysmac software's network configuration.

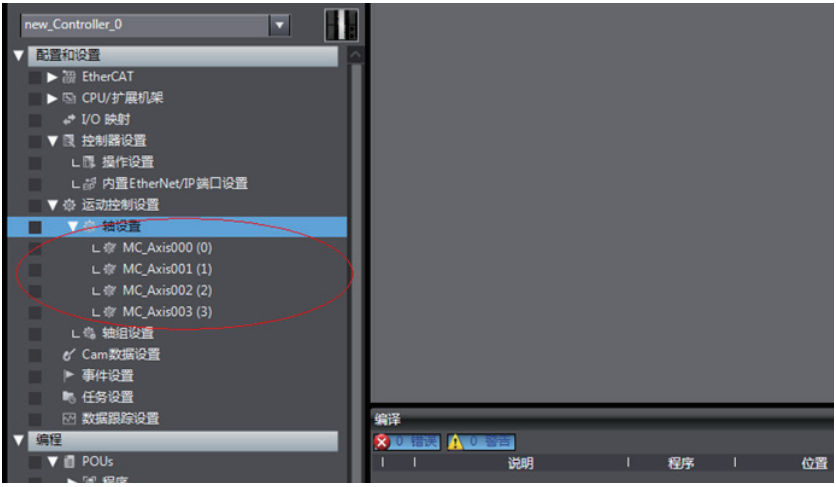




6.6.2 Commnucation Data Configuration

Motion control axis settings

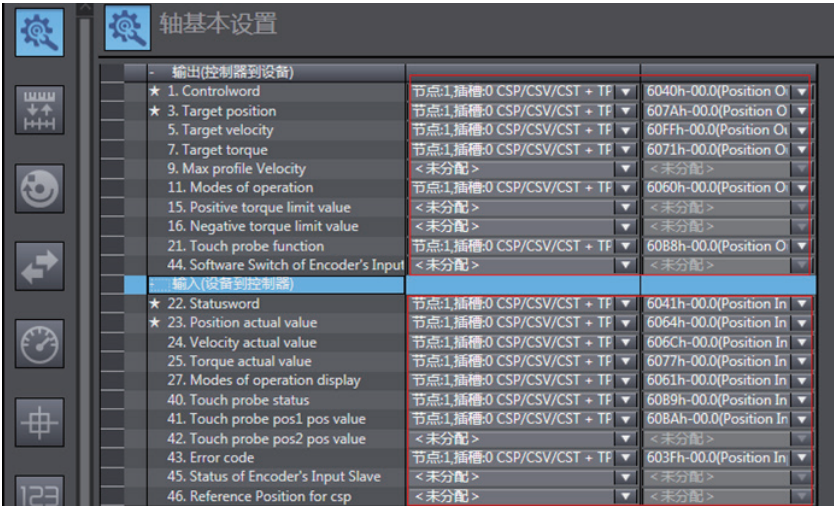
1. Add axis settings in motion control. Double-click "MC_Axis000" as shown below. Then configure the SV820N device for the corresponding site in the related axis basic settings page. "MC_Axis000" can be renamed (Chinese is applicable). For example, when named as "右放卷 (right unwinding)," then the use of "右放卷" in NJ program indicates the control of the SV820N servo axis.

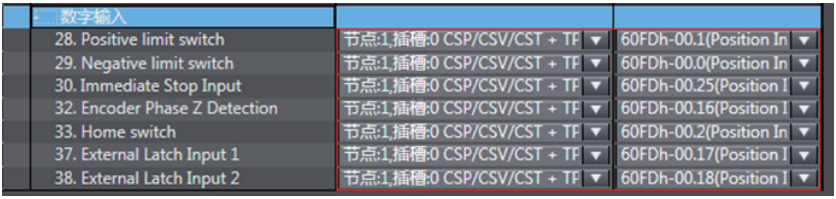


2. Perform detailed configuration for the axis parameters: all four axes of each slave station need to be configured with the same configuration process. If the number of axes is less than 4, set the value of 0200 of the SV820 servo drive to 255 to shield the axis; for the axes in normal use, set the normal configuration. The following example shows how to configure one of the axes.

Variable configuration for servo axis communication mapping

Click the detailed settings to expand the configuration parameters, then follow the table for the object mapping configuration and carefully check it. The axis configuration of the IS820N needs to be performed manually due to the current Omron background configuration limit.



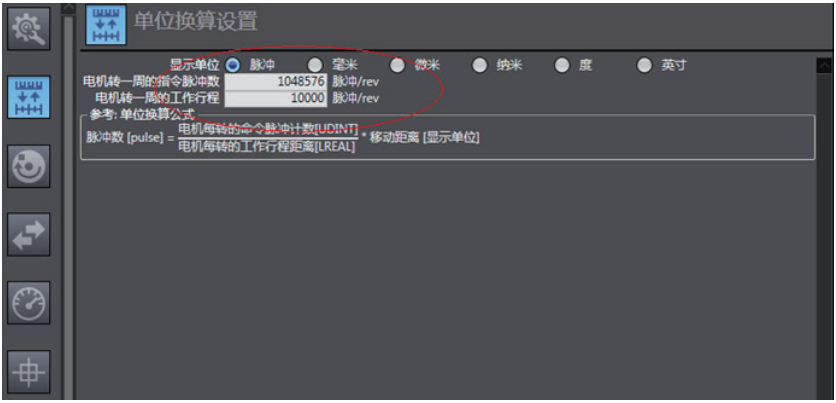


Servo axis parameters settings

Unit conversion setting:

Select 838,8608 pulses for a circle for the SV820N motor,

while using the default value for the working stroke per circle of the motor. The effect is similar to how the host controller converts electronic gear ratio, and the servo drive need not set the conversion again.

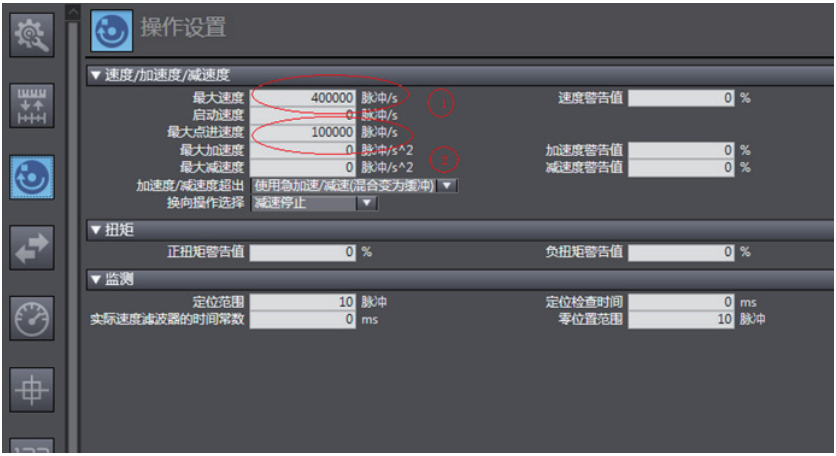


Operation setting

After setting the electronic gear ratio, the maximum speed will output an alarm, which means reset the parameters. Set the unit to

the converted speed unit. 10,000 pulses/s represents 1 R/S (60 RPM) of the actual servo motor.

Please set the maximum speed and jog speed according to the actual operation. If there is no special requirement, other parameters may not be set.

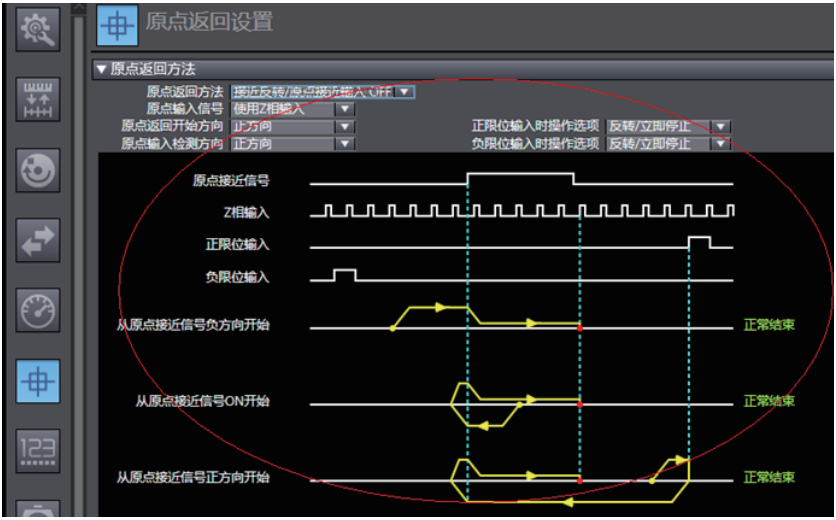


Homing setting

The homing mode affects working between the servo drive and the host controller. Set it according to the following table.

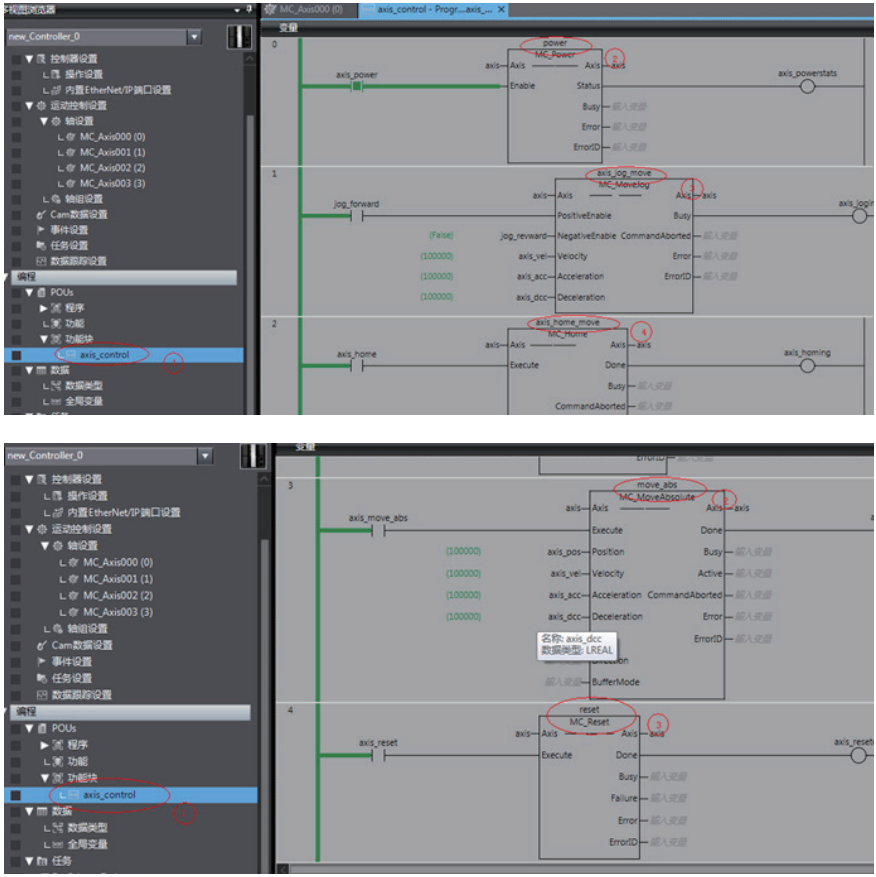
NJ Software Description	Servo Drive Function	Terminal Configuration
Home near signal	Home switch (FUN31)	DI9
External home input	Probe 1 (FUN38)	DI8
Phase Z signal input	Motor encoder phase Z signal	N/A
Positive limit input	P-OT (FUN14)	DI1
Negative limit input	N-OT (FUN15)	DI2

Note	Phase Z signal and external home switch signal shall not be used at the same time.

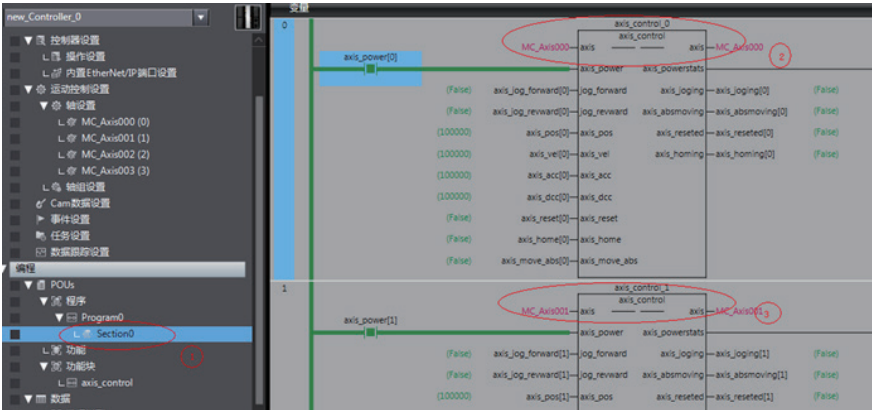


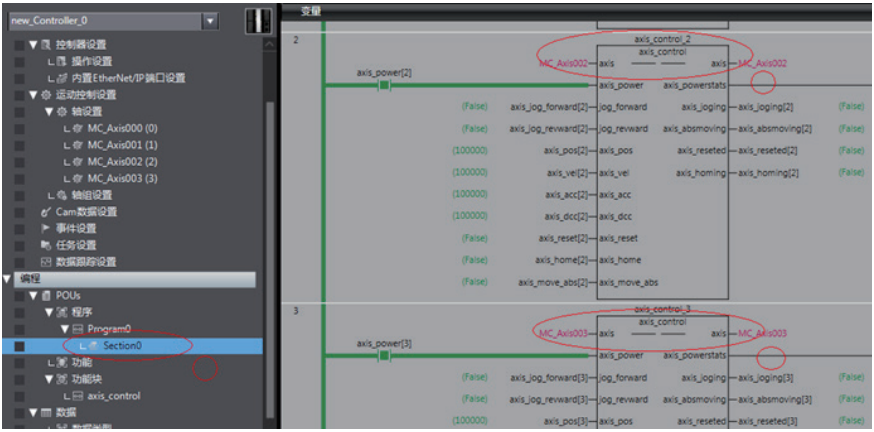
6.6.3 Program Control Operation

After the configuration is completed, enable running of the servo drive via the PLC program. For more convenient programming, the four axes first packaged a functional block for easy testing, which includes MC_power, MC_moveabsolute, MC_jog, MC_home and MC_reset.



