EL7-ECS Series AC Servo Drive

User Manual

Foreword

Thank you for purchasing Leadshine EL7-ECS series AC Servo drives. This manual will provide information on the EL7-ECS series servo products regarding product safety & specifications, installations & wiring, tuning & problem diagnostics.

Please contact us at tech@leadshine.com if you need further technical support.

Incorrect operation may cause unexpected accident, please read this manual carefully before using product.

- ✧ We reserve the right to modify equipment and documentation without prior notice.
- ✧ We won't undertake any responsibility with any customer's modification of product and the warranty of product will be canceled at the same time.

Safety Precautions

Please read the safety instructions carefully before using the products and pay attention to the safety signs.

Danger	Might incur death or serious injury
Caution	Might cause injury to operating personals or damage to equipment
Warning	Might cause damage to equipment
	High voltage. Might cause electrocution to personals in contact
	Hot surface. Do not touch
	Protective Earth

Safety instructions

Warning

- ✓ The design of the product is not to be used in mechanical system which may incur health hazard.
- ✓ Users should be aware of the product safety precautions during design and installations of the equipment to prevent any unwanted accident.

Upon receiving

Caution

- ✓ The use of damaged or faulty product(s) is prohibited.
- ✓ Please refer to item checklist. If the labels don't match, please do not install.

Transportation

Caution

- ✓ Please provide storage and transportation under protected conditions.
- ✓ Do not stack the products too high up to prevent toppling.
- ✓ The product should be packaged properly during transportation,
- ✓ Do not hold the product by the cable, motor shaft or encoder while transporting it.
- ✓ The product should be protected from external forces and shock.

Installation

Caution

Servo drive and Motor:

- ✓ Do not install around combustibles to prevent fire hazard.
- ✓ Avoid vibration and impact.
- ✓ Do not install products that are damaged or incomplete.

Servo drive:

- ✓ Please install in electrical cabinet with sufficient protection from outside elements.
- ✓ Reserve sufficient gap as per the installation guide.
- ✓ Make sure to have good heat sinking.
- ✓ Avoid dust, corrosive gas, conductive object or fluid and combustibles.

Servo Motor:

- ✓ Make sure installation is tight to prevent it from loosening.
- ✓ Prevent fluid from leaking into motor and encoder.
- ✓ Protect motor from impact to avoid damaging encoder.
- ✓ Motor shaft should not bear the load beyond the limits as specified.

Wiring

Warning

- ✓ Participate installation personals should have sufficient training in product installation safety.
- ✓ Please power off and wait for 10 minutes to make sure a full discharge of electricity.
- ✓ Servo drive and motor must be connected to ground.
- ✓ Connect the cables only after servo drive motor installed correctly
- ✓ Make sure the wires are properly managed and insulation layer is not torn to prevent electrocution.

Caution

- ✓ Wiring must be correctly connected to prevent damage to product(s)
- ✓ Servo motor U, V, W terminal should be connected correctly and NOT connected directly to an AC power supply.
- ✓ Capacitor, inductor or filter shouldn't be installed between servo motor and servo drive.
- ✓ Connecting wires or any non-heat resistant components should be put near to heat sink of the servo drive or motor.
- ✓ The flyback diode which is connected in parallel to output signal DC relay must not be connected in reverse.

Tuning and running

⚠ Caution

- ✓ Make sure the wirings of servo drive and servo motor are installed and fixed properly before powering on.
- ✓ On the first time tuning of the product, it is recommended to run unloaded until all the parameter settings are confirmed to prevent any damage to the product or machine.

Usage

⚠ Caution

- ✓ Please install an emergency stop button on machine to stop operation Immediately if there is an accident.
- ✓ Please make sure machine is stopped before clearing an alarm.
- ✓ Servo drive must be matched with specified motor.
- ✓ Frequent restart of the servo system might incur damage to the product.
- ✓ Servo drive and motor will be hot to touch shortly after power off. Please be careful.
- ✓ Modification(s) to servo system is prohibited.

Error Handling

⚠ Warning

- ✓ Please wait for 5 minutes after powering off for the electricity to be fully discharged before uninstalling the cables.
- ✓ Participate maintenance personals should have sufficient training in maintenance and operation of this product series.

⚠ Caution

- ✓ Please handle the error before clearing an alarm.
- ✓ Keep away from machine after a restart upon alarm. Mechanical axis might suddenly move. Such hazard should be prevented during the utilization of the product.

Model Selection

⚠ Caution

- ✓ Rated torque of the servo motor should be higher than continuous designated torque when fully loaded.
- ✓ Load inertia ratio of the motor should be lower or equals to recommended value for specified models
- ✓ Servo drive must be matched with specified motor.

Warranty Information

Available for

Leadshine overseas warranty only covers Leadshine AC servo products that are obtained through **Leadshine certified sales channel outside of China**.

Warranty claim

- All Leadshine AC servo products (Servo drives and motors) overseas enjoy **18-month** warranty period.
- Due to unforeseen circumstances in different sales regions around the globe, we recommend users to seek technical support from directed sales channel as any warranty claim or repair services may be required.
- Please be informed that any maintenance/repair work that is outside of the warranty claim conditions might incur some charges and to be confirmed before product(s) is being sent in.
- The duration required for maintenance work to be done is to be confirmed after initial check-up but we reserve the right to prolong the repair duration if needed.
- Discontinued products within warranty period will be replaced with a product of similar specifications.

Steps to warranty claim

1. Visit Leadshine global site www.leadshine.com to look for local certified sales channel.
2. Contact designated sales channel to check if any fee might incur. May include repair fee, spare part cost or shipping cost.

Circumstances where warranty claim is not available

- Damage/Loss due to occurrence of natural or man-made disaster such as fire, flood or earthquake.
- Installation or wiring error
- If there is any modification done to the product
- Warranty label on products is torn or not existing
- Not a product bought from Leadshine certified global network of retailers/distributors.

Before warranty claim

- Please backup device parameters before any repair work/warranty claim. Leadshine and Leadshine certified retailers/distributors will not be held responsibilities for any data loss.
- If available, please send product back in original packaging or make sure it is well packaged to prevent any damage to the product during shipping.

Leadshine Technology Co.,Ltd. and its certified sales channel reserved the final right of the interpretation of the warranty information.

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Chapter 1 Introduction

1.1 Product Introduction

AC servo technology has become increasingly mature with continuously improved performance since its development in the early 1990s, and is now widely used in automation fields such as CNC machine tools, printing and packaging machinery, textile machinery, and automated production lines.

The EL7-ECS series has a power range of 400W~7.5kW and supports the EtherCAT communication protocol. With the corresponding communication interface, multiple servo drives can operate in a networked configuration with a host computer (including controllers and PLCs). Additionally, the EL7-ECS series features the latest one-click auto-tuning function, offering stiffness table setting, inertia identification, and vibration suppression. It supports Type-C connection for debugging, making servo drive operation and commissioning simple and user-friendly. When paired with ELM2 series high-response servo motors (equipped with 23-bit multi-turn absolute encoders), the system operates reliably and smoothly, with a maximum speed loop bandwidth of up to 3.2kHz.

The EL7-ECS series AC servo system offers the following advantages:

- Wide speed range and constant torque

Speed ratio of 1: 5000, ensuring stable torque characteristics from low to high speeds.

- High speed and high precision

Servo motor maximum speed up to 6500rpm, supporting 23-bit multi-turn absolute encoders.

- Simple and flexible control

The working mode and operational characteristics of the servo system can be appropriately configured by modifying parameters to meet diverse requirements.

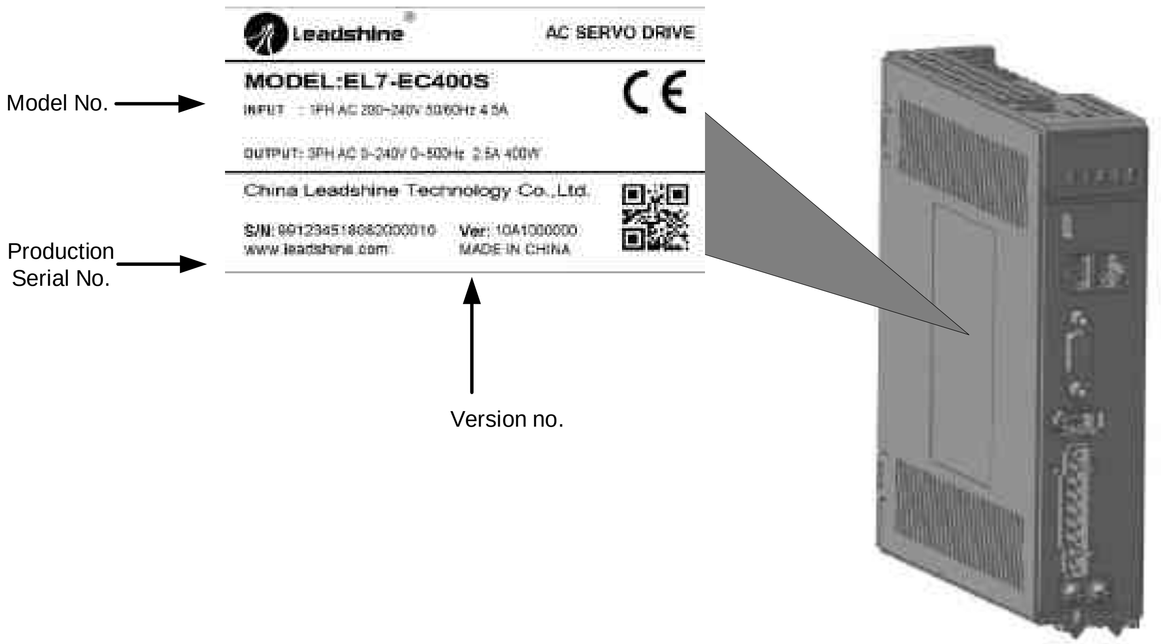
Note:
The maximum speed varies among different servo motor models.

1.2 Model Number Structure

Servo Drive

EL7-EC 750 S T
① ② ③ ④ ⑤

No.	Description
①	Series No. EL7：Servo drive series
②	Command source RS: Pulse + Direction/Analog Input/Modbus RTU EC: EtherCAT PN: PROFINET
③	Power rating 400:400W 750: 750W 1000:1000W 1500: 1500W 2000: 2000W 3000:3000W 4400:4400W 5500:5500W 7500:7500W
④	Verision S: Drive version with STO certification and UL certification
⑤	Main power input: *Blank*: 220VAC(1 or 3-phase) T: 400VAC(3-phase)



1.3 Driver Technical Specification

EL7-ECS 220V Models

EL7-ECS series	EL7-EC400S	EL7-EC750S	EL7-EC1000S	EL7-EC1500S	EL7-EC2000S
Rated power (W)	400W	750W	1000W	1500W	2000W
Rated Current (Arms)	2.5	5.5	7.0	9.5	12.0
Peak Current (Arms)	9.5	16.6	21.0	31.1	36.0
Size (mm)	168*156*40	168*156*50		168*183*80	
Main Power Supply	Single phase/Three phase AC 200V~240V, -10%~+10%, 50/60Hz				
Control Circuit Power Supply	Single phase AC 200V~240V, -10%~+10%, 50/60Hz				

EL7-ECS 400V Models

EL7-ECS_T series	EL7-EC 1000ST	EL7-EC1500ST	EL7-EC 2000ST	EL7-EC 3000ST	EL7-EC 4400ST	EL7-EC 5500ST	EL7-EC 7500ST
Rated Power(W)	1000	1500	2000	3000	4400	5500	7500
Rated Current (Arms)	3.5	5.4	8.4	11.9	16.5	20.8	25.7
Peak Current (Arms)	10.6	14.0	20.0	30.0	38.9	51.6	63.6
Size (mm)	168*183*55		168*183*80		250*230*89		
Main Power Supply	Three phase AC 380V~440V, -10%~+10%, 50/60Hz						
Control Circuit Power Supply	Single phase AC 380V~440V, -10%~+10%, 50/60Hz						

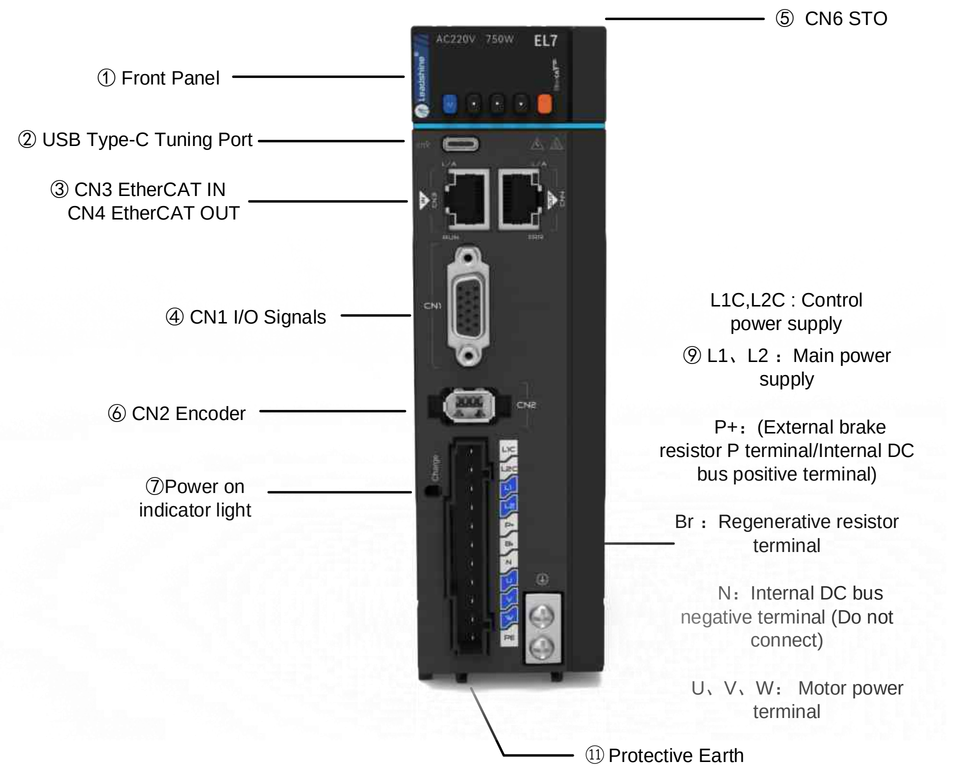
EL7-ECS 400V high power Models

Control mode		IGBT PWM sinusoidal wave drive
Control mode	Position	Profile Position Mode (PP)
		Cyclic Synchronous Position Mode (CSP)
		Homing Mode (HM)
	Velocity	Profile Velocity Mode (PV)
		Cyclic Synchronous Velocity Mode (CSV)
	Torque	Profile Torque Mode (PT)
		Cyclic Synchronous Torque Mode (CST)
Encoder Feedback		RS485 protocol: 23-bit multiturn absolute magnetic/optical encoder
I/O	Digital Input	6 Digital Inputs (Supports NPN and PNP, DI4/DI5 supports probe input)
		1. Clear Alarm （A-CLR） 2. Positive limit switch (POT) 3. Negative limit switch (NOT) 4. Homing switch (HOME-SWITCH) 5. Emergency stop (E-Stop)
	Digital Output	3 Digital Outputs (double-ended)

		1. Alarm (ALM) 2. Servo ready (SRDY) 3. External brake off (BRK-OFF) 4. Positioning completed (INP) 5. Velocity at arrival (AT-SPEED) 6. Torque limiting command (TLC) 7. Zero speed position (ZSP) 8. Velocity coincidence (V-COIN) 9. Position command (P-CMD) 10. Velocity limit (V-LIMIT) 11. Velocity command (V-CMD) 12. Servo enabled (SRV-ST) 13. Homing done (HOME-OK) 14. Dynamic Brake Output 15. Z-Phase Output 16. New: Warning Output Signal
	Probe Input	2 high speed probe inputs: EXT1+/EXT1-, EXT2+/EXT2-
Communication Port	USB Type-C	Modbus USB2.0 (No need to connect driver to power supply)
	EtherCAT	EtherCAT(RJ45)，Communication up to 128 axes to a host
Software		Driver tuning through Motion Studio Ver.3.0.0 Parameters tuning in current loop, position loop, velocity loop; Modify I/O signal and motor parameters; Variables(velocity, position deviation, etc.) monitoring using step diagrams
Black Box		Used for error solving
Notch filter		2 sets automatic notch + 2 sets manual notch (Requirement Level 4)
Driver Front Panel		Five buttons, five-digit white LED display
Holding brake		Built-in (Excluding 11 kW–22 kW; excluding 400 W and below.)
Safety Protection		Overcurrent. Overvoltage. Undervoltage. Overheat. Overload. Overtravel. Single-Phasing. Regenerative resistor error. Position deviation error. Encoder feedback error. Excessive braking rate. EEPROM error
Safe Torque Off (STO) function		Available for all EL7-ECS series products
Adjustable Carrier Frequency		220V 1 kW and below, default 16 kHz; 380V 7.5 kW and below, default 8 kHz; 11–22 kW, default 4 kHz.
Serial Encoder		Supported
Position Compare Output		Supported
Zero tracking error		Supported
Warning Output		Supported (Warnings such as: Encoder battery low voltage, positive/negative limit, overload warning, torque limit warning, etc.)
Environment	Temperature	Operating temperature: 0℃ ~55℃ (not freezing) upper 45℃, please use at a reduced rate, and the rate will be reduced by 2% for every 1℃ increase. Storage temperature: -20 ~ 80℃ (no condensation) Do not store for more than 72 hours beyond 65℃.
	Humidity	Under 90%RH (Condensation free)
	Altitude	Up to 2000m above sea level No derating for use below 1000m 1% derating for every 100m above 1000m. For altitudes above 2000m, please contact the manufacturer!
	Vibration	Less than 0.5G (4.9m/s2) 10-60Hz (non-continuous working)
	Altitude	Up to 1000m(please reduce rate beyond 1000m)
	Impact	19.6m/s^2
	IP ratings	IP20

1.4 Driver ports and connectors

EL7-ECS Series Servo Drive

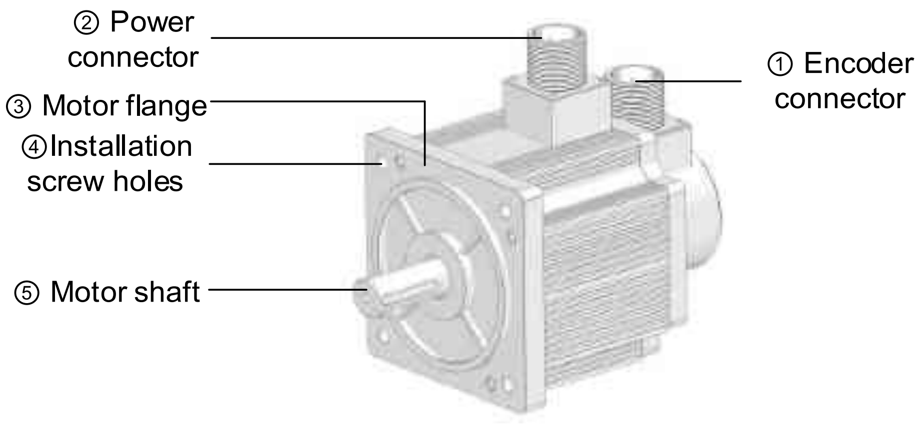


No.	Parts & Connectors	Description
①	Front Panel	Including a LED display and 5 buttons. LED display is used to display servo drive status and parameter settings. 5 buttons: M : *To switch between different modes and parameters* ◀ : *Switch between value* ▲ : *Switch between sub-menus/Increase* ▼ : *Switch between sub-menus/Decrease* S : *Enter*
②	USB Type-C tuning port	Connect to computer for tuning of servo drive. Parameters of the servo drive can be modified without connecting to main power supply.
③	CN1 I/O signal	Probe input signal & other I/O signals terminals
④	CN3 EtherCAT IN/ CN4 EtherCAT OUT	Connect to master device or next/previous slave station
⑤	CN6 STO	Safe Torque Off (STO) port
⑥	CN2 Encoder	Connect to motor encoder
⑦	Power-on indicator light	Lights up when servo drive is connected to main power supply. *Please do not touch the power terminal Immediately after power off as the capacitor might require some time to discharge.*

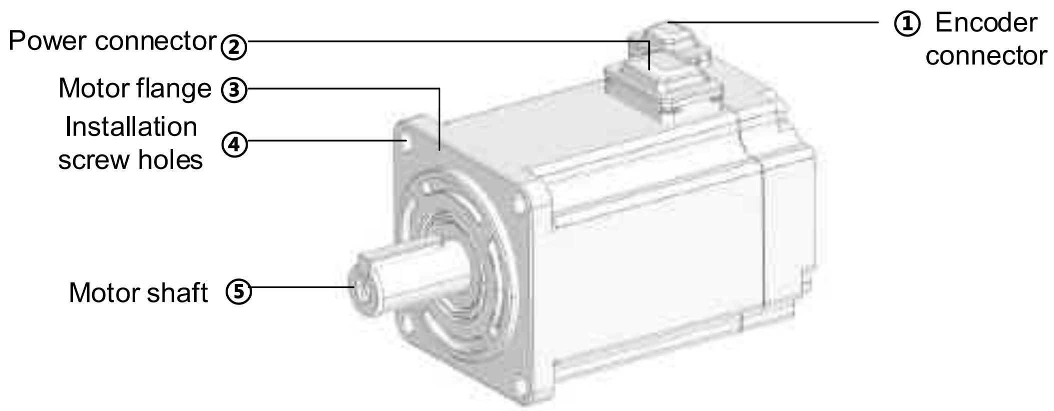
EL7-ECS models		
⑨	L1C,L2C	Control power supply 220VAC
	L1, L2	Main power supply 220VAC
	P+, Br	Connect to regenerative resistor
	P+, N	Common DC bus terminals for multiple drivers
	U, V, W	Motor connector: Connect to U,V,W power terminals on servo motor
	PE	PE motor earth terminal: Connect to motor PE terminal

1.5 Motor ports and connectors

Motors with aviation connectors



Motors with direct connectors



Chapter 2 Installation & Wiring

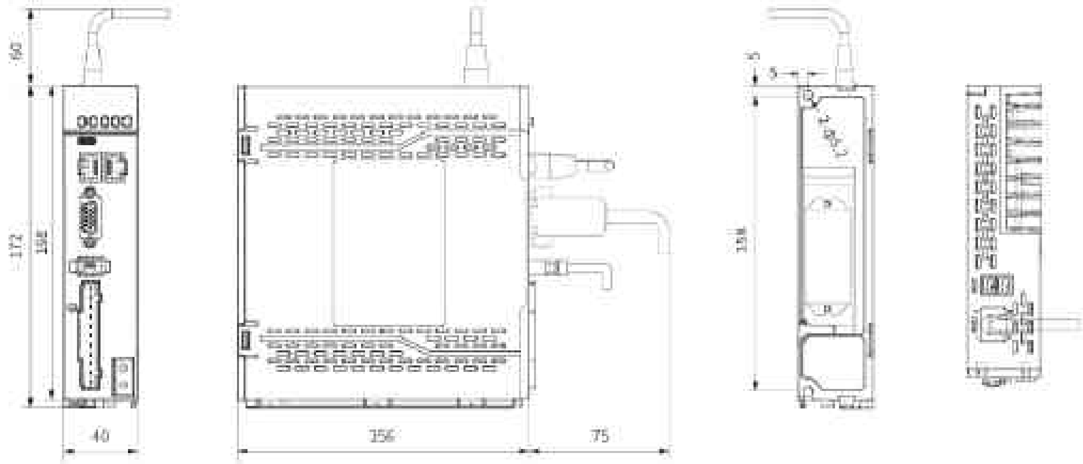
2.1 Servo Drive Installation

2.1.1 Servo drive installation environment

Temperature	Storage: -20-80℃ (Condensation free); Installation: 0-55℃ (Not frozen)
Humidity	Under 90%RH (Condensation free)
Altitude	Up to 1000m above sea level
Vibration	Less than 0.5G (4.9m/s2) 10-60Hz (non-continuous working)
Atmospheric	No corrosive gas, combustibles, dirt or dust.
IP ratings	IP20

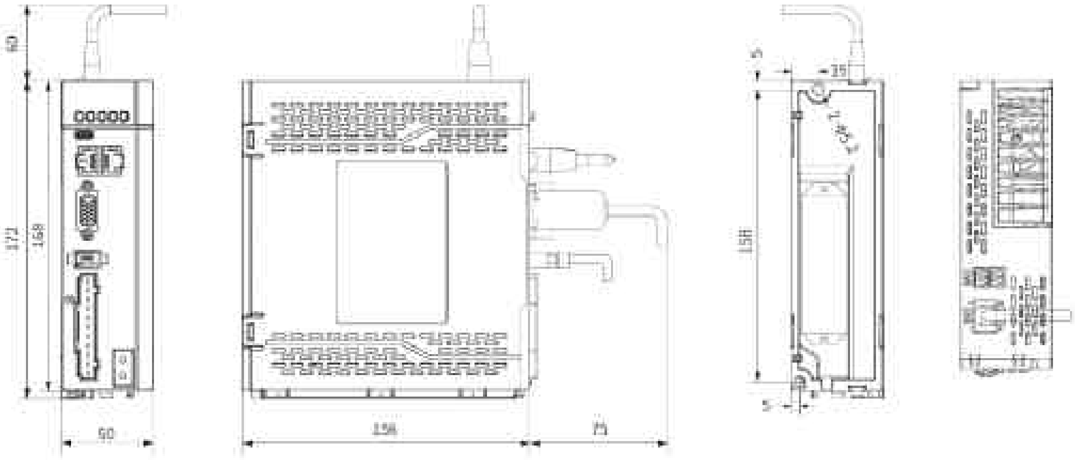
2.1.2 Servo Drive Dimension

EL7 – ECS Series 400W - 220VAC Size A



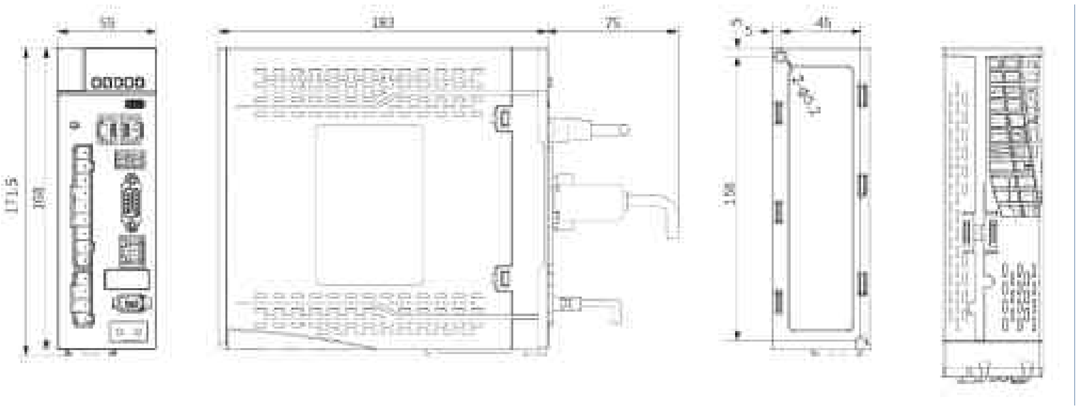
40mm x 156mm x 168mm

EL7 – ECS Series 750W/1000W -220VAC Size B



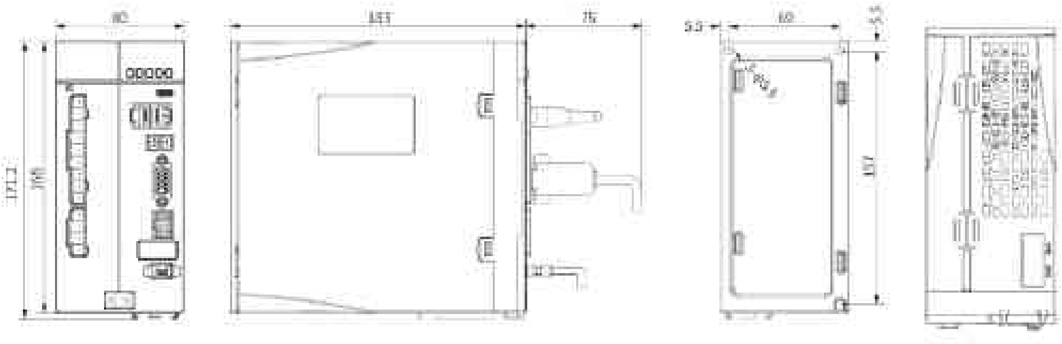
50mm x 156mm x 168mm

EL7-ECS Series 1000W/1500W -400VAC Size C



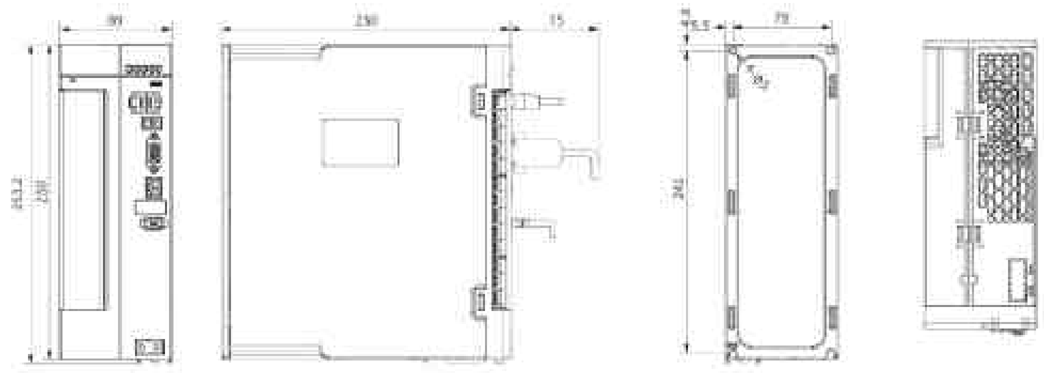
55mm×183mm×168mm

EL7-ECS Series 1500W/2000W -220VAC 2000W/3000W - 400VAC Size D



80mm×183mm×168mm

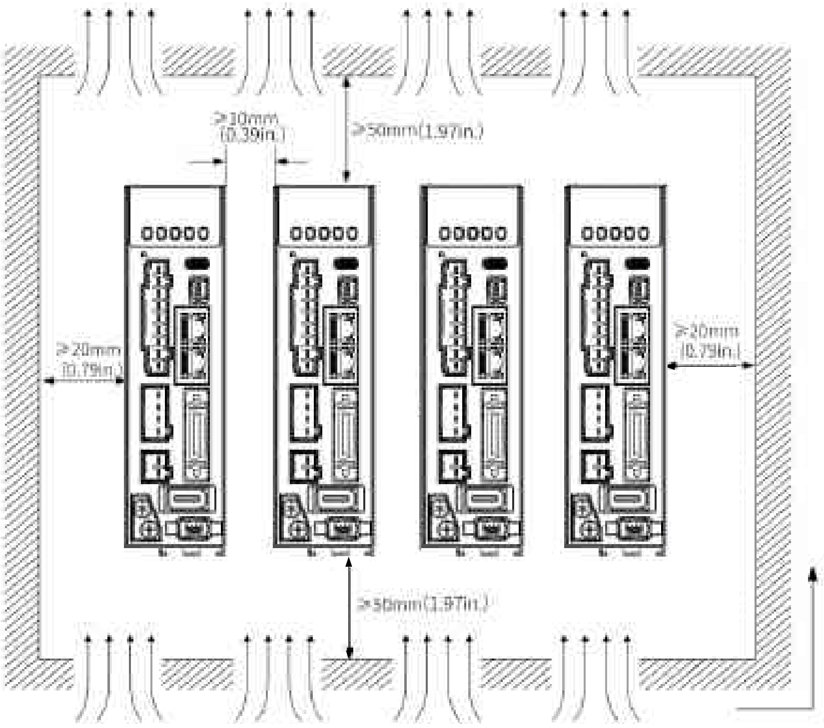
EL7-ECS Series 4400W/5500W/7500W -400VAC Size E



89mm×230mm×250mm

Space requirement for installation for 400W~7500W dirver

In order to ensure efficient heat dissipation, please leave at least 10mm installation space in between drivers. If drivers need to be mounted compactly, please leave at 1mm of installation space. Please keep in mind that under such conditions, the drivers can only run at 75% of actual load rate.



- ✓ Installation method
  Please install the driver vertical to ground facing forward for better heat dissipation. Always install in rows and use heat insulation board to separate between rows.
  Cooling fans are recommended for drivers to achieve optimal performance.
- ✓ Grounding
  PE terminals must be grounded to prevent electrocution hazard or electromagnetic interference.
- ✓ Wiring
  Please ensure there is no liquid around the wiring and connectors as liquid leakage may cause serious damage to the driver(s).

2.2 Servo Motor Installation

2.2.1 Installation conditions

Installation conditions may affect the lifespan of a motor

- ➢ Please keep away from corrosive fluid and combustibles.
- ➢ If dusty working environment is unavoidable, please use motors with oil seal.
- ➢ Please keep away from heat source.
- ➢ If motor is used in enclosed environment without heat dissipation, motor lifespan will be short.
- ➢ Please check and clean the installation spot before installation.

2.2.2 Precautions during installation

Installation method

Install horizontal to ground

Make sure power cable and encoder cable is facing downwards to make sure fluid doesn't leak into the ports.

Install vertical to ground

Please use a motor with oil seal when paired with a reducer to prevent reducer oil from leaking into the motor.

Oil- and waterproofing

- Do not submerge motor/cable under oil/water
- Please use a motor with oil seal when paired with a reducer to prevent reducer oil from leaking into the motor.
- If there is an unavoidable fluid leakage near the motor, please use motor with better IP ratings.
- Make sure power cable and encoder cable is facing downwards to make sure fluid doesn't leak into the ports.
- Avoid the usage of motor in water/oil leaking prone environment.

Cable under stress

- Do not the bend the cable especially at each ends of the connectors.
- Make sure to not let the cables be too tight and under tremendous stress especially thinner cables such as signal cables.

Connectors

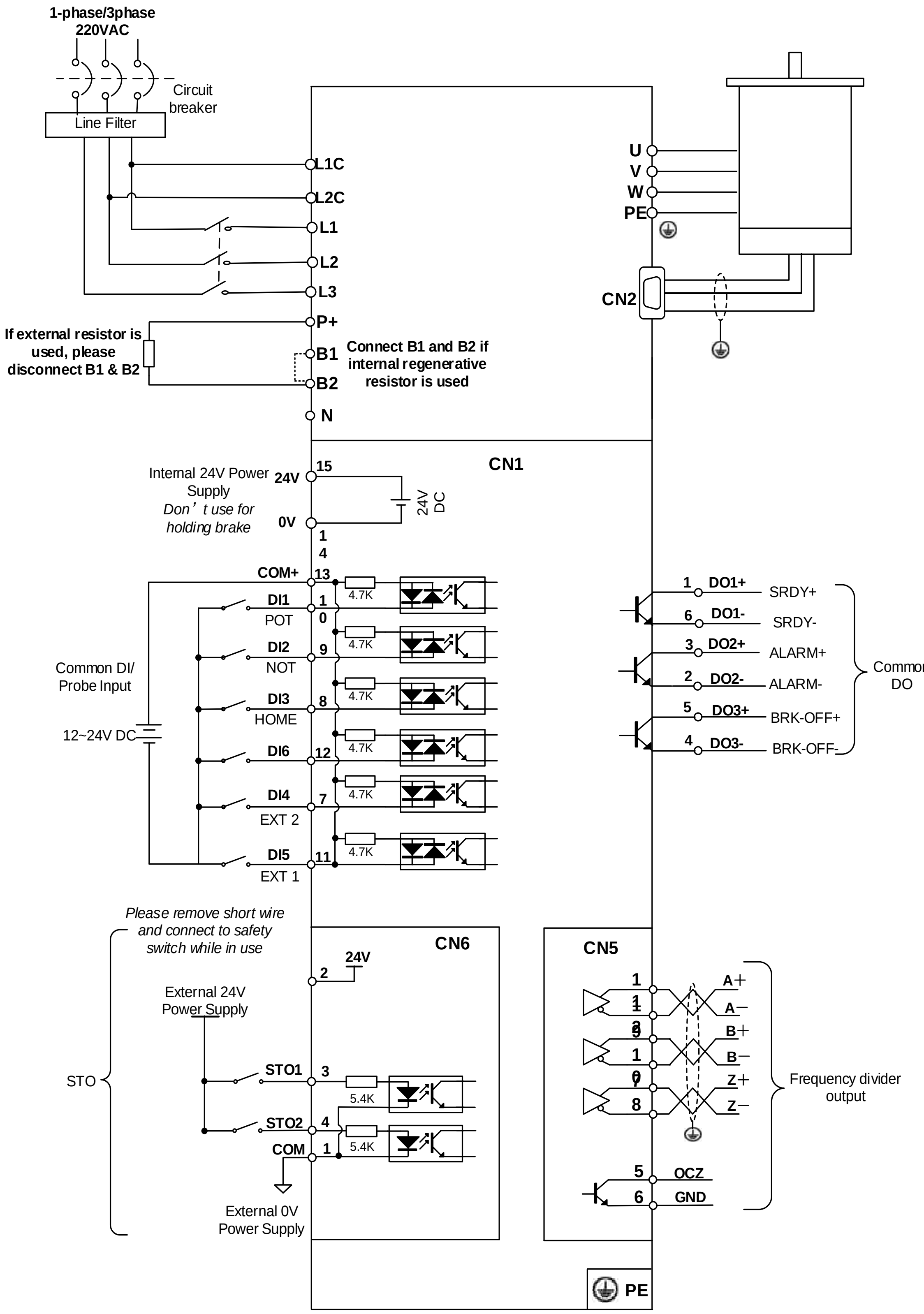
- Please to remove any conductive foreign objects from the connectors before installation
- The connectors are made of resin. May not withstand impact.
- Please hold the driver during transportation, not the cables.
- Leave enough "bend" on the connector cables to ensure less stress upon installation.

Encoder & coupling

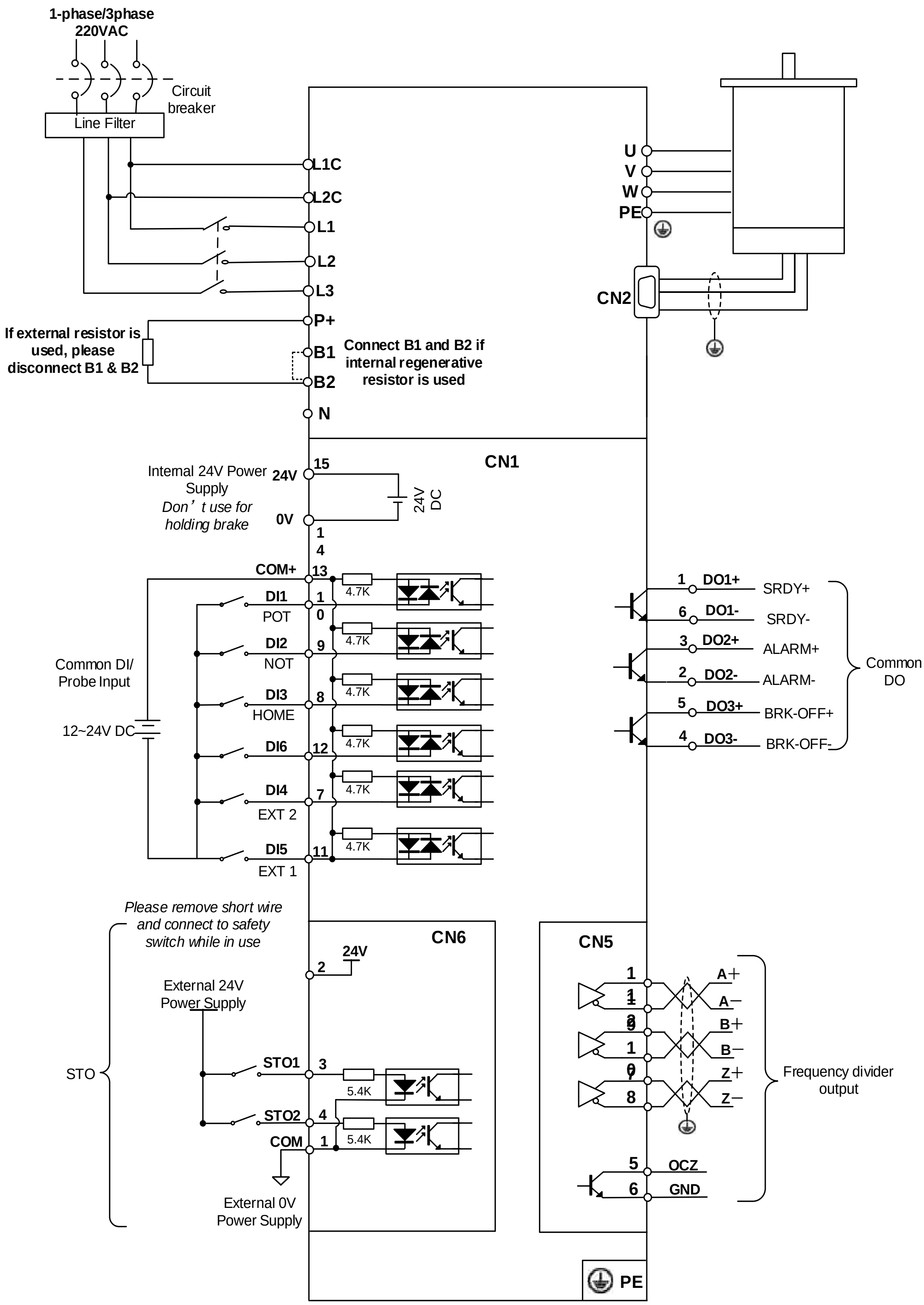
- During installation or removal of coupling, please do not hit the motor shaft with a hammer as it would cause damage to internal encoder.
- Please make sure to centralize the motor shaft and coupling, it might cause damage to motor or encoder due to vibration.
- Please make sure axial and radial load is within the limits specified as it might affect the lifespan of the motor or cause damage to it.

2.3 EL7-ECS Wiring Diagram

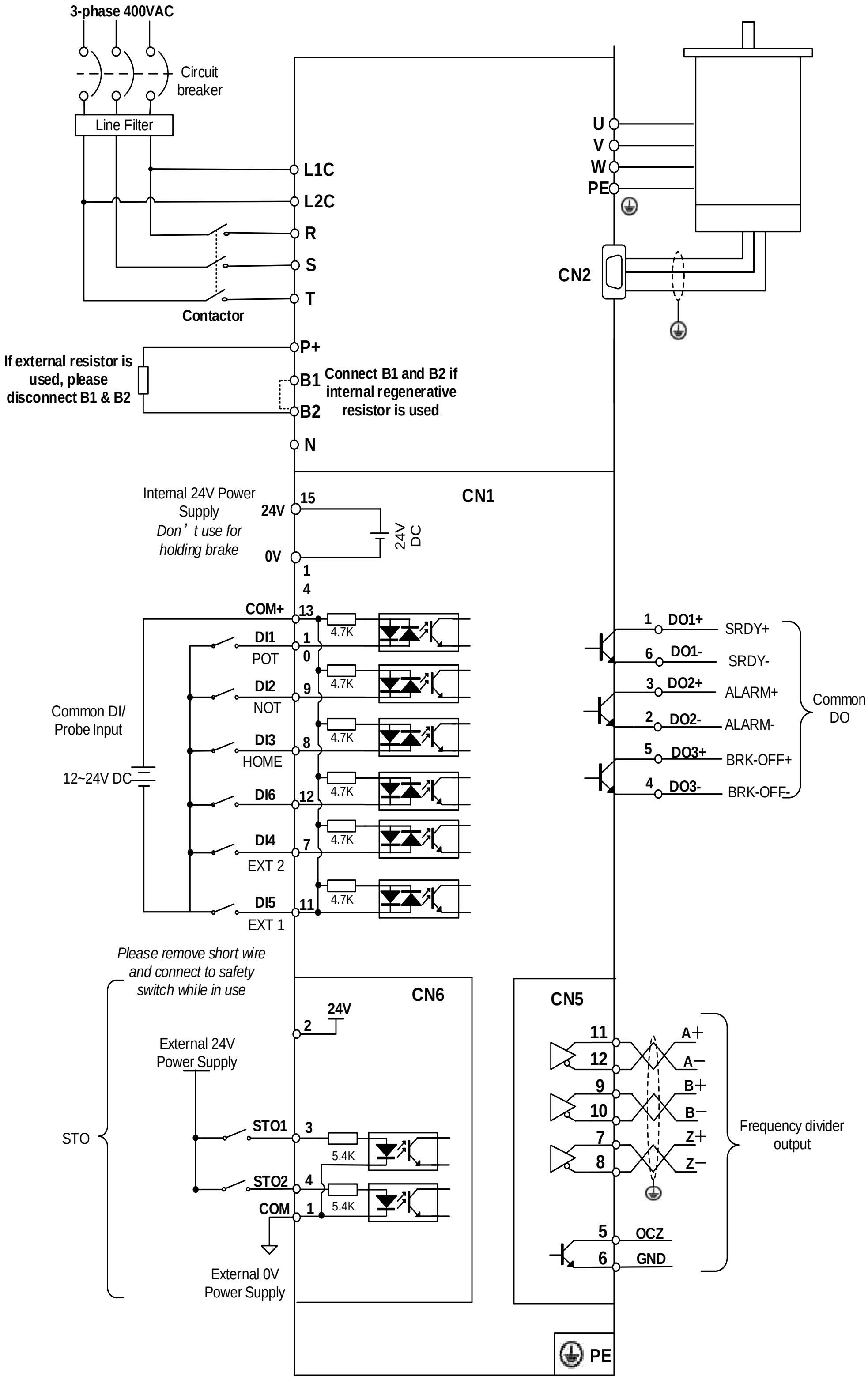
EL7-ECS Series 400W/750W/1000W – 220V Models



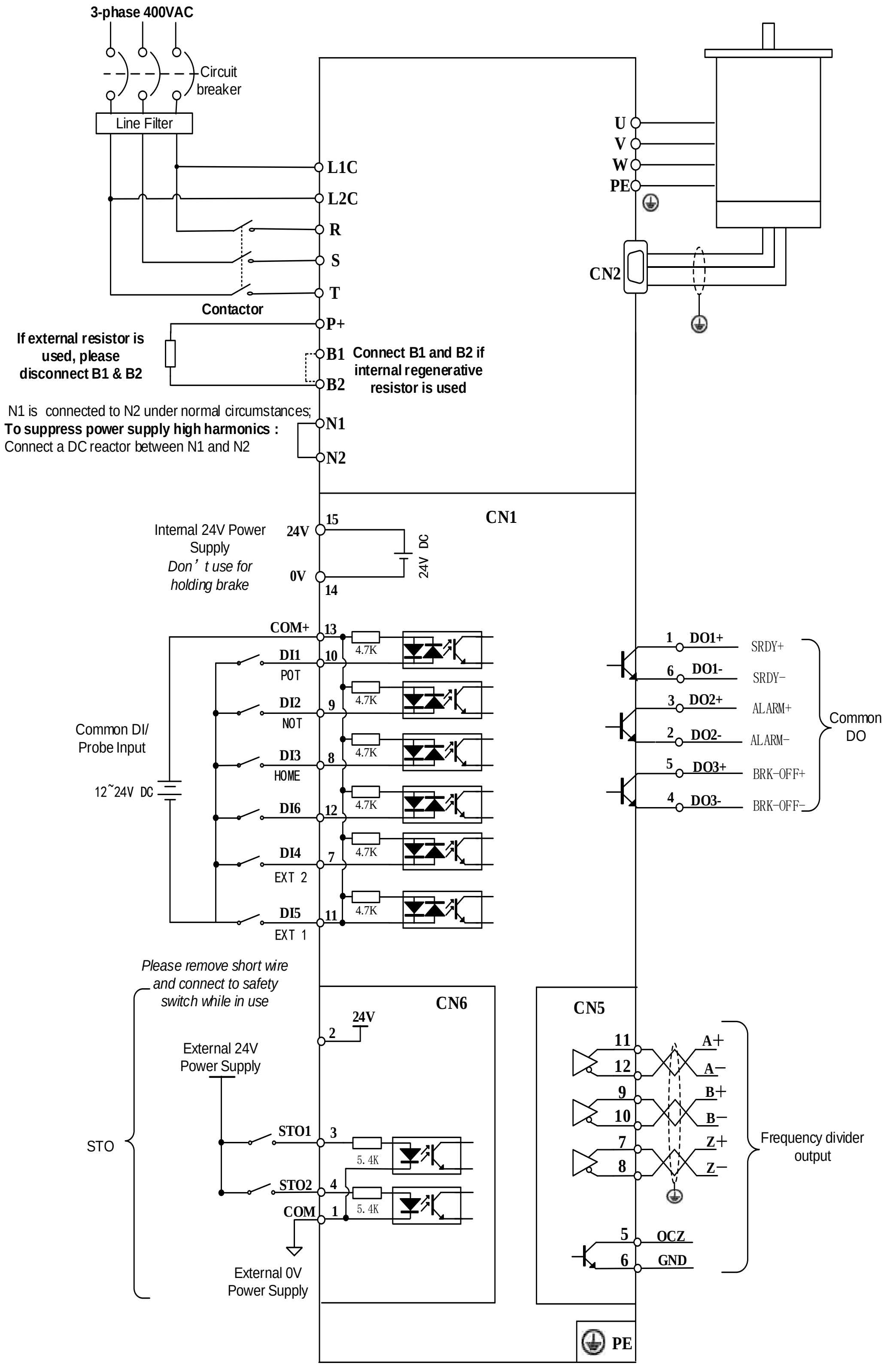
EL7-ECS Series 1500W/2000W - 220V Models



EL7-ECS Series 1000W/1500W/2000W/3000W – 400V Models

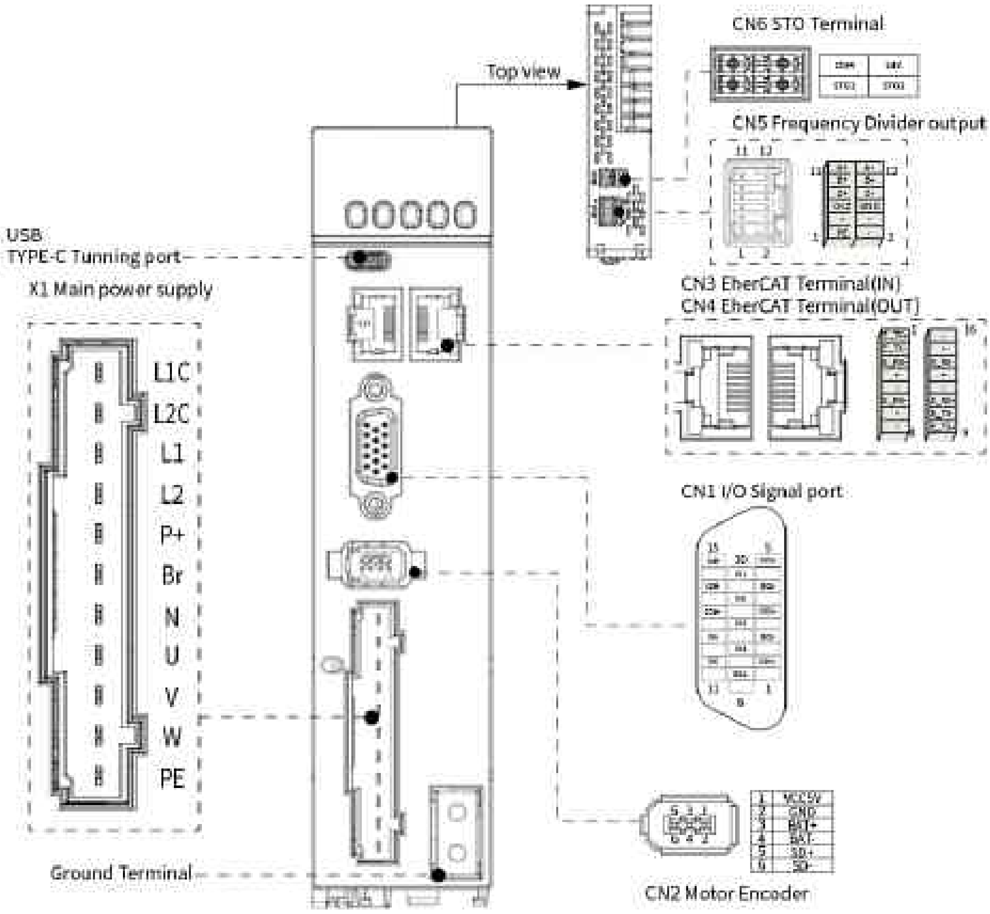


EL7-ECS Series 4400W/5500W/7500W – 400V Models



2.4 Servo Drive Ports

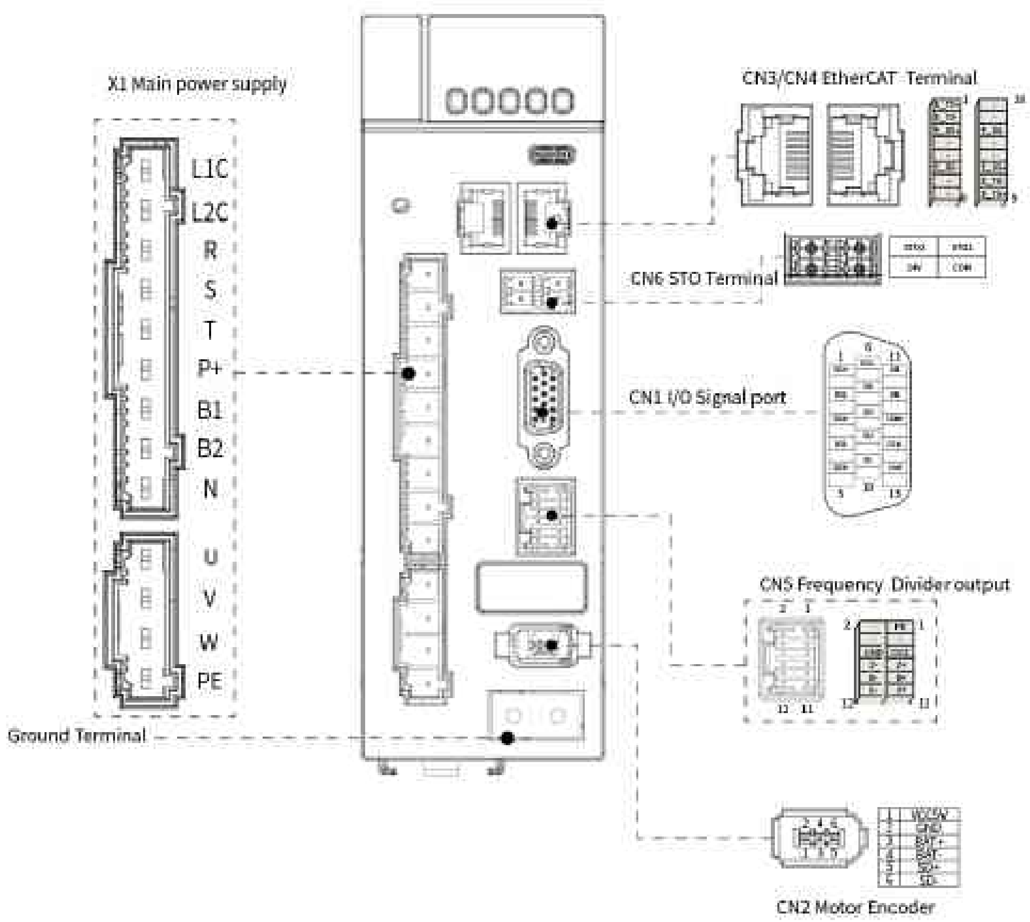
EL7-ECS Series 400W/750W/1000W – 220V Models



Functions of driver port

Port	Function
CN1	I/O Control Signal Port
CN2	Motor Encoder feedback input port
USB	PC side USB Type-C Tuning Port
CN3	EtherCAT IN Communication Port
CN4	EtherCAT OUT Communication Port
CN5	Frequency divider output port
CN6	Safe Torque Off (STO) Port
X1	Main Power Supply
Ground	Connect to the power supply's ground terminal to ensure proper earthing.

EL7-ECS Series 1500W ~ 2000W – 220V Models 1000W ~ 3000W – 400V Models



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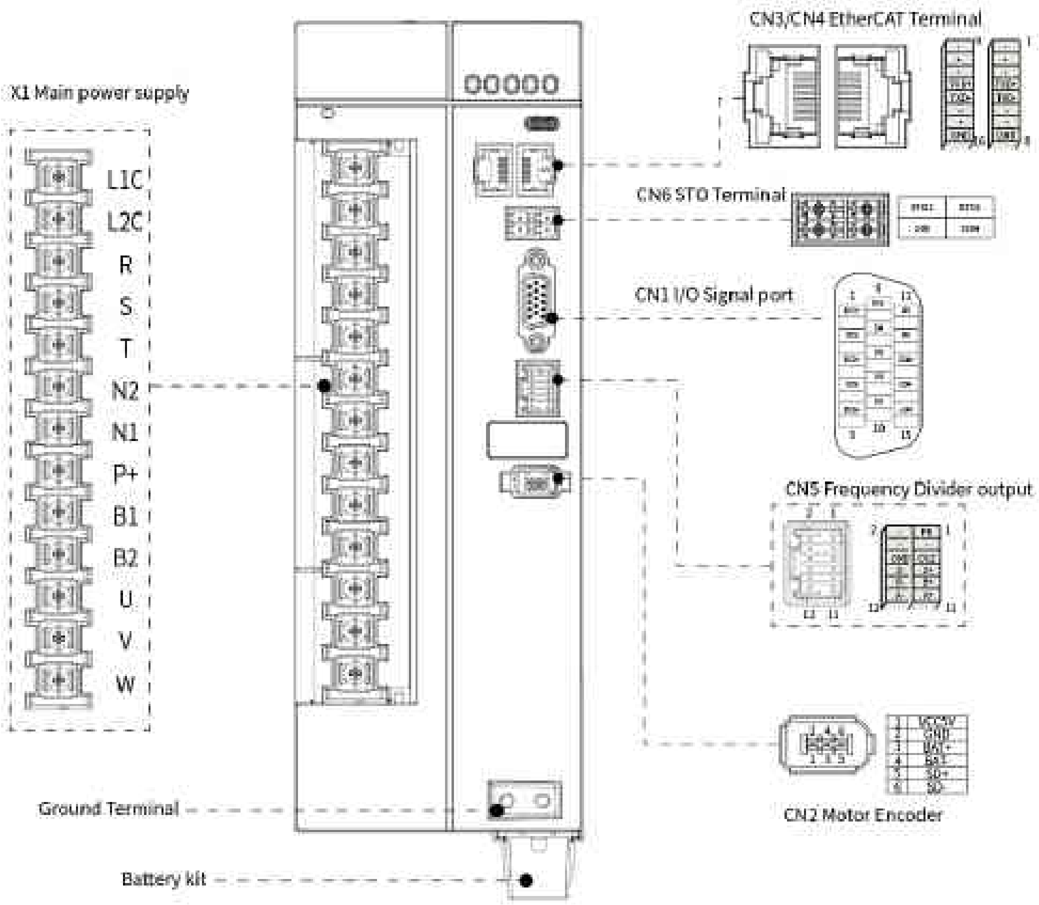
EL7-ECS Series 4400W/5500W/7500W– 400V Models



Functions of driver port

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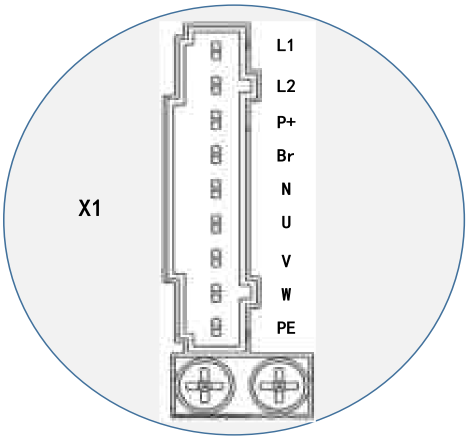
CN5	Frequency divider output port
CN6	Safe Torque Off (STO) Port
X1	Main Power Supply
Ground	Connect to the power supply's ground terminal to ensure proper earthing.

2.4.1 X1

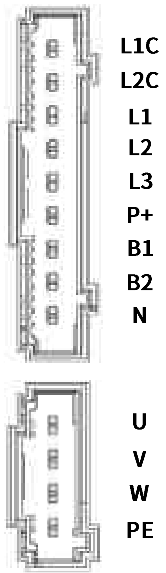
EL7-ECS Series –1000W and below Models



X1 port descriptions

Port	Pin	Functions	Remarks
X1	L1C	Control power L1C port	Single phase 200~240VAC，+10～-15%，50/60Hz
	L2C	Control power L2C port	
	L1	Main power L1 port	Single/Three phase 200~240VAC，+10～-15%，50/60Hz
	L2	Main power L2 port	
	P+	● Internal DC bus positive terminal ● External regenerative resistor P terminal	If an external regeneration resistor is required, connect the regeneration resistor between P+ and Br.
	Br	External regenerative resistor terminal	
	N	Internal DC bus negative terminal	Please do not connect
	U	Motor U terminal	Please ensure proper wire connection on motor.
	V	Motor V terminal	
	W	Motor W terminal	
	PE	Motor Protective Earth	Please ground PE of driver and motor together

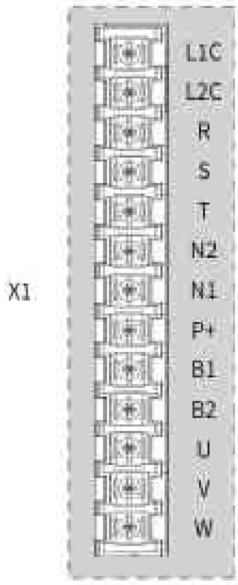
EL7-ECS 1500S ~ 2000S / 1000ST ~ 3000ST Models



Pin	Functions	Remarks
L1C	EL7 EC-1500S ~ EL7 EC 2000S Control power supply Single phase 220VAC，+10～-15%，50/60Hz	● Optional isolation transformer ● In case of serious interference, it is recommended to connect a line filter to main power supply; ● Don't connect EL7 EC-1500S ~ EL7 EC 2000S to 400VAC power supply, this will result in serious damage to the drive; It is recommended to install a fuseless circuit breaker to cut off power supply in time when the driver fails.
L2C	EL7 EC-1000ST ~ EL7 EC 3000ST Control power supply Single phase 400VAC，+10～-15%，50/60Hz	
L1(R)	EL7 EC-1500S ~ EL7 EC 2000S Main Power Supply: Single /Three phase 220VAC，+10～-15%，50/60Hz (When using a single-phase 220V input, either L1, L2 or L3 may be selected for use)) EL7 EC-1000ST ~ EL7 EC 3000ST Main Power Supply: Three phase 400VAC，+10～-15%，50/60Hz	
L2(S)		
L3(T)		
P + B1/B2	External regenerative resistor terminal	If an external regenerative resistor is required, please disconnect B1 and B2. Connect the external regenerative resistor to terminal P+ and B2.

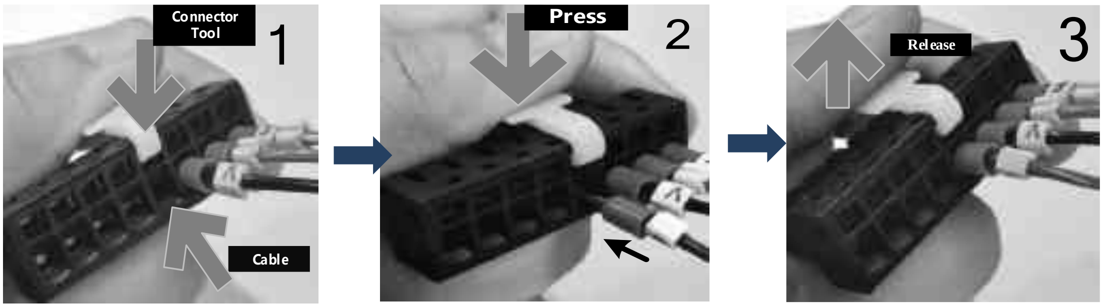
<table>
<tr><td></td><td></td><td><table><tr><th>Driver</th><th>Resistance(Ω)</th><th>Power (w)</th></tr><tr><td>EL7EC-1500S/2000S</td><td>50</td><td>≧100</td></tr><tr><td>EL7EC-1000ST~1500ST</td><td>100</td><td>≧100</td></tr><tr><td>EL7EC-2000ST~3000S</td><td>50</td><td>≧100</td></tr></table></td></tr>
<tr><td>P+</td><td rowspan="2">Internal DC bus terminal</td><td rowspan="2">Please do not connect</td></tr>
<tr><td>N</td></tr>
<tr><td>U</td><td>Motor U terminal</td><td rowspan="3">Please ensure proper wire connection on motor.</td></tr>
<tr><td>V</td><td>Motor V terminal</td></tr>
<tr><td>W</td><td>Motor W terminal</td></tr>
<tr><td>PE</td><td>Motor Protective Earth</td><td>Please ground PE of driver and motor together</td></tr>
</table>

EL7-ECS 4400ST ~ 7500ST Models

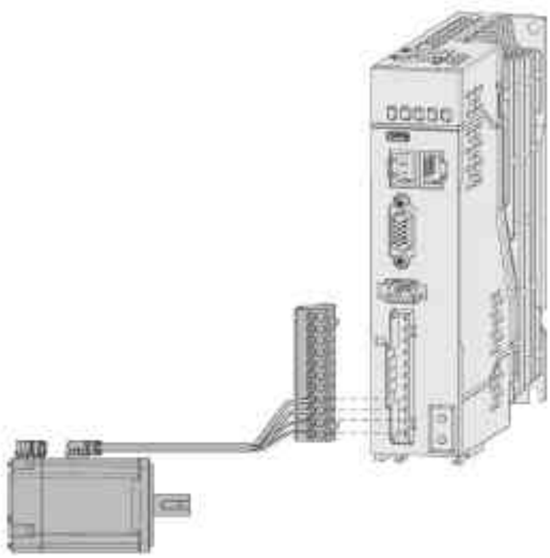


<table>
<tr><th>Pin</th><th>Functions</th><th>Remarks</th></tr>
<tr><td>L1C</td><td rowspan="2">Single phase 400VAC，+10～-15%，50/60Hz</td><td rowspan="5">● Optional isolation transformer
● In case of serious interference, it is recommended to connect a line filter to main power supply;
It is recommended to install a fuseless circuit breaker to cut off power supply in time when the driver fails.</td></tr>
<tr><td>L2C</td></tr>
<tr><td>R</td><td rowspan="3">Three phase 400VAC，+10～-15%，50/60Hz</td></tr>
<tr><td>S</td></tr>
<tr><td>T</td></tr>
<tr><td>N2</td><td rowspan="2">External reactor terminals</td><td rowspan="2">By default, a short is connected between N1 and N2. To suppress high-order harmonics in the power supply, remove the jumper and connect an external DC reactor between N1 and N2.</td></tr>
<tr><td>N1</td></tr>
<tr><td>P +
B1/B2</td><td>Braking resistor terminals</td><td>If an external regenerative resistor is required, please disconnect B1 and B2. Connect the external regenerative resistor to terminal P+ and B2.<table><tr><th>Driver</th><th>Resistance(Ω)</th><th>Power (w)</th></tr><tr><td>EL7EC-4400ST/7500ST</td><td>35</td><td>≧100</td></tr></table></td></tr>
<tr><td>U</td><td>Motor U terminal</td><td rowspan="3">Please ensure proper wire connection on motor.</td></tr>
<tr><td>V</td><td>Motor V terminal</td></tr>
<tr><td>W</td><td>Motor W terminal</td></tr>
</table>

To fix wire cables into connector



When the servo drive is matched with an AMP flying lead motor



When connecting the motor power cables to the servo drive, the ends of the four cables are labelled U, V, W and PE respectively. These must be matched up one-to-one and connected correctly to the corresponding slots on the drive's main circuit terminal block.

2.4.2 Regenerative resistor selection and connections

The use of regenerative resistor

When the motor opposes the direction of rotation as in deceleration or vertical axis escalation, part of the regenerative energy will be delivered back to the driver. This energy will first be stored in internal capacitors of the driver. When the energy stored in the capacitors reach the maximum capacity, a regenerative resistor is required the excessive energy to prevent over-voltage.

Selection of regenerative resistor

Recommended selection of regenerative resistor

Model no.	Internal resistance (Ω)	Internal resistor power rating (W)	Minimum resistance (Ω)	Minimum power rating (W)
EL7-EC400S	-	-	50	50
EL7-EC750S	50	75	30	50
EL7 -EC1000S	50	75	30	75
EL7 -EC1500S	50	100	30	100
EL7 –EC2000S	50	100	30	100
EL7-EC1000ST	100	100	80	100
EL7-EC1500ST	100	100	60	100
EL7-EC2000ST	50	100	40	100
EL7-EC3000ST	50	100	40	100
EL7-EC4400ST	35	100	35	100
EL7-EC5500ST	35	100	25	100
EL7-EC7500ST	35	100	25	100

Calculation of regenerative resistance under normal operation

Steps:

1. Determine if driver comes with a regenerative resistor. If not, please prepare a regenerative resistor with resistance value higher than might be required.
2. Monitor the load rate of the regenerative resistor using front panel (d14). Set the driver on high velocity back and forth motions with high acceleration/deceleration.
3.Please make sure to obtain the value under following conditions: Driver temperature < 60℃, d14<80(Won't trigger alarm), Regenerative resistor is not fuming, No overvoltage alarm(Err120).

Pb(Regenerative power rating) = Resistor power rating x Regenerative load rate (%)

Please choose a regenerative resistor with power rating Pr about **2-4 times the value of Pb** in considered of harsh working conditions and some 'headroom'.
If the calculated Pr value is less than internal resistor power rating, external resistor is not required.

$$R(\text{Max. required regenerative resistance}) = (380^2 - 370^2)/Pr$$

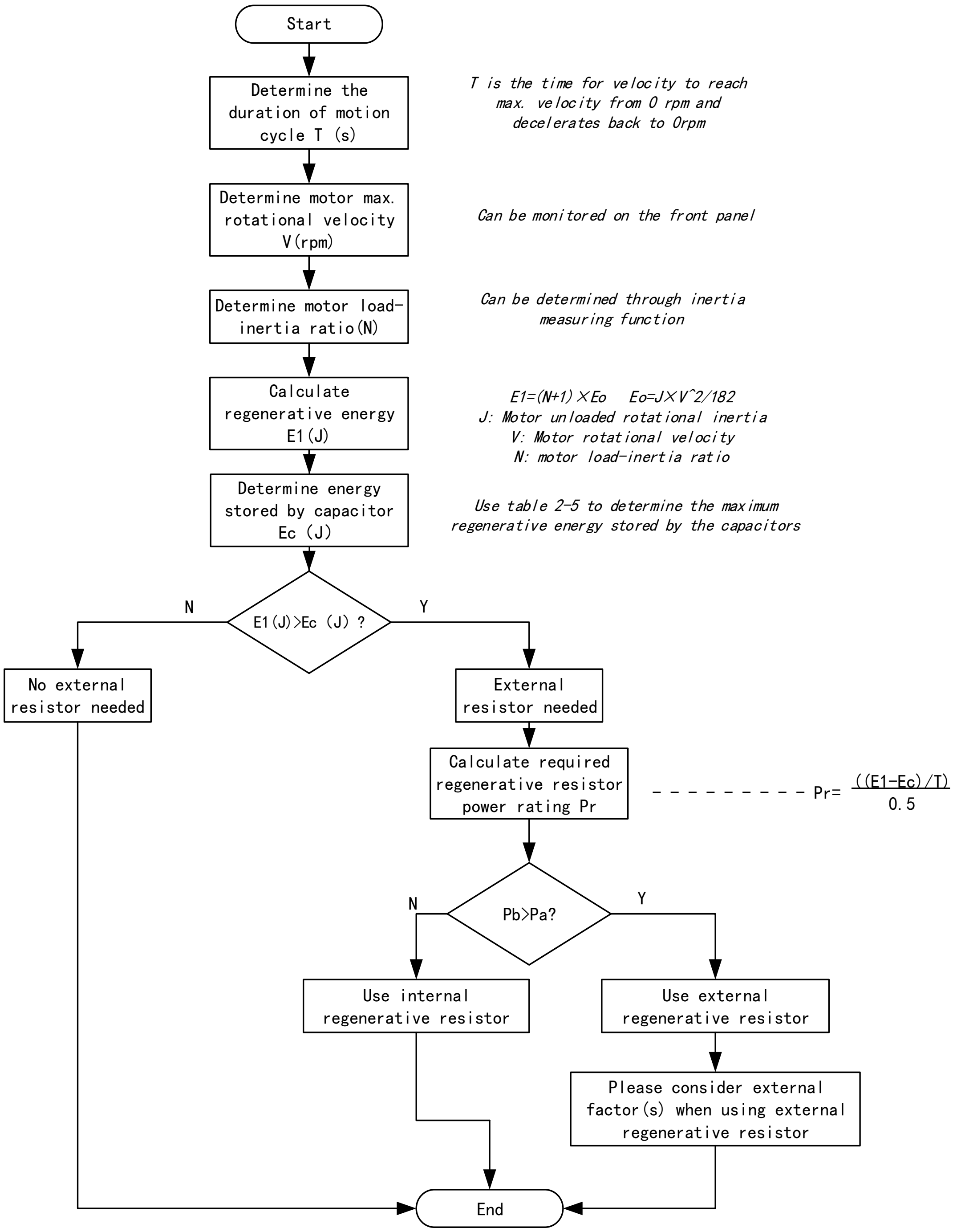
Problem diagnostics related to regenerative resistor:

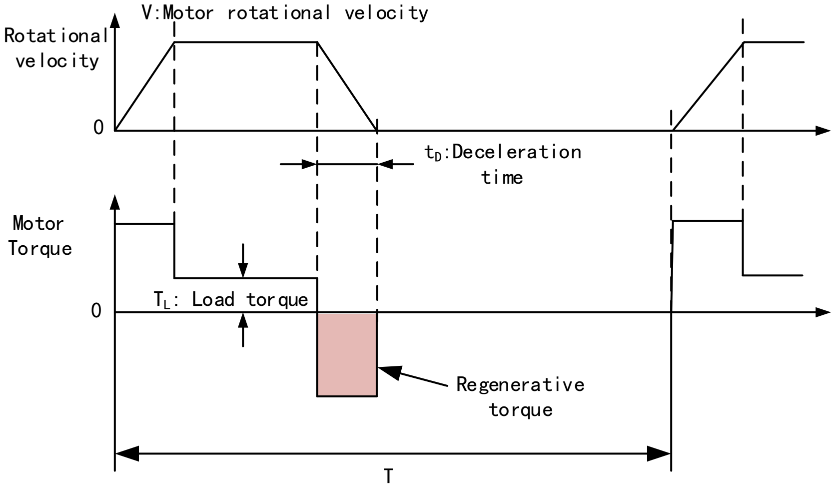
- If driver temperature is high, reduce regenerative energy power rating or use an external regenerative resistor.
- If regenerative resistor is fuming, reduce regenerative energy power rating or use an external regenerative resistor with higher power rating.
- If d14 is overly large or increasing too fast, reduce regenerative energy power rating or use an external regenerative resistor with higher power rating.
- If driver overvoltage alarm (Er120) occurs, please use an external regenerative resistor with lower resistance or connect another resistor in parallel.

Please take following precautions before installing an external regenerative resistor.
1. Please set the correct resistance value in P00.16 and resistor power rating P00.17 for the external regenerative resistor.
2. Please ensure the resistance value is higher or equals to the recommended values in table 2-3. Regenerative resistors are generally connected in series but they can also be connected in parallel to lower the total resistance.
3. Please provided enough cooling for the regenerative resistor as it can reach above 100℃ under continuous working conditions.
4. The min. resistance of the regenerative resistor is dependent on the IGBT of the holding brake. Please refer to table

Theoretical selection of regenerative resistor

Without external loading torque, the need for an external regenerative resistor can be determined as the flow chart below


Start
Determine the duration of motion cycle T (s)
T is the time for velocity to reach max. velocity from 0 rpm and decelerates back to 0rpm
Determine motor max. rotational velocity V(rpm)
Can be monitored on the front panel
Determine motor load-inertia ratio(N)
Can be determined through inertia measuring function
Calculate regenerative energy E1(J)
E1=(N+1)×Eo Eo=J×V^2/182
J: Motor unloaded rotational inertia
V: Motor rotational velocity
N: motor load-inertia ratio
Determine energy stored by capacitor Ec (J)
Use table 2-5 to determine the maximum regenerative energy stored by the capacitors
E1(J)>Ec (J) ?
N
Y
No external resistor needed
External resistor needed
Calculate required regenerative resistor power rating Pr
Pr= ((E1-Ec)/T) / 0.5
Pb>Pa?
N
Y
Use internal regenerative resistor
Use external regenerative resistor
Please consider external factor(s) when using external regenerative resistor
End



Steps to calculate capacity of regenerative resistor

Steps	Calculation	Symbol	Formula
1	Servo system regenerative energy	E1	$E1=(N+1)\times J\times V^2/182$
2	Depleted energy from loss of load system during acceleration	E_L	$E_L = (\pi/60)\ V\times T_L\times tD$ *If loss is not determined, please assume E_L = 0.*
3	Depleted energy due to motor coil resistance.	E_M	$E_M=(U^2/R)\times tD$ R= coil resistance, U = operating voltage *If R is not determined, please assume E_M = 0.*
4	Energy stored by internal DC capacitors	Ec	Please refer to table 2-5
5	Depleted energy due to regenerative resistance	E_K	E_K=E1-(EL+EM+EC), If loss is ignored, EK=E1-EC
6	Required power rating of regenerative resistor	Pr	$Pr=E_K/(0.5\times T)$

Internal capacitor capacity and rotor inertia

EL7-ECS Drivers	Servo motor	Rotor Inertia （$\times 10^{-4}$kg.m^2）	Max. regenerative energy stored in capacitor Ec(J)
400S	ELM2H-0400LA60	0.6	13.47
750S	ELM2H-0750LA80	1.8	22.85
1000S	ELM2H-1000LA80	2.03	27.74
1500S	ELM2M-1300LA130	18.7	33.46
2000S	ELM2M-1800LA130	23.8	40.8
1500ST	ELM2M-0850LA130T	12.5	26.3
1000ST	ELM2M-1300LA130T	18.7	32
2000ST	ELM2M-1800LA130T	23.8	38
3000ST	ELM2M-2900LA180T	56.8	47
4400ST	ELM2M-4400LA180T	78.2	77
5500ST	ELM2M-5500LA180T	109	93.4
7500ST	ELM2M-7500LA180T	130	126.3

There are motors with low, medium and high inertia. Different motor models have different rotor inertia. Please refer to servo product catalogue for more information on rotor inertia.

Calculation examples:
Servo drive: EL7-ECS750N, Servo Motor: ELM2H-0750LA80. When T = 2s, rotational velocity = 3000rpm, load inertia is 5 times of motor inertia.

EL7-ECS Drivers	Servo motor	Rotor Inertia （$\times 10^{-4}$kg.m^2）	Max. regenerative energy stored in capacitor Ec(J)
750W	ELM2H-0750LA80	1.66	22.85

Regenerative energy produced:

$$\mathrm{E1} = \frac{(\mathrm{N}+1) \times \mathrm{J} \times \mathrm{V}^2}{182} = \frac{(5+1) \times 1.66 \times 3000^2}{182} = 49.3\mathrm{J}$$

If E1 > Ec, internal capacitors can't take in excessive regenerative energy, regenerative resistor is required.
Required regenerative resistor power rating Pr:

$$\mathrm{Pr} = \frac{(\mathrm{E1} - \mathrm{Ec})}{0.5\mathrm{T}} = \frac{49.3 - 22.85}{0.5 \times 2} = 26.45\mathrm{W}$$

Hence, with the internal regenerative resistor Pa = 75W, Pr<Pa, no external regenerative resistor is required.

Let's assume if the load inertia is 15 times of motor inertia, Pr = 108.6W, Pr>Pa, external regenerative resistor is required. And to consider for harsh working environment,

Pr(external)=108.6/(1-40%)=181 W

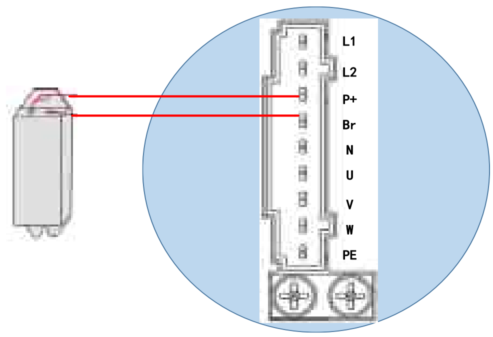
When selecting the resistance of the regenerative resistor, please be higher than the minimum value recommended in table 2-3 but lower than Rmax

$$R_{max} = (380^2 - 370^2)/Pr = 7500/108.6 = 69\Omega$$

In conclusion, a regenerative resistor with resistance 40Ω - 70Ω and power rating 110W to 180W can be chosen.

Please take note that theoretical calculations of the regenerative resistance is not as accurate as calculations done under normal operation.

Connection of a regenerative resistor



External Resistor Note:

1. If you do not connect an external regenerative resistor, short B1 and B2, and the built-in regenerative resistor is used at this time;
2. If external regenerative resistor is required, it is necessary to remove the shorting wire between B1 and B2, and connect it between P+ and B2(Br), otherwise it will lead to overcurrent of the brake pipe, and it is necessary to set the function code P11.31 to select to turn on the braking resistor drain.
3. Do not connect the external brake resistor directly to the positive and negative terminals of the busbar, otherwise it will cause the machine to blow up and cause a fire!
4. please refer to 'Table 2-3 Regenerative Braking Resistor Specification Table'.
5. Make sure that the regenerative braking resistor parameters P00.16 and P00.17 are set correctly before using the servo.
6. Mount the external braking resistor on a non-flammable object such as metal.
7. Do not make any connection to N!

Wire Gauge for Main Power Supply

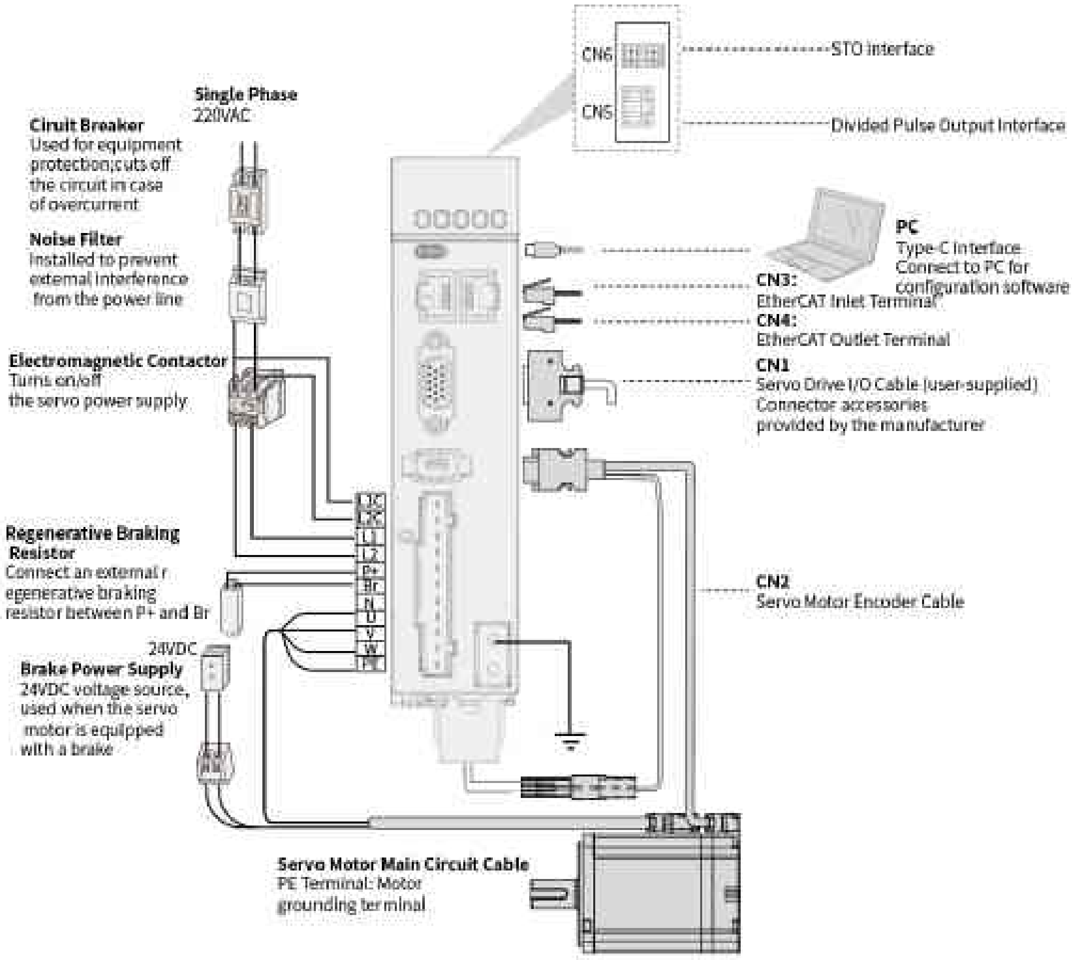
Main power supply wire gauge

Driver	Rated input current	Wire diameter (mm^2/AWG)			
		L1,L2,L3	P+ （B2）BR	U V W	PE
EL7-EC400S	5.0	1.3/AWG16	2.1/AWG14	0.52/AWG14	0.52/AWG14
EL7-EC750S	7.9	1.3/AWG16	2.1/AWG14	0.52/AWG14	0.52/AWG14
EL7-EC1000S	8.8	2.1/AWG14	2.1/AWG14	0.52/AWG14	0.52/AWG14
EL7-EC1500S	13.0	2.1/AWG14	2.1/AWG14	1.3/AWG16	1.3/AWG16
EL7-EC2000S	15.5	2.1/AWG14	2.1/AWG14	1.3/AWG16	1.3/AWG16
EL7-EC750ST	1.9	1.3/AWG16	2.1/AWG14	0.52/AWG14	0.52/AWG14
EL7-EC1000ST	2.4	1.3/AWG16	2.1/AWG14	1.3/AWG16	1.3/AWG16
EL7-EC1500ST	3.6	1.3/AWG16	2.1/AWG14	1.3/AWG16	1.3/AWG16
EL7-EC2000ST	5.6	2.1/AWG14	2.1/AWG14	1.3/AWG16	1.3/AWG16
EL7-EC3000ST	7.9	2.1/AWG14	2.1/AWG14	3.3/AWG12	3.3/AWG12
EL7-EC4400ST	11.6	2.1/AWG14	2.1/AWG14	3.3/AWG12	3.3/AWG12
EL7-EC5500ST	15.8	2.6/AWG13	2.6/AWG13	3.3/AWG12	3.3/AWG12
EL7-EC7500ST	20.8	4.2/AWG11	2.6/AWG13	3.3/AWG12	3.3/AWG12

- Grounding: Grounding wire should be thicker. Ground PE terminal of servo drive and servo motor together with resistance <100 Ω.
- A 3-phase isolation transformer is recommended to lessen the risk of electrocution
- Connect a line filter to power supply to reduce electromagnetic interference.
- Please install a fuseless circuit breaker to cut off power supply in time when the driver fails.

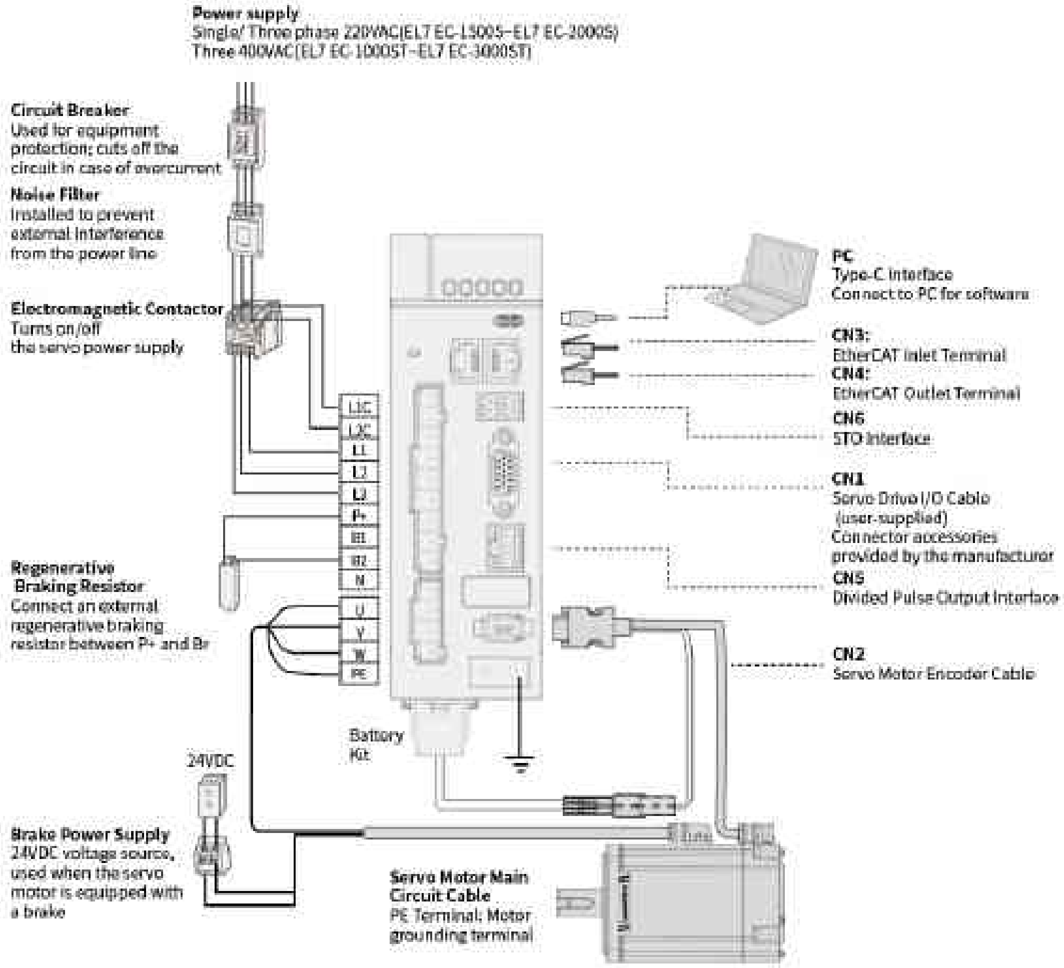
2.4.3 Wiring connections for EL7-ECS series servo drives

EL7-EC 400S/750S/1000S Series



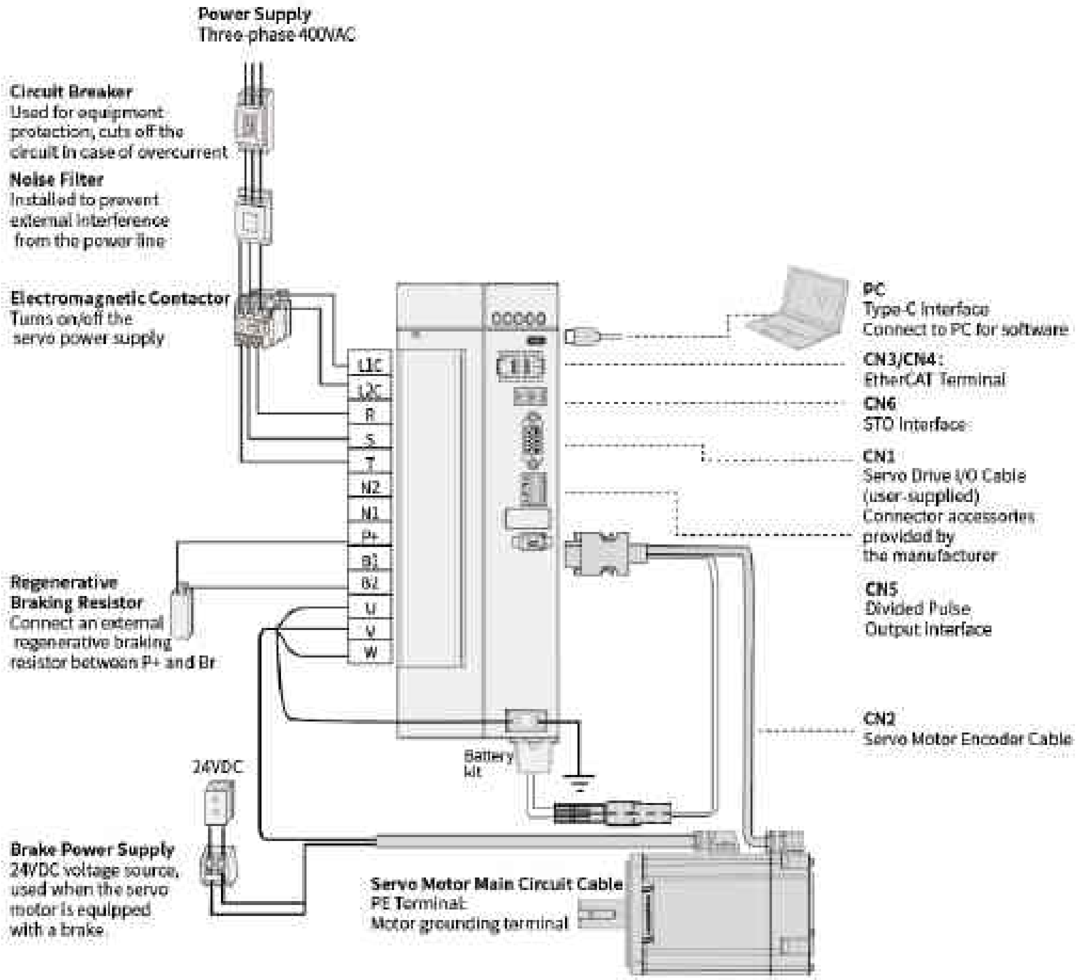
- EL7 EC-S series models from 1000S to 400S only support single-phase 220V power supply.
- The servo drive is directly connected to the industrial power supply without isolation via a transformer or similar device. To prevent cross-electric shock accidents in the servo system, use fuses or wiring breakers on the input power supply. For a safer system, use an earth leakage circuit breaker that provides both overload and short-circuit protection, or a dedicated earth leakage circuit breaker with ground fault protection.
- Do not use an electromagnetic contactor to start or stop the motor. As the motor is a large inductive component, the instantaneous high voltage generated may damage the contactor.
- When connecting an external control power supply or 24VDC power supply, pay attention to the power supply capacity. Insufficient capacity, especially when supplying multiple drives or multiple brakes simultaneously, may cause insufficient supply current, resulting in drive or brake failure. The brake power supply must be a 24VDC source, with power rating based on the motor model and meeting the brake power requirements.

EL7-EC 1500S ~ 2000S / 1000ST ~ 3000ST Series



- EL7 EC-S series models from 1500S to 2000S support single-phase or three-phase 220V power supply.
- EL7 EC-S series models from 1000ST to 3000ST only support three-phase 400V power supply.
- The servo drive is directly connected to the industrial power supply without isolation via a transformer or similar device. To prevent cross-electric shock accidents in the servo system, use fuses or wiring breakers on the input power supply. For a safer system, use an earth leakage circuit breaker that provides both overload and short-circuit protection, or a dedicated earth leakage circuit breaker with ground fault protection.
- Do not use an electromagnetic contactor to start or stop the motor. As the motor is a large inductive component, the instantaneous high voltage generated may damage the contactor.
- When connecting an external control power supply or 24VDC power supply, pay attention to the power supply capacity. Insufficient capacity, especially when supplying multiple drives or multiple brakes simultaneously, may cause insufficient supply current, resulting in drive or brake failure. The brake power supply must be a 24VDC source, with power rating based on the motor model and meeting the brake power requirements.

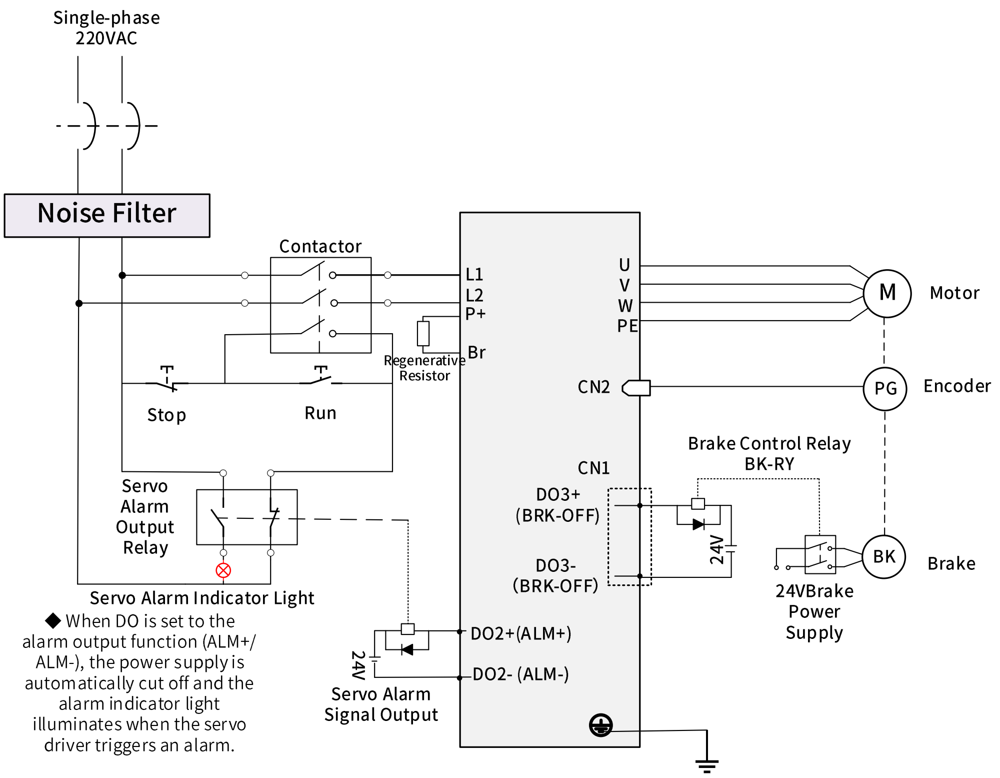
EL7-EC 4400ST ~ 7500ST Series



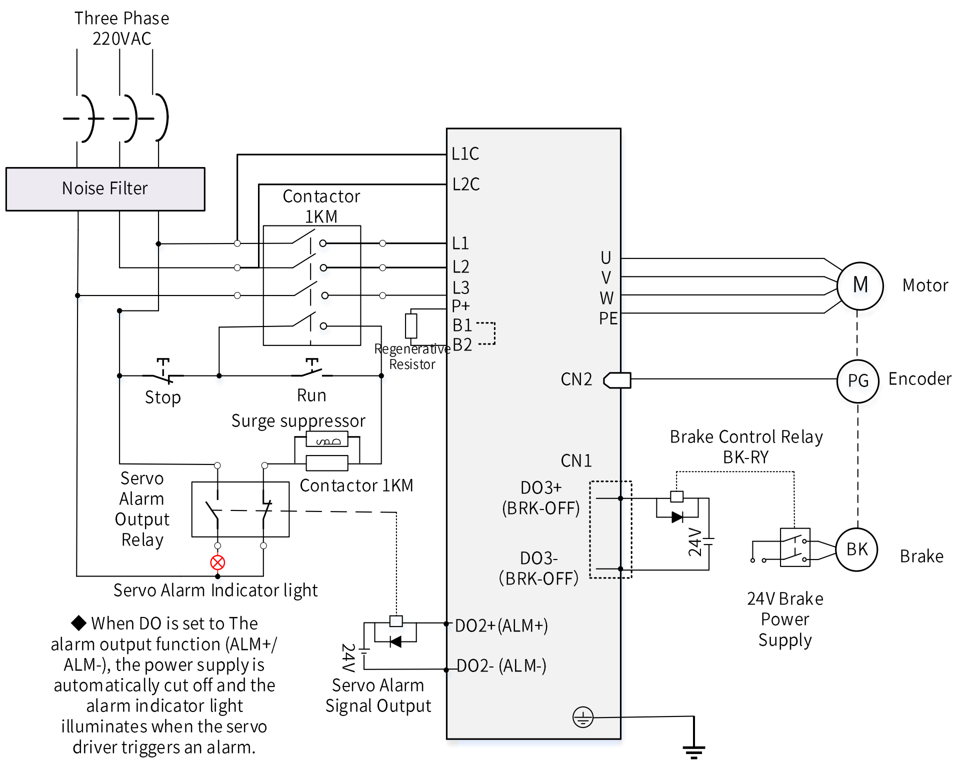
- EL7 EC-S series models from 4400ST to 7500ST only support three-phase 400V power supply.
- The servo drive is directly connected to the industrial power supply without isolation via a transformer or similar device. To prevent cross-electric shock accidents in the servo system, use fuses or wiring breakers on the input power supply. For a safer system, use an earth leakage circuit breaker that provides both overload and short-circuit protection, or a dedicated earth leakage circuit breaker with ground fault protection.
- Do not use an electromagnetic contactor to start or stop the motor. As the motor is a large inductive component, the instantaneous high voltage generated may damage the contactor.
- When connecting an external control power supply or 24VDC power supply, pay attention to the power supply capacity. Insufficient capacity, especially when supplying multiple drives or multiple brakes simultaneously, may cause insufficient supply current, resulting in drive or brake failure. The brake power supply must be a 24VDC source, with power rating based on the motor model and meeting the brake power requirements.

2.4.4 Example of main circuit power supply wiring

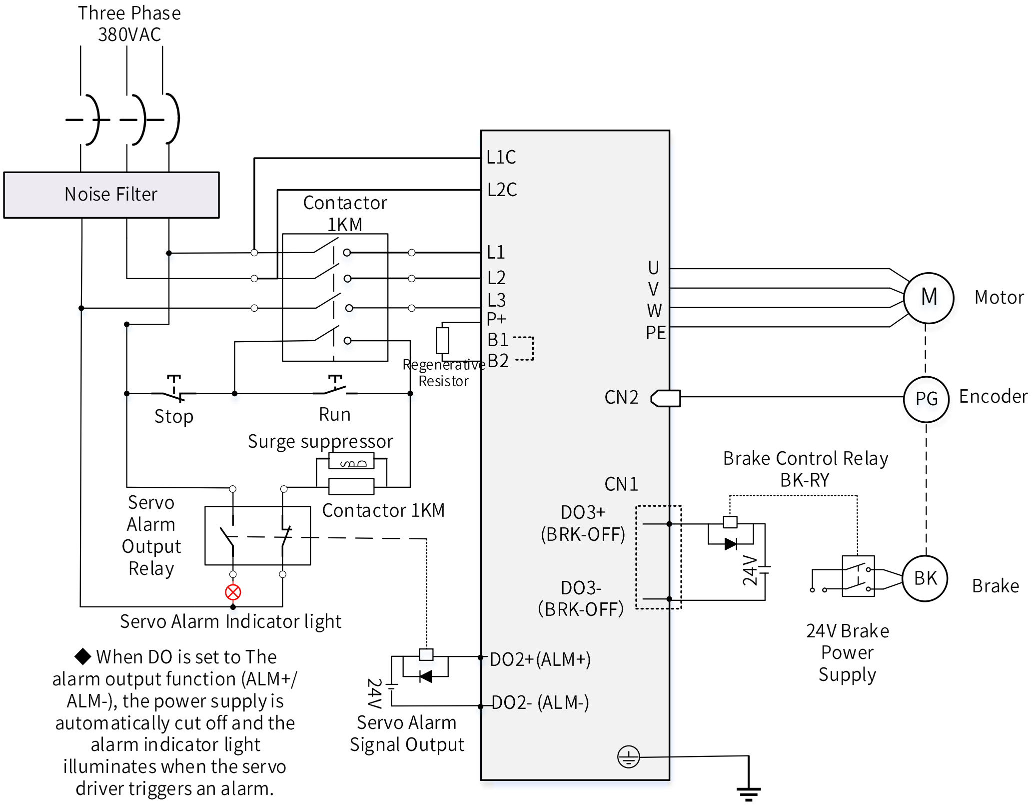
Single-phase 220V supply: EL7EC-400S ~ 1000S



Three-phase 220V supply: EL7EC-1500S ~ 2000S



Three-phase 380V supply: EL7EC-1000ST ~ 7500ST



2.5 Cable Selection

Motor winding power cable

- Wire length available: 1.5m, 3m and 5m….
- Connectors type available: Aviation connectors, direct connectors (recommended)
- Please contact Leadshine sales team or any Leadshine certified local retailers for any customized needs.

CABLE RZS H 3M0 - 1 1 3 - T - R

Sign	Meaning
CABLE	Cable identification

Sign	Cable type
RZ	Without brake motor cable
RZS	With brake motor cable
SC	Brake cable
***	Reserved

Sign	Voltage
H	AC Servo motor cable
D	DC Servo motor cable

Sign	Length	Sign	Length
1M5	1.5 meter	13M0	13 meter
3M0	3 meter	15M0	15 meter
5M0	5 meter	***	Please contact leadshine teams for other lengths
7M0	7 meter		
10M0	10 meter		

Sign	Drive side terminal type
1	Wire ferrule
2	Spade terminal

Sign	Customized models
R	Direct plug for back-facing wiring
***	Customized

Sign	Special requirements
Blank	Fixed cable
T	flexible cable
TS	flexible & oil proof cable
***	Reserved

Sign	Motor side terminal type
1	AMP plastic plug
2	Reserved
3	Assembly type aviation plug
4	Terminal type direct plug
***	Reserved

Sign	Cable specifications
1	20AWG
2	18AWG
3	16AWG
4	15AWG
5	14AWG
6	12AWG
7	10AWG
***	Reserved

**M*: Length of the cable*

a) *Please ground cable shield foil to drive to prevent servo error alarm*

b) *Please use a double winded shielded cable and make sure to be as short as possible.*

c) *Please separate CN1 cable from power cables with a minimum gap of 30cm.*

Encoder cable:

CABLE BMA H 3M0 - 1 1 3 - T - R

Sign	Meaning
CABLE	Cable identification

Sign	Cable type
BM	Incremental encoder cable
BMA	Absolute encoder cable (Including Battery Kit)

Sign	Voltage
H	AC Servo motor cable
D	DC Servo motor cable

Sign	Length	Sign	Length
1M5	1.5 meter	13M0	13 meter
3M0	3 meter	15M0	15 meter
5M0	5 meter	***	Please contact leadshine teams for other lengths
7M0	7 meter		
10M0	10 meter		

Sign	Drive side terminal type
1	1394-6P Connector
2	MOLEX Connector

Sign	Cable specifications
1	2PX24AWG
2	3PX24AWG
3	2PX26AWG
4	3PX26AWG
5	Reserved

Sign	Motor side terminal type
1	AMP plastic plug
2	Reserved
3	Assembly type aviation plug
4	Terminal type direct plug
***	Reserved

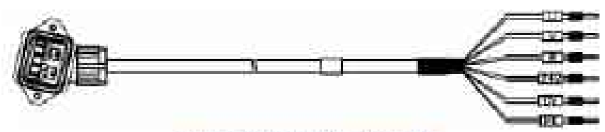
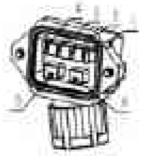
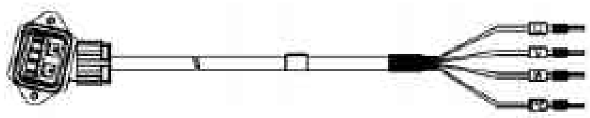
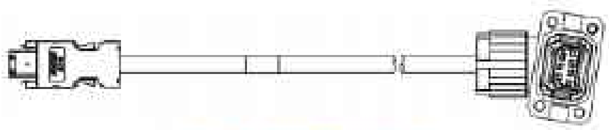
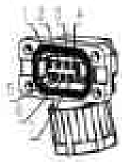
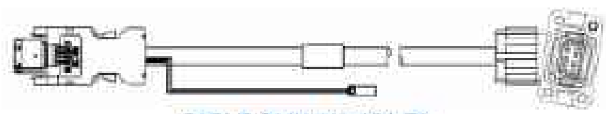
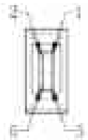
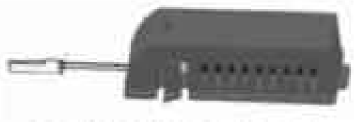
Sign	Special requirements
Blank	Fixed cable
T	flexible cable
TS	flexible & oil proof cable
***	Reserved

Sign	Customized models
R	Direct plug for back-facing wiring
***	Customized

ELM1/ELM2 Series:

Frame size:40mm/60mm/80mm

Power rating:50W-1000W

Cable Type		Diagram	Pin
Motor power	With brake	 CABLE-RZSH*M*-114-TS	
	Without brake	 CABLE-RZH*M*-114-TS	
Motor encoder	Incremental	 CABLE-BMH*M*-114-TS	
	Absolute	 CABLE-BMH*M*-124-TS	
	Battery kit	 ER14505 BOX-G DCH ROHS	

Motor power pins:

1	Blue	U
2	Black	V
3	Red	W
4	Yellow Green	PE
A*	Black	0V
B*	Red	24V

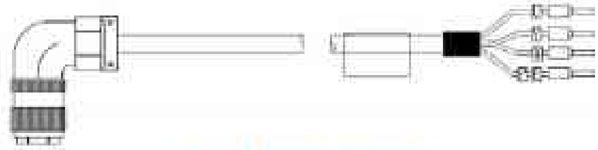
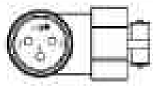
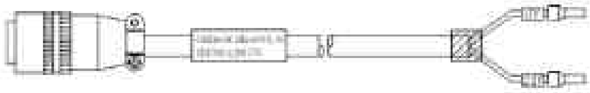
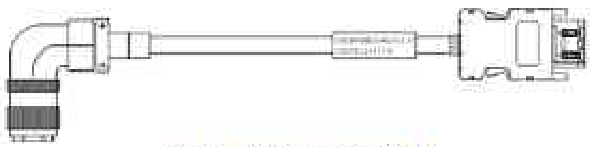
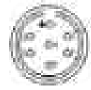
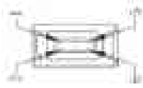
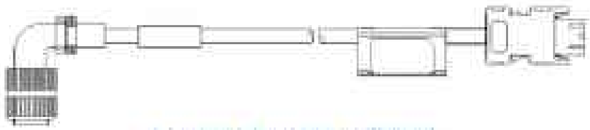
*A&B terminal for motor with brake

Motor encoder pins:

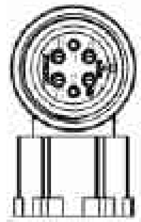
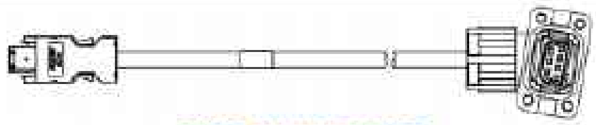
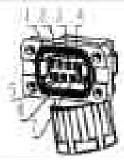
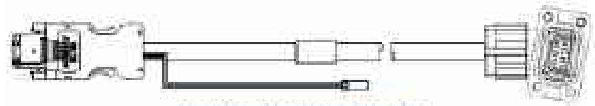
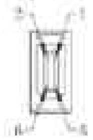
A	Terminal	B
1	PE	-
2	5V	1
3	0V	2
4	SD+	5
5	SD-	6
6*	BAT+	-
7*	BAT-	-

*Terminal 6 & 7 is to be connected to battery kit for absolute encoder

ELM2 Series
Frame size:100mm/130mm
Power rating:1000W/1500W/2000W/2500W/3800W

Cable Type		Diagram	Pin		
Motor power		 CABLE-RZ*M*-H(V2.0)			
			1	Yellow	PE
			2	Red	U
			3	Green	V
			4	Black	W
Motor brake		 CABLE-SC*M*-H(V3.0)			
			1	Black	0V
			2	Red	24V
Motor encoder	Incremental	 CABLE-7BM*M*-HZ(V3.0)	 		
	Absolute	 CABLE-7BMA*M*-HZ(V3.0)	A	Terminal	B
			1	PE	-
			2	5V	1
			3	0V	2
			4	SD+	5
			5	SD-	6
			6*	BAT+	-
			7*	BAT-	-
			*Terminal 6 & 7 is to be connected to battery kit for absolute encoder		

ELM1 Series
Frame size: 130mm
Power rating: 850W/1300W/1500W/1800W

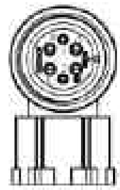
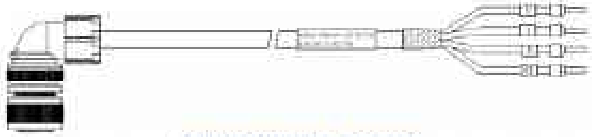
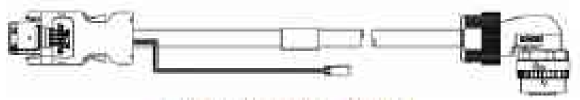
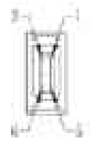
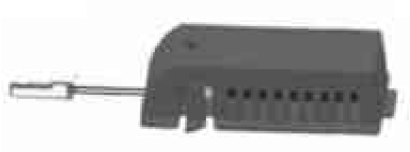
Cable Type		Diagram	Pin
Motor power	With brake	 CABLE-RZSH*M*-135-TS	
	Without brake	 CABLE-RZH*M*-135-TS	A Blue U B Black V C Red W D Yellow Green PE 1* Black 0V 2* Red 24V *1&2 terminal for motor with brake
Motor encoder	Incremental	 CABLE-BMH*M*-114-TS	
	Absolute	 CABLE-BMH*M*-124-TS	
	Battery kit	 ER14505 BOX-G DCH ROHS	A / Terminal / B 1 / PE / - 2 / 5V / 1 3 / 0V / 2 4 / SD+ / 5 5 / SD- / 6 6* / BAT+ / - 7* / BAT- / - *Terminal 6 & 7 is to be connected to battery kit for absolute encoder

ELM2 Series

Frame size: 130mm

Power rating:

850W/1300W/1800W/3000W/4000W/5000W

Cable Type		Diagram	Pin
Motor power	With brake	 CABLE-RZSH*M*-135-TS	
	Without brake	 CABLE-RZH*M*-135-TS	see motor power pin table below
Motor encoder	Incremental	 CABLE-BMH*M*-115-TS	
	Absolute	 CABLE-BMH*M*-125-TS	
	Battery kit	 ER14505 BOX-G DCH ROHS	see encoder pin table below

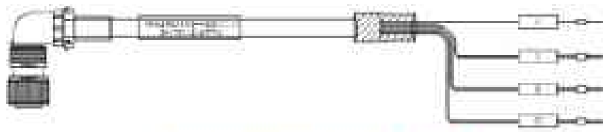
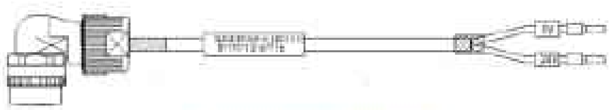
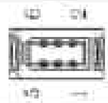
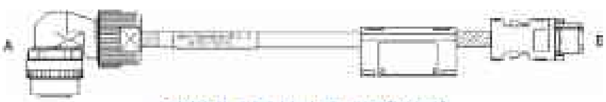
A	Blue	U
B	Black	V
C	Red	W
D	Yellow Green	PE
1*	Black	0V
2*	Red	24V

*1&2 terminal for motor with brake

A	Terminal	B
10	PE	-
2	5V	1
3	0V	2
4	SD+	5
5	SD-	6
6*	BAT+	-
7*	BAT-	-

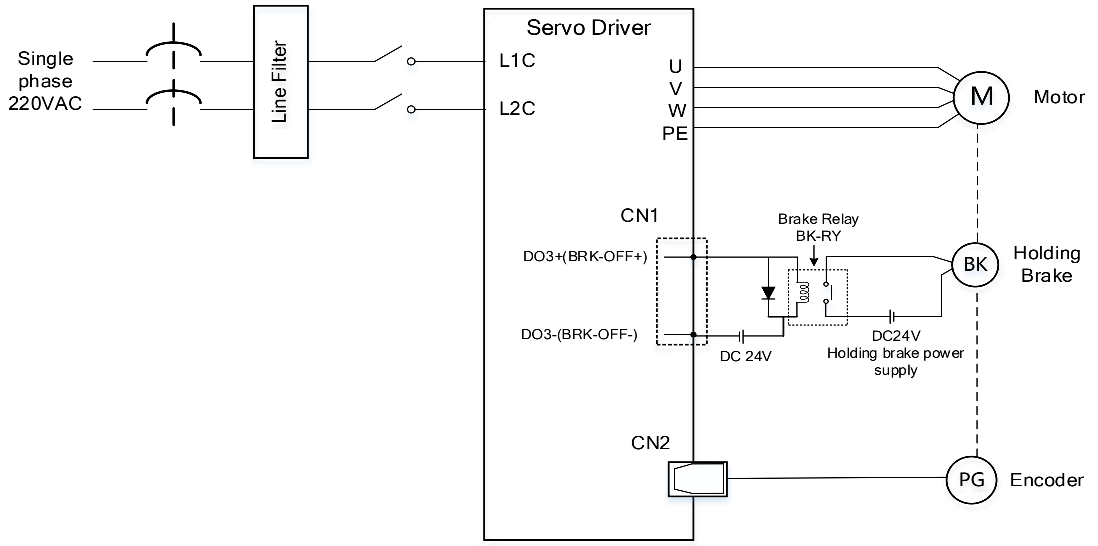
*Terminal 6 & 7 is to be connected to battery kit for absolute encoder

ELM2M Series
Frame size:180mm
Power rating:2900W-7500W

Cable Type		Diagram	Pin		
Motor power	2900W	 CABLE-RZA*M*-H-180(V1.0)			
			A	Blue	U
			B	Black	V
			C	Red	W
			D	Yellow Green	PE
	4400W-7500W	 CABLE-RZB*M*-H-180(V1.0)			
			A	White	U
			B	Black	V
			C	Red	W
			D	Yellow Green	PE
Motor brake		 CABLE-SC-H-180(V1.0)			
			1	Black	0V
			2	Red	24V
Motor encoder	Incremental	 CABLE-7BM-HZ-180(V1.0)			
					
	Absolute	 CABLE-7BMA-HZ-180(V1.0)	A	Terminal	B
			10	PE	-
			2	5V	1
			3	0V	2
			4	SD+	5
			5	SD-	6
			6*	BAT+	-
			7*	BAT-	-
			*Terminal 6 & 7 is to be connected to battery kit for absolute encoder		

2.6Holding brake connection

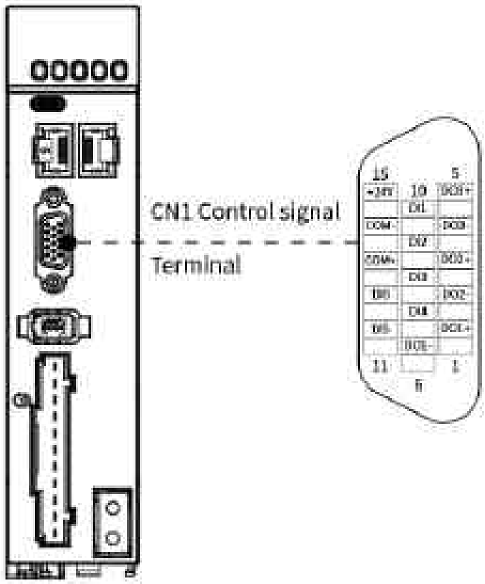
Holding brake is activated when servo drive is not powered on to prevent axis from moving due to gravitational pull or other external forces by locking the motor in place. Usually used on axis mounted vertically to the ground so that the load would not drop under gravitational force when the driver is powered off or when alarm occurs.



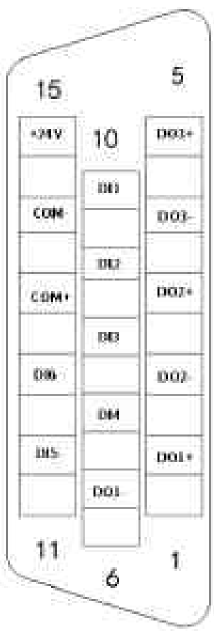
Holding brake wiring diagram

- When a motor with a built-in brake runs, the brake may produce a clicking sound, which does not affect functionality.
- When the brake coil is energized (brake released), magnetic flux leakage may occur at the shaft end. Use caution with magnetic sensors near the motor.
- Account for voltage drop from brake cable resistance; maintain ~24V input to ensure proper brake operation.
- Do not share the brake power supply with other loads, as this may cause voltage/current drops and unintended brake operation.

2.7CN1 I/O Signal Port



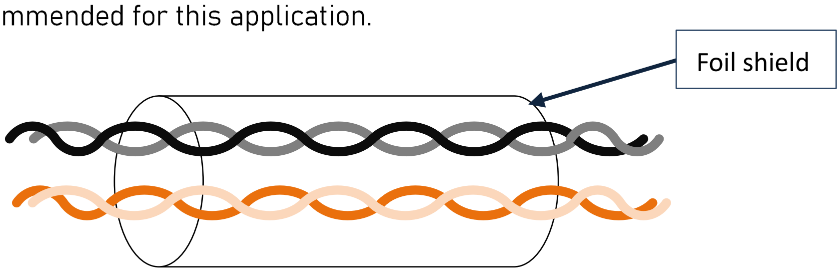
Recommend using cable with a gauge of 24–26 AWG for the connection to CN1; the CN1 connector is a 15-pin DB connector.

Port	Pin	Signal	Description	Remarks
	1	DO1+	SRDY+	Servo Ready Output Signal
	6	DO1-	SRDY-	
	3	DO2+	ALM+	Alarm Output Signal
	2	DO2-	ALM-	
	5	DO3+	BRK-OFF+	Break Off Output Signal
	4	DO3-	BRK-OFF-	
	10	DI1	POT	Positive limit switch
	9	DI2	NOT	Negative limit switch
	8	DI3	HOME	Homing switch
	7	DI4	EXT 2	Touch Probe 2
	11	DI5	EXT 1	Touch Probe 1
	12	DI6	-	Up to user configuration
	13	COM+	Common DI	Common digital input terminal
	14	COM-	Internal 24V Power Supply	Output voltage: 20~28VDC, max current output: 200mA （Don't used it on motor brake power supply）
	15	+24V+		

2.7.1 Selection of I/O signal cable

I/O signal cable

To ensure I/O signal to not be affected by electromagnetic interference, a **shielded twisted pair cable** is recommended for this application.

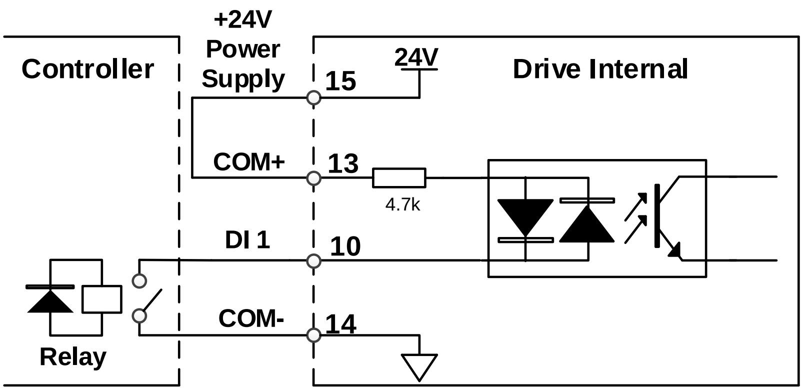


2.7.2 Common input circuit

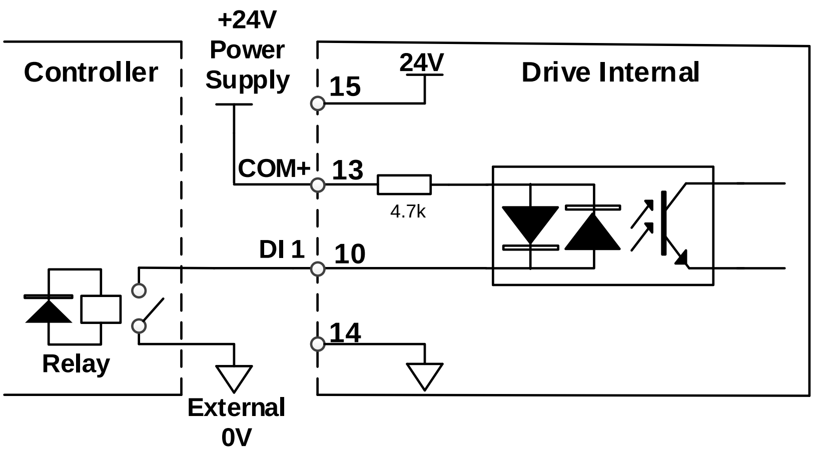
The internal circuit of common input is a bidirectional optocoupler which supports common anode and common cathode configurations. There are 2 types of outputs from master device: Relay output and Open Collector output as shown below.

① Output from master device: Relay

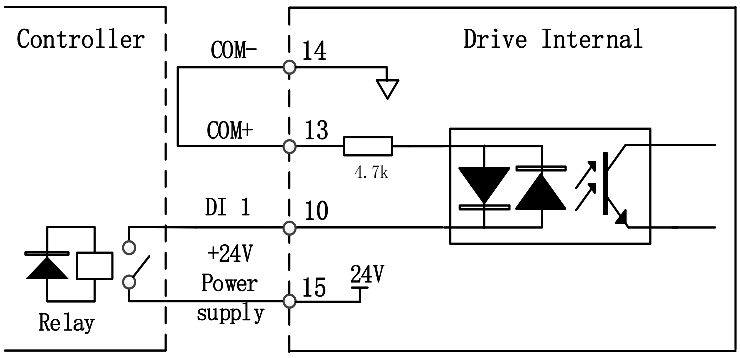
Common Anode(Internal 24V):



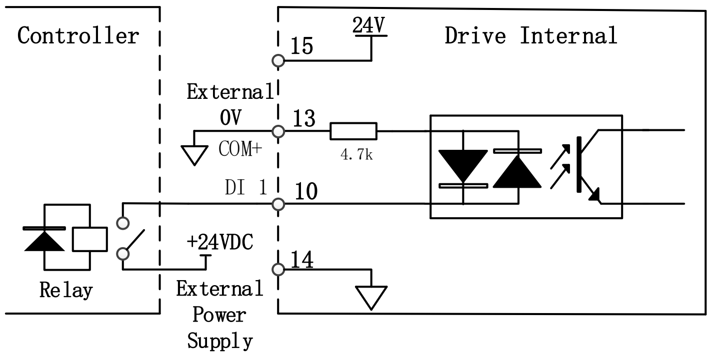
Common Anode(External 24V):



Common Cathode(Internal 24V):

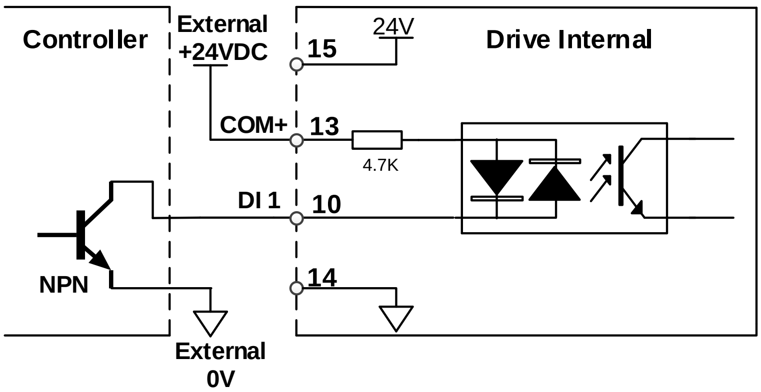


Common Cathode(External 24V):

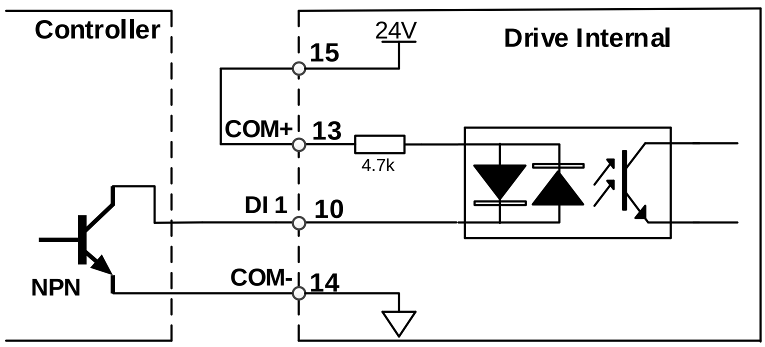


② Output from master device: Open Collector

Common Anode(Internal 24V):

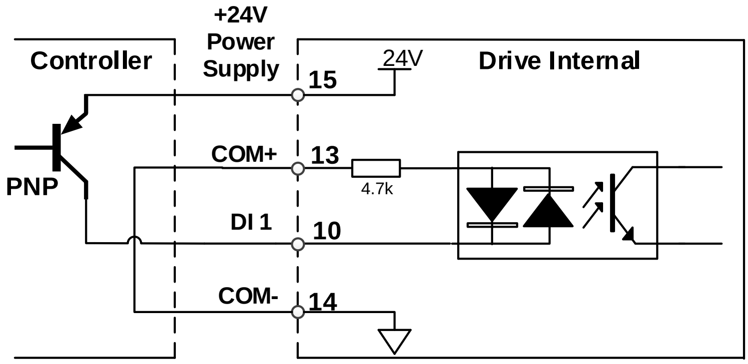


Common Anode(External 24V):

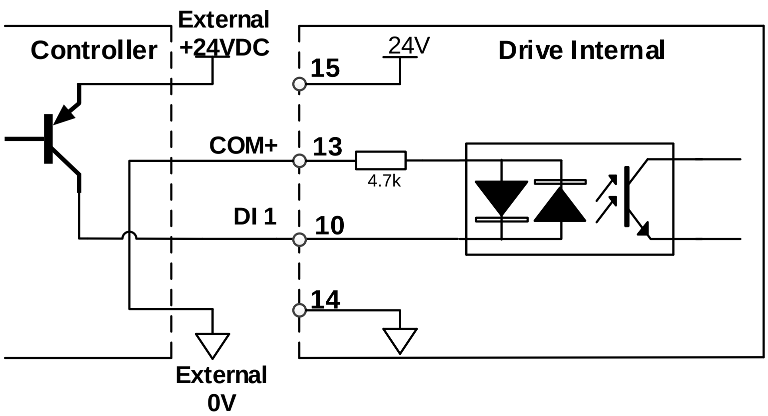


Please prepare switching power supply with output of 12-24VDC, current≥ 100mA;

Common Cathode(Internal 24V):



Common Cathode(External 24V):



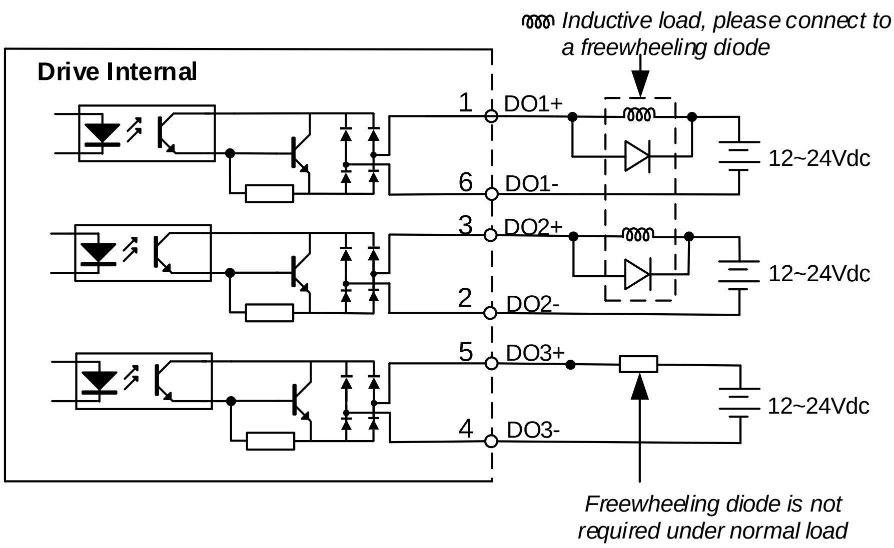
Digital input DI (1~6) default functions

Signal		Default function	PIN No.	Description
Command Digital output	DI 1	POT	10	Positive drive inhibit input
	DI 2	NOT	9	Negative drive inhibit input
	DI 3	HomeSwitch	8	Home switch input
	DI 4	EXT 2	7	Probe 2
	DI 5	EXT 1	11	Probe 1
	DI 6	-	12	Unassigned function (configurable by user)
+24V			15	Internal 24V power supply, voltage range +20~28V, maximum output current 200mA.
COM-			14	
COM+			13	Common terminal for DI input pins.

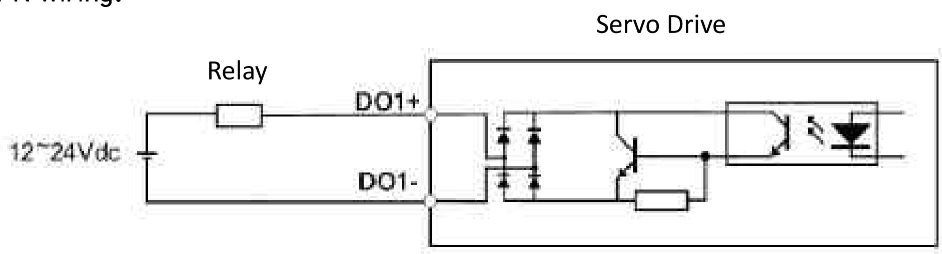
2.7.3 Common output circuit

There are 3 common outputs: DO1 ~ DO3 are double-ended, having an isolated 24v power supply.

