STEPPERONLINE®

A6-RS

Servo Drive

User Guide

Power range: 0.2 kW to 1.0 kW

Legal Information Statement:

- The product described in this documentation may be operated only by personnel qualified for the specific task in accordance with the relevant documentation.
- All operations on the product must follow respective descriptions provided in the documentation, in particular, its warning notices and safety instructions.
- Damage caused by improper use is not covered by warranty.
- The company will disclaim any legal liability for any personal injury or property damage caused by improper usage.

Contents

Safety Information and Precautions

To avoid personal injury or damage to the equipment, matters to be followed are stated as follows:

- Read and follow the Safety Information and Precautions before use.
- Use this product according to the designated environment requirements.
- Follow all safety information and precautions described in the product identification and manual.

The degree of injury and damage caused by improper use of this product is distinguished and described as follows:

DANGER	This mark indicates that failure to comply with the notice will result in severe personal injury or even death.
WARNING	This mark indicates that failure to comply with the notice may result in severe personal injury or even death.
CAUTION	This mark indicates that failure to comply with the notice may result in minor or moderate personal injury or damage to the equipment.
NOTICE	If rated precautions are not taken, it may cause undesirable result or state.

Matters to be followed are described using the following graphic marks:

This graphic mark indicates contents that must be performed.	This graphic mark indicates contents that must not be performed.

DANGER

- Install this product on non-combustible materials such as metal.
- Set up the product in a clean place where it does not contact water or oil.
- Installation and wiring must be performed by qualified electricians.
- Installation personnel must be familiar with product installation requirements and relevant technical materials.
- The moving, installation, wiring, and inspection of this product can be performed only after you cut off the power supply, wait at least 10 minutes, and determine that there is no risk of electric shock.
- Follow the proper electrostatic discharge (ESD) procedures and wear an anti-static wrist strap to perform wiring.
- The cables should be properly connected. The energized part must be properly insulated using an insulator.

- Do not place any combustible material around this product.
- Do not place this product around heating elements such as heaters and large wire-wound resistors.
- Do not use this product in a corrosive and inflammable gas environment or in a place close to combustible materials.
- Do not use this product in a place with strong vibration or impact.
- Do not use this product after the cables are immersed in oil or water.
- Do not perform wiring at power-on.
- Do not damage the cables or apply any excessive external force, weight, or pinch to them.
- Do not connect this product directly to the commercial power supply.
- Do not perform installation and wiring in a place with strong electric or magnetic field.
- Do not perform wiring and equipment operations with wet hands.
- Do not reach your hands into this product.

WARNING

- Specialized loading and unloading equipment must be used to handle the product.
- When handling the equipment with bare hands, hold the equipment casing firmly with care to prevent parts from falling.
- Handle the equipment with care during transportation and mind your steps.
- When this product is installed in a terminal device, the terminal device must be equipped with protection. The protection class must comply with relevant IEC standards and local regulations.
- Cables used for wiring must meet cross sectional area and shielding requirements. The shield of the cable must be reliably grounded at one end.

- Do not install the equipment if you find damage, rust, or signs of use on the equipment or accessories upon unpacking.
- Do not install the equipment if you find water seepage or missing or damaged components upon unpacking.
- Do not install the equipment if you find the packing list does not conform to the equipment you received.
- When the product is lifted by a crane, personnel cannot stand or stay under the product.
- Do not modify this product.
- Do not fiddle with the bolts used to fix equipment components or the bolts marked in red.
- Do not connect the input power supply to the output end of the equipment.

CAUTION

- Check whether the equipment or accessories show the evidence of damage, rust, impact, or dampness.
- Check whether the package contents are consistent with the packing list.
- After wiring is completed, ensure that there are no screws fallen or cables exposed in the equipment.
- Make sure that the temperature around the equipment is within the range of temperature and humidity.
- Dispose of the equipment as industrial waste during discarding.

- Do not stand on the equipment or place a weight on it.
- Do not let the equipment fall or invert it during the handling or setup.
- Do not place any barriers around the product and peripheral equipment to hinder ventilation.
- Do not let the equipment suffer from any strong impact.

Safety Signs

Danger
- Conduct protective grounding to prevent electric shock. Read through the guide and follow the safety instructions before use.

High Voltage
- Do not touch terminals with power-on or within 10 minutes after disconnecting the power supply to prevent the risk of electric shock.

Hot
- Do not touch the drive during operation and within a short time after shutdown. Failure to comply may cause burns.

Environmental Protection

Reuse
- Some components of the product can be reused due to high metal content. Dismantle the product into individual components to improve the metal recycling efficiency. Electrical and electronic components contain metal materials that can also be recycled through a specific separation process.

Disposal
- Discard components that cannot be degraded and recycled as industrial wastes according to local regulations.

Chapter 1 Product Information

Extreme Performance and Efficient Application

A6-RS is a new-generation high-performance servo drive system promoted by STEPPERONLINE. This system is dedicated to realizing optimized configurations with higher productivity and production efficiency and lower production costs and providing drive solutions with optimal balance between performance and costs, helping your business success.

The A6-RS system consists of the series A6-RS servo drive and the A6M60 or A6M80 series servo motor, with the power in the range of 0.2kW to 1.0kW. The pulse reference mode is adopted, meeting various standard applications.

1.1 Features

Excellent performance:

- High response: 2 kHz speed loop bandwidth
- High accuracy: 17-bit absolute encoder
- High efficiency: highly dynamic and high precision to achieve higher productivity

Reliable operation:

- Built-in dynamic brake function.
- High-quality motor bearings extend the service life.
- The drive can run stably in harsh environment.
- The product is CE certified, meeting the equipment export requirement.

Easy-to-use:

- Compact design, making the product be able to be installed in narrow space.
- Easy to connect and use. The USB cable is used to improve debugging efficiency.

1.2 Model

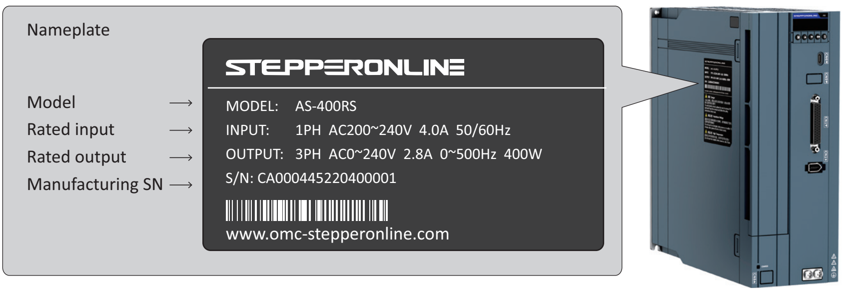
A6-1000 RS

RS	Pulse and 485

200	200W
400	400W
750	750W
1000	1000W

A6	A6 series servo drive

1.3 Nameplate



1.4 Components

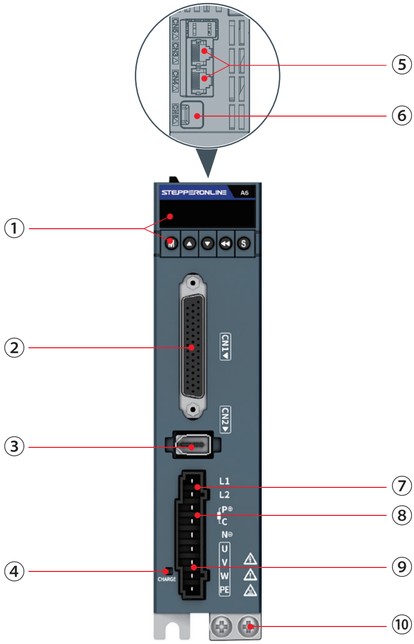


Figure 1-1 Components of the A6-RS servo drive (SIZE A)

No.	Name	No.	Name
①	Display and operation area	⑥	Commissioning and communication port (CN6)
②	Control signal port (CN1)	⑦	Power input
③	Encoder signal port (CN2)	⑧	Braking resistor port
④	Charging indicator	⑨	Motor power output
⑤	Communication port (CN3 and CN4)	⑩	System ground

NOTICE

- The above figure describes the component layout of the SIZE A drive. Component layout of other models may be different. For positions of ports of other models, see section 3.3 Ports.

1.5 Rated Data

Single-phase 220 V servo drive

Item	SIZE-A		SIZE-B
Power	0.2kW	0.4 kW	0.75 kW
Drive model	A6-200RS	A6-400RS	A6-750RS
Continuous output current (Arms)	1.6	2.8	5.5
Maximum output current (Arms)	5.8	10.1	16.9
Main circuit power supply	Single-phase 200–240 V AC, –10% to +10%, 50/60 Hz		
Control circuit power supply	Powered up by the bus, sharing one power supply and rectification part with the main circuit		
Braking capability	External braking resistor		Built-in braking resistor

Single-phase/Three-phase 220 V servo drive

Item	SIZE-C
Power	1.0 kW
Drive model	A6-1000RS
Continuous output current (Arms)	7.6
Maximum output current (Arms)	23
Main circuit power supply	Single-phase/three-phase 200–240 V AC, –10% to +10%, 50/60 Hz
Control circuit power supply	Single-phase 200–240 V AC, –10% to +10%, 50/60 Hz
Braking capability	Built-in braking resistor

1.6 Technical Specifications

Basic specifications

Item	Specifications
Control mode	IGBT PWM control, sine wave current drive mode 220 V, 380 V: Single-phase or three-phase full-bridge rectification
Encoder feedback	23-bit / 26-bit multi-turn absolute encoder, which can be used as a single-turn absolute encoder in absence of the battery
Operating temperature	0°C to +55°C (over 45°C: derate 10% for every additional 5°C)
Storage temperature	–40°C to +70°C
Altitude	Up to 2000 m. For altitude above 1000 m, derate 1% for every additional 100 m
IP rating	IP20 (except for the power terminal IP00)

Speed/torque control mode

Item	Specifications
Speed control range	1:6000 (The lower limit is the threshold within which the servo drive keeps running with the rated torque load.)
Frequency characteristic	2 kHz
Torque control accuracy	±1%
Soft start time setting	0 s to 3600 s (This parameter can be set for acceleration and deceleration separately.)

Position control mode

Item	Specifications
Feedforward compensation	0% to 100.0% (A resolution of 0.1% FS)
Input pulse form	Including "direction+pulse", "Phase A + B quadrature pulse" and "CW/CCW pulse reference form"
Input pulse frequency	Differential input: Up to 4 Mpps at high speed, and the pulse width cannot be less than 0.125 µs Open collector: Up to 200 kpps, and the pulse width cannot be less than 2.5 µs
Multi-position reference	Position 0 to position 15 selectable through DI signal combination
Output form	Phase A, phase B: differential output; Phase Z: differential output or open collector output

Built-in functions

Item	Specifications
Overtravel (OT) prevention	The servo drive stops immediately when P-OT or N-OT becomes active
Protection functions	Protections against overcurrent, overvoltage, undervoltage, overload, main circuit detection error, heatsink overheat, overspeed, encoder error, CPU error, and parameter error
LED display	Main power supply CHARGE indicator, 5-digit LED display
Vibration suppression	Five notches (including two adaptive notches), 50 Hz to 8000 Hz
Connection protocol	USB
Communication protocol	Modbus
Multi-station communication	Communication: When RS485 is used, up to 128 nodes can be connected
Axis address setting	Based on the user parameter setting
Function	Status display, user parameter setting, monitored value display, alarm tracing display, jogging, and speed/torque reference signal observation
Other	Gain tuning, alarm record, I/O setting, and jogging

Chapter 2 Mechanical Installation

CAUTION

- To facilitate heat dissipation upward, fix the drive longitudinally on the mounting surface.
- When installing the drive in a control cabinet, take into consideration the temperature change of the cooling air. Rapid temperature drop of the cooling air is not allowed.
- For installation of multiple servo drives inside the cabinet, install them side by side.
- For dual-row installation, install an air guide plate.
- Use the flame-retardant mounting bracket if necessary.
- Ground the grounding terminal properly. Failure to comply may cause an electric shock or malfunction due to interference.
- Route the servo drive cables downwards to prevent liquid from flowing into the servo drive along the cables.

2.1 Installation Environment

Item	Requirements
Place	Indoors
Grid	Overvoltage category (OVC): III
Altitude	Below 1000 m, up to 2000 m. For altitude above 1000 m, derate 1% for every additional 100 m.
Temperature	Storage: –40°C to +70°C Operation: 0°C to +55°C (For temperature above 45°C, derate 10% for every additional 5°C.), with temperature change less than 0.5°C/min
Humidity	Less than 95% RH, non-condensing
Vibration	Less than 4.9 m/s^2
Heat dissipation	Install and fix the device to the surface of an incombustible object and leave sufficient surrounding space for heat dissipation
Protection	• IP rating: IP20 (except for the power terminal IP00) • Avoid places with direct sunlight exposure, moisture, and water drop • Avoid places with corrosive, combustible, or explosive gas • Avoid places with oil and dust • Avoid places with strong electromagnetic interference • Avoid places with constant vibration or physical shock

2.2 Installation clearance

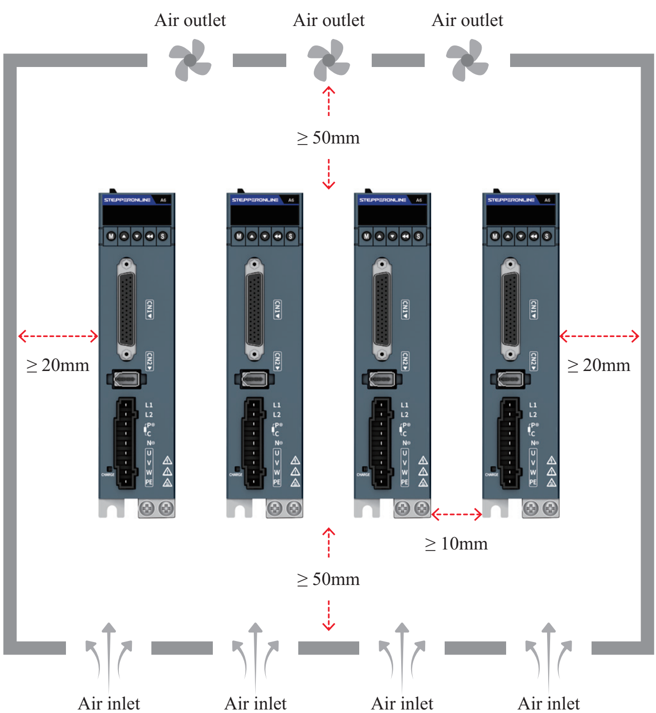
The A6-RS drive can only operate in an enclosed housing or control cabinet and must be fitted with a protective device and protective cover. Three clearances are allowed based on the drive power rating and heat dissipation requirements.

CAUTION

- To ensure the cooling effect and uniform temperature distribution in the control cabinet, reserve sufficient space and install a fan.
- The drive heats up as the motor runs, and running the drive in an enclosed control cabinet may cause abnormal temperature rise inside the cabinet. Install a cooling device for the drive to meet the ambient temperature requirements.

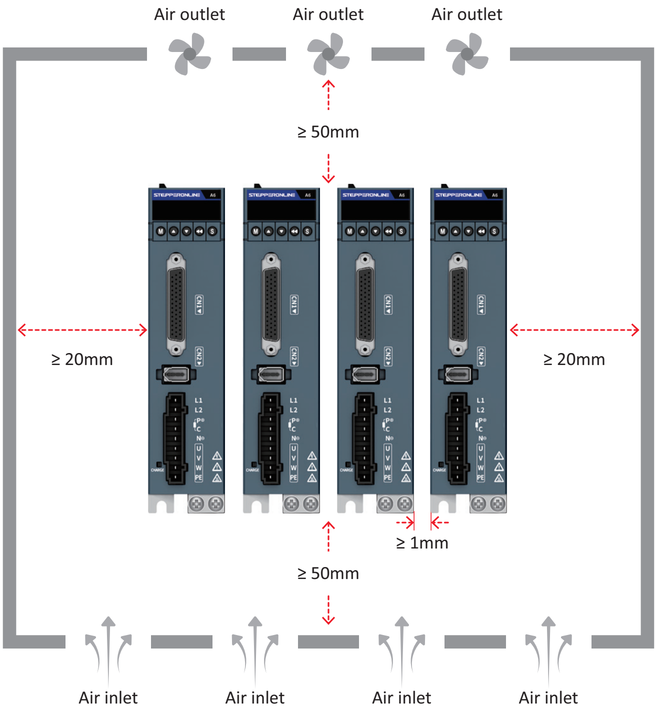
Clearance for side-by-side installation:

Applicable for all models.



Clearance for compact installation:

Applicable for models of SIZE A and SIZE B (0.2kW to 0.75 kW).

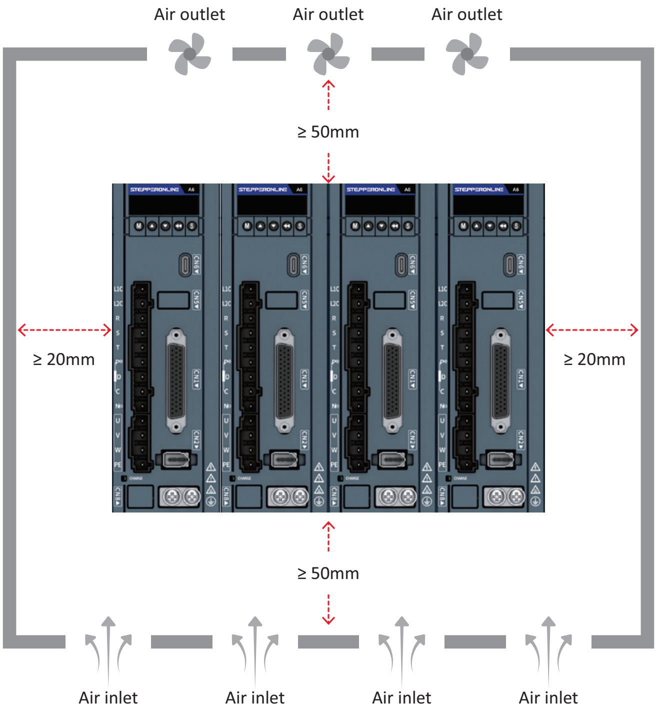


CAUTION

- The distance between adjacent servo drives must be equal to or greater than 1 mm. Take the installation tolerance into consideration.
- When adopting compact installation, derate the rated load rate to 75%.

Zero-clearance installation:

Applicable for models of SIZE C (1.0 kW), no derating.



2.3 Installation Orientation

The A6-RS drive can only be installed vertically, and improper installation orientation may cause over-temperature.

CAUTION

- The A6-RS series servo drive has a vertical structure and thus must be installed vertically. Improper installation orientation may cause over-temperature and then damage to the drive.

2.4 Installation Dimensions

SIZE A (rated power: 0.2kW to 0.4 kW)

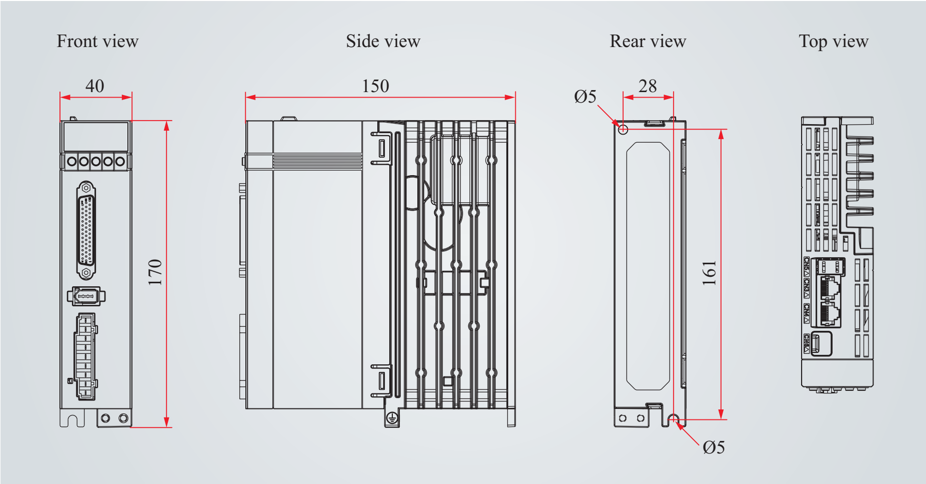


Figure 2-1 Installation dimensions for SIZE A (unit: mm)

SIZE B (rated power: 0.75 kW)

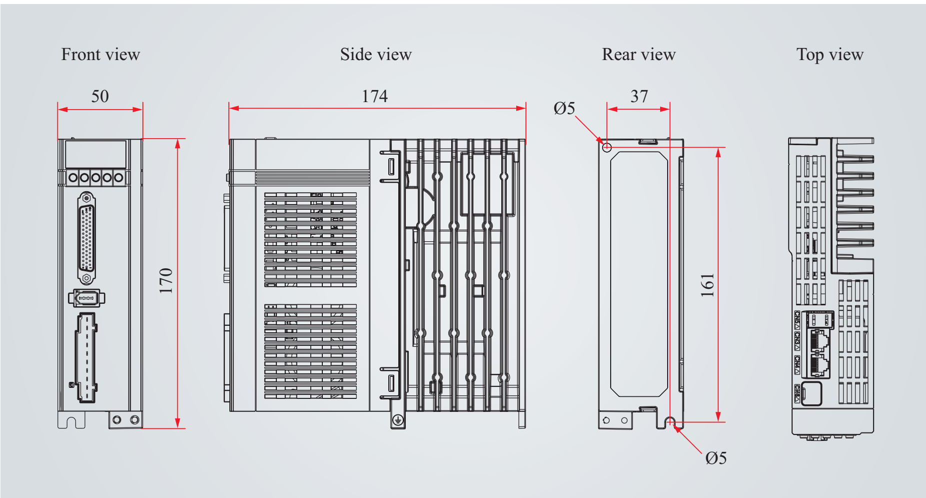


Figure 2-2 Installation dimensions for SIZE B (unit: mm)

SIZE C (rated power: 1.0kW)

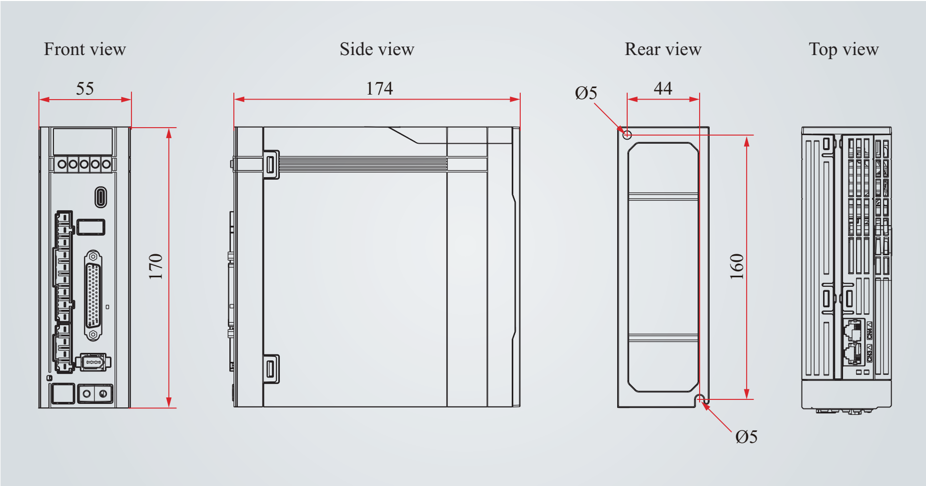


Figure 2-3 Installation dimensions for SIZE C (unit: mm)

Table 2-1

Table 2-2 Dimensions of the outer packing box

SIZE	Drive Model	Outer Length	Outer Height	Outer Width	Weight
A	A6-200RS / A6-400RS	215 mm	85 mm	195 mm	0.78 kg
B	A6-750RS	220 mm	95 mm	215 mm	1.04 kg
C	A6-1000RS	220 mm	95 mm	215 mm	1.20 kg

2.5 Installation Guide

The A6-RS series servo drive must be installed on a base through a backplate. For the mounting holes, see the dimensions diagrams of each model.

NOTICE

Fixing with upper and lower screws

- SIZE-A/B/C: M4 screws, 1 each on top and bottom. Torque: 1.3 N·m to 1.6 N·m

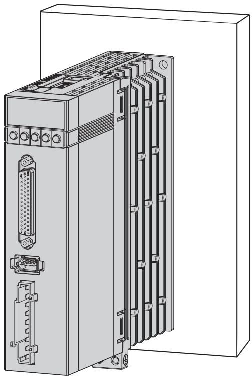


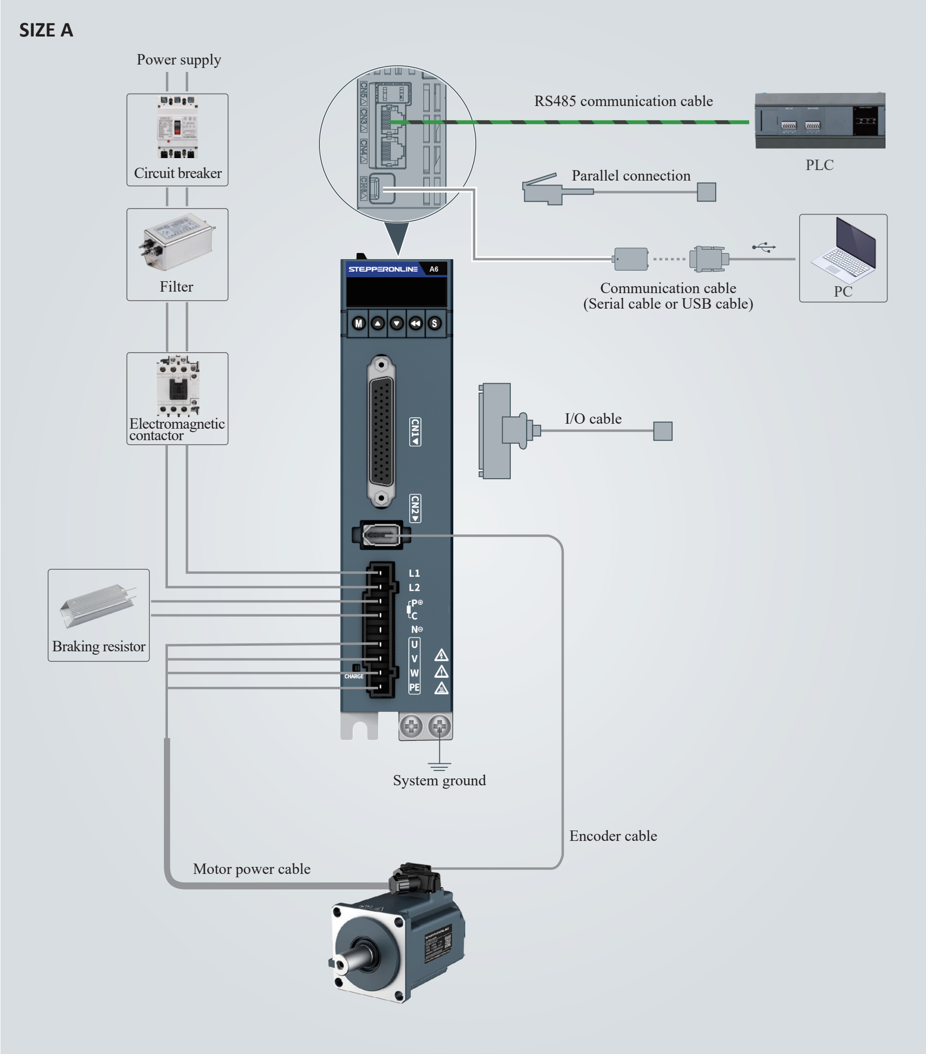
Figure 2-4 Backplate mounting

CAUTION

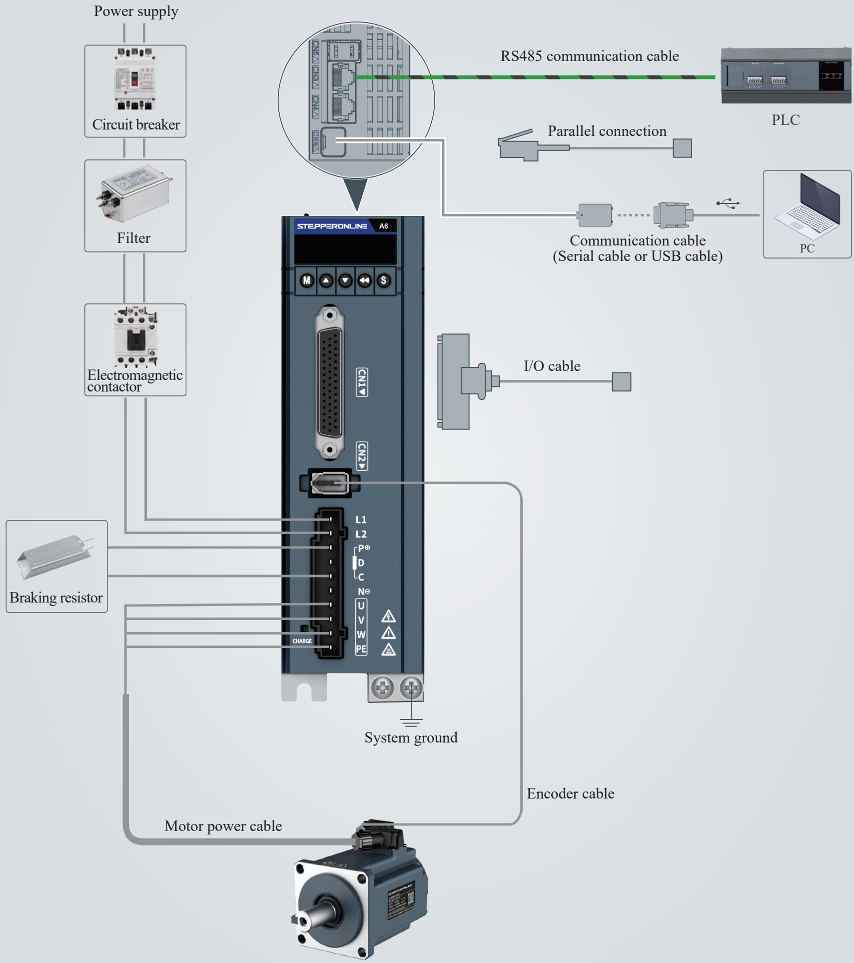
- For the tightening torque of the mounting screws, take into account the strength of the screws used and the material of the mounting position, and ensure that there is no looseness or damage.

Chapter 3 Electrical Installation

3.1 System Topology

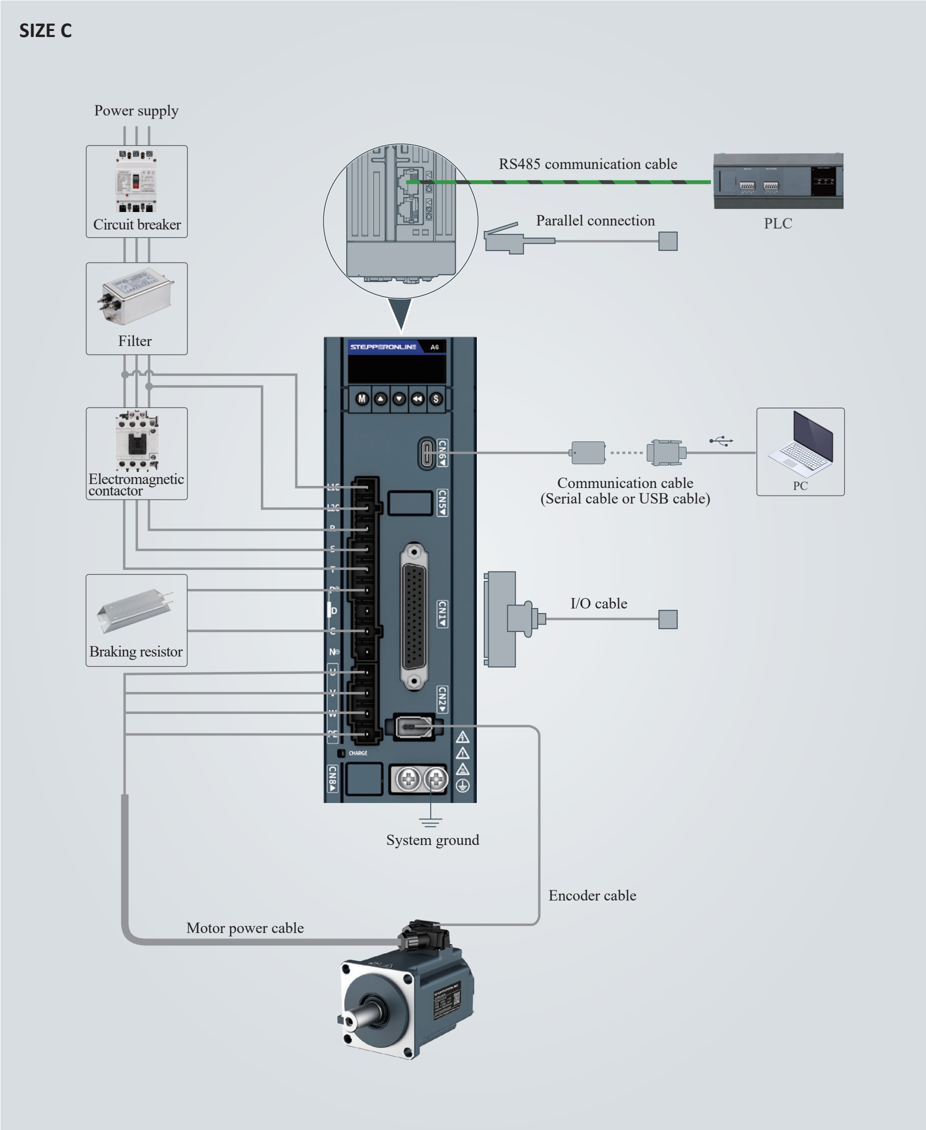


SIZE B



NOTICE

- Remove the jumper bar between terminals P⊕ and D before connecting an external braking resistor.



NOTICE

- Remove the jumper bar between terminals P⊕ and D before connecting an external braking resistor.

3.2 System Wiring

WARNING

- Only electrical engineering specialists can perform wiring.
- Connect an electromagnetic contactor between the input power supply and the main circuit of the drive, to form a structure that can cut off the power supply on the power side of the drive. If no electromagnetic contactor is connected, continuous large current upon drive faults may cause a fire.
- Ensure that the input voltage of the drive is within the allowable range. Failure to comply may result in product faults.
- Connect the drive protective earth (PE) terminal to that of the control cabinet. Failure to comply may result in an electric shock.
- Insulate the connection part of power supply terminals during wiring of the power supply and main circuit. Failure to comply may result in an electric shock.
- Ground the entire system. Failure to comply may result in malfunction.
- After power-off, wait at least 10 minutes before further wiring operations because residual voltage exists after power-off. Failure to comply may result in an electric shock.

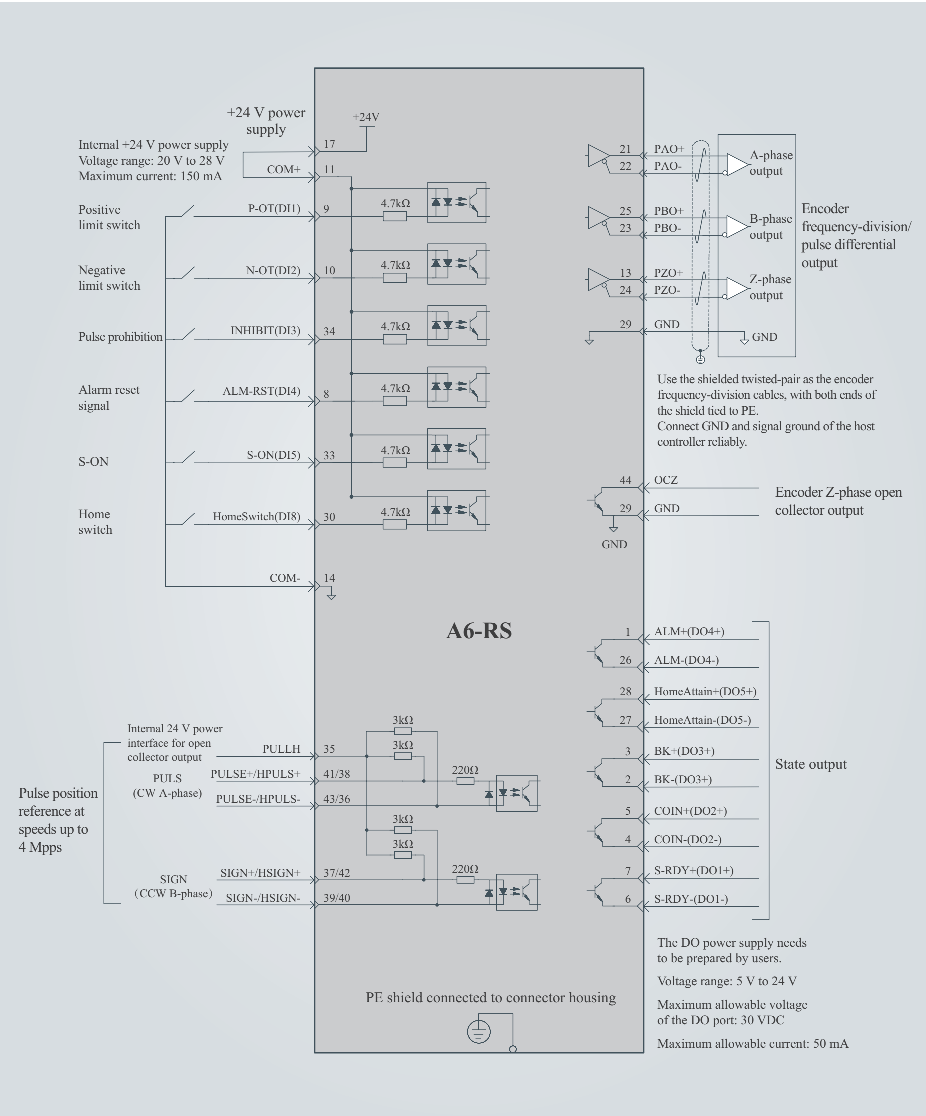
- Never power the servo drive with the IT grid. Use the TN or TT grid instead. Failure to comply may result in an electrical shock.
- Do not connect the output terminals U, V, and W of the drive to a three-phase power supply. Failure to comply may result in physical injury or a fire.
- Do not connect the motor terminals U, V, and W to a mains power supply. Failure to comply may result in physical injury or a fire.
- Do not power on the device before wiring is completed. Failure to comply may result in an electrical shock.

CAUTION

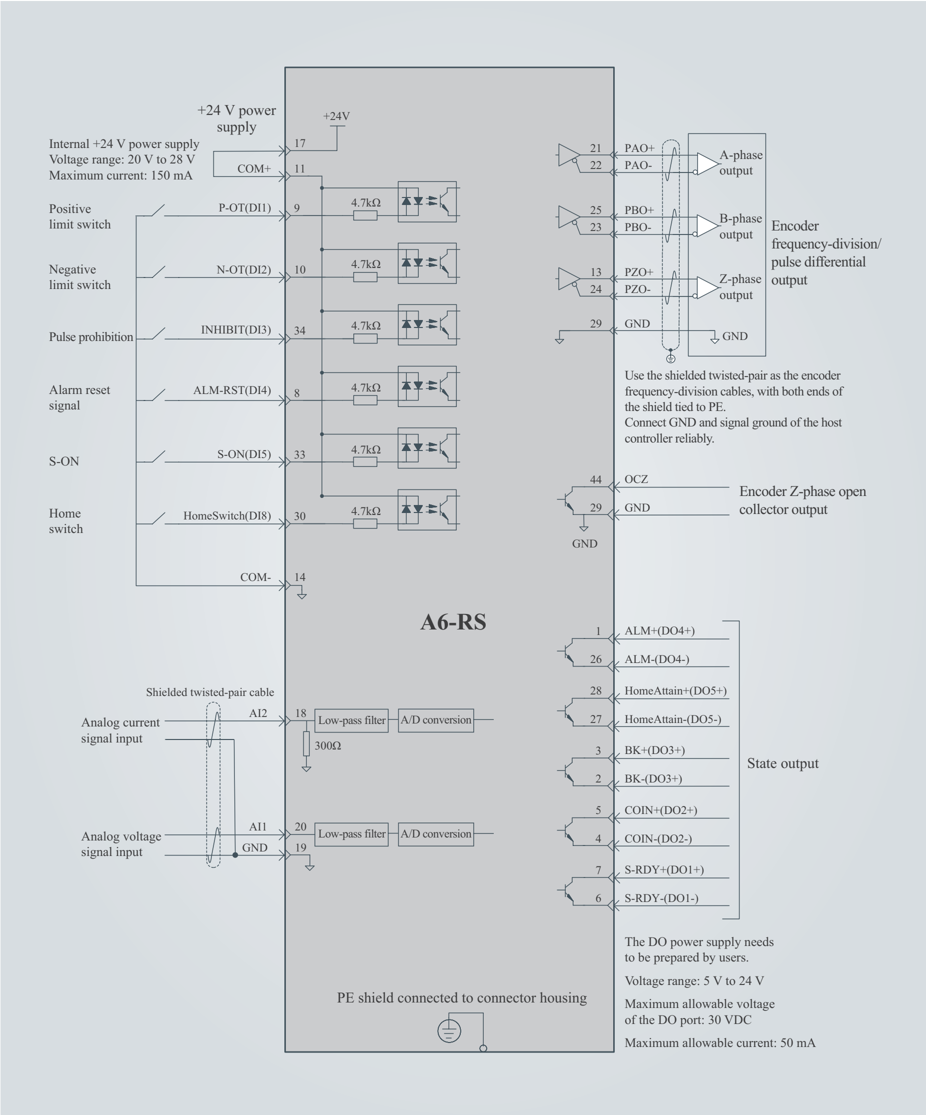
- Protect external wiring, branches, and short circuits according to local regulations.
- When using peripheral devices, read the user guide for each component and use it properly after fully confirming the precautions.
- Route the device properly. Improper wiring may cause damage to the drive and motor.
- Connect the drive to the motor directly, without connecting any electromagnetic contactor between them. Failure to comply may result in faults.
- Separate the main circuit cables from the I/O signal cables and encoder cables by at least 30 cm. Failure to comply may result in drive malfunction.
- Use twisted pairs or multi-conductor shielded twisted pairs as I/O signal cables or encoder cables. Failure to comply may result in drive malfunction.
- The maximum wiring lengths of I/O signal cables and encoder cables are 3 m and 10 m, respectively.
- Use a power filter to reduce electromagnetic interference on electronic devices around the drive.

- When wiring, do not allow conductive materials such as wire shavings to fall inside the drive.
- Never place cables under heavy objects or drag cables vigorously. Failure to comply may result in an electric shock due to cable damage.

Position mode

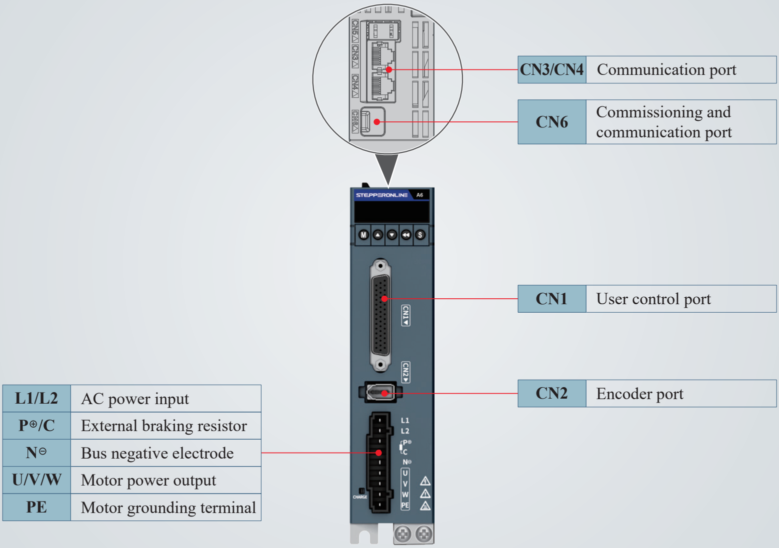


Torque mode

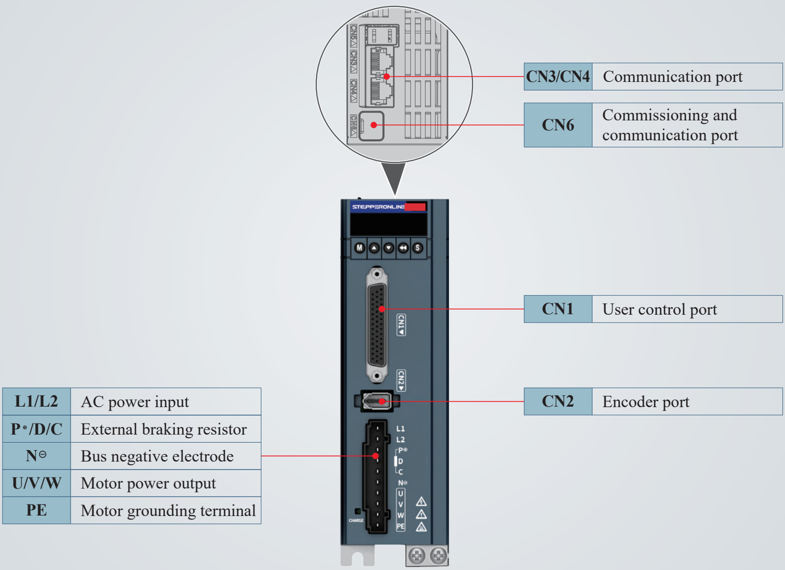

+24 V power supply
+24V
Internal +24 V power supply
Voltage range: 20 V to 28 V
Maximum current: 150 mA
17
COM+
11
Positive limit switch
P-OT(DI1)
9
Negative limit switch
N-OT(DI2)
10
Pulse prohibition
INHIBIT(DI3)
34
Alarm reset signal
ALM-RST(DI4)
8
S-ON
S-ON(DI5)
33
Home switch
HomeSwitch(DI8)
30
4.7kΩ
COM-
14
A6-RS
Shielded twisted-pair cable
Analog current signal input
AI2
18
Low-pass filter
A/D conversion
300Ω
Analog voltage signal input
AI1
20
GND
19
PE shield connected to connector housing
21 PAO+
22 PAO-
A-phase output
25 PBO+
23 PBO-
B-phase output
13 PZO+
24 PZO-
Z-phase output
29 GND
GND
Encoder frequency-division/ pulse differential output
Use the shielded twisted-pair as the encoder frequency-division cables, with both ends of the shield tied to PE.
Connect GND and signal ground of the host controller reliably.
44 OCZ
29 GND
GND
Encoder Z-phase open collector output
1 ALM+(DO4+)
26 ALM-(DO4-)
28 HomeAttain+(DO5+)
27 HomeAttain-(DO5-)
3 BK+(DO3+)
2 BK-(DO3+)
5 COIN+(DO2+)
4 COIN-(DO2-)
7 S-RDY+(DO1+)
6 S-RDY-(DO1-)
State output
The DO power supply needs to be prepared by users.
Voltage range: 5 V to 24 V
Maximum allowable voltage of the DO port: 30 VDC
Maximum allowable current: 50 mA

3.3 Ports

SIZE A



SIZE B



SIZE C

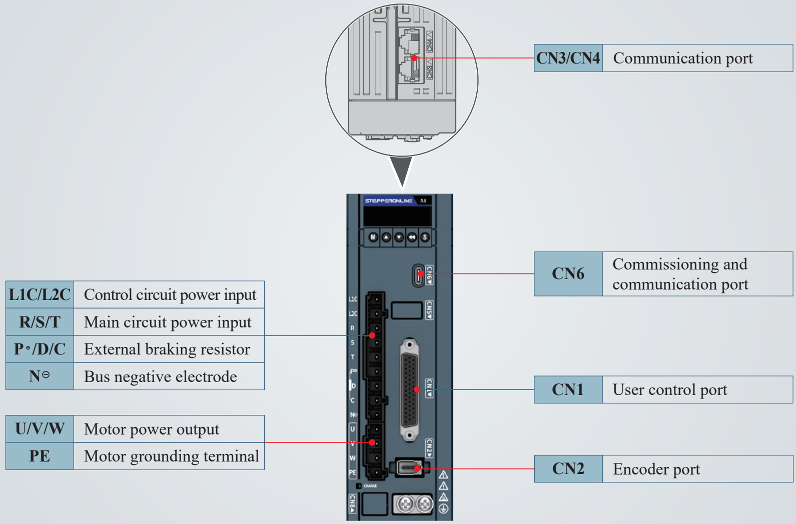
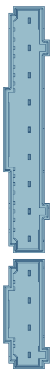
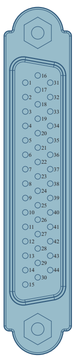
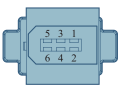
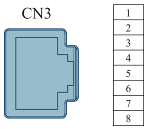
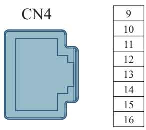
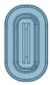


Table 3-1 Drive terminals

Terminal	Pin	Description
 L1C L2C R S T P⊕ D C N⊖ U V W PE Main circuit terminals	L1C and L2C: Control circuit power input terminals	Connected to the control circuit power supply as per the rated voltage class on the nameplate.
	R, S, and T: Main circuit power input terminals	Connected to the main circuit power supply as per the rated voltage class on the nameplate.
	P⊕ and N⊖: Servo bus terminals	Used when multiple servo drives share one DC bus.
	P⊕, D, and C: External braking resistor connection terminals	If an external braking resistor is needed, connect it between terminals P⊕ and C. ***Note:*** *Remove the jumper between terminals P⊕ and D before installing an external braking resistor. Otherwise, the braking transistor will be damaged due to overcurrent.*

Terminal	Pin		Description
	U, V, and W: Servo motor connection terminals		Connected to U, V, and W phases of the servo motor.
	PE: Motor grounding terminal		Connected to the grounding terminal of the motor for grounding purpose.
 CN1 user control terminal	7	DO1+	Servo ready
	6	DO1-	
	5	DO2+	Positioning completed
	4	DO2-	
	3	DO3+	Brake output
	2	DO3-	
	1	DO4+	Fault output
	26	DO4-	
	28	DO5+	Home attaining completed
	27	DO5-	
	9	DI1	Positive limit switch
	10	DI2	Negative limit switch
	34	DI3	Position reference inhibited
	8	DI4	ALM-RST (edge valid function)
	33	DI5	S-ON
	32	DI6	-
	12	DI7	-
	30	DI8	Home switch
	17	24V	Internal 24 V power supply Voltage range: 20 V to 28 V Max. output current: 150 mA
	14	COM-	
	11	COM+	Common terminal of DI terminals
	41	PULSE+	Low-speed pulse reference mode: • Differential drive input • Open collector Input pulse form: • Direction+pulse • Phase A + B quadrature pulse • CW/CCW pulse
	43	PULS-	
	37	SIGN+	
	39	SIGN-	

Terminal	Pin		Description
	38	HPULS+	High-speed input pulse reference
	36	HPULS-	
	42	HSIGN+	High-speed position reference symbol
	40	HSIGN-	
	35	PULLH	Input interface of external power supply for reference pulse
	21	PAO+	A-phase frequency-division output/fully closed-loop input
	22	PAO-	
	25	PBO+	B-phase frequency-division output/fully closed-loop input
	23	PBO-	
	13	PZO+	Z-phase frequency-division output/fully closed-loop input
	24	PZO-	
	29	GND	Signal ground
	44	OCZ	Encoder Z-phase open collector output
	15	5V	5 V power supply
	16	GND	Power ground
	20	AI1	Analog voltage signal input
	18	AI2	Analog current signal input
	31	AO1	Analog voltage output
	19	GND	Analog signal ground
 CN2 encoder terminal	1	+5V	5 V power supply
	2	0V	0 V power supply
	3	Reserved	-
	4	Reserved	-
	5	PS +	Encoder signal+
	6	PS -	Encoder signal-
	Enclosure	PE	Shield

Terminal	Pin		Description
 CN3 communication terminals	4	RS485+	Data transmit+
	5	RS485-	Data transmit–
	6	-	-
	7	-	-
	8	GND	Data receive–
	Enclosure	PE	Shielding layer
 CN4 communication terminals	12	RS485+	Data transmit+
	13	RS485-	Data transmit–
	14	-	-
	15	-	-
	16	GND	Data receive–
	Enclosure	PE	Shielding layer
 CN6 commissioning and communication terminal	Type-C		1: Type-c to serial, serial to USB 2: Type-c→USB

3.4 Power Supply Connection

CAUTION

- Do not connect the input power cables to the output terminals U, V and W. Failure to comply may cause damage the servo drive.
- Do not touch power terminals within 10 minutes after power-off because high voltage exists inside the drive after power off.
- Do not bundle power cables and signal cables together or route them through the same duct. Power cables and signal cables must be separated by a distance of at least 30 cm to prevent interference.
- Do not turn on and off the power supply frequently (once a minute). Failure to comply may cause drive faults.
- Do not power on the servo drive when any screw of the terminal block or any cable becomes loose. Failure to comply may cause a fire.

- Select cables based on the ambient temperature of the controller:
  When the ambient temperature is high, use heat-resistant cables. Teflon cables are recommended.
  Take heat preservation measures in low-temperature environments because the surface of regular cables may be easily hardened and cracked under low temperature.
- Use cables that can resist a voltage of 600 V AC or above and have a rated temperature of 75°C or above for the main circuit.
- Use a grounding cable with the same cross-sectional area as the main circuit cable. If the cross-sectional area of the main circuit cable is less than 1.6 mm^2, use a grounding cable with a cross-sectional area of 2.0 mm^2.
- Ground the drive reliably. Failure to comply may result in malfunction or even damage of the drive.
- Use shielded cables to comply with the EMC requirements.

3.4.1 Main circuit wiring

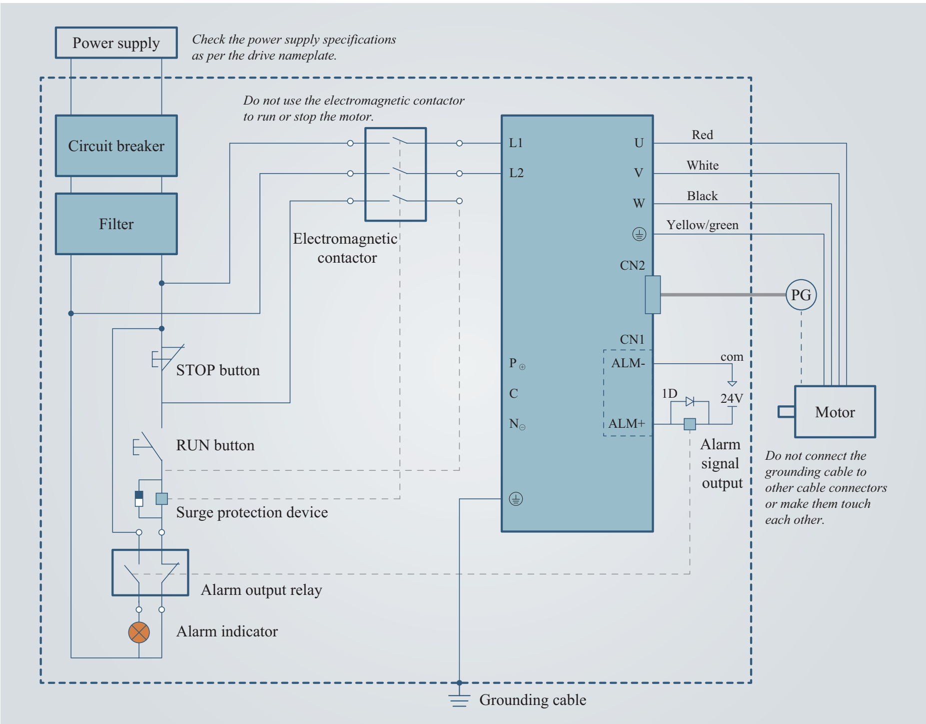


Figure 3-1 Wiring of the single-phase 220 V main circuit

NOTICE

Models with a single-phase 220 V power supply

- Model SIZE-A: A6-200RS, A6-400RS
- Model SIZE-B: A6-750RS
- Model SIZE-C: A6-1000RS(The main circuit can be connected to a single-phase or a three-phase 220 V power supply, depending on which one is available on site.)

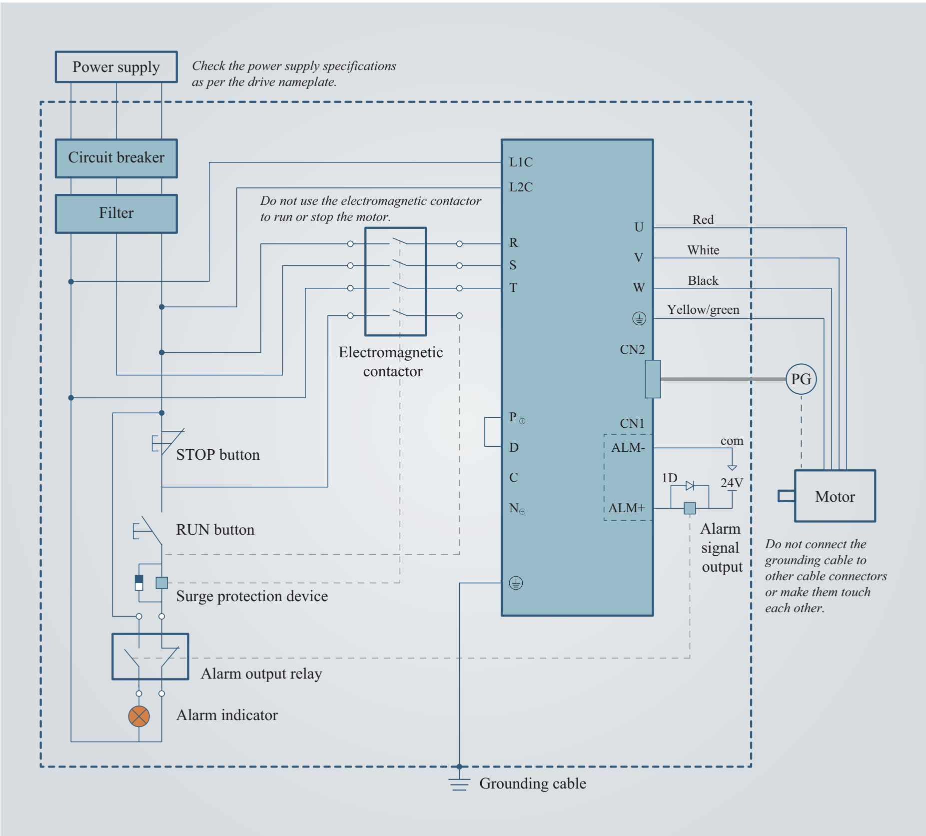


Figure 3-2 Wiring of the three-phase 220 V main circuit

NOTICE

Models with a three-phase 220 V power supply

- Model SIZE-C: A6-1000RS (The main circuit can be connected to a single-phase or a three-phase 220 V power supply, depending on which one is available on site.)

3.4.2 Cable specifications and recommendations

Table 3-2 Drive input and output current and recommended cables

Drive Model		Rated Input Current	Rated Output Current	Max. Output Current	Input Cable Specifications
Single-phase 220 V					
SIZE A	A6-200RS	2.3A	1.6A	5.8A	0.75 mm^2
SIZE A	A6-400RS	4 A	2.8 A	10.1 A	0.75 mm^2
SIZE B	A6-750RS	7.9 A	5.5 A	16.9 A	0.75 mm^2
SIZE C	A6-1000RS	9.6 A	7.6 A	23 A	1 mm^2
Three-phase 220 V					
SIZE C	A6-1000RS	5.1 A	7.6 A	23 A	0.75 mm^2

Table 3-3 Drive cable specifications and recommendations

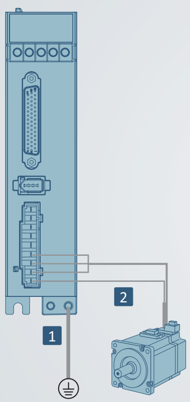
Cable Type	Cable Size	Outer Diameter (OD)
Power cable	4 × 12 AWG	12.2 ± 0.4 mm
	4 × 14 AWG	10.5 ± 0.3 mm
	4 × 16 AWG	9.5 ± 0.4 mm
	4 × 18 AWG	7.8 ± 0.2 mm
	4 × 20 AWG	6.5 ± 0.2 mm
Power shielded cable	4 × 12 AWG	12.9 ± 0.4 mm
	4 × 14 AWG	11.2 ± 0.4 mm
	4 × 16 AWG	10.1 ± 0.4 mm
	4 × 18AWG	8.3 ± 0.2 mm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

3.4.3 Grounding

CAUTION

- To prevent electric shock, ground the grounding terminal properly.
- Use grounding cables that meet technical standards for electrical devices and use protective grounding conductors that meet technical specifications. and shorten the grounding cable as much as possible.
- For use of multiple servo drives, ground them all. Improper grounding of the device may cause malfunction of the servo drive and the device.
- Do not use one grounding cable for multiple devices. Improper grounding of the device may result in servo drive or device faults caused by electrical interference.
- For drives equipped with selective grounding screws for VDR and insulation resistor, remove the selective grounding screw for VDR before voltage resistance test. Failure to comply may cause the servo drive to fail the test.
- Install the servo drive on a conductive metal mounting surface. Ensure that the whole conductive bottom of the device is attached properly to the mounting surface.
- Fix the grounding screw with the recommended torque. Avoid loosening or over-tightening of the protective grounding conductor.

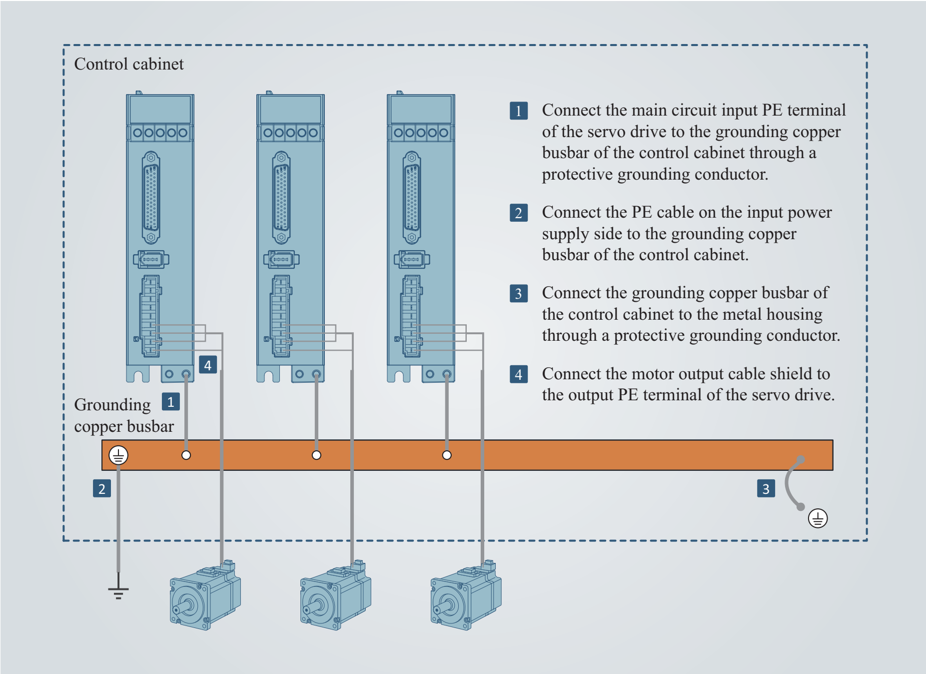
Grounding one servo drive alone



1 Connect the PE cable on the input power supply side to the input PE terminal of the drive.

2 Connect the output PE terminal of the drive to the motor output cable shield.

Grounding multiple servo drives



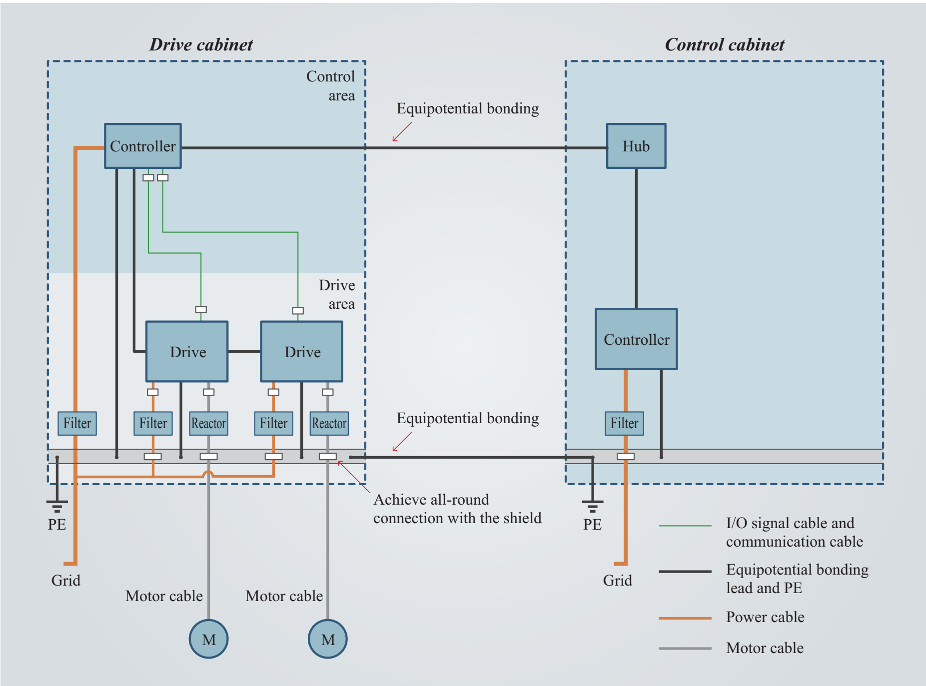
Grounding the control cabinet system

To suppress interference in the control cabinet, isolate the interference source from devices that may be interfered with. Divide the control cabinet into multiple EMC compartments or use multiple control cabinets based on the intensity of interference sources.

NOTICE

System installation principles:

- Place the control unit and the drive unit in two separate control cabinets.
- For installation involving multiple control cabinets, use a grounding cable with a cross-sectional area of at least 16 mm^2 to connect the control cabinets. This is to ensure equipotentiality between the cabinets.
- If only one control cabinet is used, place different devices in different compartments of the control cabinet based on signal intensity.
- Apply equipotential bonding to devices in different compartments inside the control cabinet.
- Shield all communication and signal cables drawn from the control cabinet.
- Place the power input filter in a position near the input interface of the control cabinet.
- Apply spray coating to each grounding point in the control cabinet.



Recommended grounding cable lugs for main circuit

Table 3-4 Recommended grounding cable lugs for power circuit

Drive Model		Rated Output Current	Lug Model of Power Cable	Lug Model of Brake Cable	Lug Model of PE Cable
SIZE A	A6-200RS	1.6A	E1008	E0508	TVR2-4
	A6-400RS	2.8 A	E1008	E0508	TVR2-4
SIZE B	A6-750RS	5.5 A	E1008	E0508	TVR2-4
SIZE C	A6-1000RS	7.6 A	E1508	E1008	TVR2-4

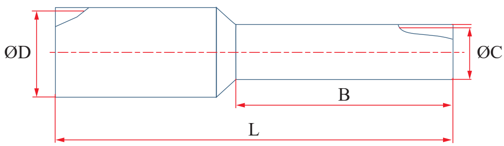
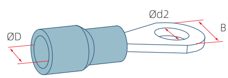


Table 3-5 Lug models and dimensions

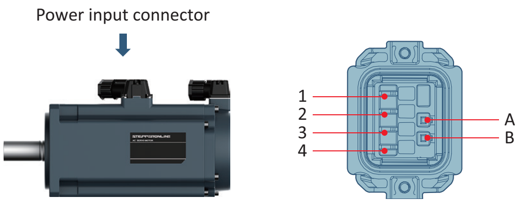
Lug model	L	B	ØC	ØD	Color
E0508	14 mm	8 mm	1.0 mm	2.6 mm	Orange
E1008	14 mm	8 mm	1.4 mm	3.0 mm	Yellow
E1508	14 mm	8 mm	1.7 mm	3.5 mm	Red

Table 3-6 Dimensions and appearance of TVR2-4 cable lugs of the grounding cable

Lug model		D	d2	B	Appearance
TVR	2-4	4.5mm	4.3mm	8.5mm	

3.5 Motor Connection

Terminal-type motor



Pin No.	Usage
1	Phase V
2	Phase U
3	Phase W
4	Grounding cable
A	Brake (polarity insensitive)
B	Brake (polarity insensitive)

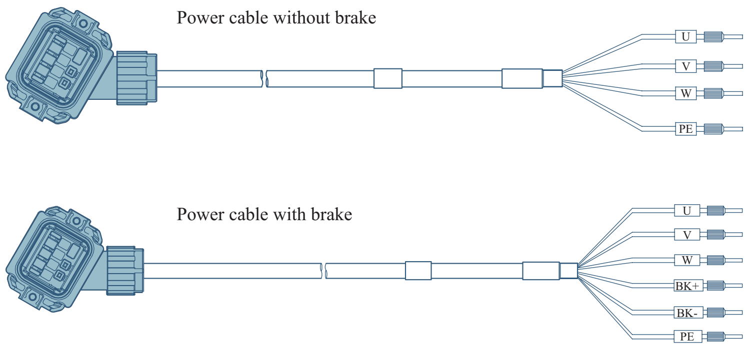
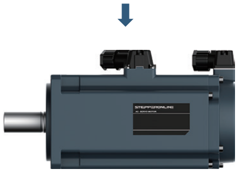
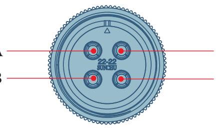


Figure 3-3 Power cable for terminal-type motor

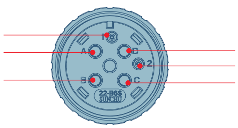
Aviation plug-type motor

Power input connector





Pin No.	Usage
A	Phase U
B	Phase V
C	Phase W
D	Grounding cable



Pin No.	Usage
A	Phase U
B	Phase V
C	Phase W
D	Grounding cable
1	Brake (polarity insensitive)
2	Brake (polarity insensitive)

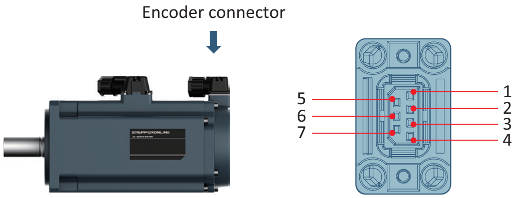
3.6 Encoder Connection (CN2)

CAUTION

Precautions for wiring of encoder signal cables:

- Ground the shield on the drive side and the motor side. Otherwise, the drive will report false alarms.
- Do not connect cables to "reserved" terminals.
- When determining the length of the encoder cable, take into full account the voltage drop caused by cable resistance and signal attenuation caused by distributed capacitance. Use shielded twisted pairs above 26 AWG (as per UL2464 standard) and keep the length within 10 m.

Terminal-type motor



Pin No.	Usage
1	DATA+
2	DATA-
3	BAT+
4	BAT-
5	+5V
6	0V
7	FG

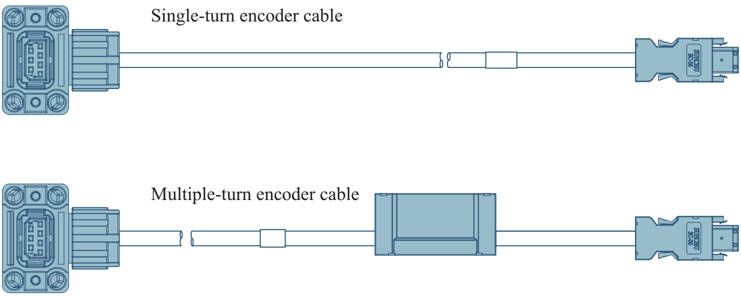


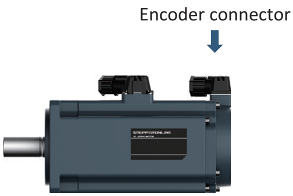
Figure 3-4 Absolute encoder signal cables

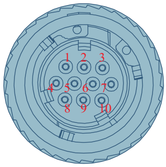
⚠ CAUTION

Battery box precautions:

- Install the battery in the correct direction. Do not pinch the connector cable when closing the battery box cover.
- Do not disassemble the battery because the internal electrolyte may spread out and cause physical injury.
- Do not short circuit the battery. Failure to comply may deteriorate the battery power and even incur the risk of explosion due to violent overheating.
- Before discarding the battery, insulate the battery with tape and then dispose of it according to local regulations.

Aviation plug-type motor





Pin No.	Usage
1	DATA+
2	DATA-
4	+5V
5	BAT-
6	BAT+
9	0V
10	Enclosure

3.7 Control Signal Connection (CN1)

Control terminal	Connector Kit/Material No.	AWG
CN1	DB44	24~30

Use shielded signal cables to protect I/O signal circuits against strong interference noise at the periphery.

- Use a separate shielded cable for each type of analog signal.
- Shielded twisted pairs are recommended as digital signal cables.

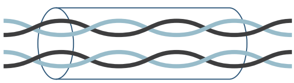


Figure 3-5 Shielded twisted pairs

CAUTION

- To avoid electromagnetic interference, keep a distance of at least 30 cm between I/O signal cables and power cables (input RST cables, output UVW cables, DC bus, and braking cables).

3.7.1 Position reference input signal

The pulse reference and symbol signal output circuit on the host controller side can either be differential drive output or open-collector output.

The following table lists the maximum input frequency and minimum pulse width of these output modes.

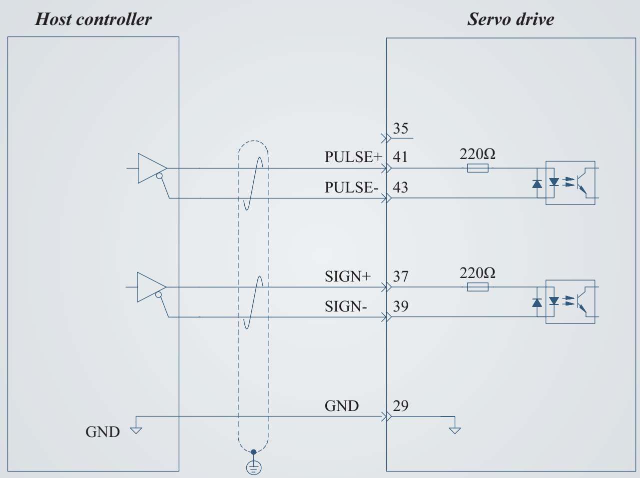
Pulse Mode		Single Channel Maximum Pulse Frequency (pps)	Minimum Pulse Width (µs)
Low speed	Differential	500k	1
	Open collector	200k	2.5
High-speed differential		4M	0.125

CAUTION

- The high-speed pulse and low-speed pulse cannot be used simultaneously, and only one of them can be used at a time.
- If the output pulse width of the host controller is smaller than the minimum value, an error occurs when the servo drive receives pulses.

Low-speed pulse reference input

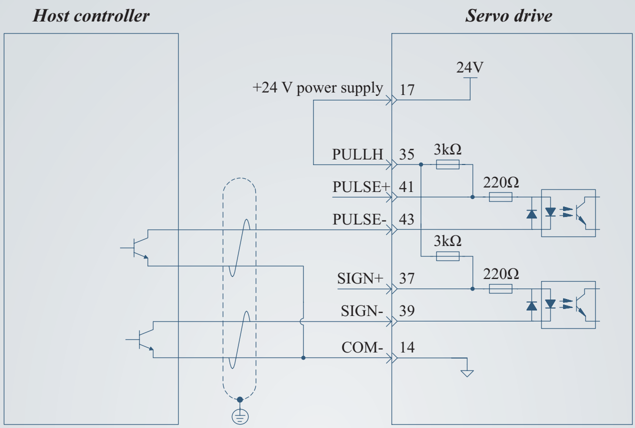
Differential mode

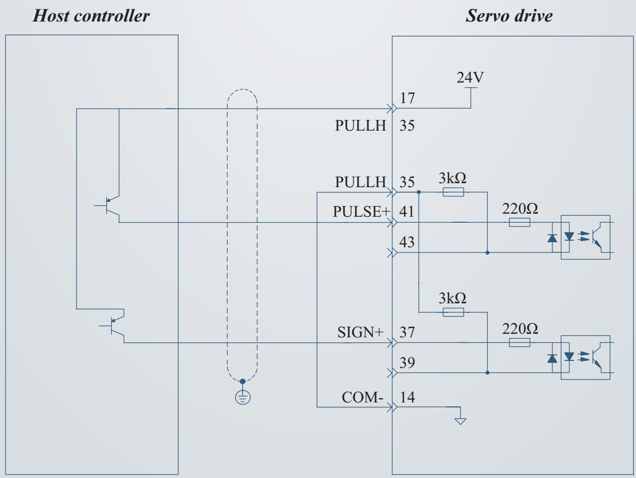


Note: This is a 5 V system. Please do not input the 24 V power.

Open collector mode

①When the internal 24 V power supply of the servo drive is used:

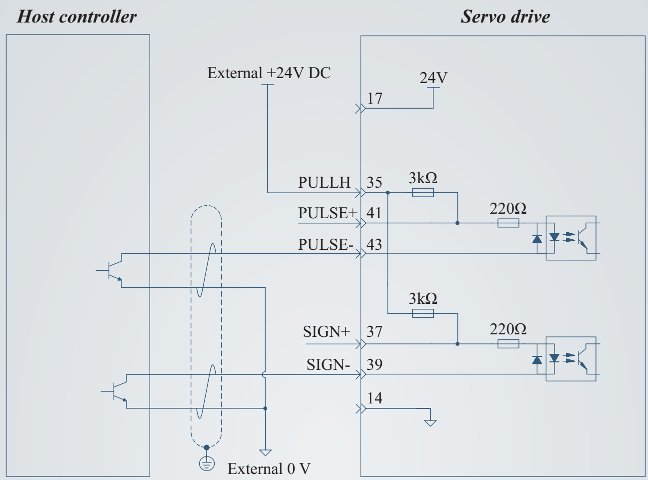


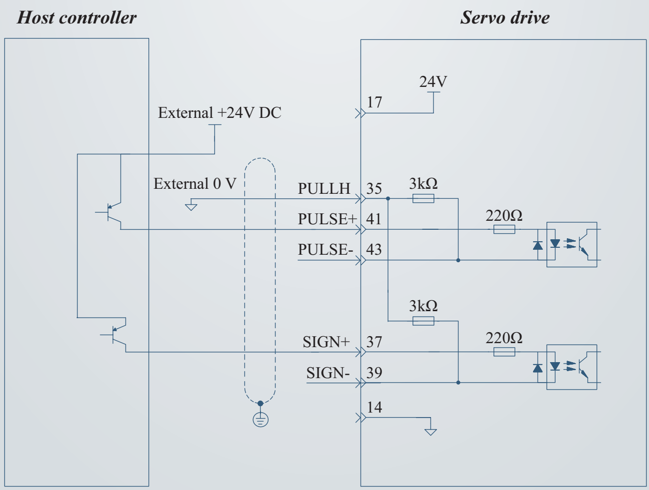


Open collector mode

②When the external power supply is used:

Scheme 1: using the internal resistor of the servo drive

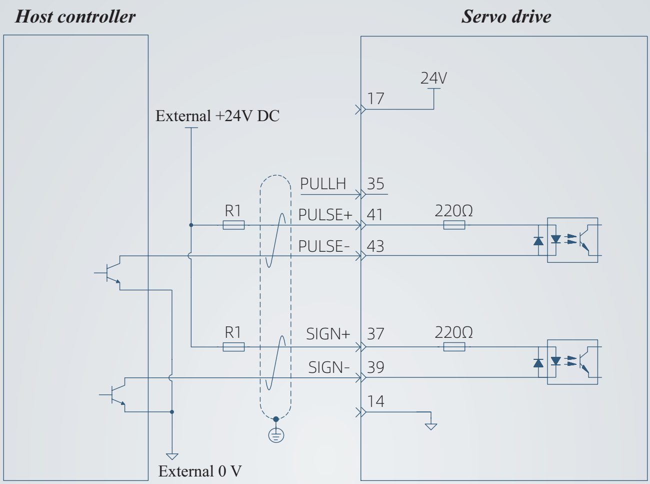


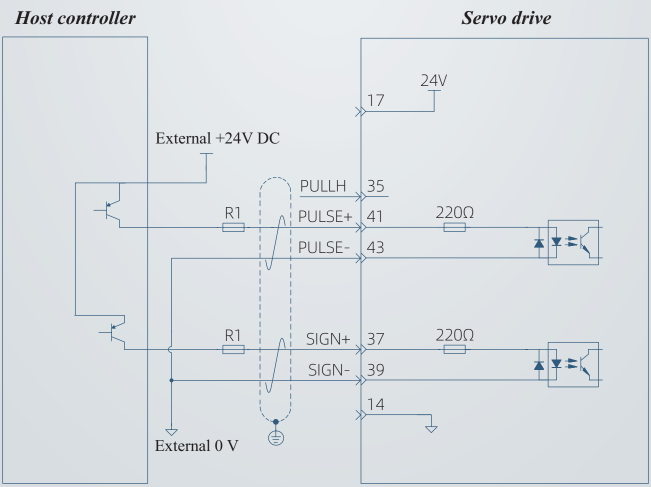


Open collector mode

②When the external power supply is used:

Scheme 2: using the external resistor





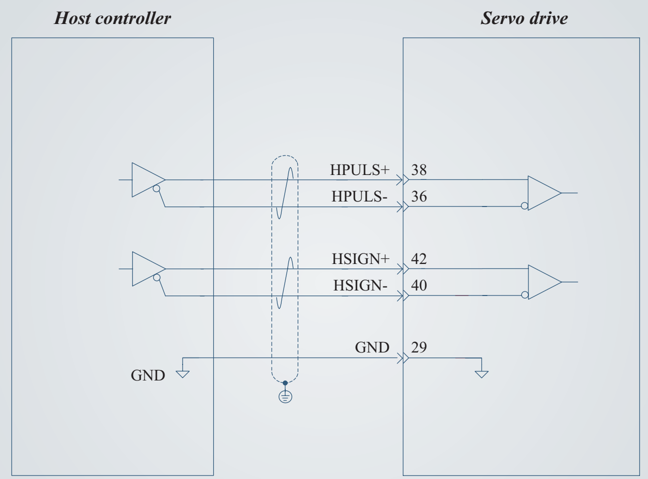
CAUTION

Avoid the following wiring errors:

- The current-limit resistor is not connected, resulting in burnout of terminals.
- Multiple terminals share the same current-limit resistor, resulting in the pulses receiving error.
- SIGN terminals are not connected, resulting in that these two terminals receive no pulses.
- Terminals are not correctly connected, resulting in burnout of terminals.
- Multiple terminals share the same current-limit resistor, resulting in the pulses receiving error.