In section0, call the function block, then the axis can be moved by the bus.



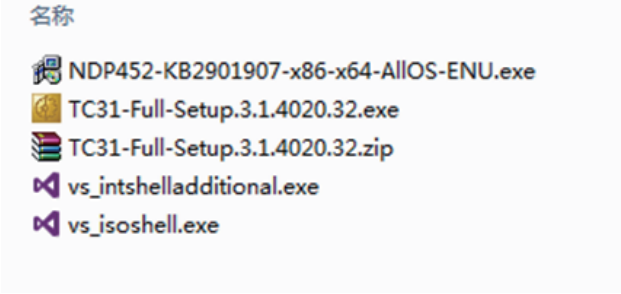


6.7 Performing the CSP Mode and NC Axis Jog Running with Beckhoff Controllers

The following describes how to configure the SV820N servo drive with Beckhoff TwinCAT master station used and CSP mode.

1. Install the TwinCAT software.

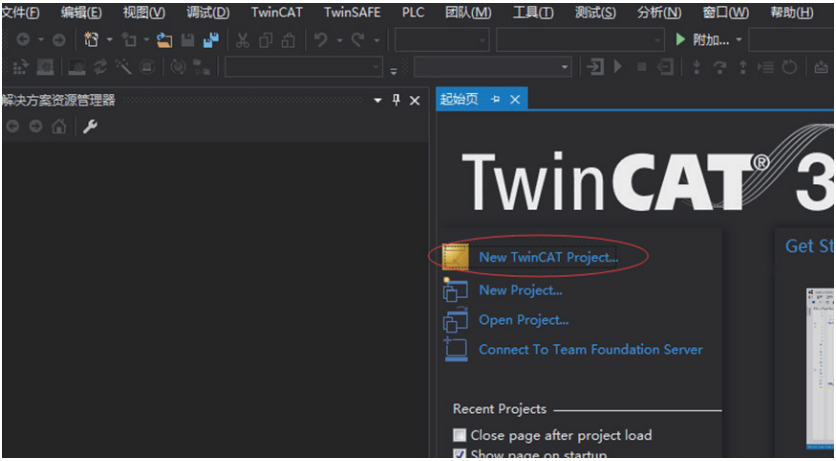
twinCAT3 (supports Windows 7 32-bit system or Windows 7 64-bit) is available on Beckhoff's official website. (This example uses the 32-bit system)

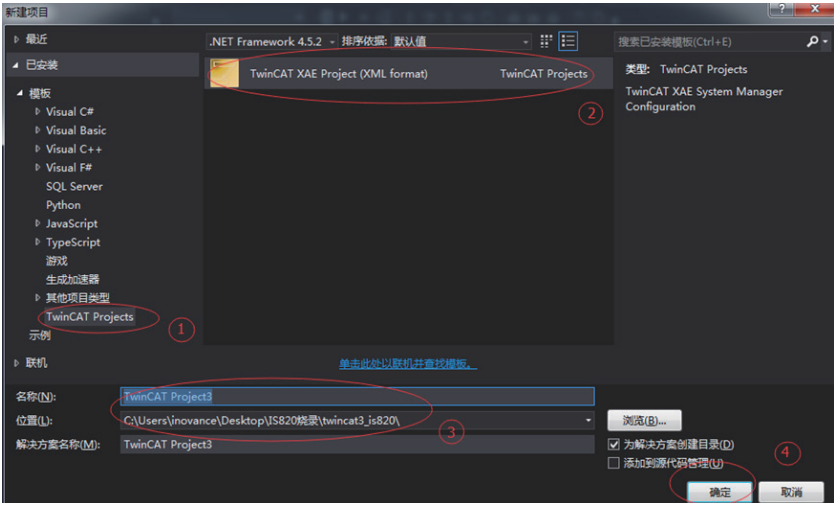


Note	If you use a PC to drive directly, the 100M-Ethernet network adapter with Intel chip must be used. Other network adapters may not support EtherCAT.

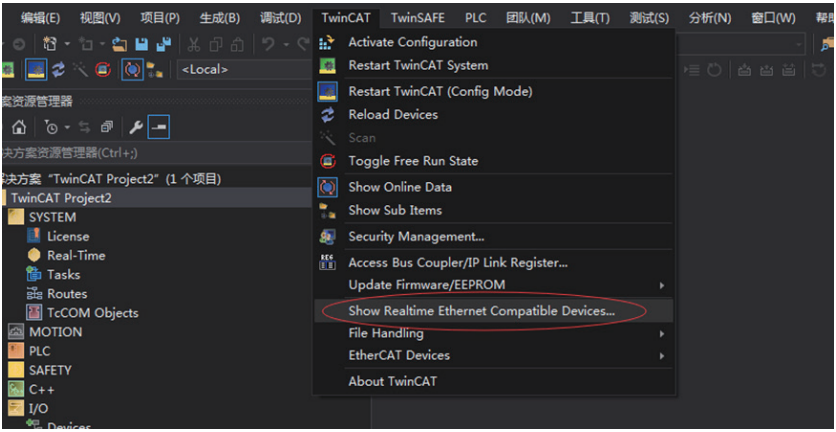
2. Copy the EtherCAT configuration file (Ino_MultiAxesDrive_ECAT_V0.10.xml) of SV820N to the TwinCAT installation directory: \TwinCAT\IO\EtherCAT.

3. Open Visual studio, and create a New Twincat3 Project.

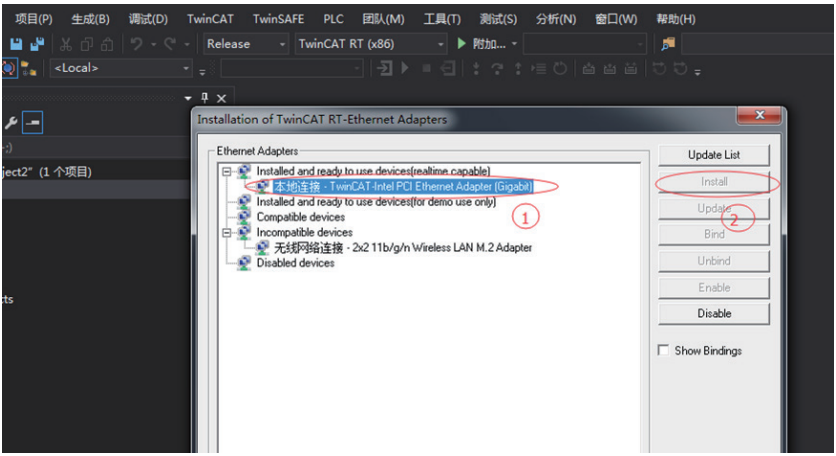




4. Install the TwinCAT network adapter driver.



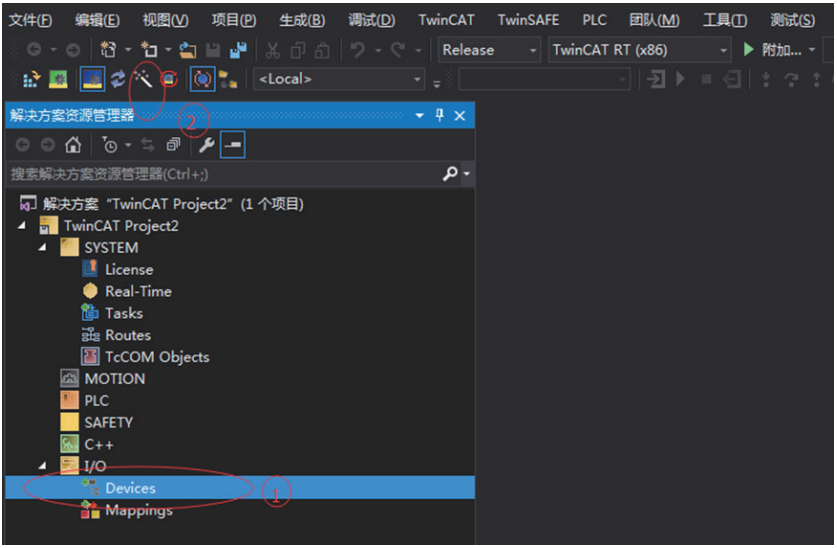
Open the menu "Show Real Time Ethernet Compatible Devices…" as shown above. In the displayed dialog box, select the local network in "Incompatible devices," then click "Install." After installation, the installed network adapter is displayed in "Installed and ready to use devices."

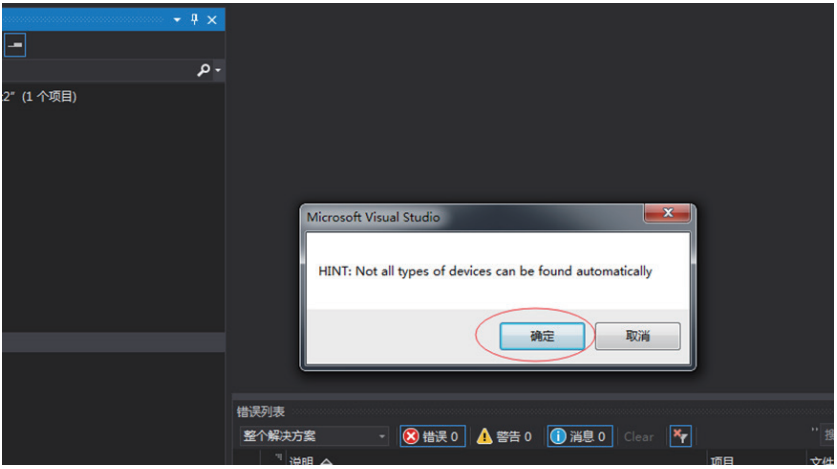


5. Search for devices.

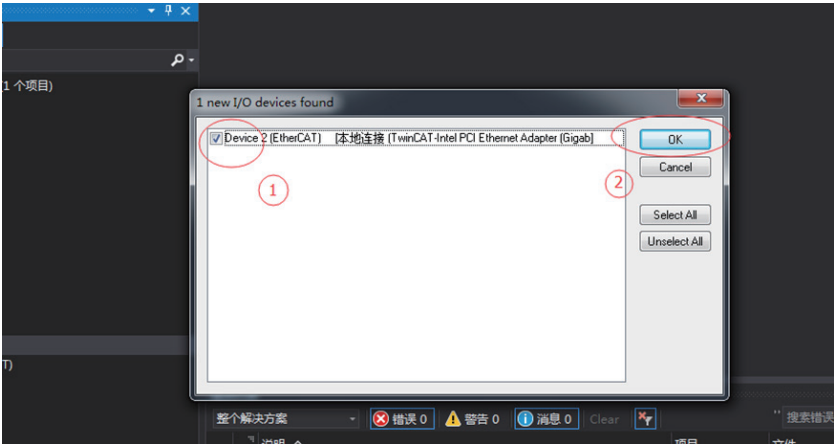
Create a project and search for devices. Select " 

" and click "  " as shown in the following picture:

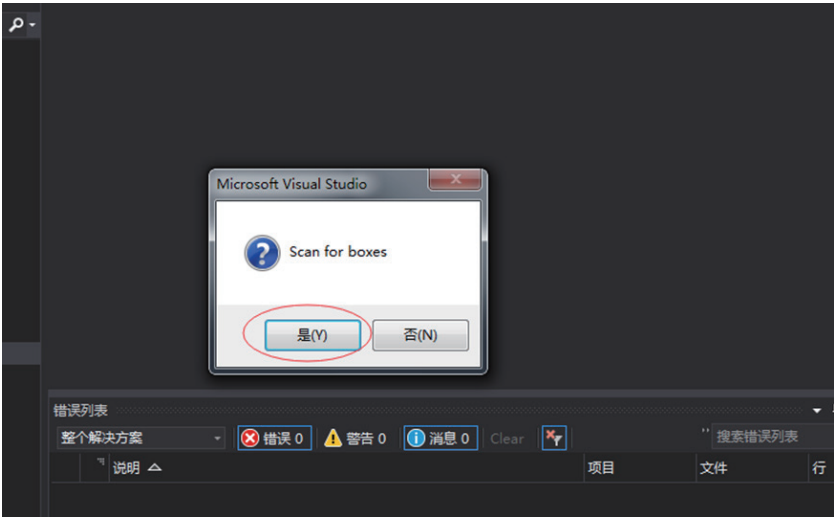




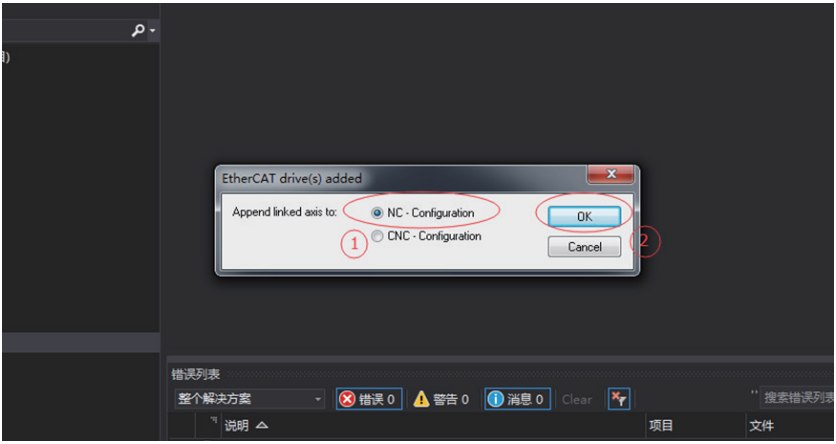
Click "OK."