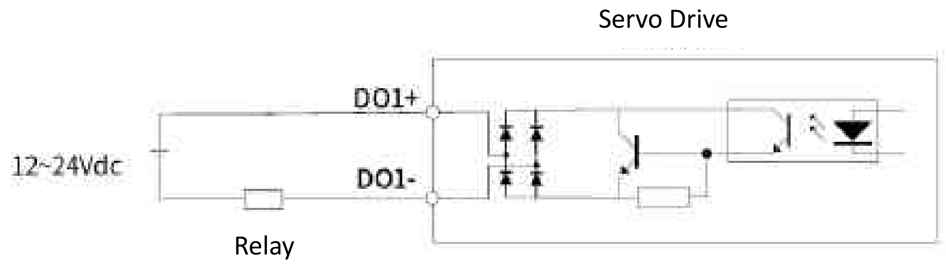
Double-ended Digital Outputs



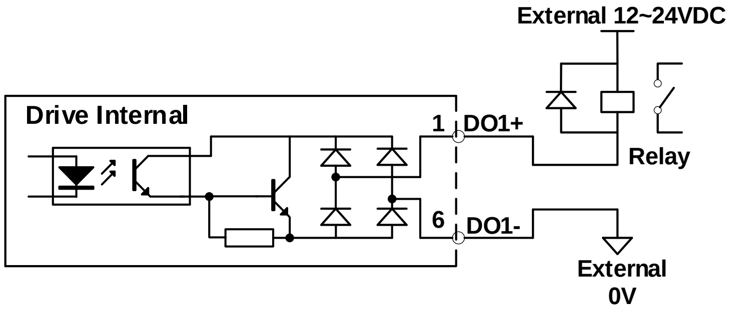
NPN wiring:



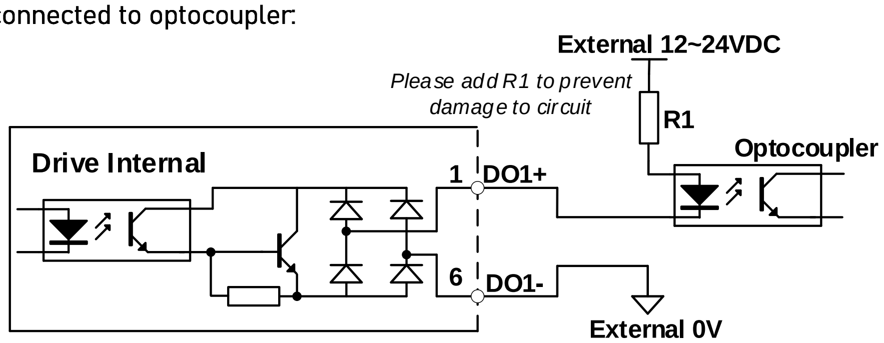
PNP wiring:



When connected to a relay:



When connected to optocoupler:



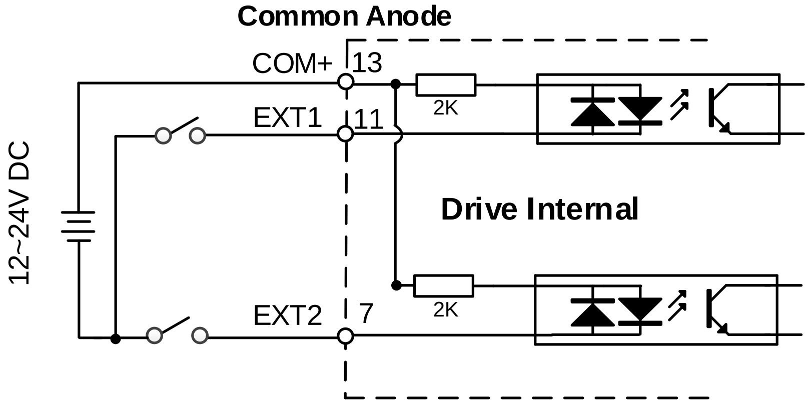
- Power supply is provided by user. Please be aware that reversed power supply polarity might cause damage to the driver.
- When it is an open collector output, max current: 50mA, max supplying voltage: 25V. Please ensure the switching power supply fulfills the conditions.
- If the load is an inductive load such as a relay, please connect a flyback diode in parallel in reverse. A wrong installation of the flyback diode might cause damage to the driver.

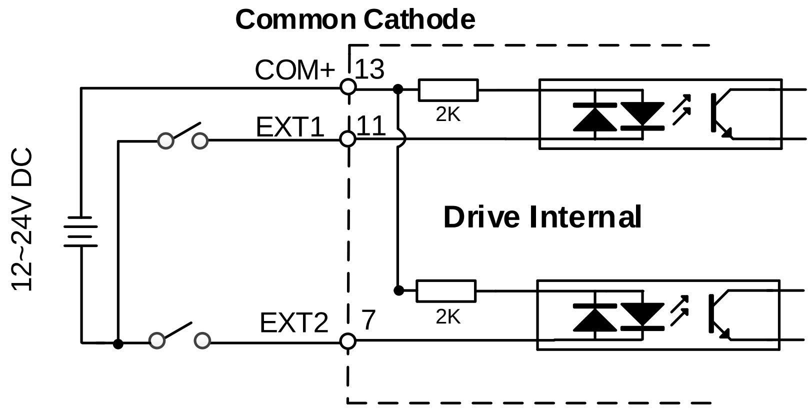
Digital input DO (1~3) default functions

Signal		Default function	PIN No.	Description
Command Digital output	DO1+	SRDY+	1	Servo ready
	DO1-	SRDY-	6	
	DO2+	ALM+	3	ALARM
	DO2-	ALM-	2	
	DO3+	BRK-OFF+	5	Brake output
	DO3-	BRK-OFF-	4	
	+24V	-	15	Internal 24V power supply, voltage range +20~28V, maximum output current 200mA.
	COM-	-	14	
	COM+	-	13	Common terminal for DI input pins.

2.7.4 Probe input circuit

The internal circuit of probe input is a bidirectional optocoupler.





2.7.5 DI signal function configuration

Default DI signal functions

CN1 Pin	Signal	Parameter	Default function	Factory default Status
13	DI COM	-	Common Digital Input	-
10	DI1	P01.00	Positive limit switch (POT)	Normally open OFF
9	DI2	P01.01	Negative limit switch (NOT)	Normally open OFF
8	DI3	P01.02	Home switch (HOME)	Normally open OFF
7	DI4	P01.03	Prode 2	Normally open OFF
11	DI5	P01.04	Prode 1	Normally open OFF
12	DI6	P01.05	User configurable	Normally open OFF

***NO: Normally Open*

- When limit switch or emergency stop is used, POT, NOT and E-STOP signal will be normally close (NC) by default. Please make sure there is no safety concern if these signals need to be set to normally open (NO).

Relevant parameters

P01.00	**Label**	Input selection DI1	**Mode**	**F**			
	Range	0x0~0xFF	**Default**	0x0	**Unit**	-	
	Activation	Immediate			**Index**	2001-01h	
P01.01	**Label**	Input selection DI2	**Mode**	**F**			
	Range	0x0~0xFF	**Default**	0x0	**Unit**	-	
	Activation	Immediate			**Index**	2001-02h	
P01.02	**Label**	Input selection DI3	**Mode**	**F**			
	Range	0x0~0xFF	**Default**	0x0	**Unit**	-	
	Activation	Immediate			**Index**	2001-03h	
P01.03	**Label**	Input selection DI4	**Mode**	**F**			
	Range	0x0~0xFF	**Default**	0x0	**Unit**	-	
	Activation	Immediate			**Index**	2001-04h	
P01.04	**Label**	Input selection DI5	**Mode**	**F**			
	Range	0x0~0xFF	**Default**	0x0	**Unit**	-	
	Activation	Immediate			**Index**	2001-05h	
P01.05	**Label**	Input selection DI6	**Mode**	**F**			
	Range	0x0~0xFF	**Default**	0x0	**Unit**	-	
	Activation	Immediate			**Index**	2001-06h	

Digital input DI allocation using hexadecimal system

Input	Symbol	Set value		0x60FD(bit)
		Normally open	Normally close	
Invalid	—	0h	-	×
Positive limit switch	POT	1h	81h	Bit1
Negative limit switch	NOT	2h	82h	Bit0
Clear alarm	A-CLR	4h	-	×
Forced alarm	E-STOP	14h	94h	Bit23
Home switch	HOME-SWITCH	16h	96h	Bit2

- Please don't set anything other than listed in table above.
- Normally open: Valid when input = ON Normally close: Valid when input = OFF
- Er210 might occur if same function is allocated to different channels at the same time
- Channel that has no value doesn't affect driver motion.
- Front panel is of hexadecimal system.

P01.00~P01.05 corresponds to DI1~DI6, which can be connected to external sensor signals, and the master control can read bit4~bit9 of 60FDh directly to get the real status of DI1~DI6. P01.03/P01.04 corresponds to DI4/DI5, the default setting is 0x0, which is used as probe signal input.

2.7.6 DO signal function configuration

DO signal functions by default

CN1 Pin	Signal	Parameter	Default function
1	DO1+	P01.16	Servo Ready (S-RDY)
6	DO1+		
3	DO1+	P01.17	Alarm (ALM)
2	DO1+		
5	DO1+	P01.18	External brake released (BRK-OFF)
4	DO1+		

*** NO: Normally Open*

Relevant parameters

P01.16	**Label**	Output selection DO1	**Mode**	F		
	Range	0x0~0xFF	**Default**	0x2	**Unit**	-
	Activation	Immediate			**Index**	2001-11h
P01.17	**Label**	Output selection DO2	**Mode**	F		
	Range	0x0~0xFF	**Default**	0x81	**Unit**	-
	Activation	Immediate			**Index**	2001-12h
P01.18	**Label**	Output selection DO3	**Mode**	F		
	Range	0x0~0xFF	**Default**	0x3	**Unit**	-
	Activation	Immediate			**Index**	2001-13h

Digital output DO allocation using hexadecimal system.

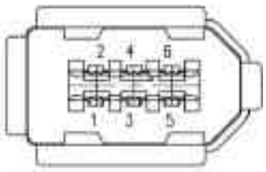
Output	Symbol	Set value	
		Normally open	Normally close
Master device control	—	00h	-
Alarm	ALM	01h	81h
Servo-Ready	S-RDY	02h	82h
External brake released	BRK-OFF	03h	83h
Positioning completed	INP	04h	84h
At-speed	AT-SPEED	05h	85h
Torque limit signal	TLC	06h	86h
Zero speed clamp detection	ZSP	07h	87h
Velocity coincidence	V-COIN	08h	88h
Position command ON/OFF	P-CMD	0Bh	8Bh
Velocity limit signal	V-LIMIT	0Dh	8Dh
Velocity command ON/OFF	V-CMD	0Fh	8Fh
Servo status	SRV-ST	12h	92h
Homing done	HOME-OK	22h	A2h
DB brake output	-	2Dh	AD
Z-phase output	-	2Eh	AE

Please don't set any other than the outputs listed in the table above.

- Normally open：Active low
- Normally close：Active high
- Front panel is of hexadecimal system.

P01.16 – P01.18 corresponds to DO1 – DO3. If all parameters are set to 0, master device controls the outputs, object dictionary 0x60FE sub-index 01 bit16-18 corresponds to DO1-DO3.

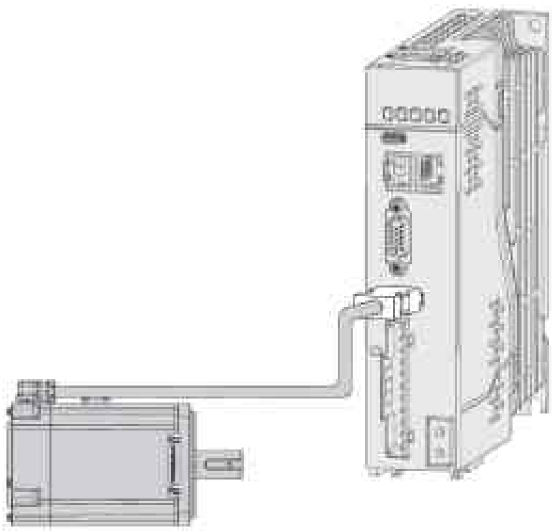
2.8 CN2 Encoder



Connector	Pin	Signal	Description
CN2	1	VCC5V	Power supply 5V
	2	GND	Power supply ground
	3	BAT+	Battery positive terminal
	4	BAT-	Battery negative terminal
	5	SD+	SSI Data+
	6	SD-	SSI Data-
	Frame	PE	Shield grounding

- Please ground both driver and motor PE terminals to avoid any servo alarms.
- It is recommended to use a shielded twisted pair cable not longer than 20m.
- Please leave a space of min. 30cm between motor power cable and encoder to avoid interference.

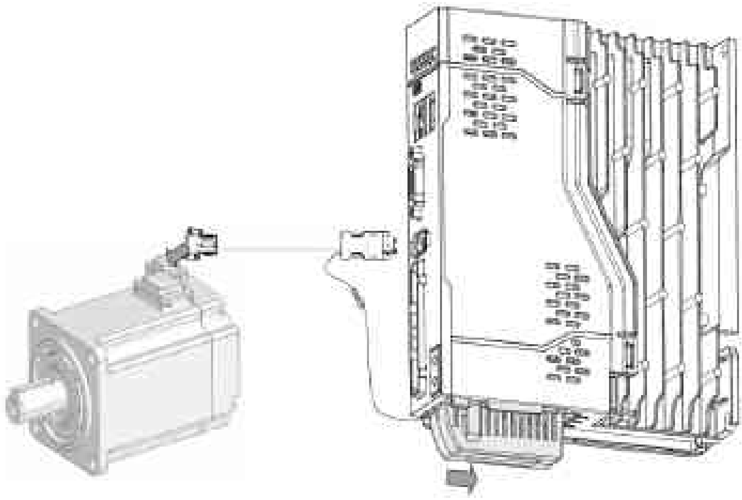
Connecting motor encoder cable to servo drive



- Please ensure the shield of both the drive side and motor side is properly grounded. Otherwise, the drive may trigger false alarms!
- It is recommended to use twisted-pair shielded cables for encoder wiring, and keep the wiring length as short as possible!
- Encoder cables and power cables must be routed separately to avoid interference! Maintain a minimum separation of at least 30cm!

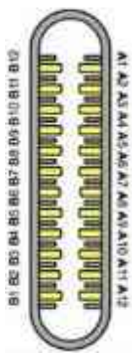
Absolute Battery kit installation

Absolute battery kit installation is shown in the figure below:
Only when purchasing our direct-plug motor with a cable that has no built-in battery kit but leads out battery wires, you may connect by clipping the battery kit onto the driver.



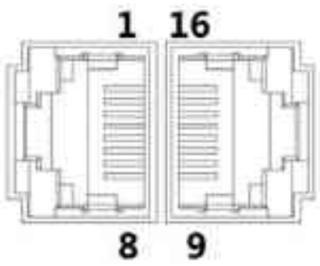
2.9 USB Type-C Tuning Port

EL7-ECS series servo drive can be connected to PC for performance tuning, data monitoring and parameters modifying using a **USB Type-C data cable**. Can be done without the servo drive connecting to main power supply.

Port	Figure	Pin	Signal	Description
USB Type-C		A4, B4,A9, B9	VCC 5V	Power supply positive terminal 5V
		A12,B12,A1,B1	GND	Power supply negative terminal
		A6,B6	D+	USB data positive terminal
		A7,B7	D-	USB data negative terminal
		Frame	USB_GND	Ground through capacitor

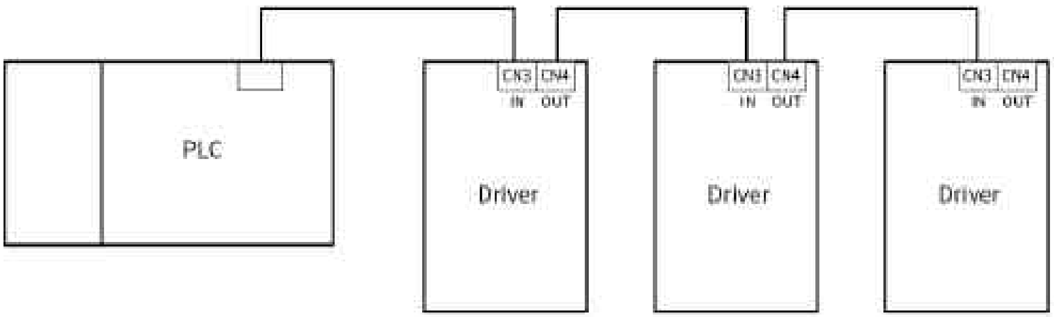
2.10 CN3/CN4 EtherCAT Communication Port

CN3 and CN4 are communication ports for EtherCAT protocol. LAN cable from master device will be connected to CN3 (IN) and CN4 (OUT) will be connected to the next slave device.

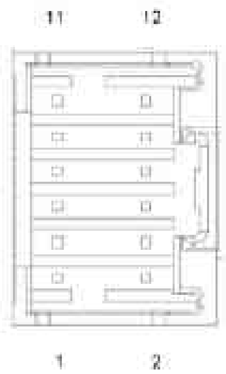
Port	Pin	Signal	Description
	1, 9	E_TX+	EtherCAT Data sending positive terminal
	2, 10	E_TX-	EtherCAT Data sending negative terminal
	3, 11	E_RX+	EtherCAT Data receiving positive terminal
	4, 12	--	--
	5, 13	--	--
	6, 14	E_RX-	EtherCAT Data receiving negative terminal
	7, 15	--	--
	8, 16	--	--
	Frame	PE	Shielded ground

■ The L7N-S model supports EtherCAT communication with the following connection methods:

1) Communication between multiple drives and the host is available.
2) Communication between a single drive and the host is also available.



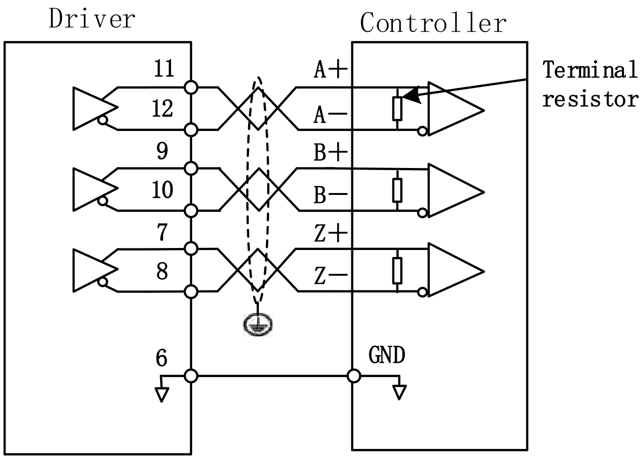
2.11 CN5 Frequency divider pulse output port

Port	Diagram	Pin	Signal	Label
CN5		11	A+	Motor encoder phase A frequency divider output
		12	A-	
		9	B+	Motor encoder phase B frequency divider output
		10	B-	
		7	Z+	Motor encoder phase Z frequency divider output
		8	Z-	
		5	OCZ	Motor encoder Z-signal OC output
		6	GND	Motor encoder Z-signal OF output reference ground
		3	/	/
		4	/	/
		1	PE	Shield grounding
		2	/	/

**Please use stranded shielded cable ≥ 0.14mm² with shield foil grounded to PE terminal.*
***Keep it shorter than 3 meters and away from any power cables.*

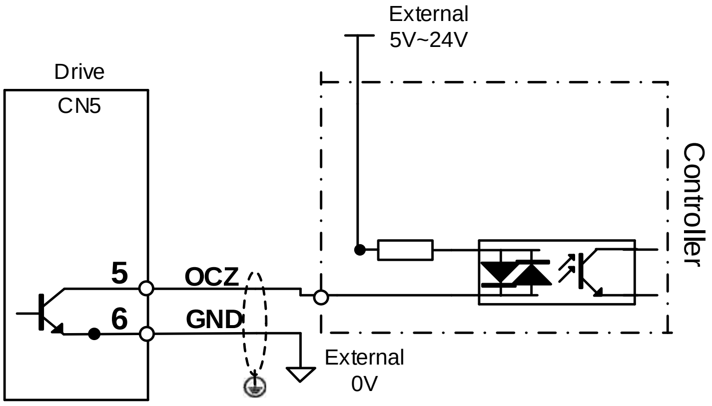
The encoder signal, following frequency division processing, is output as a differential signal via a differential driver. This typically provides a feedback signal when a position control system is configured with a host device.

Differential Connection:

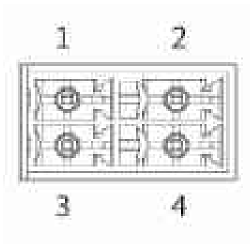


If controller input circuit is not an optocoupler input circuit but a differential receiving circuit, please connect CN5 pin 6 (OC reference ground) to GND of controller differential receiving circuit.

Encoder Z-phase frequency divider output:



2.12 CN6 Safe Torque Off (STO) Port

Port	Pin	Signal	Description	Remarks
	1	COM	STO Reference Ground (0V)	Used to short STO1 and STO2 when no safety devices are connected. Must not be used to power external equipment.
	2	24V	24V Power Supply	
	3	STO1	STO Control Signal 1 Input	The STO safety function will be enabled when the STO1 signal is OFF, the STO2 signal is OFF, or both STO1 and STO2 signals are OFF.
	4	STO2	STO Control Signal 2 Input	

Introduction to Safe Torque Off (STO)

Function: Cut off motor current supply physically (through mechanical means)

STO module (CN6 connector) consists of 2 input channels. It cuts off the motor current supply by blocking of PWM control signal from the power module. When the motor current is cut off, the motor will still move under inertia and stops gradually.

The STO function is set up ready to be used by factory default. Please remove STO connector if it is not needed.

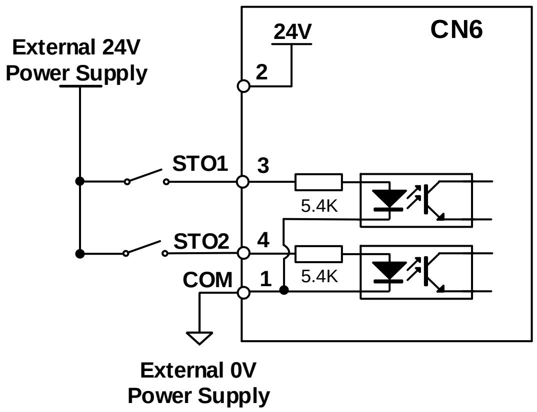
STO functional principle

STO module cuts off the motor current supply and stops motor gradually by blocking of PWM control signal from the power module through 2 isolated circuits. When a STO error occurs, the actual status of STO can be determined by the EDM status feedback.

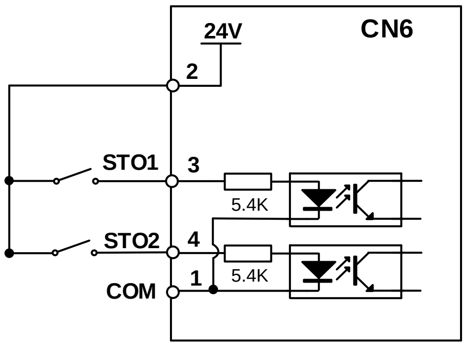
STO1 Input Status	STO2 Input Status	PWM control signal	Alarm code
ON	ON	Normal	-
ON	OFF	Blocked	Er 1c2
OFF	ON	Blocked	Er 1c1
OFF	OFF	Blocked	Er 1c0

STO wiring diagram

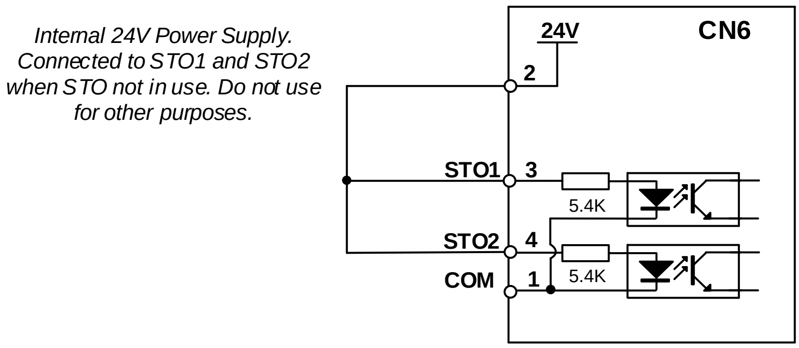
STO in use (External 24V)



STO in use (Internal 24V)



STO not in use (STO1 & STO2 shorted together)



- *Please take precautions when enabling STO functions as servo drive will lose control over the motion of the motor. Motor might dropped under gravitational pull (vertically mounted load) or moved when external forces are applied to it. Alternatively, motor with holding brake can be chosen.*
- *STO is not meant to cut off the power supply of the servo drivers and motors completely. Please power off and wait for a few minutes before starting maintenance work.*
- *It is recommended to use an isolated power supply for STO signal input as any current leakage might cause STO malfunction.*

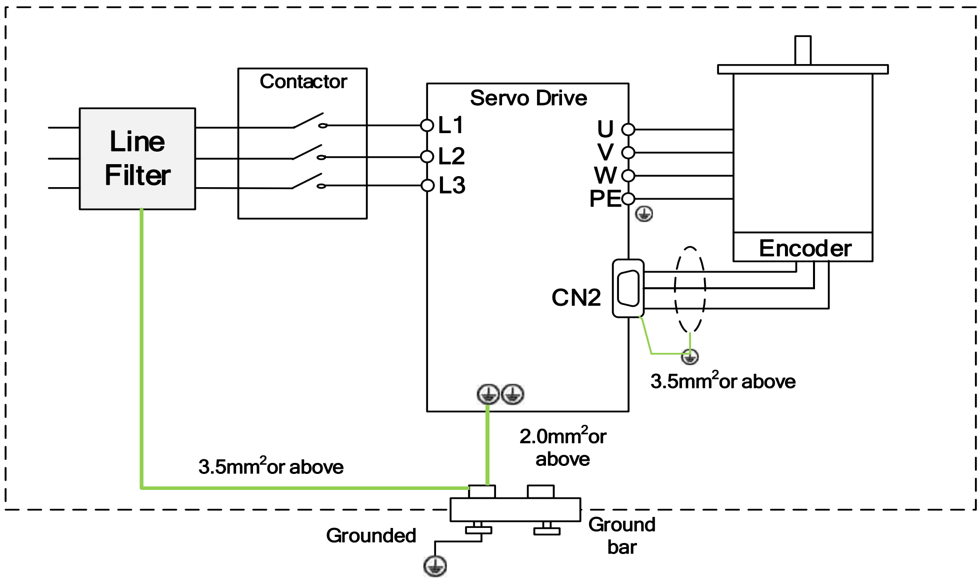
STO1 Input status	STO2 Input status	Alarm Cancellation
OFF→ON	ON	Errors 1C1 can be cleared via the main station, host computer, or by power cycling.
ON	OFF→ON	Errors 1C2 can be cleared via the main station, host computer, or by power cycling.
OFF→ON	OFF→ON	Er 1C0 Automatic clearing

2.13 Measures against electromagnetic interference

To reduce interference, please take the following measures:

- I/O signal cable > 3m; Encoder cable > 20m
- Use cable with larger diameter for grounding
  ①Grounding resistance > 100Ω
  ②When there are multiple drivers connected in parallel, PE terminal of the main power supply and ground terminal of servo drives must be connected to copper ground bar in the electrical cabinet and the copper ground bar needs to be connected to the metal frame of the cabinet.
- Please install a line filter on main power supply cable to prevent interference from radio frequency.
- In order to prevent malfunctions caused by electromagnetic interference, please take following measures:
  ①Install master device and line filter close to the servo drive
  ②Install surge suppressor for relay and contactor
  ③Please separate signal/encoder cable from power cable with a space of at least 30cm
  ④Install a line filter for the main power supply if a device with high frequency generation such as a welding machine exists nearby

2.13.1 Grounding connection and other anti-interference wiring connections

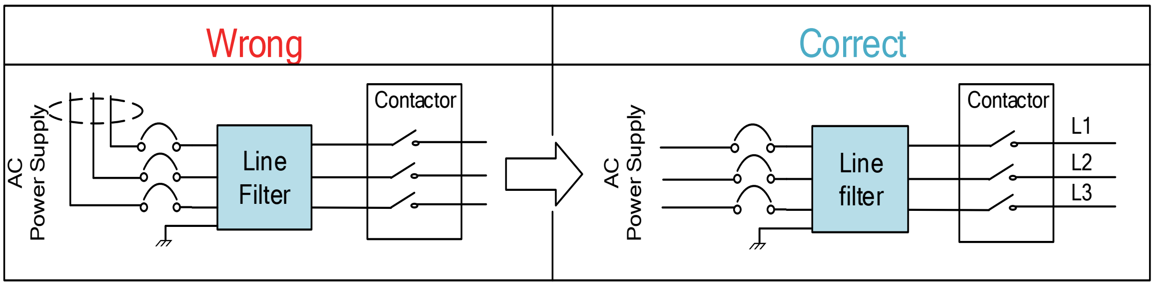


- Servo motor frame should be grounded. Please connect the PE terminal of servo motor and servo drive and ground them together to reduce interference.
- Ground both ends of the foil shield of encoder cable.

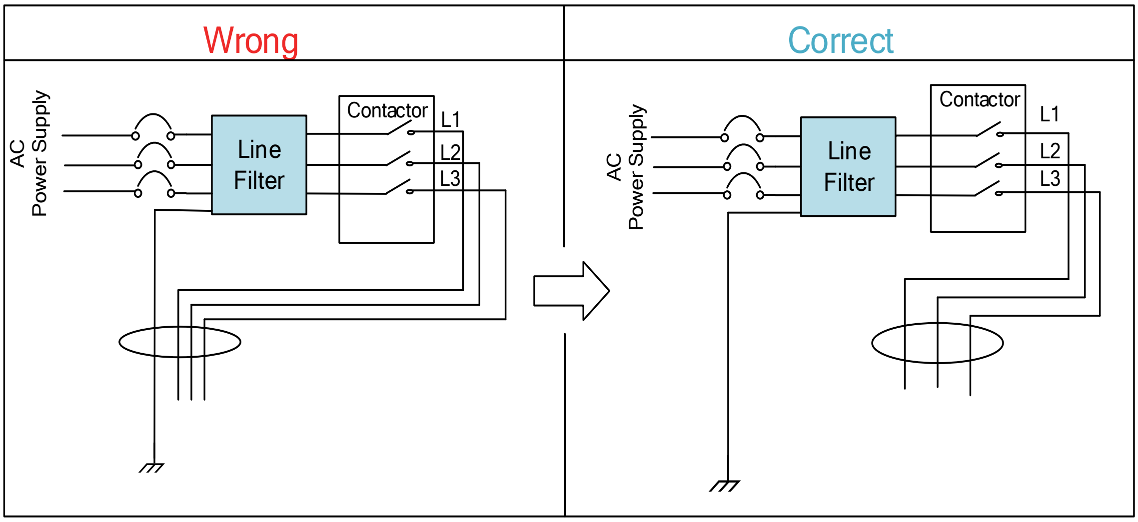
2.13.2 Using line filter

To reduce interference from main power supply cable and to prevent from affecting other sensitive components around the servo drive, please choose a line filter based on actual supply current. Please do be aware of the following mistake when installing a line filter.

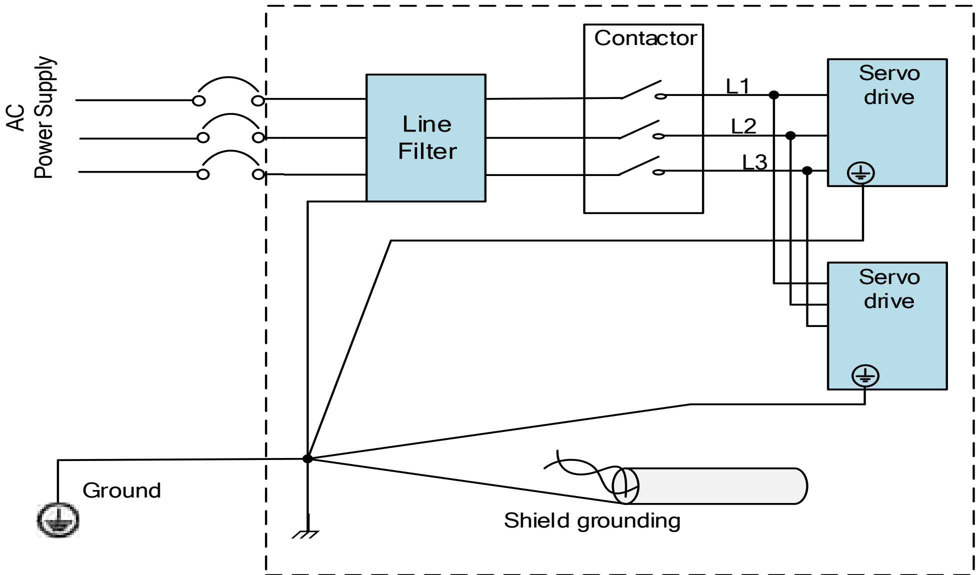
Do not band the main power supply cable together.



Separate the ground wire from the line filter and the main power supply cable.



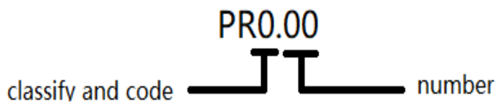
Ground wires inside an electrical cabinet



Chapter 3 Parameter

3.1 Parameter List

- Panel Display as follows:



- Parameter Valid mode Description
  CSP: Valid in cyclic synchronous position mode
  CSV: Valid in cyclic synchronous velocity mode
  CST: Valid in cyclic synchronous torque mode
  HM: Valid in homing mode
  PP: Valid in profile position mode
  PV: Valid in profile velocity mode
  PT: Valid in profile torque mode
  F: Valid in all modes

3.1.1 Servo Driver Parameter

Category	No.	Name	EtherCAT Address	Unit	Activation	Mode
P00	01	Control Mode	2000-02h	-	Take effect after re-enable	F
	06	Command Polarity Setting	2000-07h	-	Take effect after power off	F
	11	Pulse Count Per Revolution for Frequency Division Output	2000-0Ch	P/rev	Take effect after power off	F
	12	Logic Inversion of Frequency Division Output	2000-0Dh	-	Take effect after power off	F
	13	Z Signal Polarity of Frequency Division Output	2000-0Eh	-	Take effect after power off	F
	14	Z Signal Width of Frequency Division Output	2000-0Fh	us	Take effect after power off	F
	15	Source Selection of Frequency Division Output	2000-10h	-	Take effect after power off	F
	16	Delay Compensation of Frequency Division Output	2000-11h	us	Take effect immediately	PP/CSP

	21	Regenerative Discharge Resistance Value	2000-16h	Ω	Take effect immediately	F
	22	Regenerative Discharge Resistance Power	2000-17h	W	Take effect immediately	F
	25	Motor Power-off Delay Time	2000-1Ah	ms	Take effect immediately	F
	26	Brake Release Waiting Time	2000-1Bh	ms	Take effect immediately	F
	27	Brake Release Speed Setting	2000-1Ch	r/min	Take effect immediately	F
	28	Maximum Stop Time When Servo Disabled	2000-1Dh	ms	Take effect immediately	F
	29	Deceleration Time for Mode Switching	2000-1Eh	ms/(1000r/min)	Take effect immediately	F
	30	Stop Mode When Servo Enable is Off	2000-1Fh	-	Take effect immediately	F
	31	Class 1 Fault Stop Mode	2000-20h	-	Take effect immediately	F
	32	Class 2 Fault Stop Mode	2000-21h	-	Take effect immediately	F
	33	Forced Stop Mode	2000-22h	-	Take effect immediately	F
	34	Positive & Negative Limit Stop Mode	2000-23h	-	Take effect immediately	F
	35	Deceleration Time for Positive & Negative Limit	2000-24h	ms/(1000r/min)	Take effect immediately	F
	36	Emergency Stop Deceleration Time	2000-25h	ms/(1000r/min)	Take effect immediately	F
	37	Fault Deceleration Time	2000-26h	ms/(1000r/min)	Take effect immediately	F
	38	Maximum Deceleration Time	2000-27h	ms/(1000r/min)	Take effect immediately	F
	39	Torque Limit During Immediate Stop	2000-28h	-	Take effect immediately	F
	40	E-STOP Function Selection	2000-29h	-	Take effect immediately	F
	41	Position Feedback Polarity Setting	2000-2Ah	-	Take effect immediately	F
	43	LED Initial State	2000-2Ch	-	Take effect after power off	F
	48	Z Signal Holding Time	2000-31h	ms	Take effect immediately	F
	51	Position Setting Unit Selection	2000-34h	-	Take effect after re-enable	P/PP/HM/CSP

	55	Soft Limit Function Setting	2000-38h	-	Take effect immediately	F
	56	Positive Software Limit	2000-39h	unit	Take effect immediately	PR/CSP/PP
	57	Negative Software Limit	2000-3Ah	unit	Take effect immediately	PR/CSP/PP

Category	No.	Name	EtherCAT Address	Unit	Activation	Mode
P01	00	DI-1 Input Selection	2001-01h	-	Take effect immediately	F
	01	DI-2 Input Selection	2001-02h	-	Take effect immediately	F
	02	DI-3 Input Selection	2001-03h	-	Take effect immediately	F
	03	DI-4 Input Selection	2001-04h	-	Take effect immediately	F
	04	DI-5 Input Selection	2001-05h	-	Take effect immediately	F
	05	DI-6 Input Selection	2001-06h	-	Take effect immediately	F
	16	DO-1 Output Selection	2001-11h	-	Take effect immediately	F
	17	DO-2 Output Selection	2001-12h	-	Take effect immediately	F
	18	DO-3 Output Selection	2001-13h	-	Take effect immediately	F
	25	Forced DIDO Enable Switch	2001-1Ah	-	Take effect immediately	F
	26	Forced DI Set Value	2001-1Bh	-	Take effect immediately	F
	27	Forced DO Set Value	2001-1Ch	-	Take effect immediately	F
	28	DI Status	2001-1Dh	-	Take effect immediately	F
	29	DO Status	2001-1Eh	-	Take effect immediately	F
	30	DI Filter Setting	2001-1Fh	ms	Take effect immediately	F

Category	No.	Name	EtherCAT Address	Unit	Activation	Mode
P02	00	Virtual DIDO Enable	2002-01h	-	Take effect immediately	F
	01	VDI-01 Input Selection	2002-02h	-	Take effect immediately	F
	02	VDI-02 Input Selection	2002-03h	-	Take effect immediately	F
	03	VDI-03 Input Selection	2002-04h	-	Take effect immediately	F
	04	VDI-04 Input Selection	2002-05h	-	Take effect immediately	F
	05	VDI-05 Input Selection	2002-06h	-	Take effect immediately	F
	06	VDI-06 Input Selection	2002-07h	-	Take effect immediately	F
	07	VDI-07 Input Selection	2002-08h	-	Take effect immediately	F
	08	VDI-08 Input Selection	2002-09h	-	Take effect immediately	F
	09	VDI-09 Input Selection	2002-0Ah	-	Take effect immediately	F
	10	VDI-10 Input Selection	2002-0Bh	-	Take effect immediately	F
	11	VDI-11 Input Selection	2002-0Ch	-	Take effect immediately	F
	12	VDI-12 Input Selection	2002-0Dh	-	Take effect immediately	F
	13	VDI-13 Input Selection	2002-0Eh	-	Take effect immediately	F
	14	VDI-14 Input Selection	2002-0Fh	-	Take effect immediately	F
	15	VDI-15 Input Selection	2002-10h	-	Take effect immediately	F
	16	VDI-16 Input Selection	2002-11h	-	Take effect immediately	F
	17	VDO-01 Output Selection	2002-12h	-	Take effect immediately	F
	18	VDO-02 Output Selection	2002-13h	-	Take effect immediately	F
	19	VDO-04 Output Selection	2002-14h	-	Take effect immediately	F
	20	VDO-03 Output Selection	2002-15h	-	Take effect immediately	F

	21	VDO-05 Output Selection	2002-16h	-	Take effect immediately	F
	22	VDO-06 Output Selection	2002-17h	-	Take effect immediately	F
	23	VDO-07 Output Selection	2002-18h	-	Take effect immediately	F
	24	VDO-08 Output Selection	2002-19h	-	Take effect immediately	F
	25	VDO-09 Output Selection	2002-1Ah	-	Take effect immediately	F
	26	VDO-10 Output Selection	2002-1Bh	-	Take effect immediately	F
	27	VDO-11 Output Selection	2002-1Ch	-	Take effect immediately	F
	28	VDO-12 Output Selection	2002-1Dh	-	Take effect immediately	F
	29	VDO-13 Output Selection	2002-1Eh	-	Take effect immediately	F
	30	VDO-14 Output Selection	2002-1Fh	-	Take effect immediately	F
	31	VDO-15 Output Selection	2002-20h	-	Take effect immediately	F
	32	VDO-16 Output Selection	2002-21h	-	Take effect immediately	F
	45	VDI Status	2002-2Eh	-	Take effect immediately	F
	46	VDO Status	2002-2Fh	-	Take effect immediately	F

Category	No.	Name	EtherCAT Address	Unit	Activation	Mode
P04	02	Position Deviation Excessive Setting	2004-03h	unit	Take effect immediately	P/PP/HM/CSP
	03	Fault Clear Mode	2004-04h	-	Take effect immediately	F
	05	Current Fault Code	2004-06h	-	Take effect immediately	F
	06	Current Warning Code	2004-07h	-	Take effect immediately	F
	07	Overspeed Level Setting	2004-08h	-	Take effect immediately	F
	17	E2 Storage Overfast Threshold	2004-12h	min	Take effect immediately	F

	19	Discharge Overload Level	2004-14h	-	Take effect immediately	F
	20	Overload Level Setting	2004-15h	-	Take effect immediately	F
	23	Motor Stall Alarm Torque Threshold	2004-18h	%	Take effect immediately	F

Category	No.	Name	EtherCAT Address	Unit	Activation	Mode
P05	00	Position Command (User Unit)	2005-01h	unit	Take effect immediately	F
	01	Position Feedback (User Unit)	2005-02h	unit	Take effect immediately	F
	02	Position Command (Encoder Unit)	2005-03h	pulse	Take effect immediately	F
	03	Position Feedback (Encoder Unit)	2005-04h	pulse	Take effect immediately	F
	04	Relative Position Error (Encoder Unit)	2005-05h	pulse	Take effect immediately	F
	05	Absolute Position Error	2005-06h	pulse	Take effect immediately	F
	06	Relative Position Error (User Unit)	2005-07h	unit	Take effect immediately	F
	07	Encoder Single-turn Position	2005-08h	pulse	Take effect immediately	F
	08	Encoder Multi-turn Position	2005-09h	r	Take effect immediately	F
	09	Position Command Speed	2005-0Ah	r/min	Take effect immediately	F
	10	Speed Command	2005-0Bh	r/min	Take effect immediately	F
	11	Motor Speed	2005-0Ch	r/min	Take effect immediately	F
	12	Speed Error	2005-0Dh	r/min	Take effect immediately	F
	13	Torque Current Command	2005-0Eh	%	Take effect immediately	F
	14	Torque Current Feedback	2005-0Fh	%	Take effect immediately	F
	15	Field-weakening Current Command	2005-10h	%	Take effect immediately	F
	16	Field-weakening Current Feedback	2005-11h	%	Take effect immediately	F

	17	Vector Current	2005-12h	%	Take effect immediately	F
	18	U-phase Current	2005-13h	A	Take effect immediately	F
	19	V-phase Current	2005-14h	A	Take effect immediately	F
	20	W-phase Current	2005-15h	A	Take effect immediately	F
	21	Bus Voltage	2005-16h	V	Take effect immediately	F
	22	Drive Temperature	2005-17h	°C	Take effect immediately	F
	23	Monitor Channel 1 Selection	2005-18h	-	Take effect immediately	F
	24	Monitor Channel 2 Selection	2005-19h	-	Take effect immediately	F
	25	Monitor Channel 3 Selection	2005-1Ah	-	Take effect immediately	F
	26	Monitor Channel 4 Selection	2005-1Bh	-	Take effect immediately	F
	27	Monitor Channel 1	2005-1Ch	-	Take effect immediately	F
	28	Monitor Channel 2	2005-1Dh	-	Take effect immediately	F
	29	Monitor Channel 3	2005-1Eh	-	Take effect immediately	F
	30	Monitor Channel 4	2005-1Fh	-	Take effect immediately	F

Category	No.	Name	EtherCAT Address	Unit	Activation	Mode
P10	03	Command Pulse Per Revolution	2010-04h	pulse	Take effect after re-enable	F
	04	1st Command Scaling Numerator	2010-05h	-	Take effect after re-enable	F
	05	1st Command Scaling Denominator	2010-06h	-	Take effect after re-enable	F
	09	Absolute Encoder Reset Enable	2010-0Ah	-	Take effect after re-enable	F
	10	Absolute Encoder Setting	2010-0Bh	-	Take effect after power off	F
	11	Absolute Value Rotation Mode Minimum Value	2010-0Ch	pulse	Take effect after power off	F

	12	Absolute Value Rotation Mode Range Value	2010-0Dh	pulse	Take effect after power off	F
	14	Position Command Low-pass Filter	2010-0Fh	ms	Take effect after stop	P/PP/HM/CSP
	15	Position Command FIR Filter	2010-10h	ms	Take effect after stop	P/PP/HM/CSP
	19	Positioning Completion Range	2010-14h	Unit set by P00.51	Take effect immediately	P/PP/HM/CSP
	20	Positioning Output Setting	2010-15h	-	Take effect immediately	P/PP/HM/CSP
	21	INP Delay In-position Output Time	2010-16h	ms	Take effect immediately	P/PP/HM/CSP

Category	No.	Name	EtherCAT Address	Unit	Activation	Mode
P11	07	S-type Acceleration/Deceleration Setting	2011-08h	ms	Take effect after re-enable	S
	08	Zero Speed Clamp Function Selection	2011-09h	-	Take effect immediately	S/PV/CSV
	09	Zero Speed Clamp Level	2011-0Ah	r/min	Take effect immediately	S/PV/CSV
	10	Zero Speed Clamp Standstill Delay Time	2011-0Bh	ms	Take effect immediately	S/PV/CSV
	11	Motor Maximum Speed Limit	2011-0Ch	r/min	Take effect immediately	F
	13	Zero Speed Setting	2011-0Eh	r/min	Take effect immediately	F
	14	Speed Consistency Band Setting	2011-0Fh	r/min	Take effect immediately	S/PV/CSV
	15	Speed Attainment Setting	2011-10h	r/min	Take effect immediately	S/PV/CSV
	16	Speed Attainment Hysteresis Band Width	2011-11h	r/min	Take effect immediately	S/PV/CSV

Category	No.	Name	EtherCAT Address	Unit	Activation	Mode
P12	00	Torque Mode Selection	2012-01h	-	Take effect immediately	F
	01	1st Torque Limit	2012-02h	%	Take effect immediately	F
	02	2nd Torque Limit	2012-03h	%	Take effect immediately	F

Category	No.	Name	EtherCAT Address	Unit	Activation	Mode
P20	00	1st Position Loop Gain	2020-01h	Hz	Take effect immediately	P/PP/HM/CSP
	01	1st Speed Loop Gain	2020-02h	Hz	Take effect immediately	F
	02	1st Speed Loop Integral Time Constant	2020-03h	ms	Take effect immediately	F
	04	1st torque filter time constant Time Constant	2020-05h	ms	Take effect immediately	F
	05	2nd Position Loop Gain	2020-06h	Hz	Take effect immediately	P/PP/HM/CSP
	06	2nd Speed Loop Gain	2020-07h	Hz	Take effect immediately	F
	07	2nd Speed Loop Integral Time Constant	2020-08h	ms	Take effect immediately	F
	09	2nd Torque Filter Time Constant	2020-0Ah	ms	Take effect immediately	F
	10	Speed Feedforward Gain	2020-0Bh	1	Take effect immediately	P/PP/HM/CSP
	11	Speed Feedforward Filter Time Constant	2020-0Ch	ms	Take effect immediately	F
	12	Torque Feedforward Gain	2020-0Dh	1	Take effect immediately	P/S/PP/PV/HM/CSP/CSV
	13	Torque Feedforward Filter Time Constant	2020-0Eh	ms	Take effect immediately	P/S/PP/PV/HM/CSP/CSV
	15	Position Control Parameter Switching Mode	2020-10h	-	Take effect immediately	P/PP/HM/CSP
	16	Position Control Parameter Switching Delay	2020-11h	ms	Take effect immediately	P/PP/HM/CSP
	17	Position Control Parameter Switching Level	2020-12h	-	Take effect immediately	P/PP/HM/CSP
	18	Position Control Parameter Switching Hysteresis	2020-13h	-	Take effect immediately	P/PP/HM/CSP
	19	Position Control Parameter Switching Time	2020-14h	ms	Take effect immediately	P/PP/HM/CSP
	21	Speed Regulator -kr	2020-16h	%	Take effect immediately	S/PV/CSV
	22	Speed Feedback Filter Level	2020-17h	-	Take effect immediately	P/S/PP/PV/HM/CSP/CSV
	23	Position 3rd Gain Valid	2020-18h	ms	Take effect	P/PP/HM/

		Time			immediately	CSP
	24	Position 3rd Gain Multiplier	2020-19h	%	Take effect immediately	P/PP/HM/ CSP
	28	Speed Observer Gain	2020-1Dh	%	Take effect immediately	F
	29	Speed Observer Bandwidth	2020-1Eh	ms	Take effect immediately	F

Category	No.	Name	EtherCAT Address	Unit	Activation	Mode
P21	00	Model Following Bandwidth (MFC)	2021-01h	Hz	Take effect immediately	F
	01	Real-time Auto-tuning Mode	2021-02h	-	Take effect immediately	F
	02	Real-time Auto-tuning Stiffness	2021-03h	-	Take effect immediately	F
	03	Inertia Ratio	2021-04h	%	Take effect immediately	F
	04	MFC Curve Damping Correction Coefficient	2021-05h	%	Take effect immediately	F
	05	Forward & Reverse Torque Compensation Gain Difference Percentage	2021-06h	%	Take effect immediately	F
	06	MFC Type	2021-07h	-	Take effect immediately	P/PP/CSP
	07	Speed Feedforward Compensation Coefficient	2021-08h	-	Take effect immediately	P/PP/CSP
	08	Torque Feedforward Compensation Coefficient	2021-09h	-	Take effect immediately	P/S/PP/PV/ CSP/CSV
	09	Dynamic Friction Compensation Coefficient	2021-0Ah	-	Take effect immediately	F
	10	Overshoot Time Constant	2021-0Bh	-	Take effect immediately	F
	11	Overshoot Suppression Gain	2021-0Ch	-	Take effect immediately	F
	12	One-click Tuning Mode	2021-0Dh	-	Take effect immediately	F
	14	One-click Tuning Progress	2021-0Fh	-	Take effect immediately	F
	15	One-click Tuning Error Code	2021-10h	-	Take effect immediately	F
	16	One-click Tuning Speed Limit	2021-11h	r/min	Take effect immediately	F

	19	Auxiliary Adjustment Mode	2021-14h	-	Take effect immediately	F
	20	Ltune Off Time	2021-15h	s	Take effect immediately	F
	21	Ltune Progress	2021-16h	%	Take effect immediately	F
	22	Friction Compensation Function Setting	2021-17h	-	Take effect immediately	F
	23	Forward Torque Compensation Value	2021-18h	%	Take effect immediately	F
	24	Reverse Torque Compensation Value	2021-19h	%	Take effect immediately	F
	25	Torque Command Addition Value	2021-1Ah	%	Take effect immediately	F
	27	Vibration Detection Threshold	2021-1Ch	%	Take effect immediately	F
	30	Inertia Identification Value	2021-1Fh	-	Take effect immediately	F
	32	Tuning In-position Count	2021-21h	counts	Take effect immediately	F
	33	Tuning In-position Time	2021-22h	s	Take effect immediately	F
	34	Tuning Overshoot	2021-23h	%	Take effect immediately	F
	35	Tuning Jitter Count	2021-24h	counts	Take effect immediately	F
	36	Tuning Maximum Current	2021-25h	%	Take effect immediately	F
	37	Tuning Maximum Speed	2021-26h	r/min	Take effect immediately	F
	41	Vibration Monitoring Value	2021-2Ah	%	Take effect immediately	F

Category	No.	Name	EtherCAT Address	Unit	Activation	Mode
P22	00	Adaptive Notch Filter Mode Setting	2022-01h	-	Take effect immediately	F
	01	1st Notch Frequency	2022-02h	Hz	Take effect immediately	F
	02	1st Notch Width	2022-03h	-	Take effect immediately	F
	03	1st Notch Depth	2022-04h	-	Take effect immediately	F
	04	2nd Notch Frequency	2022-05h	Hz	Take effect immediately	F
	05	2nd Notch Width	2022-06h	-	Take effect immediately	F
	06	2nd Notch Depth	2022-07h	-	Take effect immediately	F
	07	3rd Notch Frequency	2022-08h	Hz	Take effect immediately	F
	08	3rd Notch Width	2022-09h	-	Take effect immediately	F
	09	3rd Notch Depth	2022-0Ah	-	Take effect immediately	F
	10	4th Notch Frequency	2022-0Bh	Hz	Take effect immediately	F
	11	4th Notch Width	2022-0Ch	-	Take effect immediately	F
	12	4th Notch Depth	2022-0Dh	-	Take effect immediately	F
	13	1st Vibration Suppression Frequency	2022-0Eh	Hz	Take effect immediately	F
	14	1st Vibration Suppression Filter	2022-0Fh	-	Take effect immediately	F
	15	2nd Vibration Suppression Frequency	2022-10h	Hz	Take effect immediately	F
	16	2nd Vibration Suppression Filter	2022-11h	-	Take effect immediately	F
	47	d-axis Current Filter Time Constant	2033-30h	0.01ms	Take effect immediately	F

Category	No.	Name	EtherCAT Address	Unit	Activation	Mode
P30	00	Homing Mode	2030-01h	-	Take effect immediately	HM
	01	Homing High Speed	2030-02h	unit/s	Take effect immediately	HM
	02	Homing Low Speed	2030-03h	unit/s	Take effect immediately	HM
	03	Homing Acceleration/Deceleration	2030-04h	unit/s^2	Take effect immediately	HM
	04	Set Current Position as Origin	2030-05h	-	Take effect immediately	HM
	08	Homing Position Offset	2030-09h	unit	Take effect immediately	HM
	09	Torque Homing Torque Limit Value	2030-0Ah	%	Take effect immediately	HM
	10	Torque Homing Time	2030-0Bh	ms	Take effect immediately	HM
	11	Homing Over Travel	2030-0Ch	r	Take effect immediately	HM
	12	Homing Timeout	2030-0Dh	ms	Take effect immediately	HM
	14	Homing In-position Threshold	2030-0Fh	0.00001rev	Take effect immediately	HM
	15	Homing Auxiliary Function	2030-10h	-	Take effect immediately	HM
	18	Homing In-position Delay Time	2030-13h	ms	Take effect immediately	HM
	22	Homing Maximum Speed Limit Value	2030-17h	rpm	Take effect immediately	HM

Category	No.	Name	EtherCAT Address	Unit	Activation	Mode
P31	00	Probe 1 Rising Edge Position Capture Compensation	2031-01h	unit	Take effect immediately	F
	01	Probe 1 Falling Edge Position Capture Compensation	2031-02h	unit	Take effect immediately	F
	02	Probe 2 Rising Edge Position Capture Compensation	2031-03h	unit	Take effect immediately	F
	03	Probe 2 Falling Edge	2031-04h	unit	Take effect	F

		Position Capture Compensation			immediately	
	04	Probe 1 Input Selection	2031-05h	-	Take effect immediately	F
	05	Probe 2 Input Selection	2031-06h	-	Take effect immediately	F
	06	Probe 1 Capture Direction Selection	2031-07h	-	Take effect immediately	F
	07	Probe 2 Capture Direction Selection	2031-08h	-	Take effect immediately	F
	08	Probe Input Filter	2031-09h	us	Take effect immediately	F

Category	No.	Name	EtherCAT Address	Unit	Activation	Mode
P41	00	Position Comparison Enable	2041-01h	-	Take effect immediately	F
	01	Position Comparison Mode Selection	2041-02h	-	Take effect after re-enable	F
	02	Position Comparison Pulse Output Width	2041-03h	ms	Take effect immediately	F
	03	Position Comparison Output Delay Compensation	2041-04h	us	Take effect immediately	F
	04	Position Comparison Start Point Value	2041-05h	-	Take effect immediately	F
	05	Position Comparison End Point Value	2041-06h	-	Take effect immediately	F
	06	Fixed Count Mode Cycle Count	2041-07h	counts	Take effect immediately	F
	07	Set Current Position as Position Comparison Zero Point	2041-08h	-	Take effect immediately	F
	08	Position Comparison Zero Point Offset	2041-09h	unit	Take effect immediately	F
	10	Position Comparison Real-time Position	2041-0Bh	unit	Take effect immediately	F
	11	Position Comparison Current Comparison Point	2041-0Ch	-	Take effect immediately	F
	12	Position Comparison Output Count	2041-0Dh	counts	Take effect immediately	F
	13	Position Comparison Cycle Count	2041-0Eh	counts	Take effect immediately	F

	15	Position Comparison Value Resolution	2041-10h	pulse	Take effect after power off	F

Category	No.	Name	EtherCAT Address	Unit	Activation	Mode
P42	00	Position Comparison 1 Target Value	2042-01h	unit	Take effect immediately	F
	01	Position Comparison 1 Attribute Value	2042-02h	-	Take effect immediately	F
	02	Position Comparison 2 Target Value	2042-03h	unit	Take effect immediately	F
	03	Position Comparison 2 Attribute Value	2042-04h	-	Take effect immediately	F
	04	Position Comparison 3 Target Value	2042-05h	unit	Take effect immediately	F
	05	Position Comparison 3 Attribute Value	2042-06h	-	Take effect immediately	F
	06	Position Comparison 4 Target Value	2042-07h	unit	Take effect immediately	F
	07	Position Comparison 4 Attribute Value	2042-08h	-	Take effect immediately	F
	08	Position Comparison 5 Target Value	2042-09h	unit	Take effect immediately	F
	09	Position Comparison 5 Attribute Value	2042-0Ah	-	Take effect immediately	F
	10	Position Comparison 6 Target Value	2042-0Bh	unit	Take effect immediately	F
	11	Position Comparison 6 Attribute Value	2042-0Ch	-	Take effect immediately	F
	12	Position Comparison 7 Target Value	2042-0Dh	unit	Take effect immediately	F
	13	Position Comparison 7 Attribute Value	2042-0Eh	-	Take effect immediately	F
	14	Position Comparison 8 Target Value	2042-0Fh	unit	Take effect immediately	F
	15	Position Comparison 8 Attribute Value	2042-10h	-	Take effect immediately	F
	16	Position Comparison 9 Target Value	2042-11h	unit	Take effect immediately	F
	17	Position Comparison 9 Attribute Value	2042-12h	-	Take effect immediately	F
	18	Position Comparison 10 Target Value	2042-13h	unit	Take effect immediately	F

	19	Position Comparison 10 Attribute Value	2042-14h	-	Take effect immediately	F
	20	Position Comparison 11 Target Value	2042-15h	unit	Take effect immediately	F
	21	Position Comparison 11 Attribute Value	2042-16h	-	Take effect immediately	F
	22	Position Comparison 12 Target Value	2042-17h	unit	Take effect immediately	F
	23	Position Comparison 12 Attribute Value	2042-18h	-	Take effect immediately	F
	24	Position Comparison 13 Target Value	2042-19h	unit	Take effect immediately	F
	25	Position Comparison 13 Attribute Value	2042-1Ah	-	Take effect immediately	F
	26	Position Comparison 14 Target Value	2042-1Bh	unit	Take effect immediately	F
	27	Position Comparison 14 Attribute Value	2042-1Ch	-	Take effect immediately	F
	28	Position Comparison 15 Target Value	2042-1Dh	unit	Take effect immediately	F
	29	Position Comparison 15 Attribute Value	2042-1Eh	-	Take effect immediately	F
	30	Position Comparison 16 Target Value	2042-1Fh	unit	Take effect immediately	F
	31	Position Comparison 16 Attribute Value	2042-20h	-	Take effect immediately	F
	32	Position Comparison 17 Target Value	2042-21h	unit	Take effect immediately	F
	33	Position Comparison 17 Attribute Value	2042-22h	-	Take effect immediately	F
	34	Position Comparison 18 Target Value	2042-23h	unit	Take effect immediately	F
	35	Position Comparison 18 Attribute Value	2042-24h	-	Take effect immediately	F
	36	Position Comparison 19 Target Value	2042-25h	unit	Take effect immediately	F
	37	Position Comparison 19 Attribute Value	2042-26h	-	Take effect immediately	F
	38	Position Comparison 20 Target Value	2042-27h	unit	Take effect immediately	F
	39	Position Comparison 20 Attribute Value	2042-28h	-	Take effect immediately	F
	40	Position Comparison 21 Target Value	2042-29h	unit	Take effect immediately	F

	41	Position Comparison 21 Attribute Value	2042-2Ah	-	Take effect immediately	F
	42	Position Comparison 22 Target Value	2042-2Bh	unit	Take effect immediately	F
	43	Position Comparison 22 Attribute Value	2042-2Ch	-	Take effect immediately	F
	44	Position Comparison 23 Target Value	2042-2Dh	unit	Take effect immediately	F
	45	Position Comparison 23 Attribute Value	2042-2Eh	-	Take effect immediately	F
	46	Position Comparison 24 Target Value	2042-2Fh	unit	Take effect immediately	F
	47	Position Comparison 24 Attribute Value	2042-30h	-	Take effect immediately	F
	48	Position Comparison 25 Target Value	2042-31h	unit	Take effect immediately	F
	49	Position Comparison 25 Attribute Value	2042-32h	-	Take effect immediately	F
	50	Position Comparison 26 Target Value	2042-33h	unit	Take effect immediately	F
	51	Position Comparison 26 Attribute Value	2042-34h	-	Take effect immediately	F
	52	Position Comparison 27 Target Value	2042-35h	unit	Take effect immediately	F
	53	Position Comparison 27 Attribute Value	2042-36h	-	Take effect immediately	F
	54	Position Comparison 28 Target Value	2042-37h	unit	Take effect immediately	F
	55	Position Comparison 28 Attribute Value	2042-38h	-	Take effect immediately	F
	56	Position Comparison 29 Target Value	2042-39h	unit	Take effect immediately	F
	57	Position Comparison 29 Attribute Value	2042-3Ah	-	Take effect immediately	F
	58	Position Comparison 30 Target Value	2042-3Bh	unit	Take effect immediately	F
	59	Position Comparison 30 Attribute Value	2042-3Ch	-	Take effect immediately	F
	60	Position Comparison 31 Target Value	2042-3Dh	unit	Take effect immediately	F
	61	Position Comparison 31 Attribute Value	2042-3Eh	-	Take effect immediately	F
	62	Position Comparison 32 Target Value	2042-3Fh	unit	Take effect immediately	F

	63	Position Comparison 32 Attribute Value	2042-40h	-	Take effect immediately	F
	64	Position Comparison 33 Target Value	2042-41h	unit	Take effect immediately	F
	65	Position Comparison 33 Attribute Value	2042-42h	-	Take effect immediately	F
	66	Position Comparison 34 Target Value	2042-43h	unit	Take effect immediately	F
	67	Position Comparison 34 Attribute Value	2042-44h	-	Take effect immediately	F
	68	Position Comparison 35 Target Value	2042-45h	unit	Take effect immediately	F
	69	Position Comparison 35 Attribute Value	2042-46h	-	Take effect immediately	F
	70	Position Comparison 36 Target Value	2042-47h	unit	Take effect immediately	F
	71	Position Comparison 36 Attribute Value	2042-48h	-	Take effect immediately	F
	72	Position Comparison 37 Target Value	2042-49h	unit	Take effect immediately	F
	73	Position Comparison 37 Attribute Value	2042-4Ah	-	Take effect immediately	F
	74	Position Comparison 38 Target Value	2042-4Bh	unit	Take effect immediately	F
	75	Position Comparison 38 Attribute Value	2042-4Ch	-	Take effect immediately	F
	76	Position Comparison 39 Target Value	2042-4Dh	unit	Take effect immediately	F
	77	Position Comparison 39 Attribute Value	2042-4Eh	-	Take effect immediately	F
	78	Position Comparison 40 Target Value	2042-4Fh	unit	Take effect immediately	F
	79	Position Comparison 40 Attribute Value	2042-50h	-	Take effect immediately	F
	80	Position Comparison 41 Target Value	2042-51h	unit	Take effect immediately	F
	81	Position Comparison 41 Attribute Value	2042-52h	-	Take effect immediately	F

Category	No.	Name	EtherCAT Address	Unit	Activation	Mode
P47	00	Collision Detection Mode	2047-01h	-	Take effect after re-enable	F

	01	Collision Detection Forward Current Threshold	2047-02h	%	Take effect immediately	F
	02	Collision Detection Reverse Current Threshold	2047-03h	%	Take effect immediately	F
	03	Collision Detection Speed Threshold	2047-04h	r/min	Take effect immediately	F
	08	Collision Detection Forward Current Filter Coefficient	2047-09h	ms	Take effect immediately	F
	09	Collision Detection Reverse Current Filter Coefficient	2047-0Ah	ms	Take effect immediately	F
	10	Collision Detection Time	2047-0Bh	ms	Take effect immediately	F
	12	Collision BLF Delay Enable Time	2047-0Dh	ms	Take effect immediately	F
	13	Collision BLF Threshold	2047-0Eh	-	Take effect immediately	F
	14	Collision BLF Center Frequency	2047-0Fh	Hz	Take effect immediately	F
	15	Collision BLF Q Value	2047-10h	-	Take effect immediately	F
	17	Emergency Stop	2047-12h	-	Take effect immediately	F
	18	Software Reset	2047-13h	-	Take effect immediately	F
	19	Current Fault Clear	2047-14h	-	Take effect immediately	F
	20	Historical Fault Clear	2047-15h	-	Take effect immediately	F
	21	Encoder Initial Angle Identification	2047-16h	-	Take effect immediately	F
	22	Status Function Setting Source	2047-17h	-	Take effect immediately	F
	24	JOG Test Run Torque Command	2047-19h	%	Take effect immediately	F
	25	JOG Test Run Speed Command	2047-1Ah	r/min	Take effect immediately	F
	26	Test Run Distance	2047-1Bh	r	Take effect immediately	F
	27	Test Run Waiting Interval	2047-1Ch	ms	Take effect immediately	F
	28	Test Run Cycle Count	2047-1Dh	counts	Take effect immediately	F
	29	Test Run	2047-1Eh	ms/(1000r/	Take effect	F

		Acceleration/Deceleration Time		min)	immediately	

Category	No.	Name	EtherCAT Address	Unit	Activation
P50	00	STO Fault Flag	2050-01h	-	Take effect immediately
	01	STO Buffer Diagnosis and Filter Time	2050-02h	ms	Take effect immediately
	02	STO Power Supply and Optocoupler Diagnosis and Filter Time	2050-03h	ms	Take effect immediately
	04	STO Version	2050-05h	-	Take effect immediately
	05	STO Real-time Running Timestamp	2050-06h	-	Take effect immediately

Category	No.	Name	EtherCAT Address	Unit	Activation	Mode
P60	00	Slave Station Alias	2060-01h	-	Take effect after power off	F
	01	Slave Station Alias Source	2060-02h	-	Take effect after power off	F
	02	Synchronization Time Compensation Value 1	2060-03h	us	Take effect immediately	CSP
	03	Synchronization Time Compensation Value 2	2060-04h	us	Take effect immediately	CSP
	04	Synchronization Mode Command Delay Cycle Count	2060-05h	-	Take effect after power off	CSP
	05	CSP Mode Safe Auto-run Position Setting	2060-06h	-	Take effect immediately	CSP
	06	Synchronization Mode Loss Threshold Setting	2060-07h	-	Take effect immediately	CSP
	07	Compensation Limit Value	2060-08h	ns	Take effect immediately	CSP
	08	Synchronization Switching Time	2060-09h	ns	Take effect immediately	CSP
	09	Synchronization Mode Setting	2060-0Ah	-	Take effect after re-enable	CSP
	10	RPDO Byte Count	2060-0Bh	counts	Take effect immediately	PP/PV/PT/ CSP/CSV/C ST/HM
	11	TPDO Byte Count	2060-0Ch	counts	Take effect	PP/PV/PT/

					immediately	CSP/CSV/CST/HM
	12	SM2 Loss Count	2060-0Dh	counts	Take effect immediately	PP/PV/PT/CSP/CSV/CST/HM
	13	Sync Loss Count	2060-0Eh	counts	Take effect immediately	PP/PV/PT/CSP/CSV/CST/HM
	14	Synchronization Drift Excess Count	2060-0Fh	counts	Take effect immediately	PP/PV/PT/CSP/CSV/CST/HM
	15	Slave Station Formal Name	2060-10h	-	Take effect immediately	PP/PV/PT/CSP/CSV/CST/HM
	19	Communication Operation E2 Setting	2060-14h	-	Take effect immediately	PP/PV/PT/CSP/CSV/CST/HM
	21	Port 0 Invalid Frame Count (300)	2060-16h	counts	Take effect immediately	PP/PV/PT/CSP/CSV/CST/HM
	22	Port 0 Receive Error Count (301)	2060-17h	counts	Take effect immediately	PP/PV/PT/CSP/CSV/CST/HM
	23	Port 0 Forward Error Count (308)	2060-18h	counts	Take effect immediately	PP/PV/PT/CSP/CSV/CST/HM
	24	EPU Error Count (30C)	2060-19h	counts	Take effect immediately	PP/PV/PT/CSP/CSV/CST/HM
	25	Port 0 Link Loss Count (310)	2060-1Ah	counts	Take effect immediately	PP/PV/PT/CSP/CSV/CST/HM
	26	Port 1 Invalid Frame Count (302)	2060-1Bh	counts	Take effect immediately	PP/PV/PT/CSP/CSV/CST/HM
	27	Port 1 Receive Error Count (303)	2060-1Ch	counts	Take effect immediately	PP/PV/PT/CSP/CSV/CST/HM
	28	Port 1 Forward Error Count (309)	2060-1Dh	counts	Take effect immediately	PP/PV/PT/CSP/CSV/CST/HM
	29	PDI Error Count (30D)	2060-1Eh	counts	Take effect immediately	PP/PV/PT/CSP/CSV/CST/HM

	30	Port 1 Link Loss Count (311)	2060-1Fh	counts	Take effect immediately	PP/PV/PT/ CSP/CSV/C ST/HM
	31	Internal SM Watchdog Value	2060-20h	-	Take effect after power off	PP/PV/PT/ CSP/CSV/C ST/HM
	32	SM Sync0 Watchdog Value	2060-21h	-	Take effect after power off	PP/PV/PT/ CSP/CSV/C ST/HM
	33	Synchronization Function Setting	2060-22h	-	Take effect after power off	PP/PV/PT/ CSP/CSV/C ST/HM
	34	Synchronization Error Detection Setting	2060-23h	-	Take effect after power off	PP/PV/PT/ CSP/CSV/C ST/HM
	36	Valid Output/Input Watchdog Time	2060-25h	-	Take effect after power off	PP/PV/PT/ CSP/CSV/C ST/HM
	37	Synchronization Cycle Minimum Value Setting	2060-26h	-	Take effect after power off	PP/PV/PT/ CSP/CSV/C ST/HM
	38	Synchronization Cycle Maximum Value Setting	2060-27h	-	Take effect after power off	PP/PV/PT/ CSP/CSV/C ST/HM

Category	No.	Name	EtherCAT Address	Unit	Activation	Mode
PA0	11	Motor Model Input	20A0-0Ch	-	Take effect after re-enable	PP/PV/PT/ CSP/CSV/C ST/HM
PA1	00	Encoder Selection	20A1-01h	-	Take effect after power off	PP/PV/PT/ CSP/CSV/C ST/HM
	17	Encoder Feedback Pulse Digital Filter	20A1-12h	-	Take effect immediately	PP/PV/PT/ CSP/CSV/C ST/HM

Category	No.	Name	EtherCAT Address	Unit	Activation	Mode
PA2	00	MCU1 Version Number	20A2-01h	-	Take effect immediately	PP/PV/PT/ CSP/CSV/C ST/HM
	01	MCU2 Version Number	20A2-02h	-	Take effect immediately	PP/PV/PT/ CSP/CSV/C ST/HM
	02	FPGA Version Number	20A2-03h	-	Take effect immediately	PP/PV/PT/ CSP/CSV/C ST/HM
	06	Drive Voltage Class	20A2-07h	V	Take effect immediately	PP/PV/PT/ CSP/CSV/C ST/HM
	07	Drive Rated Power	20A2-08h	W	Take effect immediately	PP/PV/PT/ CSP/CSV/C ST/HM
	08	Drive Rated Current	20A2-09h	A	Take effect immediately	PP/PV/PT/ CSP/CSV/C ST/HM
	09	Drive Maximum Current	20A2-0Ah	A	Take effect immediately	PP/PV/PT/ CSP/CSV/C ST/HM
	12	Dead Time Compensation Coefficient 1	20A2-0Dh	-	Take effect immediately	PP/PV/PT/ CSP/CSV/C ST/HM
	13	Dead Time Compensation Coefficient 2	20A2-0Eh	-	Take effect immediately	PP/PV/PT/ CSP/CSV/C ST/HM
	19	Current Loop Gain	20A2-14h	Hz	Take effect immediately	PP/PV/PT/ CSP/CSV/C ST/HM
	20	Current Loop Integral Time	20A2-15h	ms	Take effect immediately	PP/PV/PT/ CSP/CSV/C ST/HM
	21	Current Differential Coefficient	20A2-16h	-	Take effect immediately	PP/PV/PT/ CSP/CSV/C ST/HM
	40	Control Supply Undervoltage Value	20A2-29h	V	Take effect immediately	PP/PV/PT/ CSP/CSV/C ST/HM
	42	Main Power Loss Detection Delay	20A2-2Bh	ms	Take effect immediately	PP/PV/PT/ CSP/CSV/C ST/HM

	43	DC Bus Undervoltage (LV) Detection Delay	20A2-2Ch	ms	Take effect immediately	PP/PV/PT/CSP/CSV/CST/HM
	52	Bus Voltage Discharge Control Mode	20A2-35h	-	Take effect after power off	PP/PV/PT/CSP/CSV/CST/HM
	94	Hardware Version	20A2-5Fh	-	Take effect immediately	PP/PV/PT/CSP/CSV/CST/HM

3.1.2 1000 Parameter

Index	Sub	Name	Unit	Default	Minimum value	Maximum Value	Mode
1000h	00h	Device Type	-	0	0	0	PP/PV/PT/CSP/CSV/CST/HM
1001h	00h	Fault Register	-	0	0	0	PP/PV/PT/CSP/CSV/CST/HM
1018h	01h	Manufacturer Code	-	0	0	0	PP/PV/PT/CSP/CSV/CST/HM
1018h	02h	Product Code	-	0	0	0	PP/PV/PT/CSP/CSV/CST/HM
1018h	03h	Revision Code	-	1	0	1	PP/PV/PT/CSP/CSV/CST/HM
1018h	04h	Serial Number	-	1	0	1	PP/PV/PT/CSP/CSV/CST/HM
10F1h	02h	Synchronization Error Counter Limit Value	-	9	0	200	PP/PV/PT/CSP/CSV/CST/HM
1600h	00h	RPDO1 Valid Mapping Object Count	-	3	0	16	PP/PV/PT/CSP/CSV/CST/HM
1600h	01h	RPDO1 Mapping Object 1	-	0x6040 0010	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1600h	02h	RPDO1 Mapping Object 2	-	0x607A 0020	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1600h	03h	RPDO1 Mapping Object 3	-	0x60B8 0010	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1600h	04h	RPDO1 Mapping Object 4	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1600h	05h	RPDO1 Mapping Object 5	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1600h	06h	RPDO1 Mapping Object 6	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1600h	07h	RPDO1 Mapping Object 7	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1600h	08h	RPDO1 Mapping Object 8	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM

1600h	09h	RPDO1 Mapping Object 9	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1600h	0Ah	RPDO1 Mapping Object 10	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1600h	0Bh	RPDO1 Mapping Object 11	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1600h	0Ch	RPDO1 Mapping Object 12	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1600h	0Dh	RPDO1 Mapping Object 13	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1600h	0Eh	RPDO1 Mapping Object 14	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1600h	0Fh	RPDO1 Mapping Object 15	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1600h	10h	RPDO1 Mapping Object 16	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1601h	00h	RPDO2 Valid Mapping Object Count	-	6	0	16	PP/PV/PT/CSP/CSV/CST/HM
1601h	01h	RPDO2 Mapping Object 1	-	0x6040 0010	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1601h	02h	RPDO2 Mapping Object 2	-	0x607A 0020	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1601h	03h	RPDO2 Mapping Object 3	-	0x6081 0020	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1601h	04h	RPDO2 Mapping Object 4	-	0x6083 0020	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1601h	05h	RPDO2 Mapping Object 5	-	0x6084 0020	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1601h	06h	RPDO2 Mapping Object 6	-	0x6060 0008	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1601h	07h	RPDO2 Mapping Object 7	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1601h	08h	RPDO2 Mapping Object 8	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1601h	09h	RPDO2 Mapping Object 9	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1601h	0Ah	RPDO2 Mapping Object 10	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1601h	0Bh	RPDO2 Mapping Object 11	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1601h	0Ch	RPDO2 Mapping Object 12	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1601h	0Dh	RPDO2 Mapping	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM

		Object 13					
1601h	0Eh	RPDO2 Mapping Object 14	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1601h	0Fh	RPDO2 Mapping Object 15	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1601h	10h	RPDO2 Mapping Object 16	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1602h	00h	RPDO3 Valid Mapping Object Count	-	5	0	16	PP/PV/PT/CSP/CSV/CST/HM
1602h	01h	RPDO3 Mapping Object 1	-	0x6040 0010	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1602h	02h	RPDO3 Mapping Object 2	-	0x60FF 0020	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1602h	03h	RPDO3 Mapping Object 3	-	0x6083 0020	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1602h	04h	RPDO3 Mapping Object 4	-	0x6084 0020	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1602h	05h	RPDO3 Mapping Object 5	-	0x6060 0008	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1602h	06h	RPDO3 Mapping Object 6	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1602h	07h	RPDO3 Mapping Object 7	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1602h	08h	RPDO3 Mapping Object 8	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1602h	09h	RPDO3 Mapping Object 9	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1602h	0Ah	RPDO3 Mapping Object 10	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1602h	0Bh	RPDO3 Mapping Object 11	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1602h	0Ch	RPDO3 Mapping Object 12	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1602h	0Dh	RPDO3 Mapping Object 13	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1602h	0Eh	RPDO3 Mapping Object 14	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1602h	0Fh	RPDO3 Mapping Object 15	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1602h	10h	RPDO3 Mapping Object 16	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1603h	00h	RPDO4 Valid Mapping Object	-	7	0	16	PP/PV/PT/CSP/CSV/CST/HM

		Count					
1603h	01h	RPDO4 Mapping Object 1	-	0x6040 0010	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1603h	02h	RPDO4 Mapping Object 2	-	0x6098 0008	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1603h	03h	RPDO4 Mapping Object 3	-	0x6099 0120	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1603h	04h	RPDO4 Mapping Object 4	-	0x6099 0220	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1603h	05h	RPDO4 Mapping Object 5	-	0x609A 0020	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1603h	06h	RPDO4 Mapping Object 6	-	0x607C 0020	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1603h	07h	RPDO4 Mapping Object 7	-	0x6060 0008	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1603h	08h	RPDO4 Mapping Object 8	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1603h	09h	RPDO4 Mapping Object 9	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1603h	0Ah	RPDO4 Mapping Object 10	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1603h	0Bh	RPDO4 Mapping Object 11	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1603h	0Ch	RPDO4 Mapping Object 12	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1603h	0Dh	RPDO4 Mapping Object 13	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1603h	0Eh	RPDO4 Mapping Object 14	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1603h	0Fh	RPDO4 Mapping Object 15	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1603h	10h	RPDO4 Mapping Object 16	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A00h	00h	TPDO1 Valid Mapping Object Count	-	7	0	16	PP/PV/PT/CSP/CSV/CST/HM
1A00h	01h	TPDO1 Mapping Object 1	-	0x603F 0010	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A00h	02h	TPDO1 Mapping Object 2	-	0x6041 0010	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A00h	03h	TPDO1 Mapping Object 3	-	0x6061 0008	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A00h	04h	TPDO1 Mapping Object 4	-	0x6064 0020	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM

1A00h	05h	TPDO1 Mapping Object 5	-	0x60B9 0010	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A00h	06h	TPDO1 Mapping Object 6	-	0x60BA 0020	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A00h	07h	TPDO1 Mapping Object 7	-	0x60FD 0020	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A00h	08h	TPDO1 Mapping Object 8	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A00h	09h	TPDO1 Mapping Object 9	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A00h	0Ah	TPDO1 Mapping Object 10	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A00h	0Bh	TPDO1 Mapping Object 11	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A00h	0Ch	TPDO1 Mapping Object 12	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A00h	0Dh	TPDO1 Mapping Object 13	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A00h	0Eh	TPDO1 Mapping Object 14	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A00h	0Fh	TPDO1 Mapping Object 15	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A00h	10h	TPDO1 Mapping Object 16	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A01h	00h	TPDO2 Valid Mapping Object Count	-	0	0	16	PP/PV/PT/CSP/CSV/CST/HM
1A01h	01h	TPDO2 Mapping Object 1	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A01h	02h	TPDO2 Mapping Object 2	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A01h	03h	TPDO2 Mapping Object 3	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A01h	04h	TPDO2 Mapping Object 4	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A01h	05h	TPDO2 Mapping Object 5	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A01h	06h	TPDO2 Mapping Object 6	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A01h	07h	TPDO2 Mapping Object 7	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A01h	08h	TPDO2 Mapping Object 8	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A01h	09h	TPDO2 Mapping	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM

		Object 9					
1A01h	0Ah	TPDO2 Mapping Object 10	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A01h	0Bh	TPDO2 Mapping Object 11	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A01h	0Ch	TPDO2 Mapping Object 12	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A01h	0Dh	TPDO2 Mapping Object 13	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A01h	0Eh	TPDO2 Mapping Object 14	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A01h	0Fh	TPDO2 Mapping Object 15	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1A01h	10h	TPDO2 Mapping Object 16	-	0	0	0x7FFFFFFF	PP/PV/PT/CSP/CSV/CST/HM
1C00h	01h	SM0 Communication Type	-	1	0	0	PP/PV/PT/CSP/CSV/CST/HM
1C00h	02h	SM1 Communication Type	-	2	0	0	PP/PV/PT/CSP/CSV/CST/HM
1C00h	03h	SM2 Communication Type	-	3	0	0	PP/PV/PT/CSP/CSV/CST/HM
1C00h	04h	SM3 Communication Type	-	4	0	0	PP/PV/PT/CSP/CSV/CST/HM
1C12h	00h	Sub-index Count	-	1	0	4	PP/PV/PT/CSP/CSV/CST/HM
1C12h	01h	SM2 PDO Mapping Index 0	-	0x1600	0	0x1700	PP/PV/PT/CSP/CSV/CST/HM
1C12h	02h	SM2 PDO Mapping Index 1	-	0	0	0x1700	PP/PV/PT/CSP/CSV/CST/HM
1C12h	03h	SM2 PDO Mapping Index 2	-	0	0	0x1700	PP/PV/PT/CSP/CSV/CST/HM
1C12h	04h	SM2 PDO Mapping Index 3	-	0	0	0x1700	PP/PV/PT/CSP/CSV/CST/HM
1C13h	00h	Sub-index Count	-	1	0	4	PP/PV/PT/CSP/CSV/CST/HM
1C13h	01h	SM3 PDO Mapping Index 0	-	0x1A00	0	0x1B00	F
1C13h	02h	SM3 PDO Mapping Index 1	-	0	0	0x1B00	F
1C13h	03h	SM3 PDO Mapping Index 2	-	0	0	0x1B00	F
1C13h	04h	SM3 PDO Mapping	-	0	0	0x1B00	F

		Index 3					
1C32h	01h	Synchronization Type	-	0	0	0	PP/PV/PT/CSP/CSV/CST/HM
1C32h	02h	Synchronization Cycle	-	0	0	0	CSV/CST/HM
1C32h	03h	Offset Time	-	0	0	0	CSV/CST/HM
1C32h	04h	Supported Synchronization Types	-	0	0	0	PP/PV/PT/CSP/CSV/CST/HM
1C32h	05h	Minimum Synchronization Cycle	-	0	0	0	PP/PV/PT/CSP/CSV/CST/HM
1C32h	06h	Calculation and Copy Time	-	0	0	0	PP/PV/PT/CSP/CSV/CST/HM
1C32h	07h	Reserved	-	0	0	0	CSV/CST/HM
1C32h	08h	Obtain Synchronization Cycle	-	0	0	0	CSV/CST/HM
1C32h	09h	Delay	-	0	0	0	CSV/CST/HM
1C32h	0Ah	Sync0 Synchronization Cycle	-	0	0	0	CSV/CST/HM
1C32h	0Bh	Sync Manager Time Loss Count	-	0	0	0	PP/PV/PT/CSP/CSV/CST/HM
1C32h	0Ch	Cycle Excess Count	-	0	0	0	CSV/CST/HM
1C32h	0Dh	Offset Excess Count	-	0	0	0	PP/PV/PT/CSP/CSV/CST/HM
1C32h	0Eh	PDO Flip Count	-	0	0	0	PP/PV/PT/CSP/CSV/CST/HM
1C32h	0Fh	Minimum Synchronization Cycle Measured Value	-	0	0	0	PP/PV/PT/CSP/CSV/CST/HM
1C32h	10h	Maximum Synchronization Cycle Measured Value	-	0	0	0	PP/PV/PT/CSP/CSV/CST/HM
1C32h	11h	Minimum Measured Value Between Sync Manager Event and Synchronization Time	-	0	0	0	PP/PV/PT/CSP/CSV/CST/HM
1C32h	12h	Maximum Measured Value Between Sync Manager Event and	-	0	0	0	PP/PV/PT/CSP/CSV/CST/HM

		Synchronization Time					
1C33h	01h	Synchronization Type	-	0	0	0	PP/PV/PT/CSP/CSV/CST/HM
1C33h	02h	Synchronization Cycle	-	0	0	0	PP/PV/PT/CSP/CSV/CST/HM
1C33h	03h	Offset Time	-	0	0	0	PP/PV/PT/CSP/CSV/CST/HM
1C33h	04h	Supported Synchronization Types	-	0	0	0	PP/PV/PT/CSP/CSV/CST/HM
1C33h	05h	Minimum Synchronization Cycle	-	0	0	0	PP/PV/PT/CSP/CSV/CST/HM
1C33h	06h	Calculation and Copy Time	-	0	0	0	PP/PV/PT/CSP/CSV/CST/HM
1C33h	07h	Reserved	-	0	0	0	PP/PV/PT/CSP/CSV/CST/HM
1C33h	08h	Obtain Synchronization Cycle	-	0	0	0	PP/PV/PT/CSP/CSV/CST/HM
1C33h	09h	Delay	-	0	0	0	PP/PV/PT/CSP/CSV/CST/HM
1C33h	0Ah	Sync0 Synchronization Cycle	-	0	0	0	PP/PV/PT/CSP/CSV/CST/HM
1C33h	0Bh	Sync Manager Time Loss Count	-	0	0	0	PP/PV/PT/CSP/CSV/CST/HM
1C33h	0Ch	Cycle Undersize Count	-	0	0	0	PP/PV/PT/CSP/CSV/CST/HM
1C33h	0Dh	Offset Undersize Count	-	0	0	0	PP/PV/PT/CSP/CSV/CST/HM

3.1.3 6000 402 Parameter

Index	Sub	Name	Unit	Default	Minimum value	Maximum Value	Mapping Type	Mode
603Fh	00h	Error Code	-	0	0	0xFFFF	TPDO	PP/PV/PT/CSP/CSV/CST/HM
6040h	00h	Control Word	-	0	0	0xFFFF	RPDO	PP/PV/PT/CSP/CSV/CST/HM
6041h	00h	Status Word	-	0	0	0xFFFF	TPDO	PP/PV/PT/CSP/CSV/CST/HM
605Ah	00h	Quick Stop Mode Selection	-	2	0	6	RPDO	PP/PV/PT/CSP/CSV/CST/HM

605Ch	00h	Disable Stop Mode Selection	-	0	0	8	RPDO	PP/PV/PT/CSP/CSV/CST/HM
605Dh	00h	Pause Stop Mode Selection	-	1	1	3	RPDO	PP/PV/PT/CSP/CSV/CST/HM
605Eh	00h	Warning Stop Code	-	0	0	8	RPDO	PP/PV/PT/CSP/CSV/CST/HM
6060h	00h	Operation Mode Setting	-	8	1	10	RPDO	PP/PV/PT/CSP/CSV/CST/HM
6061h	00h	Operation Mode Display	-	8	1	10	TPDO	PP/PV/PT/CSP/CSV/CST/HM
6062h	00h	Position Command	unit	0	-2147483648	2147483647	TPDO	PP/CSP/HM
6063h	00h	Actual Internal Position	pulse	0	-2147483648	2147483647	TPDO	PP/PV/PT/CSP/CSV/CST/HM
6064h	00h	Actual Feedback Position	unit	0	-2147483648	2147483647	TPDO	PP/PV/PT/CSP/CSV/CST/HM
6065h	00h	Position Deviation Window	unit	27486951	0	2147483647	RPDO	PP/CSP/HM
6066h	00h	Position Deviation Detection Time	ms	0	0	65535	RPDO	PP/CSP/HM
6067h	00h	Position Window	unit	5872	0	2147483647	RPDO	PP/CSP/HM
6068h	00h	Position Window Time	ms	300	0	65535	RPDO	PP/CSP/HM
6069h	00h	Speed Sensor Actual Value	-	0	-2147483648	2147483647	TPDO	PP/PV/PT/CSP/CSV/CST/HM
606Bh	00h	Internal Command Speed	unit/s	0	-2147483648	2147483647	TPDO	PV/CSV
606Ch	00h	Actual Feedback Speed	unit/s	0	-2147483648	2147483647	TPDO	PP/PV/PT/CSP/CSV/CST/HM
606Dh	00h	Speed Window	r/min	10	0	65535	RPDO	PV/CSV
606Eh	00h	Speed Window Time	ms	0	0	65535	RPDO	PV/CSV
606Fh	00h	Zero Speed Threshold	unit/s	10	0	65535	RPDO	PV/CSV
6070h	00h	Zero Speed	ms	0	0	65535	RPDO	PV/CSV

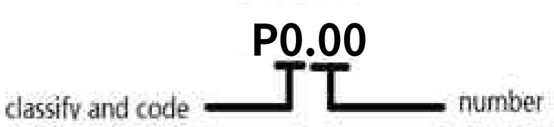
		Threshold Time						
6071h	00h	Target Torque	0.1%	0	-7500	7500	RPDO	PT/CST
6072h	00h	Max Torque	0.1%	5000	0	7500	RPDO	PP/PV/PT/CSP/CSV/ CST/HM
6073h	00h	Max Current	0.1%	5000	0	7500	TPDO	PP/PV/PT/CSP/CSV/ CST/HM
6074h	00h	Torque Command	0.1%	0	-7500	7500	TPDO	PP/PV/PT/CSP/CSV/ CST/HM
6075h	00h	Motor Rated Current	mA	3000	0	2147483647	TPDO	PP/PV/PT/CSP/CSV/ CST/HM
6077h	00h	Actual Torque	0.1%	0	-7500	7500	TPDO	PP/PV/PT/CSP/CSV/ CST/HM
6079h	00h	DC Bus Voltage	mV	0	0	2147483647	TPDO	PP/PV/PT/CSP/CSV/ CST/HM
607Ah	00h	Target Position	unit	0	-2147483648	2147483647	RPDO	PP/CSP
607Ch	00h	Zero Offset	unit	0	-2147483648	2147483647	RPDO	HM
607Dh	01h	Soft Limit Min	unit	0	-2147483648	2147483647	RPDO	PP/CSP
607Dh	02h	Soft Limit Max	unit	0	-2147483648	2147483647	RPDO	PP/CSP
607Eh	00h	Motor Running Direction	-	0	0	255	RPDO	PP/PV/PT/CSP/CSV/ CST/HM
607Fh	00h	Max Protocol Speed	unit/s	838860800	0	2147483647	RPDO	PP/HM/PV/CST
6080h	00h	Motor Max Speed	r/min	10000	0	2147483647	RPDO	PP/PV/PT/CSP/CSV/ CST/HM
6081h	00h	Protocol Speed	unit/s	13981013	0	2147483647	RPDO	PP
6083h	00h	Protocol Acceleration	unit/s²	1398101333	0	2147483647	RPDO	PP/PV
6084h	00h	Protocol Deceleration	unit/s²	1398101333	0	2147483647	RPDO	PP/PV
6085h	00h	Emergency Stop Deceleration	unit/s²	2147483647	0	2147483647	RPDO	PP/PV/HM/CSP/CSV
6087h	00h	Torque Slope	0.1%/s	2147483647	0	2147483647	RPDO	PT
608Fh	01h	Encoder Resolution	pulse	0	0	2147483647	TPDO	PP/PV/PT/CSP/CSV/ CST/HM

6091h	01h	Electronic Gear Ratio Numerator	r	1	1	2147483647	RPDO	PP/PV/PT/CSP/CSV/CST/HM
6091h	02h	Electronic Gear Ratio Denominator	r	1	1	2147483647	RPDO	PP/PV/PT/CSP/CSV/CST/HM
6092h	01h	Required Command Pulses Per Motor Revolution	unit	0	0	67108864	RPDO	PP/PV/PT/CSP/CSV/CST/HM
6098h	00h	Homing Method	-	19	-6	37	RPDO	HM
6099h	01h	Homing High Speed	unit/s	13981013	0	2147483647	RPDO	HM
6099h	02h	Homing Low Speed	unit/s	1398101	0	2147483647	RPDO	HM
609Ah	00h	Homing Acceleration/Deceleration	unit/s²	1398101333	1	2147483647	RPDO	HM
60B0h	00h	Position Feedforward	unit	0	-2147483648	2147483647	RPDO	PP/CSP
60B1h	00h	Velocity Feedforward	unit/s	0	-2147483648	2147483647	RPDO	PP/PV/HM/CSP/CSV
60B2h	00h	Torque Feedforward	0.1%	0	-32768	32767	RPDO	PP/PV/PT/CSP/CSV/CST/HM
60B8h	00h	Probe Function	-	0	0	0xFFFF	RPDO	PP/PV/PT/CSP/CSV/CST/HM
60B9h	00h	Probe Status	-	0	0	0xFFFF	TPDO	PP/PV/PT/CSP/CSV/CST/HM
60BAh	00h	Probe 1 Rising Edge Captured Position	unit	0	-2147483648	2147483647	TPDO	PP/PV/PT/CSP/CSV/CST/HM
60BBh	00h	Probe 1 Falling Edge Captured Position	unit	0	-2147483648	2147483647	TPDO	PP/PV/PT/CSP/CSV/CST/HM
60BCh	00h	Probe 2 Rising Edge Captured Position	unit	0	-2147483648	2147483647	TPDO	PP/PV/PT/CSP/CSV/CST/HM
60BDh	00h	Probe 2 Falling Edge Captured Position	unit	0	-2147483648	2147483647	TPDO	PP/PV/PT/CSP/CSV/CST/HM
60C5h	00h	Protocol Max	unit/s²	214748	1	214748364	RPDO	PP/PV/PT/CSP/CSV/

		Acceleration		3647		7		CST/HM
60C6h	00h	Protocol Max Deceleration	unit/s²	2147483647	1	2147483647	RPDO	PP/PV/PT/CSP/CSV/CST/HM
60D0h	01h	Probe 1 Source	-	5	1	16	-	PP/PV/PT/CSP/CSV/CST/HM
60D0h	02h	Probe 2 Source	-	6	1	16	-	PP/PV/PT/CSP/CSV/CST/HM
60D5h	00h	Probe 1 Rising Edge Capture Count	-	0	0	65535	TPDO	PP/PV/PT/CSP/CSV/CST/HM
60D6h	00h	Probe 1 Falling Edge Capture Count	-	0	0	65535	TPDO	PP/PV/PT/CSP/CSV/CST/HM
60D7h	00h	Probe 2 Rising Edge Capture Count	-	0	0	65535	TPDO	PP/PV/PT/CSP/CSV/CST/HM
60D8h	00h	Probe 2 Falling Edge Capture Count	-	0	0	65535	TPDO	PP/PV/PT/CSP/CSV/CST/HM
60E0h	00h	Positive Max Torque Limit	0.1%	5000	0	7500	RPDO	PP/PV/PT/CSP/CSV/CST/HM
60E1h	00h	Negative Max Torque Limit	0.1%	5000	0	7500	RPDO	PP/PV/PT/CSP/CSV/CST/HM
60F4h	00h	Actual Following Error	unit	0	-2147483648	2147483647	TPDO	PP/CSP/HM
60FAh	00h	Position Loop Output Speed	unit/s	0	-2147483648	2147483647	TPDO	PP/CSP/HM
60FCh	00h	Internal Command Position	pulse	0	-2147483648	2147483647	TPDO	PP/CSP/HM
60FDh	00h	Input IO Status Mapping	-	0	0	0xFFFFFFFF	TPDO	PP/PV/PT/CSP/CSV/CST/HM
60FEh	01h	Output IO Valid	-	0	0	0xFFFFFFFF	RPDO	PP/PV/PT/CSP/CSV/CST/HM
60FEh	02h	Output IO Enable	-	0x7FFF0000	0	0xFFFFFFFF	RPDO	PP/PV/PT/CSP/CSV/CST/HM
60FFh	00h	Target Speed	unit/s	0	-2147483648	2147483647	RPDO	PP/PV/PT/CSP/CSV/CST/HM
6502h	01h	Supported Operation Modes	-	0	0	0xFFFFFFFF	TPDO	PP/PV/PT/CSP/CSV/CST/HM

3.2 General Parameters

- Panel Display as follows:



- Parameter valid under following modes
  CSP: Cyclic synchronous position mode
  CSV: Cyclic synchronous velocity mode
  CST: Cyclic synchronous torque mode
  HM: Homing mode
  PP: Profile position mode
  PV: Profile velocity mode
  PT: Profile torque mode
  F: All modes

3.2.1【Class P00】Basic Settings

P00.01	**Label**	Control Mode Settings	**Mode**	F		
	Range	0~9	**Default**	9	**Unit**	-
	Activation	After restart	**Attribute**	RW	**Index**	2000-02h

Set value to use following control modes：

Value	Content	Details
0-8	Reserved	Reserved
9	EtherCAT mode	PP/PV/PT/HM/CSP/CSV/CST

P00.06	**Label**	Command polarity inversion	**Mode**	F		
	Range	0 ~ 1	**Default**	0	**Unit**	—
	Activation	After restart	**Attribute**	RW	**Index**	2000-07h

Used to change the rotational direction of the motor.

Set value	Details
0	Polarity of the command is not inversed. The direction of rotation is consistent with the polarity of command.
1	Polarity of command is inversed. The direction of rotation is opposite to the polarity of command.

Note: Rotational direction of the motor is recommended to be set through object dictionary 607E. However, P00.06 has higher priority than object dictionary 607E. 607E only takes effect when P00.06 = 0.

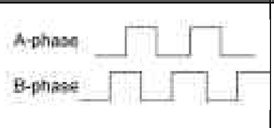
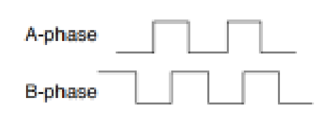
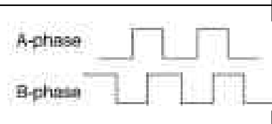
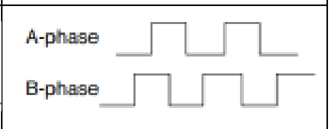
P00.11	Label	Frequency-divided pulse output per revolution	Mode	F		
	Range	1~4194304	Default	2500	Unit	P/r
	Activation	After restart	Attribute	RW	Index	2000-0Ch

Set the number of output pulses from phase A and phase B of the frequency division output terminals for one revolution of the motor, which is used as position feedback in the host device. The pulse resolution output from the frequency division terminals for one revolution of the motor = P00.11×4.
When setting this parameter, the following condition must be satisfied: motor speed × P00.11 (number of pulses output by the encoder per revolution) × 4 ≤ 1MHz. If this value exceeds 1MHz, alarm Er280 will be triggered.

P00.12	Label	Frequency-divided output logic inversion	Mode	F		
	Range	0~1	Default	0	Unit	-
	Activation	After restart	Attribute	RW	Index	2000-0Dh

To set phase B logic and output source from encoder pulse output. To inverse B-Phase pulse logic and change the phase relation between Phase A and Phase B

Pulse output logic inversion

P00.12	Phase B logic	CW direction	CCW direction
[0]	Not inverted		
[1]	Inverted		

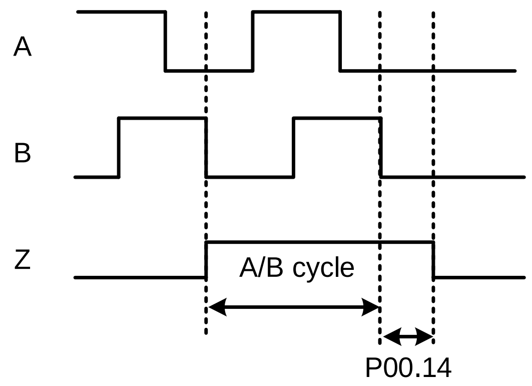
P00.13	Label	Frequency divider output - Z signal polarity	Mode	F		
	Range	0~1	Default	0	Unit	%
	Activation	Immediate	Attribute	RW	Index	2000-0Eh

Set the polarity of the Z signal for frequency division output:
0: Positive polarity; 1: Negative polarity.

P00.14	Label	Frequency divider output – Z-signal width	Mode	F		
	Range	0~100000	Default	30	Unit	Us
	Activation	Immediate	Attribute	RW	Index	2000-0Fh

Set value	Description
【0】	Z bandwidth equivalent to 1 cycle of A/B
1~100000	Delay setting on top of A/B cycle width

When P0014 0, width of frequency divider output Z-signal is equivalent to width of 1 cycle of A/B, value set in P00.14 A/B cycle width = delay setting.



P00.15	Label	Frequency Output Source	Mode	F		
	Range	0~1	Default	1	Unit	-
	Activation	Immediate	Attribute	RW	Index	2000-10h

Set Value	Description
【0】	Disable frequency division output;
1	Use the feedback position of the motor (first encoder) as the frequency division output source;

P00.16	Label	Frequency Output Delay Compensation	Mode	F		
	Range	-1000.0~1000.0	Default	0.0	Unit	us
	Activation	Immediate	Attribute	RW	Index	2000-11h

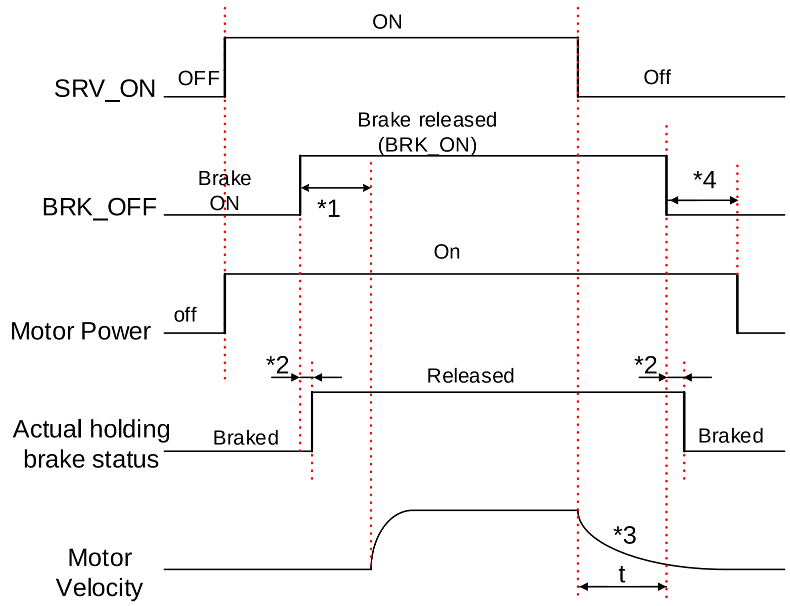
Used to compensate for the fixed delay of frequency division output, allowing the drive to output frequency division pulses in advance or delayed, thereby offsetting the internal processing delay and fully aligning the feedback signal with the actual motor position in time. The larger the value set, the better the compensation effect.

The servo drive processes and divides the frequency of the original high-resolution signal from the motor encoder, then outputs standard A/B quadrature pulses to the host computer as feedback. This processing process introduces an extremely small, fixed time delay (usually in the microsecond level). The function of P00.16 (frequency division output delay compensation) is to actively perform software compensation for this fixed delay.

P00.21	**Label**	Regenerative discharge resistor value	**Mode**	F		
	Range	25~500	**Default**	100	Unit	Ω
	Activation	Immediate	**Attribute**	RW	Index	2000-16h
	To set resistance value of regenerative resistor The values of P00.21 and P00.22 determine the threshold of the over-current alarm Er120 for the discharge circuit. When the set value is greater than the actual regenerative resistance value, the Er120 alarm will occur later compared to the scenario where the resistance value is set correctly.					
P00.22	**Label**	Regenerative discharge resistor Power	**Mode**	F		
	Range	20~5000	**Default**	50	**Unit**	W
	Activation	Immediate	**Attribute**	RW	**Index**	2000-17h
	P00.21 and P00.22 determines the threshold value of Er 120. Please set accordingly or it might trigger false alarm or damage to servo driver. *Note: If external regenerative resistor is used, please set according to its labeled power rating.*					
P00.25	**Label**	Motor power-off delay time	**Mode**	F		
	Range	0~3000	**Default**	150	**Unit**	ms
	Activation	Immediate	**Attribute**	RW	**Index**	2000-1Ah
To set delay time for holding brake to be activated after motor power off to prevent axis from sliding.						

P00.26	**Label**	Delay time for holding brake release	**Mode**	F		
	Range	0~3000	**Default**	0	**Unit**	ms
	Activation	Immediate	**Attribute**	RW	**Index**	2000-1Bh

To set delay time for holding brake to be released after motor power on. Motor will remain at current position and input command is masked to allow holding brake to be fully released before motor is set in motion.



*1: Delay time set in P00.25

*2: Delay time from the moment BRK_OFF signal is given until actual holding brake is released or BRK_ON signal is given until actual holding brake is activated. It is dependent on the holding brake of the motor.

*3: Deceleration time is determined by P00.28 or if motor speed goes below Trigger brake speed, whichever comes first. BRK_OFF given after deceleration time.

*4: P00.25 set time value.

Delay time from the moment SRV_ON is given until BRK_OFF switch to BRK_ON, is less than 500ms.

P00.27	**Label**	Brake release speed setting	**Mode**	F		
	Range	10~3000	**Default**	30	**Unit**	r/min
	Activation	Immediate	**Attribute**	RW	**Index**	2000-1Ch

Set the motor speed threshold when the speed signal BRK is set to OFF (start holding brake) during disable.

When the servo enable is turned off (SRV-OFF), the motor starts to decelerate. When the motor speed is lower than the set value of this parameter and the time of P00.28 has not elapsed, the holding brake signal (BRK-OFF) is output. The actual timing for BRK to be set to OFF is whichever comes first: the time of P00.28 or the time taken for the motor speed to drop to the speed set by P00.27.

	Application examples: Case 1: After disable, if the motor deceleration time has reached the set time of P00.28, even if the motor speed is still higher than the speed set by P00.27, the drive's holding brake signal BRK is set to OFF (start holding brake).Case 2: After disable, if the motor deceleration time has not reached the set time of P00.28, but the motor speed is already lower than the speed set by P00.27, the drive's holding brake signal BRK is set to OFF (start holding brake).

P00.28	**Label**	Max. time to stop after disabling	**Mode**	F		
	Range	0~3000	**Default**	500	**Unit**	ms
	Activation	Immediate	**Attribute**	RW	**Index**	2000-1Dh
	To set the max. time allowed for the axis to stop on emergency stop or normal axis disabling. After disabling axis, if motor speed is still higher than P04.39 but the time set in P00.28 is reached, BRK_ON given and holding brake activated. BRK_ON given time is determined by P00.28 or when motor speed goes below P04.39, whichever comes first. Applications: 1. After disabling axis, if motor speed is still higher than Trigger brake speed but the time set in P00.28 is reached, BRK_ON given and holding brake activated. 2. After disabling axis, if motor speed is already lower than P04.39 but the time set in P00.28 is not yet reached, BRK_ON given and holding brake activated.					

P00.29	**Label**	Mode Switching Deceleration Time	**Mode**	F		
	Range	0~60000	**Default**	0	**Unit**	ms/(1000r/min)
	Activation	Immediate	**Attribute**	RW	**Index**	2000-1Eh
	Used to set the deceleration time for switching between different modes. Switching between speed, position, and torque modes, as well as mutual switching between all EC modes.					

P00.30	Label	Stop Mode when Servo Enable Off	Mode	F		
	Range	0~8	Default	0	Unit	-
	Activation	Immediate	Attribute	RW	Index	2000-1Fh

Value	Description	Deceleration for Servo Braking Stop
0	Servo braking stop, the servo state is dynamic braking after stop;	Determined by P00.37 (Fault deceleration time).
1	Servo braking stop, the servo state is dynamic braking after stop;	In homing mode, deceleration is 609Ah (Homing acceleration/deceleration);in non-homing mode, deceleration is 6084h (Protocol deceleration).
2	Servo braking stop, the servo state is dynamic braking after stop;	Determined by 6085h (Emergency stop deceleration).
3	Servo braking stop, the servo state is free after stop;	When enable is off, the deceleration for servo braking stop is determined by P00.37 (Fault deceleration time).
4	Servo braking stop, the servo state is free after stop;	In homing mode, deceleration is 609Ah (Homing acceleration/deceleration);in non-homing mode, deceleration is 6084h (Protocol deceleration).
5	Servo braking stop, the servo state is free after stop;	Determined by 6085h (Emergency stop deceleration).
6	DB braking stop, the servo state is dynamic braking after stop;	-
7	DB braking stop, the servo state is free after stop;	
8	Free stop, the servo state is free after stop;	

P00.31	Label	Class 1 Fault Stop Mode	Mode	F		
	Range	0~2	Default	0	Unit	-
	Activation	Immediate	Attribute	RW	Index	2000-20h

Set the stop method and stop state for Class 1 faults.

0: Stop via dynamic braking, and the state after stop is dynamic braking state;

1: Stop via free stop method, and the state after stop is free state;

2: Stop via DB braking method, and the state after stop is free state.

<table>
<tr><td rowspan="3">P00.32</td><td>Label</td><td>Class 2 Fault Stop Mode</td><td>Mode</td><td colspan="3">F</td></tr>
<tr><td>Range</td><td>0~8</td><td>Default</td><td>0</td><td>Unit</td><td>-</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td>RW</td><td>Index</td><td>2000-21h</td></tr>
</table>

Set the stop method and stop state for Class 1 faults. P00.32 is equivalent to PF2.08 (605Eh), and the parameters are interrelated, i.e., changing the value of P00.32 will synchronously update PF2.08, and vice versa.

Refer to the table below for the stop methods of Class 2 alarms (excluding Er260/Er570/Er571):

Value	Description	Deceleration for Servo Braking Stop
0	Servo braking stop, the servo state is dynamic braking after stop;	Deceleration is determined by P00.37 (Fault deceleration time)
1	Servo braking stop, the servo state is dynamic braking after stop;	In homing mode, deceleration is 609Ah (Homing acceleration/deceleration);In non-homing mode, deceleration is 6084h (Protocol deceleration)
2	Servo braking stop, the servo state is dynamic braking after stop;	Deceleration is determined by 6085h (Emergency stop deceleration)
3	Servo braking stop, the servo state is free after stop;	Deceleration is determined by P00.37 (Fault deceleration time)
4	Servo braking stop, the servo state is free after stop;	In homing mode, deceleration is 609Ah (Homing acceleration/deceleration);In non-homing mode, deceleration is 6084h (Protocol deceleration)
5	Servo braking stop, the servo state is free after stop;	Deceleration is 6085h (Emergency stop deceleration)
6	DB braking stop, the servo state is dynamic braking after stop;	-
7	DB braking stop, the servo state is free after stop;	
8	Free stop, the servo state is free after stop;	

Note：

• The stop method and deceleration of Er260 (Positive/Negative limit input valid) are selected by P00.34 (Positive/Negative limit stop mode).

• The stop method and deceleration of Er570 (Force alarm input) and Er571 (PC force alarm) are selected by P00.33 (Force stop mode).

<table>
<tr><td rowspan="3">P00.33</td><td>Label</td><td>Forced Stop Mode</td><td>Mode</td><td colspan="3">F</td></tr>
<tr><td>Range</td><td>0~6</td><td>Default</td><td>2</td><td>Unit</td><td>-</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td>RW</td><td>Index</td><td>2000-22h</td></tr>
</table>

Set the force stop mode. This parameter is linked with 605Ah, i.e., changing the value of P00.33 will synchronously update 605Ah.

<table>
<tr><th>Value</th><th>Description</th><th>Deceleration for Servo Braking Stop</th></tr>
<tr><td>0</td><td rowspan="3">Servo braking stop, the servo state is DB state after stop;</td><td>In homing mode, deceleration is 609Ah (Homing acceleration/deceleration); In non-homing mode, deceleration is 6084h (Protocol deceleration).</td></tr>
<tr><td>1</td><td>Deceleration is 6085h (Emergency stop deceleration)</td></tr>
<tr><td>2</td><td>Deceleration is fixed to the maximum value</td></tr>
<tr><td>3</td><td rowspan="4">Servo braking stop, the servo state is free after stop;</td><td>In homing mode, deceleration is 609Ah (Homing acceleration/deceleration); In non-homing mode, deceleration is 6084h (Protocol deceleration).</td></tr>
<tr><td>4</td><td>Deceleration is 6085h (Emergency stop deceleration)</td></tr>
<tr><td>5</td><td>In homing mode, deceleration is 609Ah (Homing acceleration/deceleration); In non-homing mode, deceleration is 6084h (Protocol deceleration).</td></tr>
<tr><td>6</td><td>Deceleration is 6085h (Emergency stop deceleration), continuous enabling</td></tr>
</table>

P00.34	**Label**	Positive/Negative Limit Stop Mode	**Mode**	F			
	Range	0~6	**Default**	0	**Unit**	-	
	Activation	Immediate	**Attribute**	RW	**Index**	2000-23h	

Set the Positive/Negative Limit Stop Mode.

Value	Description
0	Limit Valid Mode: Stop via servo braking, and the deceleration is selected as the larger value between P00.35 (Positive/Negative Limit Deceleration Time) and P00.38 (Maximum Deceleration Time).
1	Limit Invalid Mode.
2	Limit Alarm Trigger Mode: Stop via servo braking, the deceleration is selected as the larger value between P00.35 (Positive/Negative Limit Deceleration Time) and P00.38 (Maximum Deceleration Time), and the servo state is dynamic braking state after stopping.
3	Limit Alarm Trigger Mode: Stop via servo braking, the deceleration is selected as the larger value between P00.35 (Positive/Negative Limit Deceleration Time) and P00.38 (Maximum Deceleration Time), and the servo state is free state after stopping.
4	Limit Alarm Trigger Mode: Stop via DB braking, and the servo state is DB braking state after stopping.
5	Limit Alarm Trigger Mode: Stop via DB braking, and the servo state is free state after stopping.
6	Limit Alarm Trigger Mode: Free stop, and the servo state is free state after stopping.

P00.35	**Label**	Positive/Negative Limit Deceleration Time	**Mode**	F		
	Range	0~60000	**Default**	0	**Unit**	ms/(1000r/min)
	Activation	Immediate	**Attribute**	RW	**Index**	2000-24h

Limit Deceleration Time Setting.

=0, Deceleration is fixed to the maximum deceleration, which is subject to the maximum deceleration time specified in P00.38;

=1~60000, Deceleration time is the set value.

P00.36	**Label**	Emergency stop Deceleration Time	**Mode**	F		
	Range	0~60000	**Default**	0	**Unit**	ms/(1000r/min)
	Activation	Immediate	**Attribute**	RW	**Index**	2000-25h

Emergency stop Time Setting.

=0, Deceleration is fixed to the maximum deceleration, which is subject to the maximum deceleration time specified in P00.38;

=1~60000, Deceleration time is the set value.

P00.37	Label	Fault Deceleration Time	Mode	F		
	Range	0~60000	Default	0	Unit	ms/(1000r/min)
	Activation	Immediate	Attribute	RW	Index	2000-26h
Fault Time Setting. =0, Deceleration is fixed to the maximum deceleration, which is subject to the maximum deceleration time specified in P00.38; =1~60000, Deceleration time is the set value.						

P00.38	Label	Maximum Deceleration Time	Mode	F		
	Range	0~60000	Default	20000	Unit	ms/(1000r/min)
	Activation	Immediate	Attribute	RW	Index	2000-27h
Maximum Time Setting. =0, Deceleration is fixed to the maximum deceleration, which is subject to the maximum deceleration time specified in P00.38; =1~60000, Deceleration time is the set value.						

P00.39	Label	Torque Limit during Immediate Stop	Mode	F		
	Range	0~500	Default	0	Unit	-
	Activation	Immediate	Attribute	RW	Index	2000-28h
Set the torque limit value for the servo brake stop mode. When the set value is 0, it is determined by P12.01 (First Torque Limit); When the set value is non-zero, it is determined by P00.39 (Immediate Stop Torque Limit).						

P00.40	Label	E-Stop Function Selection	Mode	F		
	Range	0~1	Default	0	Unit	-
	Activation	Immediate	Attribute	RW	Index	2000-29h
0：Emergency stop is valid, servo driver will be forced to STOP and alarm occurs. 1：Emergency stop is invalid, servo driver will not be forced to STOP.						

P00.41	Label	Position Feedback Polarity Setting	Mode	F		
	Range	0~1	Default	0	Unit	-
	Activation	Immediate	Attribute	RW	Index	2000-2Ah

	0 When the Force Alarm Input E-STOP is active, the servo performs a forced emergency stop and displays alarm Er570; 1 When the Force Alarm Input E-STOP is active, the servo performs a forced emergency stop and displays warning Ar00. The driver operates normally after the E-STOP signal is released.

P00.43	Label	LED Initial Status	Mode	F		
	Range	0~38	Default	34	Unit	-
	Activation	After restart	Attribute	RW	Index	2000-2Ch

To set content display on front panel of the servo driver at servo driver power on.

Set value	Content	Set value	Content	Set value	Content
0	Position command deviation	14	Regenerative load rate	27	Voltage across Bus
1	Motor speed	15	Motor overload rate	28	Software version
2	Position command velocity	16	Inertia ratio	30	No. of encoder communication error
3	Velocity control command	17	Driver overload rate	32	MCU temperature
4	Actual feedback torque	18	No. of changes in I/O signals	33	Driver temperature
5	Position feedback	19	Time per power-up	34	Servo status
6	Position command	20	Power on total time	35	Motor temperature
7	Maximum torque during motion	21	Single turn position	36	Synchronous period
8	Input commend pulse frequency	22	Multiturn position		
9	Control mode	23	Communication axis address		
10	DI/DO signal status	24	Encoder position deviation		
12	Error cause and history record	25	Motor electrical angle		
13	Driver power	26	Motor mechanical angle		

P00.48	Label	Z-Signal Holding Time	Mode	F		
	Range	1~1000	Default	0	Unit	ms
	Activation	Immediate	Attribute	RW	Index	2000-31h

Z Signal High-Level Hold Time Setting.

Applicable to:

- Z signal in 60FDh
- Z signal during homing;
- Z-phase pulse width for frequency division output, with the unit being 0.1 ms at this

time; Note: When using the above three conditions, the set P00.48 time must be ≥ 0.2 ms.

P00.51	Label	Position unit setting	Mode	P/PP/HM/CSP		
	Range	0~2	Default	0	Unit	-
	Activation	After re-enable	Attribute	RW	Index	2000-34h

Set value	Unit
0	Encoder unit
1	Command unit
2	10000 Pulse / rev

Command unit: Pulse from host (Affected by electronic gear ratio)

Encoder unit: Pulse from encoder (Related to encoder resolution)

P05.20 can only be modified when axis is disabled as it will clear position data.

P00.55	Label	Software Limit Function Setting	Mode	F		
	Range	0~2	Default	2	Unit	-
	Activation	Immediate	Attribute	RW	Index	2000-38h

Set the enabling timing of the soft limit function.

0: Soft limit function disabled;

1: Soft limit function enabled;

2: Enabled after homing is completed.

P00.56	Label	Positive Software Limit	Mode	PR/CSP/PP		
	Range	-2147483648~2147483648	Default	0	Unit	Pulse
	Activation	Immediate	Attribute	RW	Index	2000-39h

Positive Software Limit Position Setting. When the motor position runs to this position, the positive limit is valid. The drive will limit the motor’s forward movement to protect the equipment and ensure operational safety. This parameter is equivalent to 607D-02h (maximum soft limit), and the two are linked; that is, changing P00.56 will result in a corresponding change to 607D-02h.

P00.57	Label	Negative Software Limit	Mode	PR/CSP/PP		
	Range	-2147483648~2147483648	Default	0	Unit	Pulse
	Activation	Immediate	Attribute	RW	Index	2000-3Ah

Negative Software Limit Position Setting. When the motor position runs to this position, the positive limit is valid. The drive will limit the motor’s forward movement to protect the equipment and ensure operational safety. This parameter is equivalent to 607D-01h (minimum soft limit), and the two are linked; that is, changing P00.56 will result in a corresponding change to 607D-01h.

3.2.2【Class P01】Digital DIDO

P01.00	**Label**	Input selection DI1		**Mode**	F		
	Range	0x0~0xFF		**Default**	0x0	**Unit**	-
	Activation	Immediate	**Attribute**	RW		**Index**	2001-01h
P01.01	**Label**	Input selection DI2		**Mode**	F		
	Range	0x0~0xFF		**Default**	0x0	**Unit**	-
	Activation	Immediate	**Attribute**	RW		**Index**	2001-02h
P01.02	**Label**	Input selection DI3		**Mode**	F		
	Range	0x0~0xFF		**Default**	0x0	**Unit**	-
	Activation	Immediate	**Attribute**	RW		**Index**	2001-03h
P01.03	**Label**	Input selection DI4		**Mode**	F		
	Range	0x0~0xFF		**Default**	0x0	**Unit**	-
	Activation	Immediate	**Attribute**	RW		**Index**	2001-04h
P01.04	**Label**	Input selection DI5		**Mode**	F		
	Range	0x0~0xFF		**Default**	0x0	**Unit**	-
	Activation	Immediate	**Attribute**	RW		**Index**	2001-05h
P01.05	**Label**	Input selection DI6		**Mode**	F		
	Range	0x0~0xFF		**Default**	0x0	**Unit**	-
	Activation	Immediate	**Attribute**	RW		**Index**	2001-06h

Digital input DI allocation using hexadecimal system

Input	Symbol	Set value	
		Normally open	Normally close
Invalid Input	—	0	--
Positive limit switch	POT	1	81
Negative limit switch	NOT	2	82
Clear alarm	A-CLR	4	-
Gain switch	GAIN	6	86
Deviation counter clear	CL	7	-
Command pulse inhibit	INH	8	88
Torque limit select	TL-SEL	9	89
Command frequency division/multiplication	DIV1	C	8C
Zero speed clamp	ZEROSPD	11h	91
Speed command sign	VC-SIGN	12h	92
Torque command sign	TC-SIGN	13h	93
Forced alarm	E-STOP	14h	94
Home switch	HOME-SWITCH	16h	96
Speed command sign 2	VC-SIGN2	4A	CA
Proportional speed control valid	-	4B	CB
Proportional speed control 1	-	4C	CC
Proportional speed control 2	-	4D	CD
Proportional speed	-	4E	CE

control 3			
Proportional speed control 4	-	4F	CF

- Please don't set anything other than listed in table above.
- Normally open: Valid when input = ON Normally close: Valid when input = OFF
- Er210 might occur if same function is allocated to different channels at the same time
- Channel that has no value doesn't affect driver motion.
- Front panel is of hexadecimal system.

P01.00~P01.05 corresponds to DI1~DI6, which can be connected to external sensor signals, and the master control can read bit4~bit9 of 60FDh directly to get the real status of DI1~DI6. P01.03/P01.04 corresponds to DI4/DI5, the default setting is 0x0, which is used as probe signal input.

P01.16	**Label**	Output selection DO1		**Mode**	**F**		
	Range	0x0~0xFF		**Default**	0x0	**Unit**	-
	Activation	Immediate	**Attribute**	RW		**Index**	2001-11h
P01.17	**Label**	Output selection DO2		**Mode**	**F**		
	Range	0x0~0xFF		**Default**	0x0	**Unit**	-
	Activation	Immediate	**Attribute**	RW		**Index**	2001-12h
P01.18	**Label**	Output selection DO3		**Mode**	**F**		
	Range	0x0~0xFF		**Default**	0x0	**Unit**	-
	Activation	Immediate	**Attribute**	RW		**Index**	2001-13h

Digital output DO allocation using hexadecimal system.

Output	Symbol	Set value	
		Normally open	Normally close
Master device control	—	00h	-
Alarm	ALM	01h	81h
Servo-Ready	S-RDY	02h	82h
External brake released	BRK-OFF	03h	83h
Positioning completed	INP	04h	84h
At-speed	AT-SPEED	05h	85h
Torque limit signal	TLC	06h	86h
Zero speed clamp detection	ZSP	07h	87h
Velocity coincidence	V-COIN	08h	88h
Position command ON/OFF	P-CMD	0Bh	8Bh
Velocity limit signal	V-LIMIT	0Dh	8Dh
Velocity command ON/OFF	V-CMD	0Fh	8Fh
Servo status	SRV-ST	12h	92h
Homing done	HOME-OK	22h	A2h
DB brake output	-	2Dh	AD

Please don't set any other than the outputs listed in the table above.

- Normally open：Active low
- Normally close：Active high
- Front panel is of hexadecimal system.

P01.16 – P01.18 corresponds to DO1 – DO3. If all parameters are set to 0, master device controls the outputs, object dictionary 0x60FE sub-index 01 bit16-18 corresponds to DO1-DO3.

P01.25	Label	Forced DI/DO Enable Switch		Mode	F	
	Range	0~7		Default	0	Unit	
	Activation	Immediate	Attribute	RW	Index	2001-1Ah

Set the valid source of forced DI/DO. Refer to the table below for the setting method:

Function	Bit Position	Set Value	Description
Forced DI Enable Switch	bit0	0	No forced DI
		1	Set DI force activation based on the value set in P01.26
Forced DO Enable Switch	bit1~2	0	No forced DO
		1	Set DO force activation based on the value set in P01.27
		2	Set DO force activation via 60FEh
		3	Reserved

P01.26	Label	Forced DI Set Value		Mode	F	
	Range	0×0~0×FFFF		Default	0	Unit	
	Activation	Immediate	Attribute	RW	Index	2001-1Bh

DI Input Signal Force Setting. When P01.25 bit0=1, DI can be forced valid by the rules set in this parameter.

P01.26 bit0~bit5 correspond to the forced outputs of DI1~DI6 respectively, and a bit position set to 1 indicates forced validity.

P01.27	Label	Forced DO Set Value		Mode	F	
	Range	0×0~0×FFFF		Default	0	Unit	
	Activation	Immediate	Attribute	RW	Index	2001-1Ch

DO Output Signal Force Setting. When P01.25 bit1~2=1, DO can be forced valid by the rules set in this parameter.

P01.27 bit0~bit3 correspond to the forced outputs of DO1~DO4 respectively, and a bit position set to 1 means forced validity.

P01.28	Label	DI Status		Mode	F	
	Range	-2147483648~2147483647		Default	0	Unit	
	Activation	Immediate	Attribute	RO	RW	2001-1Dh

DI status display.

bit0~bit5 correspond to the statuses of DI1~DI6 respectively.

A bit value of 0 indicates the status OFF;

A bit value of 1 indicates the status ON.

P01.29	**Label**	DO Status	**Mode**	F		
	Range	-2147483648~2147483647	**Default**	0	**Unit**	
	Activation	Immediate	**Attribute**	RO	**Index**	2001-1Eh

DO status display.

bit0~bit3 correspond to the statuses of DO1~DO3 respectively.

A bit value of 0 indicates the status OFF;

A bit value of 1 indicates the status ON.

P01.30	**Label**	DI Filter Setting	**Mode**	F		
	Range	0~25.5	**Default**	1	**Unit**	ms
	Activation	Immediate	**Attribute**	RW	**Index**	2001-1Fh

Set the reading filter time constant of DI to avoid excessive signal interference that causes level jumps. An excessively large setting value will result in control delay.

3.2.3【Class P02】Virtual DIDO

P02.00	**Label**	Virtual DIDO Enable	**Mode**	F		
	Range	0×0~0×1	**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW	**Index**	2002-01h

0: Not enabled;

1: Virtual DI DO enabled.

P02.01	**Label**	VDI-01 Input Selection	**Mode**	F		
	Range	0×0~0×FF	**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW	**Index**	2002-02h
P02.02	**Label**	VDI-02 Input Selection	**Mode**	F		
	Range	0×0~0×FF	**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW	**Index**	2002-03h
P02.03	**Label**	VDI-03 Input Selection	**Mode**	F		
	Range	0×0~0×FF	**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW	**Index**	2002-04h
P02.04	**Label**	VDI-04 Input Selection	**Mode**	F		
	Range	0×0~0×FF	**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW	**Index**	2002-05h
P02.05	**Label**	VDI-05 Input Selection	**Mode**	F		
	Range	0×0~0×FF	**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW	**Index**	2002-06h
P02.06	**Label**	VDI-06 Input Selection	**Mode**	F		
	Range	0×0~0×FF	**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW	**Index**	2002-07h
P02.07	**Label**	VDI-07 Input Selection	**Mode**	F		
	Range	0×0~0×FF	**Default**	0×0	**Unit**	

	Activation	Immediate	**Attribute**	RW	**Index**	2002-08h
P02.08	**Label**	VDI-08 Input Selection	**Mode**	F		
	Range	0×0~0×FF	**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW	**Index**	2002-09h
P02.09	**Label**	VDI-09 Input Selection	**Mode**	F		
	Range	0×0~0×FF	**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW	**Index**	2002-0Ah

P02.10	**Label**	VDI-10 Input Selection	**Mode**	F		
	Range	0×0~0×FF	**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW	**Index**	2002-0Bh
P02.11	**Label**	VDI-11 Input Selection	**Mode**	F		
	Range	0×0~0×FF	**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW	**Index**	2002-0Ch
P02.12	**Label**	VDI-12 Input Selection	**Mode**	F		
	Range	0×0~0×FF	**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW	**Index**	2002-0Dh
P02.13	**Label**	VDI-13 Input Selection	**Mode**	F		
	Range	0×0~0×FF	**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW	**Index**	2002-0Eh
P02.14	**Label**	VDI-14 Input Selection	**Mode**	F		
	Range	0×0~0×FF	**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW	**Index**	2002-0Fh
P02.15	**Label**	VDI-15 Input Selection	**Mode**	F		
	Range	0×0~0×FF	**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW	**Index**	2002-10h
P02.16	**Label**	VDI-16 Input Selection	**Mode**	F		
	Range	0×0~0×FF	**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW	**Index**	2002-11h

Configure virtual DI input function.

For example: If you configure the function of VDI-01 as forward drive inhibit input, the parameter value of P02.01 is 0x01.

P02.17	**Label**	VD0-01 Input Selection	**Mode**	F		
	Range	0×0~0×FF	**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW	**Index**	2002-12h
P02.18	**Label**	VDO-02 Input Selection	**Mode**	F		
	Range	0×0~0×FF	**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW	**Index**	2002-13h
P02.19	**Label**	VD0-04 Input Selection	**Mode**	F		
	Range	0×0~0×FF	**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW	**Index**	2002-14h
P02.20	**Label**	VD0-03 Input Selection	**Mode**	F		

	Range	0×0~0×FF		**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2002-15h
P02.21	**Label**	VD0-05 Input Selection		**Mode**	F		
	Range	0×0~0×FF		**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2002-16h
P02.22	**Label**	VDO-06 Input Selection		**Mode**	F		
	Range	0×0~0×FF		**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2002-17h
P02.23	**Label**	VD0-07 Input Selection		**Mode**	F		
	Range	0×0~0×FF		**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2002-18h
P02.24	**Label**	VDO-08 Input Selection		**Mode**	F		
	Range	0×0~0×FF		**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2002-19h
P02.25	**Label**	VD0-09 Input Selection		**Mode**	F		
	Range	0×0~0×FF		**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2002-1Ah
P02.26	**Label**	VDO-10 Input Selection		**Mode**	F		
	Range	0×0~0×FF		**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2002-1Bh
P02.27	**Label**	VDO-11 Input Selection		**Mode**	F		
	Range	0×0~0×FF		**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2002-1Ch
P02.28	**Label**	VDO-12 Input Selection		**Mode**	F		
	Range	0×0~0×FF		**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2002-1Dh
P02.29	**Label**	VDO-13 Input Selection		**Mode**	F		
	Range	0×0~0×FF		**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2002-1Eh
P02.30	**Label**	VDO-14 Input Selection		**Mode**	F		
	Range	0×0~0×FF		**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2002-1Fh

P02.31	**Label**	VDO-15 Input Selection		**Mode**	F		
	Range	0×0~0×FF		**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2002-20h
P02.32	**Label**	VDO-16 Input Selection		**Mode**	F		
	Range	0×0~0×FF		**Default**	0×0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2002-21h
	Configure virtual DO output function. For example: If you configure the function of VDO-01 as positioning complete output, the parameter value of P02.32 is 0x04.						

P02.45	Label	VDI Status		Mode	F		
	Range	-2147483648~2147483647		Default	0	Unit	
	Activation	Immediate	Attribute	RO		Index	2002-2Eh

Configure virtual VDI output function.
Bit0~Bit15 correspond to the states of VDI1~VDI16.
A bit value of 0 indicates status OFF;A bit value of 1 indicates status ON.

P02.46	Label	VDO Status		Mode	F		
	Range	-2147483648~2147483647		Default	0	Unit	
	Activation	Immediate	Attribute	RO		Index	2002-2Fh

Configure virtual VDO output function.
Bit0~Bit15 correspond to the states of VDO1~VDO16.
A bit value of 0 indicates status OFF;A bit value of 1 indicates status ON.

3.2.3【Class P04】Fault parameters

P04.02	Label	Excessive Position Deviation Settings		Mode	P/PP/HM/CSP		
	Range	0~2147483647		Default	2147483647	Unit	Unit
	Activation	Immediate	Attribute	RW		Index	2004-03h

Please set threshold value for position deviation accordingly. Default factory setting = 30, Er180 will be triggered if positive deviation is in excess of 3 revolutions.

