FL20-C series

Power Range 220V 0.05kW~4.5kW

380V/400V 1.0kW~37kW

Product Manual (English)

Version: N2017122802

aerospace
climate control
electromechanical
filtration
fluid & gas handling
hydraulics
pneumatics
process control
sealing & shielding

Parker

ENGINEERING YOUR SUCCESS.

FOREWORD

Thanks for your selection of the servo drive. Meanwhile, please enjoy the comprehensive and sincere service from our technical teams.

The user manual is used for providing the instructions of installation and debugging, operation and use, fault diagnosis and attentions of routine maintenance. Please read this manual carefully before installing and using. This manual will be supplied together with servo drive, keep properly for further consulting and use.

If there are any questions in use and user cannot find any solutions in this manual, please contact and consult with our company or distributors directly. Our professional technique service team will offer the dedicated service to you. We are looking forward to your valuable comment and suggestion.

Our company is committed to the improvement of products and function upgrade. The content of user manual could be amended at any time without prior notice. The latest and detailed user manual will be launched in corporate website.

Unpacking Inspection:

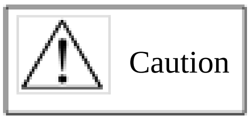
Please check as below carefully when unpacking:

Item to check	Description
Check if arrived goods are in complete accord with the ordered product model?	Box contains ordered goods, user manual of FL20 and accessories of servo drive. Please use nameplates of servo drive and motor to confirm.
Check if there is any damage of product?	Check the appearance of machine to see if there is any damage during the transportation. Please contact with our company or distributor in time to solve if any damage or lost.
Check if the rotation axis of servo motor running smoothly?	It is normal if the axis can be rotated gently by hand, except for servo motor with brake.

■ SAFETY SIGNS

The safety operation of the product depends on the correct installation and operation and proper maintenance. Make sure to comply with the below safety signs in user manual:

Incorrect operation could trigger hazardous conditions, which may result in personnel injury and death.



Incorrect operation could trigger hazardous conditions, which may result in moderate to minor personnel injury, or device damage.
In addition, matters mentioned in this sign may result in severe consequence sometimes.

The significance of identifier in the drive case as below:

High voltage, electrical shock hazard.

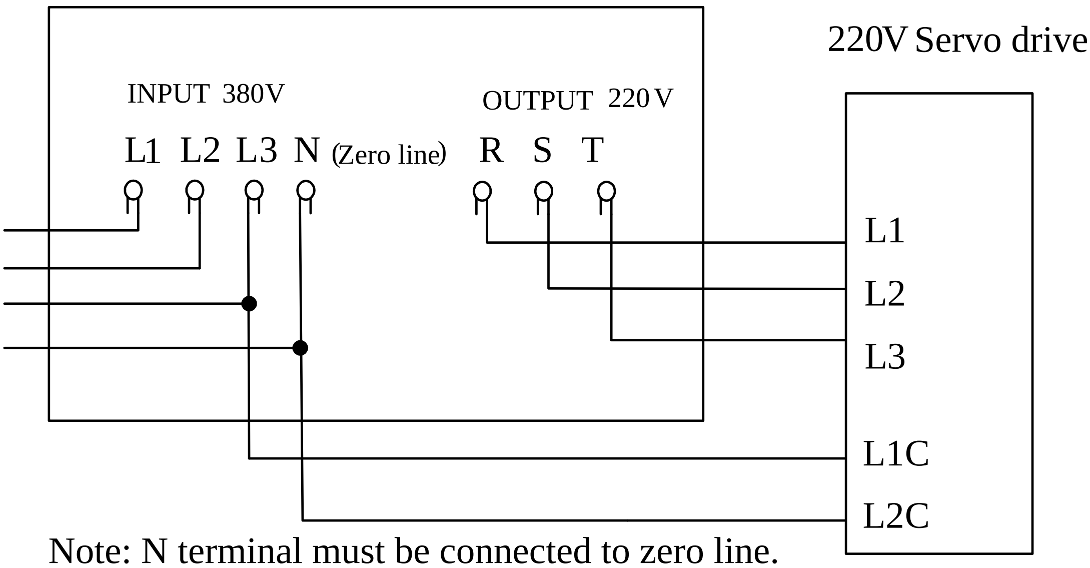
Heat surface, do not touch.

■ IEC STANDARD

IEC/EN 61800-5-1: 2007 Adjustable speed electrical power drive systems safety requirements.
IEC/EN 61800-3: 2004/ +A1: 2012 Adjustable speed electrical power drive system. Part 3: EMC product standard including specific test methods.

Attention: Please connect electronic transformer sequence correctly, or may lead to danger.

Electronic transformer wiring diagram



Note: N terminal must be connected to zero line.

NOTICE FOR USE:

■ Basic Terms

The user manual, unless special instructions, is used by the proper technical terms as below:

Servo drive: to drive and control servo motor.

Servo system: servo control system, which consist of servo drive, servo motor, instruction control unit and peripheral devices.

User parameter: monitor or set the parameters related to servo drive, dividing into monitoring parameter and setting parameter.
Monitoring parameter: read only, cannot modify.
Setting parameter: can be read and modified. Based on the function, it can be divided into function parameter and data parameter.

EtherCAT Common Term	Definition
CiA	CAN in Automation
CoE	CANopen over EtherCAT
DC	Distribute Clock: make all slave stations receive the same time
ECAT	Short for EtherCAT
ESC	EtherCAT Slave Controller
ESM	EtherCAT state machine
ETG	EtherCAT technology group
EtherCAT	Real-time industrial Ethernet standard
OD	Object dictionary
INIT	EtherCAT state machine： Initialization state
PREOP	EtherCAT state machine： Pre-operation state
SAFEOP	EtherCAT state machine： Safe operation state
OP	EtherCAT state machine： Operation state
SyncManager	Synchronous manager: control the access of application storage area
SDO	Service data object
PDO	Process data object
TXPDO	Transmit process data
RXPDO	Receive process data
APRD	Auto-increment physical read: Read slave storage area selected from the salve position in network segment.
APWR	Auto-increment physical write: Write slave storage area selected from the slave position in network segment.
APRW	Auto-increment physical read-write single slave
ARMW	Auto-increment physical multiple read-write slaves
BRD	Broadcast read: read the physical storage area of all network slaves.
FMMU	Fieldbus Memory Management Unit
LRD	Read single or multiple salve storage area selected from logic address.
LWR	Write data to slave area select from logic address.
LRW	Read or write data to the slave storage area selected from logic address.

■ Common Symbol

This manual is used symbols as below for convenient representation.

1. Mode description

PP：Profile Position mode	ALL：All modes
CSP：Cycle Sync. Position mode	
PV：Profile Velocity mode	
CSV：Cycle Sync. Velocity mode	
PT：Profile Toque mode	
CST：Cycle Sync. Torque mode	
HM：Homing mode	

2. Use of backslash (/)

Backslash is used in wiring circuit diagram, which is descripted for default logic of IO port.
For input signal, with backslash means that the input signal is enabled when input side on, so default logic is positive logic; without backslash means that the input signal is enabled when input side is off, so default logic is negative logic.
For output signal, with backslash means that the output side is always off, it is on only when signal outputs; without backslash means that the output side is always on, it is off only when signal outputs.

3. Others

NC: Not connected; **N/A**: No unit

■ XML File Configuration Instruction:

1. Please use proper ".XML" file to configure or install on the EtherCAT master before using FL20-C series servo slave to connect to the EtherCAT master.
2. The version of ".XML" file can be identified by servo parameter So-60 (Index 2008h-3Dh). The ".XML" file can be read from servo slave and configured to master by operating EtherCAT master. User also can ask the related personnel for the XML file.

■ Parameter entry-into-effect time

1. The entry-into-effect time of below parameters is 1000ms, which means that the parameter will take 1000ms to take into effect after setting the parameter. These parameters are Po500, Po501, Po503, Po504, Po506, So-20, So-21, So-22, So-24, and So-62.
2. Excluding the parameters above, the entry-into-effect time of the rest FL20-C servo parameters is 100ms.

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I. User Reminder

1.1 Safety Precautions

Important matters that users must abide by are explained in the chapter, which relates to product confirm, storage, transportation, installation, wiring, operation, inspection, disposal, and so on.

Danger

- After the power off for at least 5 min and the power light is off, using multimeter to check the voltage between B1 and N+ firstly, then the drive can be disassembled and installed. Otherwise, residual voltage may cause electric shock.
- Never touch the inside of servo drive, or electric shock may occur.
- Process insulating treatment for the connecting part of power terminal.
- The GND terminal of servo drive must be grounded, or electric shock may occur.
- Do not damage or hard pull the cables, or make the cable bear overweight, otherwise, the inside cable may be damaged or electric shock may occur, which also may cause the damage of the product.
- Unless the designated professional personnel. Do not disassemble or repair the drive oneself, or electric shock may occur.
- Follow the procedures required in user manual to test running.
- In the connection status of servo motor and machinery, wrong operation may cause the damage of machinery, sometimes even human injury occurs, so operate discreetly.
- Except for special purpose, do not modify max speed value (Po002). Or machinery may damage or human injury occurs.
- Within a period time after power on and off, do not touch cooling fin, external braking unit, and servo motor, because the temperature could be very high, which may cause scald.
- Never touch the rotating part when servo motor running.
- Put servo motor in the status that can be emergency stop anytime when running installed with the matched machinery.
- For safety purpose, install the emergency stop device in the machinery side.
- The brake of servo motor is not used to make sure the safe stop device. Damage of equipment may occur without installing stop device.
- If momentary power loss then power recovers during the running process, unexpected restart of machinery may occur, press emergency stop key when power off, and then proceed to operate until the power supplies stably, meanwhile, do not close to the machinery to avoid hazard.
- Take appropriate measures to ensure safety against an unexpected restart.
- Do not modify products. Failure to observe this warning may result in personal injury and damage to products.
- Install servo drive, servo motor and external braking unit on the noncombustible.
- MCTT (electromagnetic contactor) and NFB(no fuse breaker) must be installed between main circuit power (L1,L3 for 1-phase, L1/R, L2/S, L3/T for 3-phase)。
- Do not leave flammable foreign object such as oil, grease and conductive matter such as screw, sheet metal, or may result in fire risk.

1.2 Storage and transportation

Caution
● Do not store or install product in the following circumstance to avoid fire, electric shock or damage: • Location subjects to direct sunlight; • Location that environment temperature exceeds the range specified in temperature condition of storage and installation. • Location that relative humidity exceeds the range specified in the humidity condition of storage and installation. • Location subjects to large temperature difference and dew formation; • Location subjects to causticity gas, flammability gas and location with more dust, dirt, salts and metal dust; • Location subjects to drips of water, oil and drug; location that vibration or shock can be transferred to subject. ● Do not place any load exceeding the limit specified on the packing box； ● Do not hold the product by the cables or motor shaft when transporting it;

1.3 Installation

Caution
● Do not install the product in the environment of water, corrosive gases, inflammable gases, or combustibles. ● Do not step on or place a heave object on the product. ● Do not block inlet or outlet ports, preventing foreign objects from entering the product. ● Be sure to install the product in the correct direction. ● Keep specified space between servo drive and cabinet surface and other devices. ● Do not apply any strong impact.

1.4 Wiring

Caution

- Do not connect a three-phase power supply to the U, V, or W output terminals.
- Connect U, V and W of servo drive directly to U, V, and W of servo motor, and avoid using MCtt when connecting.
- When DO output connecting to relay, pay attention to the polarity of FWD (fly-wheel diode). Otherwise, damage of servo drive may occur, and signal outputs abnormally.
- Firmly fasten and securely connect power supply terminals and motor output terminals.
- Do not connect 220V servo drive directly to 400V voltage.
- Do not bundle the power cable and signal cable together or passing through in the same pipeline. Keep both cables separated by at least 30cm.
- Use twisted-pair shielded wires or multi-core twisted pair shielded wires for signal and encoder cables.
- The maximum length is 3m for reference input cable and the maximum length is 15m for encoder cable.
- Take appropriate countermeasures to potential interference when using the servo system in following locations.
- Locations subjects to static electricity or other forms of noise.
- Locations subjects to strong electromagnetic fields and magnetic fields.
- Locations subjects to possible exposure to radioactivity.
- Repair or maintain servo drive only after the CHARGE indication goes off.

1.5 Maintenance and Inspection

Caution

- Repair or maintenance of the servo drive can be performed only by qualified personnel.
- Cut off all connections of servo drive before the insulation resistor test of servo drive.
- To avoid the discoloration or damage of cover, do not use petrol, diluent, ethyl alcohol, acidic and alkaline detergent to clean.
- When replacing the servo drive, resume operation only after transferring the previous user parameters to the new servo drive or computer.
- Do not attempt to change wiring while the power is ON.
- Do not disassemble the servo motor.

II. Product Information
2.1 Servo drive introduction
2.1.1 Nameplate and Model selection

FL20 — C 152 T3 M2 F5 D7 B3

Product Series
FL20 seiries

Function	
C	Bus type

	Power Rating		Structure
1- phase 220V	500	0.05kW	M1
	101	0.1kW	
	201	0.2kW	
	401	0.4kW	
	751	0.75kW	
	102	1kW	M2
	122	1.2 kW	
	182	1.8 kW	
3- phase 220V	500	0.05kW	M1
	101	0.1kW	
	201	0.2 kW	
	401	0.4 kW	
	751	0.75kW	
	102	1 kW	M2
	122	1.2kW	
	182	1.8kW	
	302	3 kW	M3
	452	4.5kW	
3- phase 400V	102	1 kW	M2
	152	1.5kW	
	202	2 kW	M3
	302	3 kW	
	452	4.5 kW	
	552	5.5 kW	
	752	7.5 kW	MM4
	113	11 kW	
	153	15 kW	M4
	183	18 kW	M5
	223	22 kW	
	303	30 kW	M6
	373	37 kW	

Voltage	
S2	1 - phase220V
T2	3-phase220V
T3	3-phase400V

Structure size (W*H*D)		Brake type
M1	48*175*195	B3(no brake)
M2	75*175*195	B1 B3
M3	100*203*218	B1 B3
M3(5.5kW)	100*203*218	B1
MM4	150*336*203	B1(no brake)
M4	185*380*215	B1(no brake)
M5	210*420*215	B1(no brake)
M6	268.4*498*234	B1(no brake)

Communication	
F5	Modbus Internal EtherCAT

FeedbackType	
D2	Differential resolver
D5	14-core2500-ppr incremental encoder
D51	8-core2500-ppr incremental encoder
D52	4-core 23- bit incremental encoder
D7	4- core17- bit absolute encoder
D71	4- core 23-bit absolute encoder

Brake Type	
B1	Built- in brake
B3	Built-in+Dynamic

Note: No built-in brake resistors for M1, MM4 and above drives.

2.1.1 Servo drive naming rule

Parker	Parker Hannifin Corporation www . Parker com			
Model	FL20- C202T3M3		Function code	F5D5B3
Input	AC 3 PH 380 V 50 / 60 Hz			
Output	AC 3 PH 6 A 0 ～380 V			
	0 ~ 400Hz	Matched motor	FMSA-202F67ED	
BAR CODE				

Fig 2.1.2 Servo drive nameplate

2.1.2 Connection to Peripheral Devices

Each part name of Servo drive

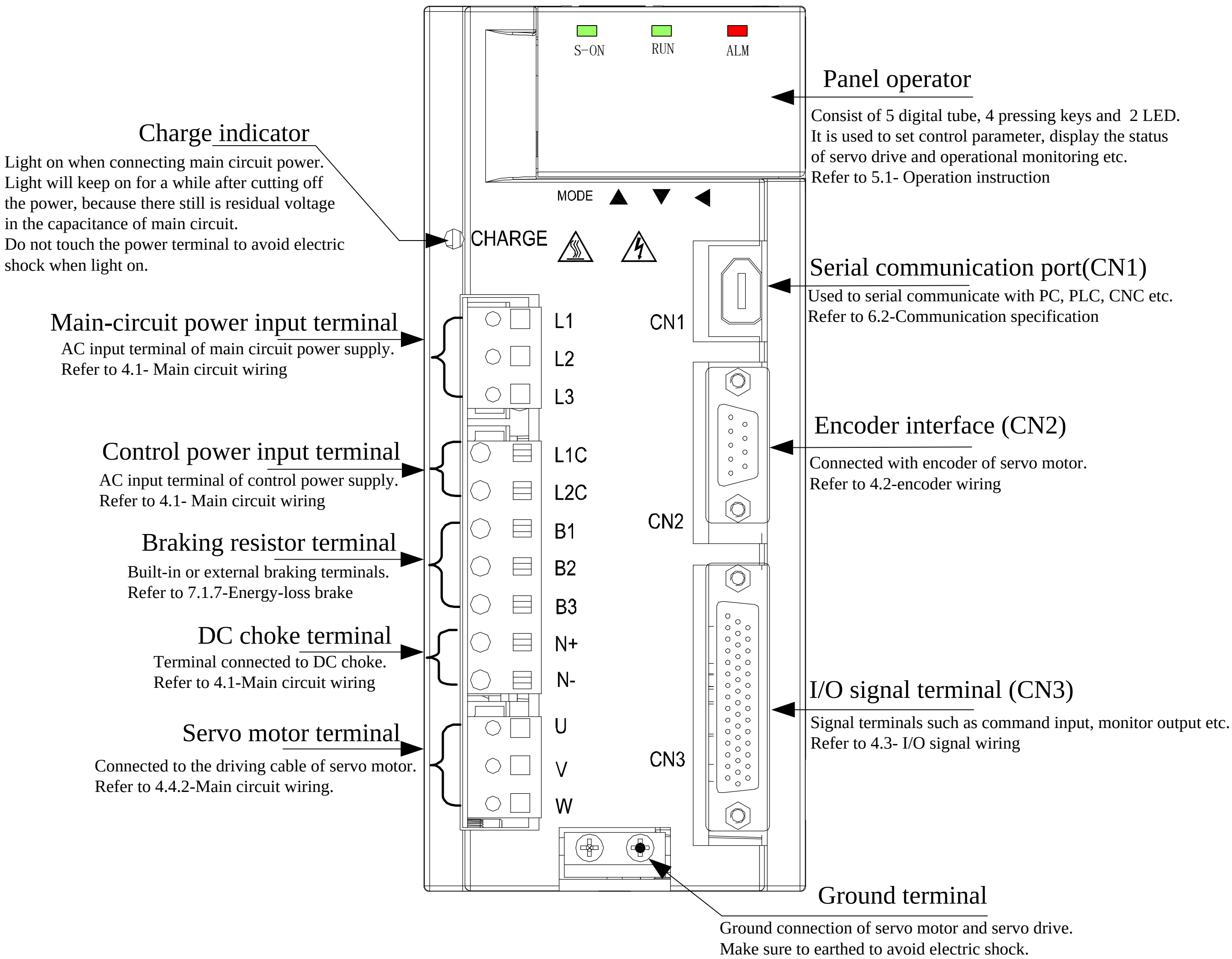


Fig 2.1.3 Composition of servo drive

2.1.3 Servo drive specification

1） Electrical specification

a） 220V servo drive

Item	M1				M2			M3	
Drive model	101	201	401	751	102	122	182	302	452
Continuous output current (Arms)	1.2	1.5	2.8	3.5	4.5	6.0	8.0	12	17
Max output current (Arms)	3.6	4.2	8.0	9.8	12.6	16.8	22.4	33.6	47.6
Main circuit power	1-phase/3-phase AC 220V -15～+10% 50/60Hz								
Control circuit power	1-phase/3-phase AC 220V -15～+10% 50/60Hz								
Brake mode	External brake resistor				Built-in brake resistor				

b） 380/400V servo drive

Item	M2		M3				MM4		M4	M5		M6	
Drive model	102	152	202	302	452	552	752	113	153	183	223	303	373
Continuous output current (Arms)	3	3.5	6.0	8.0	10.0	12.0	20	23	32	38	44	60	75
Max output current (Arms)	8.4	9.8	16	19.2	28	33	56	64	80	95	110	150	187
Main circuit power	1-phase/3-phase AC 380/400V -10～+10% 50/60Hz												
Control circuit power	No control circuit												
Brake mode	Built-in brake resistor						External brake resistor						