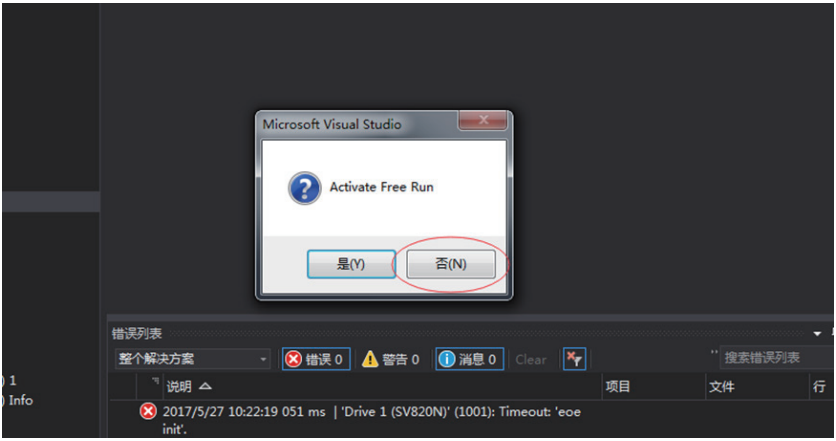
Click "OK."



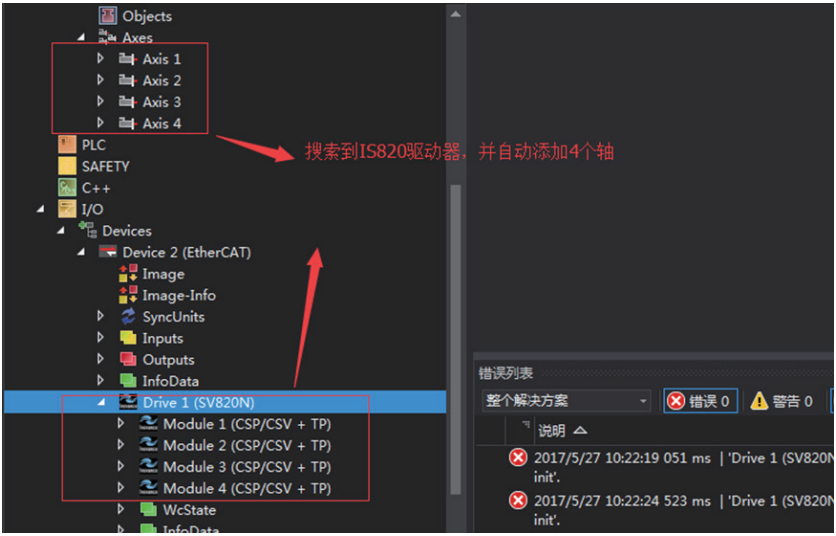
Click "Yes."



Click "OK."



Click "No." The equipment search is completed for now, as shown in the following:



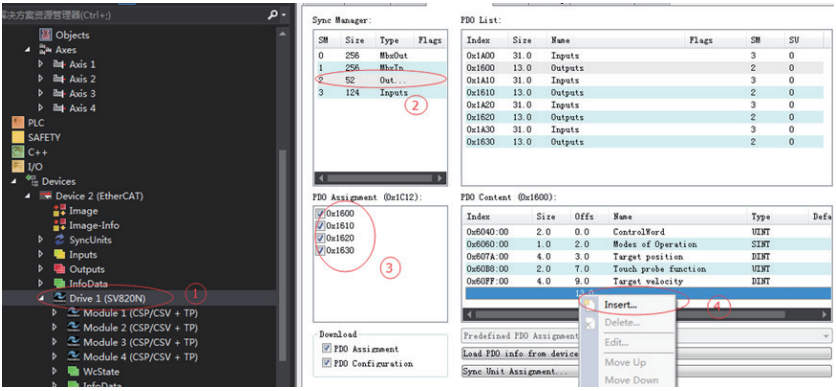
6. Configure PDO content.

Take implementing periodic synchronization location CSP mode as an example:

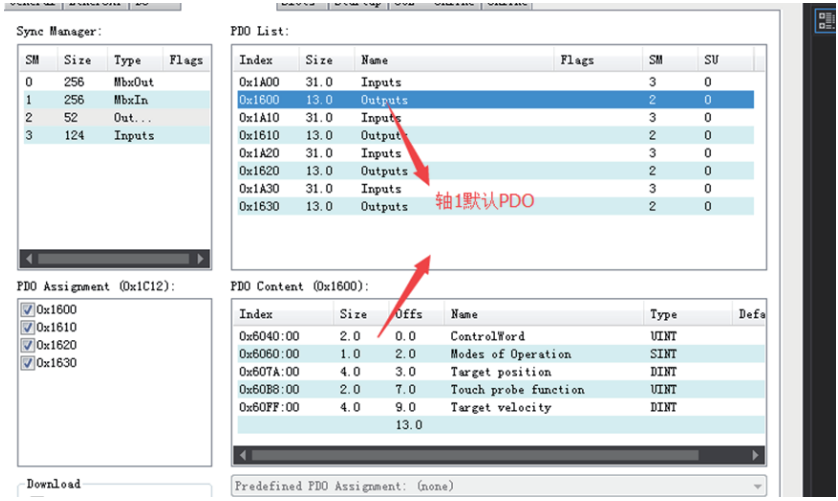
a) Configure RPDO: If 4 axes are used, then check all 0x1600, 0x1610, 0x1620, 0x1630

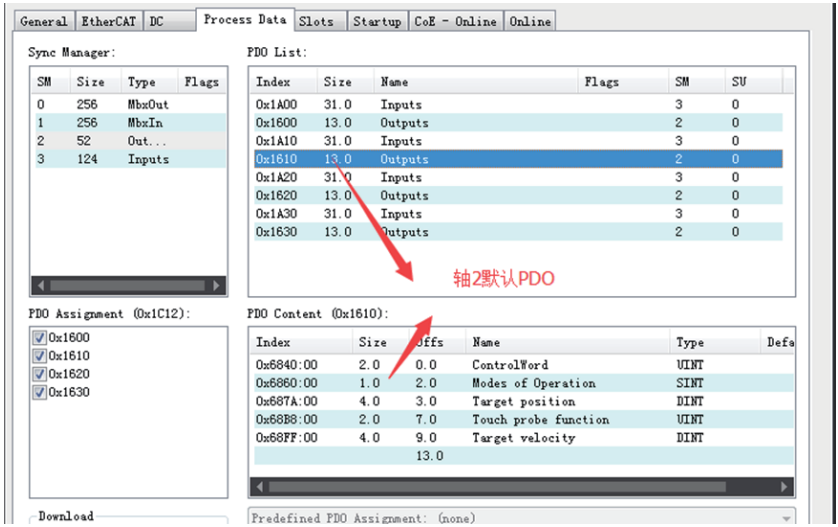
b) The RPDO configuration procedure is listed in detail as follows:

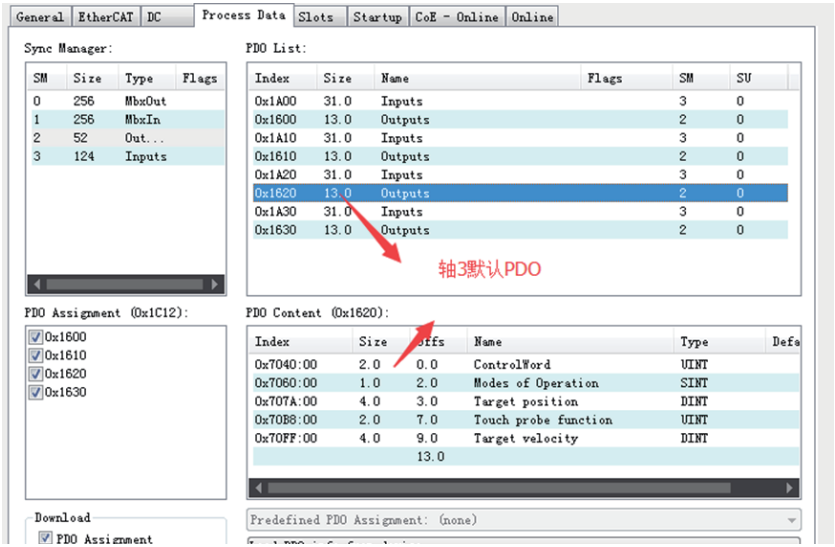
If you are running the location mode, you do not need to change it, otherwise you need to simply change the PDO list to suit your mode. If you need to modify, you can right click on the PDO Content window "Delete" to delete the default redundant PDO, and click "Insert" to increase the required PDO.

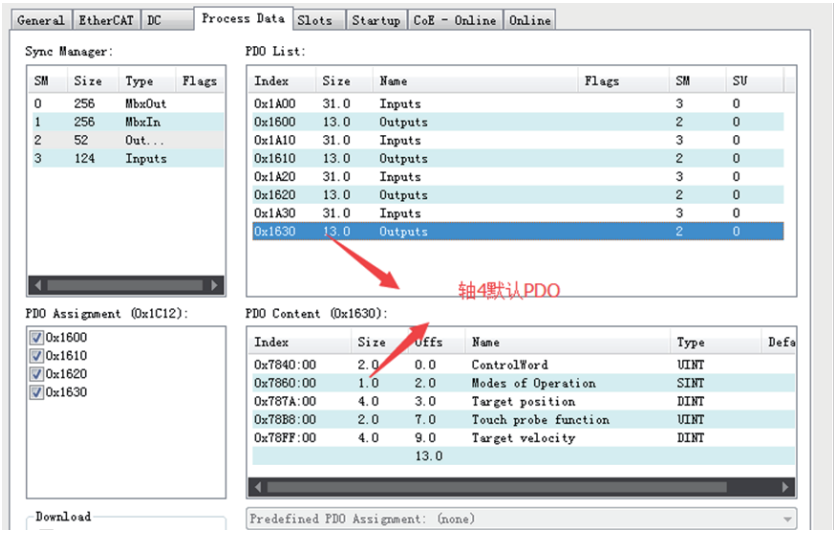


C) The default RPDO list is as follows:

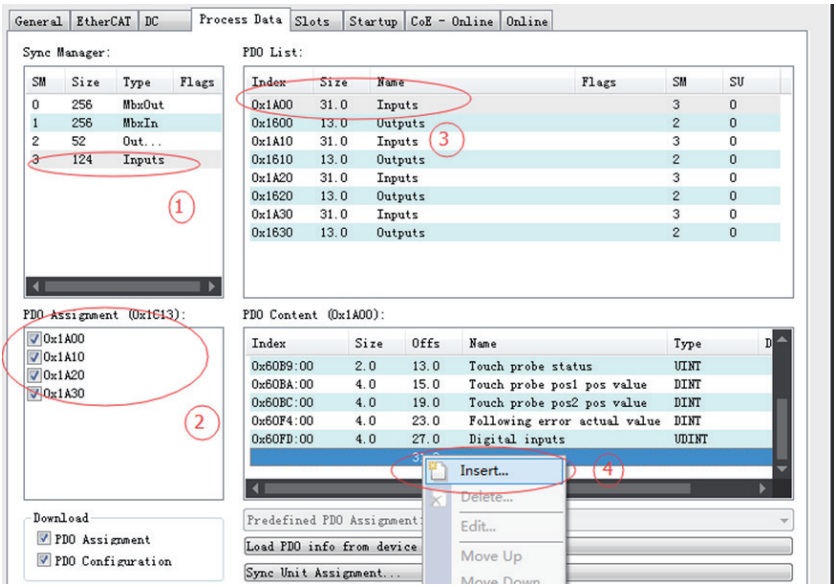




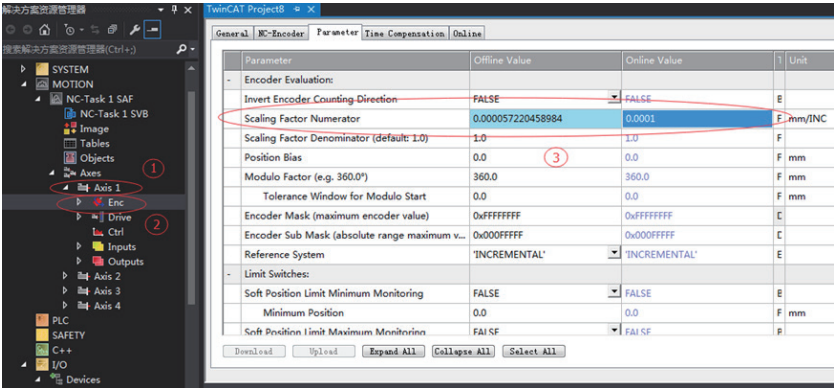

General
EtherCAT
DC
Process Data
Slots
Startup
CoE - Online
Online
Sync Manager:
SM Size Type Flags
0 256 MbxOut
1 256 MbxIn
2 52 Out...
3 124 Inputs
PDO List:
Index Size Name Flags SM SU
0x1A00 31.0 Inputs 3 0
0x1600 13.0 Outputs 2 0
0x1A10 31.0 Inputs 3 0
0x1610 13.0 Outputs 2 0
0x1A20 31.0 Inputs 3 0
0x1620 13.0 Outputs 2 0
0x1A30 31.0 Inputs 3 0
0x1630 13.0 Outputs 2 0
轴3默认PDO
PDO Assignment (0x1C12):
0x1600
0x1610
0x1620
0x1630
PDO Content (0x1620):
Index Size Offs Name Type Defa
0x7040:00 2.0 0.0 ControlWord UINT
0x7060:00 1.0 2.0 Modes of Operation SINT
0x707A:00 4.0 3.0 Target position DINT
0x70B8:00 2.0 7.0 Touch probe function UINT
0x70FF:00 4.0 9.0 Target velocity DINT
13.0
Download
PDO Assignment
Predefined PDO Assignment: (none)


General
EtherCAT
DC
Process Data
Slots
Startup
CoE - Online
Online
Sync Manager:
SM Size Type Flags
0 256 MbxOut
1 256 MbxIn
2 52 Out...
3 124 Inputs
PDO List:
Index Size Name Flags SM SU
0x1A00 31.0 Inputs 3 0
0x1600 13.0 Outputs 2 0
0x1A10 31.0 Inputs 3 0
0x1610 13.0 Outputs 2 0
0x1A20 31.0 Inputs 3 0
0x1620 13.0 Outputs 2 0
0x1A30 31.0 Inputs 3 0
0x1630 13.0 Outputs 2 0
轴4默认PDO
PDO Assignment (0x1C12):
0x1600
0x1610
0x1620
0x1630
PDO Content (0x1630):
Index Size Offs Name Type Defa
0x7840:00 2.0 0.0 ControlWord UINT
0x7860:00 1.0 2.0 Modes of Operation SINT
0x787A:00 4.0 3.0 Target position DINT
0x78B8:00 2.0 7.0 Touch probe function UINT
0x78FF:00 4.0 9.0 Target velocity DINT
13.0
Download
Predefined PDO Assignment: (none)

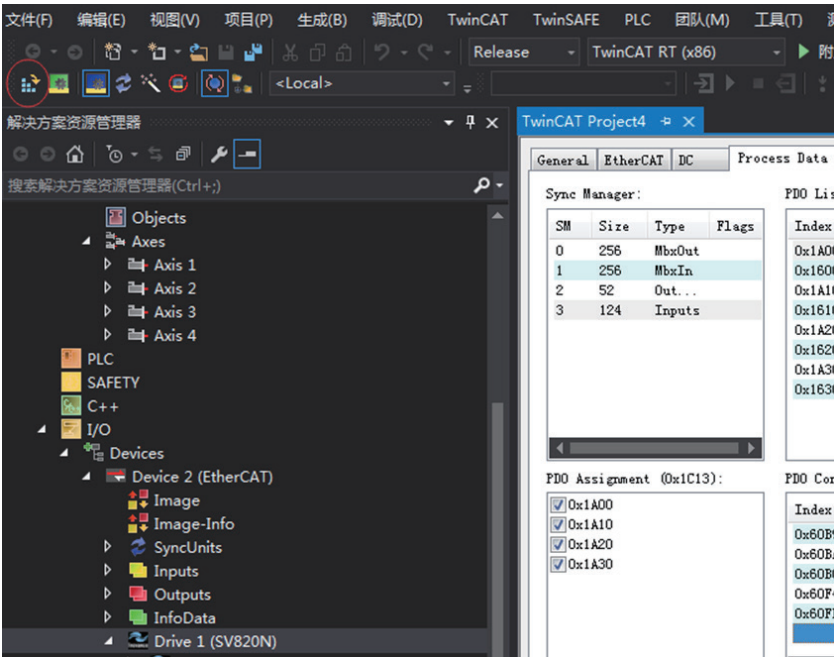
d) To take implementing CSP (position) + CSV (speed) + TP (probe) mode as an example:
Configure TPDO: If you use all four axes then check all 0x1A00, 0x1A10, 0x1A20, 0x1A30
The RPDO configuration procedure is listed in detail as follows:
If you are running the location mode, you do not need to change it, otherwise you need to simply change the PDO list to suit your
mode. If you need to modify, you can right click on the PDO Content window "Delete" to delete the default redundant PDO, and click "Insert" to increase the required PDO.

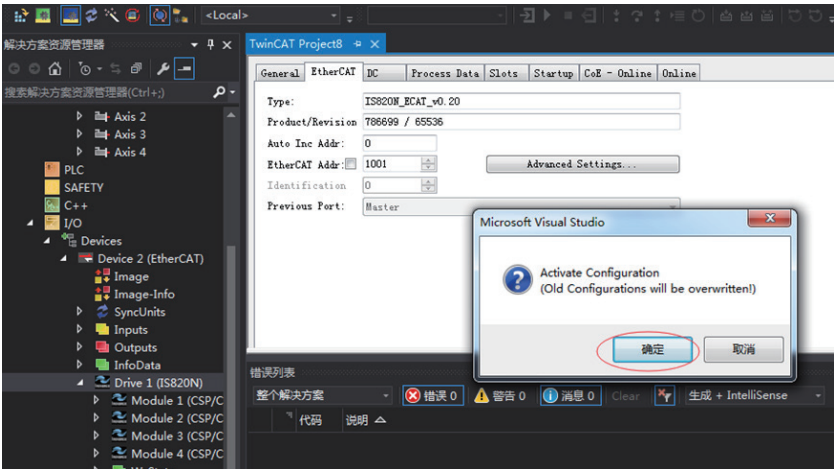


The 0x1A00, 0x1A10, 0x1A20, 0x1A30 list and RPDO has a similar default view and change method, so the details are not described here.
Click Axis 1 in Axes, select Parameter, the scaling parameters of the device axis, and set the servo motor to rotate in one turn in this example.
The unit of motion is 60 mm and the value of Scaling Factor Numerator is 60/1048576. (The other three axes are the same.)

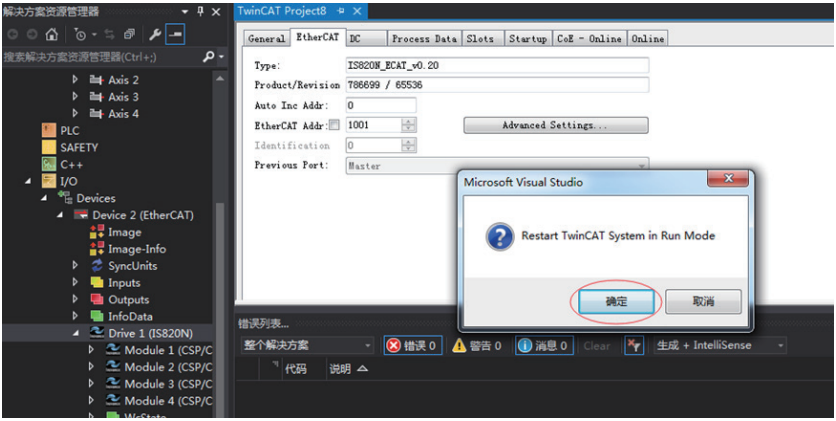


7. Activate the configuration and switch over to the running mode.
   Click "  "

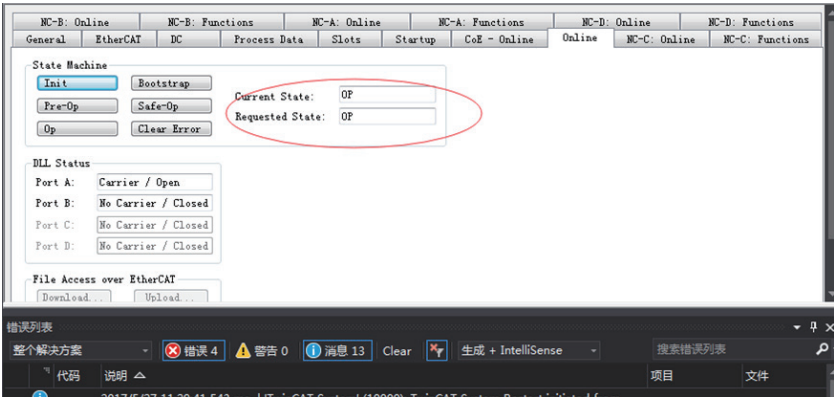




Click "OK."

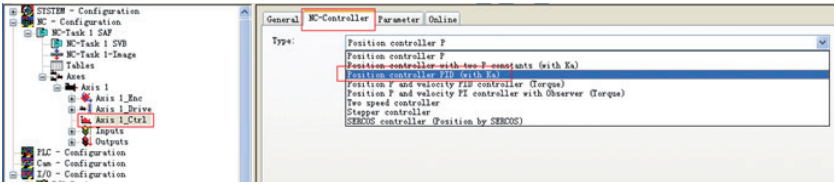


After clicking "OK," the device is observed to have turned into OP state in the "Online" screen, while the second LED of the servo panel displays "8," the panel displays "1_88RY."



8. Control the servo drive through the NC controller or PLC program.

a) You can set the control type.

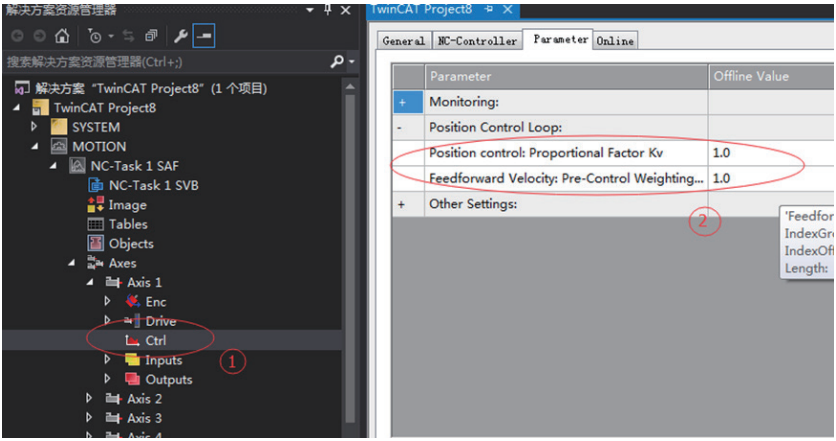


b) PID type of control loop:

Position loop: Drive		
Speed loop: Drive	Drive: Position mode	Position Controller P
Position loop: TWinCAT NC		
Speed loop: Drive	Drive: Velocity mode	Position Controller PID (With Ka)

Note	The TWinCAT NC controller can also implement the speed loop, and sends the target torque to the drive in each cycle. This method however, actually increases the CPU and network load, and is not recommended.

c) Set the control parameters.



Adjust the proportion of the position loop based on actual response:

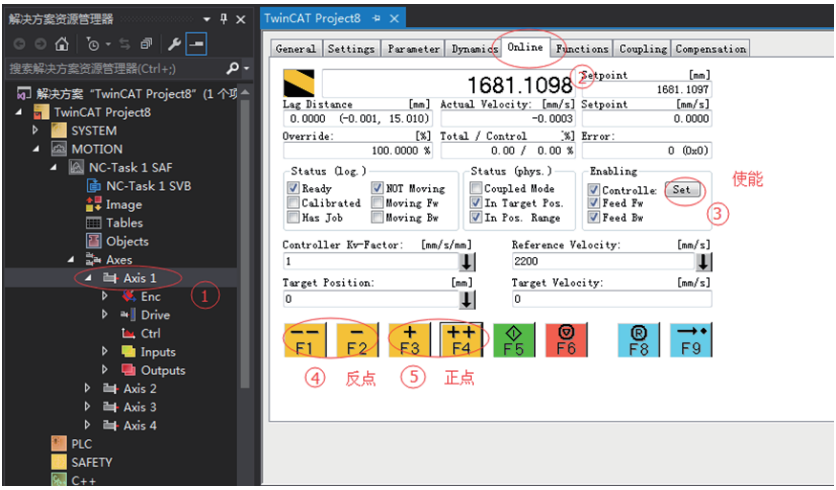
Position control: Proportional Factor Kv	1.0

Adjust the speed feedforward coefficient based on actual response:

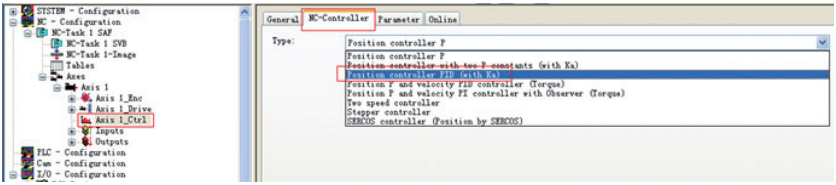
Feedforward Velocity: Pre-Control Weighting [0.0 ...	0.0

9. Perform the test run of the NC axis.

a) Click "Set" to open the pop-up dialog box, then click "All," the servo drive is now enabled. Click F1 to F4 to carry out the jog running.



b) You can set the control type.