P04.03	Label	Fault Clearing Mode		Mode	F		
	Range	0~1		Default	1	Unit	
	Activation	Immediate	Attribute	RW		Index	2004-04h

Set the clearing conditions for the alarm clear input signal.

Set Value	Description
0	Always clear (level clear)
1	Clear only once (rising edge clear)

P04.05	Label	Current Fault Code		Mode	F		
	Range	-2147483648~2147483647		Default	0	Unit	
	Activation	Immediate	Attribute	RO		Index	2004-06h

Current Fault Code

P04.06	Label	Current Warning Code		Mode	F		
	Range	-2147483648~2147483647		Default	0	Unit	
	Activation	Immediate	Attribute	RO		Index	2004-07h

Current Warning Code

P04.07	Label	Overspeed Level Setting		Mode	F		
	Range	0~10000		Default	0	Unit	
	Activation	Immediate	Attribute	RW		Index	2004-08h
	If the motor speed exceeds this set value, Er1A0 "Over-speed" will occur.When the speed level set value is set to 0, the speed level is equivalent to 1.2 times the maximum motor speed.						

P04.17	Label	E2 Storage Speed Threshold		Mode	F		
	Range	0~10		Default	4	Unit	min
	Activation	Immediate	Attribute	RW		Index	2004-12h
	This parameter is used to set the judgment threshold for the "too fast storage" threshold of the servo EEPROM storage module. When the actual storage speed exceeds the set threshold, the system will trigger the corresponding protection mechanism to avoid data or hardware failures caused by abnormal storage speed. The EEPROM storage module is mainly used to store key data such as system parameters, fault records, and operation logs. Its storage operations must comply with specific speed specifications. If the data write/update speed exceeds the safe range, it may cause data loss, writing exceptions, or even damage the EEPROM storage module, affecting the normal operation of the driver.						

P04.19	Label	Regeneration Overload Level		Mode	F		
	Range	0~115		Default	0	Unit	
	Activation	Immediate	Attribute	RW		Index	2004-14h

Set value	Description
【0】	Default level: 80%
1~115	Set vent overload level accordingly

P04.20	Label	Overload Level Setting		Mode	F		
	Range	0~115		Default	0	Unit	
	Activation	Immediate	Attribute	RW		Index	2004-15h
	Set the overload level. When the set value is 0, the overload level is set to 100%. Note: Please set it to 0 during normal use. Reducing the overload level will shorten the motor's overload time. A normal motor overload triggers alarm Er100, indicating excessive load, meaning the driver's output current is greater than the motor's rated current.						

P04.23	Label	Motor Stall Alarm Torque Threshold		Mode	F		
	Range	0~300		Default	300	Unit	%
	Activation	Immediate	Attribute	RW		Index	2004-18h
	Set the torque threshold for the motor stall alarm. When the speed is less than 20r/min and the torque output is greater than this threshold, the motor stall alarm (Er102) will be triggered. 0: Mask motor stall (Er102) alarm; Non-0: Set the torque threshold for motor stall alarm according to the set value.						

3.2.4【Class P05】Monitor parameters

P05.00	**Label**	Position Setpoint (User Units)	**Mode**	F		
	Range	-2147483647~2147483647	**Default**	0	**Unit**	unit
	Activation	Immediate	**Attribute**	RO	**Index**	2005-01h
	Display position setting, unit is user unit. The received command pulse count is converted and displayed in user units. For example, if the user unit is 10000LU/rev and the encoder unit is 8388608P/rev, when the driver receives 8388608 pulses, this parameter will display 10000.					

P05.01	**Label**	Position feedback (User Units)	**Mode**	F		
	Range	-2147483647~2147483647	**Default**	0	**Unit**	unit
	Activation	Immediate	**Attribute**	RO	**Index**	2005-02h
	Display position feedback, unit is user unit. The position feedback pulse count of the motor encoder is converted and displayed in user units. For example, if the user unit is 10000LU/rev and the encoder unit is 8388608P/rev, when the driver receives 8388608 feedback pulses from the encoder, this parameter will display 10000.					

P05.02	**Label**	Position Setting (Encoder Units)	**Mode**	F		
	Range	-2147483647~2147483647	**Default**	0	**Unit**	pulse
	Activation	Immediate	**Attribute**	RO	**Index**	2005-03h
	Display position setpoint in encoder units. The received command pulse count is converted and displayed in motor encoder units.					

P05.03	**Label**	Position Feedback (Encoder Units)	**Mode**	F		
	Range	-2147483647~2147483647	**Default**	0	**Unit**	pulse
	Activation	Immediate	**Attribute**	RO	**Index**	2005-04h
	Displays position feedback in encoder units. The received command pulse count is converted and displayed based on the motor encoder feedback of the driver.					

P05.04	**Label**	Positioning Error (Encoder Units)	**Mode**	F		
	Range	-2147483647~2147483647	**Default**	0	**Unit**	pulse
	Activation	Immediate	**Attribute**	RO	**Index**	2005-05h
	Displays the positioning error in encoder units. The driver displays the received positioning error pulses from the motor encoder.					

P05.05	**Label**	Absolute Position Error (Encoder Units)	**Mode**	F		
	Range	-2147483647~2147483647	**Default**	0	**Unit**	pulse
	Activation	Immediate	**Attribute**	RO	**Index**	2005-06h
	Displays the absolute position error in encoder units, which is the difference between the position setpoint and the position feedback.					

P05.06	Label	Relative Position Error (User Unit)		Mode	F		
	Range	-2147483647~2147483647		Default	0	Unit	unit
	Activation	Immediate	Attribute	RO		Index	2005-07h
Displays the relative position error in user units.							

P05.07	Label	Encoder Single-turn Position		Mode	F		
	Range	-2147483647~2147483647		Default	0	Unit	pulse
	Activation	Immediate	Attribute	RO		Index	2005-08h
Displays the current single-turn position value of the encoder.							

P05.08	Label	Encoder Multi-turn Position		Mode	F		
	Range	-2147483647~2147483647		Default	0	Unit	r
	Activation	Immediate	Attribute	RO		Index	2005-09h
Displays the Encoder Multi-turn Position.							

P05.09	Label	Position Command Speed		Mode	F		
	Range	-2147483647~2147483647		Default	0	Unit	rpm
	Activation	Immediate	Attribute	RO		Index	2005-0Ah
Displays the Position Command Speed							

P05.10	Label	Speed Setpoint		Mode	F		
	Range	-2147483647~2147483647		Default	0	Unit	rpm
	Activation	Immediate	Attribute	RO		Index	2005-0Bh
Displays the Speed Setpoint							

P05.11	Label	Motor Speed		Mode	F		
	Range	-2147483647~2147483647		Default	0	Unit	rpm
	Activation	Immediate	Attribute	RO		Index	2005-0Ch
Displays the Motor Speed							

P05.12	Label	Speed Error		Mode	F		
	Range	-2147483647~2147483647		Default	0	Unit	rpm
	Activation	Immediate	Attribute	RO		Index	2005-0Dh
Displays the speed error , which is the error between speed setpoint and motor speed.							

P05.13	Label	Torque Current Setpoint		Mode	F		
	Range	-2147483647~2147483647		Default	0	Unit	%
	Activation	Immediate	Attribute	RO		Index	2005-0Eh
	Displays the current torque current setpoint. The unit is the percentage of the motor's rated current.						

P05.14	Label	Torque Current Feedback		Mode	F		
	Range	-2147483647~2147483647		Default	0	Unit	%
	Activation	Immediate	Attribute	RO		Index	2005-0Fh
	Displays the current torque current feedback. The unit is the percentage of the motor's rated current						

P05.15	Label	Flux-weakening Current Setpoint		Mode	F		
	Range	-2147483647~2147483647		Default	0	Unit	%
	Activation	Immediate	Attribute	RO		Index	2005-10h
	Displays the Flux-weakening current setpoint. The unit is the percentage of the motor's rated current.						

P05.16	Label	Flux-weakening Current Feedback		Mode	F		
	Range	-2147483647~2147483647		Default	0	Unit	%
	Activation	Immediate	Attribute	RO		Index	2005-11h
	Displays the Flux-weakening current feedback. The unit is the percentage of the motor's rated current.						

P05.17	Label	Vector Current		Mode	F		
	Range	-2147483647~2147483647		Default	0	Unit	%
	Activation	Immediate	Attribute	RO		Index	2005-12h
	Displays the vector current values output by the driver to the U, V, and W windings of the motor.						

P05.18	Label	Phase U Current		Mode	F		
	Range	-2147483647~2147483647		Default	0	Unit	A
	Activation	Immediate	Attribute	RO		Index	2005-13h
	Displays the real-time current value of the U-phase winding output by the driver.						

P05.19	Label	Phase V Current		Mode	F		
	Range	-2147483647~2147483647		Default	0	Unit	A
	Activation	Immediate	Attribute	RO		Index	2005-14h
	Displays the real-time current value of the V-phase winding output by the driver.						

P05.20	Label	Phase W Current		Mode	F		
	Range	-2147483647~2147483647		Default	0	Unit	A
	Activation	Immediate	Attribute	RO		Index	2005-15h

Displays the real-time current value of the W-phase winding output by the driver.

P05.21	Label	Bus Voltage		Mode	F		
	Range	-2147483647~2147483647		Default	0	Unit	V
	Activation	Immediate	Attribute	RO		Index	2005-16h

Displays the real-time bus voltage.

P05.22	Label	Driver Temperature		Mode	F		
	Range	-2147483647~2147483647		Default	0	Unit	° C
	Activation	Immediate	Attribute	RO		Index	2005-17h

Displays the real-time driver temperature.

P05.23	Label	Monitor Channel 1 Selection		Mode	F		
	Range	0~300		Default	0	Unit	-
	Activation	Immediate	Attribute	RW		Index	2005-18h

value	Content	value	Content	value	Content
00	Current Fault Code	20	PRS Code	40	U-phase Current (0.1%)
01	Motor Overload Rate (%)	21	PR Error Code	41	V-phase Current (0.1%)
02	DI Status	22	Discharge Overload Rate (%)	42	W-phase Current (0.1%)
03	DO Status	23	Average Load Rate (0.1%)	43	Hall Status
04	Drive Overload (%)	24	Peak Current (within 2s, 0.1%)	44	Current Position Feedback (Encoder Unit)
05	Control Voltage (0.1V)	25	Inertia Identification Value (%)	45	Paired Position Feedback (Encoder Unit)
06	MCU Temperature (℃)	26	External Encoder Position	46	Current Speed Feedback (0.1)
07	Pulse Command Frequency (Hz)	27	IO Change Count	47	Paired Speed Feedback (0.1)
08	Analog Input 1 (mV)	28	Single Power-on Time (s)	48	Current Feedback (0.1%)

09	Analog Input 2 (mV)	29	DC Synchronization Period (μs)	49	Paired Current Feedback (0.1%)
10	Analog Input 3 (mV)	30	SM2 Interrupt Status	50	Center Position (Encoder Unit)
11	Analog Output 1	31	DC Type	51	Center Speed (0.1)
12	Analog Output 2	32	Position Command 32bit (Encoder Unit)	52	Gantry Synchronization Deviation (Encoder Unit)
13	Mechanical Angle (0.1°)	33	Position Feedback 32bit (Encoder Unit)	53	Gantry Communication Count Error
14	Electrical Angle (0.1°)	34	Internal Position Command (Encoder Unit)	54	Gantry Communication Error Rate
15	Encoder Communication Error Count	35	Internal Position Feedback (Encoder Unit)	55	Gantry Synchronization Error Count
16	External Encoder Error Count	36	External Encoder Resolution Recognition Value	-	-
17	Hybrid Error (External Encoder Unit)	37	External Encoder Direction Recognition Value	-	-
19	Cumulative Power-on Time (s)	38	Operation Mode	-	-
-	-	39	Motor Temperature (℃)	-	-

P05.24	**Label**	Monitor Channel 2 Selection		**Mode**	F		
	Range	0~300		**Default**	1	**Unit**	-
	Activation	Immediate	**Attribute**	RW		**Index**	2005-19h

P05.25	**Label**	Monitor Channel 3 Selection		**Mode**	F		
	Range	0~300		**Default**	2	**Unit**	-
	Activation	Immediate	**Attribute**	RW		**Index**	2005-1Ah

P05.26	**Label**	Monitor Channel 4 Selection		**Mode**	F		
	Range	0~300		**Default**	3	**Unit**	-
	Activation	Immediate	**Attribute**	RW		**Index**	2005-1Bh
	Same as 05.23						

P05.27	**Label**	Monitor Channel 1 Value		**Mode**	F		
	Range	-2147483647~2147483647		**Default**	0	**Unit**	-
	Activation	Immediate	**Attribute**	RO		**Index**	2005-1Ch
P05.28	**Label**	Monitor Channel 2 Value		**Mode**	F		
	Range	-2147483647~2147483647		**Default**	0	**Unit**	-
	Activation	Immediate	**Attribute**	RO		**Index**	2005-1Dh
P05.29	**Label**	Monitor Channel 3 Value		**Mode**	F		
	Range	-2147483647~2147483647		**Default**	0	**Unit**	-
	Activation	Immediate	**Attribute**	RO		**Index**	2005-1Eh

P05.30	**Label**	Monitor Channel 4 Value		**Mode**	F		
	Range	-2147483647~2147483647		**Default**	0	**Unit**	-
	Activation	Immediate	**Attribute**	RO		**Index**	2005-1Fh
Monitor Channel Value							

3.3 Basic Control

3.3.1【Class P10】Position Control

P10.03	**Label**	Command Pulses Per Revolution		**Mode**	**F**		
	Range	0~67108864		**Default**	0	**Unit**	Pulse
	Activation	After reset	**Attribute**	RW		**Index**	2010-04h
	This parameter is used to set the number of command pulses per revolution of the motor. Note: The command pulses per revolution can also be configured via object dictionaries 608F, 6091, and 6092; however, P10.03 takes precedence.						

P10.04	**Label**	1st Command Frequency Division Numerator		**Mode**	**F**		
	Range	1~2147483647		**Default**	1	**Unit**	
	Activation	After reset	**Attribute**	RW		**Index**	2010-05h
	Sets the numerator for frequency division and frequency multiplication processing of the command pulse input. This value is valid when P10.03 (Command Pulses Per Revolution) = 0. For details, refer to the parameter description of P10.05.						

P10.05	**Label**	1st Command Frequency Division Denominator		**Mode**	**F**		
	Range	1~2147483647		**Default**	1	**Unit**	
	Activation	After reset	**Attribute**	RW		**Index**	2010-06h
	Sets the denominator for frequency division and frequency multiplication processing of the command pulse input, which is used as follows: • Settings 1) The number of command pulses input to the driver is X 2) The number of encoder pulses after frequency division and frequency multiplication is Y 3) The number of pulses per revolution of the motor is Z 4) The number of running revolutions of the motor is W • Calculations 1) Calculation of X and Y Y=X*P10.04/P10.05 Note: The value range of P00.09 and P00.10 must be less than 2^24 (i.e. 16777216). Exceeding the above range may result in incorrect frequency division and frequency multiplication results. 2) Description of Z For 17-bit motor: Z=2^17=131072 ;For 23-bit motor: Z=2^23=8388608 3) Calculation of Y, Z and W W=Y/Z Note: Although the values of the denominator and numerator can be set to any value within the range, normal operation cannot be guaranteed when an extreme frequency division ratio or frequency multiplication ratio is set. If the converted pulse command per magnetic pole pitch of the motor is less than 500, the Er1b1 alarm will be triggered.						

P10.09	Label	Absolute Encoder Reset Enable		Mode	F		
	Range	0~2		Default	0	Unit	
	Activation	After reset	Attribute	RW		Index	2010-0Ah

Sets functions related to the absolute encoder.

0: Function disabled;

1: Clear encoder alarm;

2: Clear encoder alarm and multi-turn position.

P10.10	Label	Absolute Encoder Setting		Mode	F		
	Range	0~3		Default	0	Unit	
	Activation	Immediate	Attribute	RW		Index	2010-0Bh

Sets the type and usage mode of the absolute encoder.

The specific usage can be set as follows:

0: Incremental mode. The encoder is used as a bus incremental encoder, with no power-off position memory function. There is no restriction on the load travel range of the equipment.

1: Multi-turn linear mode. Enables the multi-turn absolute value function, with power-off position memory function. It is applicable to scenarios where the load travel range of the equipment is fixed and the encoder's multi-turn data will not overflow.

2: Multi-turn rotary mode. Enables the multi-turn absolute value function, with power-off position memory function. The actually fed back multi-turn data cycles back and forth between 0 and (P10.12+1); it is applicable to scenarios where the load travel range of the equipment is unrestricted.

3: Single-turn absolute value mode. This mode is mainly used in scenarios where the equipment load only needs to record the position within one revolution of the motor. The initial position fed back at each power-on is used to calculate the current position feedback based on the coordinate system after the last homing operation, with no need for re-homing.

P10.11	Label	Absolute Multi-turn Mode Minimum Value		Mode	F		
	Range	0~2147483647		Default	0	Unit	pulse
	Activation	Immediate	Attribute	RW		Index	2010-0Ch

Sets the minimum value of multi-turn data when the absolute encoder is in rotary mode.

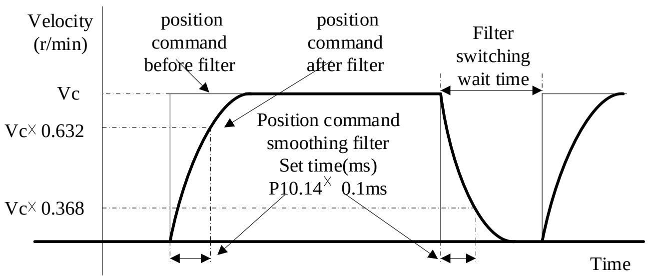
When P10.10=2 (multi-turn rotary mode), the number of pulses per single revolution is: P10.12 (range value of absolute value rotary mode) - P10.11 (minimum value of absolute value rotary mode).

P10.12	**Label**	Absolute Multi-turn Mode Range Value	**Mode**	**F**		
	Range	0~2147483647	**Default**	0	**Unit**	pulse
	Activation	Immediate			**Index**	2010-0Dh
	Sets the value range of multi-turn data when the absolute encoder is in rotary mode. When P10.10=2 (multi-turn rotary mode), the number of pulses per single revolution is: P10.12 (range value of absolute value rotary mode) - P10.11 (minimum value of absolute value rotary mode).					

P10.14	**Label**	Position Command Low-pass Filter		**Mode**	**P/PP/HM/CSP**		
	Range	0~300		**Default**	0	**Unit**	ms
	Activation	Immediate	**Attribute**	RW		**Index**	2010-0Fh

Sets the time constant of the first-order low-pass filter for the position command, i.e., performs smoothing processing on the command.

For the square command of the target speed Vc , as shown in the figure below, set the time constant of the 1st-order delay filter.

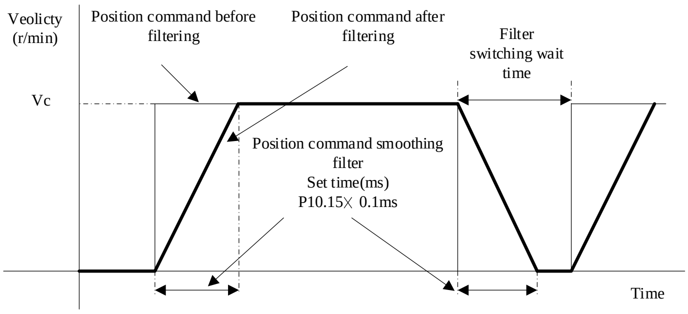


- This parameter is generally used when the command is relatively rough or the command acceleration is too large, causing overshoot or undershoot of the motor. It can smooth the command mutation, reduce the impact on the equipment, and eliminate vibration. It should be noted that setting this parameter too large may increase the settling time.
- After modifying P10.14 (Position Command Low-Pass Filter), the parameters will not be immediately applied to the internal calculation of the driver, and there will be a fixed delay. If the "Filter Switching Waiting Time" is triggered during this period, the effective time of the parameter change will be further delayed.

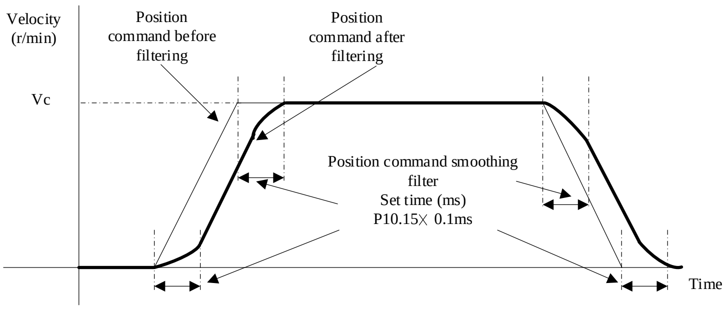
<table>
<tr><td rowspan="3">P10.15</td><td>Label</td><td colspan="2">Position Command FIR Filter</td><td>Mode</td><td colspan="3">P/PP/HM/CSP</td></tr>
<tr><td>Range</td><td colspan="2">0~250</td><td>Default</td><td>0</td><td>Unit</td><td>ms</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>2010-10h</td></tr>
</table>

Sets the time constant of the FIR filter for the position command.

For the square command of the target speed Vc, set the time taken to reach Vc as shown in the figure below; after filtering, the waveform is trapezoidal.



For the trapezoidal command of the target speed Vc, set the time taken to reach Vc as shown in the figure below; after filtering, the waveform is S-shaped.



- This parameter is generally used when the command is relatively rough or there is no acceleration/deceleration, causing the motor to overshoot or undershoot due to abrupt acceleration. It can smooth the command mutation, reduce the impact on the equipment, and eliminate vibration. It should be noted that setting this parameter too large may increase the settling time.
- Please stop the command, and perform the change of P10.15 (Position Command FIR Filter) after the duration reaches the filter waiting time. The filter waiting time = (Set value × 0.1ms + 0.25ms). If P10.15 (Position Command FIR Filter) is changed when a command is input, the change cannot be applied immediately. It will be updated in the subsequent command-free state and after the duration reaches the filter waiting time.
- From the change of P10.15 (Position Command FIR Filter) until it is applied to the internal calculation, there will be a delay. During this period, if the switching time is reached, the change may be delayed.
- It takes effect when stopping at rest.

P10.19	Label	Positioning Completion Range		Mode	P/PP/HM/CSP		
	Range	0.0000~1.0000		Default	0.0020	Unit	rev
	Activation	Immediate	Attribute	RW		Index	2010-14h

Sets the position deviation range for the output of the positioning completion signal (INP1). The positioning completion signal (INP1) can be output when the position deviation is within the set range.

Note: The default unit is ten-thousandths of a revolution. This can be set to the command unit or encoder unit via P00.51 (Position Setting Unit Selection).

P10.20	Label	Positioning Output Setting		Mode	P/PP/HM/CSP		
	Range	0~4		Default	1	Unit	
	Activation	Immediate	Attribute	RW		Index	2010-15h

Sets the output conditions for the positioning completion signal (INP1).

0: **Position deviation condition**: The INP1 output signal is valid when the position deviation is less than P10.19 (Positioning Range).

1: **No command + zero speed detection condition**: The INP1 output signal is valid when there is no position command, the zero speed detection signal ZSP is valid, and the position deviation is less than P10.19 (Positioning Range).

3: **Position command + delay condition**: The INP1 output signal is valid after the expiration of the time set by P10.21 (INP Delay Output Time) when the position deviation is less than P10.19 (Positioning Range). It remains OFF during the set time of P10.21 (INP Delay Output Time).

4: **Command change + delay condition**: Positioning judgment starts after the expiration of the delay time set by P10.21 (INP Delay Output Time) when a change from a command to no command occurs. If there is no position command, INP1 is turned OFF immediately when the position deviation is less than P10.19 (Positioning Range).

P10.21	Label	INP Delay Arrival Output Time		Mode	P/PP/HM/CSP		
	Range	0~15000		Default	0	Unit	ms
	Activation	Immediate	Attribute	RW		Index	2010-16h

Sets the delay time for the INP signal output when P10.20 (Positioning Setup) = 3.

0: The INP output signal turns ON immediately.

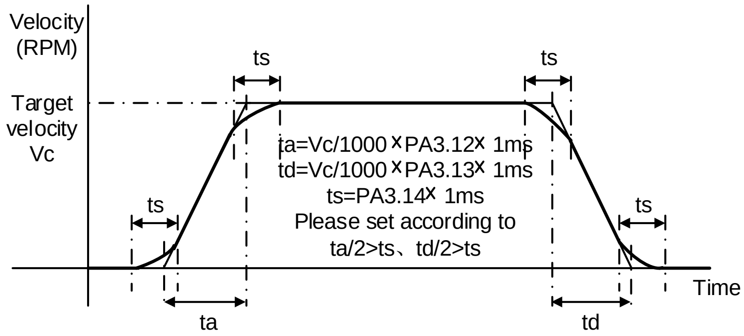
1-15000: The INP output signal remains OFF during the set time (in ms), and turns ON after the set time elapses. It then remains ON until a position command is received, upon which it turns OFF.

3.3.2【Class P11】Velocity Control

P11.07	Label	Sigmoid acceleration/deceleration settings	Mode	S		
	Range	0~1000	Default	0	Unit	ms
	Activation	After re-enable	Attribute	RW	Index	2011-08h

To set sigmoid acceleration and deceleration turning point in accordance to acceleration and deceleration time.

Sets the S-curve time range centered on the acceleration/deceleration inflection point for the acceleration time (P36.19) and deceleration time (P36.20) settings.



P11.08	Label	Zero speed clamp function select	Mode	S	PV	CSV
	Range	0~2000	Default	0	Unit	-
	Activation	Immediate	Attribute	RW	Index	2011-09h

Sets the zero-speed clamp function.

Value	Zero-Speed Clamp Function
0	Disables the zero-speed clamp function.
1	When the zero-speed clamp (ZEROSPD) input signal is valid, the speed command is forcibly set to 0.
2	When the speed command in speed control mode is less than the set value of P11.09 (Zero-Speed Clamp Level), the speed command is forcibly set to 0.
3	When the zero-speed clamp (ZEROSPD) input signal is valid or the speed command in speed control mode is less than the set value of P11.09 (Zero-Speed Clamp Level), the speed command is forcibly set to 0.
4	When the zero-speed clamp (ZEROSPD) input signal is valid and the speed command in speed control mode is less than the set value of P11.09 (Zero-Speed Clamp Level), the speed command is forcibly set to 0.

P11.09	Label	Zero speed clamp level		Mode	S	PV	CSV
	Range	0~2000		Default	30	Unit	rpm
	Activation	Immediate	Attribute	RW		Index	2011-0Ah

Sets the judgment level for zero speed.
P11.08 is set to 2, 3, or 4 for this function to take effect.
When P11.08=2 or 3: If the speed command in speed control mode is less than the zero-speed clamp level setting, the speed command is forcibly set to 0.
When P11.08=4: The speed command is forcibly set to 0 when the zero-speed clamp (ZEROSPD) input signal is valid and the speed command in speed control mode is less than the set value of P11.09 (Zero-Speed Clamp Level).

P11.10	Label	Zero speed clamp static time		Mode	S	PV	CSV
	Range	0~2000		Default	0	Unit	ms
	Activation	Immediate	Attribute	RW		Index	2011-0Bh

Sets the zero-speed stop delay time in speed mode; that is, the time taken for the motor to come to a complete stop after reaching the zero-speed clamp position.This prevents the motor from creeping slowly when stationary in speed mode.

Setting 0: The zero-speed stop delay function is ineffective in speed mode.

Setting 1~2000: The motor comes to a complete stop after the speed reaches P11.09 (Zero-Speed Clamp Level) and the set time has elapsed.

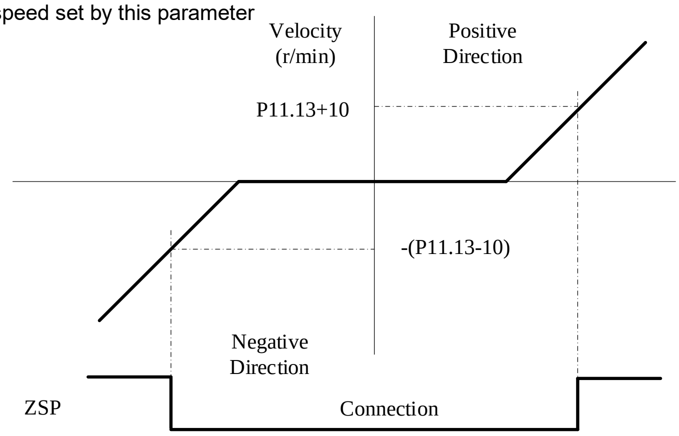
P11.11	Label	Motor maximum velocity limit		Mode	F		
	Range	0~10000		Default	0	Unit	r/min
	Activation	Immediate	Attribute	RW		Index	2011-0Ch

Sets the maximum speed of motor operation, which must not exceed the maximum speed allowed by the motor.

A setting of 0 defaults the maximum speed limit to the maximum rated speed of the motor parameter. Compare it with the limit value of 6080h; take the smaller value of the two as the final maximum speed limit value.

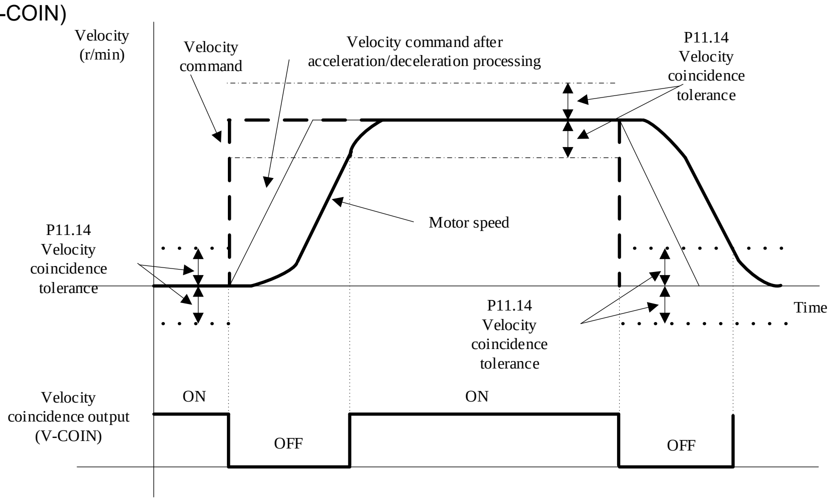
P11.13	Label	Zero Speed Setting		Mode	PV		CSV
	Range	1~2000		Default	50	Unit	rpm
	Activation	Immediate	Attribute	RW		Index	2011-0Eh

Sets the threshold for the Zero Speed Detection (ZSP).
The Zero Speed Detection signal (ZSP) is output when the motor speed is lower than the speed set by this parameter



<table>
<tr><td rowspan="3">P11.14</td><td>Label</td><td colspan="2">Speed Coincidence Range Setting</td><td>Mode</td><td colspan="2">S</td><td>PV</td><td>CSV</td></tr>
<tr><td>Range</td><td colspan="2">10~2000</td><td>Default</td><td>50</td><td>Unit</td><td colspan="2">rpm</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td colspan="2">2011-0Fh</td></tr>
</table>

Set the maximum speed allowed for motor operation.If the difference between the speed command and the motor speed is below this set value, the output speed shall be consistent (V-COIN)



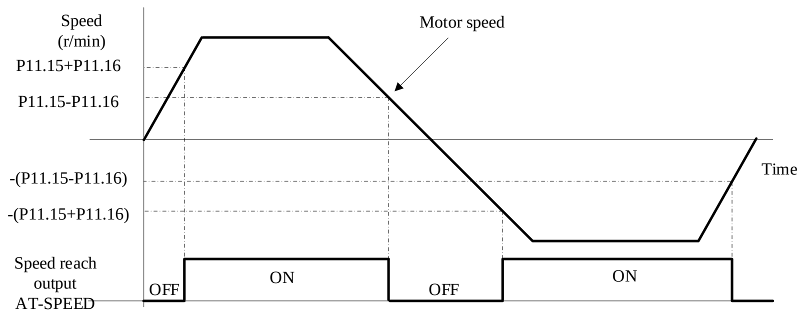
speed consistency output:
Timing of ON → OFF: (P11.14-10)r/min;
Timing of ON ↔ OFF when: (P11.14+10)r/min.

<table>
<tr><td rowspan="3">P11.15</td><td>Label</td><td colspan="2">Speed Reached Setting</td><td>Mode</td><td colspan="2">S</td><td>PV</td><td>CSV</td></tr>
<tr><td>Range</td><td colspan="2">10~2000</td><td>Default</td><td>1000</td><td>Unit</td><td colspan="2">rpm</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td colspan="2">2011-10h</td></tr>
</table>

Sets the detection timing for the Speed Reach Output (AT-SPEED).

The Speed Reach Output (AT-SPEED) is output when the motor speed exceeds the set value.

Hysteresis for detection is specified using P11.16.



<table>
<tr><td rowspan="3">P11.16</td><td>Label</td><td colspan="2">Speed Reached Hysteresis Band</td><td>Mode</td><td colspan="2">S</td><td>PV</td><td>CSV</td></tr>
<tr><td>Range</td><td colspan="2">0~100</td><td>Default</td><td>10</td><td>Unit</td><td colspan="2">rpm</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td colspan="2">2011-11h</td></tr>
</table>

Sets the hysteresis bandwidth for speed arrival detection.
Timing for OFF → ON transition (motor speed absolute value is between P11.15 ± P11.16).
Timing for ON → OFF transition (motor speed absolute value is outside P11.15 ± P11.16).

3.3.3【Class P12】Torque Control

P12.00	Label	Torque Mode Selection		Mode	F		
	Range	0~5		Default	0	Unit	-
	Activation	Immediate	Attribute	RW		Index	2012-01h

Set Value	Positive Torque Limit Value	Negative Torque Limit Value
0	P12.01 (1st Torque Limit)	
1	P12.02 (2nd Torque Limit)	
2	TL-SEL OFF	P12.01 (1st Torque Limit)
	TL-SEL ON	P12.02 (2nd Torque Limit)
3	60E0h	60E1h
4	Reserved	
5	P12.01 (1st Torque Limit)	P12.02 (2nd Torque Limit)

In Emergency Stop mode: The torque limit value is determined by P00.39 (Instant Stop Torque Limit Value);
In Jog mode: The torque limit is determined by P47.24 (Jog Mode Instruction Torque Limit);
In Torque Return mode: The torque limit value is determined by P30.09 (Torque Return Torque Limit Value);
In other operating states, the torque limit value selected by P12.00 is used;
In EC mode, all operating states are limited by 6072h (Maximum Torque).

P12.01	Label	1st Torque Limit		Mode	F		
	Range	0~500		Default	350	Unit	%
	Activation	Immediate	Attribute	RW		Index	2012-02h

Set the 1st torque limit value of the drive output, which is the percentage of the maximum output current of the driver that the motor cannot exceed
It is compared with the parameter object 6072h (actual torque limit value), and the smaller value of the two is taken as the actual torque limit value.

P12.02	Label	2nd Torque Limit		Mode	F		
	Range	0~500		Default	350	Unit	%
	Activation	Immediate	Attribute	RW		Index	2012-03h

Set the 2nd torque limit value of the drive output, which is the percentage of the maximum output current of the driver that the motor cannot exceed.
It is compared with the parameter object 6072h (actual torque limit value), and the smaller value of the two is taken as the actual torque limit value.

3.4 Servo Control

3.4.1【Class P20】Gain Parameters

P20.00	**Label**	1st Position Loop Gain		**Mode**	**P/PP/HM/CSV**		
	Range	0~3000.0		**Default**	48.0	**Unit**	Hz
	Activation	Immediate	**Attribute**	RW		**Index**	2020-01h
	Higher position loop gain value improves the responsiveness of the servo driver and lessens the positioning time. Position loop gain value shouldn't exceed responsiveness of the mechanical system and take in consideration velocity loop gain, if not it might cause vibration, mechanical noise and overtravel. As velocity loop gain is based on position loop gain, please set both values accordingly. Recommended range: 12≤P20.00/P20.01≤18						

P20.01	**Label**	1st velocity loop gain		**Mode**	**F**		
	Range	0.1~3276.7		**Default**	27	**Unit**	Hz
	Activation	Immediate	**Attribute**	RW		**Index**	2020-02h
	To determine the responsiveness of the velocity loop. If inertia ratio of P00.04 is uniform with actual inertia ratio, velocity loop responsiveness = P20.01. To increase position loop gain and improve responsiveness of the whole system, velocity loop gain must be set at higher value. Please notice that if the velocity loop gain is too high, it might cause vibration.						

P20.02	**Label**	1st Integral Time Constant of Velocity Loop		**Mode**	**F**		
	Range	1~1000.0		**Default**	21.0	**Unit**	ms
	Activation	Immediate	**Attribute**	RW		**Index**	2020-03h
	If auto gain adjusting function is not enabled, P20.02 is activated. The lower the set value, the closer the lag error at stop to 0 but might cause vibration. If the value set is overly large, overshoot, delay of positioning time duration and lowered responsiveness might occur. Set 10000 to deactivate P20.02. Recommended range: 50000≤P01.01xP20.02≤150000 For example: Velocity loop gain P20.01=500(0.1Hz), which is 50Hz. Integral time constant of velocity loop should be 100(0.1ms)≤P20.02≤300(0.1ms)						

P20.04	**Label**	1st torque filter time constant Time Constant		**Mode**	**F**		
	Range	0.00~25.00		**Default**	0.84	**Unit**	ms
	Activation	Immediate	**Attribute**	RW		**Index**	2020-05h

To set torque command low-pass filter, add a filter delay time constant to torque command and filter out the high frequencies in the command.
Often used to reduce or eliminate some noise or vibration during motor operation, but it will reduce the responsiveness of current loop, resulting in undermining velocity loop and position loop control. P01.04 needs to match velocity loop gain.
Recommended range: 1,000,000/(2π×P01.04) ≥P01.01×4

For example: Velocity loop gain P01.01=180(0.1Hz) which is 18Hz. Time constant of torque filter should be P01.01≤221(0.01ms)
If mechanical vibration is due to servo driver, adjusting P01.04 might eliminate the vibration.

P20.05	**Label**	2^{nd} Position Loop Gain		**Mode**	**P/PP/HM/CSV**		
	Range	0.0~3000.0		**Default**	57.0	**Unit**	Hz
	Activation	Immediate	**Attribute**	RW		**Index**	2020-06h

Same as 20.00.

P20.06	**Label**	2^{nd} velocity loop gain		**Mode**	**F**		
	Range	0.1~3276.0		**Default**	27.0	**Unit**	Hz
	Activation	Immediate	**Attribute**	RW		**Index**	2020-07h

Same as 20.01.

P20.07	**Label**	2^{nd} Integral Time Constant of Velocity Loop		**Mode**	**F**		
	Range	0.1~1000.0		**Default**	1000	**Unit**	ms
	Activation	Immediate	**Attribute**	RW		**Index**	2020-08h

Same as 20.02.

P20.09	**Label**	2^{nd} Torque Filter Time Constant		**Mode**	**F**		
	Range	0.0~25.0		**Default**	0.84	**Unit**	ms
	Activation	Immediate	**Attribute**	RW		**Index**	2020-0Ah

Same as 20.04.

P20.10	Label	Velocity feed forward gain		Mode	P/PP/HM/CSV		
	Range	0.0~1.000		Default	0.3	Unit	1
	Activation	Immediate	Attribute	RW		Index	2020-0Bh

According to the position command feedforward compensation amount calculated by the differentiation, the speed command calculated by the differentiation is multiplied by the setting value of this parameter, skipping the "position controller" and directly added to the speed command input. This parameter is often used to reduce the following error and stabilize the setting value during slow speed response.
Increasing the setting value: It can enhance the front feedback compensation amount, further reduce the following error, and improve the response agility of the system. However, please note that if the setting value is too large, it may easily cause system overshoot or oscillation. It is recommended to set it in combination with the actual commissioning situation.
Decreasing the setting value: The front feedback compensation effect is weakened, and the system stability is improved. But it may lead to an increase in the following error and a slower response speed. This setting is suitable for working conditions that require high stability of the dynamic response of the system.

P20.11	Label	Velocity feed forward filter time constant		Mode	F		
	Range	0.0~64.00		Default	0.50	Unit	ms
	Activation	Immediate	Attribute	RW		Index	2020-0Ch

Set velocity feed forward low pass filter to eliminate high or abnormal frequencies in velocity feed forward command. Often used when position command with low resolution or high electronic gear ration to smoothen velocity feed forward.
Position deviation under constant velocity can be lowered with higher velocity feed forward gain. Please to refer to the equation below.

Position deviation[Uint]= $\frac{Set\ velocity[\frac{Uint}{s}]}{Position\ loop\ gain[Hz]} \times \frac{100 - Velocity\ feed\ foward\ gain[\%]}{100}$

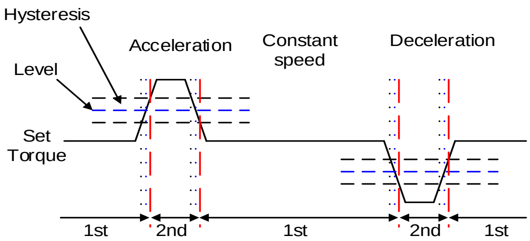
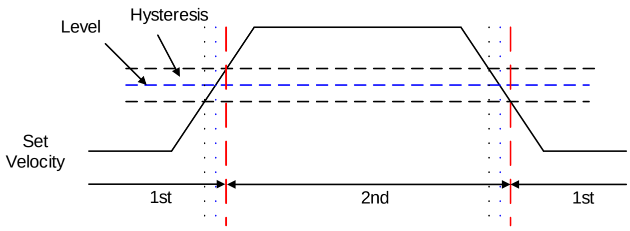
P20.12	Label	Torque feedforward gain		Mode	P/S/PP/PV/HM/CSP/CSV		
	Range	0.0~1.0		Default	0	Unit	1
	Activation	Immediate	Attribute	RW		Index	2020-0Dh

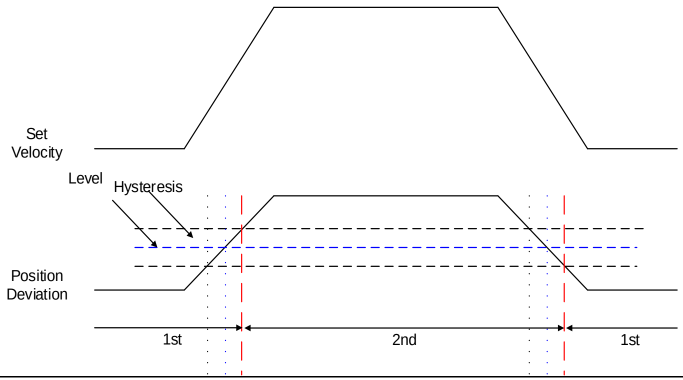
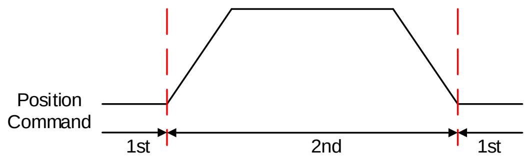
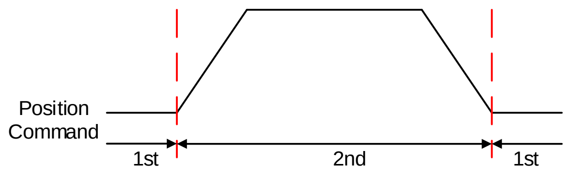
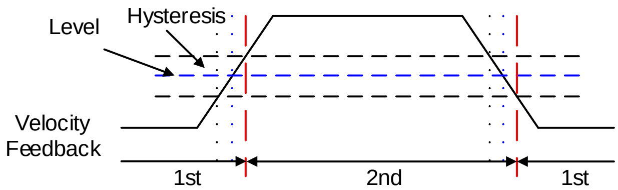
Before using torque feed forward, please set correct inertia ratio P20.04. By increasing torque feed forward gain, position deviation on constant acceleration/deceleration can be reduced to close to 0. Under ideal condition and trapezoidal speed profile, position deviation of the whole motion can be reduced to close to 0. In reality, perturbation torque will always exist, hence position deviation can never be 0.

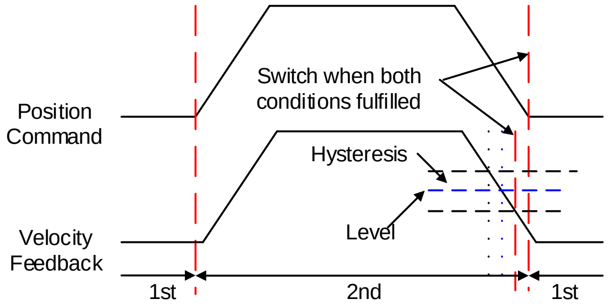
P20.13	Label	Torque feed forward filter time constant		Mode	P/S/PP/PV/HM/CSP/CSV		
	Range	0.0~64.00		Default	0.00	Unit	ms
	Activation	Immediate	Attribute	RW		Index	2020-0Eh

Low pass filter to eliminate abnormal or high frequencies in torque feed forward command. Usually used when encoder has lower resolution or precision.
Noise reduces if torque feed forward filter time constant is set higher but position deviation will increase at acceleration varied points.

P20.15	Label	Position control gain switching mode		Mode	P/PP/HM/CSP	
	Range	0.0~12		Default	0	Unit	
	Activation	Immediate	Attribute	RW	Index	2020-10h

Set Value	Condition	Gain switching condition
0	1st gain fixed	Fixed on using 1st gain(P20.00-P20.04)
1	2nd gain fixed	Fixed on using 2nd gain (P20.05-P20.09)
2	Reserved	
3	High set torque	Switch to 2nd gain when set torque command absolute value larger than (level + hysteresis)[%] Switch to 1st gain when set torque command absolute value smaller than (level + hysteresis)[%] 
4	Reserved	Reserved
5	High set velocity	 Valid for position and velocity control. Switch to 2nd gain when set velocity command absolute value larger than (level + hysteresis)[r/min] Switch to 1st gain when set velocity command absolute value smaller than (level-hysteresis)[r/min]
6	Large position deviation	Valid for position control. Switch to 2nd gain when position deviation absolute value larger than (level + hysteresis)[pulse] Switch to 1st gain when position deviation absolute value smaller than

		(level-hysteresis)[pulse] 
7	Pending position command	Valid for position control. Switch to 2nd gain if position command ≠ 0 Switch to 1st gain if position command remains = 0 throughout the duration of delay time. 
8	Not yet in position	Valid for position control. Switch to 2nd gain if position command is not completed. Switch to 1st gain if position command remains uncompleted throughout the duration of delay time. 
9	High actual velocity	 Valid for position control. Switch to 2nd gain when actual velocity absolute value larger than (level + hysteresis)[r/min] Switch to 1st gain when actual velocity absolute value remains smaller throughout the duration of delay time than (level-hysteresis)[r/min]

10	Pending position command +actual velocity	 Valid for position control. Switch to 2nd gain if position command ≠ 0 Switch to 1st gain if positional command = 0 throughout the duration of delay time and absolute value of actual velocity remains smaller than (level - hysteresis) (r/min)

For position control mode, set P20.15=3,5,6,9,10;

For velocity control mode, set P20.15=3,5,9;

*** Above 'level' and 'hysteresis' are in correspondence to P20.17 Position control gain switching level and P20.18 Hysteresis at position control switching.*

P20.16	**Label**	Position Control Switching Delay		**Mode**	P/PP/HM/CSP		
	Range	0.0~1000.0		**Default**	0.0	**Unit**	ms
	Activation	Immediate	**Attribute**	RW		**Index**	2020-11h

When P20.15 is set to 2, 3, or 10, it represents the time from the detection trigger to the actual gain switchover when switching from the 1st gain to the 2nd gain.

P20.17	**Label**	Position control gain switching level		**Mode**	P/PP/HM/CSP		
	Range	0~20000		**Default**	50	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2020-12h

Set threshold value for gain switching to occur.
Unit is mode dependent.

Switching condition	Unit
Position	Encoder pulse count
Velocity	RPM
Torque	%

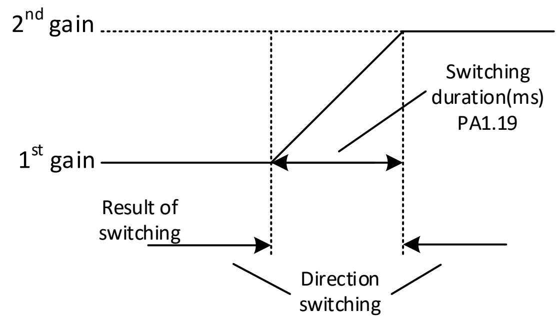
Please set level ≥ hysteresis

P20.18	**Label**	Hysteresis at position control switching		**Mode**	P/PP/HM/CSP		
	Range	0~20000		**Default**	33	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2020-13h

To eliminate the instability of gain switching. Used in combination with P20.17 If level< hysteresis, drive will set internally hysteresis = level.

P20.19	Label	Position gain switching time		Mode	P/PP/HM/CSP		
	Range	0~1000.0		Default	3.3	Unit	ms
	Activation	Immediate	Attribute	RW		Index	2020-14h

During position control, if 1st and 2nd gain difference is too large, to ease torque changes and vibration due to rapid changes in position loop gain, set suitable P01.19 value
For example: 1st (P20.00) <-> 2nd (P20.05)



P20.21	Label	Speed Regulator - kr		Mode	S	PV	CSV
	Range	0~200		Default	100	Unit	%
	Activation	Immediate	Attribute	RW		Index	2020-16h

Speed command adjustment coefficient: used to adjust the relationship between the target value and feedback, and affect the system's response to errors.

P20.22	Label	Speed Feedback Filter Level		Mode	P/S/PP/PV/HM/CSP/CSV		
	Range	0~15		Default	0	Unit	
	Activation	Immediate	Attribute	RW		Index	2020-17h

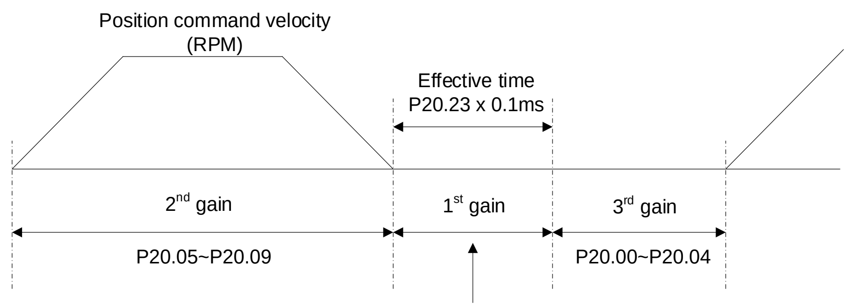
Set the filtering times for speed feedback. The larger the filtering times, the smaller the fluctuation will be, but the greater the delay will be.

P20.23	Label	3rd Position Gain Active Time		Mode	P/PP/HM/CSP		
	Range	0~10000		Default	0	Unit	ms
	Activation	Immediate	Attribute	RW		Index	2020-18h

Set the effective time of the 3rd gain.
When not in use, please set P20.23=0 and P20.24=100.

P20.24	Label	3rd Position Gain Multiplier		Mode	P/PP/HM/CSP		
	Range	0~1000		Default	100	Unit	%
	Activation	Immediate	Attribute	RW		Index	2020-19h

The 3rd gain becomes effective after the position command speed reaches zero and the time set by P20.23 has elapsed.
3rd gain = 1st gain × P20.24 / 100.
The 3rd gain does not change the original speed loop integral time, speed filter, or torque filter values.



P20.28	Label	Speed Observer Gain		Mode	F		
	Range	0~32767		Default	160	Unit	%
	Activation	Immediate	Attribute	RW		Index	2020-1Dh

The servo system usually obtains the motor position through encoder feedback and then calculates the speed through differentiation. The differentiation calculation will introduce noise and delay.
The speed observer is a technology based on motor mathematical models and real-time current sampling. It can estimate a smoother and lower-latency speed signal, serving as a supplement or alternative to speed control.
P20.28 is the gain of the observer. It determines the correction force of the observer on the speed estimation error.
(1) A higher gain value: The system responds faster to speed changes and can track actual speed changes more quickly, but it is also more sensitive to feedback noise.
(2) A lower gain value: The observer responds more slowly, and the noise suppression capability is stronger, but the estimation will have a lag.

P20.29	Label	Speed Observer Bandwidth		Mode	F		
	Range	0~32767		Default	160	Unit	ms
	Activation	Immediate	Attribute	RW		Index	2020-1Eh

The servo system obtains motor position feedback via an encoder and calculates speed through differentiation. This process introduces noise and delay.
The speed observer is an algorithm based on motor mathematical models and real-time current sampling. It can estimate a smoother speed signal with lower latency, serving as a supplement or alternative to speed control.
P20.29 directly sets the bandwidth of this observer algorithm.
(1) Higher numerical value: The observer has a wider bandwidth and a faster response, enabling it to track actual speed changes more quickly. However, it is more sensitive to feedback noise and may cause high-frequency system oscillations.
(2) Lower numerical value: The observer has a narrower bandwidth and a slower, more stable response. It has strong noise suppression capabilities and stable estimation, but this introduces lag, leading to dynamic state hysteresis.

3.4.2【Class P21】Self-Tuning Parameters

<table>
<tr><td rowspan="3">P21.00</td><td>Label</td><td colspan="2">Model-following bandwidth(MFC)</td><td>Mode</td><td colspan="3">F</td></tr>
<tr><td>Range</td><td colspan="2">0~2000.0</td><td>Default</td><td>0.1</td><td>Unit</td><td>Hz</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>2021-01h</td></tr>
</table>

Model-following bandwidth, also known as model-following control (MFC), is used to control the position loop to improve the responsiveness to commands, speed up positioning time and reduce following error. The effect is obvious especially in low and medium mechanical stiffness. Use mainly for MFC or ZTC tuning.

Value	Description
0	Disable the function.
0.1	Enable the function to set bandwidth automatically
0.2~0.9	Reserved
1~2000.0	Manually set the bandwidth; belt application recommend 3.0~10.0

<table>
<tr><td rowspan="3">P21.01</td><td>Label</td><td colspan="2">Real time Auto Gain Adjusting</td><td>Mode</td><td colspan="3">F</td></tr>
<tr><td>Range</td><td colspan="2">0x0~0xFFF</td><td>Default</td><td>0x5</td><td>Unit</td><td></td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>2021-02h</td></tr>
</table>

Set up the mode of the real time auto gain adjusting.

Data bits	Category	Settings	Application
0x00_	Motion setting mode	Used to set motion setting mode, which can be selected according to the motion characteristics or setting requirements. Generally, it is recommended to select mode 1 with good generality when there is no special requirement, mode 2 when rapid positioning is needed If mode 1 and mode 2 cannot meet the requirements, please choose mode 0.	
		0:Manual	P21.02 invalid. Gain value must be adjusted manually and accordingly.
		1:Standard	P21.02 valid. Quick gain adjusting can be achieved by changing P00.03 stiffness value. Gain switching is not used in this mode, suitable for applications with requirements for stability.
		2:Positioning	P21.02 valid. Quick gain adjusting can be achieved by changing P00.03 stiffness value. This mode is suitable for applications requiring quick positioning. Not recommended for load mounted vertical to ground, or please compensate for the load using P21.25
		3: Standard Expansion	Consistent with the 1-standard mode; the difference lies in that the gain used in the same rigid software is different.
		4: Positioning Expansion	Consistent with the 2-positioning mode; the difference lies in that the gain used in the same rigid software is different.
		5: Standard + Inertia Identification & Notch Auto-Setting	On the basis of the 1-standard mode, add inertia identification and notch auto-setting; after the setting is completed, automatically return to the standard mode 0x5 → 0x1.
		6: Positioning + Inertia Identification & Notch Auto-Setting	On the basis of the 2-positioning mode, add inertia identification and notch auto-setting; after the setting is completed, automatically return to the positioning mode 0x6 → 0x2.
0x0_0	Load type setting	Used to select the load type, choose according to load-inertia ratio and mechanical structure.	
		0: Rigid structure	This mode prioritizes system responsiveness. Use this mode when there is a relatively rigid structure with low load inertia. Typical application including directly connected high-precision gearbox, lead screw, gears, etc.
		1:High inertia	For applications with higher load inertia (10 times or above), gain settings take into account both machine stability and responsiveness. Not recommended to set stiffness above 15 for high load inertia.
		2: Flexible structure	This mode prioritizes system stability. Use this mode when there is low rigidity structure with high load inertia. Typical applications included belts and chains.
0x_00	*Reserved*		

The setting type combination is a hexadecimal standard, as follows:

Setting type combination	Application type
0X000	Rigid structure + Manual
0X001	Rigid structure +Standard

0X002	Rigid structure +Positioning
0X010	High inertia + Manual
0X011	High inertia + Standard
0X012	High inertia + Positioning
0X020	Flexible structure + Manual
0X021	Flexible structure +Standard
0X022	Flexible structure +Positioning

P21.02	**Label**	Real time Auto Gain Adjusting		**Mode**	**F**		
	Range	50~81		**Default**	70	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2021-03h

Valid when P21.02 = 1,

Low → Mechanical stiffness ← High

Low → Servo gain ← High

81.80·······························70.69.68·····························51.50

Low → Responsiveness ← High

- Lower values ensure better system responsiveness and mechanical stiffness but machine vibration might occur, please set accordingly. Please stop the motor before doing any changes to the stiffness settings.
- When P21.01 = 0x010, please set stiffness level to around 65.

P21.03	**Label**	Inertia ratio		**Mode**	**F**		
	Range	0~20000		**Default**	250	**Unit**	%
	Activation	Immediate	**Attribute**	RW		**Index**	2021-03h

P21.03=(load inertia/motor rotational inertia)×100%

Set inertia ratio according to actual load inertia. When both are uniform, actual motor velocity loop responsiveness and gain settings will be consistent. If inertia ratio is greater than actual value, velocity loop gain settings will be higher and vice versa.
For motor with high inertia, P21.03 can be left unfilled but optimal setting of P21.03 could improve system performance.

P21.04	**Label**	MFC Curve Damping Correction Coefficient		**Mode**	**F**		
	Range	-100.00~100.00		**Default**	0.00	**Unit**	%
	Activation	Immediate	**Attribute**	RW		**Index**	2021-05h

Used to improve positioning smoothness and positioning time.

<table>
<tr><td rowspan="3">P21.05</td><td>Label</td><td>Forward/Reverse Torque Comp Gain Difference Percentage</td><td>Mode</td><td colspan="3">F</td></tr>
<tr><td>Range</td><td>-20.00~20.00</td><td>Default</td><td>0.00</td><td>Unit</td><td>%</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td>RW</td><td>Index</td><td>2021-06h</td></tr>
<tr><td></td><td colspan="6">Used to set the difference ratio of torque compensation gains between the forward rotation and reverse rotation of the servo motor, with the forward torque being P21.05×100% of the reverse torque.</td></tr>
</table>

<table>
<tr><td rowspan="3">P21.06</td><td>Label</td><td>MFC Type</td><td>Mode</td><td>P</td><td>PP</td><td>CSP</td></tr>
<tr><td>Range</td><td>0~5</td><td>Default</td><td>3</td><td>Unit</td><td></td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td>RW</td><td>Index</td><td>2021-07h</td></tr>
</table>

Set value	Description
【0】	Model following control
1	Zero tracking control
2	3 inertia (future upgrade)
3	Path following (future upgrade)
4	Traditional Feedforward
5	Vibration Suppression Type

<table>
<tr><td rowspan="3">P21.07</td><td>Label</td><td>Velocity feedforward compensation coefficient</td><td>Mode</td><td>P</td><td>PP</td><td>CSP</td></tr>
<tr><td>Range</td><td>-10000~ 10000</td><td>Default</td><td>0</td><td>Unit</td><td>-</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td>RW</td><td>Index</td><td>2021-08h</td></tr>
<tr><td></td><td colspan="6">This parameter is used for feedforward compensation of speed to reduce system tracking errors and improve dynamic response speed. As an open-loop control technology, it predicts load changes or command changes to adjust control output in advance, making the system more stable and accurate.</td></tr>
</table>

<table>
<tr><td rowspan="3">P21.08</td><td>Label</td><td>Torque feedforward compensation coefficient</td><td>Mode</td><td>PP</td><td>PV</td><td>CSP</td><td>CSV</td></tr>
<tr><td>Range</td><td>-10000~ 10000</td><td>Default</td><td>0</td><td>Unit</td><td colspan="2">-</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td>RW</td><td>Index</td><td colspan="2">2021-09h</td></tr>
<tr><td></td><td colspan="7">This parameter enables feedforward compensation for torque control when set, enhancing the system’s ability to predict and compensate for load changes (such as external torque disturbances). This improves the system’s response speed and reduces tracking errors. As an open-loop control strategy, feedforward compensation, when combined with feedback control, significantly improves overall system stability.</td></tr>
</table>

<table>
<tr><td rowspan="3">P21.09</td><td>Label</td><td>Dynamic friction compensation coefficient</td><td>Mode</td><td colspan="3">F</td></tr>
<tr><td>Range</td><td>0~1000</td><td>Default</td><td>0</td><td>Unit</td><td></td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td>RW</td><td>Index</td><td>2021-0Ah</td></tr>
</table>

	To set ratio of rated torque/rated rotational speed, to compensate for dynamic friction during motion and have better control over acceleration/deceleration. $\text{Dynamic friction coefficient} = \left\lvert \frac{\text{Torque(Rotational speed 1)} - \text{Torque(Rotational speed 2)}}{\text{Rotational speed 1} - \text{Rotational speed 2}} * \text{rated rotational speed} \right\rvert$ When there is an excess position deviation during acceleration/deceleration, please adjust friction coefficient to reduce the deviation to 0.

P21.10	Label	Overtravel time coefficient		Mode	F		
	Range	0~10000		Default	0	Unit	-
	Activation	Immediate	Attribute	RW		Index	2021-0Bh
	By setting this time constant, the system's overshoot suppression capability can be adjusted. The settling time refers to the time it takes for the system (such as position, speed, etc.) to return to and stabilize within a specified range after a target value disturbance. This parameter adjusts the damping characteristic of the control algorithm, reducing overshoot and making the system run more smoothly.						

P21.11	Label	Overtravel suppression gain		Mode	F		
	Range	0~1000		Default	0	Unit	-
	Activation	Immediate	Attribute	RW		Index	2021-0Ch
	Suppression improves with larger set value but might affect the performance of MFC. Please use with caution for any value above 100.						

P21.12	Label	One-click Tuning Mode		Mode	F		
	Range	0x0~0xFFFF		Default	0x0	Unit	
	Activation	Immediate	Attribute	RW		Index	2021-0Dh

Functions	Bit	Value	Description
Response Level Setting	bit0~3	0	Medium response
		1	Low response
		2	High response
Operation Mode Setting	bit4~7	0	Positioning
		1	Interpolation
Operation Direction Setting	bit8~9	1	Forward/Reverse operation
		1	Forward operation
		2	Reverse operation
Inertia Identification Failure Alarm Shielding Setting	bit10	0	Do not shield inertia identification failure alarm
		1	Shield inertia identification failure alarm

P21.14	Label	One-click Tuning Progress		Mode	F		
	Range	0~100		Default	0	Unit	
	Activation	Immediate	Attribute	RO		Index	2021-0Fh
	Displays the current progress of the One-click Tuning.						

P21.15	Label	One-click Tuning Error Code		Mode	F		
	Range	0x0~0xFFFF		Default	0x1	Unit	
	Activation	Immediate	Attribute	RO		Index	2021-10h
	Displays the error code for the current One-click Tuning.						

P21.16	Label	One-click Tuning Velocity Limit		Mode	F		
	Range	10~6000		Default	1500	Unit	r/min
	Activation	Immediate	Attribute	RW		Index	2021-11h
	Displays the One-click Tuning Velocity Limitation						

P21.19	Label	Auxiliary Tuning Mode		Mode	F		
	Range	0x0~0x6		Default	0x0	Unit	
	Activation	Immediate	Attribute	RW		Index	2021-14h
	Set auxiliary adjustment mode: Bit0: Automatic softness Bit1: Automatic rigidity						

P21.20	Label	Ltune Close Time		Mode	F		
	Range	0~6000		Default	0	Unit	s
	Activation	Immediate	Attribute	RW		Index	2021-15h
	Set Ltune tuning time						

P21.21	Label	Ltune Progress		Mode	F		
	Range	0~100		Default	0	Unit	%
	Activation	Immediate	Attribute	RO		Index	2021-16h
	Displays the Ltune progress in tuning.						

P21.22	Label	Friction Compensation Function Setting		Mode	F		
	Range	1~1000		Default	1	Unit	r/min
	Activation	Immediate	Attribute	RW		Index	2021-17h
	This parameter is used by the driver's main output to set additional torque compensation for overcoming mechanical transmission friction, addressing issues such as low-speed crawling, shaking, and error following, and improving the smoothness of motor movement. The larger the value, the stronger the compensation effect, and the greater the output compensation torque. =0: The default value is equivalent to 1, indicating a fixed and small friction compensation value. =x, Range 1~1000: Represents the friction compensation strength. The calculation formula for the compensated torque rate is: (x+1)/10000 Example: If set to 499, the compensation rate is (499+1)/10000=500/10000=5%						

P21.23	Label	Positive Torque Compensation Value		Mode	F		
	Range	-100~100		Default	0	Unit	%
	Activation	Immediate	Attribute	RW		Index	2021-18h

	Set to add feedforward torque superposition to the torque command, mainly for friction compensation in horizontal movement.It reduces the impact of friction in mechanical transmission on operation effects and provides positive and negative compensation values for torque in the same forward and reverse direction. Example: When the motor speed is at a constant speed, the monitored torque output value for forward operation is recorded as T1, and the torque output value for reverse operation is recorded as T2. If T2 = |T1-T2|/2, the friction torque is Tf = |T1-T2|/2. The magnitude of Tf is determined by the settings of P21.23 and P21.24. Note: Positive and negative compensation directions are determined based on the actual position command. The forward torque compensation value is set to positive (P21.23=+Tf), and the reverse direction friction compensation value is set to negative (P21.24=-Tf).

P21.24	Label	Negative Torque Compensation Value		Mode	F		
	Range	-100~100		Default	0	Unit	%
	Activation	Immediate	Attribute	RW		Index	2021-19h
	Check 21.23						

P21.25	Label	Torque Command Additive Value		Mode	F		
	Range	-100~100		Default	0	Unit	%
	Activation	Immediate	Attribute	RW		Index	2021-1Ah
	Set the feedforward addition value of the vertical torque. It is applied to vertical load conditions to compensate for the torque caused by gravity. Example: When moving along the vertical direction, select any position within the stroke as the load point. When the load moves to that point, the motor is controlled to stop but not move. Record the torque value T output at that time as the torque command addition value (gravity compensation value).						

P21.27	Label	Vibration Detection Threshold		Mode	F		
	Range	0~10		Default	0	Unit	%
	Activation	Immediate	Attribute	RW		Index	2021-1Ch
	Set the threshold value for the alarm when the position error exceeds the set value (Er190). 0:optical 5%, Magnetic 10%						

P21.30	Label	Inertia Identification Value		Mode	F		
	Range	-2147483648~2147483647		Default	0	Unit	%
	Activation	Immediate	Attribute	RO		Index	2021-1Fh
	Displays the Inertia Identification Value						

P21.32	Label	Tuning Completion Count		Mode	F		
	Range	-2147483648~2147483647		Default	0	Unit	
	Activation	Immediate	Attribute	RO		Index	2021-21h
	Displays the Tuning Completion Count						

P21.33	Label	Tuning Completion Time		Mode	F		
	Range	-2147483648~2147483647		Default	0	Unit	s

	Activation	Immediate	**Attribute**	RO		**Index**	2021-22h
	Displays the Tuning Completion Time						

P21.34	**Label**	Tuning Overshoot		**Mode**	F		
	Range	-2147483648~2147483647		**Default**	0	**Unit**	%
	Activation	Immediate	**Attribute**	RO		**Index**	2021-23h
	Displays the Tuning Overshoot						

P21.35	**Label**	Tuning Jitter Count		**Mode**	F		
	Range	-2147483648~2147483647		**Default**	0	**Unit**	counts
	Activation	Immediate	**Attribute**	RO		**Index**	2021-24h
	Displays the Tuning Jitter Count						

P21.36	**Label**	Tuning Maximum Current		**Mode**	F		
	Range	-2147483648~2147483647		**Default**	0	**Unit**	%
	Activation	Immediate	**Attribute**	RO		**Index**	2021-25h
	Displays the Tuning Maximum Current						

P21.37	**Label**	Tuning Maximum Velocity		**Mode**	F		
	Range	-2147483648~2147483647		**Default**	0	**Unit**	r/min
	Activation	Immediate	**Attribute**	RW		**Index**	2021-26h
	Displays the Tuning Maximum Velocity						

P21.41	**Label**	Vibration Monitor Value		**Mode**	F		
	Range	-2147483648~2147483647		**Default**	0	**Unit**	%
	Activation	Immediate	**Attribute**	RO		**Index**	2021-2Ah
	Displays the Vibration Monitor Value						

3.4.2【Class P22】Filter Parameter

P22.00	**Label**	Adaptive filtering mode settings		**Mode**	F		
	Range	0~4		**Default**	3	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2022-1h

Set value	Description	
0	Adaptive filter: invalid	Parameters related to 3rd and 4th notch filter remain unchanged
1	Adaptive filter: 1 filter valid for once.	1 adaptive filter becomes valid. 3rd notch filter related parameters updated accordingly. P22.00 switches automatically to 0 once updated.
2	Adaptive filter: 1 filter remains valid	1 adaptive filter becomes valid. 3rd notch filter related parameters will keep updating accordingly.
3	Adaptive filter: 1&2 filter remains valid	1 & 2 adaptive filter becomes valid. 3rd & 4th notch filter related parameters will keep updating accordingly.
4	-	Filtering clearing.

P22.01	Label	1st notch frequency		Mode	F		
	Range	50~8000		Default	8000	Unit	Hz
	Activation	Immediate	Attribute	RW		Index	2022-02h

Set center frequency of 1st torque command notch filter.
Set P22.01 to 8000 to deactivate notch filter

P22.02	Label	1st notch bandwidth		Mode	F		
	Range	0~20		Default	4	Unit	
	Activation	Immediate	Attribute	RW		Index	2022-03h

Set notch bandwidth for 1st resonant notch filter.
Under normal circumstances, please use factory default settings. If resonance is under control, in combination with P22.01 and P22.03, P22.02 can be reduced to improve current loop responsiveness which allows higher mechanical stiffness settings.

P22.03	Label	1st notch depth		Mode	F		
	Range	0~99		Default	0	Unit	
	Activation	Immediate	Attribute	RW		Index	2022-04h

Set notch depth for 1st resonant notch filter.
Under normal circumstances, please use factory default settings. If resonance is under control, in combination with P22.01 and P22.02, P22.03 can be reduced to improve current loop responsiveness which allows higher mechanical stiffness settings

P22.04	Label	2nd notch frequency		Mode	F		
	Range	50~8000		Default	8000	Unit	Hz
	Activation	Immediate	Attribute	RW		Index	2022-05h

Set center frequency of 2nd torque command notch filter.
Set P22.04 to 8000 to deactivate notch filter

P22.05	Label	2nd notch bandwidth		Mode	F		
	Range	0~20		Default	4	Unit	
	Activation	Immediate	Attribute	RW		Index	2022-06h

Set notch bandwidth for 2nd resonant notch filter.
Under normal circumstances, please use factory default settings. If resonance is under control, in combination with P22.04 and P22.06, P22.05 can be reduced to improve current loop responsiveness which allows higher mechanical stiffness settings.

P22.06	Label	2nd notch depth		Mode	F		
	Range	0~99		Default	0	Unit	
	Activation	Immediate	Attribute	RW		Index	2022-07h

Set notch depth for 1st resonant notch filter. Under normal circumstances, please use factory default settings. If resonance is under control, in combination with P22.04 and P22.05, P22.06 can be reduced to improve current loop responsiveness which allows higher mechanical stiffness settings

P22.07	**Label**	3rd notch frequency		**Mode**	F		
	Range	50~8000		**Default**	8000	**Unit**	Hz
	Activation	Immediate	**Attribute**	RW		**Index**	2022-08h
Set center frequency of 3rd torque command notch filter. Set P22.07 to 8000 to deactivate notch filter							

P22.08	**Label**	3rd notch bandwidth		**Mode**	F		
	Range	0~20		**Default**	4	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2022-09h
Set notch bandwidth for 3rd resonant notch filter. Same as above.							

P22.09	**Label**	3rd notch depth		**Mode**	F		
	Range	0~99		**Default**	0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2022-0Ah
Set notch depth for 3rd resonant notch filter. Same as above.							

P22.10	**Label**	4th notch frequency		**Mode**	F		
	Range	50~8000		**Default**	8000	**Unit**	Hz
	Activation	Immediate	**Attribute**	RW		**Index**	2022-0Bh
Set center frequency of 4th torque command notch filter. Set P22.10 to 8000 to deactivate notch filter							

P22.11	**Label**	4th notch bandwidth		**Mode**	F		
	Range	0~20		**Default**	4	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2022-0Ch
Set notch bandwidth for 4th resonant notch filter. Same as above.							

P22.12	**Label**	4th notch depth		**Mode**	F		
	Range	0~99		**Default**	0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2022-0Dh
Set notch depth for 4th resonant notch filter. Same as above.							

P22.13	**Label**	1st Vibration Suppression Frequency		**Mode**	F		
	Range	0~200		**Default**	0	**Unit**	Hz
	Activation	Immediate	**Attribute**	RW		**Index**	2022-0Eh
	Set the vibration suppression frequency to suppress end shaking. After measuring the vibration frequency of the load, set it in units of 0.1 [Hz]. 0.0: Turn off the vibration suppression function. 1.0~200.0: Set the vibration suppression frequency. Note: The suppression function targets end shaking. It is specifically used to suppress end shaking caused by high deceleration impacts during motor stops, which is particularly effective for shaking at frequencies around 100Hz. During use, set this parameter to the frequency of the shaking. (For vibration frequencies, you can try to use servo adjustment software to collect waveform analysis for acquisition).						

P22.14	**Label**	1st Vibration Suppression Filter		**Mode**	F		
	Range	0~99		**Default**	1	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2022-0Fh
	Set the gain of the 1st-order low-pass filter; a higher gain results in a more significant vibration suppression effect, but it may also introduce time delay and reduce the response speed.						

P22.15	**Label**	2nd Vibration Suppression Frequency		**Mode**	F		
	Range	0~200		**Default**	0	**Unit**	H
	Activation	Immediate	**Attribute**	RW		**Index**	2022-10h
	Check 22.13						

P22.16	**Label**	2nd Vibration Suppression Filter		**Mode**	F		
	Range	0~9		**Default**	1	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2022-11h
	Check 22.14						

P22.47	**Label**	d-axis Current Filter Time Constant		**Mode**	F		
	Range	0~2500		**Default**	0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2022-30h
	Sets the time constant for the d-axis current low-pass filter. A larger value provides stronger ripple suppression, but also increases delay and reduces response speed.						

3.5 Basic Functions

3.5.1【Class P30】Homing Function

P30.00	Label	Homing Mode		Mode	HM		
	Range	-6~37		Default	19	Unit	
	Activation	Immediate	Attribute	RW		Index	2030-01h
Homing Mode setting , check homing page for more details.							

P30.01	Label	Homing High Speed		Mode	HM		
	Range	0~2147483647		Default	139810 13	Unit	unit/s
	Activation	Immediate	Attribute	RW		Index	2030-02h
Homing High Speed setting							

P30.02	Label	Homing Low Speed		Mode	HM		
	Range	0~2147483647		Default	139810 1	Unit	unit/s
	Activation	Immediate	Attribute	RW		Index	2030-03h
Homing Low Speed setting							

P30.03	Label	Homing Acceleration/Deceleration		Mode	HM		
	Range	0~2147483647		Default	139810133 3	Unit	unit/s2
	Activation	Immediate	Attribute	RW		Index	2030-04h
Homing Acceleration/Deceleration setting							

P30.04	Label	Current position as origin		Mode	HM		
	Range	0~1		Default	0	Unit	unit
	Activation	Immediate	Attribute	RW		Index	2030-05h
Force-set the current servo position as the coordinate origin to establish a new coordinate reference for subsequent absolute positioning and relative positioning.							

P30.08	Label	Homing Position Offset		Mode	HM		
	Range	-2147483647~2147483647		Default	0	Unit	unit
	Activation	Immediate	Attribute	RW		Index	2030-09h
Homing Position Offset setting							

P30.09	Label	Torque Homing Force Limit		Mode	HM		
	Range	0~150		Default	80	Unit	%
	Activation	Immediate	Attribute	RW		Index	2030-0Ah
	Torque Homing Force Limit setting						

P30.10	Label	Torque Homing Time		Mode	HM		
	Range	0~200		Default	50	Unit	ms
	Activation	Immediate	Attribute	RW		Index	2030-0Bh
	Torque Homing & Torque Holding Time setting						

P30.11	Label	Homing Overtravel		Mode	HM		
	Range	0~214748364.7		Default	0	Unit	r
	Activation	Immediate	Attribute	RW		Index	2030-0Ch
	Homing Overtravel setting						

P30.12	Label	Homing Timeout		Mode	HM		
	Range	0~1000000		Default	60000	Unit	ms
	Activation	Immediate	Attribute	RW		Index	2030-0Dh
	Set the threshold value for the return-to-zero timeout alarm. If the return-to-zero time exceeds the set threshold, the system will trigger the alarm Er741 (Return-to-Zero Timeout).						

P30.14	Label	Homing In-Place Threshold		Mode	HM		
	Range	0~100		Default	8	Unit	unit
	Activation	Immediate	Attribute	RW		Index	2030-0Fh
	Homing In-Place Threshold setting						

P30.15	Label	Homing Auxiliary Function		Mode	HM		
	Range	0x0~0x1		Default	0x1	Unit	
	Activation	Immediate	Attribute	RW		Index	2030-10h
	Bit0: Set 1, clear the origin position.						

P30.18	Label	Homing Axis Delay Time		Mode	HM		
	Range	0~15000		Default	0	Unit	
	Activation	Immediate	Attribute	RW		Index	2030-13h
	Homing Axis Delay Time setting						

P30.22	Label	Homing Maximum speed limit		Mode	HM		
	Range	0~3000		Default	0	Unit	rpm
	Activation	Immediate	Attribute	RW		Index	2030-13h
	Homing Maximum speed limit setting						

3.5.2【Class P31】Probe Function

P31.00	**Label**	Probe 1 Rising Edge Position Capture Compensation		**Mode**	F		
	Range	-2147483647~2147483647		**Default**	0	**Unit**	unit
	Activation	Immediate	**Attribute**	RW		**Index**	2031-01h
	Compensate for the error caused by the transmission delay captured on the rising edge of Probe 1						

P31.01	**Label**	Probe 1 Falling Edge Position Capture Compensation		**Mode**	F		
	Range	-2147483647~2147483647		**Default**	0	**Unit**	unit
	Activation	Immediate	**Attribute**	RW		**Index**	2031-02h
	Compensate for the error caused by the transmission delay captured on the Falling edge of Probe 1						

P31.02	**Label**	Probe 2 Rising Edge Position Capture Compensation		**Mode**	F		
	Range	-2147483647~2147483647		**Default**	0	**Unit**	unit
	Activation	Immediate	**Attribute**	RW		**Index**	2031-03h
	Compensate for the error caused by the transmission delay captured on the rising edge of Probe 2						

P31.03	**Label**	Probe 2 Falling Edge Position Capture Compensation		**Mode**	F		
	Range	-2147483647~2147483647		**Default**	0	**Unit**	unit
	Activation	Immediate	**Attribute**	RW		**Index**	2031-04h
	Compensate for the error caused by the transmission delay captured on the Falling edge of Probe 2						

P31.04	**Label**	Probe 1 Input Selection		**Mode**	F		
	Range	1~16		**Default**	5	**Unit**	unit
	Activation	Immediate	**Attribute**	RW		**Index**	2031-05h
	Probe 1 Input DI Selection: Default value is 5, which means DI5 is selected as the input for Probe 1.						

P31.05	**Label**	Probe 2 Input Selection		**Mode**	F		
	Range	1~16		**Default**	4	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2031-06h
	Probe 2 Input DI Selection: Default value is 4, which means DI4 is selected as the input for Probe 1.						

P31.06	**Label**	Probe 1 Capture Direction Selection		**Mode**	F		
	Range	0~1		**Default**	0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2031-07h
	0: Rising edge capture; 1: Falling edge capture.						

P31.07	**Label**	Probe 2 Capture Direction Selection		**Mode**	F		
	Range	0~1		**Default**	0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2031-08h
	0: Rising edge capture; 1: Falling edge capture.						

P31.08	**Label**	Probe Input Filtering		**Mode**	F		
	Range	0~3		**Default**	3	**Unit**	us
	Activation	Immediate	**Attribute**	RW		**Index**	2031-09h
	Probe IO Input Filter Time Setting: The larger the set value, the stronger the filtering effect. However, an excessively large setting will result in an overly long delay.						

3.6 Advanced Functions

3.6.1【Class P41】Position Comparison Output

P41.00	**Label**	Position comparison enable		**Mode**	F	
	Range	0~3		**Default**	0	**Unit**	
	Activation	Immediate	**Attribute**	RW	**Index**	2041-01h
	Set position comparison enable; position comparison will start after the enable becomes valid: 0: Disable;1: Enable (rising edge active).					

P41.01	**Label**	Position Comparison Mode Selection		**Mode**	F	
	Range	0~255		**Default**	0	**Unit**	
	Activation	Immediate	**Attribute**	RW	**Index**	2041-02h
	Set position comparison mode: 0: Sequential comparison; 1: Reciprocal comparison.					

P41.02	**Label**	Position Comparison Output Width		**Mode**	F	
	Range	0.1~409.5		**Default**	0.1	**Unit**	ms
	Activation	Immediate	**Attribute**	RW	**Index**	2041-03h
	Set the pulse width of the output signal when the position comparison point is reached.					

P41.03	**Label**	Position Comparison Pulse Output Compensation		**Mode**	F	
	Range	-1000.0~1000.0		**Default**	0	**Unit**	
	Activation	Immediate	**Attribute**	RW	**Index**	2041-04h
	Set the position comparison output delay compensation to compensate for the delay caused by the DO/frequency division output circuit.					

P41.04	**Label**	Position Comparison Start Point Value		**Mode**	F	
	Range	1~42		**Default**	1	**Unit**	
	Activation	Immediate	**Attribute**	RW	**Index**	2041-05h
	Set Position Comparison Start Point Value					

P41.05	**Label**	Position Comparison Stop Point Value		**Mode**	F	
	Range	1~42		**Default**	1	**Unit**	
	Activation	Immediate	**Attribute**	RW	**Index**	2041-06h
	Set Position Comparison Stop Point Value					

P41.06	**Label**	Fixed-Count Mode Cycle Times		**Mode**	F		
	Range	0~60000		**Default**	1	**Unit**	counts
	Activation	Immediate	**Attribute**	RW		**Index**	2041-07h

P41.07	**Label**	Set Current Position as Position Comparison Zero Point		**Mode**	F		
	Range	0~1		**Default**	0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2041-08h
	Set the zero point for position comparison. When enabled (rising edge active), the current position can be set as the zero point: 0: Disable; 1: Enable (rising edge active).						

P41.08	**Label**	Position Comparison Zero Point offset		**Mode**	F		
	Range	-2147483648~2147483648		**Default**	0	**Unit**	unit
	Activation	Immediate	**Attribute**	RW		**Index**	2041-09h
	Set the position offset after taking the current position as the zero point for position comparison.						

P41.10	**Label**	Actual position of Position Comparison		**Mode**	F		
	Range	-2147483648~2147483648		**Default**	0	**Unit**	unit
	Activation	Immediate	**Attribute**	RO		**Index**	2041-0Bh
	Displays the Actual position of Position Comparison						

P41.11	**Label**	Current Comparison Point of Position Comparison		**Mode**	F		
	Range	-2147483648~2147483648		**Default**	0	**Unit**	
	Activation	Immediate	**Attribute**	RO		**Index**	2041-0Ch
	Displays the Current Comparison Point of Position Comparison						

P41.12	**Label**	Position Comparison Output times		**Mode**	F		
	Range	-2147483648~2147483648		**Default**	0	**Unit**	counts
	Activation	Immediate	**Attribute**	RO		**Index**	2041-0Dh
	Displays the Position Comparison Output times						

P41.13	**Label**	Position Comparison Cycle Times		**Mode**	F		
	Range	-2147483648~2147483648		**Default**	0	**Unit**	counts
	Activation	Immediate	**Attribute**	RO		**Index**	2041-0Dh
	Displays the Position Comparison Cycle Times						

P41.15	Label	Position Comparison resolution		Mode	F		
	Range	-2147483648~2147483648		Default	2500	Unit	counts
	Activation	Immediate	Attribute	RO		Index	2041-0Dh
	Set the position comparison resolution.						

3.6.2【Class P42】Target Position Parameter

P42.00	Label	Position Comparison 1 Target Value		Mode	F		
	Range	-2147483648~2147483648		Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW		Index	2042-01h
	Set the target value for the position comparison point. When the position reaches this comparison point, the position comparison point's attribute (position comparison value) will be output.						

P42.01	Label	Position Comparison 1 Attribute Value		Mode	F		
	Range	0x0~0xFFFF		Default	0x0	Unit	
	Activation	Immediate	Attribute	RW		Index	2042-02h

Two position comparison points share one address. For example, object dictionary index 2042-02h:

bit	Position Comparison Point 1 Attribute
0	=0: No forward pass comparison; =1: Forward pass comparison
1	=0: No reverse pass comparison; =1: Reverse pass comparison
2~5	Reserved
6	Output attribute setting: =0: Pulse mode; =1: Toggle mode
7	DO1 output
8	DO2 output
9	DO3 output
10~12	Reserved
13	Frequency division phase A output
14	Frequency division phase B output
15	Frequency division phase Z output

bit16~31: Position comparison point 2 attributes

bit	Position Comparison Point 2 Attribute
16	=0: No forward pass comparison; =1: Forward pass comparison
17	=0: No reverse pass comparison; =1: Reverse pass comparison
18~21	Reserved
22	Output attribute setting: =0: Pulse mode; =1: Toggle mode
23	DO1 output
24	DO2 output
25	DO3 output
26~28	Reserved
29	Frequency division phase A output
30	Frequency division phase B output

	31	Frequency division phase Z output

P42.02	Label	Position Comparison 2 Target Value		Mode	F		
	Range	-2147483648~2147483648		Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW		Index	2042-03h
	Check 42.00 for details						

P42.03	Label	Position Comparison 2 Attribute Value		Mode	F		
	Range	0x0~0xFFFF		Default	0x0	Unit	
	Activation	Immediate	Attribute	RW		Index	2042-04h
	Check 42.01 for details						

P42.04	Label	Position Comparison 3 Target Value		Mode	F		
	Range	-2147483648~2147483648		Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW		Index	2042-05h
	Check 42.00 for details						

P42.05	Label	Position Comparison 3 Attribute Value		Mode	F		
	Range	0x0~0xFFFF		Default	0x0	Unit	
	Activation	Immediate	Attribute	RW		Index	2042-06h
	Check 42.01 for details						

P42.06	Label	Position Comparison 4 Target Value		Mode	F		
	Range	-2147483648~2147483648		Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW		Index	2042-07h
	Check 42.00 for details						

P42.07	Label	Position Comparison 4 Attribute Value		Mode	F		
	Range	0x0~0xFFFF		Default	0x0	Unit	
	Activation	Immediate	Attribute	RW		Index	2042-08h
	Check 42.01 for details						

P42.08	Label	Position Comparison 5 Target Value		Mode	F		
	Range	-2147483648~2147483648		Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW		Index	2042-09h
	Check 42.00 for details						

P42.09	Label	Position Comparison 5 Attribute Value		Mode	F		
	Range	0x0~0xFFFF		Default	0x0	Unit	
	Activation	Immediate	Attribute	RW		Index	2042-0Ah
Check 42.01 for details							

P42.10	Label	Position Comparison 6 Target Value		Mode	F		
	Range	-2147483648~2147483648		Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW		Index	2042-0Bh
Check 42.00 for details							

P42.11	Label	Position Comparison 6 Attribute Value		Mode	F		
	Range	0x0~0xFFFF		Default	0x0	Unit	
	Activation	Immediate	Attribute	RW		Index	2042-0Ch
Check 42.01 for details							

P42.12	Label	Position Comparison 7 Target Value		Mode	F		
	Range	-2147483648~2147483648		Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW		Index	2042-0Dh
Check 42.00 for details							

P42.13	Label	Position Comparison 7 Attribute Value		Mode	F		
	Range	0x0~0xFFFF		Default	0x0	Unit	
	Activation	Immediate	Attribute	RW		Index	2042-0Eh
Check 42.01 for details							

P42.14	Label	Position Comparison 8 Target Value		Mode	F		
	Range	-2147483648~2147483648		Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW		Index	2042-0Fh
Check 42.00 for details							

P42.15	Label	Position Comparison 8 Attribute Value		Mode	F		
	Range	0x0~0xFFFF		Default	0x0	Unit	
	Activation	Immediate	Attribute	RW		Index	2042-10h
Check 42.01 for details							

P42.16	Label	Position Comparison 9 Target Value		Mode	F		
	Range	-2147483648~2147483648		Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW		Index	2042-11h
Check 42.00 for details							

P42.17	Label	Position Comparison 9 Attribute Value		Mode	F		
	Range	0x0~0xFFFF		Default	0x0	Unit	
	Activation	Immediate	Attribute	RW		Index	2042-12h
Check 42.01 for details							

P42.18	Label	Position Comparison 10 Target Value		Mode	F		
	Range	-2147483648~2147483648		Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW		Index	2042-13h
Check 42.00 for details							

P42.19	Label	Position Comparison 10 Attribute Value		Mode	F		
	Range	0x0~0xFFFF		Default	0x0	Unit	
	Activation	Immediate	Attribute	RW		Index	2042-14h
Check 42.01 for details							

P42.20	Label	Position Comparison 11 Target Value		Mode	F		
	Range	-2147483648~2147483648		Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW		Index	2042-15h
Check 42.00 for details							

P42.21	Label	Position Comparison 11 Attribute Value		Mode	F		
	Range	0x0~0xFFFF		Default	0x0	Unit	
	Activation	Immediate	Attribute	RW		Index	2042-16h
Check 42.01 for details							

P42.22	Label	Position Comparison 12 Target Value		Mode	F		
	Range	-2147483648~2147483648		Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW		Index	2042-17h
Check 42.00 for details							

P42.23	Label	Position Comparison 12 Attribute Value		Mode	F		
	Range	0x0~0xFFFF		Default	0x0	Unit	
	Activation	Immediate	Attribute	RW		Index	2042-18h
	Check 42.01 for details						

P42.24	Label	Position Comparison 13 Target Value		Mode	F		
	Range	-2147483648~2147483648		Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW		Index	2042-19h
	Check 42.00 for details						

P42.25	Label	Position Comparison 13 Attribute Value		Mode	F		
	Range	0x0~0xFFFF		Default	0x0	Unit	
	Activation	Immediate	Attribute	RW		Index	2042-1Ah
	Check 42.01 for details						

P42.26	Label	Position Comparison 14 Target Value		Mode	F		
	Range	-2147483648~2147483648		Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW		Index	2042-1Bh
	Check 42.00 for details						

P42.27	Label	Position Comparison 14 Attribute Value		Mode	F		
	Range	0x0~0xFFFF		Default	0x0	Unit	
	Activation	Immediate	Attribute	RW		Index	2042-1Ch
	Check 42.01 for details						

P42.28	Label	Position Comparison 15 Target Value		Mode	F		
	Range	-2147483648~2147483648		Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW		Index	2042-1Dh
	Check 42.00 for details						

P42.29	Label	Position Comparison 15 Attribute Value		Mode	F		
	Range	0x0~0xFFFF		Default	0x0	Unit	
	Activation	Immediate	Attribute	RW		Index	2042-1Eh
	Check 42.01 for details						

<table>
<tr><td rowspan="3">P42.30</td><td>Label</td><td colspan="2">Position Comparison 16 Target Value</td><td>Mode</td><td colspan="3">F</td></tr>
<tr><td>Range</td><td colspan="2">-2147483648~2147483648</td><td>Default</td><td>0</td><td>Unit</td><td>Unit</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>2042-1Fh</td></tr>
<tr><td colspan="8">Check 42.00 for details</td></tr>
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<table>
<tr><td rowspan="3">P42.31</td><td>Label</td><td colspan="2">Position Comparison 16 Attribute Value</td><td>Mode</td><td colspan="3">F</td></tr>
<tr><td>Range</td><td colspan="2">0x0~0xFFFF</td><td>Default</td><td>0x0</td><td>Unit</td><td></td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>2042-20h</td></tr>
<tr><td colspan="8">Check 42.01 for details</td></tr>
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<table>
<tr><td rowspan="3">P42.32</td><td>Label</td><td colspan="2">Position Comparison 17 Target Value</td><td>Mode</td><td colspan="3">F</td></tr>
<tr><td>Range</td><td colspan="2">-2147483648~2147483648</td><td>Default</td><td>0</td><td>Unit</td><td>Unit</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>2042-21h</td></tr>
<tr><td colspan="8">Check 42.00 for details</td></tr>
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<tr><td rowspan="3">P42.33</td><td>Label</td><td colspan="2">Position Comparison 17 Attribute Value</td><td>Mode</td><td colspan="3">F</td></tr>
<tr><td>Range</td><td colspan="2">0x0~0xFFFF</td><td>Default</td><td>0x0</td><td>Unit</td><td></td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>2042-22h</td></tr>
<tr><td colspan="8">Check 42.01 for details</td></tr>
</table>

<table>
<tr><td rowspan="3">P42.34</td><td>Label</td><td colspan="2">Position Comparison 18 Target Value</td><td>Mode</td><td colspan="3">F</td></tr>
<tr><td>Range</td><td colspan="2">-2147483648~2147483648</td><td>Default</td><td>0</td><td>Unit</td><td>Unit</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>2042-23h</td></tr>
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<table>
<tr><td rowspan="3">P42.35</td><td>Label</td><td colspan="2">Position Comparison 18 Attribute Value</td><td>Mode</td><td colspan="3">F</td></tr>
<tr><td>Range</td><td colspan="2">0x0~0xFFFF</td><td>Default</td><td>0x0</td><td>Unit</td><td></td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>2042-24h</td></tr>
<tr><td colspan="8">Check 42.01 for details</td></tr>
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<table>
<tr><td rowspan="3">P42.36</td><td>Label</td><td colspan="2">Position Comparison 19 Target Value</td><td>Mode</td><td colspan="3">F</td></tr>
<tr><td>Range</td><td colspan="2">-2147483648~2147483648</td><td>Default</td><td>0</td><td>Unit</td><td>Unit</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>2042-25h</td></tr>
<tr><td colspan="8">Check 42.00 for details</td></tr>
</table>

P42.37	**Label**	Position Comparison 19 Attribute Value	**Mode**	F		
	Range	0x0~0xFFFF	**Default**	0x0	**Unit**	
	Activation	Immediate	**Attribute**	RW	**Index**	2042-26h
	Check 42.01 for details					

P42.38	**Label**	Position Comparison 20 Target Value	**Mode**	F		
	Range	-2147483648~2147483648	**Default**	0	**Unit**	Unit
	Activation	Immediate	**Attribute**	RW	**Index**	2042-27h
	Check 42.00 for details					

P42.39	**Label**	Position Comparison 20 Attribute Value	**Mode**	F		
	Range	0x0~0xFFFF	**Default**	0x0	**Unit**	
	Activation	Immediate	**Attribute**	RW	**Index**	2042-28h
	Check 42.01 for details					

P42.40	**Label**	Position Comparison 21 Target Value	**Mode**	F		
	Range	-2147483648~2147483648	**Default**	0	**Unit**	Unit
	Activation	Immediate	**Attribute**	RW	**Index**	2042-29h
	Check 42.00 for details					

P42.41	**Label**	Position Comparison 21 Attribute Value	**Mode**	F		
	Range	0x0~0xFFFF	**Default**	0x0	**Unit**	
	Activation	Immediate	**Attribute**	RW	**Index**	2042-2Ah
	Check 42.01 for details					

P42.42	**Label**	Position Comparison 22 Target Value	**Mode**	F		
	Range	-2147483648~2147483648	**Default**	0	**Unit**	Unit
	Activation	Immediate	**Attribute**	RW	**Index**	2042-2Bh
	Check 42.00 for details					

P42.43	**Label**	Position Comparison 22 Attribute Value	**Mode**	F		
	Range	0x0~0xFFFF	**Default**	0x0	**Unit**	
	Activation	Immediate	**Attribute**	RW	**Index**	2042-2Ch
	Check 42.01 for details					

P42.44	Label	Position Comparison 23 Target Value		Mode	F		
	Range	-2147483648~2147483648		Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW		Index	2042-2Dh
	Check 42.00 for details						

P42.45	Label	Position Comparison 23 Attribute Value		Mode	F		
	Range	0x0~0xFFFF		Default	0x0	Unit	
	Activation	Immediate	Attribute	RW		Index	2042-2Eh
	Check 42.01 for details						

P42.46	Label	Position Comparison 24 Target Value		Mode	F		
	Range	-2147483648~2147483648		Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW		Index	2042-2Fh
	Check 42.00 for details						

P42.47	Label	Position Comparison 24 Attribute Value		Mode	F		
	Range	0x0~0xFFFF		Default	0x0	Unit	
	Activation	Immediate	Attribute	RW		Index	2042-30h
	Check 42.01 for details						

P42.48	Label	Position Comparison 25 Target Value		Mode	F		
	Range	-2147483648~2147483648		Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW		Index	2042-31h
	Check 42.00 for details						

P42.49	Label	Position Comparison 25 Attribute Value		Mode	F		
	Range	0x0~0xFFFF		Default	0x0	Unit	
	Activation	Immediate	Attribute	RW		Index	2042-32h
	Check 42.01 for details						

P42.50	Label	Position Comparison 26 Target Value		Mode	F		
	Range	-2147483648~2147483648		Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW		Index	2042-33h
	Check 42.00 for details						

P42.51	**Label**	Position Comparison 26 Attribute Value		**Mode**	F		
	Range	0x0~0xFFFF		**Default**	0x0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2042-34h
Check 42.01 for details							

P42.52	**Label**	Position Comparison 27 Target Value		**Mode**	F		
	Range	-2147483648~2147483648		**Default**	0	**Unit**	Unit
	Activation	Immediate	**Attribute**	RW		**Index**	2042-35h
Check 42.00 for details							

P42.53	**Label**	Position Comparison 27 Attribute Value		**Mode**	F		
	Range	0x0~0xFFFF		**Default**	0x0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2042-36h
Check 42.01 for details							

P42.54	**Label**	Position Comparison 28 Target Value		**Mode**	F		
	Range	-2147483648~2147483648		**Default**	0	**Unit**	Unit
	Activation	Immediate	**Attribute**	RW		**Index**	2042-37h
Check 42.00 for details							

P42.55	**Label**	Position Comparison 28 Attribute Value		**Mode**	F		
	Range	0x0~0xFFFF		**Default**	0x0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2042-38h
Check 42.01 for details							

P42.56	**Label**	Position Comparison 29 Target Value		**Mode**	F		
	Range	-2147483648~2147483648		**Default**	0	**Unit**	Unit
	Activation	Immediate	**Attribute**	RW		**Index**	2042-39h
Check 42.00 for details							

P42.57	**Label**	Position Comparison 29 Attribute Value		**Mode**	F		
	Range	0x0~0xFFFF		**Default**	0x0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2042-3Ah
Check 42.01 for details							

P42.58	Label	Position Comparison 30 Target Value	Mode	F		
	Range	-2147483648~2147483648	Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW	Index	2042-3Bh
Check 42.00 for details						

P42.59	Label	Position Comparison 30 Attribute Value	Mode	F		
	Range	0x0~0xFFFF	Default	0x0	Unit	
	Activation	Immediate	Attribute	RW	Index	2042-3Ch
Check 42.01 for details						

P42.60	Label	Position Comparison 31 Target Value	Mode	F		
	Range	-2147483648~2147483648	Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW	Index	2042-3Dh
Check 42.00 for details						

P42.61	Label	Position Comparison 31 Attribute Value	Mode	F		
	Range	0x0~0xFFFF	Default	0x0	Unit	
	Activation	Immediate	Attribute	RW	Index	2042-3Eh
Check 42.01 for details						

P42.62	Label	Position Comparison 32 Target Value	Mode	F		
	Range	-2147483648~2147483648	Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW	Index	2042-3Fh
Check 42.00 for details						

P42.63	Label	Position Comparison 32 Attribute Value	Mode	F		
	Range	0x0~0xFFFF	Default	0x0	Unit	
	Activation	Immediate	Attribute	RW	Index	2042-40h
Check 42.01 for details						

P42.64	Label	Position Comparison 33 Target Value	Mode	F		
	Range	-2147483648~2147483648	Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW	Index	2042-41h
Check 42.00 for details						

P42.65	Label	Position Comparison 33 Attribute Value		Mode	F		
	Range	0x0~0xFFFF		Default	0x0	Unit	
	Activation	Immediate	Attribute	RW		Index	2042-42h
Check 42.01 for details							

P42.66	Label	Position Comparison 34 Target Value		Mode	F		
	Range	-2147483648~2147483648		Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW		Index	2042-43h
Check 42.00 for details							

P42.67	Label	Position Comparison 34 Attribute Value		Mode	F		
	Range	0x0~0xFFFF		Default	0x0	Unit	
	Activation	Immediate	Attribute	RW		Index	2042-44h
Check 42.01 for details							

P42.68	Label	Position Comparison 35 Target Value		Mode	F		
	Range	-2147483648~2147483648		Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW		Index	2042-45h
Check 42.00 for details							

P42.69	Label	Position Comparison 35 Attribute Value		Mode	F		
	Range	0x0~0xFFFF		Default	0x0	Unit	
	Activation	Immediate	Attribute	RW		Index	2042-46h
Check 42.01 for details							

P42.70	Label	Position Comparison 36 Target Value		Mode	F		
	Range	-2147483648~2147483648		Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW		Index	2042-47h
Check 42.00 for details							

P42.71	Label	Position Comparison 36 Attribute Value		Mode	F		
	Range	0x0~0xFFFF		Default	0x0	Unit	
	Activation	Immediate	Attribute	RW		Index	2042-48h
Check 42.01 for details							

P42.72	Label	Position Comparison 37 Target Value		Mode	F		
	Range	-2147483648~2147483648		Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW		Index	2042-49h
	Check 42.00 for details						

P42.73	Label	Position Comparison 37 Attribute Value		Mode	F		
	Range	0x0~0xFFFF		Default	0x0	Unit	
	Activation	Immediate	Attribute	RW		Index	2042-4Ah
	Check 42.01 for details						

P42.74	Label	Position Comparison 38 Target Value		Mode	F		
	Range	-2147483648~2147483648		Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW		Index	2042-4Bh
	Check 42.00 for details						

P42.75	Label	Position Comparison 38 Attribute Value		Mode	F		
	Range	0x0~0xFFFF		Default	0x0	Unit	
	Activation	Immediate	Attribute	RW		Index	2042-4Ch
	Check 42.01 for details						

P42.76	Label	Position Comparison 39 Target Value		Mode	F		
	Range	-2147483648~2147483648		Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW		Index	2042-4Dh
	Check 42.00 for details						

P42.77	Label	Position Comparison 39 Attribute Value		Mode	F		
	Range	0x0~0xFFFF		Default	0x0	Unit	
	Activation	Immediate	Attribute	RW		Index	2042-4Eh
	Check 42.01 for details						

P42.78	Label	Position Comparison 40 Target Value		Mode	F		
	Range	-2147483648~2147483648		Default	0	Unit	Unit
	Activation	Immediate	Attribute	RW		Index	2042-4Fh
	Check 42.00 for details						

P42.79	**Label**	Position Comparison 40 Attribute Value		**Mode**	**F**		
	Range	0x0~0xFFFF		**Default**	0x0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2042-50h
Check 42.01 for details							

P42.80	**Label**	Position Comparison 41 Target Value		**Mode**	**F**		
	Range	-2147483648~2147483648		**Default**	0	**Unit**	Unit
	Activation	Immediate	**Attribute**	RW		**Index**	2042-51h
Check 42.00 for details							

P42.81	**Label**	Position Comparison 41 Attribute Value		**Mode**	**F**		
	Range	0x0~0xFFFF		**Default**	0x0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2042-52h
Check 42.01 for details							

P42.82	**Label**	Position Comparison 42 Target Value		**Mode**	**F**		
	Range	-2147483648~2147483648		**Default**	0	**Unit**	Unit
	Activation	Immediate	**Attribute**	RW		**Index**	2042-53h
Check 42.00 for details							

P42.83	**Label**	Position Comparison 42 Attribute Value		**Mode**	**F**		
	Range	0x0~0xFFFF		**Default**	0x0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2042-54h
Check 42.01 for details							

3.6.7【Class P47】Special Functions 1

P47.00	**Label**	Collision Detection Mode		**Mode**	**F**		
	Range	0~1		**Default**	0	**Unit**	
	Activation	Re-enable	**Attribute**	RW		**Index**	2047-01h

Set collision detection mode.
0: Disable collision detection;
1: Enable collision detection.
When the rotational speed is lower than the collision detection speed threshold (P47.03), and the absolute value of the load current exceeds the set values of the collision detection forward current threshold (P47.01) and collision detection reverse current threshold (P47.02) during forward and reverse rotation of the motor, a motor collision alarm will be output.

P47.01	**Label**	Collision Detection Positive Current Threshold		**Mode**	**F**		
	Range	0~750		**Default**	100	**Unit**	%
	Activation	Immediate	**Attribute**	RW		**Index**	2047-02h

Set the collision detection forward current threshold. When the speed and forward current threshold conditions are met during forward operation, a collision alarm will be output.

P47.02	**Label**	Collision Detection Negative Current Threshold		**Mode**	**F**		
	Range	0~750		**Default**	100	**Unit**	%
	Activation	Immediate	**Attribute**	RW		**Index**	2047-03h

Set the collision detection backward current threshold. When the speed and backward current threshold conditions are met during backward operation, a collision alarm will be output.

P47.03	**Label**	Collision Detection Velocity Threshold		**Mode**	**F**		
	Range	0~10000		**Default**	0	**Unit**	rpm
	Activation	Immediate	**Attribute**	RW		**Index**	2047-04h

Set the collision detection speed threshold. After collision detection is enabled, when the drive detects that the motor speed is lower than this set value and the collision conditions are met, a motor collision alarm will be triggered.

P47.08	**Label**	Collision Detection Positive Current Filter Coefficient		**Mode**	**F**		
	Range	0~1000		**Default**	0	**Unit**	ms
	Activation	Immediate	**Attribute**	RW		**Index**	2047-09h

Set the forward current filtering coefficient for collision detection. The larger this value is set, the stronger the filtering effect will be. However, it is not recommended to set it too large, as it may easily cause position deviation.

P47.09	**Label**	Collision Detection Negative Current Filter Coefficient		**Mode**	F		
	Range	0~1000		**Default**	0	**Unit**	ms
	Activation	Immediate	**Attribute**	RW		**Index**	2047-0Ah
Set the reverse current filtering coefficient for collision detection. The larger this value is set, the stronger the filtering effect will be. However, it is not recommended to set it too large, as it may easily cause position deviation.							

P47.10	**Label**	Collision Detection Time		**Mode**	F		
	Range	0~10000		**Default**	0	**Unit**	ms
	Activation	Immediate	**Attribute**	RW		**Index**	2047-0Bh
Set the collision detection delay time. After the collision detection mode is enabled, when the drive detects that the speed and current meet the collision conditions, a collision alarm will be triggered after the set delay time.							

P47.12	**Label**	Collision BLF Delay Enable Time		**Mode**	F		
	Range	0~10000		**Default**	200	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2047-0Dh
Set the delay time from detecting the collision signal to triggering the protective action (such as stopping or reversing rotation).							

P47.13	**Label**	Collision BLF Threshold		**Mode**	F		
	Range	0~5000		**Default**	0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2047-0Eh
Set the signal amplitude threshold for triggering collision protection. Commissioning suggestion: Determine the vibration amplitude during normal operation through experiments, and set this value to 1.5 to 2 times the normal value. If the value is set too small: It will be overly sensitive, and slight vibrations will trigger protection. If the value is set too large: Missed detections may occur, resulting in loss of protective function.							

P47.14	**Label**	Collision BLF Center Frequency		**Mode**	F		
	Range	1.00~4000.00		**Default**	100	**Unit**	Hz
	Activation	Immediate	**Attribute**	RW		**Index**	2047-0Fh
Set the center frequency of the frequency band for collision monitoring. Collision energy is usually concentrated at specific frequencies (such as mechanical resonance points). If the wrong frequency band is set, the collision signal may not be captured effectively. You can identify the characteristic frequency of the mechanical system during collision through a spectrum analyzer or the diagnostic function of the drive.							

P47.15	**Label**	Collision BLF Q-Value		**Mode**	F		
	Range	1~5000		**Default**	1000	**Unit**	1
	Activation	Immediate	**Attribute**	RW		**Index**	2047-10h
	Set the quality factor (Q factor) of the band-pass filter, which determines the width of the monitoring frequency band (the higher the Q value, the narrower the frequency band). High Q value: Only monitors signals within a narrow band, offering strong anti-interference capability, but may miss collisions outside the frequency band. Low Q value: Monitors wide-band signals with broader coverage, but is susceptible to noise interference. Select the Q factor based on the frequency concentration of the collision signal (e.g., use a high Q value when the mechanical resonance point is clearly identified; use a low Q value when the collision spectrum is dispersed).						

P47.17	**Label**	Emergency Stop		**Mode**	F		
	Range	-2147483648~2147483647		**Default**	0	**Unit**	Hz
	Activation	Immediate	**Attribute**	RW		**Index**	2047-12h
	=0, cancel emergency stop;=1, enable emergency stop.						

P47.18	**Label**	Software Reset		**Mode**	F		
	Range	0~1		**Default**	0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2047-13h
	=1, execute the software reset function, valid on rising edge.						

P47.19	**Label**	Current Fault Clear		**Mode**	F		
	Range	0~1		**Default**	0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2047-14h
	=1, Current Fault Clear, valid on rising edge.						

P47.20	**Label**	Historical Fault Clear		**Mode**	F		
	Range	0~1		**Default**	0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2047-15h
	=1, Historical Fault Clear, valid on rising edge.						

P47.21	**Label**	Encoder Initial Angle Identification		**Mode**	F		
	Range	0~1		**Default**	0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2047-16h
	=1, starts Encoder Initial Angle Identification, valid on rising edge.						

P47.22	**Label**	Status Function Setting Source		**Mode**	F		
	Range	0~0xFF		**Default**	0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2047-17h
	bit0 =1: In-position judgment is based on relative position error; =0: In-position judgment is						

	based on absolute position error.						
P47.24	Label	JOG Trial Operation Command Torque		Mode	F		
	Range	0~500		Default	100	Unit	%
	Activation	Immediate	Attribute	RW		Index	2047-19h
	JOG Trial Operation Command Torque setting						

P47.25	Label	JOG Trial Operation Command Velocity		Mode	F		
	Range	0~10000		Default	50	Unit	r/min
	Activation	Immediate	Attribute	RW		Index	2047-0Ah
	JOG Trial Operation Command Velocity setting						

P47.26	Label	Trial Operation Distance		Mode	F		
	Range	0~120.0		Default	1.0	Unit	r
	Activation	Immediate	Attribute	RW		Index	2047-0Bh
	JOG operation (position control): The travel distance per operation.						

P47.27	Label	Trial Operation Waiting Interval		Mode	F		
	Range	0~30000		Default	300	Unit	ms
	Activation	Immediate	Attribute	RW		Index	2047-0Ch
	JOG operation (position control): The waiting time after each operation						

P47.28	Label	Trial Operation Cycle Count		Mode	F		
	Range	0~32767		Default	5	Unit	counts
	Activation	Immediate	Attribute	RW		Index	2047-0Dh
	JOG operation (position control): Number of cycles.						

P47.29	Label	Trial Operation Accel/Decel Time		Mode	F		
	Range	0~10000		Default	200	Unit	ms/1000r/min
	Activation	Immediate	Attribute	RW		Index	2047-0Eh
	Acceleration and deceleration time for JOG test run from 0 to 1000 r/min.						

3.7 Safety Functions

3.7.1【Class P50】STO Functions

P50.00	Label	STO error sign		Mode	F		
	Range	-2147483648~2147483647		Default	0	Unit	
	Activation	Immediate	Attribute	RW		Index	2050-01h
STO fault detection flag, used to indicate the specific fault point.							

P50.02	Label	STO diagnosis and filtering time		Mode	F		
	Range	1~2		Default	1	Unit	ms
	Activation	Immediate	Attribute	RW		Index	2050-03h
STO diagnosis and filtering time. This parameter can be adjusted if the input signal is subject to significant interference.							

P50.04	Label	STO Version		Mode	F		
	Range	0~32767		Default	0	Unit	
	Activation	Immediate	Attribute	RO		Index	2050-05h
Displays the STO version							

P50.05	Label	STO real-time running timestamp		Mode	F		
	Range	-2147483648~2147483647		Default	0	Unit	
	Activation	Immediate	Attribute	RO		Index	2050-06h
STO real-time running timestamp display.							

3.8 Communication functions

3.8.1【Class P60】EtherCAT Functions

P60.00	**Label**	Slave Name		**Mode**	F		
	Range	0~65535		**Default**	2	**Unit**	
	Activation	After restart	**Attribute**	RW		**Index**	2060-01h
	Set the slave station number in EtherCAT mode.						

P60.01	**Label**	Slave Name Source		**Mode**	F		
	Range	0~1		**Default**	0	**Unit**	
	Activation	After restart	**Attribute**	RW		**Index**	2060-02h
	0: The master automatically assigns the slave address; 1: The slave address is sourced from parameter P60.00.						

P60.02	**Label**	Synchronization Time Compensation Value 1		**Mode**	CSP		
	Range	0.0~10.0		**Default**	1.0	**Unit**	us
	Activation	After restart	**Attribute**	RW		**Index**	2060-03h
	This parameter sets the dead band threshold for synchronization compensation time. When the detected synchronization time deviation is less than this value, the drive deems such jitter insignificant, and will not perform any compensation to ensure absolute system stability. Feature: This threshold has a low value and is used to filter out extremely minor jitter.						

P60.03	**Label**	Synchronization Time Compensation Value 2		**Mode**	CSP		
	Range	0.1~200.0		**Default**	5.0	**Unit**	us
	Activation	Immediate	**Attribute**	RW		**Index**	2060-04h
	Sets the upper limit of the synchronization compensation time. When the jitter deviation exceeds P60.02 but is less than P60.03, the drive will activate the compensation algorithm and automatically adjust its own PWM cycle to eliminate the synchronization error. If the deviation exceeds this value, it indicates that the synchronization jitter is too severe for the compensation algorithm to handle, and the drive may fail to enable on the bus or trigger a synchronization error alarm.						

<table>
<tr><td rowspan="3">P60.04</td><td>Label</td><td colspan="2">Synchronization Mode Command Delay Cycles</td><td>Mode</td><td colspan="3">CSP</td></tr>
<tr><td>Range</td><td colspan="2">0~100</td><td>Default</td><td>0</td><td>Unit</td><td></td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>2060-05h</td></tr>
<tr><td></td><td colspan="7">The drive delays receiving the position command from the master station by N position loop cycles, which is used to eliminate motor jitter caused by a master station with poor synchronization performance.
In CSP (Cyclic Synchronous Position) mode, the drive receives a new target position command from the master station in every cycle. If the master station has poor performance, the consecutive position commands it sends may not form a smooth curve, but contain jumps or minor fluctuations. This will cause torque ripple in the motor, which manifests as jitter or noise. This parameter allows the drive to delay the processing of these commands, with the purpose of reducing the response speed of the motor system to improve running smoothness.</td></tr>
</table>

<table>
<tr><td rowspan="3">P60.05</td><td>Label</td><td colspan="2">CSP Mode Safety Self-operation Position Setting</td><td>Mode</td><td colspan="3">CSP</td></tr>
<tr><td>Range</td><td colspan="2">500~30000</td><td>Default</td><td>10000</td><td>Unit</td><td></td></tr>
<tr><td>Activation</td><td>After restart</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>2060-06h</td></tr>
<tr><td></td><td colspan="7">Synchronization jitter compensation range, applied to master stations with poor synchronization performance.
In Cyclic Synchronous Position (CSP) mode, if the command increment received within one cycle exceeds this threshold, the alarm Er1B0 (Frequent Command Input Error) will be triggered.</td></tr>
</table>

<table>
<tr><td rowspan="3">P60.06</td><td>Label</td><td colspan="2">Synchronization Mode Synchronization Node</td><td>Mode</td><td colspan="3">CSP</td></tr>
<tr><td>Range</td><td colspan="2">0~15</td><td>Default</td><td>3</td><td>Unit</td><td></td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>2060-07h</td></tr>
<tr><td></td><td colspan="7">In synchronization mode, this parameter sets the sync0 loss threshold.</td></tr>
</table>

<table>
<tr><td rowspan="3">P60.07</td><td>Label</td><td colspan="2">Compensation Limit Value</td><td>Mode</td><td colspan="3">CSP</td></tr>
<tr><td>Range</td><td colspan="2">20~200000</td><td>Default</td><td>1000</td><td>Unit</td><td>ns</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>2060-08h</td></tr>
<tr><td></td><td colspan="7">Sets the synchronization compensation limit value. This value should not be set too large, as an excessively high setting may easily lead to synchronization exceptions or alarms.</td></tr>
</table>

<table>
<tr><td rowspan="3">P60.08</td><td>Label</td><td colspan="2">Synchronization Switching Time</td><td>Mode</td><td colspan="3">CSP</td></tr>
<tr><td>Range</td><td colspan="2">20~200000</td><td>Default</td><td>0</td><td>Unit</td><td>ns</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>2060-09h</td></tr>
<tr><td></td><td colspan="7">Sets the synchronization switching time. The default value is 0, which means the switching occurs at the start of a cycle. This can be adjusted according to actual requirements.</td></tr>
</table>

P60.09	**Label**	Synchronization Mode Setting		**Mode**	CSP		
	Range	0~1		**Default**	2	**Unit**	
	Activation	Re-enable	**Attribute**	RW		**Index**	2060-0Ah
	= 1, enables the phase shift function.						

P60.10	**Label**	RPDO Bytes		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~2147483647		**Default**	0	**Unit**	count
	Activation	Immediate	**Attribute**	RO		**Index**	2060-0Bh
	bit0~3: 0: Save only before the EtherCAT state machine enters "Operational" 1: Allow saving at any time 2: Prohibit saving bit4~7: 0: Restore only before the EtherCAT state machine enters "Operational" 1: Allow restoring at any time 2: Prohibit restoring						

P60.11	**Label**	TPDO Bytes		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~2147483647		**Default**	0	**Unit**	count
	Activation	Immediate	**Attribute**	RO		**Index**	2060-0C
	Displays the TPDO Bytes						

P60.12	**Label**	SM2 Loss Count		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~2147483647		**Default**	0	**Unit**	count
	Activation	Immediate	**Attribute**	RO		**Index**	2060-0D
	Displays the SM2 Loss Count						

P60.13	**Label**	Sync Loss Count		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~2147483647		**Default**	0	**Unit**	count
	Activation	Immediate	**Attribute**	RO		**Index**	2060-0E
	Displays the Sync Loss Count						

P60.14	**Label**	Excess Synchronization Drift Count		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~2147483647		**Default**	0	**Unit**	count
	Activation	Immediate	**Attribute**	RO		**Index**	2060-0F
	Displays the Excess Synchronization Drift Count						

P60.15	**Label**	Slave Registered Name		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~65535		**Default**	0	**Unit**	
	Activation	After restart	**Attribute**	RO		**Index**	2060-10
	Displays the Slave Registered Name						

P60.19	**Label**	Communication Operation E2 Setting		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0xFF		**Default**	0x0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2060-14h
	bit0~3 (Save Control) 0: Save only before the EtherCAT state machine enters "Operational" mode 1: Allow saving at any time 2: Prohibit saving bit4~7 (Restore Control) 0: Restore only before the EtherCAT state machine enters "Operational" mode 1: Allow restoring at any time 2: Prohibit restoring						

P60.21	**Label**	Port 0 Invalid Frame Count (300)		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	-2147483648~2147483647		**Default**	0	**Unit**	count
	Activation	Immediate	**Attribute**	RO		**Index**	2060-16h
	-						

P60.22	**Label**	Port 0 Receive Error Count (301)		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	-2147483648~2147483647		**Default**	0	**Unit**	count
	Activation	Immediate	**Attribute**	RO		**Index**	2060-17h
	-						

P60.23	**Label**	Port 0 Forwarding Error Count (308)		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	-2147483648~2147483647		**Default**	0	**Unit**	count
	Activation	Immediate	**Attribute**	RO		**Index**	2060-18h
	-						

P60.24	**Label**	EPU Error Count (30C)		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	-2147483648~2147483647		**Default**	0	**Unit**	count
	Activation	Immediate	**Attribute**	RO		**Index**	2060-19h
	-						

P60.25	**Label**	Port 0 Link Loss Count (310)		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	-2147483648~2147483647		**Default**	0	**Unit**	count
	Activation	Immediate	**Attribute**	RO		**Index**	2060-1Ah
	-						

P60.26	**Label**	Port 1 Invalid Frame Count (302)		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	-2147483648~2147483647		**Default**	0	**Unit**	count
	Activation	Immediate	**Attribute**	RO		**Index**	2060-1Bh
	-						

P60.27	**Label**	Port 1 Receive Error Count (303)		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	-2147483648~2147483647		**Default**	0	**Unit**	count
	Activation	Immediate	**Attribute**	RO		**Index**	2060-1Ch
	-						

P60.28	**Label**	Port 1 Forwarding Error Count (309)		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	-2147483648~2147483647		**Default**	0	**Unit**	count
	Activation	Immediate	**Attribute**	RO		**Index**	2060-1Dh
	-						

P60.29	**Label**	PDI Error Count (30D)		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	-2147483648~2147483647		**Default**	0	**Unit**	count
	Activation	Immediate	**Attribute**	RO		**Index**	2060-1Eh
	-						

P60.30	**Label**	Port 1 Link Loss Count (311)		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	-2147483648~2147483647		**Default**	0	**Unit**	count
	Activation	Immediate	**Attribute**	RO		**Index**	2060-1Fh
	-						

P60.31	**Label**	SM Watchdog Value Internal		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0xFFFF		**Default**	4	**Unit**	
	Activation	After restart	**Attribute**	RW		**Index**	2060-20h
	SM2/Sync0 watchdog counter.						

P60.32	**Label**	SM Sync0 Watchdog Value		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0xFFFF		**Default**	4	**Unit**	
	Activation	After restart	**Attribute**	RW		**Index**	2060-21h
	SM2/Sync0 watchdog limit value.						

P60.33	**Label**	Sync Function Setting		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0xFFFF		**Default**	0x3	**Unit**	
	Activation	After restart	**Attribute**	RW		**Index**	2060-22h
	Sync function setting						

<table>
<tr><td rowspan="3">P60.34</td><td>Label</td><td colspan="2">Sync Error Detect Setting</td><td>Mode</td><td colspan="3">PP/PV/PT/CSP/CSV/CST/HM</td></tr>
<tr><td>Range</td><td colspan="2">0x0~0xFFFF</td><td>Default</td><td>0x7B</td><td>Unit</td><td></td></tr>
<tr><td>Activation</td><td>After restart</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>2060-23h</td></tr>
<tr><td></td><td colspan="7">Bit0: 818h Alarm enable switch
Bit1: 819h
Bit2: 81Ah
Bit3: 824h
Bit4: 825h
Bit5: Reserved
Bit6: Reserved
Bit7: 82Ch
Bit8: 82Dh
Bit9: 832h
Bit10: 833h
Bit11: 834h
Bit12: Send emergency message
Bit13~14: Reserved
Bit15: 950h
All bits: 1 means enabled</td></tr>
</table>

<table>
<tr><td rowspan="3">P60.36</td><td>Label</td><td colspan="2">Valid output/input watchdog time.</td><td>Mode</td><td colspan="3">PP/PV/PT/CSP/CSV/CST/HM</td></tr>
<tr><td>Range</td><td colspan="2">0~6000</td><td>Default</td><td>5000</td><td>Unit</td><td>-</td></tr>
<tr><td>Activation</td><td>After restart</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>2060-25h</td></tr>
<tr><td></td><td colspan="7">Valid output/input watchdog time.</td></tr>
</table>

<table>
<tr><td rowspan="3">P60.37</td><td>Label</td><td colspan="2">Minimum synchronization cycle value</td><td>Mode</td><td colspan="3">PP/PV/PT/CSP/CSV/CST/HM</td></tr>
<tr><td>Range</td><td colspan="2">62500~1000000</td><td>Default</td><td>62500</td><td>Unit</td><td></td></tr>
<tr><td>Activation</td><td>After restart</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>2060-26h</td></tr>
<tr><td></td><td colspan="7">Sets the minimum synchronization cycle value.</td></tr>
</table>

<table>
<tr><td rowspan="3">P60.38</td><td>Label</td><td colspan="2">Maximum synchronization cycle value</td><td>Mode</td><td colspan="3">PP/PV/PT/CSP/CSV/CST/HM</td></tr>
<tr><td>Range</td><td colspan="2">4000000~20000000</td><td>Default</td><td>10000000</td><td>Unit</td><td></td></tr>
<tr><td>Activation</td><td>After restart</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>2060-27h</td></tr>
<tr><td></td><td colspan="7">Sets the maximum synchronization cycle value.</td></tr>
</table>

3.9 System Parameters

3.9.1【Class PA0】Motor Parameters

PA0.11	Label	Motor Model		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0xFFFF		Default	0x0	Unit	
	Activation	After restart	Attribute	RW		Index	20A0-0Ch
	Motor Type Setting: 0x00: AC rotary motor 0x01: DC rotary motor 0x10: AC linear motor 0x11: DC linear motor						

3.9.2【Class PA1】Encoder Parameters

PA1.00	Label	Encoder selection		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0xFFFFFFFF		Default	0x0	Unit	
	Activation	After restart	Attribute	RW		Index	20A1-01h
	Encoder Type Setting: 0: RS communication encoder 1: ABZ encoder 2: BISS encoder						

PA1.17	Label	Encoder Feedback Pulse Digital Filter		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~300		Default	5	Unit	
	Activation	Immediate	Attribute	RW		Index	20A1-12h
	This parameter configures the filter time for encoder feedback pulses to smooth raw signals and suppress high-frequency noise, enhancing position/velocity feedback stability. Larger filter time: Better noise suppression, but introduces minor control delay. Smaller filter time: Faster system response, but reduced noise immunity.						

3.9.3【Class PA2】Driver Parameters

PA2.00	Label	MCU1 Version Number		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~2147483647		Default	0	Unit	
	Activation	Immediate	Attribute	RO		Index	20A2-01h
	Displays the MCU1 Version Number						

PA2.01	Label	MCU2 Version Number		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~2147483647		Default	0	Unit	
	Activation	Immediate	Attribute	RO		Index	20A2-02h
	Displays the MCU2 Version Number						

PA2.02	Label	FPGA Version Number		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~2147483647		Default	0	Unit	
	Activation	Immediate	Attribute	RO		Index	20A2-03h
	Displays the FPGA Version Number						

PA2.06	Label	Driver Voltage Level		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~2147483647		Default	0	Unit	
	Activation	Immediate	Attribute	RO		Index	20A2-07h
	Displays the Driver Voltage Level						

PA2.07	Label	Driver Rated Power		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~2147483647		Default	0	Unit	W
	Activation	Immediate	Attribute	RO		Index	20A2-08h
	Displays the Driver Rated Power						

PA2.08	Label	Driver Rated Current		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0.00~21474836.47		Default	0	Unit	A
	Activation	Immediate	Attribute	RO		Index	20A2-09h
	Displays the Driver Rated Current						

PA2.09	Label	Driver Maximum Current		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0.00~21474836.47		Default	0	Unit	A
	Activation	Immediate	Attribute	RO		Index	20A2-0Ah
	Displays the Driver Maximum Current						

PA2.12	Label	Dead Zone Compensation Coefficient 1		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~32767		Default	0	Unit	
	Activation	Immediate	Attribute	RW		Index	20A2-0Dh
	This parameter compensates for the dead zone effect of inverter IGBTs. Dead time avoids upper/lower arm shoot-through but introduces voltage distortion, current ripple, torque pulsation, and low-speed vibration. By injecting compensation voltage, this parameter cancels dead-time errors. Larger values improve compensation but increase harmonic distortion and current noise.						

PA2.13	Label	Dead Zone Compensation Coefficient 2		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~100		Default	0	Unit	
	Activation	Immediate	Attribute	RW		Index	20A2-0Eh
	Check PA2.12						

PA2.19	Label	Current Loop Gain		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	100~5000		Default	1500	Unit	Hz
	Activation	Immediate	Attribute	RW		Index	20A2-14h
	The default current loop gain of the servo has already ensured sufficient responsiveness and generally does not require adjustment. Current loop gain refers to the response degree of the current loop to the input error signal. The higher the gain, the faster the system responds to errors, but excessively high gain may lead to system instability and oscillation.						

PA2.20	Label	Current Loop Integral Time		Mode	F PP/PV/PT/CSP/CSV/CST/HM		
	Range	0.1~1000.0		Default	50.0	Unit	ms
	Activation	Immediate	Attribute	RW		Index	20A2-15h
	Current Loop Integral Time setting						

PA2.21	Label	Current Differential Coefficient		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~30000		Default	0	Unit	
	Activation	Immediate	Attribute	RW		Index	20A2-16h
	Current Differential Coefficient setting						

PA2.40	Label	Control Power Undervoltage Value		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	125~350		Default	160	Unit	V
	Activation	Immediate	Attribute	RW		Index	20A2-29h
	This parameter sets the control undervoltage detection threshold. When the control voltage is detected to be lower than this threshold, a control undervoltage will be triggered.						

PA2.42	Label	Main Power-off Detection Delay		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	20~100		Default	0	Unit	ms
	Activation	Immediate	Attribute	RW		Index	20A2-2Bh
	This parameter sets the delay time for main power loss detection. When the main power voltage is detected to be below the undervoltage threshold and persists for the set duration, a power loss alarm will be triggered.						

PA2.43	Label	DC Bus Undervoltage (LV) Detection Delay		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~200		Default	0	Unit	ms
	Activation	Immediate	Attribute	RW		Index	20A2-2Ch
	This parameter sets the detection time required for identifying a main power circuit break or low-voltage condition when such a state persists. Example: When set to 200, lower the input power supply voltage so that the bus voltage drops below the undervoltage threshold. The drive will detect the undervoltage after 0.2 seconds and trigger the corresponding protection.						

<table>
<tr><td rowspan="3">PA2.52</td><td>Label</td><td colspan="2">Bus Voltage Bleeding Control Mode</td><td>Mode</td><td colspan="3">F PP/PV/PT/CSP/CSV/CST/HM</td></tr>
<tr><td>Range</td><td colspan="2">0~1</td><td>Default</td><td>1</td><td>Unit</td><td></td></tr>
<tr><td>Activation</td><td>After Restart</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>20A2-35h</td></tr>
<tr><td></td><td colspan="7">Sets the discharge mode.
For the L7N-S series, regenerative resistors are not included as standard for models with power of 400W and below.</td></tr>
</table>

Power (W)	Value	Description
100/400	1	Regenerative energy is only absorbed by the built-in bus capacitors of the drive.
750 and above	0	Regenerative energy can be discharged via a regenerative resistor.

<table>
<tr><td rowspan="3">PA2.94</td><td>Label</td><td colspan="2">Hardware Version</td><td>Mode</td><td colspan="3">PP/PV/PT/CSP/CSV/CST/HM</td></tr>
<tr><td>Range</td><td colspan="2">-2147483648~2147483647</td><td>Default</td><td>0</td><td>Unit</td><td></td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RO</td><td>Index</td><td>20A2-5Fh</td></tr>
<tr><td></td><td colspan="7">Displays the Hardware Version.</td></tr>
</table>

3.10 Bus Functions

3.10.1【Class PF0】Series 1000

*1000 parameters can't be mapped

PF0.00	**Label**	Device Type		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0~0		**Default**	0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RO		**Index**	1000-00h
	Device Type						

PF0.01	**Label**	Error Register		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0~0		**Default**	0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RO		**Index**	1001-00h
	Display error status						

PF0.02	**Label**	Vendor ID		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x0		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RO		**Index**	1018-01h
	Vendor ID						

PF0.03	**Label**	Product Code		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x0		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RO		**Index**	1018-02h

PF0.04	**Label**	Revision		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x0		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RO		**Index**	1018-03h
	Revision						

PF0.05	**Label**	Device Type		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x1		**Default**	0x1	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RO		**Index**	1018-04h
	Device Type						

PF0.10	**Label**	limit value of the synchronization error counter		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0~200		**Default**	0x1	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	10F1-02h
	Sets the limit value of the synchronization error counter.						