2） Technical specification

Item		**Content**
Input power supply	**S2/T2**	220VAC -15~+10%　50/60Hz
	T3	380/400VAC　-10~+10%　50/60Hz
Control mode		1. Profile position control mode (PP) 2. Profile velocity mode (PV) 3. Profile torque mode (PT) 4. Homing mode (HM) 5. Cycle synchronous position mode (CSP) 6. Cycle synchronous velocity mode (CSV) 7. Cycle synchronous torque mode (CST)
Energy-loss brake		Built-in or External brake resistor (external brake alternative) M1 frame and above 7.5kW drive: No built-in brake resistor. Other models: Built-in brake resistor
Control feature	Control type	PMSM motor
	Response frequency	PMSM servo: 1.2KHz
	Baud rate	±0.01% (load 0~100%)
	Speed fluctuation	PMSM: ±0.01% (VC, load fluctuation 0 to 100%)
	Speed ratio	1: 10000
EtherCAT specification	Communication protocol	EtherCAT protocol
	Support service	CoE (PDO, SDO)
	Synchronous method	DC distributed clock
	Physical layer	100BASE-TX
	Transmission speed	100 Mbit/s (100Base-TX)
	Duplex mode	Full duplex
	Transmission media	CAT5E class and above shielded cable
	Transmission distance	The distance between 2 nodes ＜100M (good surroundings and cables)
	Slave station	Max 65535 (lower than 100 in practical use)
	Synchronization jitter	＜1us
	Minimum communication cycle	500us

<table>
<tr><td rowspan="2">Input signal</td><td>Control input</td><td>Servo enabled, alarm reset, command pulse clear, command pulse prohibited, forward prohibited, reverse prohibited, forward torque limit, reverse torque limit, internal speed selection, internal position triggered, origin/mechanical origin searching triggered, zero speed clamp, probe etc.</td></tr>
<tr><td>Feedback</td><td>1. Absolute value encoder.
2. Incremental encoder.
3. Resolver</td></tr>
<tr><td rowspan="2">Output signal</td><td>Control output</td><td>Servo ready, servo alarm, positioning reach, speed reach, electromagnetic brake output, rotation detection, speed limit, homing completed, torque limit etc.</td></tr>
<tr><td>Encoder signal frequency dividing output</td><td>1. Encoder Z phases open-collector output;
2. Phase -A, -B: frequency-division differential output（not isolated, any frequency-division ratio）
Phase-Z is not frequency-division output.
3. Z pulse time extended function.</td></tr>
<tr><td rowspan="2">Position control</td><td>Input mode</td><td>EtherCAT communication set, internal register,
high-speed pulse input</td></tr>
<tr><td>Electronic gear ratio</td><td>1. 0.01≤ B / A ≤100
2. Support 2 groups of electronic gear, which can be selected or switchover by users.</td></tr>
<tr><td colspan="2">Acceleration/Deceleration</td><td>The setting range of accel/decel time is 1～30000ms
(from 0 accelerated to rated speed)</td></tr>
<tr><td colspan="2">Communication</td><td>1. RS485/RS232 communication port is connected with PC, to set control parameters and to monitor servo.
2. Support EtherCAT bus.</td></tr>
<tr><td rowspan="2">Parameter setting</td><td>Keypad</td><td>Use 4 keys to set parameter, which is displayed by 5 LEDs.</td></tr>
<tr><td>PC/PLC</td><td>PC/PLC software can be used to set servo parameter through RS485 communication interface.</td></tr>
<tr><td colspan="2">Monitor function</td><td>Output current, PN voltage, motor speed, motor feedback pulse, motor feedback revolution, given pulse, given pulse error, given speed, given torque etc.</td></tr>
<tr><td colspan="2">Protection function</td><td>Main circuit overvoltage, undervoltage, overload, overcurrent, encoder error, overspeed, abnormal pulse control command, emergency stop, servo overheat, main-circuit power phase-loss, regeneration brake error, position, over position control, lithium battery alarm, Sync. loss, network initialization failure, sync. cycle setting error, sync. cycle excessive error etc.</td></tr>
<tr><td colspan="2">Applicable load inertia</td><td>Lower than 5 times of servo motor inertia.</td></tr>
</table>

2.1.4 Connection to Peripheral Devices

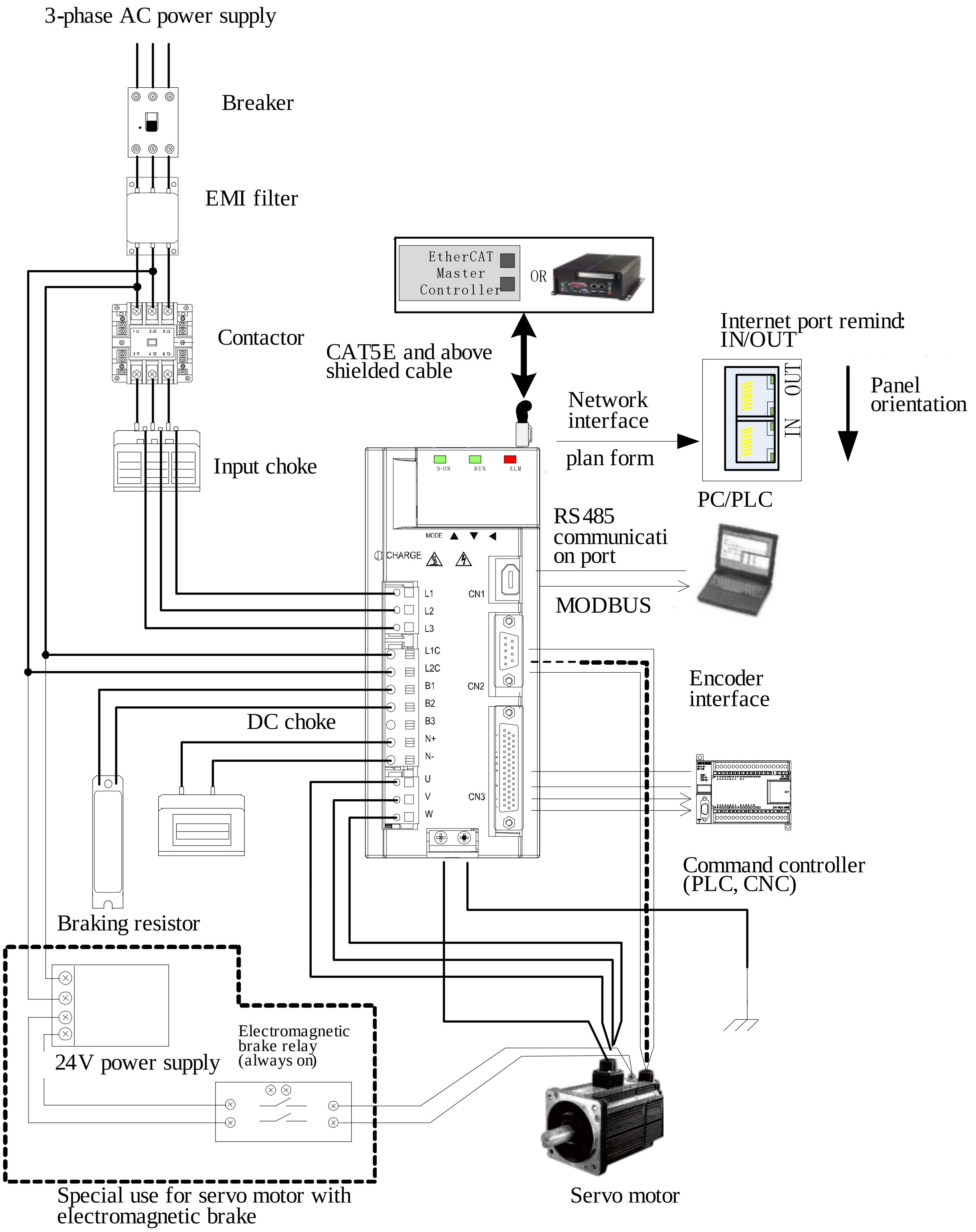


Fig 2.1.4 Composition of servo system

2.2 Servo motor introduction

2.2.1 Servo motor nameplate and model selection

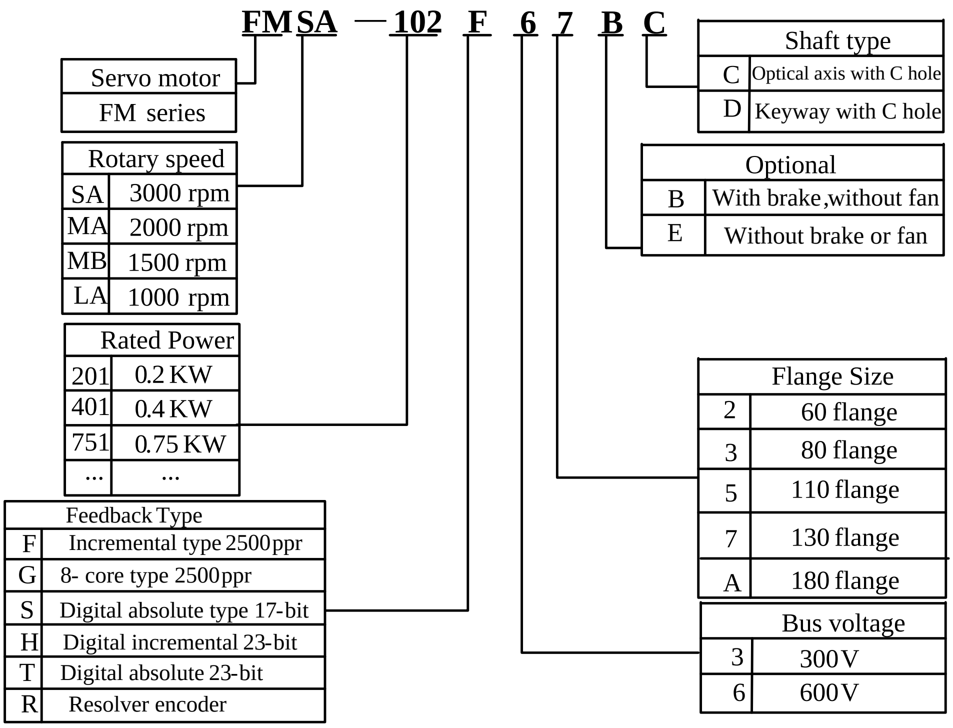


Fig 2.2.1 Servo motor naming rule (for 180 flange and below 180 flange motor)

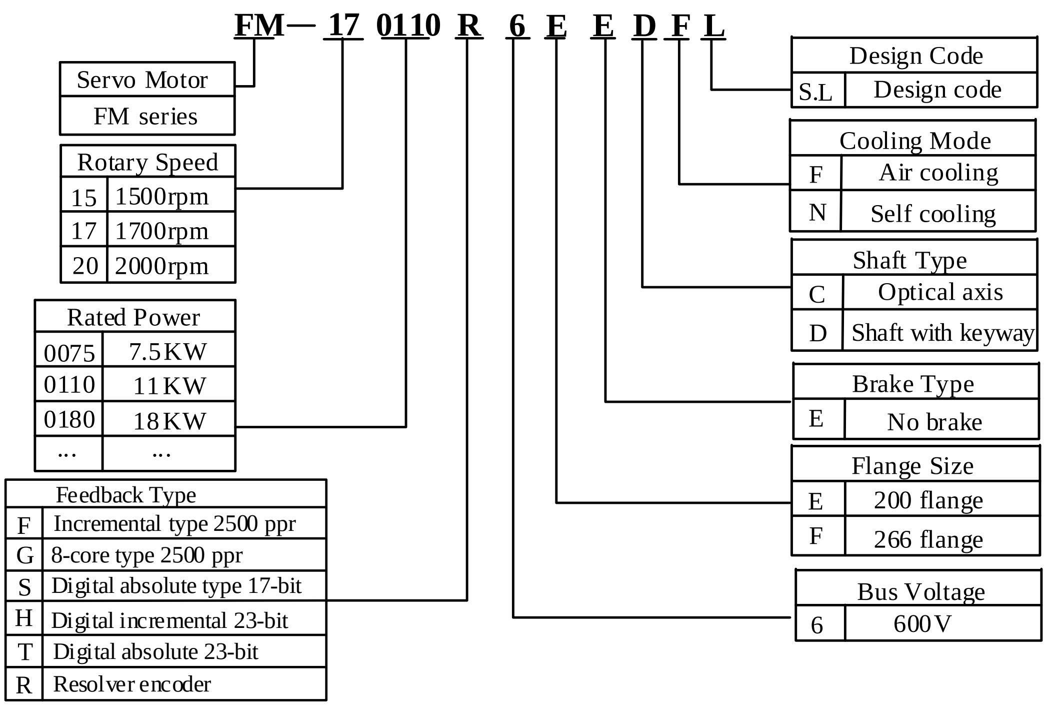
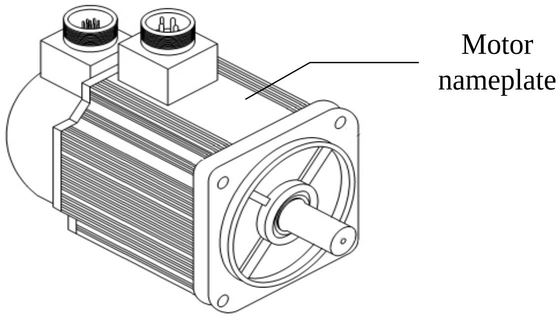


Fig 2.2.2 Servo motor naming rule (for 180 spigot and 250 spigot motor)



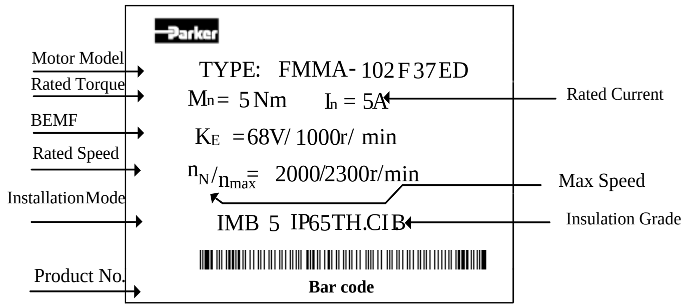


Fig 2.2.3 Servo motor nameplate (for 180 flange and below 180 flange motor)

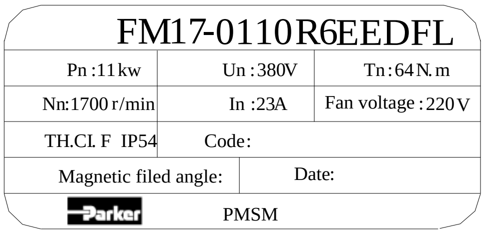


Fig 2.2.4 Servo motor nameplate (for 180 spigot and 250 spigot motor)

【note】

1. Please refer to the chapter of 《3.2.4 servo motor dimension》 for flange dimension.
2. For 180 spigot and 250 spigot motor, they can be installed by flanged mounting and base mounting, user should select the mounting types by themselves.

2.2.2 Servo motor components

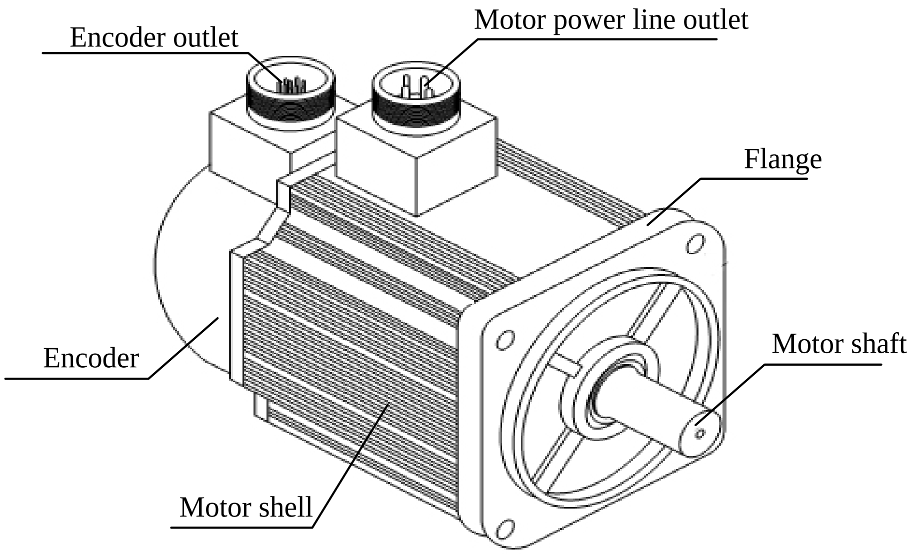


Fig 2.2.5 component name of servo motor

2.2.3 Servo motor model

1） 220V motor model

Motor model[note]		Rated power	Rated torque	Rated current	Rotation inertia
		W	N·m	A	10^{-4}Kg·m^2
FMS series 3000r/min	FMSA-201*32***	200	0.64	1.2	0.17
	FMSA-401*32***	400	1.27	2.8	0.29
	FMSA-751*33***	750	2.39	3.5	1.82
	FMSA-102*33***	1000	3.5	4.5	2.9
	FMSA-122*35***	1200	4	5	6.9
	FMSA-152*37***	1500	5	7.5	12.2
	FMSA-182*35***	1800	6	8	10.1
	FMSA-232*37***	2300	7.7	10	18.2
	FMSA-302*37***	3000	10	15.5	24.2
FMM series 2000 r/min	FMMA-801*35**	800	4	3.5	6.9
	FMMA-851*37**	850	4	4	10.8
	FMMA-102*37**	1000	5	5	12.2

	FMMA-122*35**	1200	6	5	10.1
	FMMA-132*37**	1300	6	6	15
	FMMA-152*37**	1500	7.7	7.5	18.2
	FMMA-202*37**	2000	10	10	24.2
	FMMA-312*37**	3100	15	14	34.9
	FMMA-352*3A**	3500	17.2	16	55.3
FMM series 1500 r/min	FMMB-122*37**	1200	7.7	5	18.2
	FMMB-152*37**	1500	10	6	24.2
	FMMB-232*37**	2300	14.6	10	34．9
	FMMB-272*3A**	2700	17.2	11	55.3
	FMMB-302*3A**	3000	19	12	66.3
	FMMB-432*3A**	4300	27	16	84.8
FML series 1000 r/min	FMLA-102*37**	1000	10	4.5	24.2
	FMLA-152*37**	1500	14.3	7	34.9
	FMLA-292*3A**	2900	27	12	84.8
	FMLA-372*3A**	3700	35	16	119.5

2） 380V motor model

Motor model[note]		Rated power	Rated torque	Rated current	Rotation inertia
		W	N·m	A	10^{-6}Kg·m^2
FMS series 3000 r/min	FMSA-751*63***	750	2.39	2	1.82
	FMSA-102*63***	1000	3.5	3	2.9
	FMSA-122*65***	1200	4	4	6.9
	FMSA-152*67***	1500	5	5	12.2
	FMSA-182*65***	1800	6	6	10.1
	FMSA-232*67***	2300	7.7	7	18.2
	FMSA-302*67***	3000	10	8	24.2
FMM series 2000 r/min	FMMA-801*65**	800	4	2.5	6.9
	FMMA-851*67**	850	4	3	10.8
	FMMA-102*67**	1000	5	3	12.2
	FMMA-122*65**	1200	6	3.5	10.1
	FMMA-132*67**	1300	6	3.5	15
	FMMA-152*67**	1500	7.7	4.5	18.2

	FMMA-202*67**	2000	10	5.5	24.2
	FMMA-312*67**	3100	15	9	34.9
	FMMA-352*6A**	3500	17.2	8	55.3
	FMMA-452*6A**	4500	21.5	10	74.8
	FMMA-602*6A**	6000	27	14	84.8
	FMMA-802*6A**	8000	35	18	119.5
	FMMA-103*6A**	10000	48	24	133
FMM series 1500 r/min	FMMB-122*67**	1200	7.7	4	18.2
	FMMB-152*67***	1500	10	4	24.2
	FMMB-232*67**	2300	14.6	6	34．9
	FMMB-302*67**	3000	14.6	7.5	34．9
	FMMB-272*6A**	2700	17.2	8	55.3
	FMMB-302*6A**	3000	19	8	66.3
	FMMB-432*6A**	4300	27	10	84.8
	FMMB-552*6A**	5500	35	12.5	119.5
	FMMB-752*6A**	7500	48	17	133
FML series 1000 r/min	FMLA-102*67***	1000	10	3	24.2
	FMLA-292*6A**	2900	27	7	84.8
	FMLA-372*6A**	3700	35	9	119.5

3) Servo motor of 180 spigot and 250 spigot

Motor model[note]		Rated power	Rated torque	Rated current
		KW	N·m	A
FMM series 1500 r/min	FM15-0082*6EE*FL	8.2	52	16.6
	FM15-0100*6EE*FL	10	64	20.7
	FM15-0124*6EE*FL	12.4	80	24.7
	FM15-0160*6EE*FL	16	102	33.5
	FM15-0180*6EE*FL	18	118	40
	FM15-0210*6FE*FL	21	135	43.2
	FM15-0240*6EE*FL	24	152	46.7
	FM15-0290*6FE*FL	29	185	57.5
	FM15-0350*6FE*FL	35	225	71.7
FMM series	FM17-0075*6EE*FL	7.5	42	13.7

1700 r/min	FM17-0092*6EE*FL	9.2	52	18
	FM17-0110*6EE*FL	11	64	23
	FM17-0140*6EE*FL	14	80	29.2
	FM17-0180*6EE*FL	18	102	38.5
	FM17-0210*6FE*FL	21	118	45
	FM17-0240*6EE*FL	24	135	48.5
	FM17-0270*6EE*FL	27	152	57.5
	FM17-0330*6FE*FL	33	185	68
FMM series 2000 r/min	FM20-0070*6EE*FL	7	33.6	14.8
	FM20-0100*6EE*FL	10	52	22
	FM20-0140*6EE*FL	14	64	30
	FM20-0180*6EE*FL	18	80	37
	FM20-0220*6EE*FL	22	102	43
	FM20-0250*6EE*FL	25	118	49
	FM20-0280*6EE*FL	28	135	56.9
	FM20-0300*6EE*FL	30	152	67
	FM20-0360*6FE*FL	36	185	74
	FM20-0071*6FEDNL	7.1	34	14.5
	FM20-0094*6EEDNL	9.4	45	18.8
	FM20-0117*6EEDNL	11.7	56	24.4
	FM20-0140F6EEDNL	14	67	28.6

Note: ** represents shaft type and brake type, please refer to the chapter of servo motor naming rule.