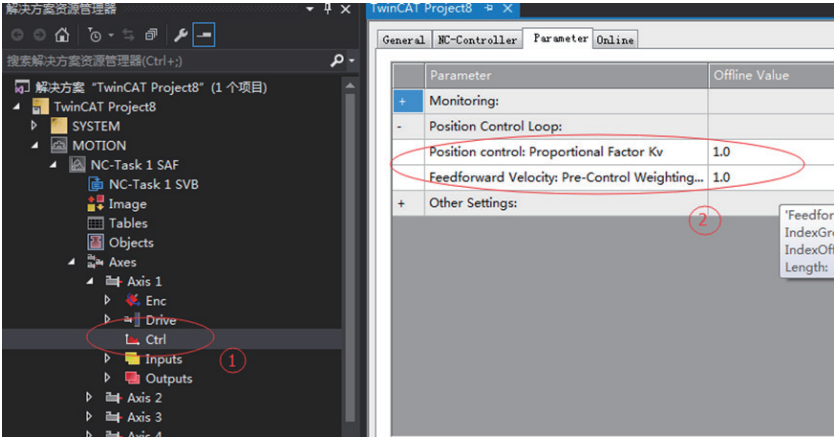


c) PID type of control loop:

Position loop: Drive Speed loop: Drive	Drive: Position mode	Position Controller P
Position loop: TWinCAT NC Speed loop: Drive	Drive: Velocity mode	Position Controller PID (With Ka)

Note	The TWinCAT NC controller can also implement the speed loop, and sends the target torque to the drive in each cycle. This method however, actually increases the CPU and network load, and is not recommended.

d) Set the control parameters.



Adjust the proportion of the position loop based on actual response:

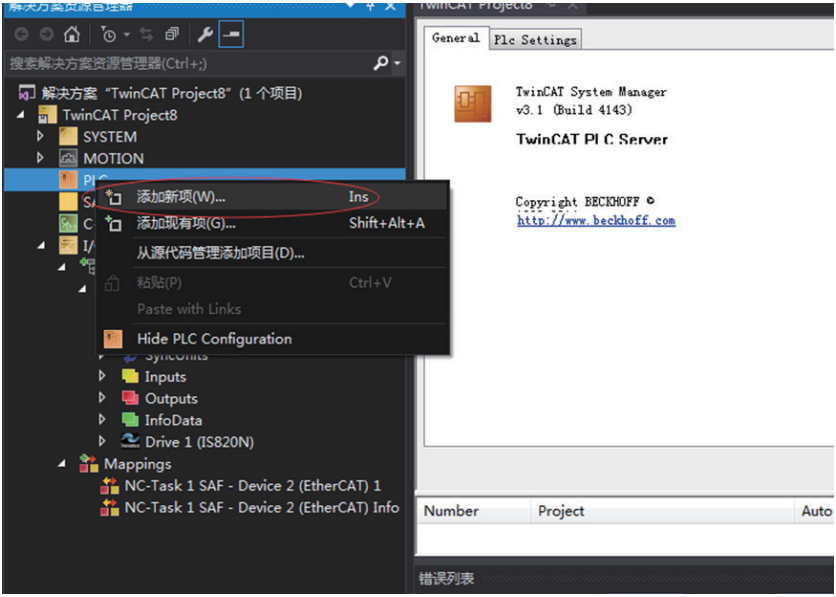
Position control: Proportional Factor Kv	1.0

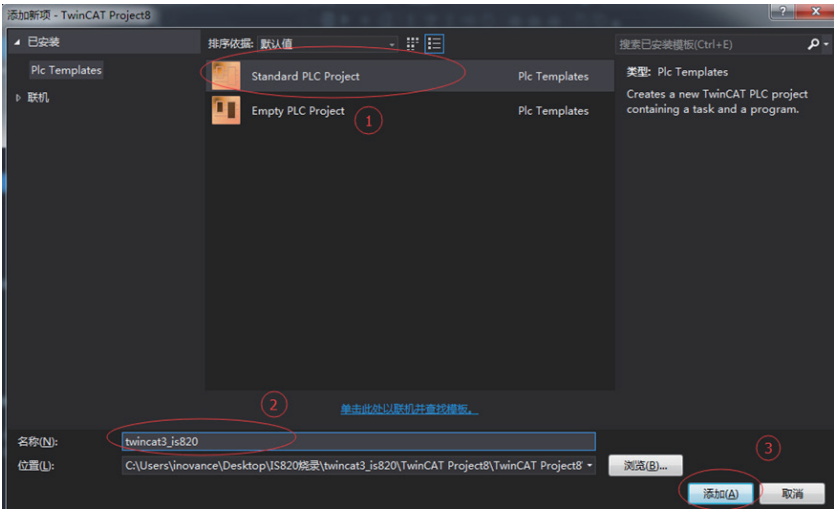
Adjust the speed feedforward coefficient based on actual response:

Feedforward Velocity: Pre-Control Weighting [0.0 ...	0.0

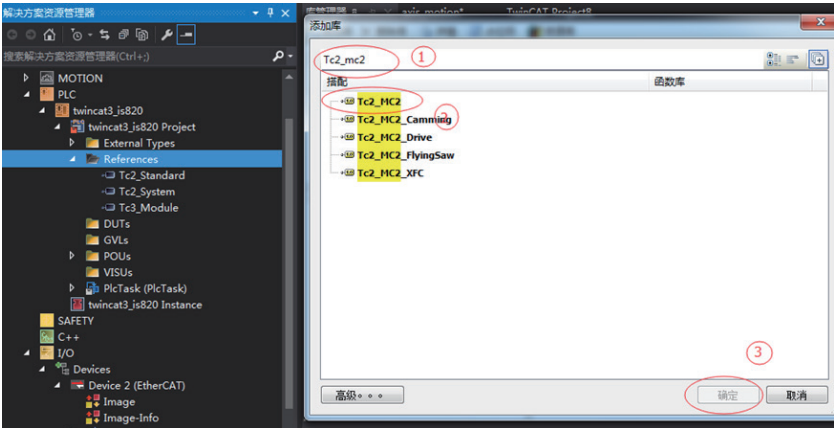
10. PLC program

a) Create a PLC program.

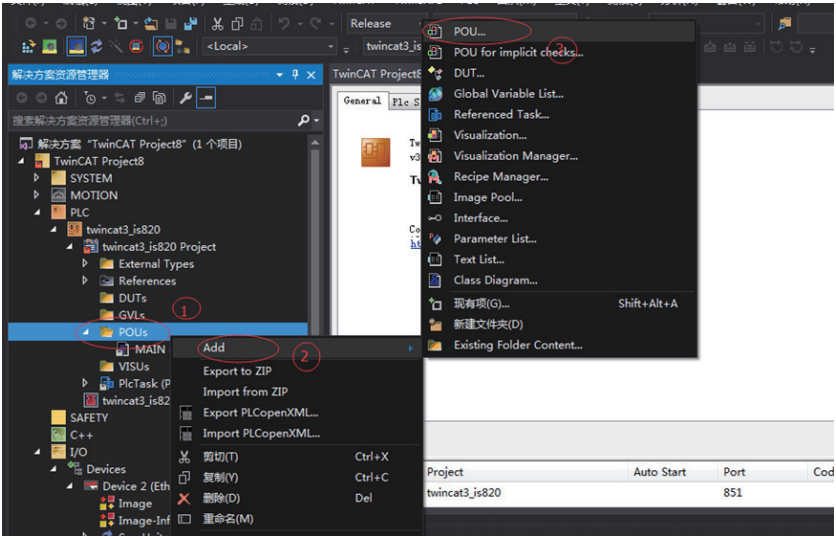


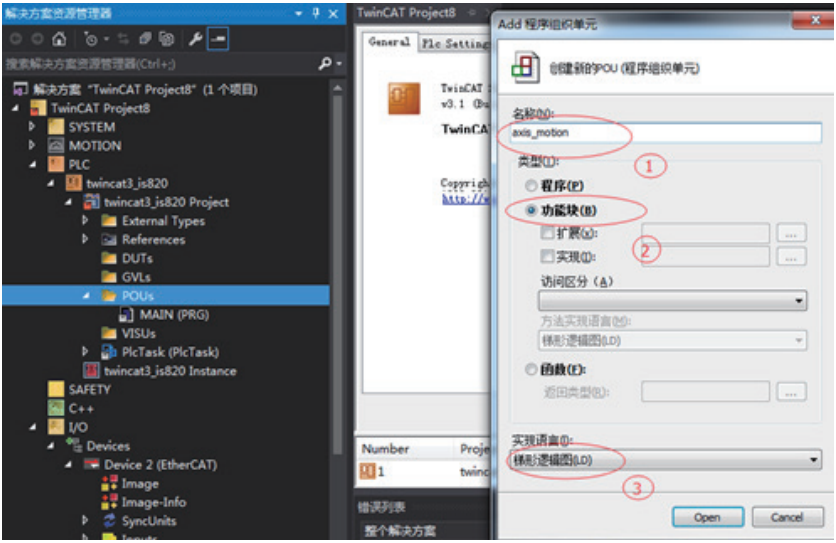


Add a motion control library, making it easy to call the control function block.

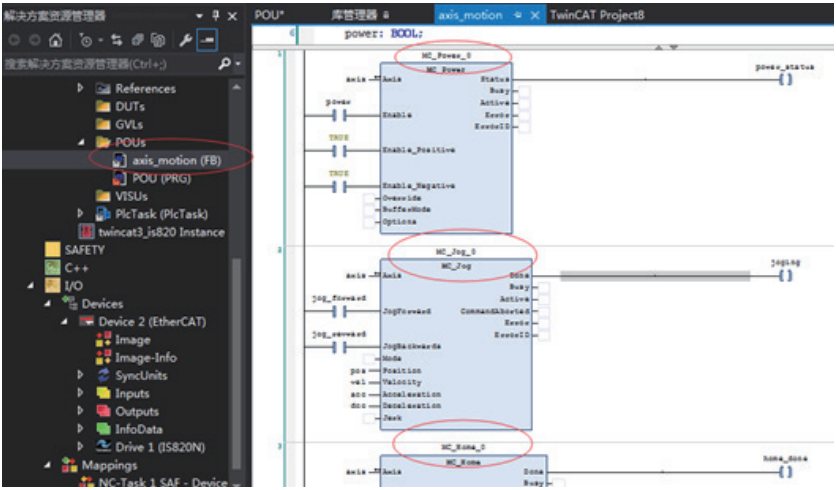


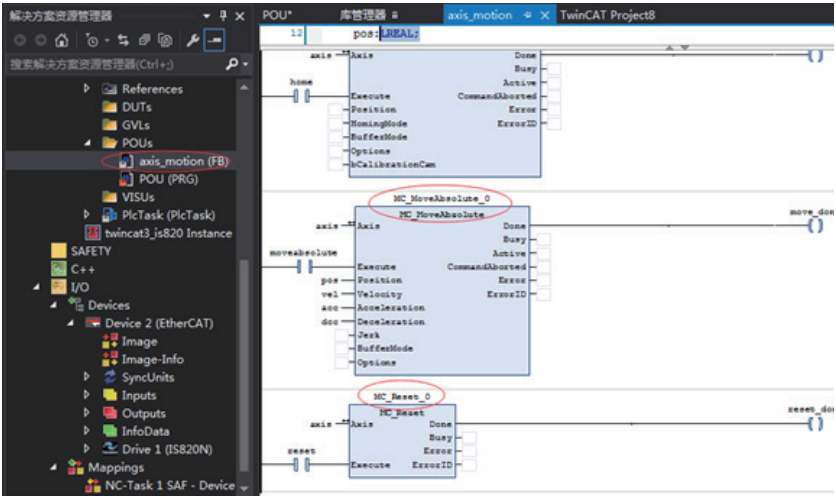
Create a new POU.