<table>
<tr><td rowspan="3">PF0.11</td><td>Label</td><td colspan="2">Number of valid mapping objects in RPDO1</td><td>Mode</td><td colspan="3">PP/PV/PT/CSP/CSV/CST/HM</td></tr>
<tr><td>Range</td><td colspan="2">0~16</td><td>Default</td><td>3</td><td>Data</td><td>UNIT16</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>1600-00h</td></tr>
<tr><td></td><td colspan="7">Number of sub-indexes: indicates the total number of objects contained in this RPDO.
Modification of this object is only supported when the PDO is invalid, and other sub-index mapping objects will be cleared.
*The following 16 mapping information are the RPDO1 mapping objects
*The description of the mapping objects are all the same.</td></tr>
</table>

<table>
<tr><td rowspan="3">PF0.12</td><td>Label</td><td colspan="2">Mapping Information 1</td><td>Mode</td><td colspan="3">PP/PV/PT/CSP/CSV/CST/HM</td></tr>
<tr><td>Range</td><td colspan="2">0x0~0x7FFFFFFF</td><td>Default</td><td>0x60
400
010</td><td>Data</td><td>UNIT32</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>1600-01h</td></tr>
<tr><td></td><td colspan="7">The total bit length of the mapped object must not exceed 64 bits. Only byte-wise mapping is supported; bit-wise mapping is not allowed. The index and sub-index of the mapped object content must exist in the object dictionary, with writable and mappable attributes.
Mapping content breakdown:
bit0~7: Object bit length;
bit8~15: Sub-index;
bit16~31: Index.</td></tr>
</table>

<table>
<tr><td rowspan="3">PF0.13</td><td>Label</td><td colspan="2">Mapping Information 2</td><td>Mode</td><td colspan="3">PP/PV/PT/CSP/CSV/CST/HM</td></tr>
<tr><td>Range</td><td colspan="2">0x0~0x7FFFFFFF</td><td>Default</td><td>0x60
7A0
020</td><td>Data</td><td>UNIT32</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>1600-02h</td></tr>
<tr><td></td><td colspan="7">Check PF0.12</td></tr>
</table>

<table>
<tr><td rowspan="3">PF0.14</td><td>Label</td><td colspan="2">Mapping Information 3</td><td>Mode</td><td colspan="3">PP/PV/PT/CSP/CSV/CST/HM</td></tr>
<tr><td>Range</td><td colspan="2">0x0~0x7FFFFFFF</td><td>Default</td><td>0x60
B80
010</td><td>Data</td><td>UNIT32</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>1600-03h</td></tr>
<tr><td></td><td colspan="7">Check PF0.12</td></tr>
</table>

<table>
<tr><td rowspan="3">PF0.15</td><td>Label</td><td colspan="2">Mapping Information 4</td><td>Mode</td><td colspan="3">PP/PV/PT/CSP/CSV/CST/HM</td></tr>
<tr><td>Range</td><td colspan="2">0x0~0x7FFFFFFF</td><td>Default</td><td>0x0</td><td>Data</td><td>UNIT32</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>1600-04h</td></tr>
<tr><td></td><td colspan="7">Check PF0.12</td></tr>
</table>

PF0.16	**Label**	Mapping Information 5	**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF	**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW	**Index**	1600-05h
	Check PF0.12					

PF0.17	**Label**	Mapping Information 6	**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF	**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW	**Index**	1600-06h
	Check PF0.12					

PF0.18	**Label**	Mapping Information 7	**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF	**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW	**Index**	1600-07h
	Check PF0.12					

PF0.19	**Label**	Mapping Information 8	**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF	**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW	**Index**	1600-08h
	Check PF0.12					

PF0.20	**Label**	Mapping Information 9	**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF	**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW	**Index**	1600-09h
	Check PF0.12					

PF0.21	**Label**	Mapping Information 10	**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF	**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW	**Index**	1600-0Ah
	Check PF0.12					

PF0.22	**Label**	Mapping Information 11	**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF	**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW	**Index**	1600-0Bh
	Check PF0.12					

PF0.23	**Label**	Mapping Information 12	**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF	**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW	**Index**	1600-0Ch
	Check PF0.12					

PF0.24	**Label**	Mapping Information 13	**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF	**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW	**Index**	1600-0Dh
	Check PF0.12					

PF0.25	Label	Mapping Information 14		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x0	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1600-0Eh
	Check PF0.12						

PF0.26	Label	Mapping Information 15		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x0	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1600-0Fh
	Check PF0.12						

PF0.27	Label	Mapping Information 16		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x0	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1600-10h
	Check PF0.12						

PF0.28	Label	RPDO2 Number of Entries		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~16		Default	6	Data	UNIT16
	Activation	Immediate	Attribute	RW		Index	1601-00h
	Number of sub-indexes: indicates the total number of objects contained in this RPDO. Modification of this object is only supported when the PDO is invalid, and other sub-index mapping objects will be cleared. *The following 16 **mapping information** are the RPDO2 mapping objects *The description of the mapping objects are all the same.						

PF0.29	Label	Mapping Information 1		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x60400010	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1601-01h
	Check PF0.12						

PF0.30	Label	Mapping Information 2		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x607A0020	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1601-02h
	Check PF0.12						

PF0.31	Label	Mapping Information 3		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x60810020	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1601-03h
	Check PF0.12						

PF0.32	Label	Mapping Information 4		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x60830020	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1601-04h
	Check PF0.12						

PF0.33	Label	Mapping Information 5		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x60840020	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1601-05h
	Check PF0.12						

PF0.34	Label	Mapping Information 6		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x60600008	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1601-06h
	Check PF0.12						

PF0.35	Label	Mapping Information 7		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x0	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1601-07h
	Check PF0.12						

PF0.36	Label	Mapping Information 8		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x0	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1601-08h
	Check PF0.12						

PF0.37	Label	Mapping Information 9		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x0	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1601-09h
	Check PF0.12						

PF0.38	**Label**	Mapping Information 10		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1601-0Ah
	Check PF0.12						

PF0.39	**Label**	Mapping Information 11		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1601-0Bh
	Check PF0.12						

PF0.40	**Label**	Mapping Information 12		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1601-0Ch
	Check PF0.12						

PF0.41	**Label**	Mapping Information 13		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1601-0Dh
	Check PF0.12						

PF0.42	**Label**	Mapping Information 14		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1601-0Eh
	Check PF0.12						

PF0.43	**Label**	Mapping Information 15		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1601-0Fh
	Check PF0.12						

PF0.44	**Label**	Mapping Information 16		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1601-10h
	Check PF0.12						

PF0.45	**Label**	RPDO3 Number of Entries		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~16		**Default**	5	**Data**	UNIT16
	Activation	Immediate	**Attribute**	RW		**Index**	1602-00h
	Number of sub-indexes: indicates the total number of objects contained in this RPDO. Modification of this object is only supported when the PDO is invalid, and other sub-index mapping objects will be cleared. *The following 16 mapping information are the RPDO3 mapping objects *The description of the mapping objects are all the same.						

<table>
<tr><td rowspan="3">PF0.46</td><td>Label</td><td colspan="2">Mapping Information 1</td><td>Mode</td><td colspan="3">PP/PV/PT/CSP/CSV/CST/HM</td></tr>
<tr><td>Range</td><td colspan="2">0x0~0x7FFFFFFF</td><td>Default</td><td>0x60
400
010</td><td>Data</td><td>UNIT32</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>1602-01h</td></tr>
<tr><td colspan="8">Check PF0.12</td></tr>
</table>

<table>
<tr><td rowspan="3">PF0.47</td><td>Label</td><td colspan="2">Mapping Information 2</td><td>Mode</td><td colspan="3">PP/PV/PT/CSP/CSV/CST/HM</td></tr>
<tr><td>Range</td><td colspan="2">0x0~0x7FFFFFFF</td><td>Default</td><td>0x60
FF0
020</td><td>Data</td><td>UNIT32</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>1602-02h</td></tr>
<tr><td colspan="8">Check PF0.12</td></tr>
</table>

<table>
<tr><td rowspan="3">PF0.48</td><td>Label</td><td colspan="2">Mapping Information 3</td><td>Mode</td><td colspan="3">PP/PV/PT/CSP/CSV/CST/HM</td></tr>
<tr><td>Range</td><td colspan="2">0x0~0x7FFFFFFF</td><td>Default</td><td>0x60
830
020</td><td>Data</td><td>UNIT32</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>1602-03h</td></tr>
<tr><td colspan="8">Check PF0.12</td></tr>
</table>

<table>
<tr><td rowspan="3">PF0.49</td><td>Label</td><td colspan="2">Mapping Information 4</td><td>Mode</td><td colspan="3">PP/PV/PT/CSP/CSV/CST/HM</td></tr>
<tr><td>Range</td><td colspan="2">0x0~0x7FFFFFFF</td><td>Default</td><td>0x60
840
020</td><td>Data</td><td>UNIT32</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>1602-04h</td></tr>
<tr><td colspan="8">Check PF0.12</td></tr>
</table>

<table>
<tr><td rowspan="3">PF0.50</td><td>Label</td><td colspan="2">Mapping Information 5</td><td>Mode</td><td colspan="3">PP/PV/PT/CSP/CSV/CST/HM</td></tr>
<tr><td>Range</td><td colspan="2">0x0~0x7FFFFFFF</td><td>Default</td><td>0x60
600
008</td><td>Data</td><td>UNIT32</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>1602-05h</td></tr>
<tr><td colspan="8">Check PF0.12</td></tr>
</table>

<table>
<tr><td rowspan="3">PF0.51</td><td>Label</td><td colspan="2">Mapping Information 6</td><td>Mode</td><td colspan="3">PP/PV/PT/CSP/CSV/CST/HM</td></tr>
<tr><td>Range</td><td colspan="2">0x0~0x7FFFFFFF</td><td>Default</td><td>0x0</td><td>Data</td><td>UNIT32</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>1602-06h</td></tr>
<tr><td colspan="8">Check PF0.12</td></tr>
</table>

<table>
<tr><td rowspan="3">PF0.52</td><td>Label</td><td colspan="2">Mapping Information 7</td><td>Mode</td><td colspan="3">PP/PV/PT/CSP/CSV/CST/HM</td></tr>
<tr><td>Range</td><td colspan="2">0x0~0x7FFFFFFF</td><td>Default</td><td>0x0</td><td>Data</td><td>UNIT32</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>1602-07h</td></tr>
<tr><td colspan="8">Check PF0.12</td></tr>
</table>

PF0.53	**Label**	Mapping Information 8		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1602-08h
	Check PF0.12						

PF0.54	**Label**	Mapping Information 9		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1602-09h
	Check PF0.12						

PF0.55	**Label**	Mapping Information 10		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1602-0Ah
	Check PF0.12						

PF0.56	**Label**	Mapping Information 11		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1602-0Bh
	Check PF0.12						

PF0.57	**Label**	Mapping Information 12		**Mode**	**F PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1602-0Ch
	Check PF0.12						

PF0.58	**Label**	Mapping Information 13		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1602-0Dh
	Check PF0.12						

PF0.59	**Label**	Mapping Information 14		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1602-0Eh
	Check PF0.12						

PF0.60	**Label**	Mapping Information 15		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1602-0Fh
	Check PF0.12						

PF0.61	**Label**	Mapping Information 16		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1602-10h
	Check PF0.12						

PF0.62	**Label**	RPDO4 Number of Entries		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0~16		**Default**	7	**Data**	UNIT16
	Activation	Immediate	**Attribute**	RW		**Index**	1603-00h
	Number of sub-indexes: indicates the total number of objects contained in this RPDO. Modification of this object is only supported when the PDO is invalid, and other sub-index mapping objects will be cleared. *The following 16 mapping information are the RPDO4 mapping objects *The description of the mapping objects are all the same.						

PF0.63	**Label**	Mapping Information 1		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF		**Default**	0x60400010	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1603-01h
	Check PF0.12						

PF0.64	**Label**	Mapping Information 2		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF		**Default**	0x60980008	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1603-02h
	Check PF0.12						

PF0.65	**Label**	Mapping Information 3		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF		**Default**	0x60990120	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1603-03h
	Check PF0.12						

PF0.66	**Label**	Mapping Information 4		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF		**Default**	0x60990220	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1603-04h
	Check PF0.12						

PF0.67	Label	Mapping Information 5		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x609A0020	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1603-05h
	Check PF0.12						

PF0.68	Label	Mapping Information 6		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x607C0020	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1603-06h
	Check PF0.12						

PF0.69	Label	Mapping Information 7		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x60600008	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1603-07h
	Check PF0.12						

PF0.70	Label	Mapping Information 8		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x0	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1603-08h
	Check PF0.12						

PF0.71	Label	Mapping Information 9		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x0	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1603-09h
	Check PF0.12						

PF0.72	Label	Mapping Information 10		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x0	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1603-0Ah
	Check PF0.12						

PF0.73	Label	Mapping Information 11		Mode	F PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x0	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1603-0Bh
	Check PF0.12						

PF0.74	**Label**	Mapping Information 12		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1603-0Ch
	Check PF0.12						

PF0.75	**Label**	Mapping Information 13		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1603-0Dh
	Check PF0.12						

PF0.76	**Label**	Mapping Information 14		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1603-0Eh
	Check PF0.12						

PF0.77	**Label**	Mapping Information 15		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1603-0Fh
	Check PF0.12						

PF0.78	**Label**	Mapping Information 16		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1603-10h
	Check PF0.12						

PF0.79	**Label**	TPDO1 Number of Entries		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~16		**Default**	7	**Data**	UNIT16
	Activation	Immediate	**Attribute**	RW		**Index**	1A00-00h
	Indicates the total number of objects contained in this TPDO1. Modification of this object is only supported when the PDO is disabled. Writing 0 to this object will clear all sub-index mapping objects of the TPDO. ● The following mapping information are the TPDO1 mapping objects.						

PF0.80	**Label**	Mapping Information 1		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		**Default**	0x603F0010	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1A00-01h
	Same as PF0.12						

PF0.81	Label	Mapping Information 2		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x60410010	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1A00-02h
Same as PF0.12							

PF0.82	Label	Mapping Information 3		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x60610008	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1A00-03h
Same as PF0.12							

PF0.83	Label	Mapping Information 4		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x60640020	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1A00-04h
Same as PF0.12							

PF0.84	Label	Mapping Information 5		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x60B90010	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1A00-05h
Same as PF0.12							

PF0.85	Label	Mapping Information 6		Mode	F PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x60BA0020	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1A00-06h
Same as PF0.12							

PF0.86	Label	Mapping Information 7		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x60FD0020	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1A00-07h
Same as PF0.12							

PF0.87	**Label**	Mapping Information 8		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1A00-08h
	Same as PF0.12						

PF0.88	**Label**	Mapping Information 9		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1A00-09h
	Same as PF0.12						

PF0.89	**Label**	Mapping Information 10		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1A00-0Ah
	Same as PF0.12						

PF0.90	**Label**	Mapping Information 11		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1A00-0Bh
	Same as PF0.12						

PF0.91	**Label**	Mapping Information 12		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1A00-0Ch
	Same as PF0.12						

PF0.92	**Label**	Mapping Information 13		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1A00-0Dh
	Same as PF0.12						

PF0.93	**Label**	Mapping Information 14		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1A00-0Eh
	Same as PF0.12						

PF0.94	**Label**	Mapping Information 15		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1A00-0Fh
	Same as PF0.12						

PF0.95	**Label**	Mapping Information 16		**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1A00-10h
	Same as PF0.12						

PF0.96	Label	TPDO2 Number of Entries		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~16		Default	0	Data	UNIT16
	Activation	Immediate	Attribute	RW		Index	1A01-00h
	Indicates the total number of objects contained in this TPDO2. Modification of this object is only supported when the PDO is disabled. Writing 0 to this object will clear all sub-index mapping objects of the TPDO. ● The following mapping information are the TPDO2 mapping objects.						

PF0.97	Label	Mapping Information 1		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x0	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1A01-01h
	Same as PF0.12						

PF0.98	Label	Mapping Information 2		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x0	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1A01-02h
	Same as PF0.12						

PF0.99	Label	Mapping Information 3		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x0	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1A01-03h
	Same as PF0.12						

PF0.100	Label	Mapping Information 4		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x0	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1A01-04h
	Same as PF0.12						

PF0.101	Label	Mapping Information 5		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x0	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1A01-05h
	Same as PF0.12						

PF0.102	Label	Mapping Information 6		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x0	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1A01-06h
	Same as PF0.12						

PF0.103	Label	Mapping Information 7		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x0	Data	UNIT32
	Activation	Immediate	Attribute	RW		Index	1A01-07h
	Same as PF0.12						

PF0.104	**Label**	Mapping Information 8		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1A01-08h
	Same as PF0.12						

PF0.105	**Label**	Mapping Information 9		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1A01-09h
	Same as PF0.12						

PF0.106	**Label**	Mapping Information 10		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1A01-0Ah
	Same as PF0.12						

PF0.107	**Label**	Mapping Information 11		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1A01-0Bh
	Same as PF0.12						

PF0.108	**Label**	Mapping Information 12		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1A01-0Ch
	Same as PF0.12						

PF0.109	**Label**	Mapping Information 13		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1A01-0Dh
	Same as PF0.12						

PF0.110	**Label**	Mapping Information 14		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1A01-0Eh
	Same as PF0.12						

PF0.111	**Label**	Mapping Information 15		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1A01-0Fh
	Same as PF0.12						

PF0.112	**Label**	Mapping Information 16		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		**Default**	0x0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RW		**Index**	1A01-10h
	Same as PF0.12						

PF0.147	Label	Sync Manager 0 Type		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		Default	1	Data	UNIT8
	Activation	Immediate	Attribute	RW		Index	1C00-01h
	SM0 communication type. Value: 1, mailbox receive (master → slave).						

PF0.148	Label	Sync Manager 1 Type		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		Default	2	Data	UNIT8
	Activation	Immediate	Attribute	RW		Index	1C00-02h
	SM1 communication type. Value: 2, mailbox receive (master → slave).						

PF0.149	Label	Sync Manager 2 Type		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		Default	3	Data	UNIT8
	Activation	Immediate	Attribute	RW		Index	1C00-03h
	SM2 communication type. Value: 3, process data output (slave → master).						

PF0.150	Label	Sync Manager 3 Type		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		Default	4	Data	UNIT8
	Activation	Immediate	Attribute	RW		Index	1C00-04h
	SM3 communication type. Value: 4, process data output (slave → master).						

PF0.151	Label	Number of Entries		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~4		Default	1	Data	UNIT8
	Activation	Immediate	Attribute	RW		Index	1C12-00h
	Number of Entries						

PF0.152	Label	SM2 PDO Mapping 0		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x1700		Default	0x1600	Data	UNIT16
	Activation	Immediate	Attribute	RW		Index	1C12-01h
	SM2 PDO mapping object index 0, used to assign RxPDO mapping objects (0x1600~0x1603) to SyncManager 2. This object (1C12h/1C13h) can only be modified when EtherCAT is in Pre-Operational state.						

PF0.153	Label	SM2 PDO Mapping 1		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x1700		Default	0x0	Data	UNIT16
	Activation	Immediate	Attribute	RW		Index	1C12-02h
	SM2 PDO mapping object index 1, used to assign RxPDO mapping objects (0x1600~0x1603) to SyncManager 2. This object (1C12h/1C13h) can only be modified when EtherCAT is in Pre-Operational state.						

PF0.154	**Label**	SM2 PDO Mapping 2		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x1700		**Default**	0x0	**Data**	UNIT16
	Activation	Immediate	**Attribute**	RW		**Index**	1C12-03h
	SM2 PDO mapping object index 2, used to assign RxPDO mapping objects (0x1600~0x1603) to SyncManager 2. This object (1C12h/1C13h) can only be modified when EtherCAT is in Pre-Operational state.						

PF0.155	**Label**	SM2 PDO Mapping 3		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x1700		**Default**	0x0	**Data**	UNIT16
	Activation	Immediate	**Attribute**	RW		**Index**	1C12-04h
	SM2 PDO mapping object index 3, used to assign RxPDO mapping objects (0x1600~0x1603) to SyncManager 2. This object (1C12h/1C13h) can only be modified when EtherCAT is in Pre-Operational state.						

PF0.156	**Label**	Number of Entries		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~4		**Default**	1	**Data**	UNIT8
	Activation	Immediate	**Attribute**	RW		**Index**	1C13-00h
	Number of Entries						

PF0.157	**Label**	SM3 PDO Mapping 0		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x1B00		**Default**	0x1A00	**Data**	UNIT16
	Activation	Immediate	**Attribute**	RW		**Index**	1C13-01h
	SM3 PDO mapping object index 0, used to assign RxPDO mapping objects (0x1600~0x1603) to SyncManager 2. This object (1C12h/1C13h) can only be modified when EtherCAT is in Pre-Operational state.						

PF0.158	**Label**	SM3 PDO Mapping 1		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x1B00		**Default**	0x0	**Data**	UNIT16
	Activation	Immediate	**Attribute**	RW		**Index**	1C13-02h
	SM3 PDO mapping object index 1, used to assign RxPDO mapping objects (0x1600~0x1603) to SyncManager 2. This object (1C12h/1C13h) can only be modified when EtherCAT is in Pre-Operational state.						

PF0.159	Label	SM3 PDO Mapping 2		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x1B00		Default	0x0	Data	UNIT16
	Activation	Immediate	Attribute	RW		Index	1C13-03h
	SM3 PDO mapping object index 2, used to assign RxPDO mapping objects (0x1600~0x1603) to SyncManager 2. This object (1C12h/1C13h) can only be modified when EtherCAT is in Pre-Operational state.						

PF0.160	Label	SM3 PDO Mapping 3		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x1B00		Default	0x0	Data	UNIT16
	Activation	Immediate	Attribute	RW		Index	1C13-04h
	SM3 PDO mapping object index 3, used to assign RxPDO mapping objects (0x1600~0x1603) to SyncManager 2. This object (1C12h/1C13h) can only be modified when EtherCAT is in Pre-Operational state.						

PF0.161	Label	Sync Type		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		Default	0	Data	UNIT16
	Activation	Immediate	Attribute	RO		Index	1C32-01h
	Synchronization type, current DC mode status: 0: Free-run (DC not used, no PDO mapping); 1: Free-run (DC not used, PDO mapping enabled); 2: DC Sync0 (DC used).						

PF0.162	Label	Cycle Time		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		Default	0	Data	UNIT32
	Activation	Immediate	Attribute	RO		Index	1C32-02h
	Synchronization cycle, Sync0 event cycle (unit: ns), set periodically by the master via the ESC registers.						

PF0.163	Label	Shift Time		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		Default	0	Data	UNIT32
	Activation	Immediate	Attribute	RO		Index	1C32-03h
	Shift time: the delay time from the Sync0 event to the start of receiving and processing data for SM2 (RxPDO) (unit: ns).						

PF0.164	Label	Sync Type Supported		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		Default	0	Data	UNIT16
	Activation	Immediate	Attribute	RO		Index	1C32-04h
	Supported synchronization types: Bit 0 = 1: Free-run mode is supported; Bits 2~4 = 001: DC Sync0 mode is supported; Bits 5, 6 = 00: Output Shift is not supported.						

PF0.165	**Label**	Minimum Sync Time		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		**Default**	0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RO		**Index**	1C32-05h
	Minimum Cycle Time						

PF0.166	**Label**	Calculate and Copy Time		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		**Default**	0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RO		**Index**	1C32-06h
	Calculate and Copy Time						

PF0.167	**Label**	reserve		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		**Default**	0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RO		**Index**	1C32-07h
	-						

PF0.168	**Label**	Get Cycle Time		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		**Default**	0	**Data**	UNIT16
	Activation	Immediate	**Attribute**	RO		**Index**	1C32-08h
	Get Cycle Time						

PF0.169	**Label**	Delay Time		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		**Default**	0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RO		**Index**	1C32-09h
	Delay Time						

PF0.170	**Label**	Sync0 Cycle Time		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		**Default**	0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RO		**Index**	1C32-0Ah
	Sync0 Cycle Time						

PF0.171	**Label**	SM Event Miss Counter		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		**Default**	0	**Data**	UNIT16
	Activation	Immediate	**Attribute**	RO		**Index**	1C32-0Bh
	SM Event Miss Counter						

PF0.172	**Label**	Cycle Exceeded Counter		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		**Default**	0	**Data**	UNIT16
	Activation	Immediate	**Attribute**	RO		**Index**	1C32-0Ch
	Cycle Exceeded Counter						

PF0.173	**Label**	Shift Too Short Counter		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		**Default**	0	**Data**	UNIT16
	Activation	Immediate	**Attribute**	RO		**Index**	1C32-0Dh
	Shift Too Short Counter						

PF0.174	**Label**	PDO Toggle Counter		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		**Default**	0	**Data**	UNIT16
	Activation	Immediate	**Attribute**	RO		**Index**	1C32-0Eh
	PDO Toggle Counter						

PF0.175	**Label**	Minimum Sync cycle Distance		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		**Default**	0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RO		**Index**	1C32-0Fh
	Minimum Sync Cycle Distance						

PF0.176	**Label**	Maximum Sync Cycle Distance		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		**Default**	0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RO		**Index**	1C32-10h
	Maximum Sync Cycle Distance						

PF0.177	**Label**	Minimum SM Sync Distance		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		**Default**	0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RO		**Index**	1C32-11h
	Minimum SM Sync Distance						

PF0.178	**Label**	Maximum SM Sync Distance		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		**Default**	0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RO		**Index**	1C32-12h
	Maximum SM Sync Distance						

PF0.180	**Label**	Sync Type		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		**Default**	0	**Data**	UNIT16
	Activation	Immediate	**Attribute**	RO		**Index**	1C33-01h
	Synchronization type, current DC mode status: 0: Free-run (DC not used, no PDO mapping); 1: Free-run (DC not used, PDO mapping enabled); 2: DC Sync0 (DC used).						

PF0.181	**Label**	Sync Cycle Time		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		**Default**	0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RO		**Index**	1C33-02h
	Synchronization cycle, Sync0 event cycle (unit: ns). This parameter is subject to modification by the master station via the ESC registers.						

PF0.182	Label	Shift Time		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		Default	0	Data	UNIT32
	Activation	Immediate	Attribute	RO		Index	1C33-03h
	Shift time: the time delay from the Sync0 event to the start of SM3 (TxPDO) transmission (unit: ns).						

PF0.183	Label	Sync Type Supported		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		Default	0	Data	UNIT16
	Activation	Immediate	Attribute	RO		Index	1C33-04h
	Supported synchronization types: Bit 0 = 1: Free-run mode is supported; Bits 2~4 = 001: DC Sync0 mode is supported; Bits 5, 6 = 00/01: Input Shift is supported via the local timer.						

PF0.184	Label	Minimum Cycle Time		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		Default	0	Data	UNIT32
	Activation	Immediate	Attribute	RO		Index	1C33-05h
	Minimum Cycle Time						

PF0.185	Label	Calculate and Copy Time		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		Default	0	Data	UNIT32
	Activation	Immediate	Attribute	RO		Index	1C33-06h
	Calculate and Copy Time						

PF0.186	Label	reserve		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		Default	0	Data	UNIT32
	Activation	Immediate	Attribute	RO		Index	1C33-07h
	-						

PF0.187	Label	Get Cycle Time		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		Default	0	Data	UNIT16
	Activation	Immediate	Attribute	RO		Index	1C33-08h
	Get Cycle Time						

PF0.188	Label	Delay Time		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		Default	0	Data	UNIT32
	Activation	Immediate	Attribute	RO		Index	1C33-09h
	Delay Time						

PF0.189	Label	Sync0 Cycle Time		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		Default	0	Data	UNIT32
	Activation	Immediate	Attribute	RO		Index	1C33-0Ah
	Sync0 Cycle Time						

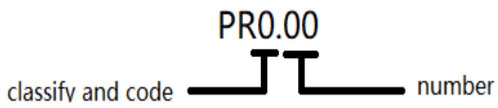
PF0.190	**Label**	Sync Manager time loss count		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		**Default**	0	**Data**	UNIT32
	Activation	Immediate	**Attribute**	RO		**Index**	1C33-0Bh
	Sync Manager time loss count						

PF0.191	**Label**	SM Event Miss Counter		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		**Default**	0	**Data**	UNIT16
	Activation	Immediate	**Attribute**	RO		**Index**	1C33-0Ch
	SM Event Miss Counter						

PF0.192	**Label**	Shift Too Short Counter		**Mode**	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~0		**Default**	0	**Data**	UNIT16
	Activation	Immediate	**Attribute**	RO		**Index**	1C33-0Dh
	Shift Too Short Counter						

3.10.2【Class PF2】Series 6000

- Panel Display as follows:



- Parameter Valid mode Description

CSP: Valid in cyclic synchronous position mode

CSV: Valid in cyclic synchronous velocity mode

CST: Valid in cyclic synchronous torque mode

HM: Valid in homing mode

PP: Valid in profile position mode

PV: Valid in profile velocity mode

PT: Valid in profile torque mode

F: Valid in all modes

PF2.01	Label	Error code			Mode	PP/PV/PT/CSP/CSV/CST/HM		
Index	Range	0x0~0xFFFF			Default	0X0	Unit	-
603Fh	Structure	VAR	Type	Uint16	Mapping	TPDO	Access	RO
	Error code							

PF2.02	Label	Control word			Mode	PP/PV/PT/CSP/CSV/CST/HM		
Index	Range	0x0~0xFFFF			Default	0X0	Unit	-
6040h	Structure	VAR	Type	Uint16	Mapping	RPDO	Access	RW

Bit	Label	Description
0	Start	1 - valid, 0 - invalid
1	Main circuit power on	1 - valid, 0 - invalid
2	Quick stop	0 - valid,1 - invalid
3	Servo running	1 - valid, 0 - invalid
4-6	Running mode related	Related to each servo running mode
7	Fault reset	Reset resettable fault alarm. Rising edge of Bit7 is valid, bit7 remains at 1, and all other instructions are invalid
8	Pause	For more information on how to pause in each mode, refer to Object Dictionary 605Dh
9	No definition	Undefined
10	Reserved	Undefined
11-15	Reserved	Undefined

PF2.03 Index 6041h	Label	Status word			Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0xFFFF			Default	0X0	Unit	-
	Structure	VAR	Type	Uint16	Mapping	TPDO	Access	RO

Bit	Label	Description
0	Servo ready	1 - valid, 0 - invalid
1	Start	1 - valid, 0 - invalid
2	Servo running	1 - valid, 0 - invalid
3	Fault	1 - valid, 0 - invalid
4	Main circuit power on	1 - valid, 0 - invalid
5	Quick stop	0- valid, 1 - invalid
6	Servo cannot run	1 - valid, 0 - invalid
7	Warning	1 - valid, 0 - invalid
8	Reserved	Reserved
9	Remote control	1 - valid, 0 - invalid
10	Arrived at position	1 - valid, 0 - invalid
11	Internal limit valid	1 - valid, 0 - invalid
12-13	Mode related	Related to each servo operation mode
14	Reserved	Reserved
15	Origin found	1 - valid, 0 - invalid

PF2.04 Index 605Ah	Label	Quick stop option code			Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~6			Default	2	Unit	-
	Structure	VAR	Type	INT16	Mapping	-	Access	RW

Sets the forced stop mode. This parameter is linked with P00.33: modifying the value of 605Ah will synchronously update P00.33.

EtherCAT mode:

When 605Ah = 0/3: In homing mode, the deceleration is selected as 609Ah; in non-homing mode, the deceleration is selected as 6084h.

When 605Ah = 1/4: The deceleration is selected as 6085h.

When 605Ah = 2: The deceleration is fixed to the maximum value.

PF2.06 Index 605Ch	Label	Disable Operation Option Code			Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~8			Default	0	Unit	-
	Structure	VAR	Type	INT16	Mapping	-	Access	RW

To set motor stopping mode when servo drive is disabled.

Value	Description	Servo Braking Stop Deceleration
0	Stop via servo braking; after stop, the servo state is dynamic braking state.	Determined by P00.37 (Fault Deceleration Time).
1	Stop via servo braking; after stop, the servo state is dynamic braking state.	In homing mode, the deceleration is 609Ah (homing acceleration/deceleration); in non-homing mode, the deceleration is 6084h (protocol deceleration).
2	Stop via servo braking; after stop, the servo state	Determined by 6085h (emergency stop deceleration).

	is dynamic braking state.	
3	Stop via servo braking; after stop, the servo state is free state.	The servo braking stop deceleration when the enable is turned off is determined by P00.37 (Fault Deceleration Time).
4	Stop via servo braking; after stop, the servo state is free state.	In homing mode, the deceleration is 609Ah (homing acceleration/deceleration); in non-homing mode, the deceleration is 6084h (protocol deceleration).
5	Stop via servo braking; after stop, the servo state is free state.	Determined by 6085h (emergency stop deceleration).
6	Stop via DB braking; after stop, the servo state is dynamic braking state.	-
7	Stop via DB braking; after stop, the servo state is free state.	
8	Stop via free run; after stop, the servo state is free state.	

PF2.07 Index 605Dh	Label	Halt Option Code			Mode	F		
	Range	1~3			Default	1	Unit	-
	Structure	VAR	Type	INT16	Mapping	RPDO	Access	RW

When control word is set to halt, set deceleration and stop option. Also suitable for deceleration mode settings during mode switching

PP, CSP, CSV, PV

1 ： Motor decelerates and stops through 6084. Status: Operation enabled, axis enabled.

2 ： Motor decelerates and stops through 6085. Status: Operation enabled, axis enabled.

3 ： Motor decelerates and stops through 60C6. Status: Operation enabled, axis enabled.

HM

1 ： Motor decelerates and stops through 609A. Status: Operation enabled, axis enabled.

2 ： Motor decelerates and stops through 6085. Status: Operation enabled, axis enabled.

3 ： Motor decelerates and stops through 60C6. Status: Operation enabled, axis enabled.

CST,PT

1, 2 ： Motor decelerates and stops through 6087. Status: Operation enabled, axis enabled.

3 ： Motor decelerates and stops through torque = 0. Status: Operation enabled, axis enabled.

<table>
<tr><td rowspan="3">PF2.08
Index
605Eh</td><td>Label</td><td colspan="3">Fault Reaction Option Code</td><td>Mode</td><td colspan="3">PP/PV/PT/CSP/CSV/CST/HM</td></tr>
<tr><td>Range</td><td colspan="3">0~8</td><td>Default</td><td>0</td><td>Unit</td><td>-</td></tr>
<tr><td>Structure</td><td>VAR</td><td>Type</td><td>INT16</td><td>Mapping</td><td>RPDO</td><td>Access</td><td>RW</td></tr>
</table>

Sets the stop mode and stop state for Class 2 faults. P00.32 is equivalent to PF2.08 (605Eh), and the parameters are interlinked: modifying the value of P00.32 will synchronously update PF2.08, and vice versa.

For Class 2 alarms (excluding Er260/Er570/Er571), refer to the table below for the stop mode:

Value	Description	Servo Braking Stop Deceleration
0	Stop via servo braking; after stop, the servo state is dynamic braking state.	Determined by P00.37 (Fault Deceleration Time).
1	Stop via servo braking; after stop, the servo state is dynamic braking state.	In homing mode, the deceleration is 609Ah (homing acceleration/deceleration); in non-homing mode, the deceleration is 6084h (protocol deceleration).
2	Stop via servo braking; after stop, the servo state is dynamic braking state.	Determined by 6085h (emergency stop deceleration).
3	Stop via servo braking; after stop, the servo state is free state.	The servo braking stop deceleration when the enable is turned off is determined by P00.37 (Fault Deceleration Time).
4	Stop via servo braking; after stop, the servo state is free state.	In homing mode, the deceleration is 609Ah (homing acceleration/deceleration); in non-homing mode, the deceleration is 6084h (protocol deceleration).
5	Stop via servo braking; after stop, the servo state is free state.	Determined by 6085h (emergency stop deceleration).
6	Stop via DB braking; after stop, the servo state is dynamic braking state.	-
7	Stop via DB braking; after stop, the servo state is free state.	
8	Stop via free run; after stop, the servo state is free state.	

For Er260 (positive/negative overtravel input active), the stop mode and deceleration are selected by P00.34 (Positive/Negative Limit Stop Mode).

For Er570 (forced alarm input) and Er571 (PC forced alarm), the stop mode and deceleration are selected by P00.33 (Forced Stop Mode).

PF2.09	Label	Mode of Operation			Mode	PP/PV/PT/CSP/CSV/CST/HM		
Index	Range	1~10			Default	8	Unit	-
6060h	Structure	VAR	Type	INT8	Mapping	RPDO	Access	RW

No.	Mode	Abbr.
1	Profile position mode	PP
3	Profile velocity mode	PV
4	profile Torque mode	PT
6	Homing mode	HM
8	Cyclic synchronous position mode	CSP
9	Cyclic synchronous velocity mode	CSV
10	Cyclic synchronous torque mode	CST

PF2.10	Label	Mode of Operation display			Mode	PP/PV/PT/CSP/CSV/CST/HM		
Index	Range	1~10			Default	8	Unit	-
6061h	Structure	VAR	Type	INT8	Mapping	-	Access	RW

No.	Mode	Abbr.
1	Profile position mode	PP
3	Profile velocity mode	PV
4	profile Torque mode	PT
6	Homing mode	HM
8	Cyclic synchronous position mode	CSP
9	Cyclic synchronous velocity mode	CSV
10	Cyclic synchronous torque mode	CST

PF2.11	Label	Position Demand Value			Mode	PP	CSP	HM
Index	Range	-2147483648~2147483647			Default	0	Unit	*unit*
6062h	Structure	VAR	Type	INT32	Mapping	TPDO	Access	RO

Reflects position command when servo driver is enabled.

PF2.12	Label	Position Actual Internal Value			Mode	PP/PV/PT/CSP/CSV/CST/HM		
Index	Range	-2147483648~2147483647			Default	0	Unit	*pulse*
6063h	Structure	VAR	Type	INT32	Mapping	TPDO	Access	RO

Reflects motor absolute position (Encoder unit)

PF2.13	Label	Position Actual Value			Mode	PP/PV/PT/CSP/CSV/CST/HM		
Index	Range	-2147483648~2147483647			Default	0	Unit	*unit*
6064h	Structure	VAR	Type	INT32	Mapping	TPDO	Access	RO
	Reflects user's real time absolute position 6064h*Gear ratio = 6063h							

PF2.14	Label	Follow Error Window			Mode	PP	CSP	HM
Index	Range	0~2147483647			Default	27486 951	Unit	*unit*
6065h	Structure	VAR	Type	UINT32	Mapping	RPDO	Access	RO
	To set an acceptable deviation for requested position. When actual position exceed position deviation window, error might occur.							

PF2.15	Label	Follow Error Time Out			Mode	PP	CSP	HM
Index	Range	0~65535			Default	0	Unit	*ms*
6066h	Structure	VAR	Type	UINT16	Mapping	RPDO	Access	RO
	To set position deviation detection time							

PF2.16	Label	Position window			Mode	PP	CSP	HM
Index	Range	0~2147483647			Default	5872	Unit	*unit*
6067h	Structure	VAR	Type	UINT32	Mapping	RPDO	Access	RO
	To set an acceptable extent of arrival position							

PF2.17	Label	Position window time			Mode	PP	CSP	HM
Index	Range	0~65535			Default	300	Unit	*ms*
6068h	Structure	VAR	Type	UINT16	Mapping	RPDO	Access	RO
	To set the time between arrival to the output of INP (In position) signal.							

PF2.18	Label	Velocity Sensor Actual Value			Mode	PP/PV/PT/CSP/CSV/CST/HM		
Index	Range	-2147483648~2147483647			Default	0	Unit	
6069h	Structure	VAR	Type	UINT16	Mapping		Access	
	Velocity Sensor Actual Value							

PF2.20	Label	Velocity Demand Value			Mode	CSV		PV
Index	Range	-2147483648~2147483647			Default	0	Unit	*unit/s*
606Bh	Structure	VAR	Type	INT32	Mapping	TPDO	Access	RO
	Show user set velocity demand value.							

PF2.21	**Label**	Velocity Actual Value			**Mode**	**F**		
Index	**Range**	-2147483648~2147483647			**Default**	0	**Unit**	*unit/s*
606Ch	**Structure**	VAR	**Type**	INT32	**Mapping**	TPDO	**Access**	RO
	Show actual velocity value.							

PF2.22	**Label**	Velocity window			**Mode**	**CSV**		**PV**
Index	**Range**	0~65535			**Default**	10	**Unit**	*unit/s*
606Dh	**Structure**	VAR	**Type**	UINT16	**Mapping**	RPDO	**Access**	RO
	Set the range of velocity							

PF2.23	**Label**	Velocity window time			**Mode**	**CSV**		**PV**
Index	**Range**	0~65535			**Default**	0	**Unit**	ms
606Eh	**Structure**	VAR	**Type**	UINT16	**Mapping**	RPDO	**Access**	RO
	To set the time between velocity reached and status word set to TargetReached.							

PF2.24	**Label**	Velocity Threshold			**Mode**	**CSV**		**PV**
Index	**Range**	0~65535			**Default**	10	**Unit**	*Command/s*
606Fh	**Structure**	VAR	**Type**	UINT16	**Mapping**	RPDO	**Access**	RO
	To set to zero-speed range.							

PF2.25	**Label**	Velocity Threshold Time			**Mode**	**CSV**		**PV**
Index	**Range**	0~65535			**Default**	0	**Unit**	ms
6070h	**Structure**	VAR	**Type**	UINT16	**Mapping**	RPDO	**Access**	RO
	To set the time until status word – zero speed detection is canceled.							

PF2.26	**Label**	Target torque			**Mode**	**CST**		**PT**
Index	**Range**	-4032~4000			**Default**	0	**Unit**	0.001
6071h	**Structure**	VAR	**Type**	INT16	**Mapping**	RPDO	**Access**	RW
	To set target torque for profile and cyclic torque mode.							

PF2.27	**Label**	Maximum torque			**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
Index	**Range**	0~7500			**Default**	5000	**Unit**	0.1%
6072h	**Structure**	VAR	**Type**	UINT16	**Mapping**	RPDO	**Access**	RW
	To set max torque for servo drive, limited by motor's highest torque.							

PF2.28	Label	Maximum current			Mode	PP/PV/PT/CSP/CSV/CST/HM		
Index	Range	0~7500			Default	5000	Unit	0.1%
6073h	Structure	VAR	Type	UINT16	Mapping	TPDO	Access	RO
	To set max. current for servo driver.							

PF2.29	Label	Torque Demand			Mode	PP/PV/PT/CSP/CSV/CST/HM		
Index	Range	-4032~4000			Default	0	Unit	0.1%
6074h	Structure	VAR	Type	INT16	Mapping	TPDO	Access	RO
	Internal command torque							

PF2.30	Label	Motor Rated Current			Mode	PP/PV/PT/CSP/CSV/CST/HM		
Index	Range	0~2147483647			Default	3000	Unit	mA
6075h	Structure	VAR	Type	INT32	Mapping	TPDO	Access	RO
	Shows motor rated current.							

PF2.32	Label	Torque Actual Value			Mode	PP/PV/PT/CSP/CSV/CST/HM		
Index	Range	-4032~4000			Default	0	Unit	0.1%
6077h	Structure	VAR	Type	INT16	Mapping	TPDO	Access	RO
	Shows servo driver actual torque feedback							

PF2.34	Label	DC Link Circuit Voltage			Mode	PP/PV/PT/CSP/CSV/CST/HM		
Index	Range	0~2147483647			Default	0	Unit	mV
6079h	Structure	VAR	Type	UINT32	Mapping	TPDO	Access	RO
	Shows DC bus voltage across P, N terminals							

PF2.35	Label	Target position			Mode	PP		CSP
Index	Range	-2147483647~2147483647			Default	0	Unit	*unit*
607Ah	Structure	VAR	Type	INT32	Mapping	RPDO	Access	RW
	To set the target position under profile and cyclic position mode.							

PF2.38	Label	Home Offset			Mode	HM		
Index	Range	-2147483647~2147483647			Default	0	Unit	*unit*
607Ch	Structure	VAR	Type	INT32	Mapping	RPDO	Access	RW
	To set position offset to compensate for the deviation of mechanical origin from motor origin under homing							

PF2.39 Index 607Dh-01	Label	Min Position Limit			Mode	PP		CSP
	Range	-2147483647~2147483647			Default	0	Unit	*unit*
	Structure	VAR	Type	INT32	Mapping	RPDO	Access	RW

Setting the minimum value for the software limit; when the motor reaches this position, the negative software limit becomes active. The drive will prevent the motor from continuing to move in the negative direction to ensure equipment and operational safety. This parameter is equivalent to P00.57 (Negative Software Limit), and the two are interlinked; that is, changing 607D-01h will result in a synchronous change to P00.57.

PF2.40 Index 607Dh-02	Label	Max Position Limit			Mode	PP		CSP
	Range	-2147483647~2147483647			Default	0	Unit	*unit*
	Structure	VAR	Type	INT32	Mapping	RPDO	Access	RW

Setting the maximum value for the forward software limit: when the motor reaches this position, the forward software limit becomes active. The drive will prevent the motor from continuing to move in the forward direction to ensure equipment and operational safety. This parameter is equivalent to P00.56 (Forward Software Limit), and the two are interlinked; that is, changing 607D-02h will result in a synchronous change to P00.56.

PF2.41 Index 607Eh	Label	Polarity			Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~255			Default	0	Unit	
	Structure	VAR	Type	UINT8	Mapping	RPDO	Access	RW

Set input polarity of the command.

Mode		Set Value
Position mode	PP	0：Rotate in the same direction as the position command 128：Rotate in the opposite direction to the position command
	HM	
	CSP	
Velocity mode	PV	0：Rotate in the same direction as the position command 64：Rotate in the opposite direction to the position command
	CSV	
Torque mode	PT	0：Rotate in the same direction as the position command 32：Rotate in the opposite direction to the position command
	CST	
ALL mode		0：Rotate in the same direction as the position command 224：Rotate in the opposite direction to the position command

PF2.42 Index 607Fh	Label	Max Profile Velocity			Mode	PP	HM	PV	CST
	Range	0~2147483647			Default	838860800	Unit	*unit*/s	
	Structure	VAR	Type	UINT32	Mapping	RPDO	Access	RW	

To set max allowable velocity. Limited by 6080

PF2.43 Index 6080h	Label	Max Motor Speed			Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~2147483647			Default	10000	Unit	r/min
	Structure	VAR	Type	UINT32	Mapping	RPDO	Access	RW
To set the maximum allowable motor velocity.								

PF2.44 Index 6081h	Label	Profile velocity			Mode	PP		
	Range	0~2147483647			Default	13981013	Unit	*unit*/s
	Structure	VAR	Type	UINT32	Mapping	RPDO	Access	RW
To set target velocity. Limited by 607Fh.								

PF2.46 Index 6083h	Label	Profile acceleration			Mode	PP		PV
	Range	1~2147483647			Default	1398101333	Unit	*unit*/s^2
	Structure	VAR	Type	UINT32	Mapping	RPDO	Access	RW
To set motor acceleration								

PF2.47 Index 6084h	Label	Profile deceleration			Mode	PP		PV
	Range	1~2147483647			Default	1398101333	Unit	*unit*/s^2
	Structure	VAR	Type	UINT32	Mapping	RPDO	Access	RW
To set motor deceleration								

PF2.48 Index 6085h	Label	Quick Stop Deceleration			Mode	CSP	CSV	PP	PV	HM
	Range	1~2147483647			Default	2147483647		Unit	*unit*/s^2	
	Structure	VAR	Type	UINT32	Mapping	RPDO		Access	RW	
To set the deceleration during an emergency stop										

PF2.50 Index 6087h	Label	Torque slope			Mode	PT		
	Range	1~2147483647			Default	2147483647	Unit	0.1%/s
	Structure	VAR	Type	UINT32	Mapping	RPDO	Access	RW
To set values for tendency torque command								

PF2.52	Label	Encoder Increments			Mode	PP/PV/PT/CSP/CSV/CST/HM		
Index	Range	0~2147483647			Default	0	Unit	*Pulse*
608Fh-01	Structure	VAR	Type	UINT32	Mapping	TPDO	Access	RO
	To set encoder resolution							

PF2.54	Label	Motor Revolutions			Mode	PP/PV/PT/CSP/CSV/CST/HM		
Index	Range	1~2147483647			Default	1	Unit	r
6091h-01	Structure	VAR	Type	UINT32	Mapping	RPDO	Access	RW
	To set electronic gear ratio numerator							
PF2.55	Label	Shaft Revolutions			Mode	PP/PV/PT/CSP/CSV/CST/HM		
Index	Range	1~2147483647			Default	1	Unit	r
6091h-02	Structure	VAR	Type	UINT32	Mapping	RPDO	Access	RW
	To set electronic gear ratio denominator							
PF2.56	Label	Feed			Mode	PP/PV/PT/CSP/CSV/CST/HM		
Index	Range	0~67108864			Default	0	Unit	unit
6092h-01	Structure	VAR	Type	UINT32	Mapping	RPDO	Access	RW
	If 6092h-01(Feed constant) is not equal to 608Fh(Position encoder resolution), then: Electronic gear ratio = Encoder increments / 6092h-01 If 6092h-01(Feed constant) is equal to 608Fh(Position encoder resolution), then: Electronic gear ratio = 6091-01 / 6092h-01							

PF2.58	Label	Homing method			Mode	HM		
Index	Range	-6 ~ 37			Default	19	Unit	-
6098h	Structure	VAR	Type	UINT8	Mapping	RPDO	Access	RW

The table below describes the velocity, direction and stopping conditions of each homing methods.

Value	Direction	Deceleration point	Home	Before Z-signal
-6	Negative	-	Stop immediately once torque is reached	
-5	Positive	-	Stop immediately once torque is reached	
-4	Negative	-	Stop immediately after reversing direction and torque dissipation	
-3	Positive	-	Stop immediately after reversing direction and torque dissipation	
-2	Negative	-	Stop after reversing direction, torque dissipation, and detection of the first Z signal	
-1	Positive	-	Stop after reversing direction, torque dissipation, and detection of the first Z signal	
1	Negative	Negative limit switch	Motor Z-signal	Negative limit switch falling edge
2	Positive	Positive limit switch	Motor Z-signal	Positive limit switch falling edge
3	Positive	Homing switch	Motor Z-signal	Falling edge on same side of homing switch
4	Positive	Homing switch	Motor Z-signal	Rising edge on same side of homing switch
5	Negative	Homing switch	Motor Z-signal	Falling edge on same side of homing switch
6	Negative	Homing switch	Motor Z-signal	Rising edge on same side of homing switch
7	Positive	Homing switch	Motor Z-signal	Falling edge on same side of homing switch
8	Positive	Homing switch	Motor Z-signal	Rising edge on same side of homing switch
9	Positive	Homing switch	Motor Z-signal	Rising edge on same side of homing switch
10	Positive	Homing switch	Motor Z-signal	Falling edge on same side of homing switch
11	Negative	Homing switch	Motor Z-signal	Failling edge on same side of homing switch
12	Negative	Homing switch	Motor Z-signal	Rising edge on same side of homing switch
13	Negative	Homing switch	Motor Z-signal on other side of homing switch	Rising edge on other side of homing switch
14	Negative	Homing switch	Motor Z-signal on other side of homing switch	Falling edge on other side of homing switch
15				
16				
17-32	Similar with 1-14, but deceleration point = homing point			
33	Home in negative direction, Homing point = motor Z-signal			
34	Home in positive direction, Homing point = motor Z-signal			
35-37	Set current position as homing point			

PF2.59 Index 6099h-01	Label	Speed During Search For Switch			Mode	HM		
	Range	0~2147483647			Default	13981013	Unit	unit/s
	Structure	VAR	Type	UINT32	Mapping	RPDO	Access	RW
	To set the speed used in homing							

<table>
<tr><td rowspan="3">PF2.60
Index
6099h-02</td><td>Label</td><td colspan="3">Speed During Search For Zero</td><td>Mode</td><td colspan="3">HM</td></tr>
<tr><td>Range</td><td colspan="3">0~2147483647</td><td>Default</td><td>1398101</td><td>Unit</td><td>unit/s</td></tr>
<tr><td>Structure</td><td>VAR</td><td>Type</td><td>UINT32</td><td>Mapping</td><td>RPDO</td><td>Access</td><td>RW</td></tr>
<tr><td colspan="9">To set the speed used in homing</td></tr>
</table>

<table>
<tr><td rowspan="3">PF2.61
Index
609Ah</td><td>Label</td><td colspan="3">Homing acceleration</td><td>Mode</td><td colspan="3">HM</td></tr>
<tr><td>Range</td><td colspan="3">1~2147483647</td><td>Default</td><td>1398101333</td><td>Unit</td><td>unit/s^2</td></tr>
<tr><td>Structure</td><td>VAR</td><td>Type</td><td>UINT32</td><td>Mapping</td><td>RPDO</td><td>Access</td><td>RO</td></tr>
<tr><td colspan="9">To set acceleration and deceleration used in homing</td></tr>
</table>

<table>
<tr><td rowspan="3">PF2.62
Index
60B0h</td><td>Label</td><td colspan="3">Position feedforward</td><td>Mode</td><td colspan="2">CSP</td><td>PP</td></tr>
<tr><td>Range</td><td colspan="3">-2147483647~2147483647</td><td>Default</td><td>0</td><td>Unit</td><td>unit</td></tr>
<tr><td>Structure</td><td>VAR</td><td>Type</td><td>INT32</td><td>Mapping</td><td>RPDO</td><td>Access</td><td>RO</td></tr>
<tr><td colspan="9">To add offset to target position</td></tr>
</table>

<table>
<tr><td rowspan="3">PF2.63
Index
60B1h</td><td>Label</td><td colspan="3">Velocity feedforward</td><td>Mode</td><td colspan="3">CSP | CSP | PP | PV | HM</td></tr>
<tr><td>Range</td><td colspan="3">-2147483647~2147483647</td><td>Default</td><td>0</td><td>Unit</td><td>unit/s</td></tr>
<tr><td>Structure</td><td>VAR</td><td>Type</td><td>INT32</td><td>Mapping</td><td>RPDO</td><td>Access</td><td>RO</td></tr>
<tr><td colspan="9">To add offset to velocity demand value.</td></tr>
</table>

<table>
<tr><td rowspan="3">PF2.64
Index
60B2h</td><td>Label</td><td colspan="3">Torque feedforward</td><td>Mode</td><td colspan="3">PP/PV/PT/CSP/CSV/CST/HM</td></tr>
<tr><td>Range</td><td colspan="3">-32768~32767</td><td>Default</td><td>0</td><td>Unit</td><td>0.1%</td></tr>
<tr><td>Structure</td><td>VAR</td><td>Type</td><td>INT32</td><td>Mapping</td><td>RPDO</td><td>Access</td><td>RO</td></tr>
<tr><td colspan="9">To add offset to torque demand value.</td></tr>
</table>

PF2.65	Label	Touch Probe function			Mode	F		
Index	Range	0x0-0xFFFF			Default	0x0	Unit	-
60B8h	Structure	VAR	Type	UINT16	Mapping	RPDO	Access	RW

Bit	Description	Details
0	Probe 1	0--Disable 1--Enable
1	Probe 1 trigger mode	0--Single trigger, triggered only when trigger signal is valid 1—Continuous trigger
2	Probe 1 trigger signal selection	0—Probe 1 captured 1--Z signal
3	Reserved	-
4	Probe 1 rising edge enabled	0--Disable 1--Enable
5	Probe 1 falling edge enabled	0--Disable 1--Enable
6-7	Reserved	-
8	Probe 2	0--Disable 1--Enable
9	Probe 2 trigger mode	0--Single trigger, triggered only when trigger signal is valid 1—Continuous trigger
10	Probe 2 trigger signal selection	0—Probe 2 captured 1--Z signal
11	Reserved	-
12	Probe 2 rising edge enabled	0—Rising edge not latched 1—Rising edge latched
13	Probe 2 falling edge enabled	0—Falling edge not latched 1—Falling edge latched
14-15	Reserved	-

PF2.66	Label	Touch Probe status			Mode	PP/PV/PT/CSP/CSV/CST/HM		
Index	Range	0x0-0xFFFF			Default	0x0	Unit	-
60B9h	Structure	VAR	Type	UINT16	Mapping	TPDO	Access	RO

Bit	Definition	Details
0	Probe 1	0--Disable 1--Enable
1	Probe 1 rising edge latching	0—Rising edge not latched 1—Rising edge latched
2	Probe 1 falling edge latching	0—Falling edge not latched 1—Falling edge latched
3-5	-	-
6-7	-	-
8	Probe 2	0--Disable 1--Enable
9	Probe 2 rising edge latching	0—Rising edge not latched 1—Rising edge latched
10	Probe 2 falling edge latching	0—Falling edge not latched 1—Falling edge latched
11-13	-	-
14-15	-	-

PF2.67	Label	Touch Probe 1 Positive Position			Mode	PP/PV/PT/CSP/CSV/CST/HM		
Index	Range	-2147483647~2147483647			Default	0	Unit	*unit*
60BAh	Structure	VAR	Type	INT32	Mapping	TPDO	Access	RO

Shows position feedback at rising edge of probe 1 signal

PF2.68	Label	Touch Probe 1 Negative Position			Mode	PP/PV/PT/CSP/CSV/CST/HM		
Index	Range	-2147483647~2147483647			Default	0	Unit	*unit*
60BBh	Structure	VAR	Type	INT32	Mapping	TPDO	Access	RO

Shows position feedback at falling edge of probe 1 signal

PF2.69	Label	Touch Probe 2 Positive Position			Mode	PP/PV/PT/CSP/CSV/CST/HM		
Index	Range	-2147483647~2147483647			Default	0	Unit	*unit*
60BCh	Structure	VAR	Type	INT32	Mapping	TPDO	Access	RO

Shows position feedback at rising edge of probe 2 signal

PF2.70	Label	Touch Probe 2 Negative Position			Mode	PP/PV/PT/CSP/CSV/CST/HM		
Index	Range	-2147483647~2147483647			Default	0	Unit	*unit*
60BDh	Structure	VAR	Type	INT32	Mapping	TPDO	Access	RO

Shows position feedback at falling edge of probe 2 signal

PF2.71 Index 60C5h	Label	Max Acceleration		Mode	PP/PV/PT/CSP/CSV/CST/HM			
	Range	1~2147483647		Default	2147483647	Unit	unit/s^2	
	Structure	VAR	Type	UINT32	Mapping	RPDO	Access	RW
To set upper limit of acceleration.								

PF2.72 Index 60C6h	Label	Max Deceleration		Mode	PP/PV/PT/CSP/CSV/CST/HM			
	Range	1~2147483647		Default	2147483647	Unit	unit/s^2	
	Structure	VAR	Type	UINT32	Mapping	RPDO	Access	RW
To set upper limit of deceleration.								

PF2.73 Index 60D0h-01	Label	Touch Probe 1 Source		Mode	PP/PV/PT/CSP/CSV/CST/HM			
	Range	1~6		Default	5	Unit	-	
	Structure	VAR	Type	UINT16	Mapping	-	Access	RW
Touch Probe 1 Source								

PF2.74 Index 60D0h-02	Label	Touch Probe 2 Source		Mode	PP/PV/PT/CSP/CSV/CST/HM			
	Range	1~6		Default	6	Unit	-	
	Structure	VAR	Type	UINT16	Mapping	-	Access	RW
Touch Probe 2 Source								

PF2.75 Index 60D5h	Label	Touch Probe 1 Positive Edge Counter		Mode	PP/PV/PT/CSP/CSV/CST/HM			
	Range	0~65535		Default	0	Unit	-	
	Structure	VAR	Type	UINT16	Mapping	TPDO	Access	RO
Shows the number of times probe 1 rising edge latched.								

PF2.76 Index 60D6h	Label	Touch Probe 1 Negative Edge Counter		Mode	PP/PV/PT/CSP/CSV/CST/HM			
	Range	0~65535		Default	0	Unit	-	
	Structure	VAR	Type	UINT16	Mapping	TPDO	Access	RO
Shows the number of times probe 1 falling edge latched.								

PF2.77 Index 60D7h	Label	Touch Probe 2 Positive Edge Counter		Mode	PP/PV/PT/CSP/CSV/CST/HM			
	Range	0~65535		Default	0	Unit	-	
	Structure	VAR	Type	UINT16	Mapping	TPDO	Access	RO

Shows the number of times probe 2 rising edge latched.

PF2.78 Index 60D8h	**Label**	Touch Probe 2 Negative Edge Counter			**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0~65535			**Default**	0	**Unit**	-
	Structure	VAR	**Type**	UINT16	**Mapping**	TPDO	**Access**	RO
Shows the number of times probe 2 falling edge latched.								

PF2.81 Index 60E0h	**Label**	Positive Torque Limit			**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0~4000			**Default**	3500	**Unit**	0.1%
	Structure	VAR	**Type**	UINT16	**Mapping**	RPDO	**Access**	RW
To set the maximum torque of servo drive in positive direction								

PF2.82 Index 60E1h	**Label**	Negative Torque Limit			**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0~4000			**Default**	3500	**Unit**	0.1%
	Structure	VAR	**Type**	UINT16	**Mapping**	RPDO	**Access**	RW
To set the maximum torque of servo drive in negative direction								

PF2.85 Index 60F4h	**Label**	Following Error Actual Value			**Mode**	**CSP**	**PP**	**HM**
	Range	-2147483647~2147483647			**Default**	0	**Unit**	*unit*
	Structure	VAR	**Type**	INT32	**Mapping**	TPDO	**Access**	RO
Shows position following error								

PF2.86 Index 60FAh	**Label**	Control Effort			**Mode**	**CSP**	**PP**	**HM**
	Range	-2147483647~2147483647			**Default**	0	**Unit**	*unit/s*
	Structure	VAR	**Type**	INT32	**Mapping**	TPDO	**Access**	RO
Position loop output speed: Represents the internal command speed (output from the position loop). When feedforward is enabled: Internal command speed = Feedforward speed + Position loop output speed.								

PF2.87 Index 60FCh	**Label**	Position Demand Internal Value			**Mode**	**CSP**	**PP**	**HM**
	Range	-2147483647~2147483647			**Default**	0	**Unit**	*pulse*
	Structure	VAR	**Type**	INT32	**Mapping**	TPDO	**Access**	RO
Shows position demand value of servo drive.								

PF2.88 Index	**Label**	Digital Inputs Mapping			**Mode**	**PP/PV/PT/CSP/CSV/CST/HM**		
	Range	0x0~0x7FFFFFFF			**Default**	0x0	**Unit**	-

60FDh	Structure	VAR	Type	UINT32	Mapping	TPDO	Access	RO

The bits of 60FDh object are functionally defined as follow:

Bit31	Bit30	Bit29	Bit28	Bit27	Bit26	Bit25	Bit24
Z signal	*Reserved*	*Reserved*	*Reserved*	Probe 2	Probe 1	BRAKE	INP/V-COIN /TLC
Bit23	**Bit22**	**Bit21**	**Bit20**	**Bit19**	**Bit18**	**Bit17**	**Bit16**
E-STOP	*Reserved*	*Reserved*	*Reserved*	*Reserved*	*Reserved*	DI14	DI13
Bit15	**Bit14**	**Bit13**	**Bit12**	**Bit11**	**Bit10**	**Bit9**	**Bit8**
DI12	DI11	DI10	DI9	DI8	DI7	DI6	DI5
Bit7	**Bit6**	**Bit5**	**Bit4**	**Bit3**	**Bit2**	**Bit1**	**Bit0**
DI4	DI3	DI2	DI1	*Reserved*	HOME	POT	NOT

PF2.89 Index 60FEh-01	Label	Outputs IO valid		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0x0	Unit	-
	Structure	ARRAY	Type UINT32	Mapping	RPDO	Access	RW

The bits of 60FEh object are functionally defined as follow:

Bit / Sub-index	31~21	21	20	19	18	17	16	15~0
01h	*Reserved*	DO6 valid	DO5 valid	DO4 valid	DO3 valid	DO2 valid	DO1 valid	*Reserved*

PF2.90 Index 60FEh-02	Label	Output IO enable		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0x0~0x7FFFFFFF		Default	0xFFFF0000	Unit	-
	Structure	ARRAY	Type UINT32	Mapping	RPDO	Access	RW

The bits of a 60FEh object are functionally defined as follow:

Bit / Sub-index	31~21	21	20	19	18	17	16	15~0
02h	*Reserved*	DO6 enabled	DO5 enabled	DO4 enabled	DO3 enabled	DO2 enabled	DO1 enabled	*Reserved*

PF2.91 Index 60FFh	Label	Target velocity		Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	-2147483647~2147483647		Default	0	Unit	*Unit/s*
	Structure	VAR	Type INT32	Mapping	RPDO	Access	RW

Shows set target velocity. Limited by 6080h

PF2.92 Index 6502h	Label	Supported Drive Modes		Mode	F		
	Range	0x0~0x7FFFFFFF		Default	0x3AD	Unit	-
	Structure	ARRAY	Type UINT32	Mapping	TPDO	Access	RO

Shows the control modes supported by the servo drive.

Chapter 4 Servo Drive Operation

4.1 Get Started with Driver Operation

4.1.1 Checklist before operation

No.	Description
Power supply	
1	The voltage of main and control circuit power supply is within rated values.
2	Power supply polarity is rightly connected.
Wiring	
1	Power supply input is rightly connected.
2	Driver's power output UVW matches UVW terminals on the main circuit.
3	No short circuit of driver's input and output UVW terminals.
4	Signal cables are correctly and well connected.
5	Drivers and motors are connected to ground
6	All cables under stress within recommended range.
7	No foreign conductive objects inside/outside the driver.
Mechanical	
1	Driver and external holding brake are not place near combustibles.
2	Installations of driver, motor and axis is fastened.
3	Movement of motors and mechanical axes are not obstructed.

4.1.2 Power On

Connect 400V power supply into main power supply R, S, T terminals and 220V power supply into control circuit power supply L1C, L2C. After power on, light indicator will light up and front panel will display rEAdy, then LED initial status will be displayed. Driver is ready for operation if no alarm occurs.

4.1.3 Trial Run

Servo drive must be disabled before performing trial run. For safety precautions, please JOG under minimal velocity.

Related Parameters

No.	Parameters	Label	Set value	Unit
1	P00.01	Control mode settings	9	/
2	P47.25	JOG trial run command velocity	User defined	r/min
3	P47.29	Trial run acc-/deceleration time	User defined	ms/1000rpm

- *Please make sure the mechanical axis is within the range of motion and travelled distance should not be too long to avoid collision.*
- *Set optimal velocity and acceleration for trial run (not too high!)*
- *Do not modify any gain related parameters during motion to avoid vibration.*

Please refer to "AF_Jog Trial Run" for detailed explanations on how to perform trial run using front panel operation

4.1.4 Motor rotational direction settings

Motor rotational direction can be changed through P00.06 without changing the polarity of the input command.

P00.06	Label	Command polarity inversion	Mode	F		
	Range	0 ~ 1	Default	0	Unit	—
	Activation	After restart			Index	2000-07h

Used to change the rotational direction of the motor.

Set value	Details
0	Polarity of the command is not inversed. The direction of rotation is consistent with the polarity of command.
1	Polarity of command is inversed. The direction of rotation is opposite to the polarity of command.

Note: Rotational direction of the motor is recommended to be set through object dictionary 607E. However, P00.06 has higher priority than object dictionary 607E. 607E only takes effect when P00.06 = 0.

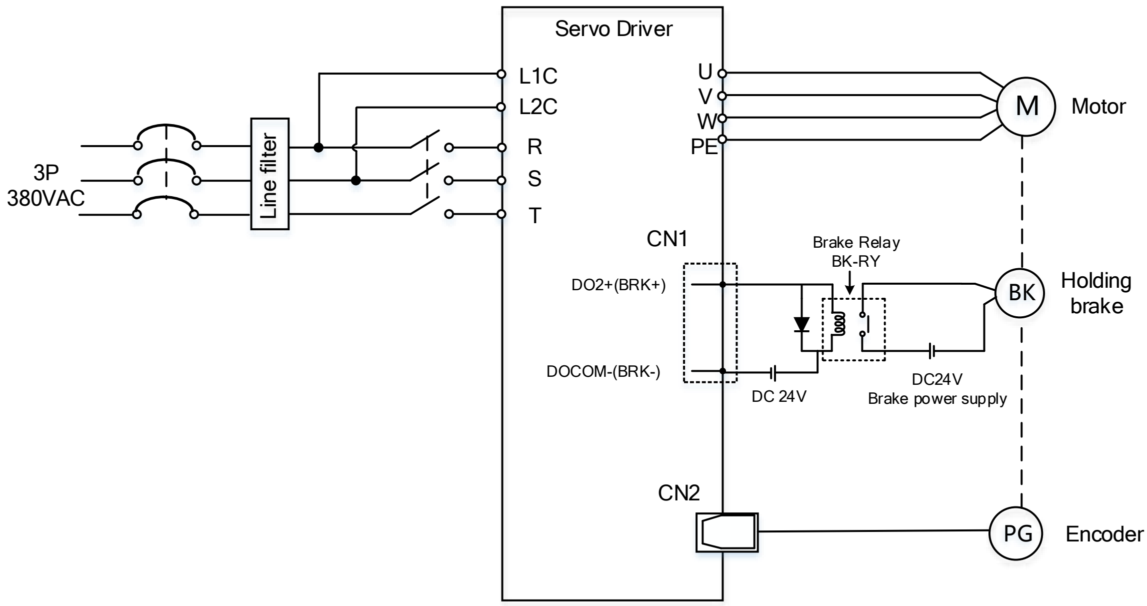
4.1.5 Holding Brake Settings

Holding brake is designed to hold the axis in position to prevent it from sliding due to applied external forces when the driver is disabled. Holding brake is optional and depends on the model of motor chosen for the application.

- *Please only use holding brake when motor is stopped. No applicable when motor is in motion.*
- *Holding brake coil has no polarity.*
- *Motor should be disabled after stopped.*
- *There is some noise when motors with brake are in motion but that doesn't affect its functionality.*
- *Magnetic sensors might be affected when the holding brake is on. Please be aware.*

Holding brake wiring

Holding brake input signal is without polarity. An isolated 24V switching power supply is recommended to prevent abnormal holding brake behavior in case of sudden drop in working current or voltage.



Wiring diagram of motor holding brake

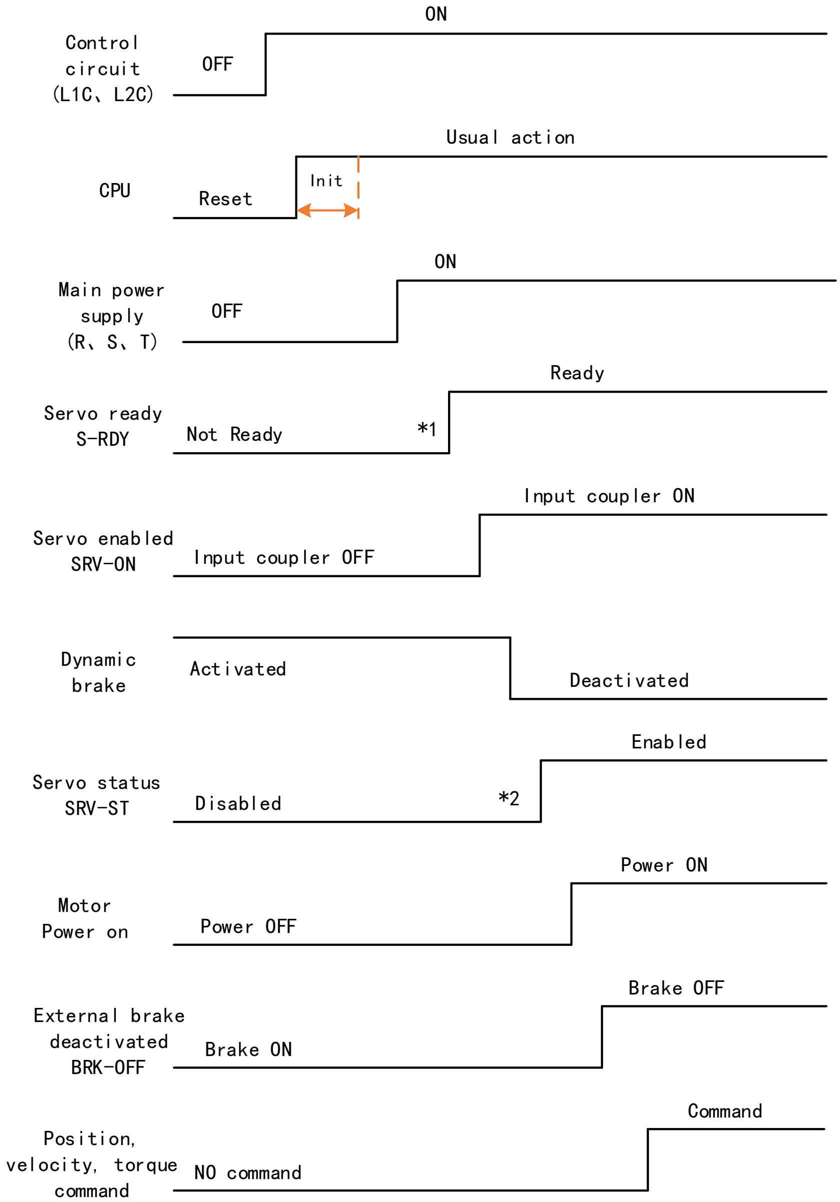
4.1.6 Servo Running

1. Enable servo driver

Check if CN3/CN4 is connected properly. Servo driver is in ready mode. Motor is stopped and holding brake is activated. Front panel display shows 402 state machine = Operational, EtherCAT communication status = operational, Running mode = 8, servo is in stop mode.

2. Motor starts to move after command input
   i. On first time operation, please use suitable command at low velocity. Confirm if motor is working normally.
   ii. Check if motor rotational direction is correct. If not, please check input command or parameter settings. (P00.06).
   iii. If motor is working normally, motion data such as motor rotational velocity “d01SP” and actual torque feedback “d04tr” can be monitored on the front panel or through Motion Studio.

3. Power on sequence diagram



Please enter servo status, position, velocity, torque command as sequence diagram above.

*** 1. S-RDY signal is given after CPU initialization and main power supply powered on.*

2. SRV-ST signal is received when servo driver is enabled. Command input is not allowed yet.

4.1.7 Servo stop

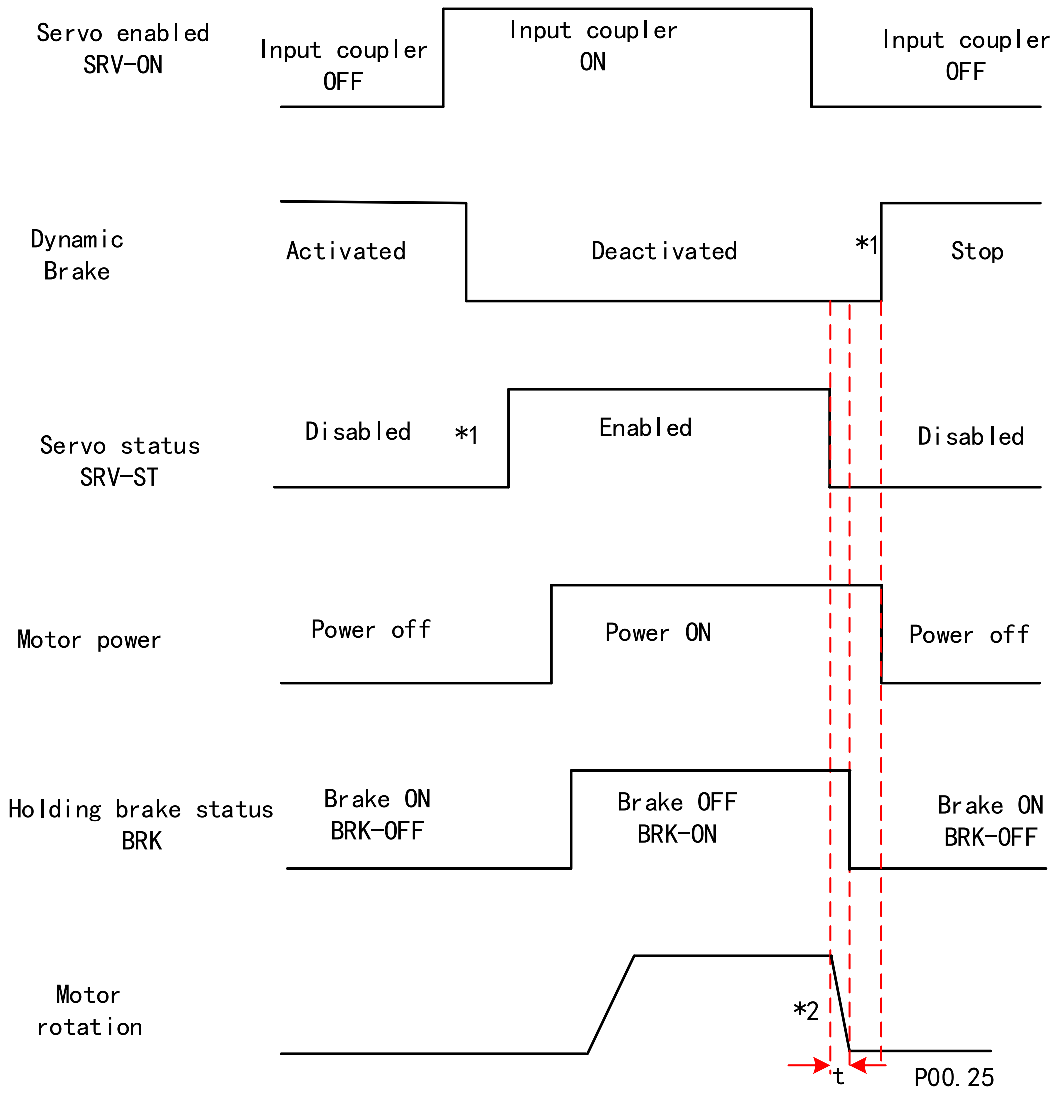
Servo stopping are of 3 different methods: Servo braking method, free stopping method, dynamic braking method.

Stopping method	Description	Details
Servo braking	Servo driver delivers braking torque in opposite direction	Quick stopping but mechanical impact might exist
Free stopping	Motor power cut off. Free to move until velocity = 0. Affected inertia, friction and other factors	Smooth deceleration, low mechanical impact but slow stopping
Dynamic braking	Brake activated when in motion	Quick stopping but mechanical impact might exist

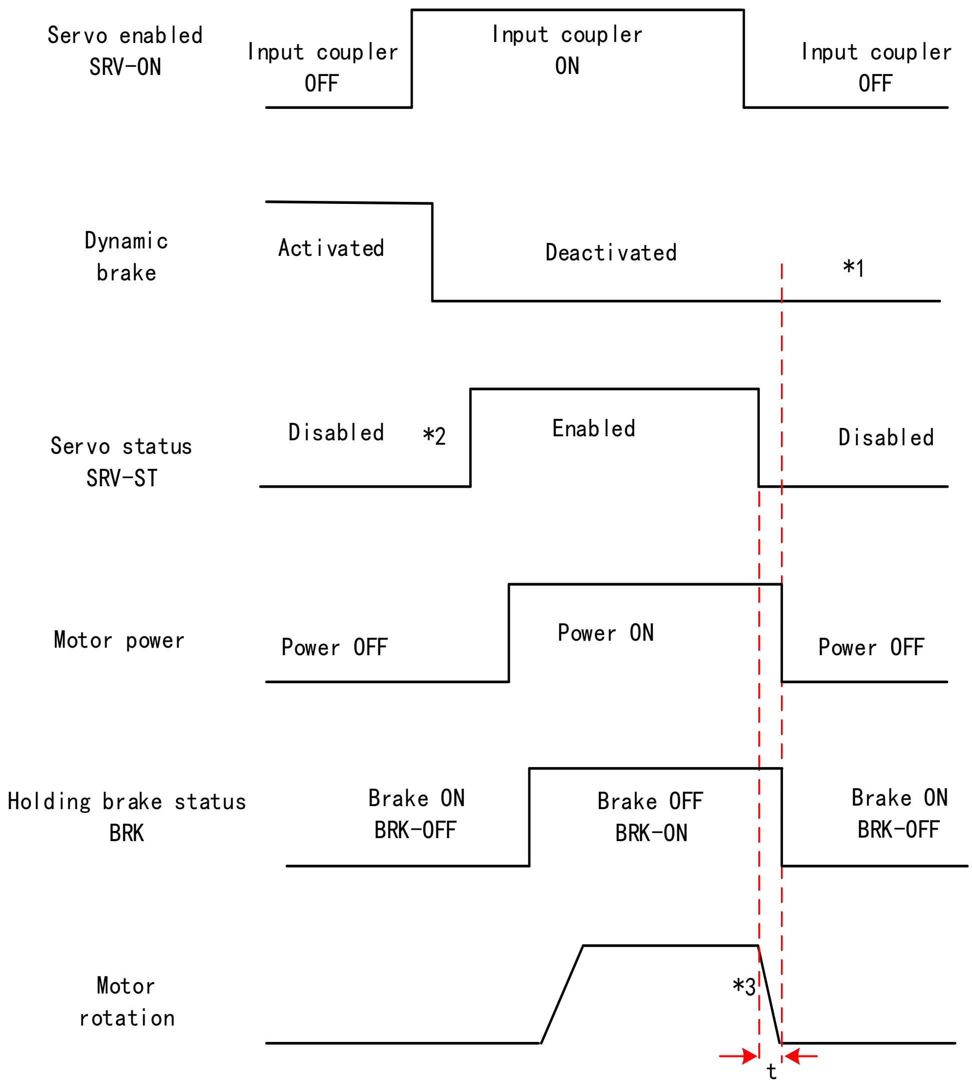
Stopping status	Status after stopped
Free moving	Motor is powered off, rotor is free to rotate
Dynamic braking	Motor is powered off, rotor is not free to rotate
Holding brake stopping	Motor axis is locked, cannot rotate freely

Motor stopping（Servo disabled）- Sequence Diagram

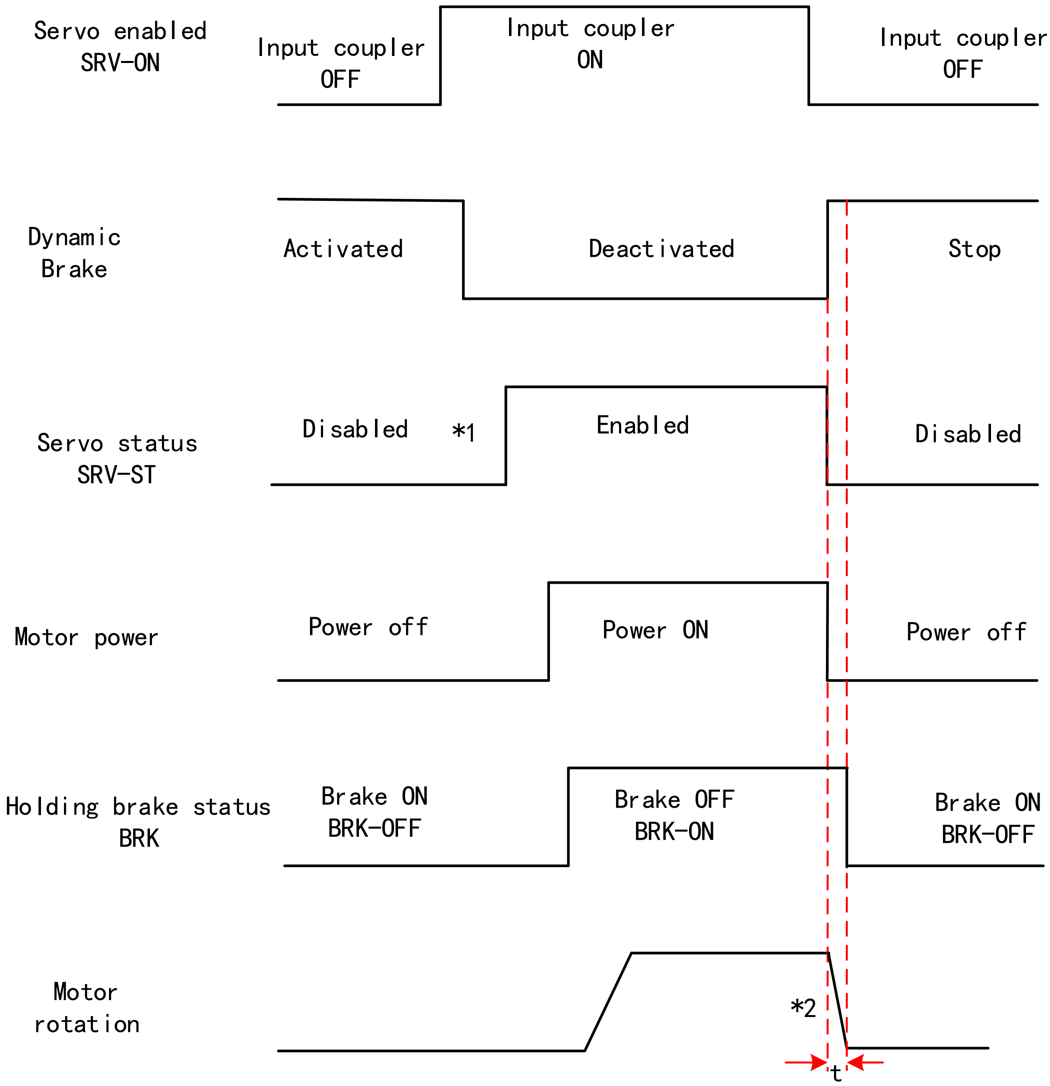
Servo braking method. Status after stopping: Dynamic braking(P00.30=0/1/2)



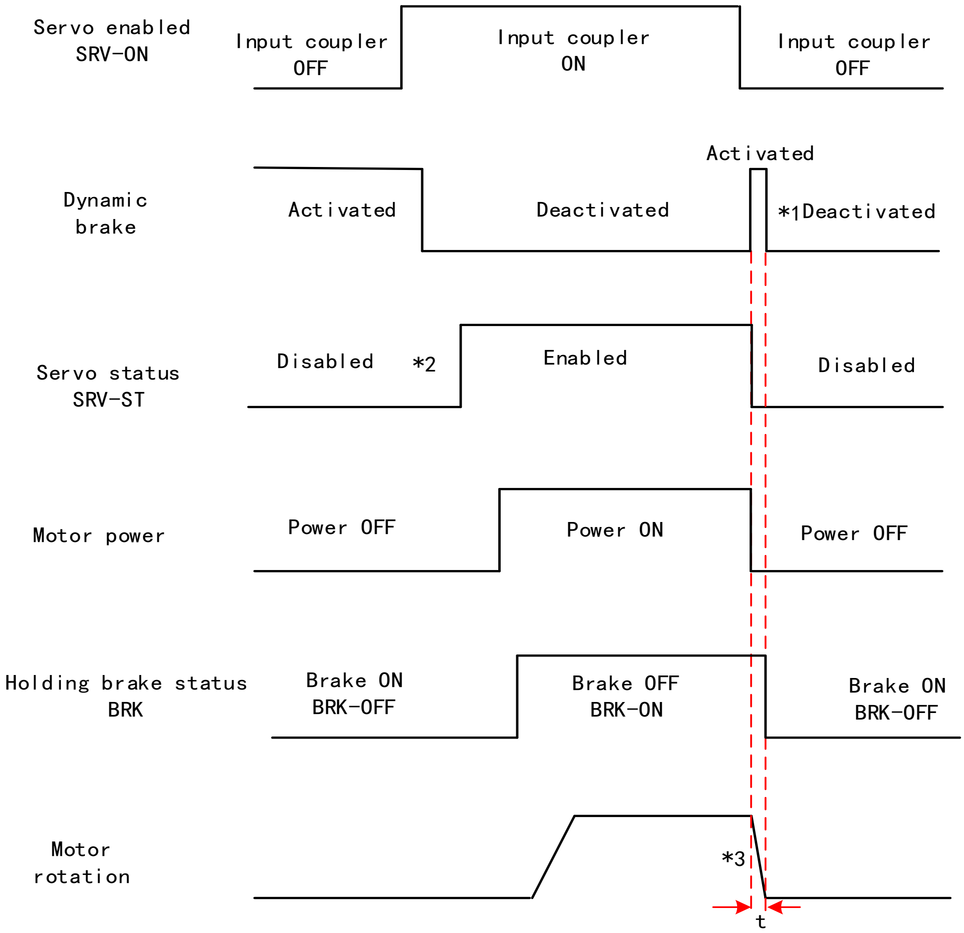
Servo stopping method. Status after stopping: free moving(P05.06 = 3/4/5)



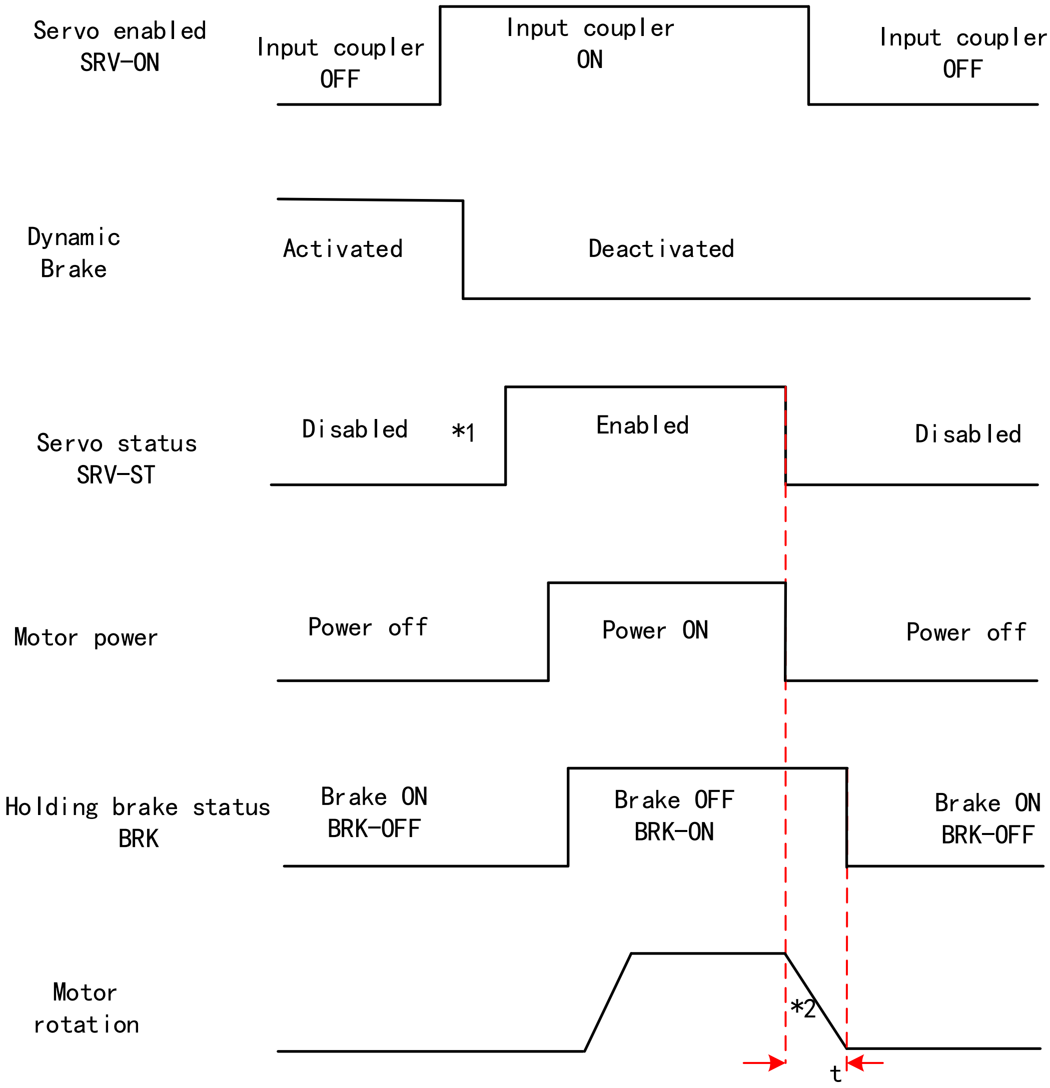
Free stopping method. Status after stopping: Free moving (P00.30 = 6)



Dynamic braking method. Status after stopping: Free moving (P05.06 = 7)



Free stoping method. Status after stopping: Free moving (P05.06 = 8)



*** 1. Status after stopping is as defined in P05.06.*

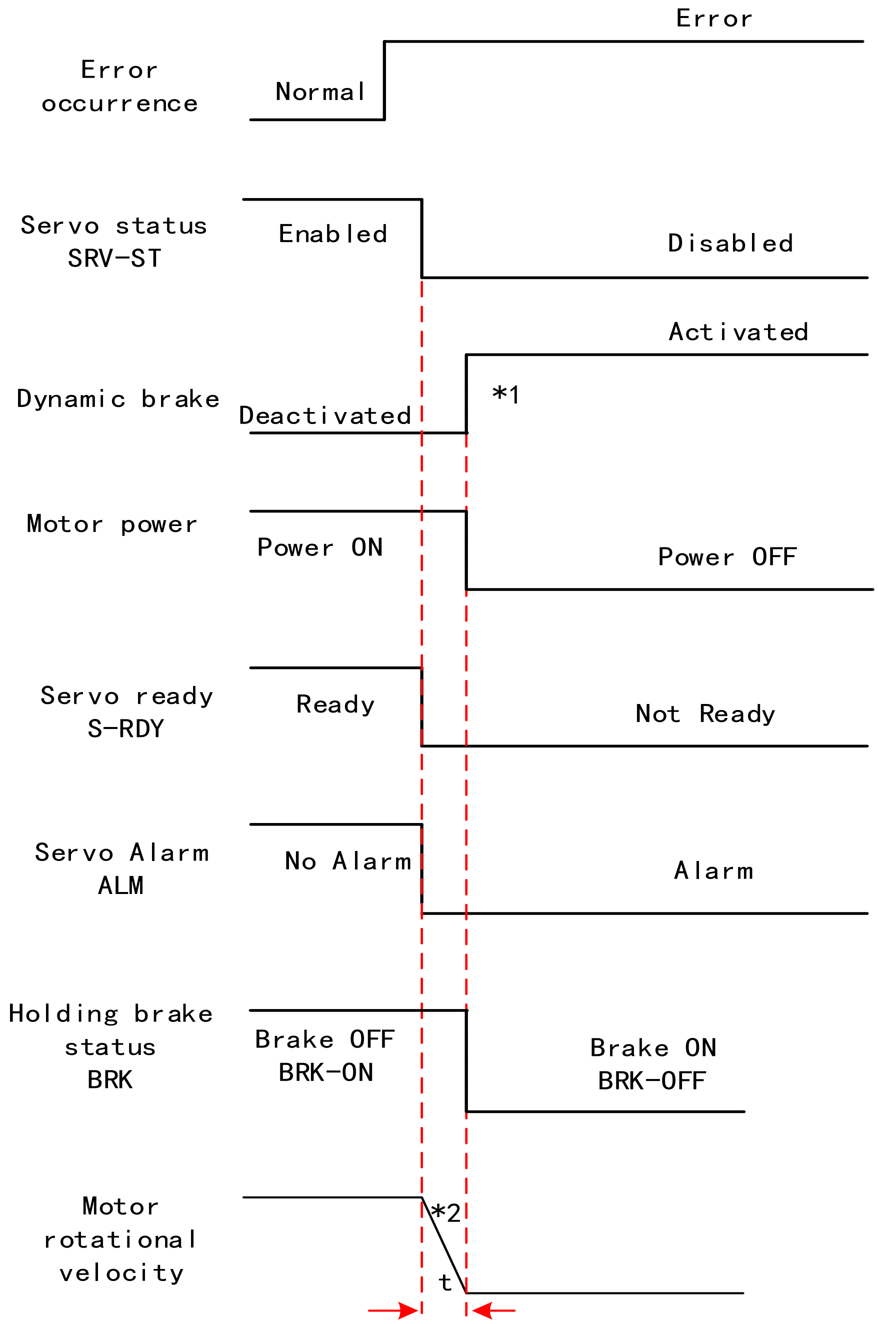
2. SRV-ST signal is received when servo driver is enabled. Command input is not allowed yet.

3. Servo stopping method is as defined in P05.06; braking torque in opposite direction to decelerate the motor is as defined in P05.11. Deceleration time t is determined by whichever comes first between time set in P06.14 and time needed for motor to drop below velocity set in P04.39. After deceleration time t, dynamic braking will be off and holding brake signal will be set to OFF (Holding brake is activated. Although BRK-OFF signal is valid, actual activation of holding brake is dependent on whether the motor comes with holding brake).

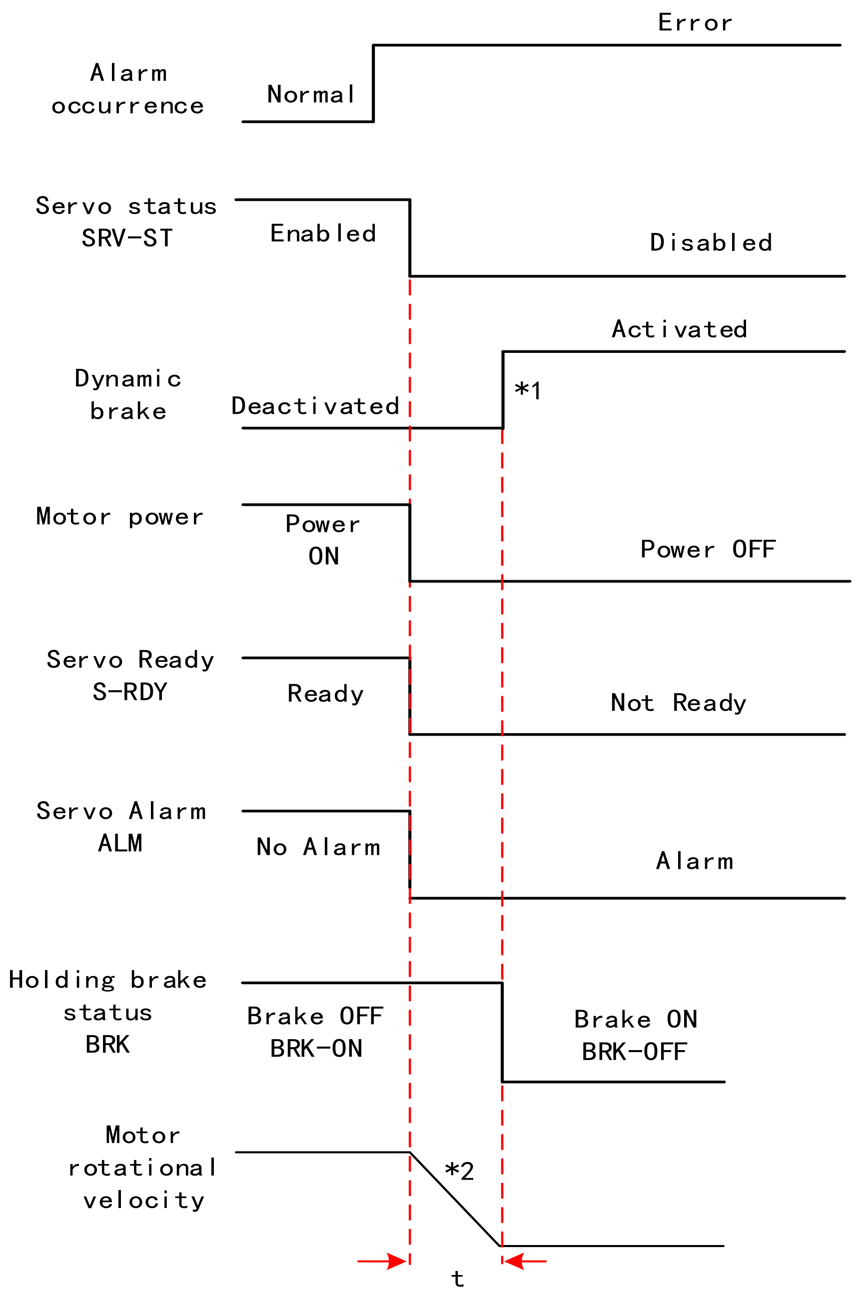
4. BRK-ON signal doesn't indicate the activation of holding brake but the validation of the signal. Holding brake is not applied when BRK-ON signal is valid. Same idea goes for BRK-OFF signal.

Stopping when alarm occurs – Sequence Diagram

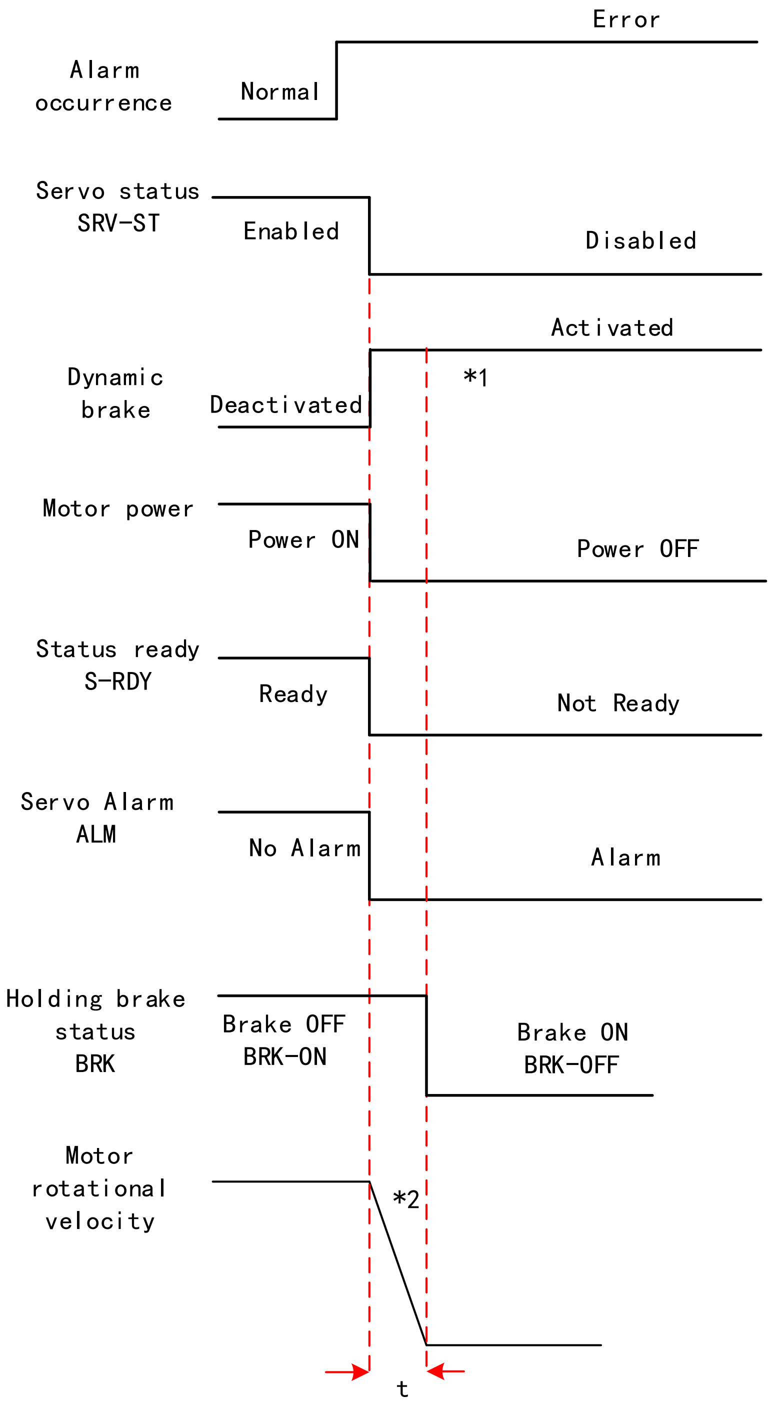
Servo braking method. Status after stopping: Dynamic braking



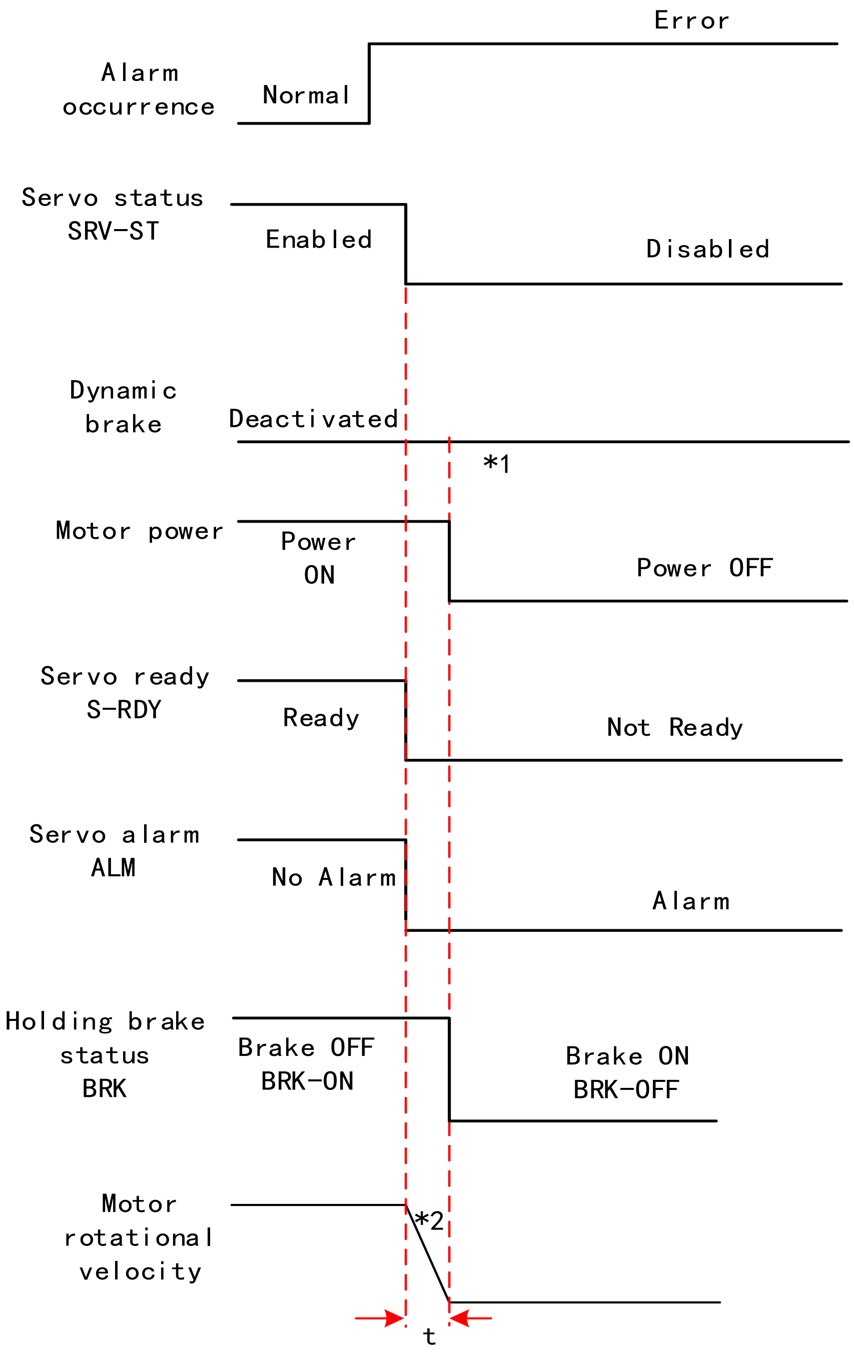
Free stopping method. Status after stopping: Dynamic braking



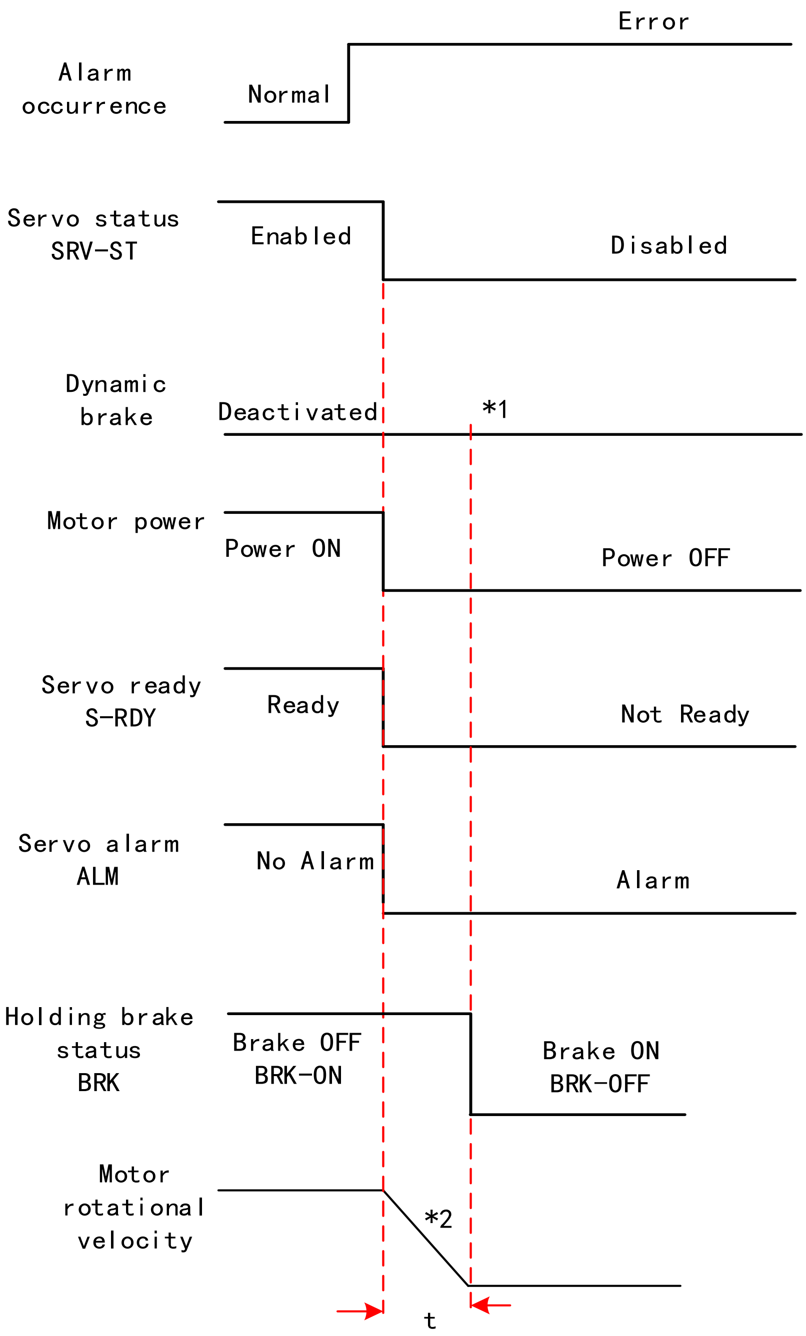
Dynamic braking method. Status after stopping: Dynamic braking



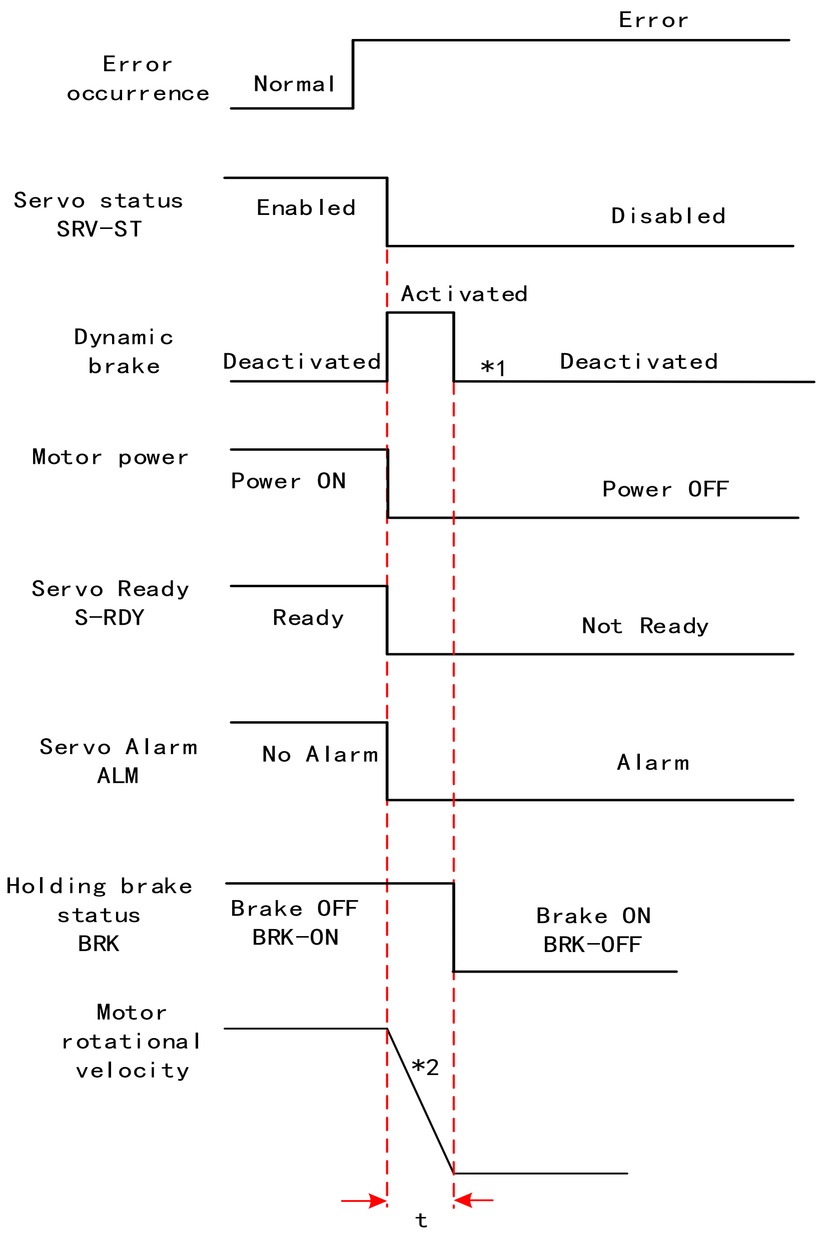
Servo braking method. Status after stopping: Free moving



Free stopping method. Status after stopping: Free moving



Dynamic braking. Status after stopping: Free moving

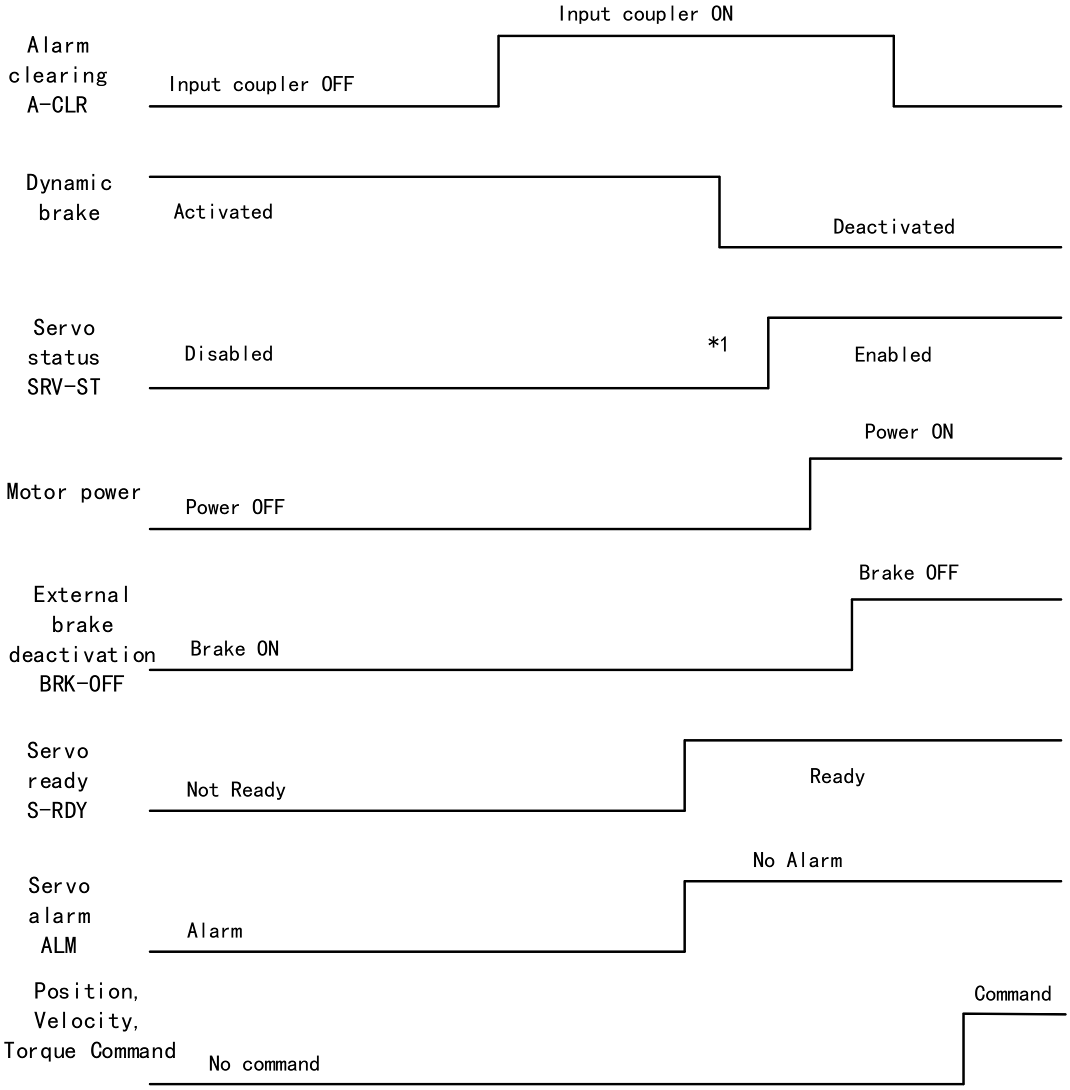


*** 1. Status after stopping is as defined in P05.10.*

2. Servo stopping method is as defined in P05.10. Deceleration time t is determined by whichever comes first between time set in P06.14 and time needed for motor to drop below velocity set in P04.39. After deceleration time t, dynamic braking will be off and holding brake signal will be set to OFF (Holding brake is activated. Although BRK-OFF signal is valid, actual activation of holding brake is dependent on whether the motor comes with holding brake).

3. BRK-ON signal doesn't indicate the activation of holding brake but the invalidation of the signal. Holding brake is not applied when BRK-ON signal is valid. Same idea goes for BRK-OFF signal.

Alarm clearing - Sequence diagram



*** 1.SRV-ST signal is received when servo driver is enabled. Command input is not allowed yet*

2. BRK-OFF signal doesn't indicate the deactivation of holding brake but the invalidation of the signal. Holding brake is applied when BRK-OFF signal is invalid.

4.2 Electronic gear ratio

When loaded axis moved for 1 command unit, it corresponds to motor encoder unit which is converted in more comprehensible physical units such as µm. The use of electronic gear ratio is to turn the movement in physical units to required pulse count equivalency.

Electronic gear ratio = $\frac{\text{Rotor movement (Encoder unit)}}{\text{Loaded axis movement(Command unit)}}$

Rotor might be connected to load through reducer or other mechanical structures. Hence, the gear ratio is closely related to reducer gear ratio, position encoder resolution and mechanical dimensions related parameters.

Electronic gear ratio = $\frac{\text{Encoder resolution}}{\text{Loaded axis resolution}}$

Electronic gear can be set through P00.08. If P00.08 $\neq$ 0, P00.08 is valid. If P00.08 = 0, object dictionary 6092-01 is valid.
Command pulse count per motor revolution needs to be $\geq$ Encoder Pulse Count per Revolution / 8000.

EL7-ECS series comes with motors with 23-bit encoder. Pulse count per revolution for 23-bit encoder = 8388608. From the condition above, the command pulse count per motor revolution for 23-bit encoder $\geqslant$ 1049.

<table>
<tr><td rowspan="3">P00.08</td><td>Label</td><td colspan="2">Command pulse count per revolution</td><td>Mode</td><td colspan="4">F</td></tr>
<tr><td>Range</td><td colspan="2">0~8388608</td><td>Default</td><td>0</td><td>Unit</td><td colspan="2">P-</td></tr>
<tr><td>Activation</td><td colspan="4">After restart</td><td>Index</td><td colspan="2">2008h</td></tr>
<tr><td></td><td colspan="8">Pulses per revolution can be set using object dictionary 608F, 6091, 6092. However, P00.08 has higher priority.</td></tr>
<tr><td rowspan="3">Index 608Fh-01</td><td>Label</td><td colspan="3">Encoder Increments</td><td>Mode</td><td colspan="3">PT</td></tr>
<tr><td>Range</td><td colspan="3">0~2147483647</td><td>Default</td><td>0</td><td>Unit</td><td>encoder</td></tr>
<tr><td>Structure</td><td>VAR</td><td>Type</td><td>UINT32</td><td>Mapping</td><td>TPDO</td><td>Access</td><td>RO</td></tr>
<tr><td></td><td colspan="8">To set encoder resolution</td></tr>
<tr><td rowspan="3">Index 6091h-01</td><td>Label</td><td colspan="3">Motor Revolutions</td><td>Mode</td><td colspan="3">F</td></tr>
<tr><td>Range</td><td colspan="3">1~2147483647</td><td>Default</td><td>1</td><td>Unit</td><td>r</td></tr>
<tr><td>Structure</td><td>VAR</td><td>Type</td><td>UINT32</td><td>Mapping</td><td>RPDO</td><td>Access</td><td>RW</td></tr>
<tr><td></td><td colspan="8">To set electronic gear ratio numerator</td></tr>
<tr><td rowspan="3">Index 6091h-02</td><td>Label</td><td colspan="3">Shaft Revolutions</td><td>Mode</td><td colspan="3">F</td></tr>
<tr><td>Range</td><td colspan="3">1~2147483647</td><td>Default</td><td>1</td><td>Unit</td><td>r</td></tr>
<tr><td>Structure</td><td>VAR</td><td>Type</td><td>UINT32</td><td>Mapping</td><td>RPDO</td><td>Access</td><td>RW</td></tr>
</table>

	To set electronic gear ratio denominator							
Index 6092h-01	**Label**	Feed			**Mode**	F		
	Range	1~2147483647			**Default**	10000	**Unit**	*Command*/r
	Structure	VAR	**Type**	UINT32	**Mapping**	RPDO	**Access**	RW
	If 6092h-01(Feed constant) is not equal to 608Fh(Position encoder resolution), then: Electronic gear ratio = Encoder increments / 6092h-01 If 6092h-01(Feed constant) is equal to 608Fh(Position encoder resolution), then: Electronic gear ratio = 6091-01 / 6092h-01							

4.3 Front Panel

Servo Driver front panel consists of 5 push buttons and a 5-segments display. Can be used for displaying of status, alarms, functions, parameters setting and auxiliary functions.

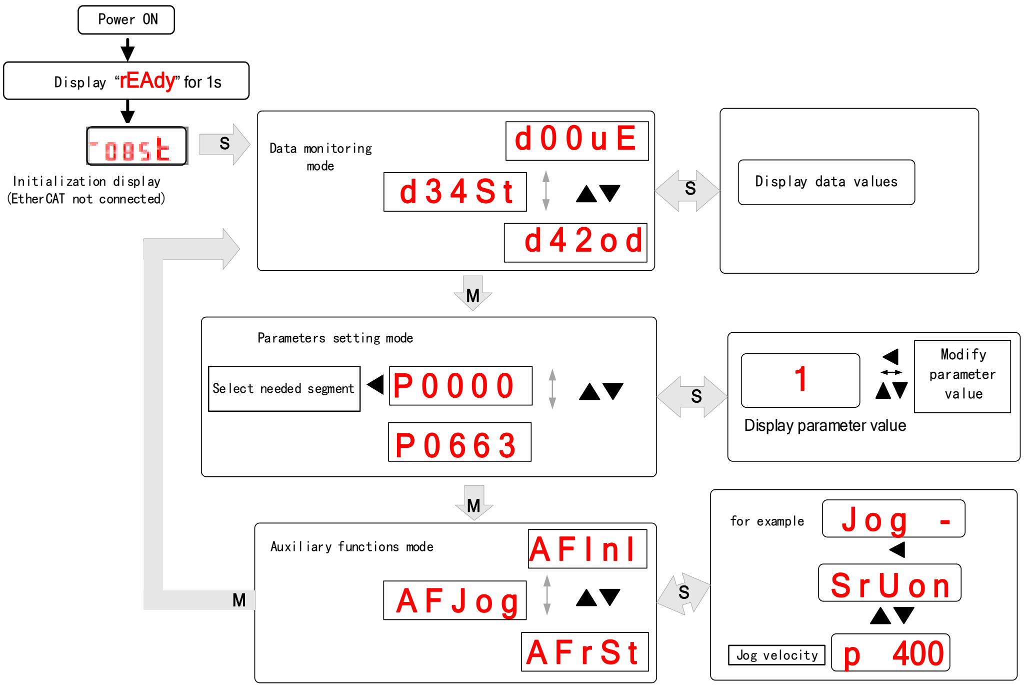
Front panel

Buttons and functions

Label	Symbol	Function
Display	/	Consists of 5 push buttons
Mode	M	To switch between 4 modes: 1. Data monitoring mode : To monitor changes of motion data values 2. Parameters setting mode : To set parameters 3. Auxiliary functions mode: To operate common functions, such as trial run, alarm clearing
Enter(set)	S	To enter or confirm
Up	▲	To switch between sub-menus / Increase
Down	▼	To switch between sub-menus / Decrease
Left	◀	To switch between values

4.4 Panel Display and Operation

4.4.1 Panel Operation



Flow diagram of panel operation

(1) rEAdY will be displayed for about 1 second after driver is powered on. Then, automatically enters data monitoring mode and displays initial data value. Otherwise, alarm code will be displayed if error occurs.

(2) Press **M** key to switch between modes.

Data monitoring mode → Parameters setting mode → Auxiliary functions mode

Alarm code will be displayed regardless of any mode if alarm occurs. Press **M** to switch to other modes.

(3) Press ▲ or ▼ to select the type of parameters in data monitoring mode. Press **S** to confirm.

(4) Press ◀ to select current segment in parameters settings mode. Press ▲ or ▼ to increase/decrease the value of segment. Press **S** to confirm the modified value(s) and save the parameters.

4.4.2 Data Monitoring Mode

EL7 series servo driver offers the function to monitor different types of data in data monitoring mode. After entering this mode, press S to monitor any data that starts with d. Press S again to get back to data monitoring mode and M to switch to any other modes.

Data list in data monitoring mode

No.	Label	Descriptions	Display	Unit	Data Format (x = numerical value)
0	d00	Position command deviation	d00	pulse	“xxx”
1	d01	Motor velocity	d01	r/min	“r xxx”
2	d02	Position control command velocity	d02	r/min	“xxx”
3	d03	Velocity control command velocity	d03	r/min	“xxx”
4	d04	Actual feedback torque	d04	%	“xxx”
5	d05	Feedback pulse sum	d05	pulse	“xxx”
6	d06	Command pulse sum	d06	pulse	“xxx”
7	d07	Maximum torque during motion	d07	/	"d xxx" xxx: Maximum torque during operation % "j xxx" xxx: Average load rate %
8	d08	Internal command position sum	d08	pulse	“xxxx”
9	d09	Control mode	d09	/	Position: "Ct Pos" Speed: "Ct Spd" Torque: "Ct Trq"
10	d10	I/O signal status	d10	/	-
11	d11	Internal usage	d11	V	-
12	d12	Error cause and record	d12	/	“Er xxx”
13	d13	Warning	d13	/	“xxx”
14	d14	Regeneration load factor	d14	%	“xxx”
15	d15	Motor overload ratio	d15	%	“xxx”
16	d16	Inertia ratio	d16	%	“xxx”
17	d17	Driver overload ratio	d17	/	“CP xxx”
18	d18	No. of changes in I/O signals	d18	/	“xxx”
19	d19	Single power-on duration	d19	s	“xxx”
20	d20	Cumulative power-on time	d20	h	“xxx”
21	d21	Single turn encoder data	d21	pulse	“xxx”
22	d22	Multiturn encoder data	d22	r	“xxx”
23	d23	Control power voltage	d23	0.1 V	“xxx”
25	d25	Mechanical Angle	d25	0.1°	“xxx”
26	d26	Motor mechanical angle	d26	0.1°	“xxx”
27	d27	Voltage across PN	d27	0.1V	“xxx”

28	d28	Software version	d28	/	"d xxx Servo software" "F xxx Communication software" "h xxx hardware version" "xx CPLD software"
29	d29	Internal usage	d29	/	"xxx"
30	d30	No. of times of encoder communication error	d30	/	"xxx"
32	d32	MCU temperature	d32	℃	"xxx"
33	d33	Driver temperature	d33	℃	"xxx"
34	d34	Servo status	d34	/	
35	d35	Motor temperature	d35	℃	"xxx"
36	d36	DC synchronisation cycle	d36	us	"xxx"

When the drive is powered up, it will display 

To change the power-on display, change P05 28 (LED initial status setting).

Description of data monitoring function

When using the front panel to monitor data, data is divided in low/high bit and positive/negative.

Data is differentiated as below.

. 2 .   6 0 8 8 5

High bit: 1st and 2nd values on the right has two decimal points

Low bit: 1st and 2nd values on the right has no decimal point.

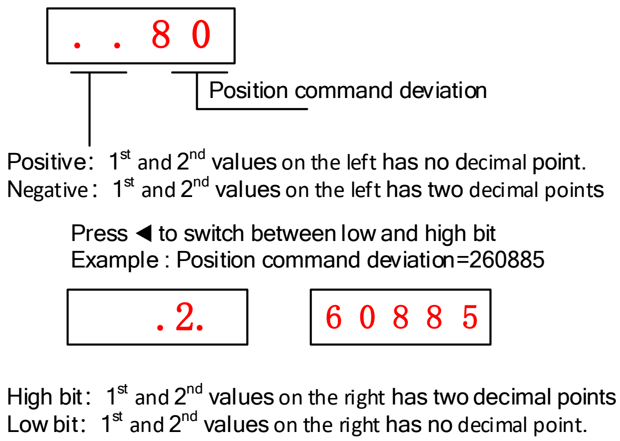
. . 5 0   5 0

Positive: 1st and 2nd values on the left has no decimal point.

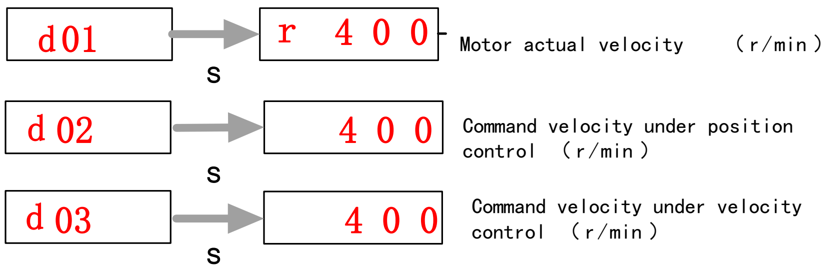
Negative: 1st and 2nd values on the left has two decimal points

1. d00 Position command deviation

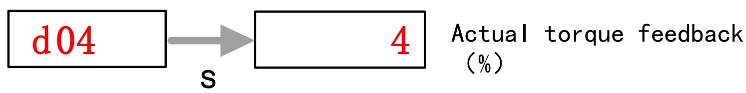
Shows high bit and low bit of position deviation



2. d01 Motor velocity,d02CS Position control command velocity,d03CU Velocity control command velocity



3. d04 Actual torque feedback



4. d05 Feedback pulse sum d06CP Command pulse sum

Feedback pulse sum(Encoder feedback pulse)

d05nP S 10016

Feedback pulse sum
(unit)

Press ◀ to switch between high/low bit
Example: Feedback pulse sum=210016

. 2.　10016

High bit　Low bit

Command pulse sum (Command pulse)

d06CP S 10016

Command pulse sum
(unit)

Press ◀ to switch between high/low bit
Example: Command pulse sum=210017

. 2.　10017

High bit　Low bit

5. d07 Maximum torque during motion

d07 S d 7　Maximum torque during motion (%)

▲ ▼

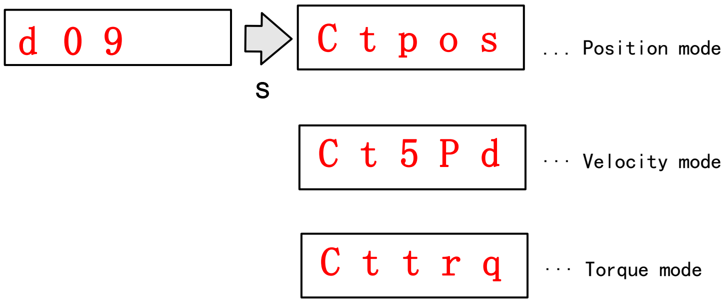
J 7　Average Load Rating (%)

6. d08 Internal command pulse sum

d 0 8 s 2 0

Internal command pulse sum
(pulse)

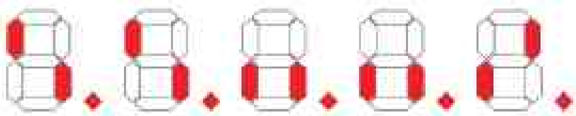
7. d09 Control mode



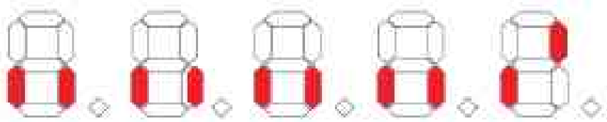
8. d10 I/O signal status

When the top half of the digital tube is lighted, the signal is valid; when the bottom half of the digital tube is lighted, the signal is not valid. Decimal points represent I/O status, input when lighted, output when not lighted.

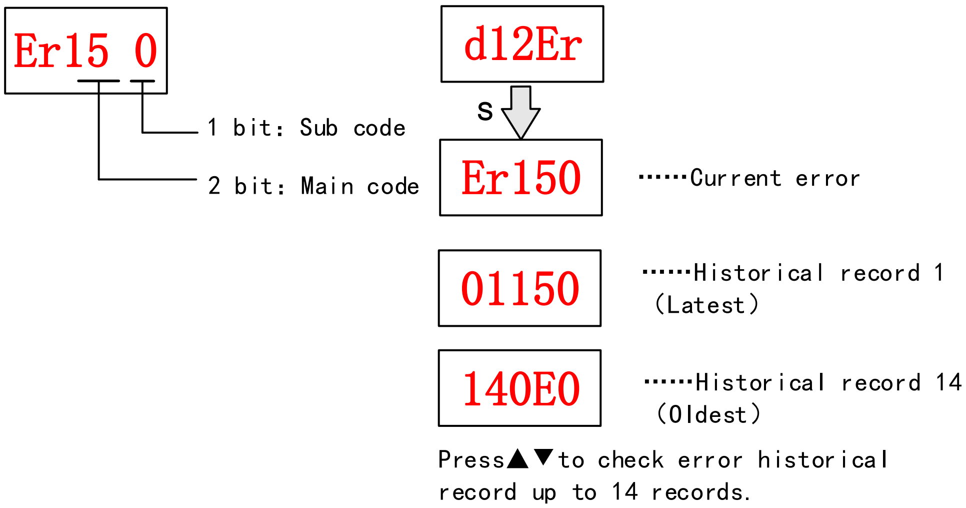
- **Input:** From low to high bit(Right to left) DI1,DI2....DI10. Decimal point is lighted to represent input signals.
  In the example below, DI1, DI8 and DI10 input signal is valid; DI2-DI7, DI9 input signal is invalid.