2.3 Combination of servo drive and servo motor

Combination of 220V servo motor and FL20 servo drive

Motor model[note]		Power	Adaptable servodrive (Note)		
		W	1 phase220V	3 phase 220V	Function code
FMS series 3000r/min	FMSA-201F/S32***	200	FL20-C201S2M1	FL20-C201T2M1	F5D*B*
	FMSA-401F/S32***	400	FL20-C401S2M1	FL20-C401T2M1	
	FMSA-751*33***	750	FL20-C751S2M1	FL20-C751T2M1	
	FMSA-102*33***	1000	FL20-C102S2M2	FL20-C102T2M2	
	FMSA-122*35***	1200	FL20-C122S2M2	FL20-C122T2M2	
	FMSA-152*37***	1500	FL20-C182S2M2	FL20-C182T2M2	

	FMSA-182*35***	1800			
	FMSA-232*37***	2300	—	FL20-C302T2M3	
	FMSA-302*37***	3000	—	FL20-C452T2M3	
FMM series 2000r/min	FMMA-801*35**	800	FL20-C102S2M2	FL20-C102T2M2	
	FMMA-851*37**	850			
	FMMA-102*37**	1000	FL20-C122S2M2	FL20-C122T2M2	
	FMMA-122*35**	1200			
	FMMA-132*37**	1300	FL20-C182S2M2	FL20-C182T2M2	
	FMMA-152*37**	1500			
	FMMA-202*37**	2000	—	FL20-C302T2M3	
	FMMA-312*37**	3100	—	FL20-C452T2M3	
	FMMA-352*3A**	3500	—		
FMM series 1500r/min	FMMB-122*37**	1200	FL20-C122S2M2	FL20-C122T2M2	
	FMMB-152*37**	1500	FL20-C182S2M2	FL20-C182T2M2	
	FMMB-232*37**	2300	—	FL20-C302T2M3	
	FMMB-272*3A**	2700	—		
	FMMB-302*3A**	3000	—		
	FMMB-432*3A**	4300	—	FL20-C452T2M3	
FML series 1000r/min	FMLA-102*37**	1000	FL20-C102S2M2	FL20-C102T2M2	
	FMLA-152*37**	1500	FL20-C182S2M2	FL20-C182T2M2	
	FMLA-292*3A**	2900	—	FL20-C302T2M3	
	FMLA-372*3A**	3700	—	FL20-C452T2M3	

Combination of 380V servo motor and FL20 servo drive

Motor model[note]		Power	Adaptable servodrive (Note)	
		W	Three-phase 380 v	Function code
FMS series 3000r/min	FMSA-751*63***	750	FL20-C102T3M2	F5D*B*
	FMSA-102*63***	1000		
	FMSA-122*65***	1200	FL20-C202T3M3	
	FMSA-152*67***	1500		
	FMSA-182*65***	1800		
	FMSA-232*67***	2300	FL20-C302T3M3	
	FMSA-302*67***	3000	FL20-C302T3M3	

FMM series 2000r/min	FMMA-801*65***	800	FL20-C102T3M2	
	FMMA-851*67**	850		
	FMMA-102*67**	1000		
	FMMA-122*65**	1200	FL20-C152T3M2	
	FMMA-132*67**	1300		
	FMMA-152*67**	1500	FL20-C202T3M3	
	FMMA-202*67**	2000		
	FMMA-312*67**	3100	FL20-C452T3M3	
	FMMA-352*6A**	3500		
	FMMA-452*6A**	4500		
	FMMA-602*6A**	6000	FL20-C752T3MM4	
	FMMA-802*6A**	8000		
	FMMA-103*6A**	10000	FL20-C153T3M4	
FMM series 1500r/min	FMMB-122*67**	1200	FL20-C152T3M3	
	FMMB-152*67**	1500	FL20-C202T3M3	
	FMMB-232*67**	2300		
	FMMB-302*67**	3000	FL20-C302T3M3	
	FMMB-272*6A**	2700		
	FMMB-302*6A**	3000		
	FMMB-432*6A**	4300	FL20-C452T3M3	
	FMMB-552*6A**	5500	FL20-C552T3M3	
	FMMB-752*6A**	7500	FL20-C752T3MM4	
FML series 1000r/min	FMLA-102*67**	1000	FL20-C152T3M2	
	FMLA-292*6A**	2900	FL20-C302T3M3	
	FMLA-372*6A**	3700	FL20-C452T3M3	
FMM series 1500r/min	FM15-0082*6EE*FL	8200	FL20-C752T3MM4	
	FM15-0100*6EE*FL	10000	FL20-C113T3MM4	
	FM15-0124*6EE*FL	12400	FL20-C153T3M4	
	FM15-0160*6EE*FL	16000	FL20-C183T3M5	
	FM15-0180*6EE*FL	18000	FL20-C223T3M5	
	FM15-0210*6EE*FL	21000		
	FM15-0240*6EE*FL	24000	FL20-C303T3M6	
	FM15-0290*6EE*FL	29000		

	FM15-0350*6EE*FL	35000	FL20-C373T3M6	
FMM series 1700r/min	FM17-0075*6EEDFL	7500	FL20-C752T3MM4	
	FM17-0092*6EE*FL	9200	FL20-C113T3MM4	
	FM17-0110*6EE*FL	11000		
	FM17-0140*6EE*FL	14000	FL20-C153T3M4	
	FM17-0180*6EE*FL	18000	FL20-C183T3M5	
	FM17-0210*6EE*FL	21000	FL20-C223T3M5	
	FM17-0240*6EE*FL	24000	FL20-C303T3M6	
	FM17-0270*6EE*FL	27000		
	FM17-0330*6EE*FL	33000	FL20-C373T3M6	
FMM series 2000r/min	FM20-0070*6EE*FL	7000	FL20-C752T3MM4	
	FM20-0100*6EE*FL	10000	FL20-C113T3MM4	
	FM20-0140*6EE*FL	14000	FL20-C153T3M4	
	FM20-0180*6EE*FL	18000	FL20-C183T3M5	
	FM20-0220*6EE*FL	22000	FL20-C223T3M5	
	FM20-0250*6EE*FL	25000	FL20-C303T3M6	
	FM20-0280*6EE*FL	28000		
	FM20-0300*6EE*FL	30000	FL20-C373T3M6	
	FM20-0360*6FE*FL	36000		
	FM20-0071*6FEDNL	7100	FL20-C752T3MM4	
	FM20-0094*6EEDNL	9400		
	FM20-0117*6EEDNL	11700	FL20-C153T3M4	
	FM20-0140*6EEDNL	14000		

Note:

1. 5.5 kw and above 5.5kw servo drive doesn't have dynamic brake. M1, MM4 structure and above servodrive doesn't have built-in resistor, customer should purchase braking resistor separately.
2. R means resolver, F means 14-core 2500ppr incremental encoder, G means 8-core 2500ppr incremental encoder, H means 4-core 23-bit incremental encoder, S means 4-core 17-bit absolute, and T means 4-core 23-bit absolute.
3. ** means shaft type and brake type, please refer to the chapter of servo motor naming rule.

III. Installation

3.1 Servo drive installation

3.1.1 Installation conditions

Environment Conditions	Equipment location	In an indoor location, preventing exposure from direct sunlight, free from dust, tangy caustic gases, flammable gases, steam or the salt-contented etc.
	Altitude/level	1000m and below(derate use if over 1000m)
	Atmospheric pressure	86kPa~106kPa
	Operating temperature	-10℃~40℃
	Storage temperature	-20℃~60℃
	Humidity	0~ 90% RH (no water-bead coagulation)
	Vibration Strength	Below 0.5G（4.9m/s^2）,10~60Hz (Discontinuous)
	IP rating	IP20
	Power system	TN system (Note)

Note: TN system: A power distribution system having one point directly earthed, the exposed conductive parts of the installation being connected to that points by protective earth conductor.

3.1.2 Installation precautions

To make good effect of cooling circulation, user needs to ensure to leave enough space for ventilation when installing servo drive. The typical minimum installation dimension is shown as below in figure 3.1.1.

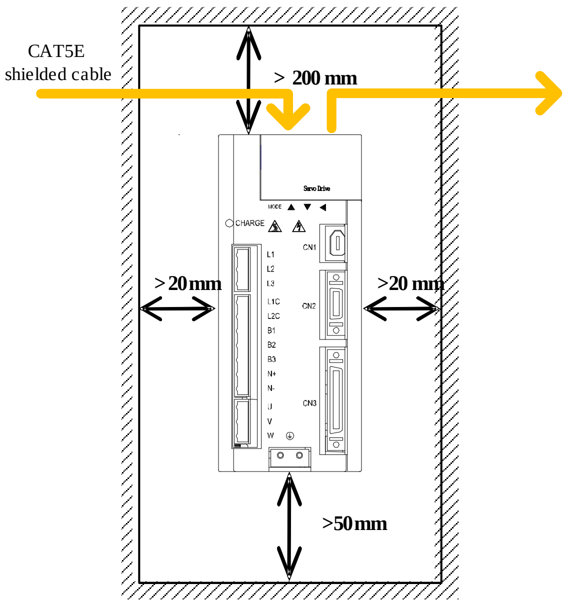


Fig 3.1.1 typical min installation dimension

If multiple drives are installed in parallel, the distance between each drive is at least 20mm in horizontal, at least 100mm in vertical. Cooling fan can be placed on top to avoid the temperature rise. Consult with supplier if smaller space need.

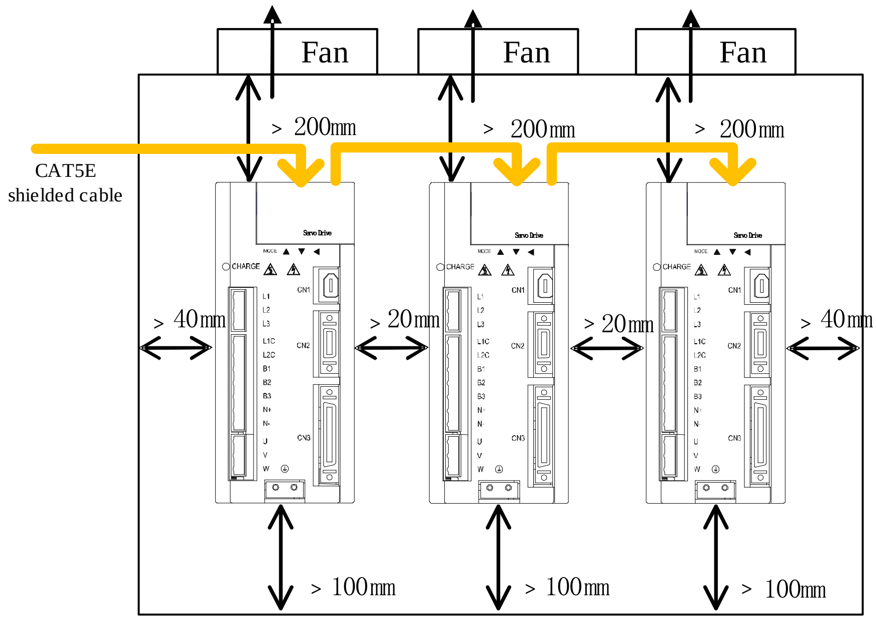


Fig 3.1.2 min installation dimension for multiple drives installed

3.1.3 Servo drive dimension

M1 structure dimension: (unit: mm)

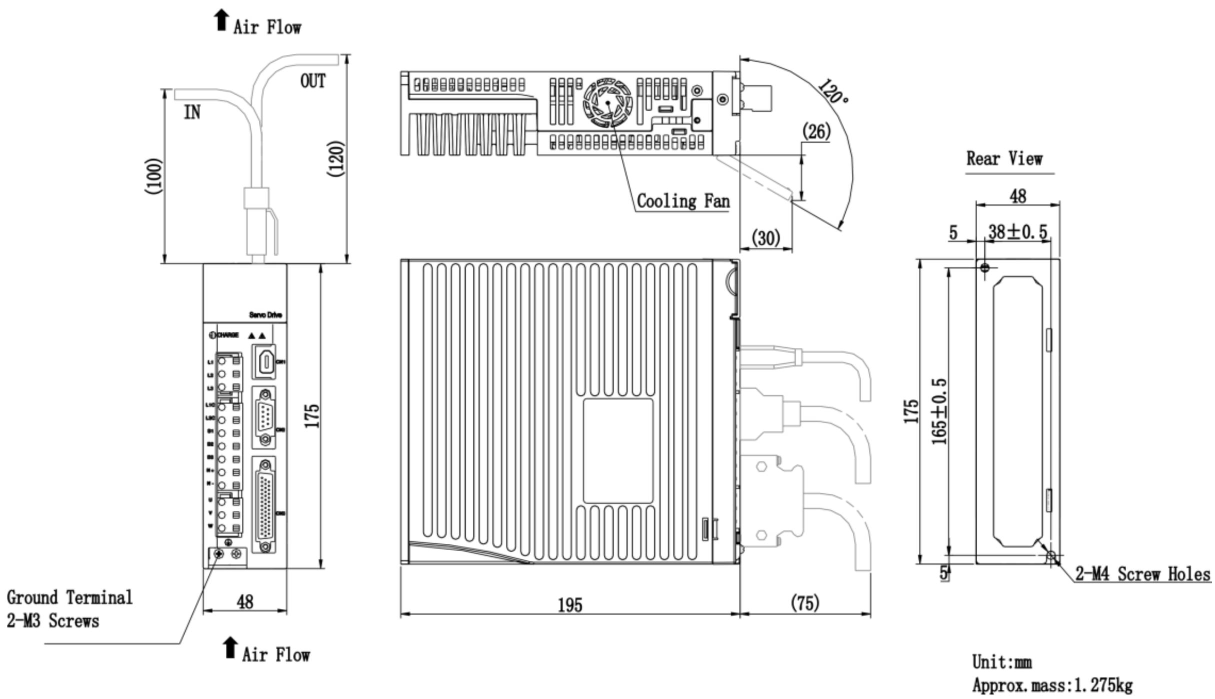


Fig 3.1.3 Servo drive structure size 1

M2 structure dimension: (unit: mm)

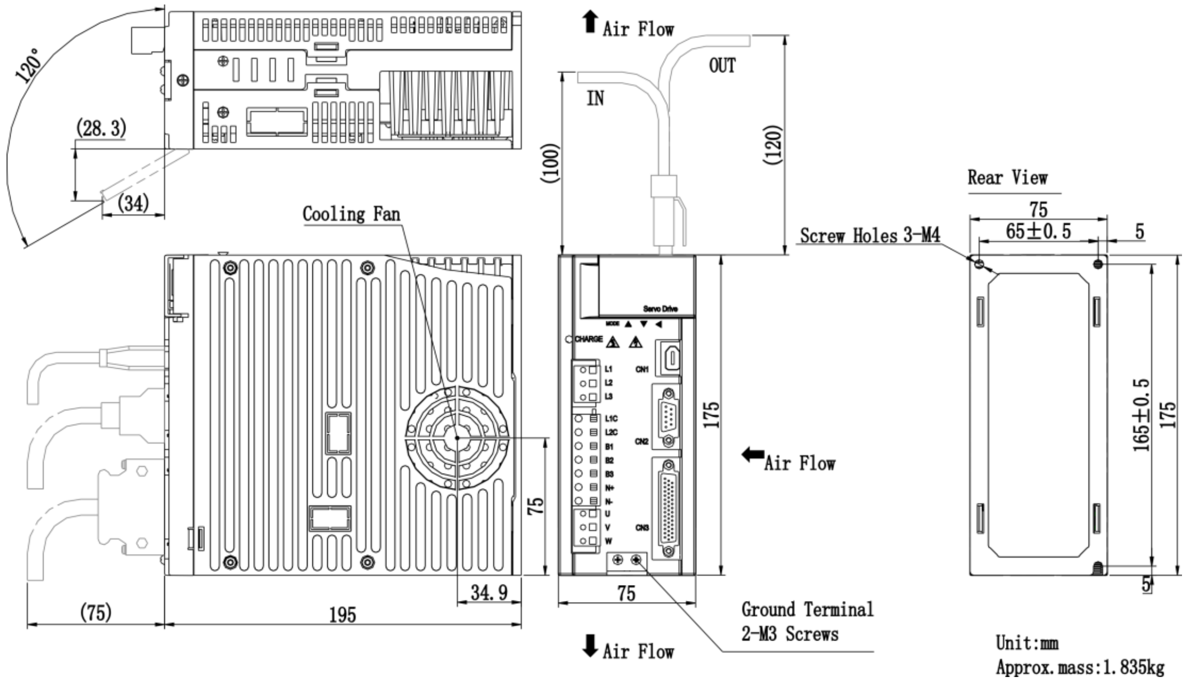


Fig 3.1.4 servo drive structure size 2

M3 structure dimension: (unit: mm)

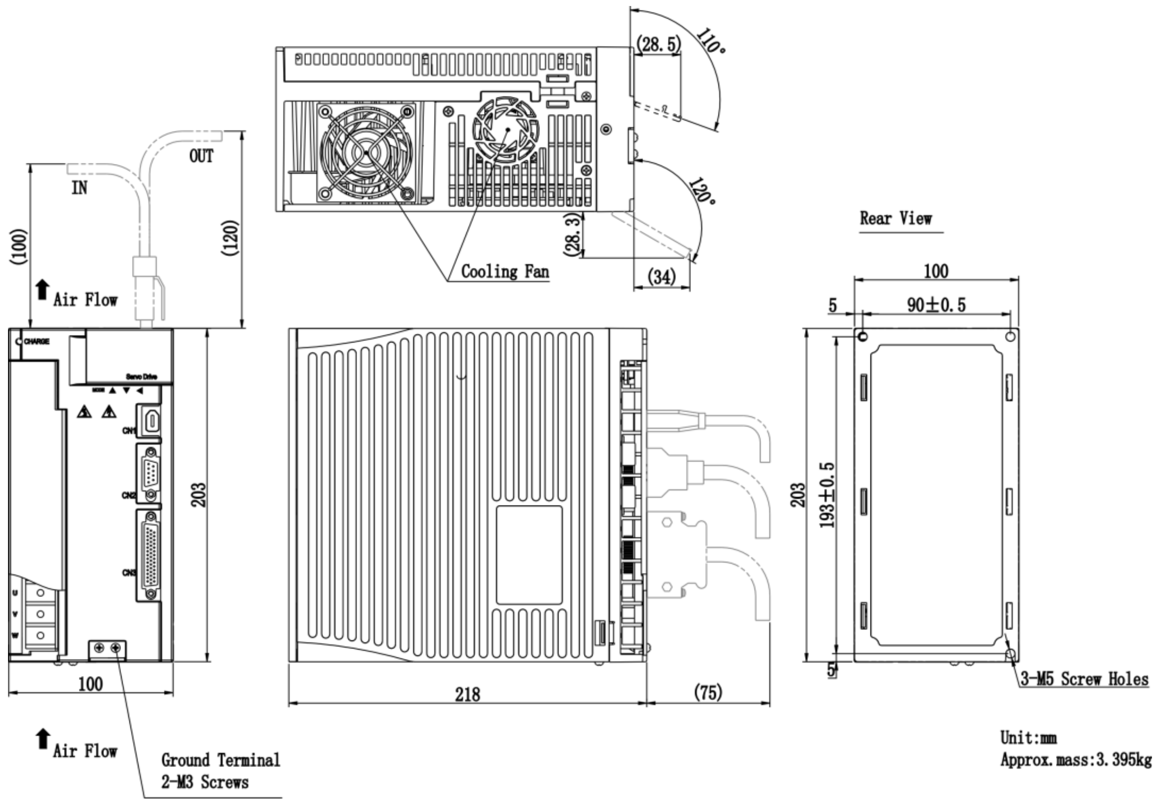


Fig 3.1.5 servo drive structure size 3

MM4 structure dimension: (unit: mm)