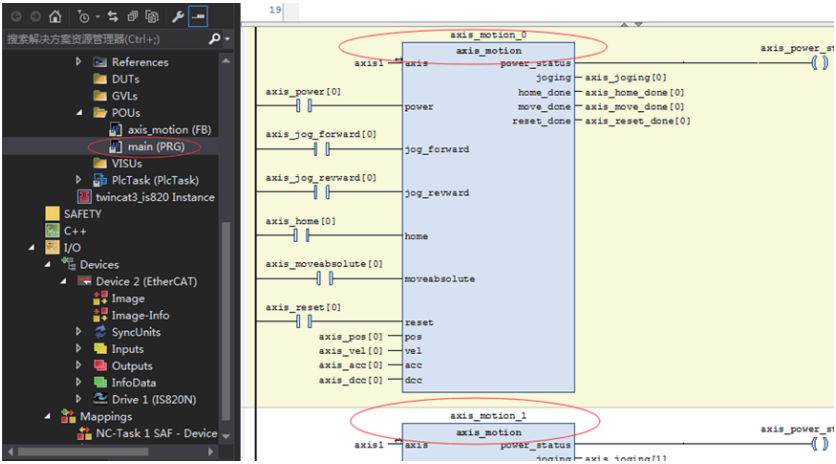


Create a new FB, add MC_power, MC_jog, MC_home, MC_absolute, MC_reset to FB.

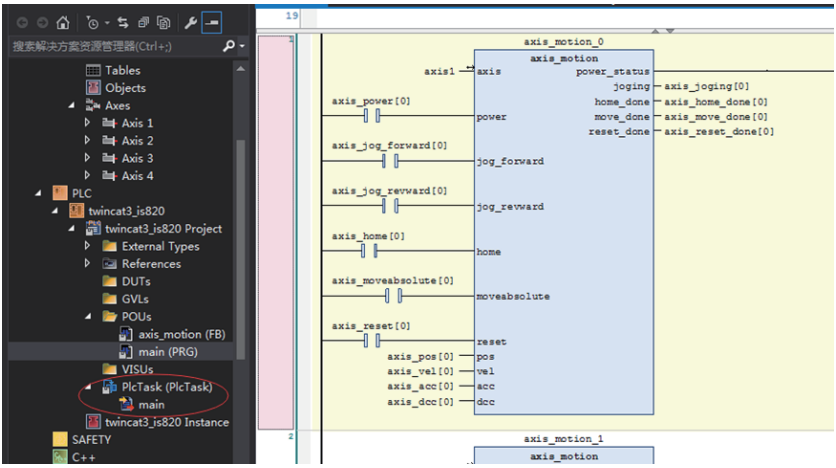




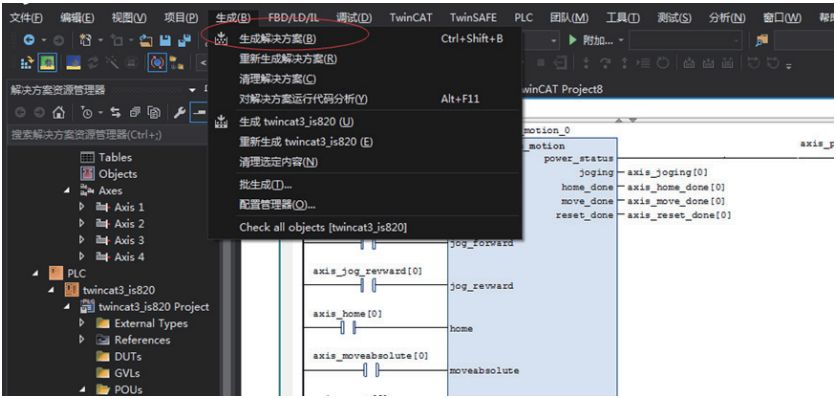
Call axis_motion in main.

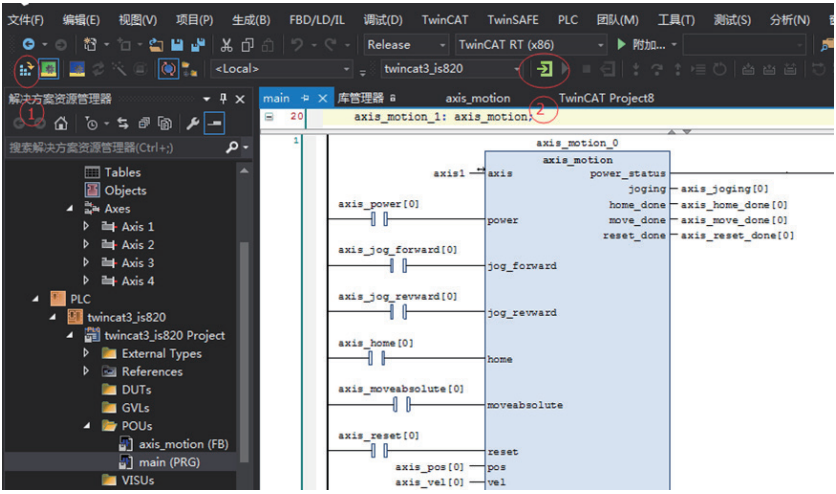


Call the program in PLCTASK.

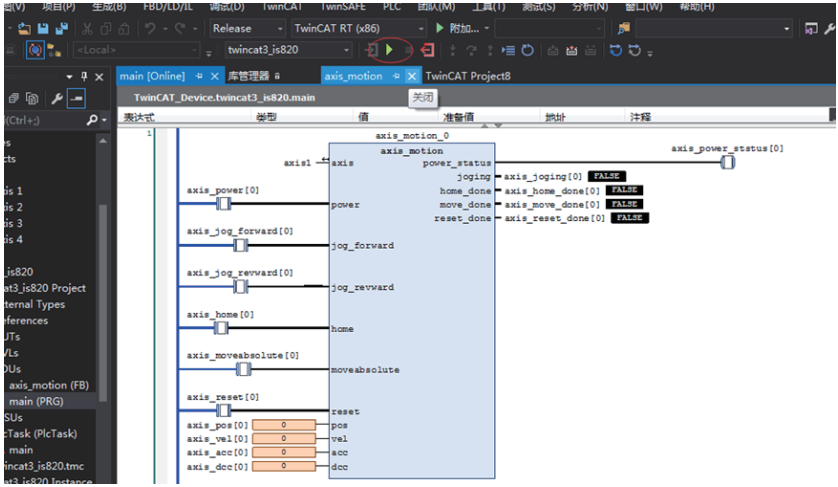


Compile the program, if there is no fault, configuration can be activated, and then log in to the PLC.





Click and run PLC, so that the servo drive can be run through the bus.



6.8 Servo Stop

Servo stop includes coast to stop and zero-speed stop based on the stop mode, and de-energized state and position lock based on the stop state, as described in the following table. Specific information is as follows:

Table 6-2 Comparison of two stop modes

Stop Mode	Stop Description	Stop Characteristics
Coast to stop	The servo motor is de-energized and decelerates to stop gradually. The deceleration time is affected by the friction inertia and mechanical friction.	This mode features smooth deceleration and a small mechanical impact, but the deceleration process is long.
Stop at zero speed	From the current speed immediately stop at 0 speed as the target speed	This mode features quick deceleration but a larger impact.
Stop according to ramp	The speed reference stops smoothly to stop at 0 speed	Smooth deceleration and small mechanical impact, but the deceleration process is controllable.
Emergency torque stop	The servo drive outputs the reverse braking torque to stop	This mode features quick deceleration but a larger impact.
DB brake	Servo motor is working	This mode features quick deceleration but a larger impact.

Table 6-3 Comparison of two stop states

De-energized State	Position Lock
The motor is not energized after stopping rotation, and the motor shaft can be rotated freely.	The motor shaft is locked and cannot rotated freely after the motor stops rotation.

The servo drive stops due to the following causes:

1) Stop at S-ON signal off:

Turn off the S-ON signal via communication, and the servo drive stops according to the enabled OFF mode.

- Associated parameters:

605Ch	Name	Disable operation option code			Setting & Effective	Any setting Upon stop	Data Structure	-	Data Format	int16
	Access	RW	Mapping	NO	Relevant Mode	ALL	Data Range	0–1	Default	0

It sets the deceleration mode of the servo motor from rotation to stop and the servo motor status after stop when the S-ON signal is turned off.

Value	Stop mode
0	Coast to stop, keeping the de-energized state
1	Stop according to ramp, keeping the de-energized state

Set the correct stop mode according to the mechanical status and running requirement.

Enable the brake output, the stop mode at S-ON OFF is forced to "Stop at zero speed, keeping de-energized state"

2) Stop at fault:

The stop mode varies according to the fault type. For fault classification, refer to Chapter 9.

- Associated parameters:

H02-08	Name	Stop mode at NO.1 fault			Setting & Effective	At stop Immediate	Data Structure	-	Data Format	Uint16
2002-09h	Access	RW	Mapping	RPDO	Relevant Mode	ALL	Data Range	0–2	Default	0

It sets the deceleration mode of the servo motor from rotation to stop and the servo motor status occurrence of NO.1 fault.

Value	Stop Mode
0	Coast to stop, keeping the de-energized state
1	DB stop, de-energized state
2	DB stop, keeping the DB state

After enabling the brake output, stop mode at NO.1 fault is forced to "DB stop, keeping the de-energized state."

605Eh	Name	Fault reaction option code			Setting & Effective	Any setting Upon stop	Data Structure	VAR	Data Format	int16
	Access	RW	Mapping	NO	Relevant Mode	ALL	Data Range	0–3	Default	2

It sets the deceleration mode of the servo motor from rotation to stop and the servo motor status occurrence of NO.2 fault.

Value	Stop Mode
0	Coast to stop, keeping the de-energized state
1	Stop according to ramp in 6084h/609Ah (HM), keeping de-energized state
2	Stop according to ramp in 6085h, keeping de-energized state
3	Stop at the emergency stop torque, keeping de-energized state

After enabling the brake output, stop mode at NO.2 fault is forced to "zero speed stop, keeping the de-energized state."

3) Stop at limit switch signal active:

- Definitions:

"Limit switch": The mechanical movement goes beyond the designed range of safe movement.

"Stop at limit switch signal active": When the mechanical movement goes beyond the range of safe movement, the limit switch outputs level change, and the servo drive forcibly stops the motor.

- Associated parameters:

H02-07	Name	Stop mode at limit switch signal			Setting & Effective	At stop Immediate	Data Structure	-	Data Format	Uint16
2002-08h	Access	RW	Mapping	-	Relevant Mode	ALL	Data Range	0–2	Default	1

It sets the deceleration mode of the servo motor from rotation to stop and the servo motor status when the limit switch signal is active during motor running.

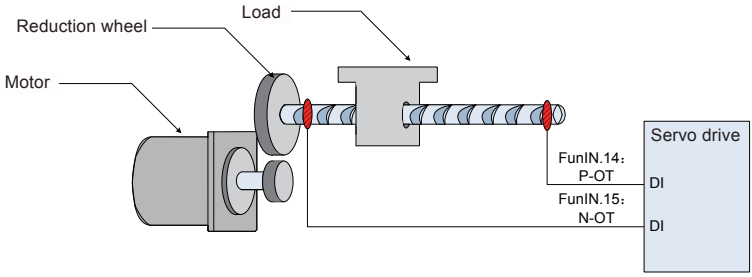
Value	Stop Mode
0	Coast to stop, keeping the de-energized state
1	Stop at zero speed, position remains locked
2	Stop at zero speed, keeping de-energized state

In the vertical axis application, set 2002-08h = 1 to fix the motor axis in the position locking state after the limit switch signal is active to ensure safety.

After enabling the brake output, stop mode at limit switch signal option is forced to "Stop at zero speed, position remains locked."

When the limit switch signal is active in the servo motor's vertical axis application, the workpiece might fall. To prevent the workpiece from falling when the limit switch signal is active, set (2002-08h) to "1-Stop at zero speed, the position remains locked." When the work moves in linear, make sure to connect the limit switch to prevent mechanical damage. If the limit switch signal becomes active, enter a reverse reference to make the motor (workpiece) run in reverse direction.

Figure 6-1 Installation diagram of limit switch



To use the limit switch function, set two DI terminals of the servo drive respectively with function 14 (FunIN.14: P-OT, positive limit switch) and function 15 (FunIN.15: N-OT, negative limit switch) to receive the limit switch input level signals, and set the terminal logics. The servo drive determines whether to enable or disable the limit switch function based on the DI terminal level.

- Relevant function No.:

Code	Name	Function Name	Function
FunIN.14	P-OT	Positive limit switch	When the mechanical movement is outside the movable range, the servo drive implements the function of preventing the motor from sensing the limit switch. ● Invalid: Forward drive permitted ● Valid: Forward drive inhibited
FunIN.15	N-OT	Negative limit switch	When the mechanical movement is outside the movable range, the servo drive implements the function of preventing the motor from sensing the limit switch. ● Invalid: Reverse drive permitted ● Valid: Reverse drive inhibited

4) Emergency stop:

Use the auxiliary: Emergency stop function.

- Associated parameters:

H0D-05	Name	Emergency stop			Setting & Effective	Run settings Immediate	Data Structure	-	Data Format	Uint16
200D-06h	Access	RW	Mapping	-	Relevant Mode	-	Data Range	0–1	Default	0

Emergency stop operation selection:

Value	Function
0	No operation
1	Enable emergency stop

When this function is enabled, the servo drive immediately stops according to the Stop mode at S-ON OFF 605Ch regardless of its state.

5) Quick stop

When the control word 6040h bit 2 (Quick stop) is 0 in servo drive running state, the servo drive implements Quick stop in the mode set in object dictionary 605Ah.