- **Output:** From low to high bit(Right to left) DO1,DO2....DO10. Decimal point is not lighted to represent output signals.
  In the example below, DO1 output signal is valid; DO2-DO10 output signal is invalid.

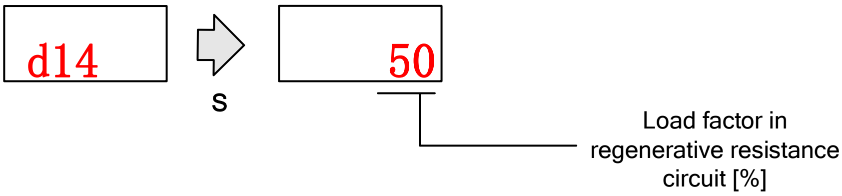


9. d12 Alarm cause and historical record

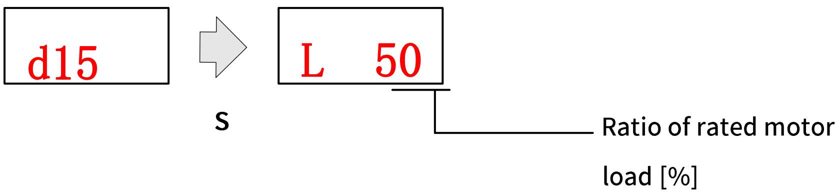


10. d14 Regenerative load factor d15oL Overload factor

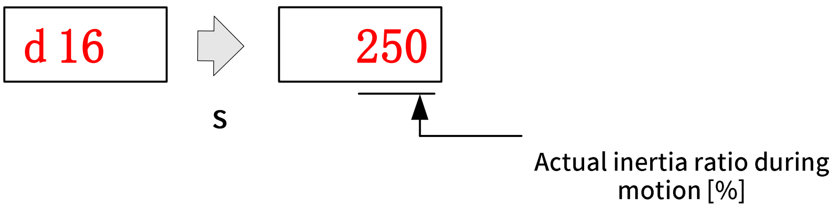
Regenerative load factor（Er120 might occur, if the value increases indefinitely）



Overload factor（Er100 might occur, if the value increases indefinitely）

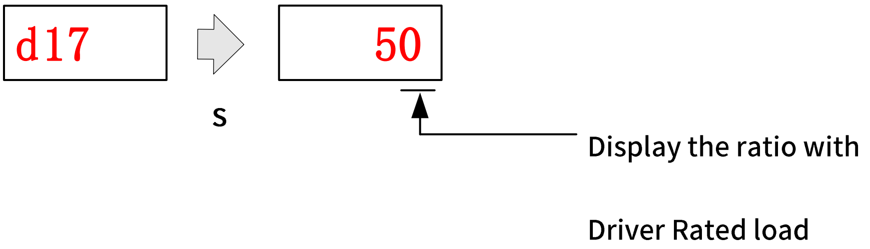


11、d16 Inertia ratio



Please refer to Inertia Measuring section for detailed explanations.

12、d17 Driver overloading ratio



13、d18 Driver overloading ratio

Display DI/DO toggle count.

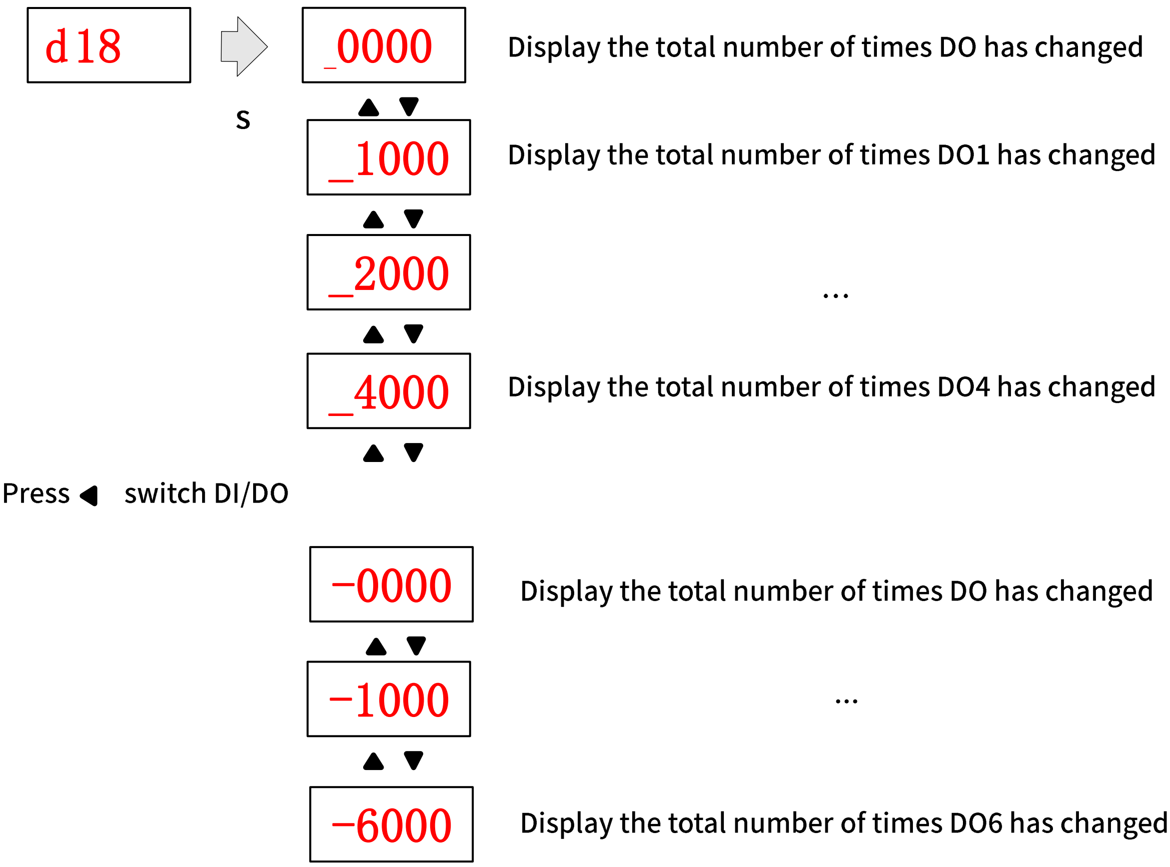
1st digit: Displays DI/DO type

- Shows "_": indicates current display is DO count
- Shows "~": indicates current display is DI count

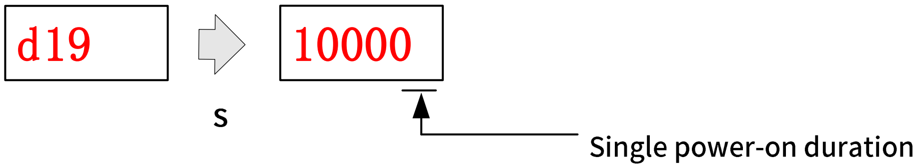
2nd digit: Channel selection

- 0: Displays cumulative toggle count of all DI or DO channels
- x: Displays individual cumulative toggle count of DIx or DOx, x ranges from 1 to 6

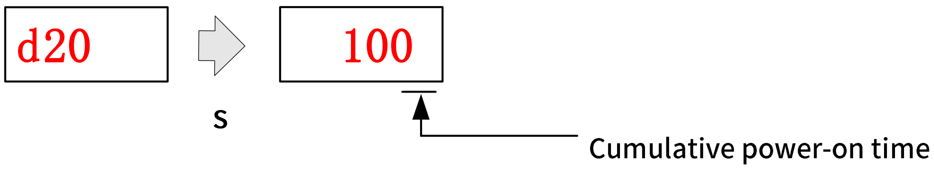
3rd ~ 5th digits: Toggle count value.



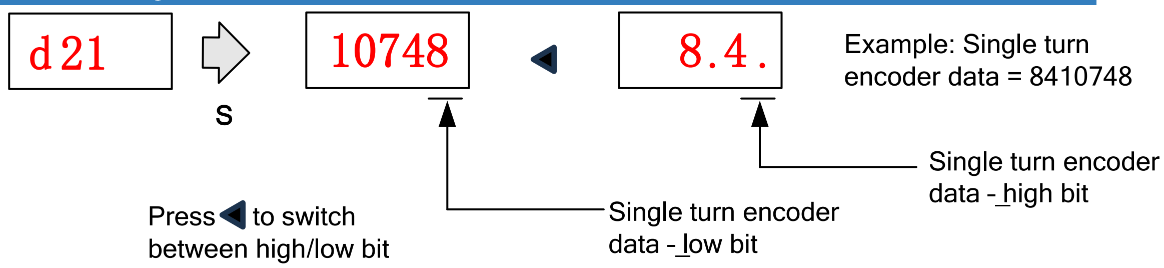
14、d19 Single power-on duration



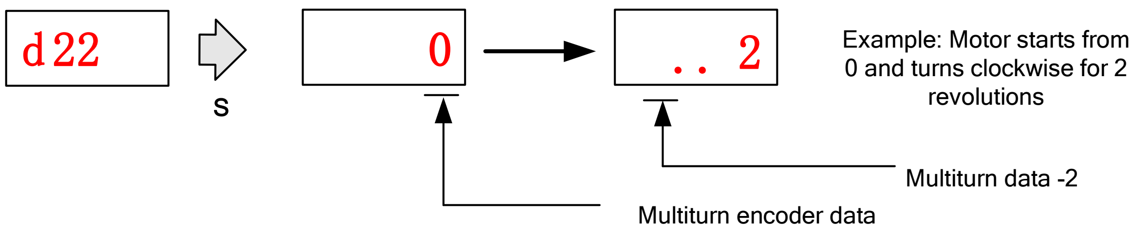
15、d20 Cumulative power-on time



16、d21 Single turn encoder data d22 Multiturn encoder data

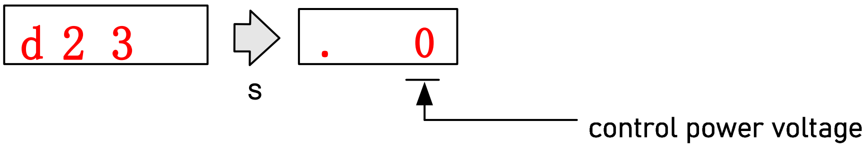


For 23-bit encoder, single turn encoder data = 0~8388607.Each value corresponds to certain position in a single revolution of the rotor, clockwise motion as negative, counter clockwise motion as positive. When counter clockwise single turn data > 8388607, multiturn data +1, clockwise single turn data < 0, multiturn data -1.

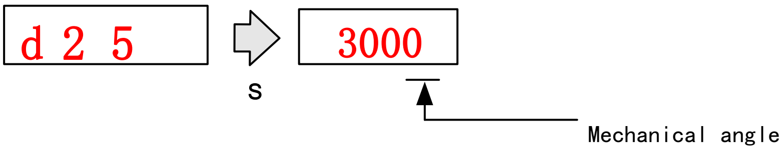


Multiturn encoder data range:-32768~+32767, As no. of revolution goes over range,32767 will jump to -32768、 -32767(counter clockwise)； -32768 will jump to 32767、 32766 (clockwise)

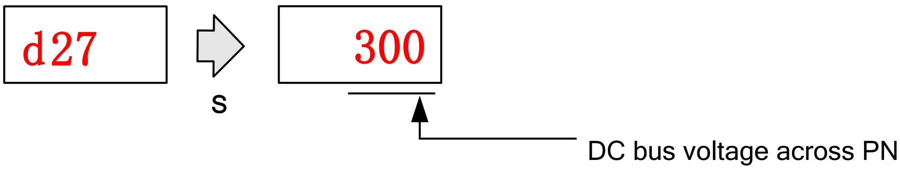
17、d23 control power voltage



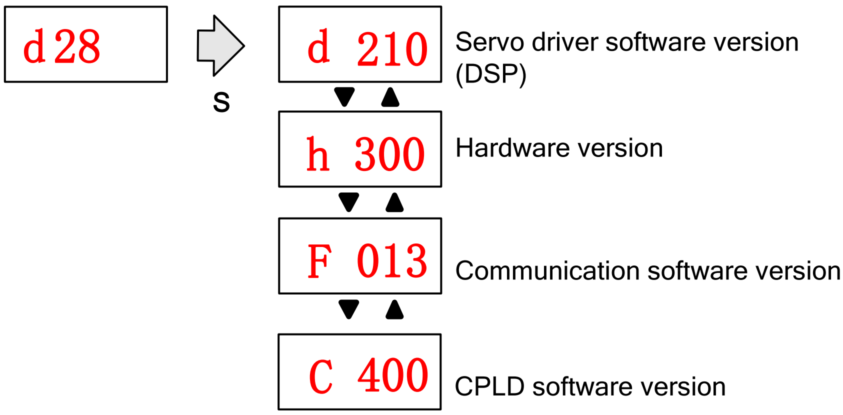
18、d25 Mechanical Angle



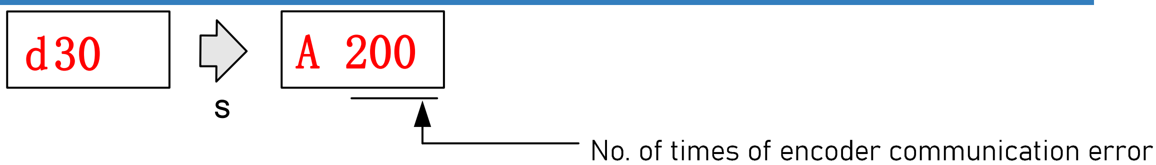
19、d27 DC bus voltage



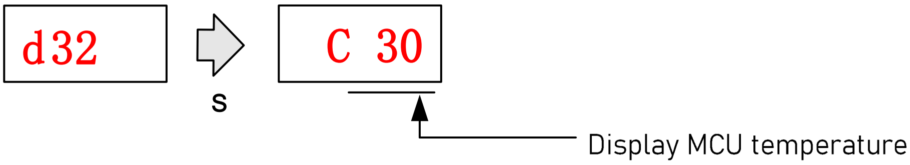
20、d28 Software version



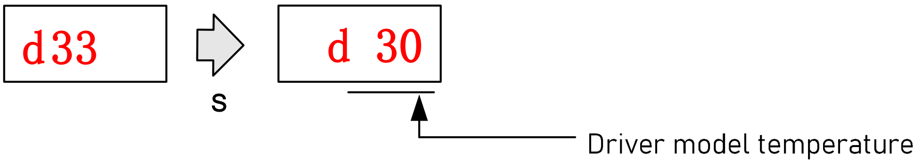
21、d30 No. of times of encoder communication error



22、d32 MCU temperature

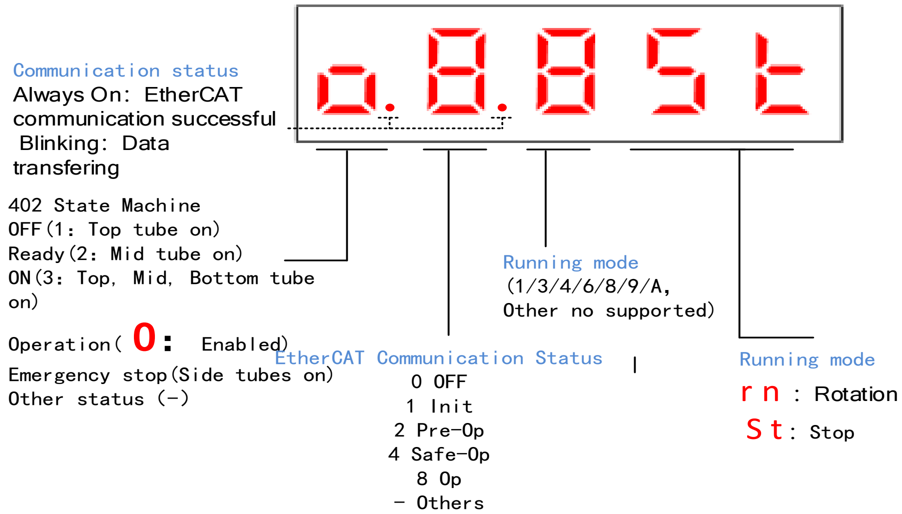


23、d33 Driver model temperature

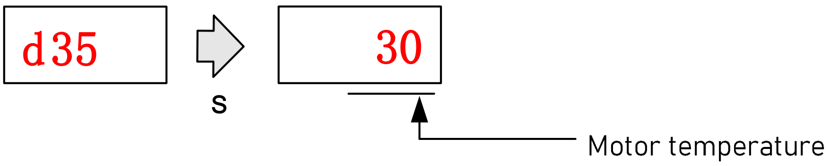


24、d34 Servo driver status display

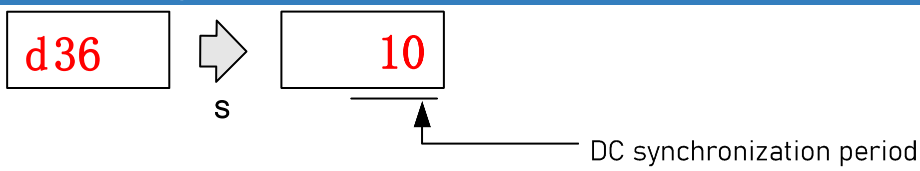
Driver status: 402 state machine, EtherCAT communication, running mode, running



25、d35 Motor temperature

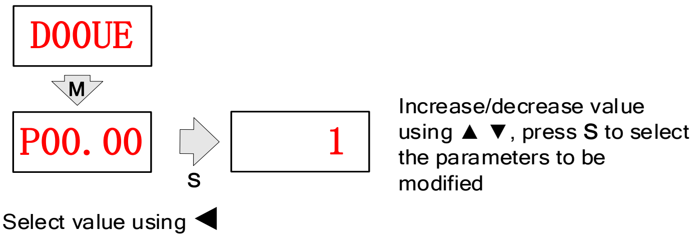


26、d36 DC Synchronization Period



Display setting at power on

Please refer to P00.43 for any display content required on the front panel during initialization



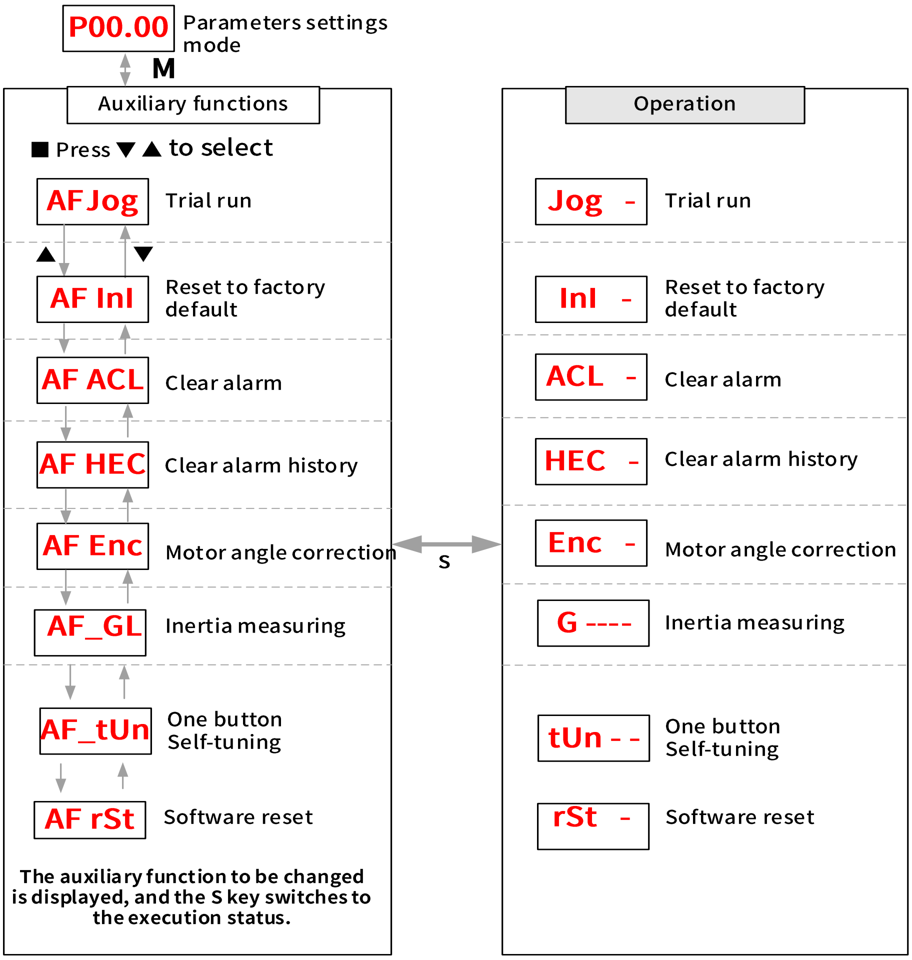
If you have changed a parameter but have not pressed the S key to confirm the change, you can press 'M' to exit the change if you do not want to change the parameter. After modifying the parameters, some parameters need to be powered up to take effect, we need to re-power up to make the parameters take effect.

P00.43	Label	LED Initial Status	Mode	F		
	Range	0~38	Default	34	Unit	-
	Activation	After restart	Attribute	RW	Index	2000-2Ch

To set content display on front panel of the servo driver at servo driver power on.

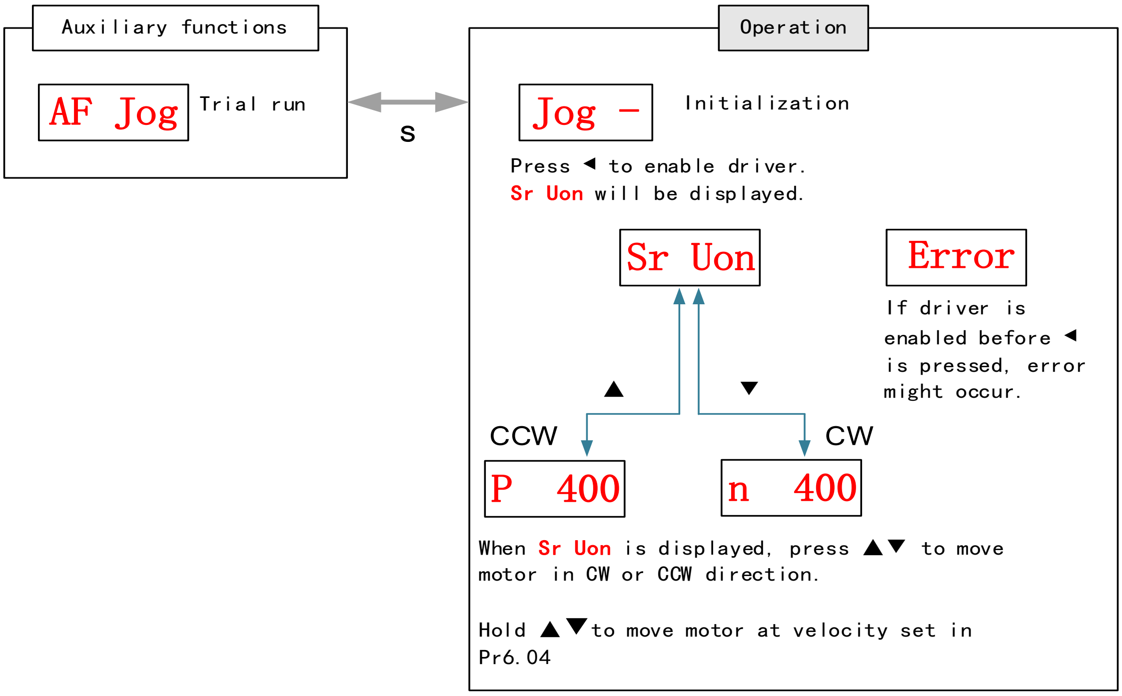
Set value	Content	Set value	Content	Set value	Content
0	Position command deviation	14	Regenerative load rate	27	Voltage across Bus
1	Motor speed	15	Motor overload rate	28	Software version
2	Position command velocity	16	Inertia ratio	30	No. of encoder communication error
3	Velocity control command	17	Driver overload rate	32	MCU temperature
4	Actual feedback torque	18	No. of changes in I/O signals	33	Driver temperature
5	Position feedback	19	Time per power-up	34	Servo status
6	Position command	20	Power on total time	35	Motor temperature
7	Maximum torque during motion	21	Single turn position	36	Synchronous period
8	Input commend pulse frequency	22	Multiturn position		
9	Control mode	23	Communication axis address		
10	DI/DO signal status	24	Encoder position deviation		
12	Error cause and history record	25	Motor electrical angle		
13	Driver power	26	Motor mechanical angle		

4.4.4 Auxiliary functions



AF jog Trial run

Please disable servo driver before performing any trial run. Please don't modify gain related parameters during trial run to prevent any occurrence of mechanical vibrations. Press S to exit trial run.



Trial run JOG pointing control specific operation procedure:

(1)Firstly, set all the parameters corresponding to the pointing control;

(2)After writing successfully, restart the drive after power failure, and make sure the drive is in the non-enable state, so that it can enter the JOG control.

(3) Enter the 'AFJog' submenu under the auxiliary function mode;

(4)Press the SET key once, then 'Jog -' should be displayed;

(5)Press the key once, if there is no abnormality, then 'srUon' should be displayed; if it is 'Error', press the key again once, then 'srUon' should be displayed;

If 'Error' is still displayed, please switch to 'd17Ch' sub-menu under data monitoring mode to find out the reason why the motor does not rotate, and try again after troubleshooting;

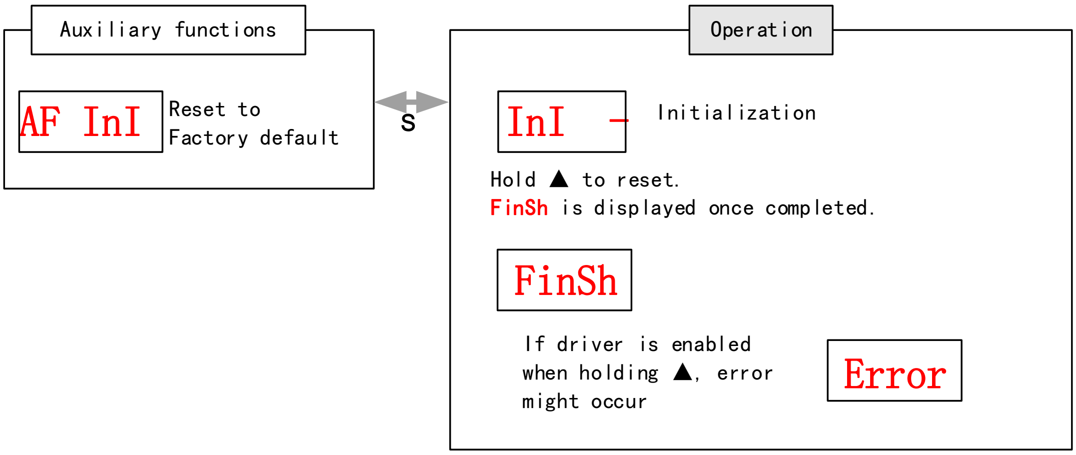
(6)If it is in position JOG mode, under the premise of displaying 'srUon', pressing and holding down the key will make the motor speed increase all the way up to the maximum speed set in P06.04 and continue to run in the forward direction, and then release the key to decelerate and stop at once, and then 'srUon' should be displayed. Similarly, holding down the key will increase the motor speed all the way up to the maximum speed set in P06.04 and continue in reverse. Release the key to stop deceleration Immediately and 'srUon' should be displayed;

If the motor does not rotate, switch to the 'd17Ch' sub-menu in the data monitoring mode to find out why the motor does not rotate, and try again after troubleshooting;

(7) During the JOG test run, press the SET key to exit the JOG control.

AF Inl Reset to factory default

To reset parameters settings to factory default. Can be used to reset parameters using auxiliary function on front panel or using object dictionary.

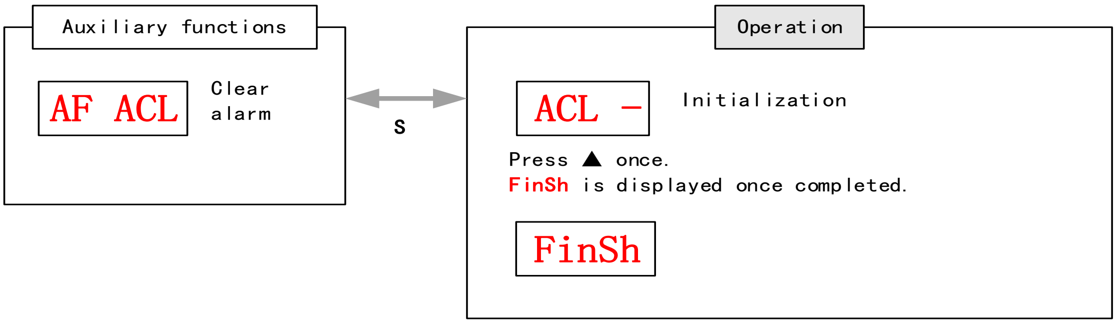


Reset to factory default using object dictionary

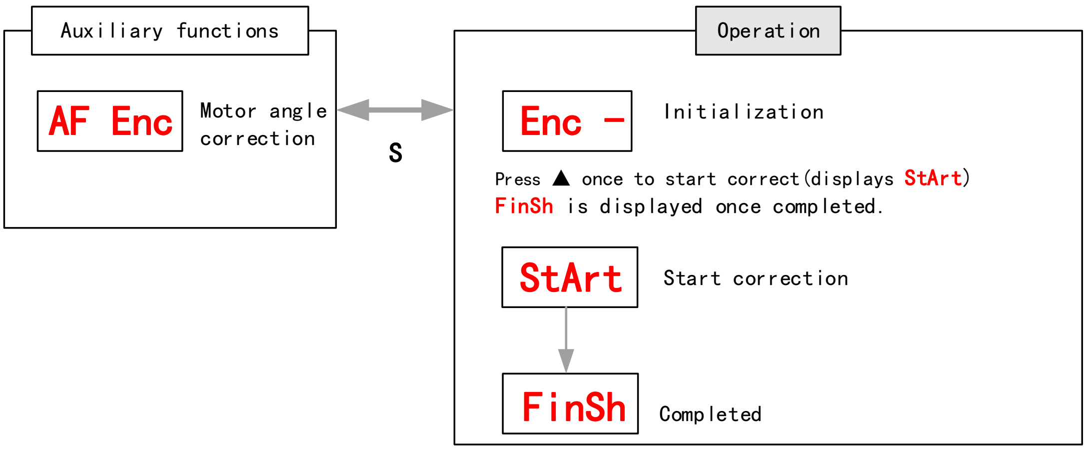
Object dictionary	Parameters to reset	Method
0x1011-01	All parameters	Controller can reset all parameters using 0x1011-01. If driver receives the data of 0x1011-01 as 0x64616f6c, all parameters will be reset to factory default and 1011-01=1 after saving.
0x1011-02	Communication parameters	Controller can reset communication parameters using 0x1011-02. If driver receives the data of 0x1011-02 as 0x64616f6c, communication parameters will be reset to factory default and 1011-02=1 after saving.
0x1011-03	402 parameters	Controller can reset 402 parameters using 0x1011-03. If driver receives the data of 0x1011-03 as 0x64616f6c, 402 parameters will be reset to factory default and 1011-03=1 after saving.
0x1011-04	Drivers' supplier parameters	Controller can reset drivers' supplier parameters using 0x1011-04. If driver receives the data of 0x1011-04 as 0x64616f6c, drivers' supplier parameters will be reset to factory default and 1011-04=1 after saving.

AF ACL Clear alarm

Alarms can be cleared by the **AFACL** alarm clearing function in the auxiliary functions. Other than that, alarms need to be cleared by removing the cause of the error and reconnecting the power supply.

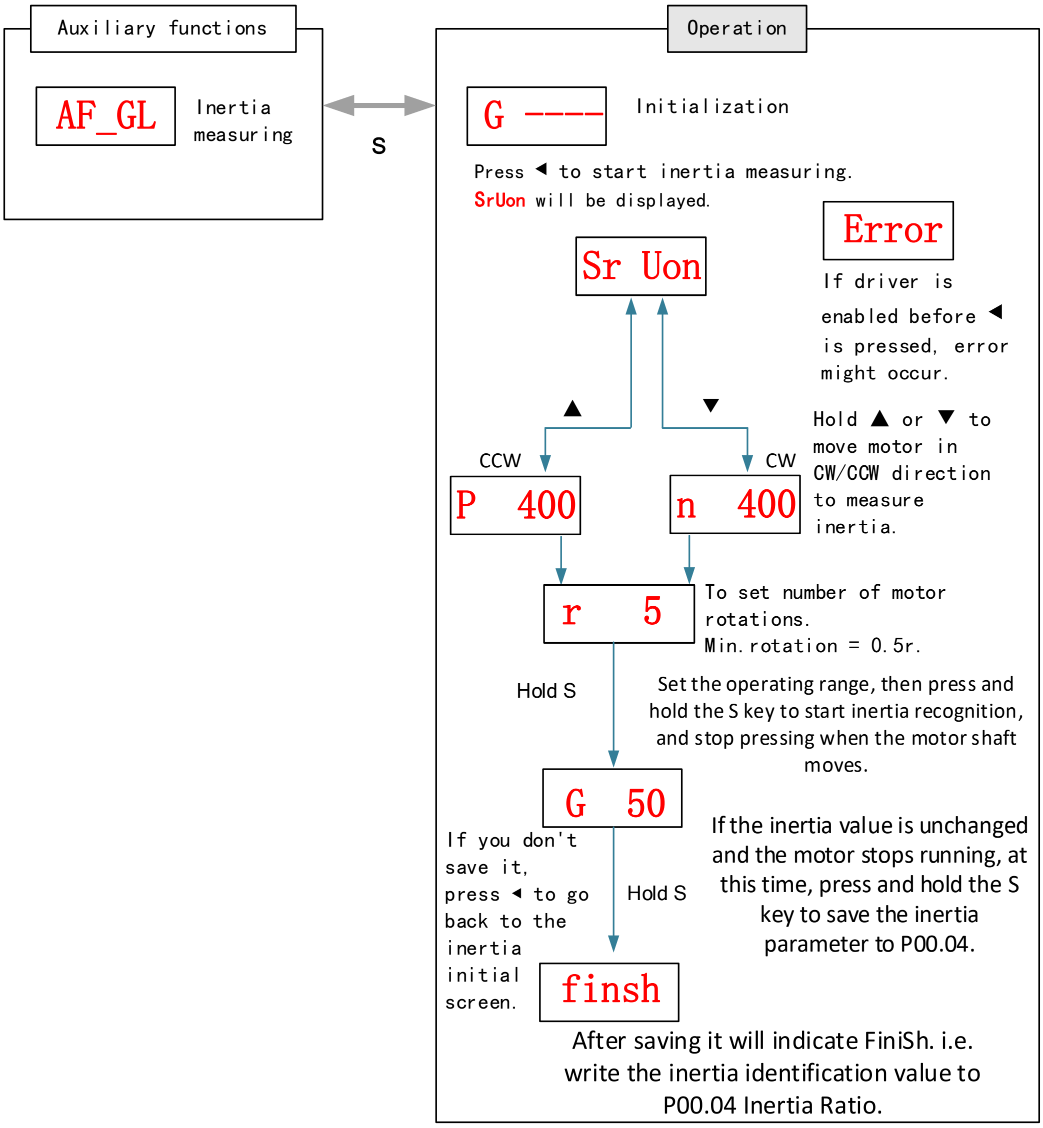


AF Enc Motor angle correction



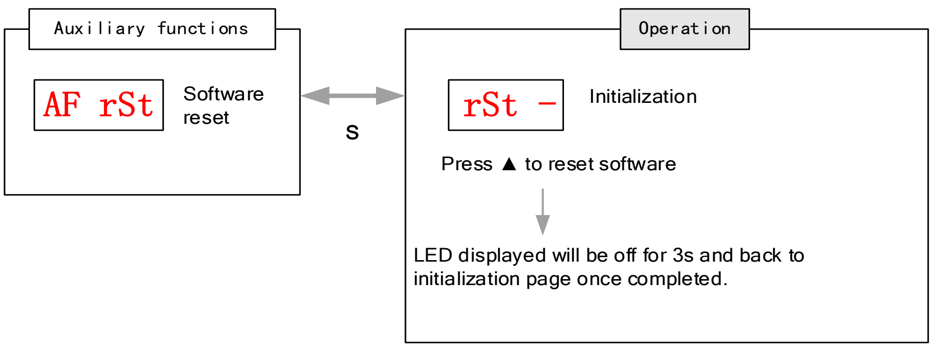
AF_GL Inertia measuring

Please make sure to use suitable velocity and acceleration for the measuring process. Press S to exit and disable the driver once completed.



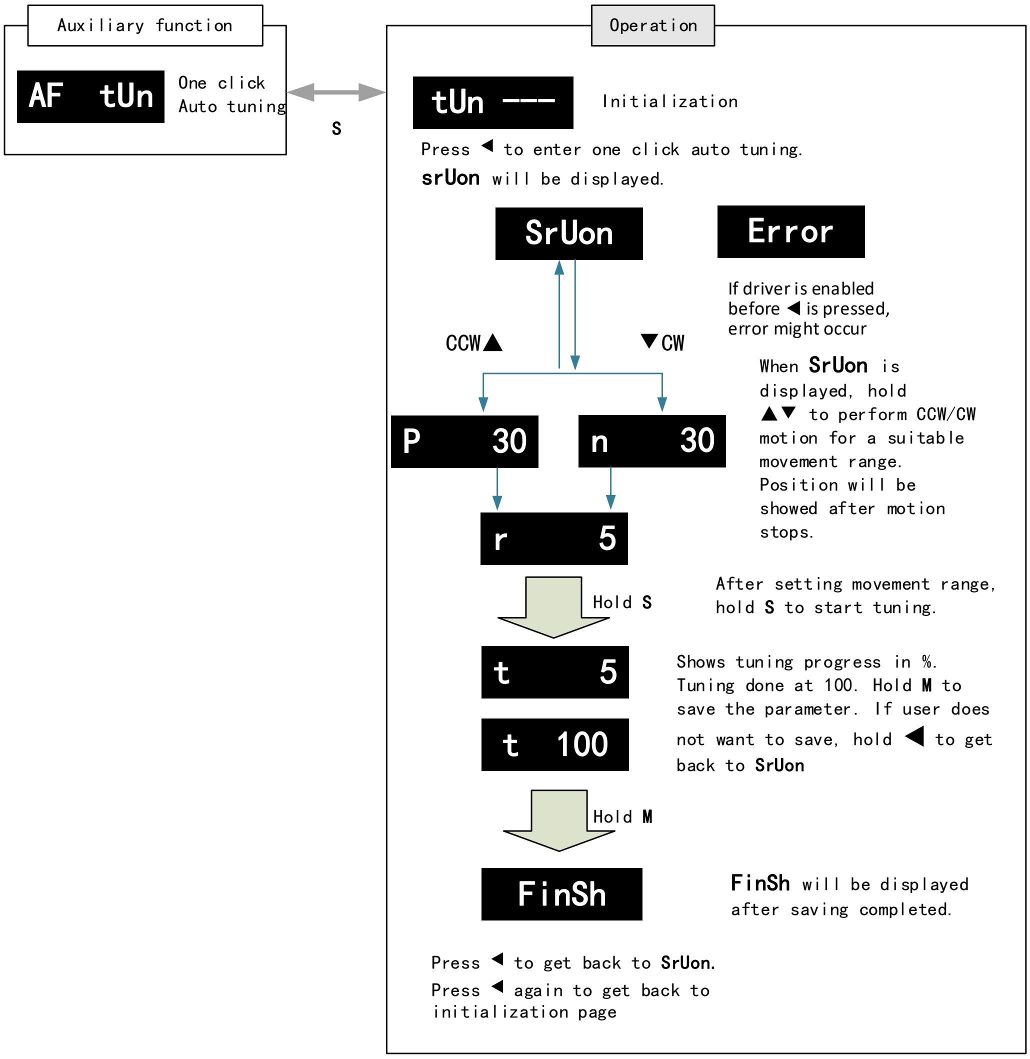
AF rSt Software reset

Software reset is used mainly on parameters modification that takes effect only after driver restart.



AF_tun One click auto tuning

One click auto tuning can be applied by operating the front panel. Set simple movement range and movement range has to be more than 0.5 motor revolution.



Chapter 5 Control Mode

5.1 EL7-ECS motion control step-by-step

A. EtherCAT master device sends "control word (6040h)" to initialize the drive.

B. Driver sends feedback "status word (6041h)" to the master device to indicate ready status (status word indication).

C. Master device sends enable command (control word switch).

D. The driver enables and sends feedback status to the master device.

E. The master station sends homing command to home the axis. (Homing parameter and control word switch)

F. Driver returns to home and sends feedback homed status to master device (status word indication)

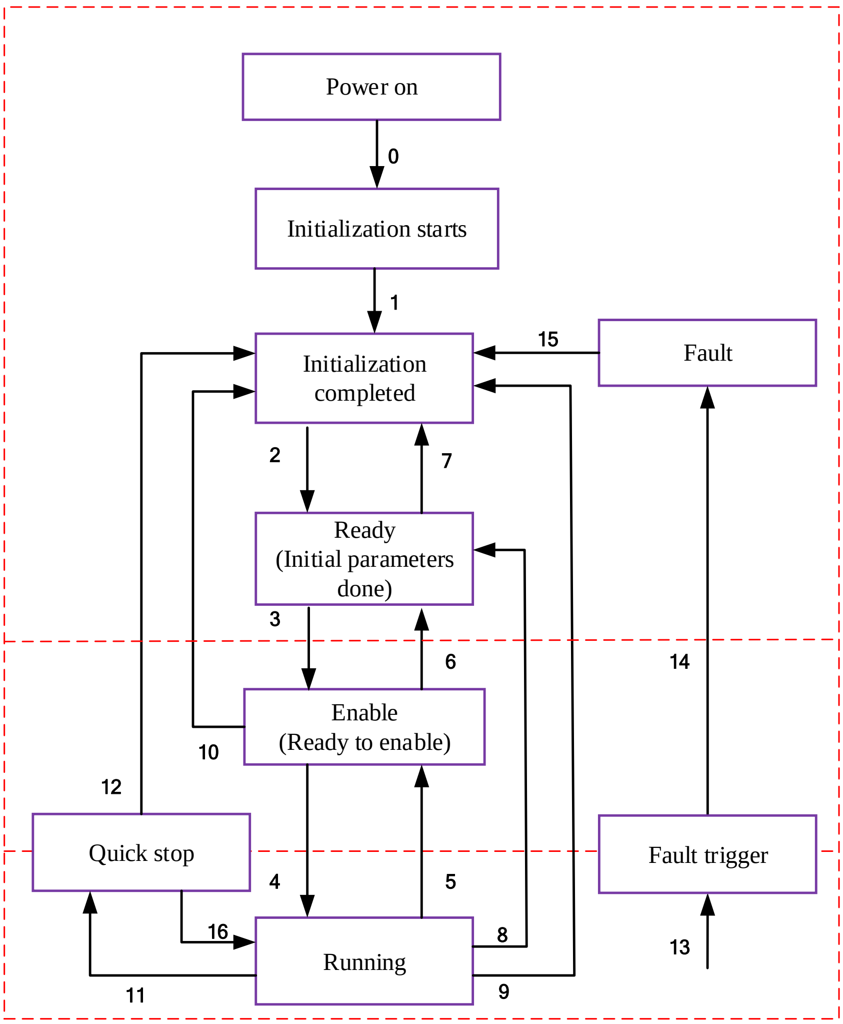
G. The master station sends the position mode command for position movement (position motion parameters and control word switch) or sends the velocity command for velocity movement (velocity motion parameters and control word switch).

H. When the drive is finished executing the command (position command), EL7-ECS feedbacks the position/velocity to the master device for monitoring during the motion.

I. The master device sends commands for the next motion.

5.2 CiA 402 State Machine

State machine switchover diagram



Control Circuit	Main Power	Enable Disable
ON	OFF	Disable
ON	ON	Disable
ON	ON	Enable

Figure 5.1 EL7-ECS 402 State Machine switchover diagram

Table 5.1 Status description

Status	Description
Initialization starts	Driver powered on, initialization starts; Holding brake activated; Axis disabled
Initialization done	Initialization done; Parameters initialize, faultless; Axis disabled.
Ready	Parameter initialization done; Axis disabled.
Enable	Servo driver is ready to be enabled.
Running	Driver enabled, faultless
Quick stop	Quick stop activated
Fault triggered	Alarm not solved yet; Axis disabled.
Fault	Alarm solved. Waiting to switch from 402 state machine to Initialization starts; Axis disabled.

402 state machine switching is dependent on master device controlled servo driver control word (6040h)

CiA402 status switching		Control word 6040h	Status word 6041h Bit1-Bit9
0	Power on→ Initialization	Transit automatically	0x0000
1	Initialization→ Faultless	Transit automatically, Enter 13 if fault occurs	0x0250
2	Faultless--→ Ready	0x0006	0x0231
3	Servo ready→ Waiting to enable	0x0007	0x0233
4	Waiting to enable-→ Running	0x000F	0x0237
5	Running→ Waiting to enable	0x0007	0x0233
6	Waiting to enable→ Ready	0x0006	0x0231
7	Ready→ Faultless	0x0000	0x0250
8	Running → Ready	0x0006	0x0231
9	Running-→ Faultless	0x0000	0x0250
10	Waiting to enable → Faultless	0x0000	0x0250
11	Running-→ Quick stop	0x0002	0x0217
12	Quick stop→ Faultless	Transit automatically	0x0250
13	Fault stop	Transit automatically	0x021F
14	Fault stop--→ Fault	Transit automatically	0x0218
15	Fault → Faultless	0x80	0x0250
16	Quick stop--→ Running	0x0F	0x0237

5.3 Driver Control Mode Setting

5.3.1 Supported control mode (6502h)

EL7-ECS supports seven modes, as defined in 6502h.

Bit	31~10	9	8	7	6	5	4	3	2	1	0
Mode	Reserved	CST	CSV	CSP	Reserved	HM	Reserved	PT	PV	Reserved	PP
1:Supported	0	1	1	1	0	1	0	1	1	0	1

Description	Abbr.
Profile position mode	PP
Profile velocity mode	PV
Profile Torque mode	PT
Homing mode	HM
Cyclic synchronous position mode	CSP
Cyclic synchronous velocity mode	CSV
Cyclic synchronous torque mode	CST

5.3.2 Operational mode setting (6060h) and Operational mode display (6061h)

The operation mode of the servo drive is set in 6060h. The operation mode of the servo drive is viewed in 6061h.

Bit	Description	Abbr.
1	Profile position mode	PP
3	Profile velocity mode	PV
4	Profile Torque mode	PT
6	Homing mode	HM
8	Cyclic synchronous position mode	CSP
9	Cyclic synchronous velocity mode	CSV
10	Cyclic synchronous torque mode	CST

5.4 Common Functions for All Modes

5.4.1 Digital input setting and status display

Please refer to chapter 5 for more details on digital I/O input and polarity settings.60FDh object complies with IEC61800-200 standard input I/O status mapping object. 60FDh is set according to function as the table below shows.

Bit31	Bit30	Bit29	Bit28	Bit27	Bit26	Bit25	Bit24
Z signal	Reserved	Reserved	Reserved	Touch Probe 2	Touch Probe 1	BRAKE	6041 Bit10 Arrival Signal V-COIN (Velocity Consistent Output) TLC (Torque Limit)
Bit23	**Bit22**	**Bit21**	**Bit20**	**Bit19**	**Bit18**	**Bit17**	**Bit16**
E-STOP	Reserved	Reserved	Reserved	Reserved	Reserved	DI14	DI13
Bit15	**Bit14**	**Bit13**	**Bit12**	**Bit11**	**Bit10**	**Bit9**	**Bit8**
DI12	DI11	DI10	DI9	DI8	DI7	DI6	DI5
Bit7	**Bit6**	**Bit5**	**Bit4**	**Bit3**	**Bit2**	**Bit1**	**Bit0**
DI4	DI3	DI2	DI1	Reserved	HOME	POT	NOT

5.4.2 Digital output setting and control operation method

In addition to the internal operation of the servo system, EL7-ECS also provides a function for the master device to operate digital I/O output of the servo driver.
If I/O output function is set up as master device control, master device can control servo driver digital I/O output through 60FEh object

Bit / Sub-index	31~21	21	20	19	18	17	16	15~0
01h	Reserved	DO6 valid	DO5 valid	DO4 valid	DO3 valid	DO2 valid	DO1 valid	Reserved
02h		DO6 enabled	DO5 enabled	DO4 enabled	DO3 enabled	DO2 enabled	DO1 enabled	

5.4.3 Motor Rotational Direction

Rotational direction is defined in 607Eh.

PF2.41 Index 607Eh	Label	Polarity			Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~255			Default	0	Unit	
	Structure	VAR	Type	UINT8	Mapping	RPDO	Access	RW

Set input polarity of the command.

Mode		Set Value
Position mode	PP	0：Rotate in the same direction as the position command 128：Rotate in the opposite direction to the position command
	HM	
	CSP	
Velocity mode	PV	0：Rotate in the same direction as the position command 64：Rotate in the opposite direction to the position command
	CSV	
Torque mode	PT	0：Rotate in the same direction as the position command 32：Rotate in the opposite direction to the position command
	CST	
ALL mode		0：Rotate in the same direction as the position command 224：Rotate in the opposite direction to the position command

5.4.4 Stop Settings

EL7-ECS provides quick stop function. Stopping is different under different modes.
Controlled by using object dictionary 605A.
When 402 state machine is disabled, the motor will stop freely.
When bit8(Halt) of 6040h is 1, the motor will stop with deceleration set in 6083h/6084h.

PF2.04 Index 605Ah	Label	Quick stop option code			Mode	PP/PV/PT/CSP/CSV/CST/HM		
	Range	0~6			Default	2	Unit	-
	Structure	VAR	Type	INT16	Mapping	-	Access	RW

Sets the forced stop mode. This parameter is linked with P00.33: modifying the value of 605Ah will synchronously update P00.33.

EtherCAT mode:

When 605Ah = 0/3: In homing mode, the deceleration is selected as 609Ah; in non-homing mode, the deceleration is selected as 6084h.

When 605Ah = 1/4: The deceleration is selected as 6085h.

When 605Ah = 2: The deceleration is fixed to the maximum value.

5.4.5 Position mode – Electronic Gear

The EL7EC position modes are Cyclic Synchronised Position (CSP), Protocol Position (PP) and Home Mode (HM), where the electronic gear settings take effect.
The electronic gear ratio range is set between 0.001 and 4000 x encoder resolution /10000. Exceeding the range will result in an Er1B1 alarm (after changing to a reasonable range, the alarm at the operation panel will disappear automatically, but the 402 status machine will still be in the 'Error' state, and it is necessary to switch to cancellation of startup by writing 0x80 to the control word (6040h)).
For example:
17-bit motor: The electronic gear ratio range must satisfy (0.001, 52428.8)
23-bit motor: The electronic gear ratio range must satisfy (0.001, 3355443.2)

How to set it up:

Electronic gears adjust the motor's position movement via the master sending object dictionary 608Fh (Position ratio) and 6092h (Feed constant). Changes take effect only in the pre-operational state (Preencoder resolution).

- 608Fh (Position encoder resolution): Encoder resolution, read internally and requires no additional configuration.
- 6092-01h: Sets the command pulses required per motor revolution; updates take effect after re-enabling.
- 6091-01h/6091-02h: Updates take effect in real time.

The electronic gear division method is determined by modifying 6092-01h (Feed constant):
If 6092-01h (Feed constant) ≠ 608Fh (Position encoder resolution):
Electronic gear ratio = Encoder resolution / 6092-01h
Adjust the electronic gear ratio by setting 6092-01h.
If 6092-01h (Feed constant) = 608Fh (Position encoder resolution):
Electronic gear ratio = 6091-01h / 6091-02h
Adjust the electronic gear ratio by setting 6091-01h/6091-02h.

Note:
Parameter P10.03 is equivalent to 6092-01h, and the two are linked: changing P10.03 updates 6092-01h synchronously, and vice versa.

5.4.6 Position Limits

The drive limit function includes two parts: hardware limit and software limit. The hardware limit mainly uses external hardware digital signal inputs to restrict the motor's operating range, while the software limit uses software commands to restrict the motor's operating range.
Hardware limits are effective in all operation modes, while software limits only take effect in Cyclic Synchronous Position mode (CSP) and Profile Position mode (PP).
Software limits can be set via 607Dh or parameters P00.56 and P00.57. 607D-01h or P00.57 sets the maximum position in the negative direction, and 607D-02h or P00.56 sets the maximum position in the positive direction. The unit is consistent with the command unit.

PF2.39 Index 607Dh-01	Label	Min Position Limit			Mode	PP		CSP
	Range	-2147483647~2147483647			Default	0	Unit	*unit*
	Structure	VAR	Type	INT32	Mapping	RPDO	Access	RW
	Setting the minimum value for the software limit; when the motor reaches this position, the negative software limit becomes active. The drive will prevent the motor from continuing to move in the negative direction to ensure equipment and operational safety. This parameter is equivalent to P00.57 (Negative Software Limit), and the two are interlinked; that is, changing 607D-01h will result in a synchronous change to P00.57.							

PF2.40 Index 607Dh-02	Label	Max Position Limit			Mode	PP		CSP
	Range	-2147483647~2147483647			Default	0	Unit	*unit*
	Structure	VAR	Type	INT32	Mapping	RPDO	Access	RW
	Setting the maximum value for the forward software limit: when the motor reaches this position, the forward software limit becomes active. The drive will prevent the motor from continuing to move in the forward direction to ensure equipment and operational safety. This parameter is equivalent to P00.56 (Forward Software Limit), and the two are interlinked; that is, changing 607D-02h will result in a synchronous change to P00.56.							

EL7-ECS Software position limits valid conditions:

1. It can only be set in the pre-operational state of ESM. It is recommended to configure it by SDO when the system starts.
2. Only in the absolute mode of CSP and PP, in CSP mode, it is recommended to use the software limit function of the master station to achieve the fastest limit performance.
3. The incremental encoder motor is not effective until the homing process completed.
4. The setting rule is 607d-01h < 607d-02h(P00.57 < P00.56), that is, the negative position limit value is less than the positive position limit value.

5.4.7 CiA DSP402 Control Word

Bit definition of Control Word 6040h.

bit	PP	PV	PT	HM	CSP	CSV	CST
0	Ready to switch on	Ready to switch on	Ready to switch on	Ready to switch on	Ready to switch on	Ready to switch on	Ready to switch on
1	Switched on	Switched on	Switched on	Switched on	Switched on	Switched on	Switched on
2	Operatio n enabled	Operation enabled	Operation enabled	Operation enabled	Operation enabled	Operation enabled	Operation enabled
3	Fault	Fault	Fault	Fault	Fault	Fault	Fault
4	Voltage enabled	Voltage enabled	Voltage enabled	Voltage enabled	Voltage enabled	Voltage enabled	Voltage enabled
5	Quick stop	Quick stop	Quick stop	Quick stop	Quick stop	Quick stop	Quick stop
6	Drive not operation al	Drive not operation al	Drive not operation al	Drive not operation al	Drive not operation al	Drive not operation al	Drive not operation al
7	Warning	Warning	Warning	Warning	Warning	Warning	Warning
8	-	-	-	-	-	-	-
9	Remote control	Remote control	Remote control	Remote control	Remote control	Remote control	Remote control
10	Target reached (pos)	Target reached (vel)	Target reached (trq)	Target reached	Target reached (pos)	Target reached (vel)	Target reached (trq)
11	Limit active	Limit active	Limit active	Limit active	Limit active	Limit active	Limit active
12	Target position updated	Speed is zero	-	Home signal found	-	-	-
13	Position error too large	-	-	Homing error	Position error too large	-	-
14	Motion paramete rs are zero	-	-	Motion paramete rs are zero	-	-	-
15	Homing complete d	-	-	Homing complete d	Homing complete d	-	-

Command	Bit7 and Bit0 to Bit3					6040 Value	402 State machine *1)
	7：Fault reset	3：Operation enable	2：Quick stop	1：Voltage output	0：Start		
Power off	0	×	1	1	0	0006h	2;6;8
Switch on	0	0	1	1	1	0007h	3*
Switch on	0	1	1	1	1	000Fh	3**
No voltage output	0	×	×	0	×	0000h	7;9;10;12
Quick stop	0	×	0	1	×	0002h	7;10;11
Operation enable	0	0	1	1	1	0007h	5
enable	0	1	1	1	1	000Fh	4;16
Fault reset	Rising edge	×	×	×	×	0080h	15

× is not affected by this bit state

* indicates that this transition is performed in the device start state

** indicates that it has no effect on the start state and remains in the start state

*1) The state machine switch corresponds to figure 5.1

The definition of bit 8 and bit 6~4 in different operation modes are shown in the following table

5.4.7 CiA DSP402 Status Word

Bit definition of Status Word 6041h.

Bit	PP Mode	PV Mode	PT Mode	HM Mode	CSP Mode	CSV Mode	CST Mode
bit0	Ready to switch on	Ready to switch on	Ready to switch on	Ready to switch on	Ready to switch on	Ready to switch on	Ready to switch on
bit1	Switched on	Switched on	Switched on	Switched on	Switched on	Switched on	Switched on
bit2	Operation enabled	Operation enabled	Operation enabled	Operation enabled	Operation enabled	Operation enabled	Operation enabled
bit3	Fault	Fault	Fault	Fault	Fault	Fault	Fault
bit4	Voltage output	Voltage output	Voltage output	Voltage output	Voltage output	Voltage output	Voltage output
bit5	Quick stop	Quick stop	Quick stop	Quick stop	Quick stop	Quick stop	Quick stop
bit6	Drive not operational	Drive not operational	Drive not operational	Drive not operational	Drive not operational	Drive not operational	Drive not operational
bit7	Warning	Warning	Warning	Warning	Warning	Warning	Warning
bit8	-	-	-	-	-	-	-
bit9	Remote control	Remote control	Remote control	Remote control	Remote control	Remote control	Remote control
bit10	Target position reached	Target speed reached	Target torque reached	Target reached	Target position reached	Target speed reached	Target torque reached
bit11	Limit active	Limit active	Limit active	Limit active	Limit active	Limit active	Limit active
bit12	Target position updated	Speed is zero	-	Home signal found	-	-	-
bit13	Position error too large	-	-	Homing error	Position error too large	-	-
bit14	Motion parameters zero	-	-	Motion parameters zero	-	-	-
bit15	Homing completed	-	-	Homing completed	Homing completed	-	-

Bit 11 is valid when the software or hardware limit is in effect.
The combination of bit 6 and bit 3~0 represents the device state shown in following table

Combination of bit 6 and bit 3~0	Description
××××,××××,×0××,0000	Not ready to switch on
××××,××××,×1××,0000	Switch on disabled
××××,××××,×01×,0001	Ready to switch on
××××,××××,×01×,0011	Switch on
××××,××××,×01×,0111	Operation enabled
××××,××××,×00×,0111	Quick stop active
××××,××××,×0××,1111	Fault reaction active
××××,××××,×0××,1000	Fault

× is not affected by this bit state

5.4.8 Synchronous cycle time setting

The default synchronous cycle time range of EL7-ECS series is 250us – 10ms. Min value: 125us; Max value: 20ms. Please make sure the values set is the multiplier of 250us.

5.4.9 Driver Enabling

This section describes how to use control words 6040h/ status word 6041h command switching/status determination forEL7-ECS controlled motor.

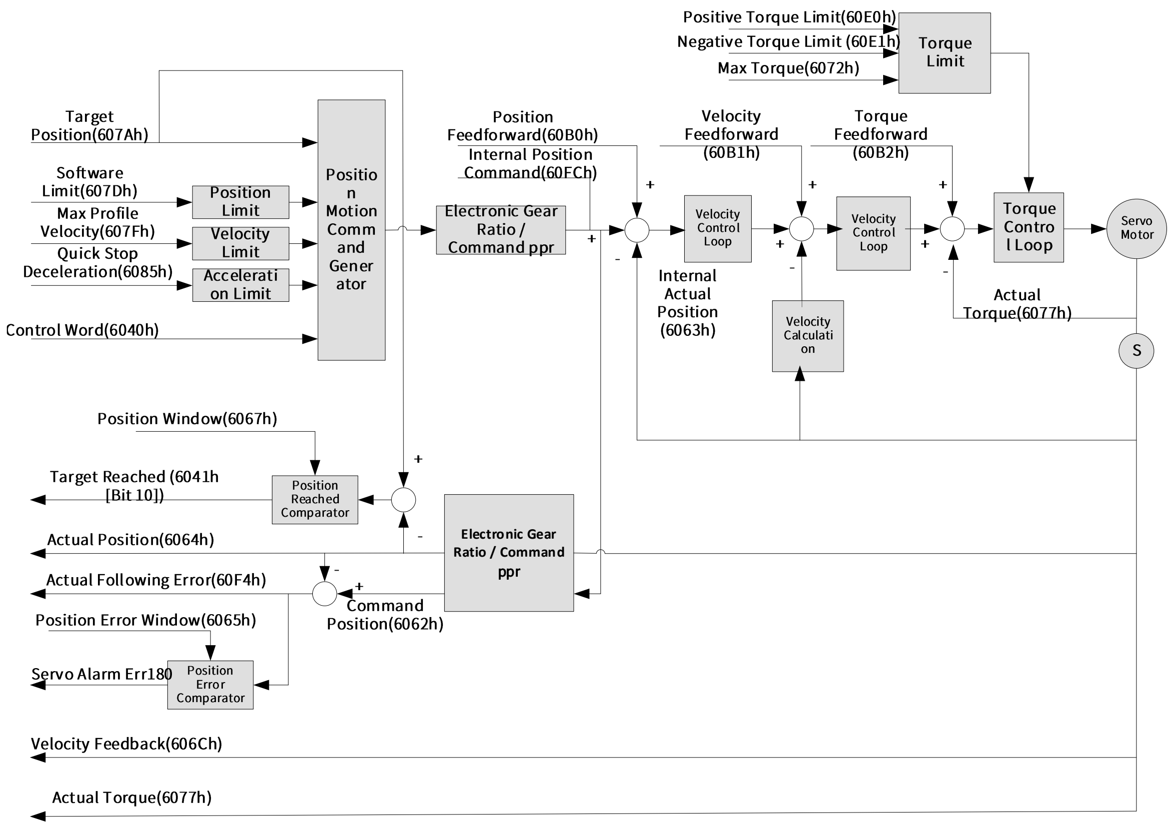
Steps：

1：Write 0x0 to the control word 6040h, and then AND 0x250 by bit, whether it is equal to 0x250
2：Write 0x6 to the control word 6040h, and then AND 0x231 by bit, whether it is equal to 0x231
3：Write 0x7 to the control word 6040h, and then AND 0x233 by bit, whether it is equal to 0x233
4：Write 0xF to the control word 6040h, and then AND 0x237 by bit, whether it is equal to 0x237

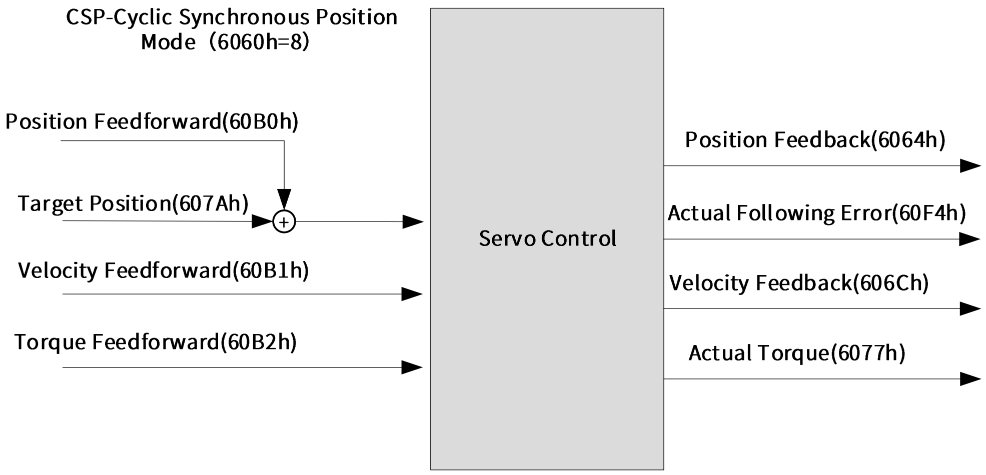
5.5 Cyclic Synchronous Position Mode (CSP)

In Cyclic Synchronous Position mode, the controller completes position command planning and then cyclically sends the planned target position to the drive. Position, velocity, and torque control are performed internally by the servo drive. In addition, velocity feedforward (60B1h) and torque feedforward (60B2h) can be configured as velocity and torque feedforward control settings.

5.5.1 Functional Block Diagram



5.5.2 Configuration Block Diagram



5.5.3 Parameter configuration

- Control words and status words in CSP mode

Control Word (6040h) Definition in CSP Mode

Bit Position	Function	Description
bit0	Switch on	0: Disabled, 1: Enabled
bit1	Enable voltage	0: Disabled, 1: Enabled
bit2	Quick stop	0: Disabled, 1: Enabled
bit3	Enable operation	0: Disabled, 1: Enabled
bit4~6	-	-
bit7	Fault reset	0 → 1: Execute fault reset
bit8	-	-

Status Word (6041h) Definition in CSP Mode

Bit Position	Function	Description
bit0	Ready to Switch On	0: Disabled, 1: Enabled
bit1	Switched On	0: Disabled, 1: Enabled
bit2	Operation Enabled	0: Disabled, 1: Enabled
bit3	Fault	0: Disabled, 1: Enabled
bit4	Voltage Enabled	0: Disabled, 1: Enabled
bit5	Quick Stop	0: Disabled, 1: Enabled
bit6	Switch On Disabled	0: Disabled, 1: Enabled
bit7	Warning	0: No warning, 1: Warning present
bit8	-	-
bit9	Remote	0: Disabled; 1: Enabled, control word is active
bit10	Target Reached	0: Target position not reached; 1: Target position reached
bit11	Internal Limit Active	0: Position within limits; 1: Position limit exceeded
bit12	-	-
bit13	Following Error	0: No following error fault; 1: Following error fault present
bit14	-	-
bit15	Homing Attained	0: Homing not completed; 1: Homing completed. In absolute position mode, this bit remains 1 after homing is completed.

- Basic parameter objects (recommended configuration objects)

Data Direction [1]	Index + Sub-index	Name	Data Type	Access Type	Unit	Remarks
Output (RXPDO) [1]	6040-00h	Control Word	U16	RW	-	Mandatory
	607A-00h	Target Position	I32	RW	Unit	Mandatory
	60B0-00h	Position Feedforward	I32	RW	Unit	Optional
	60B1-00h	Velocity Feedforward	I32	RW	Unit/s	Optional
	60B2-00h	Torque Feedforward	I16	RW	0.1%	Optional
Input (TXPDO)	6041-00h	Status Word	U16	RO	-	Mandatory
	603F-00h	Error Code	U16	RO	-	Optional
	6064-00h	Position Feedback	I32	RO	Unit	Mandatory
	606C-00h	Velocity Feedback	I32	RO	Unit/s	Optional
	60F4-00h	Position Error	I32	RO	Unit	Optional
	6077-00h	Actual Torque	I16	RO	0.1%	Optional

[1]: The data flow is defined with the master server as the reference point: output flows from the master server to the slave server, and input flows from the slave server to the master server.

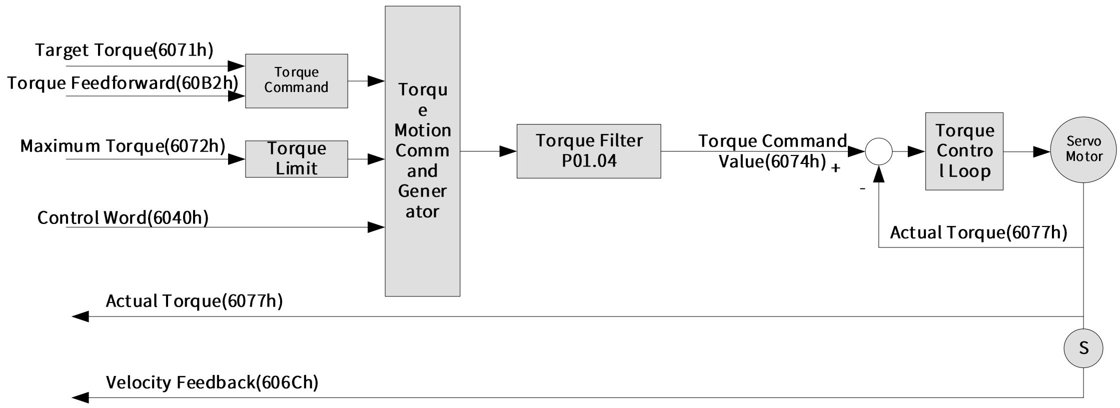
- Extension parameter object

Index + Sub-index	Name	Data Type	Access Type	Unit
603F-00h	Most Recent Error Code	U16	RO	-
6060-00h	Operation Mode	I8	RW	-
6061-00h	Operation Mode Display	I8	RO	-
6062-00h	Internal Command Position	I32	RO	Unit
606B-00h	Internal Command Velocity	I32	RO	Unit
607D-01h	Negative Position Limit	I32	RO	Unit
607D-02h	Positive Position Limit	I32	RO	Unit
605A-00h	Quick Stop Code	I16	RW	-
6085-00h	Quick Stop Deceleration	U32	RW	Unit/s
608F-01h	Encoder Resolution	U32	RO	P
6091-01h	Electronic Gear Ratio Numerator	U32	RW	-
6091-02h	Electronic Gear Ratio Denominator	U32	RW	-
6092-01h	Command Pulses Per Revolution	U32	RW	-

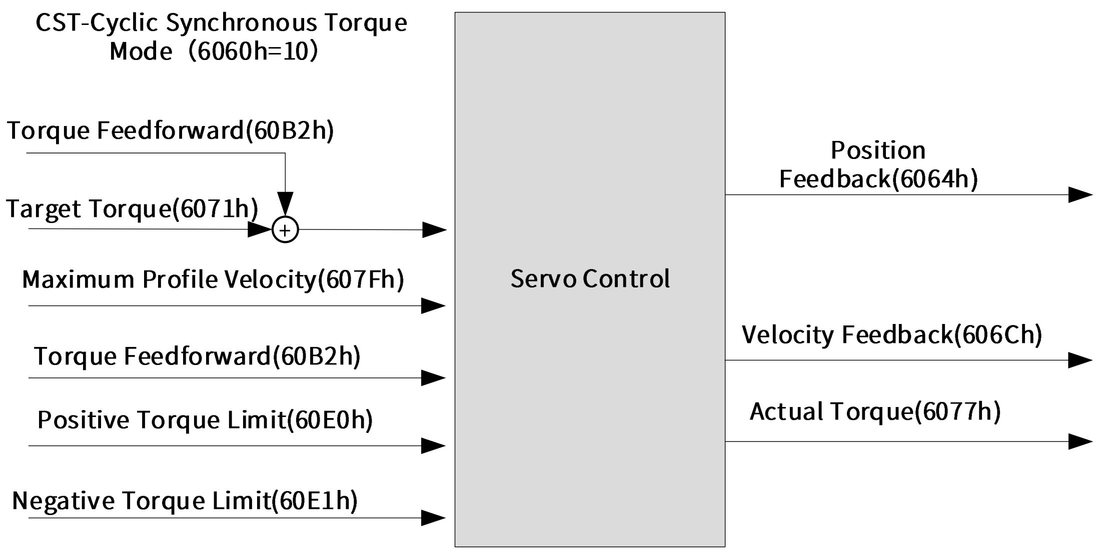
5.6 Cyclic Synchronous Torque Mode (CST)

In Cyclic Synchronous Torque mode, the controller cyclically sends the calculated target torque to the drive, and torque regulation is performed internally by the servo drive. In addition, torque feedforward (60B2h) can be configured for torque feedforward control.

5.6.1 Functional Block Diagram



5.6.2 Configuration Block Diagram



5.6.3 Parameter configuration

- Control words and status words in CST mode

Control Word (6040h) Definition in CST Mode

Bit Position	Function	Description
bit0	Switch on	0: Disabled, 1: Enabled
bit1	Enable voltage	0: Disabled, 1: Enabled
bit2	Quick stop	0: Disabled, 1: Enabled
bit3	Enable operation	0: Disabled, 1: Enabled
bit4~6	-	-
bit7	Fault reset	0 → 1: Execute fault reset
bit8	-	-

Status Word (6041h) Definition in CST Mode

Bit position	Function (English)	Description
bit0	Ready to Switch On	0: Disabled, 1: Enabled
bit1	Switched On	0: Disabled, 1: Enabled
bit2	Operation Enabled	0: Disabled, 1: Enabled
bit3	Fault	0: Disabled, 1: Enabled
bit4	Voltage Enabled	0: Disabled, 1: Enabled
bit5	Quick Stop	0: Disabled, 1: Enabled
bit6	Switch On Disabled	0: Disabled, 1: Enabled
bit7	Warning	0: No warning, 1: Warning present
bit8	-	-
bit9	Remote	0: Disabled; 1: Enabled, control word is active
bit10	Target Reached	0: Target torque not reached; 1: Target torque reached
bit11	Internal Limit Active	0: Position within limits; 1: Position limit exceeded
bit12~15	-	-

■ Basic parameter objects (recommended configuration objects)

Data Direction [1]	Index + Sub-index	Name	Data Type	Access Type	Unit	Remarks
Output (RXPDO)	6040-00h	Control Word	U16	RW	-	Mandatory
	6071-00h	Target Torque	I16	RW	0.1%	Mandatory
	6087-00h	Torque Slope	U32	RW	0.1%/s	Optional
Input (TXPDO)	6041-00h	Status Word	U16	RO	-	Mandatory
	603F-00h	Error Code	U16	RO	-	Optional
	6064-00h	Position Feedback	I32	RO	Unit	Optional
	606C-00h	Velocity Feedback	I32	RO	Unit/s	Optional
	60F4-00h	Position Error	I32	RO	Unit	Optional
	6077-00h	Actual Torque	I16	RO	0.1%	Mandatory

[1]: The data flow is defined with the master server as the reference point: output flows from the master server to the slave server, and input flows from the slave server to the master server.

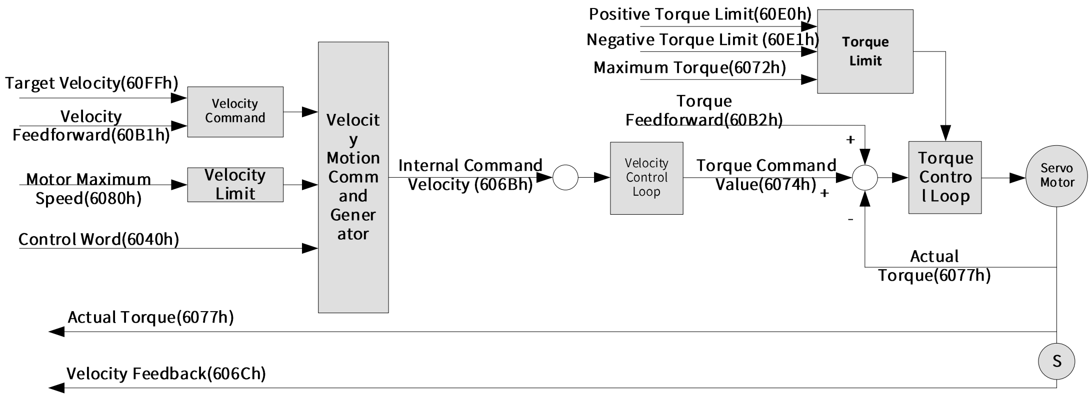
■ Extension parameter object

Index + Sub-index	Name	Data Type	Access Type	Unit
603F-00h	Most Recent Error Code	U16	RO	-
6060-00h	Operation Mode	I8	RW	-
6061-00h	Operation Mode Display	I8	RO	-
6074-00h	Internal Command Torque	I16	RO	0.1%
605A-00h	Quick Stop Code	I16	RW	-
6080-00h	Motor Maximum Speed	U32	RW	r/min
6085-00h	Quick Stop Deceleration	U32	RW	Unit/s
60B1-00h	Velocity Feedforward	I32	RW	Unit/s
607F-00h	Maximum Speed Limit	I16	RW	Unit/s

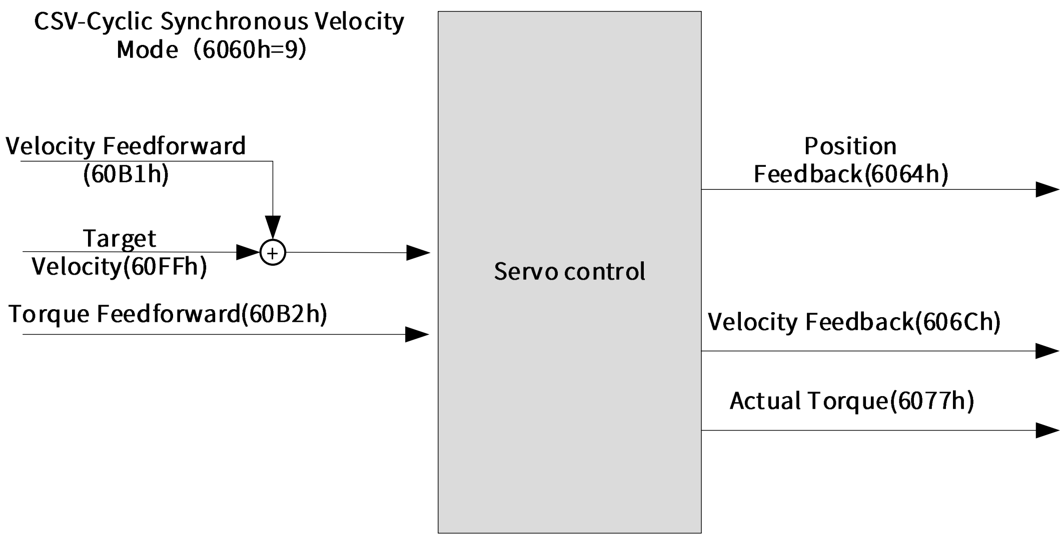
5.7 Cyclic Synchronous Velocity Mode (CSV)

In Cyclic Synchronous Velocity mode, the controller cyclically sends the calculated target velocity to the drive. Velocity and torque regulation are performed internally by the servo. In addition, velocity feedforward (60B1h) and torque feedforward (60B2h) can be configured for velocity and torque feedforward control.

5.7.1 Functional Block Diagram



5.7.2 Configuration Block Diagram



5.7.3 Parameter configuration

- Control words and status words in CSV mode

Control Word (6040h) Definition in CSV Mode

Bit Position	Function	Description
bit0	Switch on	0: Disabled, 1: Enabled
bit1	Enable voltage	0: Disabled, 1: Enabled
bit2	Quick stop	0: Disabled, 1: Enabled
bit3	Enable operation	0: Disabled, 1: Enabled
bit4~6	-	-
bit7	Fault reset	0 → 1: Execute fault reset
bit8	-	-

Status Word (6041h) Definition in CSV Mode

Bit position	Function (English)	Description
bit0	Ready to Switch On	0: Disabled, 1: Enabled
bit1	Switched On	0: Disabled, 1: Enabled
bit2	Operation Enabled	0: Disabled, 1: Enabled
bit3	Fault	0: Disabled, 1: Enabled
bit4	Voltage Enabled	0: Disabled, 1: Enabled
bit5	Quick Stop	0: Disabled, 1: Enabled
bit6	Switch On Disabled	0: Disabled, 1: Enabled
bit7	Warning	0: No warning, 1: Warning present
bit8	-	-
bit9	Remote	0: Disabled; 1: Enabled, control word is active
bit10	Target Reached	0: Target torque not reached; 1: Target torque reached
bit11	Internal Limit Active	0: Position within limits; 1: Position limit exceeded
bit12~15	-	-

■ Basic parameter objects (recommended configuration objects)

Data Direction [1]	Index + Sub-index	Name	Data Type	Access Type	Unit	Remarks
Output (RXPDO)	6040-00h	Control Word	U16	RW	-	Mandatory
	60FF-00h	Target Velocity	I32	RW	Unit	Mandatory
	60B1-00h	Velocity Feedforward	I32	RW	Unit/s	Optional
	60B2-00h	Torque Feedforward	I16	RW	0.1%	Optional
	6041-00h	Status Word	U16	RO	-	Mandatory
Input (TXPDO)	603F-00h	Error Code	U16	RO	-	Optional
	6064-00h	Position Feedback	I32	RO	Unit	Optional
	606C-00h	Velocity Feedback	I32	RO	Unit/s	Optional
	60F4-00h	Position Error	I32	RO	Unit	Optional
	6077-00h	Actual Torque	I16	RO	0.1%	Optional

[1]: The data flow is defined with the master server as the reference point: output flows from the master server to the slave server, and input flows from the slave server to the master server.

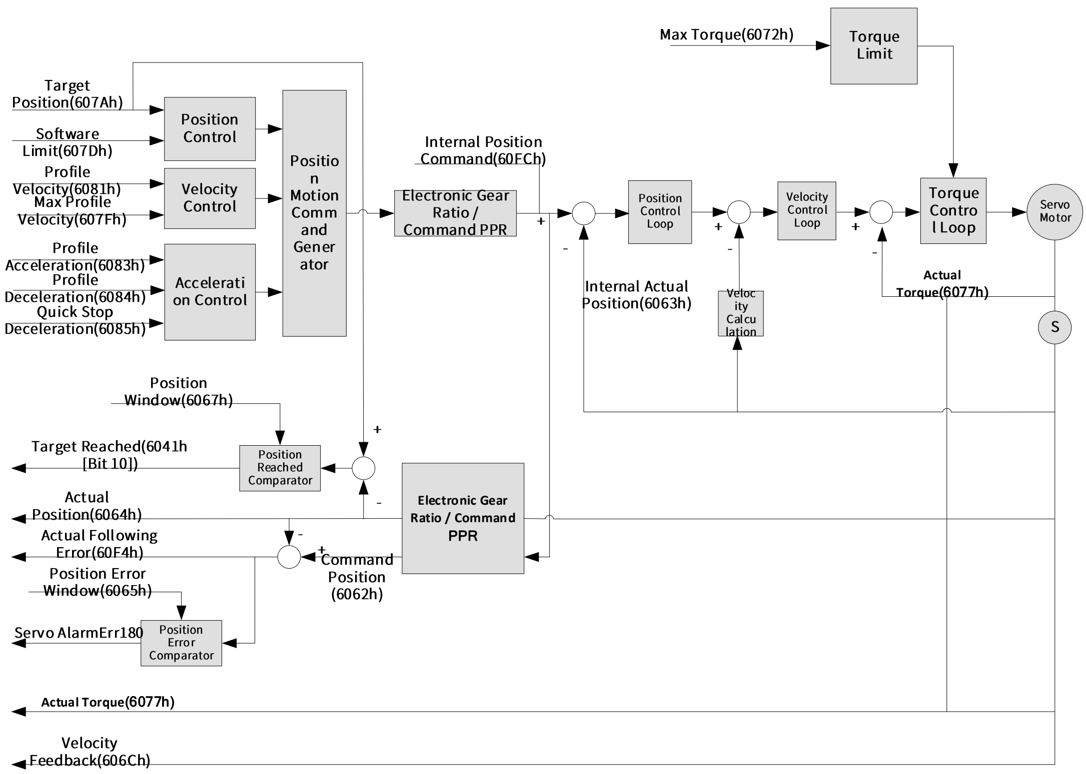
■ Extension parameter object

Index + Sub-index	Name	Data Type	Access Type	Unit
603F-00h	Most Recent Error Code	U16	RO	-
6060-00h	Operation Mode	I8	RW	-
6061-00h	Operation Mode Display	I8	RO	-
606B-00h	Internal Command Velocity	I32	RO	Unit
605A-00h	Quick Stop Code	I16	RW	-
6085-00h	Quick Stop Deceleration	U32	RW	Unit/s

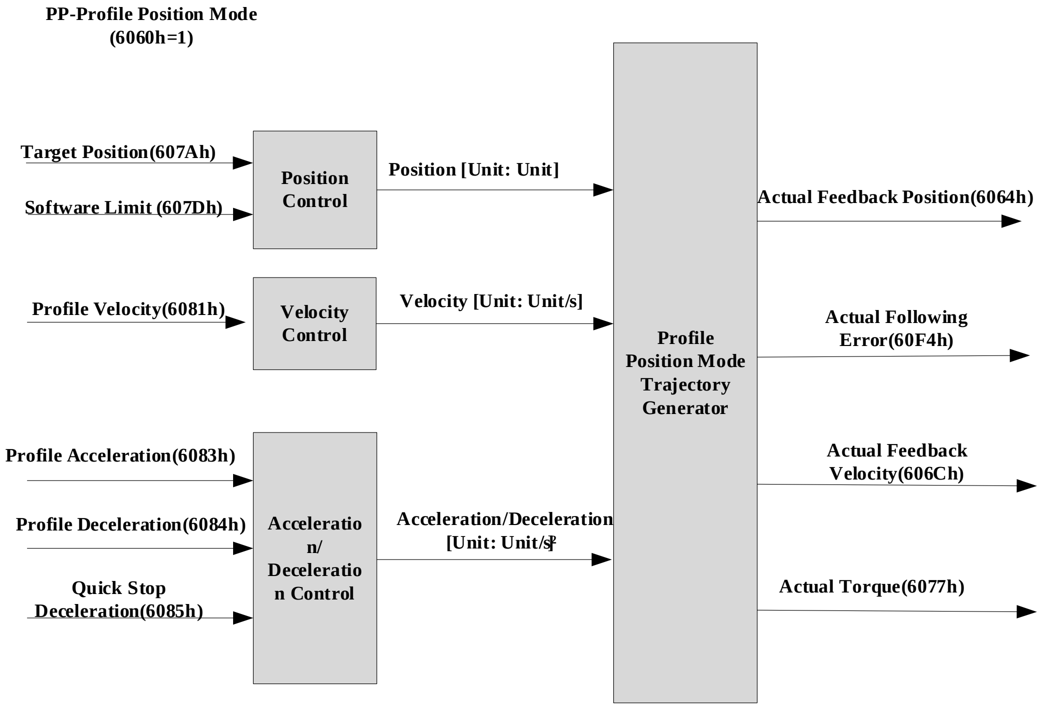
5.8 Profile Position Mode (PP)

In non-synchronous motion mode, the master station is only responsible for sending motion parameters and control commands. After receiving the motion start command from the master station, the servo drive performs trajectory planning according to the motion parameters sent by the master station. In non-synchronous motion mode, the motion of each motor axis is asynchronous.
Profile Position mode is mainly used for point-to-point positioning applications. In this mode, the host computer sets the target position, operating speed, acceleration, and deceleration. The position trajectory generator inside the servo generates position profile commands based on these settings, and the drive performs position control, speed control, and torque control internally.

5.8.1 Functional Block Diagram



5.8.2 Configuration Block Diagram



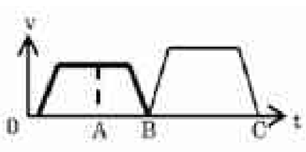
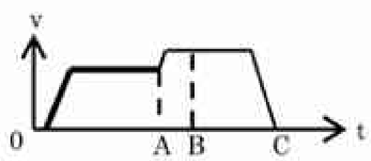
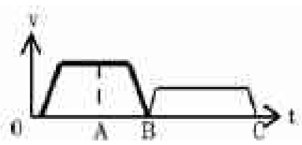
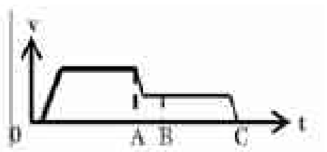
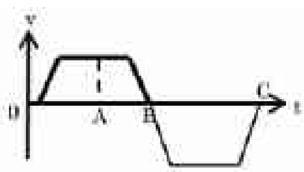
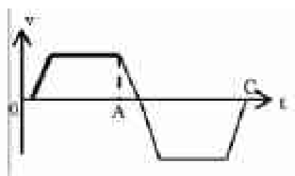
5.8.3 Parameter configuration

- Control words and status words in CSP mode

Control Word (6040h) Definition in PP Mode

Bit position	Function	Description
bit0	Switch on	0: Disabled, 1: Enabled
bit1	Enable voltage	0: Disabled, 1: Enabled
bit2	Quick stop	0: Disabled, 1: Enabled
bit3	Enable operation	0: Disabled, 1: Enabled
bit4	New set-point	0 → 1: Trigger new target position1 → 0: Reset status word bit 12
bit5	Change set immediately	0: Non-interruptible; new movement can only start after current movement finishes1: Interruptible; immediately start new movement, interrupting the current one
bit6	Absolute/Relative	0: Absolute position command1: Relative position command
bit7	Fault reset	0 → 1: Execute fault reset
bit8	Halt	0: Maintain current operating status; 1: Halt

Behavior Model of Control Word Bit 5 in PP Mode

Control Word Bit 5	0	1
When updating the target position in the same direction during acceleration/constant speed phase		
When updating the target position in the same direction during deceleration phase		
When updating the target position in the reverse direction		

A: Command change time from the master station.
B: Arrival time of the original target position (before update).
C: Arrival time of the new target position (after update).
Thick line: Motion profile under conditions before the command change.
Thin line: Motion profile under conditions after the command change.

Status Word (6041h) Definition in PP Mode

Bit Position	Function	Description
bit0	Ready to Switch On	0: Disabled, 1: Enabled
bit1	Switched On	0: Disabled, 1: Enabled
bit2	Operation Enabled	0: Disabled, 1: Enabled
bit3	Fault	0: Disabled, 1: Enabled
bit4	Voltage Enabled	0: Disabled, 1: Enabled
bit5	Quick Stop	0: Disabled, 1: Enabled
bit6	Switch On Disabled	0: Disabled, 1: Enabled
bit7	Warning	0: No warning, 1: Warning present
bit8	-	-
bit9	Remote	0: Disabled; 1: Enabled, control word is active
bit10	Target Reached	0: Target position not reached; 1: Target position reached
bit11	Internal Limit Active	0: Position within limits; 1: Position limit exceeded
bit12	Set-point acknowledge	0: New target position can be updated; 1: New target position cannot be updated
bit13	Following Error	0: No following error fault; 1: Following error fault occurred
bit14	Zero motion parameter	When necessary motion parameters are 0 (i.e., when any of Max Speed (6081h), Acceleration (6083h), Deceleration (6084h) is 0), bit14=1
bit15	Homing Attained	0: Homing not completed; 1: Homing completed. In absolute position mode, this bit remains 1 after homing is completed.

- Basic parameter objects (recommended configuration objects)

Data Direction [1]	Index + Sub-index	Name	Data Type	Access Type	Unit	Remarks
Output (RXPDO)	6040-00h	Control Word	U16	RW	-	Mandatory
	607A-00h	Target Position	I32	RW	Unit	Mandatory
	6081-00h	Profile Velocity	U32	RW	Unit	Mandatory
	6083-00h	Acceleration	I32	RW	Unit/s	Optional
Input (TXPDO)	6041-00h	Status Word	U16	RO	-	Mandatory
	603F-00h	Error Code	U16	RO	-	Optional
	6064-00h	Position Feedback	I32	RO	Unit	Mandatory
	606C-00h	Velocity Feedback	I32	RO	Unit/s	Optional
	60F4-00h	Position Error	I32	RO	Unit	Optional
	6077-00h	Actual Torque	I16	RO	0.1%	Optional

[1]: The data flow is defined with the master server as the reference point: output flows from the master server to the slave server, and input flows from the slave server to the master server.

- Extension parameter object

Index + Sub-index	Name	Data Type	Access Type	Unit
603F-00h	Most recent error code	U16	RO	-
6060-00h	Operation mode	I8	RW	-
6061-00h	Operation mode display	I8	RO	-
6062-00h	Internal command position	I32	RO	Unit
606B-00h	Internal command velocity	I32	RO	Unit
607D-01h	Negative position limit	I32	RO	Unit
607D-02h	Positive position limit	I32	RO	Unit
605A-00h	Quick stop code	I16	RW	-
6084-00h	Deceleration	U32	RW	Unit/s
6085-00h	Quick stop	U32	RW	Unit/s

Index + Sub-index	Name	Data Type	Access Type	Unit
	deceleration			
608F-01h	Encoder resolution	U32	RO	P
6091-01h	Electronic gear ratio numerator	U32	RW	-
6091-02h	Electronic gear ratio denominator	U32	RW	-
6092-01h	Command pulses per revolution	U32	RW	-

- Example – Implementation of Relative Position Movement

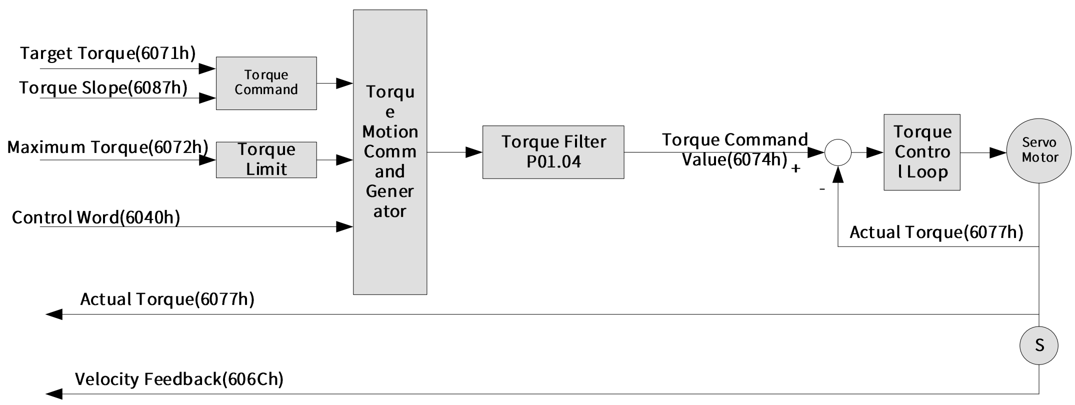
This section provides an example of how to implement relative position movement. Steps are as follows:

1) Write 1 to the operation mode (6060h), and verify that 6061h is 1 to confirm the drive has switched to PP mode;
2) Set the motion parameters: target position (607Ah), profile velocity (6081h), acceleration (6083h), and deceleration (6084h);
3) With the drive enabled, toggle control word bits 6 and 4 to execute one relative position movement.

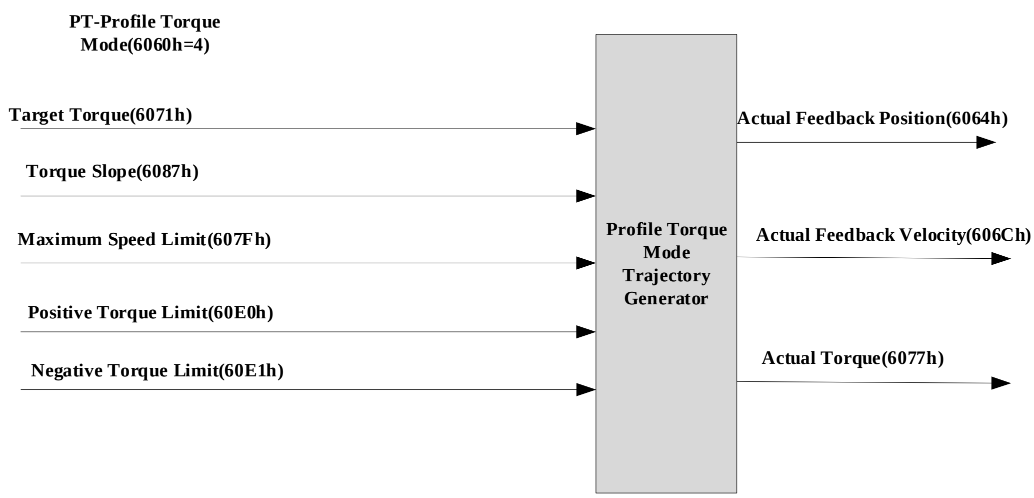
5.9 Profile Torque Mode (PT)

In Profile Torque mode, the controller sends the target torque (6071h) and torque slope constant (6087h) to the servo drive. The drive itself generates the torque command profile, and torque regulation is performed internally by the servo.

5.9.1 Functional Block Diagram



5.9.2 Configuration Block Diagram



5.9.3 Parameter configuration

■ Control words and status words in CSP mode

Control Word (6040h) Definition in PT Mode

Bit Position	Function	Description
bit0	Switch on	0: Disabled, 1: Enabled
bit1	Enable voltage	0: Disabled, 1: Enabled
bit2	Quick stop	0: Disabled, 1: Enabled
bit3	Enable operation	0: Disabled, 1: Enabled
bit4~6	-	-
bit7	Fault reset	0 → 1: Execute fault reset
bit8	Halt	0: Maintain current operating status1: Halt

Status Word (6041h) Definition in PT Mode

Bit Position	Function	Description
bit0	Ready to Switch On	0: Disabled, 1: Enabled
bit1	Switched On	0: Disabled, 1: Enabled
bit2	Operation Enabled	0: Disabled, 1: Enabled
bit3	Fault	0: Disabled, 1: Enabled
bit4	Voltage Enabled	0: Disabled, 1: Enabled
bit5	Quick Stop	0: Disabled, 1: Enabled
bit6	Switch On Disabled	0: Disabled, 1: Enabled
bit7	Warning	0: No warning, 1: Warning present
bit8	-	-
bit9	Remote	0: Disabled; 1: Enabled, control word active
bit10	Target Reached	0: Target torque not reached; 1: Reached
bit11	Internal Limit Active	0: Position within limits; 1: Limit triggered
bit12~15	-	-

■ Basic parameter objects (recommended configuration objects)

Data Direction [1]	Index + Sub-index	Name	Data Type	Access Type	Unit	Remarks
Output (RXPDO)	6040-00h	Control Word	U16	RW	-	Mandatory
	6071-00h	Target Torque	I16	RW	0.1%	Mandatory
	6087-00h	Torque Slope	U32	RW	0.1%/s	Optional

Data Direction [1]	Index + Sub-index	Name	Data Type	Access Type	Unit	Remarks
Input (TXPDO)	6041-00h	Status Word	U16	RO	-	Mandatory
	603F-00h	Error Code	U16	RO	-	Optional
	6064-00h	Position Feedback	I32	RO	Unit	Optional
	606C-00h	Velocity Feedback	I32	RO	Unit/s	Optional
	60F4-00h	Position Error	I32	RO	Unit	Optional
	6077-00h	Actual Torque	I16	RO	0.1%	Optional

[1]: The data flow is defined with the master server as the reference point: output flows from the master server to the slave server, and input flows from the slave server to the master server.

- Extension parameter object

Index + Sub-index	Name	Data Type	Access Type	Unit
603F-00h	Most Recent Error Code	U16	RO	-
6060-00h	Operation Mode	I8	RW	-
6061-00h	Operation Mode Display	I8	RO	-
6074-00h	Internal Torque Command	I16	RO	0.1%
6080-00h	Motor Maximum Speed	U32	RW	r/min
605A-00h	Quick Stop Code	I16	RW	-
6085-00h	Quick Stop Deceleration	U32	RW	Unit/s
607F-00h	Maximum Speed Limit	I16	RW	Unit/s
607F-00h	Maximum Speed Limit	I16	RW	Unit/s

- Example – Implementation of PT Motion

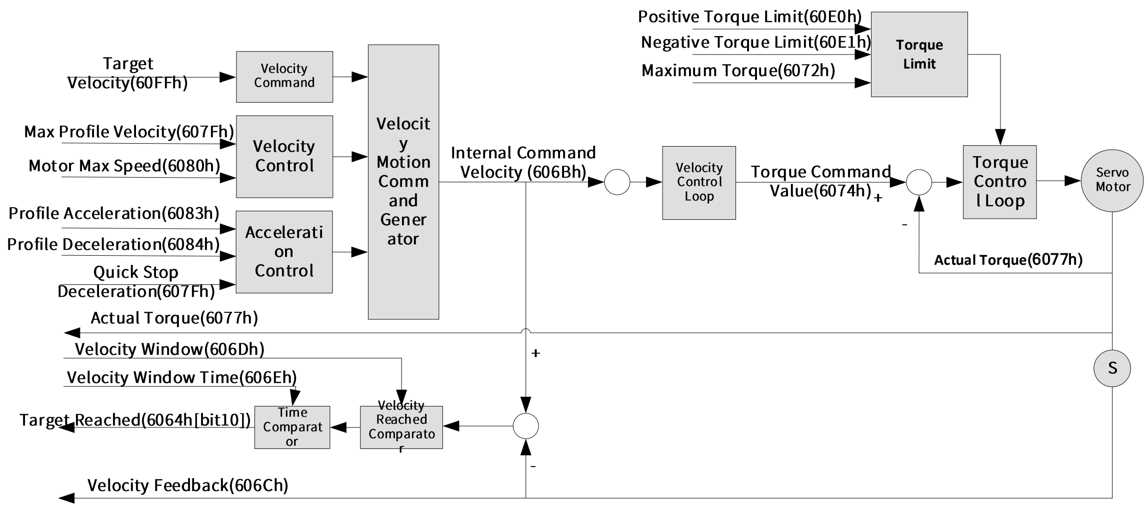
This section describes how to implement PT motion with an example.
Steps are as follows:

1) Write 4 to the operation mode (6060h), and verify that 6061h is 4 to confirm the drive has switched to PT mode;
2) Set the motion parameters: target torque (6071h), torque slope (6087h), and maximum speed limit (6080h).

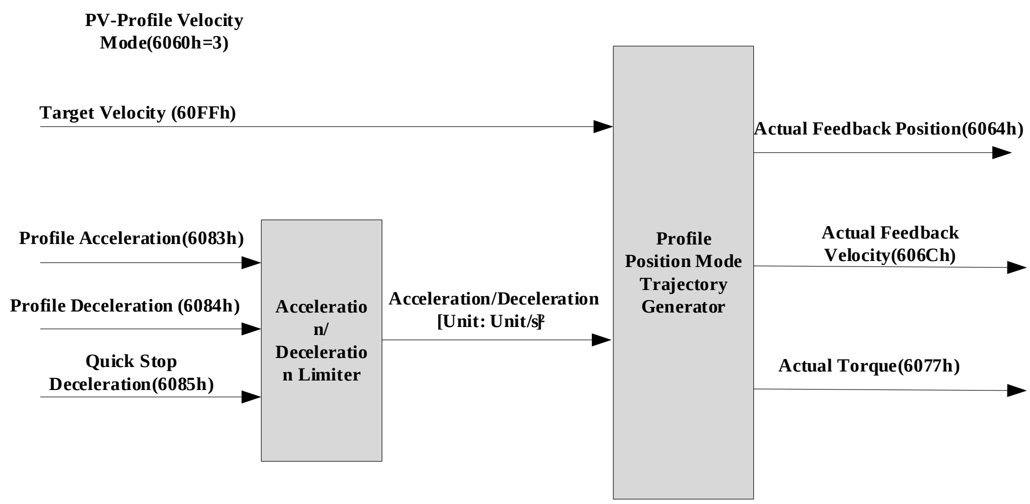
5.10 Profile Velocity Mode (PV)

In Profile Velocity mode, the controller sends the target velocity, acceleration, and deceleration to the servo drive. The servo drive generates the velocity command profile internally, and velocity and torque regulation are executed within the servo.

5.10.1 Functional Block Diagram



5.10.2 Configuration Block Diagram



5.10.3 Parameter configuration

- Control words and status words in CSP mode

Control Word (6040h) Definition in PV Mode

Bit position	Function	Description
bit0	Switch on	0: Disabled, 1: Enabled
bit1	Enable voltage	0: Disabled, 1: Enabled
bit2	Quick stop	0: Disabled, 1: Enabled
bit3	Enable operation	0: Disabled, 1: Enabled
bit4~6	-	-
bit7	Fault reset	0 → 1: Execute fault reset
bit8	Halt	0: Maintain current operating status1: Halt

Status Word (6041h) Definition in PV Mode

Bit Position	Function	Description
bit0	Ready to Switch On	0: Disabled, 1: Enabled
bit1	Switched On	0: Disabled, 1: Enabled
bit2	Operation Enabled	0: Disabled, 1: Enabled
bit3	Fault	0: Disabled, 1: Enabled
bit4	Voltage Enabled	0: Disabled, 1: Enabled
bit5	Quick Stop	0: Disabled, 1: Enabled
bit6	Switch On Disabled	0: Disabled, 1: Enabled
bit7	Warning	0: No warning, 1: Warning present
bit8	-	-
bit9	Remote	0: Disabled; 1: Enabled, control word active
bit10	Target Reached	0: Target speed not reached; 1: Target speed reached
bit11	Internal Limit Active	0: Position within limits; 1: Position limit triggered
bit12	Zero velocity	0: Speed not zero, motor is moving; 1: Speed is zero or about to be zero. Judgment condition: Velocity feedback (606Ch) $\leqslant \pm$ 606Fh and maintained for the time set in 6070h, indicating zero velocity, bit set to 1.
bit13~15	-	-

- Basic parameter objects (recommended configuration objects)

Data Direction	Index + Sub-index	Name	Data Type	Access Type	Unit	Remarks
Output (RXPDO)	6040-00h	Control Word	U16	RW	-	Mandatory
	60FF-00h	Target Velocity	I32	RW	Unit	Mandatory
	6083-00h	Acceleration	I32	RW	Unit/s	Optional
Input (TXPDO)	6041-00h	Status Word	U16	RO	-	Mandatory
	603F-00h	Error Code	U16	RO	-	Optional
	6064-00h	Position Feedback	I32	RO	Unit	Optional
	606C-00h	Velocity Feedback	I32	RO	Unit/s	Optional
	60F4-00h	Position Error	I32	RO	Unit	Optional
	6077-00h	Actual Torque	I16	RO	0.1%	Optional

[1]: The data flow is defined with the master server as the reference point: output flows from the master server to the slave server, and input flows from the slave server to the master server.

- Extension parameter object

Index + Sub-index	Name	Data Type	Access Type	Unit
603F-00h	Most recent error code	U16	RO	-
6060-00h	Operation mode	I8	RW	-
6061-00h	Operation mode display	I8	RO	-
605A-00h	Quick stop code	I16	RW	-
6084-00h	Deceleration	U32	RW	Unit/s
6085-00h	Quick stop deceleration	U32	RW	Unit/s

- Example – Implementation of PV Motion

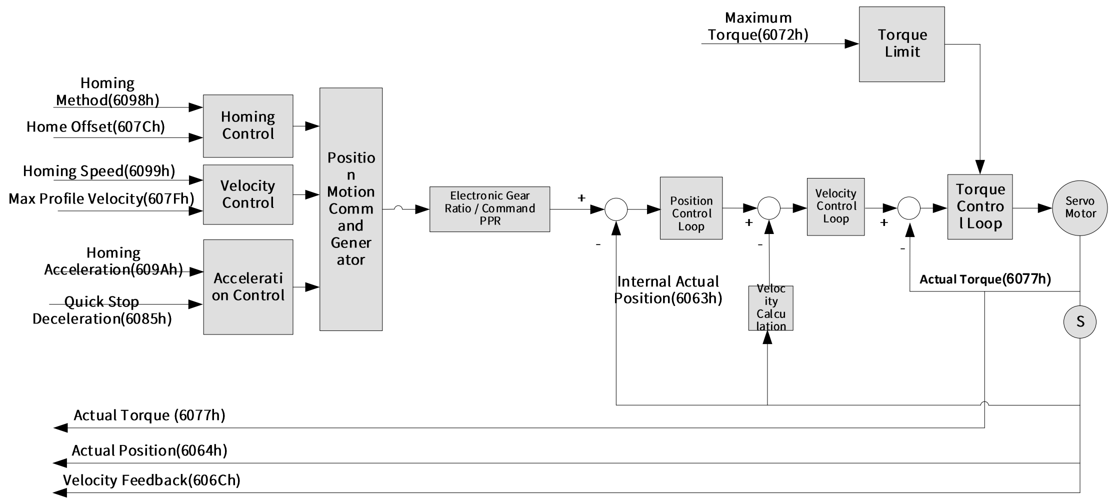
This section provides an example of how to implement PV motion.
The steps are as follows:

1) Write 3 to the operation mode (6060h), and verify that 6061h is 3 to confirm the drive has switched to PV mode;
2) Set the motion parameters: target velocity (60FFh), acceleration (6083h), and deceleration (6084h).

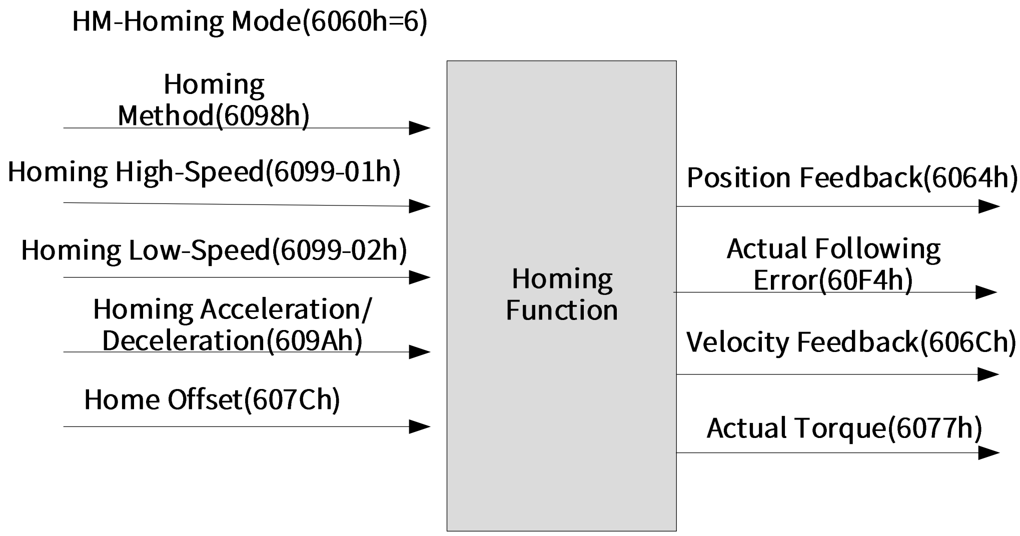
5.11 Homing mode (HM)

The homing function operates similarly to the profile position mode and falls under the position control category. After completing the homing sequence, the drive establishes its coordinate system and can begin executing position commands from the controller.
Typically, homing is only required for motors with incremental encoders. After homing, the homed position is set as the mechanical origin, and subsequent motion in other modes is referenced to this point.

5.10.1 Functional Block Diagram



5.10.2 Configuration Block Diagram



5.11.3 Parameter configuration

- Control words and status words in CSP mode

Control Word (6040h) Definition in HM Mode

Bit position	Function	Description
bit0	Switch on	0: Disabled, 1: Enabled
bit1	Enable voltage	0: Disabled, 1: Enabled
bit2	Quick stop	0: Disabled, 1: Enabled
bit3	Enable operation	0: Disabled, 1: Enabled
bit4	Enable Homing	0 → 1: Homing Enabled 1 → 0: Homing stoped
bit5~6	-	-
bit7	Fault reset	0 → 1: Execute fault reset
bit8	Halt	0: Maintain current operating status1: Halt

Status Word (6041h) Definition in HM Mode

Bit Position	Function	Description
bit0	Ready to switch on	0: Invalid, 1: Valid
bit1	Switched on	0: Invalid, 1: Valid
bit2	Operation enabled	0: Invalid, 1: Valid
bit3	Fault	0: Invalid, 1: Valid
bit4	Voltage enabled	0: Invalid, 1: Valid
bit5	Quick stop	0: Invalid, 1: Valid
bit6	Switch on disabled	0: Invalid, 1: Valid
bit7	Warning	0: No warning, 1: Warning present
bit8	-	-
bit9	Remote	0: Invalid 1: Valid, control word takes effect
bit10	Target reached	0: Motion not completed 1: Target reached, positioning or homing interrupted
bit11	Internal limit active	This bit is invalid and always 0 during homing; set after homing completion or limit trigger under non-enable state.0: Position not out of limit1: Position over limit
bit12	Homing attained	0: Home signal not detected 1: Home signal detected[1]
bit13	Homing error	0: No error during homing 1: Error occurred during homing
bit14	Zero motion parameter	Bit14=1 when essential motion parameters are 0.Bit set to 1 if any

		of the following conditions is met:• Both home fast speed (6099-01h) & home slow speed (6099-02h) = 0 • Home method (6098h) = 0• Home acceleration/deceleration (609Ah) = 0
bit15	Homing finished	0: Homing not completed 1: Homing completedIn absolute position mode, this bit remains 1 after homing completion

[1]: To determine whether the origin movement has been completed, one must check whether both bits 10 and 12 are set.

Conditions for HM Motion Error Occurrence

Trigger Condition	Remarks
Absolute Encoder Homing Motion	Bit 4 of Control Word (6040h) changes from 0 to 1
Two Limit Signals Detected	Both positive and negative limit signals are detected simultaneously during HM motion
Negative Limit Active When Using Positive Limit Method	Negative limit signal is active under homing methods 2, 7~10, 23~26
Positive Limit Active When Using Negative Limit Method	Positive limit signal is active under homing methods 1, 11~14, 27~30
Limit Signal Active When Not Using Limit Signal Method	Limit signal is active under homing methods 3, 4, 19, 20
Limit/Homing Signal Triggered When Only Using Z-Signal Method	Limit signal or homing signal is active under homing methods 33, 34

■ Basic parameter objects (recommended configuration objects)

Data Direction [1]	Index + Sub-index	Name	Data Type	Access Type	Unit	Remarks
Output (RXPDO)	6040-00h	Control Word	U16	RW	-	Mandatory
	6098-00h	Homing Method	I8	RW	-	Optional
	6099-01h	Homing Fast Speed	U32	RW	Unit/s	Optional
	6099-02h	Homing Slow Speed	U32	RW	Unit/s	Optional
	609A-00h	Homing Acceleration	U32	RW	Unit/s 2	Optional
	607C-00h	Homing Offset	I32	RW	Unit	Optional
Input (TXPDO)	6041-00h	Status Word	U16	RO	-	Mandatory
	603F-00h	Error Code	U16	RO	-	Optional
	6064-00h	Position Feedback	I32	RO	Unit	Optional
	606C-00h	Velocity Feedback	I32	RO	Unit/s	Optional
	60F4-00h	Position Error	I32	RO	Unit	Optional
	6077-00h	Actual Torque	I16	RO	0.1%	Optional

[1]: The data flow is defined with the master server as the reference point: output flows from the master server to the slave server, and input flows from the slave server to the master server.

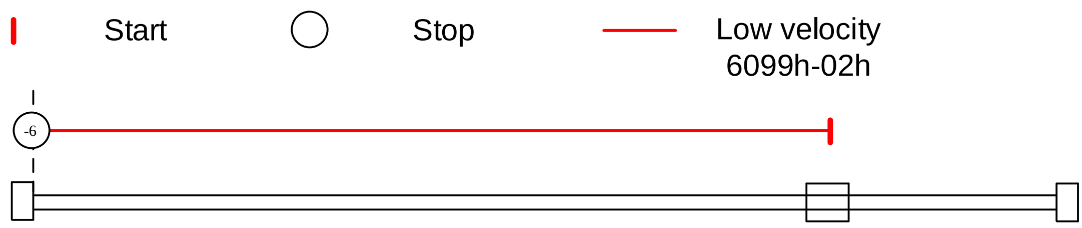
■ Extension parameter object

Index + Sub-index	Name	Data Type	Access Type	Unit
603F-00h	Latest Error Code	U16	RO	-
6060-00h	Operating Mode	I8	RW	-
6061-00h	Operating Mode Display	I8	RO	-
6062-00h	Internal Command Position	I32	RO	Unit
606B-00h	Internal Command Velocity	I32	RO	Unit
608F-01h	Encoder Resolution	U32	RO	P
6091-01h	Electronic Gear Ratio Numerator	U32	RW	-
6091-02h	Electronic Gear Ratio Denominator	U32	RW	-
6092-01h	Required Command Pulses Per Motor Revolution	U32	RW	-

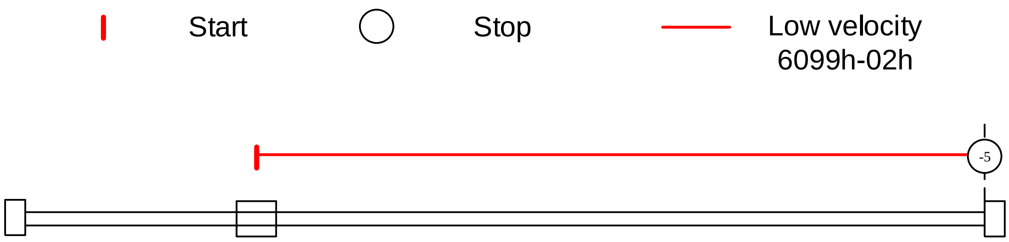
5.11.4 Homing action introduction

Torque limiting mode

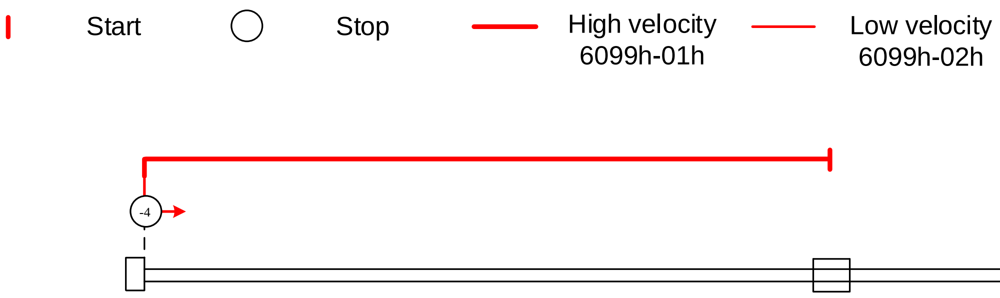
Mode-6: Search for homing point in **negative direction** at **low velocity**. Stop after torque reaches the value set in P30.09 and homing done signal is delivered.



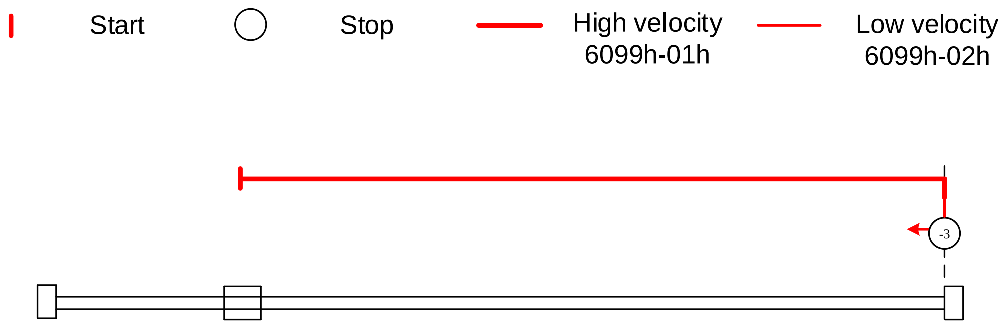
Mode -5: Search for homing point in **positive direction** at **low velocity**. Stop after torque reaches the value set in P30.09 and homing done signal is delivered.



Mode -4: Search for homing point in **negative direction** at **high velocity**. Move in **positive direction** after torque reaches the value set in P30.09, stops when torque is gone. Homing done signal delivers after the time value.

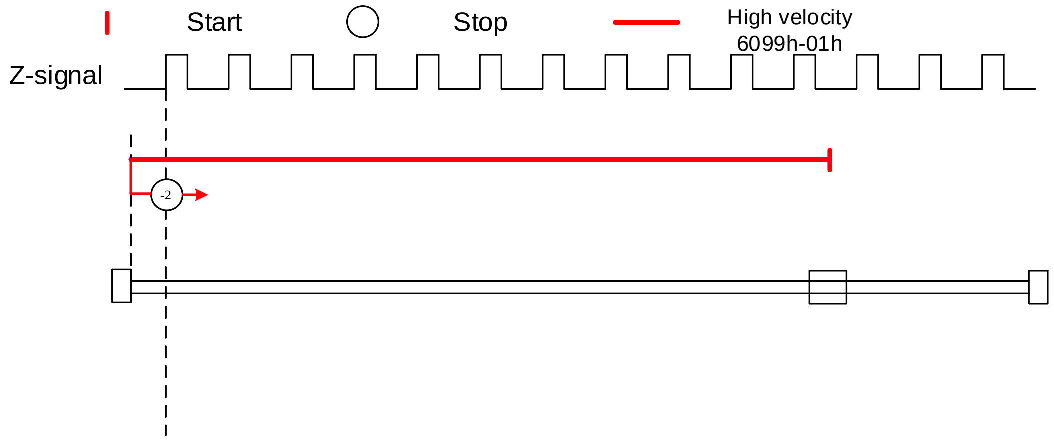


Mode -3: Search for homing point in **positive direction** at **high velocity**. Move in **negative direction** after torque reaches the value set in P30.09, stops when torque is gone.

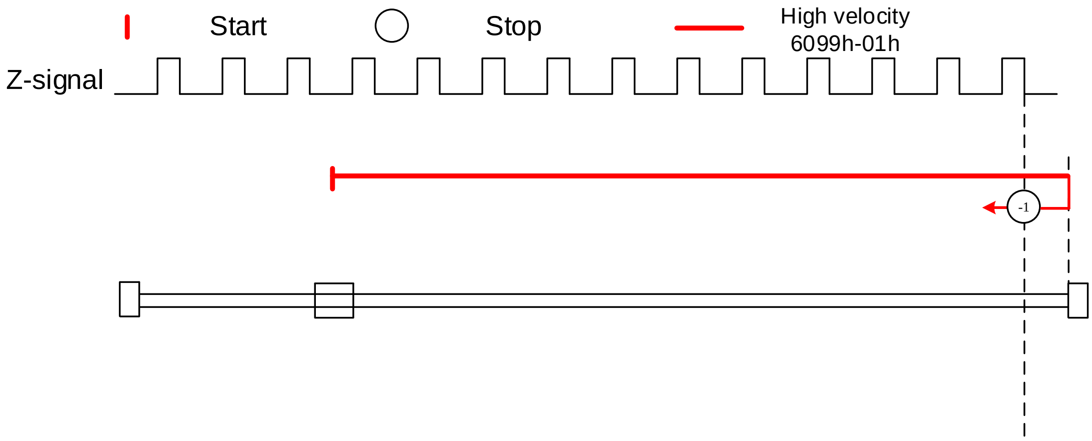


Torque limiting + Z-signal mode

Mode -2: Search for homing point in **negative direction** at **high velocity**. Move in **positive direction** after torque reaches the value set in P30.09, stops when torque is gone with the **first Z-signal**.



Mode -1: Search for homing point in **positive direction** at **high velocity**. Move in **negative direction** after torque reaches the value set in P30.09, stops when torque is gone with the **first Z-signal**.



Limit switch signal + Z-signal mode

Mode 1:

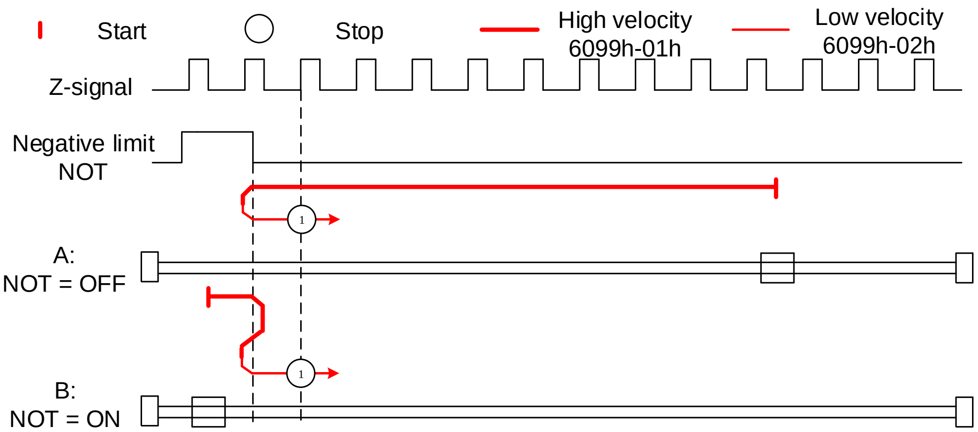
Diagram A: *Negative limit switch = OFF*

1. Move in **negative direction** at **high velocity** until **negative limit switch valid.**
2. Move in **positive direction** at **low velocity** and stops **after negative limit switch** and **first encoder Z-signal valid**

Diagram B: *Negative limit switch = ON*

1. Start to move at **negative limit switch position** in **positive direction** at **high velocity** until **negative limit switch invalid.**
2. Move in **negative direction** at **high velocity** until **negative limit switch valid.**
3. Move in **positive direction** at **low velocity** and stops **after negative limit switch** and **first encoder Z-signal valid**

If the positive limit signal is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop Immediately.



Mode 2:

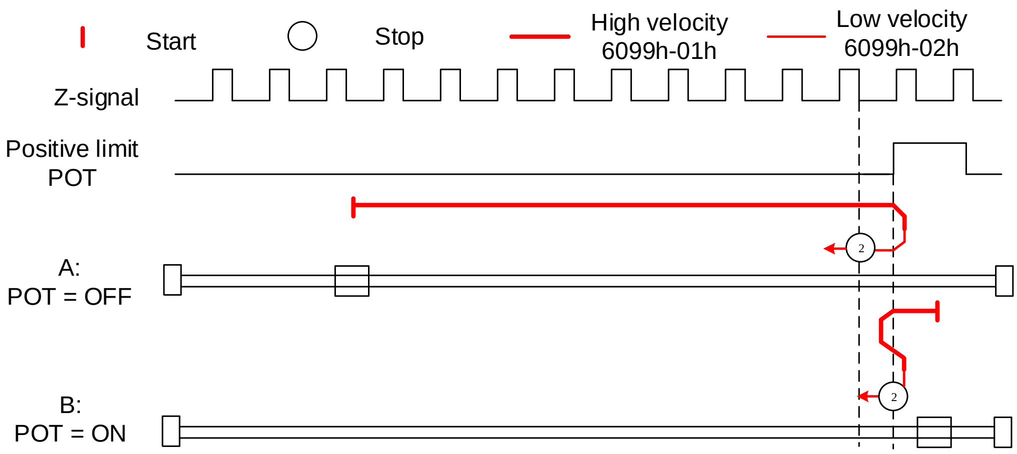
Diagram A: *Positive limit switch = OFF*

1. Move in **positive direction** at **high velocity** until **positive limit switch valid.**
2. Move in **negative direction** at **low velocity** and stops **after positive limit switch** and **first encoder Z-signal valid**

Diagram B: *Positive limit switch = ON*

1. Start to move at **positive limit switch position** in **negative direction** at **high velocity** until **positive limit switch invalid.**
2. Move in **positive direction** at **high velocity** until **positive limit switch valid.**
3. Move in **negative direction** at **low velocity** and stops **after positive limit switch** and **first encoder Z-signal valid**

If the negative limit signal is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop Immediately.



Homing switch signal + Z-signal mode

Mode 3:

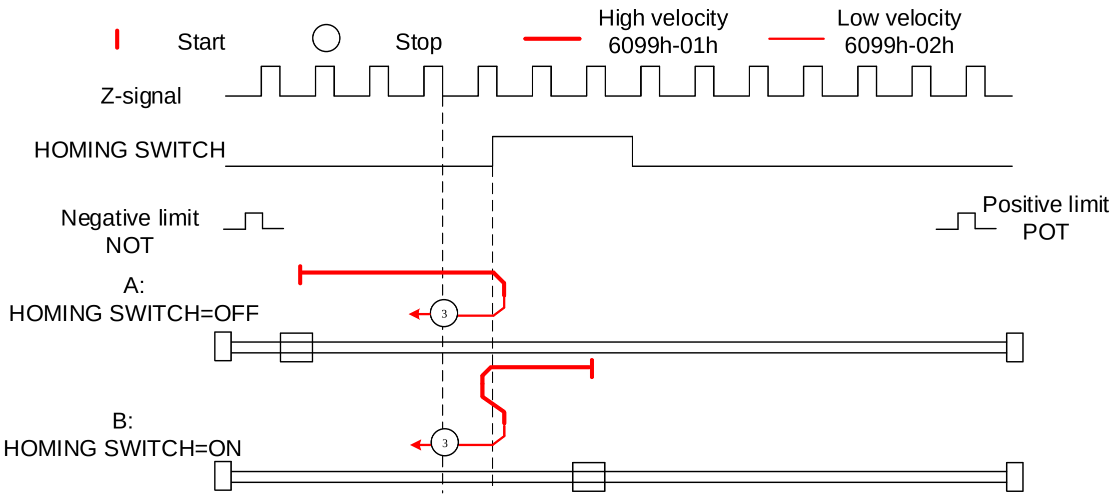
Diagram A: *Homing switch = OFF*

1. Move in **positive direction** at **high velocity** until **homing switch valid.**
2. Move in **negative direction** at **low velocity** and stops **after homing switch** and **first encoder Z-signal valid**

Diagram B: *Homing switch = ON*

1. Start to move at **homing switch position** in **negative direction** at **high velocity** until **after homing switch.**
2. Move in **positive direction** at **high velocity** until **homing switch valid.**
3. Move in **negative direction** at **low velocity** and stops **after homing switch** and **first encoder Z-signal valid**

If the positive/negative limit switch signal is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop Immediately.



Mode 4:

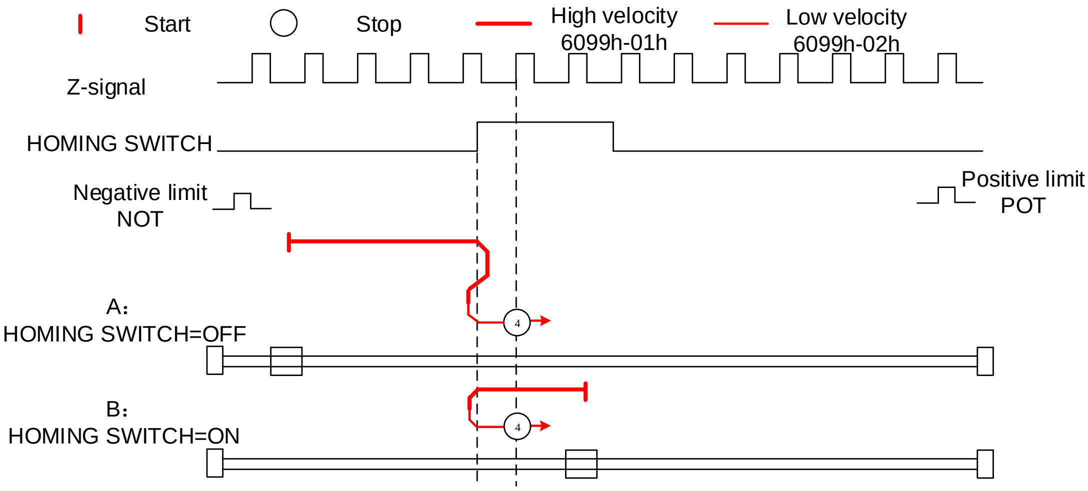
Diagram A: *Homing switch = OFF*

1. Move in **positive direction** at **high velocity** until **homing switch valid.**
2. Move in **negative direction** at **high velocity** until **homing switch invalid.**
3. Move in **positive direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid**

Diagram B: *Homing switch = ON*

1. Start to move at **homing switch position** in **negative direction** at **high velocity** until **after homing switch.**
2. Move in **positive direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid**

If the positive/negative limit switch signal is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop Immediately.



Mode 5:

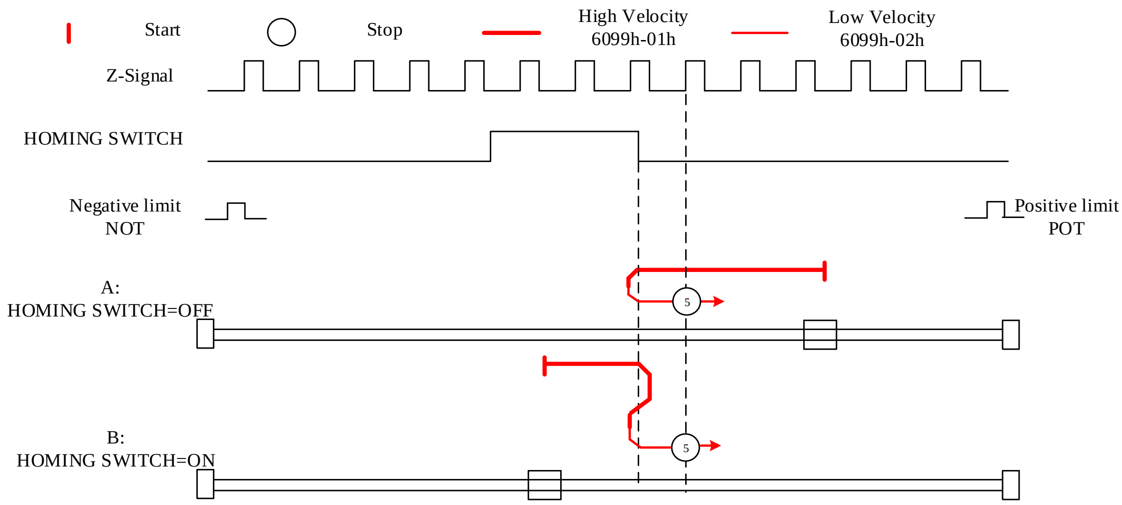
Diagram A: *Homing switch = OFF*

1. Move in **negative direction** at **high velocity** until **homing switch valid.**
2. Move in **positive direction** at **low velocity** and stops **after homing switch** and **first encoder Z-signal valid**

Diagram B: *Homing switch = ON*

1. Start to move at **homing switch position** in **positive direction** at **high velocity** until **after homing switch.**
2. Move in **negative direction** at **high velocity** until **homing switch valid.**
3. Move in **positive direction** at **low velocity** and stops **after homing switch** and **first encoder Z-signal valid**

If the positive/negative limit switch signal is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop Immediately.