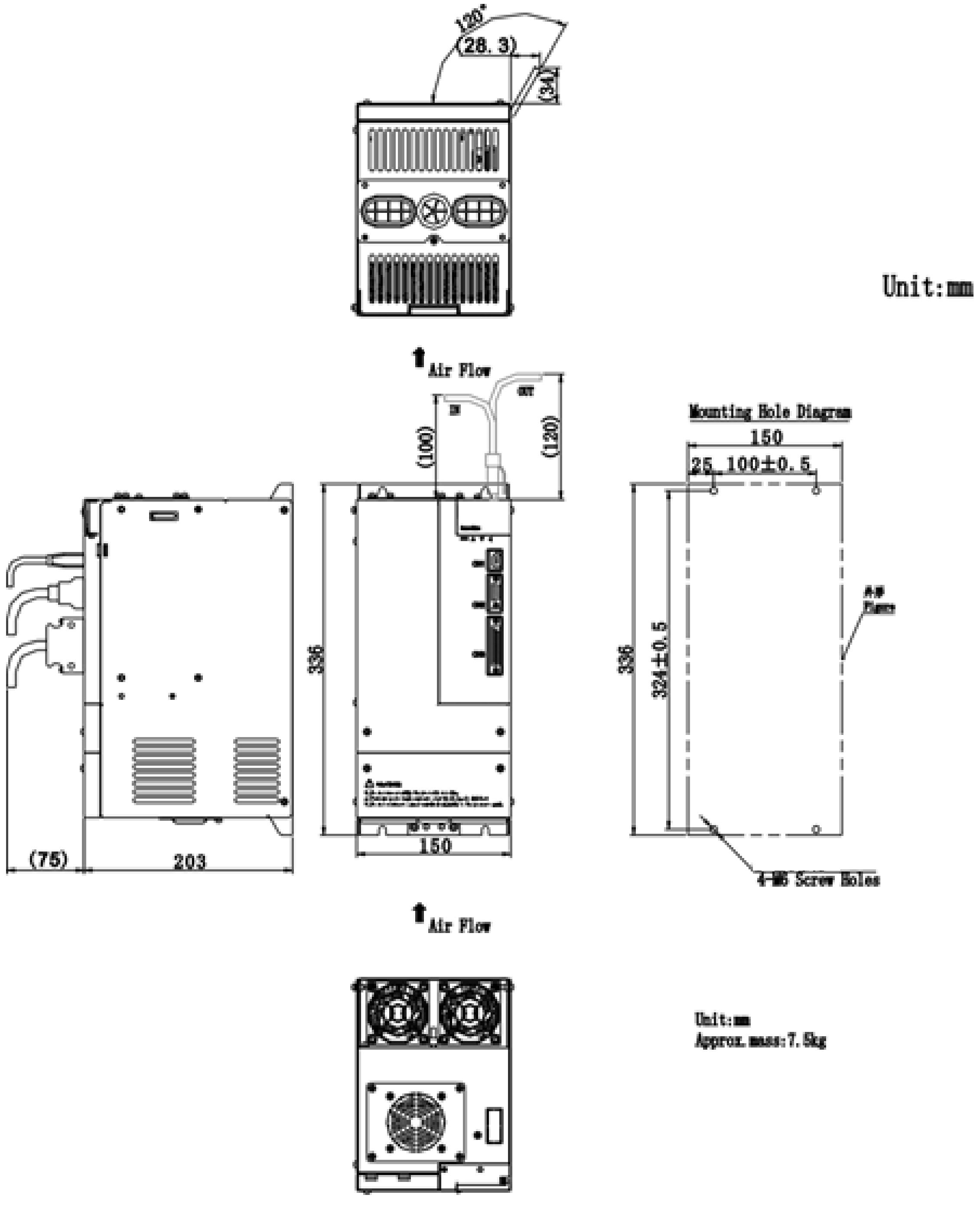


Fig 3.1.6 Servo drive structure size 4

M4 structure dimension: (unit: mm)

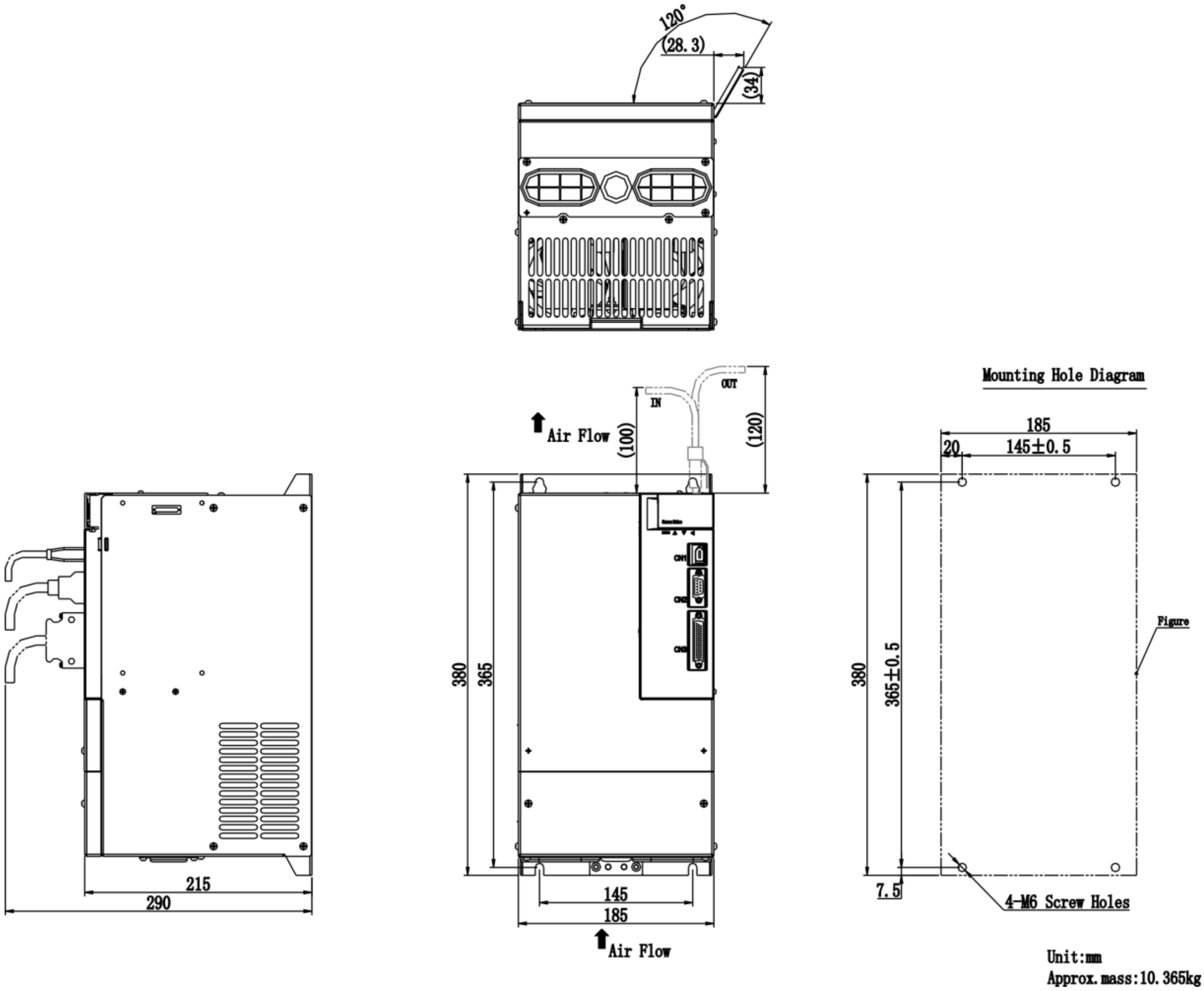


Fig 3.1.7 Servo drive structure size 5

M5 structure dimension: (unit: mm)

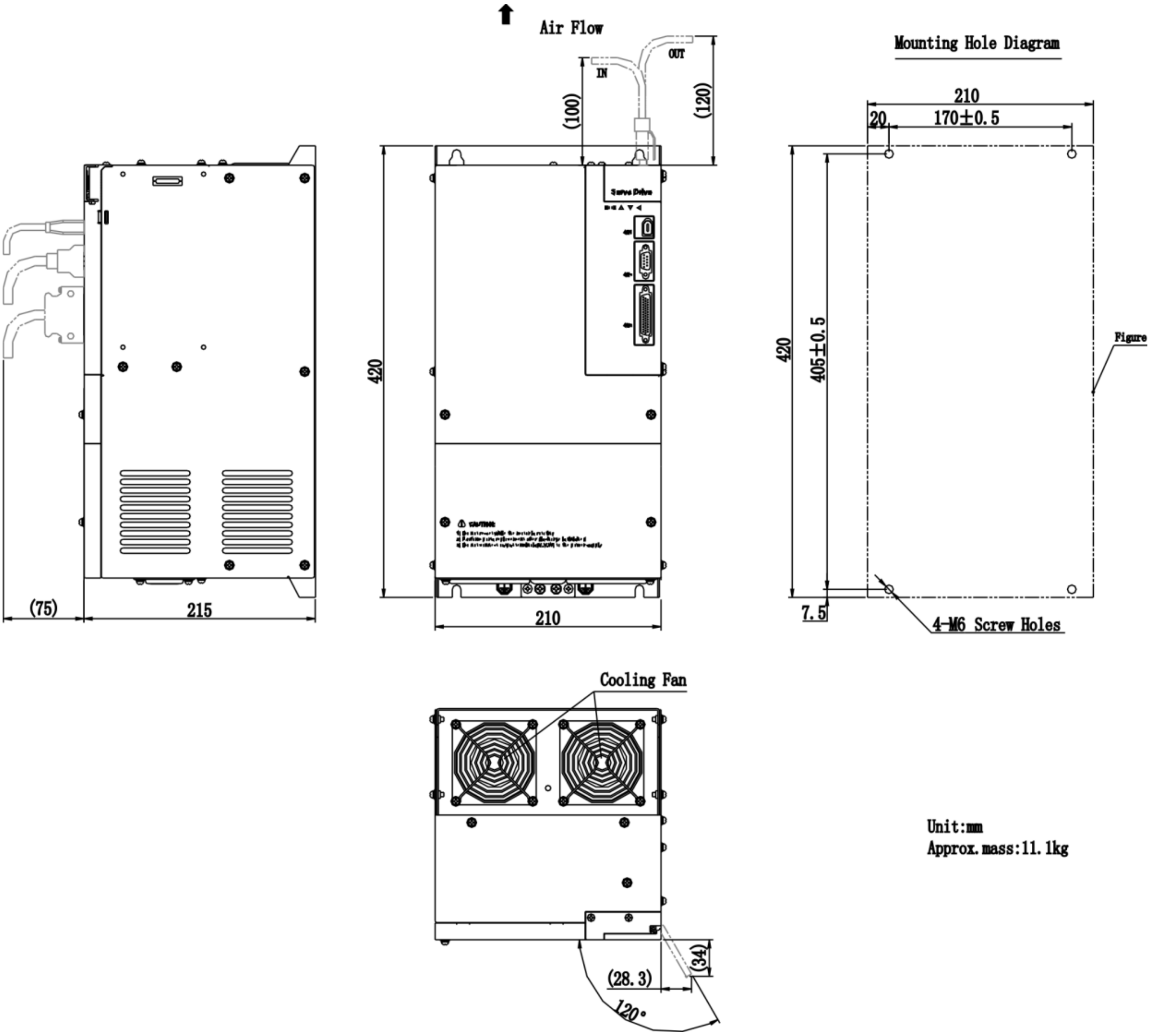


Fig 3.1.8 Servo drive structure size 6

M6 structure dimension: (unit: mm)

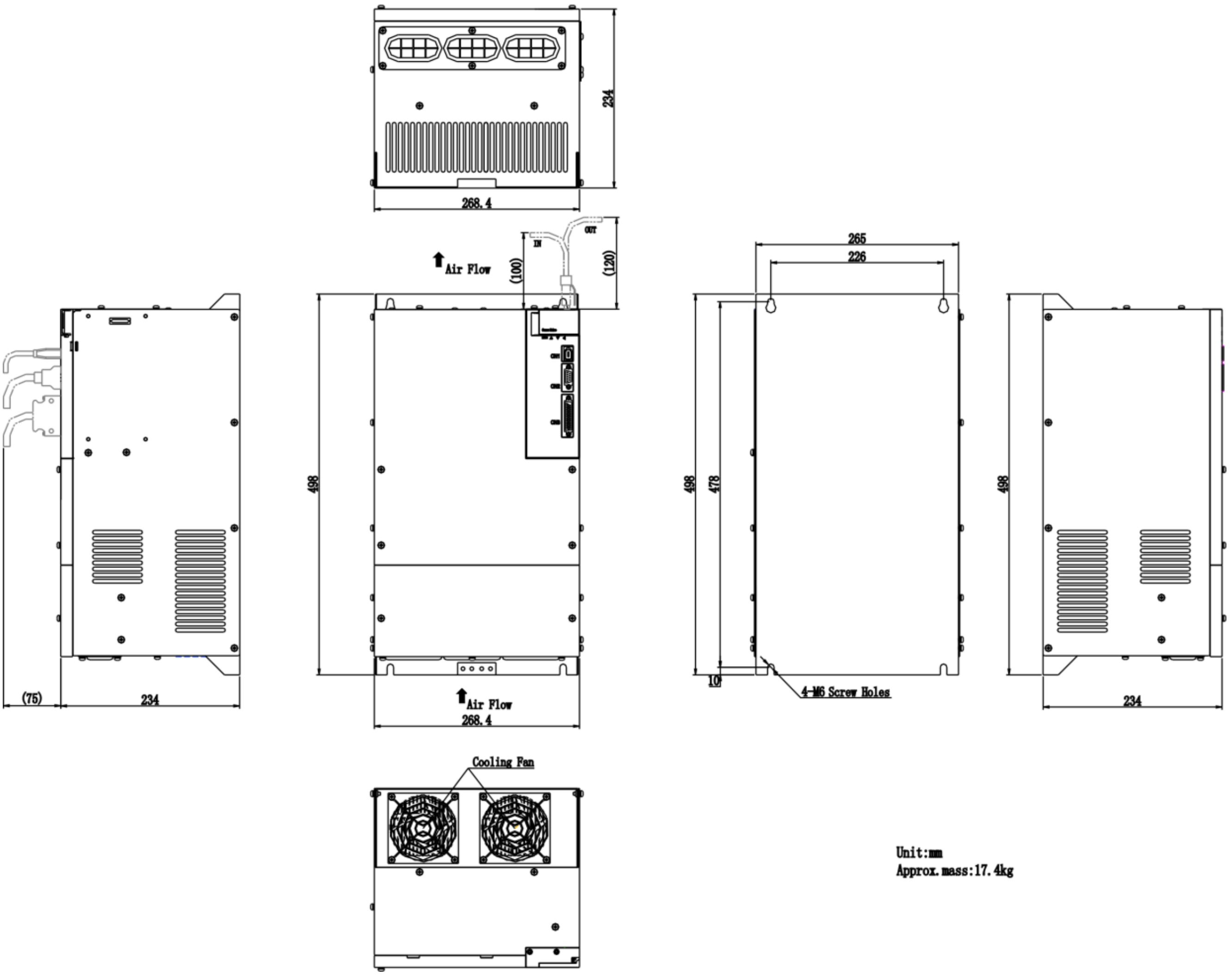


Fig 3.1.9 Servo drive structure size 7

Note: All changes of structure dimension without prior notice.

3.2 Installation of Servo motor

3.2.1 Installation location

- Install the servo motor in an environment free from corrosive or inflammable gases or combustibles, such as hydrogen sulfide, chlorine, ammonia, sulphur gas, chloridize gas, acid, soda and salt.
- Select and use the servo motor with oil seal in a place with grinding fluid, oil spray, iron powder or cuttings.
- Install the servo motor away from heat sources such as heating stove.
- Never use the servo motor in an enclosed environment. Working in the enclosed environment could result in high temperature of the servo motor, which will shorten its service life.

3.2.2 Installation conditions

Environment conditions	Equipment location	Prevent tangy caustic gases and flammable gases
	Altitude	1000m or below (derate use if over 1000m)
	Atmospheric pressure	86kPa~106kPa
	Operating temperature	-15°C~40°C（no freezing）
	Storage temperature	-20~80°C
	Humidity	Below 90% (no water-bead coagulation)
	Vibration Strength	Below 0.5G（4.9m/s^2）,10~60Hz (Discontinuous)
	IP rating	IP65

3.2.3 Precautions on installation

Item	Description
Anticorrosive	Clean the anticorrosive paint that coasts the end of motor shaft before installation, and then proceed the rust-proof treatment.
Encoder	Use screw hole on the shaft end when installing pulley on the servo motor shaft with key slot. To install pulley, insert the double-headed nail into screw hole firstly, use cushion ring on the surface of coupling end, and use nut to lock in the pulley gradually. Install with the screw hole in shaft end for the servo motor shaft with key slot. Use methods such as friction coupling for servo motor shaft without key slot. To avoid bearings bear strong impact of load, use remover to assemble pulley. Install protective cover or similar device on the rotation zone, such as pulley.
Alignment	Use coupler to align the servo motor shaft with the shaft of the equipment when connecting to the machinery.
Orientation	Servo motor can be installed either horizontally or vertically.
Handing oil and water	When using in the location with water drops, the protection level of servo motor needs to be confirmed firstly. When using in the location that oil could drops into the shaft through position, do not remove the oil seal of servo motor. Precautions on using servo motor with oil seal ● The oil surface must be under the oil seal lip. ● Use oil seal in favorably lubricated condition. ● When servo motor installed vertically, do not make oil seal lip deposit oil.
Cable stress	Make sure there are no bends or tension on cables, especially for the signal line, which core is only 0.2mm or 0.3mm, do not make too tight when wiring.

Connectors	Precautions on the connector parts as below: ● Make sure there are no foreign matters such as dust and metal chips in the connector before connecting. ● When the connectors are connected to the motor, make sure to connect from the side of servo motor main-circuit cables firstly, and the grounding cable must be earthed reliably. If connecting from the side of encoder cables firstly, encoder fault may occur because of the potential difference between PE. ● Make sure the correct pin arrangement. ● Do not exert force to connector, which is made from resin. ● When handling a servo motor with its cable connected, do not exert force to the connector. The connector may be damaged because of the stress.