605Ah	Name	Quick stop option code			Setting & Effective	Any setting Upon stop	Data Structure	VAR	Data Format	int16
	Access	RW	Mapping	NO	Relevant Mode	ALL	Data Range	0–7	Default	2

When the servo drive implements a quick stop, the servo motor is switched from the rotation mode to the deceleration mode, and to the status after it stops.

Value	Stop Mode
0	Coast to stop, keeping the de-energized state
1	Stop according to ramp in 6084h/609Ah (HM), keeping de-energized state
2	Stop according to ramp in 6085h, keeping de-energized state
3	Stop at the emergency stop torque, keeping de-energized state
4	NA
5	Stop according to ramp in 6084h/609Ah (HM), maintaining the locked position
6	Stop according to ramp in 6085h, maintaining the locked position
7	Stop at the emergency stop torque, maintaining the locked position

6) Halt

When the servo drive is in running state and control word 6040h bit8 = 1 (Halt), a halt command is input and the servo drive performs the halt operation in the mode set in 605Dh.

605Dh	Name	Halt option code			Setting & Effective	Any setting Upon stop	Data Structure	VAR	Data Format	int16
	Access	RW	Mapping	NO	Relevant Mode	ALL	Data Range	1–3	Default	1

Selects the deceleration mode of the servo motor from rotation to stop when the servo drive is paused and the motor status after it stops.

CSP/CST/CST/PP/HM

Value	Stop Mode
1	Stop according to ramp in 6084h/609Ah (HM), maintaining the locked position
2	Stop according to ramp in 6085h, maintaining the locked position
3	Stop at the emergency stop torque, maintaining the locked position

Profile torque mode

Value	Stop Mode
1/2/3	Stop according to ramp in 6087h, maintaining the locked position

6.9 Conversion Factor Setting

Note	• For encoders with 20-bit resolution, the default value of the SV820N gear ratio 6091-01/6091-02 is 1:1. • For encoders with 23-bit resolution, the default value of the SV820N gear ratio 6091-01/6091-02 is 8:1.

6091h: Gear ratio

The gear ratio indicates the motor displacement (in encoder unit) is corresponding to the load shaft displacement of 1 reference unit.

The gear ratio is defined by the numerator 6091-01h and denominator 6091-02h. It determines the relationship between the load shaft displacement (in reference unit) and the motor displacement (in encoder unit):

Motor displacement = Load shaft displacement x Gear ratio

The motor is connected with the load through the reduction wheel and other mechanical transmission mechanism. The gear ratio is calculated based on parameters such as the mechanical reduction ratio, mechanical size and motor resolutions: It can be calculated as follows:

$$\text{Gear ratio} = \frac{\text{Motor resolution}}{\text{Load shaft resolution}}$$

Index 6091h	Name	Gear Ratio			Setting & Effective	-	Data Structure	ARR	Data Format	Uint32
	Access	-	Mapping	Energy	Relevant Mode	ALL	Data Range	OD Data Range	Default	OD Default Value

It sets the relationship between the number of motor shaft revolutions and the number of load shaft revolutions.

The electronic gear ratio must be within the following range:

(0.001 x encoder resolution/10,000, 4,000 x encoder resolution/10,000)

If this range is exceeded, Er.B03 (electronic gear ratio exceeding limit) will be detected.

The motor position feedback (encoder unit) and load shaft position feedback (reference unit) is in the following relationship:

Motor position feedback = load shaft position feedback x gear ratio

The motor speed (RPM) and the load shaft speed (reference unit/s) is in the following relationship:

$$\text{Motor speed (rpm)} = \frac{\text{Load shaft speed} \times \text{Gear ratio 6091h}}{\text{Encoder resolution}} \times 60$$

The motor acceleration rate (RPM/ms) and the load shaft speed (reference unit/s^2) is in the following relationship:

$$\text{Motor acceleration rate} = \frac{\text{Load shaft acceleration rate} \times \text{Gear ratio 6091h}}{\text{Encoder resolution}} \times \frac{1{,}000}{60}$$

Sub-index 0h	Name	Number of sub-indexes of the gear ratio			Setting & Effective	-	Data Structure	-	Data Format	Uint8
	Access	RO	Mapping	NO	Relevant Mode	-	Data Range	-	Default	2

Sub-index 1h	Name	Motor resolution			Setting & Effective	Run settings Immediate	Data Structure	-	Data Format	Uint32
	Access	RW	Mapping	RPDO	Relevant Mode	-	Data Range	0–0xFFFFFFFF	Default	8

Sub-index 2h	Name	Axis resolution			Setting & Effective	Run settings Immediate	Data Structure	-	Data Format	Uint32
	Access	RW	Mapping	RPDO	Relevant Mode	-	Data Range	0–0xFFFFFFFF	Default	1
The gear ratio is within the range: (0.001 x encoder resolution/10,000, 4,000 x encoder resolution/10,000) If this range is exceeded, Er.B03 (gear ratio setting exceeding limit) will be detected.										

Take the load ball screw as an example.

Minimum reference unit fc = 1 mm

Lead pB = 10 mm/r

Reduction ratio n = 5:1

Inovance 20-bit serial encoder motor resolution P = 1048576(p/r)

The position factor is calculated as follows:

Position factor:

$$\text{Position factor} = \frac{\text{Motor resolution P*n}}{\text{PB}}$$

$$= \frac{1048576 \times 5}{10}$$

$$= \frac{5242880}{10}$$

$$= 524288$$

Therefore, 6091-1h = 524288, 6091-2h = 1,

which means that when the drive shaft displacement is 1 mm, the motor displacement is 524288.

The ratio of 6091-1h and 6091-2h must be reduced to without common divisor, and is subject to the final value!

Appendix List of Object Groups

Parameter Address Structure

Parameter access address: Index+subindex, both are hexadecimal data.

The CiA402 protocol has the following constraints on the address of the parameter:

Index (Hex)	Description
0000-0FFF	Data format description
1000-1FFF	CoE communication object
2000-5FFF	Manufacturer specific object
6000-9FFF	Sub-protocol object
A000-FFFF	Reserved

The SV820N servo drive has 4 drive modules on one axis, and each module supports the same parameter. Except that 1000h-1FFFh CoE communication object's 4 modules have a common parameter, unless otherwise stated, the parameter address of each module is independent of each other. However, the following relation exists among them:

Parameter address (HEX) of Module N = Parameter address (HEX) of Module 1 + 0x800 x (N - 1)

Example:

	Module 1	Module 2	Module 3	Module 4
Manufacturer specific object: Speed loop gain address	2008-01h	2808-01h	3008-01h	3808-01h
Sub-protocol object: Control word address	6040-00h	6840-00h	7040-00h	7840-00h

This document describes all the parameters based on the parameter address of Module 1, unless otherwise specified.

Object Group 1000h

Index (hex)	Sub-index (hex)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default
1000	00	Device type	RO	NO	UINT32	-	-	0x00020192
1008	00	Manufacturer device name	RO	NO	-	-	-	SV820N-ECAT
1009	00	Manufacturer hardware version	RO	NO	-	-	-	Determined by the software version
100A	00	Manufacturer software version	RO	NO	-	-	-	Determined by the hardware version
1018	ID Object							
	00	Highest sub-index supported	RO	NO	UINT8	-	-	0x04
	01	Vendor	RO	NO	UINT32	-	-	0x00100000
	02	Product code	RO	NO	UINT32	-	-	0x000C010B
	03	Revision number	RO	NO	UINT32	-	-	0x00010000
1C00	Factory Software Version							
	00	Number of Sync Manager channels	RO	NO	UINT8	-	-	0x04
	01	Communication type SM0	RO	NO	UINT8	-	-	0x01
	02	Communication type SM1	RO	NO	UINT8	-	-	0x02
	03	Communication type SM2	RO	NO	UINT8	-	-	0x03
	04	Communication type SM3	RO	NO	UINT8	-	-	0x04

Index (hex)	Sub-index (hex)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default
1600	RPDO1 Mapping Object							
	00	Number of mapped application objects in RPDO1	RW	NO	UINT8	-	0–0x0A	0x05
	01	1st application object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x60400010
	02	2nd application object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x60600008
	03	3rd application object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x607A0020
	04	4th application object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x60B80010
	05	5th application object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x60FF0020
	06	6th application object	RW	NO	UINT32	-	0–0xFFFFFFFF	
	07	7th application object	RW	NO	UINT32	-	0–0xFFFFFFFF	-
	08	8th application object	RW	NO	UINT32	-	0–0xFFFFFFFF	-
	09	9th application object	RW	NO	UINT32	-	0–0xFFFFFFFF	-
	0A	10th application object	RW	NO	UINT32	-	0–0xFFFFFFFF	-
1610	RPDO11 Mapping Object							
	00	Number of mapped objects in RPDO11	RW	NO	UINT8	-	0–0x0A	0x05
	01	1st mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x68400010
	02	2nd mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x68600008
	03	3rd mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x687A0020
	04	4th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x68B80010
	05	5th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x68FF0020
	06	6th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	-
	07	7th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	-
	08	8th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	-
	09	9th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	-
	0A	10th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	-
1620	RPDO21 Mapping Object							
	00	Number of mapped objects in RPDO21	RW	NO	UINT8	-	0–0x0A	0x05
	01	1st mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x70400010
	02	2nd mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x70600008
	03	3rd mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x707A0020
	04	4th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x70B80010
	05	5th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x70FF0020
	06	6th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	
	07	7th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	-
	08	8th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	-
	09	9th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	-
	0A	10th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	-

Index (hex)	Sub-index (hex)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default
1630	RPDO31 Mapping Object							
	00	Number of mapped objects in RPDO31	RW	NO	UINT8	-	0–0x0A	0x05
	01	1st mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x78400010
	02	2nd mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x78600008
	03	3rd mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x787A0020
	04	4th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x78B80010
	05	5th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x78FF0020
	06	6th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	
	07	7th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	-
	08	8th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	-
	09	9th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	-
	0A	10th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	-
1A00	TPDO1 Mapping Object							
	00	Number of mapped application objects in TPDO1	RW	NO	UINT8	-	0–0x0A	0x0A
	01	1st application object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x603F0010
	02	2nd application object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x60410010
	03	3rd application object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x60610008
	04	4th application object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x60640020
	05	5th application object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x606C0020
	06	6th application object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x60B90010
	07	7th application object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x60BA0020
	08	8th application object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x60BC0020
	09	9th application object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x60F40010
	0A	10th application object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x60FD0010
1A10	TPDO11 Mapping Object							
	00	Number of mapped objects in TPDO11	RW	NO	UINT8	-	0–0x0A	0x0A
	01	1st mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x683F0010
	02	2nd mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x68410010
	03	3rd mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x68610008
	04	4th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x68640020
	05	5th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x686C0020
	06	6th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x68B90010
	07	7th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x68BA0020
	08	8th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x68BC0020
	09	9th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x68F40010
	0A	10th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x68FD0010

Index (hex)	Sub-index (hex)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default
1A20	TPDO21 Mapping Object							
	00	Number of mapped objects in TPDO21	RW	NO	UINT8	-	0–0x0A	0x0A
	01	1st mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x703F0010
	02	2nd mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x70410010
	03	3rd mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x70610008
	04	4th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x70640020
	05	5th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x706C0020
	06	6th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x70B90010
	07	7th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x70BA0020
	08	8th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x70BC0020
	09	9th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x70F40020
	0A	10th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x70FD0020
1A30	TPDO31 Mapping Object							
	00	Number of mapped objects in TPDO31	RW	NO	UINT8	-	0–0x0A	0x0A
	01	1st mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x783F0010
	02	2nd mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x78410010
	03	3rd mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x78610008
	04	4th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x78640020
	05	5th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x786C0020
	06	6th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x78B90010
	07	7th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x78BA0020
	08	8th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x78BC0020
	09	9th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x78F40020
	0A	10th mapping object	RW	NO	UINT32	-	0–0xFFFFFFFF	0x78FD0020
1C12	Sync Manager 2_Assigned RPDO							
	00	Number of assigned RPDOs	RW	NO	UINT8	-	0–0x04	0x04
	01	1st PDO mapping object index of assigned RPDO	RW	YES	UINT16	-	0–0xFFFF	0x1600
	02	Index for Object 2 of assigned RPDO	RW	YES	UINT16	-	0–0xFFFF	0x1610
	03	Index for Object 3 of assigned RPDO	RW	YES	UINT16	-	0–65535	0x1620
	04	Index for Object 4 of assigned RPDO	RW	YES	UINT16	-	0–65535	0x1630

Index (hex)	Sub-index (hex)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default
1C13	Sync Manager 2_Assigned TPDO							
	00	Number of assigned TPDOs	RW	NO	UINT8	-	0–0x4	0x04
	01	1st PDO mapping object index of assigned TPDO	RW	YES	UINT16	-	0–0xFFFF	0x1A00
	02	Index for Object 2 of assigned TPDO	RW	YES	UINT16	-	0–0xFFFF	0x1A10
	03	Index for Object 3 of assigned TPDO	RW	YES	UINT16	-	0–65535	0x1A20
	04	Index for Object 4 of assigned TPDO	RW	YES	UINT16	-	0–65535	0x1A30
1C32	Sync Manager 2 Synchronization Output							
	00	Number of synchronization parameters	RO	NO	UINT8	-	-	0x20
	01	Synchronization type	RO	NO	UINT16	-	-	0x0002
	02	Cycle Time	RO	NO	UINT32	ns	-	0
	04	Synchronization types supported	RO	NO	UINT16	-	-	0x0004
	05	Minimum cycle time	RO	NO	UINT32	ns	-	0x000F4240
	06	Calc and copy time	RO	NO	UINT32	ns	-	-
	09	DelayTime (ns)	RO	NO	UINT32	ns	-	-
	20	Sync error	RO	NO	BOOL	-	-	-
1C33	Sync Manager 2 Synchronization Input							
	00	Number of synchronization parameters	RO	NO	UINT8	-	-	0x20
	01	Synchronization type	RO	NO	UINT16		-	0x0002
	02	Cycle Time	RO	NO	UINT32	ns	-	0
	04	Synchronization types supported	RO	NO	UINT16	-	-	0x0004
	05	Minimum cycle time	RO	NO	UINT32	ns	-	0x000F4240
	06	Calc and copy time	RO	NO	UINT32	ns	-	-
	09	Delay time	RO	NO	UINT32	ns	-	-
	20	Sync error	RO	NO	BOOL	-	-	-

Object Group 6000h

Object group 6000h contains supported sub-protocol DSP 402 related objects.