High-speed pulse reference input

High-speed reference pulse and symbol signals on the host controller side can only be output to the servo drive via differential drive output.



Note: This is a 5 V system. Please do not input the 24 V power.

3.7.2 Analog input and output signals

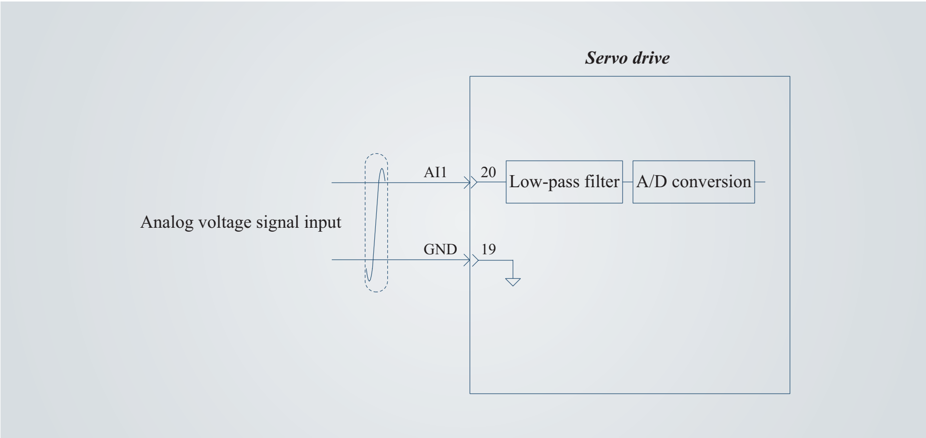
Analog input circuit

2-channel speed and torque analog signal input port: AI1/AI2

- AI1 voltage analog input (12-bit resolution)
  Input specification: -10 V to +10 V

Maximum allowable voltage: ±12 V
Input impedance: about 10 kΩ

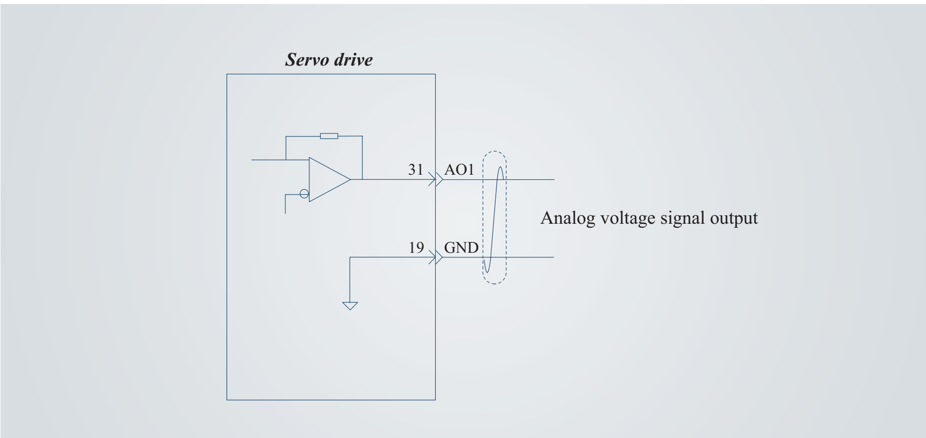
- AI2 current analog input
  Input specification: 4 mA to 20 mA
  Resolution: 12 bit



Analog output circuit

The speed and torque analog signal output terminal is AO1.

- Voltage range: -10 V to +10 V
- Output current limit: <1 mA



3.7.3 Digital input/output (DI/DO) signals

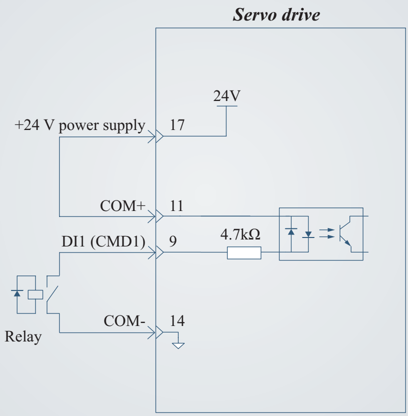
DI circuits

NOTICE

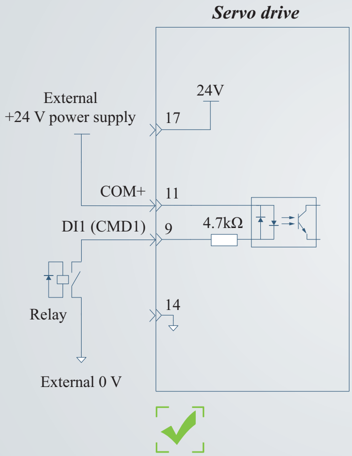
- The following takes DI1 as an example, and the remaining DI circuits are the same.

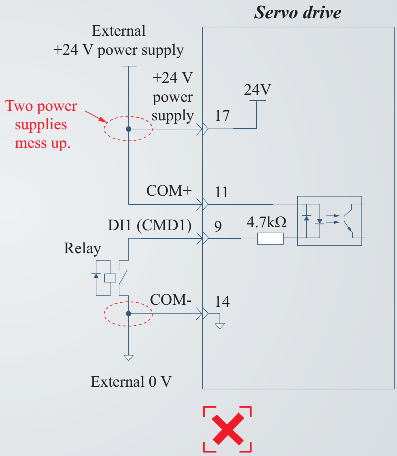
When the host controller adopts relay output:

- For use of the internal 24 V power supply of the servo drive.



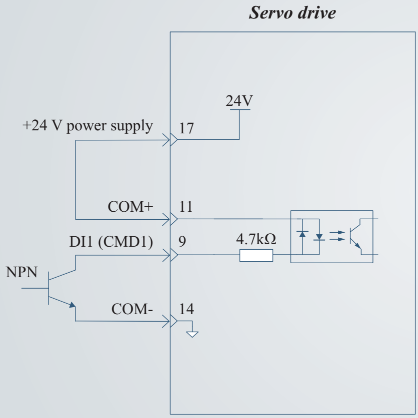
- For use of an external power supply.

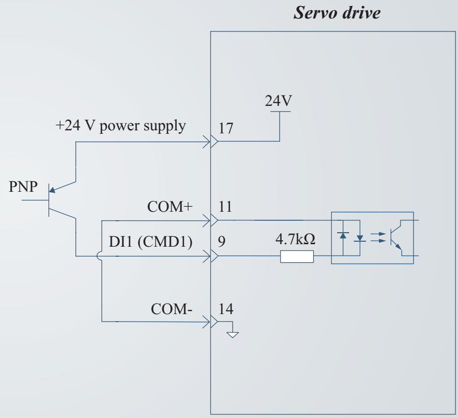




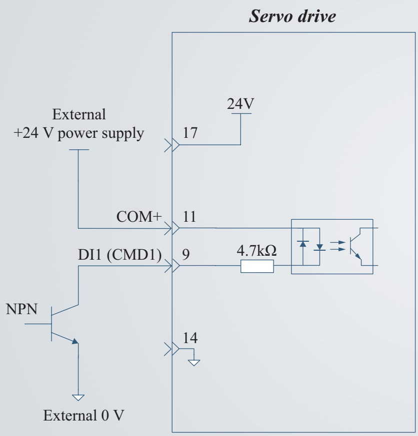
When the host controller adopts open collector output:

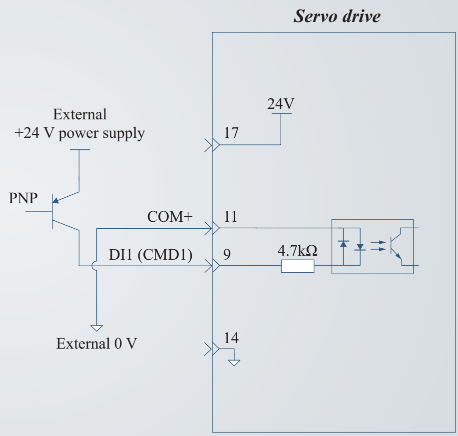
- For use of the internal 24 V power supply of the servo drive.





- For use of an external power supply.





NOTICE

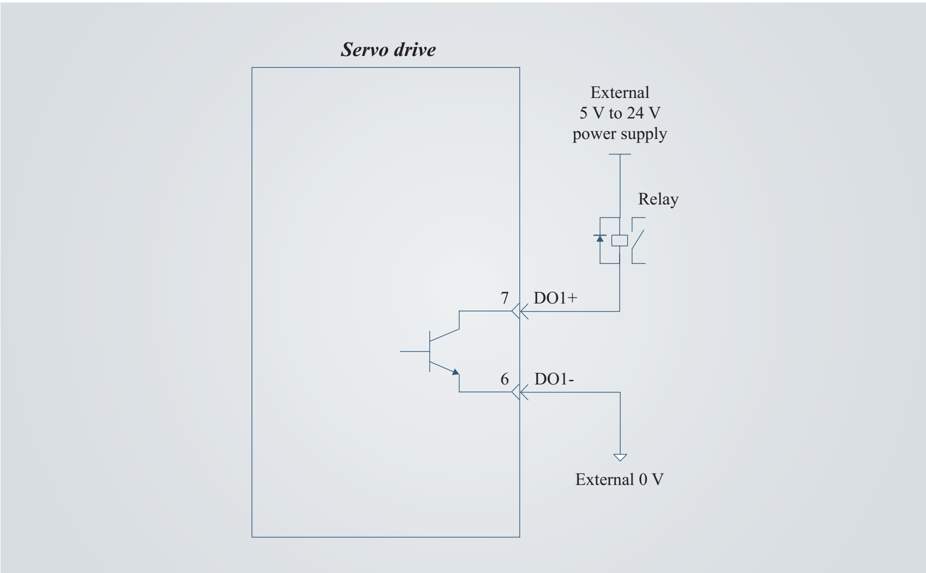
- PNP and NPN inputs cannot be used together in the same circuit.

DO circuits

NOTICE

- The following takes DO1 as an example, and the remaining DO circuits are the same.

When the host controller adopts relay input:



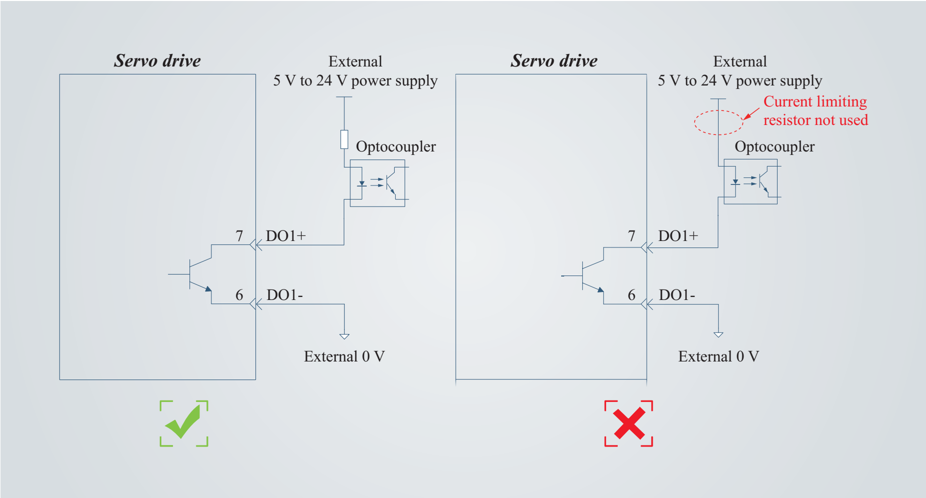
CAUTION

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

When the host controller adopts optocoupler input:

NOTICE

- The maximum allowable voltage and maximum current capacity of the optocoupler output circuit inside the servo drive are 30 VDC and DC50 mA, respectively.



3.7.4 Wiring of the brake

Some servo motors have a brake inside. The motor brake is used to prevent the movement of the servo motor shaft and keep the motor locked in the position when the servo motor may move unexpectedly due to external forces or its own weight during non-running conditions.

CAUTION

- The motor brake can only be used on a stopped motor and is only used to keep the load stationary. Do not use it to brake a moving load.

NOTICE

- The brake coil has no polarity.
- Switch off the S-ON signal after the servo motor stops.
- When the motor with a built-in brake runs, the brake may generate a click sound, which does not affect its function.
- When brake coils are energized (the brake is released), flux leakage may occur on the shaft end. Pay special attention when using magnetic sensors near the motor.

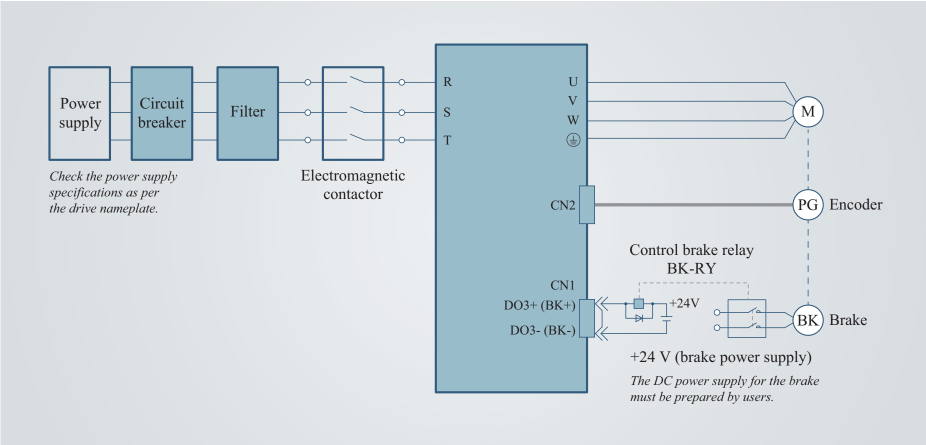


Figure 3-6 Wiring of the brake

Precautions during wiring:

When determining the length of the motor brake cable, take into full account the voltage drop caused by cable resistance. The input voltage must be at least 21.6 V to enable the brake to work properly.

Table 3-7 Brake specifications

Motor Model	Holding Torque	Rated Power	Power Supply Voltage
A6M40-100L2B1-M17	0.32N.m	6.9 W	24 V DC
A6M60-400H2B1-M17	1.27 N·m	7.3 W	24 V DC
A6M80-750H2B1-M17	3.2 N·m	8.5 W	24 V DC
A6M80-1000H2B1-M17	3.2 N·m	8.5 W	24 V DC

3.8 Communication Signal Connection (CN3 and CN4)

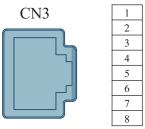
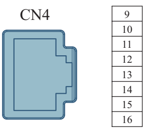
CN3 and CN4 are two same communication signal terminal connectors connected in parallel. Through CN3 and CN4, the following communication connections can be realized:

- Communication connection between the drive and PLC;
- Communication connection between drives.

NOTICE

RS485 communication connection of parallel drivers:

- When the number of nodes is large, the daisy chain connection mode is recommended for the RS485 bus.
- The RS485 signal reference ground of all nodes must be connected together. A maximum of 128 nodes can be connected.

CN3/CN4	Pin No.	Signal	Description
 CN3 communication terminals	4	RS485+	Data transmit+
	5	RS485-	Data transmit–
	6	-	-
	7	-	-
	8	GND	Data receive–
	Enclosure	PE	Shielding layer
 CN4 communication terminals	12	RS485+	Data transmit+
	13	RS485-	Data transmit–
	14	-	-
	15	-	-
	16	GND	Data receive–
	Enclosure	PE	Shielding layer

3.9 Communication Terminal Connection (CN6)

You can connect the drive to the PC through the CN6 terminal by using a serial cable (two-part wiring: Type-c to serial, and serial to USB) or a USB cable.

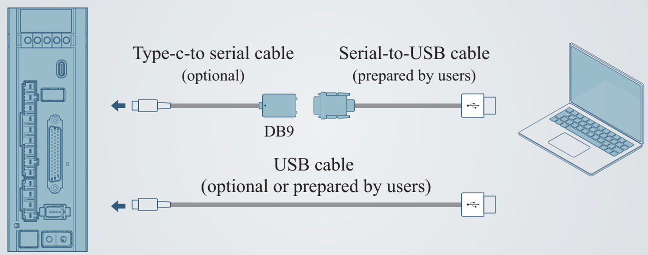
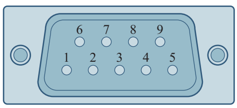


Figure 3-7 Communication terminal connection

DB9 Female Connector (Hole Type)	Pin No.	Signal	Description
	2	RXD	PC receive end
	3	TXD	PC transmit end
	5	GND	Ground
	Housing	PE	Shield

3.10 Braking Resistor Connection

CAUTION

- Do not connect the external braking resistor directly to positive and negative electrodes of the bus. Failure to comply may result in drive damage or even a fire.
- Do not select a resistor with resistance lower than the allowable minimum value. Failure to comply may result in an alarm or damage to the servo drive.
- Do not contact the external braking resistor during use. Failure to comply may result in burns caused by the hot braking resistor.

- Set parameters of the braking resistor properly before using the servo drive.
- Install the external braking resistor on incombustible objects (such as metal).

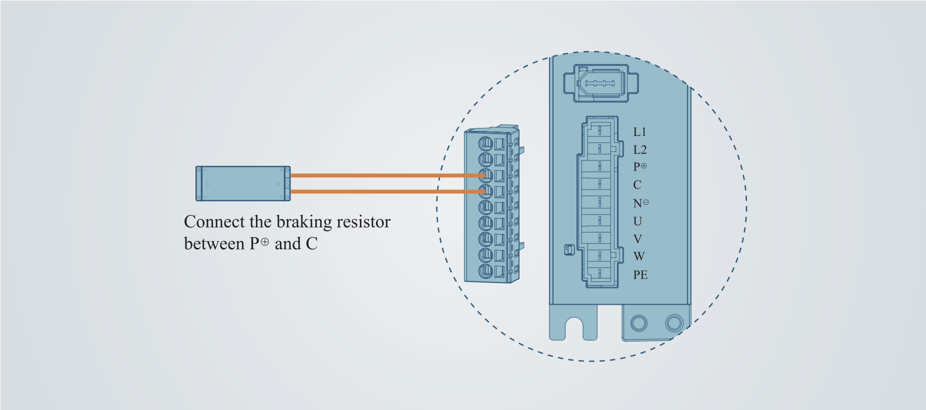


Figure 3-8 Connection of the external braking resistor

NOTICE

- The above connection example is for model SIZE A. Remove the jumper bar between terminals P⊕ and D before connecting an external braking resistor for other models.

Table 3-8 Specifications of the braking resistor

Drive Model		Resistance	Resistor Power	Minimum Allowable Resistance of External Resistor	Maximum Braking Energy Absorbed by Capacitor	Braking Resistor Type
SIZE A	A6-200RS	-	-	45 Ω	9.3 J	External braking resistor
	A6-400RS	-	-	45 Ω	26.29 J	External braking resistor
SIZE B	A6-750RS	50 Ω	50 W	40 Ω	22.41 J	Built-in braking resistor
SIZE C	A6-1000RS	25 Ω	80 W	20 Ω	26.70 J	Built-in braking resistor

Chapter 4 Function overview

4.1 Position control mode

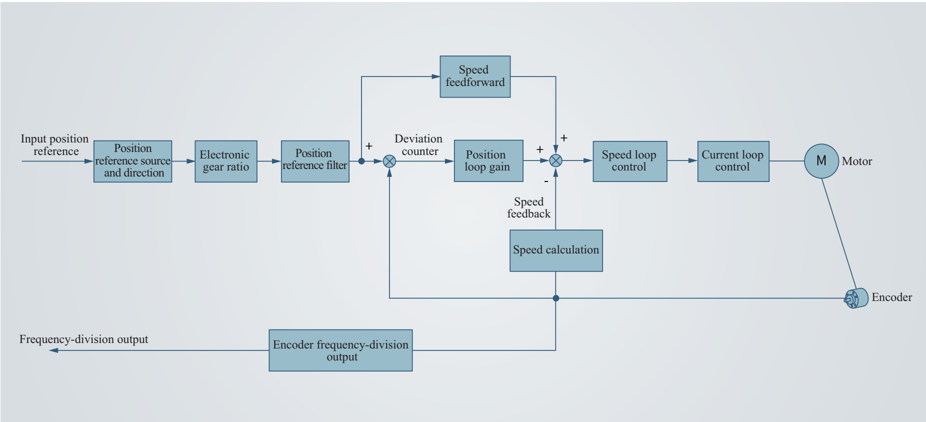


Figure 4-1 Position control block diagram

Set the parameter C00.00 = 0 through the servo drive panel or the drive debugging platform, and then the servo drive will work in the position control mode.

4.1.1 Block diagram of function codes in position control mode

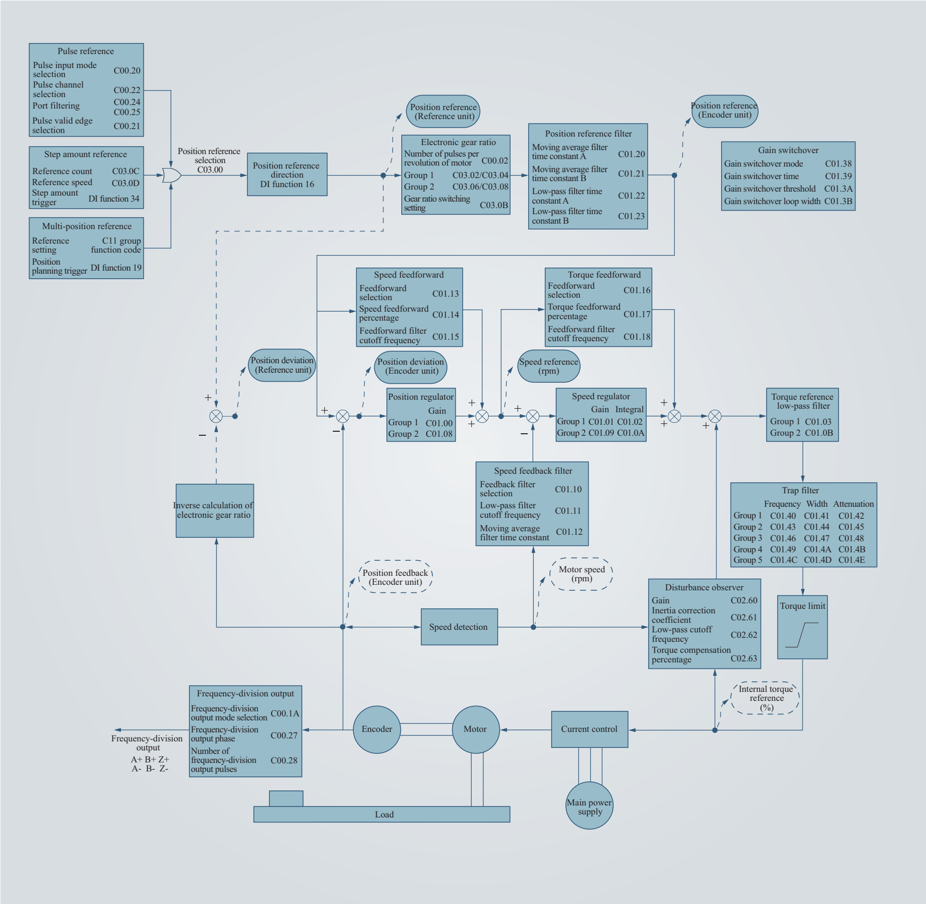


Figure 4-2 Block diagram of function codes in position control mode

4.1.2 Position reference input

Position reference inputs include: position reference source, position reference direction and position reference prohibition.

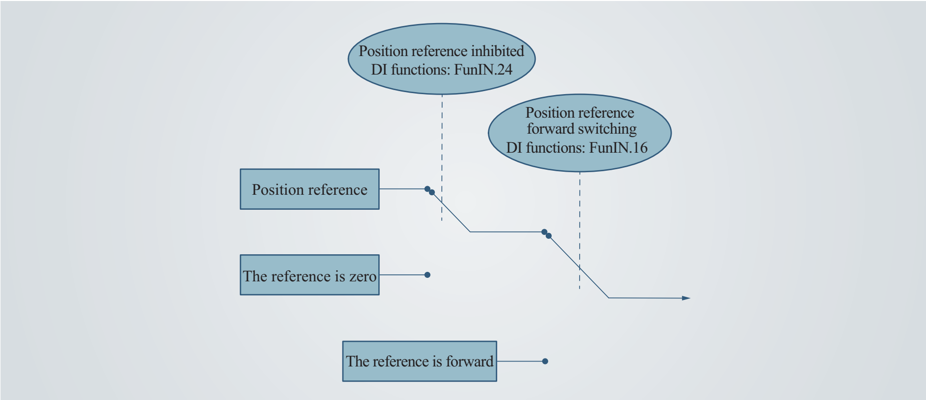


Figure 4-3 Block diagram of the position reference input setting

Position reference source

In position control mode, the position reference source should be set by parameter C03.00 first.

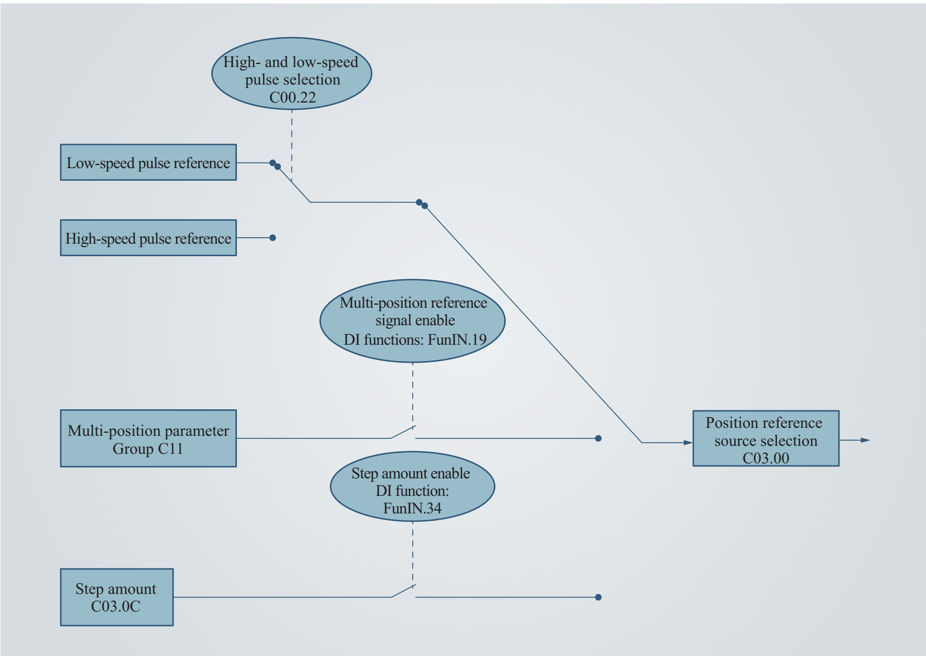


Figure 4-4 Position reference source setting

The position reference is a pulse reference (C03.00 = 0)

When selecting the pulse reference, perform the following steps to obtain the correct pulse reference form.

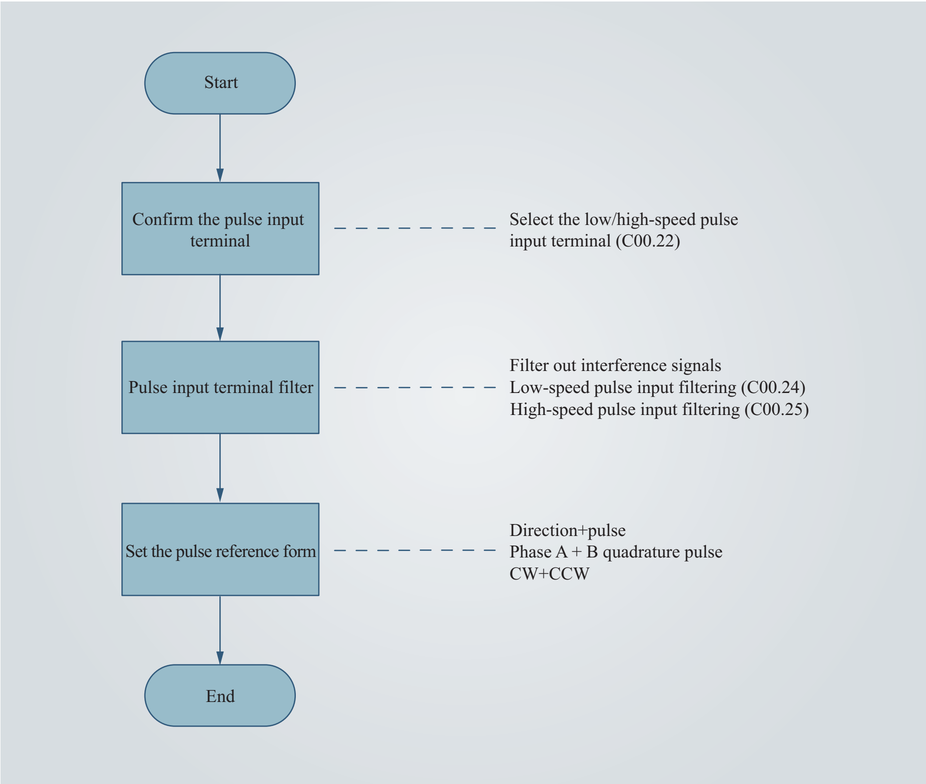
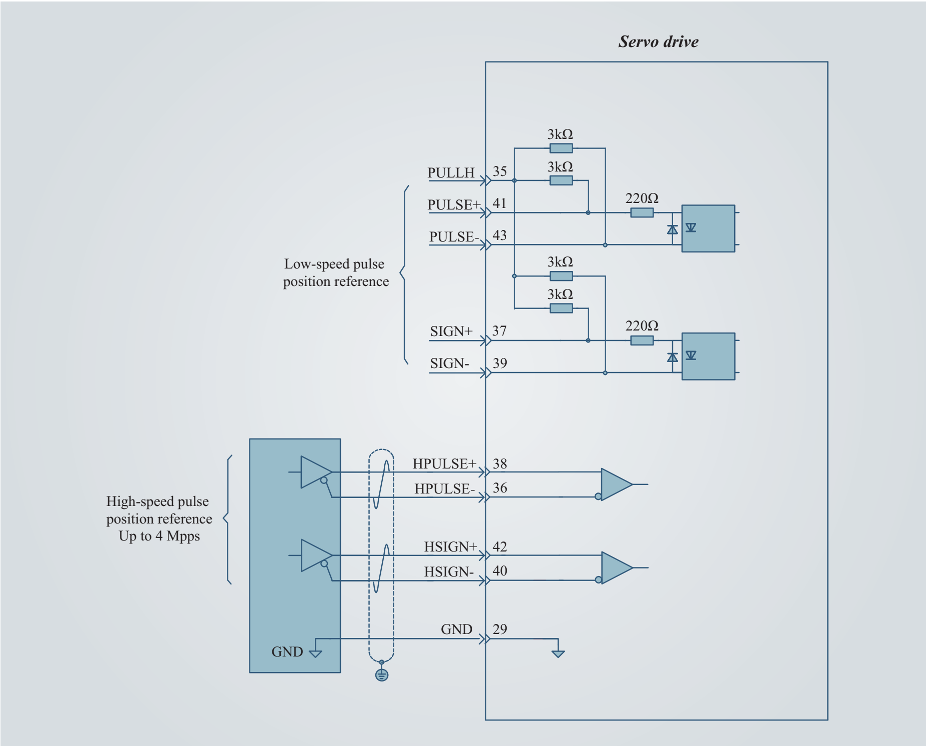


Figure 4-5 Pulse reference source setting flowchart

Pulse input terminal

The servo drive provides two pulse input terminals:



The low-speed pulse input terminals (PULSE+, PULSE-, SIGN+, and SIGN-) receive open-collector input (maximum frequency 200 kpps).

The high-speed pulse input terminals (HPULSE+, HPULSE-, HSIGN+, and HSIGN-) receive only differential input (maximum frequency 4 Mpps).

Table 4-1 Pulse input specification

Pulse		Maximum Frequency	Voltage	Forward Current
High-speed pulse	Differential signal	4 Mpps	5 V	<15 mA
Low-speed pulse	Differential signal	500 kpps	5 V	<15 mA
	Open-collector signal	200 kpps	24 V	<15 mA

Pulse input terminal filter

Set the filter time to filter the pulses from the low-speed/high-speed pulse input terminals to prevent motor malfunction due to interference on the servo drive.

If the filter time constant is t_F, and the minimum width of input signals is t_{min}, the input signal and filtered signal are as shown in the following figure. The filtered signal has a t_F delay over the input signal.

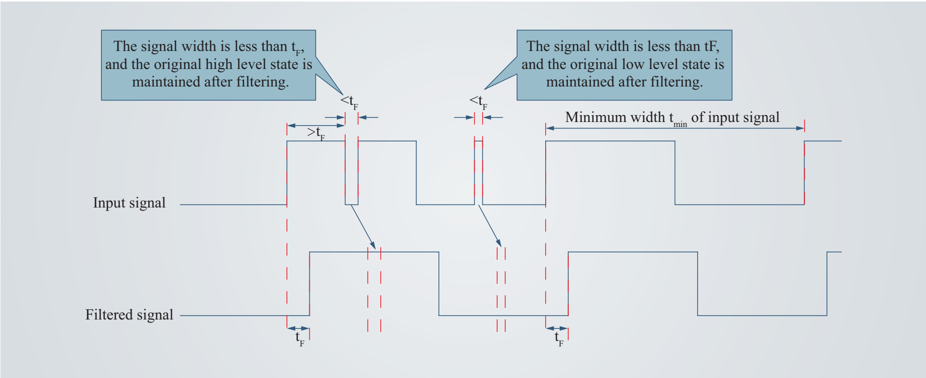


Figure 4-6 Schematic diagram of filtered signal waveform

The filter time constant t_F must meet the requirement: $t_F \leq (20\% - 25\%)\ t_{min}$.
The recommended filter parameter setting based on the maximum frequency (minimum width) of input pulses is described in the following table.

Table 4-2 Recommended Filter Time Constant

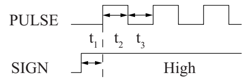
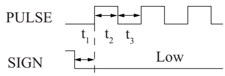
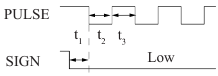
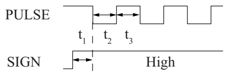
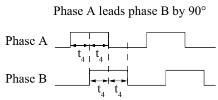
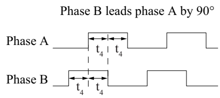
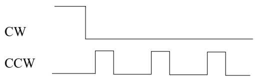
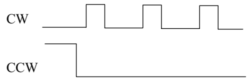
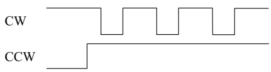
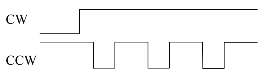
Pulse Input Terminal	Parameter	Maximum Frequency of Input Pulses	Recommended Filter Time Constant (Unit: ns)
Low-speed pulse input terminal	C00.24	< 167k	750
		167k to 200k	500
High-speed pulse input terminal	C00.25	200k to 1M	125
		> 1M	75

Pulse reference form

The servo drive supports three pulse input forms:

- Direction + pulse (positive or negative logic)
- Phase A + phase B quadrature pulse, 4-frequency multiplication
- CW+CCW (positive logic or negative logic)

Select the pulse input format appropriate for the host controller or other pulse output device.

C00.20	Pulse Form	Signal	Schematic Diagram of Forward Pulse	Schematic Diagram of Reverse Pulse
0	Pulse + direction Positive logic	PULSE SIGN		
1	Pulse + direction Negative logic	PULSE SIGN		
2	Phase A + B quadrature pulse 4-frequency multiplication	PULSE (Phase A) SIGN (Phase B)		
3	CW + CCW Positive logic	PULSE (CW) SIGN (CCW)		
4	CW + CCW Negative logic	PULSE (CW) SIGN (CCW)		

The following table describes the maximum frequencies and widths of position pulses from different terminals.

Table 4-3 Pulse reference specification

Input Terminal		Maximum Frequency	Minimum Time Width (μs)			
			t_1	t_2	t_3	t_4
High-speed pulse input terminal		4 Mpps	0.125	0.125	0.125	0.25
Low-speed pulse input terminal	Differential	500 kpps	1	1	1	1
	Open collector	200 kpps	2.5	2.5	2.5	5

The rising time and falling time of position pulses must be smaller than 0.1 μs.

<u>Multi-position reference as the position reference source (C03.00 = 1)</u>

The servo drive supports multi-position running. It stores 16 position references, and the displacement, maximum running speed, and acceleration/deceleration time of each position reference can be set respectively. The waiting time and switch mode between positions can also be set according to actual requirements. The setting flowchart is as follows:

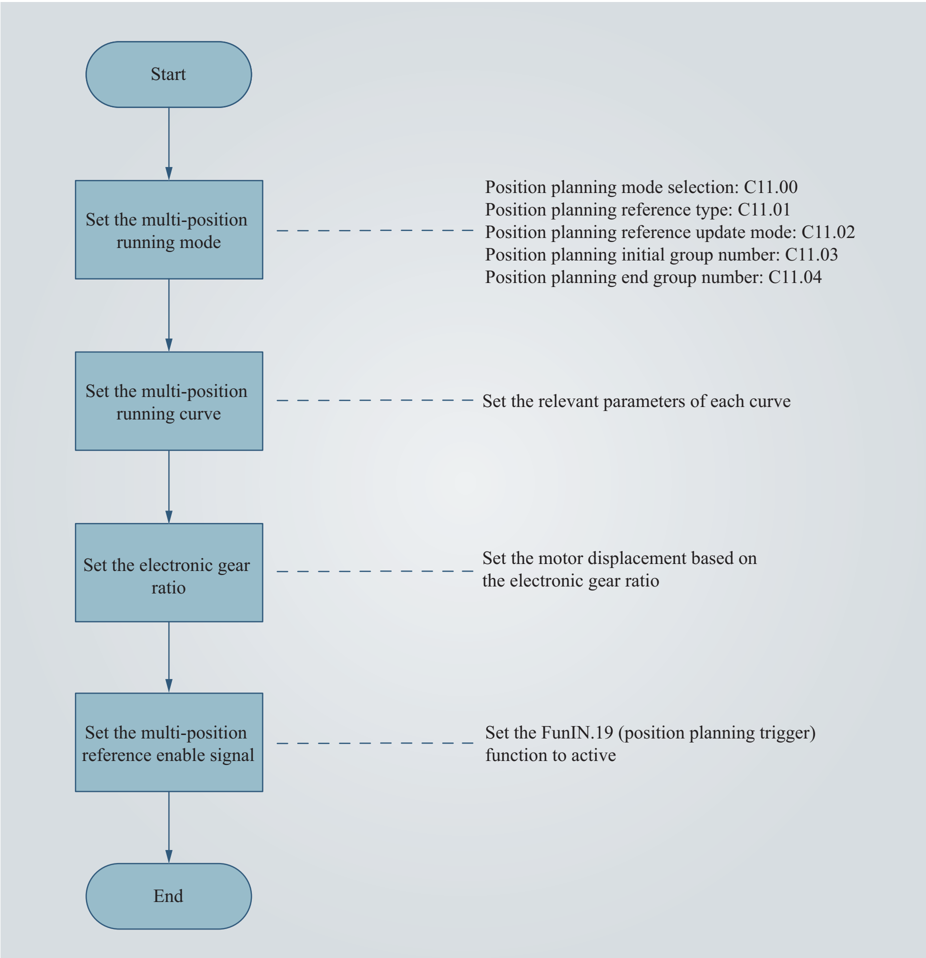


Figure 4-7 Multi-position reference source setting flowchart

Multi-position running mode

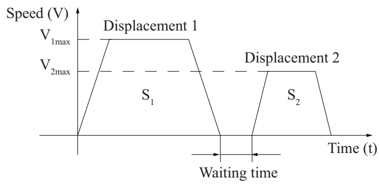
1. Individual running (C11.00 = 0)

Table 4-4 Individual running description

<table>
<tr><th>Mode Description</th><th>Running Curve</th></tr>
<tr><td>

- The drive stops after one cycle of running.
- The drive switches to the next displacement automatically.
- The interval time between displacements can be set as needed.
- The position planning trigger (PosInSen) signal is level triggered.

</td><td>



V_{1max}, V_{2max}: maximum running speeds in displacement 1 and displacement 2

S_1, S_2: displacement 1 and displacement 2

- The positioning completed signal is active after each displacement is reached.
- If the multi-position reference enable signal is switched off during operation, the drive abandons the unfinished displacement and stops. The COIN (positioning completed) signal is activated after the drive stops.
- If the S-ON signal is switched off during operation, the motor stops according to the stop mode at S-ON OFF. The COIN (positioning completed) signal is deactivated after the motor stops.
- Position planning can be paused through the DI function (FunIN.20: position planning pause).

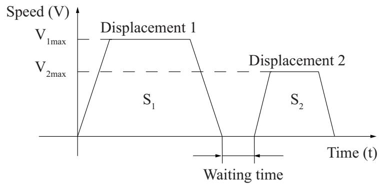
</td></tr>
</table>

NOTICE

- A cycle of running refers to the process that the drive runs from the initial position group number (C11.03) to the end position group number (C11.04).

2. Cyclic running (C11.00 = 1)

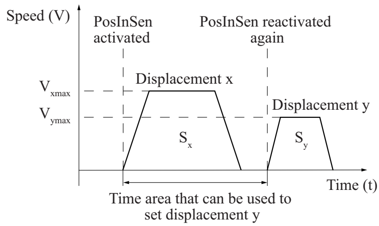
Table 4-5 Cyclic running description

Mode Description	Running Curve
	
• The drive starts from displacement 1 again after each cycle of running. • The drive switches to the next displacement automatically. • The interval time between displacements can be set as needed. • The cyclic running mode is kept when the FunIN.19 (position planning trigger) is active. • The position planning trigger (PosInSen) signal is level triggered.	V_{1max}, V_{2max}: maximum running speeds in displacement 1 and displacement 2 S_1, S_2: displacement 1 and displacement 2 • The positioning completed signal is active after each displacement is reached. • If the multi-position reference enable signal is turned off during running, the servo drive discards the uncompleted displacement and stops. After the stop process is completed, the positioning completion signal is active. • If the S-ON signal is switched off during operation, the motor stops according to the stop mode at S-ON OFF. The COIN (positioning completed) signal is deactivated after the motor stops. • Position planning can be paused through the DI function (FunIN.20: position planning pause).

3. DI switchover running (C11.00 = 2)

When the multi-position running mode is DI switchover running, assign functions 12 to 15 (FunIN.12: CMD1 to FunIN.15: CMD4, multi-reference switchover) to four DIs of the servo drive, and set the active logic of these DIs.

Table 4-6 DI switchover running description

Mode Description	Running Curve
• The displacement to be executed next can be set when the current displacement is in progress. The motor stops after the current displacement is done executing. After the multi-position reference enable signal is switched on again, the present displacement will be executed. • The displacement No. is determined by the DI terminal logic. • There is no waiting time between displacements. The interval time between displacements is determined by the command delay of the host controller. • The position planning trigger (PosInSen) signal is edge triggered.	 V_{xmax}, V_{ymax}: maximum running speeds in displacement X and displacement Y S_x, S_y: displacement X and displacement Y • The positioning completed signal is active after each displacement is reached. • If the multi-position reference enable signal is switched off during operation, the drive continues to execute the unfinished displacement and outputs the COIN (positioning completed) signal. • The displacements must be switched in the following sequence: a. Wait until displacement x is done executing before switching the displacement No. b. When displacement x is in progress or done, switch off the multi-position reference enable signal first, and then change the displacement No. from x to y (if x = y, the drive executes displacement x again). c. After displacement x is done executing, switch on the multi-position reference enable signal again to make the drive execute displacement y. • If the S-ON signal is switched off during operation, the motor stops according to the stop mode at S-ON OFF. The COIN (positioning completed) signal is deactivated after the motor stops. • Position planning can be paused through the DI function (FunIN.20: position planning pause).

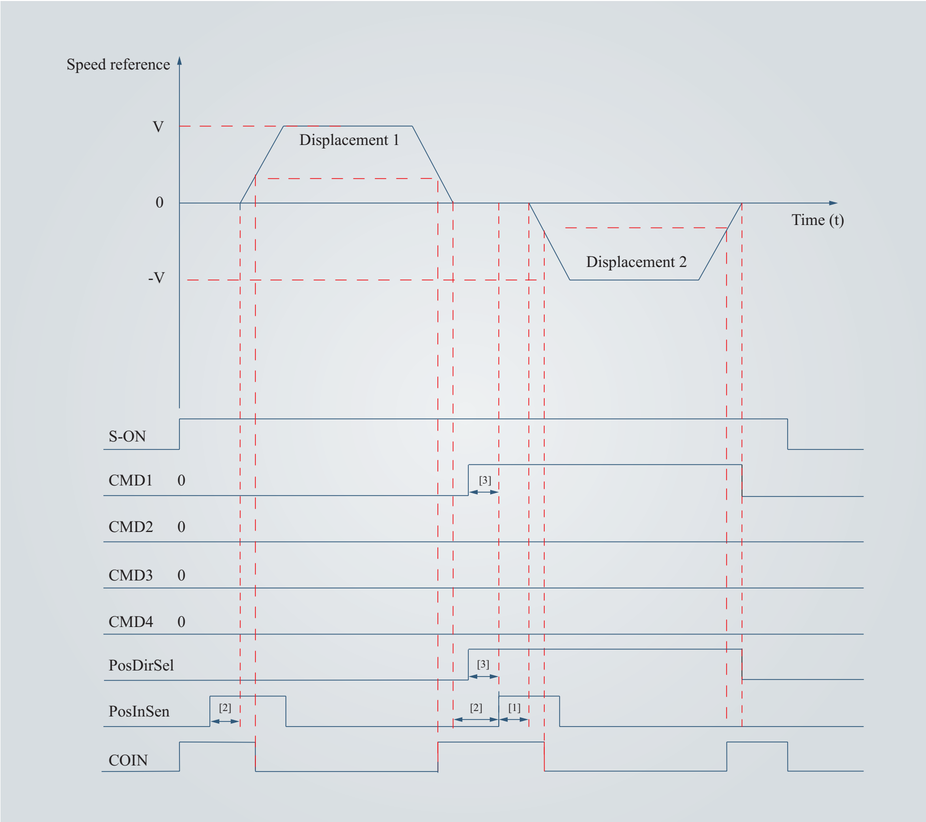


Figure 4-8 Multi-position sequence diagram

NOTICE

- The PosInSen signal is edge triggered. When using a normal DI terminal, ensure the effective signal width is at least 3 ms; when using a high-speed DI terminal, ensure the effective signal width is at least 0.25 ms.
- Area for switching the displacement No.: Refers to the range that starts from the moment the last position reference is done transmitting to the moment the next PosInSen signal is activated again.
- When a normal DI is used, an effective signal width of 0.125 ms must be kept.

Related functions:

Code	Name	Function Name	Function
FunIN.12	CMD1	Multi-reference switchover 1	The position No. is a 4-bit binary value, and the relationship between the displacement No. and CMD1 to CMD4 is shown in the following table. The DI terminal logic is level triggered. The CMD value is 1 upon active level input or 0 upon inactive level input.
FunIN.13	CMD2	Multi-reference switchover 2	
FunIN.14	CMD3	Multi-reference switchover 3	
FunIN.15	CMD4	Multi-reference switchover 4	

Table 4-7   Relationship between the displacement No. and CMD1 to CMD4

CMD4	CMD3	CMD2	CMD1	Displacement No.
0	0	0	0	1
0	0	0	1	2
		...		
1	1	1	1	16

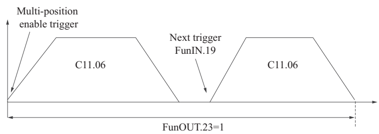
4. PP mode running (C11.00 = 3)

Table 4-8   Description of PP mode running

<table>
<tr><th>Mode Description</th><th>Running Curve</th></tr>
<tr><td>

- The drive executes displacement 1 only.
- The position planning trigger (PosInSen) signal is edge triggered.

</td><td>

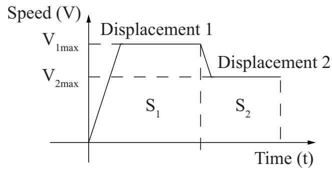


- Trigger a servo multi-position enable (FunIN.19). The servo drive stops after running for a distance defined by C11.06.
- Position planning can be paused through the DI function (FunIN.20: position planning pause).

</td></tr>
</table>

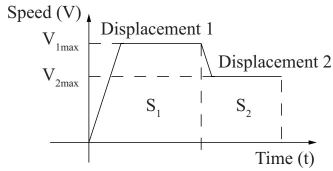
5. Single continuous running (C11.00 = 4)

Table 4-9 Description of single continuous running

Mode Description	Running Curve
• The drive stops after running for one cycle. • The drive switches to the next displacement automatically. • There is no waiting time between displacements.	 V_{1max}, V_{2max}: maximum running speeds in displacement 1 and displacement 2 S_1, S_2: displacement 1 and displacement 2 • The positioning completed signal is active after each displacement is reached. • If the multi-position reference enable signal is switched off during operation, the drive abandons the unfinished displacement and stops. The COIN (positioning completed) signal is activated after the drive stops. • If the S-ON signal is switched off during operation, the motor stops according to the stop mode at S-ON OFF. The COIN (positioning completed) signal is deactivated after the motor stops. • Position planning can be paused through the DI function (FunIN.20: position planning pause).

6. Cyclic continuous running (C11.00 = 5)

Table 4-10 Description of cyclic continuous running

Mode Description	Running Curve
• The drive starts from displacement 1 again after each cycle of running. • The drive switches to the next displacement automatically. • There is no waiting time between displacements. • The position planning trigger (PosInSen) signal is edge triggered. • The position planning trigger (PosInSen) signal is active, and the drive maintains the cyclic running state.	 V_{1max}, V_{2max}: maximum running speeds in displacement 1 and displacement 2 S_1, S_2: displacement 1 and displacement 2 • The positioning completed signal is active after each displacement is reached. • If the multi-position reference enable signal is switched off during operation, the drive abandons the unfinished displacement and stops. The COIN (positioning completed) signal is activated after the drive stops. • If the S-ON signal is switched off during operation, the motor stops according to the stop mode at S-ON OFF. The COIN (positioning completed) signal is deactivated after the motor stops. • Position planning can be paused through the DI function (FunIN.20: position planning pause).

Multi-position running curve

A total of 16 position references can be set during multi-position operation. The displacement, maximum running speed, acceleration/deceleration time, and interval time between displacements can be set separately. The following table takes displacement 1 as an example.

The actual motor running curve according to the preceding setting is shown in the following figure.

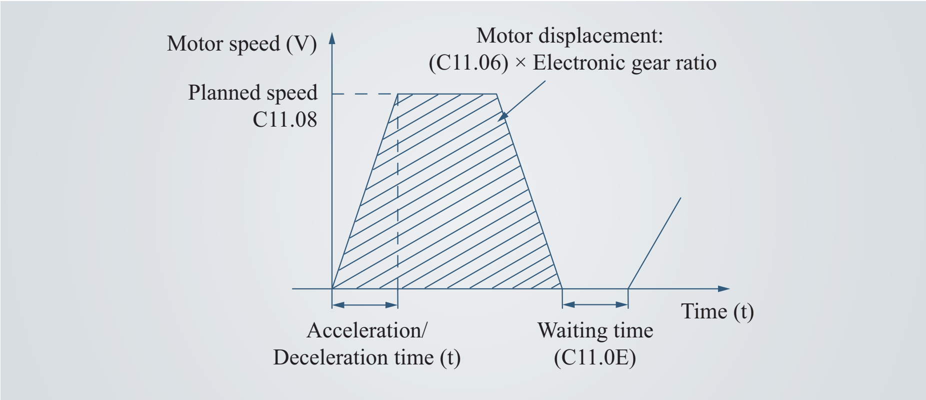


Figure 4-9 Motor running curve in displacement 1

<u>Position planning trigger and pause</u>

When using multi-position reference as the position reference source, assign function 19 (FunIN19: position planning trigger) and function 20 (FunIN20: position planning pause) to two DIs of the servo drive, and set the active logic of these DIs.

Code	Function Name	Function
FunIN.19	Position planning trigger	Active: The servo motor executes the multi-position planning. Inactive: The servo motor is in locked state.
FunIN.20	Position planning disable	Active: The servo motor pauses execution of the multi-position planning. Inactive: The servo motor executes the multi-position planning.

<u>Step amount as the position reference source (C03.00 = 2)</u>

NOTICE

- When the servo drive is in running state (S-ON signal active), the motor is in locked state if the step amount reference enable signal is inactive; the server motor runs if the step amount reference enable signal is active. When the execution of the C03.0C reference is completed and the step amount reference enable signal is no longer triggered, the motor is in locked state.

The servo drive also has the step amount running function, which means that the servo drive runs according to the internal fixed speed until the set displacement is reached. The setting flowchart is as follows:

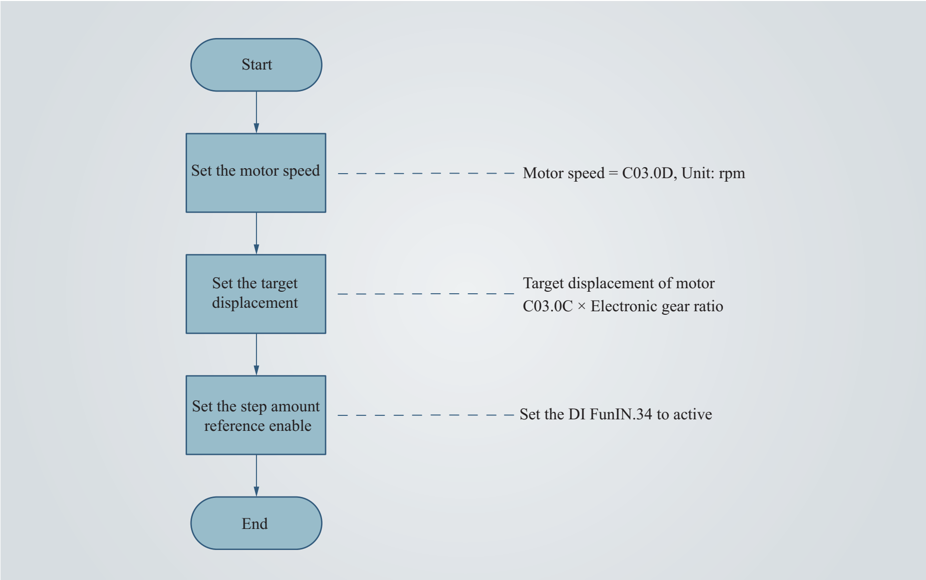


Figure 4-10 Flowchart for setting step amount reference as the position reference source

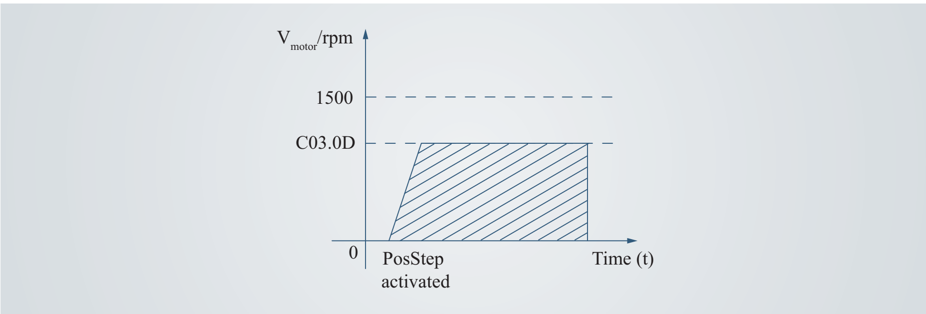


Figure 4-11 Motor running curve when C03.00 = 2

The hatched area in the preceding figure indicates the motor displacement: C03.0C x Electronic gear ratio, and the motor speed cannot exceed 1500 rpm.

- Motor displacement

  When the position reference source is the step amount, the position reference sum (reference unit) is set in C03.0C. The sign of the C03.0C value determines whether the motor speed is a positive or negative value.

Parameter	Name	Value Range	Default	Unit	Modificantion Mode
C03.0C	Step amount reference value	-9999 to 9999	50	Unit in application	During operation

- Step amount reference enable

  When using the step amount as the position reference source, assign function 34 (FunIN.34: PosStep, step amount reference enable) to a DI of the servo drive, and set the active logic of the DI.

  Related functions:

Code	Name	Function Name	Function
FunIN.34	PosStep	Step amount reference enable	Servo running state Active: The position reference defined by C03.0C is input to the servo drive, driving the motor to run. Inactive: The servo motor is in locked state.

FunIN.34 (Step amount reference enable) is edge-triggered. The motor is locked after the step amount reference is done executing. When FunIN.34 is triggered again, the motor executes the step amount reference defined by C03.0C again.

Position reference direction

A DI can be used to change the position reference direction, so as to change the motor direction of rotation. Assign function 16 (FunIN.16: position reference direction) to a DI of the servo drive, and set the active logic of this DI.

Code	Function Name	Function
FunIN.16	Position reference direction	Inactive: Actual position reference direction same as the set direction. Active: Actual position reference direction opposite to the set direction.

NOTICE

- The actual motor direction is related to the rotating direction in C00.01, positive/negative of position reference, position reference direction (FunIN.16).

Table 4-11 Motor direction of rotation

C00.01	Sign of Position Reference	FunIN.16	Actual Motor Direction of Rotation
0	+	Inactive	CCW
0	+	Active	CW
0	-	Inactive	CW
0	-	Active	CCW
1	+	Inactive	CW
1	+	Active	CCW
1	-	Inactive	CCW
1	-	Active	CW

Position reference inhibited

The servo drive provides the position reference inhibited function (FunIN.24).

Position reference inhibited

The servo drive sets all the position references to 0, which means it does not respond to any internal or external position references, and the motor is in the locked state in the position control mode. In this case, the drive can switch to other control modes to continue operating. To use this function, assign function 24 (FunIN.24: position reference inhibited) to a DI of the servo drive, and set the active logic of this DI. The high-speed DI terminal (DI7 or DI8) is recommended.

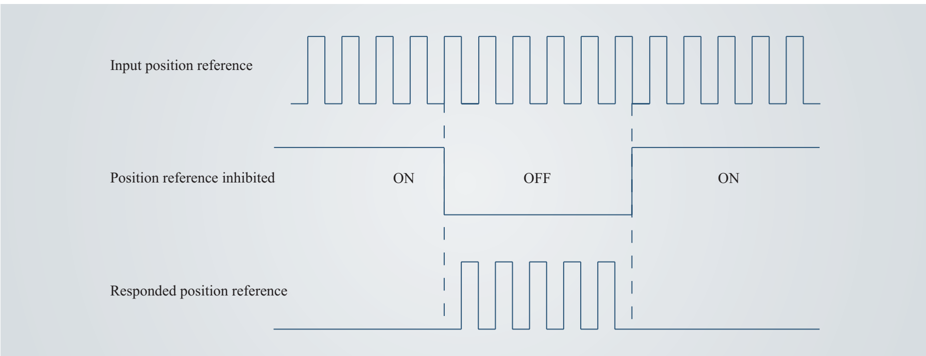


Figure 4-12 Waveform example for position reference inhibited

Related functions:

Code	Function Name	Function
FunIN.24	Position reference inhibited	Inactive: The drive responds to position references in position control mode. Active: The drive does not respond to any internal or external position references in position control mode.

NOTICE

- When DI is used, keep an interval of at least 0.5 ms from the moment the DI logic is deactivated to the moment the internal position reference is inputted.

4.1.3 Reference Frequency Division/Multiplication (Electronic Gear Ratio)

Definition of the electronic gear ratio

In the position control mode, the input position reference (reference unit) defines the load displacement; the motor position reference (encoder unit) defines the motor displacement. The electronic gear ratio is used to establish a proportional relationship between the input position reference and motor position reference.

The electronic gear ratio, which allows frequency division (electronic gear ratio < 1) or frequency multiplication (electronic gear ratio > 1), can be used to set the actual displacement corresponding to the input position reference per reference unit, or used to increase the position reference frequency when the motor speed needed cannot be fulfilled due to limited pulse output frequency of the host controller or limited parameter value range.

NOTICE

- Reference unit: Refers to the minimum identifiable value input from the host controller to the servo drive.
- Encoder unit: Refers to the value of the input reference multiplied/divided by the electronic gear ratio.

Procedure for setting the electronic gear ratio

The electronic gear ratio varies according to the mechanical structure. Set it according to the following flowchart.

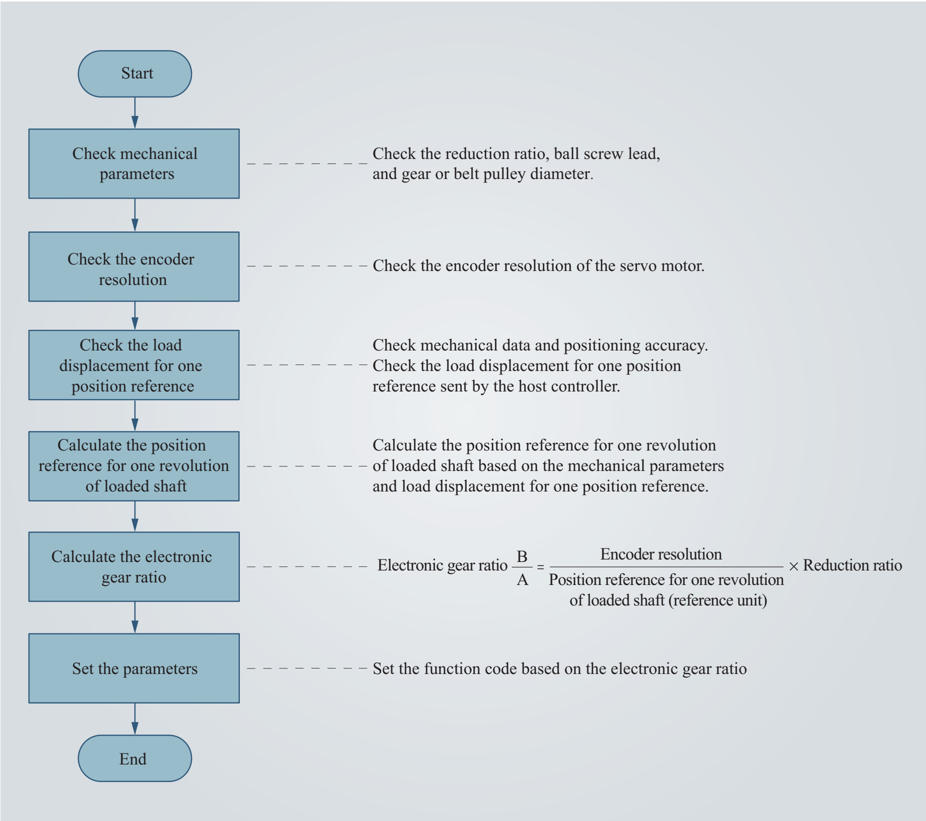


Figure 4-13 Procedure for setting the electronic gear ratio

See the following figure for how to set parameters.

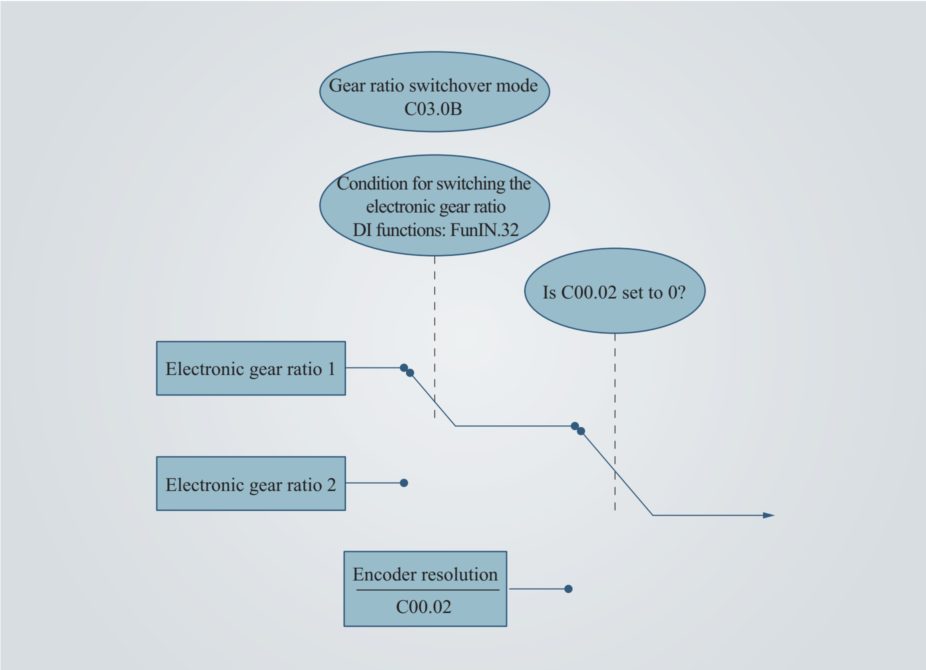


Figure 4-14 Flowchart for setting the electronic gear ratio

NOTICE

- When C00.02 is not equal to 0, the following formula applies

$$\text{Electronic gear ratio } \frac{B}{A} = \frac{\text{Encoder resolution}}{\text{C00.02}}$$

In this case, electronic gear ratios 1 and 2 are invalid.

⚠ CAUTION

- The motor speed may fluctuate significantly if the electronic gear ratio changes sharply in real time or electronic gear ratio 1 differs greatly from electronic gear ratio 2. In this case, use the position reference filter function (C01.20, C01.21, C01.22, or C01.23) to allow smooth switchover of position references.

Switching the electronic gear ratio

- The electronic gear ratio can be switched when C00.02 is set to 0. Determine whether it is necessary to switch between electronic gear ratios 1 and 2 based on mechanical conditions. Set the condition for switching the electronic gear ratio.
- Only one electronic gear ratio is effective at a moment.
- The effective time of real-time change in the electronic gear ratio is also restricted by the switchover condition.

Assign function 32 (FunIN.32: electronic gear ratio switchover) to a DI of the servo drive, and set the active logic of this DI.

Related functions:

Code	Function Name	Function
FunIN.32	Condition for switching the electronic gear ratio	Inactive: Electronic gear ratio 1 is selected in position control mode. Active: Electronic gear ratio 2 is selected in position control mode.

The electronic gear ratio selected by the servo drive is described in the following table.

<table>
<tr><th>C00.02</th><th>C03.0B</th><th>Level of DI Assigned with FunIN.32</th><th>Electronic gear ratio</th></tr>
<tr><td rowspan="4">0</td><td rowspan="2">0</td><td>Inactive</td><td>C03.02/C03.04</td></tr>
<tr><td>Active</td><td>C03.06/C03.08</td></tr>
<tr><td rowspan="2">1</td><td>Inactive</td><td>C03.02/C03.04</td></tr>
<tr><td>Active</td><td>C03.06/C03.08</td></tr>
<tr><td>1 to 1048576</td><td colspan="3">-</td></tr>
</table>

The resolution of the serial encoder is 2^n (P/r), where "n" is the number of bits of the serial encoder.

Calculating the electronic gear ratio

The following figure shows the relationship among the position reference (reference unit), load displacement, and electronic gear ratio:

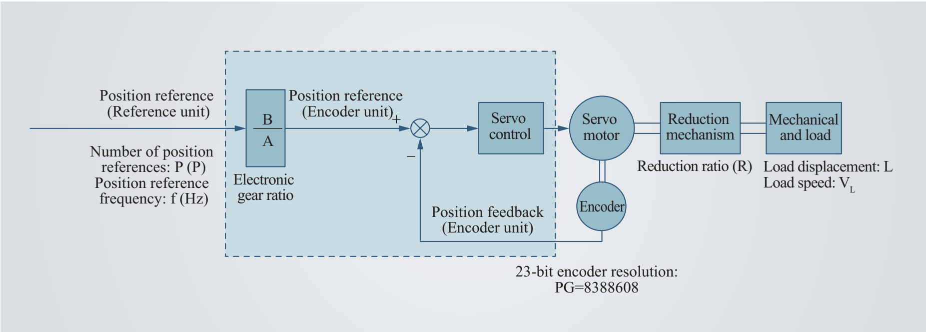


Figure 4-15 Relationship among the position reference (reference unit), load displacement, and electronic gear ratio

Take the ball screw in linear motion as an example, with p_B (mm) as the screw lead, P_G as the encoder resolution, and R as the reduction ratio of the reduction mechanism.

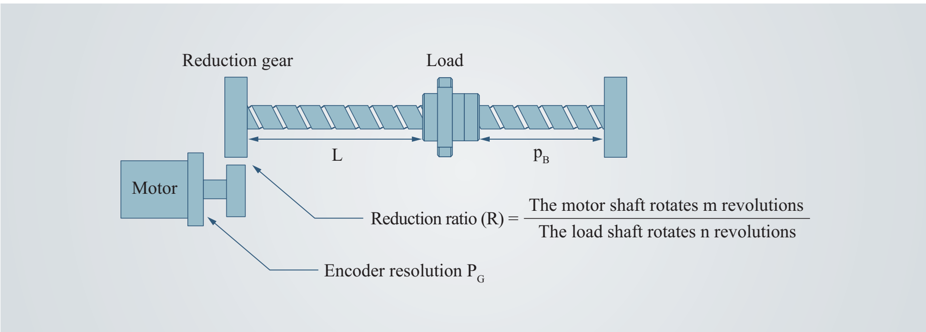


Figure 4-16 Ball screw

- When the load displacement per pulse ΔL (mm) is known:

  When the load displacement is ΔL, the load shaft rotates $\frac{\Delta L}{p_B}$ revolutions, and the motor shaft rotates $\frac{\Delta L}{p_B}$ × R revolutions.

$$1 \times \frac{B}{A} = \frac{\Delta L}{p_B} \times R \times P_G$$

  Therefore, the electronic gear ratio is calculated as follows:

$$\frac{B}{A} = \frac{\Delta L}{p_B} \times R \times P_G$$

- When the load displacement L (mm) and position reference sum P (P) are known:

  When the mechanical displacement is L, correspondingly the load shaft rotates $\frac{L}{p_B}$ revolutions and the motor shaft rotates $\frac{L}{p_B} \times R$ revolutions.

$$P \times \frac{B}{A} = \frac{L}{p_B} \times R \times P_G$$

  Therefore, the electronic gear ratio is calculated as follows:

$$\frac{B}{A} = \frac{L}{p_B} \times R \times P_G \times \frac{1}{P}$$

- When the load moving speed V_L (mm/s) and position reference frequency f (Hz) are known:

  Load shaft speed: $\frac{V_L}{p_B}$ (r/s)

  Motor speed: $V_M = \frac{V_L}{p_B} \times R$

  The relationship among the position reference frequency, electronic gear ratio, and motor speed is as follows:

$$f \times \frac{B}{A} = V_M \times P_G$$

  Therefore, the electronic gear ratio is calculated as follows:

$$\frac{B}{A} = \frac{V_M \times P_G}{f}$$

Example for setting the electronic gear ratio

Step	Name	Mechanical Structure		
		Ball Screw Transmission	**Belt Pulley Transmission**	**Rotating Load**
1	Mechanical parameters	Reduction ratio (R): 1/1 Screw lead: 0.01m	Reduction ratio (R): 5/1 Diameter of belt pulley: 0.2m (Circumference of belt pulley: 0.628m)	Reduction ratio (R): 10/1 Load angle of rotation per revolution of the load shaft: 360°
2	Encoder resolution	17bit=131072P/r	17bit=131072P/r	17bit=131072P/r
3	Load displacement per position reference (reference unit)	0.0001m	0.000005m	0.01°
4	Position references per revolution of the load shaft (reference unit)	$\frac{0.01}{0.0001}=100$	$\frac{0.628}{0.000005}=125600$	$\frac{360}{0.01}=36000$
5	Calculation	$\frac{B}{A}=\frac{131072}{100}\times\frac{1}{1}$	$\frac{B}{A}=\frac{131072}{125600}\times\frac{5}{1}$	$\frac{B}{A}=\frac{131072}{36000}\times\frac{10}{1}$

Step	Name	Mechanical Structure		
		Ball Screw Transmission	Belt Pulley Transmission	Rotating Load
6	Setting	C03.02=131072 C03.04=100	C03.02=655360 C03.04=125600	C03.02=1310720 C03.04=36000

4.1.4 Position reference filter

This function filters the position references (encoder unit) divided or multiplied by the electronic gear ratio. Position reference filter includes first-order low-pass filter and moving average filter.

It is applicable to the following conditions:

- The acceleration/deceleration process is not performed on the position references sent from the host controller.
- The pulse frequency is too low.
- The electronic gear ratio is larger than 10.

This function has no effect on the displacement (position reference sum).

If the setting is excessive, the response delay may be too large. Therefore, set the filter time constant based on actual conditions.

4.1.5 Position deviation clear

Position deviation = Position reference sum   Position feedback sum

The drive clears the position deviation when the position deviation clear function is enabled (C03.16=1) and DI (FunIN.23: position deviation clear) is active.

To use this function, assign function 23 (FunIN.23: position deviation clear) to a DI of the servo drive, and set the active logic of this DI. The high-speed DI terminal (DI7 or DI8) is recommended.

Related functions:

Code	Function Name	Function
FunIN.23	Position deviation clear	Active: Clear the position deviation. Inactive: Do not clear the position deviation.

4.1.6 Frequency-division output

The frequency-division output function outputs the position reference pulses or encoder feedback position references as A/B phase quadrature pulses.

Code	Function Name	Function
C00.2A	Z-pulse output polarity selection	0: Output differential Z-pulse with positive polarity, and OCZ pulse with positive polarity. 1: Output differential Z-pulse with positive polarity, and OCZ pulse with negative polarity. 2: Output differential Z-pulse with negative polarity, and OCZ pulse with positive polarity. 3: Output differential Z-pulse with negative polarity, and OCZ pulse with negative polarity.

NOTICE

- It is recommended to use the active edge output by the Z signal when a high precision frequency-division output of Z signal is required.

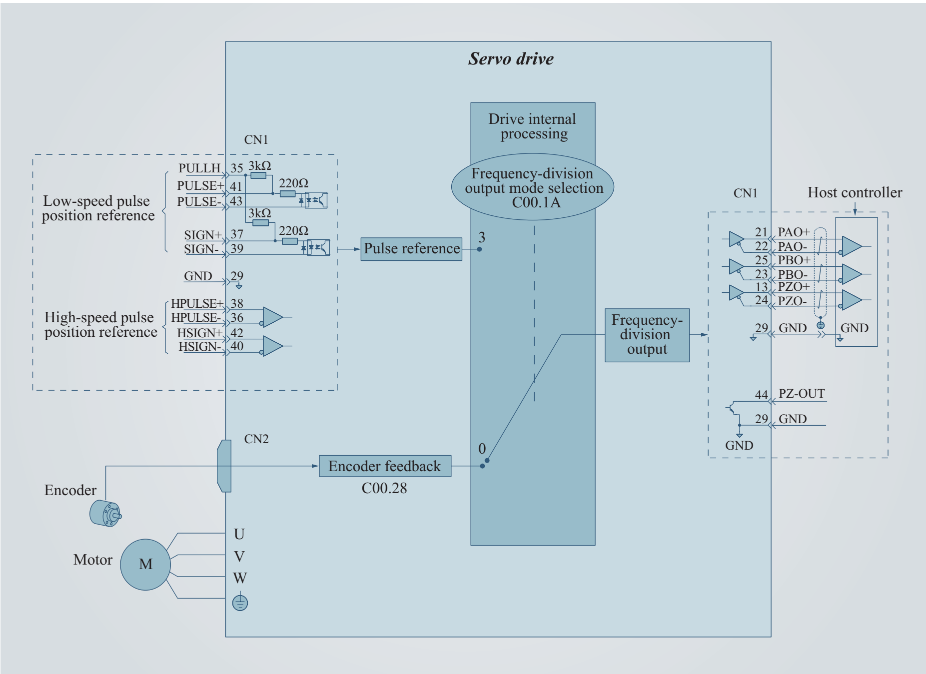


Figure 4-17 Schematic diagram of frequency-division output

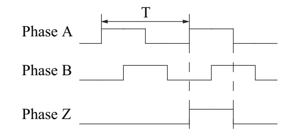
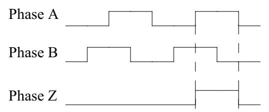
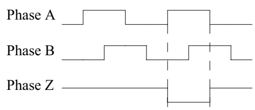
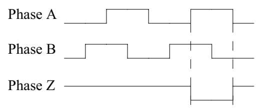
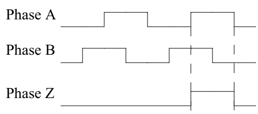
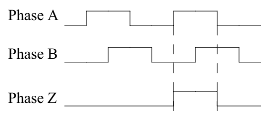
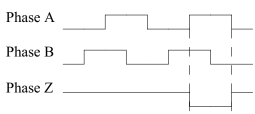
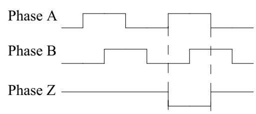
It is recommended to use synchronous output (C00.1A=3) of pulse references in case of synchronous tracing of multi-axis servo pulses. When the host controller is used for closed-loop feedback, it is recommended to use encoder frequency-division output (C00.1A=0). The servo drive provides one group of frequency-division terminals, as described below:

- Phase A pulse: PAO+, PAO , differential output, maximum output pulse frequency 4 Mpps
- Phase B pulse: PBO+, PBO , differential output, maximum output pulse frequency 4 Mpps
- Phase Z pulse: PZO+, PZO , differential output, maximum output pulse frequency 4 Mpps
- PZ OUT, GND, open-collector output, maximum output pulse frequency: 200 kpps

When using the frequency-division output function, set the output pulse source (C00.1A), phase (C00.27), resolution (C00.28), and phase Z pulse polarity (C00.2A) according to requirements.