3.2.4 Servo motor dimension

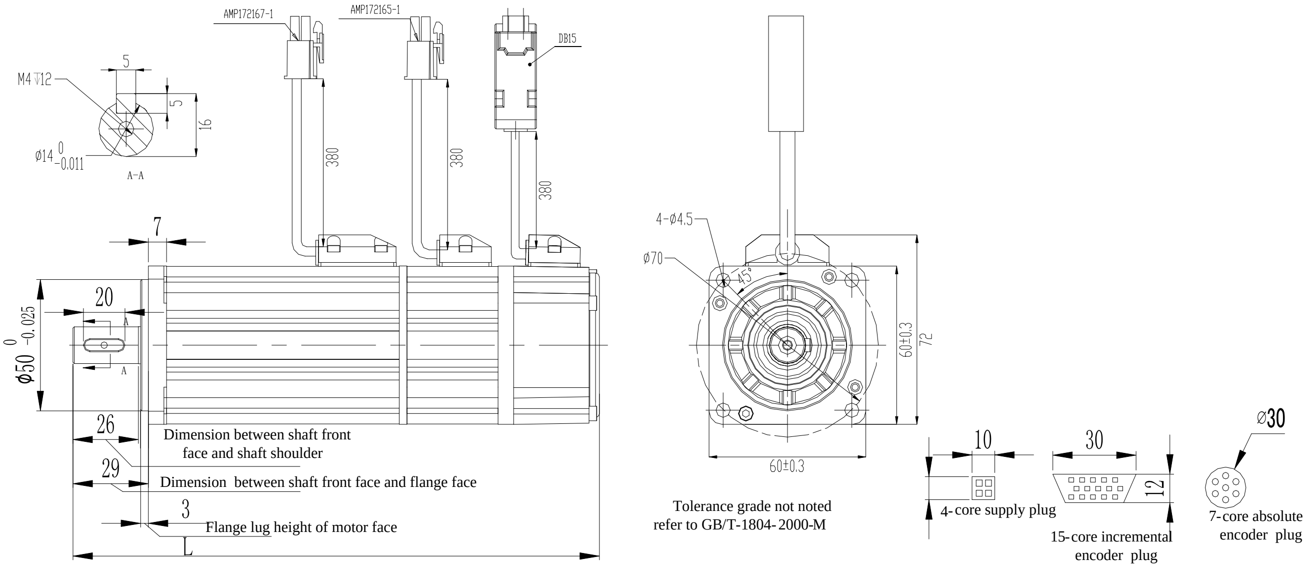


Fig 3.2.1 Motor installation dimension

Model	L(mm)	Weight（Kg）	L（mm）With brake	Remarks
FMSA-201F/S32***	130.5	1.2	162.5	The screw hole size: M4 X 12
FMSA-401F/S32***	163	1.6	195	

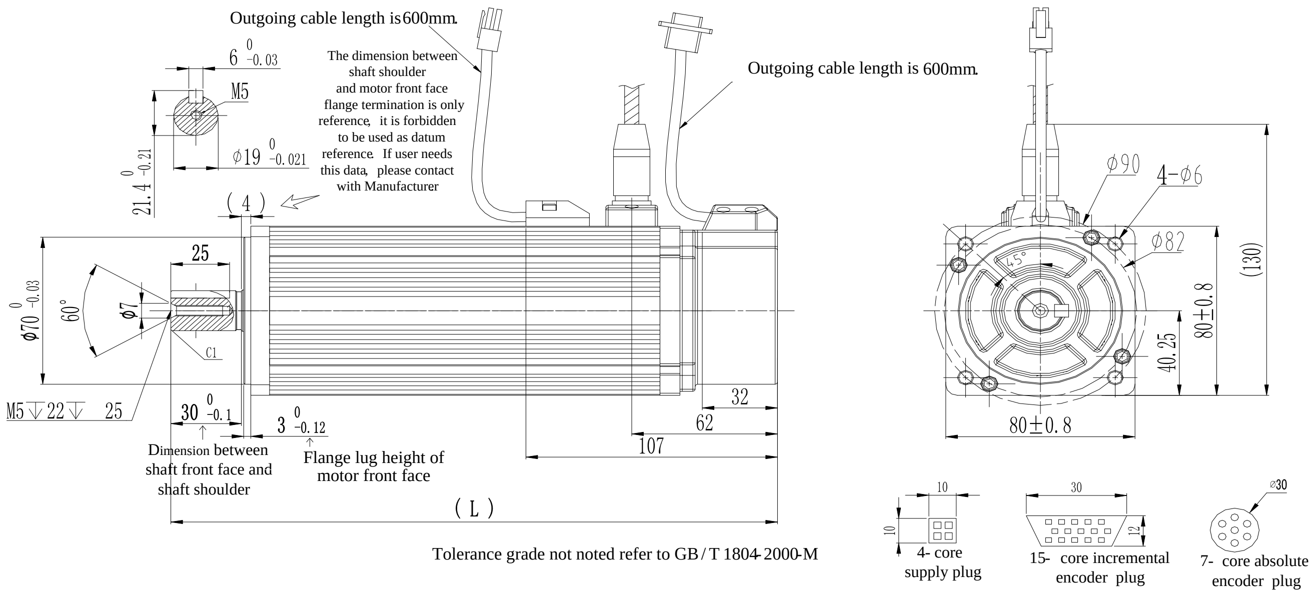


Fig 3.2.2 Servo motor installation dimension

Model	L (mm)	Weight（Kg）	L（mm） With brake	Remarks
FMSA-751**3***	192	2.8	231	The screw hole size : M5 X 22
FMSA-102**3*** FMSB-102*33***	219	3.8	258	

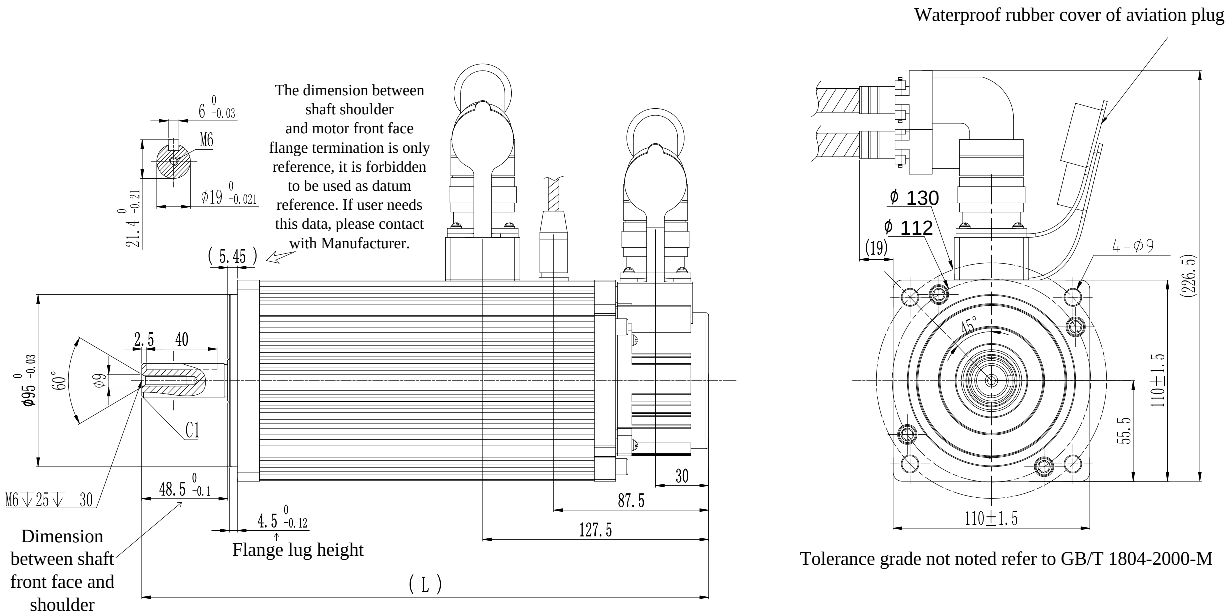


Fig 3.2.3 Servo motor installation dimension

Model	L (mm)	Weight（kg）	L (mm) with brake	Remarks
FMSA-122**5*** FMMA-801**5***	250	6.5	290	The screw hole size : M6 X 25
FMSA-182**5*** FMMA-122**5***	280	8	320	

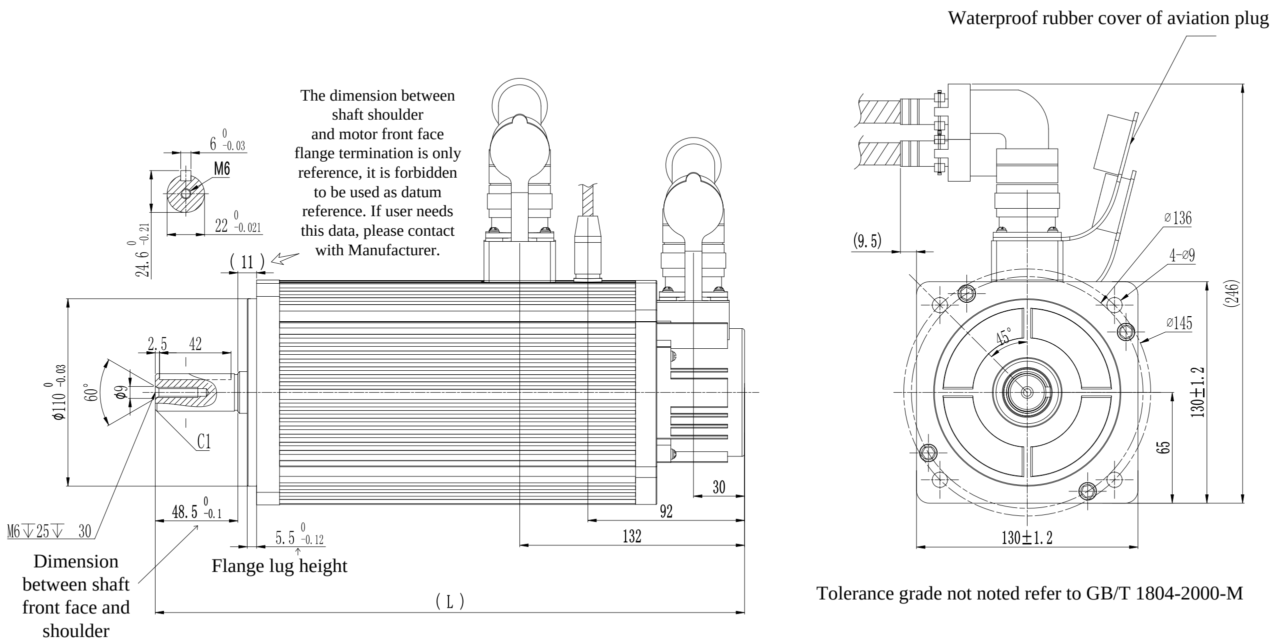


Fig 3.2.4 Servo motor installation dimension

Model	L (mm)	Weight（Kg）	L（mm）with brake	Remarks
FMMA-851**7*** FMSA-152**7*** FMMA-102**7***	230	7	275	The screw hole size： M6 X 25
FMMA-132**7***	238	7.7	283	
FMSA-232**7*** FMMA-152**7*** FMMB-122**7***	251	8	296	
FMSA-302**7*** FMMA-202**7*** FMMB-152**7*** FMLA-102**7***	274	10	319	
FMMA-312**7*** FMLA-152*37*** FMMB-232**7***	301	12	346	

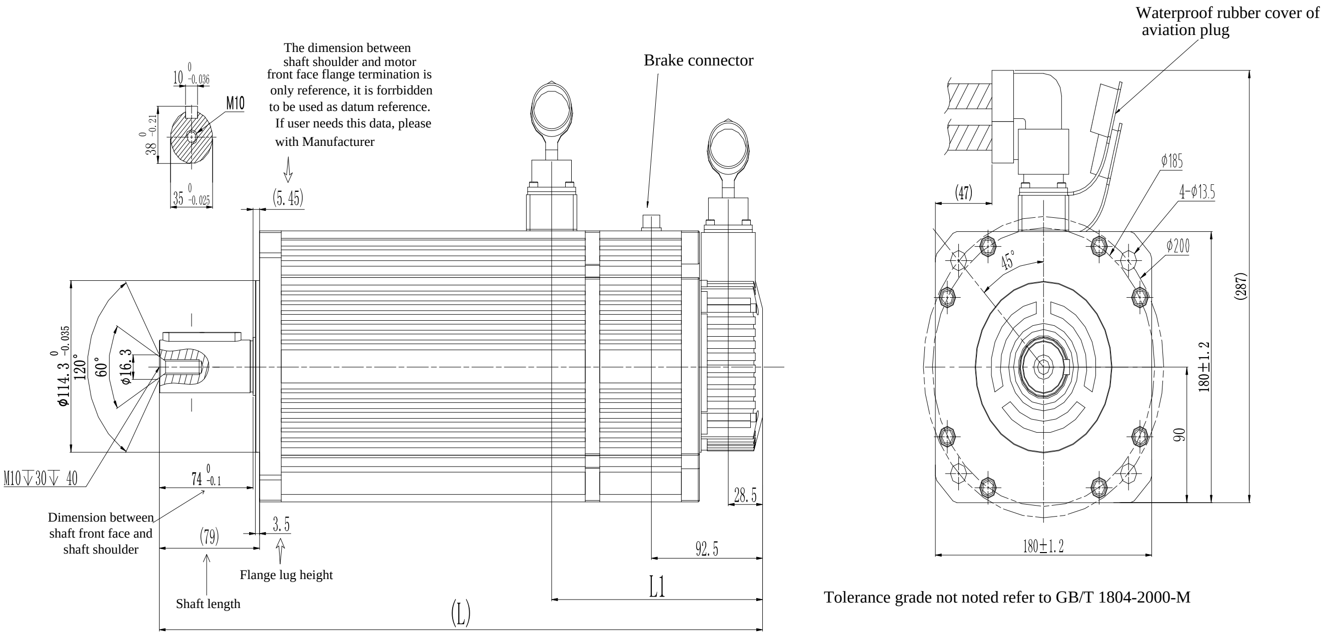


Fig 3.2.5 Servo drive installation dimension

Model	L without brake (mm)	Weight (Kg)	L with brake (mm)	L1 without brake (mm)	L1 with brake (mm)	Remarks
FMMA-352**A*** FMMB-272**A***	300	18	382	149.5	175.5	The screw hole size is M10 X 30
FMMA-452**A*** FMMB-302**A***	320	20	402	149.5	175.5	
FMMA-602*6A*** FMMB-432**A*** FMLA-292**A***	332	23	414	149.5	175.5	
FMMA-802*6A*** FMMB-552**A*** FMLA-372**A***	370	29	452	149.5	175.5	
FMMA-103*6A*** FMMB-752**A***	416	36	498	149.5	175.5	

[Note]: There are two series for 180 motor: general motor and motor with fan. 180 motor with fan can obviously decrease the temperature rise of motor. The overall length of motor with fan is 81mm longer than the overall length of general motor.

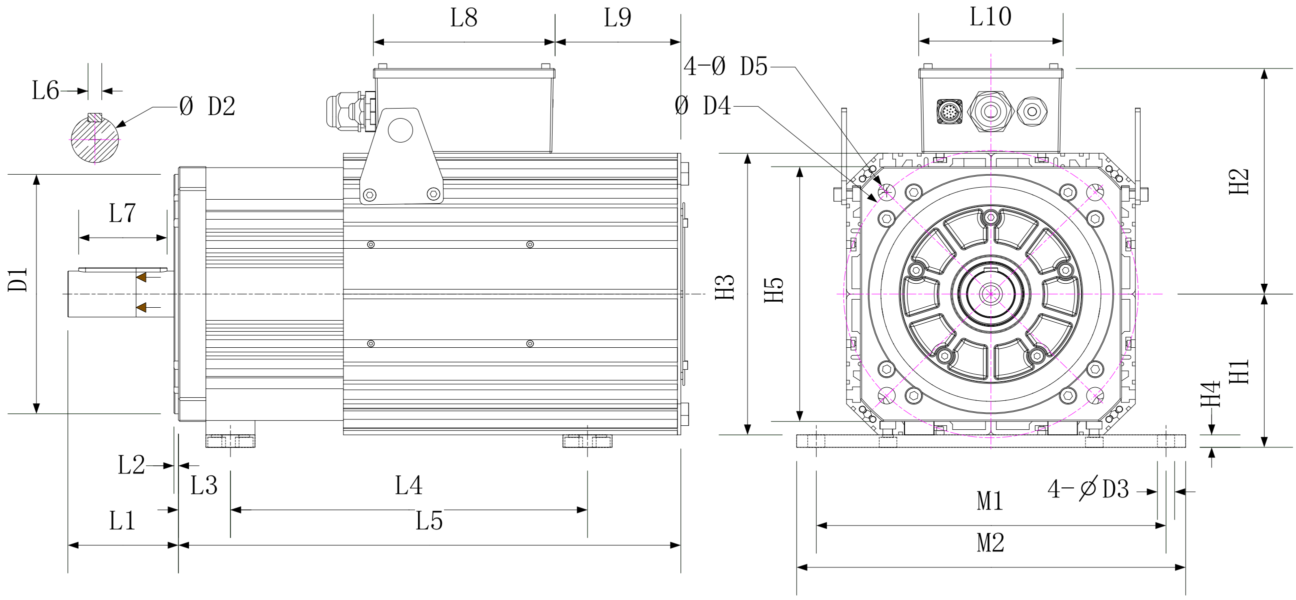


Fig 3.2.6 Servo motor installation dimension

Base	D1	D2	D3	D4	D5	L1	L2	L3	L6	L7	L8	L9	L10
E	180	42	14	215	14.5	77	5	39	12	56	185	75.5	147
F	250	48	18	300	17.5	112.5	4.5	53	14	90	185	128	147

Base	H1	H2	H3	H4	H5	M1	M2
E	124	200	224	12	200	254	278
F	160	240	294	13	266	356	396

Motor rated torque Nm (△T=100° C)	46	68	84	96	130	147	160	196	220	275	330	380	428	481
Motor rated torque Nm (△T=65° C)	42	52	64	80	102	118	135	152	185	225	270	307	324	385
Stand spigot	E	E	E	E	E	E	E	E	F	F	F	F	F	F
L4 (mm)	267	285	312	354	396	436	478	520	317	370	423	476	529	583
L5 (mm)	345	397	429	471	513	555	597	619	511.5	560.5	609.5	658.5	707.5	756.5

IV. Wiring

Internal block diagram of servo system as below:

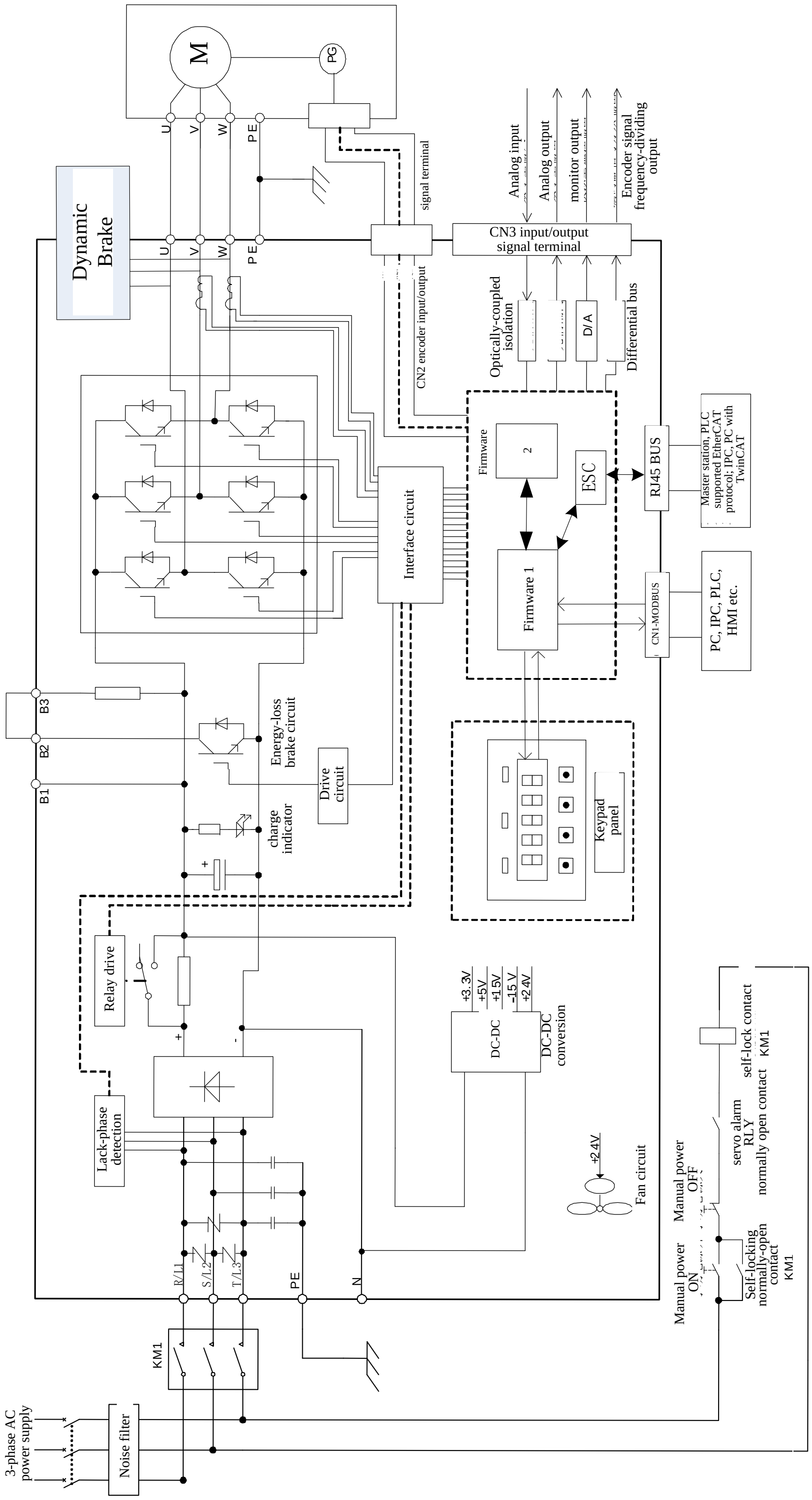


Fig 4.1.1 220V servo internal principle diagram

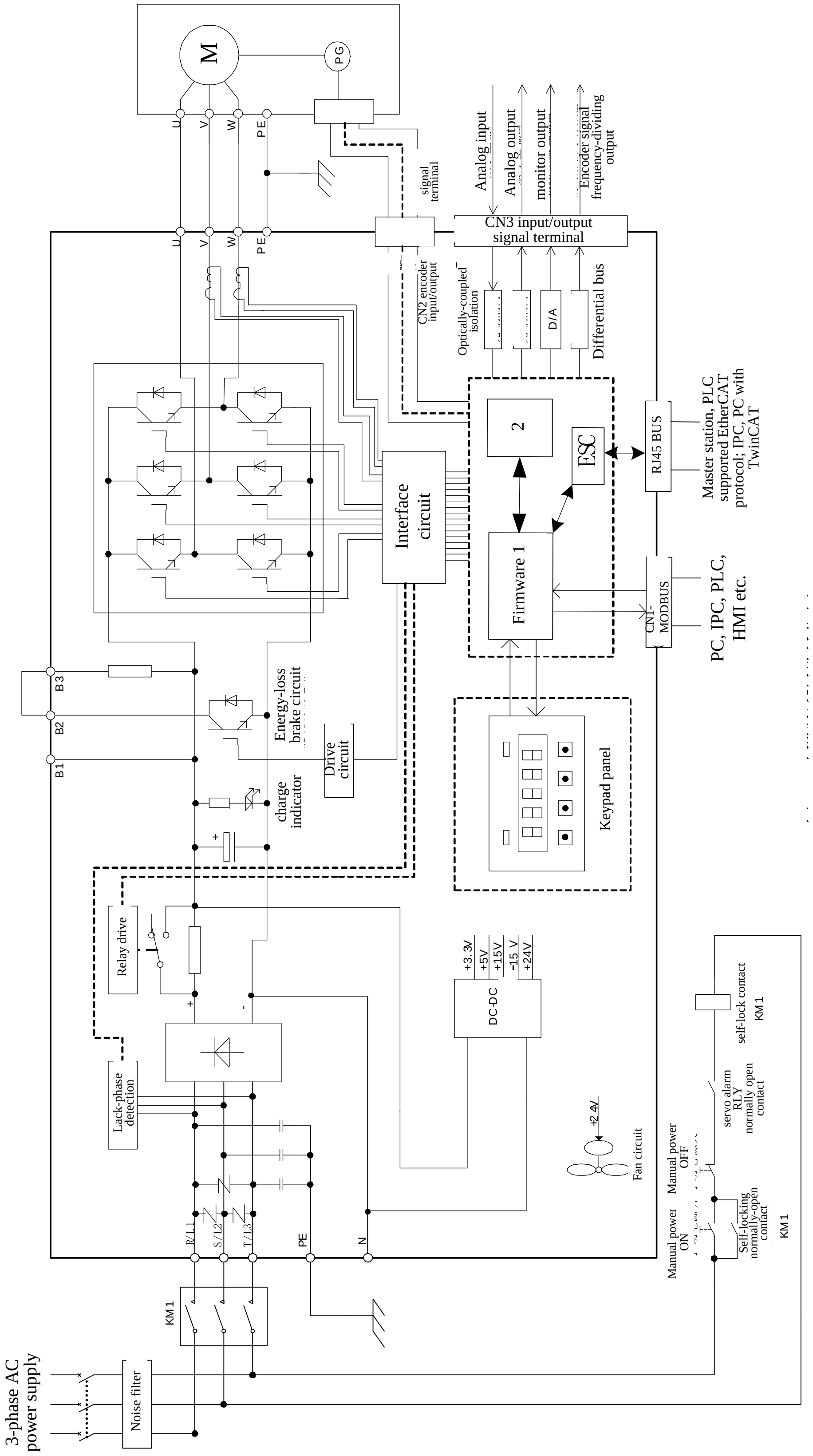


Fig 4.1.2 380V servo internal principle diagram

4.1 Main circuit wiring

4.1.1 Names and functions of Main circuit wiring terminals

1) 220V names and functions of main circuit wiring terminals

Terminal Symbol	Terminal Name	Function
L1/R，L2/S，L3/T	Main circuit power input terminals	Connect 3-phase 220V input power Connect 1-phase 220V power supply between L1 and L3. (2kW and above drive only connects to 3-phase power supply)
L1C，L2C	Control power input terminals	Connect any 2 phase in 3-phase power supply or single-phase power supply.
B1/P，B2/B，B3	B2，B3：Built-in braking resistor connecting terminal	Terminals are shorted by default. Use built-in brake resistor. (built-in braking resister for the drive of M2 and above cover)
	B1/P，B2/B：External braking resistor connecting terminal	Normally no need to connect. If built-in braking capacity is insufficient, remove the jumper between B2 and B3, and connect external braking resistor between B1 and B2.
N+，N-	DC reactor connecting terminals	Terminals are shorted by default. Connect DC reactor between both terminals when restraining power harmonic.
U，V，W	Servo motor connection terminals	Connect to servo motor.
⏚，⏊	Ground terminal	The servo drive must be grounded.

2) 380V names and functions of main circuit wiring terminals

Terminal Symbol	Terminal Name	Function
R/L1，S/L2，T/L3	Main circuit power input terminals	Connect 3-phase 380V input power supply (R, S, T are the main circuit power input terminals of M4 and above drives)
L1C，L2C	Connection forbidden	Disabled
B1/P，B2/B，B3	B2，B3： Built-in braking resistor connecting terminal	Terminals are shorted by default. Use built-in brake resistor. (no built-in braking resistor for 7.5kW and above drives)
	B1/P，B2/B： External braking resistor connecting terminal	Normally no need to connect. If the built-in braking capacity is insufficient, remove the jumper between B2 and B3, connect external braking resistor between B1 and B2.
N+、N-、—	DC bus reference terminal	Forbidden to ground or connect to zero line.
U， V，W	Servo motor connection terminals	Connect to servo motor.

⏚, ⏚	Ground terminal	The servo drive must be grounded.

4.1.2 Wiring of Main circuit terminals

There are two main circuit terminals of servo drive: plug-in terminal and screw terminal. The usage of plug-in terminal is mainly described as below:

1) The dimension of electric wire:
   Solid wire: Ø 0.5～ Ø 1.6mm;
   Twisted wire: 0.8 mm2～3.5mm2 (American-standard AWG28～AWG12)
2) Connection method:
   1. Strip off the wire skin for around 5~6cm.
   2. Use pull-rod or slotted screwdriver with 3.0~3.5mm edge to open circle opening by pushing the upper openings of terminal connector.
   3. Insert the core of wire into the circle openings, then loose the screwdriver or pull-rod.

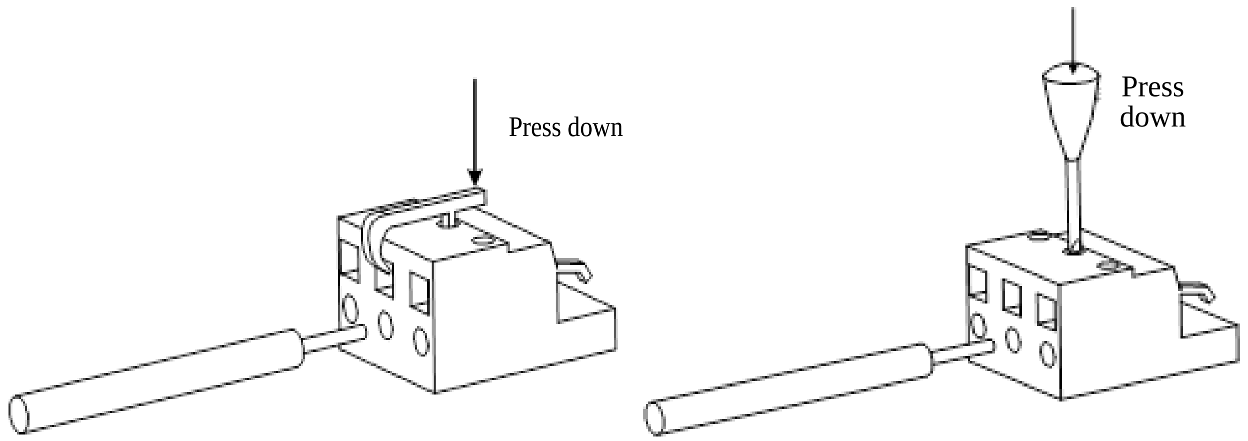


Fig 4.1.3 Main circuit terminals connection method

FL20 series product divides into 220V and 380V voltage class, 220V terminals as below:

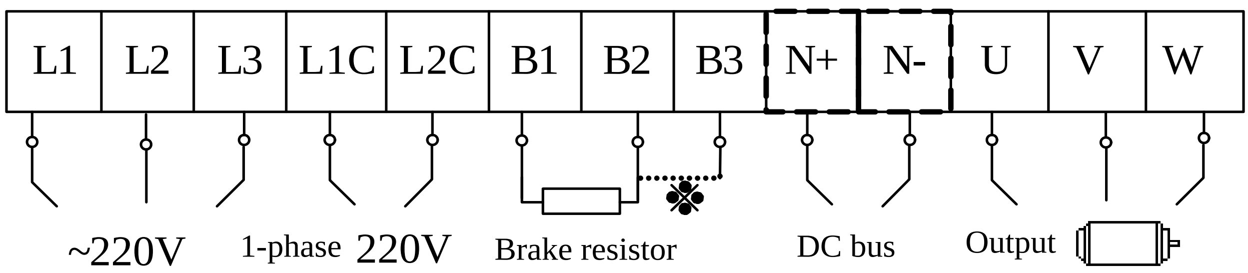


Fig 4.1.4 220V servo power terminals wiring diagram,

380V terminals as below:

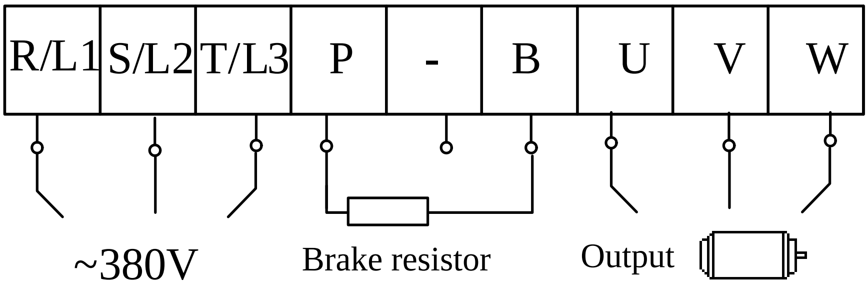


Fig 4.1.5 380V servo power terminals wiring diagram

When using screw terminal for wiring, if lug is needed, dimension of screw terminal as below:

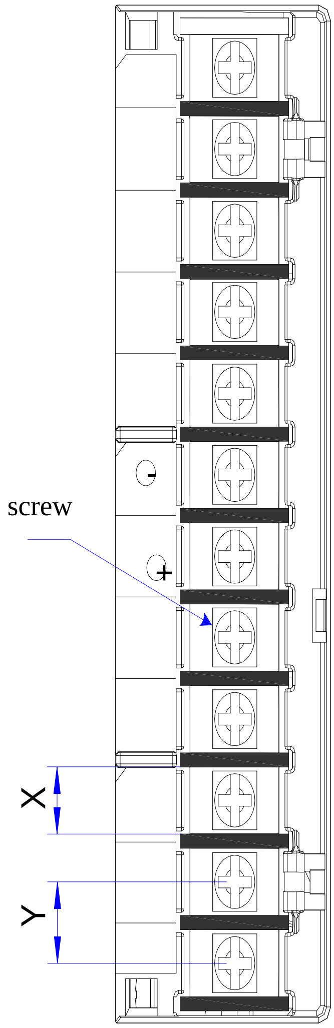


Fig 4.1.6 main circuit terminals sketch diagram

Note: The figure above is only sketch, exact shape in kind prevail.

Table 4.1.1 FL20 series servo screw terminals dimension table

Structure	**Main circuit terminals**			
	X（mm）	**Y（mm）**	**Screw**	**Locked Torque（Nm）**
M3	9.9	13.0	M4	1.24（Max）
MM4	10.2	12.7	M4	1.46
M4	11.7	16	M6	2.5
M5	13	16	M5	2.0
M6	20.3	23.5	M8	2.8

4.1.3 Typical main circuit wiring example

(1) 220V servo main circuit wiring example:

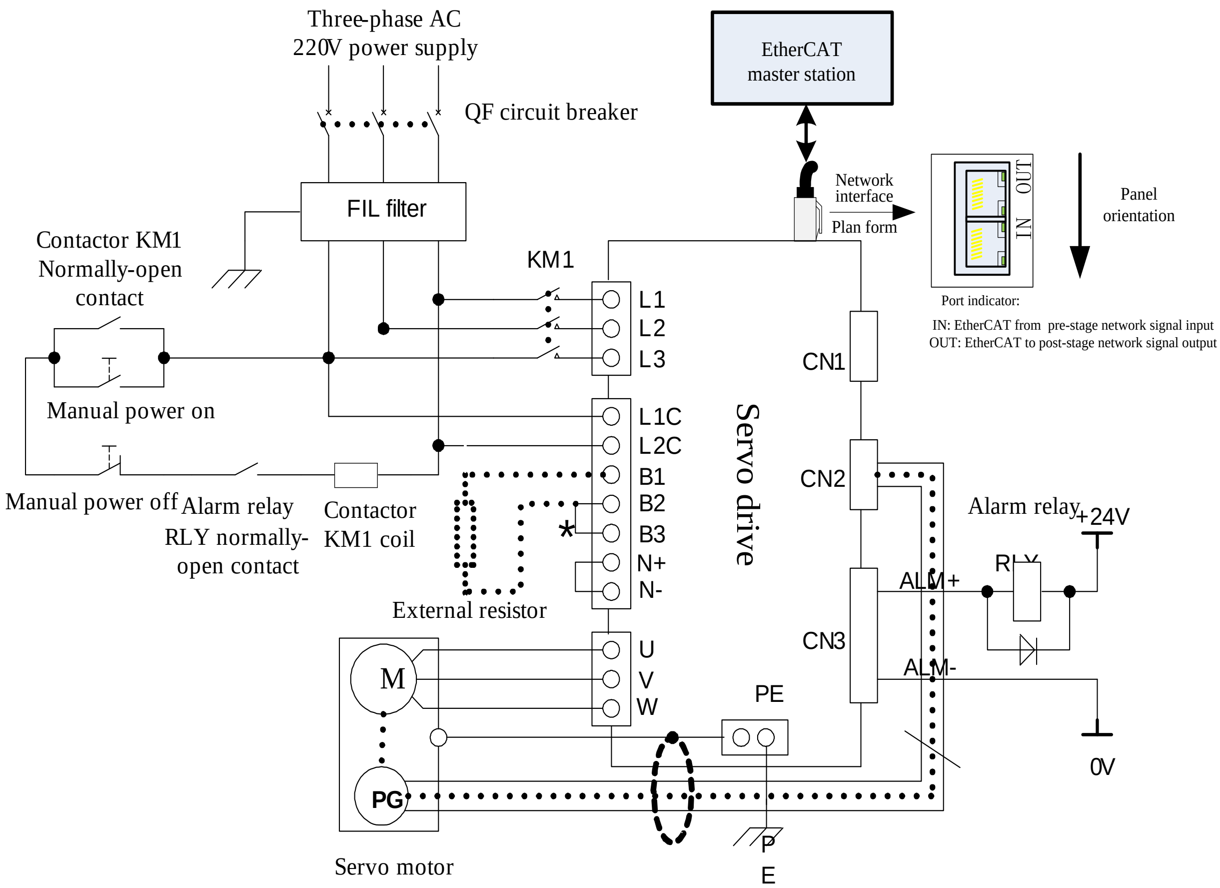


Fig 4.1.7 Typical wiring of 220V servo main circuit

Instructions:

1. Built-in brake resistor is used by default, B2 and B3 are shorted. If external resistor is need, remove the jumper between B2 and B3, then connect external resistor between B1 and B2.
2. RLY: Externally connected alarm signal output relay.
3. KM1: contactor, select connect or disconnect main circuit power input by manual switch.
4. If using the absolute encoder multi-circle function, install battery in the side of encoder cable with battery unit.

⚠ **Note: emergency stop circuit should be connected in the wiring design of main circuit. Make sure that stop running of the equipment and cut off the power supply immediately to avoid the accident.**

(2) 380V servo main circuit wiring example

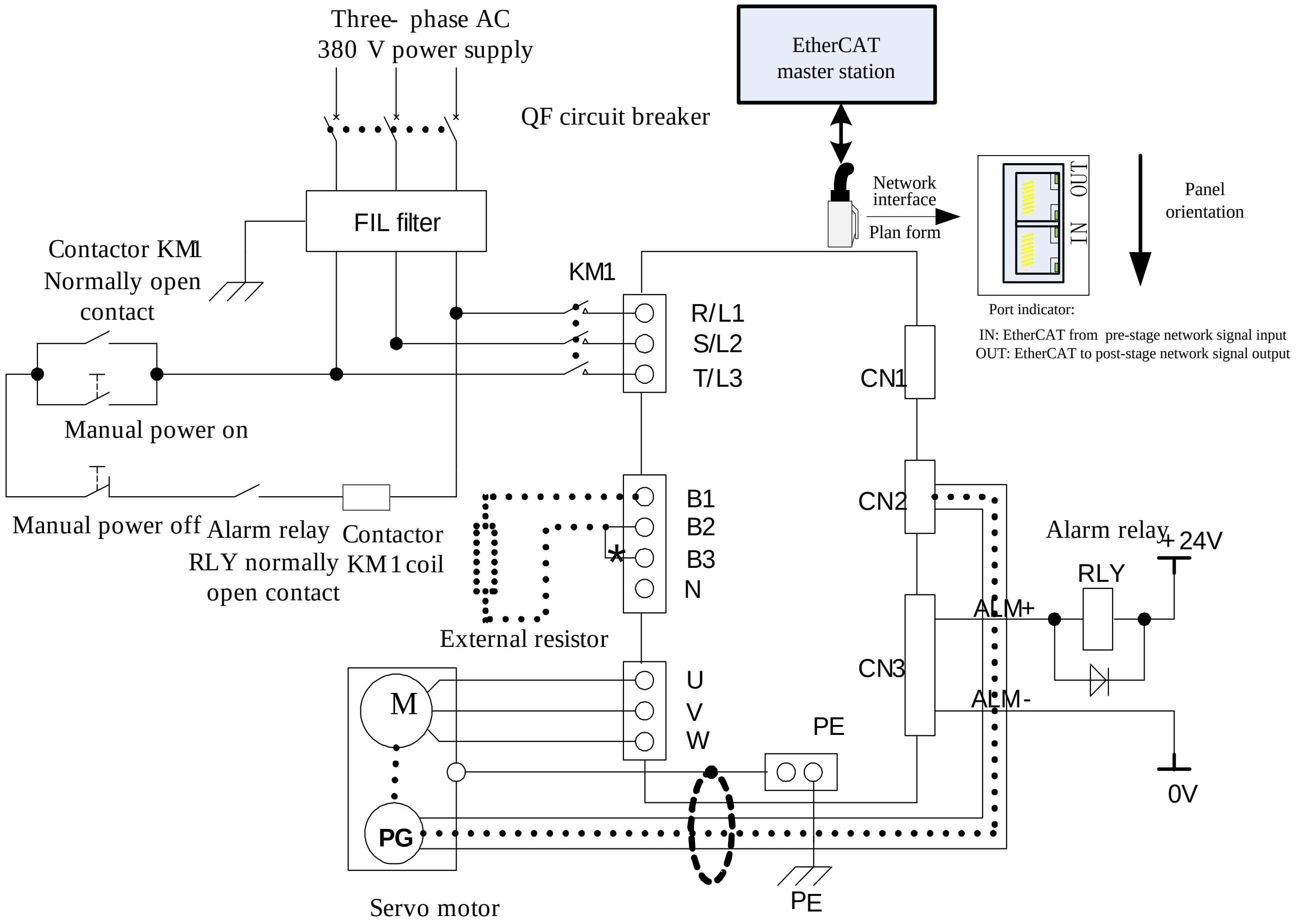


Fig 4.1.8 Typical wiring of 380V servo main circuit

Instructions:

1. Built-in brake resistor is used by default, B2 and B3 are shorted. If external resistor is need, remove the jumper between B2 and B3, then connect external resistor between B1 and B2.
2. RLY: Externally connected alarm signal output relay.
3. KM1: contactor, select connect or disconnect main circuit power input by manual switch. Mention the use of zero line if using 220V contactor.
4. N: DC bus reference.