Index (hex)	Sub-index (hex)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default	SC	EC
603F	00	Error code	RO	TPDO	UINT16	-	-	-	-	-
6040	00	Control word	RW	RPDO	UINT16	-	0–0xFFFF	0	Run settings	Immediate
6041	00	Status word	RO	TPDO	UINT16	-	-	-	-	-
605A	00	Quick stop option code	RW	NO	INT16	-	0–0x07	0x02	Run settings	Upon stop
605C	00	Disable operation option code	RW	NO	INT16	-	0–0x01	0	Run settings	Upon stop
605D	00	Halt option code	RW	NO	INT16	-	0x01–0x03	0x01	Run settings	Upon stop
605E	00	Fault reaction option code	RW	NO	INT16	-	0–0x02	0x02	Run settings	Upon stop
6060	00	Modes of operation	RW	RPDO	INT8	-	0–0x0A	0	Run settings	Immediate
6061	00	Modes of operation display	RO	TPDO	INT8	-	-	-	-	-
6062	00	Position demand value	RO	TPDO	INT32	Reference unit	-	-	-	-
6063	00	Position actual internal value	RO	TPDO	INT32	Encoder unit	-	-	-	-
6064	00	Position actual value	RO	TPDO	INT32	Reference unit	-	-	-	-
6065	00	Following error window	RW	RPDO	UINT32	Reference unit	0–0xFFFFFFFF	0x00300000	Run settings	Immediate
6066	00	Following error time out	RW	RPDO	UINT32	ms	0–0xFFFF	0	Run settings	Immediate
6067	00	Position window	RW	RPDO	UINT32	Reference unit	0–0xFFFFFFFF	0x000002DE	Run settings	Immediate
6068	00	Position window time	RW	RPDO	UINT16	ms	0–0xFFFF	0	Run settings	Immediate
606C	00	Velocity actual value	RO	TPDO	INT32	Reference unit/s	-	-	-	-
606D	00	Velocity window	RW	RPDO	UINT16	RPM	0–0xFFFF	0x0A	Run settings	Immediate
606E	00	Velocity window time	RW	RPDO	UINT16	ms	0–0xFFFF	0	Run settings	Immediate
606F	00	Velocity threshold	RW	RPDO	UINT16	RPM	0–0xFFFF	0x0A	Run settings	Immediate
6070	00	Velocity threshold time	RW	RPDO	UINT16	ms	0–0xFFFF	0	Run settings	Immediate
6071	00	Target torque	RW	RPDO	INT16	0.1%	0xF448–0x0BB8	0	Run settings	Immediate

Index (hex)	Sub-index (hex)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default	SC	EC
6072	00	Max torque	RW	RPDO	UINT16	0.1%	0–0x0BB8	0x0BB8	Run settings	Immediate
6074	00	Max torque	RO	TPDO	INT16	0.1%	-	0	-	-
6077	00	Torque actual value	RO	TPDO	INT16	0.1%	-	0	-	-
607A	00	Target position	RW	RPDO	INT32	Reference unit	0x80000000–0x7FFFFFFF	0	Run settings	Immediate
607C	00	Home offset	RW	RPDO	INT32	Reference unit	0x80000000–0x7FFFFFFF	0	Run settings	Immediate
607D	Software Absolute Position Limit									
	00	Highest sub-index supported	RO	NO	UINT8	-	-	0x02	-	-
	01	Min position limit	RW	RPDO	INT32	Reference unit	0x80000000–0x7FFFFFFF	0x80000000	Run settings	Immediate
	02	Max position limit	RW	RPDO	INT32	Reference unit	0x80000000–0x7FFFFFFF	0x7FFFFFFF	Run settings	Immediate
607E	00	Polarity	RW	RPDO	UINT8	-	0–0xFF	0	Run settings	Immediate
607F	00	Max profile velocity	RW	RPDO	UINT32	Reference unit/s	0–0xFFFFFFFF	0x06400000	Run settings	Immediate
6081	00	Profile velocity	RW	RPDO	UINT32	User speed unit	0–0xFFFFFFFF	0	Run settings	Immediate
6083	00	Profile acceleration	RW	RPDO	UINT32	Reference unit/s^2	0–0xFFFFFFFF	0x682AAAA6	Run settings	Immediate
6084	00	Profile deceleration	RW	RPDO	UINT32	Reference unit/s^2	0–0xFFFFFFFF	0x682AAAA6	Run settings	Immediate
6085	00	Quick stop deceleration	RW	RPDO	UINT32	User acceleration unit	0–0xFFFFFFFF	0xAD9C71C0	Run settings	Immediate
6086	00	Motion profile type	RW	RPDO	INT16	-	0x8000–0x7FFF	0	Run settings	Immediate
6087	00	Torque slope	RW	RPDO	UINT32	0.1%/s	0–0xFFFFFFFF	0xFFFFFFFF	Run settings	Immediate
6091	Gear Ratio									
	00	Highest sub-index supported	RO	NO	UINT8	Uint8	-	0x02	-	-
	01	Motor revolutions	RW	RPDO	UINT32	-	0–0xFFFFFFFF	20-bit encoder: 1 23-bit encoder: 8	Run settings	Immediate
	02	Shaft revolutions	RW	RPDO	UINT32	-	1–0xFFFFFFFF	1	Run settings	Immediate
6098	00	Homing method	RW	RPDO	INT8	-	0x01–0x023	0x01	Run settings	Immediate

Index (hex)	Sub-index (hex)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default	SC	EC
6099	Homing Speed									
	00	Highest sub-index supported	RO	NO	UINT8	-	-	0x02	-	-
	01	Speed during search for switch	RW	RPDO	UINT32	Reference unit/s	0–0xFFFFFFFF	0x001AAAAB	Run settings	Immediate
	02	Speed during search for zero	RW	RPDO	UINT32	Reference unit/s	0–0xFFFFFFFF	0x0002AAAB	Run settings	Immediate
609A	00	Homing acceleration	RW	RPDO	UINT32	Reference unit/s^2	0–0xFFFFFFFF	0x682AAAA6	Run settings	Immediate
60B0h	00	Position offset	RW	RPDO	INT32	Reference unit	0x80000000–0x7FFFFFFF	0	Run settings	Immediate
60B1h	00	Velocity offset	RW	RPDO	INT32	Reference unit/s	0x80000000–0x7FFFFFFF	0	Run settings	Immediate
60B2h	00	Torque offset	RW	RPDO	INT16	0.1%	0xF448–0x0BB8	0	Run settings	Immediate
60B8h	00	Touch probe function	RW	RPDO	UINT16	-	0–0xFFFF	0	Run settings	Immediate
60B9h	00	Touch probe status	RW	RPDO	UINT16	-	-	0	-	-
60BAh	00	Touch probe pos1 pos value	RW	RPDO	INT32	Reference unit	-	0	-	-
60BBh	00	Touch probe pos1 neg value	RW	RPDO	INT32	Reference unit	-	0	-	-
60BCh	00	Touch probe pos2 pos value	RW	RPDO	INT32	Reference unit	-	0	-	-
60BDh	00	Touch probe pos2 neg value	RW	RPDO	INT32	Reference unit	-	0	-	-
60D5h	0x00	Touch probe 1 positive edge counter	RO	RPDO	UINT16	-	-	0	-	-
60D6h	0x00	Touch probe 1 negative edge counter	RO	RPDO	UINT16	-	-	0	-	-
60D7h	0x00	Touch probe 2 positive edge counter	RO	RPDO	UINT16	-	-	0	-	-
60D8h	0x00	Touch probe 2 negative edge counter	RO	RPDO	UINT16	-	-	0	-	-
60E0h	00	Positive torque limit value	RW	RPDO	UINT16	0.1%	0–0x0BB8	0x0BB8	Run settings	Immediate
60E1h	00	Negative torque limit value	RW	RPDO	UINT16	0.1%	0–0x0BB8	0x0BB8	Run settings	Immediate

Index (hex)	Sub-index (hex)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default	SC	EC
60E3h	Supported Homing Methods									
	00	Highest sub-index supported	RO	NO	UINT8	-	-	0x1F		-
	01	1st supported homing method	RO	NO	UINT16	-	-	0x0301		-
	02	2nd supported homing method	RO	NO	UINT16	-	-	0x0302		-
	03	3rd supported homing method	RO	NO	UINT16	-	-	0x0303		-
	04	4th supported homing method	RO	NO	UINT16	-	-	0x0304		-
	05	5th supported homing method	RO	NO	UINT16	-	-	0x0305		-
	06	6th supported homing method	RO	NO	UINT16	-	-	0x0306		-
	07	7th supported homing method	RO	NO	UINT16	-	-	0x0307		-
	08	8th supported homing method	RO	NO	UINT16	-	-	0x0308		-
	09	9th supported homing method	RO	NO	UINT16	-	-	0x0309		-
	0A	10th supported homing method	RO	NO	UINT16	-	-	0x030A		-
	0B	11th supported homing method	RO	NO	UINT16	-	-	0x030B		-
	0C	12th supported homing method	RO	NO	UINT16	-	-	0x030C		-
	0D	13th supported homing method	RO	NO	UINT16	-	-	0x030D		-

Index (hex)	Sub-index (hex)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default	SC	EC
60E3h	0E	14th supported homing method	RO	NO	UINT16	-	-	0x030E		-
	0F	15th supported homing method	RO	NO	UINT16	-	-	0x030Fh		-
	10	16th supported homing method	RO	NO	UINT16	-	-	0x0310		-
	11	17th supported homing method	RO	NO	UINT16	-	-	0x0311		-
	12	18th supported homing method	RO	NO	UINT16	-	-	0x0312		-
	13	19th supported homing method	RO	NO	UINT16	-	-	0x0313		-
	14	20th supported homing method	RO	NO	UINT16	-	-	0x0314		-
	15	21th supported homing method	RO	NO	UINT16	-	-	0x0315		-
	16	22th supported homing method	RO	NO	UINT16	-	-	0x0316		-
	17	23th supported homing method	RO	NO	UINT16	-	-	0x0317		-
	18	24th supported homing method	RO	NO	UINT16	-	-	0x0318		-
	19	25th supported homing method	RO	NO	UINT16	-	-	0x0319		-
	1A	26th supported homing method	RO	NO	UINT16	-	-	0x031A		-
	1B	27th supported homing method	RO	NO	UINT16	-	-	0x031B		-

Index (hex)	Sub-index (hex)	Name	Access	PDO Mapping	Data Type	Unit	Data Range	Default	SC	EC
60E3h	1C	28th supported homing method	RO	NO	UINT16	-	-	0x031C		-
	1D	29th supported homing method	RO	NO	UINT16	-	-	0x031D		-
	1E	30th supported homing method	RO	NO	UINT16	-	-	0x031E		-
	1F	31th supported homing method	RO	NO	UINT16	-	-	0x031F		-
60E6h	00	Additional position encoder resolution – encoder increments	RW	NO	UINT16	-	0–1	0		Imme-diate
60F4h	00	Following error actual value	RO	RPDO	INT32	Reference unit	-	-		-
60FCh	00	Position demand internal value	RO	TPDO	INT32	Encoder unit	-	-		-
60FDh	00	Digital inputs	RO	RPDO	UINT32	-	-	-		-
60FEh	Digital Output									
	00	Highest sub-index supportedd	RO	NO	UINT8	-	-	0x02		-
	01	Physical output	RW	RPDO	UINT32	-	0–0xFFFFFFFF	0		Imme-diate
	02	Bit mask	RW	NO	UINT32	-	0–0xFFFFFFFF	0		Imme-diate
60FFh	00	Target velocity	RW	RPDO	INT32	Reference unit/s	0x80000000–0x7FFFFFFF	0		Imme-diate
6502h	00	Supported drive modes	RO	NO	UINT32	-	-	0x000003AD		-

Revision History

Date	Revised Version	Revised Details
May 2017	A00	First release