Mode 6:

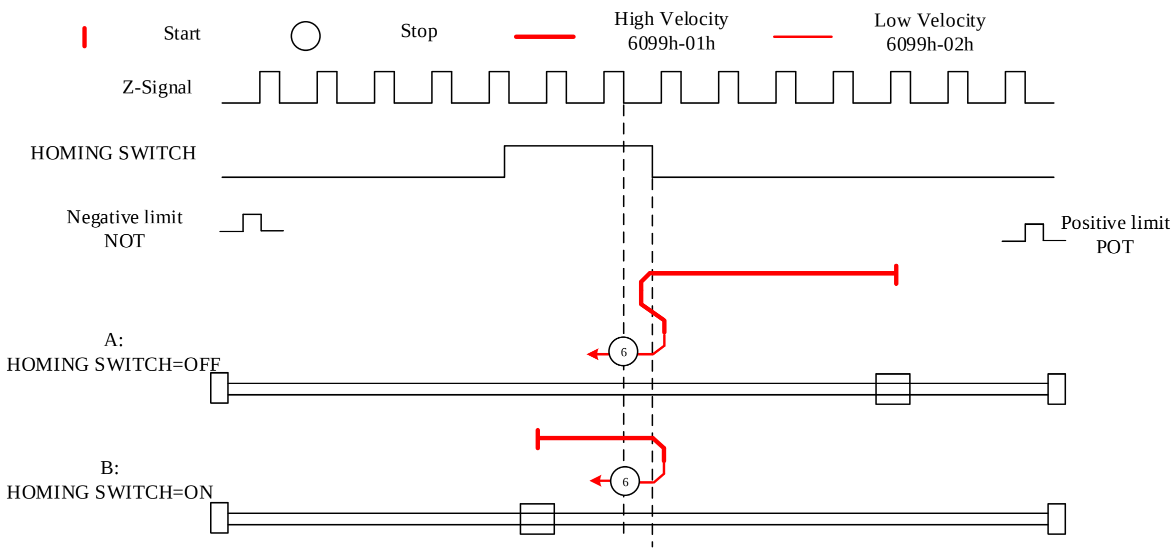
Diagram A: *Homing switch = OFF*

1. Move in **negative direction** at **high velocity** until **homing switch valid.**
2. Move in **positive direction** at **high velocity** until **homing switch invalid.**
3. Move in **negative direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid**

Diagram B: *Homing switch = ON*

1. Start to move at **homing switch position** in **positive direction** at **high velocity** until **after homing switch.**
2. Move in **negative direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid**

If the positive/negative limit switch signal is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop Immediately.



Limit switch signal + homing switch signal + Z-signal mode

Mode 7

Diagram A: *Homing switch & positive limit switch = OFF*

1. Move in **positive direction** at **high velocity** until **homing switch valid.**
2. Move in **negative direction** at **low velocity** and stops after **homing switch** and **first encoder Z-signal valid.**

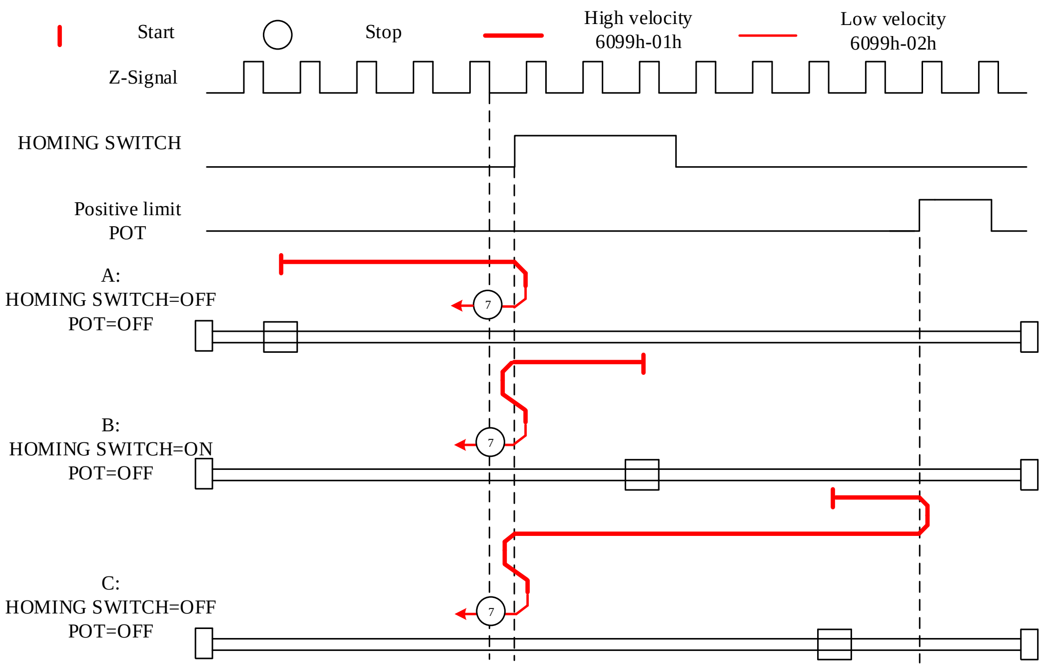
Diagram B: *Homing switch = ON, positive limit switch = OFF*

1. Start to move at **homing switch position** in **negative direction** at **high velocity** until **after homing switch.**
2. Move in **positive direction** at **high velocity** until **homing switch valid.**
3. Move in **negative direction** at **low velocity** and stops **after homing switch** and **first encoder Z-signal valid**

Diagram C: *Homing switch & positive limit switch = OFF*

1. Move in **positive direction** at **high velocity** until **positive limit switch valid.**
2. Move in **negative direction** at **high velocity** until **after homing switch.**
3. Move in **positive direction** at **high velocity** until **homing switch valid.**
4. Move in **negative direction** at **low velocity** and stops **after homing switch** and **first encoder Z signal valid**

If the negative limit switch signal is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop Immediately.



Mode 8

Diagram A: *Homing switch & positive limit switch = OFF*

1. Move in **positive direction** at **high velocity** until **homing switch valid.**
2. Move in **negative direction** at **high velocity** until **after homing switch.**
3. Move in **positive direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid.**

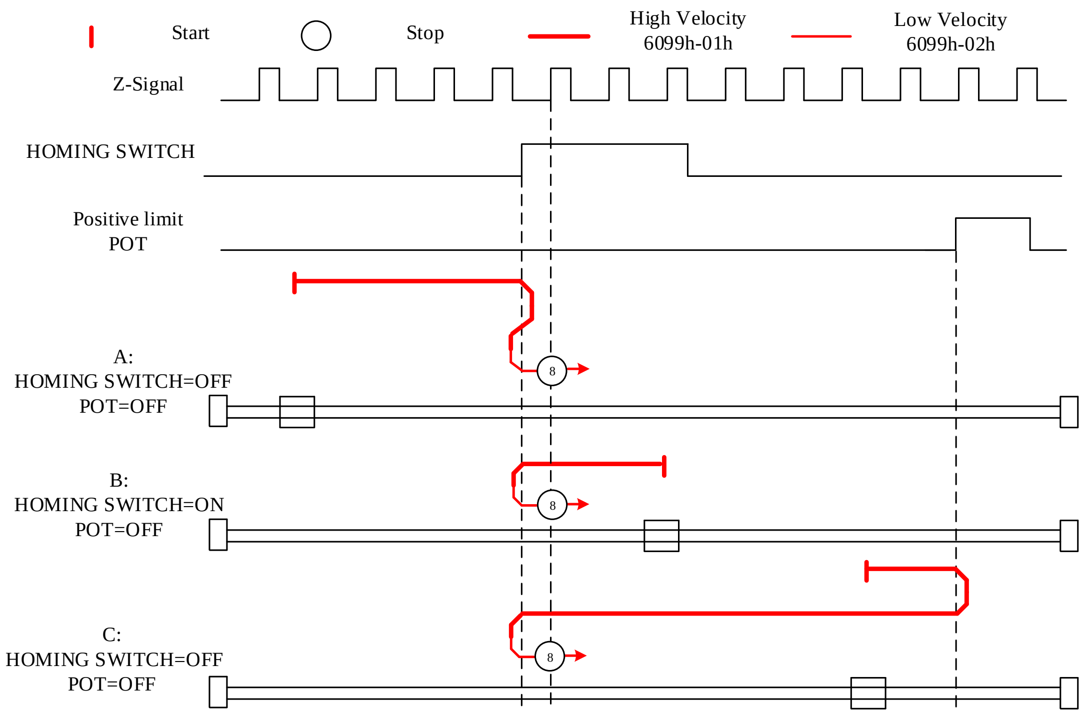
Diagram B: *Homing switch = ON, positive limit switch = OFF*

1. Start to move at **homing switch position** in **negative direction** at **high velocity** until **after homing switch.**
2. Move in **positive direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid**

Diagram C: *Homing switch & positive limit switch = OFF*

1. Move in **positive direction** at **high velocity** until **positive limit switch valid**.
2. Move in **negative direction** at **high velocity** until **after homing switch**.
3. Move in **positive direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid.**

If the negative limit switch signal is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop Immediately.



Mode 9

Diagram A: *Homing switch & positive limit switch = OFF*

1. Move in **positive direction** at **high velocity** until **after homing switch.**

2. Move in **negative direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid.**

Diagram B: *Homing switch = ON, positive limit switch = OFF*

1. Start to move at **homing switch position** in **positive direction** at **high velocity** until **homing switch invalid.**

2. Move in **negative direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid**

Diagram C: *Homing switch & positive limit switch = OFF*

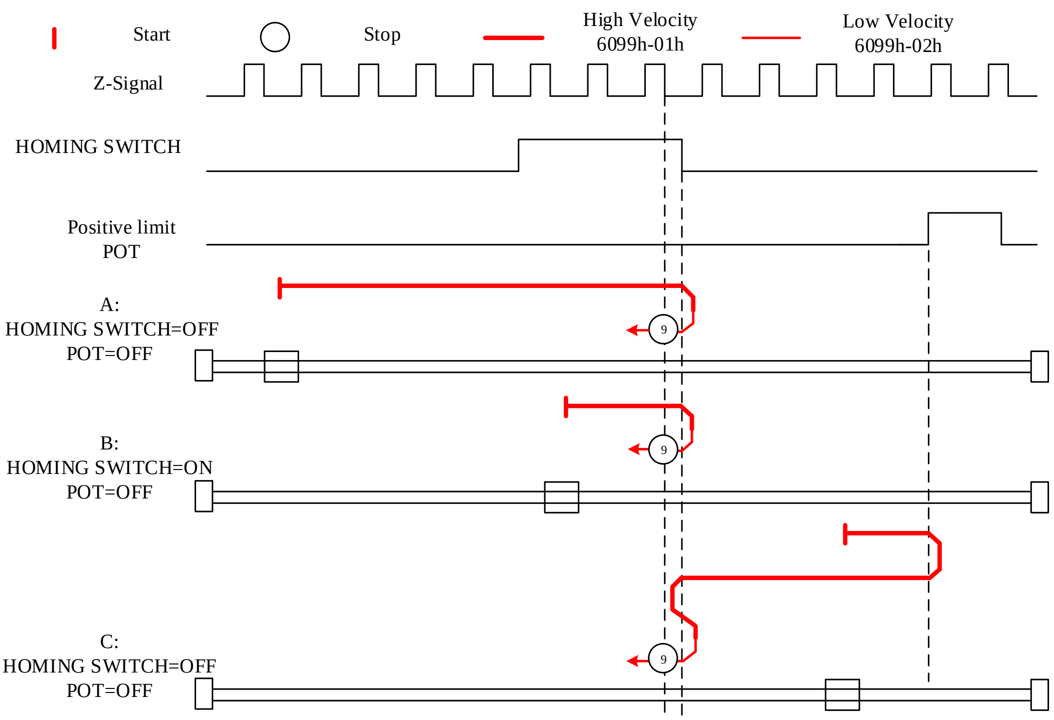
1. Move in **positive direction** at **high velocity** until **positive limit switch valid**.

2. Move in **negative direction** at **high velocity** until **homing switch valid**.

3. Move in **positive direction** at **high velocity** until **after homing switch**.

4. Move in **negative direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z signal valid**

If the negative limit switch signal is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop Immediately.



Mode 10

Diagram A: *Homing switch & positive limit switch = OFF*

1. Move in **positive direction** at **high velocity** until **after homing switch.**
2. Move in **negative direction** at **high velocity** until **homing switch valid.**
3. Move in **positive direction** at **low velocity** and stops **after homing switch** and **first encoder Z-signal valid.**

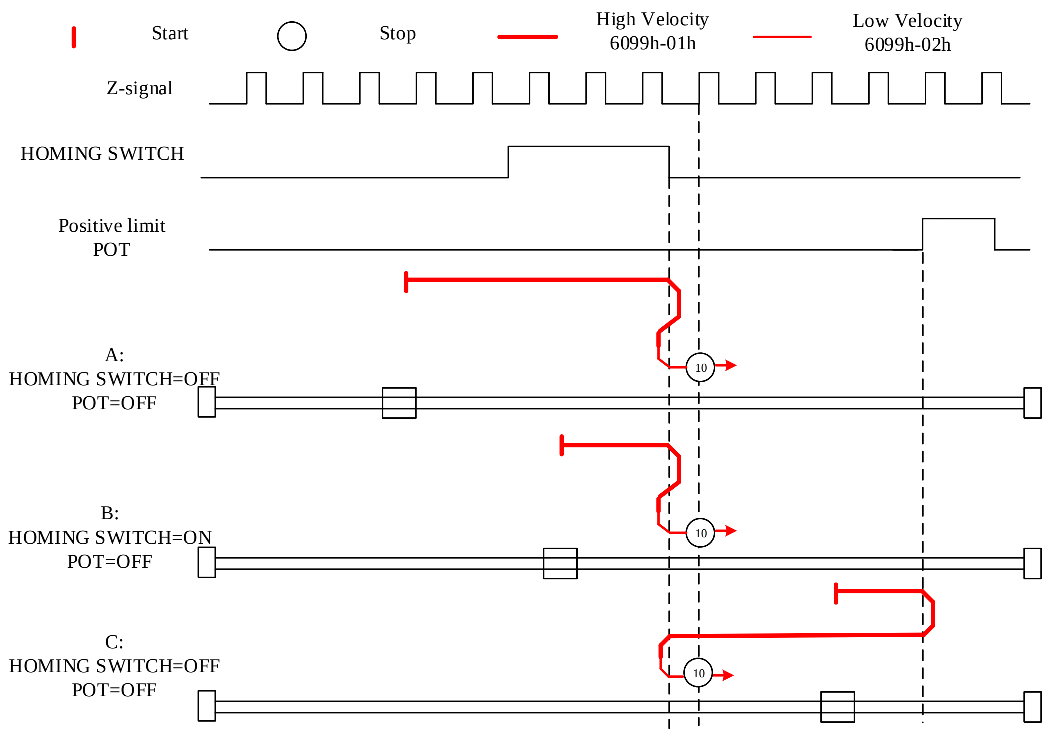
Diagram B: *Homing switch = ON, positive limit switch = OFF*

1. Start to move at **homing switch position** in **positive direction** at **high velocity** until **after homing switch.**
2. Move in **negative direction** at **high velocity** until **homing switch valid.**
3. Move in **positive direction** at **low velocity** and stops **after homing switch** and **first encoder Z-signal valid**

Diagram C: *Homing switch & positive limit switch = OFF*

1. Move in **positive direction** at **high velocity** until positive **limit switch valid**.
2. Move in **negative direction** at **high velocity** until **homing switch valid**.
3. Move in **positive direction** at **low velocity** and stops **after homing switch** and **first encoder Z signal valid**

If the negative limit switch signal is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop Immediately.



Mode 11

Diagram A: *Homing switch & negative limit switch = OFF*

1. Move in **negative direction** at **high velocity** until **homing switch valid.**
2. Move in **positive direction** at **low velocity** and stops **after homing switch** and **first encoder Z-signal valid**

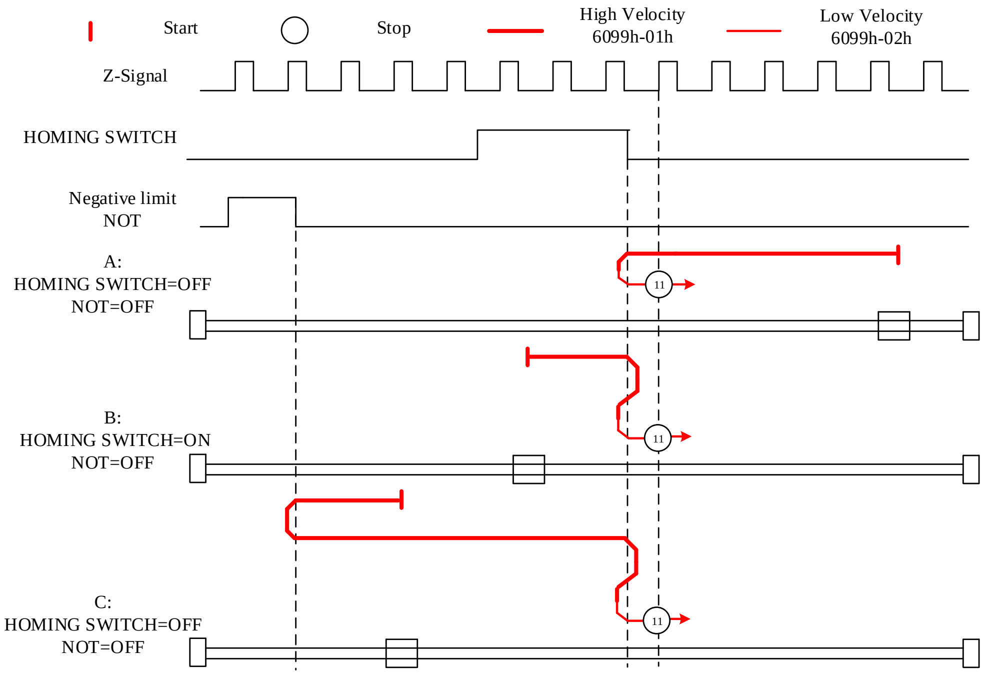
Diagram B: *Homing switch = ON, negative limit switch = OFF*

1. Start to move at **homing switch position** in **positive direction** at **high velocity** until **after homing switch.**
2. Move in **negative direction** at **high velocity** until **homing switch valid.**
3. Move in **positive direction** at **low velocity** and stops **after homing switch** and **first encoder Z-signal valid**

Diagram C: *Homing switch & negative limit switch = OFF*

1. Move in **negative direction** at **high velocity** until the **negative limit switch valid**.
2. Move in **positive direction** at **high velocity** until **homing switch invalid**.
3. Move in **negative direction** at **high velocity** until **homing switch valid**.
4. Move in **positive direction** at **low velocity** and stops **after homing switch** and **first encoder Z signal valid**

If the positive limit switch signal is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop Immediately.



Mode 12

Diagram A: *Homing switch & negative limit switch = OFF*

1. Move in **negative direction** at **high velocity** until **homing switch valid.**
2. Move in **positive direction** at **high velocity** until **after homing switch.**
3. Move in **negative direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid**

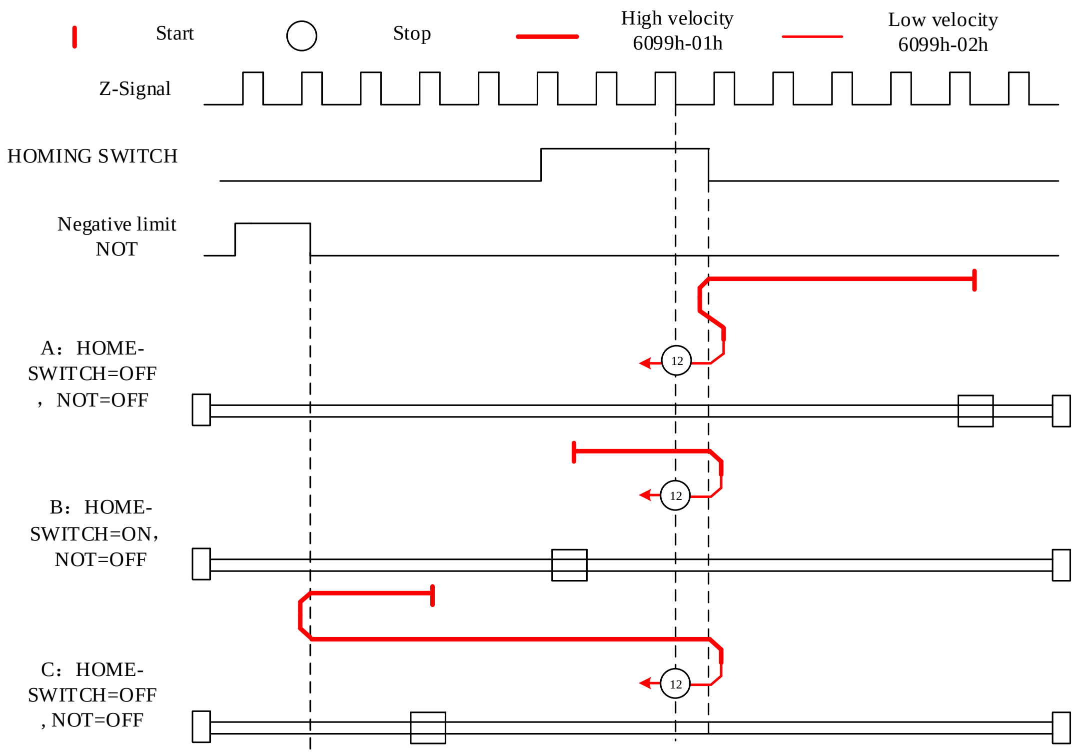
Diagram B: *Homing switch = ON, negative limit switch = OFF*

1. Move at **homing switch position** in **negative direction** at **high velocity** until **after homing switch**.
2. Move in **positive direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid.**

Diagram C: *Homing switch & negative limit switch = OFF*

1. Move in **negative direction** at **high velocity** until **negative limit switch valid.**
2. Move in **positive direction** at **high velocity** until **after homing switch**.
3. Move in **negative direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid.**

If the positive limit switch signal is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop Immediately.



Mode 13

Diagram A: *Homing switch & negative limit switch = OFF*

1. Move in **negative direction** at **high velocity** until **after homing switch**.

2. Move in **positive direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid**.

Diagram B: *Homing switch = ON, negative limit switch = OFF*

1. Start to move at **homing switch position** in **negative direction** at **high velocity** until **after homing switch.**

2. Move in positive **direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid.**

Diagram C: *Homing switch & negative limit switch = OFF*

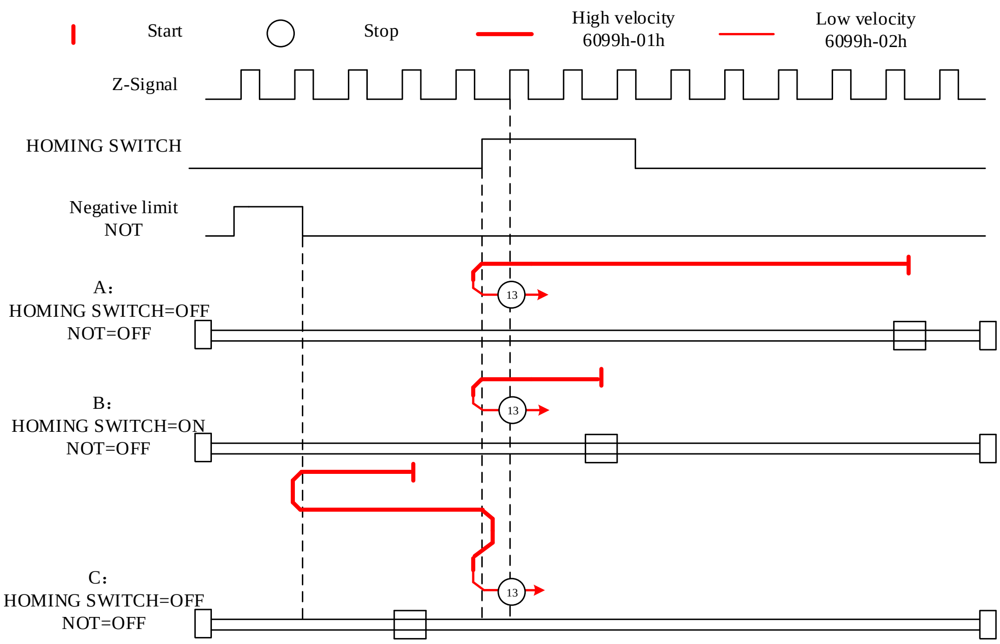
1. Move in **negative direction** at **high velocity** until **negative limit switch valid**.

2. Move in **positive direction** at **high velocity** until **homing switch valid**.

3. Move in **negative direction** at **high velocity** until **after homing switch**.

4. Move in **positive direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid.**

If the positive limit switch signal is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop Immediately.



Mode 14

Diagram A: *Homing switch & negative limit switch = OFF*

1. Move in negative direction at high velocity until after homing switch.
2. Move in positive direction at high velocity until homing switch valid.
3. Move in negative direction at low velocity and stops after homing switch and first encoder Z-signal valid.

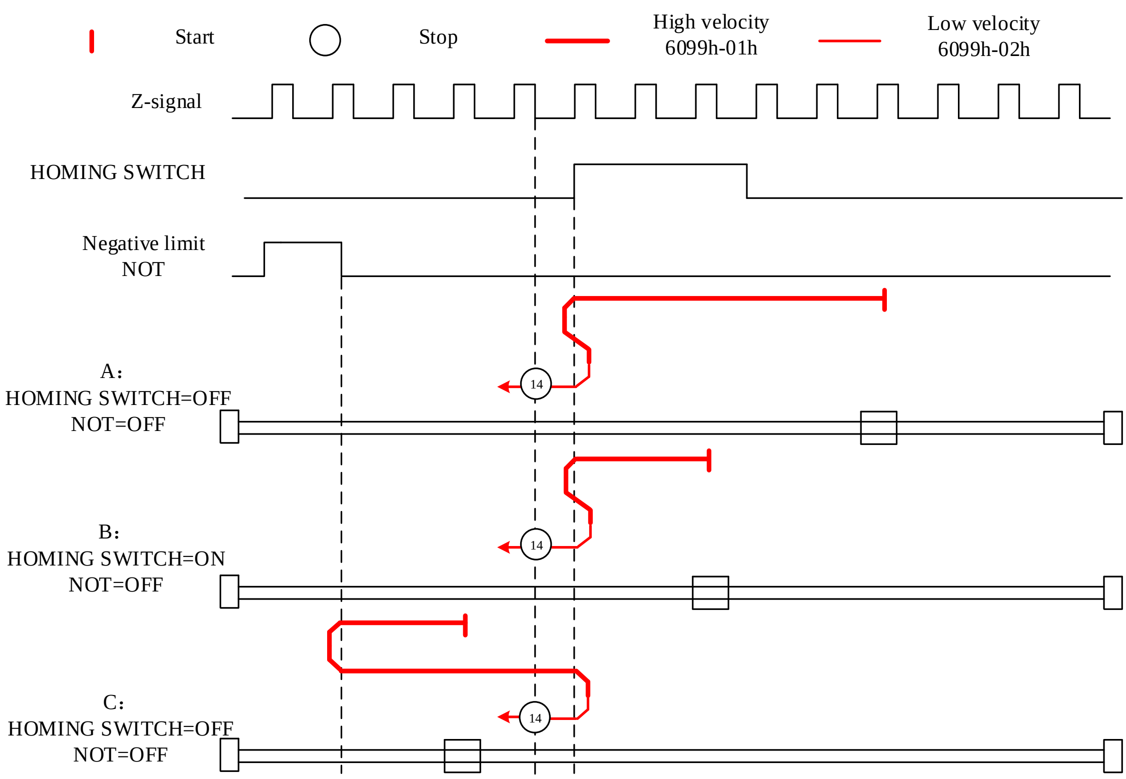
Diagram B: *Homing switch = ON, negative limit switch = OFF*

1. Start to move at homing switch position in negative direction at high velocity until homing switch invalid.
2. Move in positive direction until homing switch valid.
3. Move in negative direction at low velocity and stops after homing switch and first encoder Z signal valid.

Diagram C: *Homing switch & negative limit switch = OFF*

1. Move in negative direction at high velocity until negative limit switch valid.
2. Move in positive direction at high velocity until homing switch valid.
3. Move in negative direction at low velocity and stops after homing switch and first encoder Z-signal valid.

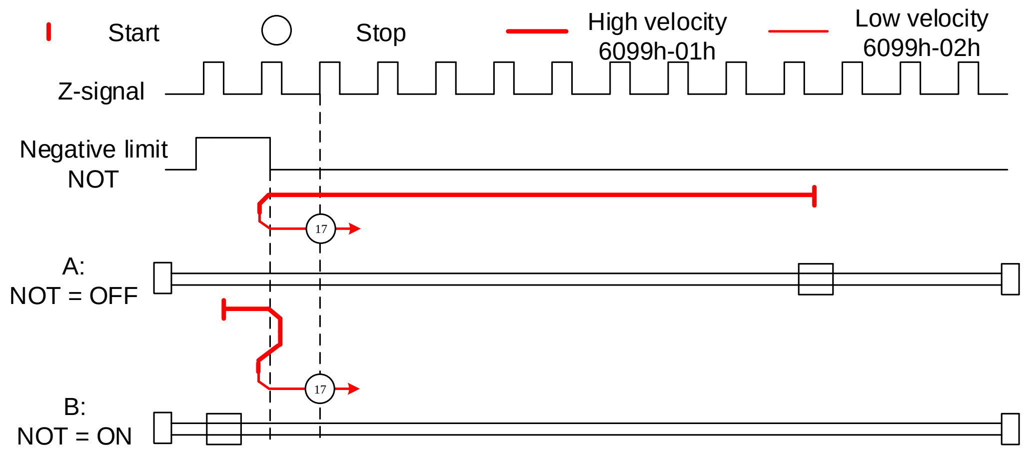
If the positive limit switch signal is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop Immediately.



Limit switch signal triggering detection mode

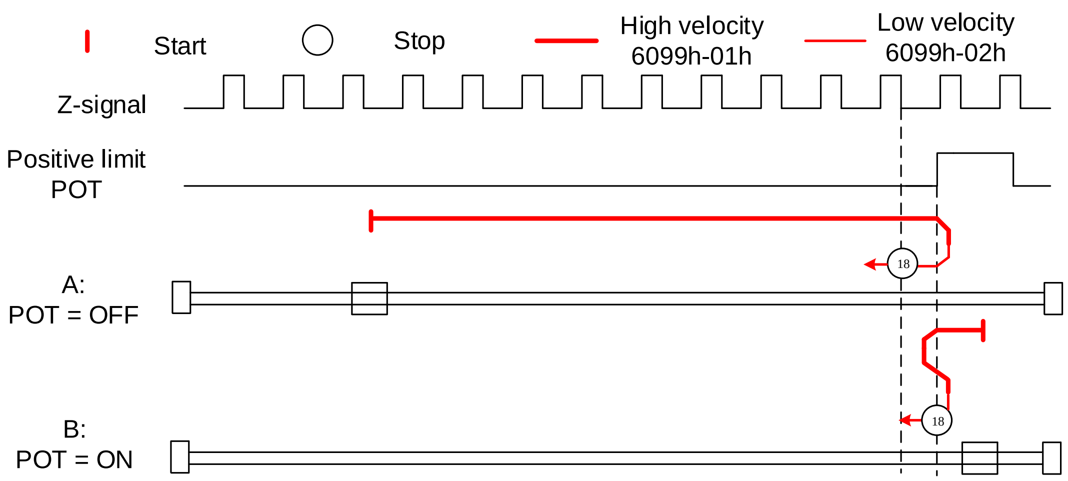
Mode 17:

This mode is similar to mode 1. Only difference is that homing point detection is not through Z-signal but through triggering of negative limit switch signal



Mode 18:

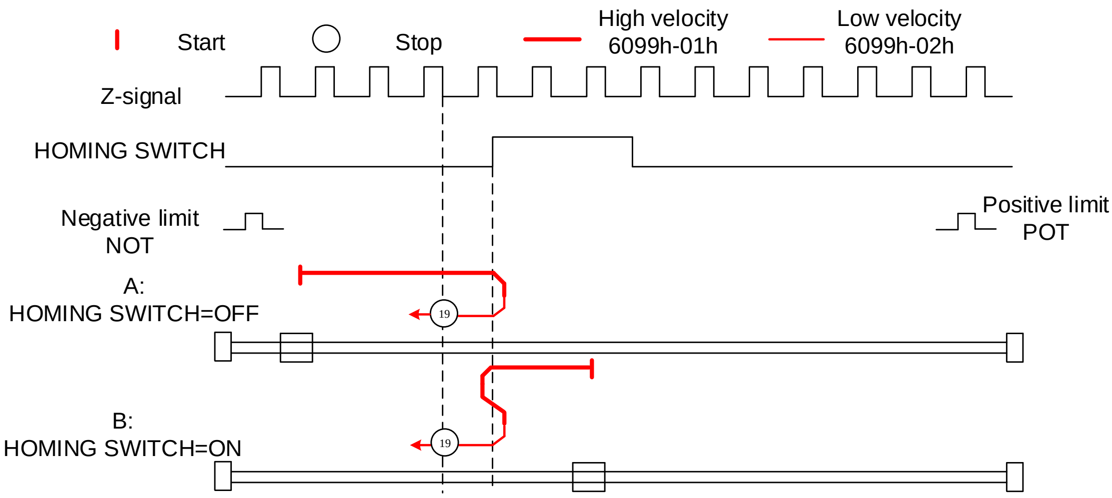
This mode is similar to mode 2. Only difference is that homing point detection is not through Z-signal but through switching of positive limit switch signal



Homing switch signal triggering detection mode

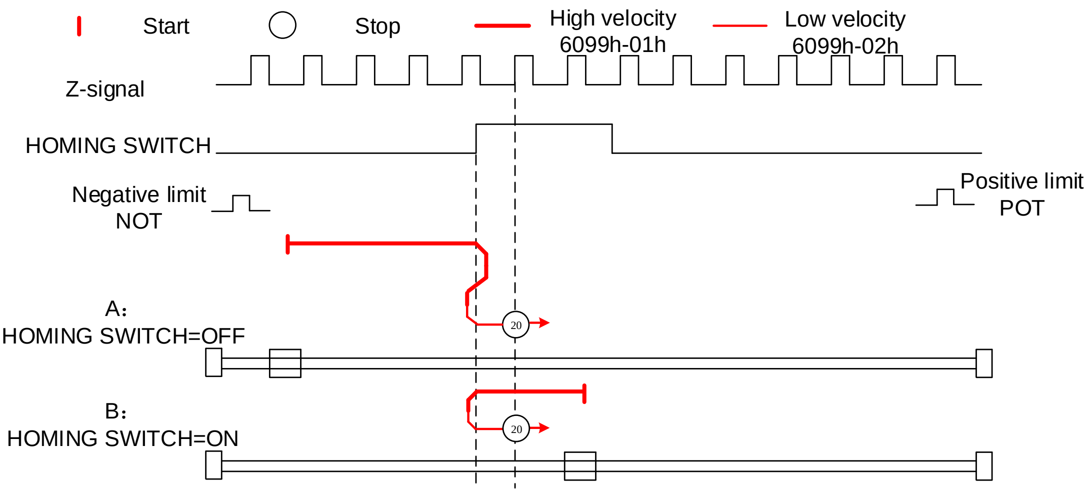
Mode 19:

This mode is similar to mode 3. Only difference is that homing point detection is not through Z-signal but through triggering of homing switch signal



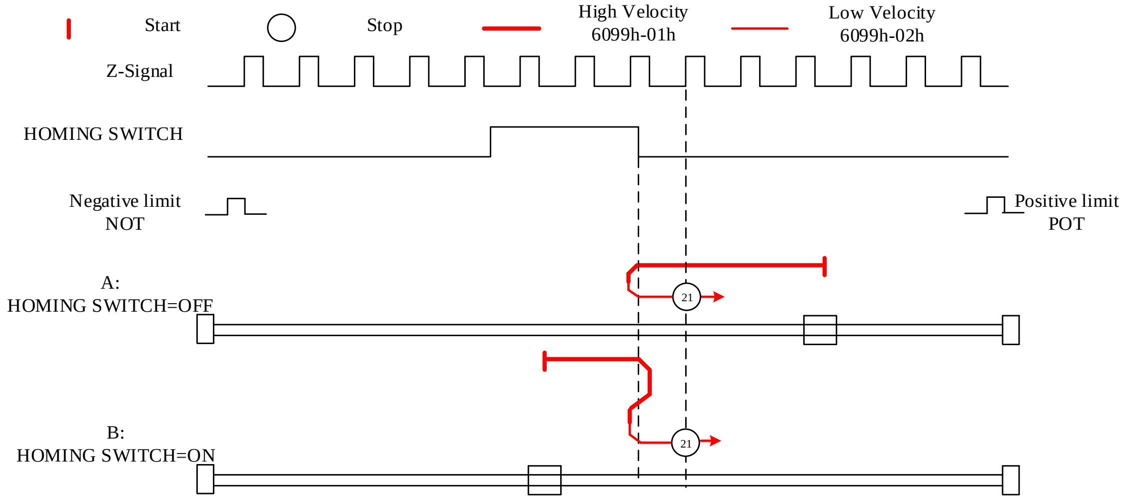
Mode 20:

This mode is similar to mode 4. Only difference is that homing point detection is not through Z-signal but through triggering of homing switch signal



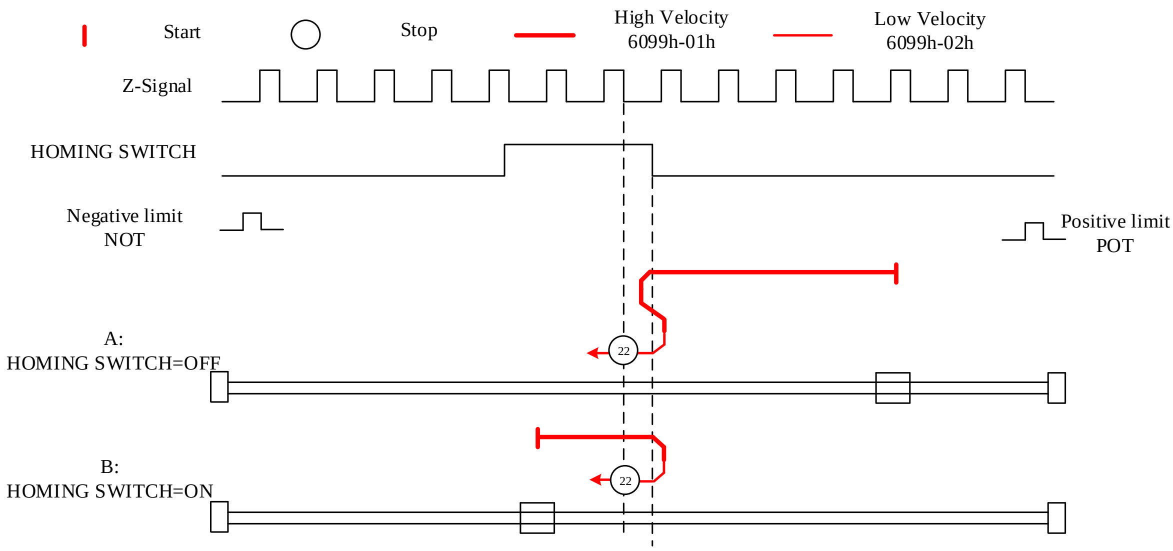
Mode 21:

This mode is similar to mode 5. Only difference is that homing point detection is not through Z-signal but through triggering of homing switch signal.



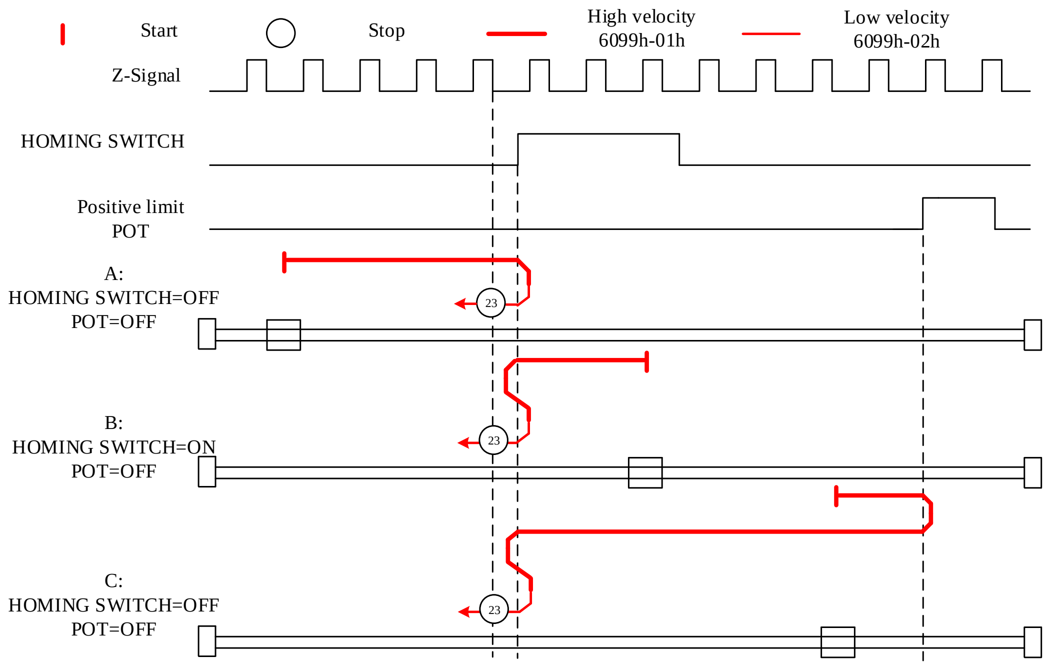
Mode 22:

This mode is similar to mode 6. Only difference is that homing point detection is not through Z-signal but through triggering of homing switch signal.



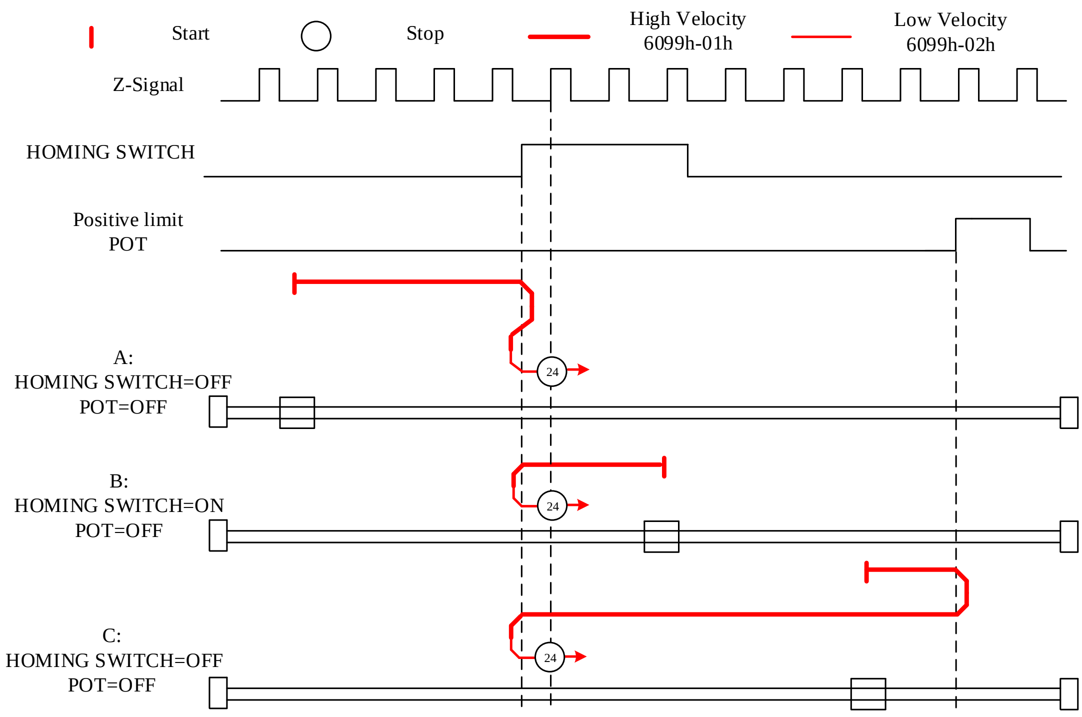
Mode 23:

This mode is similar to mode 7. Only difference is that homing point detection is not through Z-signal but through triggering of homing switch signal.



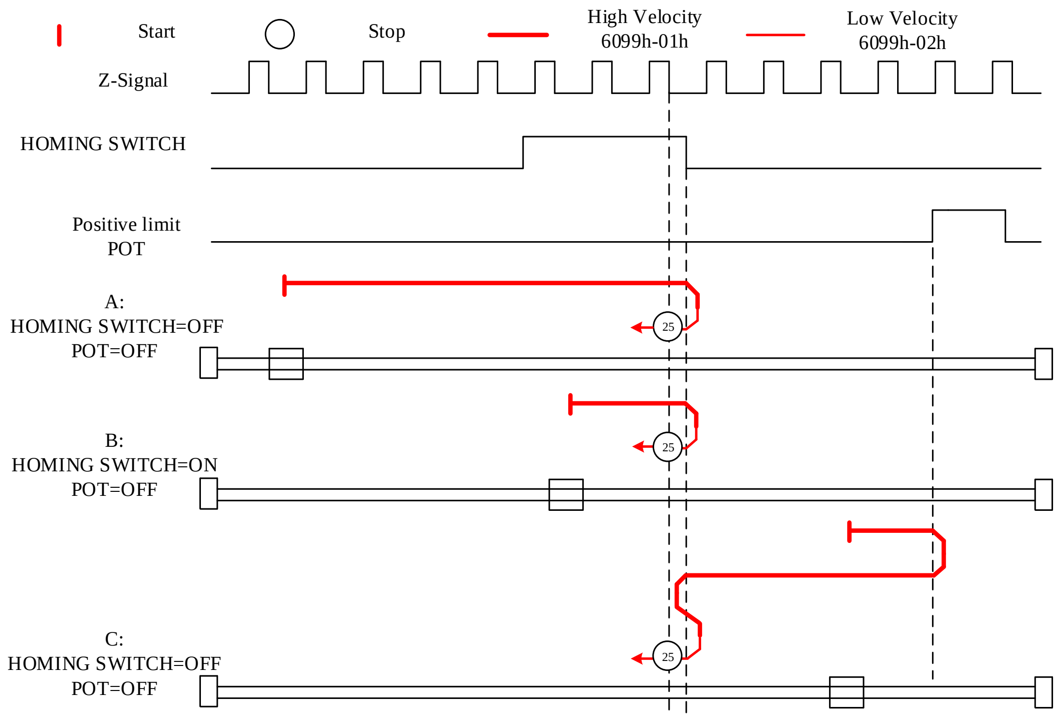
Mode 24:

This mode is similar to mode 8. Only difference is that homing point detection is not through Z-signal but through triggering of homing switch signal.



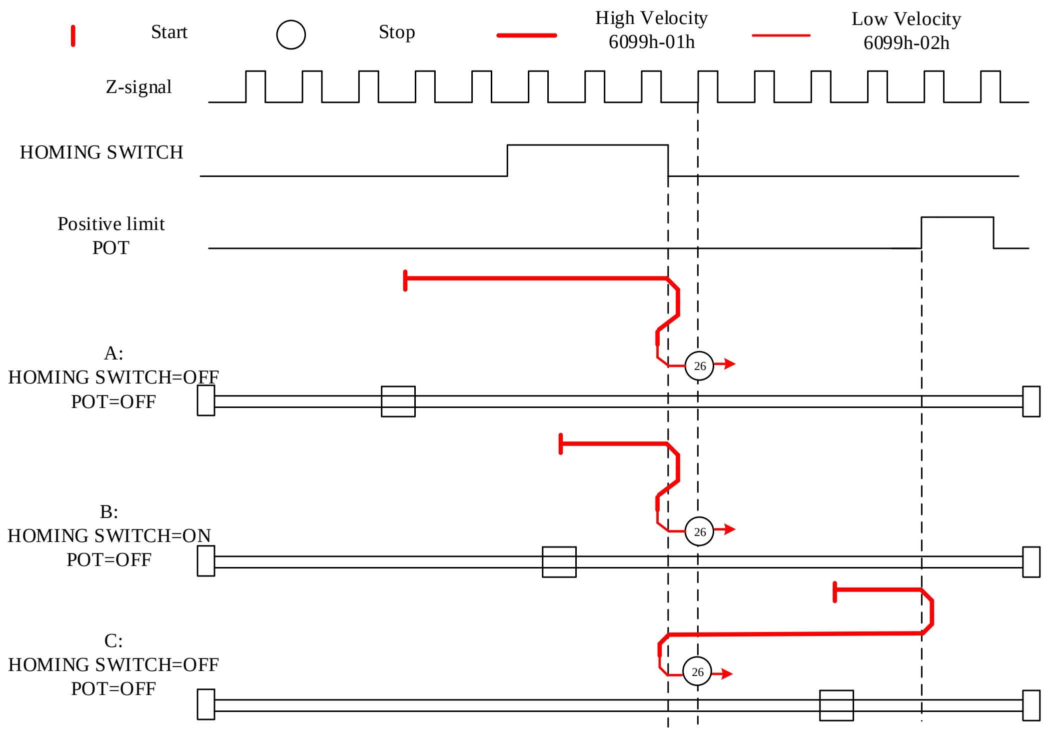
Mode 25:

This mode is similar to mode 9. Only difference is that homing point detection is not through Z-signal but through triggering of homing switch signal



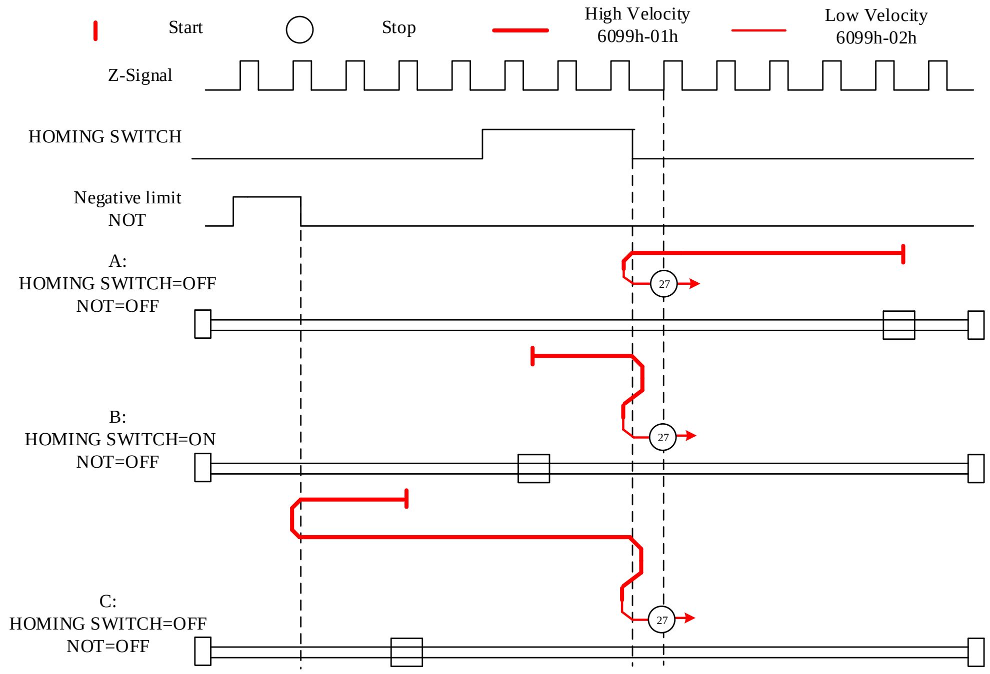
Mode 26:

This mode is similar to mode 10. Only difference is that homing point detection is not through Z-signal but through triggering of homing switch signal



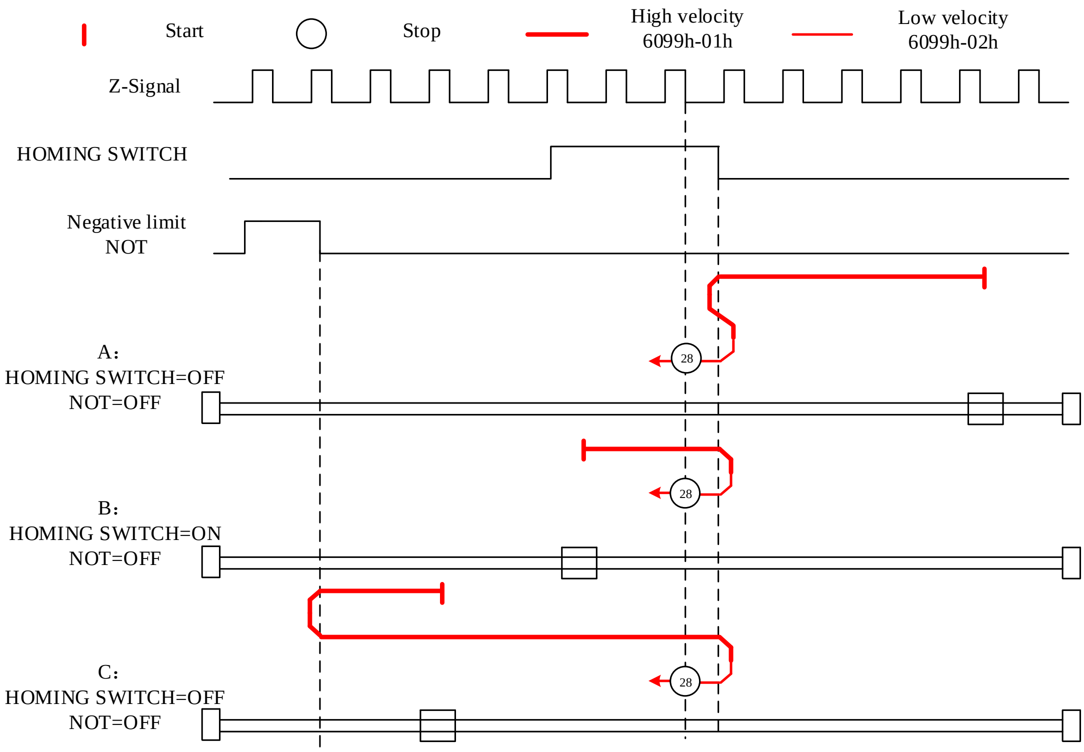
Mode 27：

This mode is similar to mode 11. Only difference is that homing point detection is not through Z-signal but through triggering of homing switch signal



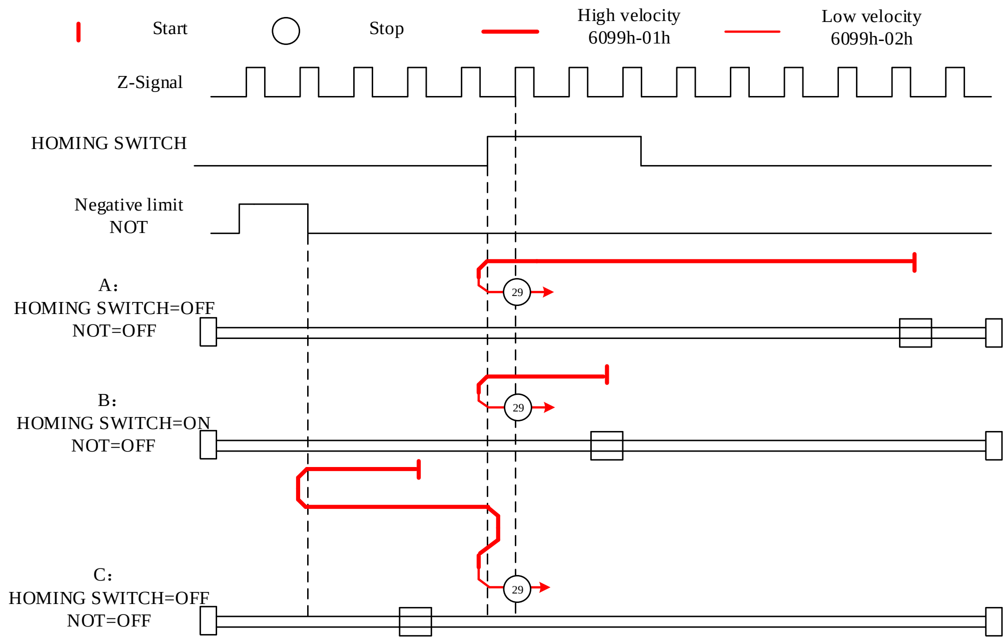
Mode 28：

This mode is similar to mode 12. Only difference is that homing point detection is not through Z-signal but through triggering of homing switch signal



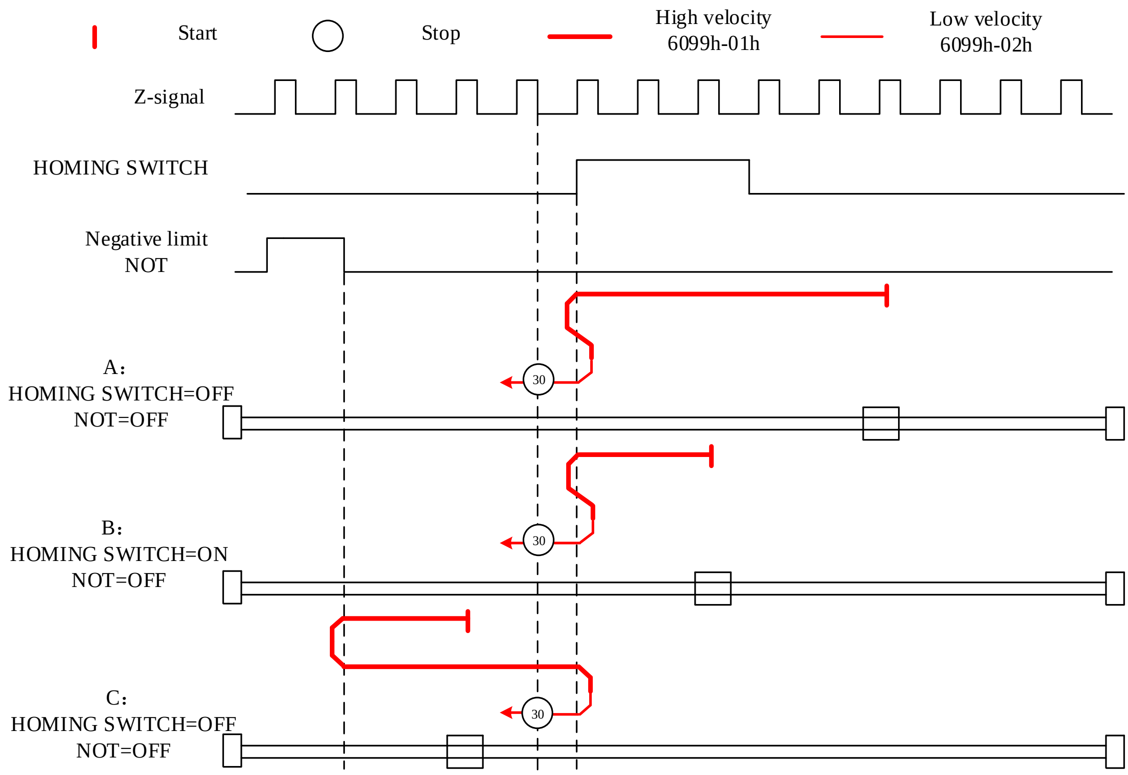
Mode 29:

This mode is similar to mode 13. Only difference is that homing point detection is not through Z-signal but through triggering of homing switch signal



Mode 30:

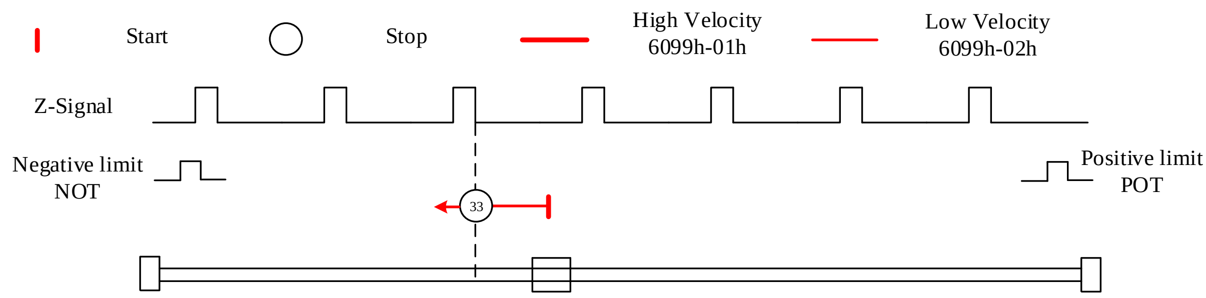
This mode is similar to mode 14. Only difference is that homing point detection is not through Z-signal but through triggering of homing switch signal



Other modes

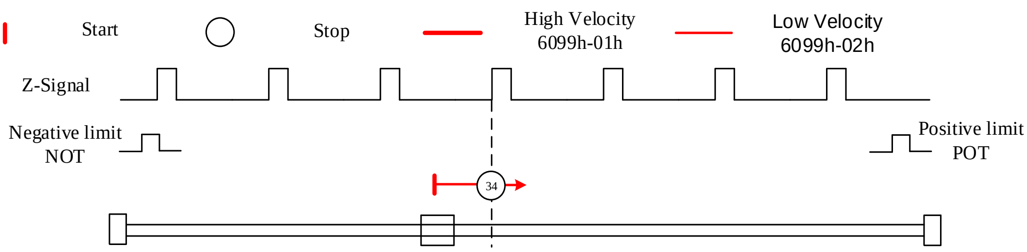
Mode 33:

The motor starts to move in **negative direction** and stops when the **Z-signal is valid**.
If the positive/negative limit switch signal or homing switch is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop Immediately.



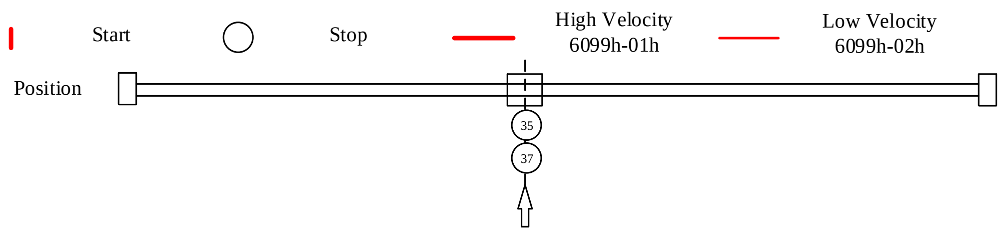
Mode 34:

The motor starts to move in **positive direction** and stops when the **Z-signal is valid**.
If the positive/negative limit switch signal or homing switch is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop Immediately.



Mode 35/37:

Set the current position as homing point. Using this mode, motor doesn't have to be enabled. Set control word 6040h bit 4 from 0 to 1.



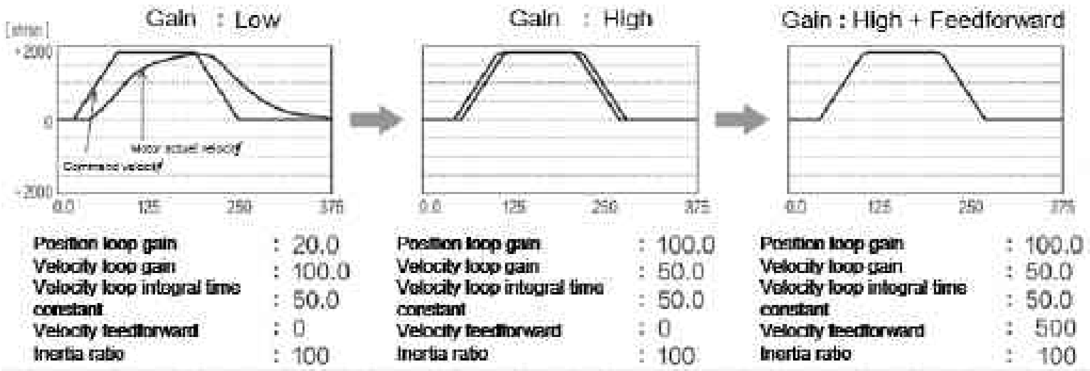
Application: Realization of homing motion

Step 1: 6060h = 6, determine if 6061h = 6. Servo driver is now under HM mode.
Step 2: Write motion parameters: Homing method 6098h, Homing velocity 6099h-01/6099h-02 and acceleration/deceleration 609Ah.
Step 3: Enable servo driver and switch bit 4 from 0 to 1 to start homing motion.

Chapter 6 Application

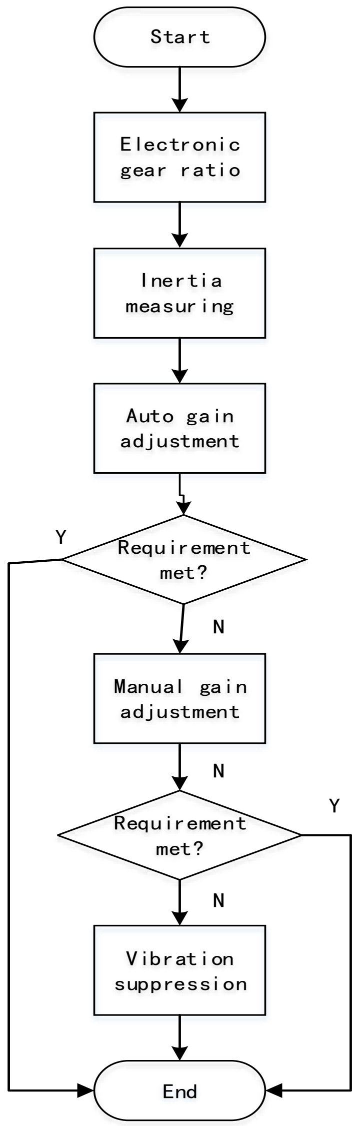
6.1 Gain Adjustment

In order for servo driver to execute commands from master device without delay and to optimize machine performance, gain adjustment has to be done.



Servo driver gain adjustment is done in combination with a few other parameters (Inertia ratio, Position loop gain, Velocity loop gain and Filters settings). These parameters will have an effect on each other so it always advisable to tune each parameter according in order to achieve optimal machine performance. Please refer to the steps below.

*Before adjusting the gain, it is advisable to carry out a test run in jog mode to ensure that the motor operates correctly.


Start
Electronic gear ratio
Inertia measuring
Auto gain adjustment
Requirement met?
Y
N
Manual gain adjustment
N
Requirement met?
Y
N
Vibration suppression
End

Gain Tuning Process	Function	Description
Inertia Identification	On-line Identification	Send commands via computer communication to drive motor motion; the drive automatically calculates the load inertia ratio
	Off-line Identification	Adopt the driver's inertia identification function; the drive automatically calculates the load inertia ratio
Automatic Gain Tuning	Automatic Gain Tuning	Real-time estimation of mechanical load characteristics, with automatic gain setting matching the estimation results. One click tuning: automatically set gain parameters and inertia matching on-site applications via the one-key tuning function of debugging software. Real-time automatic tuning: automatically adjust gain-matched parameters through the stiffness level selection function.
Manual Gain Tuning	Basic Gain	Manually adjust relevant parameters based on automatic gain tuning to optimize machine responsiveness and tracking performance.
	Basic Steps	Gain parameter tuning under position mode Gain parameter tuning under velocity mode Gain parameter tuning under torque mode
	Gain Switching Function	Switch gains via internal data or external signals to reduce stopping vibration, shorten settling time, and improve command tracking performance.
	Model Following Control	Improve responsiveness and shorten positioning time (for position control only).
	Command Filtering	Configure filtering settings for position, velocity and torque commands.
	Feedforward Gain	Enable the feedforward function to enhance tracking performance.
	Friction Compensation Function	Mitigate the impact of mechanical friction.
	Third-order Gain Switching	Based on regular gain switching, set gains for switching during the stopping phase to shorten positioning settling time.
Vibration Suppression	Mechanical Resonance	Enable the notch filter function to suppress mechanical resonance.
	Low-frequency Suppression	Enable the damping function to suppress low-frequency oscillation at the end effector.

6.2 Inertia measuring function

Inertia ratio = Total mechanical load rotational inertia / Electronic gear rotational inertia

Inertia ratio is an important parameter. Setting a suitable value can help with the precise tuning of the servo system. Inertia ratio can be set manually and also be determined automatically through servo driver

6.2.1 Online inertia determination

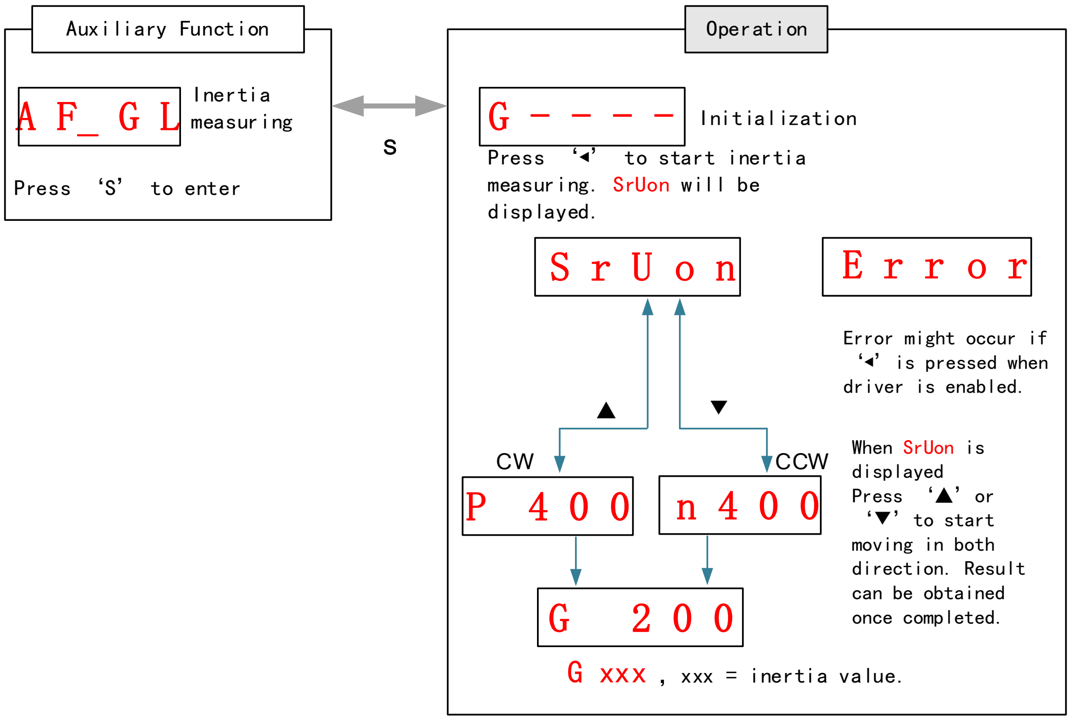
Enable motor using controller. Let motor run at above 400rpm, make sure there are acceleration, constant velocity and deceleration phase during the whole run. Cycle through 2-3 times to calculate load-inertia ratio. Result can be found on the front panel d16 or through Motion Studio system monitoring page. Enter the calculated value into P21.03 and save.

6.2.2 Offline inertia determination

Can be achieved through driver front panel or on Motion Studio.
Please make sure:
1. Servo driver is disabled.
2. Axis is within safe and allowed range and limit switch is not triggered prevent axis from over travelling.

Note:
1. Using the inertia recognition function, in order to accurately calculate the load inertia ratio, the following conditions should be met:
-Actual motor speed is greater than 300rpm, not too high to prevent crashing, it is recommended within 1000RPM.
-The motor acceleration setting is greater than 2000rpm/s;
-Motor acceleration is greater than 2000rpm/s, and the actual motor speed is greater than 300rpm and the time duration is greater than 50ms during the constant speed section;
-The load inertia ratio is within 20 times.
2. If the actual load inertia ratio is very large and the drive gain is low, it will lead to slow motor action and cannot reach the maximum speed and acceleration requirements of the motor, at this time, it can increase the speed loop gain and then re-identify the inertia. If vibration occurs during the identification process, the inertia identification should be stopped Immediately and the gain should be reduced.

6.2.3 Auxiliary function to determine inertia on front panel



Steps:

1、Set the trial run velocity **P47.25** and acceleration/declaration time **P47.29**. Value set shouldn't be too large, please keep it at around **400 r/min**.

2、Enter AF_GL for auxiliary function – Inertia ratio determination into front panel

3、Press S once to enter. "G---" will be displayed on the front panel.

4、Press ◀ once to display "StUon"

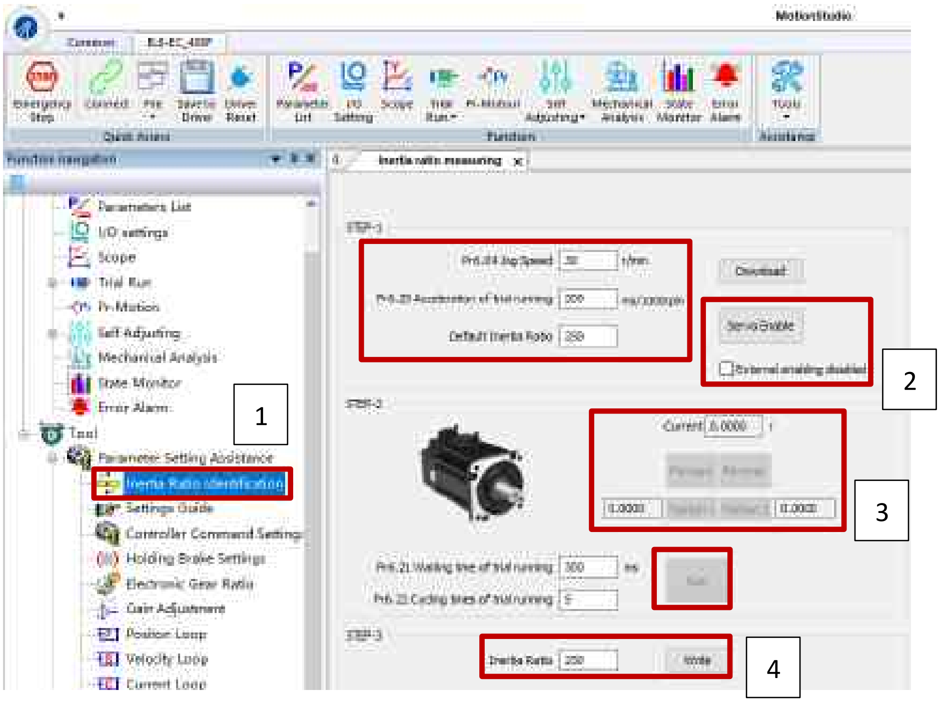
5、Press ▲ or ▼ once to start to calculate the inertia.

6、After the calculation is done, G **xxx** will be displayed and **xxx** is the value of inertia calculated.

7、Write the corresponding value into P00.04. Please refer to for parameter saving on servo driver.

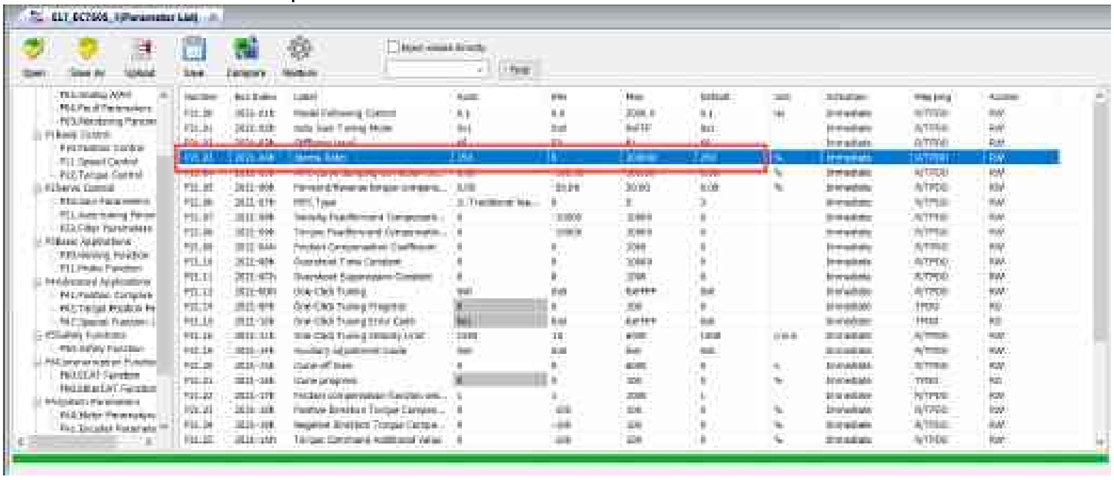
6.2.4 Inertia measuring using Motion Studio

1. Start Motion Studio and maneuver to inertia ratio identification page under performance tuning. Set trial run velocity P47.25 and acc-/deceleration time P47.29, click on 'Upload' to upload parameters to servo driver.
2. Tick "External enabling disabled" and click on "Servo Enable".
3. Click and hold "Forward" to start the motor. Current position will show motor cycles of revolution. Click on Position 1 to save current position as starting point. Click and hold "Reverse" to start the motor again. Click on Position 2 to save current position as ending point.
4. Set the waiting time between each cycle in P47.27 and no. of cycles in P47.28. Click on 'Run' and motor will run according to the parameters set.



5. After the calculation is done, inertia ratio will be calculated automatically and click on 'write' to enter the calculated value into P21.03.

6. Click on “Parameter List” to enter parameters management to check or modify P21.03. Then, click on “Save” to save parameters to driver.



Please take note:

1. *Trial run velocity and distance should be optimal to prevent any axis from bumping into objects.*
2. *It is recommended to move only in 1 direction for vertically mounted axis. Take precaution before moving the axis.*
3. *For applications with higher frictional drag, please set a minimal travel distance.*

P21.03	**Label**	Inertia ratio		**Mode**	F		
	Range	0~20000		**Default**	250	**Unit**	%
	Activation	Immediate	**Attribute**	RW		**Index**	2021-03h

P21.03=(load inertia/motor rotational inertia)×100%

Set inertia ratio according to actual load inertia. When both are uniform, actual motor velocity loop responsiveness and gain settings will be consistent. If inertia ratio is greater than actual value, velocity loop gain settings will be higher and vice versa.
For motor with high inertia, P21.03 can be left unfilled but optimal setting of P21.03 could improve system performance.

6.3 Auto gain adjustment (Auto-tuning)

6.3.1 Single-parameter tuning function

The single-parameter tuning function enables the servo drive to automatically adjust parameters—including inertia identification and vibration suppression—by setting the rigidity level, to meet the requirements for speed and stability. Advanced functions such as command filtering and low-frequency suppression can also be configured.
Recommended application scenarios for this function: Situations with small variations in load inertia. The performance of this function may be affected in cases with large inertia variations or where inertia is difficult to identify (e.g., low operating speed or excessively small acceleration).
The single-parameter tuning function delivers better performance than one-click auto-tuning but is more complex to operate. It is recommended to use one-click auto-tuning first; if the results do not meet expectations, use single-parameter tuning for further adjustments. This function can be used in scenarios with large inertia ratios (e.g., inertia ratio greater than 30:1) where one-click auto-tuning fails to achieve the desired effect.

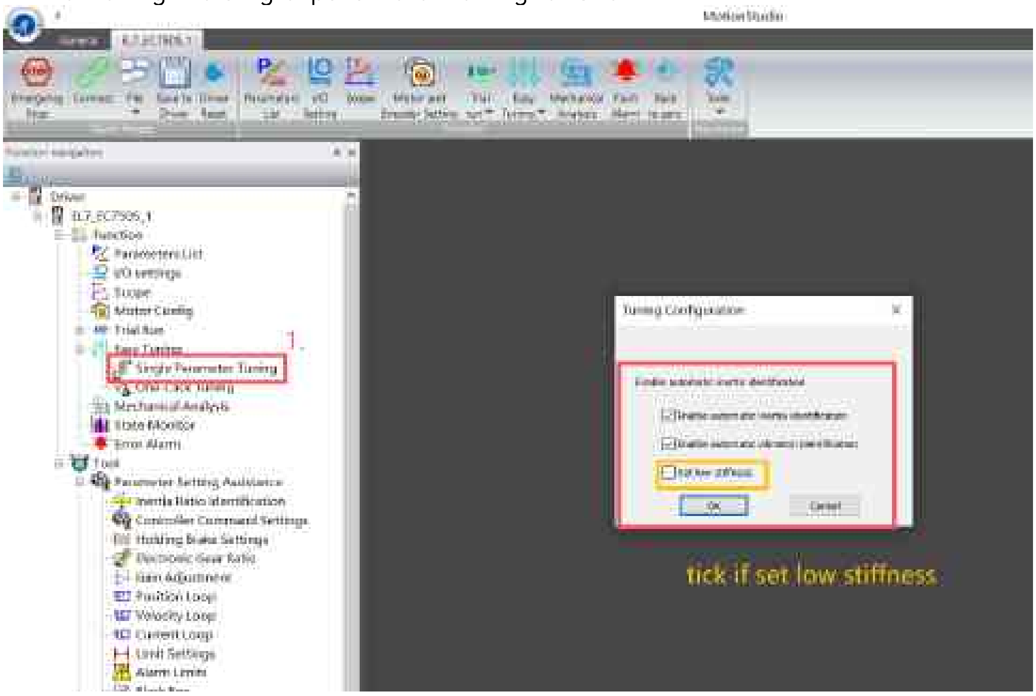
Conditions to implement	
Control Mode	Applicable to Position Mode and EtherCAT Mode (this function cannot be used in other modes)
Others	• The servo must be in the enable ON state (can be the internal enable for trial run) • Set appropriate parameters other than control such as limit position and torque limit to ensure the motor operates normally without faults • When the motor is controlled by trial run or an external controller, ensure collision-free operation

Under the following conditions, single-parameter tuning may not function correctly or may produce poor results.
In such cases, please adjust the load conditions and the operational model before attempting the adjustment again.

Affecting conditions	
Load Inertia	• External load < rotor inertia, or > 30× rotor inertia (excessive inertia ratio degrades function performance) • Inertia cannot be accurately identified if load inertia varies • Rapid changes in load torque
Load Condition	• Insufficient mechanical rigidity • Presence of non-linear characteristics such as backlash· Complex load mechanical structure
Motion Model	• Speed < 300r/min or continuous low-speed operation • Acceleration/deceleration time > 600ms (insufficient acceleration/deceleration) • Duration of speed ⩾300r/min with acceleration/deceleration time <600ms is less than 50ms

Operation Steps

1. Open the wizard and select the single-parameter tuning function. The following interface will appear. Automatic inertia identification and automatic vibration identification are enabled by default. If rigidity parameter P21.02 is greater than 68 and you select the low-rigidity option, the initial rigidity will be set to 68 when entering the single-parameter tuning function.

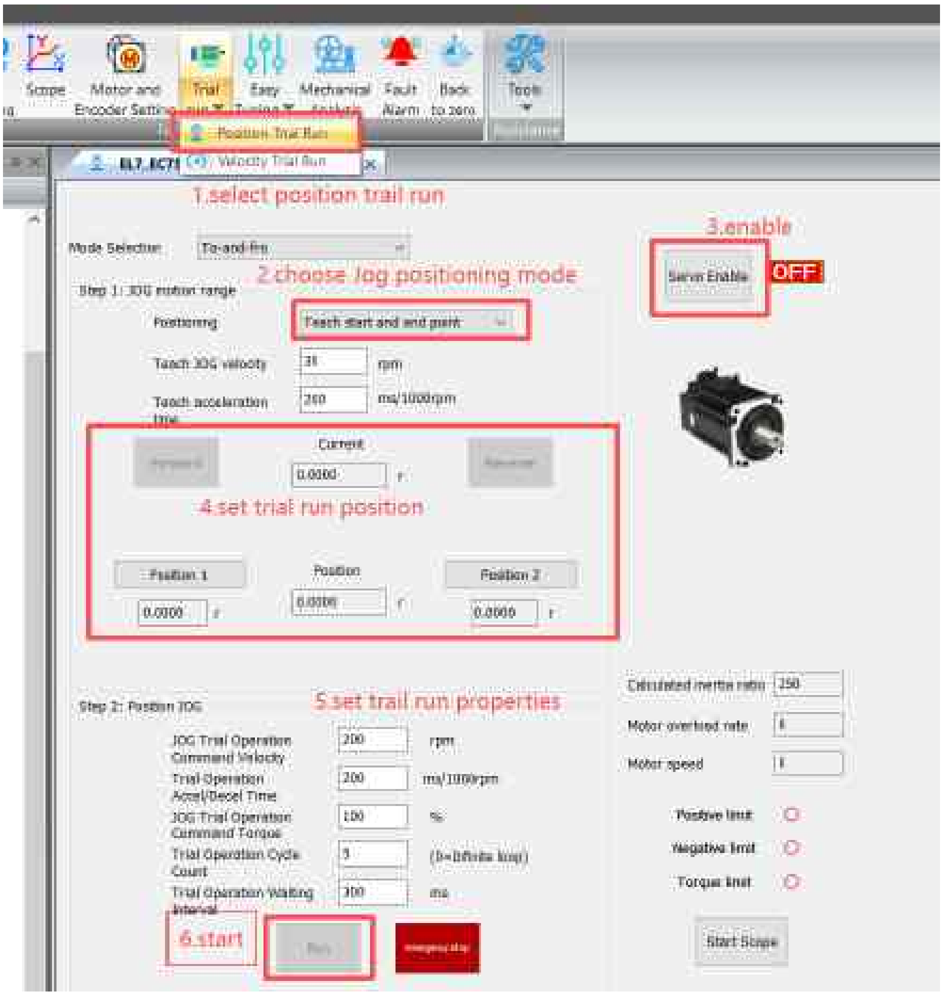


2. On the single-parameter tuning interface, the MFC bandwidth in basic settings is set to 0.1 for automatic adjustment of the model following bandwidth. You may also set other values manually. If no parameters in the advanced settings need to be adjusted, you can start the motor using the trial run function or by enabling the host computer to send motion commands.

Description

- Allow switch to flexible mode: During single-parameter auto-tuning, if the servo detects a flexible mechanical structure, large load inertia, or elastic deformation in the transmission (e.g., long lead screws, timing belts, chains, large-load cantilever mechanisms, etc.), it automatically switches to control parameters for flexible loads to prevent system resonance, squealing, jitter, or unstable positioning.
- Allow rigidity reduction: If the rigidity level is set too high, or significant vibration, overshoot, or mechanical shock occurs during operation, the drive automatically detects and moderately reduces position/velocity loop gains. It trades partial speed for smoother operation to prevent mechanical damage or positioning errors.

3. Single-parameter tuning requires motor operation to evaluate the tuning result. Use the trial run function to configure the motion path, speed, and acceleration to start the motor.



There are three methods for the drive's position trial run:

1) Teach start and end point: After enabling the servo, adjust the position using the forward/reverse buttons, then click the "Set current position as start and end point" button to complete the start and end point configuration.
2) Input start and end point: Select this mode, directly enter the positions in the start and end point input fields. The motor will move to the start point first, then perform reciprocating motion.

3) Input distance: Select this mode, enter the running distance in the position difference field. The motor will perform reciprocating motion of the specified distance starting from the current position.

Note: The teach speed should not be too high to avoid collision.

After configuring the motion range, you can set the position JOG operation parameters:

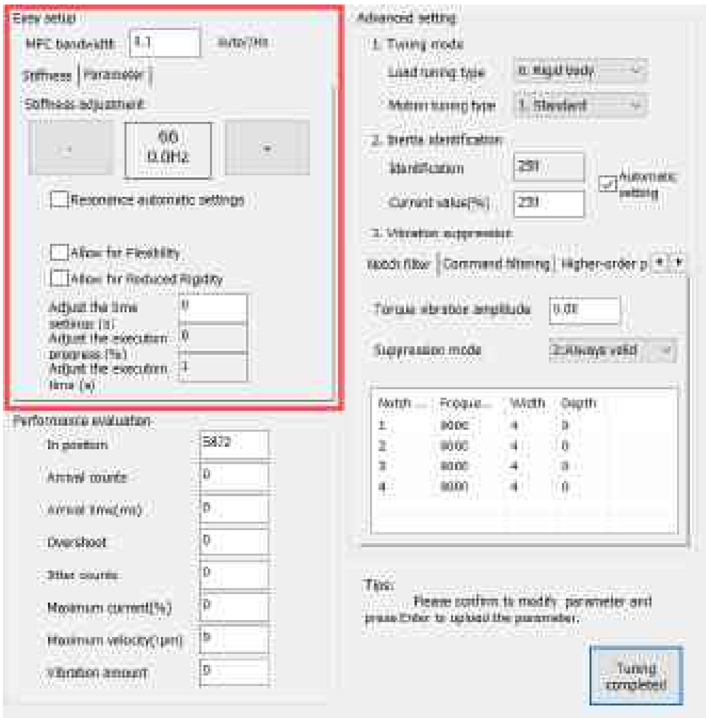
- JOG speed: Set the JOG speed. For parameter tuning, the JOG speed must be > 300 r/min.
- Acceleration/deceleration time: Set the acceleration/deceleration time. For parameter tuning, the acceleration/deceleration time must be less than 600 ms.
- Number of runs: When using single-parameter tuning, set an appropriate number of runs to facilitate the tuning process.

(Note: Single-parameter tuning can be performed using the trial run function, or by controlling the motor via the host computer.)

4. Automatic Parameter Setting

Single-Parameter Tuning: Basic Setup / Advanced Setup

1) **Easy Setup**: Achieves auto-tuning results by simply adjusting rigidity, with no other operations required. Since inertia identification is enabled by default, the inertia ratio will also be set automatically.



Basic Setup:

MFC Bandwidth: Sets the model following bandwidth. MFC (Model Following Control) is used in position loop control to improve command response, shorten positioning time, and reduce tracking error.

MFC Function Setting	Description
0.0	Disable the MFC model following control function
0.1	Automatically adjust the MFC tuning bandwidth
0.2~0.9	Invalid
1.0~2000.0	Manually set the MFC tuning bandwidth; recommended setting for belt applications: 3.0~10.0

Rigidity Adjustment: 50~81 rigidity levels. Press + to increase the rigidity level; press - to decrease the rigidity level.

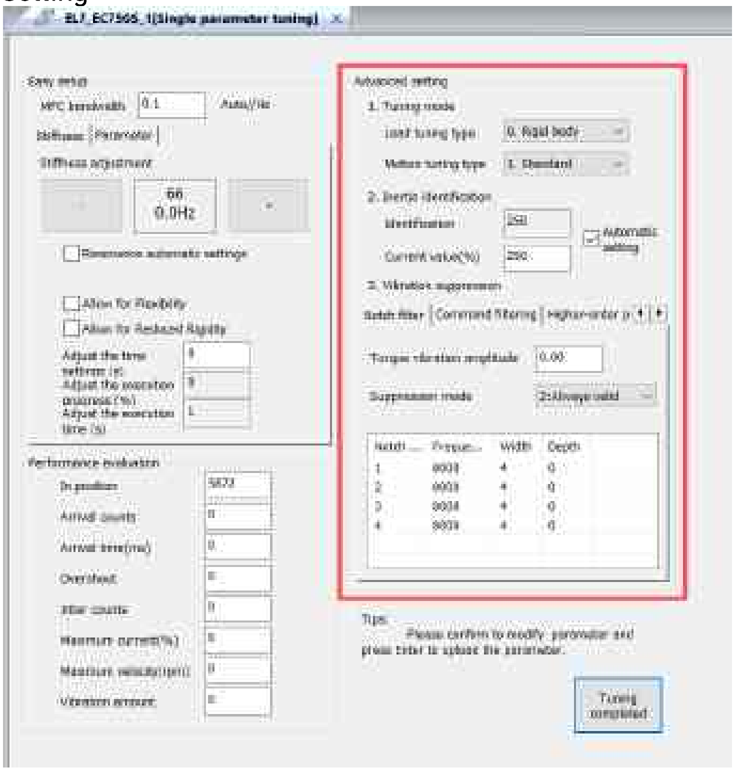
Setting Principles:

- A higher setting increases speed response but also makes the system more prone to vibration.
- Set according to mechanical structure strength: increase rigidity as structural strength improves. If the vibration count in servo performance evaluation exceeds 10, reduce rigidity by 2 levels to prevent fastener loosening caused by high-rigidity vibration during prolonged operation.
- For easily deformable structures (e.g., belts, long rods), reduce rigidity appropriately to avoid deformation, then adjust vibration suppression parameters based on performance requirements.
-

Automatic Resonance Setting:

When enabled, the function cyclically detects vibration under the current rigidity state. If no vibration is detected, settings will revert to default values. When disabled, the system continuously detects vibration and does not revert to default values.

2) Advanced setting

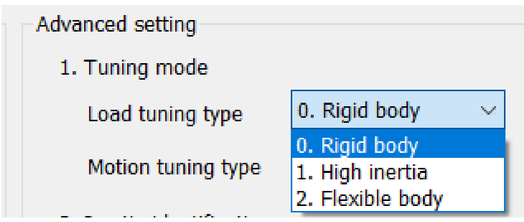


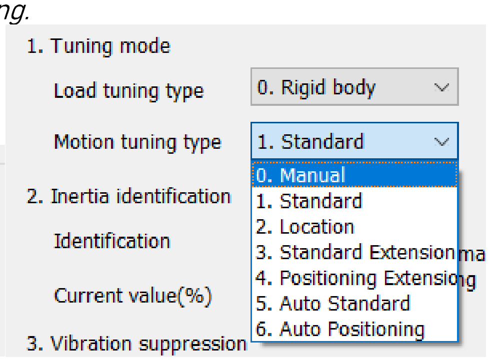
<1> Tuning Mode

Load tuning type: Default setting is Rigid (Standard). The system will automatically switch to adapt to different transmission methods if vibration occurs during operation.

- 0 Rigid: Rigid type, corresponding to ball screw transmission with low flexibility.
- 1 High inertia: High inertia type, corresponding to loads with inertia exceeding 30~40 times the motor inertia.
- 2 Flexible: Flexible type, corresponding to belt transmission with high flexibility.

Note: For optimal tuning results, set the correct load tuning type according to your actual mechanical setup before performing tuning.





Value	Description
0: Manual	P21.02 (real-time automatic rigidity adjustment setting) is invalid. Manual gain adjustment is required, and individual gain values can be adjusted as needed.
1: Standard	P21.02 (real-time automatic rigidity adjustment setting) is valid. Changing the rigidity value enables fast gain adjustment, with different rigidity values corresponding to different gain combinations. This mode does not use gain switching and is suitable for stability-prioritized

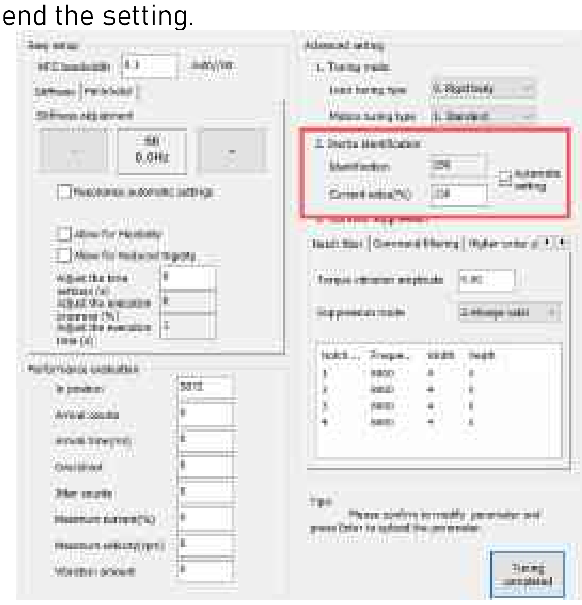
	applications.
2: Positioning	P21.02 (real-time automatic rigidity adjustment setting) is valid. Changing the rigidity value enables fast gain adjustment, with different rigidity values corresponding to different gain combinations. This mode uses gain switching and is suitable for fast-positioning applications. [Not recommended for vertically mounted gravity load axes; if used, compensate for gravity load with P21.25 (torque command addition)]
3: Standard Extended	Functionally similar to mode 1 (Standard), with different internal software gains used at the same rigidity level.
4: Positioning Extended	Functionally similar to mode 2 (Positioning), with different internal software gains used at the same rigidity level.
5: Auto Standard	Based on mode 1 (Standard), adds inertia identification and automatic notch filter tuning; automatically reverts to Standard mode after tuning completion (0x_5 → 0x_1).
6: Auto Positioning	Based on mode 2 (Positioning), adds inertia identification and automatic notch filter tuning; automatically reverts to Positioning mode after tuning completion (0x_6 → 0x_2).

<2> Inertia Identification

The inertia identification function is enabled by default.

- Identified Value %: The system continuously performs identification; the value flashes yellow upon each successful identification.
- Current Value %: If Auto Set is checked, this value is synchronized with the identified value; if unchecked, it is not synchronized, and you can manually set the current inertia ratio and press Enter to send the setting.

When Auto Set is checked, the actual inertia identification value is automatically written to parameter P21.03.
If Auto Set is unchecked, you can manually input the inertia ratio in the Current Value field and press Enter to send the setting.



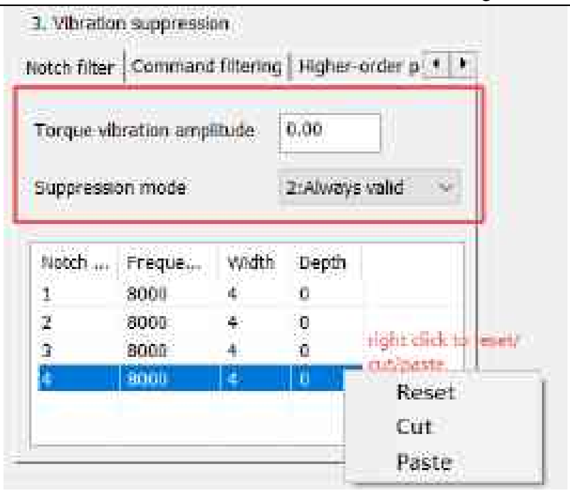
<3> Vibration Suppression:

■ Notch Filter

Torque Vibration Detection Amplitude: 0 = most sensitive, 100% = no vibration detection. Adjust this value based on on-site conditions to determine vibration presence.

Suppression Mode:

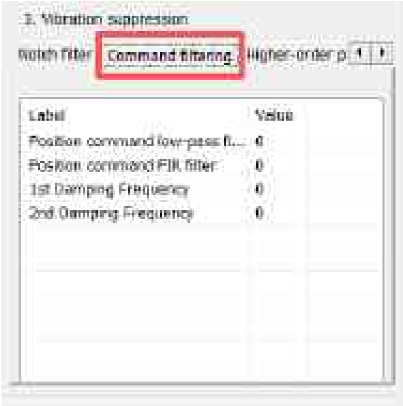
Value	Description
0	Adaptive filter disabled; parameters associated with the 3rd notch filter remain unchanged.
1	Adaptive filter: 1 filter enabled (single use). 1 adaptive filter becomes active, and parameters of the 3rd notch filter are updated based on adaptation results. After update, P22.00 automatically returns to 0, stopping the adaptive process.
2	Adaptive filter: 1 filter enabled (continuous use). 1 adaptive filter remains active, and parameters of the 3rd notch filter are continuously updated based on adaptation results.
3	Adaptive filter: 2 filters enabled (continuous use). 2 adaptive filters remain active, and parameters of the 3rd and 4th notch filters are continuously updated based on adaptation results.
4	Clear filter settings.



- Notch Filters: Adaptive notch filters, including the 1st, 2nd, 3rd, and 4th notch filters.
- Frequency: Notch filter frequency, range: 50~8000.
- Width: Filter width, range: 0~20.
- Depth: Filter depth, range: 0~99.

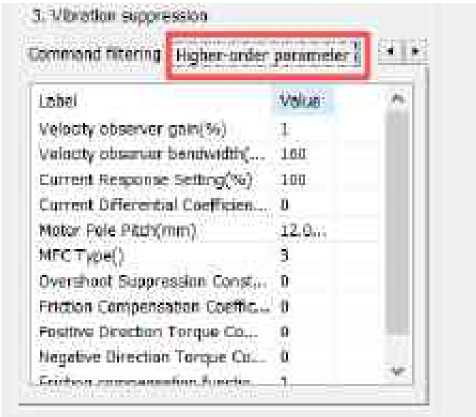
The notch filter frequency flashes yellow when it changes.

- Command Filter (Parameters require manual input and cannot be automatically identified)



- Position Command Low-Pass Filter: Range: 0.0~300.0, unit: ms. Setting this parameter too large may prolong the settling time.
- Position Command FIR Filter: Range: 0.0~250.0, unit: ms. Setting this parameter too large may prolong the settling time.
- 1st Damping Frequency: Range: 0.0~200.0, unit: Hz. Sets the damping frequency to suppress end-point oscillation.
- 2nd Damping Frequency: Range: 0.0~200.0, unit: Hz. Sets the damping frequency to suppress end-point oscillation.

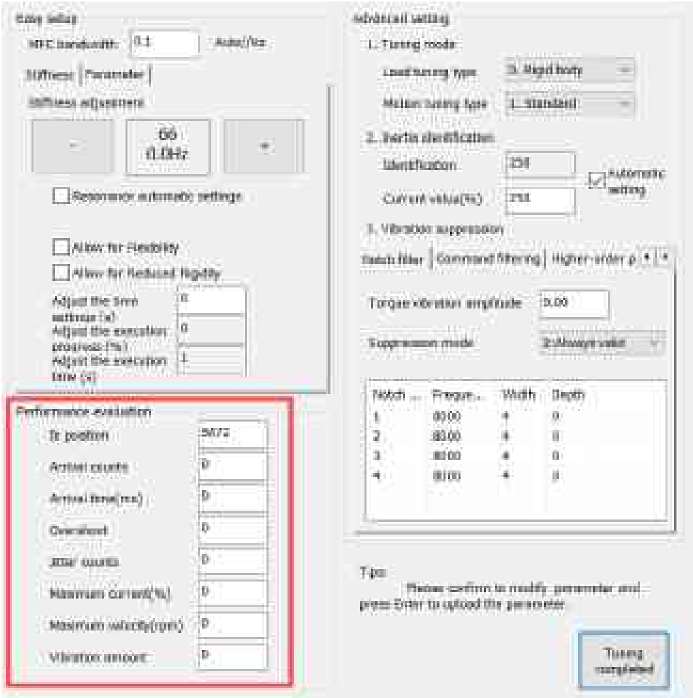
- Advanced Parameters

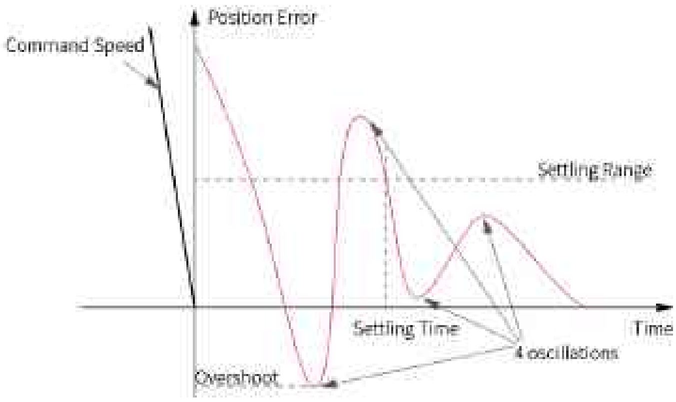


- Observer Gain: Default stable gain. Set to 1 to disable the observer.
- Observer Filter: Default stable filter. Set to 1 to disable the observer.
- Current Response: The ratio of effective values for parameters related to the drive's current loop. Range: 50~100, unit: %.

5. Performance Evaluation

Check overshoot and jitter count:

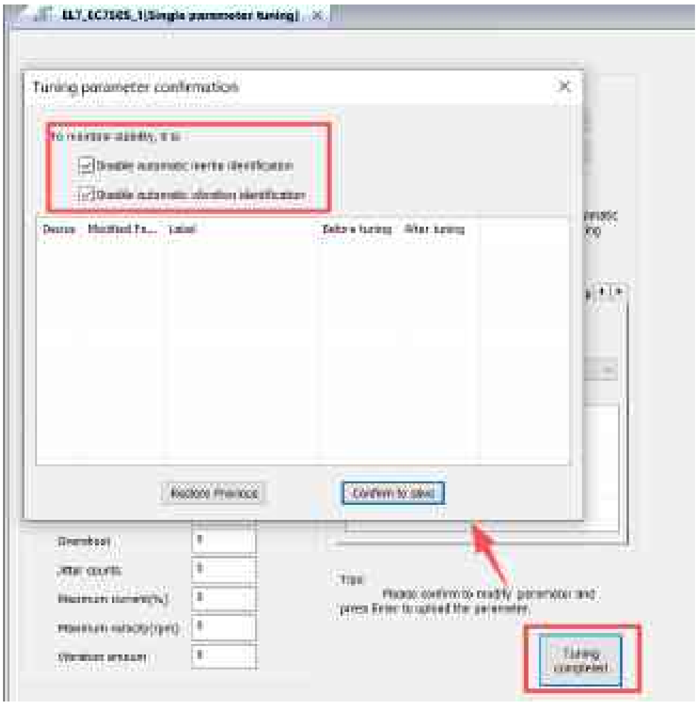




- In-position range: The allowable speed deviation between the target speed and the actual speed.
- In-position count: The number of times the target value is reached during trial run.
- Overshoot: The overshoot between the set target value and the measured actual value. Displayed as white if ≤10%, yellow if >10% but <100%, and red if ≥100%.
- Vibration count: The number of detected vibrations. Displayed as yellow when count = 1, red when count > 1, and white by default.
- Maximum current: Percentage of the maximum current.

User can continuously increase rigidity and gain using the basic or advanced settings described earlier, while observing the waveform to achieve the ideal response.

6. Single-parameter tuning complete



- Disable automatic inertia identification: Turn off automatic inertia identification after auto-tuning parameters.
- Disable automatic vibration identification: Turn off automatic vibration identification after auto-tuning parameters.
- Restore previous: Do not save the parameters obtained after auto-tuning.
- Confirm and save: Save the parameters obtained after auto-tuning.

6.3.2 One-click tuning function

The One-click tuning function enables the servo to automatically run and learn the optimal gain parameters after setting the corresponding motion path and response level. The parameters can be saved once the learning is complete. Exporting the parameters to a configuration file facilitates replication for the same model.
Recommended application scenario for this function: applications with small variations in load inertia.

Conditions to implement	
Control Mode	Applicable to Position mode and EtherCAT mode (this function cannot be used in other modes).
Other Requirements	• Ensure there is no external enable signal or external control command driving the motor; configure the motion range, speed, and acceleration/deceleration time using the built-in motion settings of One-click tuning. • Disable external enable, ensure the external motion path is unobstructed, and confirm the motor can operate normally without faults.

Under the following conditions, the One-click tuning function may not operate properly or yield poor results.
In such cases, please adjust the load conditions and motion profile, then perform the tuning again.

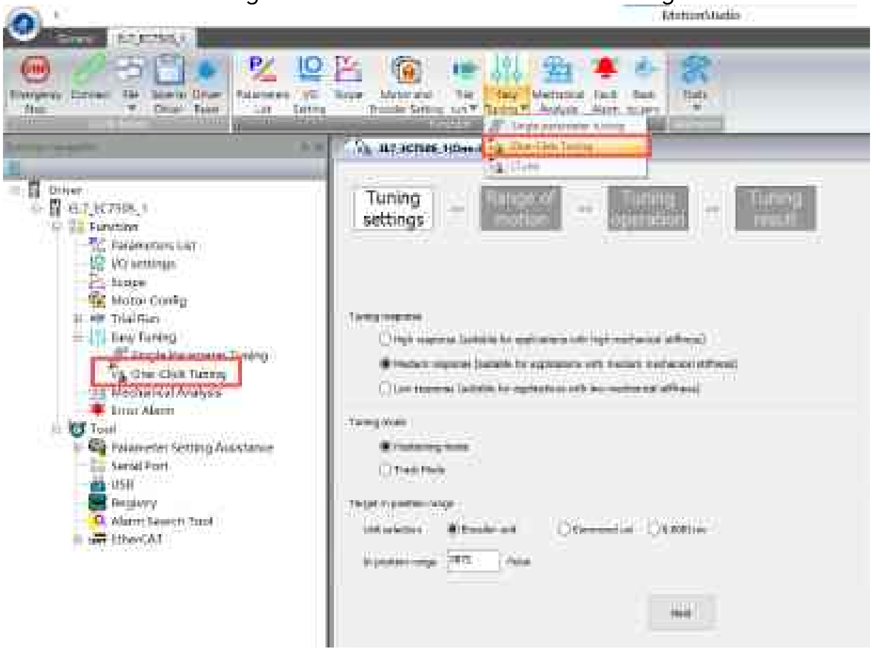
Affecting conditions	
Load Inertia	• External load inertia is less than the rotor inertia, or more than 30 times the rotor inertia (an excessively large inertia ratio affects the function's performance); • Significant variations in load inertia during operation; • For inertia ratios exceeding 30× in heavy-load applications, confirm the travel range and safety before using One-click tuning.
Load	• Loose mechanical connections in the load; • Presence of non-linear characteristics such as backlash; • Complex mechanical structure of the load.
Motion Profile	• The travel distance for One-click tuning is too short or too long. Excessively long travel may lead to overly long tuning time or failure; • The tuning travel must be greater than 0.5 revolutions.

- For vertical axes, implement anti-fall measures before executing the tuning operation.
- For belt-driven applications, set an appropriate inertia ratio in advance to avoid oscillation caused by an excessively low initial inertia ratio at the start of tuning.

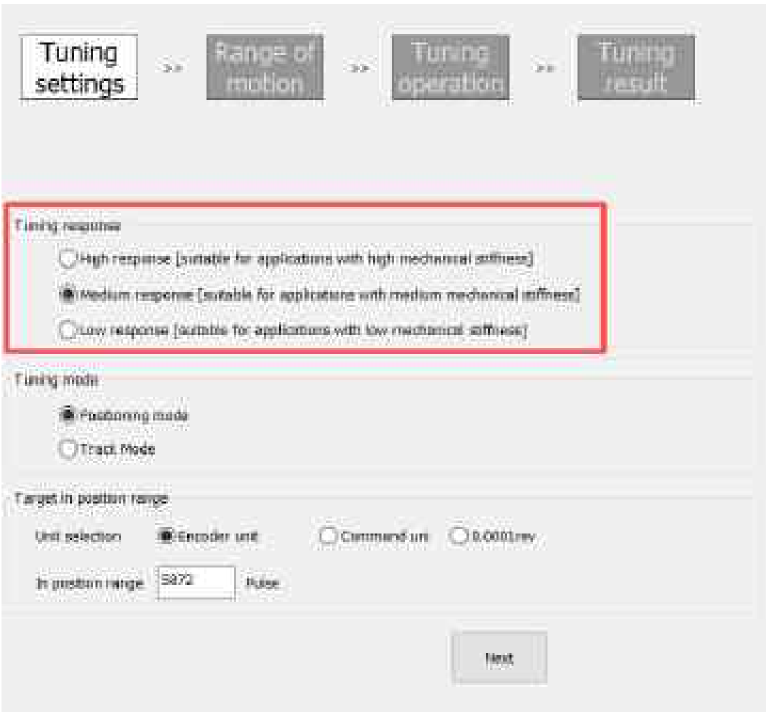
Operation Steps

Debugging Tool: Motion Studio V3.0

1. Click the One-click tuning function in the Parameter Setting Assistant of the software.



2. Click to enter the One-click tuning function interface. The first screen is the tuning adjustment page, which is used to set the execution criteria for the auto-tuning process.



3. Click Next to enter the motion range setting interface, where you can configure the travel range for the One-click tuning function.

1) There are three operation modes; select the appropriate one based on the allowable motion direction of the actual machine:

- To-and-fro: The motor moves back and forth between the start and end positions.
- One way motion (Positive): The motor uses the absolute value of the position difference between the start and end points as the travel distance for each movement, and maintains forward rotation.
- One way motion (Negative): The motor uses the absolute value of the position difference between the start and end points as the travel distance for each movement, and maintains reverse rotation.

2) There are two methods to set the start and end point range:

■ After enabling the servo, adjust the position using the forward/reverse buttons, then click the "Set current position as start and end point" button to complete the setting.

Note：

When setting the motion range, set the JOG speed between 0~200 r/min. Do not set the acceleration time too short to avoid collision. After configuring speed parameters, disable external enable first. Before enabling the servo, confirm there are no command inputs to prevent unintended movement when enabling, then click "Servo Enable".

■ Directly input the start and end point positions. Press Enter after entering the position values to confirm the changes. (Note: During reciprocating operation with directly input start/end positions, the motor will first move to the set start position before performing reciprocating motion. Therefore, verify collision risks when manually entering positions.)

The difference between the start and end points must be greater than 0.5 revolutions. The closer the start/end positions are to the actual application stroke difference, the more adaptable the tuned parameters will be, though tuning time may increase accordingly.

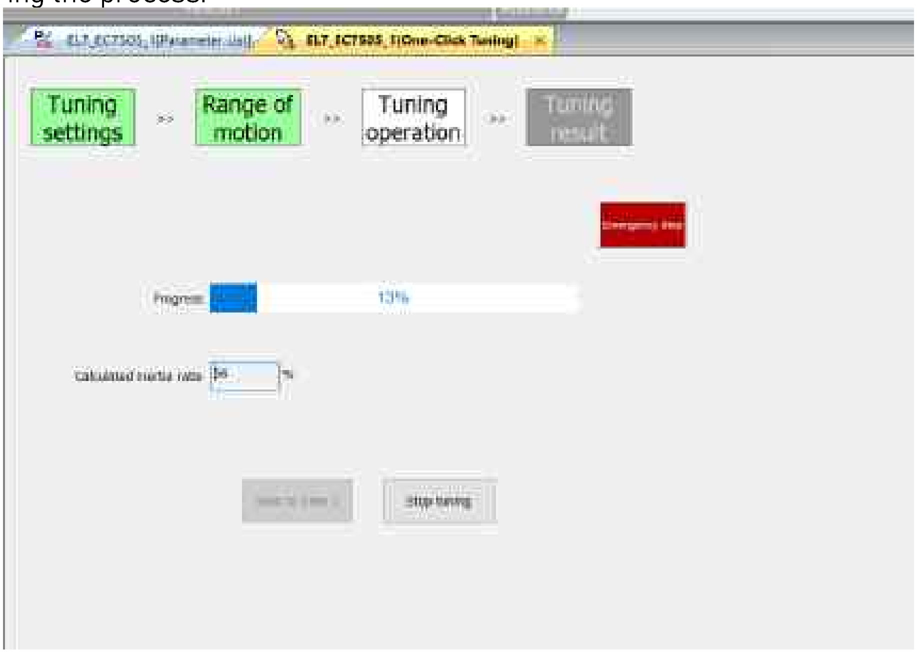
3) After setting the motion range, configure the inertia ratio:

The inertia ratio setting allows you to suppress the "inertia identification failure" alarm, preventing tuning failure caused by failed inertia detection.

User can manually input the correct inertia ratio or preset an appropriate value to avoid equipment oscillation in belt-driven applications caused by low inertia.

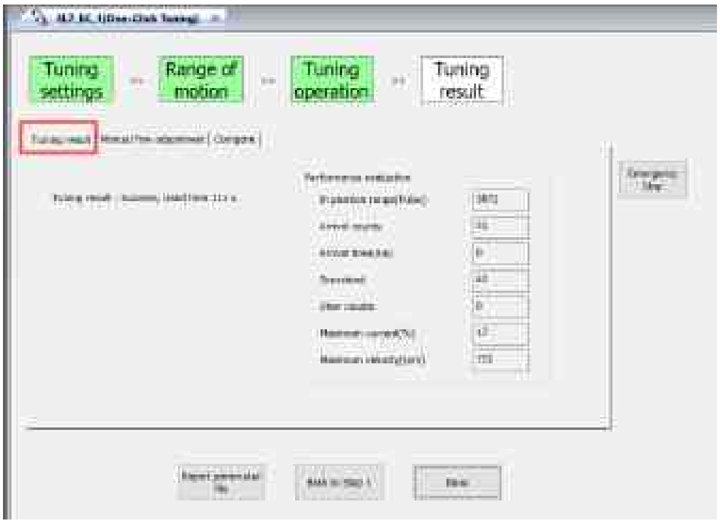
- Tuning speed limit: Limits the operating speed during tuning; the speed must not be lower than 400 r/min.

4. Click Start Tuning and confirm motion safety to enter the tuning operation interface. Tuning will start, and progress display and an emergency stop button will be provided during the process.

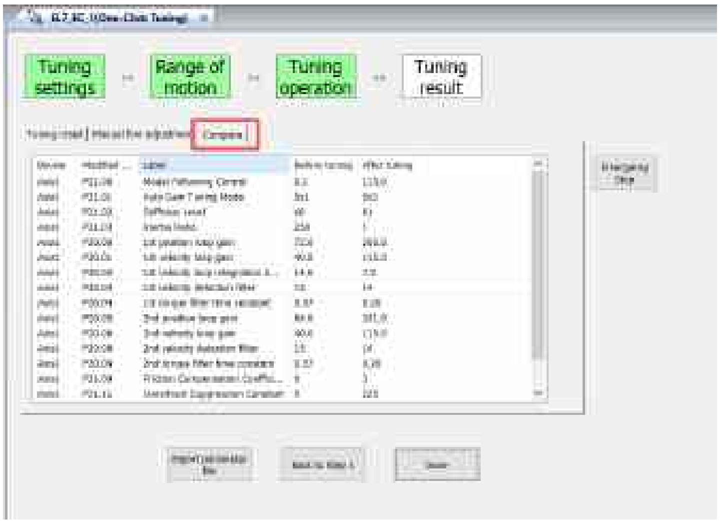


5. After tuning is completed, the system will jump to the tuning result interface, which displays the tuning results and the parameter comparison before and after tuning.

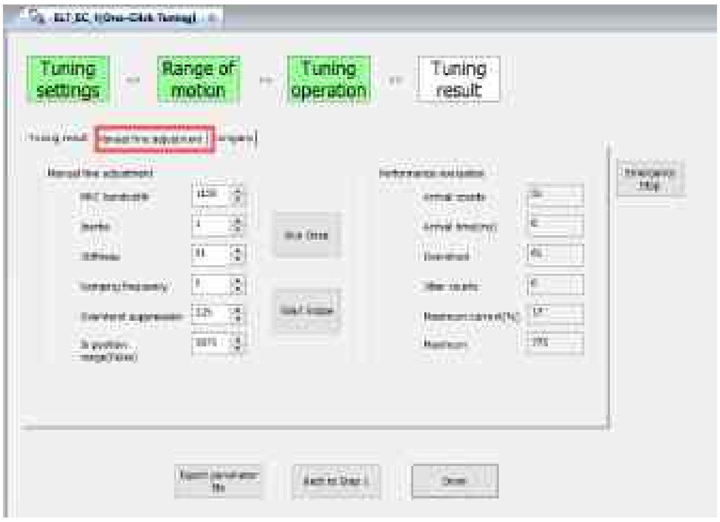
1) Tuning Result:



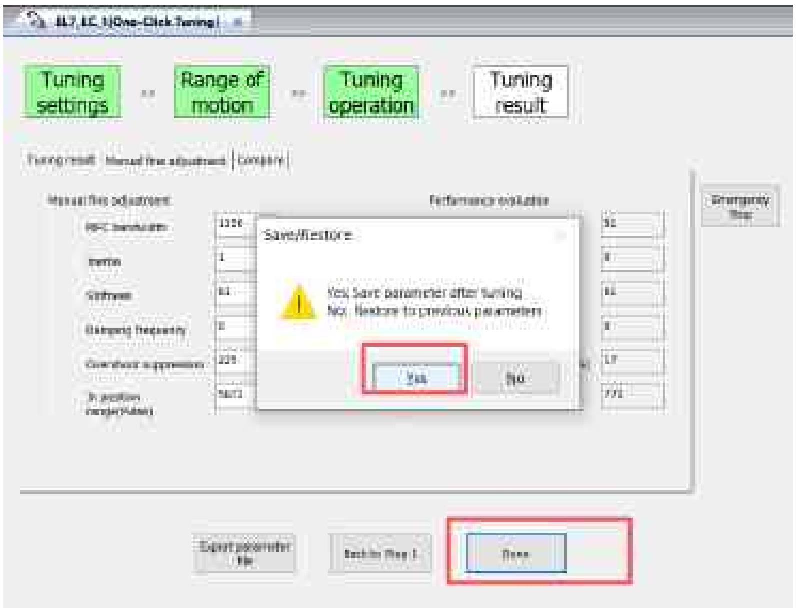
2) Parameter Comparison:



3) Manual fine adjustment:



After fine-tuning the parameters, run the test again. You can then check the performance evaluation or use the oscilloscope to verify if the results meet the actual requirements.



If user satisfied with the tuning result, click "Done". A prompt will appear asking whether to save the parameters.

- For vertical axis applications, implement anti-fall measures before performing any movements.
- For belt-driven applications, set a moderate inertia ratio in advance to prevent vibration caused by an excessively low inertia ratio at the start of auto-tuning.
- For ball screw applications, if the tuning time is too long, shorten the travel distance appropriately.

Common Tuning Failures

Fault	Cause	Solution
Inertia identification failure	Loose mechanical connection of the load	Troubleshoot mechanical faults
	Insufficient travel distance leading to inertia identification failure	Increase the travel distance appropriately
	Load is belt-driven	Pre-set a suitable inertia ratio for belt-driven applications to avoid identification failure caused by vibration due to low inertia

- If the tuning result is not as expected, perform more advanced operations via single-parameter tuning to adjust the optimal gains.

6.3.3 Ltune Intelligent Tuning-Free Function

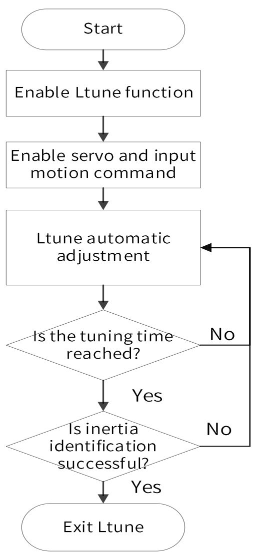
The Ltune intelligent tuning-free function automatically adjusts core gain parameters such as rigidity, inertia ratio, and notch filter suppression by identifying load conditions and dynamically recognizing mechanical inertia. It balances response speed and operational stability, enabling one-click control of the drive with high-speed response, low vibration, and low noise.

The Ltune function is enabled by default at factory (i.e., P21.01=0x5). After servo enable, as long as the axis starts moving, gain adjustment will be automatically performed in the background regardless of the command type. This process lasts for 60 seconds by default before being disabled, and the duration can be flexibly set via parameter P21.20 (Ltune Close Time).

Conditions to implement	
Control Mode	All control modes supported by the servo
Applicable Scenarios	Online simple adjustment within 100 times inertia
Prerequisites	• Command-based operation with a duration greater than or equal to the setting of P21.20; • Correct inertia ratio identification; • Appropriately set parameters other than gains (such as deviation counter reset, command input disable signals, torque limit, etc.) to ensure the motor can operate normally without obstruction.

Note:

- During the activation of the Ltune function, external interference may cause abnormalities in automatic adjustment. If stable operation cannot be guaranteed after power-up, it is recommended to disable the Ltune function.
- When the load inertia or load torque changes rapidly, normal identification may fail. In this case, adjust the load conditions and motion model, or switch to manual gain adjustment.

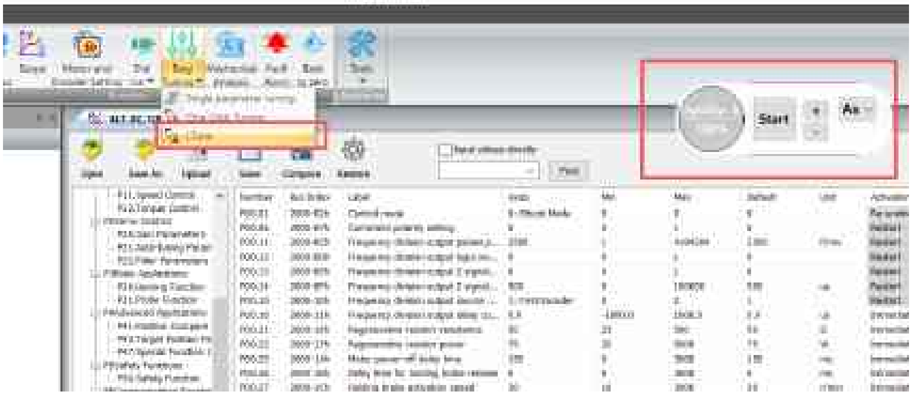


Operation Steps

Debugging Tool: Motion Studio V3.0

- **Method 1: Enable via the debug software interface**

1. Open the debug software interface, and enter "Easy tuning" → "Ltune".
2. Click "Start" to enable the Ltune function. After receiving motion commands, the system will automatically adjust parameters such as gains, inertia ratio, and notch filters until tuning is completed. The floating control interface displays the tuning progress in real time.
3. The default tuning time is 60s, which can be adjusted according to actual conditions via parameter P21.20 (Ltune Close Time).



- **Method 2: Parameter configuration**

Enable the Ltune function by setting the motion tuning mode of parameter P21.01 (Real-time Automatic Adjustment Mode) to 5/6:

P21.01=0x__5: Standard + Inertia Identification + Notch Filter Auto-tuning. Based on the 1-Standard mode, Ltune is enabled, and the mode will automatically switch to the standard mode (0x__5 → 0x__1) after tuning is completed.

P21.01=0x__6: Positioning + Inertia Identification + Notch Filter Auto-tuning. Based on the 2-Positioning mode, Ltune is enabled, and the mode will automatically switch to the standard mode (0x__6 → 0x__2) after tuning is completed.

6.4 Auto gain adjustment (Rigidity Level Selection)

6.4.1 Overview

After setting an appropriate inertia ratio, estimate the mechanical load characteristics in real time, adjust the rigidity parameter value P21.02 automatically in real time, and set the corresponding basic gain values for rigidity based on the results.

Real-time automatic adjustment is applicable to all control modes.

Conditions to implement	
Control Mode	The valid real-time automatic adjustment mode varies with the control mode. For details, refer to the description of P21.01 Real-time Automatic Adjustment Setting.
Others	• Servo must be enabled. • Appropriately set parameters other than control-related functions (such as deviation counter reset, command input disable signals, torque limit settings) to ensure the motor can operate normally without obstruction.

Precautions:

When the real-time automatic adjustment function is active, external interference and other factors may cause anomalies in the estimated values. Therefore, if stable operation after power-on cannot be guaranteed, it is recommended to disable real-time automatic adjustment.

Real-time automatic gain adjustment may not function properly under the following conditions. In such cases, adjust the load conditions, motion model, or switch to manual gain adjustment.

Conditions to implement	
Load Inertia	When the ratio to the rotor inertia is too small or too large (less than 3 times or more than 30 times), or when the load inertia changes.
Load	When the mechanical rigidity is extremely low.When there are nonlinear characteristics such as backlash.
Motion Model	• When the speed is less than 300 r/min and continuously operated at low speed. • When the acceleration/deceleration is slow (below 2000 r/min within 1 second). • When the acceleration/deceleration torque is less than the load torque or viscous friction torque. • When the speed is above 300 r/min and the acceleration/deceleration reaches above 2000 r/min within 1 second, but the duration is less than 50 ms.

6.4.2 Operation Steps

1) The motor is in the stopped state (servo enable is off). The inertia ratio must be set correctly, otherwise the tuning effect will be affected.
2) Set bit0 (motion tuning mode) of P21.01 (Real-time Automatic Adjustment) to non-manual mode, then configure P21.02 (Real-time Automatic Adjustment Rigidity).
3) Enable the servo, operate the mechanism under normal conditions, and start estimating the load characteristics. Associated control parameters will be set automatically. [Refer to the table below for details]
4) Improve the motor's responsiveness by increasing the setting value of P21.02 (Real-time Automatic Adjustment Rigidity). Observe the positioning time and whether obvious mechanical vibration occurs; set the rigidity value to the maximum possible while avoiding vibration.
5) Save the results and write them to EEPROM.

Notes:

- After setting the P21.01 (Real-time Automatic Adjustment) parameter, it must be written to the EEPROM and the power cycled to take effect. Changes to the setting value of P21.02 (Machine Rigidity Setting) take effect immediately after being sent; stop the motor when modifying parameter values.
- After power-up, when the servo is enabled for the first time or when increasing P21.02 (Machine Rigidity Setting), abnormal noise or vibration may occur before the load characteristic estimation stabilizes. If it stabilizes quickly, this is not abnormal. If abnormal noise persists after 3 or more consecutive vibrations/movements, reduce the setting value of P21.02 (Machine Rigidity Setting).

The Servo Drive provides two automatic gain adjustment modes:

- Standard mode (P21.01=0x_ _1/0x_ _3/0x_ _5): The basic mode, which emphasises stability, does not use gain switching. The standard mode in real-time automatic gain adjustment is based on P21.02 'Machine Stiffness Setting', which updates the following basic gain setting parameters.

Parameters	Label	Remarks
P20.00	1st position loop gain	When stiffness setting is valid, parameters will be updated to match stiffness value
P20.01	1st velocity loop gain	
P20.02	1st velocity integral time constant	
P20.04	1st torque filter time constant	

Parameter	Label	Parameter	Remarks
P20.10	Velocity feedforward gain constant	300（0.1%）	Parameters that do not change according to stiffness
P20.11	Velocity feedforward filter time constant	0.50ms	
P20.12	Torque feedforward gain	0	
P20.13	Torque feedforward filter time constant	0	

- Positioning mode (P21.01=0x_ _2/0x_ _4/0x_ _6): A mode that places emphasis on positioning, e.g. for use on a screw drive with low friction, can be used with gain switching. The position loop gain of the second gain parameter should be about one stiffness level higher than the first gain parameter.

The positioning mode in real-time automatic gain adjustment is based on P21.02 'Machine stiffness setting', and the following basic gain setting parameters are updated.

Parameters	Label	Remarks
P20.00	1st position loop gain	When stiffness setting is valid, parameters will be updated to match stiffness value
P20.01	1st velocity loop gain	
P20.02	1st velocity integral time constant	
P20.04	1st torque filter time constant	
P20.05	2nd position loop gain	
P20.06	2nd velocity loop gain	
P20.09	2nd torque filter time constant	

Parameter	Label	Value
P20.07	Second velocity loop integration constant	1000ms
P20.10	Velocity feedforward gain constant	30%
P20.11	Velocity feedforward filter time constant	0.50ms
P20.12	Torque feedforward gain	0
P20.13	Torque feedforward filter time constant	0
P20.15	Position control gain switching mode	0
P20.17	Position control switching level	50
P20.18	Position control switching hysteresis	33
P20.19	Position gain switching time	3.3ms

When the real-time automatic adjustment mode is set to positioning mode, the gain switching function is automatically enabled, but the gain switching mode cannot be modified.
If user need to change the switching mode, please set the automatic adjustment mode to manual mode.

■ Standard mode + large inertia free adjustment (P21.01=0x_11/0x_13/0x_15)

In addition to the existing standard mode, the large inertia adjustment-free function has been added so that inertia ratio setting is not required before stiffness setting, and the following basic gain setting parameters are updated according to P21.02 'Machine Stiffness Setting'.

Parameters	Label	Remarks
P20.00	1st position loop gain	When stiffness setting is valid, parameters will be updated to match stiffness value
P20.01	1st velocity loop gain	
P20.02	1st velocity integral time constant	
P20.04	1st torque filter time constant	

Parameter	Label	Parameter	Remarks
P20.10	Velocity feedforward gain constant	300（0.1%）	Parameters that do not change according to stiffness
P20.11	Velocity feedforward filter time constant	0.50ms	
P20.12	Torque feedforward gain	0	
P20.13	Torque feedforward filter time constant	0	

■ Positioning mode + large inertia free adjustment (P21.01=0x_21/0x_24/0x_26)
Based on the original standard mode, the large inertia adjustment-free function has been added. The inertia ratio parameter can be set at 30 times the inertia or more without adjustment.
Before setting the stiffness, it is not necessary to set the inertia ratio, and the following basic gain setting parameters are updated according to P P21.02 'Rigidity Setting'.

Parameters	Label	Remarks
P20.00	1st position loop gain	When stiffness setting is valid, parameters will be updated to match stiffness value
P20.01	1st velocity loop gain	
P20.02	1st velocity integral time constant	
P20.04	1st torque filter time constant	
P20.05	2nd position loop gain	
P20.06	2nd velocity loop gain	
P20.09	2nd torque filter time constant	

No.	Parameter	Label	Value
0	P20.07	Second velocity loop integration constant	1000ms
1	P20.10	Velocity feedforward gain constant	30%
2	P20.11	Velocity feedforward filter time constant	0.50ms
3	P20.12	Torque feedforward gain	0
4	P20.13	Torque feedforward filter time constant	0
5	P20.15	Position control gain switching mode	0
6	P20.17	Position control switching level	50
7	P20.18	Position control switching hysteresis	33
8	P20.19	Position gain switching time	33ms

Load calibration type

Used to select the type of load, according to the size of the load inertia ratio and the characteristics of the mechanical structure

0x00_: Stiff body

This mode is selected when the load is a rigid body with good rigidity and small load inertia. The gain strategy gives priority to ensuring the system responsiveness, and the typical structures are direct-connected high-precision speed reducer, screw, rack and gear and other structures.

0x01_: Large inertia

Select this mode when the load inertia is large (more than 10 times), and the gains take into account the smoothness and responsiveness of the equipment. For large inertia loads, it is recommended to set the rigidity level not greater than 15.

0x02_: Flexible

Select this mode when the load is a flexible structure with low rigidity and high inertia, and the exact inertia ratio needs to be set for this type. The gain strategy gives priority to ensure smooth operation. Typical structures are long belts and chains.