Note: emergency stop circuit should be connected in the wiring design of main circuit. Make sure that stop running of the equipment and cut off the power supply immediately to avoid the accident.

4.1.4 Precautions for Main Circuit Wiring

- Do not connect the input power cables to the output terminals U, V and W. Failure to comply will cause damage to the servo drive.
- B2 and B3 are shorted with a jumper by default. If external brake resistor is used, remove the jumper between B2 and B3, and then connect the external resistor between B1 and B2, wrong wiring method will cause damage of servo drive.
- Do not connect the resistor between DC bus terminals B1 and N+ (N-). Failure to comply may cause a fire.
- When cables are bundled in a duct, take current reduction into consideration since the cooling condition becomes poor.
- Ordinary cables become quickly aged in high temperature environment, easily sclerotic and broken in low temperature environment. Thus, use heat resistance cables in high temperature environment and take heat preservation measures in low temperature environment.
- The bending radius of a cable shall exceed 10 times that of its outer diameter to prevent the internal wire core from breaking due to long time bending.
- Do not bundle power cables and signal cables together or run them through the same duct. Power and signal cables must be separately by at least 30cm to prevent interference.
- High residual voltage may still remain in the servo drive when the power supply is cut off. Do not touch the power terminals within 5 minutes after power-off.
- Use grounding cable with the same cross-sectional area as the power cable.
- Ground the servo drive reliably.
- Do not power on the servo drive when any screw of the terminal block or any cable becomes loose. Otherwise, fire hazards may occur.
- Wiring operation should be performed by professionals.
- To avoid electric shock, user must wait for at least 5 min after power-off, “charge” indicator off, and no voltage between “B1/P” and “N+/-” tested by multimeter, then proceed to disconnect and assemble the servo motor.
- Do not damage or hard pull cables, or make the cable bear overweight, otherwise, inside cable may be damaged or electric shock may occur, which also cause damage of the product.
- Specification & installation mode of external wiring need adhere to local laws & regulations.

4.1.5 The Selection Guide of Leakage Protection Circuit Breaker

The leakage current of servo drive is higher than 3.5mA, so it must be protected by earthing. The servo device can generate DC leakage current in protective conductor, B type (time-delay) ≥200mA leakage protection circuit breaker must be selected.

When malfunction of leakage protection circuit breaker occurs, user can:

- ◆ Use the leakage protection breaker of higher rated action current and time-delay type.
- ◆ Reduce the carrier frequency of servo drive.
- ◆ Shorten the length of motor driving cable.
- ◆ Add the leakage current suppression measurement.
- ◆ The recommended brand of leakage protection circuit breaker is CHINT and SCHNEIDER.

4.2 Encoder wiring

Precautious of encoder wiring:

- Ground the servo drive and shielded layer of the servo motor reliably. Otherwise, the servo drive will report a fault alarm;
- Do not connect to "NC" terminal;
- To determine the length of the encoder cable, consider voltage drop caused by the cable resistance and signal attenuation caused by the distributed capacitance.
- Encoder cable and power cable must be separately by at least 30cm;
- If encoder cable needs to add another cable because of short, make sure that the shielded layer and grounding are connected reliably

4.2.1 Absolute encoder connector terminal layout

CN2 Encoder Connector Terminal Layout is as shown in figure 4-2-1.

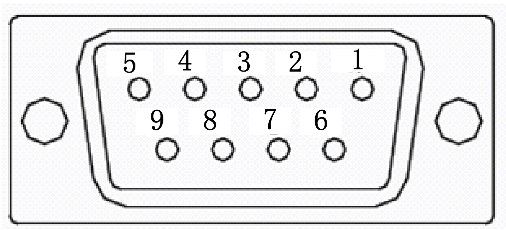


Fig 4.2.1 Absolute encoder terminal layout

Table 4.2.1 Encoder connector terminal name and function

Terminal code	Terminal abbreviation	Signal name	Function
CN2- 1	NC	NO CONNECTION	NO CONNECTION
CN2- 2	VCC	+5V power	+5V power
CN2- 3	PS	PG serial signal	Serial signal
CN2- 4	/PS	PG serial signal	Serial signal
CN2- 5	GND	Grounding	Grounding
CN2- 6			
CN2- 7	NC	NO CONNECTION	NO CONNECTION
CN2- 8	NC	NO CONNECTION	NO CONNECTION
CN2- 9	NC	NO CONNECTION	NO CONNECTION
	HOUSING	——	Shielded（plug cover）

4.2.2 Resolver encoder connector terminal layout

CN2 Encoder Connector Terminal Layout is as shown in figure 4-2-2.

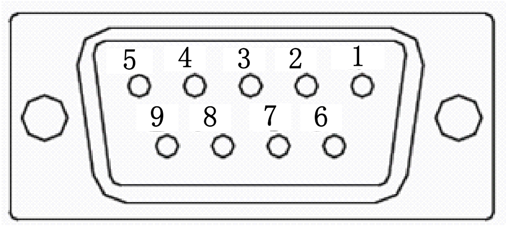


Fig 4.2.2 Resolver encoder terminal layout

Table 4.2.2 Encoder connector terminal name and function

Terminal code	Terminal abbreviation	Signal name	Function
CN2- 1	RE2	Resolver stimulus signal	Connect to servo motor stimulus signal.
CN2- 2	VCC	+5V power output	+5V power output
CN2- 3	KTY	motor temperature sensor	Motor temperature detection
CN2- 4	NC	No connection	No connection
CN2- 5	RE1	Resolver signal stimulus	Connect to servo motor stimulus signal.
CN2- 6	COS-	Resolver differential signal	Connect to servo motor differential signal.
CN2- 7	COS+	Resolver differential signal	Connect to servo motor differential signal.
CN2- 8	SIN-	Resolver differential signal	Connect to servo motor differential signal.
CN2- 9	SIN+	Resolver differential signal	Connect to servo motor differential signal.
	HOUSING	——	Shielded (plug cover)

4.2.3 Incremental encoder connector terminal layout

CN2 Encoder Connector Terminal Layout is as shown in figure 4-2-3.

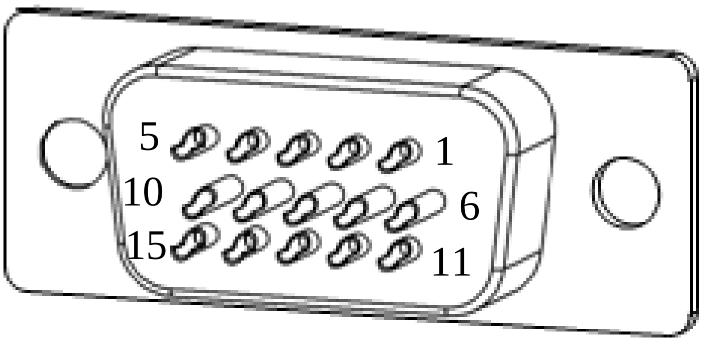


Fig 4.2.3 Incremental encoder terminal layout

Table 4.2.3 14-core Encoder connector terminal name and function

Terminal code	Terminal abbreviation	Signal name	Function
CN2- 1	V	Encoder V phase input	Connect to motor encoder V phase
CN2- 2	U	Encoder U phase input	Connect to motor encoder U phase
CN2- 3	Z	Encoder Z phase input	Connect to motor encoder Z phase
CN2- 4	B	Encoder B phase input	Connect to motor encoder B phase
CN2- 5	A	Encoder A phase input	Connect to motor encoder A phase
CN2- 6	/V	Encoder /V phase input	Connect to motor encoder /V phase
CN2- 7	/U	Encoder /U phase input	Connect to motor encoder /U phase
CN2- 8	/Z	Encoder /Z phase input	Connect to motor encoder /Z phase
CN2- 9	/B	Encoder /B phase input	Connect to motor encoder /B phase
CN2-10	/A	Encoder /A phase input	Connect to motor encoder /A phase
CN2-11	/W	Encoder /W phase input	Connect to motor encoder /W phase
CN2-12	W	Encoder W phase input	Connect to motor encoder W phase
CN2-13	VCC	+5V power	+5V power
CN2-14	GND	Grounding	Grounding
CN2-15	——	——	NO CONNECTION
	HOUSING	——	Shielded (plug cover)

Table 4.2.4 8-core encoder connector terminal name and function

Terminal code	Terminal abbreviation	Signal name	Function
CN2- 1	——	——	NO CONNECTION
CN2- 2	——	——	NO CONNECTION
CN2- 3	Z	Encoder Z phase input	Connect to motor encoder Z phase
CN2- 4	B	Encoder B phase input	Connect to motor encoder B phase
CN2- 5	A	Encoder A phase input	Connect to motor encoder A phase
CN2- 6	——	——	NO CONNECTION
CN2- 7	——	——	NO CONNECTION
CN2- 8	/Z	Encoder/Z phase input	Connect to motor encoder /Z phase
CN2- 9	/B	Encoder/B phase input	Connect to motor encoder /B phase
CN2-10	/A	Encoder/A phase input	Connect to motor encoder /A phase
CN2-11	——	——	NO CONNECTION
CN2-12	——	——	NO CONNECTION
CN2-13	VCC	+5V power	+5V power
CN2-14	GND	Grounding	Grounding
CN2-15	——	——	NO CONNECTION
	HOUSING	——	Shielded (plug cover)

4.3 Input/output signal wiring

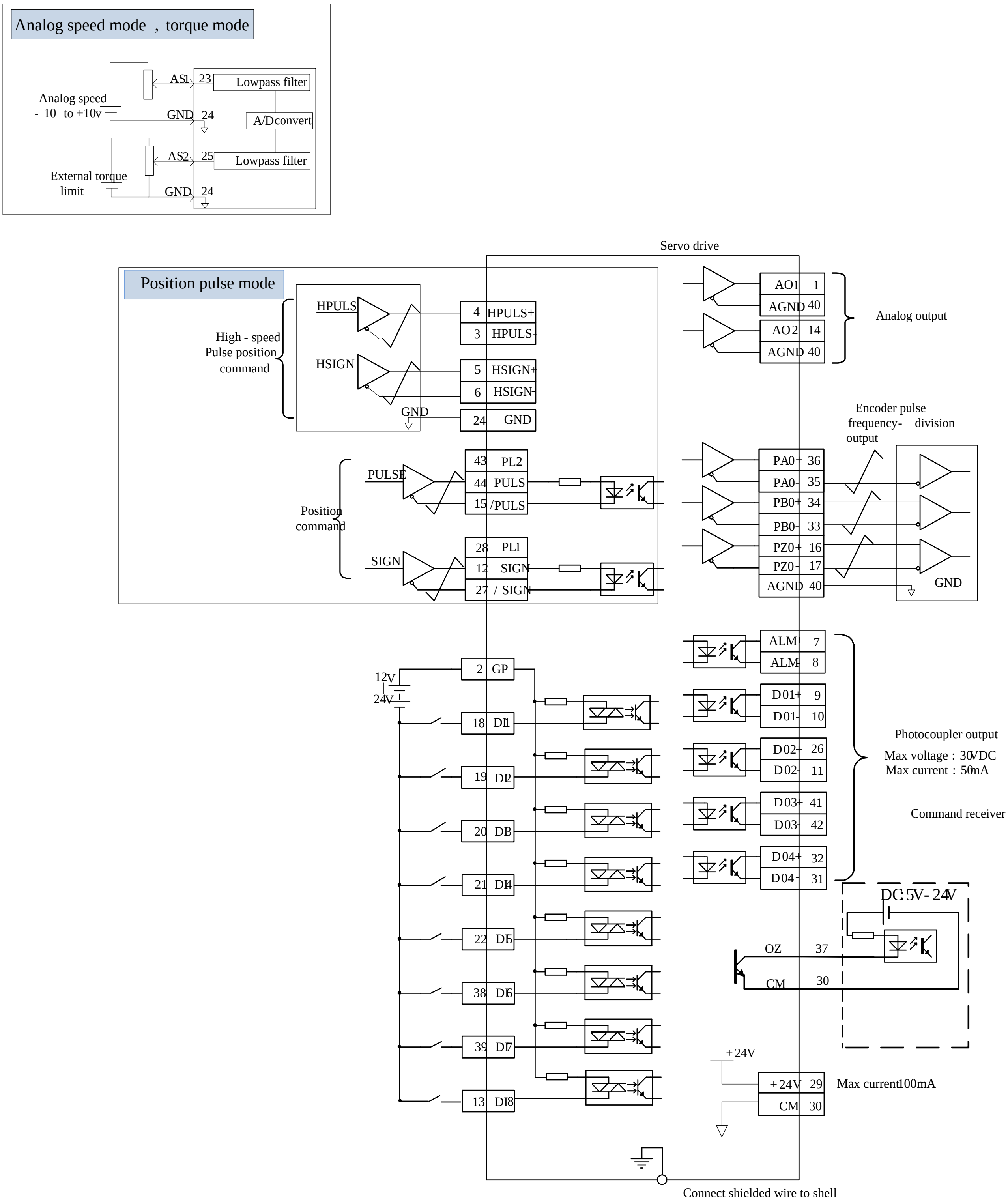


Fig 4.3.1 Wiring diagram in bus mode

CN3 Input/output signal connector terminal layout, see figure 4.3.2 as below:

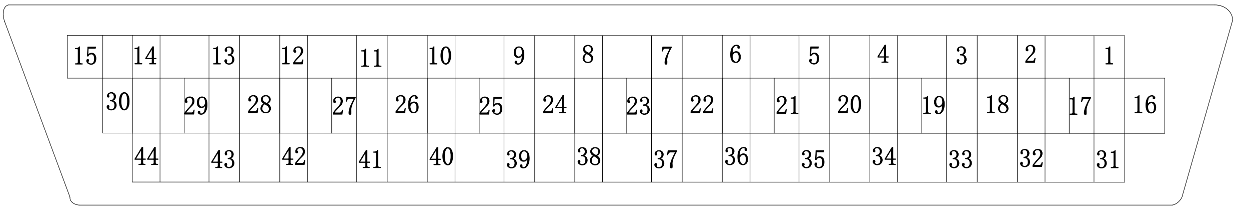


Fig 4.3.2 I/O signal connector (connected to CN3) terminal layout

1	AO1	16	PZO+	31	DO4 -
2	GP	17	PZO -	32	DO4+
3	HPULS-	18	DI1	33	PBO -
4	HPULS+	19	DI2	34	PBO+
5	HSIGN+	20	DI3	35	PAO-
6	HSIGN-	21	DI4	36	PAO+
7	ALM+	22	DI5	37	ZO
8	ALM-	23	NC	38	DI6
9	DO1+	24	GND	39	DI7
10	DO1-	25	NC	40	GND
11	DO2-	26	DO2+	41	DO3+
12	NC	27	NC	42	DO3-
13	DI8	28	NC	43	NC
14	AO2	29	+24V	44	NC
15	NC	30	CM		

4.3.1 Position command input signal and function

Table 4.3.1 Position command signal

Signal Name		Pin No.	Function
High-speed pulse receiver	HPULS+	CN3-4	High-speed pulse position command
	HPULS-	CN3-3	
	HSIGN+	CN3-5	High-speed pulse direction command
	HSIGN-	CN3-6	
	GND	CN3-24	Signal reference

The max input frequency identified by position command receiving circuit see table as below:

Pulse mode		Max frequency	Remark
High-speed	Differential	4M	5V command

High-speed pulse command input:

In host device side, the output circuit of high-speed command pulse and symbol, only output to servo drive via differential drive.

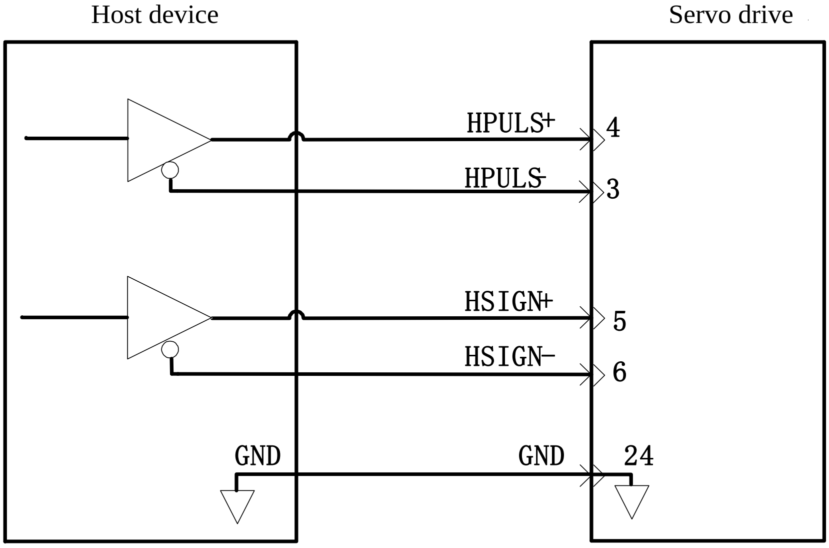


Fig 4.3.3 High-speed pulse input interface circuit

★ Make sure the differential input is 5V, otherwise, servo drive receives unstable pulses and the servo internal parts could result in damage.

★ Make sure the 5V grounding of host device is connected to GND of servo drive, otherwise, below problems may occur:

1. Pulse loss occurs when inputting pulse;
2. Interference occurs when receiving pulse, which make the received pulse inaccurate.

4.3.2 Digital input signal and function

Signal Name		Pin No.	Function
Programmable input terminal	DI1	CN3-18	DI1-DI7 are normal digital inputs, input mode is switch signal, which function can be modified according to the practical requirements. See details in 8.3.11 for DI/DO function specification.
	DI2	CN3-19	
	DI3	CN3-20	
	DI4	CN3-21	
	DI5	CN3-22	
	DI6	CN3-38	
	DI7	CN3-39	
	DI8	CN3-13	
Signal Name		Pin No.	Function

Programmable output terminal	DO1+	CN3-9	DO1-DO4 and ALM are DO output, output mode is switch signal, which function can be modified according to the practical requirements. See details in 8.3.10 for DI/DO function specification.
	DO1-	CN3-10	
	DO2+	CN3-26	
	DO2-	CN3-11	
	DO3+	CN3-41	
	DO3-	CN3-42	
	DO4+	CN3-32	
	DO4-	CN3-31	
	ALM+	CN3-7	
	ALM-	CN3-8	
Signal Name		Pin No.	Function
Built-in 24V power supply	+24V	CN3-29	Provide 24V power supply, voltage range: 20V~30V, load capacity of power supply is 100mA; Switch to external power supply if external load is higher than 100mA.
	CM	CN3-30	24V power supply reference

1） Digital input circuit

DI1~DI7 7-channel input terminals circuit adopt bidirectional photoelectric coupler isolation circuit, the common port of photoelectric coupler is GP, can be connected to power supply or GND of power supply, see figure 4.3.3 and 4.3.4. The primary side of photoelectric coupler needs DC power supply configured by user to reduce the interference of internal circuit.