When the output source is encoder frequency-division pulse (C00.1A=0), the phase A/B output pulses per motor revolution are determined by C00.28. The pulse width (T) of phase A/B is determined by the motor speed. The phase Z, whose width is also T, is synchronized with phase A. The Z signal is output once per motor revolution.

Table 4-12 Encoder frequency-division output pulses (C00.1A = 0)

C00.27 (Output pulse phase)	C00.2A (Z pulse output polarity)	Pulse Output Diagram of Forward RUN	Pulse Output Diagram of Reverse RUN
0	0	 Phase A leads phase B by 90°	 Phase B leads phase A by 90°
	1	 Phase A leads phase B by 90°	 Phase B leads phase A by 90°
1	0	 Phase B leads phase A by 90°	 Phase A leads phase B by 90°
	1	 Phase B leads phase A by 90°	 Phase A leads phase B by 90°

4.1.7 Positioning completed/near function

Positioning completed: When the position deviation fulfills the condition set by users (C03.10), it indicates the positioning in position control mode is completed. Meanwhile, the servo drive outputs positioning completed (COIN) signal, and the host controller, after receiving this signal, confirms that the positioning is completed.

The following figure shows the schematic diagram.

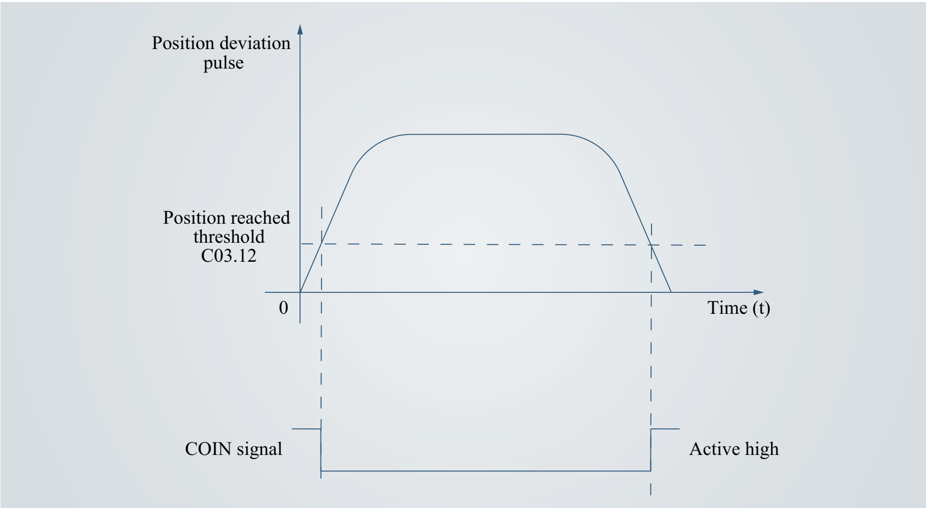


Figure 4-18 Description of the positioning completed/near function

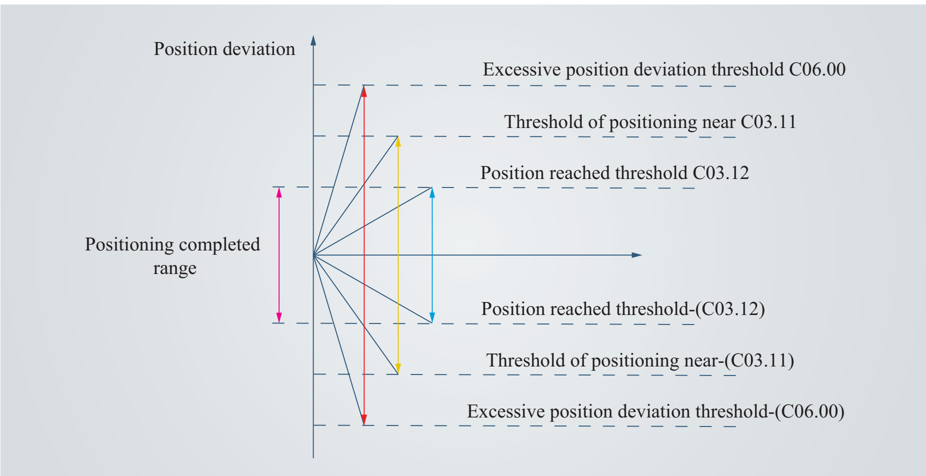


Figure 4-19 Position deviation-related signals

When the position deviation meets the condition defined by C03.10, the servo drive outputs the positioning near (NEAR) signal. The host controller sends the positioning near signal to the servo drive before confirming positioning completed, so that the servo drive prepares for the positioning completed action.

Before using the positioning completed/near function, set the output condition, threshold, window, and hold time. The schematic diagram for the window time and hold time of the positioning completed signal is as follows.

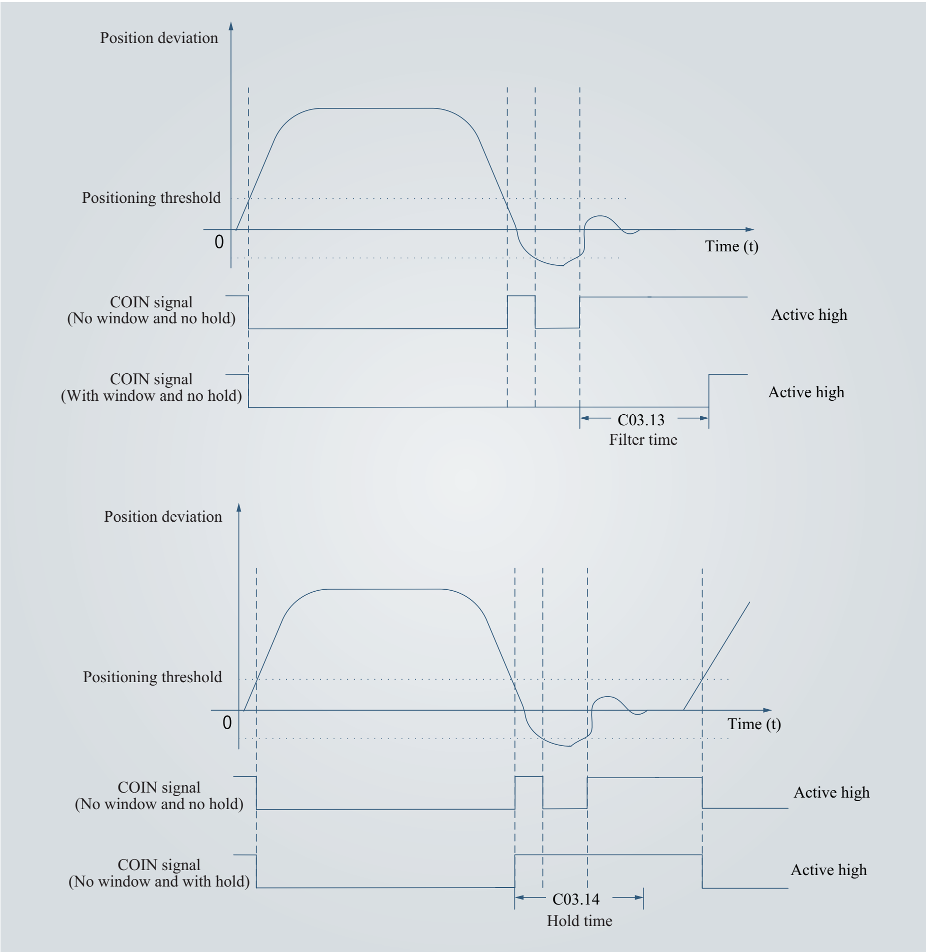


Figure 4-20 Schematic diagram for the window time and hold time of the positioning completed signal

When the COIN (positioning completed) signal has a hold time of 0, this signal remains active until the next position reference is received.

⚠ CAUTION

- Set the position near threshold (C03.11) to a value higher than the position complete threshold (C03.12) in general cases.
- The position complete threshold (C03.12) reflects only the absolute threshold when the positioning completed signal is active. It is irrelevant to the positioning precision.
- An excessively high speed feedforward gain (C01.14) or low-speed operation reduces the absolute position deviation. In this case, the COIN (positioning completed) signal may keep active if C03.12 is set to an excessively high value. To improve the positioning accuracy, decrease the value of C03.12.
- When the position complete threshold (C03.12) is set to a low value along with small position deviation, you can set C03.11 to change the condition for outputting the COIN (positioning completed) signal.
- When the S ON signal is inactive, the positioning completed signal (COIN) and positioning near signal (NEAR) are inactive.
- To use the positioning completed/near function, assign function 7 (FunOUT.7: positioning completed) and function 8 (FunOUT.8: positioning near) to two DOs of the servo drive, and set the active logic of these DOs.

Related functions:

Code	Name	Function Name	Function
FunOut.7	COIN	Positioning completed	Active: The absolute position deviation meets the threshold defined by C03.12 in position control mode, indicating positioning is completed. Inactive: The servo drive is in the positioning completion process in position control mode.
FunOut.8	NEAR	Positioning near	Active: The absolute position deviation meets the condition defined by C03.11, indicating the servo drive is close to the target position. Inactive: The servo drive is in the positioning proximity process in position control mode.

4.1.8 Interrupt positioning

⚠ CAUTION

- The interrupt positioning signal cannot be triggered during homing.

Function description

If interrupt positioning is triggered in the position control mode, the servo drive halts current operation and turns to executing the pre-set fixed distance. To be specific, when the S-ON signal is active in position control mode, if this function is enabled, the servo motor runs the position reference for interrupt positioning in the original direction (before the function is triggered).

When interrupt positioning is in progress, the servo drive does not respond to any other internal/external position references (including another interrupt positioning command). After the running of this function is complete, the servo drive keeps shielding or responds to position references according to the setting of C10.21, but discards the position references input in the running process.

After interrupt positioning is done, the servo drive outputs the interrupt positioning completed (FunOUT.10) signal and positioning completed (FunOUT.7) signal, while the host controller, upon receiving the interrupt positioning completed signal, acknowledges that interrupt positioning is done. Output of the interrupt positioning completed signal is not related to the S-ON signal or the logic of DI7.

Interrupt positioning is active only when the following conditions are met:

- The motor speed is higher than or equal to 10 rpm before interrupt positioning is triggered, or C10.22 and C10.24 are not 0.
- The DI assigned with FunIN.21 (Interrupt positioning inhibited) is not used or the logic of this DI is inactive.

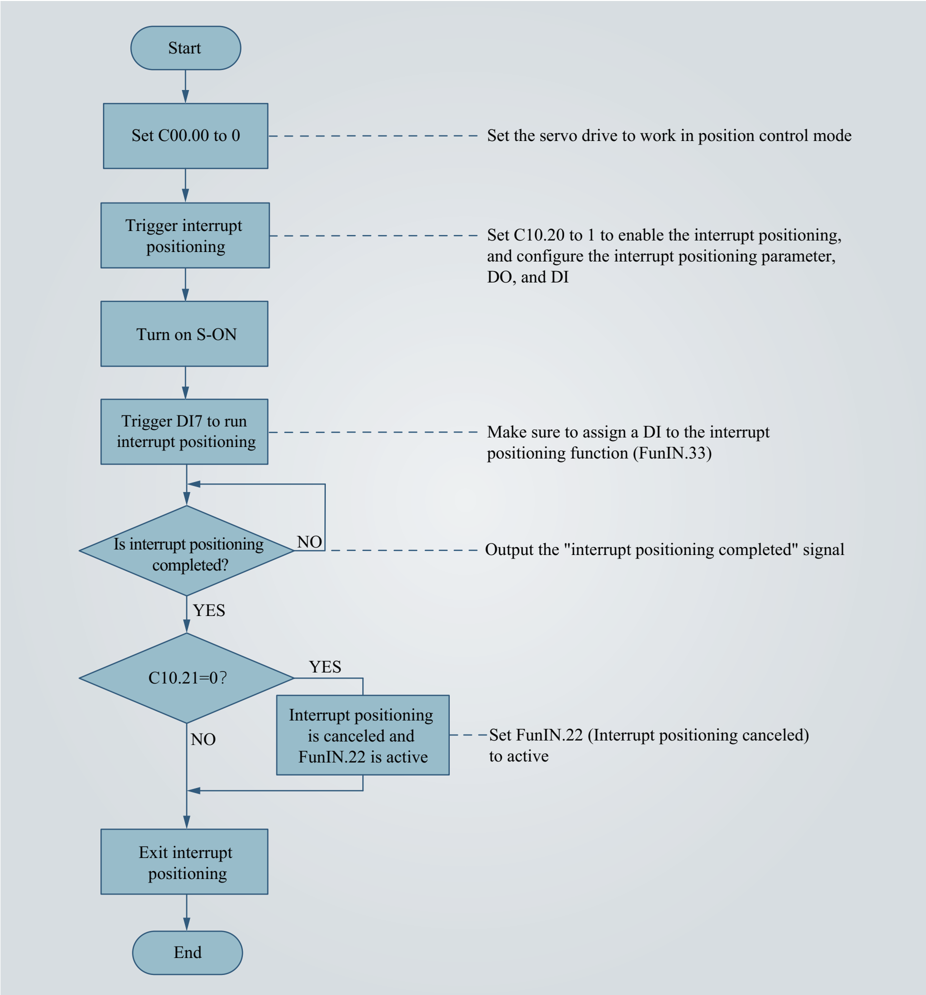


Figure 4-21 Flowchart of the interrupt positioning signal

Related functions:

Code	Function Name	Function
FunIN.22	Interrupt positioning canceled	Active: The interrupt positioning state is cleared, which means the servo drive can respond to other position references. Inactive: The interrupt positioning state is locked, which means the servo drive cannot respond to other position references.
FunIN.21	Interrupt positioning inhibited	Active: Interrupt positioning inhibited Inactive: Interrupt positioning allowed
FunIN.33	Interrupt positioning enable	Active: Interrupt positioning enabled Inactive: Interrupt positioning disable DI45 is assigned with the interrupt positioning enable function.
FunIN.10	Interrupt positioning completed	Active: Interrupt positioning is completed in position control mode. Inactive: Displacement in interrupt positioning is not completed in position control mode.

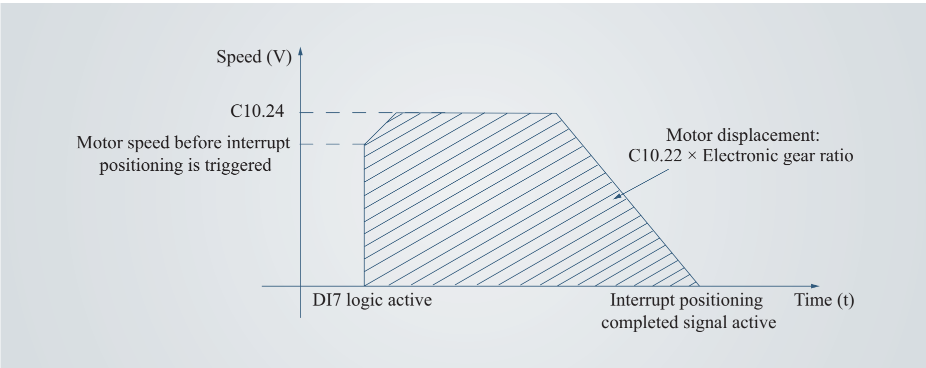


Figure 4-22 Motor operating curve during interrupt positioning

Table 4-13 Motor speed during interrupt positioning

C10.24	Motor Speed Before Interrupt Positioning Is Triggered (rpm)	Interrupt Positioning	Constant Operating Speed in Interrupt Positioning
0	<10	Inactive	-
	≥10	Active	Motor speed before interrupt positioning is triggered
1 to 6000	-	Active	C10.24

4.1.9 Homing

⚠ CAUTION

- The homing signal is shielded when the interrupt positioning or multi-position planning function is in progress.

Function description

- Home (or mechanical home): Indicates the position of the home switch or Z signal, which is determined by C10.01.
- Zero: positioning target point, represented as home + offset (set in C10.0B). When C10.0B is set to 0, the zero position coincides with the home.

In position control mode, when homing is triggered after the S-ON signal is activated, the servo motor starts searching for the zero position.

When homing is in progress, the servo drive does not respond to other position references (including another homing enable signal triggered) until homing is done. When homing is completed, the servo drive can respond to other position references.

- Home attaining: After receiving the homing signal, the servo drive proactively locates the relative position between the motor shaft and the preset mechanical home reference point; it finds the home and then moves through the offset from the home reference point to the zero point. The homing mode usually applies in initial searching for the zero position.

After the homing operation is completed, the absolute motor position (U40.16) is the same as the mechanical home offset (C10.0B).

After the homing operation is completed, the servo drive outputs the home attaining completed signal (FunOUT.9). After receiving this signal, the host controller confirms that the homing operation is completed. The home attaining completed signal is not related to the mode or running state of the servo drive.

Home attaining

⚠ CAUTION

- Set mechanical limit switches before enabling the homing function. For homing upon hit-and-stop, set the offset to a value within the travel range to prevent the machine from collision due to high-speed operation during homing.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Function Description
C10.00	Homing enable	0 to 3	0	-	Set the homing enable mode.
C10.01	Homing method selection	-2 to 35	0	-	Set the homing mode.
C10.02	Initial homing speed	0 to 8000	100	rpm	Set the homing start speed.
C10.03	End homing speed	0 to 3000	10	rpm	Set the homing end speed.
C10.04	Homing acceleration time	0 to 3600000	1000	ms	Set the homing acceleration time.
C10.06	Homing deceleration time	0 to 3600000	1000	ms	Set the homing deceleration time.
C10.08	Homing timeout interval	0 to (2^{32}-1)	60000	ms	Set the homing timeout.
C10.0A	Homing offset mode	0 to 1	0	-	Set the homing offset mode.
C10.0B	Homing offset distance	-2^{31} to (2^{31}-1)	0	Unit in application	Set the homing offset distance.

Homing mode introduction:

Table 4-14 Mode overview table

Mode setting	Description
-2	The mode is used to search for the mechanical extreme position and Z pulse in the forward direction.
-1	The mode is used to search for the mechanical extreme position and Z pulse in the reverse direction.
0	-
1	The motor starts operation in the reverse direction, switches to low-speed operation when the negative limit (NL) status changes from OFF to ON during reverse operation, and then retreats to search for the nearest Z pulse position as the home.
2	The motor starts operation in the forward direction, switches to low-speed operation when the positive limit (PL) status changes from OFF to ON during forward operation, and then retreats to search for the nearest Z pulse position as the home.
3	The motor operates in the forward direction when HSW is inactive and reverse direction when HSW is active. The motor switches to low-speed operation when the HSW status changes from ON to OFF during reverse operation, and then continues the reverse operation to search for the nearest Z pulse position as the home.

Mode setting	Description
4	The motor operates in the forward direction when HSW is inactive and reverse direction when HSW is active. The motor switches to low-speed operation when the HSW status changes from OFF to ON during forward operation, and then continues the forward operation to search for the nearest Z pulse position as the home.
5	The motor operates in the reverse direction when HSW is inactive and forward direction when HSW is active. The motor switches to low-speed operation when the HSW status changes from ON to OFF during forward operation, and then continues the forward operation to search for the nearest Z pulse position as the home.
6	The motor operates in the reverse direction when HSW is inactive and forward direction when HSW is active. The motor switches to low-speed operation when the HSW status changes from OFF to ON during reverse operation, and then continues the reverse operation to search for the nearest Z pulse position as the home.
7	The motor operates in the forward direction when HSW is inactive and reverse direction when HSW is active. The motor switches to low-speed operation when the HSW status changes from ON to OFF during reverse operation, and then continues the reverse operation to search for the nearest Z pulse position as the home.
8	The motor operates in the forward direction when HSW is inactive and reverse direction when HSW is active. The motor switches to low-speed operation when the HSW status changes from OFF to ON during forward operation, and then continues the forward operation to search for the nearest Z pulse position as the home.
9	The motor operates in the forward direction no matter whether HSW is active or inactive. The motor switches to low-speed operation when the HSW status changes from OFF to ON during reverse operation, and then continues the reverse operation to search for the nearest Z pulse position as the home.
10	The motor operates in the forward direction no matter whether HSW is active or inactive. The motor switches to low-speed operation when the HSW status changes from ON to OFF during forward operation, and then continues the forward operation to search for the nearest Z pulse position as the home.
11	The motor operates in the reverse direction when HSW is inactive and forward direction when HSW is active. The motor switches to low-speed operation when the HSW status changes from ON to OFF during forward operation, and then continues the forward operation to search for the nearest Z pulse position as the home.
12	The motor operates in the reverse direction when HSW is inactive and forward direction when HSW is active. The motor switches to low-speed operation when the HSW status changes from OFF to ON during reverse operation, and then continues the reverse operation to search for the nearest Z pulse position as the home.
13	The motor operates in the reverse direction no matter whether HSW is active or inactive. The motor switches to low-speed operation when the HSW status changes from OFF to ON during forward operation, and then continues the forward operation to search for the nearest Z pulse position as the home.
14	The motor operates in the reverse direction no matter whether HSW is active or inactive. The motor switches to low-speed operation when the HSW status changes from ON to OFF during reverse operation, and then continues the reverse operation to search for the nearest Z pulse position as the home.

Mode setting	Description
15	Reserved
16	Reserved
17	Similar to mode 1. During reverse operation, the position where the NL status changes from OFF to ON is used as the home, without searching for the Z pulse.
18	Similar to mode 2. During forward operation, the position where the PL status changes from OFF to ON is used as the home, without searching for the Z pulse.
19	Similar to mode 3. During reverse operation, the position where the HSW status changes from ON to OFF is used as the home, without searching for the Z pulse.
20	Similar to mode 4. During forward operation, the position where the HSW status changes from OFF to ON is used as the home, without searching for the Z pulse.
21	Similar to mode 5. During forward operation, the position where the HSW status changes from ON to OFF is used as the home, without searching for the Z pulse.
22	Similar to mode 6. During reverse operation, the position where the HSW status changes from OFF to ON is used as the home, without searching for the Z pulse.
23	Similar to mode 7. During reverse operation, the position where the HSW status changes from ON to OFF is used as the home, without searching for the Z pulse.
24	Similar to mode 8. During forward operation, the position where the HSW status changes from OFF to ON is used as the home, without searching for the Z pulse.
25	Similar to mode 9. During reverse operation, the position where the HSW status changes from OFF to ON is used as the home, without searching for the Z pulse.
26	Similar to mode 10. During forward operation, the position where the HSW status changes from ON to OFF is used as the home, without searching for the Z pulse.
27	Similar to mode 11. During forward operation, the position where the HSW status changes from ON to OFF is used as the home, without searching for the Z pulse.
28	Similar to mode 12. During reverse operation, the position where the HSW status changes from OFF to ON is used as the home, without searching for the Z pulse.
29	Similar to mode 13. During forward operation, the position where the HSW status changes from OFF to ON is used as the home, without searching for the Z pulse.
30	Similar to mode 14. During reverse operation, the position where the HSW status changes from ON to OFF is used as the home, without searching for the Z pulse.
31	Reserved
32	Reserved
33	The motor starts to operate in the reverse direction, and searches for the nearest Z pulse position as the home.
34	The motor starts to operate in the forward direction, and searches for the nearest Z pulse position as the home.
35	The current position is used as the home.

Home mode:

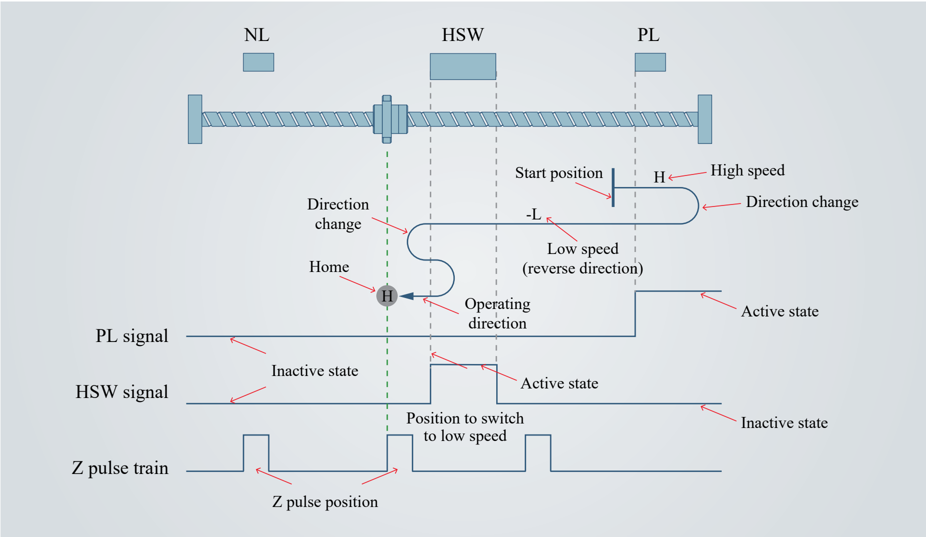


Figure 4-23 Definition of the home mode

Mode-2: The mode is used to search for the mechanical extreme position and Z pulse in the forward direction.

- The motor starts to operate in the forward direction at a high speed. After the motor runs into the mechanical extreme position, if the torque reaches the torque limit value, the speed is near zero, and the state is maintained for a certain period of time, the axis reaches the mechanical extreme position. The motor switches to operate in the reverse direction at a low speed, and searches for the nearest Z pulse position as the home.

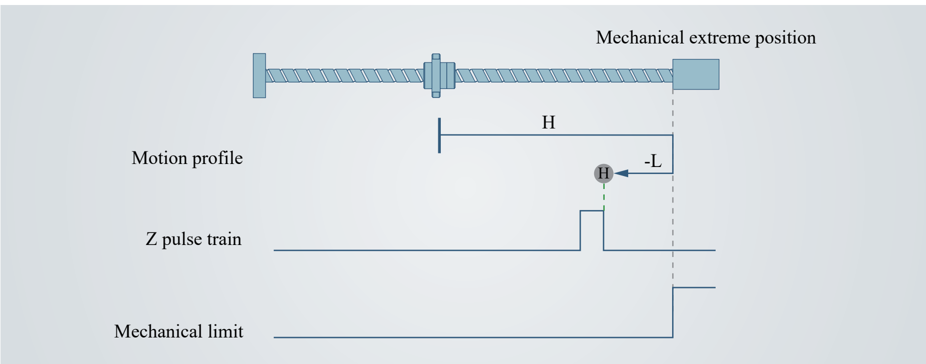


Figure 4-24 Home mode-2 profile and signal status

Mode-1: The mode is used to search for the mechanical extreme position and Z pulse in the reverse direction.

- The motor starts to operate in the reverse direction at a high speed. After the motor runs into the mechanical extreme position, if the torque reaches the torque limit value, the speed is near zero, and the state is maintained for a certain period of time, the axis reaches the mechanical extreme position. The motor switches to operate in the forward direction at a low speed, and searches for the nearest Z pulse position as the home.

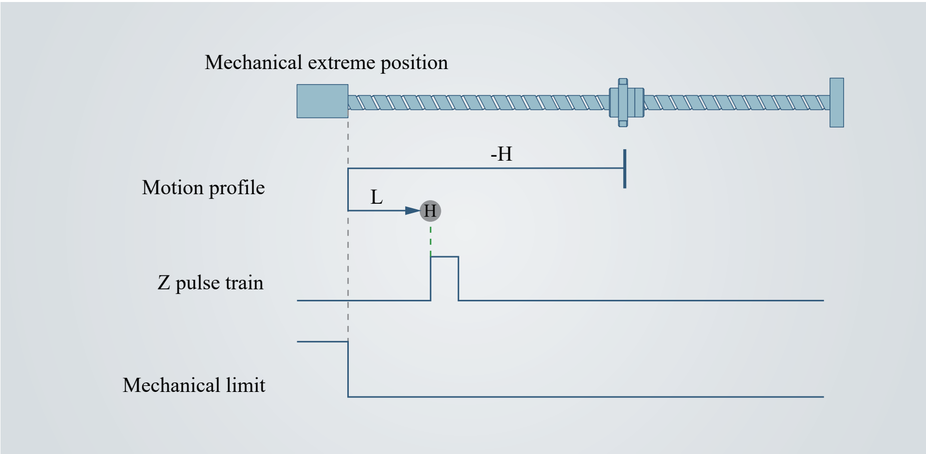


Figure 4-25 Home mode-1 profile and signal status

Mode 1: Search for the NL and Z pulse.

- If the NL is inactive upon startup, the motor operates in the reverse direction at a high speed. When the NL status changes from OFF to ON, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the NL status changes from ON to OFF during forward operation at a low speed, the motor continues the forward operation to search for the nearest Z pulse position as the home.
- If the NL is active upon startup, the motor operates in the forward direction at a low speed. When the NL status changes from ON to OFF during forward operation, the motor continues the forward operation to search for the nearest Z pulse position as the home.

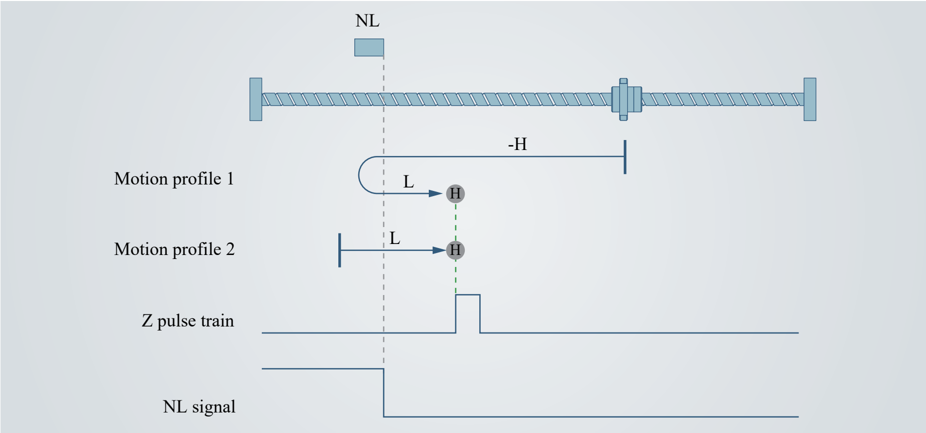


Figure 4-26 Home mode 1 profile and signal status

Mode 2: Search for the PL and Z pulse.

- If the PL is inactive upon startup, the motor operates in the forward direction at a high speed. When the PL status changes from OFF to ON, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the PL status changes from ON to OFF during reverse operation at a low speed, the motor continues the reverse operation to search for the nearest Z pulse position as the home.
- If the PL is active upon startup, the motor operates in the reverse direction at a low speed. When the PL status changes from ON to OFF during reverse operation, the motor continues the reverse operation to search for the nearest Z pulse position as the home.

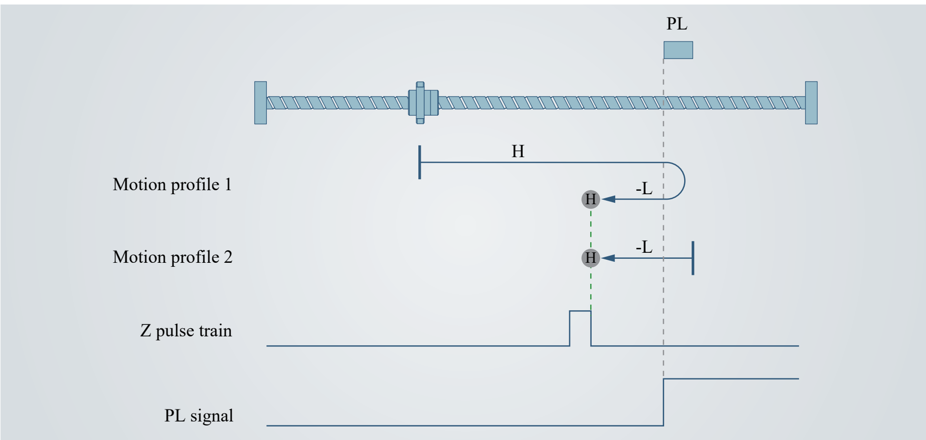


Figure 4-27 Home mode 2 profile and signal status

Mode 3: When the HSW status changes from ON to OFF during reverse operation, the motor searches for the position and Z pulse.

- If the HSW is inactive upon startup, the motor operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation at a low speed, the motor continues the reverse operation to search for the nearest Z pulse position as the home.
- If the HSW is active upon startup, the motor operates in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation at a low speed, the motor searches for the nearest Z pulse position as the home.
- In this mode, no matter whether the NL or PL is in ON state, the homing process is stopped and an alarm is reported.

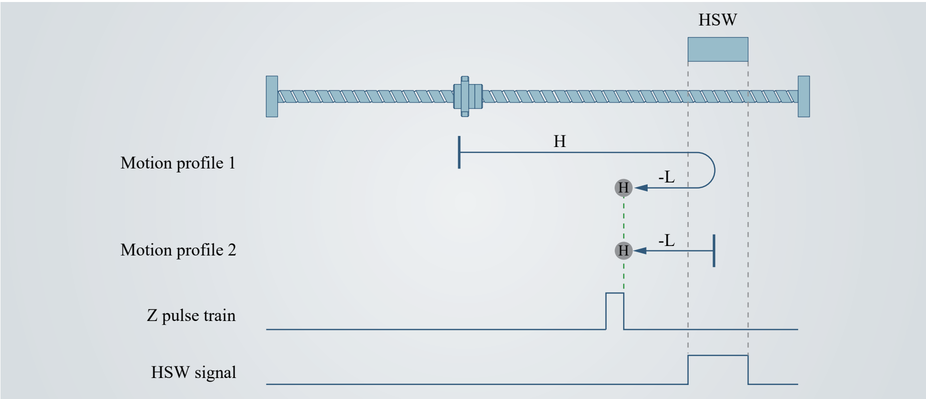


Figure 4-28 Home mode 3 profile and signal status

Mode 4: When the HSW status changes from OFF to ON during forward operation, the motor searches for the position and Z pulse.

- If the HSW is inactive upon startup, the motor operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates to stop, returns to the position where the HSW is inactive at a low speed, decelerates to stop again, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor continues the forward operation to search for the nearest Z pulse position as the home.
- If the HSW is active upon startup, the motor operates in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor continues the forward operation to search for the nearest Z pulse position as the home.
- In this mode, no matter whether the NL or PL is in ON state, the homing process is stopped and an alarm is reported.

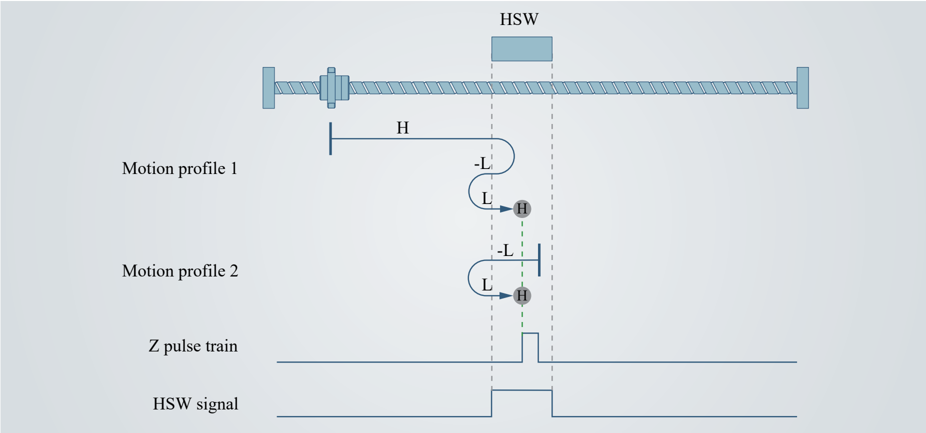


Figure 4-29 Home mode 4 profile and signal status

Mode 5: When the HSW status changes from ON to OFF during forward operation, the motor searches for the position and Z pulse.

- If the HSW is inactive upon startup, the motor operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation at a low speed, the motor continues the forward operation to search for the nearest Z pulse position as the home.
- If the HSW is active upon startup, the motor operates in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation at a low speed, the motor searches for the nearest Z pulse position as the home.
- In this mode, no matter whether the NL or PL is in ON state, the homing process is stopped and an alarm is reported.

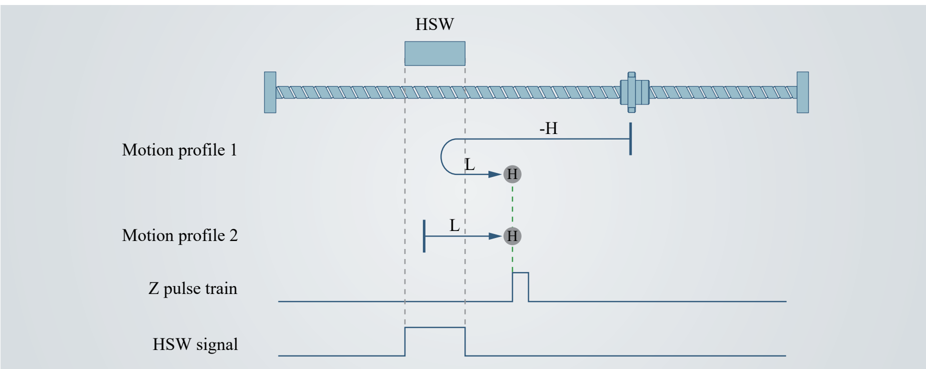


Figure 4-30 Home mode 5 profile and signal status

Mode 6: When the HSW status changes from OFF to ON during reverse operation, the motor searches for the position and Z pulse.

- If the HSW is inactive upon startup, the motor operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates to stop, returns to the position where the HSW is inactive at a low speed, decelerates to stop again, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor continues the reverse operation to search for the nearest Z pulse position as the home.
- If the HSW is active upon startup, the motor operates in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor continues the reverse operation to search for the nearest Z pulse position as the home.
- In this mode, no matter whether the NL or PL is in ON state, the homing process is stopped and an alarm is reported.

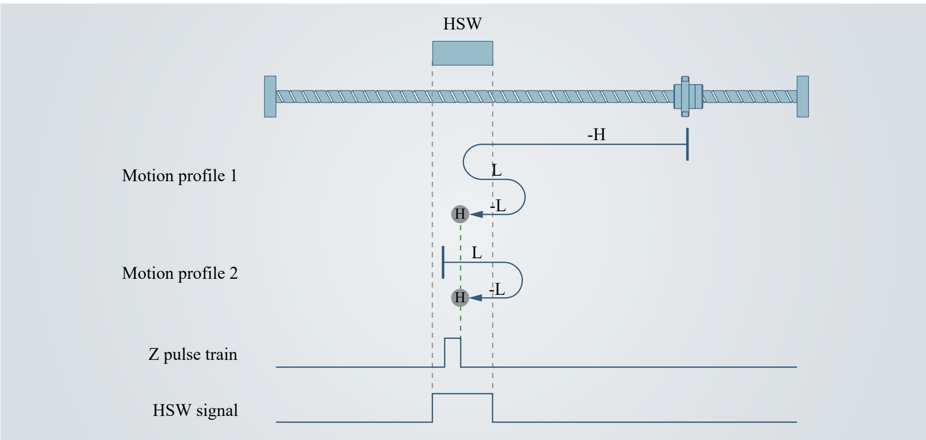


Figure 4-31 Home mode 6 profile and signal status

Mode 7: When the HSW status changes from ON to OFF during reverse operation, the motor searches for the position and Z pulse and automatically turns to another direction upon the PL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the PL is in ON state, the motor decelerates to stop, and then operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates and continues to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, returns to the position where the HSW is active at a low speed, decelerates to stop again (if the active HSW range is narrow, it may enter the inactive HSW position range on the other side), and switches to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation at a low speed, the motor continues the reverse operation to search for the nearest Z pulse position as the home.

- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation at a low speed, the motor continues the reverse operation to search for the nearest Z pulse position as the home.
- If the HSW is active upon startup, the motor operates in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation at a low speed, the motor searches for the nearest Z pulse position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the PL for the first time during forward operation. When the motor encounters the ON state of the NL or encounters the ON state of the PL again, the homing process is stopped and an alarm is reported.

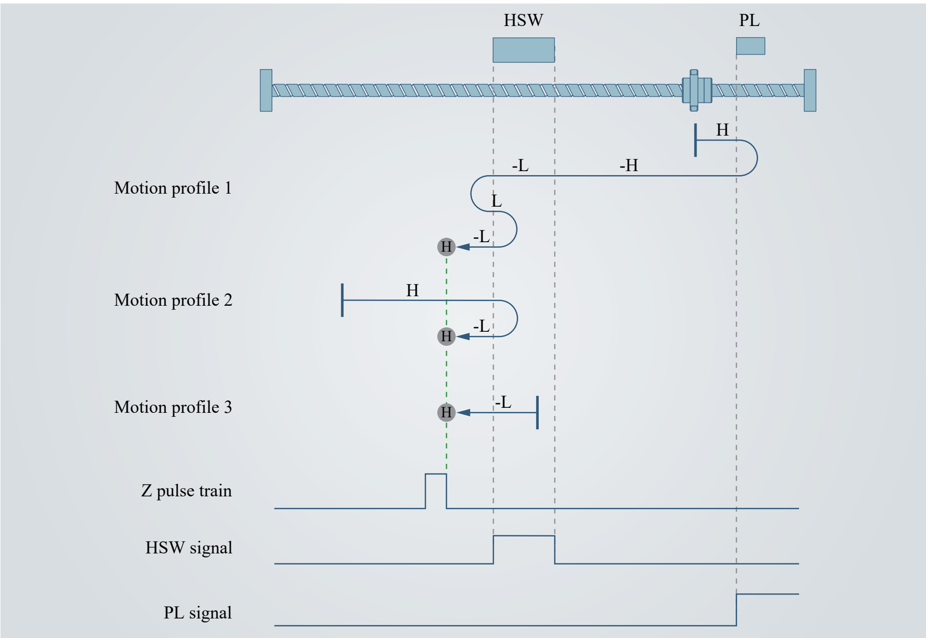


Figure 4-32 Home mode 7 profile and signal status

Mode 8: When the HSW status changes from OFF to ON during forward operation, the motor searches for the position and Z pulse and automatically turns to another direction upon the PL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the PL is in ON state, the motor decelerates to stop, and then operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates, and continues to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor continues the forward operation to search for the nearest Z pulse position as the home.

- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates to stop, returns to the position where the HSW is inactive at a low speed, decelerates to stop again, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor continues the forward operation to search for the nearest Z pulse position as the home.
- If the HSW is active upon startup, the motor operates in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor continues the forward operation to search for the nearest Z pulse position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the PL for the first time during forward operation. When the motor encounters the ON state of the NL or encounters the ON state of the PL again, the homing process is stopped and an alarm is reported.

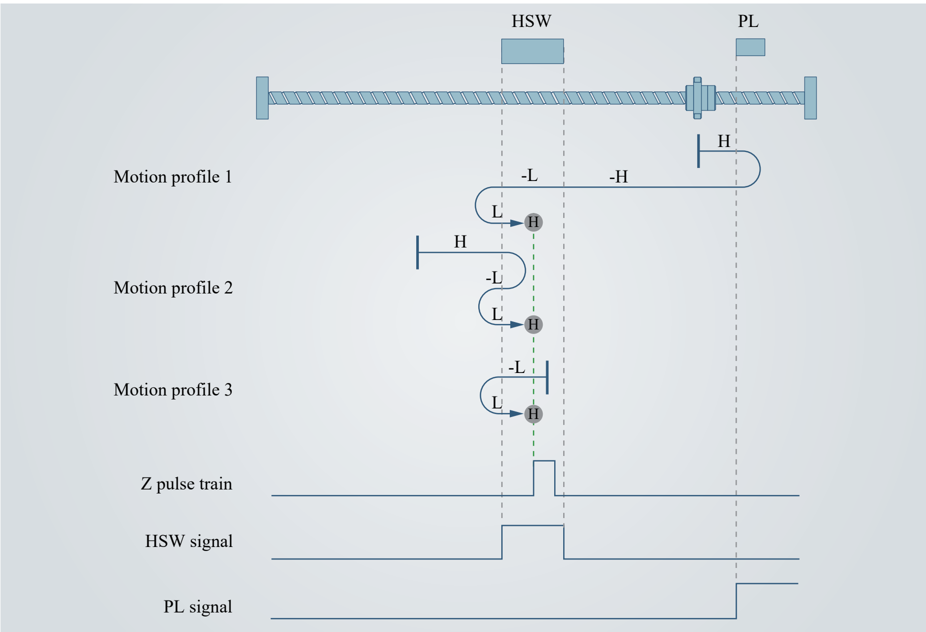


Figure 4-33 Home mode 8 profile and signal status

Mode 9: When the HSW status changes from OFF to ON during reverse operation, the motor searches for the position and Z pulse and automatically turns to another direction upon the PL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the PL is in ON state, the motor decelerates to stop, and then operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates to stop, returns to the position where the HSW is inactive at a low speed, decelerates to stop again, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor continues the reverse operation to search for the nearest Z pulse position as the home.
- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates, and continues to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor continues the reverse operation to search for the nearest Z pulse position as the home.
- If the HSW is active upon startup, the motor operates in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor continues the reverse operation to search for the nearest Z pulse position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the PL for the first time during forward operation. When the motor encounters the ON state of the NL or encounters the ON state of the PL again, the homing process is stopped and an alarm is reported.

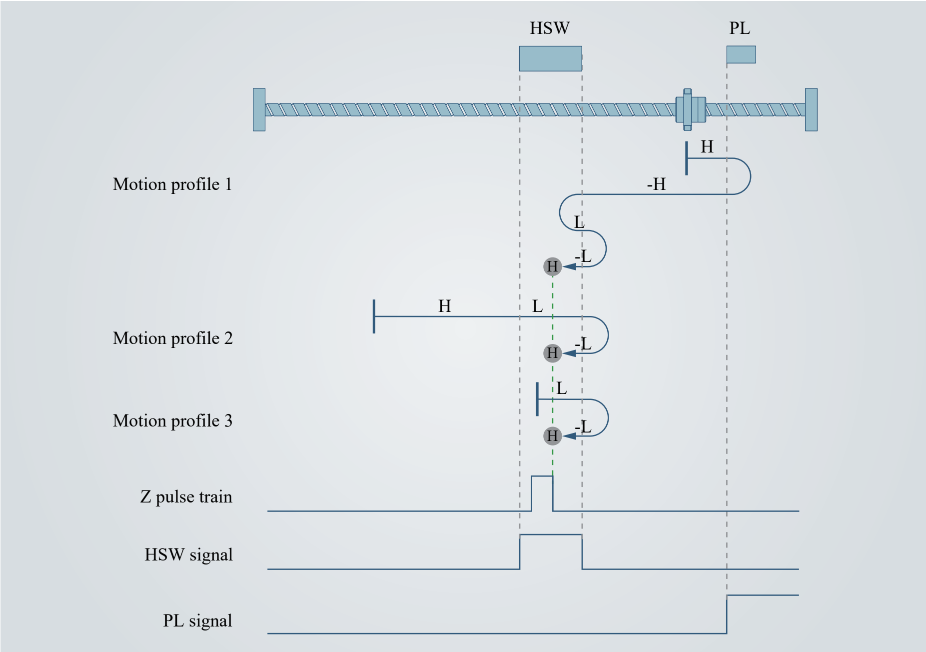


Figure 4-34 Home mode 9 profile and signal status

Mode 10: When the HSW status changes from ON to OFF during forward operation, the motor searches for the position and Z pulse and automatically turns to another direction upon the PL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the PL is in ON state, the motor decelerates to stop, and then operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation at a low speed, the motor continues the forward operation to search for the nearest Z pulse position as the home.
- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates, and continues to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, returns to the position where the HSW is active at a low speed, decelerates to stop again (if the active HSW range is narrow, it may enter the inactive HSW position range on the other side), and switches to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation at a low speed, the motor continues the forward operation to search for the nearest Z pulse position as the home.

- If the HSW is active upon startup, the motor operates in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation at a low speed, the motor searches for the nearest Z pulse position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the PL for the first time during forward operation. When the motor encounters the ON state of the NL or encounters the ON state of the PL again, the homing process is stopped and an alarm is reported.

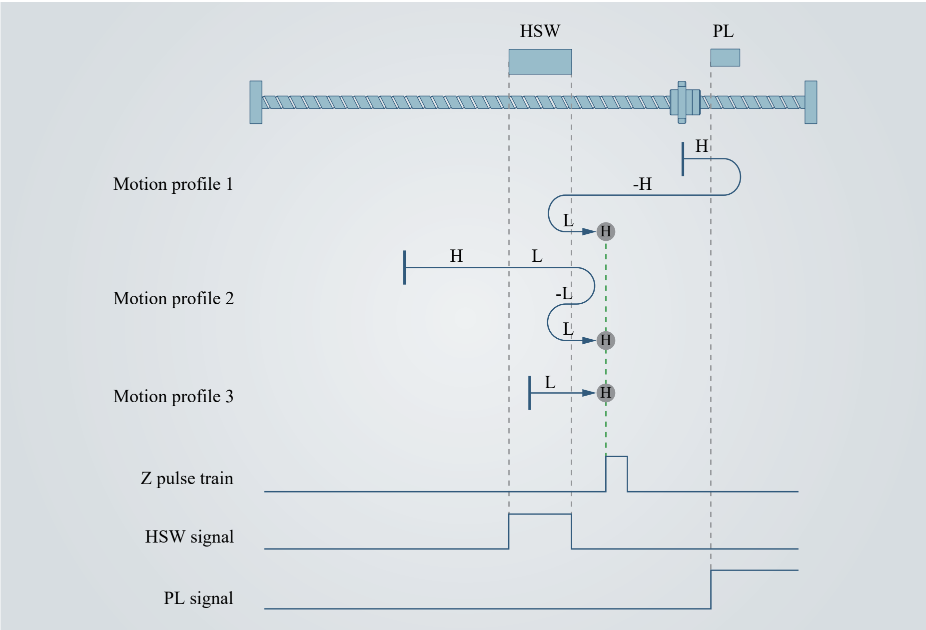


Figure 4-35 Home mode 10 profile and signal status

Mode 11: When the HSW status changes from ON to OFF during forward operation, the motor searches for the position and Z pulse and automatically turns to the forward direction upon the NL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation at a low speed, the motor continues the forward operation to search for the nearest Z pulse position as the home.
- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the NL is in ON state, the motor decelerates to stop, and then operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates and continues to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, returns to

the position where the HSW is active at a low speed, decelerates to stop again (if the active HSW range is narrow, it may enter the inactive HSW position range on the other side), and switches to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation at a low speed, the motor continues the forward operation to search for the nearest Z pulse position as the home.

- If the HSW is active upon startup, the motor operates in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation at a low speed, the motor searches for the nearest Z pulse position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the NL for the first time during reverse operation. When the motor encounters the ON state of the PL or encounters the ON state of the NL again, the homing process is stopped and an alarm is reported.

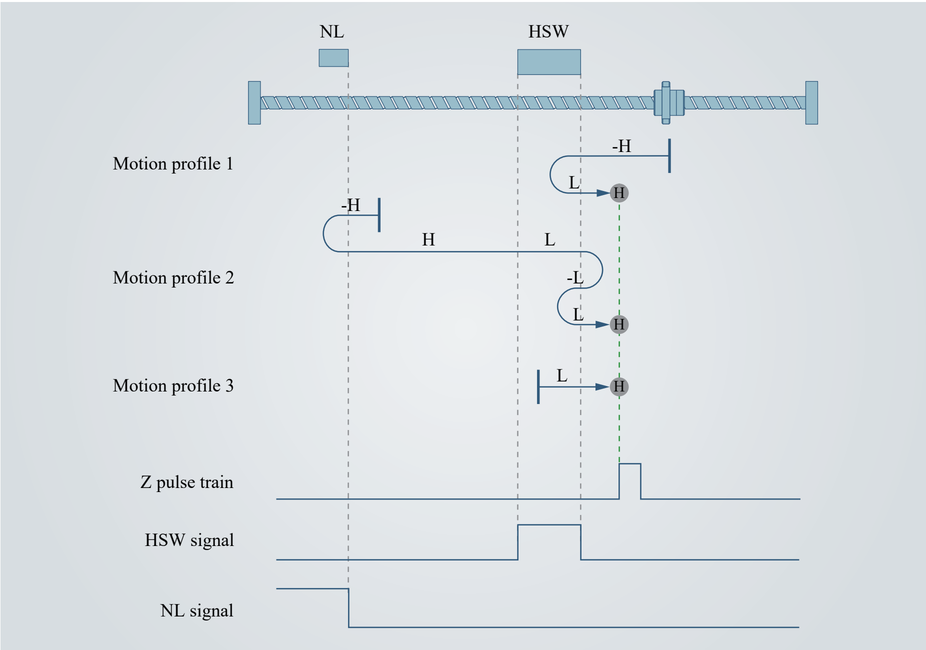


Figure 4-36 Home mode 11 profile and signal status

Mode 12: When the HSW status changes from OFF to ON during reverse operation, the motor searches for the position and Z pulse and automatically turns to another direction upon the NL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates to stop, returns to the position where the HSW is inactive at a low speed, decelerates to stop again, and then switches to operate in the reverse direction at a low speed.

When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor continues the reverse operation to search for the nearest Z pulse position as the home.

- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the NL is in ON state, the motor decelerates to stop, and then operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates, and continues to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor continues the reverse operation to search for the nearest Z pulse position as the home.
- If the HSW is active upon startup, the motor operates in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor continues the reverse operation to search for the nearest Z pulse position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the NL for the first time during reverse operation. When the motor encounters the ON state of the PL or encounters the ON state of the NL again, the homing process is stopped and an alarm is reported.

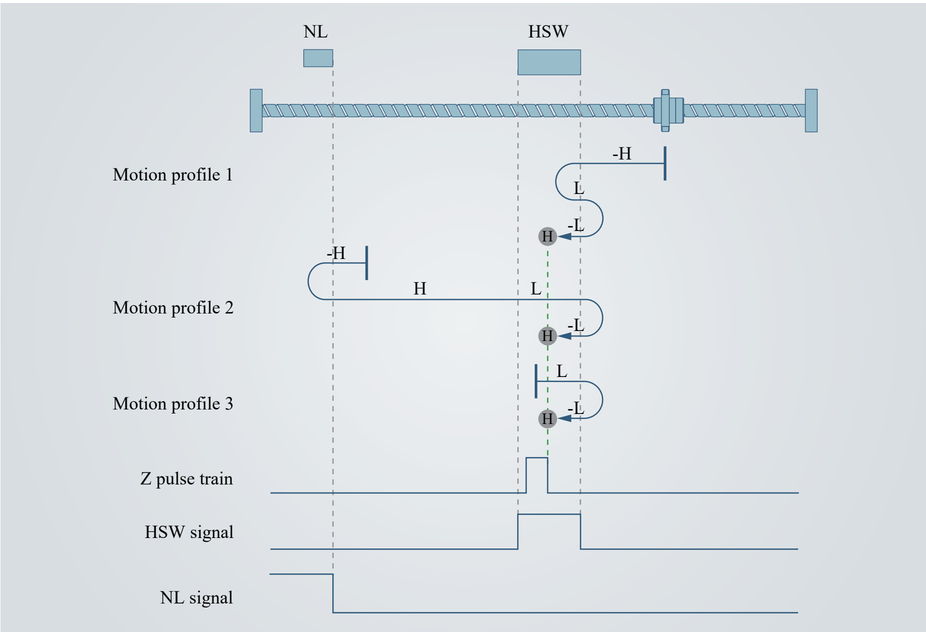


Figure 4-37 Home mode 12 profile and signal status

Mode 13: When the HSW status changes from OFF to ON during forward operation, the motor searches for the position and Z pulse and automatically turns to another direction upon the NL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates, and continues to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor continues the forward operation to search for the nearest Z pulse position as the home.
- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the NL is in ON state, the motor decelerates to stop, and then operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates to stop, returns to the position where the HSW is inactive at a low speed, decelerates to stop again, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor continues the forward operation to search for the nearest Z pulse position as the home.
- If the HSW is active upon startup, the motor operates in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor continues the forward operation to search for the nearest Z pulse position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the NL for the first time during reverse operation. When the motor encounters the ON state of the PL or encounters the ON state of the NL again, the homing process is stopped and an alarm is reported.

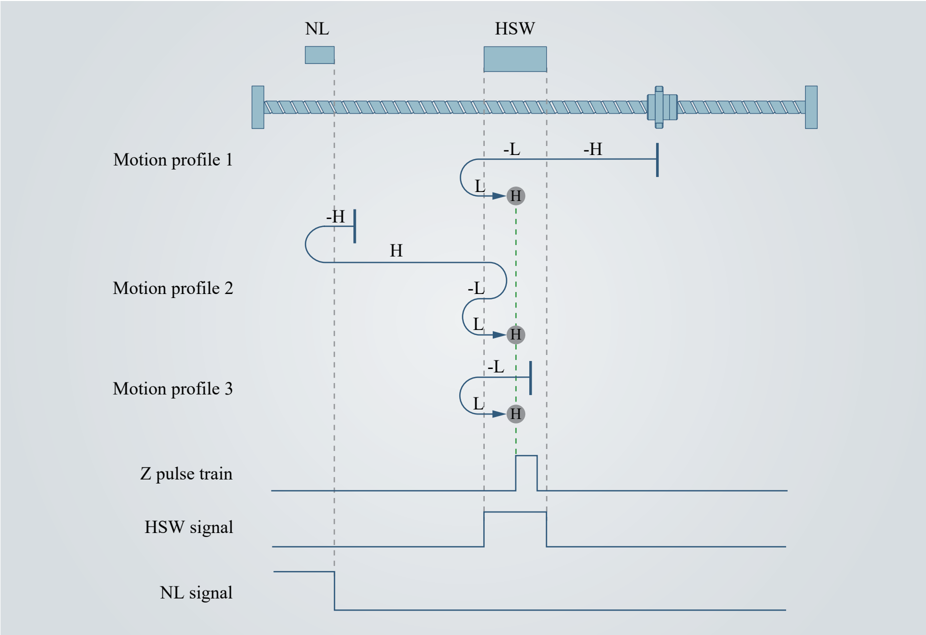


Figure 4-38 Home mode 13 profile and signal status

Mode 14: When the HSW status changes from ON to OFF during reverse operation, the motor searches for the position and Z pulse and automatically turns to another direction upon the NL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates and continues to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, returns to the position where the HSW is active at a low speed, decelerates to stop again (if the active HSW range is narrow, it may enter the inactive HSW position range on the other side), and switches to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation at a low speed, the motor continues the reverse operation to search for the nearest Z pulse position as the home.
- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the NL is in ON state, the motor decelerates to stop, and then operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation at a low speed, the motor continues the reverse operation to search for the nearest Z pulse position as the home.

- If the HSW is active upon startup, the motor operates in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation at a low speed, the motor searches for the nearest Z pulse position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the NL for the first time during reverse operation. When the motor encounters the ON state of the PL or encounters the ON state of the NL again, the homing process is stopped and an alarm is reported.

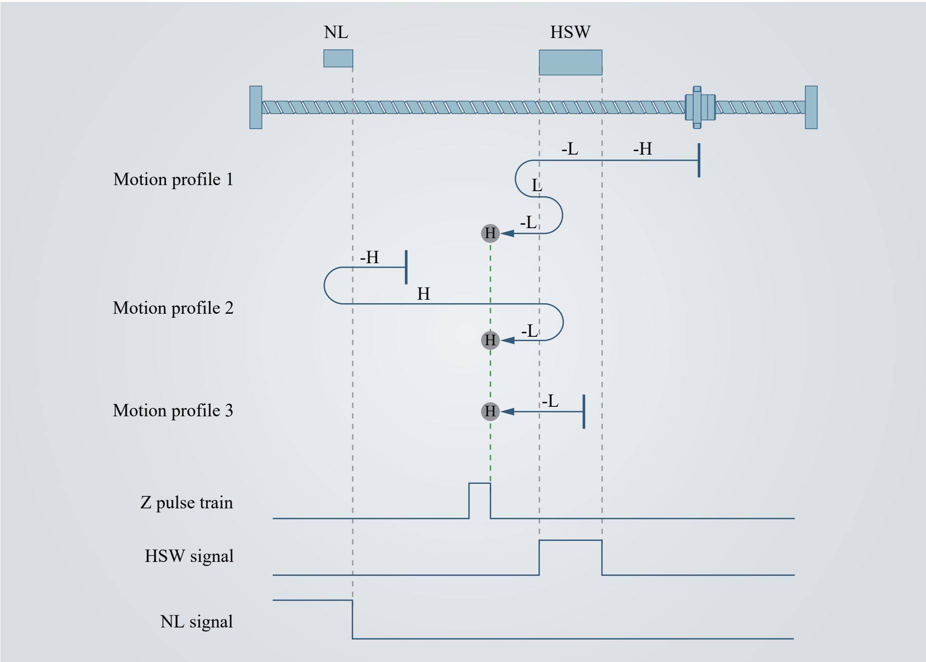


Figure 4-39 Home mode 14 profile and signal status

Mode 15 and mode 16: Reserved

Mode 17: Search for the NL.

- If the NL is inactive upon startup, the motor operates in the reverse direction at a high speed. When the NL status changes from OFF to ON, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the NL status changes from ON to OFF during forward operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the NL is active upon startup, the motor operates in the forward direction at a low speed. When the NL status changes from ON to OFF during forward operation, the motor decelerates to stop and uses the stop position as the home.

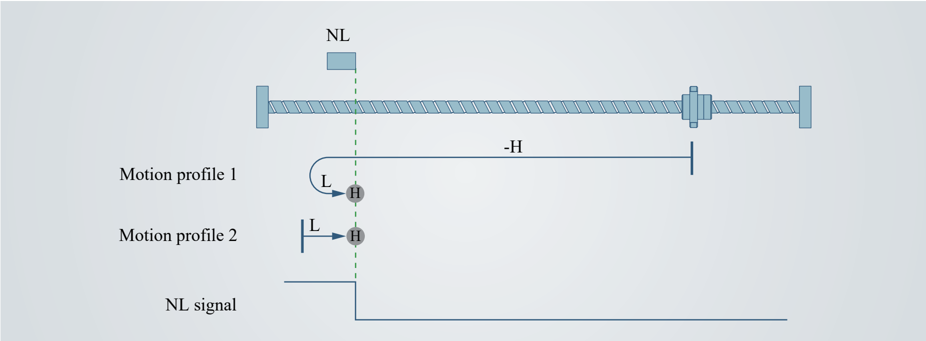


Figure 4-40 Home mode 17 profile and signal status

Mode 18: Search for the PL.

- If the PL is inactive upon startup, the motor operates in the forward direction at a high speed. When the PL status changes from OFF to ON, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the PL status changes from ON to OFF during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the PL is active upon startup, the motor operates in the reverse direction at a low speed. When the PL status changes from ON to OFF during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.

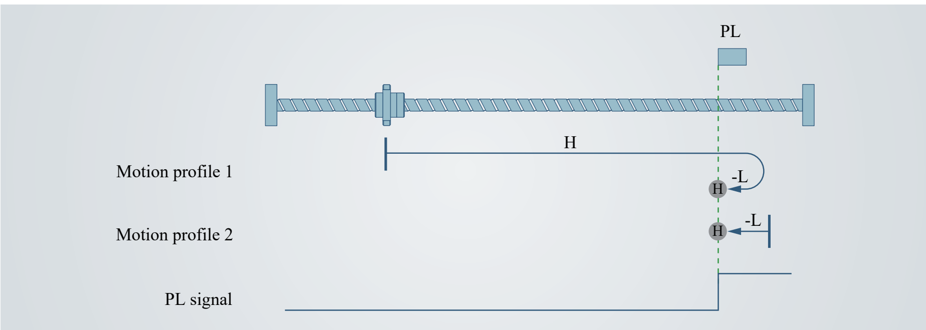


Figure 4-41 Home mode 18 profile and signal status

Mode 19: When the HSW status changes from ON to OFF during reverse operation, the motor searches for the position.

- If the HSW is inactive upon startup, the motor operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from

ON to OFF during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.

- If the HSW is active upon startup, the motor operates in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation, the motor uses the stop position as the home.
- In this mode, no matter whether the NL or PL is in ON state, the homing process is stopped and an alarm is reported.

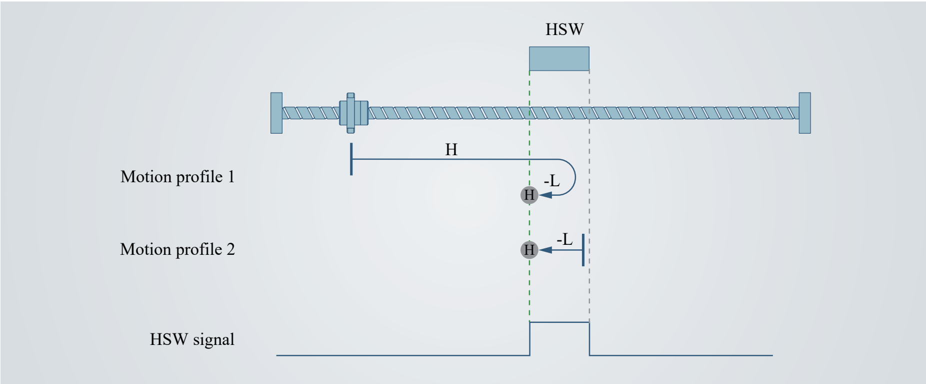


Figure 4-42 Home mode 19 profile and signal status

Mode 20: When the HSW status changes from OFF to ON during forward operation, the motor searches for the position.

- If the HSW is inactive upon startup, the motor operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates to stop, returns to the position where the HSW is inactive at a low speed, decelerates to stop again, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is active upon startup, the motor operates in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- In this mode, no matter whether the NL or PL is in ON state, the homing process is stopped and an alarm is reported.

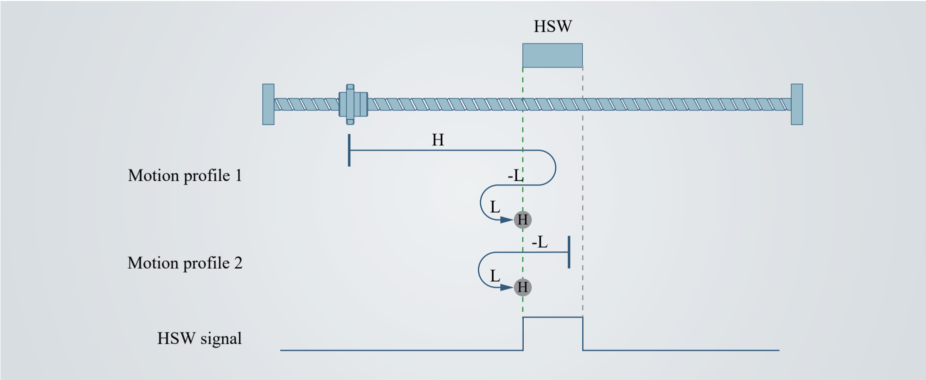


Figure 4-43 Home mode 20 profile and signal status

Mode 21: When the HSW status changes from ON to OFF during forward operation, the motor searches for the position.

- If the HSW is inactive upon startup, the motor operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is active upon startup, the motor operates in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation, the motor uses the stop position as the home.
- In this mode, no matter whether the NL or PL is in ON state, the homing process is stopped and an alarm is reported.

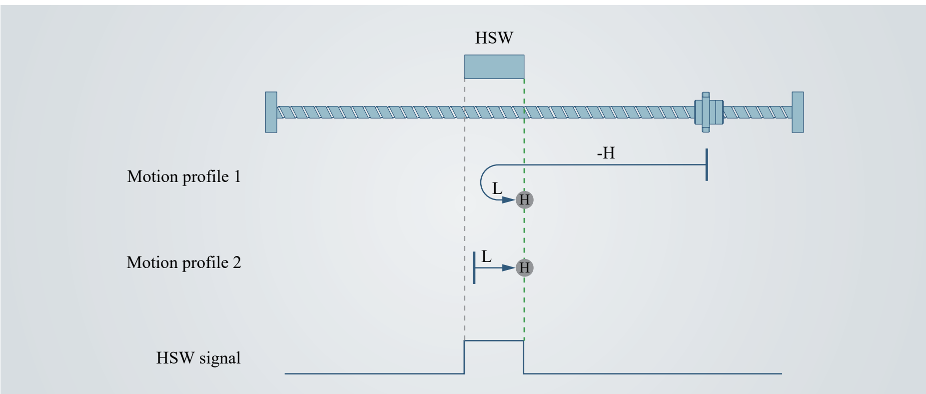


Figure 4-44 Home mode 21 profile and signal status

Mode 22: Search for the PL.

- If the HSW is inactive upon startup, the motor operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates to stop, returns to the position where the HSW is inactive at a low speed, decelerates to stop again, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is active upon startup, the motor operates in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- In this mode, no matter whether the NL or PL is in ON state, the homing process is stopped and an alarm is reported.

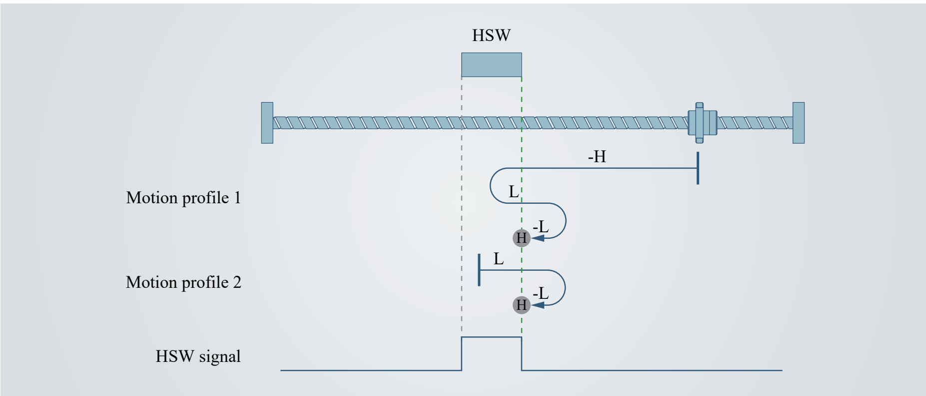


Figure 4-45 Home mode 22 profile and signal status

Mode 23: When the HSW status changes from ON to OFF during reverse operation, the motor searches for the position and automatically turns to another direction upon the PL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the PL is in ON state, the motor decelerates to stop, and then operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates and continues to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, returns to the position where the HSW is active at a low speed, decelerates to stop again (if the active HSW range is narrow, it may enter the inactive HSW position range on the other side), and switches to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates

in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.

- If the HSW is active upon startup, the motor operates in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation, the motor uses the stop position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the PL for the first time during forward operation. When the motor encounters the ON state of the NL or encounters the ON state of the PL again, the homing process is stopped and an alarm is reported.

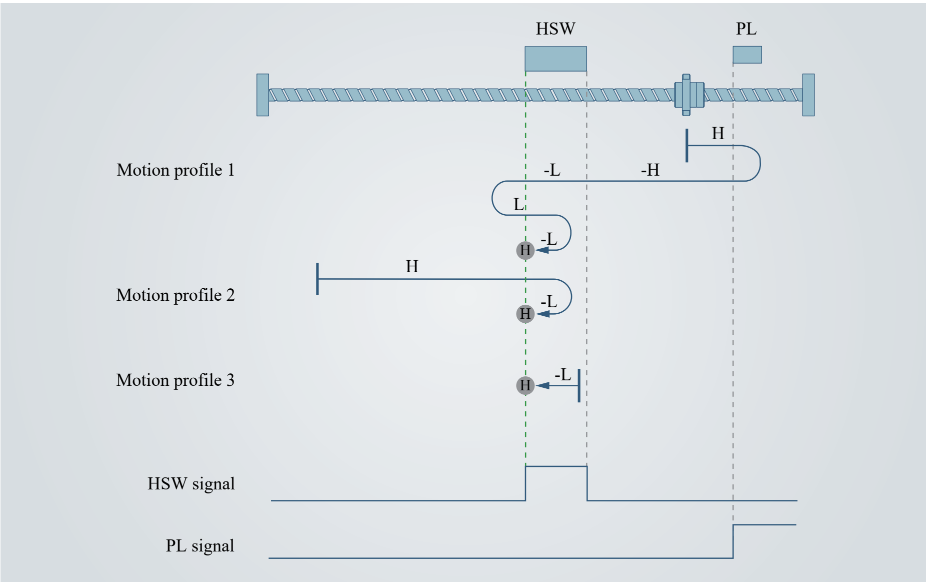


Figure 4-46 Home mode 23 profile and signal status

Mode 24: When the HSW status changes from OFF to ON during forward operation, the motor searches for the position and automatically turns to another direction upon the PL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the PL is in ON state, the motor decelerates to stop, and then operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates, and continues to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor decelerates to stop and uses the stop position as the home.

- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates to stop, returns to the position where the HSW is inactive at a low speed, decelerates to stop again, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is active upon startup, the motor operates in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the PL for the first time during forward operation. When the motor encounters the ON state of the NL or encounters the ON state of the PL again, the homing process is stopped and an alarm is reported.

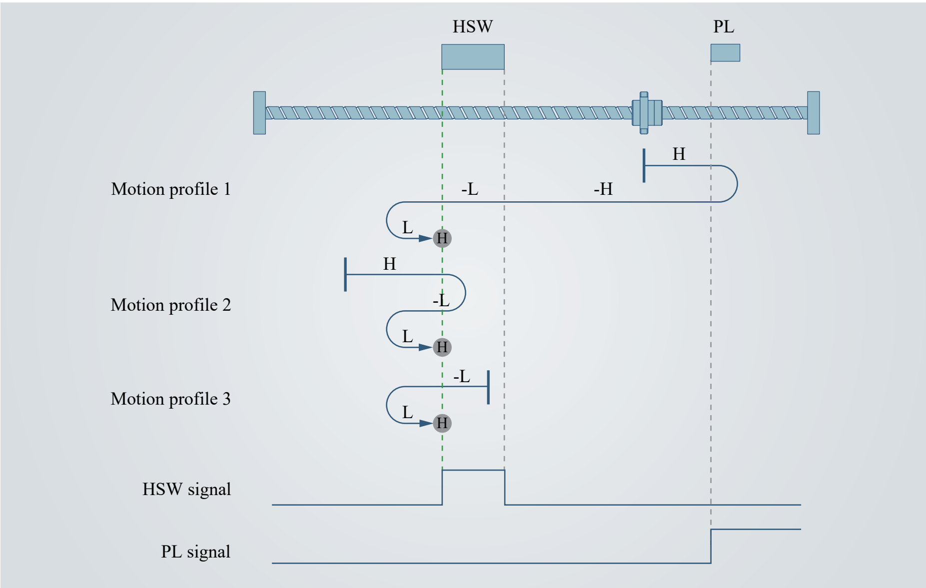


Figure 4-47 Home mode 24 profile and signal status

Mode 25: When the HSW status changes from OFF to ON during reverse operation, the motor searches for the position and automatically turns to another direction upon the PL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the PL is in ON state, the motor decelerates to stop, and then operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates to stop, returns to the position where the HSW is inactive at a low speed, decelerates to stop again, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.

- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates, and continues to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is active upon startup, the motor operates in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the PL for the first time during forward operation. When the motor encounters the ON state of the NL or encounters the ON state of the PL again, the homing process is stopped and an alarm is reported.

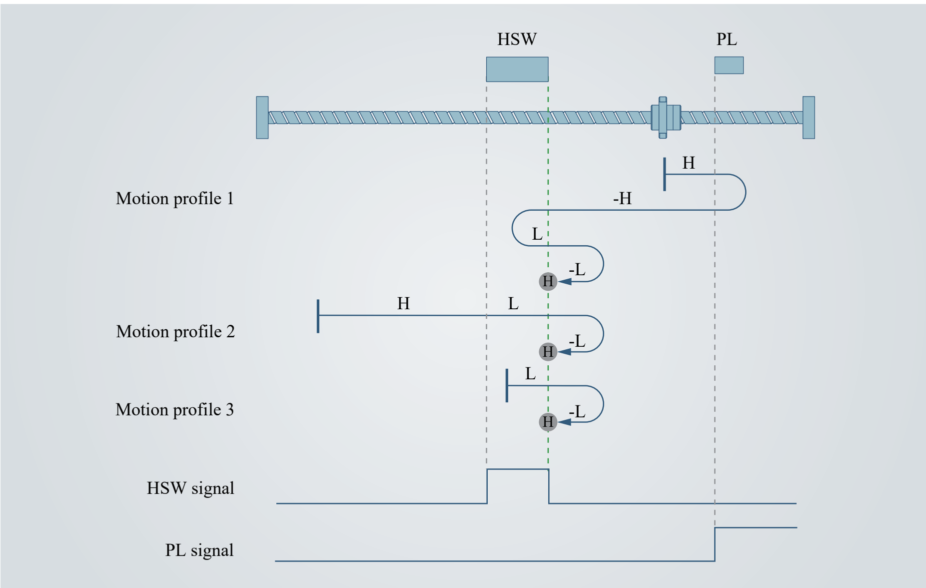


Figure 4-48 Home mode 25 profile and signal status

Mode 26: When the HSW status changes from ON to OFF during forward operation, the motor searches for the position and automatically turns to another direction upon the PL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the PL is in ON state, the motor decelerates to stop, and then operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates and continues to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, returns to the position where the HSW is active at a low speed, decelerates to stop again (if the active HSW range is narrow, it may enter the inactive HSW position range on the other side), and switches to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is active upon startup, the motor operates in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation, the motor uses the stop position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the PL for the first time during forward operation. When the motor encounters the ON state of the NL or encounters the ON state of the PL again, the homing process is stopped and an alarm is reported.

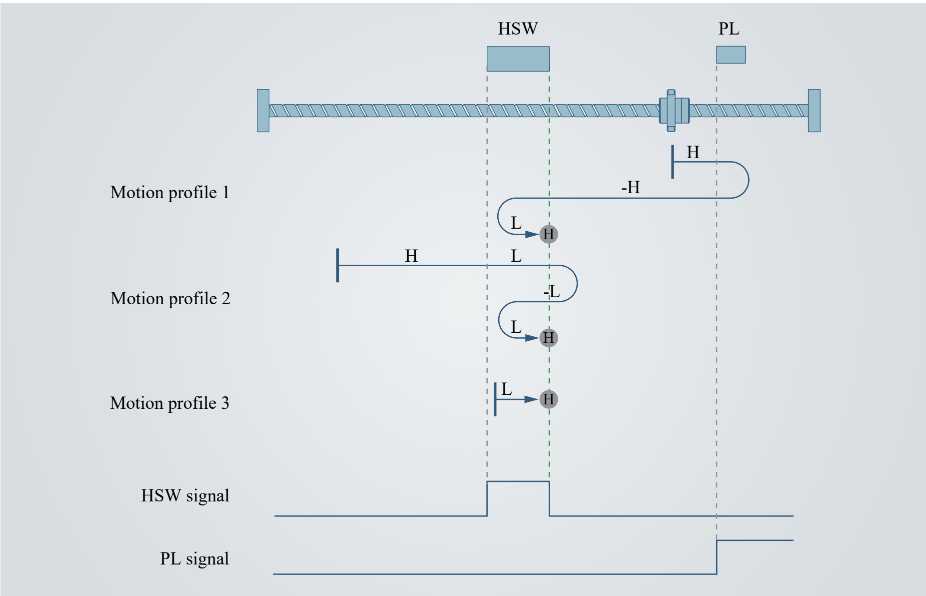


Figure 4-49 Home mode 26 profile and signal status

Mode 27: When the HSW status changes from ON to OFF during forward operation, the motor searches for the position and automatically turns to another direction upon the NL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the NL is in ON state, the motor decelerates to stop, and then operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates and continues to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, returns to the position where the HSW is active at a low speed, decelerates to stop again (if the active HSW range is narrow, it may enter the inactive HSW position range on the other side), and switches to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is active upon startup, the motor operates in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation, the motor uses the stop position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the NL for the first time during reverse operation. When the motor encounters the ON state of the PL or encounters the ON state of the NL again, the homing process is stopped and an alarm is reported.