<table>
<tr><td rowspan="3">P21.01</td><td>Label</td><td colspan="2">Real time Auto Gain Adjusting</td><td>Mode</td><td colspan="3">F</td></tr>
<tr><td>Range</td><td colspan="2">0x0~0xFFF</td><td>Default</td><td>0x5</td><td>Unit</td><td></td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>2021-02h</td></tr>
<tr><td colspan="8">Set up the mode of the real time auto gain adjusting.</td></tr>
</table>

Data bits	Category	Settings	Application
0x00_	Motion setting mode	Used to set motion setting mode, which can be selected according to the motion characteristics or setting requirements. Generally, it is recommended to select mode 1 with good generality when there is no special requirement, mode 2 when rapid positioning is needed If mode 1 and mode 2 cannot meet the requirements, please choose mode 0.	
		0:Manual	P21.02 invalid. Gain value must be adjusted manually and accordingly.
		1:Standard	P21.02 valid. Quick gain adjusting can be achieved by changing P00.03 stiffness value. Gain switching is not used in this mode, suitable for applications with requirements for stability.
		2:Positioning	P21.02 valid. Quick gain adjusting can be achieved by changing P00.03 stiffness value. This mode is suitable for applications requiring quick positioning. Not recommended for load mounted vertical to ground, or please compensate for the load using P21.25
		3: Standard Expansion	Consistent with the 1-standard mode; the difference lies in that the gain used in the same rigid software is different.
		4: Positioning Expansion	Consistent with the 2-positioning mode; the difference lies in that the gain used in the same rigid software is different.
		5: Standard + Inertia Identification & Notch Auto-Setting	On the basis of the 1-standard mode, add inertia identification and notch auto-setting; after the setting is completed, automatically return to the standard mode 0x5 → 0x1.
		6: Positioning + Inertia Identification & Notch Auto-Setting	On the basis of the 2-positioning mode, add inertia identification and notch auto-setting; after the setting is completed, automatically return to the positioning mode 0x6 → 0x2.
0x0_0	Load type setting	Used to select the load type, choose according to load-inertia ratio and mechanical structure.	
		0: Rigid structure	This mode prioritizes system responsiveness. Use this mode when there is a relatively rigid structure with low load inertia. Typical application including directly connected high-precision gearbox, lead screw, gears, etc.
		1:High inertia	For applications with higher load inertia (10 times or above), gain settings take into account both machine stability and responsiveness. Not recommended to set stiffness above 15 for high load inertia.
		2: Flexible structure	This mode prioritizes system stability. Use this mode when there is low rigidity structure with high load inertia. Typical applications included belts and chains.
0x_00	*Reserved*		

The setting type combination is a hexadecimal standard, as follows:

Setting type combination	Application type
0X000	Rigid structure + Manual
0X001	Rigid structure +Standard

0X002	Rigid structure +Positioning
0X010	High inertia + Manual
0X011	High inertia + Standard
0X012	High inertia + Positioning
0X020	Flexible structure + Manual
0X021	Flexible structure +Standard
0X022	Flexible structure +Positioning

P21.02	**Label**	Real time Auto Gain Adjusting		**Mode**	F		
	Range	50~81		**Default**	70	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2021-03h

Valid when P21.02 = 1,

Low → Mechanical stiffness ← High

Low → Servo gain ← High

81.80·······························70.69.68······························51.50

Low → Responsiveness ← High

- Lower values ensure better system responsiveness and mechanical stiffness but machine vibration might occur, please set accordingly. Please stop the motor before doing any changes to the stiffness settings.
- When P21.01 = 0x010, please set stiffness level to around 65.

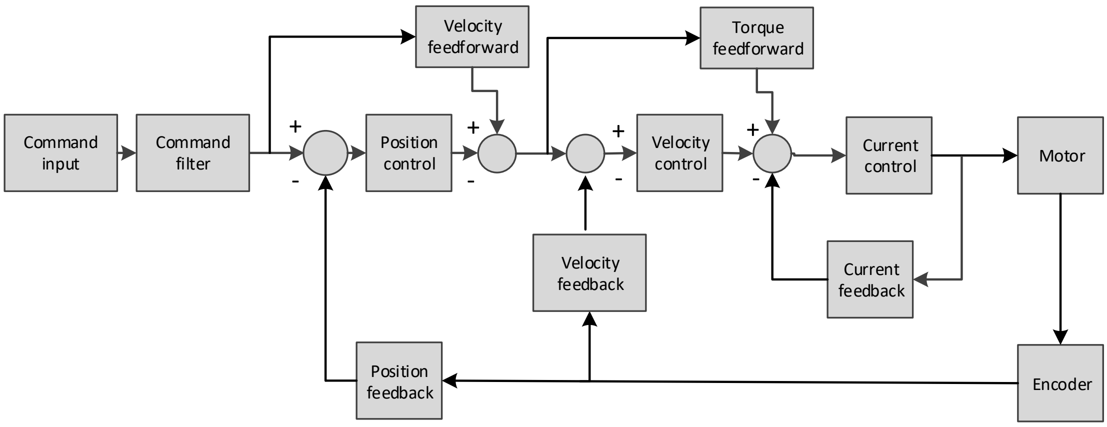
Basic gain parameter setting table (stiffness table)

Stiffness	1st gain				2nd gain			
	P20.00	P20.01	P20.02	P20.04	P20.05	P20.06	P20.07	P20.09
	Position loop gain (0.1/s)	Velocity loop gain (Hz)	Velocity loop integral time constant （0.1ms）	Torque filter (0.01ms)	Position loop gain (0.1/s)	Velocity loop gain (Hz)	Velocity loop integral time constant （0.1ms）	Torque filter (0.01ms)
81	20	15	3700	1500	25	15	10000	1500
80	25	20	2800	1100	30	20	10000	1100
79	30	25	2200	900	40	25	10000	900
78	40	30	1900	800	45	30	10000	800
77	45	35	1600	600	55	35	10000	600
76	55	45	1200	500	70	45	10000	500
75	75	60	900	400	95	60	10000	400
74	95	75	700	300	120	75	10000	300
73	115	90	600	300	140	90	10000	300
72	140	110	500	200	175	110	10000	200
71	175	140	400	200	220	140	10000	200
70	320	180	310	126	380	180	10000	126
69	390	220	250	103	460	220	10000	103
68	480	270	210	84	570	270	10000	84
67	630	350	160	65	730	350	10000	65
66	720	400	140	57	840	400	10000	57
65	900	500	120	45	1050	500	10000	45
64	1080	600	110	38	1260	600	10000	38
63	1350	750	90	30	1570	750	10000	30
62	1620	900	80	25	1880	900	10000	25
61	2060	1150	70	20	2410	1150	10000	20
60	2510	1400	60	16	2930	1400	10000	16
59	3050	1700	50	13	3560	1700	10000	13
58	3770	2100	40	11	4400	2100	10000	11
57	4490	2500	40	9	5240	2500	10000	9
56	5000	2800	35	8	5900	2800	10000	8
55	5600	3100	30	7	6500	3100	10000	7
54	6100	3400	30	7	7100	3400	10000	7
53	6600	3700	25	6	7700	3700	10000	6
52	7200	4000	25	6	8400	4000	10000	6
51	8100	4500	20	5	9400	4500	10000	5
50	9000	5000	20	5	10500	5000	10000	5

6.5 Manual gain adjustment (Basic)

6.5.1 Overview

Due to limitation of load conditions, automatic gain adjustment might not achieve expected performance. Control can be improved through manual gain adjustment
The servo system is made up of 3 control loops. From outer to inner: position loop, velocity loop, current loop as shown in the diagram below.



Inner control loop demands higher responsiveness. In order to avoid system instability, please tune in accordance to this principle. Current loop gain usually satisfies the responsiveness demand without tuning. When gain adjustment is done under position control mode, in order to keep the system stabile, position and velocity loop gain have to be increased at the same time to make sure the responsiveness of the position loop is lower than velocity loop.

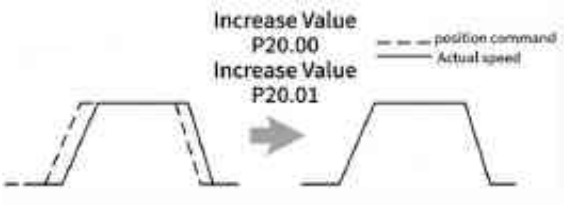
Steps to tuning (Position and velocity control)

For servo gain, if any one of the parameters is changed, please modify other gain related parameters accordingly. Make sure to the change at around 5% and follow the rules as below.

1) Increase responsiveness
   a) Reduce torque command filter time
   b) Increase velocity loop gain
   c) Decrease velocity loop integral time
   d) Increase position loop gain
2) Decrease responsiveness, prevent vibration and over shoot
   a) Reduce position loop gain
   b) Increase velocity loop integral time
   c) Reduce velocity loop gain
   d) Increase torque filter time

P20.00	Label	1st Position Loop Gain		Mode	P/PP/HM/CSV		
	Range	0~3000.0		Default	48.0	Unit	Hz
	Activation	Immediate	Attribute	RW		Index	2020-01h

Parameter function: Determines the maximum frequency of position commands that the position loop can follow and change. Maximum frequency of position loop following = P20.00



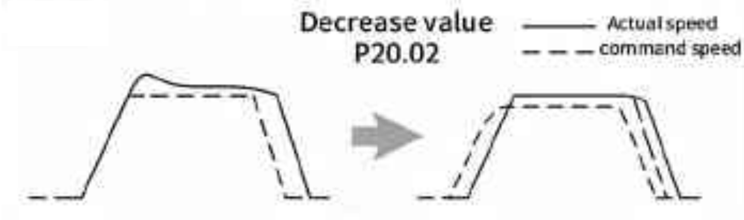
Adjustment method:
When the inertia ratio is set correctly, adjust according to the positioning time. Increase this parameter to speed up the positioning time. When noise is generated, reduce the gain appropriately.
Under the condition of ensuring that the mechanical system does not generate resonance or noise, increase the position loop gain to reduce the position tracking error and shorten the positioning time. However, excessive position loop gain may also cause mechanical system vibration or positioning overshoot.

P20.01	Label	1st velocity loop gain		Mode	F		
	Range	0.1~3276.7		Default	27	Unit	Hz
	Activation	Immediate	Attribute	RW		Index	2020-02h

Function of the parameter: Determines the maximum frequency of the speed command that the speed loop can follow. When the inertia ratio P20.04 is set correctly, the maximum frequency that the speed loop can follow = P20.01.
Adjustment method:
Within the range of no noise and no vibration, increase this parameter to speed up the positioning time and bring better speed stability and following; if noise occurs, reduce the parameter setting;
If mechanical vibration occurs, use the mechanical resonance suppression function.

P20.02	Label	1st Integral Time Constant of Velocity Loop		Mode	F		
	Range	1~1000.0		Default	21.0	Unit	ms
	Activation	Immediate	Attribute	RW		Index	2020-03h

Parameter function: Elimination of speed loop deviation



Adjustment method: It is recommended to take the value according to the following relationship:

Velocity loop integration time constant (ms) = 4000 / (2*pi*velocity loop gain (Hz))

Reducing the setting value of this parameter can strengthen the integrating effect and speed up the positioning time, but the setting value is too small to easily cause mechanical vibration, and the setting value is too large, which will lead to the speed ring deviation can never be zeroed.

Under the condition that the mechanical system does not generate resonance or noise, reducing the speed loop integration time constant can increase the system rigidity and reduce the steady state error. If the load inertia ratio is very large or there is a resonance factor in the mechanical system, the speed loop integration time constant must be increased to reduce the function of the integral, otherwise the mechanical system is prone to resonance.

P20.04	Label	1st torque filter time constant Time Constant		Mode	F		
	Range	0.00~25.00		Default	0.84	Unit	ms
	Activation	Immediate	Attribute	RW		Index	2020-05h

Parameter function: Eliminate high-frequency noise, suppress mechanical resonance

Adjustment method:

The smaller the setting value is, the better the system responsiveness can be controlled, but it is limited by mechanical conditions; the larger the setting value is, the better the high frequency resonance can be suppressed, but setting the value too large will cause the response bandwidth and phase margin to be reduced, resulting in system vibration.

It should be ensured that the cut-off frequency of the torque filter is higher than 4 times of the highest following frequency of the speed loop:

$1000000/(2\pi \times P20.04) \geqslant P20.01 \times 4$

For example, with a velocity loop gain P20.01 of 180 (0.1 Hz), the

Torque filter time constant should satisfy: P20.01⩽221 (0.01ms), so the default value satisfies this condition.

Caution:

a. When vibration occurs by increasing the speed loop gain P20.01, the vibration can be suppressed by adjusting the P20.04 torque filter:

b. Setting the value too large will result in reduced response of the current loop;

c. Vibration suppression at stopping is required, try increasing the speed loop gain and decreasing P20.04;

d. If the motor stops with excessive vibration, try reducing the P01.04 setting.

e. However, because the response of the torque loop must be much larger than the response of the speed loop, the torque command filtering time must not be too large, or it will cause the control system to become unstable.

6.5.2 Parameter adjustment under different control modes

Parameter adjustment under different control modes must follow the sequence:
"Inertia Identification" → "Automatic Gain Adjustment" → "Manual Gain Adjustment"

Parameter Adjustment in Position Mode

1) Set the load inertia ratio P21.03 through inertia identification.
2) Gain parameters in position control mode:

Parameters	Label
P20.00	1st position loop gain
P20.01	1st velocity loop gain
P20.02	1st velocity integral time constant
P20.04	1st torque filter time constant
P20.05	2nd position loop gain
P20.06	2nd velocity loop gain
P20.07	2nd velocity loop filter time constant
P20.09	2nd torque filter time constant
P20.10	Velocity feedforward gain constant
P20.11	Velocity feedforward filter time constant
P20.12	Torque feedforward gain
P20.13	Torque feedforward filter time constant
P20.15	Position control gain switching mode
P20.17	Position control switching level
P20.18	Position Control Switching Hysteresis
P20.19	Position Gain Switching Time

3) Obtain the initial values of the 1st and 2nd gains via automatic gain adjustment parameters:

Parameters	Label
P20.00	1st position loop gain
P20.01	1st velocity loop gain
P20.02	1st velocity integral time constant
P20.04	1st torque filter time constant
P20.05	2nd position loop gain
P20.06	2nd velocity loop gain
P20.07	2nd velocity loop filter time constant
P20.09	2nd torque filter time constant

4) In manual adjustment mode, fine-tune the following parameters:

Parameters	Label
P20.00	1st position loop gain
P20.01	1st velocity loop gain
P20.02	1st velocity integral time constant
P20.04	1st torque filter time constant
P20.10	Velocity feedforward gain constant
P20.11	Velocity feedforward filter time constant

Parameter Adjustment in velocity Mode

The adjustment of speed control is generally the same as the previous "Parameter Adjustment in Position Mode". Adjust according to the specified steps, except for parameters related to position loop gain setting (P10.00/P20.05) and speed feedforward gain (P20.10).

Parameter Adjustment in torque Mode

Parameter adjustment in torque control mode must be distinguished based on the following scenarios:

- When the actual speed reaches the speed limit value: The adjustment method is the same as "Parameter Adjustment in Speed Mode". At this point, the motor switches from torque control to speed control, using the speed limit value as the command.
- When the actual speed does not reach the speed limit value: The adjustment method is the same as "Parameter Adjustment in Speed Mode", except for parameters related to position loop gain, speed loop gain, and feedforward gain.

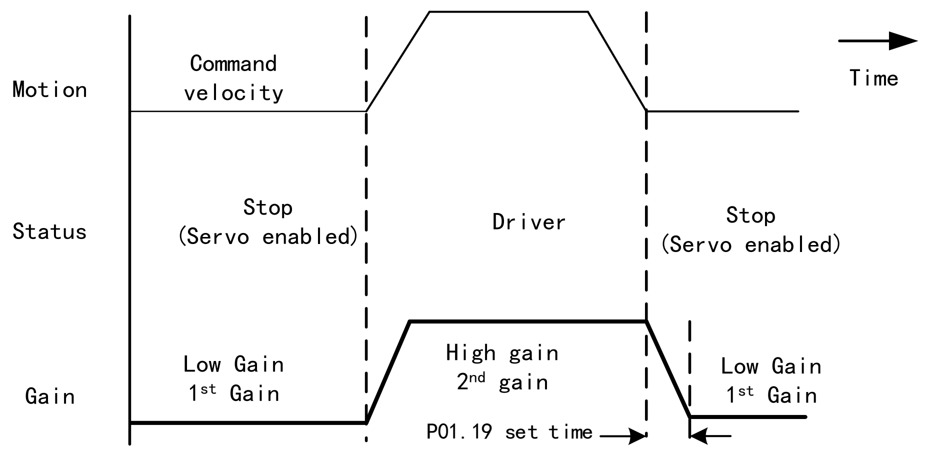
When controlling solely based on torque commands without using speed limit:
Set the torque filter and notch filter to disabled, set the speed limit value to the maximum speed, and increase the speed loop gain as much as possible.

6.5.3 Gain switching

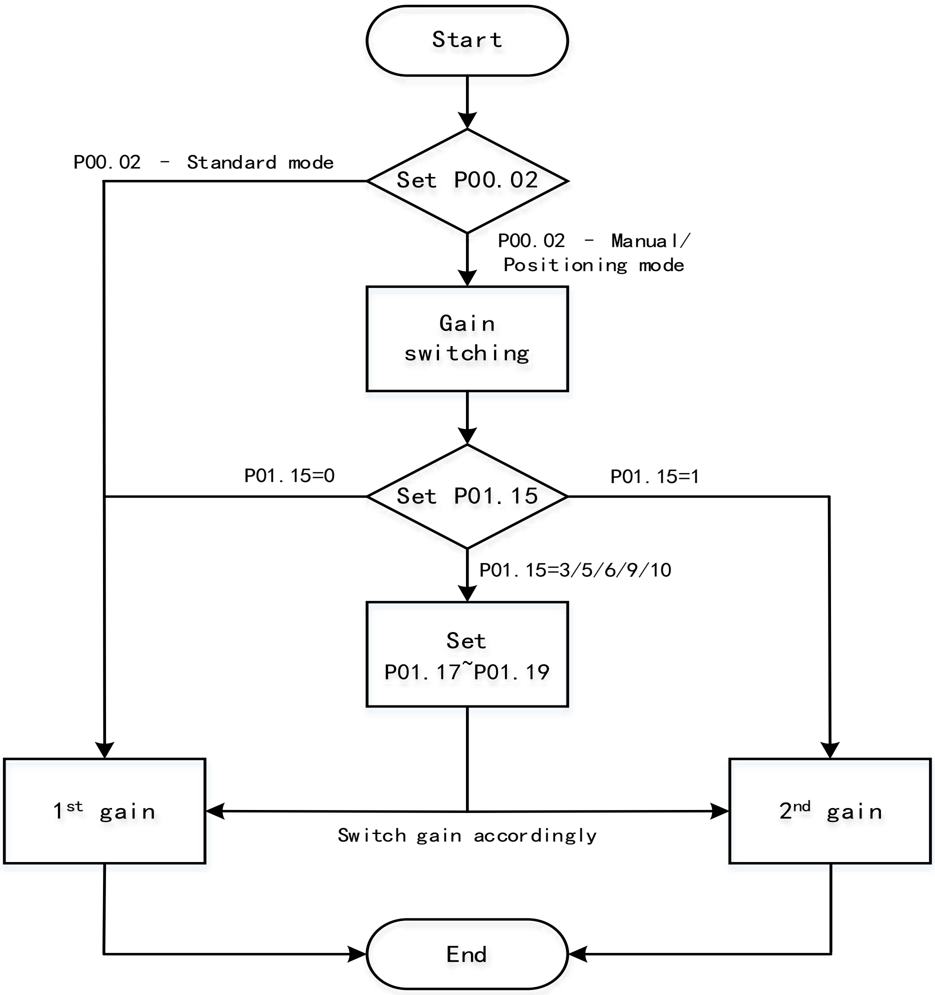
Gain switching function can be triggered internally in servo driver. Only valid under position or velocity control mode. Following effects can be realized by gain switching:

1. Switch to lower gain when motor stops to suppress vibration
2. Switch to higher gain when motor is moving at a low velocity to shorten positioning time
3. Switch to higher gain when motor is moving at a high velocity to improve command following behavior.

Diagram below shows gain switching when motor stops.



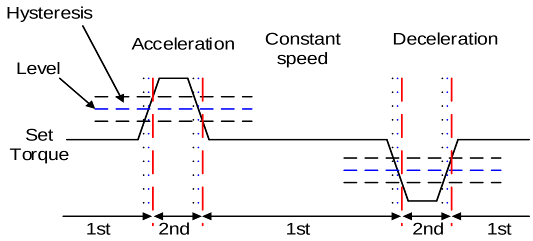
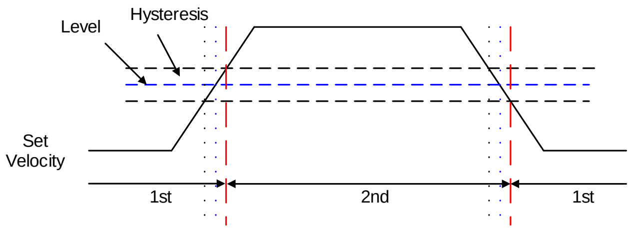
1st gain (P01.00-P01.04) and 2nd gain (P01.05-P01.09) switching can be realized through manual and positioning mode. Switching condition is set through P01.15. Gain switching is invalid under standard mode.

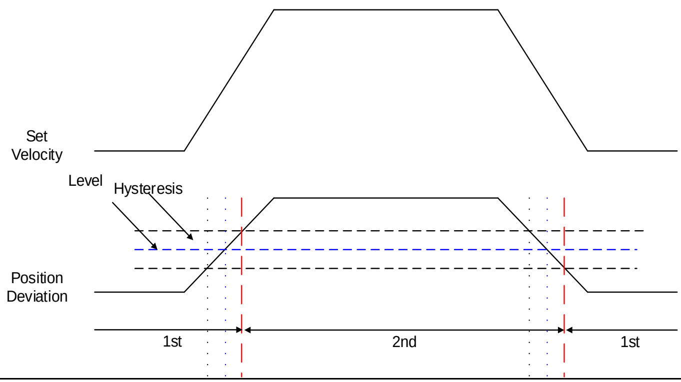
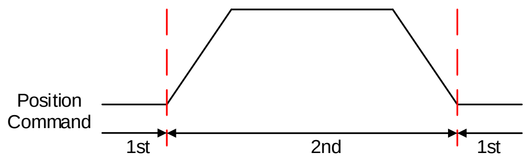


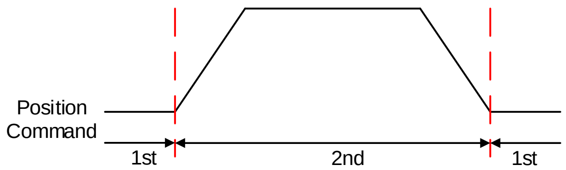
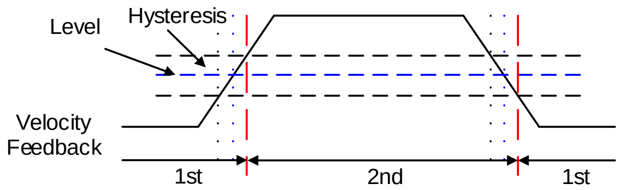
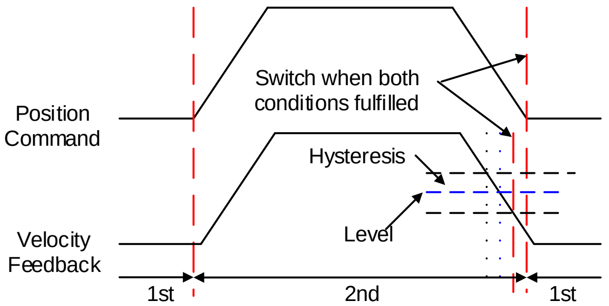
Related parameters on gain switching

P20.15	Label	Position control gain switching mode		Mode	P/PP/HM/CSP		
	Range	0.0~12		Default	0	Unit	
	Activation	Immediate	Attribute	RW		Index	2020-10h

Set Value	Condition	Gain switching condition
0	1^{st} gain fixed	Fixed on using 1^{st} gain(P20.00-P20.04)
1	2^{nd} gain fixed	Fixed on using 2^{nd} gain (P20.05-P20.09)
2	Reserved	
3	High set torque	Switch to 2^{nd} gain when set torque command absolute value larger than (level + hysteresis)[%] Switch to 1^{st} gain when set torque command absolute value smaller than (level + hysteresis)[%]

<table>
<tr><td></td><td></td><td>
</td></tr>
<tr><td>4</td><td>Reserved</td><td>Reserved</td></tr>
<tr><td>5</td><td>High set velocity</td><td>

Valid for position and velocity control.
Switch to 2nd gain when set velocity command absolute value larger than (level + hysteresis)[r/min]
Switch to 1st gain when set velocity command absolute value smaller than (level-hysteresis)[r/min]</td></tr>
<tr><td>6</td><td>Large position deviation</td><td>Valid for position control.
Switch to 2nd gain when position deviation absolute value larger than (level + hysteresis)[pulse]
Switch to 1st gain when position deviation absolute value smaller than (level-hysteresis)[pulse]

</td></tr>
<tr><td>7</td><td>Pending position command</td><td>Valid for position control.
Switch to 2nd gain if position command ≠ 0
Switch to 1st gain if position command remains = 0 throughout the duration of delay time.

</td></tr>
<tr><td>8</td><td>Not yet in position</td><td>Valid for position control.
Switch to 2nd gain if position command is not completed.</td></tr>
</table>

		Switch to 1st gain if position command remains uncompleted throughout the duration of delay time. 
9	High actual velocity	 Valid for position control. Switch to 2nd gain when actual velocity absolute value larger than (level + hysteresis)[r/min] Switch to 1st gain when actual velocity absolute value remains smaller throughout the duration of delay time than (level-hysteresis)[r/min]
10	Pending position command +actual velocity	 Valid for position control. Switch to 2nd gain if position command ≠ 0 Switch to 1st gain if positional command = 0 throughout the duration of delay time and absolute value of actual velocity remains smaller than (level - hysteresis) (r/min)

For position control mode, set P20.15=3,5,6,9,10;

For velocity control mode, set P20.15=3,5,9;

*** Above 'level' and 'hysteresis' are in correspondence to P20.17 Position control gain switching level and P20.18 Hysteresis at position control switching.*

P20.16	**Label**	Position Control Switching Delay		**Mode**	P/PP/HM/CSP		
	Range	0.0~1000.0		**Default**	0.0	**Unit**	ms
	Activation	Immediate	**Attribute**	RW		**Index**	2020-11h

When P20.15 is set to 2, 3, or 10, it represents the time from the detection trigger to the actual gain switchover when switching from the 1st gain to the 2nd gain.

P20.17	**Label**	Position control gain switching level		**Mode**	P/PP/HM/CSP		
	Range	0~20000		**Default**	50	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2020-12h

Set threshold value for gain switching to occur.
Unit is mode dependent.

Switching condition	Unit
Position	Encoder pulse count
Velocity	RPM
Torque	%

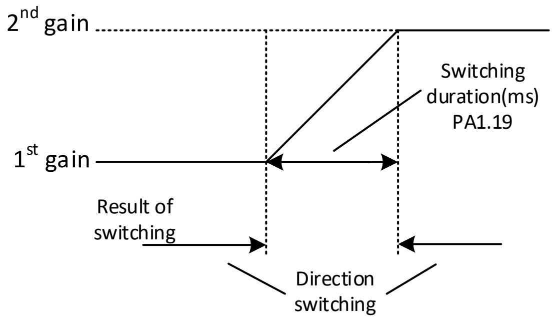
Please set level ≥ hysteresis

P20.18	**Label**	Hysteresis at position control switching		**Mode**	P/PP/HM/CSP		
	Range	0~20000		**Default**	33	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2020-13h

To eliminate the instability of gain switching. Used in combination with P20.17 If level< hysteresis, drive will set internally hysteresis = level.

P20.19	**Label**	Position gain switching time		**Mode**	P/PP/HM/CSP		
	Range	0~1000.0		**Default**	3.3	**Unit**	ms
	Activation	Immediate	**Attribute**	RW		**Index**	2020-14h

During position control, if 1st and 2nd gain difference is too large, to ease torque changes and vibration due to rapid changes in position loop gain, set suitable P01.19 value
For example: 1st (P20.00) <-> 2nd (P20.05)

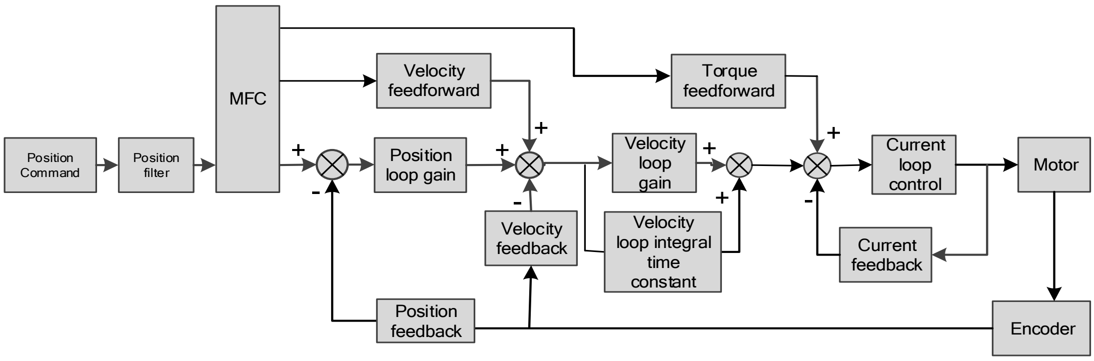


6.6 Manual gain adjustment (Application)

6.6.1 Model following control

Model following control is a type of closed loop control system. First, an ideal model is constructed and acts as a reference for actual model in a closed loop control. Model following control can be treated as a control mode with 2 flexibilities: Reference model can be used to improve command responsiveness and closed loop control used to increase responsiveness of the system towards interference. They don't affect each other.

Model following control can be used in position loop control to increase responsiveness to commands, reduce positioning time and following error. This function is only available in position control mode.



To adjust model following control

1. Automatic adjustment

   B、 Set model following bandwidth P21.00 = 1 for automatic adjustment. Now, P21.00 = P20.01, model following bandwidth is adjusted automatically according to different velocity loop gain.

2. Manual adjustment

   C、 Please used manual adjustment if

   - Automatic adjustment is not satisfactory.
   - Responsiveness needs further improvement in comparison with automatic adjustment.
   - There is a need to set servo gain or model following control parameters manually.

Steps to manually adjust

Step	Content
1	Set up vibration suppression.
2	Set up the right inertia ratio.
3	Manually adjust gain.
4	Increase P21.00 provided that there is no overshoot and vibration. Usually P21.00 ≥ P20.01 is recommended.

Model following bandwidth determines the responsiveness of the servo system. Increase the value set will increase responsiveness and reduce positioning time. Overshoot can be prevented if it is set at a lower value but responsiveness will be lowered. Model following bandwidth shouldn't be too large for mechanical structure with lower stiffness, excessive position deviation alarm might occur under high velocity.

Related Parameters:

P21.00	Label	Model-following bandwidth(MFC)		Mode	F		
	Range	0~2000.0		Default	0.1	Unit	Hz
	Activation	Immediate	Attribute	RW		Index	2021-01h

Model-following bandwidth, also known as model-following control (MFC), is used to control the position loop to improve the responsiveness to commands, speed up positioning time and reduce following error. The effect is obvious especially in low and medium mechanical stiffness. Use mainly for MFC or ZTC tuning.

Value	Description
0	Disable the function.
0.1	Enable the function to set bandwidth automatically
0.2~0.9	Reserved
1~2000.0	Manually set the bandwidth; belt application recommend 3.0~10.0

P21.04	Label	MFC Curve Damping Correction Coefficient		Mode	F		
	Range	-100.00~100.00		Default	0.00	Unit	%
	Activation	Immediate	Attribute	RW		Index	2021-05h

Used to improve positioning smoothness and positioning time.

P21.05	Label	Forward/Reverse Torque Comp Gain Difference Percentage		Mode	F		
	Range	-20.00~20.00		Default	0.00	Unit	%
	Activation	Immediate	Attribute	RW		Index	2021-06h

Used to set the difference ratio of torque compensation gains between the forward rotation and reverse rotation of the servo motor, with the forward torque being P21.05×100% of the reverse torque.

<table>
<tr><td rowspan="3">P21.06</td><td>Label</td><td colspan="2">MFC Type</td><td>Mode</td><td>P</td><td>PP</td><td>CSP</td></tr>
<tr><td>Range</td><td colspan="2">0~5</td><td>Default</td><td>3</td><td>Unit</td><td></td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td>RW</td><td></td><td>Index</td><td>2021-07h</td></tr>
</table>

Set value	Description
【0】	Model following control
1	Zero tracking control
2	3 inertia (future upgrade)
3	Path following (future upgrade)
4	Traditional Feedforward
5	Vibration Suppression Type

<table>
<tr><td rowspan="3">P21.07</td><td>Label</td><td colspan="2">Velocity feedforward compensation coefficient</td><td>Mode</td><td>P</td><td>PP</td><td>CSP</td></tr>
<tr><td>Range</td><td colspan="2">-10000~ 10000</td><td>Default</td><td>0</td><td>Unit</td><td>-</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td>RW</td><td></td><td>Index</td><td>2021-08h</td></tr>
</table>

This parameter is used for feedforward compensation of speed to reduce system tracking errors and improve dynamic response speed. As an open-loop control technology, it predicts load changes or command changes to adjust control output in advance, making the system more stable and accurate.

<table>
<tr><td rowspan="3">P21.08</td><td>Label</td><td colspan="2">Torque feedforward compensation coefficient</td><td>Mode</td><td>PP</td><td>PV</td><td>CSP</td><td>CSV</td></tr>
<tr><td>Range</td><td colspan="2">-10000~ 10000</td><td>Default</td><td>0</td><td>Unit</td><td colspan="2">-</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td>RW</td><td></td><td>Index</td><td colspan="2">2021-09h</td></tr>
</table>

This parameter enables feedforward compensation for torque control when set, enhancing the system's ability to predict and compensate for load changes (such as external torque disturbances). This improves the system's response speed and reduces tracking errors. As an open-loop control strategy, feedforward compensation, when combined with feedback control, significantly improves overall system stability.

<table>
<tr><td rowspan="3">P21.09</td><td>Label</td><td colspan="2">Dynamic friction compensation coefficient</td><td>Mode</td><td colspan="3">F</td></tr>
<tr><td>Range</td><td colspan="2">0~1000</td><td>Default</td><td>0</td><td>Unit</td><td></td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td>RW</td><td></td><td>Index</td><td>2021-0Ah</td></tr>
</table>

To set ratio of rated torque/rated rotational speed, to compensate for dynamic friction during motion and have better control over acceleration/deceleration.

$$\text{Dynamic friction coefficient} = \left|\frac{\text{Torque(Rotational speed 1)} - \text{Torque(Rotational speed 2)}}{\text{Rotational speed 1} - \text{Rotational speed 2}} * \text{rated rotational speed}\right|$$

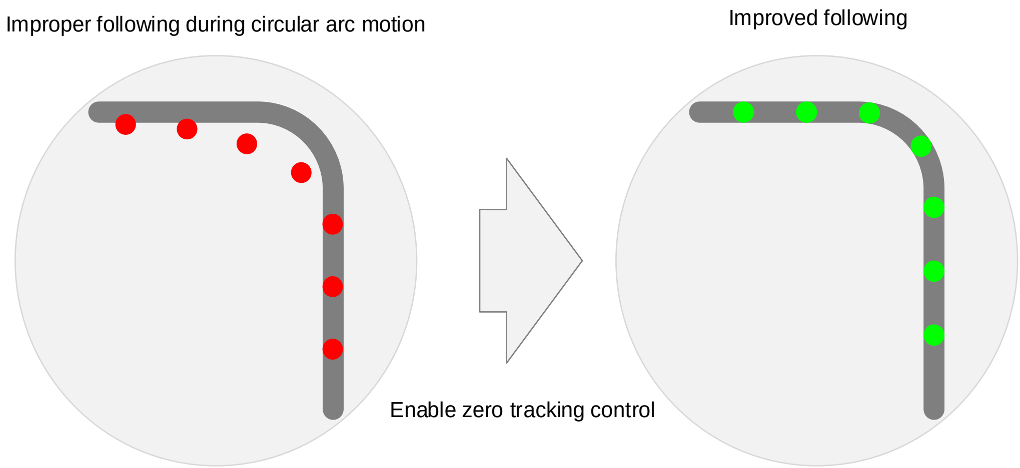
When there is an excess position deviation during acceleration/deceleration, please adjust friction coefficient to reduce the deviation to 0.

6.6.2 Zero tracking control

Zero tracking control (ZTC) is able to realize a zero position deviation during acceleration/deceleration. This function increase multi axis precision and master-slave following.

Recommended application:

1. Multi axis



2. Master-slave following

Used when driving axis sends frequency divider signal to lead following axis to improve the following control.

- ZTC only available under position control mode.
- ZTC can only be enabled when P00.00 is valid.
- Model following control (MFC) and Zero Tracking Control (ZTC) cannot be used together at the same time.

Zero tracking control can achieve better performance with the following limiting factors.

Limiting factors	
Control Mode	Applicable to position loop (this function is not available in other modes).
Other	The Zero tracking control function cannot coexist with standard MFC (Model Following Control).

Affecting conditions	
Command Electronic Gear Ratio	• The command electronic gear ratio must be small; otherwise, current noise will be high.
Mechanical Structure	• The mechanical rigidity must be good; otherwise, vibration will be significant.
Motion Profile	• The command jerk must be continuous and as small as possible. Otherwise, sudden error changes will occur during acceleration variation. • Positioning operation may involve overshoot and undershoot; S-curve commands will improve performance.

Related parameters

Parameter	Label	Description
P21.06	Model following control	0：Model following control - Default 1：Zero tracking control
P21.09	Dynamic friction compensation coefficient	Range: 0-1000, unit: 0.1% Unit：Changes in torque with the effect of friction on rotational speed. Only valid when MFC is activated
P21.00	Model following bandwidth	If P00.00 = 0, MFC and ZTC is deactivated. When P02.50 = 1 (Zero tracking control), higher bandwidth will improve following performance but noise will be higher.
Set the following parameters to default		
P21.07	Velocity feedforward compensation coefficient	Default value = 0 for zero tracking control.
P21.08	Torque feedforward compensation coefficient	
P21.10	Overtravel time constant	
P21.11	Overtravel suppression gain	

Operation steps

1) Disable the position command low-pass filter, position command FIR filter (P10.14 and P10.15), and vibration suppression (P22.13 and P22.15).

2) Normally tune the servo drive parameters to achieve the optimal performance at this stage (trajectory deviation may exist, but rigidity has reached the mechanical limit).

3) Set P21.06 to 1 to enable the Super Track function.

4) Verify if the trajectory following performance meets requirements. If satisfied, the process is complete.

5) Dynamic Friction Coefficien: This function compensates for the dynamic friction encountered by the equipment during motion, eliminating steady-state tracking errors in acceleration/deceleration phases and achieving more precise torque control. (Only valid when P21.00 Model Following Bandwidth (MFC) is enabled.)

$$\text{Dynamic Friction Coefficient} = \left| \frac{\text{Steady-state torque at speed 1} - \text{Steady-state torque at speed 2}}{\text{Speed 1} - \text{Speed 2}} \right| \times \text{Rated speed}$$

Specific Operating Steps:

a) Select two speed points: While the equipment performs acceleration/deceleration motion, observe and record two speed values (Speed 1 and Speed 2) at which constant position errors occur.
b) Read steady-state torque: Use the built-in monitoring function of the servo tuning software to read the steady-state output torque values when the equipment runs at these two speeds.
c) Substitute into the formula for calculation: Plug the obtained speed values (Speed 1, Speed 2) and corresponding steady-state torques into the formula above to calculate the value of the "Dynamic Friction Coefficient" parameter to be set.
d) Parameter input and verification: Input the calculated value into the corresponding parameter of the drive, run the equipment again, and observe whether the tracking errors in acceleration/deceleration phases are eliminated.

6) If the error during acceleration/deceleration start/stop is large, increase the model following bandwidth (P21.00) and gain. This will reduce the error during acceleration/deceleration start/stop, but the current noise will increase.

Notes:

- The Super Track function is only applicable to the position loop.
- The Super Track function is only valid after the P21.00 Model Following Bandwidth (MFC) is enabled.

6.6.3 Feedforward gain

In position control, the speed control command required for an action is calculated from the internal position command, and the speed feedforward is calculated by adding the speed command calculated by comparing it with the position feedback, which reduces the position deviation and improves the responsiveness compared with the feedback control alone.
In addition, the response of the speed control system can be improved by calculating the torque command required for the movement from the speed control command and adding the torque feedforward calculated from the torque command by comparing it with the speed feedback.
Servo drives use two types of feedforward functions: speed feedforward and torque feedforward.
Velocity feedforward can be applied to the position control mode. Using the velocity feedforward function improves the velocity command response and reduces the position deviation at fixed speeds.
In position control mode, torque feedforward can be used to improve the torque command response and reduce the position deviation at fixed acceleration and deceleration;
Speed control mode, using torque feedforward, can improve the torque command response and reduce the speed deviation at fixed speed.

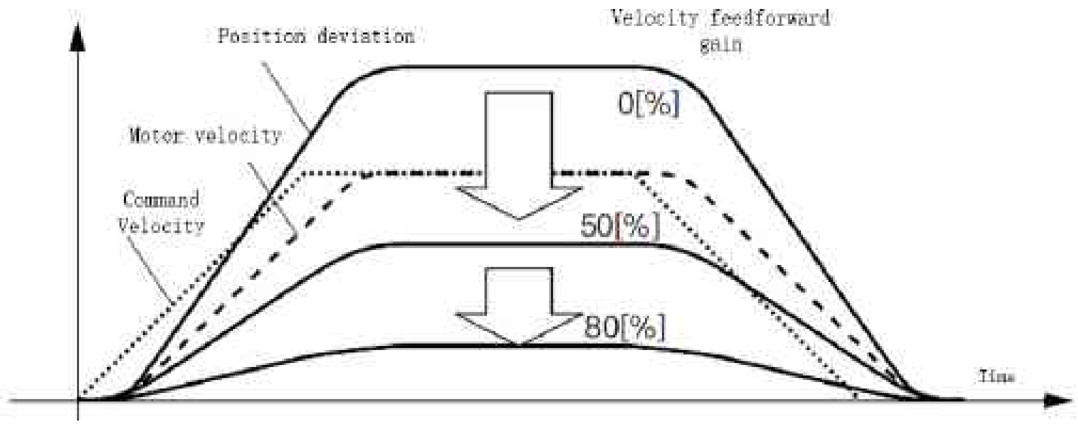
Velocity feedforward

Velocity feedforward can be used in position control mode. When the function is enabled, it can increase velocity responsiveness, reduce position deviation during constant velocity.

P20.10	**Label**	Velocity feed forward gain		**Mode**	P/PP/HM/CSV		
	Range	0.0~1.000		**Default**	0.3	**Unit**	1
	Activation	Immediate	**Attribute**	RW		**Index**	2020-0Bh
	According to the position command feedforward compensation amount calculated by the differentiation, the speed command calculated by the differentiation is multiplied by the setting value of this parameter, skipping the "position controller" and directly added to the speed command input. This parameter is often used to reduce the following error and stabilize the setting value during slow speed response. **Increasing the setting value**: It can enhance the front feedback compensation amount, further reduce the following error, and improve the response agility of the system. However, please note that if the setting value is too large, it may easily cause system overshoot or oscillation. It is recommended to set it in combination with the actual commissioning situation. **Decreasing the setting value**: The front feedback compensation effect is weakened, and the system stability is improved. But it may lead to an increase in the following error and a slower response speed. This setting is suitable for working conditions that require high stability of the dynamic response of the system.						

P20.11	**Label**	Velocity feed forward filter time constant		**Mode**	**F**		
	Range	0.0~64.00		**Default**	0.50	**Unit**	ms
	Activation	Immediate	**Attribute**	RW		**Index**	2020-0Ch
	Set velocity feed forward low pass filter to eliminate high or abnormal frequencies in velocity feed forward command. Often used when position command with low resolution or high electronic gear ration to smoothen velocity feed forward. Position deviation under constant velocity can be lowered with higher velocity feed forward gain. Please to refer to the equation below. Position deviation[Uint]= $\frac{Set\ velocity[\frac{Uint}{s}]}{Position\ loop\ gain[Hz]} \times \frac{100 - Velocity\ feed\ foward\ gain[\%]}{100}$						

Set P20.11 to around 50 (0.5ms), then tune P20.10 from 0 to bigger values until the velocity feedforward achieves better performance. Under constant velocity, the position deviation in a motion will decrease as the velocity feedforward gain increase.



Steps to tuning Velocity feedforward:

1. Increase P20.10 to increase responsiveness but velocity overshoot might occur during acc-/deceleration.
2. By reducing P20.11, velocity feedforward would be more effective and vice versa. P01.10 and P01.11 need to be tuned to a balance.
3. If mechanical noise exists under normal working conditions, please increase P20.11 or use position command filter (1 time delay/ FIR smoothing filter)

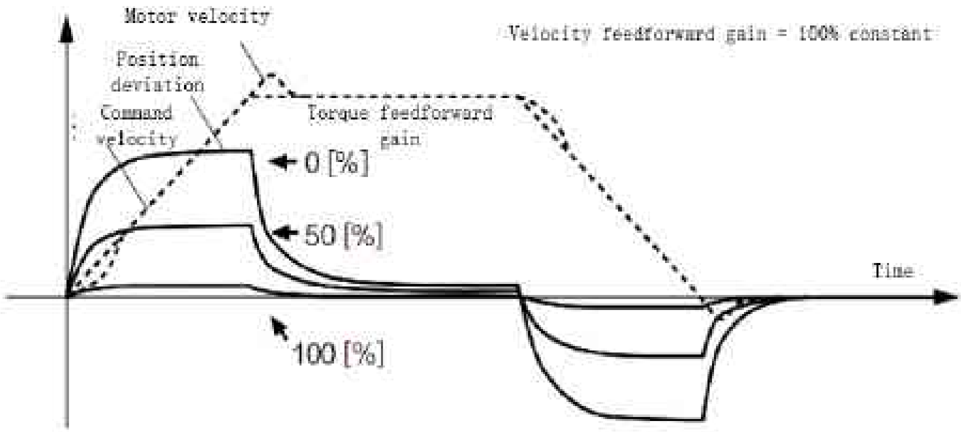
Torque feedforward

Position control mode:
Torque feedforward can increase the responsiveness of torque command, decrease position deviation during constant acc-/deceleration.
Velocity control mode:
Torque feedforward can increase the responsiveness of torque command, decrease velocity deviation during constant velocity.

P20.12	Label	Torque feedforward gain		Mode	P/S/PP/PV/HM/CSP/CSV		
	Range	0.0~1.0		Default	0	Unit	1
	Activation	Immediate	Attribute	RW		Index	2020-0Dh
	Before using torque feed forward, please set correct inertia ratio P20.04. By increasing torque feed forward gain, position deviation on constant acceleration/deceleration can be reduced to close to 0. Under ideal condition and trapezoidal speed profile, position deviation of the whole motion can be reduced to close to 0. In reality, perturbation torque will always exist, hence position deviation can never be 0.						

P20.13	Label	Torque feed forward filter time constant		Mode	P/S/PP/PV/HM/CSP/CSV		
	Range	0.0~64.00		Default	0.00	Unit	ms
	Activation	Immediate	Attribute	RW		Index	2020-0Eh
	Low pass filter to eliminate abnormal or high frequencies in torque feed forward command. Usually used when encoder has lower resolution or precision. Noise reduces if torque feed forward filter time constant is set higher but position deviation will increase at acceleration varied points.						

Set P20.13 to around 50 (0.5ms), then tune P20.10 from 0 to bigger values until torque feedforward achieves better performance. Under constant acc-/deceleration, the position deviation in a motion will decrease as the velocity feedforward gain increase.



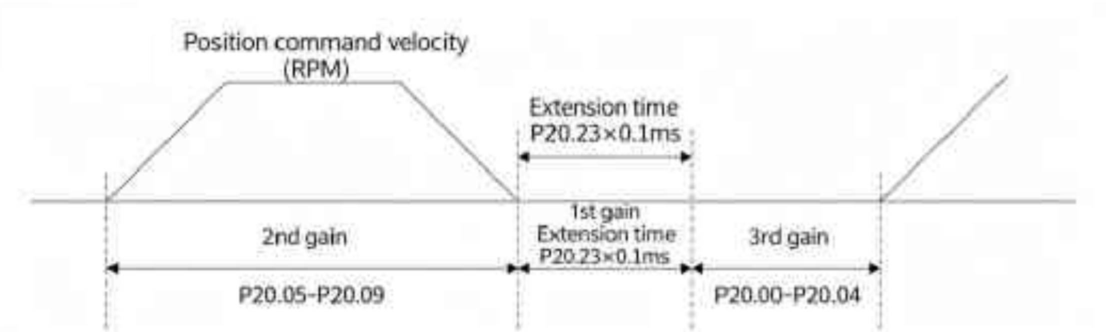
Steps to tuning Torque feedforward:

1. Increase P20.12 to increase responsiveness but velocity overshoot might occur during acc-/deceleration.
2. By reducing P20.13, torque feedforward would be more effective and vice versa. P01.12 and P01.13 need to be tuned to a balance and reduce noise.

6.6.4 3rd Gain Switching

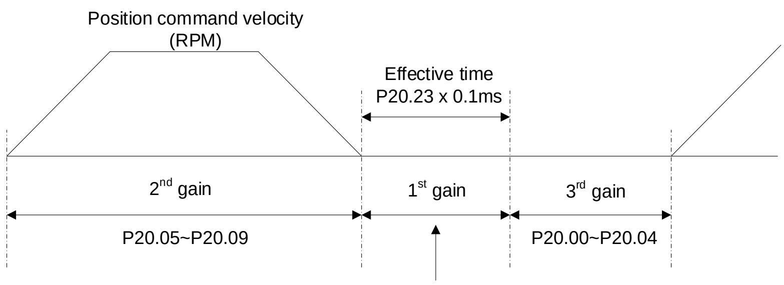
Besides switching between 1st and 2nd gain, a 3rd gain switching is added to set gain at the moment of stopping to reduce positioning time.
Only available under position mode and P20.03 ≠ 0, set P20.24 for 3rd gain value. When 2nd gain switches to 1st gain, it has to go through 3rd gain, switching time is set in P20.19.

Diagram below shows when P01.15 = 7.



Related parameters:

P20.23	**Label**	3rd Position Gain Active Time		**Mode**	**P/PP/HM/CSP**		
	Range	0~10000		**Default**	0	**Unit**	ms
	Activation	Immediate	**Attribute**	RW		**Index**	2020-18h
Set the effective time of the 3rd gain. When not in use, please set P20.23=0 and P20.24=100.							

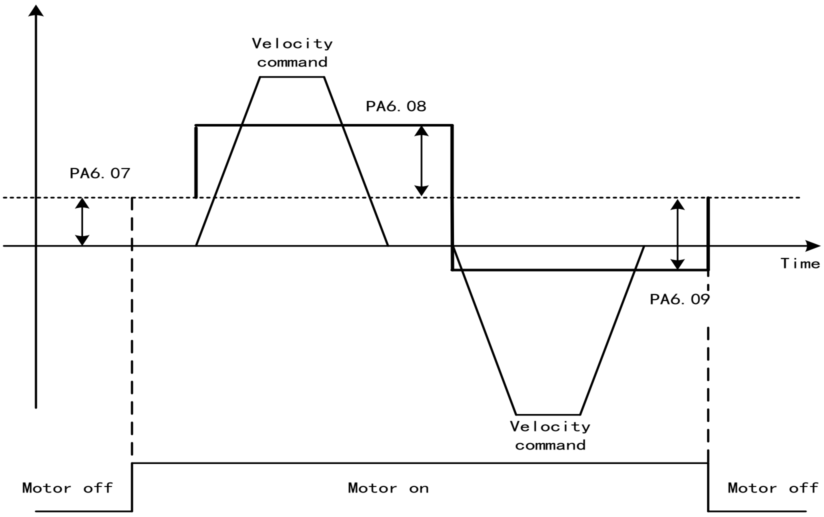
P20.24	**Label**	3rd Position Gain Multiplier		**Mode**	**P/PP/HM/CSP**		
	Range	0~1000		**Default**	100	**Unit**	%
	Activation	Immediate	**Attribute**	RW		**Index**	2020-19h
The 3rd gain becomes effective after the position command speed reaches zero and the time set by  P20.23 has elapsed. 3rd gain = 1st gain × P20.24 / 100. The 3rd gain does not change the original speed loop integral time, speed filter, or torque filter values.							

6.6.5 Friction compensation function

This function is to compensation for changes in load to reduce the effect of friction in motion. The compensation value is directional.

As a function to reduce the effect of friction on machinery, the friction torque compensation function operates under the following conditions:

■ The servo must be enabled.
■ The motor must be in normal rotation and without faults.
■ Conditions other than the control parameters are set appropriately, such as deviation counting zero command input prohibition, torque limitation, and so on.



■ Vertically loaded axis: A constant eccentric load torque is applied on the motor. By adjusting P21.25, positioning deviation due to different motional direction can be reduced.
■ Belt-driven axis: Due to large radial load with dynamic frictional torque. Positioning time delay and deviation can be reduced by adjusting P21.23 and P21.24.

Related Parameters：

P21.23	Label	Positive Torque Compensation Value		Mode	F		
	Range	-100~100		Default	0	Unit	%
	Activation	Immediate	Attribute	RW		Index	2021-18h
	Set to add feedforward torque superposition to the torque command, mainly for friction compensation in horizontal movement.It reduces the impact of friction in mechanical transmission on operation effects and provides positive and negative compensation values for torque in the same forward and reverse direction. Example: When the motor speed is at a constant speed, the monitored torque output value for forward operation is recorded as T1, and the torque output value for reverse operation is recorded as T2. If T2 = |T1-T2|/2, the friction torque is Tf = |T1-T2|/2. The magnitude of Tf is determined by the settings of P21.23 and P21.24. Note: Positive and negative compensation directions are determined based on the actual position command. The forward torque compensation value is set to positive (P21.23=+Tf), and the reverse direction friction compensation value is set to negative (P21.24=-Tf).						

P21.24	Label	Negative Torque Compensation Value		Mode	F		
	Range	-100~100		Default	0	Unit	%
	Activation	Immediate	Attribute	RW		Index	2021-19h
	Check 21.23						

P21.25	Label	Torque Command Additive Value		Mode	F		
	Range	-100~100		Default	0	Unit	%
	Activation	Immediate	Attribute	RW		Index	2021-1Ah
	Set the feedforward addition value of the vertical torque. It is applied to vertical load conditions to compensate for the torque caused by gravity. Example: When moving along the vertical direction, select any position within the stroke as the load point. When the load moves to that point, the motor is controlled to stop but not move. Record the torque value T output at that time as the torque command addition value (gravity compensation value).						

6.7 Vibration Suppression Function

6.7.1 Mechanical resonance suppression

Mechanical system has certain resonance frequencies. When servo gain is increased, resonance might occur at around mechanical resonant frequencies, preventing gain value from increasing. In such situation, notch filter can be used to suppress resonance to set higher gains or lower vibration.

To suppress mechanical resonance:

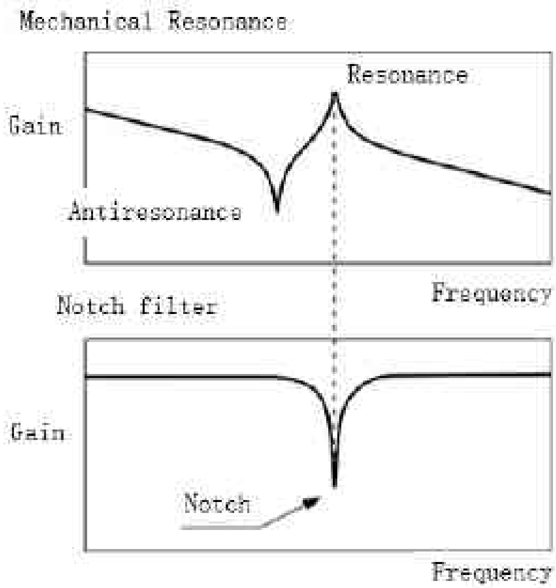
1. Torque command filter time constant

Set filter time constant to reduce gain at around resonant frequencies

Torque command filter blocked frequencies（Hz） fc=1/ [2π×P20.04(0.01ms)×0.00001）]

2. Notch filter

Notch filter suppress mechanical resonance by reducing gain at certain frequencies. When notch filter is correctly set, resonance can be suppressed and servo gain can be increased.



The servo drive has 4 groups of notch filters, each with 3 parameters: notch filter frequency, width level, and depth level. The first and second groups are manual notch filters, whose parameters are set manually by the user. The parameters of the third and fourth groups can be set manually or configured as adaptive notch filters. When P22.00=1 or 2, the third filter is an adaptive filter; when P22.00=3, both the third and fourth filters are adaptive filters, and all parameters of the adaptive filters can be automatically set by the drive.

Note:

1. When the ‘Frequency’ is the default value of 4000Hz, the trap is invalid.

2. If resonance occurs and a trapper is needed, please use the adaptive trap first. If the Adaptive Trap is not effective, then try using the Manual Trap.

Operation steps

Adaptive Notch Filter Usage Steps:

1) Set P22.00 (Adaptive Filter Mode Setting) to 1, 2, or 3 to enable filter adaptation.
2) When P22.00=1 or 2, the parameters of the 3rd group notch filter (P22.07/P22.08/P22.09) are automatically updated during servo operation. If P22.00 is set to 1, P22.00 will automatically return to 0 after the update, stopping adaptation. When P22.00=3, the parameters of the 3rd and 4th group notch filters (P22.07~P22.12) are automatically updated during servo operation.
3) If resonance is suppressed, the adaptive filter is effective. If new resonance occurs, use a manual notch filter and set its frequency to the actual resonance frequency. If vibration cannot be eliminated for a long time, please disable the servo enable in time.

Manual notch filters can be used in two ways:

- Write the parameter values obtained from the adaptive filters (3rd and 4th filters) into the 1st and 2nd group notch filters, and re-enable P22.00 (Adaptive Notch Filter Mode Setting). New resonance points will be automatically updated to the adaptive filters.
- Obtain parameters via the "Mechanical Characteristic Analysis" function in Leadshine's tuning software, then download the obtained resonance frequency, notch width, and notch depth parameters to the corresponding notch filter parameters of the drive.

Manual Notch Filter Usage Steps:

4) Analyze the resonance frequency.
5) When using a manual notch filter, set its frequency to the actual resonance frequency.

Methods to obtain the resonance frequency:

- Obtain via the "Mechanical Analysis" function in Leadshine's Motion Studio.
- Set P22.00=1; the servo will automatically test the resonance frequency during operation and save the test result in the 3rd filter. Fill the parameters of the 3rd filter into the other manual filter parameters, then test the resonance frequency again.

6) Input the resonance frequency obtained in step 1 into the selected group's notch filter parameters, along with the width level and depth level of that group's notch filter.
7) If resonance is suppressed, the notch filter is effective. You can continue to adjust the gain. If new resonance occurs after increasing the gain, repeat the previous steps.
8) If vibration cannot be eliminated for a long time, please disable the servo enable in time.

Notch filter bandwidth：

The notch width level is used to indicate the ratio of the notch width to the notch centre frequency: (fH-fL)/ fT

fT: trap centre frequency, i.e. mechanical resonance frequency.

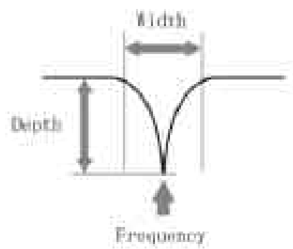
fH-fL: trap width, indicating the frequency bandwidth with amplitude attenuation of -3dB relative to the trap centre frequency.

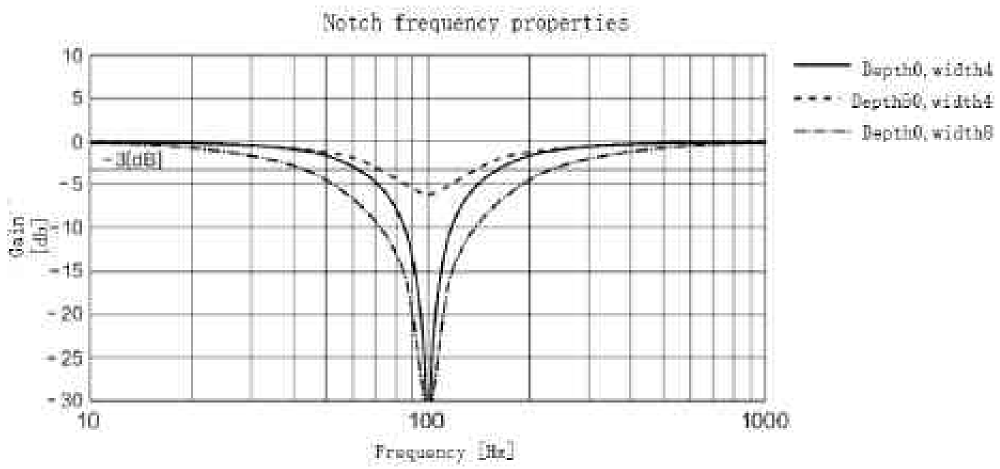
Generally, the default value of 2 can be kept.

Notch filter depth：

The ratio between input and output of center frequency.

When depth = 0, center frequency output is totally off and when depth = 100, Hence when notch filter depth is set at lower value, the depth is higher and better at suppressing mechanical resonance but it might cause system instability.





If the amplitude-frequency curve from mechanical properties analysis tool doesn't show any obvious peak but vibration did occur, it might not be due to mechanical resonance, it may be that servo gain has reached its limit. This kind of vibration can't be suppressed by using notch filter, only by reducing gain and torque command filter time.

Related Parameters：

<table>
<tr><td rowspan="3">P22.00</td><td>Label</td><td colspan="2">Adaptive filtering mode settings</td><td>Mode</td><td colspan="3">F</td></tr>
<tr><td>Range</td><td colspan="2">0~4</td><td>Default</td><td>3</td><td>Unit</td><td></td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>2022-1h</td></tr>
</table>

Set value	Description	
0	Adaptive filter: invalid	Parameters related to 3rd and 4th notch filter remain unchanged
1	Adaptive filter: 1 filter valid for once.	1 adaptive filter becomes valid. 3rd notch filter related parameters updated accordingly. P22.00 switches automatically to 0 once updated.
2	Adaptive filter: 1 filter remains valid	1 adaptive filter becomes valid. 3rd notch filter related parameters will keep updating accordingly.
3	Adaptive filter: 1&2 filter remains valid	1 & 2 adaptive filter becomes valid. 3rd & 4th notch filter related parameters will keep updating accordingly.
4	-	Filtering clearing.

<table>
<tr><td rowspan="3">P22.01</td><td>Label</td><td colspan="2">1st notch frequency</td><td>Mode</td><td colspan="3">F</td></tr>
<tr><td>Range</td><td colspan="2">50~8000</td><td>Default</td><td>8000</td><td>Unit</td><td>Hz</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>2022-02h</td></tr>
<tr><td colspan="8">Set center frequency of 1st torque command notch filter.
Set P22.01 to 8000 to deactivate notch filter</td></tr>
</table>

<table>
<tr><td rowspan="3">P22.02</td><td>Label</td><td colspan="2">1st notch bandwidth</td><td>Mode</td><td colspan="3">F</td></tr>
<tr><td>Range</td><td colspan="2">0~20</td><td>Default</td><td>4</td><td>Unit</td><td></td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>2022-03h</td></tr>
<tr><td colspan="8">Set notch bandwidth for 1st resonant notch filter.
Under normal circumstances, please use factory default settings. If resonance is under control, in combination with P22.01 and P22.03, P22.02 can be reduced to improve current loop responsiveness which allows higher mechanical stiffness settings.</td></tr>
</table>

<table>
<tr><td rowspan="3">P22.03</td><td>Label</td><td colspan="2">1st notch depth</td><td>Mode</td><td colspan="3">F</td></tr>
<tr><td>Range</td><td colspan="2">0~99</td><td>Default</td><td>0</td><td>Unit</td><td></td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>2022-04h</td></tr>
<tr><td colspan="8">Set notch depth for 1st resonant notch filter.
Under normal circumstances, please use factory default settings. If resonance is under control, in combination with P22.01 and P22.02, P22.03 can be reduced to improve current loop responsiveness which allows higher mechanical stiffness settings</td></tr>
</table>

<table>
<tr><td rowspan="3">P22.04</td><td>Label</td><td colspan="2">2nd notch frequency</td><td>Mode</td><td colspan="3">F</td></tr>
<tr><td>Range</td><td colspan="2">50~8000</td><td>Default</td><td>8000</td><td>Unit</td><td>Hz</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td colspan="2">RW</td><td>Index</td><td>2022-05h</td></tr>
<tr><td colspan="8">Set center frequency of 2nd torque command notch filter.
Set P22.04 to 8000 to deactivate notch filter</td></tr>
</table>

P22.05	**Label**	2^{nd} notch bandwidth		**Mode**	F		
	Range	0~20		**Default**	4	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2022-06h

Set notch bandwidth for 2^{nd} resonant notch filter.
Under normal circumstances, please use factory default settings. If resonance is under control, in combination with P22.04 and P22.06, P22.05 can be reduced to improve current loop responsiveness which allows higher mechanical stiffness settings.

P22.06	**Label**	2^{nd} notch depth		**Mode**	F		
	Range	0~99		**Default**	0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2022-07h

Set notch depth for 1^{st} resonant notch filter.
Under normal circumstances, please use factory default settings. If resonance is under control, in combination with P22.04 and P22.05, P22.06 can be reduced to improve current loop responsiveness which allows higher mechanical stiffness settings

P22.07	**Label**	3^{rd} notch frequency		**Mode**	F		
	Range	50~8000		**Default**	8000	**Unit**	Hz
	Activation	Immediate	**Attribute**	RW		**Index**	2022-08h

Set center frequency of 3^{rd} torque command notch filter.
Set P22.07 to 8000 to deactivate notch filter

P22.08	**Label**	3^{rd} notch bandwidth		**Mode**	F		
	Range	0~20		**Default**	4	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2022-09h

Set notch bandwidth for 3^{rd} resonant notch filter.
Same as above.

P22.09	**Label**	3^{rd} notch depth		**Mode**	F		
	Range	0~99		**Default**	0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2022-0Ah

Set notch depth for 3^{rd} resonant notch filter.
Same as above.

P22.10	**Label**	4^{th} notch frequency		**Mode**	F		
	Range	50~8000		**Default**	8000	**Unit**	Hz
	Activation	Immediate	**Attribute**	RW		**Index**	2022-0Bh

Set center frequency of 4^{th} torque command notch filter.
Set P22.10 to 8000 to deactivate notch filter

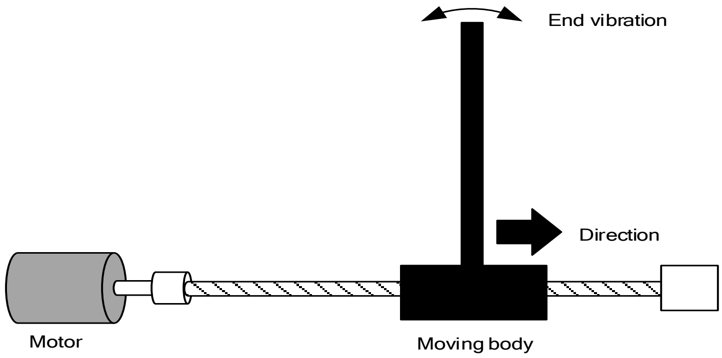
P22.11	**Label**	4^{th} notch bandwidth		**Mode**	F		
	Range	0~20		**Default**	4	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2022-0Ch

Set notch bandwidth for 4^{th} resonant notch filter.
Same as above.

P22.12	**Label**	4^{th} notch depth		**Mode**	F		
	Range	0~99		**Default**	0	**Unit**	
	Activation	Immediate	**Attribute**	RW		**Index**	2022-0Dh

Set notch depth for 4^{th} resonant notch filter.
Same as above.

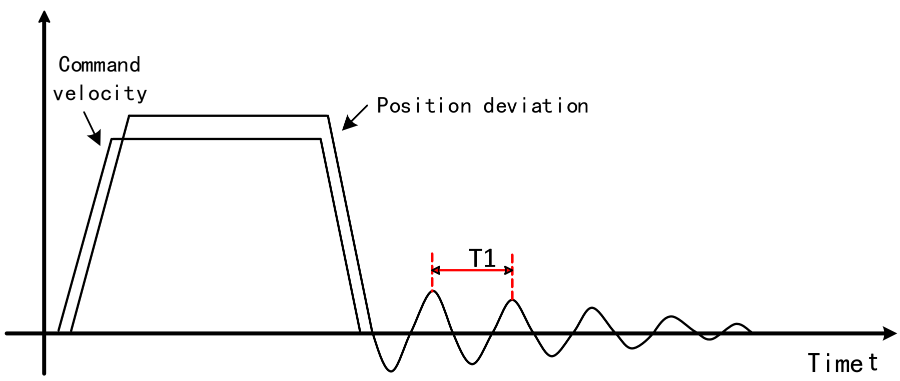
6.7.2 End vibration suppression



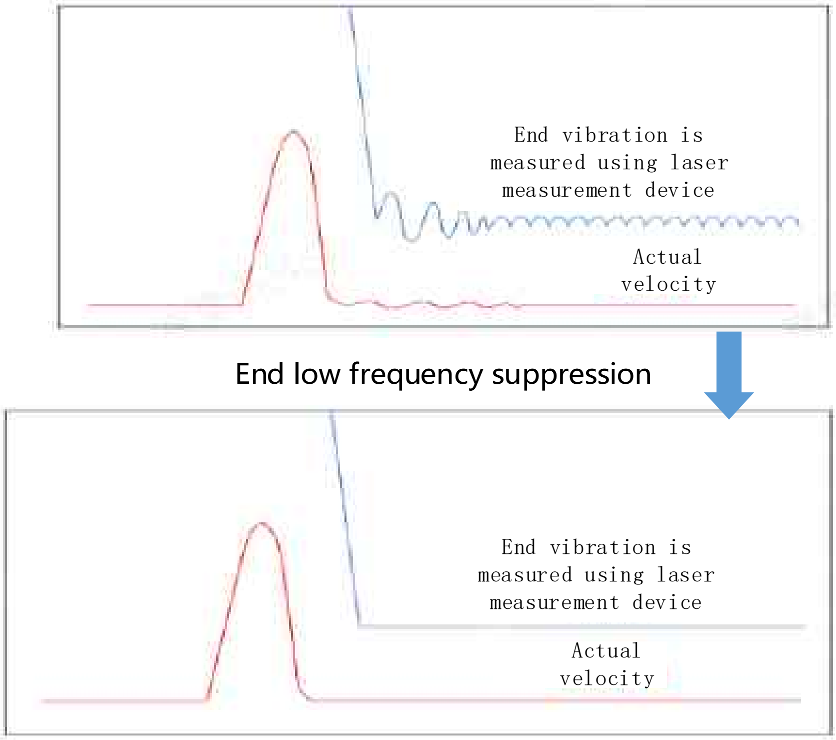
If the mechanical structure has an end that is long and heavy, it might cause end vibration at emergency stop and affect the positioning. Usually happens on long armed axis with loose end. The frequency is usually within 100Hz which is lower than mechanical resonant frequencies. It is called low-frequency resonance which can be prevented by applying low frequency suppression function.

To apply low frequency suppression

1. Trace current/ position deviation waveform when motion stops.
2. Measure the vibration cycle T1 of current waveform.
3. Convert T1 into low frequency resonance by F1 = 1/T1
4. Write F1 into P20.14
5. If some other low frequency resonance occurs, please repeat step 1-3 and write F2 into P20.16.



The result of suppressing low frequency resonance:



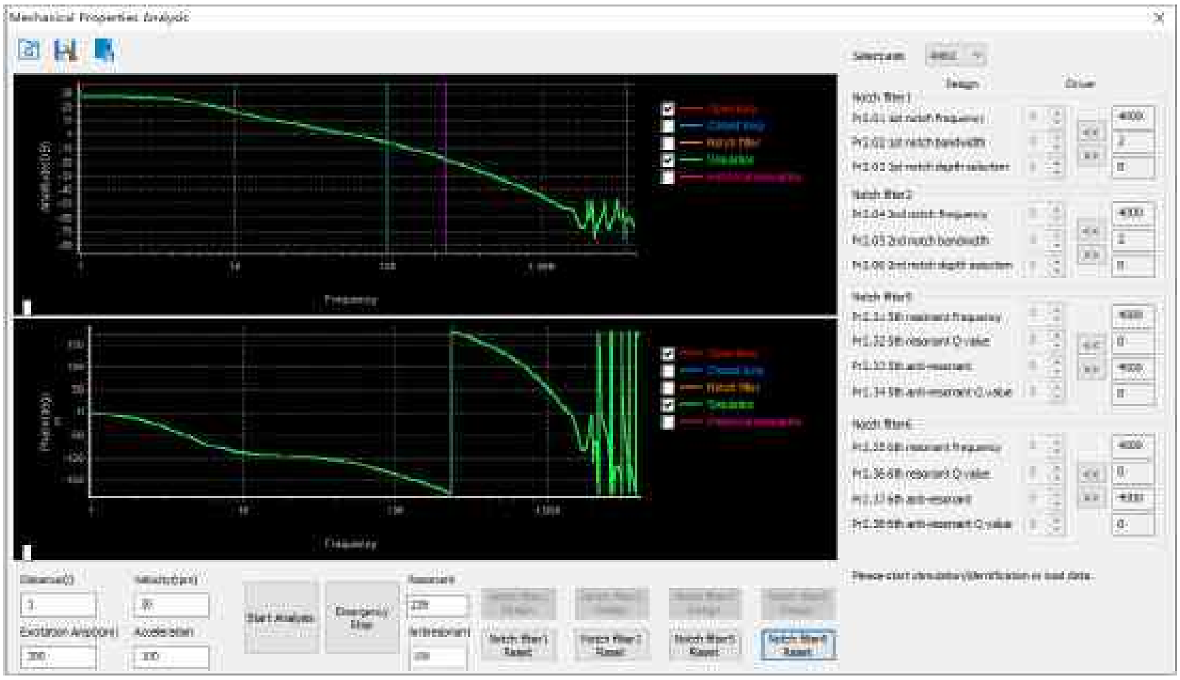
P22.13	**Label**	1st Vibration Suppression Frequency		**Mode**	**F**		
	Range	0~200		**Default**	0	**Unit**	Hz
	Activation	Immediate	**Attribute**	RW		**Index**	2022-0Eh
	Set the vibration suppression frequency to suppress end shaking. After measuring the vibration frequency of the load, set it in units of 0.1 [Hz]. 0.0: Turn off the vibration suppression function. 1.0~200.0: Set the vibration suppression frequency. Note: The suppression function targets end shaking. It is specifically used to suppress end shaking caused by high deceleration impacts during motor stops, which is particularly effective for shaking at frequencies around 100Hz. During use, set this parameter to the frequency of the shaking. (For vibration frequencies, you can try to use servo adjustment software to collect waveform analysis for acquisition).						

P22.15	**Label**	2nd Vibration Suppression Frequency		**Mode**	**F**		
	Range	0~200		**Default**	0	**Unit**	H
	Activation	Immediate	**Attribute**	RW		**Index**	2022-10h
	Check 22.13						

6.7.3 Mechanical properties analysis

Please use this function on the Leadshine drive debugging software Motion Studio.

The Mechanical Characteristic Analysis is mainly used to identify mechanical resonance points, which works together with the notch filter to effectively suppress mechanical resonance.



To avoid strong vibration, please first set lower excitation amplitude. However, if the set value is too low, data waveform will include some degree of distortion.

If vibration occurs during tests which can’t be reduce through lowering electrical current excitation, it might be due to excessive gain. Please lower velocity gain and set notch filter as accordance from the mechanical properties analysis. Or might be due to inertia settings is too large, please use optimal inertia ratio value.

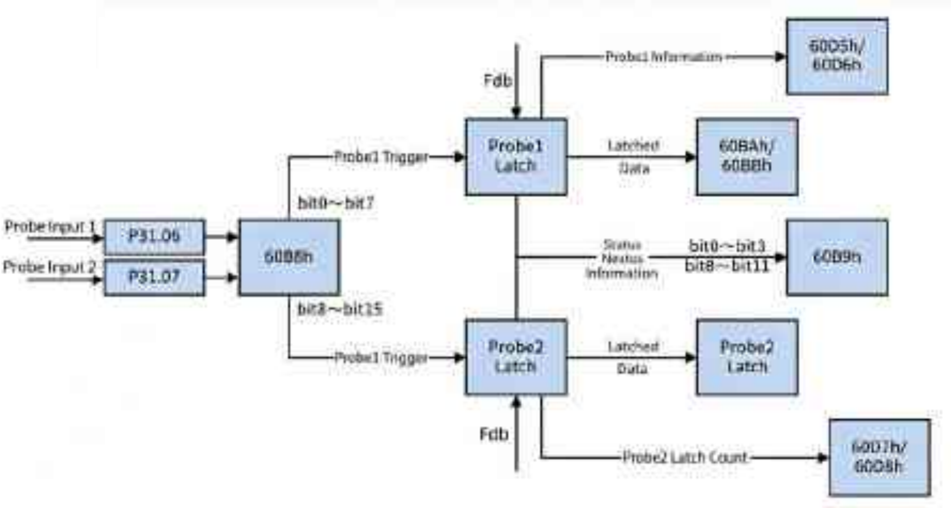
6.8 Probe

The probe function uses input signals configured with probe functionality to latch the motor's feedback position.
The drive supports two probe inputs that can operate simultaneously, recording the position information corresponding to the rising edge and falling edge of the probe signals respectively.
Probe 1 signal is sourced from pin 11 of the CN1 connector, and Probe 2 signal is sourced from pin 7 of the CN1 connector.

P31.06	Label	Probe 1 Capture Direction Selection		Mode	F		
	Range	0~1		Default	0	Unit	
	Activation	Immediate	Attribute	RW		Index	2031-07h
	0: Rising edge capture; 1: Falling edge capture.						

P31.07	Label	Probe 2 Capture Direction Selection		Mode	F		
	Range	0~1		Default	0	Unit	
	Activation	Immediate	Attribute	RW		Index	2031-08h
	0: Rising edge capture; 1: Falling edge capture.						

6.8.1 Probe function



When using EXT1 or EXT2 as probe, please set as following:

a) Set polarity of EXT 1 or EXT 2 as probe. Set the level polarity of the probes using P31.06 /P31.07. Bit 0 for EXT1 signal, bit 1 for EXT2 signal
b) Probe function is set through 0x60B8 (Bit 0-7 is for probe 1, bit8-15 is for probe 2). Functions including activation trigger signal selection, triggering mode and triggering signal edge.

Please take note:

- In single-shot mode, if both rising and falling edges are set to trigger for the same probe, only the rising edge will take effect. In continuous mode, both rising and falling edges can be set to trigger simultaneously.
- When changing settings via 0x60B8 (enabling/disabling the probe, switching capture mode, or selecting rising/falling edges), the counter registers will restart counting, and the status register 0x60B9 will update accordingly.
- The level status of probe signals is displayed in register 60FD: EXT1 corresponds to bit26 of 60FD, and EXT2 corresponds to bit27 of 60FD. This level display is no longer affected by whether the probe is enabled via 0x60B8.

Related Objects

Index	Sub Index	Label	Access	Data Type	Units	Range	Default
2031h	07H	EXT1 polarity setting	RW	Uint16		0~1	1
	08h	EXT2 polarity setting	RW	Uint16		0~1	1
60B8h	00h	Probe control word	RW	Uint16		0~0xFFFF	0
60B9h	00h	Probe status word	RO	Uint16		0~0xFFFF	0
60BAh	00h	Probe 1or Z-signal rising edge latching position	RO	int32	Command unit	-2147483648~2147483647	0
60BBh	00h	Probe 1 or Z-signal falling edge latching position	RO	int32	Command unit	-2147483648~2147483647	0
60BCh	00h	Probe 2 or Z-signal rising edge latching position	RO	int32	Command unit	-2147483648~2147483647	0
60BDh	00h	Probe 2 or Z-signal falling edge latching position	RO	int32	Command unit	-2147483648~2147483647	0
60D5h	00h	Probe 1 or Z-signal rising edge counter	RO	Uint32		0-65535	0
60D6h	00h	Probe 1 or Z-signal falling edge counter	RO	Uint32		0-65535	0
60D7h	00h	Probe 2 or Z-signal rising edge counter	RO	Uint32		0-65535	0
60D8h	00h	Probe 2 or Z-signal falling edge counter	RO	Uint32		0-65535	0

6.8.2 Signal Input of EXT1 and EXT2

EXT1：Pin10 of CN1 terminal

EXT2：Pin11 of CN1 terminal

Probe function reuse DI5/DI6, when DI5 and DI6 have no assigned functions, they are used as probes.

6.8.3 Probe Control Word 60B8h

Bit	Definition	Details
0	Probe 1 enable	0--Disable 1--Enable
1	Probe 1 mode	0--Single trigger mode 1--Continuous trigger mode
2	Probe 1 trigger signal selection	0—EXT1 signal 1--Z signal
3	Reserved	-
4	Probe 1 rising edge trigger	0--Disable 1--Enable
5	Probe 1 falling edge trigger	0--Disable 1--Enable
6-7	Reserved	-
8	Probe 2 enable	0--Disable 1--Enable
9	Probe 2 mode	0--Single trigger mode 1--Continuous trigger mode
10	Probe 2 trigger signal selection	0—EXT2 signal 1--Z signal
11	Reserved	-
12	Probe 2 rising edge trigger	0--Disable 1--Enable
13	Probe 2 falling edge trigger	0--Disable 1--Enable
14-15	Reserved	-

6.8.4 Probe Status Word 60B9h

Bit	Definition	Details
0	Probe 1 enable	0--Disable 1--Enable
1	Probe 1 or Z-signal rising edge trigger	0-- not executed 1-- executed
2	Probe 1 or Z-signal falling edge trigger	0-- not executed 1-- executed
3-5	Reserved	-
6-7	Reserved	-
8	Probe 2 enable	0--Disable 1--Enable
9	Probe 2 or Z-signal rising edge trigger	0-- not executed 1-- executed
10	Probe 2 or Z-signal falling edge trigger	0-- not executed 1-- executed
11-13	Reserved	-
14-15	Reserved	-

6.8.5 Latch Position Register

Index	Details
60BAh	Probe 1 or Z-signal rising edge latch position
60BBh	Probe 1 or Z-signal falling edge latch position
60BCh	Probe 2 or Z-signal rising edge latch position
60BDh	Probe 2 or Z-signal falling edge latch position

6.8.6 Latch Counter Register

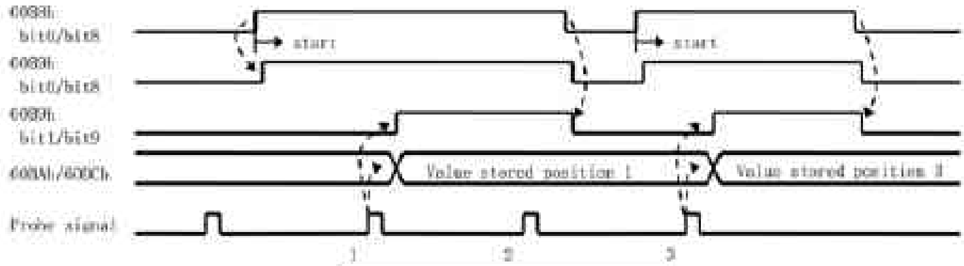
Index	Details
60D5h	Probe 1 or Z-signal rising edge counter
60D6h	Probe 1 or Z-signal falling edge counter
60D7h	Probe 2 or Z-signal rising edge counter
60D8h	Probe 2 or Z-signal falling edge counter

6.8.7 Probe mode

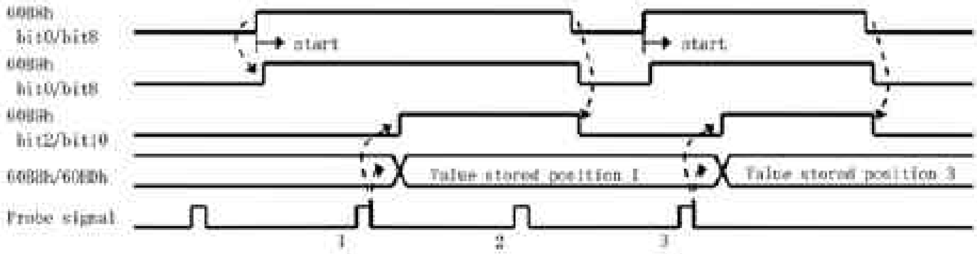
Set bit1/bit9 of 60B8h (Probe mode), 0 = Single trigger mode, 1 = Continuous trigger mode.

1) Single trigger mode

Triggers only when the trigger signal is valid for the first time. In order to latch the position, users need to set bit0/bit8 of 60B8h to 0, then set bit0/bit8 of 60B8h to 1. The sequence diagram is as shown below:



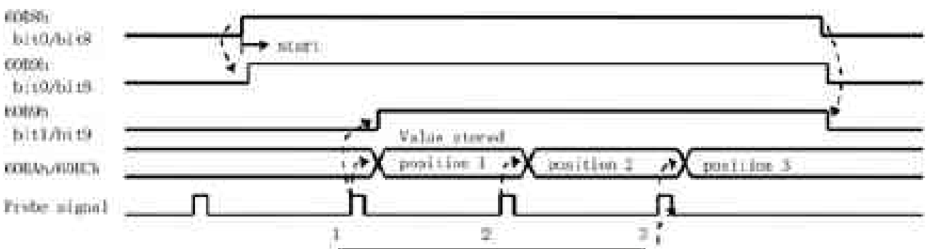
Rising edge trigger signal



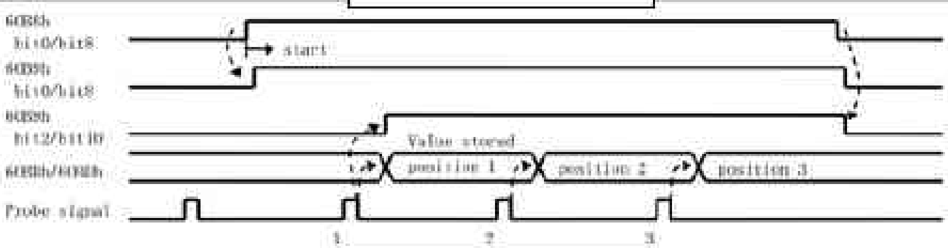
Falling edge trigger signal

2) Continuous trigger mode

The data saved from signal triggering will be saved until the next trigger signal. Enabling the probe again is not needed. Sequence diagram as shown below:



Rising edge trigger signal



Falling edge trigger signal

6.9 Safety Functions

6.9.1 Motor overspeed alarm

Parameter P04.07 is used to set the overspeed alarm threshold during motor operation; if this speed is exceeded during motion, anEr1A0 alarm will be triggered.

Related parameters:

P04.07	Label	Overspeed Level Setting		Mode	F		
	Range	0~10000		Default	0	Unit	
	Activation	Immediate	Attribute	RW		Index	2004-08h
	If the motor speed exceeds this set value, Er1A0 "Over-speed" will occur.When the speed level set value is set to 0, the speed level is equivalent to 1.2 times the maximum motor speed.						

6.9.2 Servo stop mode

- Method 1: Set up P00.30 to set servo stop mode:

P00.30	Label	Stop Mode when Servo Enable Off	Mode	F		
	Range	0~8	Default	0	Unit	-
	Activation	Immediate	Attribute	RW	Index	2000-1Fh

Value	Description	Deceleration for Servo Braking Stop
0	Servo braking stop, the servo state is dynamic braking after stop;	Determined by P00.37 (Fault deceleration time).
1	Servo braking stop, the servo state is dynamic braking after stop;	In homing mode, deceleration is 609Ah (Homing acceleration/deceleration);in non-homing mode, deceleration is 6084h (Protocol deceleration).
2	Servo braking stop, the servo state is dynamic braking after stop;	Determined by 6085h (Emergency stop deceleration).
3	Servo braking stop, the servo state is free after stop;	When enable is off, the deceleration for servo braking stop is determined by P00.37 (Fault deceleration time).
4	Servo braking stop, the servo state is free after stop;	In homing mode, deceleration is 609Ah (Homing acceleration/deceleration);in non-homing mode, deceleration is 6084h (Protocol

		deceleration).
5	Servo braking stop, the servo state is free after stop;	Determined by 6085h (Emergency stop deceleration).
6	DB braking stop, the servo state is dynamic braking after stop;	-
7	DB braking stop, the servo state is free after stop;	
8	Free stop, the servo state is free after stop;	

- Method 2: Using these parameters to set Servo class 1/2 stop mode:

P00.31	Label	Class 1 Fault Stop Mode	Mode	F		
	Range	0~2	Default	0	Unit	-
	Activation	Immediate	Attribute	RW	Index	2000-20h

Set the stop method and stop state for Class 1 faults.

0: Stop via dynamic braking, and the state after stop is dynamic braking state;

1: Stop via free stop method, and the state after stop is free state;

2: Stop via DB braking method, and the state after stop is free state.

P00.32	Label	Class 2 Fault Stop Mode	Mode	F		
	Range	0~8	Default	0	Unit	-
	Activation	Immediate	Attribute	RW	Index	2000-21h

Set the stop method and stop state for Class 1 faults. P00.32 is equivalent to PF2.08 (605Eh), and the parameters are interrelated, i.e., changing the value of P00.32 will synchronously update PF2.08, and vice versa.

Refer to the table below for the stop methods of Class 2 alarms (excluding Er260/Er570/Er571):

Value	Description	Deceleration for Servo Braking Stop
0	Servo braking stop, the servo state is dynamic braking after stop;	Deceleration is determined by P00.37 (Fault deceleration time)
1	Servo braking stop, the servo state is dynamic braking after stop;	In homing mode, deceleration is 609Ah (Homing acceleration/deceleration);In non-homing mode, deceleration is 6084h (Protocol deceleration)
2	Servo braking stop, the servo state is dynamic braking after stop;	Deceleration is determined by 6085h (Emergency stop deceleration)
3	Servo braking stop, the servo state is free after stop;	Deceleration is determined by P00.37 (Fault deceleration time)
4	Servo braking stop, the servo state is free after stop;	In homing mode, deceleration is 609Ah (Homing

		acceleration/deceleration);In non-homing mode, deceleration is 6084h (Protocol deceleration)
5	Servo braking stop, the servo state is free after stop;	Deceleration is 6085h (Emergency stop deceleration)
6	DB braking stop, the servo state is dynamic braking after stop;	-
7	DB braking stop, the servo state is free after stop;	
8	Free stop, the servo state is free after stop;	

Note：

• The stop method and deceleration of Er260 (Positive/Negative limit input valid) are selected by P00.34 (Positive/Negative limit stop mode).

• The stop method and deceleration of Er570 (Force alarm input) and Er571 (PC force alarm) are selected by P00.33 (Force stop mode).

6.9.3 Maximum Stop Time After Servo Disable

This parameter configures the maximum stop time after the servo is disabled. If the motor speed remains higher than the speed set in P00.27 when this time elapses, the drive's brake signal BRK is set to OFF (triggering brake holding). If no brake is installed, the drive will execute a forced stop based on whether dynamic braking is enabled.

Related parameters:

P00.28	Label	Max. time to stop after disabling	Mode	F		
	Range	0~3000	Default	500	Unit	ms
	Activation	Immediate	Attribute	RW	Index	2000-1Dh
	To set the max. time allowed for the axis to stop on emergency stop or normal axis disabling. After disabling axis, if motor speed is still higher than P04.39 but the time set in P00.28 is reached, BRK_ON given and holding brake activated. BRK_ON given time is determined by P00.28 or when motor speed goes below P04.39, whichever comes first. Applications: 1. After disabling axis, if motor speed is still higher than Trigger brake speed but the time set in P00.28 is reached, BRK_ON given and holding brake activated. 2. After disabling axis, if motor speed is already lower than P04.39 but the time set in P00.28 is not yet reached, BRK_ON given and holding brake activated.					

6.9.4 Maximum Stop Time After Servo Disable

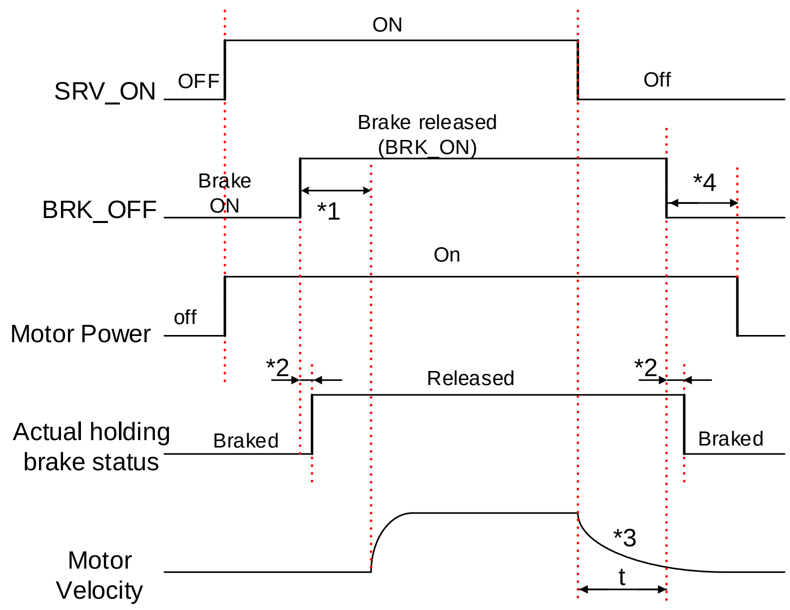
This function can be configured via the IO output function parameter, refer to the description of IO parameter P01.16. When the conditions set by P00.27 or P00.28 are met after an alarm occurs or the servo is disabled, the corresponding configured output IO port will output OFF.

Related parameters:

P00.25	Label	Motor power-off delay time	Mode	F		
	Range	0~3000	Default	150	Unit	ms
	Activation	Immediate	Attribute	RW	Index	2000-1Ah
To set delay time for holding brake to be activated after motor power off to prevent axis from sliding.						

P00.26	Label	Delay time for holding brake release	Mode	F		
	Range	0~3000	Default	0	Unit	ms
	Activation	Immediate	Attribute	RW	Index	2000-1Bh

To set delay time for holding brake to be released after motor power on. Motor will remain at current position and input command is masked to allow holding brake to be fully released before motor is set in motion.



*1: Delay time set in P00.25

*2: Delay time from the moment BRK_OFF signal is given until actual holding brake is released or BRK_ON signal is given until actual holding brake is activated. It is dependent on the holding brake of the motor.

*3: Deceleration time is determined by P00.28 or if motor speed goes below Trigger brake speed, whichever comes first. BRK_OFF given after deceleration time.

<table>
<tr><td></td><td colspan="6">*4: P00.25 set time value.
Delay time from the moment SRV_ON is given until BRK_OFF switch to BRK_ON, is less than 500ms.</td></tr>
<tr><td rowspan="3">P00.27</td><td>Label</td><td>Brake release speed setting</td><td>Mode</td><td colspan="3">F</td></tr>
<tr><td>Range</td><td>10~3000</td><td>Default</td><td>30</td><td>Unit</td><td>r/min</td></tr>
<tr><td>Activation</td><td>Immediate</td><td>Attribute</td><td>RW</td><td>Index</td><td>2000-1Ch</td></tr>
<tr><td></td><td colspan="6">Set the motor speed threshold when the speed signal BRK is set to OFF (start holding brake) during disable.
When the servo enable is turned off (SRV-OFF), the motor starts to decelerate. When the motor speed is lower than the set value of this parameter and the time of P00.28 has not elapsed, the holding brake signal (BRK-OFF) is output. The actual timing for BRK to be set to OFF is whichever comes first: the time of P00.28 or the time taken for the motor speed to drop to the speed set by P00.27.
Application examples:
Case 1: After disable, if the motor deceleration time has reached the set time of P00.28, even if the motor speed is still higher than the speed set by P00.27, the drive's holding brake signal BRK is set to OFF (start holding brake).Case 2: After disable, if the motor deceleration time has not reached the set time of P00.28, but the motor speed is already lower than the speed set by P00.27, the drive's holding brake signal BRK is set to OFF (start holding brake).</td></tr>
</table>

6.9.5 Emergency Stop function

Emergency Stop is a function where the servo drive decelerates the motor using the configured servo braking torque when it receives a forced alarm signal or a drive disable input signal while in the operating state (servo enabled).

■ Method 1: This function can be configured via the IO input parameters

P00.34	Label	Positive/Negative Limit Stop Mode	Mode	F		
	Range	0~6	Default	0	Unit	-
	Activation	Immediate	Attribute	RW	Index	2000-23h

Set the Positive/Negative Limit Stop Mode.

Value	Description
0	Limit Valid Mode: Stop via servo braking, and the deceleration is selected as the larger value between P00.35 (Positive/Negative Limit Deceleration Time) and P00.38 (Maximum Deceleration Time).
1	Limit Invalid Mode.
2	Limit Alarm Trigger Mode: Stop via servo braking, the deceleration is selected as the larger value between P00.35 (Positive/Negative Limit Deceleration Time) and P00.38 (Maximum Deceleration Time), and the servo state is dynamic braking state after stopping.
3	Limit Alarm Trigger Mode: Stop via servo braking, the deceleration is selected as the larger value between P00.35 (Positive/Negative Limit Deceleration Time) and P00.38 (Maximum Deceleration Time), and the servo state is free state after stopping.
4	Limit Alarm Trigger Mode: Stop via DB braking, and the servo state is DB braking state after stopping.
5	Limit Alarm Trigger Mode: Stop via DB braking, and the servo state is free state after stopping.
6	Limit Alarm Trigger Mode: Free stop, and the servo state is free state after stopping.

P00.40	Label	E-Stop Function Selection	Mode	F		
	Range	0~1	Default	0	Unit	-
	Activation	Immediate	Attribute	RW	Index	2000-29h

0：Emergency stop is valid, servo driver will be forced to STOP and alarm occurs.
1：Emergency stop is invalid, servo driver will not be forced to STOP.

■ Method 2: Send the corresponding object dictionary via the master station to enable the quick-stop function.

P00.39	Label	Torque Limit during Immediate Stop	Mode	F		
	Range	0~500	Default	0	Unit	-
	Activation	Immediate	Attribute	RW	Index	2000-28h

Set the torque limit value for the servo brake stop mode.

When the set value is 0, it is determined by P12.01 (First Torque Limit);

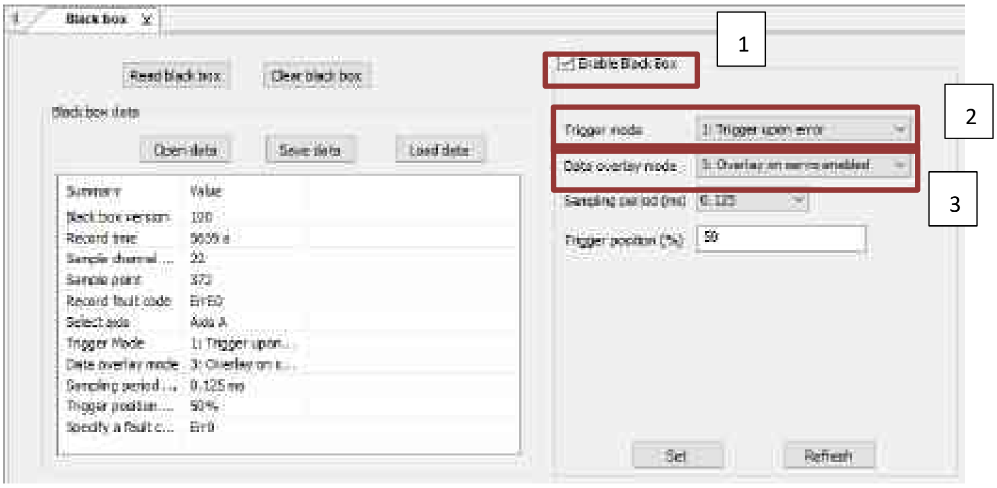
When the set value is non-zero, it is determined by P00.39 (Immediate Stop Torque Limit).

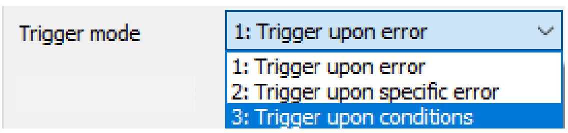
6.10 Black box

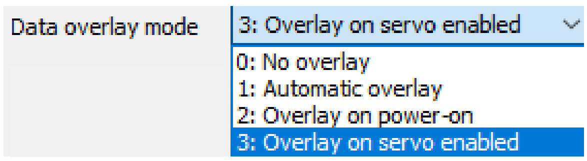
Black box is a function which allows users to set conditions or data to be captured whenever error occurs. The data will be recorded by black box at the moment of error occurrence and automatically saved. Thus, through Motion Studio, user can analyze cause of the problem with the aid of black box data.
Black box is deactivated by default. It is user configurable to choose whether to overwrite current data or when to overwrite the data in black box.

Setting Up Black Box

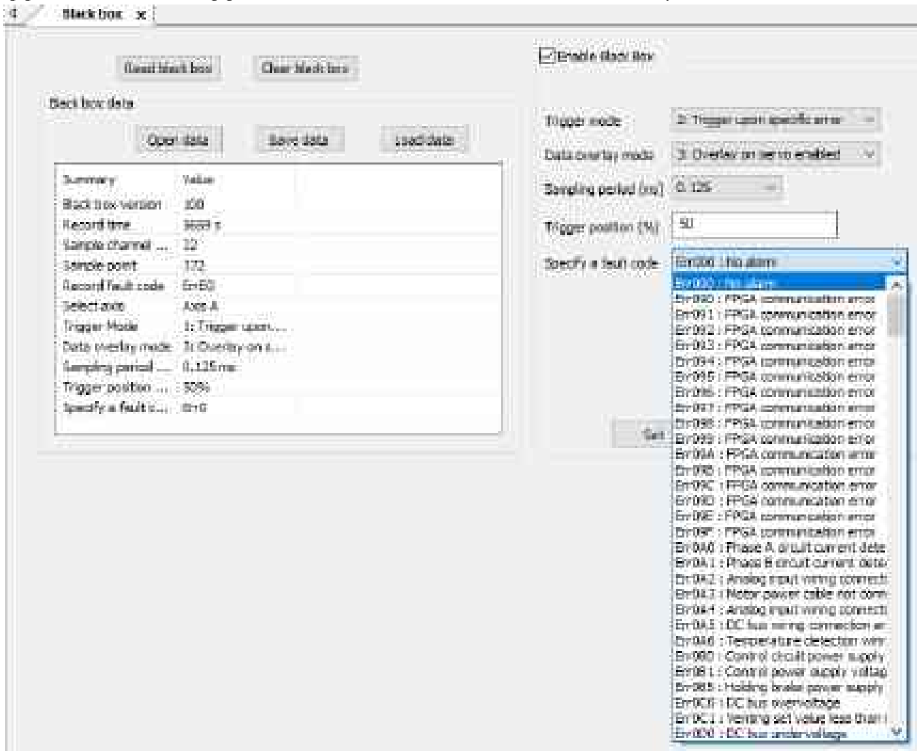
1. Click on "Black Box" under "Tool" to enter Black box setup. There 3 methods to trigger black box function: 1. Random error, 2. Specific error, 3. Conditions triggering. Choose trigger method as accordance to needs. Please pay attention to Data Overlay Mode and choose the option needed before start.



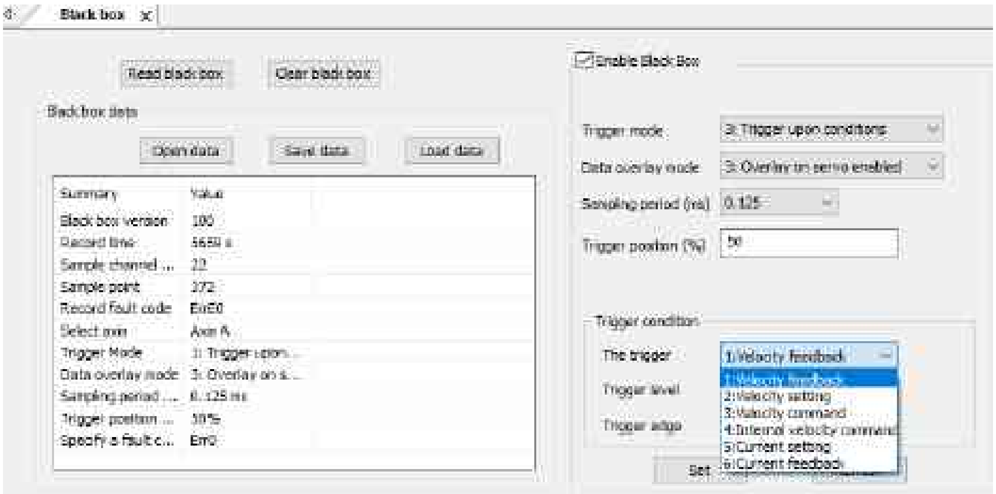




2. Trigger mode 2: Trigger black box whenever a chosen specific error occurs.



3. Trigger mode 3: Conditions for black box functions to be triggered can set. Set the source, level and edge of the trigger as shown below.

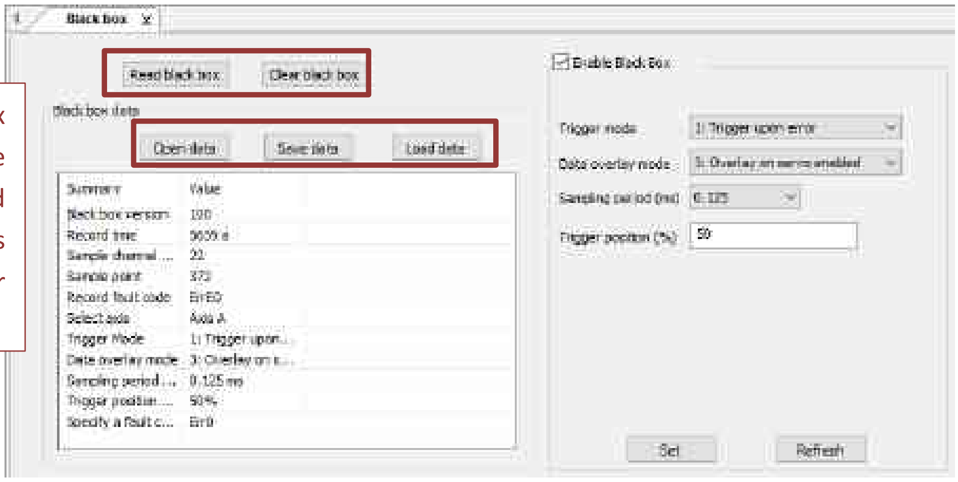


4. Data overlay mode: To select how and when black box data is overlaid. 0: Do not overlay data (Black box will only preserve the data of the first trigger). 1: Always overlay (Black box data will be overlaid every time). 2: Overlay upon powered on (Data overlaid occurs when servo drive is powered on) 3: Overlay when enabled (Data overlaid occurs when servo drive is enabled).

5. Sampling period (ms): The lower the set value, the more precise the samples are but sampling time will be shorter.

6. Trigger position (%): Set the position of trigger within the sampling period.
7. Click on "Set" to save the settings to driver.

Data recorded in Black Box can be read and cleared. The data can also be saved and read by anyone from this function interface for further analysis.



6.11 Position comparison

Position comparison is achieved by using instantaneous position data in comparison with preset position in position parameters. When the condition(s) is fulfilled, a pulse width configurable DO signal or ABZ/OCZ signal through frequency divider will be delivered. This function is operated in CPLD, without communication delay between processors hence it is suitable for application where high velocity motion is required.

Position comparison		Description
Output trigger	Output	6 DO or frequency divider ABZ/OCZ signal
	Logic	DO output valid as set in P04.10-P04.15
		ABZ/OCZ output valid as set in P05.42
		Output mode：Pulse / Flip
	Pulse width	P0C.02 set pulse width
	Delay compensation	P0C.03 compensate for hardware delay
Comparison source	Motor enclosed	Supported
	Closed loop ABZ encoder	Supported
Comparison value	Points of comparison	42 points
Comparison attribute	Comparison method	Comparison ON/OFF for positive/negative crossover
		Set comparison output

When the position comparison output function is needed, the corresponding DO needs to be configured as the CMP-OUT position comparison output signal or the frequency division ABZ needs to be allocated as the position comparison function.

Working principle

■ **Position Comparison Enable (P41.00)**

When position comparison enable P41.00 is set from 0 to 1, comparison starts, and the current comparison status is updated to the start comparison point. When position comparison enable is set to 0, comparison stops immediately, and the comparison status is cleared.

■ **Sequence Comparison Mode**

In sequence comparison mode:
When the end comparison point is completed, comparison enable is automatically turned off, and the current comparison value is reset to zero. The comparison function is re-enabled only when the comparison enable switch is detected to turn on again.
Real-time position feedback is absolute: after each point comparison, P41.10 (real-time position feedback) is linearly accumulated based on the previous comparison point and will not be automatically cleared.

- **Reciprocating Comparison Mode**

In reciprocating comparison mode:
When the end comparison point is completed, comparison enable remains active, and the current comparison value is reset to the start comparison point. After each point comparison, P41.10 (real-time position feedback) is cleared and recounted for reciprocating comparison.
Target positions are relative incremental: after the current comparison point is completed, real-time position feedback automatically clears and recounts to compare with the new target point.

- **Position Comparison Output Width (P41.02)**

When the position comparison condition is met, the DO output / frequency division output valid level signal is triggered. The width of the valid level can be set via P41.02 (Position Comparison Pulse Output Width), with a range of 1~4095 × 0.1ms. During the DO output period, comparison logic is suspended, so ensure the operation time between two target points is longer than the DO output width.

- **Target Position Comparison Points**

There are a total of 42 target position comparison points. Target position comparison values and attributes must be set in P42.00~P42.83.

- **Start Comparison Point (P41.04)**

The target position start comparison point indicates the position of the first comparison point. For example, if the start comparison point is set to 5, comparison begins from the 5th target position point.

- **End Comparison Point (P41.05)**

The target position end comparison point indicates the position of the last comparison point. For example, if the end comparison point is set to 7, comparison stops at the 7th target position or restarts from the start comparison point.

- **Position Comparison Zero Offset (P41.08)**

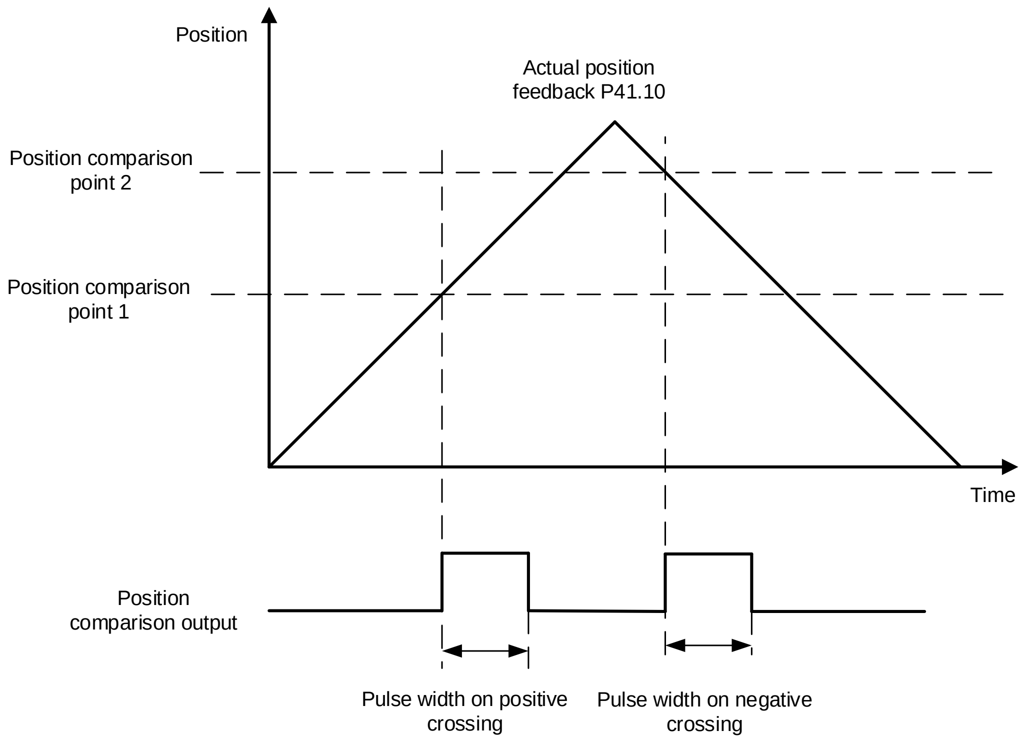
With the current position as the origin, on the rising edge of P41.07 changing from 0 → 1, the current real-time position value of P41.10 will automatically change to the offset value set in P41.08.

Applying position comparison

When the position passes through the target position comparison point, the output condition of the output attribute of the comparison point is satisfied, and the output width of the output port is the width pulse set by P41. 02.

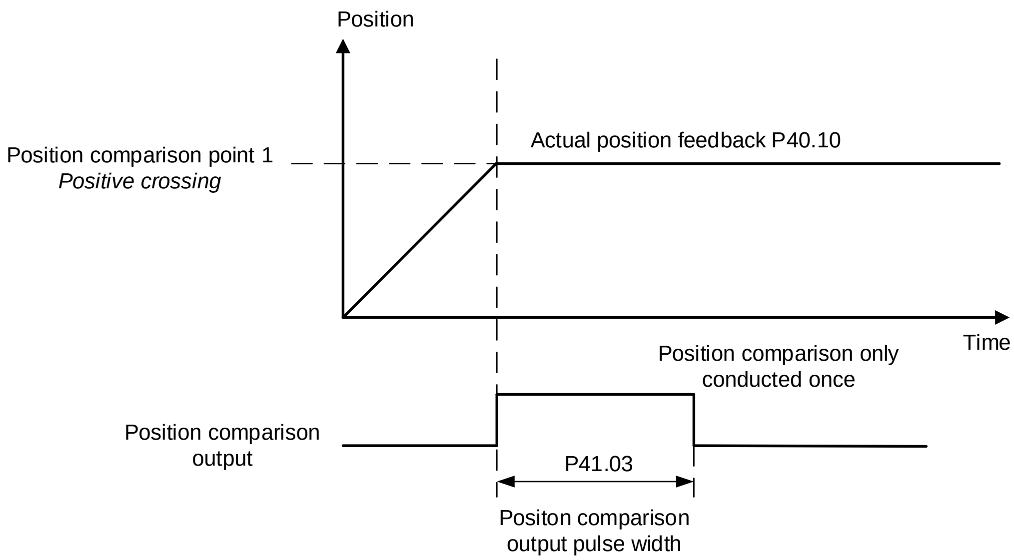
When the position comparison point attribute is set to pass through the comparison output in the forward direction, when the position feedback changes from small to large, the comparison output port will output the position comparison signal; if the position feedback changes from large to small, it will pass through the comparison point in the reverse direction, and the comparison output will not be performed.

For example, the comparison point 1 in the figure below is set to forward traversal comparison, and the comparison point 2 is set to reverse traversal comparison. When the comparison point 2 in forward traversal position is set, no comparison output will be performed.

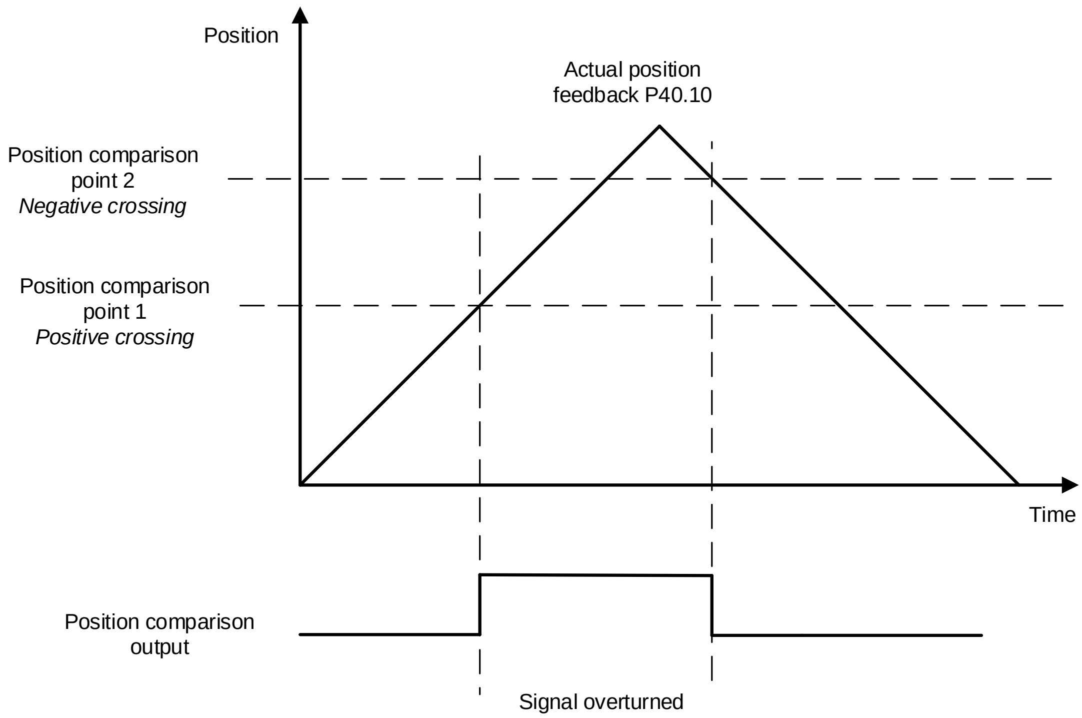


When setting multiple position comparison values, the comparison operation will not be performed during the valid period of the position comparison output port, so please keep the running time between the two target position comparison points greater than the width of the pulse output.

The following figure shows that the running time between the comparison points of the two target positions is less than the pulse output width, which leads to the reverse crossing of the target point, and no comparison operation is performed
In the case of stopping at the same position as the position comparison value, as in the case of passing, only one pulse is output.

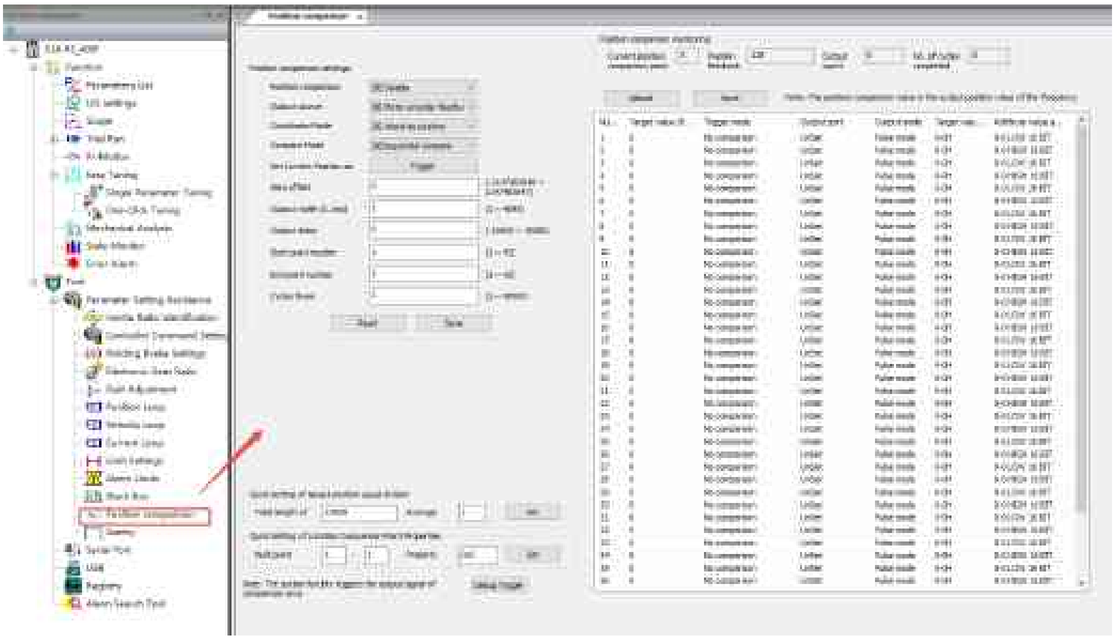


When the output mode is configured as the flip mode, when the position comparison point is reached and the output condition is met, the configured output port changes from the output setting width to the level flip.



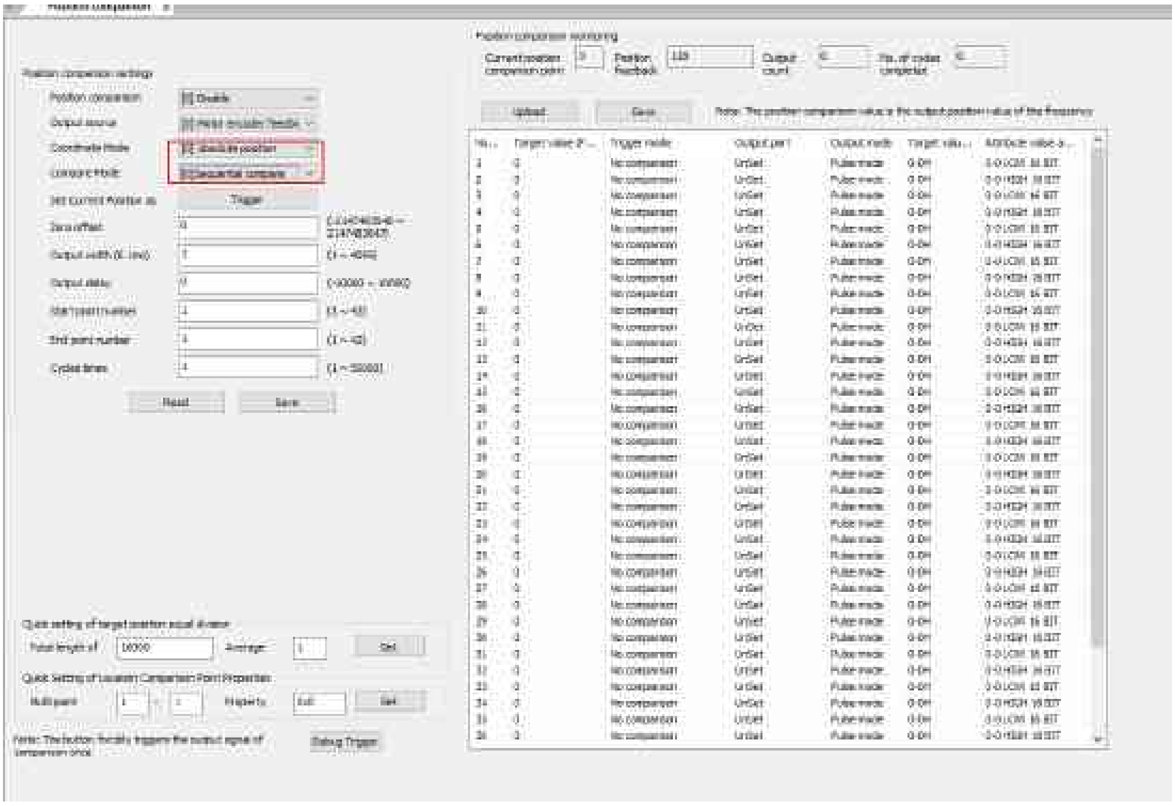
MotionStudio Quick Configuration Interface

For faster configuration of the debug position compare output, the EL7S series drives support the position compare function in the MotionStudio for configuration.
Select the location comparison function and double click to open:



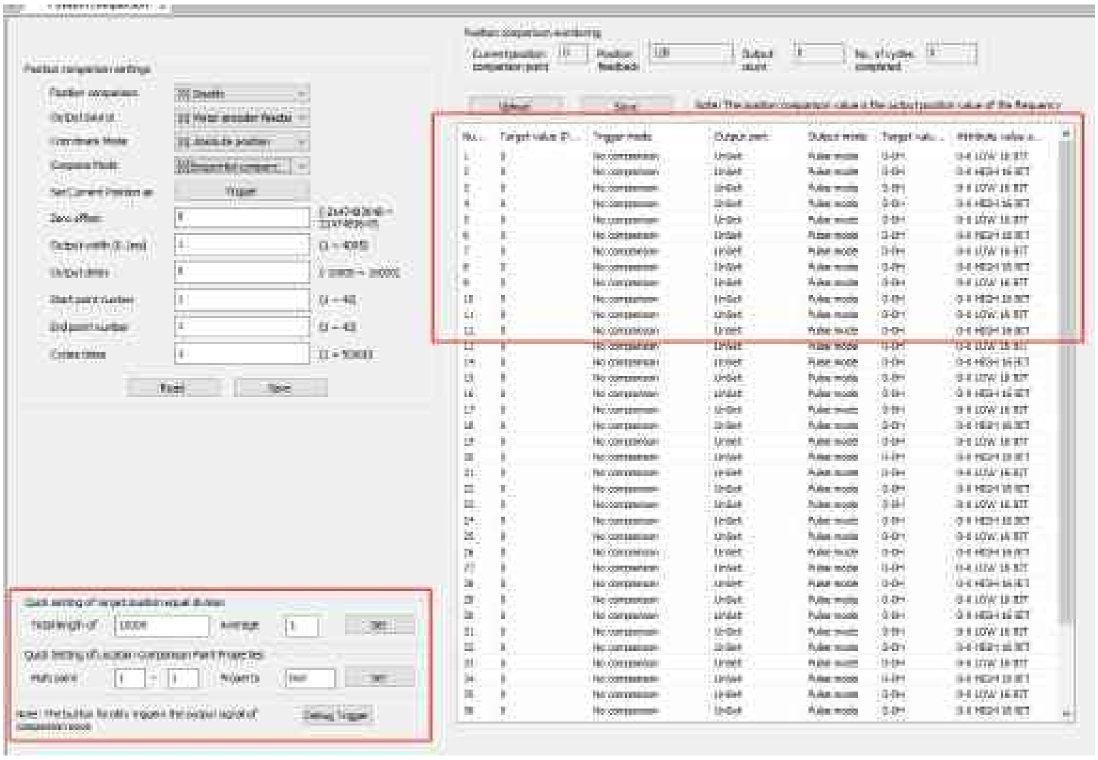
- **Sequence comparison mode for absolute positions**

1. Set the position comparison mode to 0-absolute position sequence comparison mode, and configure the output pulse width, comparison start and end points and other parameters.



2. The target position parameter setting, the comparison target position value can be set in the table on the right. If the actual working condition is equidistant, the target position can be set quickly by dividing the target position, and the target position can be set by setting the total running length and the average number of points.

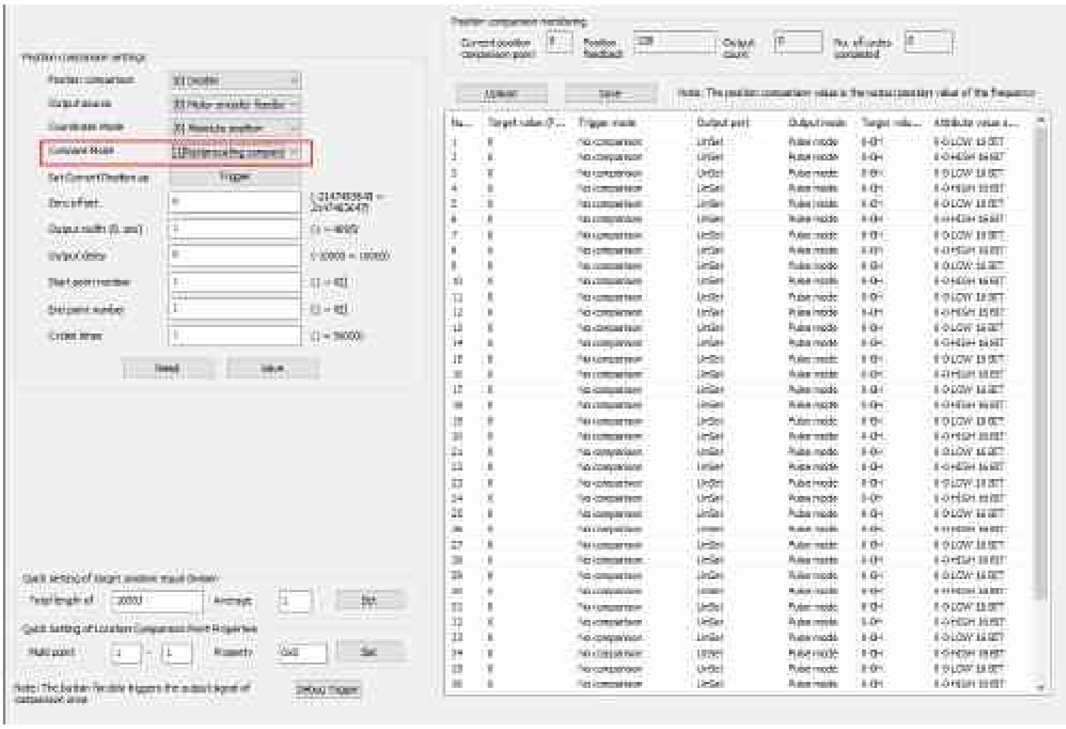
   Comparison point N Target position = N * (total length of position/average points)
   Properties can also be configured through Quick Settings.



When the position comparison enable changes from 0 to 1 (the rising edge enables the position comparison output function), the current position comparison point changes from 0 to the position comparison starting point. At this time, the starting point is 1, and the first target position value is compared. After the position feedback reaches the first target position value, the current position comparison point changes to the next point, and so on.

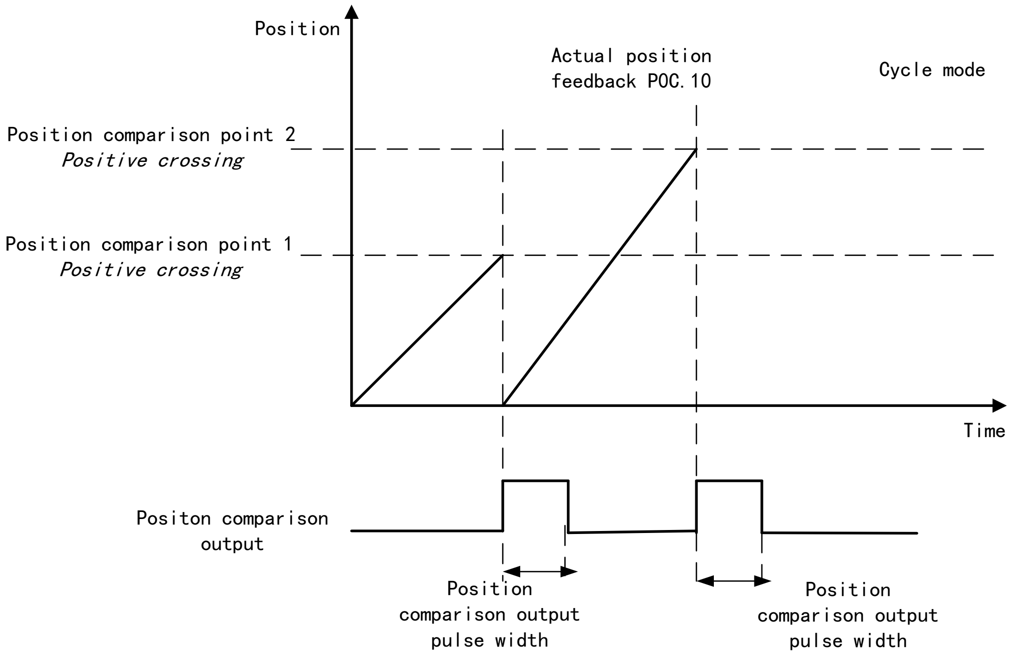
- **Reciprocating comparison mode for absolute position**

3. Set the position comparison mode to the reciprocating comparison mode of absolute position.



4. The target position parameter is set, and the comparison target position value can be set in the table on the right. At this time, the fast setting can set the running distance of two adjacent points and set the number of cycle points. The target position can be set by setting the running length and the average number of points equally. After the average number of points is set, the target values of the first to n comparison points are updated to the value of the total length of the positions at equal intervals.

5. When the position comparison enable changes from 0 to 1 (the rising edge enables the position comparison output function), the current comparison point changes from 0 to the comparison initial point, and the first target position value is compared. When the position feedback reaches the first target position value, the current comparison point becomes the next comparison point, and the position feedback starts from zero, and so on. As shown in the following figure:



Note:
It is necessary to ensure that the direction of crossing the set point during the first operation is consistent with the set direction to ensure the normal use of the function.

When setting the serial comparison mode, the comparison point position value is set to be consistent with the direction of the trigger mode.

Chapter 7 EtherCAT communication

7.1 EtherCAT principle function

In comparison to Ethernet protocol which requires huge bandwidth for packets to be moved between master and clients, EtherCAT communication protocol breaks through this systemic limitation of Ethernet which requires every client to receive the whole data package from the master.
The EtherCAT master sends a telegram that passes through each node. Each EtherCAT slave device reads the data addressed to it “on the fly”, and inserts its data in the frame as the frame is moving downstream. The frame is delayed only by hardware propagation delay times. The last node in a segment (or drop line) detects an open port and sends the message back to the master using Ethernet technology’s full duplex feature.
The telegram’s maximum effective data rate increases to over 90 %, and due to the utilization of the full duplex feature, the theoretical effective data rate is even higher than 100 Mbit/s (> 90 % of two times 100 Mbit/s).
The EtherCAT master is the only node within a segment allowed to actively send an EtherCAT frame; all other nodes merely forward frames downstream. This concept prevents unpredictable delays and guarantees real-time capabilities.