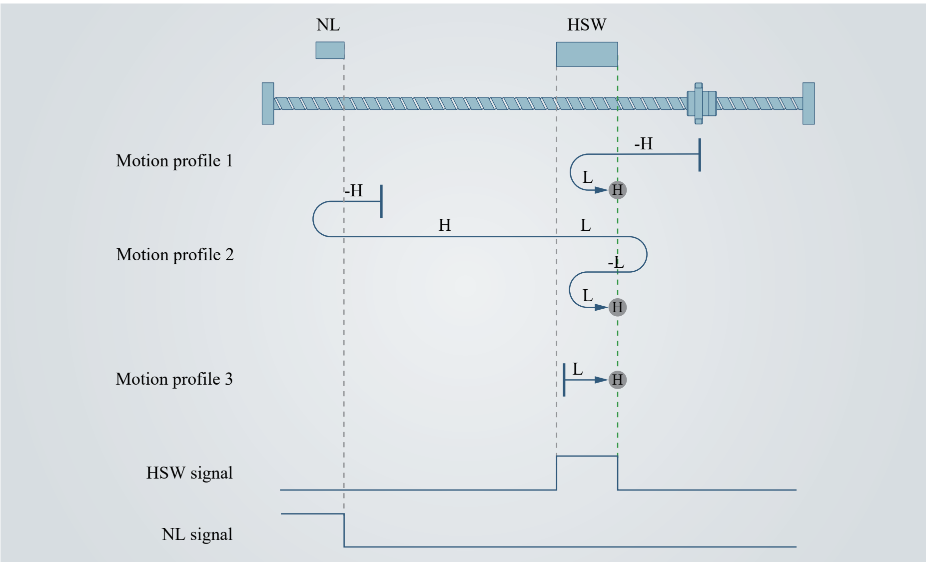


Figure 4-50 Home mode 27 profile and signal status

Mode 28: When the HSW status changes from OFF to ON during reverse operation, the motor searches for the position and automatically turns to another direction upon the NL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates to stop, returns to the position where the HSW is inactive at a low speed, decelerates to stop again, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the NL is in ON state, the motor decelerates to stop, and then operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates, and continues to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is active upon startup, the motor operates in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the NL for the first time during reverse operation. When the motor encounters the ON state of the PL or encounters the ON state of the NL again, the homing process is stopped and an alarm is reported.

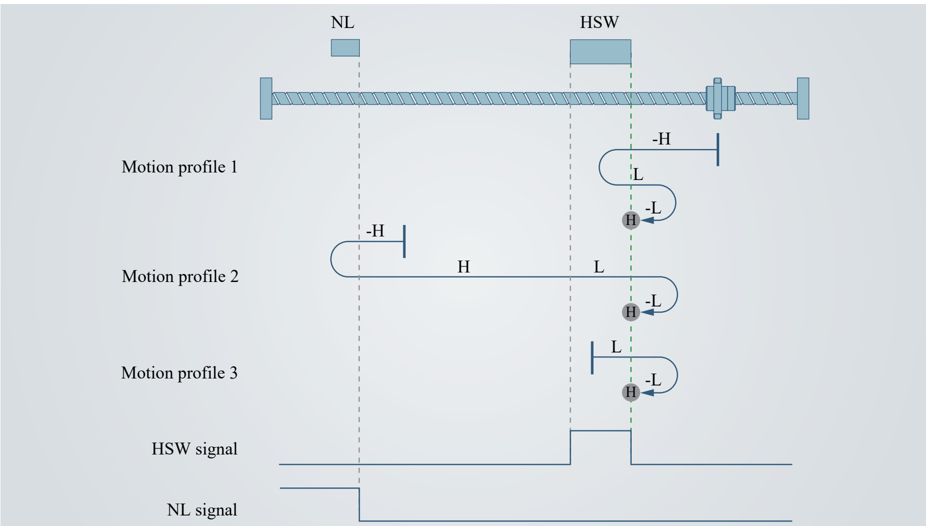


Figure 4-51 Home mode 28 profile and signal status

Mode 29: When the HSW status changes from OFF to ON during forward operation, the motor searches for the position and automatically turns to another direction upon the NL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates, and continues to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the NL is in ON state, the motor decelerates to stop, and then operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates to stop, returns to the position where the HSW is inactive at a low speed, decelerates to stop again, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is active upon startup, the motor operates in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the NL for the first time during reverse operation. When the motor encounters the ON state of the PL or encounters the ON state of the NL again, the homing process is stopped and an alarm is reported.

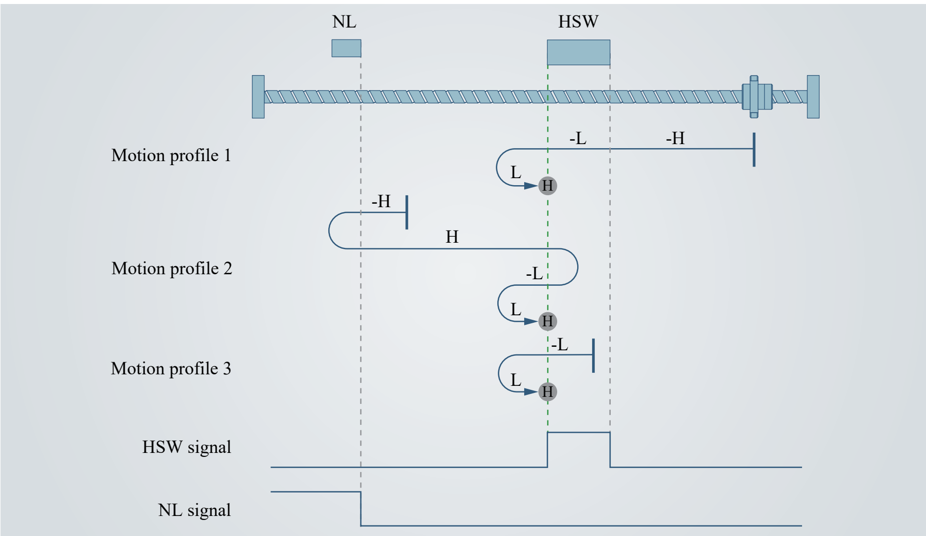


Figure 4-52 Home mode 29 profile and signal status

Mode 30: When the HSW status changes from ON to OFF during reverse operation, the motor searches for the position and automatically turns to another direction upon the NL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates and continues to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, returns to the position where the HSW is active at a low speed, decelerates to stop again (if the active HSW range is narrow, it may enter the inactive HSW position range on the other side), and switches to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the NL is in ON state, the motor decelerates to stop, and then operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is active upon startup, the motor operates in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation, the motor uses the stop position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the NL for the first time during reverse operation. When the motor encounters the ON state of the PL or encounters the ON state of the NL again, the homing process is stopped and an alarm is reported.

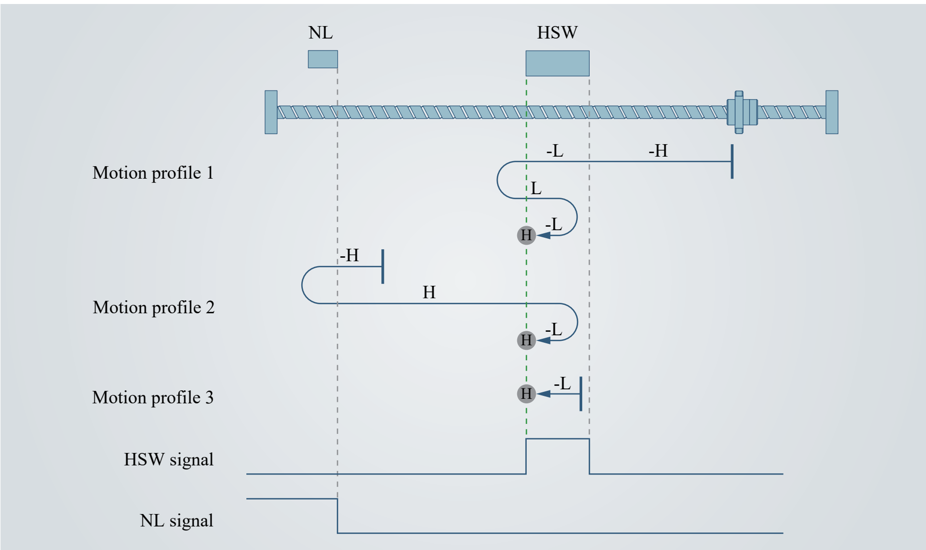


Figure 4-53 Home mode 30 profile and signal status

Mode 31 and mode 32: Reserved

Mode 33: The motor searches for the nearest Z pulse during reverse operation.

- The motor starts to operate in the reverse direction at a low speed, and searches for the nearest Z pulse position as the home. If the motor encounters the ON state of NL before the Z pulse during reverse operation, the motor decelerates to stop, and then operates in the forward direction to search for the nearest Z pulse position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the NL for the first time during reverse operation. When the motor encounters the ON state of the PL or encounters the ON state of the NL again, the homing process is stopped and an alarm is reported.

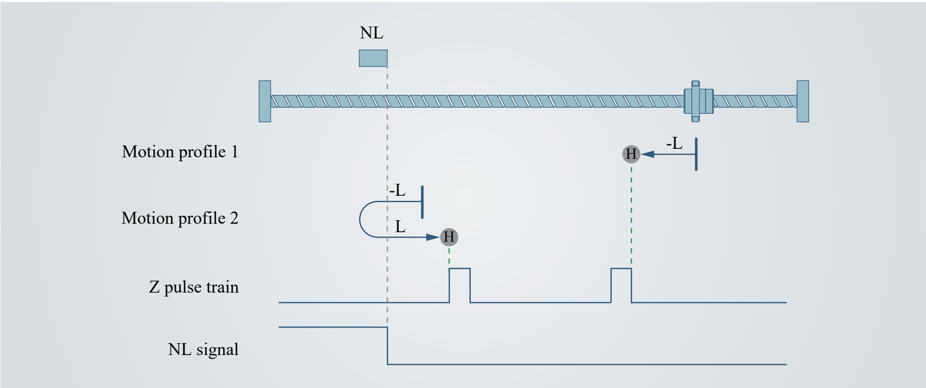


Figure 4-54 Home mode 33 profile and signal status

Mode 34: The motor searches for the nearest Z pulse during forward operation.

- The motor starts to operate in the forward direction at a low speed, and searches for the nearest Z pulse position as the home. If the motor encounters the ON state of PL before the Z pulse during forward operation, the motor decelerates to stop, and then operates in the reverse direction to search for the nearest Z pulse position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the PL for the first time during forward operation. When the motor encounters the ON state of the NL or encounters the ON state of the PL again, the homing process is stopped and an alarm is reported.

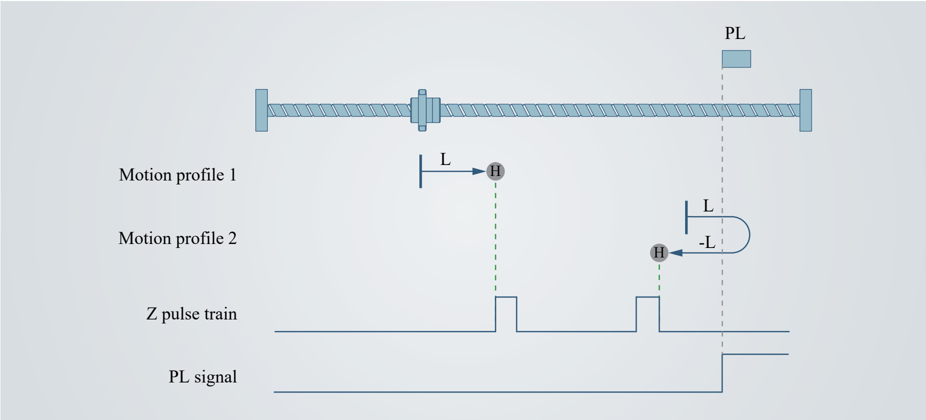


Figure 4-55 Home mode 34 profile and signal status

Mode 35: The current position is used as the home.

- Homing mode 35: The present position is taken as the mechanical home. After homing is triggered (control word 6040h: 0x0F → 0x1F):

  60E6 = 0 (absolute homing):

  6064 (position feedback) is set to 607C (home offset) after homing is done.

  60E6 = 1 (relative homing):

  6064 (position feedback) is the sum of the original value plus 607C (home offset) after homing is done.

4.2 Speed control mode

Set C00.00 to 1 on the servo drive keypad or Synland drive debugging platform to enable the speed control mode. Set the servo drive parameters based on the mechanical structure and specifications. The following part uses the basic parameter setting to describe the speed control mode.

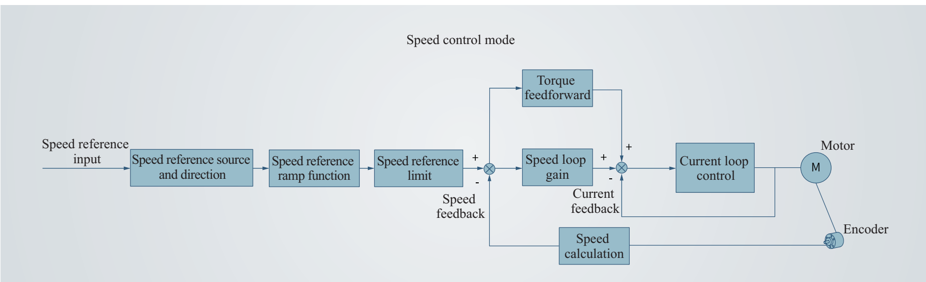


Figure 4-56 Block diagram of speed control

4.2.1 Block diagram of function codes in speed control mode

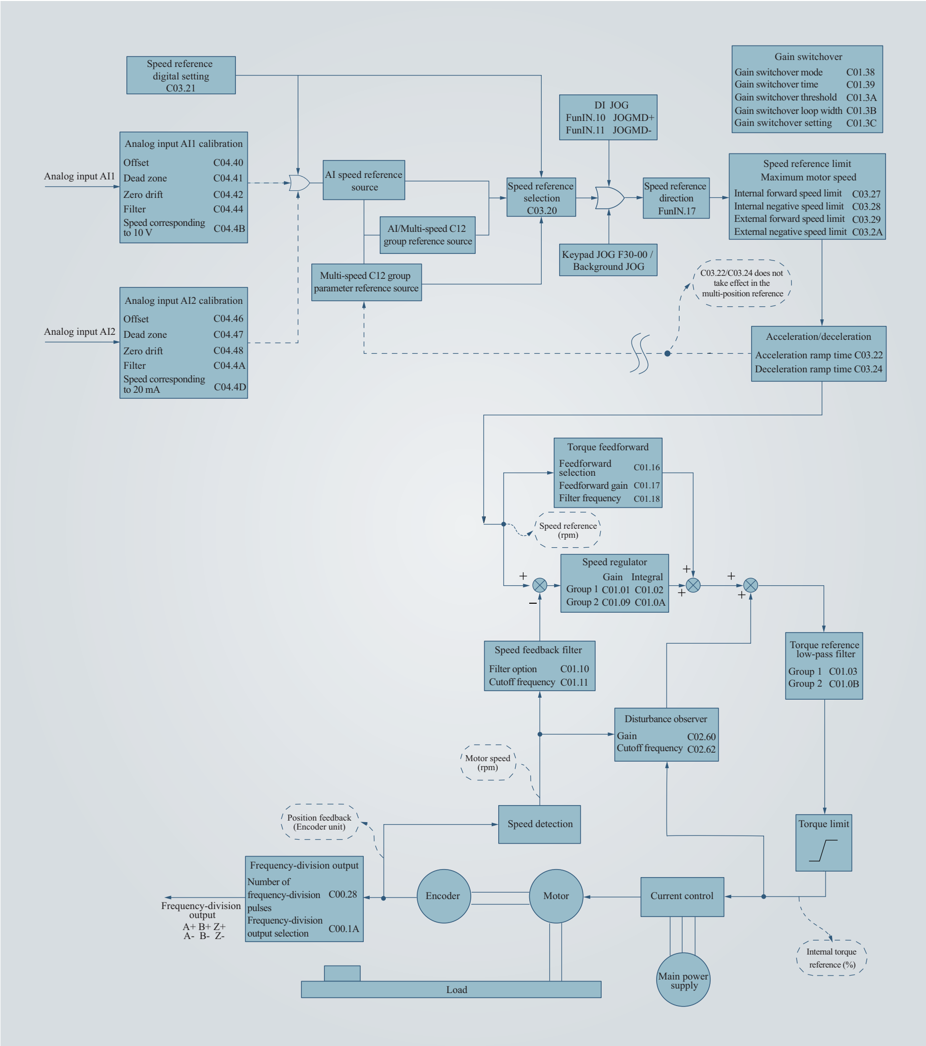


Figure 4-57 Block diagram of speed control mode

4.2.2 Speed reference input setting

Speed reference source

The speed reference sources include digital setting and analog voltage setting. Digital setting produces the internal speed reference, and the analog voltage setting produces the external speed reference.

Speed reference selection

In speed control mode, six methods of obtaining speed references are available, and you can select one by setting C03.20.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Modificantion Mode
C03.20	Speed reference selection	0: Internal digital reference 1: AI1 2: AI2 3: Internal speed planning 4: AI1 → internal speed planning 5: AI2 → internal speed planning	0	-	At stop

<u>Digital setting</u>

Set the speed through C03.21 and use it as a speed reference.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Modificantion Mode
C03.21	Speed reference	-8000 to 8000	100	-	During operation

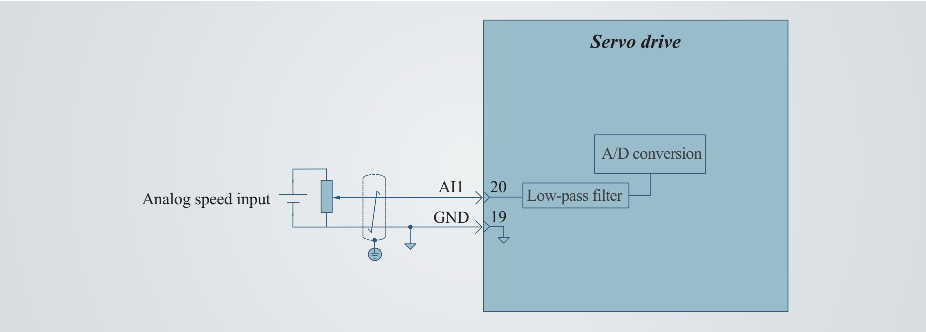
<u>Analog setting</u>

The analog signal output by the host controller or other devices is processed and then used as the speed reference.

Analog input (AI) terminals:

The servo drive provides two AIs used for control: AI1 and AI2. The maximum input voltage of AI1 is ±12 V DC, and the input impedance of AI1 is about 51 kΩ per month, while the input impedance of AI2 is about 300 Ω.

Analog voltage input circuit:



Operation method:

The following figure takes AI1 as an example to describe the analog setting of the speed reference.

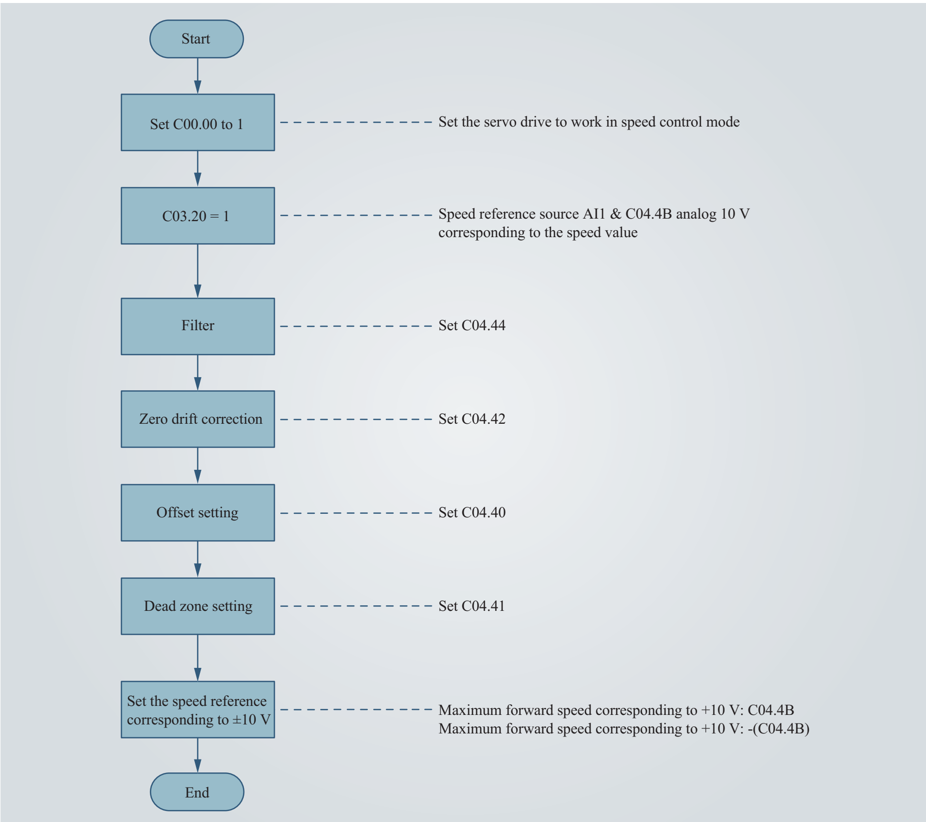


Figure 4-58 Operation flowchart of setting the speed reference by using analog voltage

NOTICE

- Zero drift: value of the servo drive sampling voltage relative to GND when the input voltage of the analog channel is zero
- Offset: input voltage value of the analog channel when the sampling voltage is zero after zero drift correction
- Dead zone: input voltage range of the analog channel when the sampling voltage is zero
- In the following figure, y_1 is the output voltage of the analog channel not processed, and y_6 is the final speed reference.

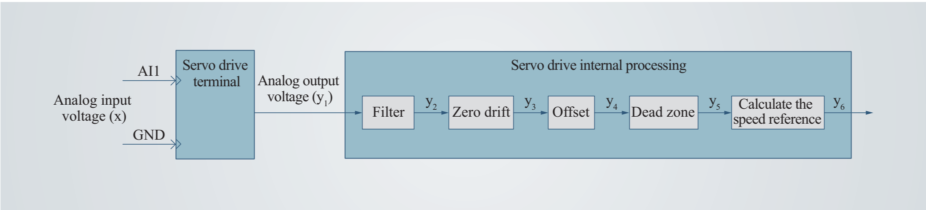


Figure 4-59 AI processing of servo drive

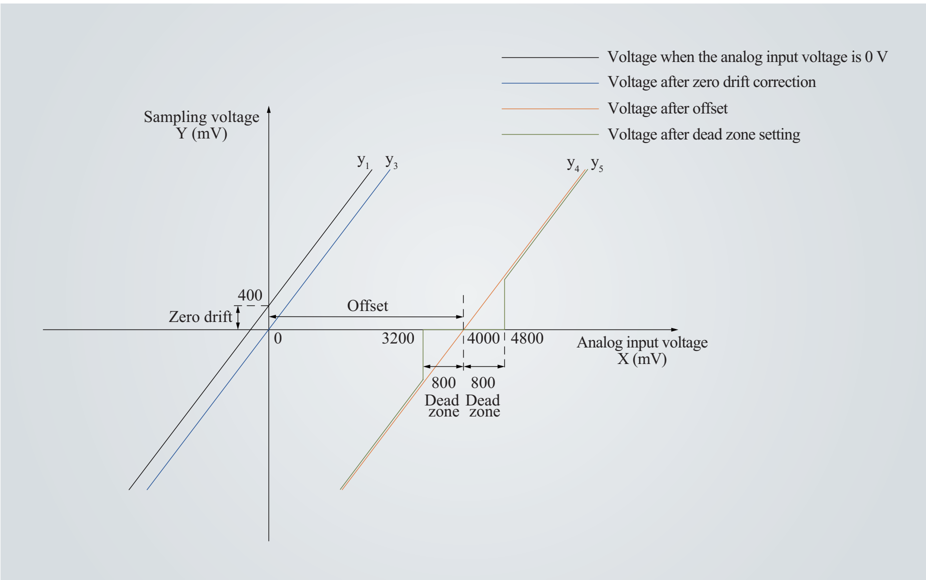


Figure 4-60 Example of sampling voltage for servo drive AI processing

Filter

The servo drive provides the analog channel filter function. Setting the filter time constant in C04.44 prevents motor reference fluctuation due to instable analog input voltage and eliminates motor malfunction due to signal interference. The filter function cannot eliminate or suppress the zero drift or dead zone.

Zero drift correction

It corrects the analog output voltage offset relative to the actual input voltage 0 V.

In the preceding figure, the analog output voltage without being processed by the servo drive is y_1. Taking the filter time constant C04.44 = 0.00 ms as an example, the sampling voltage after filter y_2 is the same as y_1.

That is, when the actual input voltage x = 0, the output voltage y_1 = 400 mV. Therefore, the zero drift voltage is 400 mV. Set C04.42 to 400.0 (mV). The sampling voltage after zero drift correction is y_3. $y_3 = y_1 - 400.0$

Offset setting

It sets the actual input voltage corresponding to sampling voltage 0.

Assume that the actual input voltage x = 4000 mV when the sampling voltage y_4 = 0. That is, the offset is 4000 mV.

Set C04.40 to 4000 (mV). The sampling voltage after offset $y_4 = x - 4000 = y_3 - 4000$.

Dead zone correction

It sets the effective input voltage range when the sampling voltage of the servo drive is not 0 V.

After the offset is set, if the sampling voltage is always 0 when the input voltage x is within 3200 mV to 4800 mV, the dead zone is ±800 mV.

Set C04.41 to 800.0. The sampling voltage after dead zone correction is y_5.

$$y_5 = \begin{cases} 0 & 3200 \le x \le 4800 \\ y_4 & 4800 < x \le 10000 \text{ or } -10000 \le x < 3200 \end{cases}$$

Calculate the speed reference

After setting the zero drift, offset, and dead zone, set the speed reference corresponding to 10 V (10000 mV) in C04.4B to obtain the actual speed reference y_6:

$$y_6 = \frac{y_5}{10000} \times (\text{C04.4B})$$

This value is used as the speed reference set via analog in the speed control mode.

It is shown on the left side of the figure below when there is no offset, and on the right side of the figure below when there is offset. After all setting is completed correctly, view the sampling voltage of AI1 in U40.0A/U40.0D.

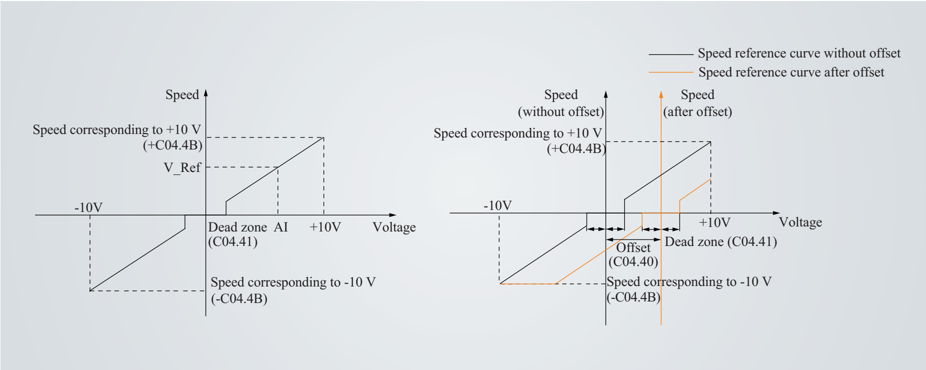


Figure 4-61 AI1 without offset (Left) & AI1 after offset (Right)

The relationship between the final speed reference y_6 and the input voltage x is:

$$y_6 = \begin{cases} 0 & B\text{-}C \le x \le B+C \\ x\text{-}B & B+C < x \le 10000 \text{ or } -10000 \le x < B\text{-}C \end{cases}$$

Wherein, B is the offset and C is the dead zone.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Modificantion Mode
C04.40	AI1 offset	-5000 to 5000	0	mV	During operation
C04.41	AI1 dead zone	0 to 50000	0	0.1mV	During operation
C04.42	AI1 zero drift	-5000 to 5000	0	0.1mV	During operation
C04.44	AI1 low-pass filter time	0 to 65535	50	0.01ms	During operation
C04.4B	Speed value corresponding to analog 10 V	0 to 20000	3000	rpm	During operation
U40.0A	AI1 input voltage	-1200 to 1200	0	0.01V	Read only
U40.0D	High-accuracy AI input voltage	-2^{31} to $(2^{31}-1)$	0	0.001mV	Read only

Internal speed planning

The servo drive supports multi-speed running. The servo drive stores 16 speed references, and the maximum running speed, running time, acceleration time, and deceleration time of each speed reference can be set respectively. The setting flowchart is as follows:

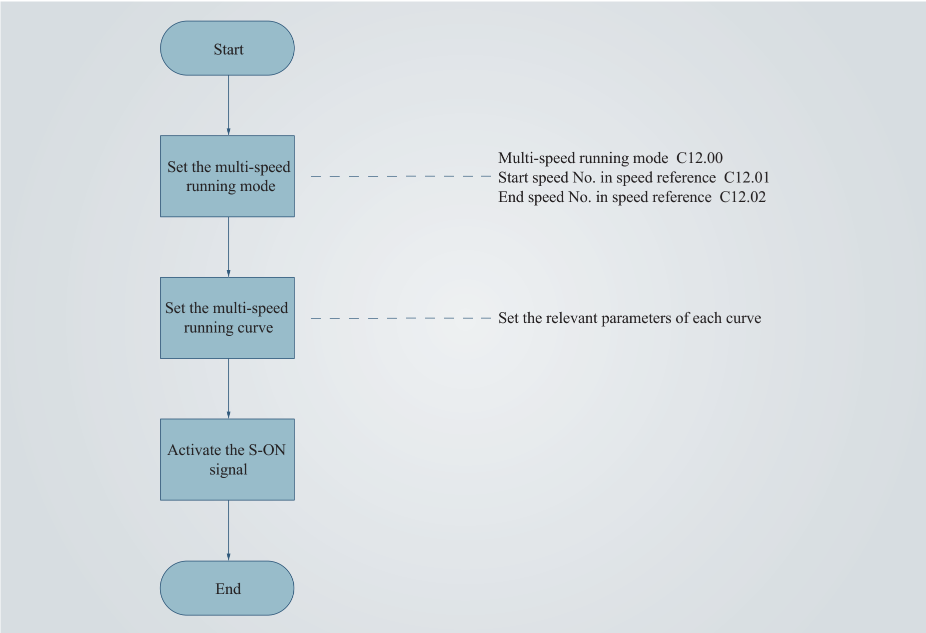


Figure 4-62 Flowchart for setting the multi-speed running function

<u>Set the multi-speed running mode</u>

Related parameters:

Parameter	Name	Value Range	Default	Unit	Modificantion Mode
C12.00	Speed planning mode selection	0: Single operation 1. Cyclic operation 2: DI selection operation	0	-	At stop
C12.01	Speed planning initial group number	1 to 16	1	-	At stop
C12.02	Speed planning end group number	1 to 16	1	-	At stop

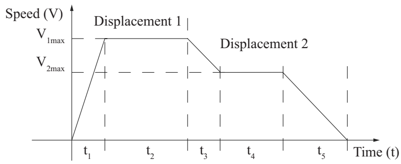
Assign FunIN.17 (speed reference direction) to an external DI to select the multi-speed running direction.

The following takes C12.01=1 and C12.02=2 as examples to describe each mode.

- Individual running (C12.00 = 0)

  Set C12.00 to 0 to select the individual running mode, in which the drive stops after running for one cycle.

  Set C12.01 and C12.02 based on the start speed and end speed, and set the reference, running time, and acceleration/deceleration time of each speed. The drive executes multi-speed references sequentially from speed 1 to speed N. After all the speeds are executed, the drive stops.

<table>
<tr><th>Mode Description</th><th>Running Curve</th></tr>
<tr><td>• The drive stops after one cycle of running.
• The drive switches to the next displacement automatically.</td><td>

V_{1max}, V_{2max}: reference values of speed 1 and speed 2
t_1: actual acceleration/deceleration time of speed 1
t_3, t_5: acceleration/deceleration time of speed 2
• Running time = Time taken in switching from the last speed to the current speed + Duration of constant-speed running at the current speed (For example, the running time of speed 1 is t_1+t_2; the running time of speed 2 is t_3+t_4.)
• Do not set the running time of a certain speed to 0. Otherwise, the drive skips this speed and switches to the next speed directly.
• The speed reach signal is activated when the motor speed feedback reaches the maximum running speed set for this speed.
• If the S-ON signal is switched off during operation, the motor stops in the mode defined by C05.00 (Stop mode at S-ON OFF).</td></tr>
</table>

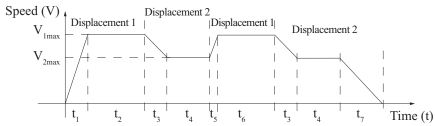
NOTICE

- A complete running cycle covers all the multi-speed references defined by C12.01 and C12.02.

- Cyclic running (C12.00 = 1)

  Set C12.00 to 1 to select the cyclic running mode.

  Set C12.01 and C12.02 based on the start speed and end speed. Then set the reference value, operating time and acceleration/deceleration time for each speed. Based on these settings, the drive executes the set speeds sequentially from speed 1 (defined by C12.01) to speed N (defined by C12.02). After all the speeds are executed, the drive jumps to speed 1 and repeats the preceding process.

Mode Description	Running Curve
• The drive starts from speed 1 again after each cycle of running. • The drive switches to the next displacement automatically. • The cyclic running state remains if the S-ON signal is active.	 V_{1max}, V_{2max}: maximum running speeds in displacement 1 and displacement 2 • Running time = Time taken in switching from the last speed to the current speed + Duration of constant-speed running at the current speed (For example, the running time of speed 1 is t_1+t_2; the running time of speed 2 is t_3+t_4.) • Do not set the running time of a certain speed to 0. Otherwise, the drive skips this speed and switches to the next speed directly. • The speed reach signal is activated when the motor speed feedback reaches the maximum running speed set for this speed. • If the S-ON signal is switched off during operation, the motor stops in the mode defined by C05.00 (Stop mode at S-ON OFF).

- DI switchover running (C12.00 = 2)

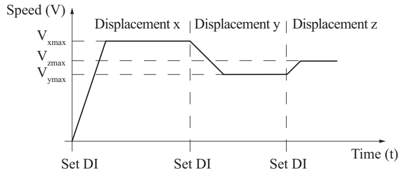
  Set C12.00 to 2 to select the DI switchover running mode.

  Set C12.01 and C12.02 based on the start speed and end speed. Then set the reference value, operating time and acceleration/deceleration time for each speed. The drive executes the speed references according to ON/OFF combination of the external DIs (CMDx).

  When the multi-speed running mode is DI switchover running, assign FunIN.12 to FunIN.15 (multi-reference switchover) to four DIs of the servo drive, and set the active logic of these DIs. In addition, assign FunIN.17 (speed reference direction) to a certain DI of the servo drive to switch the speed reference direction.

<table>
<tr><th>Mode Description</th><th>Running Curve</th></tr>
<tr>
<td>

The drive runs continuously as long as the S-ON signal is active.
The displacement No. is determined by the DI terminal logic.
The interval time between speeds is determined by the command delay of the host controller.
The multi-speed reference is edge triggered.

</td>
<td>


x, y: speed No. (The relationship between the speed No. and the DI logic is described below.)
The operating time is independent of the parameter setting. If the speed No. changes during operation, the drive switches to the new speed No. immediately.
The speed reach signal is activated when the motor speed feedback reaches the maximum running speed set for this speed.
If the S-ON signal is switched off during operation, the motor stops in the mode defined by C05.00 (Stop mode at S-ON OFF).

</td>
</tr>
</table>

Related functions:

<table>
<tr><th>Code</th><th>Name</th><th>Function Name</th><th>Function</th></tr>
<tr><td>FunIN.17</td><td>Speed reference direction</td><td>DI-based direction switchover in multi-speed mode</td><td>Defines the speed reference direction in the DI switchover running mode.
Inactive: Reference direction
Active: Opposite to the reference direction</td></tr>
<tr><td>FunIN.12</td><td>CMD1</td><td>Multi-reference switchover 1</td><td rowspan="4">The speed No. is a 4-bit binary value. The relationship between the speed no. and CMD1 to CMD4 is shown in the table below.
The value of CMD is 1 when the input level of the DI is active, and 0 upon the input level of DI is inactive.</td></tr>
<tr><td>FunIN.13</td><td>CMD2</td><td>Multi-reference switchover 2</td></tr>
<tr><td>FunIN.14</td><td>CMD3</td><td>Multi-reference switchover 3</td></tr>
<tr><td>FunIN.15</td><td>CMD4</td><td>Multi-reference switchover 4</td></tr>
</table>

Table 4-15 Relationship between the displacement No. and CMD1 to CMD4

CMD4	CMD3	CMD2	CMD1	Displacement No.
0	0	0	0	1
0	0	0	1	2
...				
1	1	1	1	16

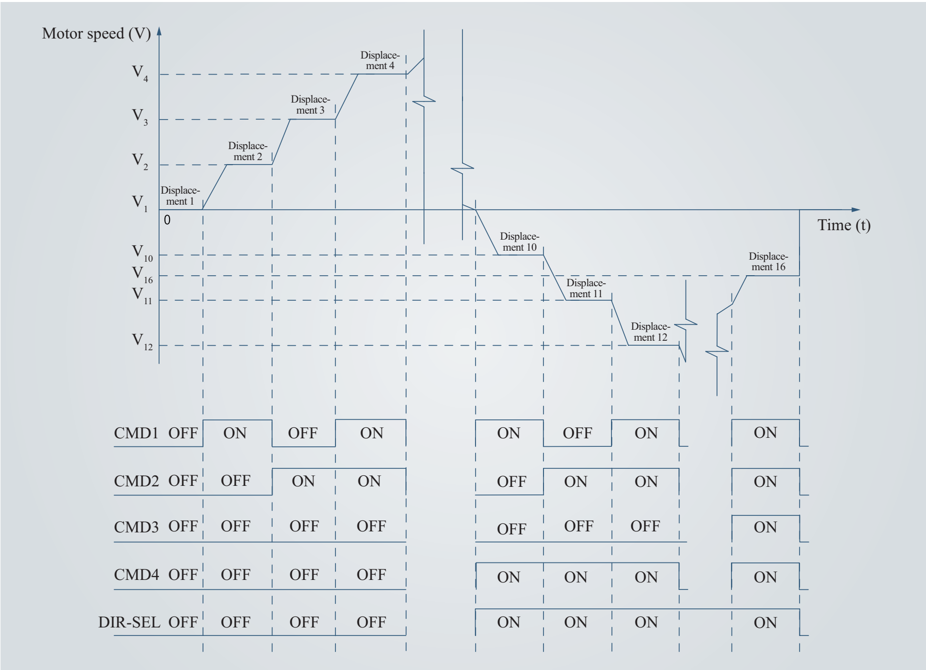


Figure 4-63 Example of multi-speed curve

Set the multi-speed running curve

The following takes speed 1 as an example.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Modificantion Mode
C12.06	Group 1 speed reference	-8000 to 8000	100	rpm	During operation
C12.08	Group 1 running time	0 to $(2^{32}-1)$	10000	ms	During operation
C12.0A	Group 1 acceleration time	0 to 65535	10	ms	During operation
C12.0C	Group 1 deceleration time	0 to 65535	10	ms	During operation
......					
C12.F6	Group 16 deceleration time	0 to 65535	10	ms	During operation

The multi-speed reference parameters include 1-16 speed references, reference running time, and acceleration/deceleration time.

The following describes the actual acceleration/deceleration time and the running time when C12.00 (multi-speed running mode) is set to 1 (Individual operation):

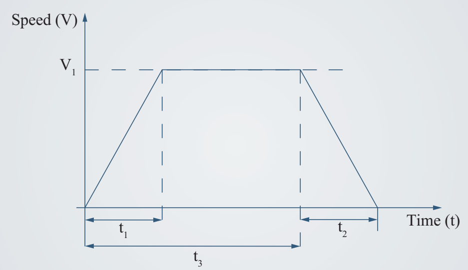


Figure 4-64 Example of multi-speed curve

As shown in the preceding figure, the speed reference is V_1, and actual acceleration time t_1 is calculated as follow:

$$t_1=\frac{V_1}{1000}\times\text{Acceleration time set for this speed}$$

The actual deceleration time t_2 is calculated as follow:

$$t_2=\frac{V_1}{1000}\times\text{Deceleration time set for this speed}$$

Running time = Time taken in switching from the last speed reference to the current speed reference + Duration of constant-speed running at the current speed (as shown by t_3 in the preceding figure)

- AI1/Internal speed planning switchover

  When setting C03.20 (speed reference source) to 4 (AI1/Internal speed planning switchover), you need to assign FunIN.26 to the corresponding DI. Based on the input signal of this DI, the drive determines which source (current AI1 reference source or multi-speed reference source) is active.

- AI2/Internal speed planning switchover

  When setting C03.20 (speed reference source) to 5 (AI2/Internal speed planning switchover), you need to assign FunIN.26 to the corresponding DI. The input signal of this DI determines which source (current AI2 reference source or multi-speed reference source) is active.

Related functions:

Code	Name	Function Name	Function
FunIN.26	Speed reference mode	Analog/Internal speed planning switchover	Inactive: The current running mode is the analog input mode. Active: The current running mode is the Internal speed planning input mode.

<u>Speed reference direction setting</u>

To switch the speed reference direction through DI, assign FunIN.17 to the corresponding DI. The input signal of this DI determines the speed reference direction, meeting the requirement for speed reference direction switchover.

The actual motor direction of rotation is related to the setting of C00.01 (direction of rotation), the sign (+/-) of the speed reference value, and the logic of FunIN.17.

Table 4-16 Actual direction of rotation in speed control mode

C00.01	Sign of Speed Reference	FunIN.17	Actual Motor Direction of Rotation
0	+	Inactive	CCW
0	+	Active	CW
0	-	Inactive	CW
0	-	Active	CCW
1	+	Inactive	CW
1	+	Active	CCW
1	-	Inactive	CCW
1	-	Active	CW

4.2.3 Ramp parameter setting

The ramp function converts the speed references with large acceleration rate to smoother speed references, that is, it controls the acceleration rate by setting the acceleration/deceleration time.

In the speed control mode, a high acceleration rate easily leads to motor jerk or intense vibration. In this case, increasing the acceleration/deceleration time can smoothen the motor speed change and prevent mechanical damage caused by jerk or vibration.

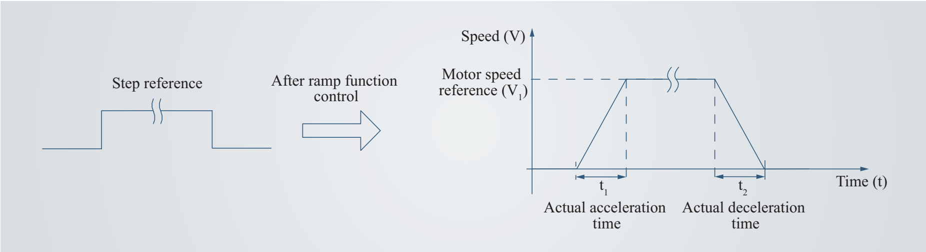


Figure 4-65 Ramp function definition

- C03.22: time for the speed reference to accelerate from zero to 1000 rpm.
- C03.24: time for the speed reference to decelerate from 1000 rpm to zero.

The formulas for calculating the actual acceleration and deceleration time are as follows:

$$\text{Actual acceleration time } t_1 = \frac{\text{Speed reference}}{1000} \times \text{Acceleration ramp time of speed reference}$$

$$\text{Actual deceleration time } t_2 = \frac{\text{Speed reference}}{1000} \times \text{Deceleration ramp time of speed reference}$$

Related parameters:

Parameter	Name	Value Range	Default	Unit	Modificantion Mode
C03.22	Acceleration rate	0 to 65535	10	ms	During operation
C03.24	Deceleration rate	0 to 65535	10	ms	During operation

4.2.4 Zero clamp

⚠ CAUTION

- Zero clamp is used in systems where position loop is unavailable in speed control mode.
- If the motor oscillates in the zero clamp state, adjust the position loop gain.

In speed control mode, if the zero clamp signal (FunIN.27) (ZCLAMP) is active, and the speed reference amplitude is smaller than or equal to the value of C03.2F, the motor enters the zero position clamp state. In this case, a position loop is built inside the drive and the speed reference is invalid. The motor is clamped within ±1 pulse of the position at which zero clamp is activated. Even if it rotates due to external force, it will return to the zero position and be clamped. When the speed reference amplitude exceeds the value of (C03.2F + 10), the motor exits from the zero clamp state and continues running according to the speed reference received. Zero clamp is deactivated when the zero clamp signal (FunIN.27) is inactive.

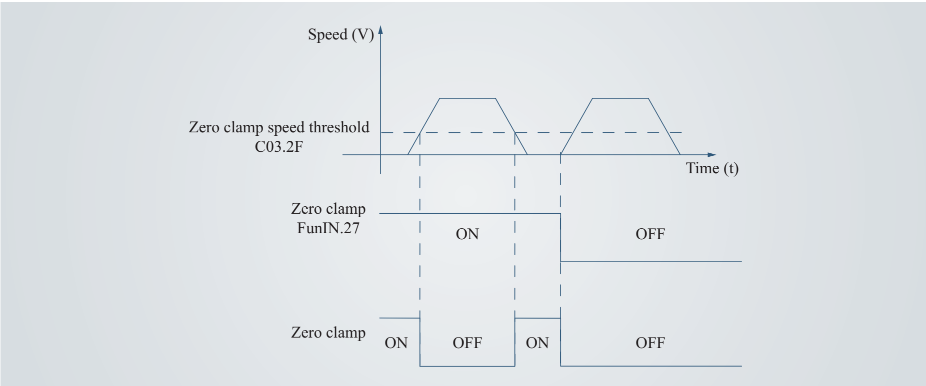


Figure 4-66 Wiring and waveform of zero clamp

Related parameters:

Parameter	Name	Value Range	Default	Unit	Modificantion Mode
C03.2F	Zero clamp threshold	0 to 1000	10	rpm	During operation

Related functions:

Code	Name	Function Name	Function
FunIN.27	Zero clamp	Zero clamp enable	Inactive: Zero clamp disabled Active: Zero clamp enabled

4.2.5 Speed reference limit

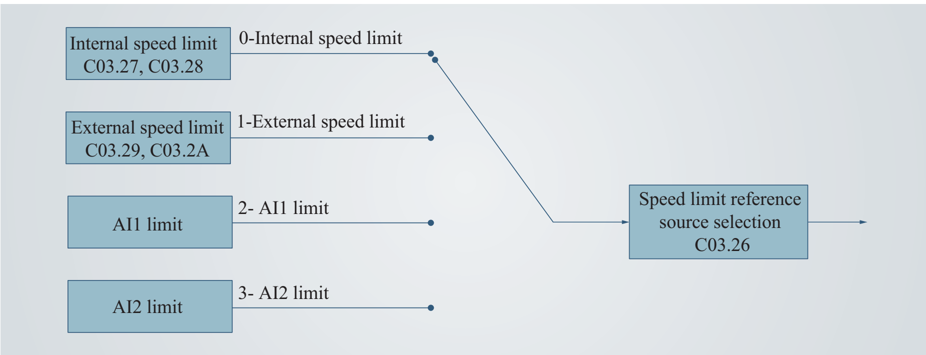
⚠ CAUTION

- When the actual speed of the motor exceeds C06.03 (overspeed threshold) or R20.14 (1.2 times the rated motor speed), whichever is smaller, Er46.0 (Motor overspeed) occurs. For details about the setting of C06.03 and R20.14, see Chapter 8 "Parameter List". The speed reference limit must be lower than C06.03 or R20.14, whichever is smaller.

In speed limit mode, the servo drive can limit the size of the speed reference. The sources of speed reference limit include:

- C03.27: Defines the internal speed limit in the forward direction. The limit value applies when the forward speed references exceed it.
- C03.28: Defines the internal speed limit in the reverse direction. The limit value applies when the reverse speed references exceed it.
- C03.29: Defines the external speed limit in the forward direction. The limit value applies when the forward speed references exceed it.
- C03.2A: Defines the external speed limit in the reverse direction. The limit value applies when the reverse speed references exceed it.

Maximum motor speed (default limit): It varies with the actual motor model.



Internal speed limit (C03.26 = 0)

Set C03.26 to 0 to select the internal speed limit.

Set C03.27 and C03.28 based on the internal forward and reverse speed limits, and then set the related speed reference parameters as needed. When a speed reference exceeds the speed limit, the speed limit applies.

External speed limit (C03.26 = 1)

Set C03.26 to 1 to select the external speed limit.

Set C03.29 and C03.2A based on the external forward and reverse speed limits, and then set FunIN.28. When the FunIN.28 is active and a speed reference exceeds the speed limit, the external speed limit applies. When the FunIN.28 is inactive and a speed reference exceed the speed limit, the internal speed limit applies.

AI1 limit (C03.26 = 2)

Set C03.26 to 2 to select the AI1 speed limit.

Set C04.4B (speed corresponding to the analog 10 V). When a speed reference exceeds the speed limit, the internal speed limit applies. When the preset speed limit exceeds R20.14 (maximum motor speed), the actual speed limit is equal to R20.14.

After setting the AI1 zero drift, offset, and dead zone, you need to set C04.4B to specify the speed limit corresponding to 10 V (10000 mV) in the sampling voltage. The formula is as follows:

$$\text{AI1 forward/reverse speed limit} = \frac{\text{AI1 voltage sampling value}}{10000} \times (\text{C04.4B})$$

This value is used as the AI1 speed limit setting.

AI2 limit (C03.26 = 3)

Set C03.26 to 3 to select the AI2 speed limit.

Set C04.4D (speed corresponding to the analog 20 mA). When a speed reference exceeds the speed limit, the speed limit applies. When the preset speed limit exceeds R20.14 (maximum motor speed), the actual speed limit is equal to R20.14.

After setting the AI2 zero drift, offset, and dead zone, you need to set C04.4D to specify the speed limit corresponding to 20 mA in the sampling current. The formula is as follows:

$$\text{AI2 forward/reverse speed limit} = \frac{\text{AI2 current sampling value - 12}}{8} \times (\text{C04.4D})$$

This value is used as the AI2 speed limit setting.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Modificantion Mode
C03.26	Speed limit selection	0 to 3	0	-	At stop
C03.27	Internal positive speed limit	0 to 8000	6000	rpm	During operation
C03.28	Internal negative speed limit	0 to 8000	6000	rpm	During operation

Parameter	Name	Value Range	Default	Unit	Modificantion Mode
C03.29	External forward speed limit	0 to 8000	6000	rpm	During operation
C03.2A	External negative speed limit	0 to 8000	6000	rpm	During operation
C04.4B	Speed value corresponding to analog 10 V	0 to 20000	3000	rpm	During operation
C04.4D	Speed value corresponding to analog 20 mA	0 to 20000	3000	rpm	During operation

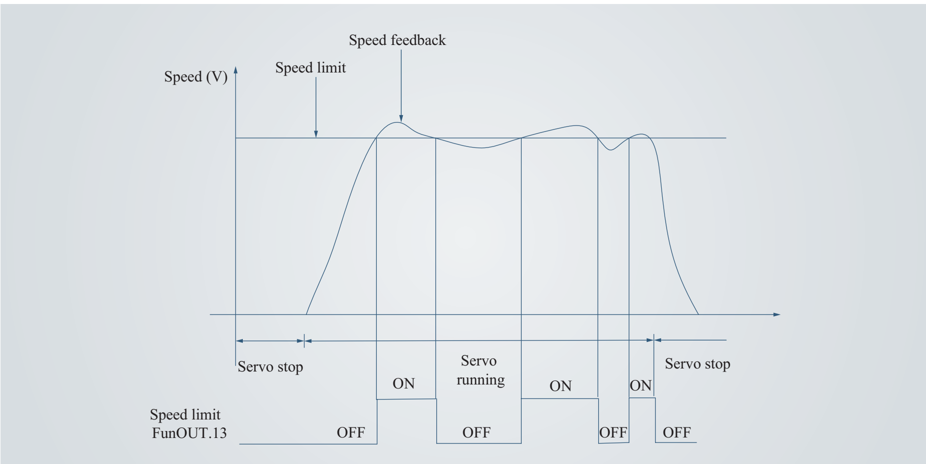
Related functions:

Code	Name	Function Name	Function
FunIN.28	External speed limit	External speed limit selection	Inactive: The internal speed limit applies. Active: The external speed limit applies.

Speed limit DO signal

In speed control mode, when the actual motor speed exceeds the speed limit, the servo drive considers that the motor speed is limited and outputs the speed limit signal (FunOUT13) to the host controller. If the preceding condition is not met, the speed limit signal is inactive.

The speed limit signal can be checked in any servo running state. For this purpose, you need to assign FunOUT.13 to a DO of the servo drive, and set the active logic of this DO.



Related functions:

Code	Name	Function Name	Function
FunOUT.13	Speed limit	Speed limit signal output	Inactive: The motor speed does not reach the speed limit. Active: The motor speed reaches the speed limit and a speed loop is built internally based on this limit.

4.2.6 Speed-related DO signals

Different DO signals are output to the host controller based on comparison between the speed feedback after filter and different thresholds. The related filter time is set in C03.33.

Motor rotation DO signal

When the absolute value of the actual motor speed after filter reaches C03.2D (motor rotation speed threshold), the motor is considered as rotating. At this moment, the servo drive outputs the motor rotation signal (FunOUT.2) to confirm that motor has rotated. When the absolute value of the actual motor speed after filter is smaller than C03.2D, the motor is considered as not rotating. Judgment on the motor rotation signal (FunOUT.2) is not affected by the servo drive running status and control mode.

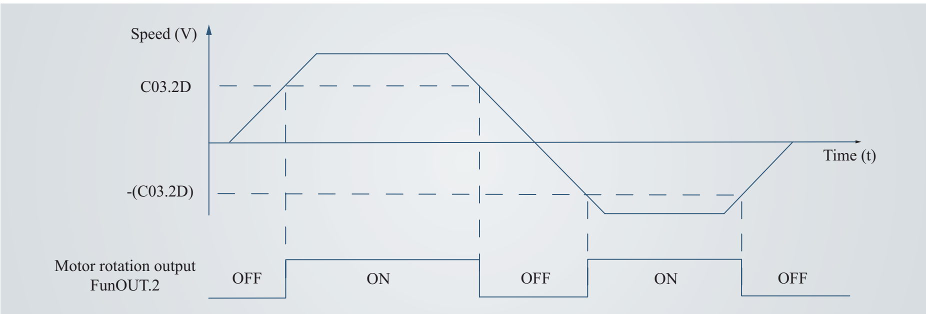


Figure 4-67 Waveform of the motor rotation signal

NOTICE

- In the preceding figure, ON indicates that the motor rotation DO signal is active, and OFF indicates that this signal is inactive.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Modification Mode
C03.2D	Speed rotation threshold	0 to 1000	20	rpm	During operation
C03.33	Speed DO filter setting	0 to 1000	100	0.1ms	During operation

To use the motor rotation signal output function, assign function 2 (FunOUT.2: motor rotation) to a DO of the servo drive, and set the active logic of this DO.

Related functions:

Code	Name	Function Name	Function
FunOUT.2	Motor rotation	Motor rotation signal output	Inactive: The absolute value of motor speed after filter is smaller than C03.2D. Active: The absolute value of motor speed after filter reaches C03.2D.

Speed synchronized DO signal

In speed control mode, when the absolute value of the difference between the actual motor speed after filter and the speed reference satisfies the setting of C03.2C, the actual motor speed is considered to reach the speed reference. At this moment, the servo drive outputs the speed synchronized signal (FunOUT.15). When the absolute value of the difference between the motor speed after filter and the speed reference exceeds C03.2C, the speed synchronized signal is inactive.

If the servo drive is not in running state or not in speed control mode, the speed synchronized signal (FunOUT.15) is always inactive.

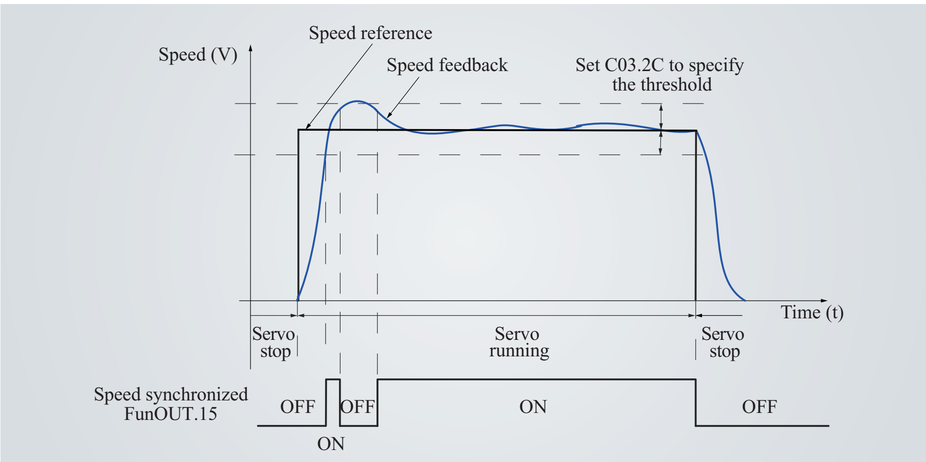


Figure 4-68 Waveform of the speed synchronized DO signal

NOTICE

- In the preceding figure, ON indicates that the speed synchronized DO signal is active, and OFF indicates that this signal is inactive.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Modificantion Mode
C03.2C	Speed synchronization threshold	0 to 1000	10	rpm	During operation

To use the speed synchronized signal output function, assign function 15 (FunOUT.15: speed synchronized) to a DO of the servo drive, and set the active logic of this DO.

Related functions:

Code	Name	Function Name	Function
FunOUT.15	Speed synchronized	Speed synchronized signal output	Inactive: The absolute value of the difference between the motor speed after filter and the speed reference is larger than C03.2C. Active: The absolute value of the difference between the motor speed after filter and the speed reference is not larger than C03.2C.

Speed reached DO signal

When the absolute value of the motor speed after filter exceeds the setting of C03.2B, the motor speed is considered to reach the desired value. At this moment, the servo drive outputs the speed reached signal (FunOUT.14). When the absolute value of the motor speed after filter is smaller than or equal to the setting of C03.2B, the speed reached signal is inactive.

Judgment on the speed reached signal is not affected by the servo drive running status and control mode.

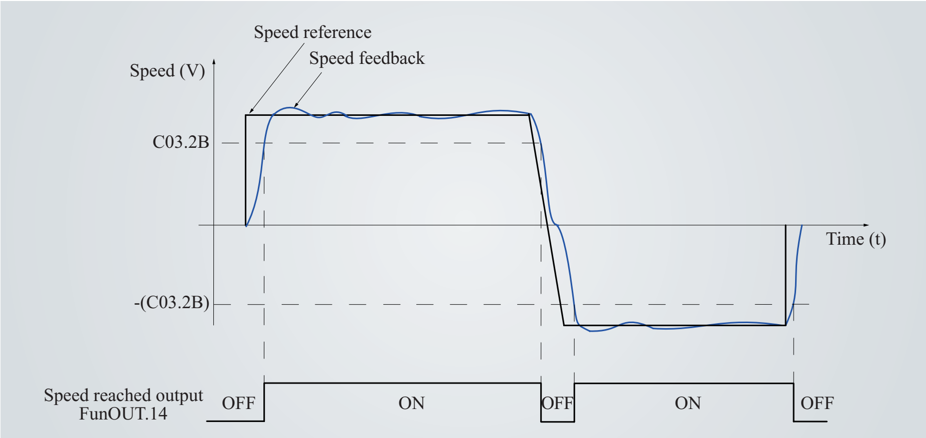


Figure 4-69 Waveform of the speed reached signal

Related parameters:

Parameter	Name	Value Range	Default	Unit	Modification Mode
C03.2B	Speed reach threshold	0 to 8000	1000	rpm	During operation

To use the speed reached signal output function, assign function 14 (FunOUT.14: speed reached) to a DO of the servo drive, and set the active logic of this DO.

Related functions:

Code	Name	Function Name	Function
FunOUT.14	Speed reached	Speed reached signal output	Inactive: The absolute value of the speed feedback after filter is larger than C03.2B. Active: The absolute value of the speed feedback after filter is not larger than C03.2B.

Zero speed DO signal

When the absolute value of the motor speed after filter is smaller than the setting of C03.2E, the motor speed is considered to be close to 0. At this moment, the servo drive outputs the zero speed signal (FunOUT.12). When the absolute value of the motor speed after filter is equal to or large than to the setting of C03.2E, the zero speed signal is inactive.

Judgment on the zero speed signal is not affected by the servo drive running status and control mode.

When there is interference on the speed feedback, eliminate the interference by using the speed feedback DO filter. Set the filter time constant in C03.33.

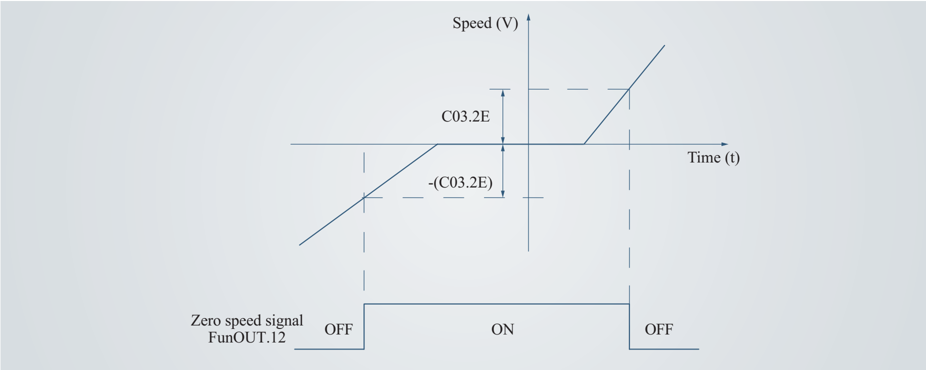


Figure 4-70 Waveform of the zero speed signal

Related parameters:

Parameter	Name	Value Range	Default	Unit	Modification Mode
C03.2E	Zero speed output threshold	5 to 1000	10	rpm	During operation

To use the zero speed signal output function, assign function 12 (FunOUT.12: zero speed) to a DO of the servo drive, and set the active logic of this DO.

Related functions:

Code	Name	Function Name	Function
FunOUT.12	Zero speed signal	Zero speed signal output	Inactive: The difference between the speed feedback and the setting is larger than C03.2E. Active: The difference between the speed feedback and the setting is not larger than C03.2E.

4.3 Torque control mode

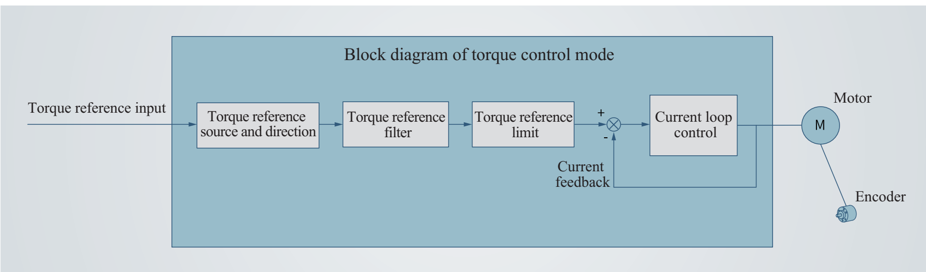


Figure 4-71 Torque control block diagram

Set C00.00 to 2 on the servo drive keypad or Synland drive debugging platform to enable the torque control mode. Set the servo drive parameters based on the mechanical structure and specifications. The following describes basic parameter settings in torque control mode.

4.3.1 Block diagram of function codes in torque control mode

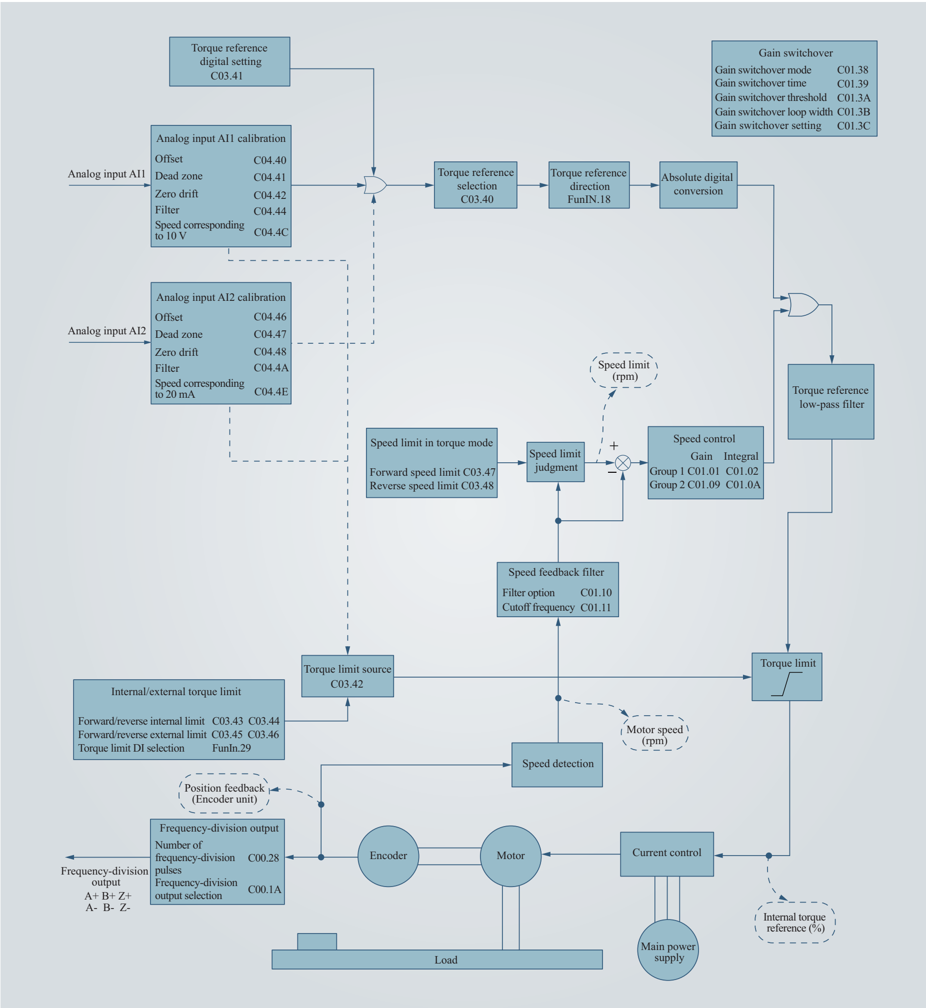


Figure 4-72 Block diagram of function codes in torque control mode

4.3.2 Torque reference input setting

Torque reference source

The torque reference sources include digital setting and analog voltage setting. Digital setting produces the internal torque reference, and the analog voltage setting produces the external torque reference.

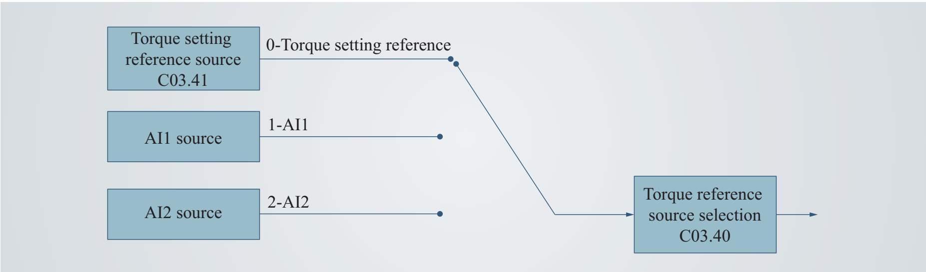


Figure 4-73 Torque reference sources

Torque reference selection

In the torque control mode, three methods of obtaining torque references are available, and you can select one by setting C03.40.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Modification Mode
C03.40	Torque reference selection	0: Internal digital setting 1: AI1 2: AI2	0	-	At stop

Digital setting

The torque reference is set in C03.41 as a percentage relative to the rated motor torque.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Modification Mode
C03.41	Torque reference	-4000 to 4000	0	0.1%	During operation

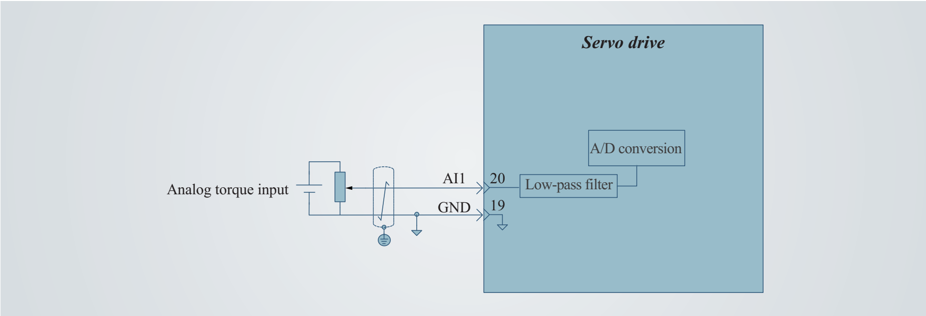
Analog setting

The analog signal output by the host controller or other devices is processed and then used as the torque reference.

Analog input (AI) terminals:

The servo drive provides two AIs used for control: AI1 and AI2. The maximum input voltage of AI1 is ±12 V DC, and the input impedance of AI1 is about 51 kΩ per month, while the input impedance of AI2 is about 300 Ω.

Analog input circuit:



Operation method:

The following table takes AI1 as an example to describe how to set the torque reference by using the analog voltage.

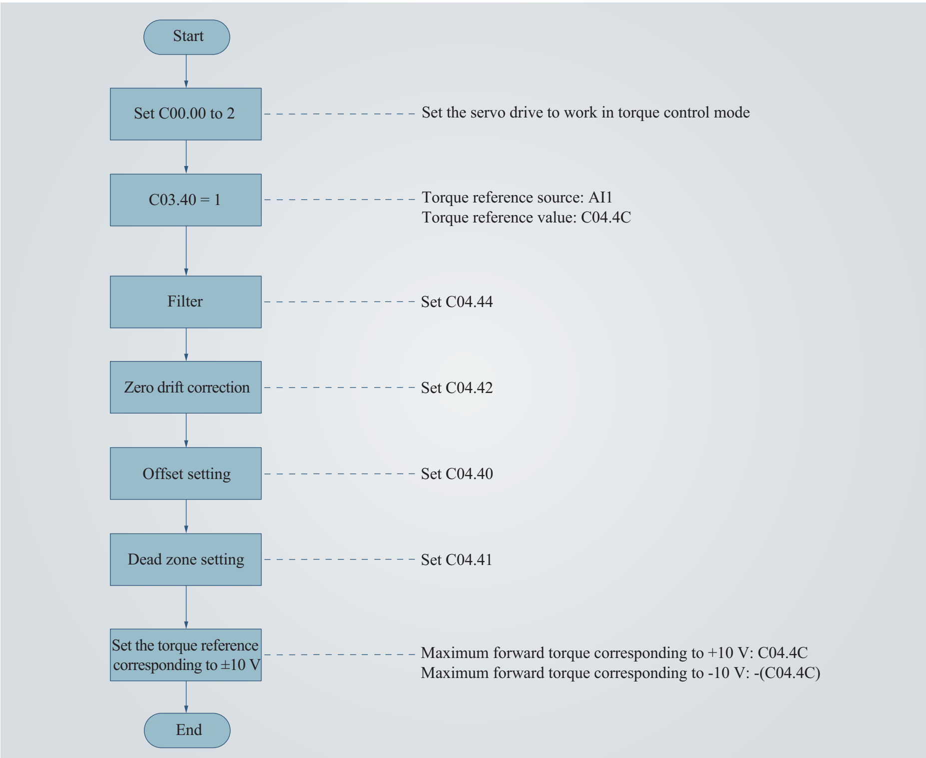


Figure 4-74 Operation flowchart of setting the torque reference by using the analog voltage

NOTICE

- Zero drift: value of the servo drive sampling voltage relative to GND when the input voltage of the analog channel is zero
- Offset: input voltage value of the analog channel when the sampling voltage is zero after zero drift correction
- Dead zone: input voltage range of the analog channel when the sampling voltage is zero
- In the following figure, y_1 is the unprocessed output voltage of the analog channel, and y_6 is the final torque reference obtained after internal processing of the servo drive.

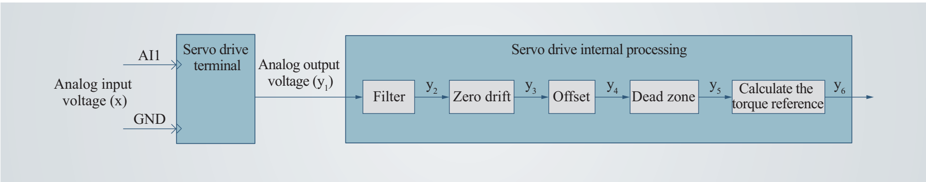


Figure 4-75 AI processing of servo drive

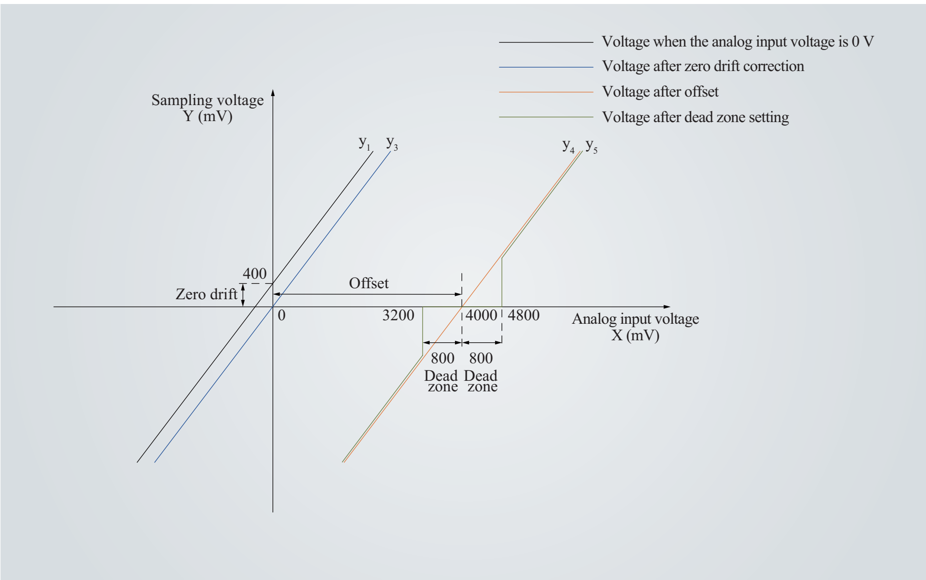


Figure 4-76 Example of sampling voltage for servo drive AI processing

Filter

The servo drive provides the analog channel filter function. Setting the filter time constant in C04.44 prevents motor reference fluctuation due to instable analog input voltage and eliminates motor malfunction due to signal interference. The filter function cannot eliminate or suppress the zero drift or dead zone.

Zero drift correction

It corrects the analog output voltage offset relative to the actual input voltage 0 V.

In the preceding figure, the analog output voltage without being processed by the servo drive is y_1. Taking the filter time constant C04.44 = 0.00 ms as an example, the sampling voltage after filter y_2 is the same as y_1.

That is, when the actual input voltage x = 0, the output voltage y_1 = 400 mV. Therefore, the zero drift voltage is 400 mV. Set C04.42 to 400.0 (mV). The sampling voltage after zero drift correction is y_3. $y_3 = y_1 - 400.0$

Offset setting

It sets the actual input voltage corresponding to sampling voltage 0.

Assume that the actual input voltage x = 4000 mV when the sampling voltage $y_4 = 0$. That is, the offset is 4000 mV.

Set C04.40 to 4000 (mV). The sampling voltage after offset $y_4 = x - 4000 = y_3 - 4000$.

Dead zone correction

It sets the effective input voltage range when the sampling voltage of the servo drive is not 0 V.

After the offset is set, if the sampling voltage is always 0 when the input voltage x is within 3200 mV to 4800 mV, the dead zone is ±800 mV.

Set C04.41 to 800.0. The sampling voltage after dead zone correction is y_5.

$$y_5 = \begin{cases} 0 & 3200 \leq x \leq 4800 \\ y_4 & 4800 < x \leq 10000 \text{ or } -10000 \leq x < 3200 \end{cases}$$

Calculating the torque reference

After setting the zero drift, offset, and dead zone, set the torque reference corresponding to 10 V (10000 mV) in C04.4C to obtain the actual torque reference y_6:

$$y_6 = \frac{y_5}{10000} \times (\text{C04.4C})$$

This value is used as the torque reference set via analog in the torque control mode.

It is shown on the left side of the figure below when there is no offset, and on the right side of the figure below when there is offset. After all setting is completed correctly, view the sampling voltage of AI1 in U40.0A/U40.0D.

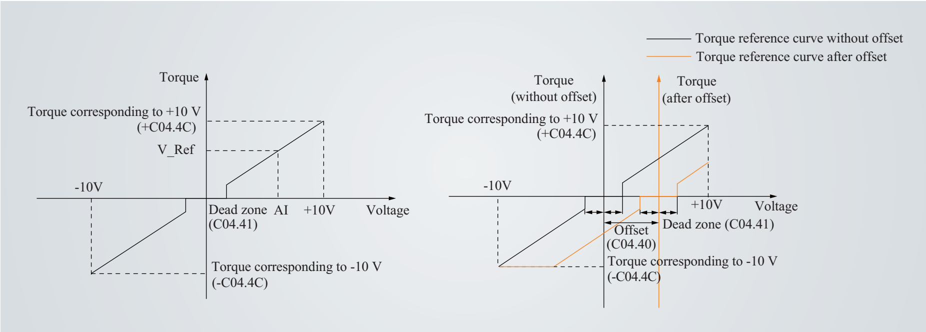


Figure 4-77 AI1 without offset (Left) & AI1 after offset (Right)

The relationship between the final torque reference y_6 and the input voltage x is as follows:

$$y_6 = \begin{cases} 0 & \text{B-C} \leq x \leq \text{B+C} \\ x\text{-B} & \text{B+C} < x < 10000 \text{ or } -10000 < x < \text{B-C} \end{cases}$$

Wherein, B is the offset and C is the dead zone.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Modificantion Mode
C04.40	AI1 offset	-5000 to 5000	0	mV	During operation
C04.41	AI1 dead zone	0 to 50000	0	0.1mV	During operation
C04.42	AI1 zero drift	-5000 to 5000	0	0.1mV	During operation
C04.44	AI1 low-pass filter time	0 to 65535	50	0.01ms	During operation
C04.4C	Torque value corresponding to analog 10 V	0 to 8000	1000	0.1%	During operation
U40.0A	AI1 input voltage	-1200 to 1200	0	0.01V	Read only
U40.0D	High-accuracy AI input voltage	-2147483648 to 2147483647	0	0.001mV	Read only

Torque reference direction

To switch the torque reference direction through DI, assign FunIN.18 to the corresponding DI. The input signal of this DI determines the torque reference direction, meeting the requirement for torque reference direction switchover.

Related functions:

Code	Name	Function Name	Function
FunIN.18	Torque reference direction	Torque reference direction	Inactive: The actual torque reference direction is the same as the set direction. Active: The actual torque reference direction is opposite to the set direction.

The actual direction of rotation is related to the setting of C00.01 (direction of rotation), the sign (+/-) of the torque reference value, and the logic of FunIN.18.

Table 4-17 Actual direction of rotation in torque control mode

C00.01	Sign (+/-) of the Torque Reference Value	FunIN.18	Actual Motor Direction of Rotation
0	+	Inactive	CCW
0	+	Active	CW
0	-	Inactive	CW
0	-	Active	CCW
1	+	Inactive	CW
1	+	Active	CCW
1	-	Inactive	CCW
1	-	Active	CW

4.3.3 Torque reference filter

⚠ **CAUTION**

- If the filter time constant is set to an excessively high value, the responsiveness will be degraded, so pay attention to the responsiveness when setting the filter time constant.

In the position, speed, torque and hybrid control modes, the servo drive can carry out low-pass filter on torque references to smoothen references and decrease vibration.

The servo drive provides two low-pass filters for torque references. By default, filter 1 is used.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Modificantion Mode
C01.03	1st torque reference filter cutoff frequency	5 to 16000	200	Hz	During operation
C01.0B	2nd torque reference filter cutoff frequency	5 to 16000	280	Hz	During operation

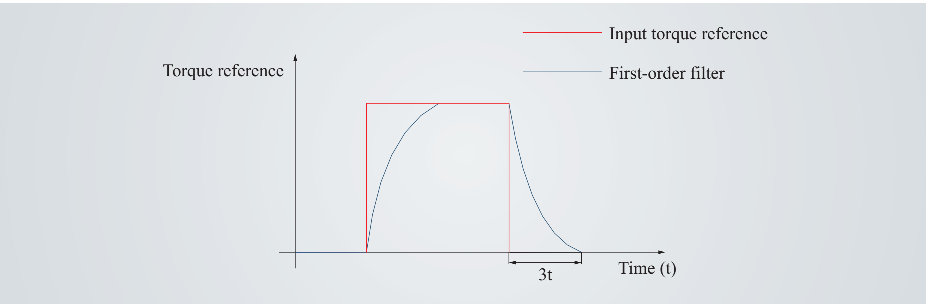


Figure 4-78 First-order filter for rectangular torque references

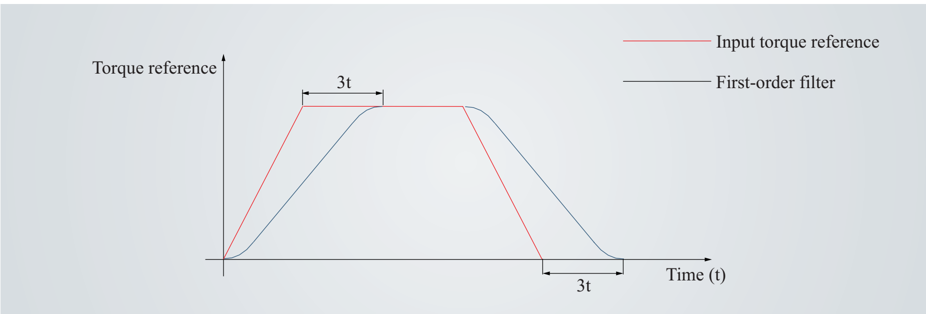


Figure 4-79 First-order filter for trapezoid torque references

4.3.4 Torque reference limit

⚠ CAUTION

- Torque reference limit is active and mandatory in all control modes, including the position, speed, torque and hybrid control modes.

Torque references are limited to protect the servo drive and motor.

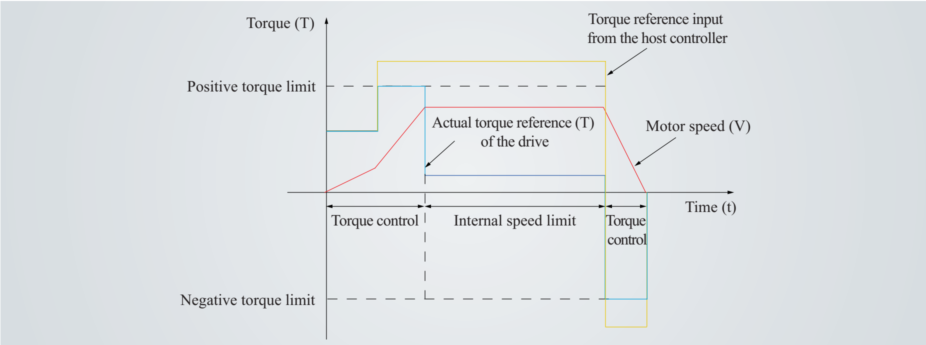


Figure 4-80 Torque setting and torque limit

When the absolute value of the torque reference input from the host controller or output by the speed regulator is larger than the absolute value of the torque reference limit, the actual torque reference of the servo drive is limited to the torque reference limit. Otherwise, the torque reference input from the host controller or output by the speed regulator is used.

Only one torque reference limit is valid at a moment. Both positive and negative torque limits cannot exceed the maximum torques of the servo drive and motor and ±300.0% of the rated torque.

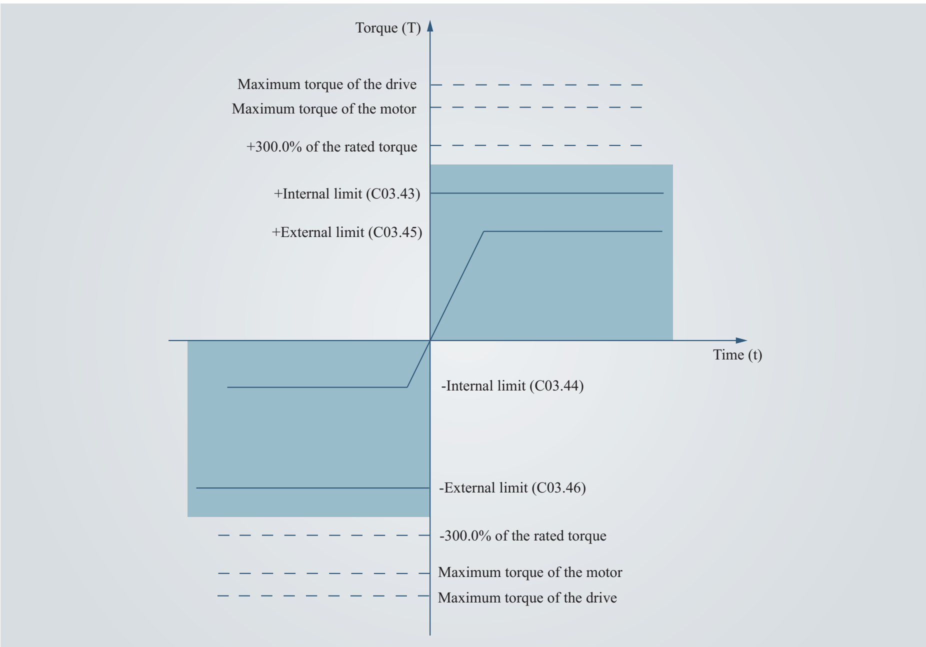


Figure 4-81 Example of torque limit

Torque limit source

The torque limit source is specified by C03.42.

After the torque limit is set, the torque limit applies when the torque reference exceeds the limit. The torque limit must be set according to the load conditions. If the setting is very small, it may cause longer acceleration/deceleration time of the motor, and the actual motor speed may not reach the required value at constant speed running.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Modificantion Mode
C03.42	Torque limit selection	0: Internal limit 1: External limit 2: AI1 3: AI2	0	-	At stop

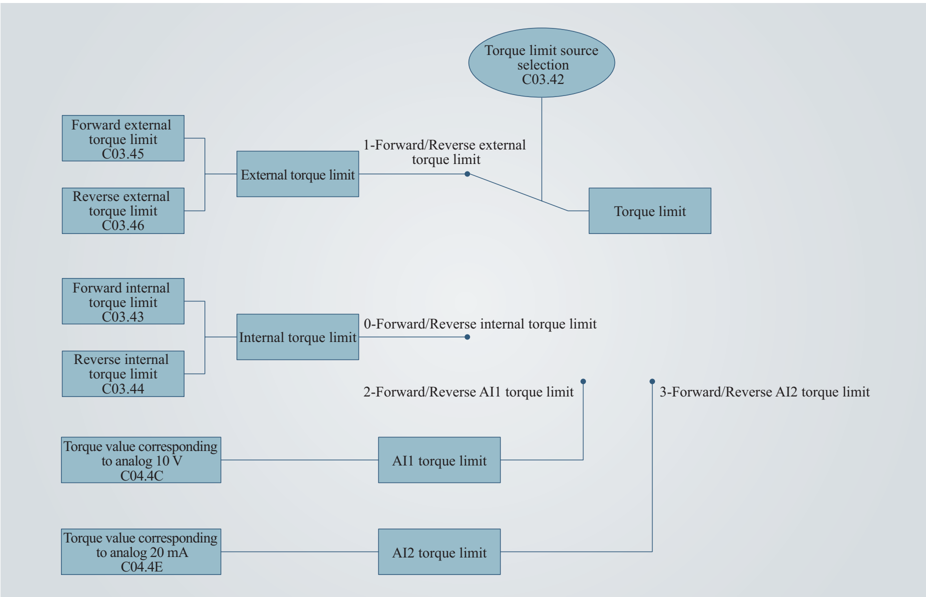


Figure 4-82 Torque limit source

The following figures show the examples when the absolute values of torque references input from the host controller exceed the absolute value of the torque limit in the torque control mode.

- Internal torque limit (C03.42 = 0)

  The torque reference limit is determined only by the internal parameters C03.43 and C03.44.

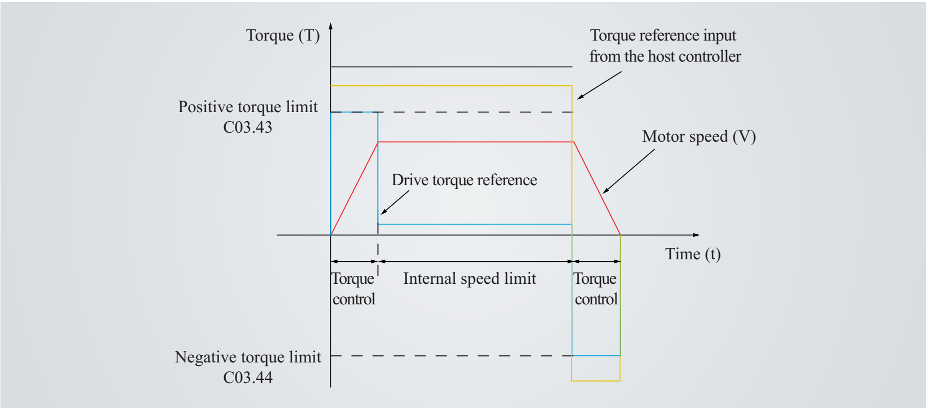


Figure 4-83 Torque limit curve (C03.42 = 0)

- External torque limit (C03.42 = 1)

  The torque reference limit is determined by the internal parameters C03.45 and C03.46. When FunIN.29 is active, C03.45 and C03.46 serve as the torque limits. Otherwise, C03.43 and C03.44 serve as the torque limits.

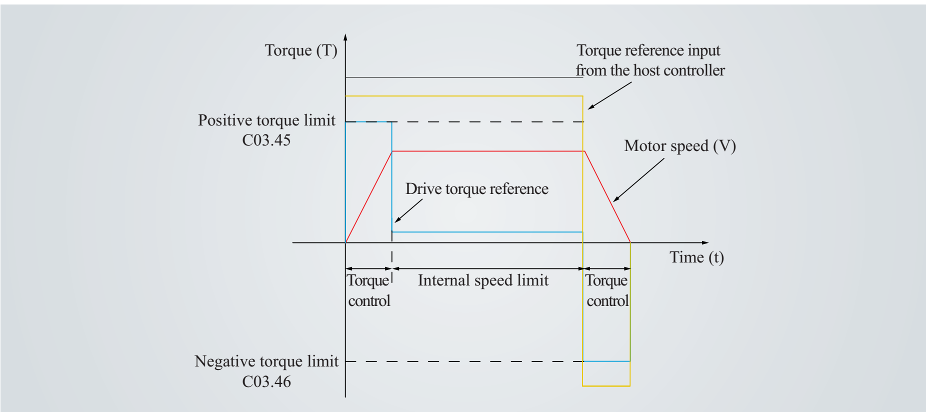


Figure 4-84 Torque limit curve (C03.42 = 1)

- AI1 torque limit (C03.42 = 2)

  The torque reference limit is related to C04.4C (torque value corresponding to 10 V) and the AI1 analog input reference.

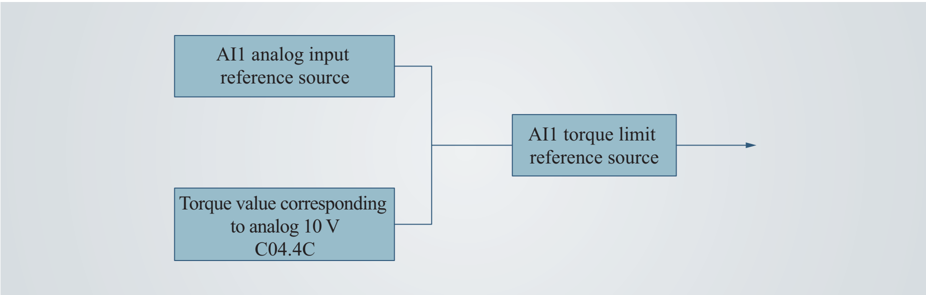


Figure 4-85 AI1 torque reference source description

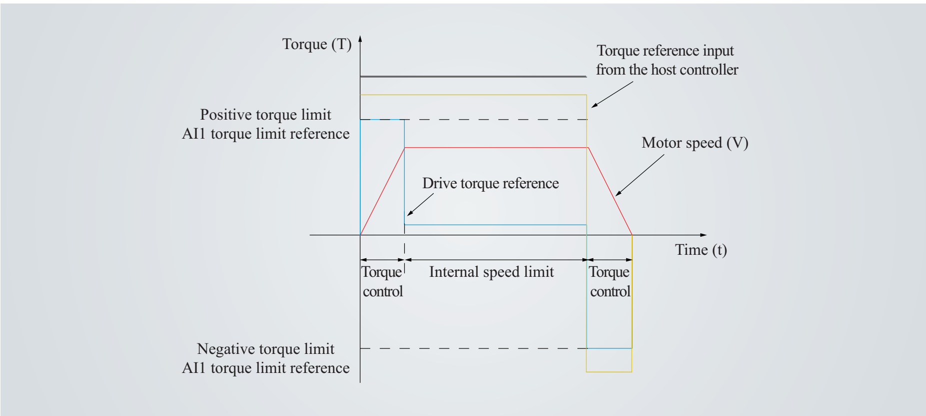


Figure 4-86 AI1 reference torque limit curve

- AI2 torque limit (C03.42 = 3)

  The torque reference limit is related to C04.4E (torque value corresponding to 20 mA) and the AI2 analog input reference.

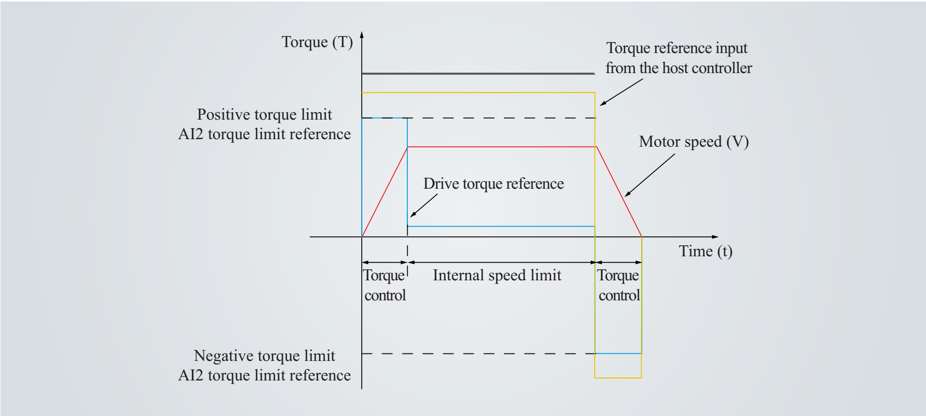


Figure 4-87 AI2 reference torque limit curve

Related parameters:

Parameter	Name	Value Range	Default	Unit	Modificantion Mode
C03.43	Internal positive torque limit	0 to 4000	3000	0.1%	During operation
C03.44	Internal negative torque limit	0 to 4000	3000	0.1%	During operation
C03.45	External forward torque limit	0 to 4000	3000	0.1%	During operation
C03.46	External reverse torque limit	0 to 4000	3000	0.1%	During operation
C04.4C	Torque value corresponding to analog 10 V	0 to 8000	1000	0.1%	During operation
C04.4E	Torque value corresponding to analog 20 mA	0 to 8000	1000	0.1%	During operation

Torque limit DO signal

When the torque reference reaches the torque limit, the servo drive outputs the torque limit signal (FunOUT.16) to the host controller. At this time, assign function 16 (FunOUT.16) to a DO of the drive, and set the logic of this DO.

Related functions:

Code	Name	Function Name	Function
FunOUT.16	Torque limit	Torque limit signal output	Active: The torque reference of the drive reaches the torque limit and is limited to the torque limit. Inactive: The torque reference of the drive does not reach the torque limit.

4.3.5 Speed limit in torque control mode

In the torque control mode, if the torque reference is larger than the load torque on mechanical side, the motor keeps accelerating, which may cause overspeed and damage the machine. The motor speed needs to be limited to protect the machine.

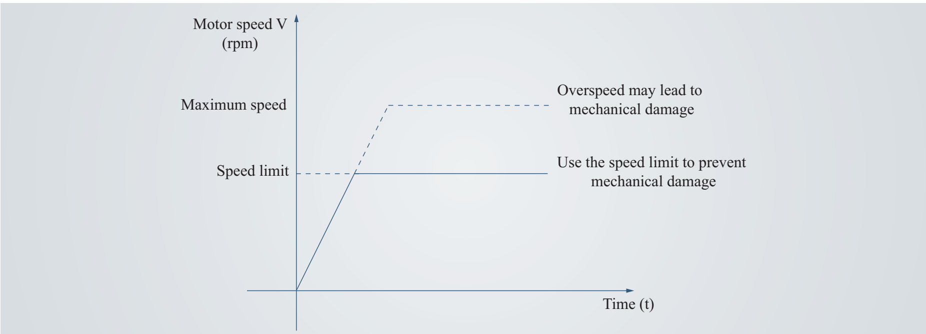
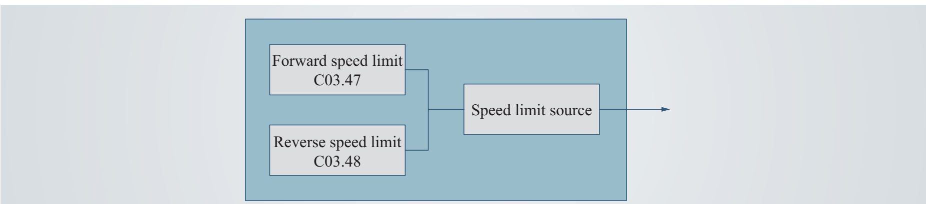


Figure 4-88 Speed limit in torque control mode

Speed limit source

In torque control mode, the speed limit source is determined by C03.47 and C03.48. After the speed limit is set, the actual motor speed is restricted to within the speed limit. After reaching the speed limit, the motor runs at the speed limit constantly. The speed limit must be set according to the load conditions.



When the motor runs in different directions, the speed limit is determined by the internal parameters C03.47 and C03.48.

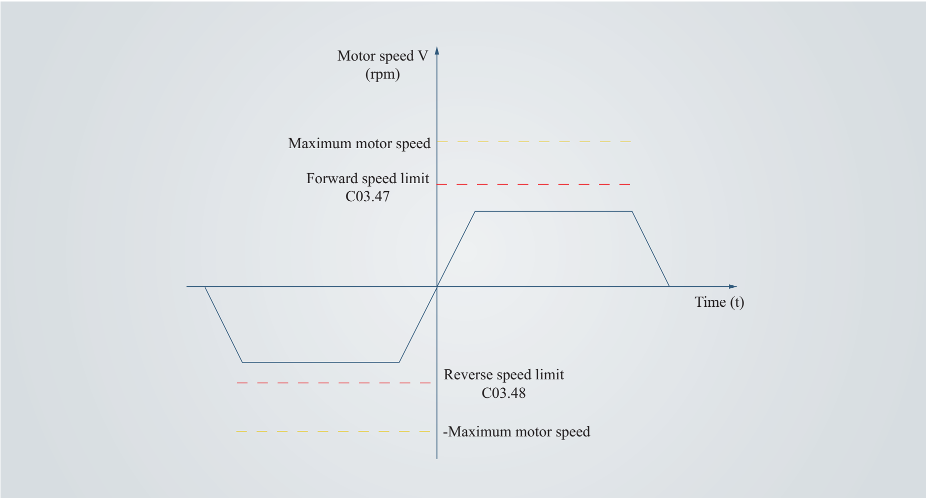


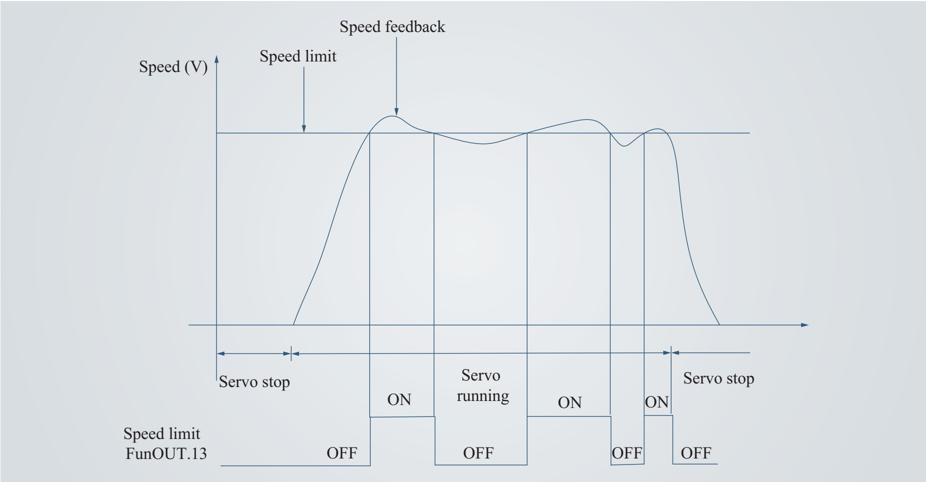
Figure 4-89 Speed limit curve

Related parameters:

Parameter	Name	Value Range	Default	Unit	Modificantion Mode
C03.47	Positive speed limit in torque mode	0 to 8000	3000	rpm	During operation
C03.48	Negative speed limit in torque mode	0 to 8000	3000	rpm	During operation

Speed limit DO signal

In torque control mode, when the actual motor speed exceeds the speed limit, the servo drive considers that the motor speed is limited and outputs the speed limit signal (FunOUT13) to the host controller. If the preceding condition is not met, the speed limit signal is inactive.
The speed limit signal can be checked in any servo running state. For this purpose, you need to assign FunOUT.13 to a DO of the servo drive, and set the active logic of this DO.



4.3.6 Torque reached output

The torque reached output function is used to determine whether the actual torque reference reaches the set range. When the actual torque reference reaches the threshold, the servo drive outputs the related DO signal (FunOUT.17: torque reached) to the host controller.

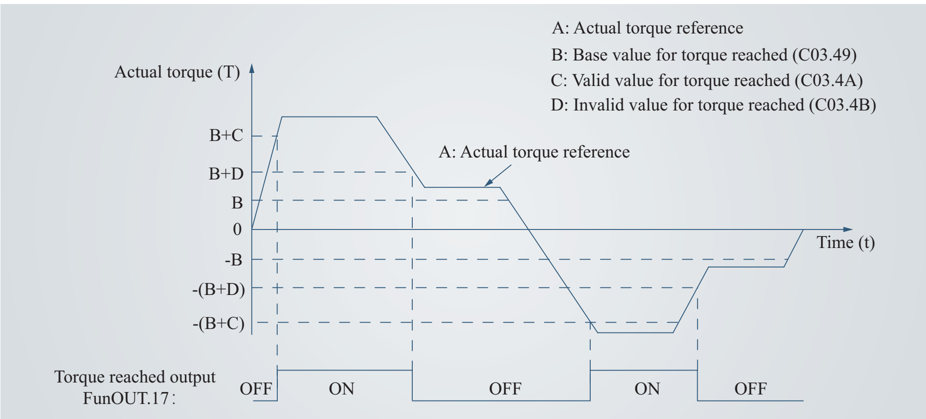


Figure 4-90 Example of the torque reached output waveform

- Actual torque reference of the loop control regulator: A
- Base value for torque reached (C03.49): B
- Valid value for torque reached (C03.4A): C
- Invalid value for torque reached (C03.4B): D

C and D are the offset based on B.

The torque reached signal becomes active when the actual torque reference meets the following condition: |A| ≥ B + C. Otherwise, the torque reached signal remains inactive. The torque reached signal becomes inactive when the actual torque reference meets the following condition: |A| < B + D. Otherwise, the torque reached signal remains active.

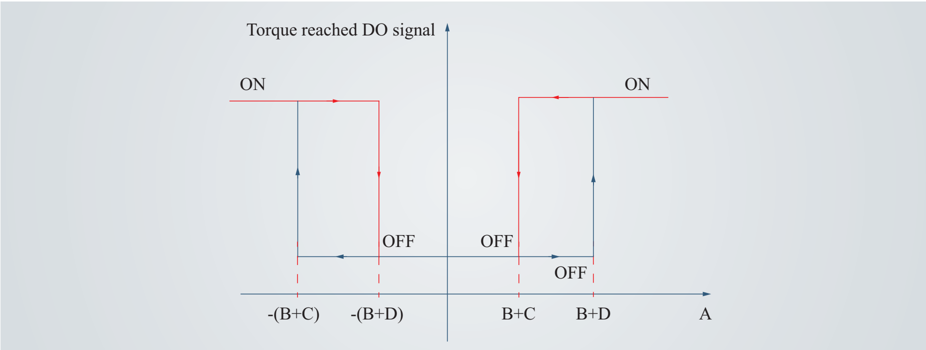


Figure 4-91 Description of torque reached output

Related parameters:

Parameter	Name	Value Range	Default	Unit	Modificantion Mode
C03.49	Reference value for torque reach	0 to 4000	0	0.1%	During operation
C03.4A	Valid value for torque reached	0 to 4000	200	0.1%	During operation
C03.4B	Invalid value for torque reached	0 to 4000	100	0.1%	During operation

To use the torque reached function, assign function 17 (FunOUT.17: torque reached) to a DO of the drive, and set the active logic of this DO.

Related functions:

Code	Name	Function Name	Function
FunOUT.17	Torque reached	Torque reached signal output	Active: The absolute value of the torque reference reaches the setpoint. Inactive: The absolute value of the torque reference is smaller than the setpoint.

4.4 Fully closed-loop function

4.4.1 Fully closed-loop parameter settings

After basic gain parameters are set, the servo can run normally without overshoot, and there is no noise after the servo stops. After the basic operating conditions are met, set the fully closed-loop parameters as follows:

1. Confirm the running direction of the external encoder.

Check whether the running directions of the external encoder and the internal encoder are the same. If they are not the same, a positive feedback effect will appear, causing runaway.

The confirmation method is as follows:

Enter the JOG mode, jog the device at a low speed in the same direction, and check the pulse feedback display C1B.10 of the internal encoder and C1B.12 of the external encoder. If the change trend of the two is the same (increasing or decreasing at the same time), set C1B.01 to 0. On the contrary, set C1B.01 to 1.

2. Determine the resolution of the external encoder (the number of pulses corresponding to the external encoder when the motor rotates for a revolution).

Rotate the motor, check the pulse feedback display C1B.10 of the internal encoder to determine that the motor rotates for a whole revolution, calculate the change of the pulse feedback display C1B.12 of the external encoder, and put the absolute value of this change into the number of external encoder pulses C1B.04 when the motor rotates for one revolution.

CAUTION

- It can be calculated as follows: before the motor rotates, the current value of C1B.10 is X_1, and the current value of C1B.12 is Y_1. After the motor rotates, the current value of C1B.10 is X_2, and the current value of C1B.12 is Y_2.
- C1B.04 = Number of internal encoder pulses in one revolution of the moto $\times \frac{Y_2-Y_1}{X_2-X_1}$

  The calculation result must be positive; otherwise, C1B.01 may be set incorrectly and needs to be reconfirmed.
- C1B.04 must be set correctly; otherwise, the alarm Er47.2 (excessive position deviation) may be misreported after the servo runs.

3. External encoder electronic gear ratio setting

If C1B.00 is 1, the setting object is C03.02/C03.04. If C1B.00 is 2, the inner loop setting object is C03.02/C03.04, and the outer loop setting object is C03.06/C03.08.

The calculation method of gear ratio is as follows: Assume that the control requirement of fully closed-loop equipment is that every time the host computer sends X_1 pulse references, the corresponding external mechanical displacement is Y_1.

Do the following:

a. Firstly, set the electronic gear ratio to 1:1.

b. The host computer sends X_2 pulses, and the measured external mechanical displacement is Y_2.

Then the electronic gear ratio can meet the demand.

NOTICE

- In the closed-loop switching mode of internal and external positions, to set the fully closed-loop electronic gear ratio, you need to set the DI terminal configuration function FunIN.32 (electronic gear switching switch) to the external closed-loop state.
- This method is also applicable to the internal closed-loop mode, and you just need to ensure that the current state is the internal closed-loop state.
- Be sure to set the electronic gear ratio correctly; otherwise, it will inevitably lead to mechanical deviation.

4. Set alarm detection

The settings for alarm detection (C1B.08 and C1B.0A) are as follows.

- Setting of excessive value of mixed control deviation (C1B.08)

The excessive value of mixed control deviation (C1B.08) is used to set the allowable deviation between the current position of the motor and the current position of the external encoder. The unit of this parameter is 1 reference unit (same as 1 external encoder unit).

Example: If C1B.08 is set to 1000, it means that when the displacement of the motor driving the mechanical movement and the displacement of the external encoder measuring the mechanical movement (that is, the mixed deviation) exceed the displacement corresponding to 1000 external encoder pulses, the alarm Er47.2 (excessive inner and outer loop deviation in fully closed-loop mode) is output.

NOTICE

- When it is set to "0", the alarm Er47.2 (excessive inner and outer loop deviation in fully closed-loop mode) will not be output.
- C1B.08 setting must be less than (C1B.04) × (C1B.0A) (for example, C1B.04 × C1B.0A × 50%); otherwise, the alarm cannot be output.

- Mixed control deviation clearing (C1B.0A) setting

This set value indicates that the mixed control deviation of the motor is cleared to zero every C1B.0A revolution. When the value is set to 0, the mixed control deviation is always 0.

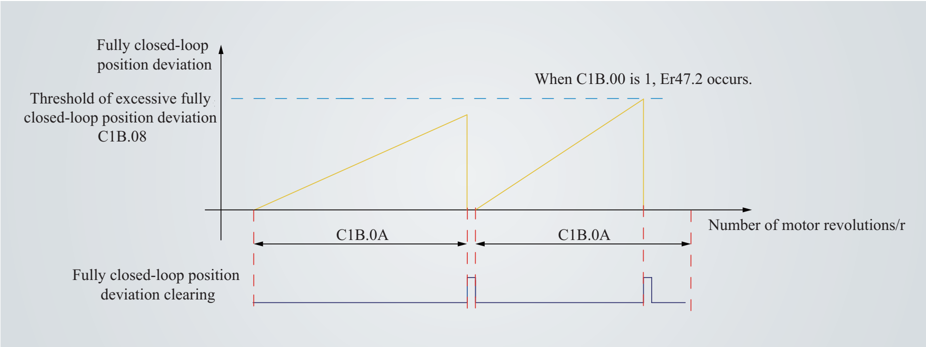


Figure 4-92 Fully closed-loop position deviation clearing description

Through the feedback pulse of the internal encoder, the number of revolutions of the mixed control deviation clearing setting C1B.0A is detected.

Example: If C1B.0A is set to 50, it means whether the mixed deviation exceeds the pulse unit set in C1B.08 when the motor rotates for 50 revolutions.

If so, an alarm is generated; otherwise, when the motor rotates more than 50 revolutions, clear the deviation and start monitoring again.

- Mixed control deviation first-order low-pass filter (C1B.0B)

  It indicates the time constant of the first-order filter, used to filter the vibration of mixed control deviation, so that the speed operation is smoother in the fully closed-loop mode.

⚠ CAUTION

- When the mixed control deviation clearing is enabled, be sure to set C1B.0A to an appropriate value. According to the set value of C1B.08, if C1B.0A is set to a minimum value, the protection function of excessive deviation of mixed control cannot be realized.
- When using this function, pay full attention to the safety operation such as setting the limit encoder.
- The alarm must be set effectively; otherwise, it will cause accidents such as runaway and personal injury.

4.4.2 Fully closed-loop enabling

After the above-mentioned fully closed-loop parameters are set, check the feedback from the internal and external encoders through C1B.10 and C1B.12 to judge whether the fully closed-loop wiring and the use mode of the external encoder are correct, and then enter the step of enabling fully closed-loop.

4.5 Auxiliary functions

4.5.1 Position Comparison Function

Description:

Position comparison works by comparing the instantaneous position data with the value pre-stored in the data array and, once available, a DO signal or an ABZ/OCZ signal with a settable pulse width is immediately output. Position comparison is applicable to high-speed motion axes as comparison actions are implemented by FPGA, removing the risk of software communication delay between processors.

The specifications of the position comparison output are shown in the following table:

Position Comparison Output Specification		Function Description
Trigger output	Output port	Four DO outputs or ABZ&OCZ signals
	Logic	The active level of DO and ABZ&OCZ outputs is determined by C0D.06.
	Pulse width	The output pulse width is set by C0D_05.
	Delay compensation	Set by C0D_0E, which is used to compensate the hardware output delay.
Comparison value	Number of comparison points	40 points, unsigned 32-bit integer
Comparison attribute	Comparison point attribute	Positive and negative crossing setting
		Comparison output port setting

The comparison output is divided into four channels, among which, channel 1: differential A and DO1; channel 2: differential B and DO2; channel 3: differential Z and DO3; channel 4: OCZ and DO4. All channels can be set to output at the same time through the comparison point attribute.

Output Interface	Channel 1	Channel 2	Channel 3	Channel 4
ABZ	A+A-	B+B-	Z+Z-	OCZ
DO	DO1	DO2	DO3	DO4

NOTICE

- It is recommended that ABZ and DO not be used at the same time, because the hardware delay time of the two interfaces is different, and the delay time of DO is longer. You can set the delay compensation through the function code C0D.0E.

Related objects:

When the position comparison output function is enabled, you can set 1 to 4 DO functions to 11 (position comparison output), and then this DO is used as the signal of position comparison output.

Position comparison output parameters:

Parameter	Name	Description
C0D position comparison output		
C0D.00	Position comparison output switch	0: Disable 1: Enable (active at rising edge)
C0D.02	Position comparison resolution	The number of pulses corresponding to one revolution of the motor. For example, C0D.02 = 1 indicates that the number of pulses corresponding to one revolution of the motor is 2^{23}. 0: 24bit 1: 23bit 2: 22bit 3: 21bit 4: 20bit 5: 19bit 6: 18bit 7: 17bit
C0D.03	Position comparison mode	0: Individual absolute comparison mode 1: Cyclic incremental comparison mode 2: Fixed cyclic incremental mode 3: Cyclic absolute comparison mode
C0D.05	Position comparison output width	The active pulse width of DO output when the comparison point arrives, ranging from 5 to 1200, in the unit of 0.1 ms (effective after re-energizing).
C0D.06	Position comparison output port polarity	Bit0: Channel 1 polarity Bit1: Channel 2 polarity Bit2: Channel 3 polarity Bit3: Channel 4 polarity 0: Negative polarity (active at low level); 1: Positive polarity (active at high level)
C0D.07	Start point of position comparison	It takes effect when C0D.00 rewrites 1.
C0D.08	End point of position comparison	It takes effect when C0D.00 rewrites 1.
C0D.09	Position comparison status	0: No comparison n: Currently waiting for the nth comparison point
C0D.0A	Real-time position of position comparison	Display the current comparison position value, ranging from -2^{31} to $(2^{31} - 1)$.

Parameter	Name	Description
C0D position comparison output		
C0D.0C	Zero offset of position comparison	Offset after comparison enabled with the current position as zero, ranging from -2^{31} to $(2^{31} - 1)$.
C0D.0E	Compensation for position comparison output de-lay	Comparison delay compensation time: 0 to 10000, in the unit of 0.01 μs.
C0D.0F	Fixed number of cycles	Range: 1 to 65535 times
C0D.11	Number of cycles in certain mode	Range: 0 to 65535 times

Comparison point setting:

Parameter	Name	Description
C0E Target Position Parameter		
C0E.00	Setting of target position 1	Set value of comparison point of the 1st target position, with the range of -2^{31} to $(2^{31} - 1)$.
C0E.02	Attribute of target position 1	Comparison point attribute value setting of the first target position: Bit0: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit1: Output DO active signal if current position changes from "more than" to "less than" the comparison point (Note: When both Bit0 and Bit1 are set to 0: this point is skipped.) Bit2 to Bit7: NA Bit8: Channel 1 output Bit9: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output (Note: The corresponding port needs to be opened in advance; otherwise, the output will be inactive.)
C0E.03	Setting of target position 2	Set value of comparison point of the 2nd target position, with the range of -2^{31} to $(2^{31} - 1)$.
C0E.05	Attribute of target position 2	Comparison point attribute value setting of the 2nd target position: According to the above settings.
...		
C0E.75	Setting of target position 40	Set value of comparison point of the 40th target position, with the range of -2^{31} to $(2^{31} - 1)$.
C0E.77	Attribute of target position 40	Comparison point attribute value setting of the 40th target position: According to the above settings.

Principle:

Position comparison works by comparing the instantaneous position feedback with the value pre-stored in the data array of the target position and, once available, outputting a DO pulse signal (with the DO serial number and width settable) for future use in subsequent motion control.

Position comparison is applicable to high-speed motion axes as comparison actions are implemented by FPGA, removing the risk of software communication delay between processors.

- Position comparison switch:

  When the value of C0D.00 (comparison enable switch) changes from 0 to 1, position comparison starts and the value of C0D.0A (real-time position of position comparison) starts counting. When the value of C0D.0C is not 0, C0D.00 changes from 0 to 1 and the value of C0D.0A changes to the offset value of C0D.0C. In addition, the value of C0D.09 (current status of position comparison) is updated to the start point of position comparison When the value of C0D.00 (comparison enable switch) changes to 0, position comparison stops and the current comparison status will be cleared.

- Position comparison resolution:

  The comparison resolution defines the number of pulses per revolution. Given the maximum and minimum limits on the target position defined by group H0E, you can reset the resolution when the comparison value of the target position overflows. For example, when C0D.02 is set to 7 (17-bit), the maximum value of the target position is 2^{31}-1, and the motor rotates (2^{31} - 1)/217 circles.

  The target position in group C0E is only related to the set resolution.

- Individual absolute comparison mode:

  In single comparison mode, when comparison of the end point is done, the comparison function is switched off automatically and the current comparison value is cleared. Position comparison can be enabled again only when the position comparison switch is switched on again.

  The real-time position feedback in the single comparison mode is an absolute value, which means it is an accumulative value based on preceding comparison points, which cannot be cleared automatically.

- Cyclic incremental comparison mode:

  In cyclic comparison mode, position comparison will not be switched off when the comparison end point is reached, and current position comparison value will be reset as the start point for position comparison. After comparison of each point is done, the value of C0D.0A (real-time position feedback) will be cleared and counted again for cyclic comparison. In cyclic comparison mode, the target position is a relative (incremental) value. Each time a comparison point is reached, the real-time position feedback is automatically cleared and counted again for comparison with the new target.

- Fixed cyclic incremental comparison mode:
  The comparison mode is the same as the cyclic comparison mode. The cycle times is specified by C0D.0F. After the cycle times is reached, comparison is automatically disabled.

- Cyclic absolute comparison mode:

  In cyclic absolute comparison mode, C0D.07 (start point of position comparison), C0D.08 (end point of position comparison), and C0D.13 (start point of comparison in cyclic absolute mode) need to be set.

After the position comparison switch is switched on, the C0D.13 comparison point is first compared (not output if other comparison points are encountered before the C0D.13 comparison point). After the C0D.13 comparison point, comparison points C0D.07 to C0D.08 will be compared according to the actual position, with no specific order of comparison.

⚠ CAUTION

- In this mode, comparison positions for comparison points must be set in ascending order. Otherwise, it will result in incorrect output of comparison points.

- Position comparison output width:

  When the position comparison conditions are fulfilled, the servo drive outputs the DO active level signal. The width of the active signal can be set by C0D.05 (value range: 5 to (1200 x 0.1) ms).

  When DO is active, the comparison logic is suspended and no comparison will be performed. In this case, ensure that the operating time between two target points is greater than the output width of DO.

- Target value of position comparison:

  There are a total of 40 target values for position comparison. Each target value is a 32-bit signed number. The target values and attribute values of position comparison must be updated to target parameters in group C0E in advance.

⚠ CAUTION

- Set the target position reasonably. The position comparison mode does not support overflow comparison of C0D.0A.

- Start point for comparison:

  There are a total of 40 target values for position comparison. Each target value is a 32-bit signed number. The target values and attribute values of position comparison must be updated to target parameters in group C0E in advance.

- End point for comparison:

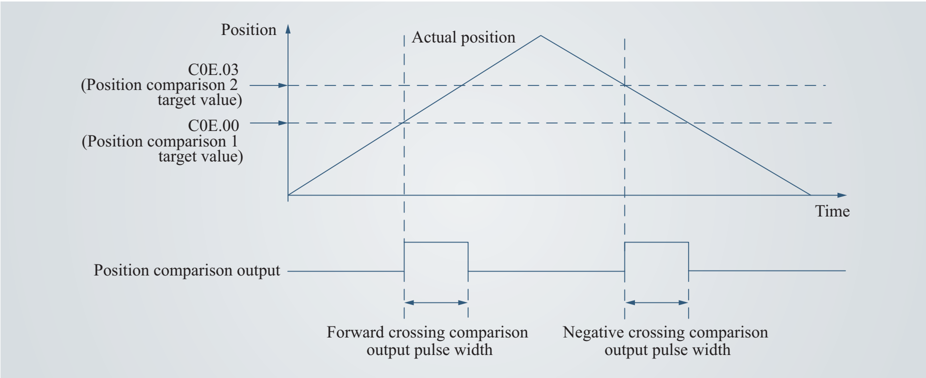
  The end point indicates the position of the last comparison point. For example, if the end point is set to 7, the comparison output function is disabled or comparison restarts from the start point after comparison of the seventh target position is completed.

⚠ CAUTION

- Before enabling the position comparing output, confirm whether to set the zero offset. Otherwise, the comparison may fail.

Function operation:

- When the actual position of the encoder passes through the target position comparison point, the output port outputs the pulse with the width set by C0D.05.

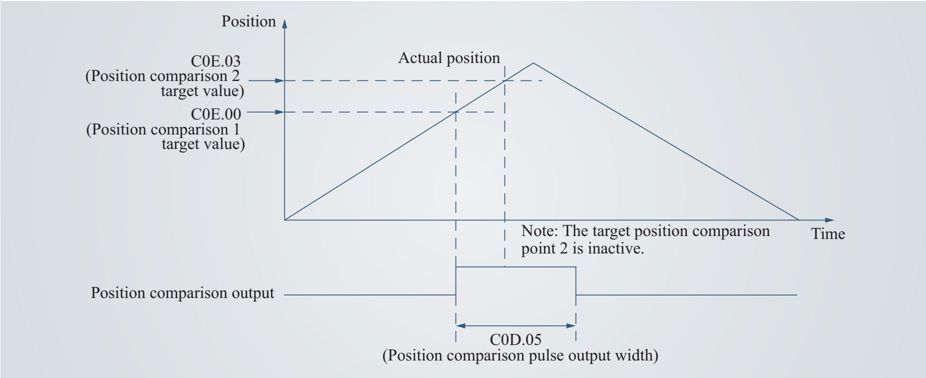


When the attribute bit0 of the target position comparison point is set to 1, in case of positive crossing comparison output, the comparison output port outputs the position comparison signal when the axis passes through the target position comparison point and the position feedback changes from small to large.

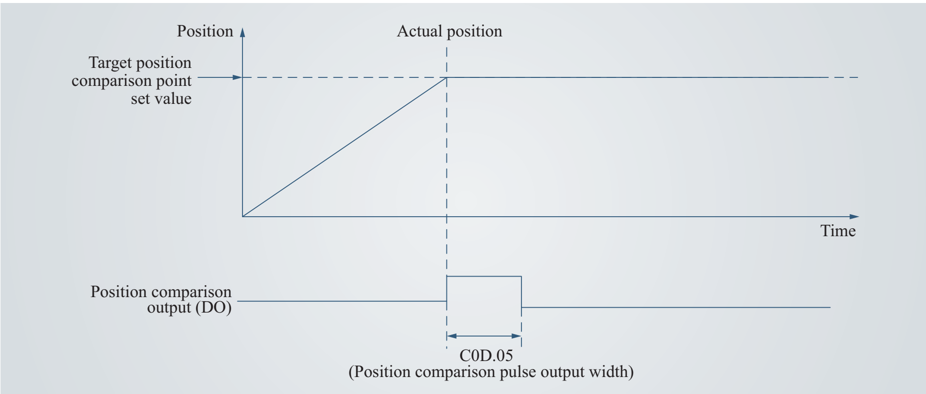
When the attribute bit1 of the target position comparison point is set to 1, in case of negative crossing comparison output, the comparison output port outputs the position comparison signal when the axis passes through the target position comparison point and the position feedback changes from large to small.

When both the attributes bit0 and bit1 of the target position comparison point are set to 1, in case of positive crossing comparison output, the comparison output port outputs the position comparison signal when the position feedback passes through the target position comparison point.

- When multiple position comparison values are set, comparison will not be performed during the validity term of the position comparison output port. Therefore, keep the running time between two target position comparison points longer than the width of the pulse output. The following figure shows that when the running time between two target position comparison points is less than the pulse output width, and the target points are crossed reversely, comparison is not performed.



- When the device stops at the same position as the position comparison value, which is the position the device passes through, only one pulse is output (as shown in the figure below).



4.5.2 Black Box Function

Description:

The black box function enables the servo drive to capture data upon failure or under specified conditions and automatically save it. The data can be uploaded and read in the backend, allowing users to analyze and address the cause of the failure.

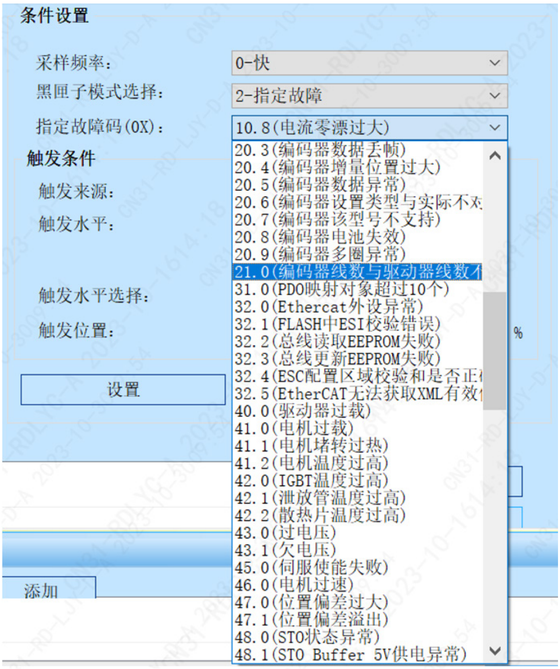
The black box function is enabled by default for A6-RS series servo drives. The black box is triggered upon any failure, with a sampling frequency of 16 kHz. After the black box is successfully triggered, the servo drive automatically shuts down. After the fault is reset or the servo drive is powered on again, the black box function is automatically enabled.

Setting for triggering the black box:

1. Sampling frequency: Three sampling frequencies are available, including fast (16 kHz), medium (4 kHz), and slow (1 kHz).

2. Black box mode: Three modes are available for the black box, including Any failure, Specified failure, and Trigger by specified condition.

3. The specified fault code can be selected from the drop-down list, as shown in the figure below.

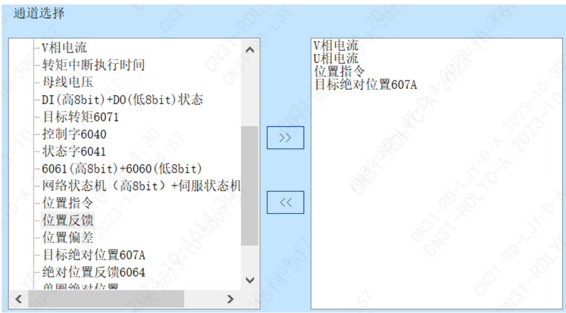


4. Specified conditions include Trigger source, Trigger level, and Trigger level selection, as shown in the figure below.

5. Trigger position specifies the position of the trigger moment within the total sampling time, which defaults to 80%.
6. After setting the black box successfully, download the parameters to the drive.

Reading of black box data:

You can read data of the specified black box channel (up to four pieces of data), and click >> to add or << to delete an option.



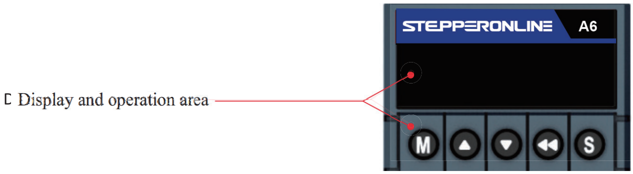
⚠ CAUTION

- After the black box is triggered, it takes 6s to 9s to save the data to EEPROM. Power-off during this period will result in the loss of black box data.

Chapter 5 System Commissioning

5.1 Commissioning Tool

The A6-RS series servo drive can be commissioned by the operating panel which consists of an LED display area and five buttons.



5.1.1 Buttons

Button		Description
	MODE	Press: • Switch/return to menus of different levels Press and hold: • Switch the group number quickly in level-2 menus
	UP	Press: • Switch the state display quickly in level-1 menus • Increase the value
	DOWN	Press: • Switch the state display quickly in level-1 menus • Decrease the value
	SHIFT	Press: • Move the cursor to the left Press and hold: • Enter the JOG mode quickly in level-1 menus • Page up or down when the content is displayed on multiple pages
	SET	Press: • Switch to the lower-level menu • Execute commands such as storing parameter setpoints

5.1.2 Display

When the servo drive is running, the servo drive status, parameters, faults, and monitored values are displayed in the LED display area.

Status display: Display current servo drive status, such as servo ready or servo running.

Parameter display: Display parameters and their setpoints.

Fault display: Display faults and alarms that occurred on the servo drive.

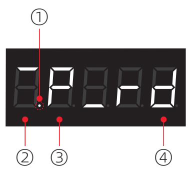
Monitored value display: Display values of running parameters of the servo drive.

NOTICE

- After power-on, "Init" is displayed in the LED display area and then the system enters the level-1 menu status display mode.
- In the status display mode, select the parameter to be monitored. When the motor rotates, the display area automatically switches to monitored value display. After the motor stops, the display area automatically returns to status display.
- In the parameter display mode, after you select the parameter to be monitored, the system switches to monitored value display.
- Once a fault occurs, the LED display area switches to fault display automatically, with all the LEDs blinking. Press S to stop the LEDs from blinking, and then press M to switch to parameter display.

Display menu

- **Level-1 menu**: Status display

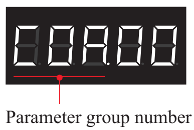


① Display of the model with brake
② Rotation direction display
③ Running mode
④ Servo status

Press ▲ and ▼ to switch among different display modes.

Press M to enter a level-2 menu.

- **Level-2 menu**: Display the parameter group number in hexadecimal



C: Function parameter
R: System parameter
F: Operation parameter
U: Monitoring parameter

Press and hold M to switch the group number.

Press S to enter a level-3 menu.

Press M to return to the level-1 menu.

- **Level-3 menu**: Offset within the parameter group in hexadecimal

Offset within the parameter group

Press S to enter a level-4 menu.

Press M to return to a level-2 menu.

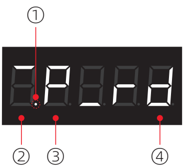
- **Level-4 menu**: Parameter setpoints in decimal

Press ▲ ▼ to increase or decrease the value.

Press S to confirm the setting. Then, the system displays .

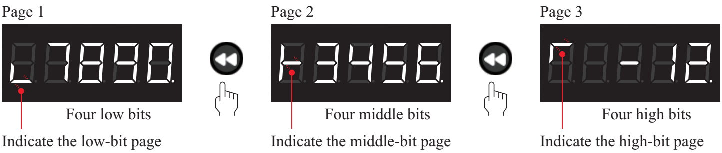
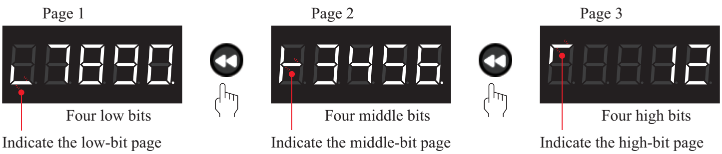
Press M to return to a level-3 menu.

Status display

LED Display	Meaning	Description	
 	① Brake status	On: Model with brake Off: Model without brake	
	② Rotation direction display	No display: No rotation " ‾ " displayed: Forward rotation " _ " displayed: Reverse rotation	
	③ Running mode	P: Position mode S: Speed mode T: Torque mode A: Initial angle auto-tuning J: Inertia auto-tuning H: Homing	
	④ Servo status	nr: Servo not ready rd: Servo ready rn: Servo running	

Parameter display

Category	LED Display
Signed number with 4 digits and below: Display on one page (5 digits) When the rightmost "●" is turned on, the high bit " _ " indicate a negative sign.	

<table>
<tr><th>Category</th><th>LED Display</th></tr>
<tr><td>Unsigned number with 5 digits and below:
Display on one page (5 digits)</td><td></td></tr>
<tr><td colspan="2">Signed number with more than 4 digits:
Such numbers are displayed from low to high bits in multiple pages (5 digits per page).
For a negative value, when the rightmost "●" is turned on, the high bit "_" indicate a negative sign.
Such numbers are displayed in the format of "number of current page + values on current page".
To switch to the next page, press and hold ⏪ for more than 2 seconds.
</td></tr>
<tr><td colspan="2">Unsigned number with more than 5 digits:
Such numbers are displayed from low to high bits in multiple pages (5 digits per page).
Such numbers are displayed in the format of "number of current page + values on current page". To switch to the next page, press and hold ⏪ for more than 2 seconds.
</td></tr>
</table>

Fault display

- The panel displays the current or history faults and alarm codes. For analysis and troubleshooting of faults and alarms, see the section "Troubleshooting".
- When a single fault or an alarm occurs, the panel displays the fault or alarm code. When multiple faults or alarms occur, the panel displays the fault code of the highest level.

5.2 Commissioning Process

Start

↓

Checklist before running

Y Mechanical and wiring inspection and safety inspection

↓

Power on the servo drive

Y Connect the power supply of the main circuit and control circuit

↓

Jogging

Y Jog through the panel

↓

Set parameters

Y Set common parameters
Y Set relevant parameters in each control mode

↓

Servo running

Y Run the servo drive at a low speed for the first time
Y Set relevant parameters to achieve the required effect
Y Commission the servo drive

↓

Stop the servo drive

Y Turn off the S-ON signal
Y Stop the servo drive upon a fault
Y Stop the servo drive if the limit switch is reached
Y Perform emergency stop

↓

Finish

5.3 Commissioning Procedure

CAUTION

- Confirm that the site is equipped with conditions suitable for the safe operation of the servo drive (no interference, no foreign objects, and no dangerous goods).
- Confirm that the power input terminals are connected correctly and firmly.
- Confirm that the wiring (U/V/W) between the servo drive and the motor is correct and firm.
- Confirm that the control signal cables of the servo drive are connected correctly. External signal cables for brake and overtravel protection are connected properly.
- Confirm that the servo motor and its axes are installed and mechanically connected reliably.
- Confirm that the servo drive and motor have been grounded reliably.

5.3.1 Power on the servo drive

NOTICE

- Single-phase input: The power terminals are L1 and L2.
- Three-phase input: The power terminals are R, S, and T for the main circuit or L1C and L2C for the control circuit.

After the input power supply is connected:

- The LED panel displays rd, which means that the servo drive is ready to run and is waiting for the S-ON signal from the host controller.
- If the LED panel keeps displaying nr or other faults, troubleshoot the problem according to the section "Troubleshooting".

5.3.2 Jogging

Use the jogging function for trial run of the servo motor and servo drive to check whether the servo motor rotates properly without abnormal vibration or noise generated during rotation.

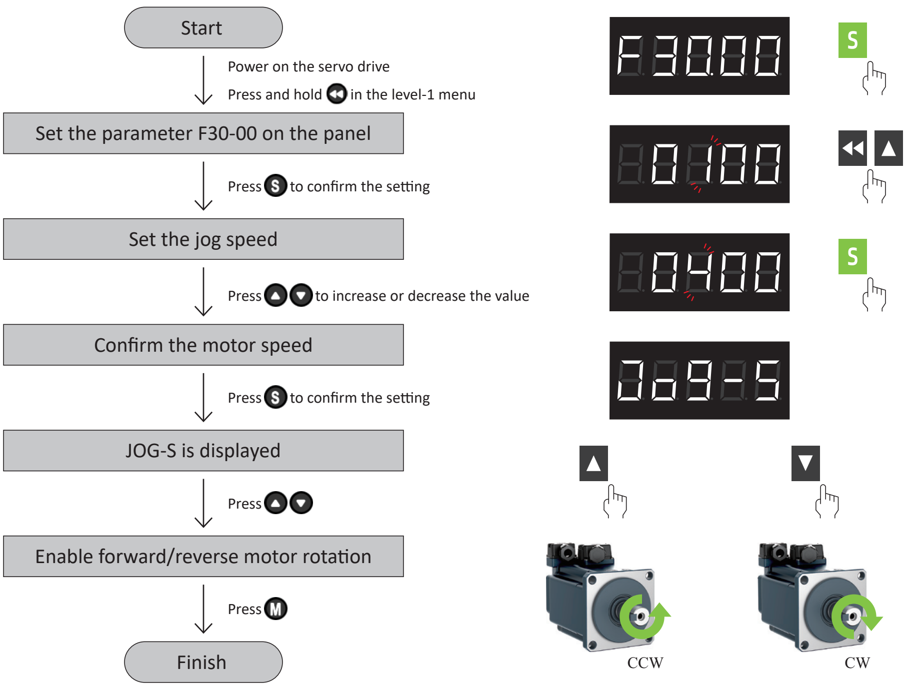
CAUTION

- To use the jogging function, deactivate the S-ON signal. Otherwise, this function cannot be used.

NOTICE

- During the jog, use F30.03 to set the acceleration/deceleration time constant for the speed/ position reference.

Procedure for setting the jogging function:



NOTICE

- Press to increase or decrease the motor speed for the jog running. If the system exits jog running, the motor speed restores to the initial value.
- Press to make the servo motor rotate in the forward or reverse direction. After the button is released, the servo motor stops running immediately.

5.3.3 Set parameters

Select the rotation direction

By setting C00.01 (rotation direction), the rotation direction of the motor can be changed without changing the polarity of the input command.

Set the brake

The brake is used to prevent the servo motor shaft from moving and lock the motor position when the servo drive is not running. This is to keep the mechanical load from moving due to gravity or external force.

NOTICE

- The built-in brake is a special non-energized mechanism designed for position-lock in the stop state. Do not use the built-in brake for any other purposes, such as braking.
- The brake coil has no polarity.
- Switch off the S-ON signal after the servo motor stops.
- When the motor with a built-in brake runs, the brake may generate a click sound, which does not affect its function.
- When brake coils are energized (the brake is released), flux leakage may occur on the shaft end. Pay special attention when using magnetic sensors near the motor.

For the servo motor with a brake, assign function 3 (brake output) to a DO terminal (DO3 by default) of the servo drive and set valid logic for the DO terminal.

The operating time sequences of the brake are different between normal state and fault state of the servo drive.

The brake time sequence in the normal state changes with the motor states: static and rotating.

- Static: The motor speed is lower than 30 rpm.
- Rotating: The motor speed is equal to or greater than 30 rpm.

Brake time sequence in the motor static state:

- If the servo enabling (S-ON) signal changes from ON to OFF, and the present motor speed is lower than 30 rpm, the servo drive acts according to the brake time sequence in the motor static state.

CAUTION

- After the brake (BK) output signal changes from OFF to ON, do not input a position/speed/torque reference within the time defined by C05.13. Otherwise, reference loss or running error may occur.

NOTICE

- When the motor is used to drive a vertical axis, the mechanical motion part may move slightly due to the gravity or external force. In the motor static state, if the S-ON signal becomes OFF, the brake (BK) output signal becomes OFF immediately. However, within the time defined by C05.10, the motor is still energized to prevent the mechanical motion part from moving due to the gravity or external force.

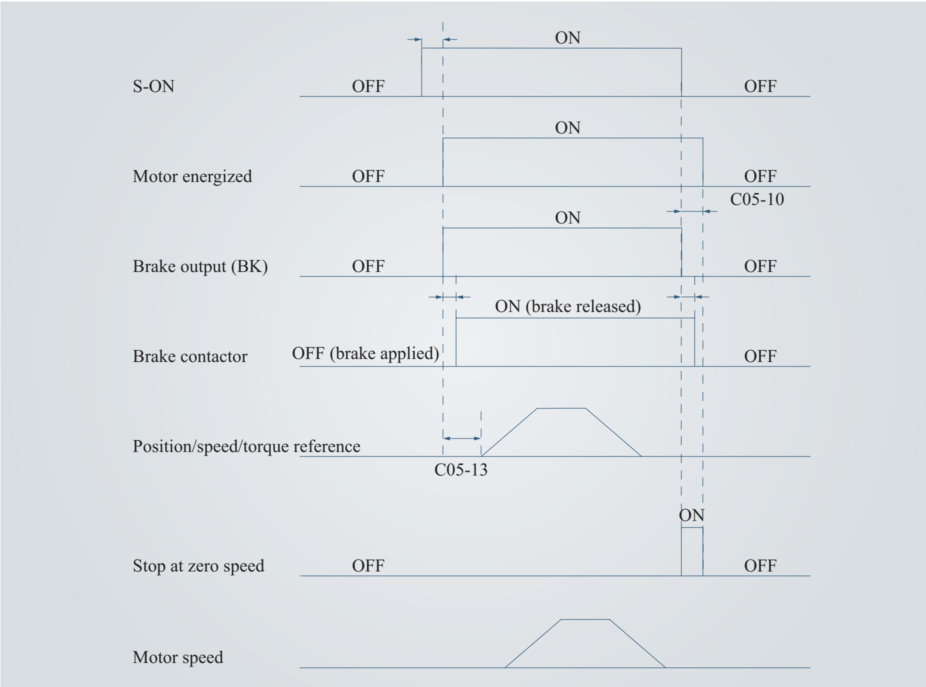


Figure 5-1 Brake time sequence in the motor static state

Brake time sequence in the motor rotating state:

- If the S-ON signal changes from ON to OFF, and the present motor speed is equal to or greater than 30 rpm, the servo drive acts according to the brake time sequence in the motor rotating state.

CAUTION

- If the S-ON signal changes from OFF to ON, do not input a position/speed/torque reference within the time defined by C05.13. Otherwise, reference loss or running error may occur.

NOTICE

- If the S-ON signal becomes OFF during motor rotating, the servo motor enters the quick ramp stop state set in C05.08 or the low ramp stop state set in C05.0A. But the brake (BK) output signal becomes OFF only after one of the following conditions is met:
  - The motor has decelerated to the value defined by C05.11, but the time defined by C05.12 is not reached.
  - The time defined by C05.12 has been reached, but the motor speed is still higher than the value defined by C05.11.
- After the brake (BK) output signal changes from ON to OFF, the motor remains energized within the time defined in C05.10 to prevent the mechanical motion part from moving due to the gravity or external force.

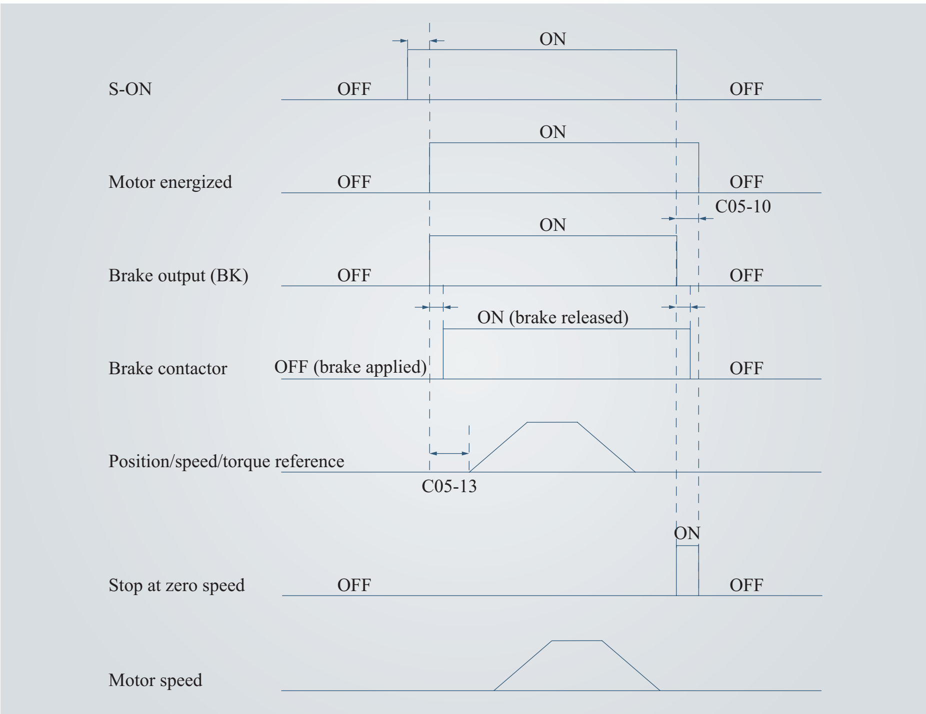


Figure 5-2 Brake time sequence in the motor rotating state

Set the brake

When the torque and speed directions of the motor are opposite, the energy is transferred from the motor to the drive, increasing the bus voltage. When the voltage is increased to the braking point, the energy can be consumed only by the braking resistor. In this case, the braking energy must be consumed according to the braking requirements. Otherwise, the servo drive may be damaged.

⚠ CAUTION

- Set the power (C00.11) and resistance (C00.12) for the external braking resistor properly. Otherwise, the braking function may be affected.
- When an external braking resistor is used, check whether its resistance is above the minimum allowable resistance.
- In a natural environment, the temperature of the resistor will rise above 120°C (under continuous braking) when the average power of the braking resistor is below its rated power. For safety consideration, use forced cooling to cool down the braking resistor or use a braking resistor with a thermal switch. Consult the manufacturer about load characteristics of the braking resistor.

Set the heat dissipation coefficient (C00.13) based on the heat dissipation condition of the external braking resistor.

5.3.4 Servo running

Switch on the S-ON signal. When the servo drive is ready to run, the LED panel displays .

If there is no command input at this moment, the servo motor does not rotate and stays locked. After a command is input, the servo motor starts rotating.

NOTICE

Operation of the servo drive

- During initial operation, set a proper command to make the motor run at low speed and check whether the motor rotates properly.
- Check whether the motor rotates in the correct direction. If the direction of rotation is opposite to the expected direction, check the reference signal and reference direction signal.
- If the motor rotates in the correct direction, you can view the actual motor speed in U40.01 and the average load factor in U40.07 through the drive panel.
- After checking preceding conditions, adjust related parameters to make the motor operate as desired.
- Adjust the servo drive parameters according to the section "Gain Tuning".

5.3.5 Stop the servo drive

Five type of stop modes are available for the servo drive: coast to stop, stop at zero speed, ramp to stop, stop at emergency-stop torque, and dynamic braking (DB) stop, along with three kinds of stop status: de-energized, position lock, and DB. After brake output is enabled, the servo drive selects a stop mode.

Table 5-1 Comparison of the stop modes

Stop Mode	Description	Feature
Coast to stop	The servo motor is de-energized and coasts to 0 RPM. The deceleration time is affected by the mechanical inertia and mechanical friction.	This mode features smooth and slow deceleration with small mechanical shock.
Stop at zero speed	The servo motor decelerates to 0 RPM immediately and stops.	This mode features quick deceleration with obvious mechanical shock.
Ramp to stop	The motor decelerates to 0 RPM smoothly upon position/speed/torque reference input.	This mode features smooth and controllable deceleration with small mechanical shock.
Stop at emergency-stop torque	The servo drive outputs a reverse braking torque to stop the motor.	This mode features quick deceleration with obvious mechanical shock.
Dynamic braking	The servo motor is in the dynamic braking status.	This mode features quick deceleration with obvious mechanical shock.

Table 5-2 Comparison of the stop statuses

Stop Status	Description
De-energized	The motor is de-energized and the motor shaft can rotate freely after the motor stops rotating.
Position lock	The motor shaft is locked and cannot rotate freely after the motor stops rotating.
Dynamic braking	The motor is de-energized and the motor shaft cannot rotate freely after the motor stops rotating.

Table 5-3 Comparison of the stop modes

Stop Mode	Description
Stop at S-ON OFF	The communication control S-ON signal is inactive, and the servo stops according to the stop mode of S-ON OFF.
Stop at fault	The stop mode varies with the fault type. For fault classification, see sections related to faults.
Stop at overtravel	When a mechanical motion part moves beyond the range of safe movement, the limit switch outputs a level change to force the servo motor to stop.
Emergency stop	Using the DI function 4: Emergency stop
Quick stop	In the servo running state, quick stop can be selected in C05.01 (quick stop mode).

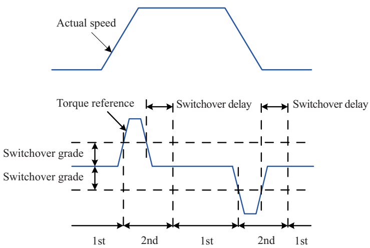
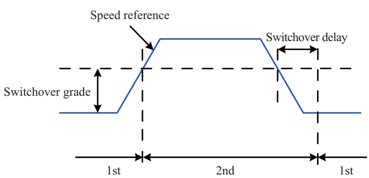
5.4 Gain switchover

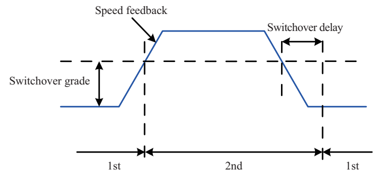
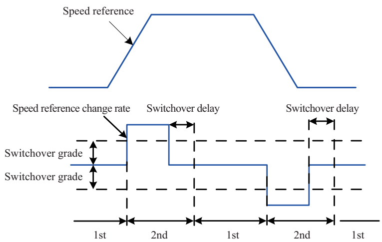
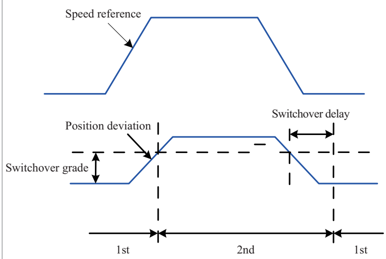
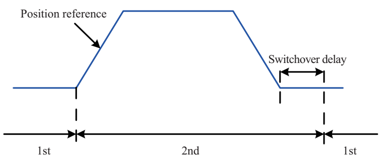
Function:

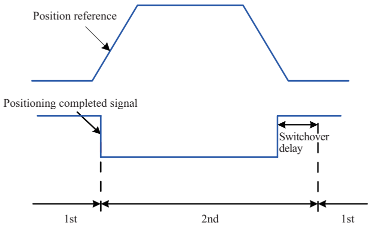
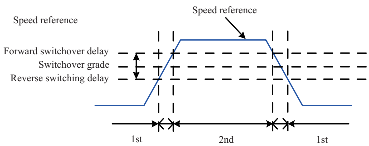
The gain switchover function can be triggered by the servo internal state or external DI. It is only active in position and speed control modes. Gain switchover has the following functions:

- Switch to a lower gain when the motor is at rest (servo enabled) to suppress vibration.
- Switch to a higher gain when the motor is at rest to shorten the positioning time.
- Switch to a higher gain when the motor is running to improve the command tracking performance.
- Different gain settings can be switched by external signals according to the load equipment conditions.

Description of gain switchover conditions:

Gain Switchover Condition Setting			Relevant Parameters		
Set value (C01.38)	**Requirements**	**Figure**	**Switchover time (C01.39)**	**Switchover threshold (C01.3A)**	**Loop width (C01.3B)**
0	Fixed to the 1st gain set	-	Inactive	Inactive	Inactive
1	DI switchover	-	Inactive	Inactive	Inactive
2	DI P-PI switchover	-	Inactive	Inactive	Inactive
3	Torque reference		Active	Active (%)	Active (%)
4	Speed reference		Active	Active (rpm)	Active (rpm)

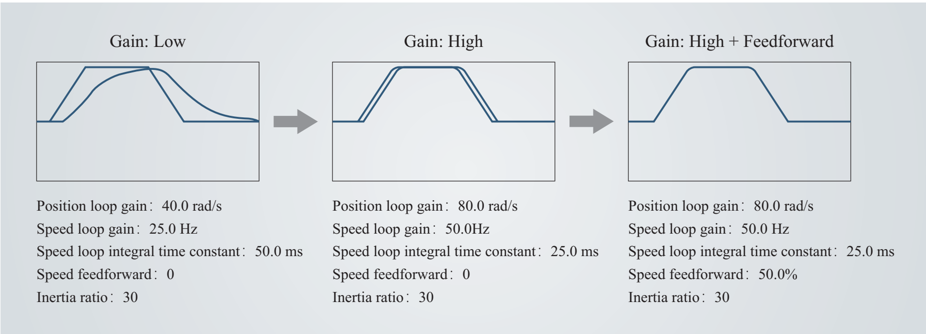
Gain Switchover Condition Setting			Relevant Parameters		
Set value (C01.38)	**Requirements**	**Figure**	**Switchover time (C01.39)**	**Switchover threshold (C01.3A)**	**Loop width (C01.3B)**
5	Speed feedback		Active	Active (rpm)	Active (rpm)
6	Speed reference change rate		Active	Active (rpm/ms)	Active (rpm/ms)
7	Position deviation		Active	Active (Encoder unit)	Active (Encoder unit)
8	Position reference		Active	Inactive	Inactive

Gain Switchover Condition Setting			Relevant Parameters		
Set value (C01.38)	**Requirements**	**Figure**	**Switchover time (C01.39)**	**Switchover threshold (C01.3A)**	**Loop width (C01.3B)**
9	Positioning completed signal		Active	Inactive	Inactive
10	Position reference and speed feedback	-	Active	Active (rpm)	Active (rpm)
11	Speed reference threshold		Inactive	Active (rpm)	Active (rpm)

Chapter 6 Gain Tuning

6.1 Overview

The servo drive must drive the motor as quick and accurate as possible to follow the commands from the host controller or internal setting. A proper gain tuning is required to make the motor actions more closely follow the commands and to maximize the performance of the servo system.



CAUTION

- Before gain tuning, perform a trial run through jogging to ensure the motor operates properly.

6.2 Inertia Auto-tuning

The load inertia ratio is the ratio of the total moment of inertia of motor load to the moment of inertia of the motor. The load inertia ratio is a critical parameter of the servo system. A correct load inertia ratio facilitates commissioning.

You can set the C00.06 (load inertia ratio) manually based on the weight and composition of different mechanical parts, but the operation is very tedious. It is increasingly difficult to get the correct solution for the complex mechanical composition. However, it can also be automatically auto-tuned by F30.10 (inertia auto-tuning function) of the servo drive.

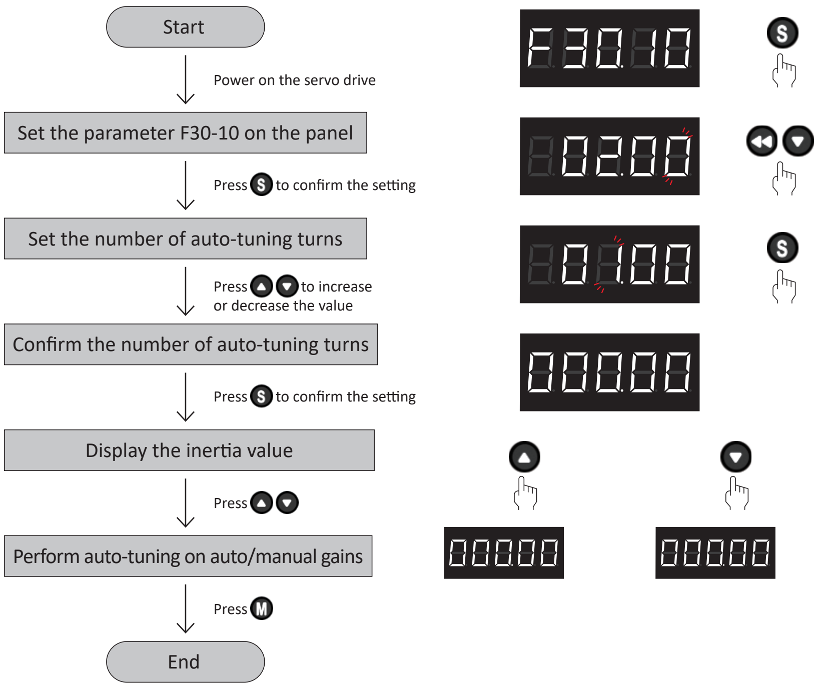
During auto-tuning, the drive will drive the servo motor to run in the forward or reverse direction multiple times, so as to obtain the load inertia ratio.

NOTICE

Inertia auto-tuning may fail or the auto-tuning accuracy is low under the following circumstances:

- The load mechanical system is poor, with low stiffness and vibration during localization.
- The motor operation range is too small, less than 0.5 turns.
- The load torque changes dramatically.
- The motor acceleration rate is less than 3000 rpm/s.
- The actual maximum speed of the motor is less than 150 rpm.

Inertia auto-tuning process:

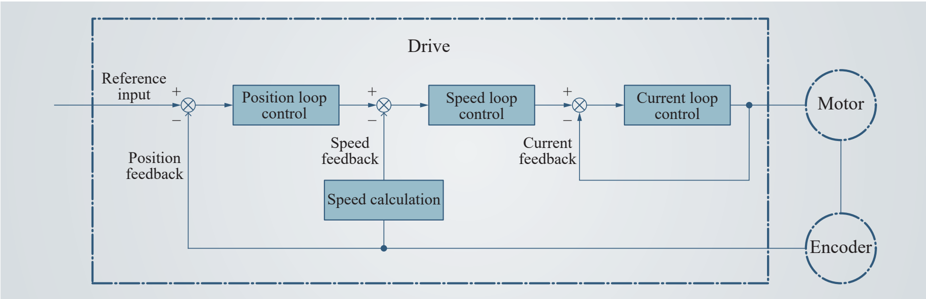


Related parameters:

Parameter	Name	Value Range	Default	Unit	Options	Modificantion Mode	Effective Time
C00.06	Load inertia ratio	0 to 12000	100	%	-	During operation	Immediately
C07.00	Offline inertia auto-tuning mode setting	0 to 785	769	-	Related modes during the auto-tuning are set.	At stop	Immediately
C07.01	Offline inertia auto-tuning speed reference	50 to 1000	500	rpm	The speed reference for auto-tuning is set.	At stop	Immediately
C07.02	Acceleration/ Deceleration time for offline inertia auto-tuning	0 to 65535	100	ms	The acceleration/ deceleration time for auto-tuning is set.	At stop	Immediately
C07.03	Offline inertia auto-tuning target torque	1 to 1500	150	0.1%	A larger target torque leads to shorter auto-tuning acceleration/ deceleration time.	At stop	Immediately
C07.04	Offline inertia auto-tuning revolutions	10 to 65535	200	0.01r	The number of auto-tuning revolutions should be within the mechanical motion range.	At stop	Immediately

6.3 Basic Gain Tuning

The servo system consists of three feedback loops, which are the position loop, speed loop, and current loop. The basic control diagram is shown in the following figure.