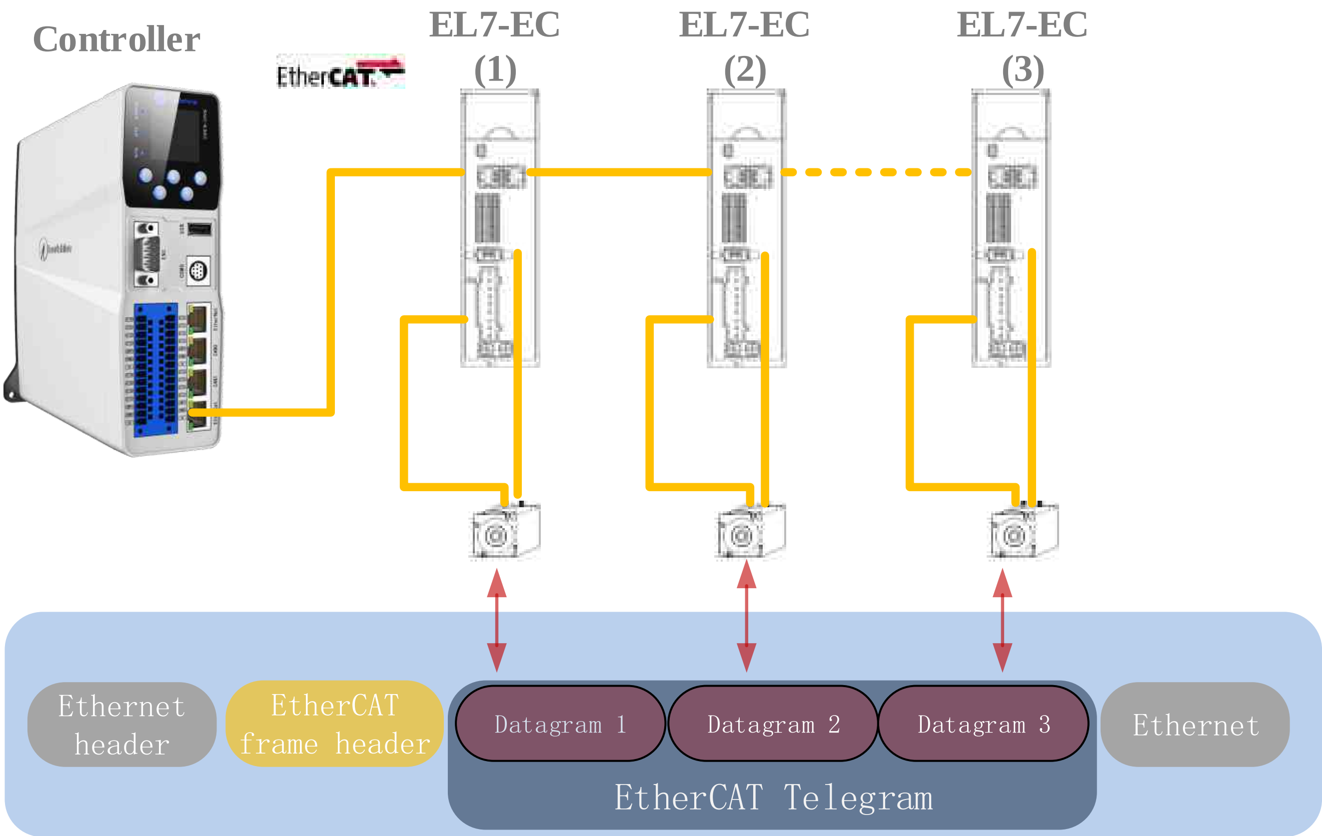


Figure 7.1 EtherCAT in standard Ethernet frame

ID number setting of EtherCAT slave station

To set up EtherCAT slave station ID number, please set P60.01 = 1 and set required ID number to P60.00.

P60.00	Label	Slave Name		Mode	F		
	Range	0~65535		Default	2	Unit	
	Activation	After restart	Attribute	RW		Index	2060-01h
	Set the slave station number in EtherCAT mode.						

P60.01	Label	Slave Name Source		Mode	F		
	Range	0~1		Default	0	Unit	
	Activation	After restart	Attribute	RW		Index	2060-02h
	0: The master automatically assigns the slave address; 1: The slave address is sourced from parameter P60.00.						

7.2 Synchronous Mode

7.2.1 Free Running Mode

In free moving mode, EL7-ECS processes the process data sent by the master asynchronously. It only applies to asynchronous motion mode such as homing mode, protocol position mode, etc

7.2.2 Distributed clock synchronization mode

EL7-ECS adopts the synchronous mode of distributed clock as shown in figure 6.2. When the master station sends process data to the slave station, the slave station Immediately reads the process data, and then waits for the synchronization signal to trigger the process data to act on the driver.
The process data must arrive at the EL7-ECS drive before the time of Sync0 signal T1. The drive has completed the analysis of the process data and relevant control calculation before the arrival of Sync0 event. After receiving Sync0 event, EL7-ECS Immediately implements the control action which has a high synchronization performance.

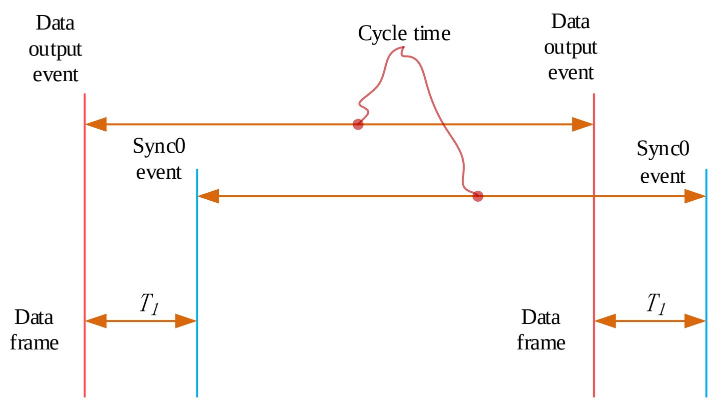


Figure 7.2 High performance synchronization mode

7.3 EtherCAT state machine

EtherCAT state machine, commonly known as "communication state machine ", is mainly used to manage communication between master and slave stations. The communication function mainly includes mailbox and process data communication. The EtherCAT state machine transition relationship is shown in figure 7.3

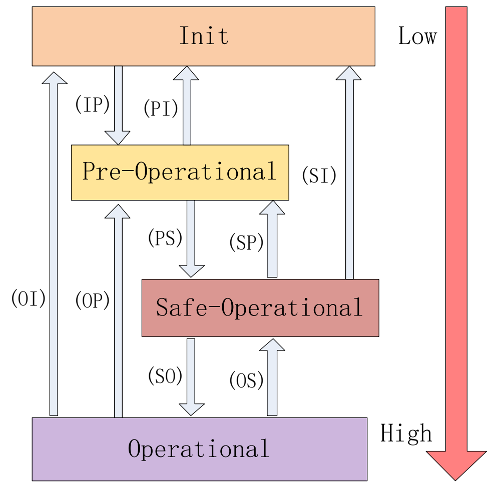


Figure 7.3 EtherCAT state machine transitions

EtherCAT state machine transitions have the following characteristics：

① From initialization to operational, the conversion must be carried out strictly in the order of initializing > pre-operational > safe operational > operational, from low to high, and no grade skipping is allowed

② When converting from high to low, grade skipping is allowed.

③ If state transition request to master station fails, slave station will send an error message to the master station.

EtherCAT 402 State Machine Communication function

State and transition	Communication function
Init	No mailbox or process data communication is possible.
Pre-Operational	Mailbox communication is effective, no process data communication, SDO

	function is valid
Safe-Operational	Mailbox communication and sending process data object is valid, SDO and TXPDO are valid
Operational	Mailbox communication, receive and send process data object valid, SDO、RXPDO and TXPDO valid

7.4 CoE

7.4.1 Network structure of EL7-ECS

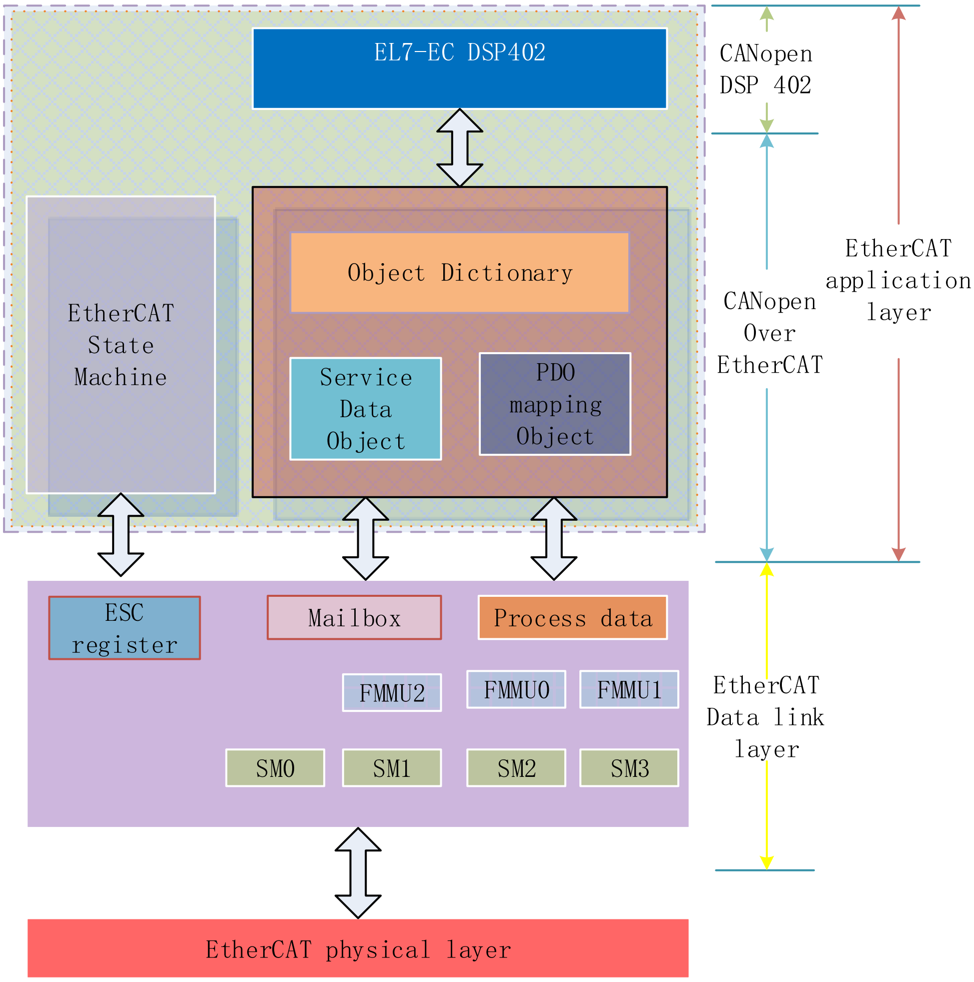


Figure 7.4 The structure of EL7-ECS network module

The data link layer is mainly implemented by EtherCAT slave station controller (ESC). EL7-ECS EtherCAT application layer protocol mainly includes application part (CANopen DSP402), object dictionary and communication function (red frame part), among which object dictionary and communication function can be jointly called CoE part.

Object dictionary——Bridge of communication function and application part.

Communication function——Implementation of communication rules (SDO, PDO, etc.)

Application part——Define the specific function of the device, such as the drive, IO module.

7.4.2 Object dictionary

EtherCAT master controls the EL7-ECS drive by writing and reading device state /information. To do this, the drive defines read-write parameters and read-only state values. Object dictionary is the collection of these parameters and states.
The EL7-ECS object dictionary contains all DSP402 and CoE related data objects in a standardized manner. It is a collection of EL7-ECS parameter data structures.
The EL7-ECS object dictionary is the interface with which the controller communicates. EtherCAT master implements EL7-ECS motion control through the interface of object dictionary.

7.4.3 Service Data Object (SDO)

The EL7-ECS series supports SDO services. EtherCAT master can configure, monitor and control EL7-ECS servos by using SDO to read and write EL7-ECS object dictionaries.
In conventional CANopen DS301 mode, SDO protocol CAN only transfer 8 bytes at a time to match the data length of CAN message. In COE enhancement mode, only the payload data is expanded without changing the protocol head; In this way, the SDO protocol uses mailboxes with larger data lengths, thus improving the transmission efficiency of big data.

7.4.4 Process Data Object (PDO)

PDO Introduction

PDO is generally used for real-time data updates. It is divided into receiving PDO (RXPDO) and sending PDO (TXPDO). The data stream direction of receiving PDO is from master station to slave station, while sending PDO is from slave station to master station
The PDO function of EL7-ECS supports both synchronous cycle mode and non-periodic update mode. When distributed clock synchronization mode is selected on master station, PDO will update according to the synchronization cycle. If free moving mode is selected, PDO data updates aperiodic.

PDO mapping

TThrough PDO mapping, real-time transmission of mapped objects can be realised. EL7EC supports simultaneous transmission of 2 groups of RXPDO and 2 groups of TXPDO, each PDO object can map 10 object dictionary objects (maximum length 40 bytes), and the format of PDO mapping content is shown in Table 7-2.

Table 7.2 Format of PDO mapping

Bit	31~16	15~8	7~0
Description	Index of mapped object	Subindex of mapped object	Bit length (Hex)
Example	6040h	00h	10h(16bit)

Default PDO mapping (consistent with the XML file) is shown in table 7.3

Table 7.3 Default PDO mapping

PDO Map object index	PDO Map object Sub-index	Mapping content	Mapped Object			Description
			Index	Sub-index	Bit length	
RXPDO1 (1600h)	01h	60400010h	6040h	00h	10h(16 bit)	01h
	02h	607A0020h	607Ah	00h	20h(32 bit)	02h
	03h	60B80010h	60B8h	00h	10h(16 bit)	03h
RXPDO2 (1601h)	01h	60400010h	6040h	00h	10h(16 bit)	Control word
	02h	60FF0020h	60FFh	00h	20h(32 bit)	Target velocity
	03h	60B20010h	60B2h	00h	10h(16 bit)	Torque feedforward
RXPDO3 (1602h)	01h	60400010h	6040h	00h	10h(16 bit)	Control word
	02h	60710010h	6071h	00h	10h(16 bit)	Target torque
	03h	60870020h	6084h	00h	20h(32 bit)	Profile deceleration
RXPDO4 (1603h)	01h	60400010h	6040h	00h	10h(16 bit)	Control word
	02h	60980008h	6098h	00h	08h(8 bit)	Homing method
	03h	60990120h	6099h	01h	20h(32 bit)	High homing velocity
	04h	60990220h	6099h	02h	20h(32 bit)	Low homing velocity
	05h	609A0020h	609Ah	00h	20h(32 bit)	Homing acceleration
	06h	607C0020h	607Ch	00h	20h(32 bit)	Homing position offset
	07h	60600008h	6060h	00h	08h(8 bit)	Operation mode
TXPDO1 (1A00h)	01h	603F0010h	603Fh	00h	10h(16 bit)	error code
	02h	60410010h	6041h	00h	10h(16 bit)	status words
	03h	60610008h	6061h	00h	08h(8 bit)	Operating mode display
	04h	60640020h	6064h	00h	20h(32 bit)	actual position
	05h	60B90010h	60B9h	00h	10h(16 bit)	Probe Status
	06h	60BA0020h	60BAh	00h	20h(32 bit)	Probe 1 Rising Edge Capture
	07h	60FD0020h	60FDh	00h	20h(32 bit)	digital input
TXPDO2 (1A01h)	No default mapping					

PDO dynamic mapping

Different from CIA DS301, CoE uses PDO specified objects (1C12h/1C13h) to configure PDO mapped objects (1600h~1603h/1A00h~1A01h) to PDO SyncManager (SyncManager 2/3). PDO specified objects are defined in table 6.4

Table 6.4 PDO specifies object definitions

Index	Sub-index	Range	Data type	Access
RXPDO (1C12h)	00h	0~4	U8*1)	RO *2)
	01h	1600h~1603h	U16	RW
	02h		U16	RW
	03h		U16	RW
	04h		U16	RW
TXPDO (1C13h)	00h	0~2	U8	RO
	01h	1A00h~1A01h	U16	RW
	02h		U16	RW

*** 1) U represents unsigned type, such as U8 for unsigned 8 bits and U16 for unsigned 16 bits*

2) Access: RO = Read Only, RW = Read and Write, WO = Write Only

PDO dynamic mapping setup procedure

A、 Switch EtherCAT state machine to pre-operational, then PDO map can be configured using SDO.

B、 Clear the PDO mapping object of the PDO specified object by setting 1C12-00h / 1C13-00h to 0.

C、 Invalidate the PDO mapping object by assigning 0 to the subindex 0 of 1600h~1603h /1A00h~1A01h.

D、 Reconfigure PDO mapping content and write the mapping object into the objects in the range of 1600-01h~1600-08h, 1601-01h~1601-08h, 1602-01h~1602-08h, 03-01h~1603-08h (RXPDO mapping content as from 1600h-01), 00-01h ~ 1A00-08h or 1A01-01h~1A01-08h (TXPDO mapping content as from 1A00h-01) according to Table 6.3

E、 Set the total number of PDO mapping objects by writing the number of mapping objects into 1600-00h, 1601-00h, 1602-00h, 1603-00h, 1A00-00h or 1A01-00h. The total number of PDO mapping objects without mapping content will be set to 0.

F、 Write valid PDO mapping object index to PDO specified object by writing valid RXPDO mapping object index 1600h~1603h into 1C12-01h ~ 1C12-04h and writing valid TXPDO mapping object index 1A00h, 1A01h into 1C13-01h, 1C13-02h.

G、 Set the total number PDO specified objects by writing the number of mapped objects to 1C12-00h and 1C13-00h.

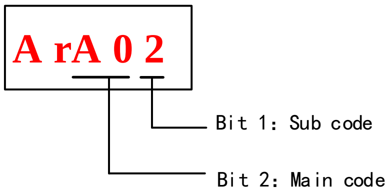
H、 Switch EtherCAT state to Safe-Operational or above, the configured PDO mapping will be valid.

Chapter 8 Warning and Alarm

8.1 Servo drive warning

When warning occurs, driver will set protective function but **motor won't stop moving**. Error code will be displayed on the front panel.

Example of warning code:



Warning Code		Content
Main	Code	
ArA	00	Quick stop valid
	01	Overload warning
	02	Regeneration energy overload warning (85% of the regeneration threshold)
	03	Absolute encoder battery voltage low (<3.1V). Valid when Pr0.15 is set to 1.
	04	Parameter setting error alarm
	05	Incorrect control mode settings warning
	06	Overheat warning
	07	Temperature sensor disconnected warning
	08	Positive limit switch valid. POT blinking on front panel
	09	Negative limit switch valid. NOT blinking on front panel
	0A	Positive and negative limit switch valid. PNOT blinking on front panel
	0B	Software positive limit switch valid warning. SPOT blinking on front panel
	0C	Software negative limit switch valid warning. SNOT blinking on front panel
	0D	Software negative and positive limit switch valid warning. SPNOT blinking on front panel
	0E	Restart after parameter restored to default
	10	Software limit settings error
	12	Motor collision warning
	13	Disable clearing of encoder multi-turn data and alarms when servo is disabled / Disable clearing of multi-turn values for non-multi-turn encoders

	14	Low bus voltage alarm
	1C	Parameter out of range
	20	Undervoltage alarm
	24	Input power Phase T disconnected
	25	Input power Phase R disconnected
	26	Input power Phase S disconnected
	27	PHY communication error
	28	PHY data checksum 1 error
	29	PHY data checksum error
	2A	PHY data checksum 2 error
	2B	PHY data checksum 3 error
	2C	PHY initialization failure
POFF		Main power supply not connected. Check the wiring of L1/L2/L3 or R/S/T.
COFF		Control power supply not connected. Check the wiring of L1C/L2C.

8.2 Warning Handling Methods

When a warning occurs, the drive will not stop the motor from rotating, and the corresponding warning code will be automatically displayed on the front panel. If the corresponding warning is addressed—for example, in the case of alarm ArA03—replace the battery with a new one while the drive is powered on, ensuring the absolute encoder battery voltage exceeds 3.0 V to clear the alarm.
Appropriate handling methods can be adopted based on the specific warning content!

<table>
<tr><td rowspan="2">warning code</td><td>Main</td><td>Sub</td><td>Display："ArA00"</td></tr>
<tr><td>A0</td><td>0</td><td>Content：Quick stop valid</td></tr>
<tr><td colspan="2">Cause of warning</td><td>Inspection methods</td><td>Disposal methods</td></tr>
<tr><td colspan="2">E-STOP active (P00.40=1 Stop without alarm triggered).</td><td>Check if the DI function E-STOP correctly triggers the DI report.</td><td>Confirm safety, then cancel the valid E-STOP signal.</td></tr>
</table>

<table>
<tr><td rowspan="2">warning code</td><td>Main</td><td>Sub</td><td>Display："ArA01"</td></tr>
<tr><td>A0</td><td>1</td><td>Content：overload warning</td></tr>
<tr><td colspan="2">Cause of warning</td><td>Inspection methods</td><td>Disposal methods</td></tr>
<tr><td colspan="2">Overload warning (80% reached).</td><td>Confirm the motor overload curve, and check whether the actual load is rated load, you can monitor the status to see whether the servo drive average load factor D07_01 is greater than 100% for a long period of time; confirm whether the D15 overload rate has a rising trend to reach 100 will alarm ER100</td><td>Replace the high-capacity servo drive and matching motor;
Reduce the load or increase the acceleration and deceleration time</td></tr>
</table>

<table>
<tr><td rowspan="2">warning code</td><td>Main</td><td>Sub</td><td>Display："ArA02"</td></tr>
<tr><td>A0</td><td>2</td><td>Content：Drain overload warning</td></tr>
<tr><td colspan="2">Cause of warning</td><td>Inspection methods</td><td>Disposal methods</td></tr>
<tr><td colspan="2">Discharge overload warning (85% reached).</td><td>Confirm whether the actual motion involves acceleration/deceleration times that are too small or motion that is too intense, causing the discharge resistor to discharge frequently..</td><td>Replace with a discharge resistor of larger power specifications or reduce load/reduce rotation speed.</td></tr>
</table>

warning code	Main	Sub	Display："ArA03"
	A0	3	Content：Encoder battery voltage low
Cause of warning		Inspection methods	Disposal methods
Abs. encoder battery <3.0V (Multi-turn enabled).		Measure if the encoder battery voltage is lower than 3.0V.	Replace with a new battery in time.

warning code	Main	Sub	Display："ArA04"
	A0	4	Content：Parameter setting error alarm
Cause of warning		Inspection methods	Disposal methods
Parameter modification pending (Power cycle required).		/	/

warning code	Main	Sub	Display："ArA05"
	A0	5	Content：Incorrect control mode settings warning
Cause of warning		Inspection methods	Disposal methods
Control mode P00.01 is not 9.		Check if the P00.01 parameter value setting is correct.	Set P00.01 to 9.

warning code	Main	Sub	Display："ArA06"
	A0	6	Content：Overheat warning
Cause of warning		Inspection methods	Disposal methods
Drive overheating		Drive temperature is greater than the set threshold (PA2.49).	Improve heat dissipation conditions and lower the ambient temperature;Increase the drive and motor capacity; increase acceleration/deceleration time; reduce the load.

warning code	Main	Sub	Display："ArA06"
	A0	7	Content：Temperature sensor disconnected warning
Cause of warning		Inspection methods	Disposal methods
Temperature sensor disconnected.		Check if the temperature sensor connection is loose.	Tighten the temperature sensor wiring.

warning code	Main	Sub	Display："Pot"
	A0	8	Content：Hardware Positive Limit Valid Alarm
Cause of warning		Inspection methods	Disposal methods
Positive limit active (panel display POT)		Check that DI is assigned a positive limit signal and that the positive limit input signal logic is valid.	Check whether the positive limit trigger is triggered normally; Non-normal triggering to confirm whether the wiring and parameter setting values are incorrect.

warning code	Main	Sub	Display："not"
	A0	9	Content：Hardware Negative Limit Valid Alarm
Cause of warning		Inspection methods	Disposal methods
Negative limit valid (panel display NOT)		Check if DI is assigned the negative limit signal, and if the negative limit input signal logic is in the active state.	Check whether the negative limit trigger triggers normally; for abnormal triggering, confirm if wiring and parameter setting values are incorrect.

warning code	Main	Sub	Display："Pnot"
	A0	A	Content：Hardware alarms for both positive and negative limits
Cause of warning		Inspection methods	Disposal methods
Positive and negative limits valid (panel display Pnot)		Check whether DI is assigned positive/negative limit signals, and whether both positive/negative limit input signal logic is in a valid state.	Check whether the positive/negative limit triggering is triggered normally; abnormal triggering confirms whether the wiring and parameter setting values are incorrect.

warning code	Main	Sub	Display："SPot"
	A0	B	Content：Software Positive Limit Valid Alarm
Cause of warning		Inspection methods	Disposal methods
Software positive limit valid (panel display SPOT)		Servo drive position feedback exceeds the set software positive limit position	Reasonable planning of servo drive commands to ensure that the load travel is within the soft limit range; set a reasonable software limit range

warning code	Main	Sub	Display："Snot"
	A0	C	Content：Software Negative Limit Valid Alarm
Cause of warning		Inspection methods	Disposal methods
Software negative limit valid (panel display snot)		Servo drive position feedback exceeds the set software negative limit position	Reasonable planning of servo drive commands to ensure that the load travel is within the soft limit range; set a reasonable software limit range

warning code	Main	Sub	Display："SPnot"
	A0	d	Content：Software alarms for both positive and negative limits
Cause of warning		Inspection methods	Disposal methods
Software positive and negative limits valid (panel display spnot)		Servo drive position feedback exceeds set software positive/negative limit positions	Reasonable planning of servo drive commands to ensure that the load travel is within the soft limit range; set a reasonable software limit range

warning code	Main	Sub	Display："ArA0E"
	A0	E	Content：Parameters need to be saved and re-powered to take effect
Cause of warning		Inspection methods	Disposal methods
Parameters that require power failure to take effect have been changed or factory restoration has been performed.		Check whether you have changed parameters that require power failure to take effect or performed a factory restore operation.	If you do perform the above operation, the warning is a normal output, re-power off and power on to release the

warning code	Main	Sub	Display："ArA10"
	A1	0	Content：Software limit settings error
Cause of warning		Inspection methods	Disposal methods
Software limit value setting error.		Check if the servo has enabled the soft limit function, and P00.56 < P00.57 (setting error).	Ensure P00.56 > P00.57.

warning code	Main	Sub	Display："ArA12"
	A1	2	Content：Motor collision warning
Cause of warning		Inspection methods	Disposal methods
After collision detection mode is enabled, the motor collides, meeting the conditions of collision detection speed (P47.03) and current thresholds (P47.01, P47.02), triggering a collision detection alarm.		Check for actual mechanical collision, jamming, or stalling in the equipment.	Reset the mechanical structure, clear the alarm, confirm no issues, and restart the equipment.
After collision detection mode is enabled, no actual collision occurs, but the conditions of collision detection speed (P47.03) and current thresholds (P47.01, P47.02) are met.		Verify whether the collision detection speed threshold and current threshold settings are reasonable.	Set reasonable collision detection speed threshold and current threshold values.

warning code	Main	Sub	Display："ArA13"
	A1	3	Content：Clearing encoder multiturns and alarms when disabling/prohibiting clearing of non-multiturn encoder multiturn values
Cause of warning		Inspection methods	Disposal methods
P10.10 written 5/9 (Clear Data) while enabled.		Prohibit clearing encoder multi-turn and alarm when enabled.	Clear encoder multi-turn and alarm when disabled.

warning code	Main	Sub	Display："ArA14"
	A1	4	Content：Bus Undervoltage Warning
Cause of warning		Inspection methods	Disposal methods
Low main circuit power input voltage		1. Verify input voltage at L1/L2(L3)/RST meets specs: · 220V drive: 198–264V (220V±10%) · 380V drive: 342–484V (400V±10%) 2. Check charge indicator, d27 bus voltage, and DC bus voltage (P+/N): · 220V drive: ~310V (fault at <180V) · 380V drive: ~540V (fault at <540V)	Increase L1/L2(L3) or RST input voltage to meet the required specifications.

warning code	Main	Sub	Display："ArA1C"
	A1	C	Content：Parameter out of range
Cause of warning		Inspection methods	Disposal methods
Parameter import out of range.		Check the out-of-limit parameter displayed in the host computer pop-up window, whether the range exceeds the current drive maximum/minimum value. performance.	Change the parameter range to within the allowable range of the current drive.

warning code	Main	Sub	Display："ArA20"
	A2	0	Content：Undervoltage alarm
Cause of warning		Inspection methods	Disposal methods
Main input low; Bus voltage		Check if the bus	Ensure main power input voltage

< PA2.43.	voltage is lower than the PA2.43 setting value, check for A20 undervoltage alarm.	meets the nameplate specified voltage

warning code	Main	Sub	Display："ArA24"
	A2	4	Content：Input power Phase T disconnected
Cause of warning		Inspection methods	Disposal methods
Input power T-phase disconnected.		Check if main power T phase is disconnected.	Correctly connect main power wiring

warning code	Main	Sub	Display："ArA20"
	A2	5	Content：Input power Phase R disconnected
Cause of warning		Inspection methods	Disposal methods
Input power R-phase disconnected.		Check if main power R phase is disconnected.	Correctly connect main power wiring

warning code	Main	Sub	Display："ArA26"
	A2	6	Content：Input power Phase S disconnected
Cause of warning		Inspection methods	Disposal methods
Input power S-phase disconnected.		Check if main power S phase is disconnected.	Correctly connect main power wiring

warning code	Main	Sub	Display："ArA27"
	A2	7	Content：PHY communication error
Cause of warning		Inspection methods	Disposal methods
PHY data read error.		Repeatedly connect power, check if the fault still exists.	Replace the servo drive
The drive is subject to strong electromagnetic interference, resulting in write operation failures.		Check if the EtherCAT communication cables run parallel to power lines, causing excessive interference.	Route communication cables separately from power lines, use shielded cables, and ensure reliable grounding.

warning code	Main	Sub	Display："ArA28"
	A2	8	Content：PHY data checksum 1 error
Cause of warning		Inspection methods	Disposal methods
PHY data checksum error.		Repeatedly connect power, check if the fault still exists.	Replace the servo drive
The drive is subject to strong electromagnetic interference, resulting in write operation failures.		Check if the EtherCAT communication cables run parallel to power lines, causing excessive interference.	Route communication cables separately from power lines, use shielded cables, and ensure reliable grounding.

warning code	Main	Sub	Display："ArA29"
	A2	9	Content：PHY data checksum error
Cause of warning		Inspection methods	Disposal methods
PHY data checksum error.		Repeatedly connect power, check if the fault still exists.	Replace the servo drive
The drive is subject to strong electromagnetic interference, resulting in		Check if the EtherCAT communication cables run parallel to power	Route communication cables separately from power lines, use shielded cables, and ensure reliable

write operation failures.	lines, causing excessive interference.	grounding.

warning code	Main	Sub	Display："ArA2A"
	A2	A	Content：PHY data checksum 2 error
Cause of warning		Inspection methods	Disposal methods
PHY data checksum error.		Repeatedly connect power, check if the fault still exists.	Replace the servo drive
The drive is subject to strong electromagnetic interference, resulting in write operation failures.		Check if the EtherCAT communication cables run parallel to power lines, causing excessive interference.	Route communication cables separately from power lines, use shielded cables, and ensure reliable grounding.

warning code	Main	Sub	Display："ArA2B
	A2	B	Content：PHY data checksum 3 error
Cause of warning		Inspection methods	Disposal methods
PHY data checksum error.		Repeatedly connect power, check if the fault still exists.	Replace the servo drive
The drive is subject to strong electromagnetic interference, resulting in write operation failures.		Check if the EtherCAT communication cables run parallel to power lines, causing excessive interference.	Route communication cables separately from power lines, use shielded cables, and ensure reliable grounding.

warning code	Main	Sub	Display："ArA2C
	A2	C	Content：PHY initialization failure
Cause of warning		Inspection methods	Disposal methods
PHY chip initialization (reset/register config) timed out or failed after drive power-up.		Check power-up sequence for PHY initialization timeout/errors.	Power-cycle drive to restart EtherCAT PHY initialization.
PHY chip power/reset/port circuit fault, chip not functional.		Check drive power stability and Ethernet port.	If repeated power cycles fail, contact manufacturer.

warning code		Display："PoFF"
		Content：Main power disconnectted
Cause of warning	Inspection methods	Disposal methods
Main power not connected, L1/L2/L3 or R/S/T wiring abnormal	1. Check L1/L2/L3 or R/S/T wiring for looseness/breaks.2. Verify power switch is ON.3. Measure voltage with multimeter.	1. Reconnect power lines.2. Replace damaged cables.3. Confirm main power output.4. Check fuse/circuit breaker.

warning code		Display："coFF"
		Content：Control power disconnectted
Cause of warning	Inspection methods	Disposal methods
Control power not connected, L1C/L2C wiring abnormal	1. Check L1C/L2C wiring for looseness/breaks.2. Verify power switch is ON.3. Measure voltage with multimeter.	1. Reconnect control power lines.2. Replace damaged cables.3. Confirm control power output.4. Check fuse.

8.3 Servo drive alarm & EtherCAT Communication Alarm

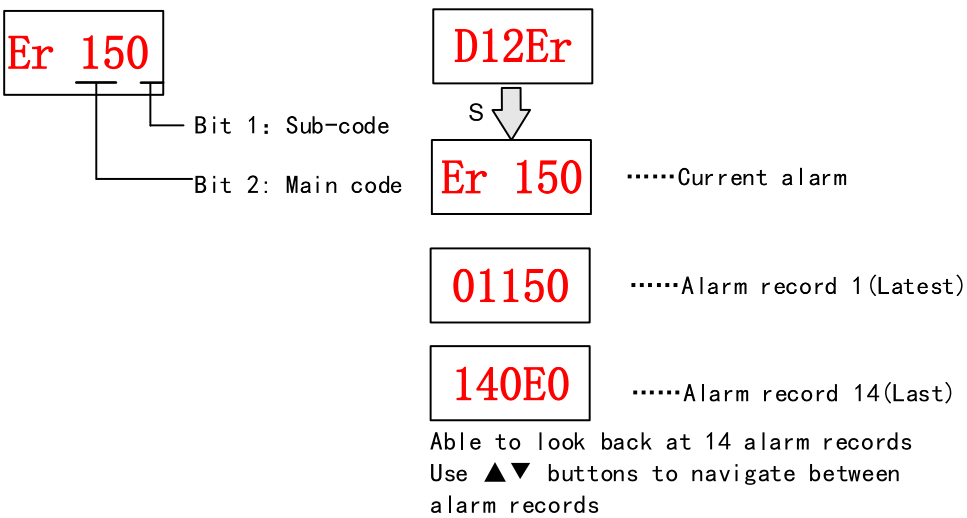
When a servo drive fault occurs, its panel will display the corresponding error code, and the corresponding detailed information can be viewed through the debugging software object dictionary index 503F.

For example:

- Panel error code: Er0A0

- The object dictionary index 503F in the commissioning software shows the value of 0x0A0.

When alarm occurs, driver will set protective function and **motor stops moving**. Error code will be displayed on the front panel. Alarm history record can also be viewed in data monitoring mode, with the alarm log sub-menu displaying "d12Er".



The list of error codes is shown below:
Save: Save the history of the error.
Stopping category: The drive will stop with an alarm fault when an error occurs, and the stopping method for category 1 and 2 faults can be set through P05.10 [Servo Alarm Stopping Sequence Mode].
Clearable: Alarms (reset alarms) can be cleared via DI inputs/front panel/commissioning software, but the conditions that actually caused the fault may still exist. To clear the alarm from the front panel, use the **AFACL** alarm clearing function in the auxiliary functions.

EtherCAT communication related alarms are erasable and will not be recorded in alarm history.

Clearing EtherCAT communication alarm is similar to clearing servo driver alarm. Please clear the alarm before switching to 402 machine state.

EtherCAT communication alarm however, relies on register clearance from the main station. Can be solved according to following steps:

1、Set bit 4 of ESC control register 0x120 (error responder) to 1.

2、The communication alarm can be cleared until the feedback of the ESC status code register 0x134~0x135 is 0.

3、By setting bit 7 of 6040h to 1, switches 402 state machine from fault to cancelling initialization.(Switch on disabled).

When a network fault occurs in the EL7EC, the operation panel will display the fault code and the ERR status indicator will indicate accordingly. In addition, the error information of the object dictionaries 1001h and 603Fh in accordance with the CIA/IEC specifications will be sent to the master station through the emergency message, and the master station can determine the specific fault through the emergency message or the alarm code of these two object dictionaries.

Table 8.1 Error Code List

Error code		Content	Attribute			object dictionary
Main	Sub		Save	Type	Clearable	603F
09	0	FPGA communication error	●	2		0x6329
	1	FPGA write CRC check error	●	2		0x632A
	2	FPGA read CRC check error	●	2		0x632B
0A	0~1	Circuiuit U;V currennt detection error	●	2		0x3150 0x3151
	3	Motor power cable not connected	●	1	●	0x3153
	5	DC bus circuit error	●	2		0x3201
	6	Temperature detection circuit error	●	2		0x4201
0b	0	Control circuit power supply voltage too low		2		0x3205
	1	Control circuit power supply voltage too high		2	●	0x3206
	2	Control power off		2		0x3202
0c	0	DC bus overvoltage	●	1	●	0x3211
0d	0	DC bus undervoltage	●	1	●	0x3221
	1	Single phasing of main	●	2	●	0x3130

		power supply				
	2	No main power supply detected		2	●	0x3222
	3	SEMI-F47 under voltage	●	1	●	0x3223
	4	Phase R power supply disconnected		2	●	0x3131
	5	Phase S power supply disconnected		2	●	0x3132
	6	Phase T power supply disconnected		2	●	0x3133
0E	0	Overcurrent	●	1		0x2211
	1	Intelligent Power Module (IPM) overcurrent	●	1		0x2212
	2	Power output to motor shorted to ground	●	1		0x2218
	4	Phase overcurrent	●	1		0x2230
	5	Phase U overcurrent	●	1		0x2231
	6	Phase V overcurrent	●	1		0x2232
	7	Phase W overcurrent	●	1		0x2233
0F	0	Driver overheated	●	2		0x4210
	1	Motor overheated alarm	●	2		0x4211
10	0	Motor overloaded	●	1	●	0x8311
	1	Driver overloaded	●	1	●	0x8310
	2	Motor rotor blocked	●	1	●	0x8301
	3	Motor collision faults	●	2	●	0x8303
	4	Driver output overload at low speeds	●	1	●	0x8304
11	0	Soft-start relay engagement failure	●	2		0x5001
	1	Cooling fan failure	●	2		0x5002
12	0	Regenerative resistor overvoltage	●	2		0x7701
	1	Discharge transistor fault	●	1		
	2	Regenerative resistor value too low		2		0x7703
	3	Regenerative circuit overcurrent	●	1		0x7704
15	0	Encoder disconnected	●	1		0x7321
	1	Encoder communication error	●	1		0x7322
	2	Encoder initial position error	●	1		0x7323
	3	Multiturn encoder battery	●	2		0x7325

		error				
	4	Encoder parameter download failure	●	2		
	5	Multiturn encoder count jump	●	2	●	0x7326
	6	Encoder overheated	●	2	●	0x7327
	7	Multiturn encoder data count overflow	●	2	●	0x7328
	A	Encoder Disconnection (A)	●	1		0x7305
	b	Encoder Disconnection (B)	●	1		0x7305
	C	Encoder Disconnection (C)	●	1		0x7305
	d	Encoder Disconnection (UVW)	●	1	●	0x7306
17	0	Encoder data error	●	1		0x7324
	1	Encoder parameter initialization error	●	2		0x7330
18	0	Excessive position deviation	●	2	●	0x8611
	1	Excessive velocity deviation	●	2	●	0x8610
	2	Command Position Overflow	●	2	●	0x860F
19	0	Motor vibration too strong	●	2	●	0x8401
	1	Excessive hybrid position deviation	●	2	●	0x8404
1A	0	Overspeed	●	2	●	0x8402
	1	Velocity out of control	●	1		0x8403
	2	External encoder overspeed feedback	●	2	●	0x7311
1b	0	Bus input signal dithering	●	2	●	0x8612
	1	Incorrect electronic gear ratio	●	2	●	0x8503
	2	Single-turn absolute value mode exceeds the upper and lower limits of the single-turn position	●	2	●	0x8613
	3	External encoder frequency divider value error	●	2	●	0x8504
	7	command overflow	●	2	●	0x8502
	8	Absolute multiturn data setting out of limits	●	2	●	0x732A
	9	Origin offset setting error	●	2	●	0x732B
	A	Electronic gear ratio numerator error	●	2	●	0x8503
1c	0	Both STO failed	●	1	●	0x8313

	1	1st STO failed	●	1	●	0x8314
	2	2nd STO failed	●	1	●	0x8315
	3	STO power supply 1 anomaly	●	1	●	0x8316
	4	STO power supply 2 anomaly	●	1	●	0x8317
	5	STO input circuit 1 anomaly	●	1	●	0x8318
	6	STO input circuit 2 anomaly	●	1	●	0x8319
	7	STO circuit BUFFER 1 anomaly	●	1	●	0x831A
	8	STO circuit BUFFER 2 anomaly	●	1	●	0x831B
	9	STO Software Process Monitoring Abnormalities	●	1	●	0x831C
21	0	I/O input interface assignment error	●	2	●	0x6321
	1	I/O input interface function assignment error	●	2	●	0x6322
	2	I/O output interface function assignment error	●	2	●	0x6323
24	0	EEPROM parameters initialization error		2		0x5530
	1	EEPROM hardware error		2		0x5531
	2	EEPROM seve overspeed error		2	●	0x5532
	3	EEPROM save vendor parameter error		2		0x5533
	4	EEPROM save communication parameter error		2		0x5534
	5	EEPROM save device parameter error		2		0x5535
	6	EEPROM save, read power failure information error		2		0x5536
	F	EEPROM power parameter error		2		0x5538
26	0	Positive/negative out-of-range input valid	●	2	●	0x7329
28	0	Pulse regeneration limit protection	●	2	●	0x7201
57	0	Forced alarm input valid	●	2	●	0x5441
	1	PC forced alarm input active				

58	0	Homing failed				
	1	Unvalid homing method				
5F	0	Motor code error		2		0x7122
	1	Driver chip select recognition abnormality		2		0x1100
	3	Drive power selection fault		2		0xFFF0
	4	Motor voltage level unmatched fault		2		0xFFF0
	6	Abnormal matching of drive model and motor model				0xFFF0
60	0	Main loop interrupted timeout		2	●	0x6204
	1	Velocity loop interrupted timeout		2	●	0x6205
	2	interrupt timeout fault		2	●	0x6204
	3	Loss of interruptions for dual-core interactions		2	●	0x6205
	4	Internal storage anomaly		2	●	0x6205
	5	Timing configuration error	●	2		
70	0	Encryption error		2		0x7001
50	0	External communication encoder disconnected	●	1		0x7531
	1	External communication encoder data error	●	1		0x7531
	2	External communication encoder checksum error	●	1		0x7532
55	0	External ABZ encoder disconnected	●	1		0x7534
	1	External encoder disconnected (Phase A disconnected)	●	1		0x7534
	2	External encoder disconnected (Phase B disconnected)	●	1		0x7534
	3	External encoder disconnected (Phase Z disconnected)	●	1		0x7534
57	0	Force alarm input valid	●	2	●	0x5441
	1	Debugging software emergency stop active	●	2	●	0x5442
58	1	Unvalid Homing method		2	●	0x8616
30	0	Current loop tuning error (Speed out of range)		1	●	0x8380

	1	Current loop tuning error (Displacement out of range)		1	●	0x8381
	2	Current loop tuning error (Parameter error)		1	●	0x8382
73	A	Excessive PDI interrupt loss		2	●	0x873A
	B	Excessive DC interrupt loss		2	●	0x873A
	C	Excessive DC cycle drift		2	●	0x873A
	D	Illegal state transition	●	2	●	0xA001
74	0	Homing status error	●	2	●	0x8614
	1	Homing mode error	●	2	●	0x8614
	2	Homing limit exceeded	●	2	●	0x8614
	3	Homing timeout	●	2	●	0x8614
	4	Homing logic error	●	2	●	0x8614
	5	Homing action abnormal	●	2	●	0x8614
	6	Homing aborted	●	2	●	0x8614
80	1	Unknown EtherCAT communication error		2	●	0x8201
	2	Memory overflow	●	2	●	0x5510
	3	RAM out of bound	●	2	●	0x5511
	5	Protocol stack initialization failure,	●	2	●	0x6202
	6	Firmware-XML mismatch / Firmware-product mismatch,	●	2	●	0x6201
	7	PDO mapping object does not exist,	●	2	●	0x8207
	8	PDO mapping object length mismatch,	●	2	●	0x8208
	9	PDO mapping object attribute error,	●	2	●	0x8209
81	1	Invalid ESM communication state transition request	●	2	●	0xA001
	2	Unknown ESM communication state transition request	●	2	●	0xA002
	3	Protection request from boot state		2	●	0x8213
	4	Invalid firmware		2	●	0x6203
	5	Invalid mailbox configuration under boot state		2	●	0x8215
	6	Pre-Op status is invalid for the mailbox configuration		2	●	0x8216
	7	Invalid SyncManager configuration		2	●	0x8217

	8	TPDO refresh timeout		2	●	0x8211
	9	RPDO refresh timeout		2	●	0x8212
	A	Synchronization error		2	●	0xFF02
	B	PDI watchdog timeout		2	●	0x821B
	C	Invalid SyncManager type		2	●	0x821C
	D	Invalid output configuration		2	●	0x821D
	E	Invalid input configuration		2	●	0x821E
	F	Watchdog configuration invalid		2	●	0x821F
82	1	Waiting for EtherCAT state machine Init state	●	2	●	0xA003
	2	Waiting for the EtherCAT state machine Pre-Op state	●	2	●	0xA004
	3	Waiting for master device for Safe-Op request	●	2	●	0xA005
	4	Invalid TPDO mapping		2	●	0x8224
	5	RPDO mapping invalid (length, parameter not present, no this property)		2	●	0x8225
	8	Sync mode not supported		2	●	0x8228
	B	TPDO/RPDO refresh timeout		2	●	0x8210
	C	Fatal synchronization error	●	2	●	0x872C
	D	No synchronization error		2	●	0x872D
	E	Synchronization cycle time is too short		2	●	0x872E
83	0	Invalid Distributed Clock synchronization settings		2	●	0x8730
	2	Excessive DC cycle drift	●	2	●	0x8732
	3	Excessive DC interrupt loss	●	2	●	0x8733
	4	Excessive PDI interrupt loss	●	2	●	0x8734
	5	Distribution Clock cycle time is invalid		2	●	0x8735
	6	Invalid Distribution Clock synchronization cycle time		2	●	0x8736
	8	Synchronization error	●	2	●	0x8738
	A		●	2	●	0x873A
85	0	ESC EEPROM is inaccessible	●	2	●	0x5550
	1	ESC EEPROM error	●	2	●	0x5551
	2	EthercCAT physical link failure	●	2	●	0x5552
86	0	Hardware frame loss error	●	2	●	0xFF01
87	0	Driver can't be enabled under current control mode		2	●	0x5201
	1	Unsupported mode under		2	●	0x5202

		current synchronization type				
89	0	Homing error		2	●	0x8614
92	0	ID configuration out of range	●	1		0x7535
	1	Baudrate over limit	●	1		0x7536

[Note:]

Some newly added alarms have not been synchronised with 603F; in this case, the 603F corresponding to the alarm is 0XFFF0

8.4 Alarm Handling

***When error occurs, please solve accordingly. Then, restart.*

Error code	Main	Sub	Display: "Er 090" --"Er 092"	
	09	0~2	Contents: FPGA communication error	
Cause			Diagnosis	Solution
FPGA failure, can not start normally.			Power on several times, the fault still exists .	Replace servo drive; contact manufacturer.
Error code	Main	Sub	Display: "Er 0A0"--"Er 0A1"	
	0A	0~1	Content: Circuit current detection error	
Cause			Diagnosis	Solution
Motor power cable wiring error			Verify motor power cable wiring	Make sure U,V,W terminal wired properly
Main power supply undervoltage			Verify L1,L2,L3 terminal voltage	Increase main power supply voltage
Driver fault			Repeatedly connect power, check if the fault still exists.	Replace driver
Analog input 1 wiring error.			Check the wiring of analog input 1.	Ensure that the analog input 1 wiring is correct.
Internal drive fault.			Confirm that the analog input wiring is correct, and repeatedly connect power, check if the fault still exists.	Replace with a new drive.

Error code	Main	Sub	Display: "Er 0A3"
	0A	3	**Content: UVW Disconnect**

Cause	Diagnosis	Solution
Power cable disconnection or phase loss.	Check whether the power cable is disconnected or missing a phase.	Confirm if the power cable has a disconnection or poor contact
Motor winding open circuit.	With the extension cable connected to the motor, use a multimeter to measure the resistance between winding wires. If the three-phase resistance is inconsistent, the winding may be open or the motor may be damaged.	Replace motor
Driver fault	Check that the above two conditions are not present, and operation is normal after replacing the drive.	Replace driver
Excessive deviation between current reference and feedback.	Check whether the deviation between the current reference and feedback is too large using the debugging software oscilloscope.	Appropriately increase parameter PA7.19 field weakening current； Contact manufacturer

Error code	Main	Sub	Display: "Er 0A5"
	0A	5	**Contents: DC bus circuit error**

Cause	Diagnosis	Solution
Whether the voltage of any two phases of the main circuit L1/L2(L3) or RST input terminals is too low.	Measure the main circuit cable L1/L2/(L3) or RST input voltage to ensure that it meets the following specifications: 220V Servo drive: Valid value: 220V-240V Allowable deviation: -10%~+10% (198V~264V) 380V Servo drive: Valid value: 380V-440V Allowable deviation: -10%~+10% (342V~484V). Check whether the charge indicator is lighted or not. 2. Check drive d27 bus voltage.	1. Ensure that the L1/L2(L3) or RST input voltage meets the following specifications

	3、Measure the DC voltage between P+(Pr), N bus voltage between P+(Pr) and N to meet the requirements: 220V drive DC bus voltage: about 310V 380V drive DC bus voltage: about 540V	
Driver fault	If all the above have been checked, repeatedly connect power, check if the fault still exists.	Replace driver

Error code	Main	Sub	Display: "Er0A6"
	0A	6	**Content: Temperature detection circuit error**

Cause	Diagnosis	Solution
Whether the voltage of any two phases of the main circuit L1/L2 (L3) or RST input terminals is too low.	Check whether the voltage of any two phases of the main circuit L1/L2 (L3) or RST input terminals is too low.	Make sure that the main circuit L1/L2 (L3) or RST input terminal voltage is in the proper range.
Driver fault	/	Replace driver

Error code	Main	Sub	Display: "Er0B0"
	0B	0	**Content: Control power supply voltage too low**

Cause	Diagnosis	Solution
The control power supply voltage of the Servo Drive with L1C/L2C power terminals is unstable, too low, or power down.	1. Confirm whether it is in the process of cutting off the control power (L1C L2C) or an instantaneous power failure occurs. 2.Measure whether the input voltage to the L1C and L2C terminals of the driver meets the following specifications: 220V servo drive: Valid value: 220V-240V Allowable deviation: -10%~+10% (198V~264V) 380V servo drive:	1, re-power on . Check whether it still appears, if it still appears, you need to ensure that the power supply is not abnormal power loss or confirm whether the input voltage meets the specifications. 2、Check whether the input voltage of L1C and L2C terminals meets the left input specification.

	Valid value: 380V-440V Allowable deviation: -10%~+10% (342V~484V).	
Control power cable of servo drive with L1C/L2C power terminals, bad contact	Detect whether the cable is connected, and measure the voltage on the servo driver side (L1C, L2C) of the control cable to ensure that it meets the above requirements.	Rewire or replace cable
Insufficient power supply capacity and voltage degradation due to mains shock.	Measurement of the input voltage of the control cable for sudden changes in voltage	Increase power supply capacity on L1C, L2C terminals
Driver fault	/	Replace driver

Error code	Main	Sub	Display: "Er 0b1"
	0b	1	**Content: Control power supply voltage too high**

Cause	Diagnosis	Solution
Input control power supply voltage is unstable or too high	Measure the input voltage of the control cable L1C/L2C to see if it meets the input specifications. Measure the input voltage of the control cable L1C/L2C to ensure that it meets the input specifications: 220V Servo drive: Valid values: 220V-240V Allowable deviation: -10%~+10% (198V~264V) 380V Servo drive: Valid value: 380V-440V Allowable deviation: -10%~+10%	Reconnect to a power source that meets the voltage specifications on the left side.

	(342V~484V)	
Driver fault	If all the above have been checked, repeatedly connect power, check if the fault still exists.	Replace driver

Error code	Main	Sub	Display: "Er0b2"
	0b	2	Content: Control power off
Cause		Diagnosis	Solution
Controls power down when USB is active only		Check that the fault is cleared when both mains and control power are switched on.	Check that the fault is cleared when both mains and control are powered up, normally this fault is only reported when the USB power supply is active.

Error code	Main	Sub	Display: "Er 0c0"
	0c	0	Content: DC bus overvoltage
Cause		Diagnosis	Solution
Motor operation acceleration and deceleration times are too short and regenerative energy exceeds the absorbable value.		Capture the waveform through the commissioning software oscilloscope to check if the bus voltage is in the deceleration section when the voltage exceeds the fault value.	Ensure that the main circuit input voltage is within specification, increase the acceleration and deceleration times where permitted, or replace the regenerative resistor with a more powerful one.
Braking resistor not discharging.(Commonly caused by failing to update PA2.52 when connecting an external resistor to a 400W drive lacking an internal resistor.)		Check if the braking resistor is actually connected, but parameter PA2.52 is not set to 0 to enable resistor discharge mode.	Set PA2.52 to 0 to discharge energy through the braking resistor.
Regenerative discharge threshold parameter error.		Check whether the bus voltage discharge threshold parameter PA2.53 is normal.	Change PA2.53 to the normal bus discharge voltage threshold parameter to enable discharge before the overvoltage point.
Overload; regenerative energy exceeds capacity.		Confirm whether the load is too large, causing the bus voltage to rise to the fault value during acceleration or deceleration.	Extend the acceleration/deceleration time or reduce the load.
Drive fault; internal braking		If all the above have been	Replace with a new drive.

circuit damaged.	checked, repeatedly connect power, check if the fault.	

Error code	Main	Sub	Display: "Er 0d0"	
	0d	0	Content: DC bus undervoltage	
Cause			Diagnosis	Solution
Main circuit input undervoltage.			Verify the servo input power by measuring the voltage at terminals L1/L2(L3) or RST to ensure it meets specifications—specifically 198V–264V for 220V drives and 342V–484V for 380V drives—while confirming the charge indicator LED is illuminated; additionally, monitor the d27 bus voltage and measure the DC bus voltage between P+ and N, ensuring values of approximately 310V for 220V drives (undervoltage threshold at 180V) and approximately 540V for 380V drives (undervoltage threshold at 540V).	Increase the L1/L2(L3) or RST input voltage according to the power specifications on the left.
Power supply unstable or voltage fluctuation.			Monitor the servo drive input power voltage and check if the same main circuit power supply has too many loads, causing insufficient power capacity and leading to voltage drop.	Increase the power capacity or connect to a stable and reliable power supply.
Drive fault.			After powering off multiple times, the fault is still reported after reconnecting main circuit power L1, L2, (L3) / (RST).	Replace with a new drive.

Error code	Main	Sub	Display: "Er 0d1"	
	0d	1	Content: Mains input phase loss	
Cause			Diagnosis	Solution
Main power supply undervoltage			Verify L1,L2,L3 terminal voltage	Increase main power supply voltage
Main power supply wiring error			Loose connection of L1, L2, L3	Secure connections
Driver fault			/	Replace driver

Error code	Main	Sub	Display: "Er 0d2"	
	0d	2	Content: No main power supply detected	
Cause			Diagnosis	Solution
Main power input undervoltage.			Measure all three phases of the input voltage at the drive side. Ensure values meet specifications: 220V drive (198V~264V) or 380V drive (342V~484V).	Increase the L1/L2/L3 or RST input voltage according to the power specifications on the left.
Main circuit wiring abnormality.			Check whether the wiring of main circuit terminals L1, L2, L3 / RST is correct and reliable.	Reconnect the main circuit power cable correctly and reliably.
Drive fault.			If all the above have been checked, the fault is still reported after reconnecting main circuit power following multiple power-offs.	Replace with a new drive.

Error code	Main	Sub	Display: "Er 0d3"	
	0d	3	Content: SEMI-F47 under voltage	
Cause			Diagnosis	Solution
Main power loss exceeds P05.72 (SEMI F47) threshold.			Check the servo input power specifications and measure whether there is a power loss in the main circuit cable servo drive side L1/L2(L3) or RST input voltage.	Increase the reporting time of the P05.72 F47 undervoltage alarm without affecting the operation of the equipment.
Error code	Main	Sub	Display: "Er 0d4"	
	0d	4	Content: Phase R power supply disconnected	
Cause			Diagnosis	Solution
Power supply R-phase loss.			Check whether the wiring of main power R/S/T phases is correct and reliable.	Reconnect the main circuit R/S/T power wiring correctly and reliably.
Error code	Main	Sub	Display: "Er 0d5"	
	0d	5	Content: Phase S power supply disconnected	
Cause			Diagnosis	Solution
Power supply S-phase loss.			Check whether the wiring of main power R/S/T phases is correct and reliable.	Reconnect the main circuit R/S/T power wiring correctly and reliably.

Error code	Main	Sub	Display: "Er 0d6"	
	0d	6	Content: Phase T power supply disconnected	
Cause			Diagnosis	Solution
Power supply T-phase loss.			Check whether the wiring of main power R/S/T phases is correct and reliable.	Reconnect the main circuit R/S/T power wiring correctly and reliably.

Error code	Main	Sub	Display: "Er 0E0"	
	0E	0	Content: Software overcurrent	
Cause			Diagnosis	Solution
Driver power output short circuit			Verify if there is short circuit between UVW terminals, or shorted to PG.	1. Make sure there is no circuit. 2. Make sure motor is not damaged
Motor wiring error			Verify motor wiring	Reconnect motor wiring
IGBT module short circuit			Disconnect motor output cable. Then, enable servo driver to check for overcurrent	Replace driver
Excessive motor load			Verify if motor torque output is too high	1. Reduce load 2. Add a gearbox
Excessive acceleration and deceleration			Verify if acceleration and deceleration duration time are too low	Increase acceleration and deceleration duration time
Motor wiring short circuit			Connect motor power cable to driver power output. Verify if resistance value of UVW to PE is equal and if there is short circuit	Replace motor

Error code	Main	Sub	Display: "Er 0E1"	
	0E	1	Content: Intelligent Power Module (IPM) overcurrent	
Cause			Diagnosis	Solution
Driver power output short circuit			Verify if there is short circuit between UVW terminals, or shorted to PG.	1. Make sure there is no circuit. 2. Make sure motor is not damaged
Motor wiring error			Verify motor wiring	Reconnect motor wiring
IGBT module short circuit			Disconnect motor output cable. Then, enable servo driver to check for overcurrent	Replace driver
IGBT module undervoltage			/	Replace driver
Excessive motor load			Verify if motor torque output is too high	1. Reduce load 2. Add a gearbox
Excessive acceleration and deceleration			Verify if acceleration and deceleration duration time are too low	Increase acceleration and deceleration duration time
Motor wiring short circuit			Connect motor power cable to driver power output. Verify if resistance value of UVW to PE is equal and if there is short circuit	Replace motor

Error code	Main	Sub	Display: "Er 0E2"	
	0E	2	Content: Power output to motor shorted to ground	
Cause			Diagnosis	Solution
Driver U, V, W terminals shorted to ground			Disconnect motor power cable and check for short circuit between driver UVW and PE	1. Reconnect wiring. 2. Change motor power cable.
Motor shorted to ground			Connect motor power cable to driver power output. Verify if resistance value of UVW to PE is in the range of MegaOhm (MΩ)	Replace motor
Driver fault			/	Replace driver

Error code	Main	Sub	Display: "Er 0E4"	
	0E	4	Content: Phase overcurrent	
Cause			Diagnosis	Solution
Driver U, V, W terminals shorted to ground			Disconnect motor power cable and check for short circuit between driver UVW and PE	1. Reconnect wiring. 2. Change motor power cable.
Motor shorted to ground			Connect motor power cable to driver power output. Verify if resistance value of UVW to PE is equal and if there is short circuit	Replace motor
Driver fault			/	Replace driver

Error code	Main	Sub	Display: "Er 0E5"	
	0E	5	Content: Phase U overcurrent	
Cause			Diagnosis	Solution
Motor cable poor contact.			Check whether the connection between the two ends of the servo drive power cable and the servo drive U/V/W side of the motor cable is loose.	Tighten any loose or detached wiring.
Motor cable grounded.			Ensure that after the servo drive power cable and motor cable are tightly connected, measure whether the insulation resistance between the servo drive U/V/W terminals and the ground wire (PE) is in the megaohm (MΩ) range.	Replace the motor if insulation is poor.
Motor short circuit.			Unplug the motor cable and measure whether the resistance between any two phases of the motor cable U/V/W is balanced. Check if U/V/W is short-circuited to ground (PE).	Replace the motor if unbalanced.

Error code	Main	Sub	Display: "Er 0E6"	
	0E	6	Content: Phase V overcurrent	
Cause			Diagnosis	Solution
Motor cable poor contact.			Check whether the connection between the two ends of the servo drive power cable and the servo drive U/V/W side of the motor cable is loose.	Tighten any loose or detached wiring.
Motor cable grounded.			Ensure that after the servo drive power cable and motor cable are tightly connected, measure whether the insulation resistance between the servo drive U/V/W terminals and the ground wire (PE) is in the megaohm (MΩ) range.	Replace the motor if insulation is poor.
Motor short circuit.			Unplug the motor cable and measure whether the resistance between any two phases of the motor cable U/V/W is balanced. Check if U/V/W is short-circuited to ground (PE).	Replace the motor if unbalanced.

Error code	Main	Sub	Display: "Er 0E7"	
	0E	7	Content: Phase W overcurrent	
Cause			Diagnosis	Solution
Motor cable poor contact.			Check whether the connection between the two ends of the servo drive power cable and the servo drive U/V/W side of the motor cable is loose.	Tighten any loose or detached wiring.
Motor cable grounded.			Ensure that after the servo drive power cable and motor cable are tightly connected, measure whether the insulation resistance between the servo drive U/V/W terminals and the ground wire (PE) is in the megaohm (MΩ) range.	Replace the motor if insulation is poor.
Motor short circuit.			Unplug the motor cable and measure whether the resistance between any two phases of the motor cable U/V/W is balanced. Check if U/V/W is short-circuited to ground (PE).	Replace the motor if unbalanced.

Error code	Main	Sub	Display: "Er 0F0"	
	0F	0	Content: Driver overheated	
Cause			Diagnosis	Solution
Driver's power module overtemperature (D33 Driver's temperature exceeds PA2.49).			Measure whether the ambient temperature exceeds 55°C, and measure whether the actual temperature of the drive heatsink is higher than the PA2.49 over-temperature threshold setting.	Improve heat dissipation conditions and lower the ambient temperature
Fan failure causing overtemperature.			Check if the fan operates when enabled.	Replace the servo drive.
Improper installation/spacing causing overtemperature.			Confirm whether the installation of the servo drive is reasonable.	Install according to the servo drive installation standards.
Servo drive fault.			If the fault is still reported after restarting following a 10-minute power-off cooling period.	Replace the servo drive.

Error code	Main	Sub	Display: "Er 0F0"	
	0F	1	Content: Motor overheated alarm	
Cause			Diagnosis	Solution
Motor temperature exceeds P04.33 threshold.			Confirm whether the motor temperature exceeds the set range.	Improve ambient temperature or cooling if the motor overheats. For false alarms, contact the manufacturer to inspect for PTC sensor abnormalities.

Error code	Main	Sub	Display: "Er 100"	
	10	0	Content: Motor overloaded	
Cause		Diagnosis		Solution
Heavy load; torque exceeds rating for extended time.		Confirm the motor overload curve, and check if the actual load is the rated load. You can view via status monitoring whether the servo drive average load ratio D07_01 is greater than 100% for a long time; confirm whether the D15 overload ratio has a rising trend, and if it reaches 100, alarm ER100 will be reported.		Replace with a larger capacity servo drive and matching motor; Reduce the load or increase the acceleration/deceleration time.
Frequent accelerate/decelerate or high load		Calculate the mechanical inertia ratio or perform inertia identification to check if the P00.04 inertia ratio is set		Increase the acceleration/deceleration time in a single run; Reduce the operation frequency and lengthen the pause time.

inertia.	correctly; confirm the single run cycle when the motor operates reciprocally.	
Improper gain or high stiffness causing system oscillation.	Check whether the motor or machinery vibrates during operation, and whether the sound is abnormal.	Re-adjust gain parameters or reduce stiffness.
Motor/Encoder wiring error or poor contact.	Verify motor and encoder wiring for connection errors or cable breaks. For self-made cables, ensure the pinout definitions are correct.	Correct the wiring or replace with Leadshine original cables. Ensure self-made cables strictly follow the hardware pinout definitions.
P04.20 Overload level set too low.	Check whether the P04.20 overload level setting has been manually modified to be too small by mistake; overload is easily reported when it is less than 100%.	Change P04.20 to the default value.
Motor average load ratio too high.	You can check via status monitoring channel 23 whether the servo drive average load ratio is close to or reaches 100% for a long time.	Change P04.20 to 115; when setting this parameter value, ensure that the motor heat dissipation environment is good and the motor will not overheat.
Motor brake failed to operate.	Check whether the motor brake wiring and whether the brake is open.	Re-adjust the brake wiring to ensure the brake opens after enabling.
Servo drive fault.	If all the above have been checked, repeatedly connect power, check if the fault still exists.	Replace the servo drive.

Error code	Main	Sub	Display: “Er101”
	10	1	Content: Drive Overload
Cause		Diagnosis	Solution
Servo driver UVW output phase missing, broken wire, wrong phase sequence connection		Perform a trial run of the motor without a load to confirm that the error still exists; Check that the motor winding wires UVW and drive terminal wiring phase sequence is correct	Confirm the phase sequence of the motor winding wiring, UVW corresponding connection, to ensure that the wiring is correct.
Mismatch between servo drive and motor power, small drive with large motor		Check that the actual matching motor rated current is greater than the drive rated current. The actual load is larger, resulting in the motor current being larger than the drive rated current, but not reaching the motor rated current	The rated current of the motor is higher than the rated current of the drive, replace the drive with a high power one that matches the motor.

P04.20 Overload level set too low.		Check whether the P04.20 overload level setting has been manually modified to be too small by mistake; overload is easily reported when it is less than 100%.		Change P04.20 to the default value.
Motor average load ratio too high.		You can check via status monitoring channel 23 whether the servo drive average load ratio is close to or reaches 100% for a long time.		Change P04.20 to 115; when setting this parameter value, ensure that the motor heat dissipation environment is good and the motor will not overheat.
Servo drive fault.		If all the above have been checked, repeatedly connect power, check if the fault still exists.		Replace the servo drive.
Error code	Main	Sub	Display: "Er 102"	
	10	2	Content: Motor rotor blocked	
Cause		Diagnosis		Solution
U/V/W output phase loss, open, or wrong sequence.		Perform a motor trial run without load to confirm whether the error still exists; check whether the phase sequence of the motor winding wires U/V/W and the drive terminals is correct.		Confirm the wiring phase sequence of the motor winding wires; connect U, V, and W one-to-one to ensure correct wiring.
Motor locked rotor due to mechanical issue.		Verify if the load is stuck or hitting a hard limit. Use the software oscilloscope to confirm if the motor speed remains 0 during active commands, and if the current feedback reaches the Parameter P04.23 torque threshold for the duration of Parameter P04.24.		Confirm that the load has not hit a hard limit or is stuck
Locked rotor alarm parameters unreasonable.		Check whether locked-rotor parameters P04.23 and P04.24 are set too small.		Set the locked-rotor torque P04.23 and locked-rotor time P04.24 parameters reasonably.
Incorrect motor parameters (Pole pairs) or ENC tuning needed.		Confirm whether the PA1.10 encoder automatic ROM read setting in PA1 group parameters is 0x0, and whether the PA0.01 pole pair number is correct; if the above parameters are correct, perform angle identification on the motor multiple times, and confirm whether the PA1.08 angle compensation is consistent.		Set the motor parameters correctly.
Error code	Main	Sub	Display: "Er 103"	

	10	3	Content: Motor collision faults

Cause	Diagnosis	Solution
Motor collision during operation.	When the motor speed is less than the P47.03 threshold, the current is greater than P47.01/P47.02. Confirm whether the setting values are reasonable, and whether a collision occurred or it is a false alarm.	Set P47.03 and P47.01/P47.02 reasonably to ensure normal operation without false alarms.

Error code	Main	Sub	Display: "Er 104"
	10	4	Content: Drive output overload at low speeds

Cause	Diagnosis	Solution
Excessive current at low speed or locked rotor.	Check if speed < 20rpm and limits P04.28/P04.29 are exceeded. Determine if this operation is intended or abnormal.	Upgrade to a larger servo if low-speed/locked-rotor use is required. Otherwise, no action is needed; the alarm acts as a protective measure.
Drive/Motor power mismatch (Undersized drive).	Check whether the rated current of the actual matching motor is greater than the rated current of the drive, and if the actual load is large, causing the motor current to be greater than the drive low-speed overload current under low-speed operation conditions.	If the motor rated current is greater than the drive rated current, replace with a high-power drive that matches the motor.

Error code	Main	Sub	Display: "Er 110"
	11	0	Content: Soft-start relay engagement failure

Cause	Diagnosis	Solution
Main power undervoltage	1. Check the servo input power specifications and measure if the main circuit cable servo drive side L1/L2(L3) or RST input voltage meets the following specifications: 2. 220V servo drive: Effective value: 220V-240V, Allowable deviation: -10% to +10% (198V~264V). 380V servo drive: Effective value: 380V-440V, Allowable deviation: -10% to +10% (342V~484V).	Ensure the main circuit input voltage is within the specification range.
Soft-start relay parameter setting error.	Check whether parameter P11.36 has been mistakenly	Restore default parameters.

	modified and is not the factory value.	

Error code	Main	Sub	Display: "Er 111"	
	11	1	Content: Cooling fan failure	
Cause			Diagnosis	Solution
Cooling fan damaged.			Check if the fan is running during operation.	Replace the drive

Error code	Main	Sub	Display: "Er 120"	
	12	0	Content: Regenerative resistor overvoltage	
Cause			Diagnosis	Solution
Accel/Decel too fast; frequent regenerative discharge.			Check if short accel/decel times or intense motion are causing frequent resistor discharge.	Ensure input voltage meets specifications. Increase accel/decel, reduce speed/inertia, or upgrade the regenerative resistor.
Main circuit voltage too high causes unstable.			Check whether the main circuit input voltage is too high, causing continuous discharge.	Ensure the input voltage is stable and within the rated input range.
PA2.52=0 (Resistor used) but not connected.			Confirm whether the drive parameter PA2.52 is set to 0, but no discharge resistor is connected.	Correctly connect a discharge resistor of appropriate specifications.
Resistor too small or P00.21/P00.22 resistance/power settings too low.			Verify resistor sizing and ensure P00.21/P00.22 match the actual hardware specifications.	Install a compliant regenerative resistor and set P00.21/P00.22 to match the actual specifications.
Discharge resistor wiring poor, loose, or open.			Confirm that the regenerative discharge resistor wiring at P+/BR(B2) is reliably connected.	Correctly wire the discharge resistor.
Discharge resistor damaged.			The braking resistor is open circuit; measure the external regenerative resistor resistance value and confirm if the resistance is infinite.	Replace the regenerative resistor.
Discharge circuit damaged.			If all the above have been checked, and the fault is still reported after powering on again for no-load operation following multiple power-offs.	Replace with a new drive.

Error code	Main	Sub	Display: "Er 121"
	12	1	Content: Regeneration transistor failure

Cause	Diagnosis	Solution
Braking IGBT damaged.	If all the above have been checked, and the fault is still reported after powering on again for no-load operation following multiple power-offs.	Replace with a new drive.

Error code	Main	Sub	Display: "Er 122"
	12	2	Content: Regenerative resistor value too low

Cause	Diagnosis	Solution
P00.21 Regenerative resistor value below minimum allowed.	Confirm whether the P00.21 regenerative resistor resistance setting is too small, and whether it is less than the minimum value.	Use a compliant regenerative resistor and set P00.21/P00.22 to match actual hardware specifications.

Error code	Main	Sub	Display: "Er 123"
	12	3	Content: Regenerative resistor overcurrent

Cause	Diagnosis	Solution
External regenerative resistor too small	External regenerative resistor resistance is too small, resulting in excessive bleeder current	Replace the external regenerative resistor with one that meets the specifications, the resistance value needs to be greater than the minimum value

Error code	Main	Sub	Display: "Er 150"
	15	0	Content: Encoder disconnected

Cause	Diagnosis	Solution
Encoder cable open/short or impedance too high.	Confirm whether the encoder cable is normal; whether the definition of the self-made cable is correct; whether the cable is reliably connected. If the fault no longer occurs after replacing with a normally usable encoder cable, it indicates the original cable is damaged.	Replace with Leadshine original factory cable；Secure the encoder cable wiring.
Encoder port poor contact or wiring error on drive side.	Confirm the status of the encoder connection port and whether there is poor contact.	Re-insert the encoder plug and confirm the encoder wiring.
Connector contact poor	Determine whether there is	Improve the usage environment and

due to environment (moisture/vibration).	excessive water vapor, oil pollution, or vibration in the usage environment.	replace with original factory cable. If the fault is still reported, replace the servo drive or motor.
Encoder damaged.	If the fault is still reported after checking all the above, replacing with another normally usable motor, and powering on again does not report the fault.	Replace with a new motor.
Encoder measurement circuit damaged.	If the fault is still reported after checking all the above, replacing with another normally usable servo drive, and powering on again does not report the fault.	Replace with a new drive.

Error code	Main	Sub	Display: “Er 151”
	15	1	Content: Encoder communication error

Cause	Diagnosis	Solution
Encoder cable shield missing.	Check whether the encoder is a shielded twisted pair cable. Monitor D30 count increase, proving that interference exists.	Change the cable type to a shielded twisted pair encoder cable.
Encoder port poor contact or wiring error on drive side.	Confirm the status of the encoder connection port and whether there is poor contact.	Re-insert the encoder plug and confirm the encoder wiring.
Encoder cable open/short or impedance too high.	Confirm whether the encoder cable is normal; whether the definition of the self-made cable is correct; whether the cable is reliably connected. If the fault no longer occurs after replacing with a normally usable encoder cable, it indicates the original cable is damaged.	Replace with Leadshine original factory cable； Secure the encoder cable wiring.
Excessive interference on encoder cable.	Ensure encoder cables are separated from power lines and kept away from interference sources like welding machines.	Enhance encoder cable noise immunity using shielded twisted pairs with proper grounding. Route cables separately from high-power lines.
Encoder damaged.	If the fault is still reported after checking all the above, replacing with another normally usable motor, and powering on again does not report the fault.	Replace with a new motor.

Error code	Main	Sub	Display: "Er 152"
	15	2	Content: Encoder match error

Cause	Diagnosis	Solution
Motor encoder type not supported.	Check whether the motor model is a matching motor for this servo model.	For third-party motors, please contact the manufacturer's technical support to ask if it is supported.

Error code	Main	Sub	Display: "Er 153"
	15	3	Content: Multiturn encoder battery error

Cause	Diagnosis	Solution
First-time use	Check if it's the first-time use of the multi-turn function without performing multi-turn clearing and encoder alarm reset.	Execute homing and calibrate the origin. Set P10.09 to 9 to clear multi-turn data and reset alarms.
Multi-turn encoder battery low or cable disconnected.	Check whether the battery voltage in the battery box is lower than 2.5V; check whether the multi-turn data is lost or changed.	Replace the battery; after replacing the battery, perform multi-turn clearing and reset the multi-turn alarm, then restart the drive; perform reset of the multi-turn alarm.
Multi-turn function enabled but motor not supported.	Check whether the motor model used has multi-turn absolute value function.	Replace with a multi-turn absolute encoder motor； Set Parameter PA0.15 to 0 to disable the multi-turn absolute value function.
Encoder battery disconnected during power off.	Confirm whether the encoder battery might have been disconnected during the drive power-off period.	Ensure the battery connection is reliable； Set Parameter P10.10 to 9 to perform multi-turn clearing and reset multi-turn alarms.
Encoder overtemperature (Tamagawa encoder).	Check the motor temperature; verify if it is caused by motor heat conduction; exceeding 90°C will cause an encoder overheat alarm.	Improve the motor heat dissipation environment and reduce the motor temperature.
Multi-turn data error/loss.	If there are no abnormalities in the above error causes, confirm whether the alarm occurred during	The encoder cable needs to be routed separately from the power line

	operation.	

Error code	Main	Sub	Display: "Er 154"	
	15	4	Content: Encoder parameter download failure	
Cause			Diagnosis	Solution
Multi-turn mode set but motor lacks support.			Check if the motor possesses multi-turn absolute value function.	Replace with a multi-turn absolute encoder motor

Error code	Main	Sub	Display: "Er 155"	
	15	5	Content: Multiturn Encoder Multiturn Data Count Jumps	
Cause			Diagnosis	Solution
Encoder multi-turn data overflow.			When the servo drive works in P10.10=1 absolute linear mode, check whether the P05.08 multi-turn value exceeds 32767; check if the motor encoder is damaged.	Clear the multi-turn data and power on again.
Absolute mode setting error for unidirectional rotation.			-	Adjust the P10.10 absolute value application mode； Set to 2 - Multi-turn rotation mode.
Encoder damaged.			If the fault is still reported after checking all the above and re-running, replacing with another normally usable motor, and powering on again does not report the fault.	Replace with a new motor.

Error code	Main	Sub	Display: "Er 156"	
	15	6	Content: Encoder overheated	
Cause			Diagnosis	Solution
Encoder overtemperature (Tamagawa encoder).			Check the motor temperature; verify if it is caused by motor heat conduction; exceeding 90°C will cause an encoder overheat alarm.	Improve the motor heat dissipation environment and reduce the motor temperature.

Error code	Main	Sub	Display: "Er 157"	
	15	7	Content: Multiturn Encoder Multiturn Data Count Overflow	
Cause			Diagnosis	Solution
Encoder multi-turn data overflow.			When the servo drive works in P10.10=1 absolute linear mode, check whether the P05.08 multi-turn value exceeds 32767; check if the motor encoder is damaged.	Clear the multi-turn data and power on again.

Absolute mode setting error for unidirectional rotation.	-	Adjust the P10.10 absolute value application mode; Set to 2 - Multi-turn rotation mode.
Encoder damaged.	If the fault is still reported after checking all the above and re-running, replacing with another normally usable motor, and powering on again does not report the fault.	Replace with a new motor.

Error code	Main	Sub	Display: "Er 15A"	
	15	A	Content: Encoder phase A disconnected	
Cause			Diagnosis	Solution
External encoder Phase A disconnected.			Check external encoder wiring.	Ensure that the encoder Phase A wiring is correct without disconnection or breakage.
Error code	Main	Sub	Display: "Er 15B"	
	15	B	Content: Encoder phase B disconnected	
Cause			Diagnosis	Solution
External encoder Phase B disconnected.			Check external encoder wiring.	Ensure that the encoder Phase B wiring is correct without disconnection or breakage.
Error code	Main	Sub	Display: "Er 15C"	
	15	C	Content: Encoder phase C disconnected	
Cause			Diagnosis	Solution
External encoder Phase C disconnected.			Check external encoder wiring.	Ensure that the encoder Phase C wiring is correct without disconnection or breakage.
Error code	Main	Sub	Display: "Er 15d"	
	15	d	Content: Encoder phase UVW disconnected	
Cause			Diagnosis	Solution
Hall signal disconnected.			Check Hall wiring.	Ensure that the Hall signal wiring is correct without disconnection or breakage.

Error code	Main	Sub	Display: “Er 170”
	17	0	Content: Encoder data error

Cause	Diagnosis	Solution
Communication data abnormality.	Ensure encoder voltage is DC5V±5%. Inspect cables for damage, verify proper grounding, and maintain separation from power lines.	Verify 5V supply and cable integrity. Ensure proper FG grounding and separate routing from power lines.
Encoder protocol parameter setting error.	Confirm whether PA0 group parameters have been modified; restore factory settings and check if the fault recovers.	Restore factory settings.
Motor encoder type not supported.	Check whether the motor model is a matching motor for this servo model.	For third-party motors, please contact the manufacturer's technical support to ask if it is supported.
Encoder damaged.	If the fault is still reported after checking all the above, replacing with another normally usable motor, and powering on again does not report the fault.	Replace with a new motor.
Encoder measurement circuit damaged.	If all the above have been checked, replacing with another normally usable servo drive, and powering on again does not report the fault.	Replace with a new drive.

Error code	Main	Sub	Display: “Er 171”
	17	1	Content: Encoder parameter initialization error

Cause	Diagnosis	Solution
Motor not initialized or Drive/Motor mismatch.	Check whether it is our company's drive and motor.	Replace the motor or manually input parameters.
Encoder protocol parameter error or mismatch.	Confirm whether PA0 group parameters have been modified; restore factory settings and check if the fault recovers.	Restore factory settings.
Error fetching parameters from encoder.	Check whether it is our company's standard encoder cable. Check for broken skin, broken wires, or poor contact at terminals on both sides.	Use our company's standard encoder cable； Ensure that the encoder connections on both the drive side and the motor side are tightened; replace with a new encoder cable if necessary.
Encoder damaged.	If the fault is still reported after checking all the above, replacing with another normally usable motor, and powering on again does not report the fault.	Replace with a new motor.

Error code	Main	Sub	Display: "Er 180"
	18	0	Content: Excessive position deviation

Cause	Diagnosis	Solution
U/V/W output phase loss, open, or wrong sequence.	Perform a motor trial run without load and check the wiring.	Rewire; the servo motor power cable and the servo drive power cable U, V, W must correspond one-to-one. Replace with a brand new cable if necessary and ensure reliable connection.
Position error due to mechanical locked rotor.	Check whether there is a mechanical collision or jam causing the motor to lock rotor.	Troubleshoot mechanical factors to ensure no locked rotor occurs.
External load too high.	Check if the load is too large and the motor rated torque cannot guarantee normal following.	Reduce the load.
Position error threshold parameter setting unreasonable.	Check whether the parameter P04.02 position deviation excessive threshold is too small.	Increase the setting value of parameter P04.02.
Drive gain set too low.	Check if the servo drive stiffness P21.02 is set too low; in manual mode, check the position loop gain and speed loop gain: First gain: P20.00~20.01, Second gain: P20.05~20.06.	Increase P21.02 stiffness or perform manual gain adjustment;Using after One-click tuning
Torque limit too low.	Check whether the values of parameters P12.01 and P12.02 are too small, leading to insufficient output and inability to follow normally.	Increase the values of parameters P12.01 and P12.02.
Position command increment too large.	Check whether the acceleration/deceleration time is too small or the rotation speed is too fast, causing the position error generated per unit time to be greater than P04.02.	Increase acceleration/deceleration time or reduce rotation speed
Servo drive or motor fault.	Monitor the position command speed and speed feedback via the debugging software oscilloscope function.	If the position command speed is not 0 but the speed feedback is always 0, please replace the servo drive/motor.

Error code	Main	Sub	Display: "Er 181"	
	18	1	Content: Excessive velocity deviation	
Cause			Diagnosis	Solution
Deviation between set velocity and actual velocity is too great			Verify if value of P06.02 is too low	1. Increase value of P06.02; 2. Set P06.02 to 0, position error detection off.
Acceleration and deceleration duration time for set velocity is too low			Verify if value of P03.12 and P03.13 are too low	1. Increase value of P03.12, P03.13; 2. Adjust velocity gain to reduce velocity lag error

Error code	Main	Sub	Display: "Er 182"	
	18	2	Content: Command Position Overflow	
Cause			Diagnosis	Solution
Position command overflow, servo limit or soft limit signal is active, target position command is still being sent and 31 turns have been reached.			Verify that the upper computer continues to send commands even after a limit warning has occurred on the servo.	After the upper computer recognises that the servo limit signal is valid, it stops sending commands in the limit direction.
Position error data overflow			Check for speed and torque limitations, blocking, and position deviations greater than 31 revolutions;	Release the speed limit and torque limit. Physical limitations released.

Error code	Main	Sub	Display: "Er 190"	
	19	0	Content: Motor vibration too strong	
Cause			Diagnosis	Solution
System resonance; torque ripple exceeds P21.27.			Judge whether there is abnormal noise during operation or if the current feedback collected by the debugging software oscilloscope fluctuates greatly: 1. Gain is too large, producing resonance; 2. Machinery has a resonance point.	1. Set appropriate inertia ratio and reduce stiffness
Current loop gain too high.			View the current loop gain value PA2.19.	Decrease the current loop gain.

Error code	Main	Sub	Display: "Er 191"
	19	1	Content: Excessive hybrid position deviation

Cause	Diagnosis	Solution
Excessive deviation between external and motor encoder (Full-closed).	Check whether the external encoder direction and line number settings are correct.	Correctly set P40.02, P40.05, P40.06, and P40.07.
Hybrid deviation threshold setting unreasonable.	Check whether the P40.03 setting is reasonable.	Set P40.03 reasonably based on the magnitude of hybrid deviation during actual operation.

Error code	Main	Sub	Display: "Er 1A0"
	1A	0	Content: Overspeed

Cause	Diagnosis	Solution
Motor cable U/V/W phase sequence error.	Check whether the connections of the servo drive power cable ends correspond one-to-one with the motor cable U V W ends and the servo drive U V W ends.	Wire according to the correct U, V, W phase sequence.
Motor speed exceeds P04.07 overspeed threshold.	Use the debugging software oscilloscope to capture the speed feedback waveform or check the alarm record to see if the speed feedback exceeds the overspeed fault threshold.	Reduce the speed command, adjust the servo gain, or adjust the operating conditions.
Input command exceeds P04.07 overspeed threshold.	Check if the motor speed command is too large: Check if the analog speed command voltage is too large; check if parameter P04.07 is too small; for pulse drives, check the input frequency of command pulses and convert to given speed to see if it is too large.	Adjust the input speed command magnitude
P04.07 Overspeed level setting error.	Check whether the P04.07 overspeed alarm threshold is less than the actual maximum motor speed required for operation: Overspeed alarm threshold = 1.2 times motor maximum speed (P04.07=0); Overspeed fault threshold = P04.07 (P04.07≠0, and P04.07 < motor maximum speed).	Reset the overspeed alarm threshold according to mechanical requirements.
Encoder dirty/damaged causing abnormal speed feedback (32767	Check the alarm record to see if the gap between speed reference and feedback is large, and if speed feedback reaches 32767RPM; you can also turn the motor shaft when disabled to check if the single-turn	Replace with a new motor.

RPM).	encoder position data jumps.	
Internal drive fault.	If all the above have been checked, repeatedly connect power, check if the fault still exists.	Replace with a new drive.

Error code	Main	Sub	Display: "Er 1A1"
	1A	1	Content: Velocity out of control

Cause	Diagnosis	Solution
Motor cable U/V/W phase sequence error.	Check whether the connections of the servo drive power cable ends correspond one-to-one with the motor cable U V W ends and the servo drive U V W ends.	Wire according to the correct U, V, W phase sequence.
Encoder wiring error, corrosion, or interference causing communication error	Check wiring, monitor if D30 encoder error count increases, or check if the alarm record encoder error count has a value.	Anti-interference processing / Replace motor (Encoder fault).
Gravity load too high (Vertical axis).	Check whether the vertical axis load is too large, causing the speed direction to be inconsistent with the current direction or speed reference; this can be analyzed by capturing waveforms with the debugging software oscilloscope.	Reduce the vertical axis load, or increase stiffness, or mask this fault without affecting safety and use.
Special application	The actual motion direction of the servo motor is opposite to the motor output direction or the speed reference direction.	Evaluate the particularity of the actual application; without affecting safety and use, set P04.04 to 0X4 to mask the ER1A1 alarm.
Improper gain causing vibration/runaway.	Check if the stiffness level is too large causing excessive servo operation vibration.	Set appropriate inertia ratio and reduce stiffness

Error code	Main	Sub	Display: "Er 1A2"
	1A	2	Content: External encoder overspeed feedback

Cause	Diagnosis	Solution
External encoder speed exceeds P05.45.	Check whether the external encoder speed exceeds the P05.45 external encoder feedback overspeed threshold.	Appropriately reduce the speed or appropriately adjust the threshold of P05.45 according to actual working conditions.

Error code	Main	Sub	Display: "Er 1b0"	
	1b	0	Content: Pulse input frequency error/Bus input signal dithering	
Cause			Diagnosis	Solution
Controller Synchronisation vibration too large.			Check whether the master station side synchronization offset setting is relatively large.	Decrease synchronization jitter. Try setting the master station side synchronization offset to 0.
			Check if the number of slave axes is too large while the synchronization cycle time setting is small.	Set the synchronization cycle time reasonably.
			The synchronization jitter range needs adjustment.	Increase P60.02, P60.03 or increase the P60.05 allowable jitter threshold.
			The synchronization mode command delay cycle number needs adjustment.	Set P60.04 to 2 to increase the delay.
Interference on pulse signal.			Verify pulse input uses shielded twisted pairs with proper grounding. Ensure cables are routed away from motor power lines and interference sources.	Apply EMC measures: use shielded twisted pairs with proper grounding. Route pulse lines away from power lines and interference.
Bus target position increment too large (Position Mode).			Match drive/master PPR settings; ensure CSP position increments stay within speed limits and PP/HM velocity/accel parameters (6081h, 6083h/84h, 6099h, 609Ah) are appropriate for the current PPR.	Match drive/master PPR settings; for CSP, reduce command increments and increase ramps; for PP/HM modes, reduce velocity and accel/decel parameters (6081h, 6083h/84h, 6099h, 609Ah) while increasing smoothing ramps.

Error code	Main	Sub	Display: "Er 1b1"	
	1b	1	Content: Incorrect electronic gear ratio	
Cause			Diagnosis	Solution
Values out of range			Numerator or denominator is zero/Set values out of range	Reduce number of pulses per revolution

<table>
<tr><td rowspan="2">Error code</td><td>Main</td><td>Sub</td><td colspan="2">Display: “Er 1b2”</td></tr>
<tr><td>1b</td><td>2</td><td colspan="2">Content: Single-turn absolute position exceeds upper/lower limits</td></tr>
<tr><td colspan="3">Cause</td><td>Diagnosis</td><td>Solution</td></tr>
<tr><td colspan="3">Position change exceeds single turn (in Mode P10.10=3).</td><td>Check if P10.10 is in single-turn mode and verify if the motor stroke exceeds the single-turn position limits.</td><td>Verify that the PPR and electronic gear ratio are reasonable and the command stroke stays within single-turn limits; if single-turn mode was a mistake, set P10.10=1 for multi-turn linear absolute mode.</td></tr>
<tr><td rowspan="2">Error code</td><td>Main</td><td>Sub</td><td colspan="2">Display: “Er 1b3”</td></tr>
<tr><td>1b</td><td>3</td><td colspan="2">Content: External encoder frequency divider value error</td></tr>
<tr><td colspan="3">Cause</td><td>Diagnosis</td><td>Solution</td></tr>
<tr><td colspan="3">External encoder division ratio out of range.</td><td>P40.05/P40.06 external encoder frequency division numerator/denominator ratio exceeds the range 1/40 ~ 125200.</td><td>Adjust the external encoder frequency division numerator/denominator ratio so that it does not exceed the limit range.</td></tr>
</table>

<table>
<tr><td rowspan="2">Error code</td><td>Main</td><td>Sub</td><td colspan="2">Display: “Er 1b7”</td></tr>
<tr><td>1b</td><td>7</td><td colspan="2">Content: command overflow</td></tr>
<tr><td colspan="3">Cause</td><td>Diagnosis</td><td>Solution</td></tr>
<tr><td colspan="3">Position command overflow (32-bit limit) during limit signal.</td><td>Confirm whether the host computer continues to send commands after the servo limit warning occurs.</td><td>After the host computer recognizes that the servo limit signal is valid, stop sending commands in the limit direction.</td></tr>
</table>

<table>
<tr><td rowspan="2">Error code</td><td>Main</td><td>Sub</td><td colspan="2">Display: “Er 1b8”</td></tr>
<tr><td>1b</td><td>8</td><td colspan="2">Content: Absolute multiturn data setting out of limits</td></tr>
<tr><td colspan="3">Cause</td><td>Diagnosis</td><td>Solution</td></tr>
<tr><td colspan="3">Rotation range exceeds limit (Multi-turn Mode P10.10=2).</td><td>In multi-turn rotation mode, if the electronic gear ratio, P10.11, or P10.12 is modified such that the feedback position (command unit) operation upper limit exceeds 2^31, an alarm occurs.</td><td>Modify the electronic gear ratio so that the upper limit of the rotation range is less than 2^31.</td></tr>
</table>

Error code	Main	Sub	Display: “Er 1b9”	
	1b	9	Content: Origin offset setting error	
Cause			Diagnosis	Solution
Home offset exceeds position limits (Multi-turn Mode P10.10=2).			In multi-turn rotation mode, confirm the feedback position upper and lower limits according to P10.11 and P10.12, and check if the home offset setting is within the range.	Correctly set the home offset.
Error code	Main	Sub	Display: “Er 1b9”	
	1b	A	Content: Electronic gear ratio numerator error	
Cause			Diagnosis	Solution
Electronic gear ratio calculation overflow (>2^31).			Check whether the electronic gear ratio numerator setting exceeds the range: Electronic gear ratio numerator * 2^26 / Encoder lines < 2^31.	Correctly set the electronic gear ratio.

Error code	Main	Sub	Display: “Er 1c0”	
	1c	0	Content: Both STO failed	
Cause			Diagnosis	Solution
Both STO input signals valid			Check whether the STO function is enabled, and if the 24V input is disconnected normally.	Use normally, no processing required; after the STO terminal recovers, the 1C0 alarm will automatically reset the fault.
			Check if the STO power supply is normal.	Measure whether the 24V STO power supply is stable
			The switch or wiring connected to STO is disconnected abnormally.	Troubleshoot wiring and switches to ensure reliable connection and restore the switch to the closed state.
			Confirm that after the above three points, the fault still occurs.	Replace the servo drive.

Error code	Main	Sub	Display: “Er 1c1”	
	1c	1	Content: 1st STO failed	
Cause			Diagnosis	Solution
1st STO input signal valid			Check whether the STO function is enabled, and if the 1st STO 24V input is	Use normally, no processing required; after the STO terminal recovers, use the fault reset function to clear the fault.

	disconnected normally.	
	Check if the 1st STO power supply is normal.	Measure whether the 24V STO power supply is stable
	The switch or wiring connected to the 1st STO is disconnected abnormally.	Troubleshoot wiring and switches to ensure reliable connection and restore the switch to the closed state.
	Confirm that after the above three points, the fault still occurs.	Replace the servo drive.

Error code	Main	Sub	Display: "Er 1c2"
	1c	2	Content: 2nd STO failed
Cause			Diagnosis	Solution
2nd STO input signal valid			Check whether the STO function is enabled, and if the 1st STO 24V input is disconnected normally.	Use normally, no processing required; after the STO terminal recovers, use the fault reset function to clear the fault.
			Check if the 1st STO power supply is normal.	Measure whether the 24V STO power supply is stable
			The switch or wiring connected to the 1st STO is disconnected abnormally.	Troubleshoot wiring and switches to ensure reliable connection and restore the switch to the closed state.
			Confirm that after the above three points, the fault still occurs.	Replace the servo drive.

Error code	Main	Sub	Display: "Er 1c3"
	1c	3	Content: STO power supply 1 anomaly
Cause			Diagnosis	Solution
STO circuit internal 3.3V abnormal.			Check if the fault can be automatically eliminated after powering off and restarting; if it cannot be eliminated, please contact the manufacturer personnel.	Contact manufacturer personnel.

Error code	Main	Sub	Display: "Er 1c4"
	1c	4	Content: STO power supply 2 anomaly
Cause			Diagnosis	Solution
STO circuit internal 5V abnormal.			Check if the fault can be automatically eliminated after powering off and restarting; if it cannot be eliminated, please contact the manufacturer personnel.	Contact manufacturer personnel.

Error code	Main	Sub	Display: "Er 1c5"	
	1c	5	Content: STO input circuit 1 anomaly	
Cause			Diagnosis	Solution
STO circuit optocoupler abnormal.			Check if the fault can be automatically eliminated after powering off and restarting; if it cannot be eliminated, please contact the manufacturer personnel.	Contact manufacturer personnel.

Error code	Main	Sub	Display: "Er 1c6"	
	1c	6	Content: STO input circuit 2 anomaly	
Cause			Diagnosis	Solution
STO circuit optocoupler abnormal.			Check if the fault can be automatically eliminated after powering off and restarting; if it cannot be eliminated, please contact the manufacturer personnel.	Contact manufacturer personnel.

Error code	Main	Sub	Display: "Er 1c7"	
	1c	7	Content: STO circuit BUFFER 1 anomaly	
Cause			Diagnosis	Solution
STO circuit BUFFER 1 anomaly			Verify issue by restarting for a few times	Please contact manufacturer.

Error code	Main	Sub	Display: "Er 1c8"	
	1c	8	Content: STO circuit BUFFER 2 anomaly	
Cause			Diagnosis	Solution
STO circuit BUFFER 2 anomaly			Verify issue by restarting for a few times	Please contact manufacturer.

Error code	Main	Sub	Display: "Er 1c9"	
	1c	9	Content: STO Software Process Monitoring Abnormalities	
Cause			Diagnosis	Solution
STO Count Abnormal			Whether the fault can be automatically eliminated after power failure and restart, if not, please contact the manufacturer's personnel	Please contact manufacturer.

Error code	Main	Sub	Display: "Er 210"
	21	0	Content: I/O input interface assignment error

Cause	Diagnosis	Solution
Duplicate function assignment to multiple DI terminals.	Check if parameters P01.00~P01.09 or virtual DI are repeatedly set.	Ensure parameters P01.00~P01.09 are set correctly or verify virtual DI is not repeatedly set; if there is duplicate assignment, reassign functions, then power cycle to reset the fault.

Error code	Main	Sub	Display: "Er 211"
	21	1	Content: I/O input interface function assignment error

Cause	Diagnosis	Solution
Unsupported function code assigned to DI.	Check whether parameters P01.00~P01.09 or virtual DI are set with function codes supported by the current drive.	Ensure parameters P01.00~P01.09 are set correctly

Error code	Main	Sub	Display: "Er 212"
	21	2	Content: I/O output interface function assignment error

Cause	Diagnosis	Solution
Unsupported function code assigned to DO.	Check whether parameters P01.10~P01.15 or virtual DO are set with function codes supported by the current drive.	Ensure parameters P01.10~P01.15 are set correctly

Error code	Main	Sub	Display: "Er 240"
	24	0	Content: EEPROM parameters initialization CRC check error

Cause	Diagnosis	Solution
Servo dirver control power unstable, low, or lost.	1. Check for control power cutoff (L1/L2 or L1C/L2C) or momentary failures. 2. Verify input voltage at terminals meets specs: 220V drives (198V–264V) or 380V drives (342V–484V).	Power cycle the drive. If the fault persists, ensure the supply is stable and verify that L1/L2 or L1C/L2C input voltages meet the rated specifications.
Parameter save error.	Resave parameters, repower, and confirm whether the fault can be cleared.	Resave parameters once.
Power loss during parameter save.	Resave parameters or restore factory settings, repower, and confirm whether the fault can be cleared.	Resave parameters once and wait for the save to complete before powering off
Drive software update.	Confirm whether there has been a recent drive software	Restore the parameter table / object dictionary to factory settings and

	upgrade.	power on again.
Firmware mismatch during update.	Confirm whether there has been a recent drive software upgrade, and whether the firmware version matches.	Re-burn the matching drive software firmware

Error code	Main	Sub	Display: "Er 241"
	24	1	Content: EEPROM hardware error

Cause	Diagnosis	Solution
EEPROM parameter read error.	Resave parameters or restore factory settings, disconnect the USB debugging cable, completely power down the drive and then repower, and confirm whether the fault can be cleared.	Resave parameters or restore factory settings, disconnect the USB debugging cable, completely power down the drive and then repower, and confirm whether the fault can be cleared.

Error code	Main	Sub	Display: "Er 24"
	24	2	Content: EEPROM write frequency too high

Cause	Diagnosis	Solution
EEPROM write frequency too high.	Check if the fault can be automatically eliminated after powering off and restarting; if it cannot be eliminated, please contact the manufacturer personnel.	Contact manufacturer personnel.

Error code	Main	Sub	Display: "Er 243"
	24	3	Content: EEPROM save vendor parameter error

Cause	Diagnosis	Solution
Data object attribute checksum mismatch between Drive Core and Bus Core during initialization	Disconnect the USB debugging cable, completely power down the drive and then repower, and confirm whether the fault can be cleared.	Disconnect the USB debugging cable, completely power down the drive and then repower, and confirm whether the fault can be cleared.

Error code	Main	Sub	Display: "Er 244"
	24	4	Error description: EEPROM save communication parameter error

Cause	Diagnosis	Solution
Saved communication parameters modified; checksum failed.	Restore factory settings, repower and confirm whether the fault disappears.	Restore factory settings; after powering on again, confirm whether the fault disappears.
EEPROM damaged.	Restore factory settings, repower and confirm whether	Replace the drive.

	the fault disappears.	

Error code	Main	Sub	Display: "Er 245"
	24	5	Error description: EEPROM save device parameter error

Cause	Diagnosis	Solution
Saved device data modified; checksum failed.	Restore factory settings, repower and confirm whether the fault disappears.	Restore factory settings; after powering on again, confirm whether the fault disappears.
EEPROM damaged	Restart driver for a few times	Restart driver for a few times

Error code	Main	Sub	Display: "Er 246"
	24	6	Error description: EEPROM save, read power failure information error

Cause	Diagnosis	Solution
Power-off storage data modified; checksum failed.	Clear the fault storage, repower and confirm whether the fault disappears.	Clear the fault storage
EEPROM damaged.	Restore factory settings, repower and confirm whether the fault disappears.	Replace the drive.

Error code	Main	Sub	Display: "Er 24F"
	24	F	Error description: EEPROM power parameter error

Cause	Diagnosis	Solution
Drive EEPROM hardware power info error.	Check if PE0.06 is set to 0, and PE0.07 read power is inconsistent with the actual drive (220 represents 22kW).	Restore factory settings and power on again; if the alarm persists, contact manufacturer personnel.

Error code	Main	Sub	Display: "Er 260"
	26	0	Error description: Positive/negative out-of-range input valid

Cause	Diagnosis	Solution
Positive/Negative limit DI/VDI active (Non-homing mode).	Check if P01 group has set DI input positive/negative limit input signals. Check via IO settings if the positive/negative limit input signal logic is in the active state.	Check whether the limit trigger triggers normally; for abnormal triggering, confirm if wiring and parameter setting values are incorrect.

Error code	Main	Sub	Display: "Er 280"	
	28	0	Error description: Pulse regeneration limit protection	
Cause			Diagnosis	Solution
Divided pulse output frequency exceeds limit.(L7/L6:1MHz L8:2MHz 2L6P:4.4MHz)			Calculate the output pulse frequency:f(Hz)=Speed(rpm)÷60× P00.11.Verify if the motor speed and pulse frequency exceed drive limits when the fault occurs.	Lower P00.11 or reduce speed to ensure output pulse frequency remains within hardware limits throughout the entire motion.

Error code	Mai	Sub	Display: " Er 570"	
	57	0	Error description: Forced alarm input valid	
Cause			Diagnosis	Solution
E-STOP forced alarm input active.			Check whether the forced alarm input signal is conducting or if the logic is set to normally closed.	Ensure correct parameter settings for input signal wiring and corresponding DI input.

Error code	Main	Sub	Display: "Er 5F1"	
	57	1	Error description: PC forced alarm input active	
Cause			Diagnosis	Solution
E-STOP forced alarm input active.			Check whether the host computer emergency stop input signal is enabled.	Turn off the host computer emergency stop input signal.

Error code	Main	Sub	Display: "Er 580"	
	58	0	Error description: Homing failed	
Cause			Diagnosis	Solution
/			/	/
Error code	Main	Sub	Display: "Er 581"	
	58	1	Error description: Unvalid homing method	
Cause			Diagnosis	Solution
Homing method not supported.			Check if the setting value of 6098 (Homing) is reasonable.	/

Error code	Main	Sub	Display: "Er 5F0"	
	5F	0	Error description: Motor code error	
Cause			Diagnosis	Solution
PA0.11 Motor code error or mismatch.			Check if the motor model code PA0.11 is correct.	Restore factory settings and power on again or set the correct motor code PA0.11.

Error code	Main	Sub	Display: "Er 5F1"	
	5F	1	Error description: Driver chip select recognition abnormality	
Cause			Diagnosis	Solution
Drive Chip Select (CS) ID error during initiation			Check if the fault is still reported after powering off and restarting.	Contact the manufacturer for handling.

Error code	Main	Sub	Display: "Er 5F3"	
	5F	3	Error description: Drive power selection fault	
Cause			Diagnosis	Solution
Drive power rating out of range during initiation			Check if the fault is still reported after powering off and restarting.	Contact the manufacturer for handling.

Error code	Main	Sub	Display: "Er 5F4"	
	5F	4	Error description: Motor voltage level mismatch fault	
Cause			Diagnosis	Solution
PA0.13 Motor voltage mismatch with PA2.06 Drive voltage.			Check if the motor voltage level and drive voltage level can match normally; confirm if the read PA0.13 motor voltage parameter is correct.	Replace with a motor or drive where the voltage level matches correctly.

Error code	Main	Sub	Display: "Er 5F6"	
	5F	6	Error description: Abnormal matching of drive model and motor model	
Cause			Diagnosis	Solution
Drive model and motor model mismatch.			Please confirm whether the drive and motor are the matching relationship recommended by the manufacturer; if the matching relationship is confirmed correct, power off and restart to observe if the fault is still reported.	If models do not match, replace with a motor or drive that can match each other. If models match, please contact the manufacturer for handling.

Error code	Main	Sub	Display: "Er 600"	
	60	0	Error description: internal error	
Cause			Diagnosis	Solution
Current loop interrupt timeout.			Check if the fault is still reported after powering off and restarting.	Contact the manufacturer for handling.

Error code	Main	Sub	Display: "Er 601"	
	60	1	Error description: Internal timing error	
Cause			Diagnosis	Solution
Speed loop interrupt timeout.			Check if the fault is still reported after powering off and restarting.	Contact the manufacturer for handling.

Error code	Main	Sub	Display: "Er 602"	
	60	2	Error description: interrupt timeout fault	
Cause			Diagnosis	Solution
Main interrupt timeout.			Check if the fault is still reported after powering off and restarting.	Contact the manufacturer for handling.
Resource overload alarm (Gantry + Full-closed + Position comparison).			Power off and restart, do not enable any functions, and check if the fault is still reported during operation.	Contact the manufacturer for handling.

Error code	Main	Sub	Display: "Er 603"	
	60	3	Error description: Loss of interruptions for dual-core interactions	
Cause			Diagnosis	Solution
Loss of interruptions for dual-core interactions			Whether power failure and restart still report faults	Please contact our technical support

Error code	Main	Sub	Display: "Er 604"	
	60	4	Error description: Internal storage anomaly	
Cause			Diagnosis	Solution
stack overflow			Whether power failure and restart still report faults	Please contact our technical support
Error code	Main	Sub	Display: "Er 604"	
	60	5	Error description: Timing configuration error	
Cause			Diagnosis	Solution
Feedback delay too large.			Check if the fault is still reported after powering off and restarting.	Contact the manufacturer for handling.

Error code	Main	Sub	Display: "Er 700"	
	70	0	Error description: Encryption error	
Cause			Diagnosis	Solution
Encryption error during initialization upon power-on.			Restart driver	Please contact our technical support

Error code	Main	Sub	Display: "Er 500"	
	50	0	Error description: External communication encoder disconnected	
Cause			Diagnosis	Solution
Encoder type setting error.			Check the external encoder type setting.	Check whether the P40.01 setting matches the actual encoder used.
Encoder wiring error.			Check if the external encoder wiring is correct.	Check whether the external encoder wiring is correct.

Error code	Main	Sub	Display: "Er 501"	
	50	1	Error description: External communication encoder data error	
Cause			Diagnosis	Solution
Encoder wiring error or Drive improper grounding.			Check if the external encoder wiring is correct and if the drive grounding is correct.	Check whether the external encoder wiring is correct and whether the drive grounding is correct.
Encoder type not supported by drive.			Check whether the encoder conforms to the encoder communication protocol supported by the drive.	Contact the manufacturer for handling.

Error code	Main	Sub	Display: "Er 502"	
	50	2	Error description: External communication encoder checksum error	
Cause			Diagnosis	Solution
Encoder wiring error or Drive improper grounding.			Check if the external encoder wiring is correct and if the drive grounding is correct.	Check whether the external encoder wiring is correct and whether the drive grounding is correct.

Error code	Main	Sub	Display: "Er 550"	
	55	0	Error description: External ABZ encoder disconnected	
Cause			Diagnosis	Solution
External ABZ encoder disconnected.			Check if the external encoder wiring is reliable.	Ensure external encoder wiring is reliable without connection errors

Error code	Main	Sub	Display: "Er 551"	
	55	1	Error description: External encoder disconnected (Phase A)	
Cause			Diagnosis	Solution
External ABZ encoder disconnected.			Check if the external encoder wiring is reliable.	Ensure external encoder wiring is reliable without connection errors

Error code	Main	Sub	Display: "Er 552"	
	55	2	Error description: External encoder disconnected (Phase B)	
Cause			Diagnosis	Solution
External ABZ encoder disconnected.			Check if the external encoder wiring is reliable.	Ensure external encoder wiring is reliable without connection errors

Error code	Main	Sub	Display: "Er 553"	
	55	3	Error description: External encoder disconnected (Phase Z)	
Cause			Diagnosis	Solution
External ABZ encoder disconnected.			Check if the external encoder wiring is reliable.	Ensure external encoder wiring is reliable without connection errors

Error code	Main	Sub	Display: "Er 570"	
	57	0	Error description: Force alarm input valid	
Cause			Diagnosis	Solution
Debug software E-Stop triggered.			Check if the debugging software emergency stop is set to valid.	Confirm safety, then cancel the valid debugging software emergency stop signal.

Error code	Main	Sub	Display: "Er 571"	
	57	1	Error description: Debugging software emergency stop active	
Cause			Diagnosis	Solution
Debug software E-Stop triggered.			Check if the debugging software emergency stop is set to valid.	Confirm safety, then cancel the valid debugging software emergency stop signal.

Error code	Main	Sub	Display: "Er 890"	
	89	0	Error description: Homing error	
Cause			Diagnosis	Solution
Homing speed too high; sensor signal missed.			Check if the homing high speed is set too large or homing acceleration is set too small.	Decrease the homing high speed or increase the homing acceleration.
Homing method conflicts with sensor logic.			Check if the sensor input signal logic required by the homing method is the same as the actual input.	Adjust the homing method or adjust the sensor input signal logic.
Selected homing method not supported.			Check if object dictionary 6098h has selected an unsupported homing method.	Reselect a supported homing method.
Sensor signal edge unstable.			Check via debugging software if the corresponding DI input port change is normal.	Ensure sensor edges are stable.

Persistently unstable at home position.	Acceleration/deceleration setting is too small; electronic gear ratio setting is too small causing acceleration/deceleration to be too small.	Set appropriate 609A if the electronic gear ratio cannot be changed

Error code	Main	Sub	Display: "Er FFF"	
	FF	F	Error description: Communication abnormal	
Cause			Diagnosis	Solution
Communication abnormality.			Check if the line is connected normally or if the drive is powered off.	Correctly connect the drive and ensure communication is normal.

Error code	Main	Sub	Display: "Er 920"	
	92	0	Error description: External encoder parameter initialization error	
Cause			Diagnosis	Solution
Encoder parameter P40.07 setting error.			Check if P40.07 is set out of range.	Adjust the P40.07 setting value to defult

Error code	Main	Sub	Display: "Er 921"	
	92	1	Error description: External encoder resolution too high failure	
Cause			Diagnosis	Solution
Ext. incremental encoder lines/rev exceed 2^26 (Full-closed).			Check if the external encoder electronic gear ratio P40.05, P40.06 settings are correct.	Correctly set the external encoder electronic gear ratio.
Error code	Main	Sub	Display: "Er 2A2"	
	2A	2	Error description: Overvoltage during self-learning	
Cause			Diagnosis	Solution
Auto-tuning pressure feedback exceeds P0F.02 * P0F.23.			Check if the self-learning speed is too large, and if the landing threshold is too large.	Reduce self-learning speed P0F.80;Reduce pressure landing threshold P0F.22.
Error code	Main	Sub	Display: "Er 2A3"	
	2A	3	Error description: Overvoltage during return to initial position	
Cause			Diagnosis	Solution
Pressure feedback > Over-pressure threshold during return to initial.			Determine if the running direction and initial position settings are correct, and if the analog feedback is normal.	Set the correct direction and initial position
Error code	Main	Sub	Display: "Er 2A4"	
	2A	4	Error description: Overvoltage during pre-pressing	

Cause	Diagnosis	Solution
Pre-press pressure exceeds protection threshold...	Check if the landing threshold is too large; check whether the surface of the pressed object exceeds the tolerance range.	Adjust pressure landing threshold P0F.22;Adjust tolerance range P0F.25.

Error code	Main	Sub	Display: "Er 2A6"	
	2A	6	Error description: Overvoltage during pre-pressing	
Cause			Diagnosis	Solution
Pre-press pressure > P0F.32 threshold.			Check if the parameter settings for the pre-pressing stage are correct.	Correctly set pressure parameters; Adjust P0F.32 alarm threshold to a reasonable range.

Error code	Main	Sub	Display: "Er 2A9"	
	2A	9	Error description: Pressing position out of range	
Cause			Diagnosis	Solution
Position exceeds Auto-tuned pos + Tolerance P0F.25.			Check whether the surface of the pressed object exceeds the tolerance range.	Adjust tolerance range P0F.25.

Error code	Main	Sub	Display: "Er 2AA"	
	2A	A	Error description: Pressing timeout	
Cause			Diagnosis	Solution
Pressing time timeout.			Check if the pressing time is too small, if the PID gain is too small, and check if the pressure holding window time and pressure holding judgment threshold are reasonable.	Adjust pressing timeout time P0F.24;Adjust pressure PID parameters.;Appropriately reduce pressure holding window time P0F.05 and increase pressure holding judgment threshold P0F.04.

Error code	Main	Sub	Display: "Er 2AB"	
	2A	B	Error description: Overvoltage during pressing	
Cause			Diagnosis	Solution
Pressing pressure exceeds protection threshold.			Check if PID parameters are reasonable; confirm if the pressure amplifier rate is fast enough, recommended above 1kHz.	Appropriately adjust pressure PID parameters to prevent pressing overvoltage.

Error code	Main	Sub	Display: "Er 2AD"	
	2A	D	Error description: Large pressure fluctuation during pressure holding	
Cause			Diagnosis	Solution
Pressure deviation > P0F.28 (when P0F.16=Hold Position).			1. Check if the P0F.28 setting threshold is too small. 2. Check if the PID parameter settings are	1. Adjust the value of P0F.28. 2. Appropriately adjust pressure PID parameters.

	reasonable.	

Error code	Main	Sub	Display: "Er 300"	
	30	0	Error description: Current loop tuning error (Speed out of range)	
Cause			Diagnosis	Solution
Linear motor speed exceeds P10.35.			Check if the current loop tuning current size and duration settings are reasonable; if the alarm threshold setting is reasonable.	Check if the current loop tuning current size and duration settings are reasonable

Error code	Main	Sub	Display: "Er 301"	
	30	1	Error description: Current loop tuning error (Displacement out of range)	
Cause			Diagnosis	Solution
Linear motor displacement exceeds P10.36.			Check if the current loop tuning current size and duration settings are reasonable; if the alarm threshold setting is reasonable.	Check if the current loop tuning current size and duration settings are reasonable

Error code	Main	Sub	Display: "Er 302"	
	30	2	Error description: Current loop tuning error (Parameter error)	
Cause			Diagnosis	Solution
Motor parameter setting error.			Restore factory settings, repower and confirm whether the fault disappears.	If it still exists, please contact the manufacturer for handling.

Error code	Main	Sub	Display: "Er 73A"	
	73	A	Error description: Excessive PDI interrupt loss	
Cause			Diagnosis	Solution
Master station performance poor.			-	Increase the alarm threshold.
Single drive issue.			Confirm whether it is a single unit or multiple units alarming.	Swap the drive or replace the drive.
Excessive external interference.			Check servo grounding and network cable quality, whether it meets Cat 5e shielded network cable standards.	Ensure good wiring and replace with manufacturer standard network cable.

Error code	Main	Sub	Display: "Er 73B"	
	73	B	Error description: Excessive DC interrupt loss	
Cause			Diagnosis	Solution
Master station performance poor.			-	Increase the alarm threshold.
Single drive issue.			Confirm whether it is a single unit or multiple units alarming.	Swap the drive or replace the drive.
Excessive external interference.			Check servo grounding and network cable quality, whether it meets Cat 5e shielded network cable standards.	Ensure good wiring and replace with manufacturer standard network cable.

Error code	Main	Sub	Display: "Er 73C"	
	73	C	Error description: Excessive DC cycle drift	
Cause			Diagnosis	Solution
Master station performance poor.			-	Increase the alarm threshold.
Single drive issue.			Confirm whether it is a single unit or multiple units alarming.	Swap the drive or replace the drive.
Excessive external interference.			Check servo grounding and network cable quality, whether it meets Cat 5e shielded network cable standards.	Ensure good wiring and replace with manufacturer standard network cable.
Error code	Main	Sub	Display: "Er 73D"	
	73	D	Error description: Illegal state transition	
Cause			Diagnosis	Solution
Control Word violation; Standard State Machine flow not followed. (Init →PreOP→SafeOP→OP)			Check if the control word has issued an illegal state switching command.	Check the controller program to ensure the state switching command is normal.

Error code	Main	Sub	Display: "Er 740"	
	74	0	Error description: Homing status error	
Cause			Diagnosis	Solution
Homing state machine jump error.			Restore factory settings, repower and confirm whether the fault disappears.	Contact the manufacturer

Error code	Main	Sub	Display: "Er 741"	
	74	1	Error description: Homing mode error	
Cause			Diagnosis	Solution
Unsupported homing mode set.			Check homing mode setting.	Set correct homing mode parameters.

Error code	Main	Sub	Display: "Er 742"	
	74	2	Error description: Homing limit exceeded	
Cause			Diagnosis	Solution
Homing position exceeds overrun limit.			Check homing overrun parameter setting.	Set correct homing overrun parameters to ensure homing operation is performed within the overrun parameter range.

Error code	Main	Sub	Display: "Er 743"	
	74	3	Error description: Homing timeout	
Cause			Diagnosis	Solution
Homing time exceeds timeout threshold.			Check homing timeout parameter setting.	Set correct homing high/low speed or homing timeout threshold to ensure the homing process time does not exceed the homing timeout threshold.

Error code	Main	Sub	Display: "Er 744"	
	74	4	Error description: Homing logic error	
Cause			Diagnosis	Solution
Homing process condition mismatch.			Check limit and home switch positions and settings.	Ensure limit and home switch settings and positions are reasonable.

Error code	Main	Sub	Display: "Er 745"	
	74	5	Error description: Homing action abnormal	
Cause			Diagnosis	Solution
Internal target signal error during homing.			Restore factory settings, repower and confirm whether the fault disappears.	Contact the manufacturer for handling.

Error code	Main	Sub	Display: "Er 746"
	74	6	Error description: Homing aborted

Cause	Diagnosis	Solution
Homing interrupted by other operation.	Check if there is an emergency operation (operation with higher priority than homing) causing homing to pause.	Eliminate other emergency operations to ensure the homing process proceeds normally.

Error code	Main	Sub	Display: "Er 801"	
	80	1	Error description: Unknown EtherCAT communication error	
Cause			Diagnosis	Solution
ESM state machine transition failed.			Detect ESM switching sequence and whether the network connection is reliable.	Confirm network connection and master station ESM transition order.
Error code	Main	Sub	Display: "Er 802"	
	80	2	Error description: Memory overflow	
Cause			Diagnosis	Solution
CPU memory allocation failed.			Confirm if L7N hardware has a fault, disconnect the network cable and repower.	Replace the drive
Error code	Main	Sub	Display: "Er 803"	
	80	3	Error description: RAM out of bound	
Cause			Diagnosis	Solution
Master ESC memory access out of bounds.			Check master station configuration or test by replacing the master station.	Check master station configuration or test by replacing the master station.
Error code	Main	Sub	Display: "Er 805"	
	80	5	Error description: Protocol stack initialization failure	
Cause			Diagnosis	Solution
Firmware flash update initialization failed.			Check if burning was interrupted; check if burning in BOOT state; if firmware is correct.	Ensure the burning environment is stable
Error code	Main	Sub	Display: "Er 806"	
	80	6	Error description: Firmware-XML mismatch / Firmware-product mismatch	
Cause			Diagnosis	Solution
ESI mismatch with drive firmware.			Check if the burned XML file does not match the drive; repower and check for fault.	Re-burn the ESI file corresponding to the firmware or upgrade product firmware.
Error code	Main	Sub	Display: "Er 807"	
	80	7	Error description: PDO mapping object does not exist	
Cause			Diagnosis	Solution

PDO mapping object does not exist.	Check objects in PDO mapping.	Reconfigure PDO mapping.

Error code	Main	Sub	Display: "Er 808"	
	80	8	Error description: PDO mapping object length mismatch	
Cause			Diagnosis	Solution
PDO mapping object length mismatch.			Check the length of PDO mapping objects.	Reconfigure PDO mapping.
Error code	Main	Sub	Display: "Er 809"	
	80	9	Error description: PDO mapping object attribute error	
Cause			Diagnosis	Solution
PDO mapping object attribute error.			Check if the configured PDO mapping object has the corresponding mapping attribute.	Reconfigure PDO mapping.
Error code	Main	Sub	Display: "Er 811"	
	81	1	Error description: Invalid EtherCAT transition request	
Cause			Diagnosis	Solution
Received impossible ESM transition request.			Check if the master station sent an invalid ESM switch command.	Ensure the master station sends correct ESM switching information.
Error code	Main	Sub	Display: "Er 812"	
	81	2	Error description: Unknown EtherCAT state machine transition request	
Cause			Diagnosis	Solution
Received unknown ESM transition request.			Check if the master station sent an unknown ESM switching command.	Ensure the master station sends correct ESM switching information.
Error code	Main	Sub	Display: "Er 813"	
	81	3	Error description: Protection request from boot state	
Cause			Diagnosis	Solution
Received Bootstrap state transition request.			Confirm if the drive software version supports this state transition.	Confirm whether the drive software version supports this state transition.

Error code	Main	Sub	Display: "Er 814"	
	81	4	Error description: Invalid firmware	
Cause			Diagnosis	Solution
Firmware and drive mismatch.			Check if it is original factory shipment and if new firmware has been burned.	Contact manufacturer personnel
Error code	Main	Sub	Display: "Er 815"	
	81	5	Error description: Invalid mailbox configuration under boot state	

Cause			Diagnosis	Solution
Invalid Mailbox configuration (BOOT).			Check master station mailbox configuration, confirm if XML is modified.	Reconfigure the master station,Replace with the XML provided by the manufacturer.
Error code	Main	Sub	Display: "Er 816"	
	81	6	Error description: Pre-Op status is invalid for the mailbox configuration	
Cause			Diagnosis	Solution
Invalid Mailbox configuration (Pre-Op).			Check master station mailbox configuration, confirm if XML is modified.	Reconfigure the master station,Replace with the XML provided by the manufacturer.
Error code	Main	Sub	Display: "Er 817"	
	81	7	Error description: Invalid SyncManager configuration	
Cause			Diagnosis	Solution
Synchronization Manager configuration invalid.			Check master station configuration and ESI file version correspondence.	Ensure master station configuration is normal and the XML file version corresponds to the drive version.
Error code	Main	Sub	Display: "Er 818"	
	81	8	Error description: TPDO refresh timeout	
Cause			Diagnosis	Solution
TPDO update timeout (>1s).			Confirm if TPDO is set with more than 10 mapping objects, causing refresh timeout.	Ensure TPDO setting does not exceed 10 mapping objects.

Error code	Main	Sub	Display: "Er 819"	
	81	9	Error description: RPDO refresh timeout	
Cause			Diagnosis	Solution
RPDO update timeout (>1s).			Confirm if RPDO is set with more than 10 mapping objects, causing refresh timeout.	Confirm RPDO setting does not exceed 10 mapping objects.

Error code	Main	Sub	Display: "Er 81A"	
	81	A	Error description: Synchronization error	
Cause			Diagnosis	Solution
Synchronization lost error.			Confirm if master station synchronization performance meets requirements, check communication interference situation.	Replace the master station

Error code	Main	Sub	Display: "Er 81B"	
	81	B	Error description: PDI watchdog timeout	
Cause			Diagnosis	Solution
PDI Watchdog timeout.			Confirm master station process data update frequency.	Configure master station process data update frequency.
			Check if the physical connection status is disconnected, and the reliability of the connection medium.	Replace physical connection medium
			Check if a master station program download operation was performed causing the alarm.	Clear the alarm without reporting

Error code	Main	Sub	Display: "Er 81C"	
	81	C	Error description: Invalid SyncManager type	
Cause			Diagnosis	Solution
Invalid synchronization Manager type.			Confirm master station sync manager configuration; confirm consistency between XML file and program version.	Reconfigure synchronization manager information on the master station

Error code	Main	Sub	Display: "Er 81D"	
	81	D	Error description: Invalid output configuration	
Cause			Diagnosis	Solution
Invalid Output configuration.			Confirm master station output manager configuration for the drive; confirm consistency between XML file and program version.	Reconfigure synchronization manager information on the master station

Error code	Main	Sub	Display: "Er 81E"	
	81	E	Error description: Invalid input configuration	
Cause			Diagnosis	Solution
Invalid Input configuration.			Confirm master station input manager configuration for the drive; confirm consistency between XML file and program version.	Reconfigure synchronization manager information on the master station

Error code	Main	Sub	Display: "Er 81F"	
	81	F	Error description: Watchdog configuration invalid	
Cause			Diagnosis	Solution
Invalid Watchdog configuration.			Check master station watchdog configuration for the drive.	Change watchdog configuration.

Error code	Main	Sub	Display: "Er 821"	
	82	1	Error description: Waiting for EtherCAT state machine Init state	
Cause			Diagnosis	Solution
Waiting for Master Init request.			Check if master station ESM switching information is normal.	Ensure master station ESM communication state switching information is normal.

Error code	Main	Sub	Display: "Er 822"	
	82	2	Error description: Waiting for the EtherCAT state machine Pre-Op state	
Cause			Diagnosis	Solution
Waiting for Master Pre-Op request.			Check if master station ESM switching information is normal.	Ensure master station ESM communication state switching information is normal.

Error code	Main	Sub	Display: "Er 823"	
	82	3	Error description: Waiting for master device for Safe-Op request	
Cause			Diagnosis	Solution
Waiting for Master Safe-Op request.			Check if master station ESM switching information is normal.	Ensure master station ESM communication state switching information is normal.

Error code	Main	Sub	Display: "Er 824"	
	82	4	Error description: Invalid TPDO mapping	
Cause			Diagnosis	Solution
TPDO contains unmappable object.			Check if TPDO is configured with unmappable objects, such as objects with RPDO attribute.	Reconfigure TPDO mapping objects.

Error code	Main	Sub	Display: "Er 825"	
	82	5	Error description: RPDO mapping invalid (length, parameter not present, no this property)	
Cause			Diagnosis	Solution
RPDO contains unmappable object.			Check if RPDO is configured with unmappable objects, such as objects with TPDO attribute.	Reconfigure RPDO mapping objects.

Error code	Main	Sub	Display: "Er 828"	
	82	8	Error description: Sync mode not supported	
Cause			Diagnosis	Solution
Synchronization mode not supported by current configuration			Ensure master station configuration is normal; ensure XML version corresponds to product firmware.	Contact manufacturer personnel.

Error code	Main	Sub	Display: "Er 82B"	
	82	B	Error description: TPDO/RPDO refresh timeout	
Cause			Diagnosis	Solution
TPDO/RPDO refresh timeout.			Check PDO configuration validity, whether it exceeds the limit of 10 mapping objects per group, check environmental interference.	Reconfigure PDO according to requirements
Master program download.			Check if a master station program download operation was performed causing the alarm.	Clear the alarm without reporting

Error code	Main	Sub	Display: "Er 82C"	
	82	C	Error description: Fatal synchronization error	
Cause			Diagnosis	Solution
Fatal synchronization error.			Synchronization signal lost exceeding the set value.	Check synchronization configuration of the master station for the drive.

Error code	Main	Sub	Display: "Er 82D"	
	82	D	Error description: No synchronization error	
Cause			Diagnosis	Solution
No sync error (Sync lost).			No synchronization information received during the transition from safe operation to operation.	Confirm DC settings, transmission delay, and transmission interference.

Error code	Main	Sub	Display: "Er 82E"	
	82	E	Error description: Synchronization cycle time is too short	
Cause			Diagnosis	Solution
Sync cycle time too short.			Synchronization cycle setting is too small, less than 125us.	Set a synchronization cycle supported by the drive.

Error code	Main	Sub	Display: "Er 830"	
	83	0	Error description: Invalid Distributed Clock synchronization settings	
Cause			Diagnosis	Solution
Invalid DC configuration.			DC activation register setting value is invalid.	Set reasonable synchronization information.

Error code	Main	Sub	Display: "Er 832"	
	83	2	Error description: Excessive DC cycle drift	
Cause			Diagnosis	Solution
DC cycle drift too large.			DC synchronization cycle jitter is too large.	Confirm DC configuration, network transmission delay, and interference.

Error code	Main	Sub	Display: "Er 833"	
	83	3	Error description: Excessive DC interrupt loss	
Cause			Diagnosis	Solution
Excessive DC interrupt loss.			DC interrupt loss count exceeds the set value.	Confirm DC configuration, network transmission delay, and interference.

Error code	Main	Sub	Display: "Er 834"	
	83	4	Error description: Excessive PDI interrupt loss	
Cause			Diagnosis	Solution
Excessive PDI interrupt loss.			PDI has not received valid data too many times.	Confirm DC configuration, network transmission delay, and interference.

Error code	Main	Sub	Display: "Er 835"	
	83	5	Error description: Distribution Clock cycle time is invalid	
Cause			Diagnosis	Solution
Invalid DC cycle.			Confirm the synchronization cycle configured by the master station.	Change the synchronization cycle to one supported by the drive.

Error code	Main	Sub	Display: "Er 836"	
	83	6	Error description: Invalid Distribution Clock synchronization cycle time	
Cause			Diagnosis	Solution
Synchronization cycle not multiple of 125us or > 5400-02h.			Confirm the synchronization cycle configured by the master station.	Change the synchronization cycle to one supported by the drive.

Error code	Main	Sub	Display: "Er 838"	
	83	8	Error description: Synchronization error	
Cause			Diagnosis	Solution
DC offset too large			Use the diagnostic tool to check if the value of excessive synchronization offset times is relatively large	Increase the synchronization cycle

Error code	Main	Sub	Display: "Er 850"	
	85	0	Error description: ESC EEPROM is inaccessible	
Cause			Diagnosis	Solution
ESC EEPROM access error.			ESC EEPROM access permission conflict; disconnect network cable and repower to confirm if hardware fault exists.	Ensure the master station releases access rights.

Error code	Main	Sub	Display: "Er 851"	
	85	1	Error description: ESC EEPROM error	
Cause			Diagnosis	Solution
ESC EEPROM error.			ESC EEPROM data CRC or setting error.	Reconfigure and download ESC EEPROM data.

Error code	Main	Sub	Display: "Er 852"	
	85	2	Error description: EthercCAT physical link failure	
Cause			Diagnosis	Solution
ECAT physical link fault.			Check the connection order of the drive IN/OUT ports.	Reconnect

Error code	Main	Sub	Display: "Er 860"	
	86	0	Error description: Hardware frame loss error	
Cause			Diagnosis	Solution
Excessive ECAT frame loss per unit time.			Check physical connection reliability, drive fault.	Replace with Cat 5e shielded network cable

Error code	Main	Sub	Display: "Er 870"
	87	0	Error description: Driver can't be enabled under current control mode

Cause	Diagnosis	Solution
Current mode not supported.	Check if the setting value of operation mode 6060h is an operation mode supported by the drive.	Reconfigure operation mode.

Error code	Main	Sub	Display: "Er 871"
	87	1	Error description: Unsupported mode under current synchronization type

Cause	Diagnosis	Solution
Mode not supported in current sync type.	Check if the 6060h setting value under the synchronization type is an operation mode supported by the drive.	Reconfigure operation mode.

Error code	Main	Sub	Display: "Er 920"
	92	0	Error description: Error initialising external encoder parameters

Cause	Diagnosis	Solution
Encoder parameter P40.07 configuration error	Check if the P40.07 configuration is out of the valid range	Adjust the P40.07 configuration value, apply the default value and check if the issue still recurs

Error code	Main	Sub	Display: "Er 921"
	92	1	Error description: External encoder resolution too high fault

Cause	Diagnosis	Solution
In full-closed loop mode, if the external encoder is an incremental encoder and the number of lines per revolution exceeds 2^26 (67108864)	Check whether the electronic gear ratio settings of the external encoder P40.05 and P40.06 are correct	Correctly set the electronic gear ratio of the external encoder

8.5 Alarm clearing

For alarm can be cleared，There are 3 method.

Method 1：

1、By setting bit 7 of 6040h to 1, switches state machine from fault to initialization completion , No fault(Switch on disabled).

Method 2：

Use auxiliary function “AF_ACL”

1、Press M to select auxiliary function , Press SET to enter into “AF_ACL” , Press and hold to clear the alarm

Method 3：

Set IO input function as Alarm clear input “ (A-CLR)”，refer to switch input interface connection to clear the alarm.

About Us

Leadshine Technology Co., Ltd.

Headquarters

Address:
15-20/F, Block B, Nanshan I Valley, No.3157, Nanshan District, Shenzhen City, Guangdong Province, China
Tel:
+86 755 26411692
Fax:
+86 755 26402718
Website:
www.leadshine.com
Emails:
sales@leadshine.com

Leadshine Global Retailers Network

Get in touch with us or any of your local Leadshine certified retailers by visiting our global website.

Technical Support
Tel: 86-755-2641-8447
86-755-2641-8774 (Asia, Australia, Africa)
86-755-2665-5136 (North and South America)
86-755-8654-2465 (Europe)
Fax: 86-755-2640-2718
Email: tech@leadshine.com

Sales Hot Line
Tel: 86-755-2641-7674 (Asia, Australia, Africa)
86-755-2641-7617 (North and South America)
86-755-2640-9254 (Europe)
Email: sales@leadshine.com

Leadshine Overseas

Leadshine America, Inc.

North America Office

Address:
26050 Towne Centre Dr. Foothill Ranch California United States
Tel:
1-949-608-7270
Fax:
1-949-638-7298
Website:
www.leadshineusa.com
Emails:
sales@leadshineusa.com