CAUTION

- The responsiveness of the inner loop must be higher than that of the outer loop. Otherwise, the responsiveness may be poor or vibrations may occur.

The default current loop gain of the servo drive ensures sufficient responsiveness, removing the need for further tuning. You only need to adjust the position loop gain, speed loop gain, and other auxiliary gains. Therefore, to ensure system stability during gain tuning in position control mode, the position loop gain must be increased together with the speed loop gain, and the responsiveness of the former must be lower than the latter.

The drive provides three types of gain auto-tuning modes:

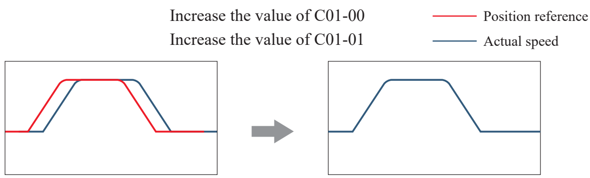
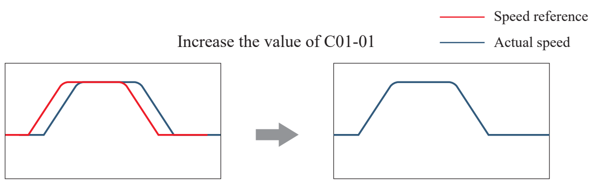
0: Manual tuning

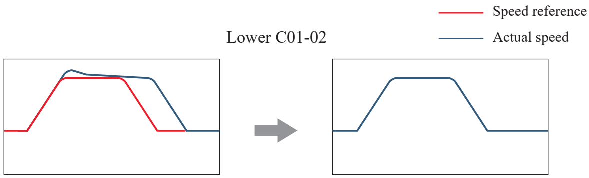
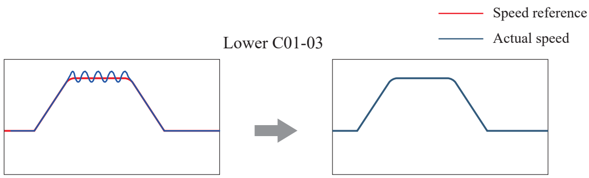
1: Standard tuning by stiffness level

2: Positioning mode

When the automatic gain tuning does not achieve the expected effect, you can manually fine-tune the gain. The effect can be optimized by more detailed tuning.

The following table lists the basic gain parameter tuning methods.

No.	Parameter	Name	Description
1	C01.00	Position loop gain	Function: Determines the responsiveness of the position loop of the servo unit. Increasing the position loop gain improves the responsiveness and shortens the positioning time. In general, the position loop gain cannot exceed the range of the certain vibration count of the mechanical system.  Tuning method: To ensure system stability, the gain frequency of the speed loop must be 3 to 5 times that of the position loop.
2	C01.01	Speed loop gain	Function: Determines the speed loop responsiveness. Too low responsiveness of the speed loop may be a delay factor of the outer position loop, so overshoot or a variable speed reference occurs. Therefore, within the non-vibration range of the mechanical system, increasing the setpoint stabilizes the speed and improves the responsiveness of the servo system.  Tuning method: In the vibration range without noise, increasing the parameter value will shorten the positioning time and lead to higher speed stability and following performance.

No.	Parameter	Name	Description
3	C01.02	Speed loop integral time constant	Function: To respond to even minor inputs, the speed loop contains an integral element. Since this integral element acts as a delay element for the servo system, when the time parameter is set too large, it will cause overshoot, or extend the positioning time, making the response worse.  Tuning method: Reducing the setpoint can enhance the integral effect and shorten the positioning time, but setting the value too low can easily cause mechanical vibration. If the value is set too high, the speed loop deviation will never return to zero.
4	C01.03	Torque reference filter cutoff frequency	Function: This parameter applies a low-pass filter to the torque reference, where the setpoint is the cutoff frequency of the low-pass filter. The smaller the setpoint, the better the filtering effect. Setting the value too low can cause excessive delay in the speed loop, thereby reducing the speed loop bandwidth. When mechanical vibrations occur, adjusting the following torque reference filter time parameters may potentially eliminate the vibrations.  Tuning method: Ensure that the cutoff frequency of the torque reference low-pass filter is more than four times the highest follow-up frequency of the speed loop.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Options	Modificantion Mode	Effective Time
C00.04	Auto-tuning mode	0 to 2	1	-	0: Manual mode 1: Standard mode 2: Positioning mode	During operation	Immediately

Parameter	Name	Value Range	Default	Unit	Options	Modificantion Mode	Effective Time
C00.05	Stiffness level	1 to 31	12	-	Increasing the stiffness level improves the responsiveness, but a too high level can cause oscillation.	During operation	Immediately
C01.00	1st position loop gain	0 to 20000	400	0.1rad/s	Increasing the setpoint improves the responsiveness and shortens the positioning time.	During operation	Immediately
C01.01	1st speed loop gain	1 to 20000	250	0.1Hz	Increasing the setpoint improves the speed follow-up responsiveness of the servo system.	During operation	Immediately
C01.02	1st speed loop integral time parameter	1 to 51200	3184	0.01ms	Reducing the setpoint can enhance the integral effect and shorten the positioning time.	During operation	Immediately
C01.03	1st torque reference filter cutoff frequency	5 to 16000	200	Hz	Reducing the setpoint improves the filtering effect but increases the delay.	During operation	Immediately

6.4 Pseudo derivative feedback and feedforward control

In position and speed modes, the pseudo derivative feedback and feedforward control can be used for the speed loop. When C01.1B is 100%, the speed loop uses proportional-integral (PI) control; when C01.1B is 0%, the speed loop switches to pure integral-proportional (IP) control.

In PI control mode, the speed response is faster, but the overshoot increases. In IP control mode, the speed response decreases correspondingly, but the follow-up is better and the overshoot decreases.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Options	Modificantion Mode	Effective Time
C01.1B	PDFF control coefficient	0 to 1000	1000	0.1%	Decreasing the value can reduce the speed overshoot.	During operation	Immediately

6.5 Gain Switchover

In position and speed modes, gain switchover can improve the system responsiveness and reference follow-up and reduce the positioning time.

High gain parameters correspond to the second group of loop gains, while low gain parameters correspond to the first group of loop gains. When the switchover conditions are met, the loop gain will switch between the first and second groups of gains.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Options	Modificantion Mode	Effective Time
C01.00	1st position loop gain	0 to 20000	400	0.1rad/s	Increasing the setpoint improves the responsiveness and shortens the positioning time.	During operation	Immediately
C01.01	1st speed loop gain	1 to 20000	250	0.1Hz	Increasing the setpoint improves the speed follow-up responsiveness of the servo system.	During operation	Immediately
C01.02	1st speed loop integral time parameter	1 to 51200	3184	0.01ms	Reducing the setpoint can enhance the integral effect and shorten the positioning time.	During operation	Immediately
C01.03	1st torque reference filter cutoff frequency	5 to 16000	200	Hz	Reducing the setpoint improves the filtering effect but increases the delay.	During operation	Immediately
C01.08	2nd position loop gain	0 to 20000	560	0.1rad/s	Increasing the setpoint improves the responsiveness and shortens the positioning time.	During operation	Immediately
C01.09	2nd speed loop gain	1 to 20000	350	0.1Hz	Increasing the setpoint improves the speed follow-up responsiveness of the servo system.	During operation	Immediately
C01.0A	2nd speed loop integral time parameter	1 to 51200	2274	0.01ms	Reducing the setpoint can enhance the integral effect and shorten the positioning time.	During operation	Immediately

Parameter	Name	Value Range	Default	Unit	Options	Modificantion Mode	Effective Time
C01.0B	2nd torque reference filter cutoff frequency	5 to 16000	280	Hz	Reducing the setpoint improves the filtering effect but increases the delay.	During operation	Immediately
C01.38	Gain switchover mode	0 to 11	0	-	Set the gain switchover mode.	During operation	Immediately
C01.39	Gain switchover time	10 to 10000	50	0.1ms	Set the gain switchover time.	During operation	Immediately
C01.3A	Gain switchover threshold	0 to 65535	10	-	Set the gain switchover threshold.	During operation	Immediately
C01.3B	Gain switchover loop width	0 to 65535	10	-	Set the gain switchover loop width.	During operation	Immediately

Mode description:

C01.38	Switchover Mode	Switchover Time	Switchover Threshold	Switchover Loop Width	Threshold and Loop Width Unit
0	Fixed to the 1st gain set	Inactive	Inactive	Inactive	-
1	DI switchover	Active	Active	Active	-
2	DI P-PI switchover	Active	Active	Active	-
3	Torque reference	Active	Active	Active	0.1%
4	Speed reference	Active	Active	Active	rpm
5	Speed feedback	Active	Active	Active	rpm
6	Speed reference change rate	Active	Active	Active	rpm/ms
7	Position deviation	Active	Active	Active	p
8	Position reference	Active	Active	Active	p

6.6 Speed Feedforward

Speed feedforward can be applied to position control mode to improve the speed reference responsiveness, shorten the positioning time, and reduce the position deviation at fixed speed.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Options	Modificantion Mode	Effective Time
C01.13	Speed feedforward source	0 to 4	0	-	0: No feedforward 1: Internal reference 2: Model tracking 3: AI1 4: AI2	At stop	Immediately
C01.14	Speed feedforward percentage	0 to 2000	0	0.1%	Increasing the speed feedforward improves the responsiveness.	During operation	Immediately
C01.15	Speed feedforward filter cutoff frequency	5 to 16000	318	Hz	Decreasing the cutoff frequency improves the feedforward smoothness but increases the response delay.	During operation	Immediately

6.7 Torque Feedforward

Torque feedforward can be applied only to the position and speed modes.

In position control mode, torque feedforward can improve torque reference responsiveness and reduce the speed deviation during operation at a constant speed. In speed control mode, torque feedforward can improve torque reference responsiveness and reduce the speed deviation during acceleration and deceleration.

A too high setpoint of torque feedforward may cause overshoot.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Options	Modificantion Mode	Effective Time
C01.16	Torque feedforward source	0 to 4	0	-	0: No feedforward 1: Internal reference 2: Model tracking 3: AI1 4: AI2	At stop	Immediately
C01.17	Torque feedforward percentage	0 to 2000	0	0.1%	Increasing the torque feedforward improves the responsiveness.	During operation	Immediately

Parameter	Name	Value Range	Default	Unit	Options	Modificantion Mode	Effective Time
C01.18	Torque feedforward filter cutoff frequency	5 to 16000	318	Hz	Decreasing the cutoff frequency improves the feedforward smoothness but increases the response delay.	During operation	Immediately

6.8 Position Reference Filter

The position reference filter filters the position references (encoder unit) divided or multiplied by the electronic gear ratio to smoothen motor operation and reduce the shock on the machine.

The position reference filter includes the low-pass and overlapping average filters.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Options	Modificantion Mode	Effective Time
C01.20	Position reference overlapping average filter time constant A	0 to 1280	0	0.1ms	Increasing the setpoint improves the reference smoothness but increases the delay.	At stop	Immediately
C01.21	Position reference overlapping average filter time constant B	0 to 1280	0	0.1ms	Increasing the setpoint improves the reference smoothness but increases the delay.	At stop	Immediately
C01.22	Position reference low-pass filter time constant A	0 to 65535	0	0.1ms	Increasing the setpoint improves the reference smoothness but increases the delay.	At stop	Immediately
C01.23	Position reference low-pass filter time constant B	0 to 65535	0	0.1ms	Increasing the setpoint improves the reference smoothness but increases the delay.	At stop	Immediately

6.9 Model Tracking Control

Model tracking control can improve the responsiveness and shorten the positioning time.

This function is only available in the position control mode.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Options	Modificantion Mode	Effective Time
C02.00	Model tracking control	0 to 1	0	-	0: Disabled 1: Single quality model tracking	At stop	Immediately
C02.01	Model tracking control gain	10 to 20000	500	0.1rad/s	Increasing the setpoint improves the position tracking.	During operation	Immediately
C02.02	Model tracking inertia correction coefficient	10 to 8000	1000	0.1%	When the inertia ratio setpoint is not accurate, this value can be used for correction.	During operation	Immediately

6.10 Speed Feedback Filter

When the encoder bit number is low or the noise contribution is large, the speed feedback fluctuation or burr calculated by the drive is large. You can set the speed feedback low-pass filter or overlapping average filter to reduce the speed feedback fluctuation. However, a too high setpoint will increase the delay in the servo system, which could potentially cause system oscillation.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Options	Modificantion Mode	Effective Time
C01.10	Speed feedback filter	0 to 4	0	-	0: Internal setting 1: Low-pass filter 2: Overlapping average filter 3: Speed observer 4: No filter	At stop	Immediately
C01.11	Cutoff frequency of speed feedback low-pass filter	10 to 16000	8000	Hz	Set the cutoff frequency of the low-pass filter.	During operation	Immediately
C01.12	Speed feedback overlapping average filter time constant	0 to 6	0	-	0: No filter 1: Two times filter 2: Four times filter 3: Eight times filter 4: Sixteen times filter 5: Thirty-second times filter 6: Sixty-fourth times filter	During operation	Immediately

6.11 Speed Observer

The speed observer can filter high-frequency signals for speed feedback, reduce the impact of encoder position feedback noise on the servo system, and improves the stiffness level of the servo system to some extent.

To enable the speed observer function, set C01.10 to 3.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Options	Modificantion Mode	Effective Time
C01.10	Speed feedback filter	0 to 4	0	-	0: Internal setting 1: Low-pass filter 2: Overlapping average filter 3: Speed observer 4: No filter	At stop	Immediately
C02.30	Speed observer gain	0 to 40000	0	0.1Hz	Increasing the setpoint improves the observation speed responsiveness, but a too large value can cause oscillation.	During operation	Immediately
C02.31	Speed observer inertia correction	10 to 8000	1000	0.1%	When the inertia ratio setpoint is not accurate, this value can be used for correction.	During operation	Immediately
C02.32	Speed observer speed feedback cutoff frequency	0 to 16000	0	Hz	Set the cutoff frequency of the speed observer low-pass filter.	During operation	Immediately

6.12 Disturbance Observer

The disturbance observer effectively observes the external disturbance. Disturbances within the frequency range can be observed and suppressed with different cutoff frequencies and compensation values.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Options	Modificantion Mode	Effective Time
C02.60	Disturbance observer gain	0 to 40000	0	0.1Hz	Increasing the value improves the responsiveness to disturbances, but a too large value can cause vibration more easily.	During operation	Immediately

Parameter	Name	Value Range	Default	Unit	Options	Modificantion Mode	Effective Time
C02.61	Disturbance observer inertia correction coefficient	1 to 10000	1000	0.1%	When the inertia ratio setpoint is not accurate, this value can be used for correction.	During operation	Immediately
C02.62	Disturbance observer low-pass cutoff frequency	0 to 16000	0	Hz	Set the cutoff frequency of the speed observer low-pass filter.	During operation	Immediately
C02.63	Disturbance observer compensation torque percentage	0 to 2000	0	0.1%	Set the percentage for observation compensation.	During operation	Immediately

6.13 Friction Compensation

The friction compensation function is used to compensate for changes in viscous friction and variations in fixed loads.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Options	Modificantion Mode	Effective Time
C02.68	Friction compensation switch and relevant setting	0~65535	0	-	Bit 0: 0: Disabled 1: Enabled Bit 4: 0: Speed threshold from speed reference 1: Speed threshold from speed feedback	During operation	Immediately
C02.69	Friction compensation speed threshold	0~5000	20	0.1rpm	Set it to the coulomb friction compensation speed threshold.	During operation	Immediately
C02.6A	Static friction compensation	0~2000	0	0.1%	Set it to the static friction compensation value.	During operation	Immediately
C02.6B	Forward friction compensation of coulomb friction	0~2000	0	0.1%	Set it to the friction force of compensation for the position reference in the forward direction.	During operation	Immediately

Parameter	Name	Value Range	Default	Unit	Options	Modificantion Mode	Effective Time
C02.6C	Reverse friction compensation of coulomb friction	-2000~0	0	0.1%	Set it to the friction force of compensation for the position reference in the reverse direction.	During operation	Immediately
C02.6D	Viscous friction torque for rated speed	0~2000	0	0.1%	Set it to the viscous friction torque for rated speed.	During operation	Immediately
C02.6E	Friction compensation filter time	0~65535	0	0.01ms	Determine the speed after overcoming resistance friction.	During operation	Immediately
C02.6F	Friction compensation threshold for zero speed	0~1000	10	0.1rpm	Set it to the friction compensation threshold for the zero speed.	During operation	Immediately

6.14 Vibration Suppression

The notch can suppress mechanical resonance by reducing the gain at a specific frequency. After the notch is correctly set, vibration can be effectively suppressed, and it may be possible to continue increasing the servo gain. The notch principle is shown in the figure below.

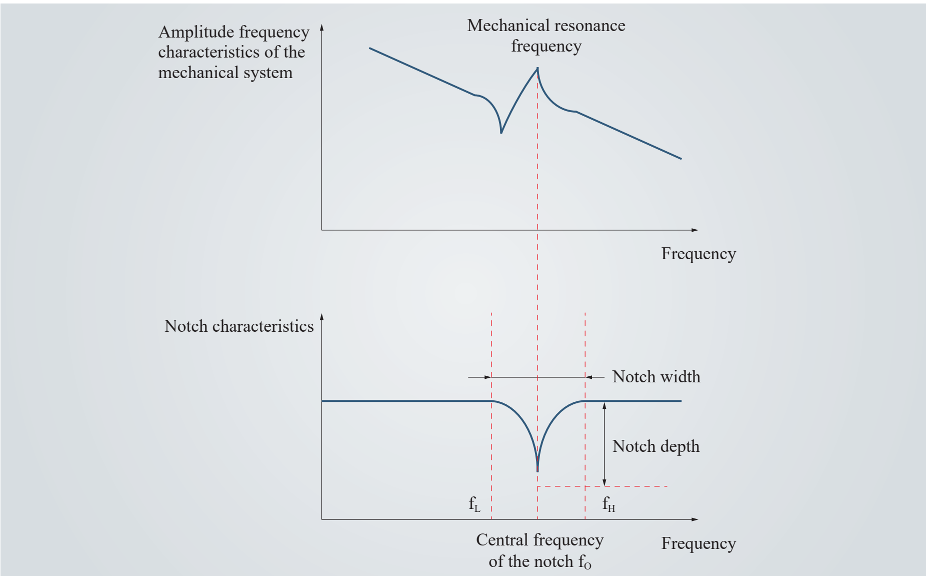


Figure 6-1 Notch suppression

The servo drive has a total of five notches, and each is defined by three parameters: notch frequency, width level, and depth level. The 1st and 2nd notches can be set manually or configured as adaptive notches (C01.30 = 1 or 2). In this case, the parameters are automatically set by the drive, while the other three notches can be set manually.

Steps to use adaptive notches:

① Set C01.30 (adaptive notch mode) to 1 or 2 based on the number of resonance points.

② When resonance occurs, set C01.30 to 1 to enable one adaptive notch. If resonance occurs again after gain tuning, set C01.30 to 2 to enable two adaptive notches. Parameters of the 1st and 2nd notches are updated automatically during servo operation.

③ If resonance is suppressed, the adaptive notch functions well. If resonance persists, use the backend tool to observe waveforms of related variables and use the other three notches to suppress resonance.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Options	Modificantion Mode	Effective Time
C01.30	Adaptive notch mode	0 to 4	0	-	0: Disabled 1: 1st notch 2: 2nd notch 3: Notch parameter reset 4: Resonance frequency tested only	During operation	Immediately
C01.31	Adaptive notch test times	0 to 65535	0	Times	-	During operation	Immediately
C01.40	Frequency of the 1st notch	10 to 8000	8000	Hz	Set it to the frequency of the 1st notch.	During operation	Immediately
C01.41	Width level of the 1st notch	0 to 4000	0	0.1%	Set it to the width level of the 1st notch.	During operation	Immediately
C01.42	Depth level of the 1st notch	10 to 1000	1000	0.1%	Set it to the depth level of the 1st notch.	During operation	Immediately
C01.43	Frequency of the 2nd notch	10 to 8000	8000	Hz	Set it to the frequency of the 2nd notch.	During operation	Immediately
C01.44	Width level of the 2nd notch	0 to 4000	0	0.1%	Set it to the width level of the 2nd notch.	During operation	Immediately
C01.45	Depth level of the 2nd notch	10 to 1000	1000	0.1%	Set it to the depth level of the 2nd notch.	During operation	Immediately
C01.46	Frequency of the 3rd notch	10 to 8000	8000	Hz	Set it to the frequency of the 3rd notch.	During operation	Immediately
C01.47	Width level of the 3rd notch	0 to 4000	0	0.1%	Set it to the width level of the 3rd notch.	During operation	Immediately

Parameter	Name	Value Range	Default	Unit	Options	Modificantion Mode	Effective Time
C01.48	Depth level of the 3rd notch	10 to 1000	1000	0.1%	Set it to the depth level of the 3rd notch.	During operation	Immediately
C01.49	Frequency of the 4th notch	10 to 8000	8000	Hz	Set it to the frequency of the 4th notch.	During operation	Immediately
C01.4A	Width level of the 4th notch	0 to 4000	0	0.1%	Set it to the width level of the 4th notch.	During operation	Immediately
C01.4B	Depth level of the 4th notch	10 to 1000	1000	0.1%	Set it to the depth level of the 4th notch.	During operation	Immediately
C01.4C	Frequency of the 5th notch	10 to 8000	8000	Hz	Set it to the frequency of the 5th notch.	During operation	Immediately
C01.4D	Width level of the 5th notch	0 to 4000	0	0.1%	Set it to the width level of the 5th notch.	During operation	Immediately
C01.4E	Depth level of the 5th notch	10 to 1000	1000	0.1%	Set it to the depth level of the 5th notch.	During operation	Immediately

Chapter 7 Troubleshooting

7.1 Fault Alarms

7.1.1 Fault display and category

The servo drive provides various protection functions, and triggers an alarm when a protection functions acts. Then, the LED panel displays the fault and its alarm code.

Figure 7-1 Fault code display

NOTICE

- The servo drive can record the latest 10 faults/alarms and the servo drive status parameters upon occurrence of the faults/alarms. Repeated faults or alarms among the latest 5 logs are logged as one fault or alarm, and the servo drive status upon its occurrence is logged only once.
- When a single fault or an alarm occurs, the panel displays the fault or alarm code. When multiple faults or alarms occur, the panel displays the fault code of the highest level.
- After a fault or an alarm is reset, the servo drive still keeps the log of the fault or alarm. You can set F31.04 (Initialize fault record) to 1 to clear the fault and alarm records.

Alarm codes are divided into three categories (category 1 indicates the most severe level) based on the fault and alarm severity, which are specified by fault codes.

Fault Category	Fault Code	Resettable
Class 1	Er0x.x to Er2x.x	Non-resettable
	Er4x.x to Er5x.x	Resettable
Class 2	Er8x.x to ErAx.x	Resettable
Class 3	ALFxx	Resettable

NOTICE

- "Resettable" means that the panel stops displaying the fault/alarm when a "reset signal" is input.

7.1.2 Troubleshooting and reset

Checklist:

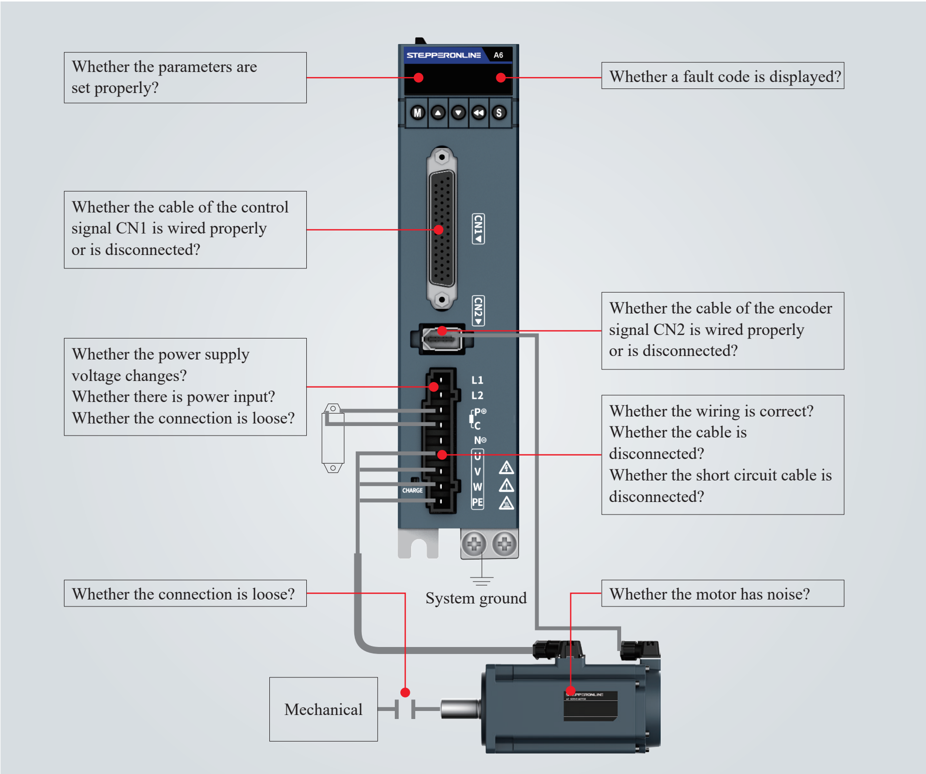


Figure 7-2 Troubleshooting checklist

Reset operation:

- Set F31.00 (Fault reset) to 1 to stop displaying the fault on the panel.
- To reset resettable faults, switch off the S-ON signal first and then send the fault reset signal (set F31.00 to 1).
- To reset resettable alarms, eliminate the alarm source and then the servo drive automatically resets the alarms.

CAUTION

- Some faults/alarms can only be reset after the causes are rectified through setting modifications. However, a reset operation does not activate modifications.
- If the modification can be effective only after power-on, power on the device again.
- If the modification can be effective only after stop, turn off the S-ON signal. The servo drive can operate properly only after modifications are activated.

7.1.3 List of faults and alarms

Table 7-1 List of factory fault codes

Fault Group	Fault Code	Fault Name	Fault Code (203F)	Bus Fault Code (603F)	Resettable
Class 1	Er01.0	Mismatch of software versions	0x010	0x6100	Non-resettable
	Er01.1	Mismatch of motor parameters	0x011	0x7122	Non-resettable
	Er02.0	Product matching fault. No specified drive	0x020	0x6100	Non-resettable
	Er02.1	Product matching fault. No specified motor	0x021	0x6100	Non-resettable
	Er02.2	Product matching fault. No specified encoder	0x022	0x6100	Non-resettable
	Er02.5	Drive 5 V voltage too low	0x025	-	Non-resettable
	Er03.0	System parameter error	0x030	0x6320	Non-resettable
	Er03.1	Parameter out-of-range	0x031	0x6320	Non-resettable
	Er03.2	Parameter writing error	0x032	0x6320	Non-resettable
	Er03.3	Parameter reading error	0x033	0x6320	Non-resettable
	Er04.0	FPGA power-on check error	0x040	0x6100	Non-resettable
	Er04.1	FPGA power-on not reset	0x041	0x6100	Non-resettable
	Er04.2	FPGA transmission interrupted	0x042	0x6100	Non-resettable
	Er05.0	Current loop timeout	0x050	0x7500	Non-resettable
	Er05.1	Speed loop timeout	0x051	0x7500	Non-resettable
	Er05.2	Position loop timeout	0x052	0x7500	Non-resettable
	Er06.0	Protection from out of control	0x060	0x8400	Non-resettable

Fault Group	Fault Code	Fault Name	Fault Code (203F)	Bus Fault Code (603F)	Resettable
Class 1	Er10.0	P-hardware overcurrent	0x100	0x2312	Non-resettable
	Er10.1	N-hardware overcurrent	0x101	0x2312	Non-resettable
	Er10.2	U phase software overcurrent	0x102	0x2312	Non-resettable
	Er10.3	V phase software overcurrent	0x103	0x2312	Non-resettable
	Er10.4	Output short circuited to ground	0x104	0x2330	Non-resettable
	Er10.5	Current sampling failure	0x105	0x6100	Non-resettable
	Er10.6	Incorrect current parameter setting	0x106	0x6320	Non-resettable
	Er10.7	UV current correction failure	0x107	0x6100	Non-resettable
	Er10.8	Excessive current zero drift	0x108	0x6100	Non-resettable
	Er10.9	Current exception during enabling	0x109	0x2312	Non-resettable
	Er11.0	Excessive motor speed upon servo drive power-on	0x110	-	Non-resettable
	Er11.1	Drive over-temperature	0x111	0x2312	Non-resettable
	Er12.0	PWM buffer detection failure	0x120	-	Non-resettable
	Er20.1	Encoder internal fault	0x201	0x7305	Non-resettable
	Er20.2	Encoder reading/writing error	0x202	0x7305	Non-resettable
	Er20.3	Encoder data frame loss	0x203	0x7305	Non-resettable
	Er20.4	Excessive encoder incremental position	0x204	0x7305	Non-resettable
	Er20.5	Abnormal encoder data	0x205	0x7305	Non-resettable
	Er20.6	Mismatch of encoder type	0x206	0x7305	Non-resettable
	Er20.7	Encoder model not supported	0x207	0x7305	Non-resettable
	Er20.8	Encoder battery failure	0x208	0x7305	Non-resettable
	Er20.9	Encoder multi-turn error	0x209	0x7305	Non-resettable
	Er21.0	Mismatch between encoder pulses per revolution and drive pulses per revolution	0x210	0x7305	Non-resettable
	Er22.0	Second encoder disconnection	0x220	0x7305	Non-resettable
	Er22.1	Fully closed-loop BISS encoder timed out	0x221	0x7305	Non-resettable
	Er22.2	Communication data error of fully closed-loop BISS encoder	0x222	0x7305	Non-resettable

Fault Group	Fault Code	Fault Name	Fault Code (203F)	Bus Fault Code (603F)	Resettable
Class 1	Er22.3	Check error of fully closed-loop BISS encoder	0x223	0x7305	Non-resettable
	Er22.4	Internal error of fully closed-loop BISS encoder	0x224	0x7305	Non-resettable
	Er22.5	Power-on reading position error in fully closed-loop BISS absolute value mode	0x225	0x7305	Non-resettable
	Er40.0	Drive overload	0x400	0x3230	Resettable
	Er41.0	Motor overload	0x410	0x3230	Resettable
	Er41.1	Motor over-temperature due to locked-rotor	0x411	0x7121	Resettable
	Er41.2	Motor over-temperature (PTC)	0x412	0x4210	Resettable
	Er41.3	Motor winding temperature is too high	0x413	0x4210	Resettable
	Er42.0	IGBT temperature too high	0x410	0x4210	Resettable
	Er42.1	Discharge tube temperature too high	0x421	0x4210	Resettable
	Er42.2	Heatsink temperature too high	0x422	0x4210	Resettable
	Er43.0	Overvoltage	0x430	0x3210	Resettable
	Er43.1	Undervoltage	0x431	0x3220	Resettable
	Er45.0	S-ON enabling failure	0x450	0xFF00	Resettable
	Er46.0	Motor overspeed	0x460	0x8400	Resettable
	Er47.0	Excessive position deviation	0x470	0x8611	Resettable
	Er47.1	Position deviation overflow	0x471	0x8611	Resettable
	Ex47.2	Excessive fully closed-loop mixed deviation	0x472	0x8611	Resettable
	Er48.0	STO status exception	0x480	0x0480	Resettable
	Er48.1	STO buffer 5 V power fault	0x481	0x0481	Resettable
	Er48.2	Optocoupler fault in STO pulse detection	0x482	0x0482	Resettable
	Er48.3	STO buffer detection failure	0x483	0x0483	Resettable
	Er49.0	Output phase loss of power cable	0x490	-	Resettable
	Er50.1	D/Q current overflow	0x501	0x6100	Resettable
	Er51.0	Offline inertia auto-tuning failure	0x510	0x6310	Resettable
	Er51.1	Offline inertia parameter error	0x511	0x6310	Resettable

Fault Group	Fault Code	Fault Name	Fault Code (203F)	Bus Fault Code (603F)	Resettable
Class 1	Er52.0	Angle auto-tuning failure	0x520	0x7122	Resettable
	Er53.0	Motor parameter auto-tuning timeout	0x530	0x7122	Resettable
	Er53.1	Resistance parameter auto-tuning failure	0x531	0x7122	Resettable
	Er53.2	Inductance parameter auto-tuning failure	0x532	0x7122	Resettable
	Er53.3	Back EMF parameter auto-tuning failure	0x533	0x7122	Resettable
	Er54.0	Current loop auto-tuning failure	0x540	0x7122	Resettable
	Er55.0	Excessive vibration	0x550	0x7122	Resettable
	Er57.0	Friction auto-tuning failed	0x570	0x7122	Resettable
Class 2	Er80.0	Control power undervoltage	0x800	0x3120	Resettable
	Er81.0	Input phase loss 1	0x810	0x3130	Resettable
	Er81.1	Input phase loss 2	0x811	0x3130	Resettable
	Er82.0	DI function allocation fault	0x820	0x6320	Resettable
	Er82.1	DO function allocation fault	0x821	0x6320	Resettable
	Er82.2	VDI function allocation fault	0x822	0xFF00	Resettable
	Er82.3	VDO function allocation fault	0x823	0xFF00	Resettable
	Er82.4	Position capture DI function allocation error	0x824	0x824	Resettable
	Er83.0	AI1 sampling overvoltage	0x830	0x6100	Resettable
	Er83.1	AI2 sampling overvoltage	0x831	0x6100	Resettable
	Er83.2	AI1 chip missing or clock failure	0x832	-	Resettable
	Er83.3	AI2 chip missing or clock failure	0x833	-	Resettable
	Er83.4	Current-type AI disconnected	0x834	-	Resettable
	Er83.5	Current-type sampling overcurrent fault	0x835	-	Resettable
	Er84.0	Electronic gear ratio setting error	0x840	0x6320	Resettable
	Er84.1	Software limit setting error	0x841	0x6320	Resettable
	Er84.2	Encoder resolution setting error	0x842	0x7122	Resettable
	Er84.3	Home position setting error	0x843	0xFF00	Resettable
	Er85.1	Frequency-division pulse output error	0x851	0x7500	Resettable
	Er87.0	Position reference increment error (pulse)	0x870	0xFF00	Resettable

Fault Group	Fault Code	Fault Name	Fault Code (203F)	Bus Fault Code (603F)	Resettable
Class 2	Er87.3	Overflow of 32-bit sign bit of the target position during limiting	0x873	0xFF00	Resettable
	Er87.4	Target position exceeding maximum value of mechanical single-turn position in rotating mode	0x874	0xFF00	Resettable
	Er87.5	Fully closed-loop parameter setting error	0x875	0x0875	Resettable
	ErA0.1	Multi-turn overflow fault	0xA01	0x7305	Resettable

Table 7-2 List of factory alarm codes

Fault Group	Alarm Code	Alarm Name	Alarm Code (203F)	Bus Fault Code (603F)	Resettable
Class 3	ALF0.0	Emergency stop alarm	0x0F00	0xF00	Resettable
	ALF1.0	Re-power-on required for parameter settings to take effect	0xF10	0x6320	Resettable
	ALF1.1	Frequent parameter storage alarm	0xF11	0x5530	Resettable
	ALF1.2	Torque reached parameter error	0xF12	0x6320	Resettable
	ALF2.0	Forward overtravel alarm	0xF20	0x5443	Resettable
	ALF2.1	Reverse overtravel alarm	0xF21	0x5444	Resettable
	ALF3.0	The AI1 zero offset is too large	0xF30	-	Resettable
	ALF3.1	The AI2 zero offset is too large	0xF31	-	Resettable
	ALF4.0	Homing timeout	0xF40	0x6320	Resettable
	ALF4.1	Homing DI conflict	0xF41	0x6320	Resettable
	ALF4.2	Homing mode conflict	0xF42	0x6320	Resettable
	ALF5.0	Braking resistor overload	0xF50	0x3210	Resettable
	ALF5.1	Too small resistance of external regenerative resistor	0xF51	0x6320	Resettable
	ALF6.0	Abnormal setting of frequency division pulse output	0xF60	-	Resettable
	ALF6.1	Output phase loss	0xF61	0x3230	Resettable

Fault Group	Alarm Code	Alarm Name	Alarm Code (203F)	Bus Fault Code (603F)	Resettable
Class 3	ALF7.0	Warning that the planning start segment number is greater than the end segment number	0xF70	-	Resettable
	ALF7.3	Initial segment of position comparison in cyclic absolute mode out of the comparison segment range	0xF73	-	Resettable
	ALF8.0	Vibration occurred during auto-tuning	0xF80	0x7122	Resettable
	ALF9.0	Encoder battery voltage low	0xF90	0x7305	Resettable
	ALFA.0	Drive high temperature warning	0xFA0	0x7305	Resettable
	ALFB.0	Brake PMOS short circuit	0xFB0	0x0FB0	Resettable
	ALFB.1	Brake NMOS short circuit	0xFB1	0x0FB1	Resettable
	ALFB.2	Brake 24 V disconnection or open circuit	0xFB2	0x0FB2	Resettable
	xxnr	Servo not ready	0xFFFF	-	Resettable

Table 7-3 List of bus fault codes

Bus Fault SN	Bus Fault Code	Bus Fault Name
0	0x0000	No fault
1	0x2312	Continuous current fault
2	0x2330	Short circuit to ground
3	0x3120	Control power overvoltage
4	0x3130	Phase loss
5	0x3210	Main circuit overvoltage
6	0x3220	Main circuit undervoltage
7	0x3230	Overload
8	0x4210	Over-temperature
9	0x5443	Forward overtravel
10	0x5444	Reverse overtravel
11	0x5530	Storage fault
12	0x6320	Parameter error
13	0x7121	Motor locked-rotor
14	0x7122	Motor mismatch
15	0x7305	Encoder error

Bus Fault SN	Bus Fault Code	Bus Fault Name
16	0x7500	Communication fault
17	0x7600	Data storage
18	0x8400	Speed control
19	0x8611	Following fault
20	0x8220	Length error
21	0x8700	Synchronization controller
22	0x8900	Process data monitoring
23	0x0FFF	Factory fault

7.2 Solutions

Table 7-4 List of causes and solutions for faults and alarms

Code	Name	Cause	Solution
Er01.0	Mismatch of software versions	• The MCU and FPGA versions are incorrect.	• Check whether the software versions are consistent. • Contact technical support personnel or update the FPGA or MCU software.
Er01.1	Mismatch of motor parameters	• Incorrect motor parameters	• Replace with a servo drive or motor of the matching power. • Contact our company for technical support.
Er02.0	Product matching fault. No specified drive	• The set servo drive model is incorrect.	• Check whether the model of the U42.10 servo drive is correct. If not, contact technical support and correct the model.
Er02.1	Product matching fault. No specified motor	• The set motor model is incorrect.	• Read the motor model U42.11 and contact technical support.
Er02.5	Drive 5 V voltage too low	• Drive 5 V voltage too low	• If the fault persists after several times of power-on, replace the servo drive.
Er03.0	System parameter error	• The software is updated.	• Check whether the software is updated. • Reset the servo drive model and the motor model, and restore default settings (set F31.02 to 1).

Code	Name	Cause	Solution
		• The control power voltage drops instantaneously. • Instantaneous power failure occurs during parameter storage.	• Check whether the voltage drops during control power cutoff or instantaneous power failure occurs. • Restore default settings (set F31.02 to 1) and write the parameters again.
		• The times of parameter writing within a certain period of time exceeds the limit.	• Check whether parameter update is performed frequently from the host controller. • Change the way of parameter writing and write the parameters again.
		• The servo drive is faulty.	• If the fault persists after several times of power-on and parameter initialization, replace the servo drive.
Er03.1	Parameter out-of-range	• The number of software parameters changes after upgrade. An address error occurs during reading and writing the change.	• Check whether the parameter access address is out of range. You can view the group number and offset of the error code in U41-06 and U41-07. • Restore factory settings.
Er03.2	Parameter writing error	• Parameter writing is frequent. • The control power is unreliable. • The servo drive is faulty.	• Check whether the communication program contains a command that frequently modifies and writes parameters. • Check the wiring of the control power and ensure that the control power voltage is within the limit. • If the fault still persists after several times of power-on, replace the servo drive.
Er03.3	Parameter reading error	• Parameter reading is frequent. • The servo drive is faulty.	• Check whether the communication program contains a command that frequently reads parameters. • Modify a parameter, power on the servo drive again, and check whether the modification is saved. • If the modification is not saved and the fault still persists after several times of power-on replace the servo drive.
Er04.0	FPGA power-on check error	FPGA power-on check error	• If the fault persists after several times of power-on, replace the servo drive.
Er04.1	FPGA power-on not reset	FPGA power-on not reset	• If the fault persists after several times of power-on, replace the servo drive.
Er04.2	FPGA transmission interrupted	• FPGA failure • Timeout of access to MCU and FPGA	• If the fault persists after several times of power-on, replace the servo drive.

Code	Name	Cause	Solution
Er05.0	Current loop timeout	• The interval for MCU torque interruption scheduling is abnormal.	• If the fault persists after several times of power-on, replace the servo drive.
Er05.1	Speed loop timeout	• The interval for MCU speed scheduling is abnormal.	• If the fault persists after several times of power-on, replace the servo drive.
Er05.2	Position loop timeout	• The interval for MCU position interruption scheduling is abnormal.	• If the fault persists after several times of power-on, replace the servo drive.
Er06.0	Runaway protection	• The control circuit is abnormal due to incorrect wiring, resulting in motor runaway and stall.	• Check whether the servo drive power cables are connected to UVW terminals of the motor and servo drive in the correct sequence on both sides. • Connect the U, V, and W phases according to the correct sequence.
		• The interference signal causes an error in the initial phase detection of the motor rotor upon power-on.	• The U, V, and W phase sequence is correct, but Er06.0 occurs when the servo drive is enabled. Power on the device again.
		• The encoder model is set incorrectly.	• Check the motor model and encoder type. • Use the matching products.
		• The encoder cable is connected incorrectly, aging, or corroded, or the encoder connector is loose.	• Check whether the encoder cable is aging, corroded, or loosened. • Re-solder, tighten, or replace the encoder cable.
		• The gravity load is too large when the motor controls a vertical axis.	• Check whether the load of the vertical axis is too large. Reduce the load of the vertical axis, increase the rigidity, or shield this fault without affecting safety and use.
		• The servo vibration is too large due to improper parameters setting.	• Set the parameters properly to avoid large servo vibration.
		• The motor is dragged by an external force in the reverse direction.	• If the motor runs properly and is actually dragged by an external force, consider to shield the protection from out of control (set C06.20 to 0 with caution).

Code	Name	Cause	Solution
Er10.0	P-hardware overcurrent	• The gain is set improperly and the motor oscillates.	• Adjust the gain after determining the cause.
		• The encoder cable is connected incorrectly, aging, or corroded, or the encoder connector is loose.	• Re-solder, tighten, or replace the encoder cable.
		• Braking resistor overcurrent	• Select a discharge resistor of proper resistance and model and route it again.
		• The servo drive is faulty.	• Replace the servo drive.
Er10.1	N-hardware overcurrent	• The gain is set improperly and the motor oscillates.	• Adjust the gain after determining the cause.
		• The encoder cable is connected incorrectly, aging, or corroded, or the encoder connector is loose.	• Re-solder, tighten, or replace the encoder cable.
		• Braking resistor overcurrent	• Select a braking resistor of proper resistance and model and route it again.
		• The motor U/V/W cables are short circuited.	• Connect motor cables correctly or replace the motor with unbalanced resistance.
		• The servo drive is faulty.	• Replace the servo drive.
Er10.2	U phase software overcurrent	• The motor cables are in poor contact.	• Tighten the cables that are loosened or disconnected.
		• The motor cables are grounded.	• Replace the motor in the case of poor insulation.
		• The motor U/V/W cables are short circuited.	• Unplug the motor cables and check whether short-circuit occurs among U, V, and W phases and whether burrs exist on the cable connections. Unplug the motor cables and measure whether the resistance among U, V, and W phases of the motor cable is balanced.
		• The motor is damaged.	• Connect motor cables correctly or replace the motor with unbalanced resistance.

Code	Name	Cause	Solution
Er10.3	V phase software overcurrent	• The motor cables are in poor contact.	• Tighten the cables that are loosened or disconnected.
		• The motor cables are grounded.	• Replace the motor in the case of poor insulation.
		• The motor U/V/W cables are short circuited.	• Unplug the motor cables and check whether short-circuit occurs among U, V, and W phases and whether burrs exist on the cable connections. Unplug the motor cables and measure whether the resistance among U, V, and W phases of the motor cable is balanced.
		• The motor is damaged.	• Connect motor cables correctly or replace the motor with unbalanced resistance.
Er10.4	Output short circuited to ground	• The servo drive power cables (U/V/W) are short-circuited to ground.	• Re-connect or replace the power cables of the servo drive.
		• The motor is short-circuited to ground.	• Replace the motor.
		• The servo drive is faulty.	• Replace the servo drive.
Er10.5	Current sampling failure	• Current sampling of phase U or V is abnormal.	• Check for interference sources on the site. • Check the grounding of the servo drive and motor and whether anti-interference measures such as shielding are properly applied. • Add magnetic rings to the power cable and encoder cable of the motor.
		• The internal current sampling chip is damaged.	• Replace the servo drive.
Er10.6	Incorrect current parameter setting	• Incorrect setting of current sampling parameters	• Change the value of R21.24 to 0. • If the fault persists upon next power-on, replace the servo drive.
Er10.7	UV current correction failure	• The current correction detection accuracy error is greater than 5%.	• If the fault persists upon next power-on, replace the servo drive.
Er10.8	Excessive current zero drift	• The current zero drift detected upon power on is greater than the threshold.	• If the fault persists upon next power-on, replace the servo drive.
Er10.9	Current exception during enabling	• The sampled current during enabling is too large.	• If the fault persists after several times of drive enabling, replace the servo drive.
		• Motor power cable not connected.	• Connect the motor power cable.

Code	Name	Cause	Solution
Er11.0	Excessive motor speed upon servo drive power-on	• The motor is rotating when the servo drive is powered on.	• Keep the motor stationary when the servo drive is powered on.
Er11.1	Drive over-temperature	• Drive over-temperature	• Check whether the fan is abnormal or whether the ambient temperature is too high. • Improve the installation conditions of the servo unit to reduce the ambient temperature. • If the fault persists upon next power-on, replace the servo drive.
Er12.0	PWM buffer detection failure	• PWM buffer detection failure upon power-on	• If the fault persists upon re-power-on, contact technical support.
Er20.1	Encoder internal fault	• The encoder has an internal fault.	• Set F31-10 to 3 to reset the encoder fault. If the fault persists upon re-power-on after reset, replace the motor.
Er20.2	Encoder reading/ writing error	• Encoder data exchange exception upon power-on.	• Use a new encoder cable. If the fault no longer occurs after cable replacement, the original encoder cable is damaged. If the fault persists after the encoder cable is replaced, the encoder may be faulty. In this case, replace the servo motor. • Add magnetic rings to the power cable and encoder cable of the motor.
Er20.3	Encoder data frame loss	• The encoder cable is abnormal.	• Replace the encoder cable.
		• Intensive interference to the encoder	• Add magnetic rings to the power cable and encoder cable of the motor. • If the fault persists after the servo drive is powered off and on several times, the encoder is faulty. In this case, replace the servo motor.
Er20.4	Excessive encoder incremental position	• Abnormal single-turn position of the encoder	• Route the motor cables and encoder cables through different routes if they are bundled together. • If the fault persists after the servo drive is powered off and on several times, the encoder is faulty. In this case, replace the servo motor.

Code	Name	Cause	Solution
Er20.5	Abnormal encoder data	• Internal parameters of the encoder are abnormal.	• Route the motor cables and encoder cables through different routes if they are bundled together. • If the fault persists after the servo drive is powered off and on several times, the encoder is faulty. In this case, replace the servo motor.
Er20.6	Mismatch of encoder type	• Motor model mismatch	• Use the motor that matches the drive.
Er20.7	Encoder model not supported	• Encoder model not supported	• Use the motor that matches the drive.
Er20.8	Encoder battery failure	• The encoder battery voltage is too low.	• Replace with a new battery of matching voltage.
		• The battery is replaced or no battery is connected during power-off. • C00.07 is set to the absolute value for the first time.	• Set F31.10 to 4 to reset the encoder, and power on the machine again.
Er20.9	Encoder multi-turn error	• An encoder multi-turn counting error occurs.	• Set F31.10 to 4 to reset the encoder, and power on the machine again. • If the fault persists after multiple times of power-on, replace the motor.
Er21.0	Mismatch between encoder pulses per revolution and drive pulses per revolution	• Mismatch between encoder pulses per revolution and drive pulses per revolution	• Distribute parameters again for the encoder.
Er22.0	Second encoder disconnection	• Second encoder disconnection	• Recheck the second encoder cable.
Er22.1	Fully closed-loop BISS encoder timed out.	• The baud rate of BISS communication is too low to transmit 1 frame of data within 62.5 µs	• Increase the baud rate of BISS (C1B.1E).
Er22.2	Communication data error of fully closed-loop BISS encoder	• Communication data error of fully closed-loop BISS encoder	• Shielded twisted pair is recommended for the data cable. • Set C1B.1D and C1B.1E according to BISS encoder specifications.
Er22.3	Check error of fully closed-loop BISS encoder	• Check error of fully closed-loop BISS encoder	• Shielded twisted pair is recommended for the data cable. • Set C1B.1D and C1B.1E according to BISS encoder specifications.

Code	Name	Cause	Solution
Er22.4	Internal error of fully closed-loop BISS encoder	• Internal error of fully closed-loop BISS encoder	• Set C1B.1D and C1B.1E according to BISS encoder specifications. • Replace the BISS encoder and perform the test again.
Er22.5	Power-on reading position error in fully closed-loop BISS absolute value mode	• Power-on reading position error in fully closed-loop BISS absolute value mode	• Shielded twisted pair is recommended for the data cable. • Set C1B.1D and C1B.1E according to BISS encoder specifications.
Er40.0	Drive overload	• The servo drive overloads.	• Check whether the load rate (U40.07) and current feedback during drive running are too large. If large load is required by the operating conditions, use a servo drive of a higher power.

<table>
<tr><th>Code</th><th>Name</th><th>Cause</th><th>Solution</th></tr>
<tr><td rowspan="7">Er41.0</td><td rowspan="7">Motor overload</td><td>• The motor and encoder cables are connected improperly or in poor contact.</td><td>• Connect the cables according to the correct wiring diagram.
• When customized cables are used, prepare and connect the cables according to the wiring instructions.</td></tr>
<tr><td>• The load is too large. The motor keeps outputting effective torque higher than the rated torque for a long time.</td><td>• Check whether the average load factor of the servo drive is greater than 100.0% for a long time.</td></tr>
<tr><td>• Acceleration/deceleration is too frequent or the load inertia is too large.</td><td>• Use a large-capacity servo drive and a matching motor, or reduce the load and increase the acceleration/deceleration time.
• Check the mechanical inertia ratio or perform inertia auto-tuning, and view the value. Check the single running cycle when the servo motor runs cyclically. Increase the acceleration/deceleration time during single-cycle running.</td></tr>
<tr><td>• The gain is improper or the rigidity is too high.</td><td>• Check whether the motor vibrates and generates abnormal noise during running.
• Adjust the gain again.</td></tr>
<tr><td>• The servo drive or motor model is set incorrectly.</td><td>• View the servo drive nameplate, set the servo drive and motor models correctly, and use a matching servo motor.</td></tr>
<tr><td>• Motor locked-rotor occurs due to mechanical factors, resulting in overload during running.</td><td>• Eliminate mechanical factors.</td></tr>
<tr><td>• The servo drive is faulty.</td><td>• If the fault persists after the servo drive is powered off and on again, replace the servo drive.</td></tr>
<tr><td>Er41.1</td><td>Motor over-temperature due to locked-rotor</td><td>• Power output (UVW) phase loss, disconnection, or incorrect phase sequence occurs on the servo drive.</td><td>• Perform motor trial run without load and check cable connections with a multimeter. Check whether the cable phase sequence is correct.
• Connect cables again according to the correct wiring diagram or replace the cables.</td></tr>
</table>

Code	Name	Cause	Solution
		• Motor parameters are set incorrectly.	• Read parameters in group R20 and check whether the number of pole pairs is correct. • Auto-tune the motor angle multiple times and check whether the obtained values are consistent. • Correct motor parameters.
		• The communication command is interfered.	• Check whether commands from the host controller jitters and eliminate EtherCAT communication interference.
		• Motor locked-rotor occurs due to mechanical factors.	• Check for mechanical factors such as locking, occasional jamming, or eccentricity. • If the fault persists after the servo drive is powered off and on several times, contact our company for technical support.
Er41.2	Motor over-temperature (PTC)	• The PTC temperature sensor of the motor detects motor over-temperature.	• Check for the PTC motor and check whether the PTC cable is connected to the servo drive. • If the servo drive or motor does not support PTC, disable the PTC function (C06.16=0).
Er41.3	Motor winding temperature is too high	• Motor winding temperature is too high.	• Improve the cooling conditions of the servo drive to reduce the ambient temperature. • Decrease load factor of the motor.
Er42.0	IGBT temperature too high	• The ambient temperature is too high.	• Improve the cooling conditions of the servo drive to reduce the ambient temperature.
		• The servo drive is powered off and on for several times to reset the overload fault.	• Change the fault reset method. In the event of overload, wait 30s before performing the reset operation. • Increase the capacity of the servo drive and motor, increase the acceleration/deceleration time, and reduce the load.
		• The fan is damaged.	• Check whether the fan works when the motor runs. Replace the servo drive.
		• The installation direction or clearance of the servo drive is improper.	• Install the servo drive according to the installation requirements.
		• The servo drive is faulty.	• If the fault persists even though the servo drive is restarted 5 minutes after power-off, replace the servo drive.
Er42.1	Discharge tube temperature too high	• The estimated temperature of the discharge tube is too high.	• Control the number of discharge tube turn-ons according to the working conditions.
		• The discharge tube is automatically closed after overload.	• Control the number of discharge tube turn-ons according to the working conditions.

Code	Name	Cause	Solution
Er42.2	Heatsink temperature too high	• The ambient temperature is too high.	• Improve the cooling conditions of the servo drive to reduce the ambient temperature.
		• The servo drive is powered off and on for several times to reset the overload fault.	• Change the fault reset method. After overload occurs, wait for 30s before reset. • Increase the capacity of the servo drive and motor, increase the acceleration/deceleration time, and reduce the load.
		• The fan is damaged.	• Check whether the fan works when the motor runs. Replace the servo drive.
		• The installation direction or clearance of the servo drive is improper.	• Install the servo drive according to the installation requirements.
		• The servo drive is faulty.	• If the fault persists even though the servo drive is restarted 5 minutes after power-off, replace the servo drive.
Er43.0	Overvoltage	• The main circuit input voltage is too high.	• Replace or adjust the power supply according to the specifications.
		• The power supply is unstable or affected by lightning.	• Monitor whether the power supply of the servo drive is stable, affected by lightning or satisfies the specifications. • Connect an SPD and then switch on the power supplies of the control circuit and the main circuit. If the fault persists, replace the servo drive.
		• The braking resistor fails.	• Check the wiring of the braking resistor. Measure the resistance of the external braking resistor between P⊕ and C. If the resistance is ∞, the internal cables of the braking resistor are broken. In this case, replace the resistor. • Set the power and resistance of the external braking resistor according to the specifications of the external braking resistor in use.
		• The resistance of the external braking resistor is too large, and energy absorption during braking is insufficient.	• Measure the resistance of the external braking resistor between P⊕ and C and compare the measured value with the recommended value. Connect a new external braking resistor of recommended resistance. • Set the power and resistance of the external braking resistor according to the specifications of the external braking resistor in use.

Code	Name	Cause	Solution
		• The motor is in abrupt acceleration/deceleration status. The maximum braking energy exceeds the energy absorption value.	• Confirm the acceleration/deceleration time during running and measure whether the DC bus voltage exceeds the fault threshold during deceleration.
		• The bus voltage sampling value deviates greatly from the actual measured value.	• Ensure the input voltage of the main circuit is within the specified range, and then increase the acceleration/deceleration time within the allowable range. • Contact our company for technical support.
		• The servo drive is faulty.	• If the fault persists after the main circuit is powered off and on several times. • Replace the servo drive.
Er43.1	Undervoltage	• The power supply of the main circuit is unstable or power failure occurs. • Instantaneous power failure occurs.	• Measure whether the input voltages at the main circuit cables and servo drive comply with the specifications. • Increase the power capacity.
		• The power voltage drops during operation.	• Monitor the power input voltage of the servo drive and check whether the main circuit power supply is applied to other devices, resulting in insufficient power capacity and voltage drop. • Increase the power capacity.
		• Phase loss: A single-phase power supply is used for a three-phase servo drive.	• Check whether the main circuit wiring is correct and secure. • Replace the cables and connect the main circuit cables properly.
		• The servo drive is faulty.	• If the fault persists after the main circuit is powered off and on several times, replace the servo drive.
Er45.0	S-ON enabling failure	• S-ON enabling failure.	• Do not turn on the S-ON signal simultaneously for multiple control modes (such as servo background and host controller).
Er46.0	Motor overspeed	• The motor cable U, V, and W phase sequence is incorrect.	• Check whether the servo drive power cables are connected to UVW terminals of the motor and servo drive in the correct sequence on both sides. Connect the U, V, and W phases according to the correct sequence.

Code	Name	Cause	Solution
		• The overspeed threshold is set incorrectly.	• Check whether the overspeed threshold is smaller than the actual maximum motor speed. Reset the overspeed threshold according to the mechanical requirements. When C06.03 is set to 0, the overspeed threshold is the maximum speed of the motor.
		• The input reference exceeds the overspeed threshold.	• Check whether the motor speed corresponding to the input reference exceeds the overspeed threshold. Set the speed limit to a value smaller than the overspeed threshold.
		• The motor speed overshoots.	• Check whether the speed feedback exceeds the overspeed threshold through the commissioning platform. Adjust the gain or mechanical operating conditions.
		• The servo drive is faulty.	• If the fault persists after the servo drive is powered off and on, replace the servo drive.
Er47.0	Excessive position deviation	• Power output (UVW) phase loss or incorrect phase sequence occurs on the servo drive.	• Perform motor trial run without load and check cable connections. • Connect cables again according to the correct wiring diagram or replace the cables.
		• The servo drive UVW output cable or the encoder cable breaks.	• Check and connect the cables again. Check whether the servo motor power cables (UVW) are in the same phase sequence as the servo drive cables. • Replace all the cables with new cables if necessary and ensure all the cables are connected securely.
		• Motor locked-rotor occurs due to mechanical factors.	• Eliminate mechanical factors.
		• The servo drive gain is low.	• Adjust the gain manually or perform gain auto-tuning.
		• The position reference increment is too large.	• Increase the acceleration/deceleration ramp. Decrease the gear ratio according to the actual conditions.
		• The fault value is too small in relative to the operating conditions.	• Check whether the position deviation fault value is set to a too small value. Increase the position deviation alarm threshold (C06.00).

Code	Name	Cause	Solution
		• The servo drive or motor is faulty.	• Monitor the operating waveform through the oscilloscope function in the drive commissioning platform: position reference, position feedback, speed reference, and torque reference. If the position reference is not 0, but the position feedback is always 0, replace the servo drive or motor. • Check whether the electronic gear ratio is too small, and increase the position deviation alarm threshold C06.00.
Er47.1	Position deviation overflow	• Power output (UVW) phase loss or incorrect phase sequence occurs on the servo drive.	• Perform motor trial run without load and check cable connections. • Connect cables again according to the correct wiring diagram or replace the cables.
		• The servo drive UVW output cable or the encoder cable breaks.	• Check and connect the cables again. Check whether the servo motor power cables (UVW) are in the same phase sequence as the servo drive cables. • Replace all the cables with new cables if necessary and ensure all the cables are connected securely.
		• Motor locked-rotor occurs due to mechanical factors.	• Eliminate mechanical factors.
		• The servo drive gain is low.	• Adjust the gain manually or perform gain auto-tuning.
		• The position reference increment is too large.	• Adjust the position reference. Decrease the gear ratio according to the actual conditions.
		• The fault value is too small in relative to the operating conditions.	• Check whether the position deviation fault value is set to a too small value. Increase the setpoint.
		• The servo drive or motor is faulty.	• Monitor the operating waveform through the oscilloscope function in the drive commissioning platform: position reference, position feedback, speed reference, and torque reference. If the position reference is not 0, but the position feedback is always 0, replace the servo drive or motor.
Ex47.2	Excessive fully closed-loop mixed deviation	• Too small drive mixed deviation threshold (C1B.08)	• Set C1B.08 to a larger value.
		• Incorrect feedback of the inner/outer loop	• Correct the value of C1B.04.
		• Failure due to mechanical factors	• Eliminate mechanical factors.

Code	Name	Cause	Solution
Er48.1	STO buffer 5 V power fault	• The buffer power supply is abnormal.	• If the fault persists after several times of power-on, replace the servo drive.
Er48.2	Optocoupler fault in STO pulse detection	• STO upstream optocoupler short circuit.	• Check wiring of STO terminals. • If the fault persists after several times of power-on, replace the servo drive.
Er48.3	STO buffer detection failure	• Buffer switch detection fault	• Check wiring of STO terminals. • If the fault persists after several times of power-on, replace the servo drive.
Er49.0	Output phase loss of power cable	• Output UVW disconnection	• Replace the motor cable.
Er50.1	D/Q current overflow	• A current sampling error occurs.	• If the fault persists after several times of power-on, replace the servo drive.
Er51.0	Offline inertia auto-tuning failure	• Continuous vibration occurs during auto-tuning. The auto-tuning result fluctuates greatly. • The mechanical connection of the load is loose due to offset of the machinery. • An alarm is reported during the auto-tuning process, leading to operation interruption. • Vibration of the load with large inertia cannot be suppressed. The acceleration/deceleration time must be increased to ensure that the motor current is not saturated.	• Enable the vibration suppression function to eliminate vibration if vibration cannot be automatically suppressed. • Troubleshoot and remove the alarm. After that, perform auto-tuning again. • Increase the maximum running speed, decrease the acceleration/deceleration time, and shorten the travel of the screw machinery. • Ensure that the actual maximum motor speed is greater than 150 rpm.
Er51.1	Offline inertia parameter error	• The torque during auto-tuning is too large.	• Decrease the auto-tuning speed (C07.01) and auto-tuning target torque (C07.03), and increase the number of auto-tuning turns (C07.04).
Er52.0	Angle auto-tuning failure	• Angle auto-tuning failure	• Set the motor parameters correctly. • Perform motor wiring again.
Er53.0	Motor parameter auto-tuning timeout	• Motor parameter auto-tuning timeout	• Contact our company for technical support.
Er53.1	Resistance parameter auto-tuning failure	• Resistance parameter auto-tuning failure	• Contact our company for technical support.
Er53.2	Inductance parameter auto-tuning failure	• Inductance parameter auto-tuning failure	• Contact our company for technical support.

Code	Name	Cause	Solution
Er53.3	Back EMF parameter auto-tuning failure	• Back EMF parameter auto-tuning failure	• Contact our company for technical support.
Er54.0	Current loop auto-tuning failure	• Current loop auto-tuning failure	• Contact our company for technical support.
Er55.0	Excessive vibration	• The vibration is excessive.	• Reset the gain parameters.
Er57.0	Friction auto-tuning failed.	• The settings of friction auto-tuning parameters C07.28 to C07.2F are unreasonable.	• Reset parameters C07.28 to C07.2F.
Er80.0	Control power undervoltage	• The control power supply is unstable or power failure occurs.	• Check whether the voltage drops during control power cutoff or instantaneous power failure occurs. Power on the device again. If the fault is caused by abnormal power failure, ensure stable power supply. Check whether the input voltage of the control power cables satisfies the specifications. Increase the power capacity.
		• The control power cables are in poor contact.	• Check whether control power cables are connected and whether voltage of control power cables on the servo drive side satisfies the specifications. Connect the cables again or replace the cables.
Er81.0	Input phase loss 1	• Input phase loss	• Check whether the input three-phase AC power supply is normal. If the power supply is normal, replace the drive.
Er81.1	Input phase loss 2	• Input phase loss	• Check whether the input three-phase AC power supply is normal. If the power supply is normal, replace the drive.
Er82.0	DI function allocation fault	• One function is allocated to multiple DI terminals.	• Allocate different function numbers to parameters allocated with the same non-zero function number, and turn on the control power supply to make the settings take effect. Or, disable the S-ON signal and then send a reset signal to make the settings take effect.
		• The function number set for the DI terminal exceeds the maximum value.	• Check whether the MCU program is updated. Restore default settings (F31.02=1) and power on the system again.
Er82.1	DO function allocation fault	• The function number set for the DO terminal exceeds the maximum value.	• Set the correct DO function number. Restore default settings (F31.02=1) and power on the system again.
Er82.2	VDI function allocation fault	• One function is allocated to both DI and VDI terminals.	• The same non-zero function number can be allocated only to DI or VDI. Restore default settings (F31.02=1).

Code	Name	Cause	Solution
Er82.3	VDO function allocation fault	• One function is allocated to both DO and VDO terminals.	• The same non-zero function number can be allocated only to DO or VDO. Restore default settings (F31.02=1).
Er82.4	Position capture DI function allocation error	• Position capture DI function allocation error.	• If you do not want to use the position capture function, just set C10.20 to 0 and power on the device again. • If the position capture function is enabled, set DI7 function to position capture function C04.18 = 33.
Er83.0	AI1 sampling overvoltage	• The AI1 input voltage is too high.	• Adjust the input voltage until it is lower than 10.23 V.
		• Check whether there is wiring error or interference.	• Use shielded twisted pairs, shorten the circuit length, and increase the input filter time of the AI1 terminal.
Er83.1	AI2 sampling overvoltage	• AI2 input voltage is too high.	• Adjust the input voltage until it is lower than 10.23 V.
		• Check whether there is wiring error or interference.	• Use shielded twisted pairs, shorten the circuit length, and increase the input filter time of the AI2 terminal.
Er83.2	AI1 chip missing or clock failure	• AI1 sampling chip missing or clock failure.	• Replace the servo drive.
Er83.3	AI2 chip missing or clock failure	• AI2 sampling chip missing or clock failure.	• Replace the servo drive.
Er83.4	Current-type AI disconnected	• The AI2 input current is too low.	• Increase the input current.
		• The AI2 input current cable is disconnected. • Check whether there is wiring error or interference.	• Use shielded twisted pairs, shorten the circuit length, and increase the input filter time of the AI2 terminal.
Er83.5	Current-type sampling overcurrent fault	• The AI2 input current is too large.	• Reduce the input current.
		• Check whether there is wiring error or interference.	• Use shielded twisted pairs, shorten the circuit length, and increase the input filter time of the AI2 terminal.
Er84.0	Electronic gear ratio setting error	• The electronic gear ratio exceeds the limit.	• Set the electronic gear ratio correctly (0.001, 4000 x Encoder resolution/10000).
Er84.1	Software limit setting error	• The software limit lower limit is greater than or equal to the upper limit.	• Reset the value to make the minimum software absolute position limit is smaller than the maximum one.
Er84.2	Encoder resolution setting error	• The encoder resolution is abnormal.	• Restore default settings (C31.02=1) and power on the system again.

Code	Name	Cause	Solution
Er84.3	Home position setting error	• The home offset is beyond the software limits.	• When the encoder works in the incremental, absolute linear, or single-turn absolute value mode, set the home offset to be within the software limits.
Er85.1	Frequency-division pulse output error	• When the pulse output function is enabled, the output pulse frequency exceeds the upper frequency limit (4 MHz) allowed by the hardware.	• Reduce C00.28 (number of divided pulses), so that the output pulse frequency is below the upper frequency limit allowed by the hardware in the whole speed range required by machinery.
		• The number of divided pulses (after quadruple frequency) exceeds the motor resolution.	• Adjust the C00.28 set value according to the resolution of the motor used.
Er87.3	Overflow of 32-bit sign bit of the target position during limiting	• 32-bit sign bit of the target position overflows during limiting.	• The target position reference at the limit is too large.
Er87.4	Target position exceeding maximum value of mechanical single-turn position in rotating mode	• The target position exceeds the single-turn position upper/lower limit in absolute value rotation mode. • In absolute rotation mode, the maximum value of the mechanical single-turn position exceeds 2^{31}.	• Set the target position to a value between the single-turn upper and lower limits. • Set the correct mechanical gear ratio in rotation mode, and appropriately adjust the electronic gear ratio to ensure that the maximum value of the mechanical single-turn position is less than 2^{31}.
Er87.5	Fully closed-loop parameter setting error	• When C1B.00 is not 0, C00.07 is set to 4 or 5 (absolute value rotation mode).	• Do not set C00.07 to the absolute rotation mode when fully closed-loop is used.
ErA0.1	Multi-turn overflow fault	• The number of turns of the absolute encoder in the forward direction or reverse direction exceeds 32767 or 32768, respectively.	• Set F31.10 to 4 to reset the fault and multi-turn data, and power on the machine again. Perform homing again when necessary.
ALF0.0	Emergency stop alarm	• Check whether the logic of the DI allocated with function 4 (Emergency stop) is valid.	• Check the operation mode and clear DI emergency stop valid signal when safety is guaranteed.
ALF1.0	Re-power-on required for parameter settings to take effect	• Modifications of some servo drive parameters take effect only after the servo drive is powered on again. After these parameters are modified, the servo drive reminds users to restart it.	• Power on the device again.

Code	Name	Cause	Solution
ALF1.1	Frequent parameter storage alarm	• A large number of parameters are modified and saved frequently to EEPROM.	• Do not frequently write parameters into cloud platform EEPROM on the host controller.
ALF1.2	Torque reached parameter error	• In torque control mode, the DO setting for torque reach is invalid.	• Set the torque output when torque reached DO signal turned on to be greater than torque output when torque reached DO signal turned off. Set C03.4A to be greater than C03.4B.
ALF2.0	Forward overtravel alarm	• The positive limit (PL) DI is active.	• Run the motor in the reverse direction to the restricted range.
		• The drive position feedback is at the forward software position limit.	• Run the motor in the reverse direction to the re-stricted range or increase the positive software position limit.
		• The home offset setting exceeds the software position limit.	• Set the home offset within the software position limit range.
ALF2.1	Reverse overtravel alarm	• The negative limit (NL) DI is active.	• Run the motor in the forward direction to the restricted range.
		• The drive position feedback is at the reverse software position limit.	• Run the motor in the forward direction to the restricted range or decrease the positive software position limit.
		• The home offset setting exceeds the software position limit.	• Set the home offset within the software position limit range.
ALF3.0	The AI1 zero offset is too large	• Check whether there is wiring error or interference.	• Use shielded twisted pairs, shorten the circuit length, and increase the input filter time of the AI1 terminal.
		• The servo drive is faulty.	• If it does not exceed 0.5 V, replace the servo drive.
ALF3.1	The AI2 zero offset is too large	• Check whether there is wiring error or interference.	• Use shielded twisted pairs, shorten the circuit length, and increase the input filter time of the AI2 terminal.
		• The servo drive is faulty.	• If it does not exceed 0.5 V, replace the servo drive.
ALF4.0	Homing timeout	• The homing time exceeds the setpoint.	• Appropriately adjust the homing speed and homing time, and ensure that the external home signal connection is reliable (if used).
ALF4.1	Homing DI conflict	• During homing, both the forward and reverse limits are valid or both the home signal and limit signal are valid.	• Check whether the home signal and limit signal are correct.

Code	Name	Cause	Solution
ALF4.2	Homing mode conflict	• The homing mode is set incorrectly.	• Check whether the homing mode set in object dictionary C10.01 on the host controller is correct.
ALF5.0	Braking resistor overload	• The cable connected to the external braking resistor is in poor contact, disconnected, or broken.	• Connect the external braking resistor between P⊕ and C with a new cable. • Replace the external braking resistor with a new one. Ensure that the resistance measured is the same as the nominal value, and then connect the resistor between P⊕ and C.
		• The resistance of the external braking resistor used is too large.	• Select a resistor with a proper resistance according to the specification requirements.
		• The resistance setpoint is greater than the resistance of the external braking resistor used.	• Set the value according to the resistance of the external bleeder resistor in use.
		• The input voltage of the main circuit is beyond the specification.	• Replace or adjust the power supply according to the specifications.
		• The load moment of inertia ratio is too large.	• Select an external braking resistor with large capacity and set its resistance to the actual one.
		• The motor speed is too high and the deceleration process is not completed within the set deceleration time. The motor is in continuous deceleration state during cyclic running.	• Select a servo drive with a large capacity.
		• The capacity of the servo drive or the braking resistor is insufficient.	• Reduce the load if allowed. • Increase the acceleration/deceleration time if allowed. • Increase the motor running cycle if allowed.
ALF5.1	External braking resistance too small	• The resistance of the external braking resistor is smaller than permissible minimum resistance by the servo drive.	• Replace with an external braking resistor matching the servo drive, with the resistance greater than the minimum value, and set C00.10 to the resistance value.
ALF6.0	Abnormal setting of frequency division pulse output	• Setting error of frequency division pulse output	• Set the correct frequency division pulse output function code.
ALF6.1	Output phase loss	• The output current is abnormal.	• Check whether the power cable is broken. If so, replace the cable.

Code	Name	Cause	Solution
ALF7.0	Warning that the planning start segment number is greater than the end segment number	• Warning that the start segment number of speed planning is greater than the end segment number	• The start segment (C12.01) of speed planning is greater than the end segment (C12.02).
ALF7.3	Initial segment of position comparison in cyclic absolute mode out of the comparison segment range	• The initial segment of position comparison loop in absolute mode is not in the range of active comparison segments.	• Change the value of C0D.13 to a value between C0D.07 and C0D.08.
ALF8.0	Vibration occurred during auto-tuning	• Continuous vibration occurs during auto-tuning. • The mechanical connection of the load is loose due to offset of the machinery.	• Check the mechanical installation clearance and connection reliability.
		• Vibration of the load with large inertia cannot be suppressed. The acceleration/ deceleration time must be increased to ensure that the mo-tor current is not saturated.	• Appropriately adjust the inertia auto-tuning parameters (C07.00, C07.01, C07.03, and C07.04), reduce the values of the auto-tuning speed (C07.01) and auto-tuning target torque (C07.03), and increase the number of auto-tuning turns (C07.04).
ALF9.0	Encoder battery voltage low	• The encoder battery voltage is too low.	• Replace the encoder battery.
ALFA.0	Drive high temperature warning	• Drive high temperature warning	• Check whether the fan is abnormal or whether the ambient temperature is too high. • Improve the installation conditions of the servo unit to reduce the ambient temperature.
ALFB.0	Brake PMOS short circuit	• When the brake function is used, the brake circuit PMOS is short-circuited.	• Replace the servo drive. • Turn off the brake switch and set C00.14 to 0. • Shield the brake fault alarm and set C06.1E to 1.
ALFB.1	Brake NMOS short circuit	• When the brake function is used, the brake circuit NMOS is short-circuited.	• Replace the servo drive. • Turn off the brake switch and set C00.14 to 0. • Shield the brake fault alarm and set C06.1E to 1.
ALFB.2	Brake 24 V disconnection or open circuit	• When the brake function is used, the brake is not connected or the 24 V power supply is not connected.	• Set C06.1E to 1. • Connect the 24 V power cable.

Code	Name	Cause	Solution
xxnr	Servo not ready	• The voltage of the control power is too low.	• Check the control power supply to ensure the normal power supply.
		• The main circuit voltage is too low.	• Check the main power supply to ensure the normal power supply.
		• The input AC signal is abnormal.	• Check the three-phase AC main power supply, and ensure that the power supply is normal.
		• The encoder battery voltage is too low.	• Replace the battery.

Chapter 8 Parameter List

8.1 Parameters (2000h/C00)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
01h	C00.00	Control mode	0: Position mode 1: Speed mode 2: Torque mode 3: Position → Speed 4: Position → Torque 5: Speed → Torque 6: Position → Speed → Torque	0-6	0	-	U16	At stop	Immediately
02h	C00.01	Motor rotating direction	0: CCW 1: CW	0-1	0	-	U16	At stop	Upon re-power-on
03h	C00.02	Number of pulses in one turn by motor	-	$0\text{-}(2^{32}\text{-}1)$	10000	Unit in application	U32	At stop	Upon re-power-on
05h	C00.04	Auto-tuning mode	0: Manual mode 1: Standard mode 2: Positioning mode	0-2	1	-	U16	During operation	Immediately
06h	C00.05	Stiffness level	-	1-31	12	-	U16	During operation	Immediately
07h	C00.06	Load inertia ratio	-	0-12000	100	%	U16	During operation	Immediately
08h	C00.07	Absolute mode	0: Incremental position mode 1: Absolute position linear mode 2: Absolute position linear infinite mode 3: Absolute position single-turn mode 4: Absolute position rotation mode 5: Absolute mechanical single-turn mode (operating direction selectable)	0-5	0	-	U16	At stop	Upon re-power-on

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
11h	C00.10	Bleeder resistor selection	0: Internal bleeder resistor 1: External bleeder resistor 2: No bleeder resistor 3: Capacitor bleeder resistor	0-3	0	-	U16	At stop	Immediately
12h	C00.11	Bleeder resistor power	-	1-65535	50	W	U16	At stop	Immediately
13h	C00.12	Bleeder resistor resistance	-	1-65535	50	Ω	U16	At stop	Immediately
14h	C00.13	Bleeder resistor heat dissipation coeffi-cient	-	1-100	30	-	U16	During operation	Immediately
15h	C00.14	Brake enable switch	-	0-1	0	-	U16	At stop	Immediately
17h	C00.16	Panel display	0: Default display 1: Speed display 2: Torque display 3: Voltage display 4: Load rate display	0-4	0	-	U16	During operation	Immediately
18h	C00.17	Fully closed-loop disconnection detection	0: Shielding detection 1: Detect phases AB only 2: Detect phases ABZ	0-2	1	-	U16	At stop	Upon re-power-on
19h	C00.18	Fully closed-loop disconnection detection filter time	-	0-6000	400	ns	U16	At stop	Upon re-power-on
1Ah	C00.19	Fully closed-loop hardware filter time	-	0-6000	125	ns	U16	At stop	Upon re-power-on
1Bh	C00.1A	ABZ port selection	0: Frequency-division output 1: Position comparison output 2: Fully closed-loop input 3: Pulse synchronization output	0-3	0	-	U16	At stop	Upon re-power-on

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
1Ch	C00.1B	OCZ port selection	0: Z-phase OC output 1: position comparison output. 2: Pulse synchronous output	0-2	0	-	U16	At stop	Upon re-power-on
21h	C00.20	Pulse input mode selection	0: Pulse+direction, positive logic 1: Pulse+direction, negative logic 2: AB orthogonal, quadruple frequency 3: CW+CCW, positive logic 4: CW+CCW, negative logic	0-4	0	-	U16	At stop	Upon re-power-on
22h	C00.21	Pulse active edge selection	0: Falling edge 1: Rising edge	0-1	0	-	U16	At stop	Upon re-power-on
23h	C00.22	Pulse channel selection	0: Normal channel 1: High-speed channel	0-1	0	-	U16	At stop	Upon re-power-on
25h	C00.24	Low-speed pulse input filter time	-	0-6000	750	ns	U16	At stop	Upon re-power-on
26h	C00.25	High-speed pulse input filter time	-	0-6000	75	ns	U16	At stop	Upon re-power-on
28h	C00.27	Frequency-division output phase	0: Phase A leads phase B 1: Phase B leads phase A	0-1	0	-	U16	At stop	Upon re-power-on
29h	C00.28	Number of frequency-division output pulses	-	0-4194304	2500	P	U32	At stop	Upon re-power-on
2Bh	C00.2A	Z-pulse output polarity selection	0: Differential Z positive polarity, OCZ positive polarity 1: Differential Z positive polarity, OCZ negative polarity 2: Differential Z negative polarity, OCZ positive polarity 3: Differential Z negative polarity, OCZ negative polarity	0-3	0	-	U16	At stop	Upon re-power-on

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
31h	C00.30	Ordinary user	-	0-65535	0	-	U16	During operation	Immediately
32h	C00.31	Super user	-	0-65535	0	-	U16	During operation	Immediately

NOTICE

- For details about parameters above, refer to section 8.24.1 "Group C00".

8.2 Basic Gain Parameters (2001h/C01)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
01h	C01.00	1st position loop gain	-	0-20000	400	0.1rad/s	U16	During operation	Immediately
02h	C01.01	1st speed loop gain	-	1-20000	250	0.1Hz	U16	During operation	Immediately
03h	C01.02	1st speed loop integral time parameter	-	1-51200	3184	0.01ms	U16	During operation	Immediately
04h	C01.03	1st torque reference filter cutoff frequency	-	5-16000	200	Hz	U16	During operation	Immediately
09h	C01.08	2nd position loop gain	-	0-20000	560	0.1rad/s	U16	During operation	Immediately
0Ah	C01.09	2nd speed loop gain	-	1-20000	350	0.1Hz	U16	During operation	Immediately
0Bh	C01.0A	2nd speed loop integral time parameter	-	1-51200	2274	0.01ms	U16	During operation	Immediately
0Ch	C01.0B	2nd torque reference filter cutoff frequency	-	5-16000	280	Hz	U16	During operation	Immediately
11h	C01.10	Speed feedback filter	0: Internal setting 1: Low-pass filter 2: Overlapping average filter 3: Speed observer 4: No filter	0-4	0	-	U16	At stop	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
12h	C01.11	Cutoff frequency of speed feedback low-pass filter	-	10-16000	8000	Hz	U16	During operation	Immediately
13h	C01.12	Speed feedback overlapping average filter time constant	0: No filter 1: 2 times filter 2: 4 times filter 3: 8 times filter 4: 16 times filter 5: 32 times filter 6: 64 times filter	0-6	0	-	U16	During operation	Immediately
14h	C01.13	Speed feedforward source	0: No feedforward 1: Internal reference 2: Model tracking 3: AI1 4: AI2	0-4	0	-	U16	During operation	Immediately
15h	C01.14	Speed feedforward percentage	-	0-2000	0	0.1%	U16	During operation	Immediately
16h	C01.15	Speed feedforward filter cutoff frequency	-	5-16000	318	Hz	U16	During operation	Immediately
17h	C01.16	Torque feedforward source	0: No feedforward 1: Internal reference 2: Model tracking 3: AI1 4: AI2	0-4	0	-	U16	During operation	Immediately
18h	C01.17	Torque feedforward percentage	-	0-2000	0	0.1%	U16	During operation	Immediately
19h	C01.18	Torque feedforward filter cutoff frequency	-	5-16000	318	Hz	U16	During operation	Immediately
1Ch	C01.1B	PDFF control coefficient	-	0-1000	1000	0.1%	U16	During operation	Immediately
1Dh	C01.1C	Damping factor control coefficient	-	0-1000	0	0.1%	U16	During operation	Immediately
21h	C01.20	Position reference overlapping average filter time constant A	-	0-1280	0	0.1ms	U16	At stop	Immediately
22h	C01.21	Position reference overlapping average filter time constant B	-	0-1280	0	0.1ms	U16	At stop	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
23h	C01.22	Position reference low-pass filter time constant A	-	0-65535	0	0.1ms	U16	At stop	Immediately
24h	C01.23	Position reference low-pass filter time constant B	-	0-65535	0	0.1ms	U16	At stop	Immediately
25h	C01.24	1st notch filter frequency of position reference	-	0-2000	0	0.1Hz	U16	At stop	Immediately
26h	C01.25	1st notch filter width of position reference	-	0-1000	0	0.1%	U16	At stop	Immediately
27h	C01.26	1st notch filter depth of position reference	-	10-1000	1000	0.1%	U16	At stop	Immediately
28h	C01.27	2nd notch filter frequency of position reference	-	0-2000	0	0.1Hz	U16	At stop	Immediately
29h	C01.28	2nd notch filter width of position reference	-	0-1000	0	0.1%	U16	At stop	Immediately
2Ah	C01.29	2nd notch filter depth of position reference	-	10-1000	1000	0.1%	U16	At stop	Immediately
2Bh	C01.2A	Position reference pre-charge filter time constant	-	0-1280	0	0.1ms	U16	At stop	Immediately
31h	C01.30	Adaptive notch mode	0: Disabled 1: 1st notch 2: 2nd notch 3: Notch parameter reset 4: Resonance frequency tested only	0-4	0	-	U16	During operation	Immediately
32h	C01.31	Adaptive notch test times	-	0-65535	0	Times	U16	At stop	Immediately
33h	C01.32	Adaptive notch test frequency	-	0-8000	0	Hz	U16	Read only	Immediately
34h	C01.33	Adaptive notch test amplitude	-	0-5000	0	0.1%	U16	Read only	Immediately
35h	C01.34	Adaptive notch target torque	-	0-2000	0	0.1%	U16	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
36h	C01.35	Adaptive notch test torque threshold	-	0-2000	0	0.1%	U16	During operation	Immediately
39h	C01.38	Gain switchover mode	0: Fixed to the 1st gain set 1: DI switchover 2: DI P-PI switchover 3: Torque reference 4: Speed reference 5: Speed feedback 6: Speed reference change rate 7: Position deviation 8: Position reference 9: Positioning completed signal 10: Position reference and speed feedback 11: Speed reference threshold	0-11	0	-	U16	At stop	Immediately
3Ah	C01.39	Gain switchover time	-	10-10000	50	0.1ms	U16	During operation	Immediately
3Bh	C01.3A	Gain switchover threshold	-	0-65535	10	-	U16	During operation	Immediately
3Ch	C01.3B	Gain switchover loop width	-	0-65535	10	-	U16	During operation	Immediately
3Dh	C01.3C	Gain switchover position lock setting	-	0-65535	0	-	U16	During operation	Immediately
3Eh	C01.3D	Gain switchover position gain conversion time	-	10-10000	50	0.1ms	U16	During operation	Immediately
41h	C01.40	Frequency of the 1st notch	-	10-8000	8000	Hz	U16	During operation	Immediately
42h	C01.41	Width level of the 1st notch	-	0-4000	0	0.1%	U16	During operation	Immediately
43h	C01.42	Depth level of the 1st notch	-	10-1000	1000	0.1%	U16	During operation	Immediately
44h	C01.43	Frequency of the 2nd notch	-	10-8000	8000	Hz	U16	During operation	Immediately
45h	C01.44	Width level of the 2nd notch	-	0-4000	0	0.1%	U16	During operation	Immediately
46h	C01.45	Depth level of the 2nd notch	-	10-1000	1000	0.1%	U16	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
47h	C01.46	Frequency of the 3rd notch	-	10-8000	8000	Hz	U16	During operation	Immediately
48h	C01.47	Width level of the 3rd notch	-	0-4000	0	0.1%	U16	During operation	Immediately
49h	C01.48	Depth level of the 3rd notch	-	10-1000	1000	0.1%	U16	During operation	Immediately
4Ah	C01.49	Frequency of the 4th notch	-	10-8000	8000	Hz	U16	During operation	Immediately
4Bh	C01.4A	Width level of the 4th notch	-	0-4000	0	0.1%	U16	During operation	Immediately
4Ch	C01.4B	Depth level of the 4th notch	-	10-1000	1000	0.1%	U16	During operation	Immediately
4Dh	C01.4C	Frequency of the 5th notch	-	10-8000	8000	Hz	U16	During operation	Immediately
4Eh	C01.4D	Width level of the 5th notch	-	0-4000	0	0.1%	U16	During operation	Immediately
4Fh	C01.4E	Depth level of the 5th notch	-	10-1000	1000	0.1%	U16	During operation	Immediately

NOTICE

- For details about parameters above, refer to section 8.24.2 "Group C01".

8.3 Advanced Gain Parameters (2002h/C02)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
01h	C02.00	Model tracking control	0: Disabled 1: Single mass model tracking	0-1	0	-	U16	At stop	Immediately
02h	C02.01	Model tracking control gain	-	10-20000	500	0.1rad/s	U16	During operation	Immediately
03h	C02.02	Model tracking inertia correction coefficient	-	10-8000	1000	0.1%	U16	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
09h	C02.08	Backlash compensation mode	0: No compensation 1: Compensation in forward direction 2: Compensation in reverse direction 3: Compensation in both forward and reverse directions	0-3	0	-	U16	At stop	Immediately
0Ah	C02.09	Number of backlash compensation pulses	-	-2^{31}-$(2^{31}-1)$	0	P	I32	At stop	Immediately
0Ch	C02.0B	Backlash compensation filter time constant	-	0-65535	0	0.01ms	U16	During operation	Immediately
31h	C02.30	Speed observer gain	-	0-40000	0	0.1Hz	U16	During operation	Immediately
32h	C02.31	Speed observer inertia correction	-	10-8000	1000	0.1%	U16	During operation	Immediately
33h	C02.32	Speed observer speed feedback cutoff frequency	-	0-16000	0	Hz	U16	During operation	Immediately
39h	C02.38	Frequency for vibration suppression 1	-	10-20000	1000	0.1Hz	U16	During operation	Immediately
3Ah	C02.39	Inertia correction for vibration suppression 1	-	10-8000	1000	0.1%	U16	During operation	Immediately
3Bh	C02.3A	Low-pass filter correction for vibration suppression 1	-	-9999-9999	0	0.1Hz	I16	During operation	Immediately
3Ch	C02.3B	Correction of high-pass filter 1 for vibration suppression 1	-	-9999-9999	0	0.1Hz	I16	During operation	Immediately
3Dh	C02.3C	Frequency of high-pass filter 2 for vibration suppression 1	-	10-50000	20000	0.1Hz	U16	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
3Eh	C02.3D	Ratio of compensation 1 for vibration suppression 1	-	0-20000	0	0.1%	U16	During operation	Immediately
3Fh	C02.3E	Ratio of compensation 2 for vibration suppression 1	-	0-20000	0	0.1%	U16	During operation	Immediately
41h	C02.40	Frequency for vibration suppression 2	-	10-20000	1000	0.1Hz	U16	During operation	Immediately
42h	C02.41	Inertia correction for vibration suppression 2	-	10-8000	1000	0.1%	U16	During operation	Immediately
43h	C02.42	Low-pass filter correction for vibration suppression 2	-	-9999-9999	0	0.1Hz	I16	During operation	Immediately
44h	C02.43	Correction of high-pass filter 1 for vibration suppression 2	-	-9999-9999	0	0.1Hz	I16	During operation	Immediately
45h	C02.44	Frequency of high-pass filter 2 for vibration suppression 2	-	10-50000	20000	0.1Hz	U16	During operation	Immediately
46h	C02.45	Ratio of compensation 1 for vibration suppression 2	-	0-20000	0	0.1%	U16	During operation	Immediately
47h	C02.46	Ratio of compensation 2 for vibration suppression 2	-	0-20000	0	0.1%	U16	During operation	Immediately
49h	C02.48	Frequency for vibration suppression 3	-	10-20000	1000	0.1Hz	U16	During operation	Immediately
4Ah	C02.49	Inertia correction for vibration suppression 3	-	10-8000	1000	0.1%	U16	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
4Bh	C02.4A	Low-pass filter correction for vibration suppression 3	-	-9999-9999	0	0.1Hz	I16	During operation	Immediately
4Ch	C02.4B	Correction of high-pass filter 1 for vibration suppression 3	-	-9999-9999	0	0.1Hz	I16	During operation	Immediately
4Dh	C02.4C	Frequency of high-pass filter 2 for vibration suppression 3	-	10-50000	20000	0.1Hz	U16	During operation	Immediately
4Eh	C02.4D	Ratio of compensation 1 for vibration suppression 3	-	0-20000	0	0.1%	U16	During operation	Immediately
4Fh	C02.4E	Ratio of compensation 2 for vibration suppression 3	-	0-20000	0	0.1%	U16	During operation	Immediately
61h	C02.60	Disturbance observer gain	-	0-40000	0	0.1Hz	U16	During operation	Immediately
62h	C02.61	Disturbance observer inertia correction coefficient	-	1-10000	1000	0.1%	U16	During operation	Immediately
63h	C02.62	Disturbance observer low-pass cutoff frequency	-	0-16000	0	Hz	U16	During operation	Immediately
64h	C02.63	Disturbance observer compensation torque percentage	-	0-2000	0	0.1%	U16	During operation	Immediately
69h	C02.68	Friction compensation switch and relevant setting	-	0-65535	0	-	U16	During operation	Immediately
6Ah	C02.69	Friction compensation speed threshold	-	0-5000	20	0.1rpm	U16	During operation	Immediately
6Bh	C02.6A	Static friction compensation	-	0-2000	0	0.1%	U16	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
6Ch	C02.6B	Forward friction compensation of coulomb friction	-	0-2000	0	0.1%	U16	During operation	Immediately
6Dh	C02.6C	Reverse friction compensation of coulomb friction	-	-2000-0	0	0.1%	I16	During operation	Immediately
6Eh	C02.6D	Viscous friction torque for rated speed	-	0-2000	0	0.1%	U16	During operation	Immediately
6Fh	C02.6E	Friction compensation filter time	-	0-65535	0	0.01ms	U16	During operation	Immediately
70h	C02.6F	Friction compensation threshold for zero speed	-	0-1000	10	0.1rpm	U16	During operation	Immediately

8.4 Instruction Parameters (2003h/C03)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
01h	C03.00	Position reference selection	0: Pulse reference 1: Internal position planning 2: Step amount	0-2	0	-	U16	At stop	Immediately
03h	C03.02	Numerator of group 1 electronic gear ratio	-	1-(2^{32}-1)	131072	-	U32	During operation	Immediately
05h	C03.04	Denominator of group 1 electronic gear ratio	-	1-(2^{32}-1)	10000	-	U32	During operation	Immediately
07h	C03.06	Numerator of group 2 electronic gear ratio	-	1-(2^{32}-1)	131072	-	U32	During operation	Immediately
09h	C03.08	Denominator of group 2 electronic gear ratio	-	1-(2^{32}-1)	10000	-	U32	During operation	Immediately
0Ch	C03.0B	Gear ratio switchover mode	0: Switch after positioning is completed 1: Switch immediately	0-1	0	-	U16	During operation	Immediately
0Dh	C03.0C	Step amount reference value	-	-9999-9999	50	Unit in application	I16	During operation	Immediately

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
0Eh	C03.0D	Step amount speed reference	-	0-1500	1000	rpm	U16	During operation	Immedi-ately
11h	C03.10	Position reached criteria	0: DO output when the loop position deviation is less than the threshold 1: DO output when the loop position deviation is less than the threshold and the filtered position reference is 0 2. DO output when the loop position deviation is less than the threshold and the filtered position reference is 0 and the output is kept active for at least the time set by C03.14 3: DO output when the actual position deviation is less than the threshold 4: DO output when the actual position deviation is less than the decision threshold and the filtered position reference is 0 5. DO output when the actual position deviation is less than the threshold, and the filtered position reference is 0 and the output is kept active for at least the time set by C03.14	0-5	1	-	U16	At stop	Immedi-ately
12h	C03.11	Threshold of positioning near	-	0-65535	625	Unit in application	U16	During operation	Immedi-ately
13h	C03.12	Position reached threshold	-	0-65535	7	Unit in application	U16	During operation	Immedi-ately
14h	C03.13	Position reached filter time	-	0-65535	0	ms	U16	At stop	Immedi-ately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
15h	C03.14	Position reached holding time	-	0-65535	0	ms	U16	At stop	Immediately
17h	C03.16	Position deviation clearing selection	0: Inactive 1: DI trigger	0-1	0	-	U16	At stop	Immediately
21h	C03.20	Speed reference selection	0: Internal digital reference 1: AI1 2: AI2 3: Internal speed planning 4: AI1 → internal speed planning 5: AI2 → internal speed planning	0-5	0	-	U16	At stop	Immediately
22h	C03.21	Speed reference	-	-8000-8000	100	rpm	I16	During operation	Immediately
23h	C03.22	Acceleration rate	-	0-65535	10	ms	U32	During operation	Immediately
25h	C03.24	Deceleration rate	-	0-65535	10	ms	U32	During operation	Immediately
27h	C03.26	Speed limit selection	0: Internal limit 1: External limit 2: AI1 3: AI2	0-3	0	-	U16	At stop	Immediately
28h	C03.27	Internal positive speed limit	-	0-8000	6000	rpm	U16	During operation	Immediately
29h	C03.28	Internal negative speed limit	-	0-8000	6000	rpm	U16	During operation	Immediately
2Ah	C03.29	External forward speed limit	-	0-8000	6000	rpm	U16	During operation	Immediately
2Bh	C03.2A	External negative speed limit	-	0-8000	6000	rpm	U16	During operation	Immediately
2Ch	C03.2B	Speed reach threshold	-	0-8000	1000	rpm	U16	During operation	Immediately
2Dh	C03.2C	Speed synchronization threshold	-	0-1000	10	rpm	U16	During operation	Immediately
2Eh	C03.2D	Speed rotation threshold	-	0-1000	20	rpm	U16	During operation	Immediately
2Fh	C03.2E	Zero speed output threshold	-	5-1000	10	rpm	U16	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
30h	C03.2F	Zero clamp threshold	-	0-1000	10	rpm	U16	During operation	Immediately
31h	C03.30	Forward DI jog speed	-	0-8000	100	rpm	U16	During operation	Immediately
32h	C03.31	Reverse DI jog speed	-	0-8000	100	rpm	U16	During operation	Immediately
33h	C03.32	Zero-speed output judgment hysteresis	-	0-200	10	rpm	U16	During operation	Immediately
34h	C03.33	Speed DO filter setting	-	0-1000	100	0.1ms	U16	During operation	Immediately
35h	C03.34	Speed S-curve enable	0: Disabled 1: Enabled	0-1	0	-	U16	At stop	Immediately
36h	C03.35	Increasing acceleration of speed S-curve acceler-ation segment	-	0-1000	500	0.1%	U16	At stop	Immediately
37h	C03.36	Increasing deceleration of speed S-curve acceler-ation segment	-	0-1000	500	0.1%	U16	At stop	Immediately
38h	C03.37	Decreasing acceleration of speed S-curve deceleration segment	-	0-1000	500	0.1%	U16	At stop	Immediately
39h	C03.38	Decreasing deceleration of speed S-curve deceleration segment	-	0-1000	500	0.1%	U16	At stop	Immediately
41h	C03.40	Torque reference selection	0: Internal digital setting 1: AI1 2: AI2	0-2	0	-	U16	At stop	Immediately
42h	C03.41	Torque reference	-	-4000-4000	0	0.1%	I16	During operation	Immediately
43h	C03.42	Torque limit selection	0: Internal limit 1: External limit 2: AI1 3: AI2	0-3	0	-	U16	At stop	Immediately
44h	C03.43	Internal positive torque limit	-	0-4000	3000	0.1%	U16	During operation	Immediately

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
45h	C03.44	Internal negative torque limit	-	0-4000	3000	0.1%	U16	During operation	Immedi-ately
46h	C03.45	External forward torque limit	-	0-4000	3000	0.1%	U16	During operation	Immedi-ately
47h	C03.46	External reverse torque limit	-	0-4000	3000	0.1%	U16	During operation	Immedi-ately
48h	C03.47	Positive speed limit in torque mode	-	0-8000	3000	rpm	U16	During operation	Immedi-ately
49h	C03.48	Negative speed limit in torque mode	-	0-8000	3000	rpm	U16	During operation	Immedi-ately
4Ah	C03.49	Reference value for torque reach	-	0-4000	0	0.1%	U16	During operation	Immedi-ately
4Bh	C03.4A	Valid value for torque reached	-	0-4000	200	0.1%	U16	During operation	Immedi-ately
4Ch	C03.4B	Invalid value for torque reached	-	0-4000	100	0.1%	U16	During operation	Immedi-ately

NOTICE

- For details about parameters above, refer to section 8.24.3 "Group C03".

8.5 I/O Parameters (2004h/C04)

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
01h	C04.00	DI1 function selection	0: No definition 1: S-ON 2: Fault reset 3: Gain switchover 4: Emergency stop 5: Home switch 6: Forward overtravel 7: Reverse overtravel 8: Mode 1 9: Mode 2 10: Positive jog 11: Negative jog 12: Segment selection 1 13: Segment selection 2 14: Segment selection 3 15: Segment selection 4 16: Position reference direction 17: Velocity reference direction 18: Torque reference direction 19: Position planning trigger 20: Position planning pause 21: Position capture inhibit 22: Position capture release 23: Position deviation clear 24: Position reference inhibit 25: Referencing start enable 26: Velocity reference mode 27: Zero clamp 28: External velocity limit 29: External torque limit 32: Electronic gear ratio switchover 33: Position capture enable 34: Position step amount enable 35: Hand wheel enable 36: Hand wheel ratio 1 37: Hand wheel ratio 2	0-37	6	-	U16	At stop	Immedi-ately
02h	C04.01	DI1 logic selection	0: NO 1: NC	0-1	0	-	U16	During operation	Immedi-ately

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
03h	C04.02	DI1 filter time	-	0-65535	150	0.01ms	U16	During operation	Immedi-ately
05h	C04.04	DI2 function selection	0: No definition 1: S-ON 2: Fault reset 3: Gain switchover 4: Emergency stop 5: Home switch 6: Forward overtravel 7: Reverse overtravel 8: Mode 1 9: Mode 2 10: Positive jog 11: Negative jog 12: Segment selection 1 13: Segment selection 2 14: Segment selection 3 15: Segment selection 4 16: Position reference direction 17: Velocity reference direction 18: Torque reference direction 19: Position planning trigger 20: Position planning pause 21: Position capture inhibit 22: Position capture release 23: Position deviation clear 24: Position reference inhibit 25: Referencing start enable 26: Velocity reference mode 27: Zero clamp 28: External velocity limit 29: External torque limit 32: Electronic gear ratio switchover 33: Position capture enable 34: Position step amount enable 35: Hand wheel enable 36: Hand wheel ratio 1 37: Hand wheel ratio 2	0-37	7	-	U16	At stop	Immedi-ately
06h	C04.05	DI2 logic selection	0: NO 1: NC	0-1	0	-	U16	During operation	Immedi-ately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
07h	C04.06	DI2 filter time	-	0-65535	150	0.01ms	U16	During operation	Immediately
09h	C04.08	DI3 function selection	0: No definition 1: S-ON 2: Fault reset 3: Gain switchover 4: Emergency stop 5: Home switch 6: Forward overtravel 7: Reverse overtravel 8: Mode 1 9: Mode 2 10: Positive jog 11: Negative jog 12: Segment selection 1 13: Segment selection 2 14: Segment selection 3 15: Segment selection 4 16: Position reference direction 17: Velocity reference direction 18: Torque reference direction 19: Position planning trigger 20: Position planning pause 21: Position capture inhibit 22: Position capture release 23: Position deviation clear 24: Position reference inhibit 25: Referencing start enable 26: Velocity reference mode 27: Zero clamp 28: External velocity limit 29: External torque limit 32: Electronic gear ratio switchover 33: Position capture enable 34: Position step amount enable 35: Hand wheel enable 36: Hand wheel ratio 1 37: Hand wheel ratio 2	0-37	24	-	U16	At stop	Immediately
0Ah	C04.09	DI3 logic selection	0: NO 1: NC	0-1	0	-	U16	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
0Bh	C04.0A	DI3 filter time	-	0-65535	150	0.01ms	U16	During operation	Immediately
0Dh	C04.0C	DI4 function selection	0: No definition 1: S-ON 2: Fault reset 3: Gain switchover 4: Emergency stop 5: Home switch 6: Forward overtravel 7: Reverse overtravel 8: Mode 1 9: Mode 2 10: Positive jog 11: Negative jog 12: Segment selection 1 13: Segment selection 2 14: Segment selection 3 15: Segment selection 4 16: Position reference direction 17: Velocity reference direction 18: Torque reference direction 19: Position planning trigger 20: Position planning pause 21: Position capture inhibit 22: Position capture release 23: Position deviation clear 24: Position reference inhibit 25: Referencing start enable 26: Velocity reference mode 27: Zero clamp 28: External velocity limit 29: External torque limit 32: Electronic gear ratio switchover 33: Position capture enable 34: Position step amount enable 35: Hand wheel enable 36: Hand wheel ratio 1 37: Hand wheel ratio 2	0-37	2	-	U16	At stop	Immediately
0Eh	C04.0D	DI4 logic selection	0: NO 1: NC	0-1	0	-	U16	During operation	Immediately

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
0Fh	C04.0E	DI4 filter time	-	0-65535	150	0.01ms	U16	During operation	Immedi-ately
11h	C04.10	DI5 function selection	0: No definition 1: S-ON 2: Fault reset 3: Gain switchover 4: Emergency stop 5: Home switch 6: Forward overtravel 7: Reverse overtravel 8: Mode 1 9: Mode 2 10: Positive jog 11: Negative jog 12: Segment selection 1 13: Segment selection 2 14: Segment selection 3 15: Segment selection 4 16: Position reference direction 17: Velocity reference direction 18: Torque reference direction 19: Position planning trigger 20: Position planning pause 21: Position capture inhibit 22: Position capture release 23: Position deviation clear 24: Position reference inhibit 25: Referencing start enable 26: Velocity reference mode 27: Zero clamp 28: External velocity limit 29: External torque limit 32: Electronic gear ratio switchover 33: Position capture enable 34: Position step amount enable 35: Hand wheel enable 36: Hand wheel ratio 1 37: Hand wheel ratio 2	0-37	1	-	U16	At stop	Immedi-ately
12h	C04.11	DI5 logic selection	0: NO 1: NC	0-1	0	-	U16	During operation	Immedi-ately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
13h	C04.12	DI5 filter time	-	0-65535	150	0.01ms	U16	During operation	Immediately
15h	C04.14	DI6 function selection	0: No definition 1: S-ON 2: Fault reset 3: Gain switchover 4: Emergency stop 5: Home switch 6: Forward overtravel 7: Reverse overtravel 8: Mode 1 9: Mode 2 10: Positive jog 11: Negative jog 12: Segment selection 1 13: Segment selection 2 14: Segment selection 3 15: Segment selection 4 16: Position reference direction 17: Velocity reference direction 18: Torque reference direction 19: Position planning trigger 20: Position planning pause 21: Position capture inhibit 22: Position capture release 23: Position deviation clear 24: Position reference inhibit 25: Referencing start enable 26: Velocity reference mode 27: Zero clamp 28: External velocity limit 29: External torque limit 32: Electronic gear ratio switchover 33: Position capture enable 34: Position step amount enable 35: Hand wheel enable 36: Hand wheel ratio 1 37: Hand wheel ratio 2	0-37	0	-	U16	At stop	Immediately
16h	C04.15	DI6 logic selection	0: NO 1: NC	0-1	0	-	U16	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
17h	C04.16	DI6 filter time	-	0-65535	150	0.01ms	U16	During operation	Immediately
19h	C04.18	DI7 function selection	0: No definition 1: S-ON 2: Fault reset 3: Gain switchover 4: Emergency stop 5: Home switch 6: Forward overtravel 7: Reverse overtravel 8: Mode 1 9: Mode 2 10: Positive jog 11: Negative jog 12: Segment selection 1 13: Segment selection 2 14: Segment selection 3 15: Segment selection 4 16: Position reference direction 17: Velocity reference direction 18: Torque reference direction 19: Position planning trigger 20: Position planning pause 21: Position capture inhibit 22: Position capture release 23: Position deviation clear 24: Position reference inhibit 25: Referencing start enable 26: Velocity reference mode 27: Zero clamp 28: External velocity limit 29: External torque limit 32: Electronic gear ratio switchover 33: Position capture enable 34: Position step amount enable 35: Hand wheel enable 36: Hand wheel ratio 1 37: Hand wheel ratio 2	0-37	33	-	U16	At stop	Immediately
1Ah	C04.19	DI7 logic selection	0: NO 1: NC	0-1	0	-	U16	During operation	Immediately

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
1Bh	C04.1A	DI7 filter time	-	0-65535	150	0.01ms	U16	During operation	Immedi-ately
1Dh	C04.1C	DI8 function selection	0: No definition 1: S-ON 2: Fault reset 3: Gain switchover 4: Emergency stop 5: Home switch 6: Forward overtravel 7: Reverse overtravel 8: Mode 1 9: Mode 2 10: Positive jog 11: Negative jog 12: Segment selection 1 13: Segment selection 2 14: Segment selection 3 15: Segment selection 4 16: Position reference direction 17: Velocity reference direction 18: Torque reference direction 19: Position planning trigger 20: Position planning pause 21: Position capture inhibit 22: Position capture release 23: Position deviation clear 24: Position reference inhibit 25: Referencing start enable 26: Velocity reference mode 27: Zero clamp 28: External velocity limit 29: External torque limit 32: Electronic gear ratio switchover 33: Position capture enable 34: Position step amount enable 35: Hand wheel enable 36: Hand wheel ratio 1 37: Hand wheel ratio 2	0-37	5	-	U16	At stop	Immedi-ately
1Eh	C04.1D	DI8 logic selection	0: NO 1: NC	0-1	0	-	U16	During operation	Immedi-ately

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
1Fh	C04.1E	DI8 filter time	-	0-65535	150	0.01ms	U16	During operation	Immedi-ately
31h	C04.30	DO1 function selection	0: No definition 1: Servo ready 2: Motor rotation 3: Brake 4: Fault 5: Alarm 6: Servo operation 7: Position reach 8: Positioning near 9: Referencing completion 10: Position capture completion 11: Position comparison output 12: Zero velocity signal 13: Velocity limit 14: Velocity reach 15: Velocity synchronization 16: Torque limit 17: Torque reached 18: EMD output 19: Angle auto-tuning completion	0-20	1	-	U16	At stop	Immedi-ately
32h	C04.31	DO1 logic selection	0: NO 1: NC	0-1	0	-	U16	During operation	Immedi-ately
33h	C04.32	DO2 function selection	0: No definition 1: Servo ready 2: Motor rotation 3: Brake 4: Fault 5: Alarm 6: Servo operation 7: Position reach 8: Positioning near 9: Referencing completion 10: Position capture completion 11: Position comparison output 12: Zero velocity signal 13: Velocity limit 14: Velocity reach 15: Velocity synchronization 16: Torque limit 17: Torque reached 18: EMD output 19: Angle auto-tuning completion	0-20	7	-	U16	At stop	Immedi-ately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
34h	C04.33	DO2 logic selection	0: NO 1: NC	0-1	0	-	U16	During operation	Immediately
35h	C04.34	DO3 function selection	0: No definition 1: Servo ready 2: Motor rotation 3: Brake 4: Fault 5: Alarm 6: Servo operation 7: Position reach 8: Positioning near 9: Referencing completion 10: Position capture completion 11: Position comparison output 12: Zero velocity signal 13: Velocity limit 14: Velocity reach 15: Velocity synchronization 16: Torque limit 17: Torque reached 18: EMD output 19: Angle auto-tuning completion	0-20	3	-	U16	At stop	Immediately
36h	C04.35	DO3 logic selection	0: NO 1: NC	0-1	0	-	U16	During operation	Immediately
37h	C04.36	DO4 function selection	0: No definition 1: Servo ready 2: Motor rotation 3: Brake 4: Fault 5: Alarm 6: Servo operation 7: Position reach 8: Positioning near 9: Referencing completion 10: Position capture completion 11: Position comparison output 12: Zero velocity signal 13: Velocity limit 14: Velocity reach 15: Velocity synchronization 16: Torque limit 17: Torque reached 18: EMD output 19: Angle auto-tuning completion	0-20	4	-	U16	At stop	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
38h	C04.37	DO4 logic selection	0: NO 1: NC	0-1	0	-	U16	During operation	Immediately
39h	C04.38	DO5 function selection	0: No definition 1: Servo ready 2: Motor rotation 3: Brake 4: Fault 5: Alarm 6: Servo operation 7: Position reach 8: Positioning near 9: Referencing completion 10: Position capture completion 11: Position comparison output 12: Zero velocity signal 13: Velocity limit 14: Velocity reach 15: Velocity synchronization 16: Torque limit 17: Torque reached 18: EMD output 19: Angle auto-tuning completion	0-20	9	-	U16	At stop	Immediately
3Ah	C04.39	DO5 logic selection	0: NO 1: NC	0-1	0	-	U16	During operation	Immediately
41h	C04.40	AI1 offset	-	-5000-5000	0	mV	I16	During operation	Immediately
42h	C04.41	AI1 dead zone	-	0-50000	0	0.1mV	U16	During operation	Immediately
43h	C04.42	AI1 zero drift	-	-5000-5000	0	0.1mV	I16	During operation	Immediately
44h	C04.43	AI1 median filter enable	0: Inactive 1: Enabled	0-1	1	-	U16	During operation	Immediately
45h	C04.44	AI1 low-pass filter time	-	0-65535	50	0.01ms	U16	During operation	Immediately
46h	C04.45	AI function configuration	Bit00: Current-type AI disconnection detection switch 0: Disabled 1: Open	0-65535	0	-	U16	At stop	Immediately
4Ah	C04.49	AI2 median filter enable	0: Inactive 1: Active	0-1	1	-	U16	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
4Bh	C04.4A	AI2 low-pass filter time	-	0-65535	50	0.01ms	U16	During operation	Immediately
4Ch	C04.4B	Speed value corresponding to analog 10 V	-	0-20000	3000	rpm	U16	During operation	Immediately
4Dh	C04.4C	Torque value corresponding to analog 10 V	-	0-8000	1000	0.1%	U16	During operation	Immediately
4Eh	C04.4D	Speed value corresponding to analog 20 mA	-	0-20000	3000	rpm	U16	During operation	Immediately
4Fh	C04.4E	Torque value corresponding to analog 20 mA	-	0-8000	1000	0.1%	U16	During operation	Immediately
51h	C04.50	AO1 mode selection	0: Speed feedback 1: Speed reference 2: Torque reference 3: Position deviation (reference unit) 4: Position deviation (encoder unit) 5: Position reference speed 6: Positioning completed 7. Speed feedforward 8: AI1 sampling value 9: AI2 sampling value 10: Torque feedforward 11: Bus voltage 12: End of position reference output 16: Voltage test	0-16	0	-	U16	During operation	Immediately
52h	C04.51	AO1 offset voltage	-	-9999-9999	0	mV	I16	During operation	Immediately
53h	C04.52	AO1 ratio	-	-9999-9999	100	0.01	I16	During operation	Immediately

8.6 Stop Mode (2005h/C05)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
01h	C05.00	Stop mode at S-ON Off	-4: Ramp to stop (C05.08), keeping the DB state -3: Stop at zero speed, keeping the DB state -2: Ramp to stop (C05.0A), keeping the DB state -1: DB stop, keeping the DB state 0: Coast to stop, keeping the de-energized state 1: Ramp to stop (C05.0A), keeping the de-energized state 2: Stop at zero speed, keeping the de-energized state	-4-2	0	-	I16	At stop	Immediately
02h	C05.01	Quick stop mode	0: Coast to stop, keeping the de-energized state 1: Ramp to stop (C05.0A), keeping the de-energized state 2: Ramp to stop (C05.08), keeping the de-energized state 3: Stop at emergency stop torque, keeping the de-energized state 4: Stop at zero speed, keeping the de-energized state 5: Ramp to stop (C05.0A), keeping the locked position 6: Ramp to stop (C05.08), keeping the locked position 7: Stop at emergency stop torque, keeping the locked position	0-7	2	-	U16	At stop	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
03h	C05.02	Stop mode at overtravel	0: Coast to stop, keeping de-energized status 1: Stop at zero speed, keeping position lock status 2: Stop at zero speed, keeping de-energized status 3: Ramp to stop as defined by C05.08, keeping de-energized status 4: Ramp to stop as defined by C05.08, keeping position lock status 5: Dynamic braking stop, keeping de-energized status 6: Dynamic braking stop, keeping dynamic braking status 7: Not responding to overtravel	0-7	1	-	U16	At stop	Immediately
04h	C05.03	Stop mode at No. 1 fault	0: Coast to stop, keeping de-energized status 1: Dynamic braking stop, keeping de-energized status 2: Dynamic braking stop, keeping dynamic braking status	0-2	2	-	U16	At stop	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
05h	C05.04	Stop mode at No. 2 fault	-5: Stop at zero speed, keeping the DB state -4: Stop at emergency stop torque, keeping the DB state -3: Ramp to stop (C05.08), keeping the DB state -2: Ramp to stop (C05.0A), keeping the DB state -1: DB stop, keeping the DB state 0: Coast to stop, keeping the de-energized state 1: Ramp to stop (C05.0A), keeping the de-energized state 2: Ramp to stop (C05.08), keeping the de-energized state 3: Stop at emergency stop torque, keeping the de-energized state	-5-3	1	-	I16	At stop	Immediately
08h	C05.07	Stop speed threshold	-	5-1000	10	rpm	U16	During operation	Immediately
09h	C05.08	Deceleration time for ramp to quick stop	-	0-3600000	0	ms	U32	During operation	Immediately
0Bh	C05.0A	Deceleration time for ramp to slow stop	-	0-3600000	100	ms	U32	During operation	Immediately
0Dh	C05.0C	Limit for stop at emergency-stop torque	-	5-3000	1000	0.1%	U16	During operation	Immediately
11h	C05.10	Delay from brake close to motor de-energized	-	0-65535	100	ms	U16	During operation	Immediately
12h	C05.11	Speed threshold at brake closing	-	10-3000	30	rpm	U16	During operation	Immediately
13h	C05.12	Maximum waiting time with S-ON off at brake closing	-	0-65535	100	ms	U16	During operation	Immediately
14h	C05.13	Delay from brake on to command received	-	0-65535	100	ms	U16	At stop	Immediately

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
15h	C05.14	Energizing delay of DB relay	-	0-65535	20	ms	U16	At stop	Immedi-ately

8.7 Protection Parameters (2006h/C06)

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
01h	C06.00	Threshold of excessive local position deviation	-	0-(2^{32}-1)	32767	Unit in application	U32	During operation	Immedi-ately
03h	C06.02	Threshold of excessive position reference frequency	-	0-4000	4000	kHz	U16	At stop	Immedi-ately
04h	C06.03	Threshold of excessive speed	-	0-9000	0	rpm	U16	During operation	Immedi-ately
05h	C06.04	Input phase loss detection	0: Enabled 1: Disabled	0-1	0	-	U16	At stop	Immedi-ately
06h	C06.05	Retentive at power failure	0: Non-retentive 1: Retentive	0-1	0	-	U16	At stop	Immedi-ately
07h	C06.06	STO function shielding	-	0-1	0	-	U16	At stop	Immedi-ately
08h	C06.07	Mechanical limit position	0: Inactive 1: Enabled 2: Enabled after homing	0-2	0	-	U16	During operation	Immedi-ately
09h	C06.08	Mechanical PL	-	-2^{31}-(2^{31}-1)	2^{31}-1	Unit in application	I32	During operation	Immedi-ately
0Bh	C06.0A	Mechanical NL	-	-2^{31}-(2^{31}-1)	-2^{31}	Unit in application	I32	During operation	Immedi-ately
0Eh	C06.0D	Three-phase 220 V to two-phase alarm switch	0: Disabled 1: Enabled	0-1	0	-	U16	At stop	Immedi-ately
0Fh	C06.0E	STO handling method	0: Fault 1: State	0-1	1	-	U16	At stop	Upon re-power-on
11h	C06.10	Drive overload protection threshold	-	0-3500	1150	0.1%	U16	At stop	Immedi-ately
12h	C06.11	Motor overload protection threshold	-	0-3500	1150	0.1%	U16	At stop	Immedi-ately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
13h	C06.12	Motor locked-rotor detection	0: Inactive 1: Enabled	0-1	1	-	U16	At stop	Immediately
14h	C06.13	Motor locked-rotor detection time	-	0-3000	200	ms	U16	At stop	Immediately
15h	C06.14	Motor locked-rotor detection speed	-	0-1000	10	rpm	U16	During operation	Immediately
16h	C06.15	Output phase loss detection	0: Inactive 1: Enabled	0-1	0	-	U16	At stop	Immediately
17h	C06.16	PTC enabling	0: Inactive 1: Enabled	0-1	0	-	U16	At stop	Immediately
18h	C06.17	Motor overload current coefficient	-	0-200	100	%	U16	At stop	Immediately
19h	C06.18	IGBT over-temperature protection threshold	-	0-200	135	℃	U16	At stop	Upon re-power-on
1Ah	C06.19	Discharge conduit over-temperature protection threshold	-	0-200	115	℃	U16	At stop	Upon re-power-on
1Bh	C06.1A	Encoder over-temperature protection threshold	-	0-200	80	℃	U16	At stop	Upon re-power-on
1Ch	C06.1B	Encoder multi-turn overflow protection	0: Inactive 1: Enabled	0-1	1	-	U16	At stop	Immediately
1Dh	C06.1C	Drive high temperature warning thresh-old	-	0-1200	900	0.1℃	U16	During operation	Immediately
1Eh	C06.1D	Output phase loss detection threshold	-	0-2000	0	0.1 times	U16	During operation	Immediately
21h	C06.20	Protection from out of control	0: Inactive 1: Enabled	0-1	1	-	U16	At stop	Immediately
22h	C06.21	Torque threshold for protection from out of control	-	1-4000	2000	0.1%	U16	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
23h	C06.22	Speed threshold for protection from out of control	-	1-1000	50	rpm	U16	During operation	Immediately
24h	C06.23	Speed filter time for protection from out of control	-	1-1000	20	0.1ms	U16	During operation	Immediately
25h	C06.24	Detection time for protection from out of control	-	10-1000	30	ms	U16	During operation	Immediately
26h	C06.25	Motor overtemperature protection enable	-	0-1	0	-	U16	During operation	Immediately
27h	C06.26	Motor overtemperature protection threshold	-	0-2000	1100	0.1℃	U16	During operation	Immediately
28h	C06.27	STO 24 V disconnection filter time	-	1-5	4	ms	U16	At stop	Upon re-power-on
29h	C06.28	Servo OFF delay after STO triggered	-	0-25	20	ms	U16	During operation	Immediately
2Ah	C06.29	SizeCDE electromagnetic shorting	-	0-1	0	-	U16	At stop	Upon re-power-on
2Ch	C06.2B	STO PWM buffer detection method	-	0-2	0	-	U16	At stop	Immediately

NOTICE

- For details about parameters above, refer to section 8.24.4 "Group C06".

8.8 Auto-tuning Parameters (2007h/C07)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
01h	C07.00	Offline inertia auto-tuning mode setting	-	0-785	769	-	U16	At stop	Immediately
02h	C07.01	Offline inertia auto-tuning speed reference	-	50-1000	500	rpm	U16	At stop	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
03h	C07.02	Acceleration/ Deceleration time for offline inertia auto-tuning	-	0-65535	100	ms	U16	At stop	Immediately
04h	C07.03	Offline inertia auto-tuning target torque	-	1-1500	150	0.1%	U16	At stop	Immediately
05h	C07.04	Offline inertia auto-tuning revolutions	-	10-65535	200	0.01r	U16	At stop	Immediately
09h	C07.08	Online inertia auto-tuning mode setting	0: Disabled 1: Slow inertia change 2: Common inertia change 3: Quick inertia change	0-3	0	-	U16	During operation	Immediately
0Ah	C07.09	Online inertia auto-tuning parameter setting	-	0-65535	19	-	U16	During operation	Immediately
0Bh	C07.0A	Online inertia auto-tuning speed feedback over-lapping filter time	-	0-400	100	0.01ms	U16	At stop	Upon re-power-on
0Ch	C07.0B	Online inertia auto-tuning torque feedback over-lapping filter time	-	0-400	400	0.01ms	U16	At stop	Upon re-power-on
29h	C07.28	Low-speed area threshold in friction identification reference	-	10-200	100	rpm	U16	At stop	Immediately
2Ah	C07.29	Number of target velocities in friction identification reference	-	10-50	40	-	U16	At stop	Immediately
2Bh	C07.2A	Maximum speed in friction identification reference	-	100-500	500	rpm	U16	At stop	Immediately
2Ch	C07.2B	Number of velocities in low-speed mode in friction identification reference	-	10-25	20	-	U16	At stop	Immediately

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
2Dh	C07.2C	Acceleration/ Deceleration time in friction identifi-cation reference	-	10-1000	120	ms	U16	At stop	Immedi-ately
2Eh	C07.2D	Constant-velocity operation time in friction identi-fication reference	-	10-1000	120	ms	U16	At stop	Immedi-ately
2Fh	C07.2E	Stop time in friction identification reference	-	10-1000	120	ms	U16	At stop	Immedi-ately
30h	C07.2F	Completion flag in friction identification reference	-	50-20000	200	0.01r	U16	At stop	Immedi-ately

8.9 Communication Parameters (200Ah/C0A)

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
01h	C0A.00	Modbus communication station number	-	1-255	1	-	U16	At stop	Immedi-ately
02h	C0A.01	Modbus communication baud rate	1: 2400bps 2: 4800bps 3: 9600bps 4: 19200bps 5: 38400bps 6: 57600bps 7: 115200bps	1-7	7	-	U16	At stop	Upon re-power-on
03h	C0A.02	Modbus communication format	0: No parity, 1 stop bit 1: Odd parity, 1 stop bit 2: Even parity, 1 stop bit 3: No parity, 2 stop bits 4: Odd parity, 2 stop bits 5: Even parity, 2 stop bits	0-5	0	-	U16	At stop	Upon re-power-on
04h	C0A.03	Modbus communication response time	-	1-1000	1	ms	U16	At stop	Immedi-ately
06h	C0A.05	Modbus communication storage selection	0: No storage 1: Storage	0-1	1	-	U16	At stop	Immedi-ately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
07h	C0A.06	Modbus data format	0: Low 16 bits before high 16 bits 1: High 16 bits before low 16 bits	0-1	0	-	U16	At stop	Immediately
09h	C0A.08	Commissioning software communication station ID	-	1-255	1	-	U16	At stop	Immediately
0Ah	C0A.09	Commissioning software communication baud rate	0: 1200bps 1: 2400bps 2: 4800bps 3: 9600bps 4: 19200bps 5: 38400bps 6: 57600bps 7: 115200bps	0-7	7	-	U16	At stop	Upon re-power-on
0Bh	C0A.0A	Commissioning software communication format	0: No parity, 1 stop bit 1: Odd parity, 1 stop bit 2: Even parity, 1 stop bit 3: No parity, 2 stop bits 4: Odd parity, 2 stop bits 5: Even parity, 2 stop bits	0-5	0	-	U16	At stop	Upon re-power-on
0Ch	C0A.0B	Commissioning software communication response time	-	1-1000	1	ms	U16	At stop	Immediately
0Eh	C0A.0D	Commissioning software communication storage	0: No storage 1: Storage	0-1	1	-	U16	At stop	Immediately
0Fh	C0A.0E	Commissioning software data format	0: Low 16 bits before high 16 bits 1: High 16 bits before low 16 bits	0-1	0	-	U16	At stop	Immediately
13h	C0A.12	USB display switch	-	0-1	1	-	U16	At stop	Upon re-power-on

NOTICE

- For details about parameters above, refer to section 8.24.5 "Group C0A".

8.10 Setting of Position Comparison (200Dh/C0D)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
01h	C0D.00	Position comparison output switch	0: Disabled 1: Enabled	0-1	0	-	U16	During operation	Immediately
03h	C0D.02	Position comparison resolution	0: 24bit 1: 23bit 2: 22bit 3: 21bit 4: 20bit 5: 19bit 6: 18bit 7: 17bit	0-7	1	-	U16	During operation	Immediately
04h	C0D.03	Position comparison mode	0: Individual absolute comparison mode 1: Cyclic incremental comparison mode 2: Fixed cyclic incremental mode 3: Cyclic absolute comparison mode	0-3	0	-	U16	During operation	Immediately
06h	C0D.05	Position comparison output width	-	5-1200	10	0.1ms	U16	During operation	Upon re-power-on
07h	C0D.06	Position comparison output port polarity	Bit00: Channel 1 polarity 0: Negative polarity 1: Positive polarity Bit01: Channel 2 polarity 0: Negative polarity 1: Positive polarity Bit02: Channel 3 polarity 0: Negative polarity 1: Positive polarity Bit03: Channel 4 polarity 0: Negative polarity 1: Positive polarity	0-65535	15	-	U16	During operation	Upon re-power-on
08h	C0D.07	Start point of position comparison	-	1-40	1	-	U16	During operation	Immediately
09h	C0D.08	End point of position comparison	-	1-40	1	-	U16	During operation	Immediately
0Ah	C0D.09	Position comparison status	-	0-1024	0	-	U16	Read only	Immediately

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
0Bh	C0D.0A	Real-time position of position comparison	-	-2^{31}-(2^{31}-1)	0	-	I32	Read only	Immedi-ately
0Dh	C0D.0C	Zero offset of position comparison	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immedi-ately
0Fh	C0D.0E	Compensation for position comparison output de-lay	-	0-10000	0	0.01us	U16	At stop	Upon re-power-on
10h	C0D.0F	Fixed number of cycles	-	1-65535	1	-	U16	During operation	Immedi-ately
12h	C0D.11	Number of cycles in certain mode	-	0-65535	0	-	U16	Read only	Immedi-ately
14h	C0D.13	Start comparison point in loop absolute mode	-	1-40	1	-	U16	During operation	Immedi-ately

8.11 Position Comparison Parameters (200Eh/C0E)

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
01h	C0E.00	Setting of target position 1	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immedi-ately
03h	C0E.02	Attribute of target position 1	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immedi-ately
04h	C0E.03	Setting of target position 2	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immedi-ately

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
06h	C0E.05	Attribute of target position 2	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immedi-ately
07h	C0E.06	Setting of target position 3	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immedi-ately
09h	C0E.08	Attribute of target position 3	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immedi-ately
0Ah	C0E.09	Setting of target position 4	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immedi-ately
0Ch	C0E.0B	Attribute of target position 4	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immedi-ately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
0Dh	C0E.0C	Setting of target position 5	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immediately
0Fh	C0E.0E	Attribute of target position 5	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immediately
10h	C0E.0F	Setting of target position 6	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immediately
12h	C0E.11	Attribute of target position 6	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immediately
13h	C0E.12	Setting of target position 7	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
15h	C0E.14	Attribute of target position 7	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immediately
16h	C0E.15	Setting of target position 8	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immediately
18h	C0E.17	Attribute of target position 8	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immediately
19h	C0E.18	Setting of target position 9	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immediately
1Bh	C0E.1A	Attribute of target position 9	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immediately

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
1Ch	C0E.1B	Setting of target position 10	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immedi-ately
1Eh	C0E.1D	Attribute of target position 10	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immedi-ately
1Fh	C0E.1E	Setting of target position 11	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immedi-ately
21h	C0E.20	Attribute of target position 11	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immedi-ately
22h	C0E.21	Setting of target position 12	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immedi-ately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
24h	C0E.23	Attribute of target position 12	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immediately
25h	C0E.24	Setting of target position 13	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immediately
27h	C0E.26	Attribute of target position 13	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immediately
28h	C0E.27	Setting of target position 14	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immediately
2Ah	C0E.29	Attribute of target position 14	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
2Bh	C0E.2A	Setting of target position 15	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immediately
2Dh	C0E.2C	Attribute of target position 15	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immediately
2Eh	C0E.2D	Setting of target position 16	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immediately
30h	C0E.2F	Attribute of target position 16	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immediately
31h	C0E.30	Setting of target position 17	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
33h	C0E.32	Attribute of target position 17	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immediately
34h	C0E.33	Setting of target position 18	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immediately
36h	C0E.35	Attribute of target position 18	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immediately
37h	C0E.36	Setting of target position 19	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immediately
39h	C0E.38	Attribute of target position 19	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
3Ah	C0E.39	Setting of target position 20	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immediately
3Ch	C0E.3B	Attribute of target position 20	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immediately
3Dh	C0E.3C	Setting of target position 21	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immediately
3Fh	C0E.3E	Attribute of target position 21	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immediately
40h	C0E.3F	Setting of target position 22	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
42h	C0E.41	Attribute of target position 22	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immediately
43h	C0E.42	Setting of target position 23	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immediately
45h	C0E.44	Attribute of target position 23	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immediately
46h	C0E.45	Setting of target position 24	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immediately
48h	C0E.47	Attribute of target position 24	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immediately

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
49h	C0E.48	Setting of target position 25	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immedi-ately
4Bh	C0E.4A	Attribute of target position 25	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immedi-ately
4Ch	C0E.4B	Setting of target position 26	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immedi-ately
4Eh	C0E.4D	Attribute of target position 26	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immedi-ately
4Fh	C0E.4E	Setting of target position 27	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immedi-ately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
51h	C0E.50	Attribute of target position 27	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immediately
52h	C0E.51	Setting of target position 28	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immediately
54h	C0E.53	Attribute of target position 28	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immediately
55h	C0E.54	Setting of target position 29	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immediately
57h	C0E.56	Attribute of target position 29	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
58h	C0E.57	Setting of target position 30	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immediately
5Ah	C0E.59	Attribute of target position 30	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immediately
5Bh	C0E.5A	Setting of target position 31	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immediately
5Dh	C0E.5C	Attribute of target position 31	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immediately
5Eh	C0E.5D	Setting of target position 32	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immediately

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
60h	C0E.5F	Attribute of target position 32	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immedi-ately
61h	C0E.60	Setting of target position 33	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immedi-ately
63h	C0E.62	Attribute of target position 33	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immedi-ately
64h	C0E.63	Setting of target position 34	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immedi-ately
66h	C0E.65	Attribute of target position 34	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immedi-ately

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
67h	C0E.66	Setting of target position 35	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immedi-ately
69h	C0E.68	Attribute of target position 35	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immedi-ately
6Ah	C0E.69	Setting of target position 36	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immedi-ately
6Ch	C0E.6B	Attribute of target position 36	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immedi-ately
6Dh	C0E.6C	Setting of target position 37	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immedi-ately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
6Fh	C0E.6E	Attribute of target position 37	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immediately
70h	C0E.6F	Setting of target position 38	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immediately
72h	C0E.71	Attribute of target position 38	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immediately
73h	C0E.72	Setting of target position 39	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immediately
75h	C0E.74	Attribute of target position 39	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
76h	C0E.75	Setting of target position 40	-	-2^{31}-(2^{31}-1)	0	-	I32	During operation	Immediately
78h	C0E.77	Attribute of target position 40	Bit00: Output DO active signal if current position changes from "less than" to "more than" the comparison point Bit01: Output DO active signal if current position changes from "more than" to "less than" the comparison point Bit08: Channel 1 output Bit09: Channel 2 output Bit10: Channel 3 output Bit11: Channel 4 output	0-65535	0	-	U16	During operation	Immediately

8.12 Homing Touch Probe Parameters (2010h/C10)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
01h	C10.00	Homing enable	0: Inactive 1: Written through communication 2: DI trigger 3: Current position as home	0-3	0	-	U16	During operation	Immediately
02h	C10.01	Homing method selection	-	-2-35	0	-	I16	During operation	Immediately
03h	C10.02	Initial homing speed	-	0-8000	100	rpm	U16	During operation	Immediately
04h	C10.03	End homing speed	-	0-3000	10	rpm	U16	During operation	Immediately
05h	C10.04	Homing acceleration time	-	0-3600000	1000	ms	U32	During operation	Immediately
07h	C10.06	Homing deceleration time	-	0-3600000	1000	ms	U32	During operation	Immediately
09h	C10.08	Homing timeout interval	-	0-(2^{32}-1)	60000	ms	U32	During operation	Immediately
0Bh	C10.0A	Homing offset mode	0: Absolute position 1: Relative position	0-1	0	-	U16	At stop	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
0Ch	C10.0B	Homing offset distance	-	-2^{31}-(2^{31}-1)	0	Unit in application	I32	During operation	Immediately
11h	C10.10	Multi-turn absolute position offset (low 32 bits)	-	-2^{31}-(2^{31}-1)	0	P	I32	At stop	Upon re-power-on
13h	C10.12	Multi-turn absolute position offset (high 32 bits)	-	-2^{31}-(2^{31}-1)	0	P	I32	At stop	Upon re-power-on
15h	C10.14	Multi-turn revolutions data offset	-	0-65535	0	Rev	U16	Read only	Immediately
16h	C10.15	Multi-turn overflow flag	-	0-1	0	-	U16	Read only	Immediately
17h	C10.16	Reference running mode in rotation mode	0: Nearest 1: Always in forward direction 2: Always in reverse direction 3: Always in current direction 4: Not specified	0-4	0	-	U16	At stop	Immediately
19h	C10.18	Numerator of electronic gear ratio in rotation mode	-	1-65535	1	-	U16	At stop	Immediately
1Ah	C10.19	Denominator of electronic gear ratio in rotation mode	-	1-65535	1	-	U16	At stop	Immediately
1Bh	C10.1A	Upper limit of mechanical absolute position in ro-tation mode (low 32 bits)	-	0-(2^{32}-1)	0	P	U32	At stop	Immediately
1Dh	C10.1C	Upper limit of mechanical absolute position in ro-tation mode (high 32 bits)	-	0-(2^{32}-1)	0	P	U32	At stop	Immediately
1Fh	C10.1E	Single-turn homing absolute value offset	-	-2^{31}-(2^{31}-1)	0	Unit in application	I32	At stop	Upon re-power-on
21h	C10.20	Probe capture enable	0: Inactive 1: Enabled	0-1	0	-	U16	At stop	Upon re-power-on

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
22h	C10.21	Release of probe capture state	0: Do not release 1. Release	0-1	0	-	U16	At stop	Upon re-power-on
23h	C10.22	Probe capture offset distance	-	-2^{31}-$(2^{31}-1)$	0	Unit in application	I32	During operation	Immediately
25h	C10.24	Probe capture speed	-	0-8000	100	rpm	U16	During operation	Immediately
26h	C10.25	Probe capture acceleration time	-	0-3600000	10	ms	U32	During operation	Immediately
28h	C10.27	Probe capture deceleration time	-	0-3600000	10	ms	U16	During operation	Immediately
2Dh	C10.2C	Probe capture pin filter time	-	0-10200	200	0.01us	U16	At stop	Upon re-power-on
31h	C10.30	Torque limit of homing upon hit-and-stop	-	0-3000	1000	0.1%	U16	During operation	Immediately
32h	C10.31	Speed for homing upon hit-and-stop	-	5-1000	10	rpm	U16	During operation	Immediately
33h	C10.32	Number of times for homing upon hit-and-stop	-	5-65535	30	-	U16	During operation	Immediately
34h	C10.33	Positioning threshold equivalent upon homing completed	-	0-50	5	rpm	U16	At stop	Upon re-power-on
35h	C10.34	Mode of homing upon hit-and-stop	0: Deviation not cleared 1: Deviation cleared	0-1	0	-	U16	During operation	Immediately

8.13 Position planning (2011h/C11)

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
01h	C11.00	Position planning mode selection	0: Single operation 1. Cyclic operation 2: DI selection mode 3. PP mode 4: Single continuous operation 5: Cyclic continuous mode	0-5	0	-	U16	At stop	Immedi-ately
02h	C11.01	Position planning reference type	0: Absolute reference 1. Relative reference	0-1	0	-	U16	At stop	Immedi-ately
03h	C11.02	Position planning reference update mode	0: Cache update 1: Update now	0-1	0	-	U16	At stop	Immedi-ately
04h	C11.03	Position planning initial group number	-	1-16	1	-	U16	At stop	Immedi-ately
05h	C11.04	Position planning end group number	-	1-16	1	-	U16	At stop	Immedi-ately
06h	C11.05	Processing of position planning remaining segments	0: Continue running the unfinished segment 1: Restart running from the first segment	0-1	0	-	U16	At stop	Immedi-ately
07h	C11.06	Group 1 planning displacement	-	-2^{31}-$(2^{31}-1)$	10000	Unit in application	I32	During operation	Immedi-ately
09h	C11.08	Group 1 planning speed	-	0-8000	100	rpm	U16	During operation	Immedi-ately
0Bh	C11.0A	Group 1 planning acceleration time	-	0-65535	10	ms	U32	During operation	Immedi-ately
0Dh	C11.0C	Group 1 planning deceleration time	-	0-65535	10	ms	U32	During operation	Immedi-ately
0Fh	C11.0E	Group 1 planning waiting time	-	0-$(2^{32}-1)$	10	ms	U32	During operation	Immedi-ately
11h	C11.10	Group 2 planning displacement	-	-2^{31}-$(2^{31}-1)$	10000	Unit in application	I32	During operation	Immedi-ately
13h	C11.12	Group 2 planning speed	-	0-8000	100	rpm	U16	During operation	Immedi-ately
15h	C11.14	Group 2 planning acceleration time	-	0-65535	10	ms	U32	During operation	Immedi-ately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
17h	C11.16	Group 2 planning deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
19h	C11.18	Group 2 planning waiting time	-	0-(2^{32}-1)	10	ms	U32	During operation	Immediately
21h	C11.20	Group 3 planning displacement	-	-2^{31}-(2^{31}-1)	10000	Unit in application	I32	During operation	Immediately
23h	C11.22	Group 3 planning speed	-	0-8000	100	rpm	U16	During operation	Immediately
25h	C11.24	Group 3 planning acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
27h	C11.26	Group 3 planning deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
29h	C11.28	Group 3 planning waiting time	-	0-(2^{32}-1)	10	ms	U32	During operation	Immediately
31h	C11.30	Group 4 planning displacement	-	-2^{31}-(2^{31}-1)	10000	Unit in application	I32	During operation	Immediately
33h	C11.32	Group 4 planning speed	-	0-8000	100	rpm	U16	During operation	Immediately
35h	C11.34	Group 4 planning acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
37h	C11.36	Group 4 planning deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
39h	C11.38	Group 4 planning waiting time	-	0-(2^{32}-1)	10	ms	U32	During operation	Immediately
41h	C11.40	Group 5 planning displacement	-	-2^{31}-(2^{31}-1)	10000	Unit in application	I32	During operation	Immediately
43h	C11.42	Group 5 planning speed	-	0-8000	100	rpm	U16	During operation	Immediately
45h	C11.44	Group 5 planning acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
47h	C11.46	Group 5 planning deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
49h	C11.48	Group 5 planning waiting time	-	0-(2^{32}-1)	10	ms	U32	During operation	Immediately
51h	C11.50	Group 6 planning displacement	-	-2^{31}-(2^{31}-1)	10000	Unit in application	I32	During operation	Immediately
53h	C11.52	Group 6 planning speed	-	0-8000	100	rpm	U16	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
55h	C11.54	Group 6 planning acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
57h	C11.56	Group 6 planning deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
59h	C11.58	Group 6 planning waiting time	-	0-(2^{32}-1)	10	ms	U32	During operation	Immediately
61h	C11.60	Group 7 planning displacement	-	-2^{31}-(2^{31}-1)	10000	Unit in application	I32	During operation	Immediately
63h	C11.62	Group 7 planning speed	-	0-8000	100	rpm	U16	During operation	Immediately
65h	C11.64	Group 7 planning acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
67h	C11.66	Group 7 planning deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
69h	C11.68	Group 7 planning waiting time	-	0-(2^{32}-1)	10	ms	U32	During operation	Immediately
71h	C11.70	Group 8 planning displacement	-	-2^{31}-(2^{31}-1)	10000	Unit in application	I32	During operation	Immediately
73h	C11.72	Group 8 planning speed	-	0-8000	100	rpm	U16	During operation	Immediately
75h	C11.74	Group 8 planning acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
77h	C11.76	Group 8 planning deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
79h	C11.78	Group 8 planning waiting time	-	0-(2^{32}-1)	10	ms	U32	During operation	Immediately
81h	C11.80	Group 9 planning displacement	-	-2^{31}-(2^{31}-1)	10000	Unit in application	I32	During operation	Immediately
83h	C11.82	Group 9 planning speed	-	0-8000	100	rpm	U16	During operation	Immediately
85h	C11.84	Group 9 planning acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
87h	C11.86	Group 9 planning deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
89h	C11.88	Group 9 planning waiting time	-	0-(2^{32}-1)	10	ms	U32	During operation	Immediately
91h	C11.90	Group 10 planning displacement	-	-2^{31}-(2^{31}-1)	10000	Unit in application	I32	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
93h	C11.92	Group 10 planning speed	-	0-8000	100	rpm	U16	During operation	Immediately
95h	C11.94	Group 10 planning acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
97h	C11.96	Group 10 planning deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
99h	C11.98	Group 10 planning waiting time	-	$0\text{-}(2^{32}\text{-}1)$	10	ms	U32	During operation	Immediately
A1h	C11.A0	Group 11 planning displacement	-	$-2^{31}\text{-}(2^{31}\text{-}1)$	10000	Unit in application	I32	During operation	Immediately
A3h	C11.A2	Group 11 planning speed	-	0-8000	100	rpm	U16	During operation	Immediately
A5h	C11.A4	Group 11 planning acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
A7h	C11.A6	Group 11 planning deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
A9h	C11.A8	Group 11 planning waiting time	-	$0\text{-}(2^{32}\text{-}1)$	10	ms	U32	During operation	Immediately
B1h	C11.B0	Group 12 planning displacement	-	$-2^{31}\text{-}(2^{31}\text{-}1)$	10000	Unit in application	I32	During operation	Immediately
B3h	C11.B2	Group 12 planning speed	-	0-8000	100	rpm	U16	During operation	Immediately
B5h	C11.B4	Group 12 planning acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
B7h	C11.B6	Group 12 planning deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
B9h	C11.B8	Group 12 planning waiting time	-	$0\text{-}(2^{32}\text{-}1)$	10	ms	U32	During operation	Immediately
C1h	C11.C0	Group 13 planning displacement	-	$-2^{31}\text{-}(2^{31}\text{-}1)$	10000	Unit in application	I32	During operation	Immediately
C3h	C11.C2	Group 13 planning speed	-	0-8000	100	rpm	U16	During operation	Immediately
C5h	C11.C4	Group 13 planning acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
C7h	C11.C6	Group 13 planning deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
C9h	C11.C8	Group 13 planning waiting time	-	$0\text{-}(2^{32}\text{-}1)$	10	ms	U32	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
D1h	C11.D0	Group 14 planning displacement	-	-2^{31}-(2^{31}-1)	10000	Unit in application	I32	During operation	Immediately
D3h	C11.D2	Group 14 planning speed	-	0-8000	100	rpm	U32	During operation	Immediately
D5h	C11.D4	Group 14 planning acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
D7h	C11.D6	Group 14 planning deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
D9h	C11.D8	Group 14 planning waiting time	-	0-(2^{32}-1)	10	ms	U32	During operation	Immediately
E1h	C11.E0	Group 15 planning displacement	-	-2^{31}-(2^{31}-1)	10000	Unit in application	I32	During operation	Immediately
E3h	C11.E2	Group 15 planning speed	-	0-8000	100	rpm	U16	During operation	Immediately
E5h	C11.E4	Group 15 planning acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
E7h	C11.E6	Group 15 planning deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
E9h	C11.E8	Group 15 planning waiting time	-	0-(2^{32}-1)	10	ms	U32	During operation	Immediately
F1h	C11.F0	Group 16 planning displacement	-	-2^{31}-(2^{31}-1)	10000	Unit in application	I32	During operation	Immediately
F3h	C11.F2	Group 16 planning speed	-	0-8000	100	rpm	U16	During operation	Immediately
F5h	C11.F4	Group 16 planning acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
F7h	C11.F6	Group 16 planning deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
F9h	C11.F8	Group 16 planning waiting time	-	0-(2^{32}-1)	10	ms	U32	During operation	Immediately

8.14 Speed planning (2012h/C12)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
01h	C12.00	Speed planning mode selection	0: Single operation 1. Cyclic operation 2: DI selection operation	0-2	0	-	U16	At stop	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
02h	C12.01	Speed planning initial group number	-	1-16	1	-	U16	At stop	Immediately
03h	C12.02	Speed planning end group number	-	1-16	1	-	U16	At stop	Immediately
07h	C12.06	Group 1 speed reference	-	-8000-8000	100	rpm	I16	During operation	Immediately
09h	C12.08	Group 1 running time	-	0-(2^{32}-1)	10000	ms	U32	During operation	Immediately
0Bh	C12.0A	Group 1 acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
0Dh	C12.0C	Group 1 deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
11h	C12.10	Group 2 speed reference	-	-8000-8000	500	rpm	I16	During operation	Immediately
13h	C12.12	Group 2 running time	-	0-(2^{32}-1)	10000	ms	U32	During operation	Immediately
15h	C12.14	Group 2 acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
17h	C12.16	Group 2 deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
21h	C12.20	Group 3 speed reference	-	-8000-8000	1000	rpm	I16	During operation	Immediately
23h	C12.22	Group 3 running time	-	0-(2^{32}-1)	10000	ms	U32	During operation	Immediately
25h	C12.24	Group 3 acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
27h	C12.26	Group 3 deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
31h	C12.30	Group 4 speed reference	-	-8000-8000	1500	rpm	I16	During operation	Immediately
33h	C12.32	Group 4 running time	-	0-(2^{32}-1)	10000	ms	U32	During operation	Immediately
35h	C12.34	Group 4 acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
37h	C12.36	Group 4 deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
41h	C12.40	Group 5 speed reference	-	-8000-8000	-1500	rpm	I16	During operation	Immediately
43h	C12.42	Group 5 running time	-	0-(2^{32}-1)	10000	ms	U32	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
45h	C12.44	Group 5 acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
47h	C12.46	Group 5 deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
51h	C12.50	Group 6 speed reference	-	-8000-8000	-1000	rpm	I16	During operation	Immediately
53h	C12.52	Group 6 running time	-	0-(2^{32}-1)	10000	ms	U32	During operation	Immediately
55h	C12.54	Group 6 acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
57h	C12.56	Group 6 deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
61h	C12.60	Group 7 speed reference	-	-8000-8000	-500	rpm	I16	During operation	Immediately
63h	C12.62	Group 7 running time	-	0-(2^{32}-1)	10000	ms	U32	During operation	Immediately
65h	C12.64	Group 7 acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
67h	C12.66	Group 7 deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
71h	C12.70	Group 8 speed reference	-	-8000-8000	-100	rpm	I16	During operation	Immediately
73h	C12.72	Group 8 running time	-	0-(2^{32}-1)	10000	ms	U32	During operation	Immediately
75h	C12.74	Group 8 acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
77h	C12.76	Group 8 deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
81h	C12.80	Group 9 speed reference	-	-8000-8000	100	rpm	I16	During operation	Immediately
83h	C12.82	Group 9 running time	-	0-(2^{32}-1)	10000	ms	U32	During operation	Immediately
85h	C12.84	Group 9 acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
87h	C12.86	Group 9 deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
91h	C12.90	Group 10 speed reference	-	-8000-8000	500	rpm	I16	During operation	Immediately
93h	C12.92	Group 10 running time	-	0-(2^{32}-1)	10000	ms	U32	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
95h	C12.94	Group 10 acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
97h	C12.96	Group 10 deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
A1h	C12.A0	Group 11 speed reference	-	-8000-8000	1000	rpm	I16	During operation	Immediately
A3h	C12.A2	Group 11 running time	-	0-(2^{32}-1)	10000	ms	U32	During operation	Immediately
A5h	C12.A4	Group 11 acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
A7h	C12.A6	Group 11 deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
B1h	C12.B0	Group 12 speed reference	-	-8000-8000	1500	rpm	I16	During operation	Immediately
B3h	C12.B2	Group 12 running time	-	0-(2^{32}-1)	10000	ms	U32	During operation	Immediately
B5h	C12.B4	Group 12 acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
B7h	C12.B6	Group 12 deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
C1h	C12.C0	Group 13 speed reference	-	-8000-8000	-1500	rpm	I16	During operation	Immediately
C3h	C12.C2	Group 13 running time	-	0-(2^{32}-1)	10000	ms	U32	During operation	Immediately
C5h	C12.C4	Group 13 acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
C7h	C12.C6	Group 13 deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
D1h	C12.D0	Group 14 speed reference	-	-8000-8000	-1000	rpm	I16	During operation	Immediately
D3h	C12.D2	Group 14 running time	-	0-(2^{32}-1)	10000	ms	U32	During operation	Immediately
D5h	C12.D4	Group 14 acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
D7h	C12.D6	Group 14 deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
E1h	C12.E0	Group 15 speed reference	-	-8000-8000	-500	rpm	I16	During operation	Immediately
E3h	C12.E2	Group 15 running time	-	0-(2^{32}-1)	10000	ms	U32	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
E5h	C12.E4	Group 15 acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
E7h	C12.E6	Group 15 deceleration time	-	0-65535	10	ms	U32	During operation	Immediately
F1h	C12.F0	Group 16 speed reference	-	-8000-8000	-100	rpm	I16	During operation	Immediately
F3h	C12.F2	Group 16 running time	-	0-(2^{32}-1)	10000	ms	U32	During operation	Immediately
F5h	C12.F4	Group 16 acceleration time	-	0-65535	10	ms	U32	During operation	Immediately
F7h	C12.F6	Group 16 deceleration time	-	0-65535	10	ms	U32	During operation	Immediately

8.15 Fully closed-loop (201Bh/C1B)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
01h	C1B.00	Encoder feedback mode	0: Internal encoder 1: External encoder 2: Switching between inner and outer loops	0-2	0	-	U16	At stop	Immediately
02h	C1B.01	Use mode of external encoder	0: Normal count direction 1: Count direction reversed	0-1	0	-	U16	At stop	Immediately
03h	C1B.02	Selection of absolute value mode of external encoder	0: Incremental mode 1: Absolute mode	0-1	0	-	U16	At stop	Upon re-power-on
04h	C1B.03	Selection of feedback type of external encoder	0: ABZ encoder 1: BISS-C encoder	0-1	0	-	U16	At stop	Upon re-power-on
05h	C1B.04	Number of external encoder pulses for one revolution of motor	-	0-(2^{31}-1)	10000	P	I32	At stop	Upon re-power-on
09h	C1B.08	Maximum deviation of mixed control	-	0-(2^{31}-1)	1000	P	I32	At stop	Immediately

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
0Bh	C1B.0A	Mixed control deviation clearance lap number setting	-	0-100	1	-	U16	During operation	Immedi-ately
0Ch	C1B.0B	First-order low-pass filter time of external and internal deviations	-	0-65535	0	0.1ms	U16	At stop	Immedi-ately
0Fh	C1B.0E	Fully closed-loop external position error	-	-2^{31}-(2^{31}-1)	0	P	I32	Read only	Immedi-ately
11h	C1B.10	Internal encoder feedback value	-	-2^{31}-(2^{31}-1)	0	P	I32	Read only	Immedi-ately
13h	C1B.12	External encoder feedback value	-	-2^{31}-(2^{31}-1)	0	P	I32	Read only	Immedi-ately
1Bh	C1B.1A	BISS encoder feedback position	-	-2^{31}-(2^{31}-1)	0	-	I32	Read only	Immedi-ately
1Dh	C1B.1C	BISS communication alarm index value	-	0-65535	0	-	U16	Read only	Immedi-ately
1Eh	C1B.1D	BISS communication position feedback active bit	-	16-48	29	-	U16	At stop	Upon re-power-on
1Fh	C1B.1E	Selection of baud rate setting for BISS communication	0: 1.6M 1: 2M 2: 4M	0-2	1	-	U16	At stop	Upon re-power-on

8.16 Motor Parameters (2020h/R20)

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
01h	R20.00	Motor model	-	0-65535	10000	-	U16	At stop	Upon re-power-on
04h	R20.03	Motor SN 1	-	0-65535	0	-	U16	Read only	Immedi-ately
05h	R20.04	Motor SN 2	-	0-65535	0	-	U16	Read only	Immedi-ately
06h	R20.05	Motor SN 3	-	0-65535	0	-	U16	Read only	Immedi-ately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
07h	R20.06	Motor SN 4	-	0-65535	0	-	U16	Read only	Immediately
08h	R20.07	Motor SN 5	-	0-65535	0	-	U16	Read only	Immediately
09h	R20.08	Rated motor voltage	0: 220V 1: 380V 2: 48V	0-2	0	-	U16	At stop	Upon re-power-on
0Ah	R20.09	Rated motor power	-	1-(2^{32}-1)	40	0.01kW	U32	At stop	Upon re-power-on
0Ch	R20.0B	Rated motor current	-	1-(2^{32}-1)	250	0.01A	U32	At stop	Upon re-power-on
21h	R20.20	Encoder software version	-	0-65535	0	0.1	U16	Read only	Immediately
23h	R20.22	Encoder type	-	0-65535	0	-	U16	Read only	Upon re-power-on
26h	R20.25	Encoder initial position	-	0-(2^{32}-1)	0	Unit	U32	At stop	Upon re-power-on
2Bh	R20.2A	Encoder resolution bit	-	0-32	23	-	U16	At stop	Upon re-power-on
41h	R20.40	Motor SN 6	-	0-65535	0	-	U16	Read only	Immediately
42h	R20.41	Motor SN 7	-	0-65535	0	-	U16	Read only	Immediately
43h	R20.42	Motor SN 8	-	0-65535	0	-	U16	Read only	Immediately
44h	R20.43	Motor SN 9	-	0-65535	0	-	U16	Read only	Immediately

8.17 Drive Parameters (2021h/R21)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
01h	R21.00	Drive model	-	0-65535	3	-	U16	At stop	Upon re-power-on
0Dh	R21.0C	Drive voltage class	-	0-2	0	-	U16	Read only	Immediately
0Eh	R21.0D	Rated drive power	-	1-(2^{32}-1)	40	0.01kW	U32	Read only	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
10h	R21.0F	Rated output current of drive	-	1-(2^{32}-1)	280	0.01A	U32	Read only	Immediately
12h	R21.11	Maximum output current of drive	-	1-(2^{32}-1)	1010	0.01A	U32	Read only	Immediately
14h	R21.13	Internal bleeder resistor power	-	1-65535	1	W	U16	Read only	Immediately
15h	R21.14	Internal bleeder resistor resistance	-	1-65535	1	Ω	U16	Read only	Immediately
16h	R21.15	Minimum resistance of external bleeder resistor	-	0-65535	40	Ω	U16	Read only	Immediately
18h	R21.17	Scaling coefficient for bus voltage of the control circuit	-	0-1500	1000	0.1%	U16	At stop	Immediately
19h	R21.18	Bus voltage scaling coefficient	-	500-1500	1000	0.1%	U16	At stop	Immediately
1Ah	R21.19	Drive undervoltage threshold	-	0-10000	2000	0.1V	U16	At stop	Upon re-power-on
1Bh	R21.1A	Drive overvoltage threshold	-	0-10000	4200	0.1V	U16	At stop	Upon re-power-on
1Ch	R21.1B	Drive bleeder threshold	-	0-10000	3800	0.1V	U16	At stop	Upon re-power-on
41h	R21.40	NTC temperature warning threshold	-	0-120	96	℃	U16	At stop	Immediately

NOTICE

- For details about parameters above, refer to section 8.24.6 "Group R21".

8.18 Motor Gain Parameters (2022h/R22)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
01h	R22.00	Current loop mode	0: Standard mode 1: Performance mode	0-1	0	-	U16	At stop	Upon re-power-on
02h	R22.01	Current loop response level	-	0-4000	0	0.1%	U16	At stop	Upon re-power-on

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
21h	R22.20	MTPA field-weakening switch	-	0-65535	256	-	U16	At stop	Immediately
22h	R22.21	Field-weakening depth	-	500-2000	1000	0.1%	U16	At stop	Immediately
23h	R22.22	Field-weakening proportional gain	-	10-1000	100	Hz	U16	At stop	Immediately
24h	R22.23	Field-weakening integral gain	-	0-8000	50	0.1%	U16	At stop	Immediately
25h	R22.24	Cutoff frequency of d axis current low-pass filter	-	0-16000	0	Hz	U16	At stop	Immediately
26h	R22.25	Field-weakening d axis current limit	-	0-3000	1500	0.1%	U16	At stop	Immediately
29h	R22.28	Overmodulation ratio	-	900-1155	1155	0.1%	U16	At stop	Immediately
31h	R22.30	Dead zone compensation	-	0-2000	1000	0.1%	U16	At stop	Immediately

8.19 Parameters of Control in Progress (2030h/F30)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
11h	F30.10	Inertia auto-tuning selection	0: Disabled 1: Enabled	0-65535	0	-	U16	During operation	Immediately
12h	F30.11	Initial angle auto-tuning selection	0: Disabled 1: Enabled	0-1	0	-	U16	During operation	Immediately
15h	F30.14	Friction force auto-tuning selection	0: Disabled 1: Enabled	0-1	0	-	U16	During operation	Immediately
22h	F30.21	AI self-regulating enable	0: Inactive 1: AI1 self-regulating	0-1	0	-	U16	At stop	Immediately
32h	F30.31	VDI1-16 functions	-	0-65535	0	-	U16	During operation	Immediately
33h	F30.32	VDI17-32 functions	-	0-65535	0	-	U16	During operation	Immediately
34h	F30.33	VDI33-48 functions	-	0-65535	0	-	U16	During operation	Immediately
35h	F30.34	VDI49-64 functions	-	0-65535	0	-	U16	During operation	Immediately

36h	F30.35	VDO1-16 functions	-	0-65535	0	-	U16	Read only	Immedi-ately
37h	F30.36	VDO17-32 functions	-	0-65535	0	-	U16	Read only	Immedi-ately

8.20 Reset Parameters (2031h/F31)

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
01h	F31.00	Fault reset	0: Inactive 1: Reset	0-1	0	-	U16	At stop	Immedi-ately
02h	F31.01	Software reset	0: Inactive 1: Reset	0-2	0	-	U16	At stop	Immedi-ately
03h	F31.02	Parameter initialization	0: Inactive 1: Restore default settings of parameters 2: Restore default settings of the object dictionary	0-2	0	-	U16	At stop	Immedi-ately
05h	F31.04	Fault record initialization	0: Inactive 1: Fault record clearing	0-1	0	-	U16	At stop	Immedi-ately
11h	F31.10	Encoder data reset	0: Inactive 1: Read encoder 2: Write encoder 3: Reset encoder fault 4: Reset encoder fault and multi-turn data 16: Operation failed	0-31	0	-	U16	At stop	Immedi-ately

NOTICE

- For details about parameters above, refer to section 8.24.7 "Group F31".

8.21 Running Monitoring Parameters (2040h/U40)

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
01h	U40.00	Speed reference	-	-9000-9000	0	rpm	I16	Read only	Immedi-ately
02h	U40.01	Speed feedback	-	-9000-9000	0	rpm	I16	Read only	Immedi-ately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
03h	U40.02	Torque reference	-	-4000-4000	0	0.1%	I16	Read only	Immediately
04h	U40.03	Torque feedback	-	-4000-4000	0	0.1%	I16	Read only	Immediately
05h	U40.04	DI status	-	0-65535	0	-	U16	Read only	Immediately
06h	U40.05	DO status	-	0-65535	0	-	U16	Read only	Immediately
07h	U40.06	Bus voltage	-	0-9000	0	0.1V	U16	Read only	Immediately
08h	U40.07	Average load ratio	-	0-4000	0	0.1%	U16	Read only	Immediately
09h	U40.08	Electrical angle	-	0-36000	0	0.01°	U16	Read only	Immediately
0Ah	U40.09	Mechanical angle	-	0-36000	0	0.01°	U16	Read only	Immediately
0Bh	U40.0A	AI1 input voltage	-	-1200-1200	0	0.01V	I16	Read only	Immediately
0Dh	U40.0C	RMS value of phase current	-	-9000-9000	0	0.1A	I16	Read only	Immediately
0Eh	U40.0D	High-accuracy AI input voltage	-	-2^{31}-$(2^{31}-1)$	0	0.001mV	I32	Read only	Immediately
10h	U40.0F	Current AI input current	-	0-40000	0	0.001mA	U16	Read only	Immediately
11h	U40.10	Position deviation counter	-	-2^{31}-$(2^{31}-1)$	0	P	I32	Read only	Immediately
13h	U40.12	Number of input pulses	-	-2^{31}-$(2^{31}-1)$	0	Unit in application	I32	Read only	Immediately
15h	U40.14	Absolute position reference	-	-2^{31}-$(2^{31}-1)$	0	Unit in application	I32	Read only	Immediately
17h	U40.16	Absolute position feedback (reference unit)	-	-2^{31}-$(2^{31}-1)$	0	Unit in application	I32	Read only	Immediately
19h	U40.18	Absolute position feedback (encoder unit)	-	-2^{31}-$(2^{31}-1)$	0	P	I32	Read only	Immediately
1Bh	U40.1A	Absolute position feedback (encoder unit)	-	-2^{31}-$(2^{31}-1)$	0	P	I32	Read only	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
1Dh	U40.1C	Encoder single-turn data	-	-2^{31}-$(2^{31}$-1)	0	P	I32	Read only	Immediately
1Fh	U40.1E	Encoder multi-turn position data	-	0-65535	0	Rev	U16	Read only	Immediately
20h	U40.1F	Encoder initial angle	-	0-36000	0	0.01°	U16	Read only	Immediately
21h	U40.20	Encoder multi-turn data (low 32 bits)	-	-2^{31}-$(2^{31}$-1)	0	P	I32	Read only	Immediately
23h	U40.22	Encoder multi-turn data (high 32 bits)	-	-2^{31}-$(2^{31}$-1)	0	P	I32	Read only	Immediately
25h	U40.24	Absolute position feedback (encoder unit) (low 32 bits)	-	-2^{31}-$(2^{31}$-1)	0	P	I32	Read only	Immediately
27h	U40.26	Absolute position feedback (encoder unit) (high 32 bits)	-	-2^{31}-$(2^{31}$-1)	0	P	I32	Read only	Immediately
29h	U40.28	Position feedback in rotation mode (reference unit) (low 32 bits)	-	-2^{31}-$(2^{31}$-1)	0	Unit in application	I32	Read only	Immediately
2Bh	U40.2A	Position feedback in rotation mode (encoder unit) (low 32 bits)	-	-2^{31}-$(2^{31}$-1)	0	P	I32	Read only	Immediately
2Dh	U40.2C	Position feedback in rotation mode (encoder unit) (high 32 bits)	-	-2^{31}-$(2^{31}$-1)	0	P	I32	Read only	Immediately
30h	U40.2F	Online inertia auto-tuning value	-	0-12000	0	%	U16	Read only	Immediately
31h	U40.30	IGBT temperature	-	-9000-9000	0	0.1℃	I16	Read only	Immediately
32h	U40.31	Motor temperature	-	-9000-9000	0	0.1℃	I16	Read only	Immediately
33h	U40.32	Encoder temperature	-	-9000-9000	0	0.1℃	I16	Read only	Immediately
34h	U40.33	Ambient temperature	-	-9000-9000	0	0.1℃	I16	Read only	Immediately
35h	U40.34	Offline inertia auto-tuning value	-	0-12000	0	%	U16	Read only	Immediately
36h	U40.35	Control circuit voltage	-	0-9000	0	0.1V	U16	Read only	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
37h	U40.36	Instantaneous value in phase U current	-	-2^{31}-$(2^{31}-1)$	0	0.001A	I32	Read only	Immediately
39h	U40.38	Instantaneous value in phase V current	-	-2^{31}-$(2^{31}-1)$	0	0.001A	I32	Read only	Immediately
3Fh	U40.3E	Drive accumulated heat	-	0-2000	0	0.1%	U16	Read only	Immediately
40h	U40.3F	Motor accumulated heat	-	0-2000	0	0.1%	U16	Read only	Immediately
43h	U40.42	Drive NotRdy state	Bit00: Control circuit error Bit01: Main circuit power input error Bit02: Bus undervoltage Bit03: Soft start failure Bit04: Encoder initialization not done Bit05: Short-circuit to ground failed Bit06: Other	0-255	0	-	U16	Read only	Immediately
44h	U40.43	Motor running failure reason	0: No reason 1: Servo not ready 2: No servo running command 3: Overtravel disabled 4: Small torque limit 5: Small position reference 6: Small speed reference 7: Small torque reference 8: Small speed limit 9: Others	0-65535	0	-	U16	Read only	Immediately
51h	U40.50	Encoder initial position	-	0-$(2^{32}-1)$	0	Unit	U32	Read only	Immediately

NOTICE

- For details about parameters above, refer to section 8.24.8 "Group U40".

8.22 Status Monitoring Parameters (2041h/U41)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
01h	U41.00	MCU system status	-	0-65535	0	-	U16	Read only	Immediately
02h	U41.01	MCU fault state	-	0-65535	0	-	U16	Read only	Immediately
03h	U41.02	FPGA system status	-	0-65535	0	-	U16	Read only	Immediately
04h	U41.03	FPGA fault state	-	0-65535	0	-	U16	Read only	Immediately
05h	U41.04	Encoder system status	-	0-65535	0	-	U16	Read only	Immediately
06h	U41.05	Encoder fault state	-	0-65535	0	-	U16	Read only	Immediately
07h	U41.06	Group number of abnormal parameter	-	0-255	0	-	U16	Read only	Immediately
08h	U41.07	Offset of the abnormal parameter within the parameter group	-	0-255	0	-	U16	Read only	Immediately
09h	U41.08	Position planning operation group number	-	0-16	0	-	U16	Read only	Immediately
0Ah	U41.09	Speed planning operation group number	-	0-16	0	-	U16	Read only	Immediately
0Bh	U41.0A	Servo Status	0: Servo not ready 1: Servo ready 2: Servo running 3: Servo fault	0-3	0	-	U16	Read only	Immediately
0Ch	U41.0B	Servo running mode	-	0-9	0	-	U16	Read only	Immediately
0Dh	U41.0C	Servo running time	-	0-(2^{32}-1)	0	0.1s	U32	Read only	Immediately
11h	U41.10	Communication encoder status bit	-	0-65535	0	-	U16	Read only	Immediately
12h	U41.11	Communication encoder fault bit	-	0-65535	0	-	U16	Read only	Immediately

8.23 Version Parameters (2042h/U42)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
01h	U42.00	ARM version	-	0-65535	0	0.01	U16	Read only	Immediately
02h	U42.01	FPGA version	-	0-65535	0	0.01	U16	Read only	Immediately
03h	U42.02	Encoder version	-	0-65535	0	0.01	U16	Read only	Immediately
04h	U42.03	ARM-based machine	-	0-65535	0	0.01	U16	Read only	Immediately
05h	U42.04	FPGA-based machine	-	0-65535	0	0.01	U16	Read only	Immediately
06h	U42.05	Internal software version	-	0-65535	0	0.01	U16	Read only	Immediately
07h	U42.06	Modbus version	-	0-65535	0	0.01	U16	Read only	Immediately
10h	U42.0F	Test software version	-	0-65535	0	0.01	U16	Read only	Immediately
11h	U42.10	Drive model	-	0-65535	0	-	U16	Read only	Immediately
12h	U42.11	Motor model	-	0-65535	0	-	U16	Read only	Immediately
13h	U42.12	Encoder model	-	0-65535	0	-	U16	Read only	Immediately
14h	U42.13	Power supply unit model identification	-	0-65535	0	-	U16	Read only	Immediately
15h	U42.14	Inverter model identification 1	-	0-65535	0	-	U16	Read only	Immediately
16h	U42.15	Inverter model identification 2	-	0-65535	0	-	U16	Read only	Immediately
17h	U42.16	Servo version	-	0-65535	0	-	U16	Read only	Immediately
18h	U42.17	Servo chip type	-	0-65535	0	-	U16	Read only	Immediately

8.24 Description of Parameters

8.24.1 Group C00

C00.05: Stiffness level

- Defines the stiffness level of the servo system. The higher the stiffness level, the stronger the gains and the quicker the response will be. But an excessively high stiffness level will cause vibration. The setpoint 0 indicates the lowest stiffness and 41 indicates the highest stiffness.

C00.06: Load inertia ratio

- Defines the mechanical load inertia ratio relative to the motor moment of inertia.
- When C00.06 is set to 0, it indicates the motor carries no load; if it is set to 1.00, it indicates the mechanical load inertia is the same as the motor moment of inertia.
- When the value of C00.06 is equal to the actual inertia ratio, the value of speed loop gain can represent the maximum follow-up frequency of actual speed loop.

8.24.2 Group C01

C01.00: 1st position loop gain

- Defines the proportional gain of the position loop.
- This parameter determines the responsiveness of the position loop. A high setpoint shortens the positioning time. Note that an excessively high setpoint may cause vibration.
- The 1st gain set includes C01.00, C01.01, C01.02, and C01.03.

C01.01: 1st speed loop gain

- Defines the speed loop proportional gain.
- This parameter determines the responsiveness of the speed loop. The higher the setpoint, the faster the speed loop response is. Note that an excessively high setpoint may cause vibration.
- In the position control mode, the position loop gain must be increased together with the speed loop gain.

C01.02: 1st speed loop integral time

- Defines the speed loop integral time constant.
- The lower the setpoint, the better the integral action, and the quicker will the deviation value be close to 0.
- There is no integral action when C01.02 is set to 512.00 ms

C01.08: 2nd position loop gain

- Defines the 2nd gain of the position loop.
- The 2nd gain set includes C01.08, C01.09, C01.0A, and C01.0B.
- For details about gain switchover, see section 7.5 "Gain Switchover".

C01.0B: 2nd torque reference filter cutoff frequency

- Defines the torque reference filter time constant.

- Low-pass filtering of torque references helps to smoothen torque references and reduce vibration.
- Pay attention to the responsiveness during setting as an excessively high setpoint lowers down the responsiveness.

NOTICE

- The servo drive offers two low-pass filters for torque references. By default, the 1st filter is used.
- Gain switchover can be used in the position or speed control mode. Once certain conditions are satisfied, the servo drive can switch to filter 2.

C01.11: Cutoff frequency of speed feedback low-pass filter

- Defines the cutoff frequency for first-order low-pass filtering on the speed feedback.
- The lower the setpoint, the weaker the speed feedback fluctuation, and the longer the feedback delay will be.
- Setting this parameter to 8000 Hz negates the filtering effect.

C01.12: Speed feedback overlapping average filter time constant

- Defines the moving average filtering times for speed feedback.
- The higher the setpoint, the weaker the speed feedback fluctuation, but the longer the feedback delay will be.
- When C01.12 is set to a value higher than 0, C01.11 (Cutoff frequency of speed feedback low-pass filter) is invalid.

C01.13: Speed feedforward source

- Defines the source of the speed loop feedforward signal.
- In the position control mode, the speed feedforward control can improve the position reference responsiveness.

Setpoint	Speed Feedforward Source	Remarks
0	No feedforward	-
1	Internal reference	The speed corresponding to the position reference (encoder unit) is defined as the speed feedforward source.
2	Model tracking	Model tracking control can improve the responsiveness and shorten the positioning time. It is only available in the position control mode. It must be used with C02.00. When C02.00 is set to 1, the speed feedforward is sourced from the speed feedforward output of model tracking.

C01.14: Speed feedforward percentage

- In the position control mode, speed feedforward is the value of C01.14 multiplied by the speed feedforward signal, which is part of the speed reference. Increasing the setpoint improves the responsiveness to position references and reduces the position deviation during operation at a constant speed.
- Set C01.15 to a fixed value first, and then gradually increase the value of C01.14 from 0 to a certain setpoint at which speed feedforward achieves the desired effect.
- Adjust C01.15 and C01.14 repeatedly until a balanced setting is achieved.
- For the speed feedforward function and speed feedforward signal selection, see C01.13 (Speed feedforward source selection).

C01.15: Speed feedforward filter cutoff frequency

- Defines the speed feedforward smoothing filter time.

C01.16: Torque feedforward source

- Defines whether to enable the internal torque feedforward function in a non-torque control mode.
- The torque feedforward function can improve the torque reference responsiveness and reduce the position deviation during operation at constant acceleration/deceleration rate.

Setpoint	Torque Feedforward Source	Remarks
0	No feedforward	-
1	Internal reference	The torque feedforward signal source is the speed reference. In the position control mode, the speed reference is output from the position controller. In the speed control mode, the speed reference is output from the user speed reference.
2	Model tracking	It must be used with C02.00. When C02.00 is set to 1, the torque feedforward is sourced from the torque feedforward output of model tracking.
5	Communication	In CSP, 60B1h is used as the source of the external torque feedforward signal. Bit 6 of 607Eh can specify the polarity of the torque feedforward signal (60B1h).

- Torque feedforward parameters include C01.17 (Torque feedforward percentage) and C01.18 (Torque feedforward cutoff frequency).
- In a non-torque control mode, the control block diagram of torque feedforward is as follows:

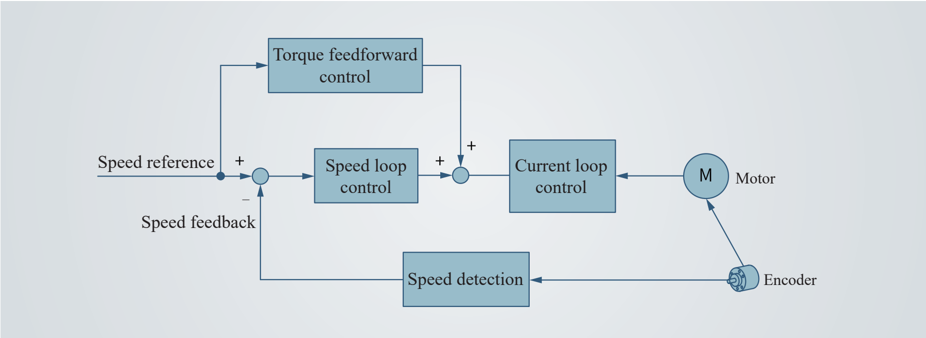


Figure 8-1 Torque feedforward control

C01.17: Torque feedforward percentage

- In control modes other than torque control, torque feedforward is the product of torque feedforward signal multiplied by C01.17 and is part of the torque reference. Increasing the setpoint improves the responsiveness to variable speed references and position references and reduces the position deviation during operation at a constant speed.

C01.18: Torque feedforward filter cutoff frequency

- Defines the filter time constant of torque feedforward.

C01.1B: PDFF control coefficient

- Defines the control method of the speed loop.
- When the setpoint is 100.0, PI control (default control mode of the speed loop) is applied to the speed loop, which features fast dynamic response.
- When the setpoint is 0.0, speed loop integral action is enhanced, which filters out low-frequency interference but also slows down the dynamic response.
- C01.1B can be used to keep a good responsiveness of the speed loop, with the anti-interference capacity in low-frequency bands improved and the speed feedback overshoot not increased.

C01.30: Adaptive notch mode

Setpoint:

0: Adaptive notch not updated

1: One adaptive notch activated (3rd notch)

2: Two adaptive notches activated (3rd and 4th notches)

3: Adaptive notch cleared, values of the 3rd and 4th notches restored to default settings

4: Resonance point tested only, displayed in C01.31, C01.32, and C01.33

Description:

- Defines the operation mode of the adaptive notch.

C01.38: Gain switchover mode

Setpoint	Gain Switchover Condition	Remarks
0	Fixed to the 1st gain set	The 1st gain set applies.
1	DI switchover	Gains are switched through bit 26 of 60FE. Bit 26 signal inactive: 1st gain set Bit 26 signal active: 2nd gain set If the bit 26 signal cannot be allocated to a DI terminal, the 1st gain set applies.
2	DI P-PI switchover	Gains are switched through bit 26 of 60FE. Bit 26 signal inactive: 1st gain set Bit 26 signal active: 2nd gain set (The 2nd speed loop integral (C01.0A) is forced to be 512 ms.) If the bit 26 signal cannot be allocated to a DI terminal, the 1st gain set applies.
3	Torque reference	When the absolute value of the torque reference exceeds (threshold + loop width, %) in the last 1st gain set, the drive switches to the 2nd gain set. When the absolute value of the torque reference is less than (threshold – loop width, %) and this status lasts within the delay (C01.39) in the last 2nd gain set, the drive returns to the 1st gain set.
4	Speed reference	When the absolute value of the speed reference exceeds (threshold + loop width, rpm) in the last 1st gain set, the drive switches to the 2nd gain set. When the absolute value of the speed reference is less than (threshold – loop width, rpm) and this status lasts within the delay (C01.39) in the last 2nd gain set, the drive returns to the 1st gain set.
5	Speed feedback	It is valid only in the position control mode. When the absolute value of the actual speed exceeds (threshold + loop width, rpm) in the last 1st gain set, the drive switches to the 2nd gain set. When the absolute value of the actual speed is less than (threshold – loop width, rpm) and this status lasts within the delay (C01.39) in the last 2nd gain set, the drive returns to the 1st gain set. The 1st gain set applies when the drive is not in the position control mode.
6	Speed reference change rate	It is valid only in non-speed control modes. When the absolute value of the change rate in the speed reference exceeds (threshold + loop width, 10 rpm/s) in the last 1st gain set, the drive switches to the 2nd gain set. When the absolute value of the change rate in the speed reference is less than (threshold – loop width, 10 rpm/s) and this status lasts within the delay (C01.39) in the last 2nd gain set, the drive returns to the 1st gain set. The 1st gain set applies in the speed control mode.

Setpoint	Gain Switchover Condition	Remarks
7	Position deviation	When the absolute value of the position deviation exceeds (threshold + loop width, encoder unit) in the last 1st gain set, the drive switches to the 2nd gain set. When the absolute value of the position deviation is less than (threshold + loop width, encoder unit) and this status lasts within the delay (C01.39) in the last 2nd gain set, the drive returns to the 1st gain set. The 1st gain set applies when the drive is not in the position control mode.
8	Position reference	It is valid only in the position control mode. When the position reference is not 0 in the last 1st gain set, the drive switches to the 2nd gain set. When the position reference is 0 and this status lasts within the delay (C01.39) in the last 2nd gain set, the drive returns to the 1st gain set. The 1st gain set applies when the drive is not in the position control mode.

C01.39: Gain switchover time

Defines the duration when the drive switches from the 2nd gain set to the 1st gain set.

C01.3A: Gain switchover threshold

- Defines the gain switchover threshold.
- Gain switchover is affected by both the threshold and the loop width, as defined by C01.38. The unit of gain switchover threshold varies with the switchover condition.
- Set C01.3A to a value greater than or equal to C01.3B. If C01.3A is set to a value less than C01.3B, the servo drive sets C01.3A to the same value as C01.3B.

C01.3B: Gain switchover loop width

- Defines the gain switchover loop width.
- Gain switchover is affected by both the threshold and the loop width. The unit of gain switchover threshold varies with the switchover condition.
- Set C01.3A to a value greater than or equal to C01.3B. If C01.3A is set to a value less than C01.3B, the servo drive sets C01.3A to the same value as C01.3B.

C01.40: Frequency of the 1st notch

- Defines the center frequency of the notch, which is the mechanical resonance frequency.
- In the torque control mode, setting the notch frequency to 8000 Hz deactivates the notch function.

C01.41: Width level of the 1st notch

- Defines the width level of the notch. Use the default value in general cases.
- Width level is the ratio of the notch width to the notch center frequency.

C01.42: Depth level of the 1st notch

- Defines the depth level of the notch.

- The depth level of the notch is the ratio between the input to the output at the notch center frequency.
- The higher the setpoint, the lower the notch depth and the weaker the mechanical resonance suppression will be. Note that an excessively high setpoint may cause system instability.
- For the use of notch, see 7.14 "Vibration Suppression".

C01.45: Depth level of the 2nd notch

- Description of the 2nd notch parameters is the same as that of the 1st notch parameters.

NOTICE

- The 1st and 2nd notches can be set manually or configured as adaptive notches (C01.30 = 1 or 2). In this case, the parameters are automatically set by the drive, while the other three notches can be set manually.

8.24.3 Group C03

C03.21: Speed reference

- It is the speed reference in the local speed mode, which is invalid in EtherCAT mode.

C03.22: Acceleration rate

- It is the acceleration ramp time of the speed reference in the local speed mode, which is invalid in EtherCAT mode.

C03.24: Deceleration rate

- It is the deceleration ramp time of the speed reference in the local speed mode, which is invalid in EtherCAT mode.

C03.27: Internal positive speed limit

- It is the PL of the speed reference in the local speed mode, which is invalid in EtherCAT mode.

C03.28: Internal negative speed limit

- It is the NL of the speed reference in the local speed mode, which is invalid in EtherCAT mode.

C03.43: Internal positive torque limit

- It is valid only in the local torque mode. For torque limit in EtherCAT mode, use 60E0h/60E1h/6072h. Use the torque limit with caution as an excessively low limit value may lead to insufficient motor torque output.
- If the setpoint exceeds the maximum torque of the servo motor and servo drive, the actual torque is limited to the maximum torque of the servo motor and servo drive.

C03.44: Internal negative torque limit

- It is valid only in the local torque mode. For torque limit in EtherCAT mode, use 60E0h/60E1h/6072h. Use the torque limit with caution as an excessively low limit value may lead to insufficient motor torque output.

- If the setpoint exceeds the maximum torque of the servo motor and servo drive, the actual torque is limited to the maximum torque of the servo motor and servo drive.

C03.47: Positive speed limit in torque mode

- It is valid only in the local torque mode. Use 607F for the speed limit in the EtherCAT, CST, and PT modes.

C03.48: Negative speed limit in torque mode

- It is valid only in the local torque mode. Use 607F for the speed limit in the EtherCAT, CST, and PT modes.

C03.4B: Invalid value for torque reached

- The torque reached function is used to judge whether the actual torque reference reaches the range of the valid value for torque reached. If yes, the servo drive outputs the corresponding flag (bit 10 of the status word) to the host controller.

  A: Actual torque reference (U40.02)

  B: Base value for torque reach (C03.49)

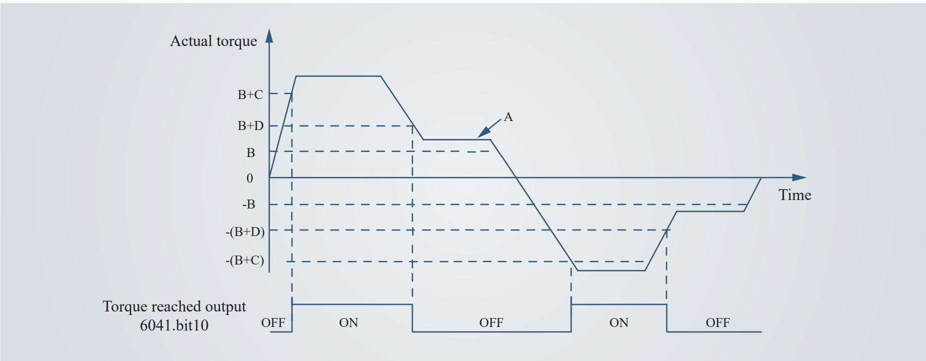
  C: Valid value for torque reach (C03.4A)

  D: Invalid value for torque reach (C03.4B)

  C and D are offsets on the basis of B.

  The torque reach signal is activated only when the actual torque reference meets the condition: |A| ≥ B + C. Otherwise, the torque reach signal remains inactive.

  The torque reach signal is deactivated only when the actual torque reference meets the condition: |A| < B + D.



8.24.4 Group C06

C06.04: Input phase loss detection

Servo drives support three-phase 380 V power supplies. When voltage fluctuation or phase loss occurs on the power supply, power input phase loss protection will be triggered by the servo drive based on the setting of C06.04.

- C06.04 = 0: The servo drive reports Er81.0 (Phase loss fault) when the servo drive is set to 3 kW.
- C06.04 = 1: The servo drive does not report Er81.0 (Phase loss fault) when the servo drive is set to 3 kW, with deration of 80%.

C06.11: Motor overload protection threshold

- Determines the motor overload duration before Er41.0 (Motor overload) is reported.
- You can change the setpoint to advance or delay the time when overload protection is triggered based on the motor temperature. The setpoint 50% indicates the time is cut by half; 150% indicates the time is prolonged by 50%.
- Set this parameter based on the actual temperature of the motor.

C06.20: Protection from out of control

- Sets whether to enable the runaway protection function.

8.24.5 Group C0A

C0A.09: Commissioning software communication baud rate

- Defines the communication rate between the servo drive and the host controller.
- The baud rate set in the servo drive must be the same as that in the host controller. Otherwise, communication will fail.

C0A.0A: Commissioning software communication format

- Defines the data check mode between the servo drive and the host controller during communication.
- The data format of the servo drive and the host controller must be the same; otherwise, the communication fails.

8.24.6 Group R21

R21.00: Drive model

Setpoint:

2: 200RS

3: 400RS

5: 750RS

6: 1000RS

Description:

- Sets the SN of the servo drive. The following table lists the servo drive SNs.

Setpoint	Servo Drive SN	Remarks
2	200RS	The rated drive power is 0.2 kW. The main circuit inputs single-phase 220 V.
3	400RS	The rated drive power is 0.4 kW. The main circuit inputs single-phase 220 V.
5	750RS	The rated drive power is 0.75 kW. The main circuit inputs single-phase 220 V.
6	1000RS	The rated drive power is 1.0 kW. The main circuit inputs single-phase or three-phase 220 V. (The main circuit of the servo drive supports single-phase 220 V power supplies without derating.)

If the voltage input to the main circuit of the servo drive does not comply with the preceding specifications, a fault or damage occurs.

8.24.7 Group F31

F31.00: Fault reset

- Defines whether to enable fault reset.

Setpoint	Function	Remarks
0	No operation	-
1	Enable	When a No.1 or No.2 resettable fault occurs, you can enable the fault reset function in the non-operational state after rectifying the fault cause and stopping the keypad from displaying the fault. When a No.3 warning occurs, you can enable the fault reset function directly.

- For fault classification, see section 10.1.3 "List of faults and alarms".
- The fault reset function, once enabled, stops the keypad from displaying the fault only. It does not activate modifications made on parameters.
- This function is not applicable to non-resettable faults. Use this function with caution in cases where the fault causes are not rectified.

F31.01 Software reset

- Defines whether to enable fault reset.

Setpoint	Function	Remarks
0	No operation	-
1	Enable	Programs in the drive are reset automatically (similar to the program reset upon power-on) after the software reset function is enabled, without the need for a power cycle.

- Software reset conditions: The servo drive is disabled, and there is no non-resettable fault such as No.1 fault.

F31.10: Encoder data reset

- The absolute position saved by the encoder changes abruptly after multi-turn data reset. In this case, perform mechanical homing.

8.24.8 Group U40

U40.00: Speed reference

- Indicates the present speed reference (accurate to 1 RPM) of the drive in the position and speed control modes.

U40.01: Speed feedback

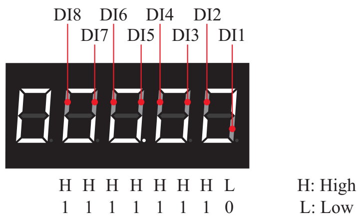
- Indicates the actual motor speed after round-off, which is accurate to 1 rpm.
- This parameter is a 32-bit integer, which is displayed as a decimal on the keypad.

U40.02: Actual torque reference

- Indicates the present torque reference (accurate to 0.1%). The value 100.0% corresponds to the rated torque of the motor.

U40.04: DI status

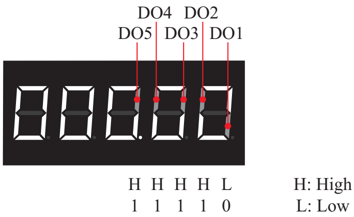
- Indicates the level status of eight DIs without filtering.
- Upper LED segments ON: high level (indicated by "1")
  Lower LED segments ON: low level (indicated by "0") In cases where DI1 is low level and DI2 to DI8 are high level, the corresponding binary value is 11111110, and the value of U40.04 read in the software tool is 0xFFFE.
- The keypad displays as follows:



U40.05: DO state

- Indicates the level status of five DOs without filtering.
- Upper LED segments ON: high level (indicated by "1")
  Lower LED segments ON: low level (indicated by "0") In cases where DO1 is low level and DO2 to DO5 are high level, the corresponding binary value is 11110, and the value of U40.05 read in the software tool is 0xFFFE.

- The keypad displays as follows:



U40.06: Bus voltage

- Indicates the DC bus voltage of the main circuit input voltage after rectification, which is accurate to 0.1 V.

U40.07: Average load ratio

- Indicates the percentage of the average load torque to the rated torque of the motor, which is accurate to 0.1%. The value 100.0% corresponds to the rated torque of the motor.

U40.08: Electrical angle

- Indicates the present electrical angle of the motor, which is accurate to 0.1°.
- The electrical angle variation range is ±360.0° when the motor rotates.
- If the motor has four pairs of poles, each revolution generates four rounds of angle changes from 0° to 359.9°.
- Similarly, if the motor has five pairs of poles, each revolution generates five rounds of angle changes from 0° to 359.9°.

U40.09: Mechanical angle

- Indicates present mechanical angle (encoder unit) of the motor. The value 0 indicates that the mechanical angle is 0°.

U40.0C: RMS value of phase current

- Indicates the RMS value of the phase current of the servo motor, which is accurate to 0.1 A.

U40.10: Position deviation counter

- Counts the position pulses fed back by the encoder in any control mode.
- This parameter is a 32-bit integer, which is displayed as a decimal on the keypad.

U40.30: IGBT temperature

- Indicates the temperature of the module inside the servo drive, which can be used as a reference for estimating the actual temperature of the servo drive.

Chapter 9 Communication Description

9.1 Modbus protocol

The parameters of the servo drive are classified into 16-bit and 32-bit parameters based on the data length. Data read/write for the parameters is implemented based on the Modbus RTU protocol. The command codes for reading/writing parameters vary with the data length.

Operation	Command Code
Read 16-bit/32-bit parameters	0x03
Write 16-bit parameters	0x06
Write 32-bit parameters	0x10

Read parameter command code: 0x03

Based on the Modbus RTU protocol, command code 0x03 is used to read both 16-bit and 32-bit parameters.

Request frame format:

Value	Description
START	Equal to or greater than 3.5-character idle time, frame start
ADDR	Servo axis addresses 1 to 247 Note: 1 to 247 are decimal values and need to be converted to hexadecimal equivalents.
CMD	Command code: 0x03
DATA[0]	Register start address (high 8 bits): parameter group number of the start register For example, for parameter C06.11, where 06 is the group number, that is, DATA[0] is 0x06.
DATA[1]	Register start address (low 8 bits): offset within the parameter group of the start register For example, for parameter C06.11, 11 is the offset within the parameter group, that is, DATA[1] is 0x11.
DATA[2]	High 8 bits of the number of parameters to be read (hexadecimal), N(H)
DATA[3]	Low 8 bits of the number of parameters to be read (hexadecimal), N(L)
CRCL	CRC active byte (low 8 bits)
CRCH	CRC active byte (high 8 bits)
END	Equal to or greater than 3.5-character idle time, frame end

Response frame format:

Value	Description
START	Equal to or greater than 3.5-character idle time, frame start
ADDR	Servo axis address, hexadecimal
CMD	Command code: 0x03
DATALENGTH	Number of parameter bytes, equal to twice the number of parameters to be read, that is, N x 2
DATA[0]	Data of the first register parameter (high 8 bits)
DATA[1]	Data of the first register parameter (low 8 bits)
DATA[…]	…
DATA[N*2 2]	Data of the Nth register parameter (high 8 bits)
DATA[N*2 1]	Data of the Nth register parameter (low 8 bits)
CRCL	CRC active byte (low 8 bits)
CRCH	CRC active byte (high 8 bits)
END	Equal to or greater than 3.5-character idle time, frame end

Based on the Modbus RTU protocol, command code 0x06 is used to write 16-bit parameters. Command code 0x10 is used to write 32-bit parameters.

Communication example

To read two-word data with C02.02 as the start register from the drive whose servo axis address is 01.

Master request frame:

01	03	02	02	00	02	CRCL	CRCH

Slave response frame:

01	03	04	00	01	00	00	CRCL	CRCH

The response frame indicates that the slave returns two-word (four-byte) data, the content of which is 0x0001 and 0x0000.

To read parameter C05.07 (32-bit) from the drive whose servo axis address is 01.

Master request frame:

01	03	05	07	00	02	CRCL	CRCH

Slave response frame:

01	03	04	00	01	00	00	CRCL	CRCH

The response frame indicates that the value of parameter C05.07 is 0x00000001.

Command code for writing 16-bit parameters: 0x06

⚠ CAUTION

- Do not use 0x06 to write 32-bit parameters; otherwise, it will lead to serious errors.

Request frame format:

Value	Description
START	Equal to or greater than 3.5-character idle time, frame start
ADDR	Servo axis addresses 1 to 247 Note: 1 to 247 are decimal values and need to be converted to hexadecimal equivalents.
CMD	Command code: 0x06
DATA[0]	Register start address (high 8 bits): parameter group number of the start register For example, for parameter C06.11, where 06 is the group number, that is, DATA[0] is 0x06.
DATA[1]	Register start address (low 8 bits): offset within the parameter group of the start register For example, for parameter C06.11, 11 is the offset within the parameter group, that is, DATA[1] is 0x11.
DATA[2]	High 8 bits of data to be written to the register (hexadecimal)
DATA[3]	Low 8 bits of data to be written to the register (hexadecimal)
CRCL	CRC active byte (low 8 bits)
CRCH	CRC active byte (high 8 bits)
END	Equal to or greater than 3.5-character idle time, frame end

Response frame format:

Value	Description
START	Equal to or greater than 3.5-character idle time, frame start
ADDR	Servo axis address, hexadecimal
CMD	Command code: 0x06
DATA[0]	Register start address (high 8 bits): parameter group number of the start register For example, for parameter C06.11, where 06 is the group number, that is, DATA[0] is 0x06.

Value	Description
DATA[1]	Register start address (low 8 bits): offset within the parameter group of the start register For example, for parameter C06.11, 11 is the offset within the parameter group, that is, DATA[1] is 0x11.
DATA[2]	High 8 bits of data to be written to the register (hexadecimal)
DATA[3]	Low 8 bits of data to be written to the register (hexadecimal)
CRCL	CRC active byte (low 8 bits)
CRCH	CRC active byte (high 8 bits)
END	Equal to or greater than 3.5-character idle time, frame end

Communication example

To write data 0x0001 to parameter C02.02 in the drive whose servo axis address is 01.

Master request frame:

01	06	02	02	00	01	CRCL	CRCH

Slave response frame:

01	06	02	02	00	01	CRCL	CRCH

The response frame indicates that data 0x0001 has been written to parameter C02.02 in the drive whose servo axis address is 01.

Command code for writing 32-bit parameters: 0x10

⚠ **CAUTION**

- Do not use 0x10 to write 16-bit parameters; otherwise, it will lead to serious errors.

Request frame format:

Value	Description
START	Equal to or greater than 3.5-character idle time, frame start
ADDR	Servo axis addresses 1 to 247 Note: 1 to 247 are decimal values and need to be converted to hexadecimal equivalents.
CMD	Command code: 0x10
DATA[0]	Register start address (high 8 bits): parameter group number of the start register For example, for parameter C11.12, where 11 is the group number, that is, DATA[0] is 0x11.

Value	Description
DATA[1]	Register start address (low 8 bits): offset within the parameter group of the start register For example, for parameter C11.12, 12 is the offset within the parameter group, that is, DATA[1] is 0x12.
DATA[2]	High 8 bits of the number of parameters to which data will be written (hexadecimal), M(H) For example, to write data to parameter C03.02 alone, DATA[2] is 00, DATA[3] is 02, and M is 0002. One 32-bit parameter is counted as two words.
DATA[3]	Low 8 bits of the number of parameters to which data will be written (hexadecimal), M(L)
DATA[4]	Number of bytes corresponding to data to be written to the register, that is, M x 2 For example, to write data to parameter C03.02 alone, DATA[4] is 04.
DATA[5]	High 8 bits of data to be written to the start register (hexadecimal)
DATA[6]	Low 8 bits of data to be written to the start register (hexadecimal)
DATA[7]	High 8 bits of data to be written to Start register address + 1 (hexadecimal)
DATA[8]	Low 8 bits of data to be written to Start register address + 1 (hexadecimal)
CRCL	CRC active byte (low 8 bits)
CRCH	CRC active byte (high 8 bits)
END	Equal to or greater than 3.5-character idle time, frame end

Response frame format:

Value	Description
START	Equal to or greater than 3.5-character idle time, frame start
ADDR	Servo axis address, hexadecimal
CMD	Command code: 0x10
DATA[0]	Register start address (high 8 bits): offset within the parameter group of the start register For example, to write data to parameter C11.12, DATA[0] is Cx11.
DATA[1]	Register start address (low 8 bits): offset within the parameter group of the start register For example, to write data to parameter C11.12, DATA[1] is 0x12.
DATA[2]	High 8 bits of the number of parameters to which data will be written (hexadecimal), M(H)
DATA[3]	Low 8 bits of the number of parameters to which data will be written (hexadecimal), M(L)
CRCL	CRC active byte (low 8 bits)

Value	Description
CRCH	CRC active byte (high 8 bits)
END	Equal to or greater than 3.5-character idle time, frame end

Error response frame

Error frame response format:

Value	Description
START	Equal to or greater than 3.5-character idle time, frame start
ADDR	Servo axis address, hexadecimal
CMD	Command code: 0x90
DATA[0]~[3]	DATA error code
CRCL	CRC active byte (low 8 bits)
CRCH	CRC active byte (high 8 bits)
END	Equal to or greater than 3.5-character idle time, frame end

Error code:

Error code	Code description
0x0001	Illegal command code
0x0002	Illegal data address
0x0003	Illegal data
0x0004	Slave device fault
0x0006	Write length error
0x0008	Sector error
0x0020	Reading disabled

32-bit parameter addressing

When Modbus commands are used to read/write 32-bit parameters, the communication address is determined by the address of the parameter with the smaller offset number. Two parameters are operated per operation. See the following examples.

NOTICE

- In the following example, the servo axis address defaults to 01.

For example, the Modbus command for reading parameter C11.12 (1st displacement) is as follows:

01	03	11	12	00	02	CRCL	CRCH

If the "1st displacement" is 0x40000000 (decimal equivalent: 1073741824), the following response frames apply.

When C0A.06 is set to 0 (Low 16 bits before high 16 bits), the response frame is as follows:

01	03	04	00	00	40	00	CRCL	CRCH

When C0A.06 is set to 1 (High 16 bits before low 16 bits), the response frame is as follows:

01	03	04	40	00	00	00	CRCL	CRCH

For example, the Modbus command for writing 0x12345678 (1st displacement) is:

When C0A.06 is set to 0 (Low 16 bits before high 16 bits), the response frame is as follows.

01	10	11	0C	00	02	04	56	78	12	34	CRCL	CRCH

When C0A.06 is set to 1 (High 16 bits before low 16 bits), the response frame is as follows.

01	10	11	0C	00	02	04	12	34	56	78	CRCL	CRCH

For example, the command for writing 0x00100000 (decimal equivalent: 1048576) to the 32-bit parameter C05.07 is as follows.

If C0A.06 is set to 0 (Low 16 bits before high 16 bits), the Modbus command is:

01	10	05	07	00	02	04	00	00	00	10	CRCL	CRCH

CRC

The host controller and the servo drive must use the same CRC algorithm during communication. Otherwise, a CRC error will occur. The A6-RS servo drive adopts 16-bit CRC, with low bytes placed before high bytes. The polynomial used for CRC is $X_{16} + X_{15} + X_2 + 1$ (0xA001).

```
Uint16 COMM_CrcValueCalc(const Uint8*data, Uint16 length)
{
  Uint16 crcValue = 0xffff;
  int16 i;
  while (length--)
  {
    crcValue ^ = *data++;
    for (i = 0; i<8; i++)
    {
      if (crcValue & 0x0001)
```

```
        {
          crcValue = (crcValue>>1) ^ 0xA001;
        }
        else
        {
          crcValue = crcValue>>1;
        }
      }
    }
    return (crcValue);
}
```

Chapter 10 Motor and Options

10.1 Model

A6M60 - 400 H2 A1-M17(S)

Number of encoder turns	S for single turn, empty for multiple turns
Resolution	17: 17-bit 23: 23-bit
Encoder type	E : Magnetic Encoders M: optical encoder
Plug Type	1: Straight Plugs 2: Plastic Plugs 3:Aviation Plugs
Brake	A: No brake B: brake
Voltage level	2: 220VAC 3: 380VAC
Intertial	H: high inertial M: neutral inertial L: low inertial
Power class	400: 400W 750: 750W 1000: 1000W
Motor Size	M60: 60mm End Flange M80: 80mm End Flange
Product series	A6 series

10.2 Nameplate

Figure 10-1 Nameplate of the A6M60 servo motor

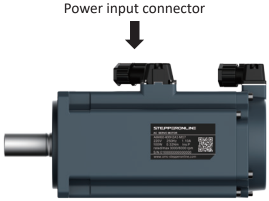
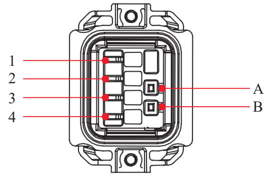
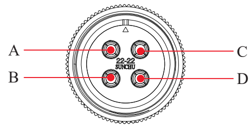
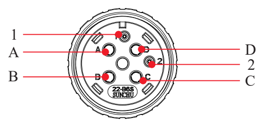
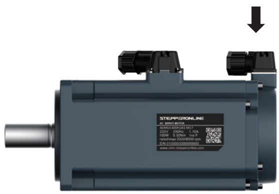
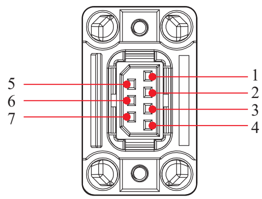
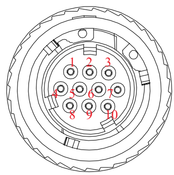
10.3 Components

Figure 10-2 Components of the A6M60 servo motor

10.4 Terminal Definition

NOTICE

- The figure is for reference only. For details about the motor correspondence and size information, refer to the supporting relationships and drawings. Pay attention to the mirror relationship between the motor side and the cable side.

Cable Type	Terminal Layout (Cable Side)	Pin No.	Usage
Power input connector 		1	Phase V
		2	Phase U
		3	Phase W
		4	Grounding cable
		A	Brake (polarity insensi-tive)
		B	Brake (polarity insensi-tive)
		A	Phase U
		B	Phase V
		C	Phase W
		D	Grounding cable
		A	Phase U
		B	Phase V
		C	Phase W
		D	Grounding cable
		1	Brake (polarity insensi-tive)
		2	Brake (polarity insensi-tive)
Encoder connector 		1	DATA+
		2	DATA-
		3	BAT+
		4	BAT-
		5	+5V
		6	0V
		7	Enclosure
		1	DATA+
		2	DATA-
		4	+5V
		5	BAT-
		6	BAT+
		9	0V
		10	Enclosure

10.5 General Specifications

10.5.1 Mechanical Characteristics

<table>
<tr><th colspan="2">Item</th><th>Description</th></tr>
<tr><td colspan="2">Duty</td><td>S1 (Continuous)</td></tr>
<tr><td colspan="2">Vibration class[1]</td><td>V15</td></tr>
<tr><td colspan="2">Insulation resistance</td><td>500 V DC, above 10 MΩ</td></tr>
<tr><td colspan="2">Excitation mode</td><td>Permanent magnetic</td></tr>
<tr><td colspan="2">Mounting mode</td><td>Flange</td></tr>
<tr><td colspan="2">Thermal class</td><td>Level F</td></tr>
<tr><td colspan="2">Insulation voltage</td><td>1500 V AC, 1 minute (220 V level)
1800 V AC, 1 minute (380 V level)</td></tr>
<tr><td colspan="2">IP rating of the enclosure</td><td>IP67 with an oil seal (oil seal installed on the axis side)</td></tr>
<tr><td colspan="2">Forward direction of rotation</td><td>The servo drive rotates counterclockwise (CCW) as observed from the axis side under the forward rotation command.</td></tr>
<tr><td rowspan="4">Ambient conditions</td><td>Ambient temperature</td><td>(Non-freezing) (Derate based on the derating curve for temperatures above 40°C.)</td></tr>
<tr><td>Ambient humidity</td><td>20% to 80% (Non-condensing)</td></tr>
<tr><td>Installation site</td><td>• Free from corrosive or explosive gases
• Well ventilated with minimum amount of dust, waste, and moisture
• Convenient for inspection and cleaning
• Derating required only for altitudes above 1000 m
• Away from sources that may generate strong magnetic field
• Away from heating sources such as a heating stove
• Use a motor with oil seal in places with grinding fluid, oil mist, iron powders or cuttings.</td></tr>
<tr><td>Storage environment</td><td>Observe the following requirements for storage of a de-energized motor:
• Storage temperature: (Non-freezing)
• Storage humidity: (Non-condensing)</td></tr>
<tr><td rowspan="2">Shock resistance[2]</td><td>Shock acceleration rate at flange</td><td>490 m/s²</td></tr>
<tr><td>Number of shocks</td><td>2</td></tr>
<tr><td>Vibration resistance[3]</td><td>Vibration acceleration rate at flange</td><td>49 m/s²</td></tr>
</table>

CAUTION

- [1] The vibration class V15 indicates that the vibration amplitude is less than 15 μm when a servo motor rotates at its rated speed.
- [2] The value in the table indicates the resistance against shock in the vertical direction with the servo motor shaft mounted horizontally.
- [3] The value in the table indicates the resistance against vibration in the vertical, left-right, and forward-backward directions with the servo motor shaft mounted horizontally.
- The strength of the vibration that the servo motor can withstand depends on the application. Check the vibration acceleration rate applied to the servo motor through the actual product.

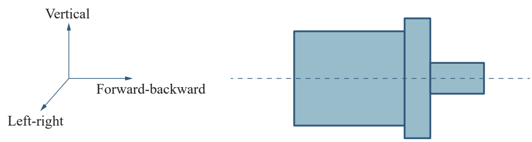


Figure 10-3 Directions of short and vibration applied to the servo motor

10.5.2 Overload Characteristics

The motor is compliant with NEC and CEC requirements and equipped with protective functions against overload and over-temperature.

To protect different load motors, set the motor overload protection gain based on the overload capacity of the motor. Use the default gain in general conditions. However, when one of the following conditions occurs, change the gain based on actual motor temperature:

- The motor operates in environments with high temperature.
- The motor is in cyclic motion featuring a short motion cycle and frequent acceleration/ deceleration.

See the following inverse time lag curve for motor overload protection.

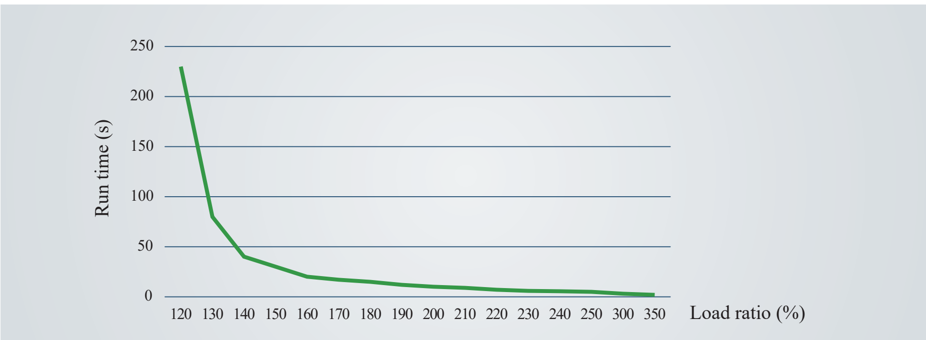


Figure 10-4 Motor overload protection curve

10.5.3 Load moment of inertia

The load moment of inertia represents the inertia of the load. Larger load moment of inertia means slower response, which may result in unstable motion. The allowable load moment of inertia of the motor is subject to a limit. The limit varies with the driving conditions of the servo motor.

An overvoltage warning may occur during deceleration if the load moment of inertia exceeds the allowable value. The servo drive with a built-in braking resistor may generate an overload warning. In case of such warnings, take one of the following measures:

- Reduce the torque limit value.
- Reduce the deceleration rate.
- Reduce the maximum speed.
- Install an external braking resistor if the warning cannot be cleared using the above measures.

NOTICE

- Servo motors with the capacity below 400 W do not have built-in braking resistors.
- When a built-in braking resistor is used, some energy generated under certain regenerative driving conditions still exceeds the allowable capacity loss (W) of the built-in braking resistor. In this case, an external braking resistor is required.

The following figure shows the relationship between the ratio of allowable load moment of inertia and the speed when a servo is used without a built-in regenerative resistor or an external braking resistor. (The following figure shows the reference values upon deceleration at 200 VAC input and torques greater than the rated torque.)

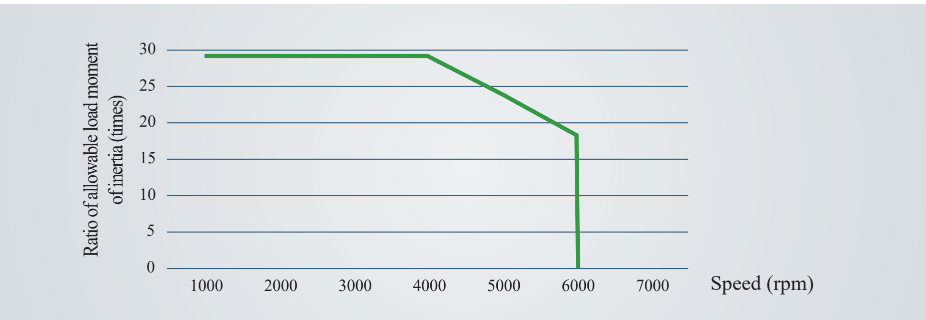


Figure 10-5 Ratio of allowable load moment of inertia for the speed

When the servo unit is used by load whose moment of inertia exceeds the allowable value, an overvoltage alarm may be triggered.

10.6 Selection Precautions

- Motors with oil seals must be derated by 10% during use.
- Do not share the power supply of the brake with other electrical devices. Failure to comply may result in malfunction of the brake due to voltage or current drop caused by other devices.
- Use cables with a cross-sectional area above 0.5 mm^2.
- All parameters and torque-speed characteristic values are subject to the conditions that the motor works with a servo drive and the armature coil temperature is 20°C.
- The torque for fastening the terminal screws must be 0.19 N·m to 0.21 N·m. Excessive torque may damage the screws.
- Radial and axial loads of the motor

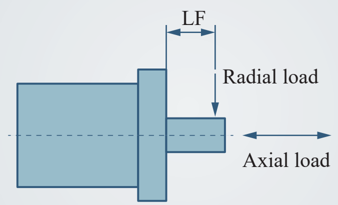


Figure 10-6 Radial and axial loads of the motor

10.7 Technical Specifications

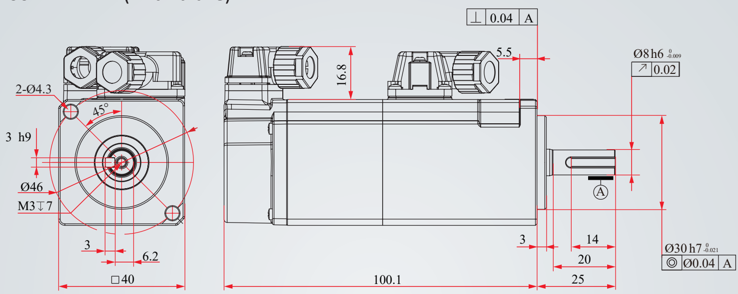
10.7.1 Model of 3000 rpm

100 W (40 frame)

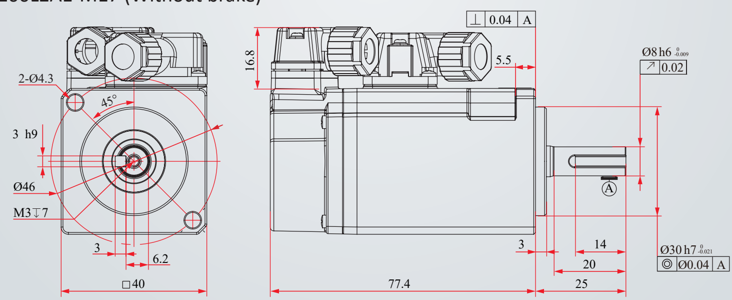
Item	A6M40-100L2B1-M17 (With brake)	A6M40-100L2A1-M17 (Without brake)
Rated power (W)	100	
Rated current (A)	1.1	
Maximum current (A)	3.9	
Rated torque (N·m)	0.32	
Maximum torque (N·m)	1.12	
Rotor inertia (10^{-4}·kg·m²)	0.033	0.03
Rated speed (rpm)	3000	
Maximum speed (rpm)	6000	
Rated voltage (V)	220	

Product Dimensions (unit: mm)

A6M40-100L2B1-M17 (With brake)



A6M40-100L2A1-M17 (Without brake)

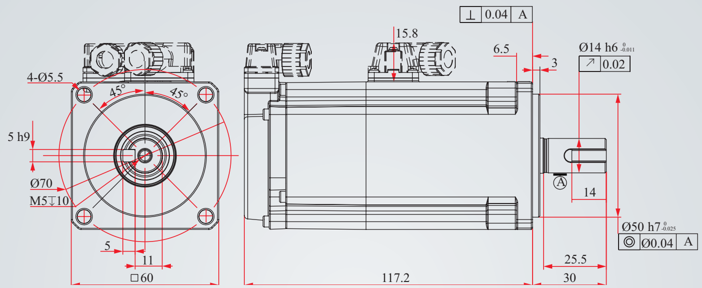


400 W (60 frame)

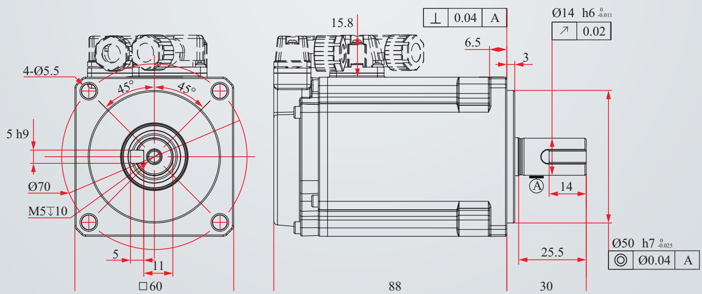
Item	A6M60-400H2B1-M17 (With brake)	A6M60-400H2A1-M17 (Without brake)
Rated power (W)	400	
Rated current (A)	2.51	
Maximum current (A)	8.78	
Rated torque (N·m)	1.27	
Maximum torque (N·m)	4.45	
Rotor inertia (10^{-4}·kg·m²)	0.60	0.59
Overload multiplier	3.5	
Rated speed (rpm)	3000	
Maximum speed (rpm)	6000	
Rated voltage (V)	220	

Product Dimensions (unit: mm)

A6M60-400H2B1-M17 (With brake)



A6M60-400H2A1-M17 (Without brake)

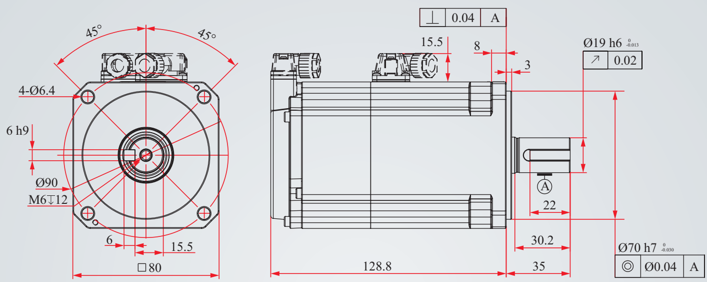


750 W (80 frame)

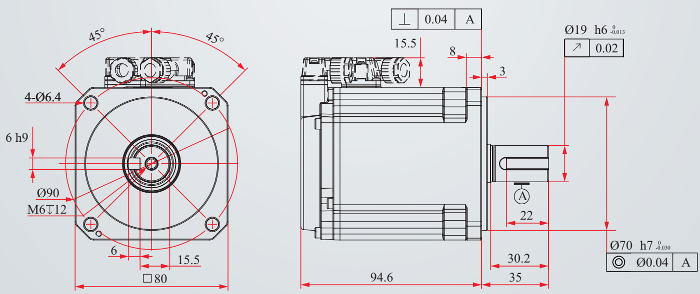
Item	A6M80-750H2B1-M17 (With brake)	A6M80-750H2A1-M17 (Without brake)
Rated power (W)	750	
Rated current (A)	4.60	
Maximum current (A)	16.30	
Rated torque (N·m)	2.39	
Maximum torque (N·m)	8.36	
Rotor inertia (10^{-4}·kg·m²)	1.77	1.72
Overload multiplier	3.5	
Rated speed (rpm)	3000	
Maximum speed (rpm)	6000	
Rated voltage (V)	220	

Product Dimensions (unit: mm)

A6M60-400H2B1-M17 (With brake)



A6M80-750H2A1-M17 (Without brake)

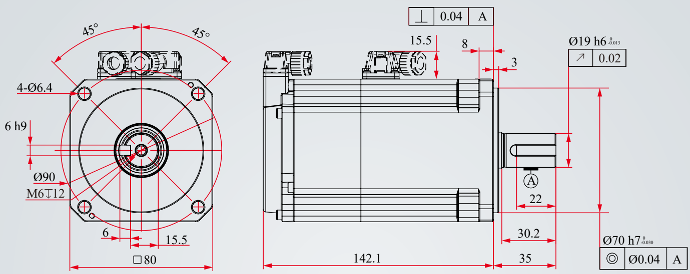


1 kW (80 frame)

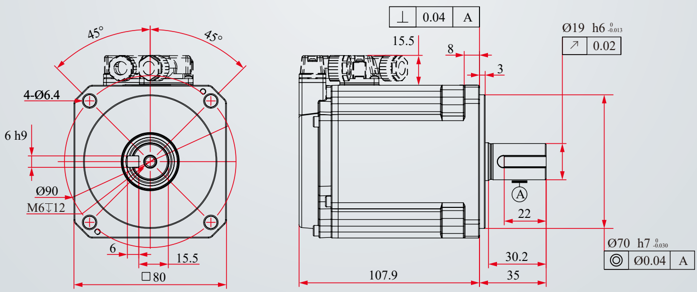
Item	A6M80-1000H2B1-M17 (With brake)	A6M80-1000H2A1-M17 (Without brake)
Rated power (W)	1000	
Rated current (A)	6.3	
Maximum current (A)	20.9	
Rated torque (N·m)	3.18	
Maximum torque (N·m)	11.13	
Rotor inertia (10^{-4}·kg·m²)	2.28	2.23
Overload multiplier	3.5	
Rated speed (rpm)	3000	
Maximum speed (rpm)	6000	
Rated voltage (V)	220	

Product Dimensions (unit: mm)

A6M80-1000H2B1-M17 (With brake)



A6M80-1000H2A1-M17 (Without brake)



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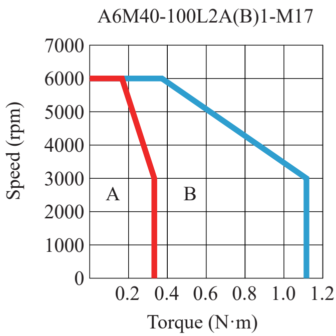
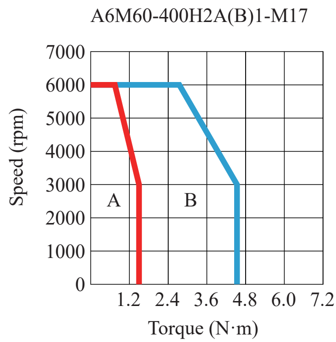
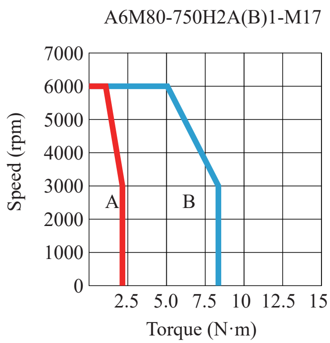
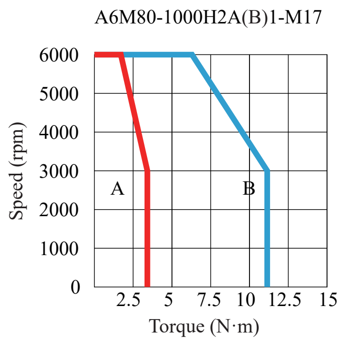
10.8 Motor torque-speed characteristics

Model of 3000 rpm









A Continuous work area

B Short-time work area

10.9 Supporting relationship between the drive and motor

220 V

	SIZE A		SIZE B
Drive model A6-RS	Single-phase 220V		
	A6-200RS	A6-400RS	A6-750RS
Motor model	100W	400W	750W
	A6M40-100L2A1-M17 A6M40-100L2B1-M17	A6M60-400H2A1-M17 A6M60-400H2B1-M17	A6M80-750H2A1-M17 A6M80-750H2B1-M17

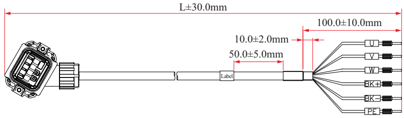
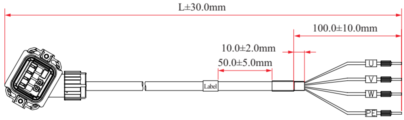
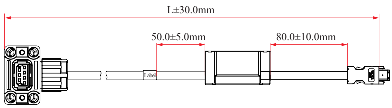
	SIZE C
Drive model A6-RS	Single-phase/three-phase 220V
	A6-1000RS
Motor model	1kW
	A6M80-1000H2A1-M17 A6M80-1000H2B1-M17

10.10 Supporting relationship between the motor and cable

Model of 3000 rpm

Motor frame number	Motor Power	Motor Model	17-bit Absolute Encoder		Brake	Oil Sealing	Shaft Diameter	Matching Accessories of Motor	
			Single-turn	Multi-turn				Power cable model	Encoder cable model
40	100W (220V)	A6M40-100L2A1-M17		●			Ø8	⑦	⑮
		A6M40-100L2B1-M17		●				①	⑮
60	400W (220V)	A6M60-400H2A1-M17		●		●	Ø14	⑦	⑮
		A6M60-400H2B1-M17		●	●	●		①	⑮
80	750W (220V)	A6M80-750H2A1-M17		●		●	Ø19	⑦	⑮
		A6M80-750H2B1-M17		●	●	●		①	⑮
80	1kW (220V)	A6M80-1000H2A1-M17		●		●	Ø19	⑦	⑮
		A6M80-1000H2B1-M17		●	●	●		①	⑮

10.11 Cable Information

<table>
<tr><th>Cable Name</th><th>Cable Model</th><th>Cable Length</th><th>Cable Appearance</th><th>No.</th></tr>
<tr><td rowspan="3">Power cable with brake</td><td>AS7-C-PWB075-3.0</td><td>3.0 m</td><td rowspan="3"></td><td rowspan="3">①</td></tr>
<tr><td>AS7-C-PWB075-5.0</td><td>5.0 m</td></tr>
<tr><td>AS7-C-PWB075-10.0</td><td>10.0 m</td></tr>
<tr><td rowspan="3">Power cable without brake</td><td>AS7-C-PWR075-3.0</td><td>3.0 m</td><td rowspan="3"></td><td rowspan="3">⑦</td></tr>
<tr><td>AS7-C-PWR075-5.0</td><td>5.0 m</td></tr>
<tr><td>AS7-C-PWR075-10.0</td><td>10.0 m</td></tr>
<tr><td rowspan="3">Multiple-turn encoder cable</td><td>AS7-C-ENC075-BAT-3.0</td><td>3.0 m</td><td rowspan="3"></td><td rowspan="3">⑮</td></tr>
<tr><td>AS7-C-ENC075-BAT-5.0</td><td>5.0 m</td></tr>
<tr><td>AS7-C-ENC075-BAT-10.0</td><td>10.0 m</td></tr>
</table>

NOTICE

- For cables related to frames of model 100 and above models, contact the manufacturer.

Chapter 11 Peripheries

11.1 List of Peripheries

Component Name	Installation Location	Applicable Model	Description
Fuse and circuit breaker	Input side of the drive	All	To comply with EN 61800-5-1 and UL 61800-5-1 standards, install a fuse/circuit breaker on the input side of the servo drive to prevent accidents caused by short circuit in the internal circuit.
AC input reactor	Input side of the drive	All	Eliminate harmonics and improves the power factor on the input side.
EMC filter	Input side of the drive	All	Reduce the conducted and radiated interference that escapes from the servo drive to the outside.
Magnetic ring	Output side of the drive	All	Reduce interference to the outside and the bearing current.
	Signal cable	All	Improve the anti-interference performance of signals.

11.2 Fuse

To prevent accidents caused by short circuit, install a fuse on the input side of the drive.

Drive Model		Rated Input Current	Recommended Fuse		
			Manufacturer	Rated Current	Model
Single-phase 220 V					
SIZE A	A6-200RS	2.3A	Bussmann	15A	FWP-15B
	A6-400RS	4 A	Bussmann	20 A	FWP-20B
SIZE B	A6-750RS	7.9 A	Bussmann	35 A	FWP-35C
SIZE C	A6-1000RS	9.6 A	Bussmann	40 A	FWP-40C
Three-phase 220 V					
SIZE C	A6-1000RS	5.1 A	Bussmann	50 A	FWP-50C

11.3 Electromagnetic Contactor

Drive Model		Rated Input Current	Recommended Contactor		
			Manufacturer	Rated Current	Model
Single-phase 220 V					
SIZE A	A6-200RS	2.3A	Schneider	9A	LC1 D09
	A6-400RS	4 A	Schneider	9 A	LC1 D09
SIZE B	A6-750RS	7.9 A	Schneider	9 A	LC1 D09
SIZE C	A6-1000RS	9.6 A	Schneider	12 A	LC1 D12
Three-phase 220 V					
SIZE C	A6-1000RS	5.1 A	Schneider	9 A	LC1 D09

11.4 Circuit Breaker

Drive Model		Rated Input Current	Recommended Contactor		
			Manufacturer	Rated Current	Model
Single-phase 220 V					
SIZE A	A6-200RS	2.3A	Schneider	4A	OSMC32N2C4
	A6-400RS	4 A	Schneider	6 A	OSMC32N2C6
SIZE B	A6-750RS	7.9 A	Schneider	16 A	OSMC32N2C16
SIZE C	A6-1000RS	9.6 A	Schneider	16 A	OSMC32N2C16
Three-phase 220 V					
SIZE C	A6-1000RS	5.1 A	Schneider	10 A	OSMC32N2C10

11.5 Absolute Encoder Battery

Select an appropriate battery according to the following table.

Battery Spec.	Item and Unit	Ratings			Requirements
		Min.	Typical	Max.	
Output Specifications: 3.6V 2500mAh	External battery volt-age (V)	3.2	3.6	5	In standby state[1]
	Circuit fault voltage (V)	-	2.6	-	In standby state
	Battery alarm voltage (V)	2.85	3	3.15	-
	Current consumed by the circuit (μA)	-	2	-	In normal operation[2]
		-	10	-	In standby state, shaft at a standstill
		-	80	-	In standby state, shaft rotating
	Ambient temperature during battery opera-tion (ºC)	0	-	40	Same as the motor
	Battery storage tem-perature (ºC)	-20	-	60	

NOTICE

- The preceding data is measured at an ambient temperature of 20ºC.
- [1] The "standby state" means that the encoder performs multi-turn counting by using the power from an external battery when the servo drive power supply is off. In this case, data transmission stops.
- [2] The "normal operation" means that the absolute encoder supports single-turn or multi-turn data counting and transceiving. Power on the servo drive after connecting the absolute encoder properly. The encoder starts data transmission after a short delay of about 5s after power-on. The motor speed must be lower than or equal to 10 rpm during transition from the standby state to the normal operation state (upon power-on). Otherwise, E740 (Encoder fault) may be reported. In this case, power off and power on the servo drive again.
- Theoretically, a battery can be used for two years, but different working conditions and environments can lead to significant differences.

Chapter 12 Maintenance

12.1 Daily Maintenance

Standard operating conditions:

- 30°C (annual average ambient temperature)
- Average load rate < 80%
- Daily operation time < 20 hours

Due to the influence of ambient temperature, humidity, dust, and vibration, the internal components of the device may age and be damaged, causing faults or reducing the service life of the device. Therefore, to ensure the normal function of the device and prevent damage, refer to the following items for daily inspection and cleaning.

Check

- The ambient temperature and humidity are normal. There is no dust or unwanted objects in the servo drive.
- There is no abnormal vibration or noise for the device.
- The voltage of the power supply is normal.
- There is no strange smell.
- There are no fibers adhered to the air inlet.
- There is no intrusion of unwanted objects on the load end.

Cleaning

- Clear the dust, especially metallic dust, on the drive surface to prevent the dust from entering the drive.
- Keep the drive in a well ventilated environment.
- Keep the front end of the servo drive and the connectors clean.

CAUTION

- Disconnect the power supply before cleaning. Use a blower gun or dry cloth to clean the equipment.
- Do not use gasoline, diluent, alcohol, acidic and alkaline detergents, to prevent discoloration or damage to the enclosure.

12.2 Periodic Maintenance

The electrical and electronic parts inside the servo drive may be mechanically worn out and degraded. Perform periodic maintenance according to the following table.

Contact us or the agent before replacement to double check whether the part needs to be replaced.

Object	Type	Standard Replacement Interval
Drive	Bus filter capacitor	About 5 years
	Cooling fan	2 to 3 years (10,000 h to 30,000 h)
	Aluminum electrolytic capacitor of the circuit board	About 5 years
	Pre-charge relay	100,000 operations (depending on the operating conditions)
	Pre-charge resistor	20,000 operations (depending on the operating conditions)
Motor	Bearing	3 to 5 years (20,000 h to 30,000 h)
	Oil Seal	5000 hours
	Encoder	3 to 5 years (20,000 h to 30,000 h)
	Absolute encoder battery	Depends on the operating conditions. See the operation instructions for the encoder battery for details.

12.3 Part Replacement

12.3.1 Plain Key Replacement

CAUTION

- Observe the uninstallation requirements described in this chapter. Failure to comply may result in equipment fault or damage.
- Disassembly by force is strictly prohibited to prevent injury to hands from bumps and knocks.

Currently, the plain keys for A6 standard motors with 60/80 frames have been unified to B-type plain keys, and come with key extraction holes. The specifications for the key extraction screws are as listed in the following table.

Motor Mode	Flat Key Size	Screw Specifications (Hexagon Screw Recommended)
60 frame	B-type plain key - B5 x 5 x 16.5	M3x10 and above
80 frame	B-type plain key - B6 x 6 x 25	M3x15 and above

Tools: Internal hexagonal wrench

Disassembly procedure:

① Prepare key extraction screws (hexagon bolts as recommended) of the corresponding specifications according to the motor models.

② Use an Allen key to turn the screws clockwise until the A-A end of the plain key completely disengages from the keyway. This will allow you to remove the plain key.

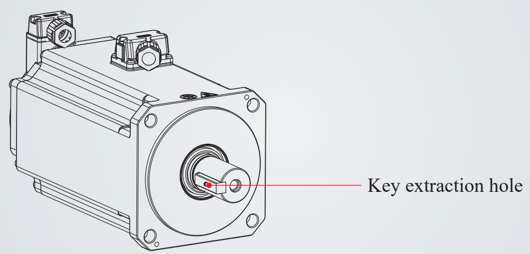


Figure 12-1 Plain key disassembly

12.3.2 Oil Seal Replacement

Tools: Needle-nose pliers, non-slip gloves, and cotton cloth

Disassembly procedure:

① Put a cotton cloth at support point B to protect the end bracket against scratch during disassembly.

② Fix the motor and prop the oil seal outer lip at point A with one end of the needle-nose pliers.

③ Pry out the oil seal slowly at point B.

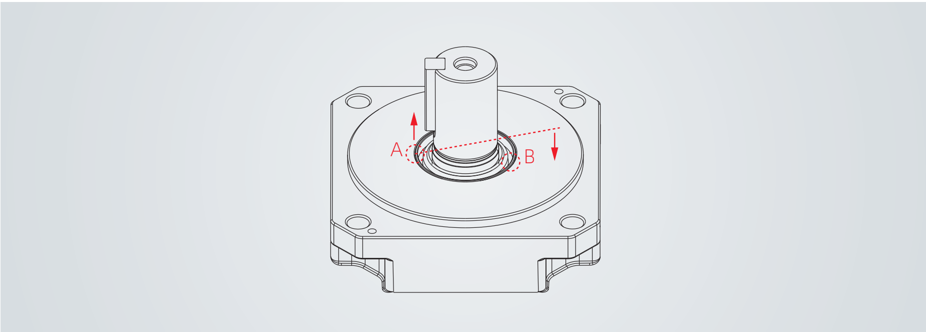


Figure 12-2 Oil seal disassembly

Chapter 13 Troubleshooting for Common EMC Issues

13.1 RCD Malfunction

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

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

When an RCD malfunctions, perform troubleshooting according to the following table.

<table>
<tr><th>Fault</th><th>Possible Cause</th><th>Solution</th></tr>
<tr><td rowspan="4">Tripping upon power-on</td><td>The anti-interference performance of the RCD is poor.</td><td rowspan="4">• Use an RCD from a recommended brand.
• Use an RCD with a high tripping current.
• Move the unbalanced load to the front end of the earth leakage circuit breaker.</td></tr>
<tr><td>The rated tripping current of the RCD is too low.</td></tr>
<tr><td>An unbalanced load is connected to the rear end of the RCD.</td></tr>
<tr><td>The ground capacitance at the front end of the drive is high.</td></tr>
<tr><td rowspan="4">Tripping during operation</td><td>The anti-interference performance of the RCD is poor.</td><td rowspan="4">• Use an RCD from a recommended brand.
• Use an RCD with a high tripping current.
• Install a simple filter on the input side of the drive, and wind the LN/RST cable on a magnetic ring near the RCD.
• Reduce the carrier frequency without compromising the performance.
• Use a shorter motor cable.</td></tr>
<tr><td>The rated tripping current of the RCD is too low.</td></tr>
<tr><td>An unbalanced load is connected to the rear end of the RCD.</td></tr>
<tr><td>The ground distributed capacitance of the motor cable and the motor is too high.</td></tr>
</table>

13.2 Harmonic Suppression

To suppress the harmonic current of the servo drive and improve the power factor, install an AC input reactor on the input side of the servo drive to meet standard requirements.

The following figure shows the reactor mounting mode.

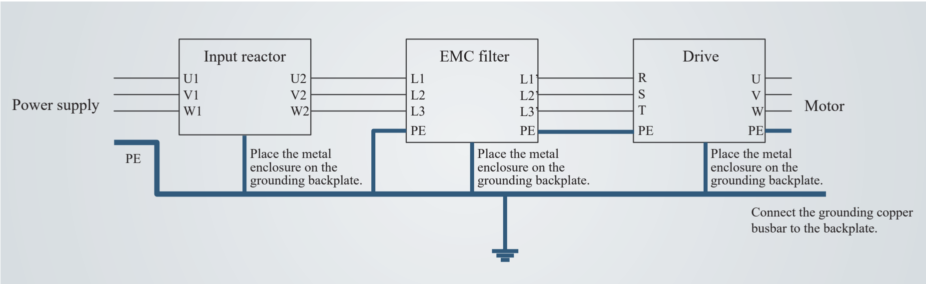


Figure 13-1　Reactor mounting mode

13.3 Control Circuit Interference

13.3.1 Common I/O Signal Interference

The drive generates very strong interference during operation. In the case of improper routing or grounding, the drive may interfere with or be interfered with by other devices. In such a case, take the following measures.

- Use shielded cables as the I/O signal cables and connect the shield to the PE terminal.
- Reliably connect the PE terminal of the motor to the PE terminal of the servo drive, and connect the PE terminal of the servo drive to the PE terminal of the grid.
- Add an equipotential bonding grounding wire between the host controller and the drive.
- Add a magnetic ring for the U/V/W output cable of the drive. Wind the cable on the ring for two to four turns.
- Increase the filter capacitance at low-speed DI terminals. A maximum of 0.1 μF capacitance is recommended.
- Increase the filter capacitance between AI and GND terminals. A maximum of 0.22 μF capacitance is recommended.
- Add a magnetic buckle or magnetic ring for the signal cable. Wind the signal cable on the buckle or ring for one or two turns.
- Use shielded cables as power cables and ground the shield securely.

Revision History

Date	Changed Version	Change Description
September 2024	A00	First release