DI8 is high-speed optocoupler channel, which can be used as either high-speed DI or normal DI optocoupler. Common input mode in DI circuit as below:

a) Passive contact

Including relay contact, travel switch, keys, buttons etc. common interface circuit as below:

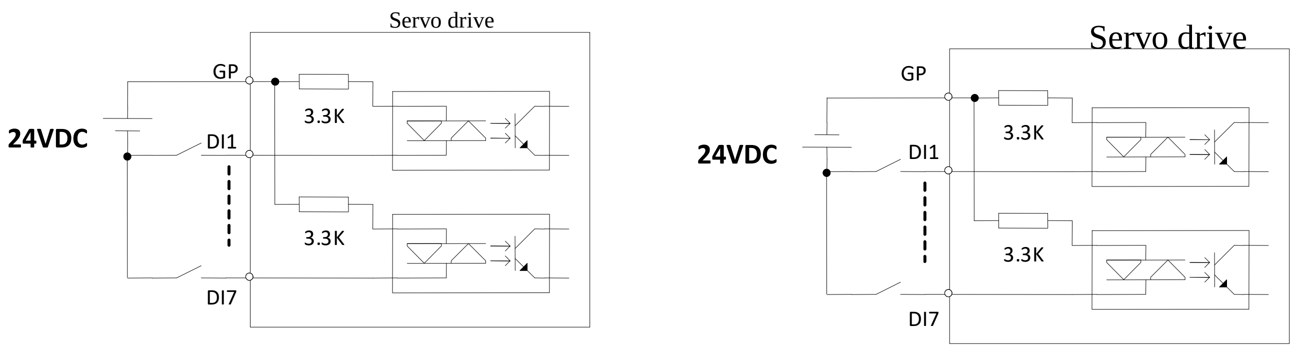
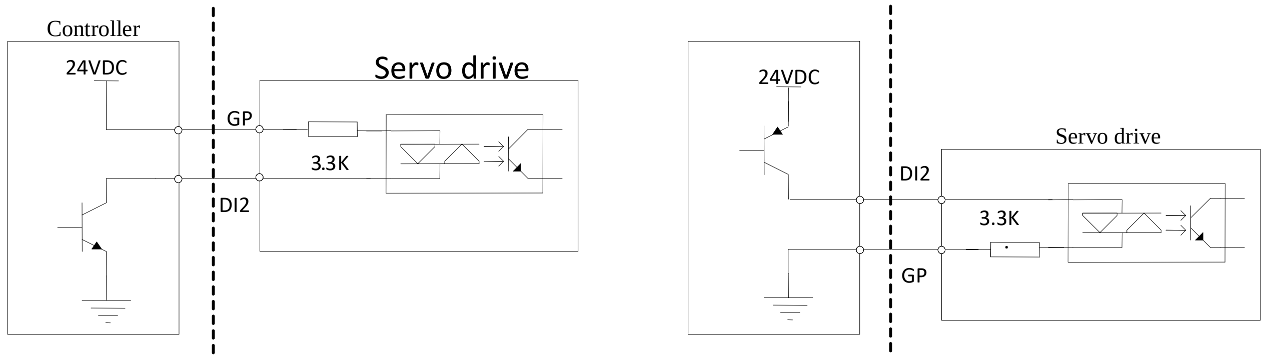


Fig 4.3.3 Passive contact interface circuit

b) Active contact

Including some photoelectric sensor, hall sensor, transistor-type PLC etc. common interface circuit as below:



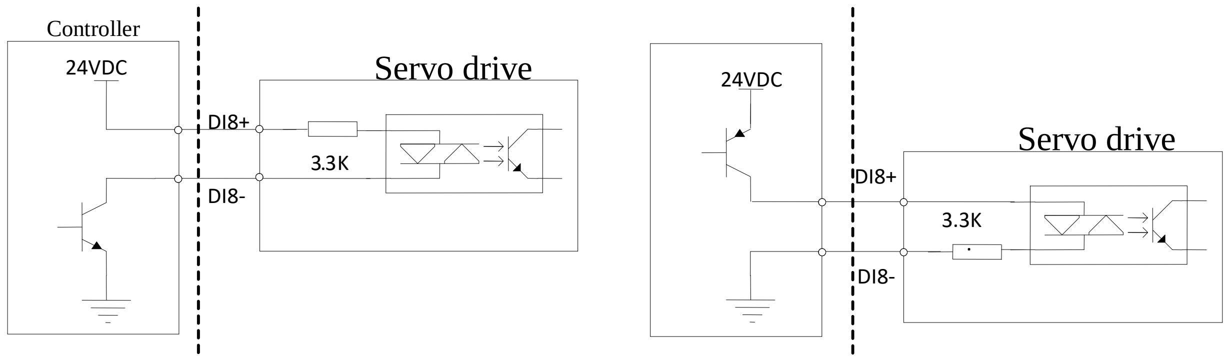
NPN type

PNP type

Fig 4.3.4 Active contact interface circuit

c) DI8 terminal connection

DI8 terminal adopts high-speed optocoupler, can either be used as high-speed DI count signal, or either be used as common DI optocoupler. Wiring as below when using DI8 contact as the high-speed optocoupler circuit:



NPN type

PNP type

Fig 4.3.5 DI8 wiring diagram

★ To avoid the wrong wiring, there is diode in parallel in DI8 circuit; make wiring strictly followed by the instruction showed in figure above, wrong wiring or improper use may result in damage of internal circuit.

★ DI8 circuit receives 24V command by default.

2） Digital output circuit

Output signals, ALM and DO1~DO4, adopt the photoelectric coupler of Darlington output, strong driving capacity can drive small relay directly, and also can drive isolation components such as photoelectric coupler to realize driving much more load. Assure the limit of output current in use (max current is 50mA). Common interface circuit as below:

a) Relay output:

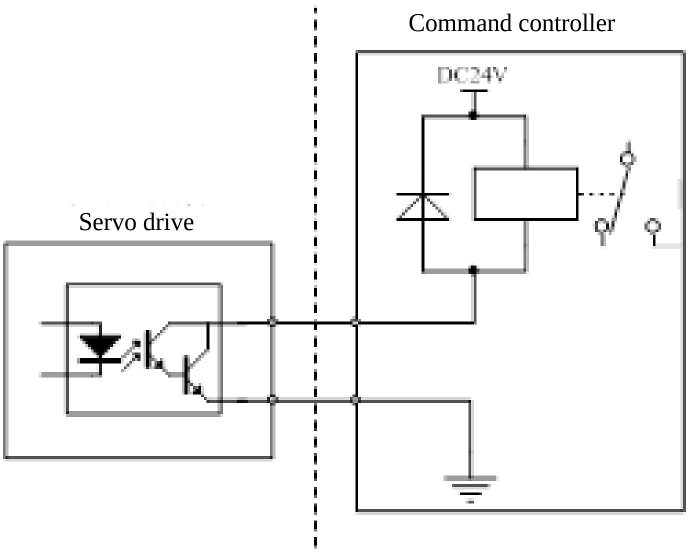


Fig 4.3.6 Relay output interface correct circuit diagram

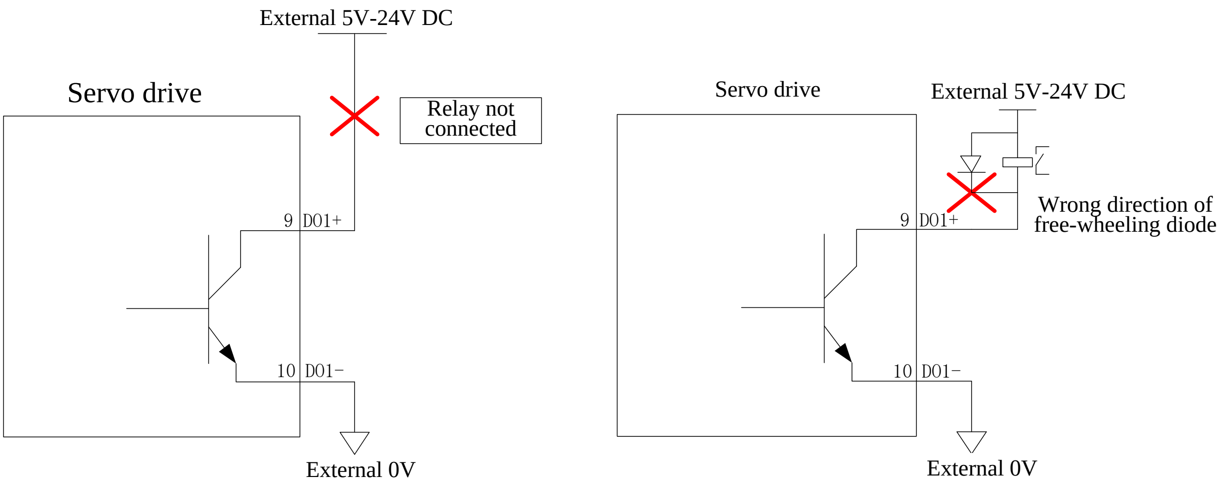
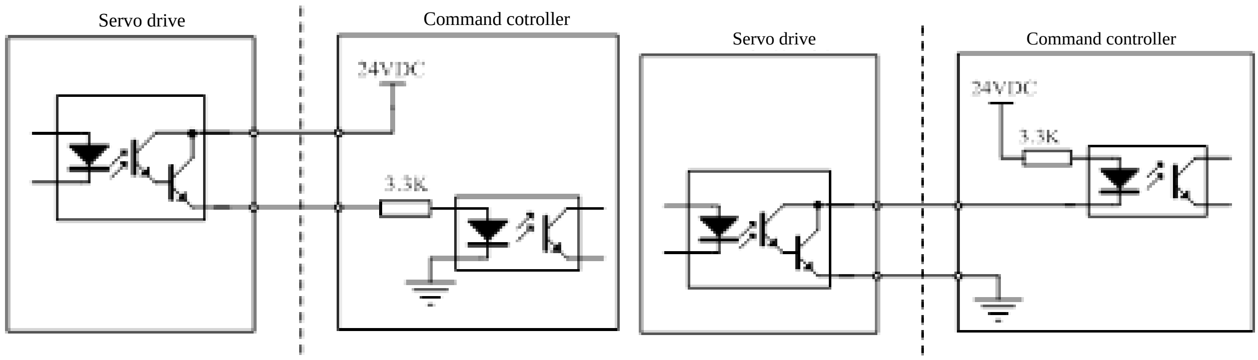


Fig 4.3.7 Wrong wiring circuit of relay output interface

Caution

★ Relay is the inductive load; Anti-parallel free-wheeling diode must be connected to both ends of the load.
★ Anti-access of free-wheeling diode could result in damage of servo drive.

b) Optocoupler isolated output



PNP type NPN type

Fig 4.3.8 photoelectric coupler output interface circuit

Caution

The power supply and current-limiting resistance must be matched to ensure the external optocoupler conduct reliably.
The max allowance voltage and current of servo drive internal optocoupler output circuit: (Max voltage: DC 30V; Max current: DC 50mA)

4.3.3 Encoder frequency-dividing output signal and function

Signal name		Pin No.	Function
General output terminal	PAO+	CN3-36	A phase frequency-dividing output signal
	PAO-	CN3-35	
	PBO+	CN3-34	B phase frequency-dividing output signal
	PBO-	CN3-33	
	PZO+	CN3-16	Z phase frequency-dividing output signal
	PZO-	CN3-17	
	OZ	CN3-37	Z pulse open collector output signal
	CM	CN3-30	Signal reference

Servo drive makes frequency division for encoder input signal by internal frequency-dividing circuit, one way is to use differential bus mode to output. The interface circuit can be divided into high-speed photoelectric coupler reception and differential chip reception. Take sample as encoder A-phase (PAO) pulse frequency-dividing output, the interface circuit shows as below figure 4.3.9 and figure 4.3.10.

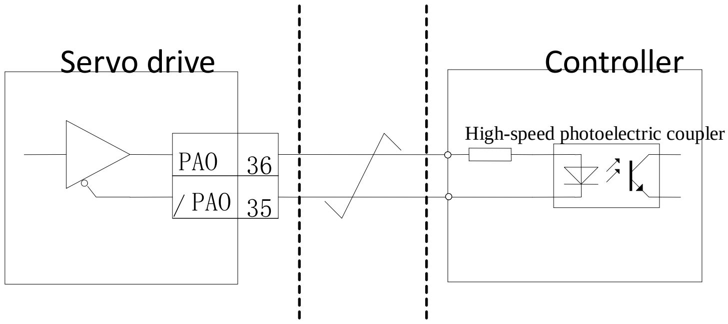


Fig 4.3.9 photoelectric coupler interface circuit of encoder frequency-dividing output

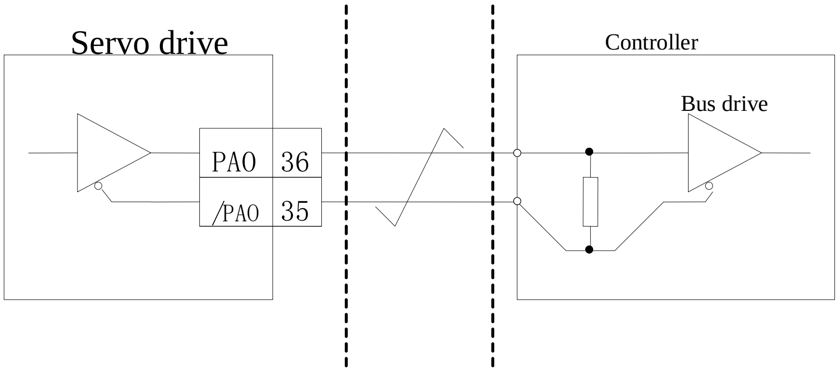


Fig 4.3.10 differential chip interface circuit of encoder frequency-dividing output

Caution

★ Receiver chip is recommended to use AM26LS32;

★ Matched resistance is recommended to use 200Ω/1/4W;

Encoder Z phase frequency-dividing output circuit uses open collector signal for providing feedback signal when forming position control system. In upper device side, use photoelectric coupler and relay circuit to receive.

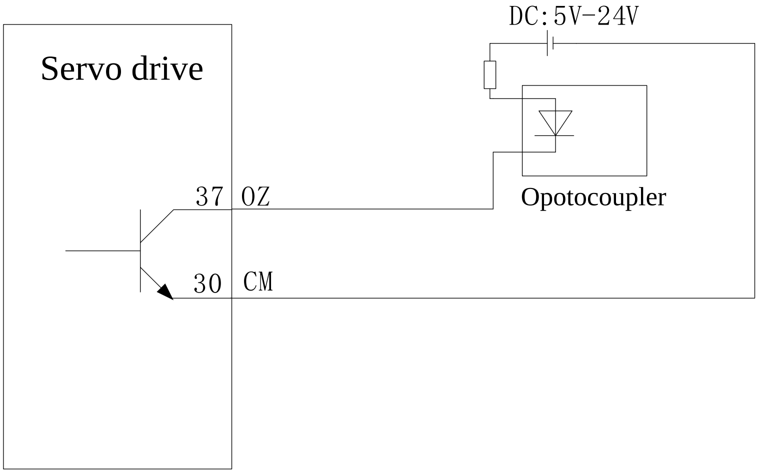


Fig 4.3.11 collector OZ signal interface circuit

4.3.4 Analogue Monitor Output

Output signal

Signal name	Short	Fixed terminal	Definition
Analogue monitor output 1	AO1	CN3-1	
Analogue monitor output 2	AO2	CN3-14	Analogue monitoring output
Reference GND	GND	CN3-24	

4.3.5 Communication wiring

(1) Serial port specification

RS485 communication interface locates in CN1 of controller; the figure below is the connector terminals diagram and definition.

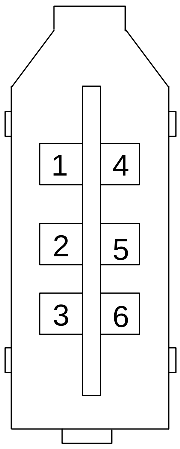


Fig 4.3.12 communication port CN1 pin terminal sequence diagram

Table 4.3.2 Communication port terminal name and function

Terminal	Name	Function
CN1-1	VCC	5V power
CN1-2	RS232-RXD	Receiver terminal of RS232
CN1-3	B-	Differential output -
CN1-4	GND	Reference terminal
CN1-5	RS232-TXD	Transmission terminal of RS232
CN1-6	A+	Differential output +

Note: CN1-1 can provide the load capacity of 100mA. Switch to external power if ＞100mA.

(2) EtherCAT interface specification

Connect EtherCAT gridding cable to network interface with metal shielded layer, dividing into input (IN) and output (OUT). The electrical characteristics meet IEEE 802.3 and ISO 8877.

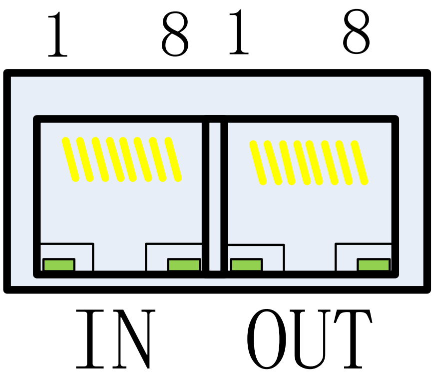
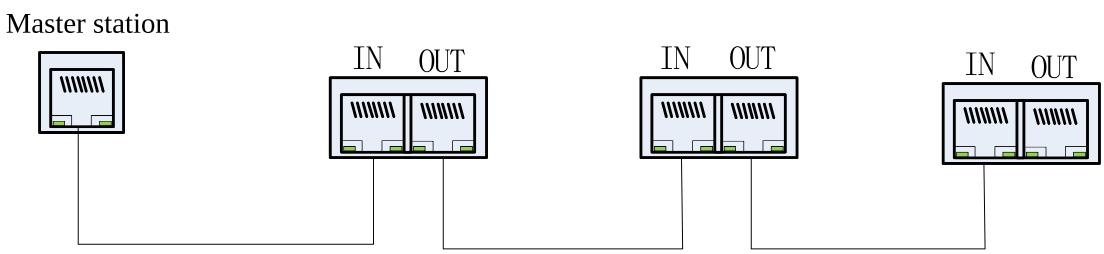


Table 4.3.3 Communication port terminal name and function

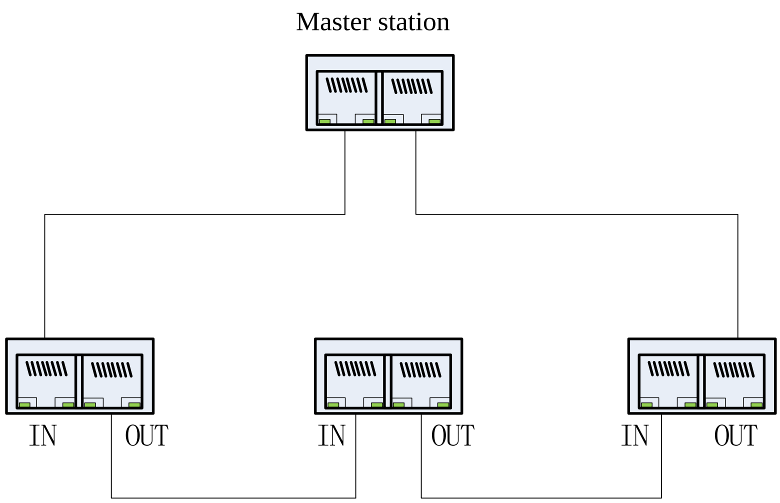
Pin	Definition	Description
1	TX+	Data send+
2	TX-	Data send-
3	RX+	Data receive+
4	Reserved	Reserved
5	Reserved	Reserved
6	RX-	Data receive-
7	Reserved	Reserved
8	Reserved	Reserved

EtherCAT topological structure connects flexibly, there is basically no limit for connection, the servo has IN and OUT interface, the topological connection as below:

Linear connection:



Redundant ring connection:



(3) Communication cable

EtherCAT communication cable use Ethernet Category 5(100BASE-TX) network cable or high-intensity shielded network cable. The shielded network cable is also needed for the servo drive, and the length of cable cannot be longer than 100M. Shielded network cable can enhance the anti-interference capacity of servo system.

4.3.6 Multiple online wiring

Alarm signal is normally closed output by default, cut-off between ALM+ and ALM- when servo drive alarms. When using in multiple drives, considering that faulty of any drive can cut off the main circuit power supply, so it can be designed that the alarm signals of multiple drives are strung together.

(1) Wiring for multiple 220V servo drives

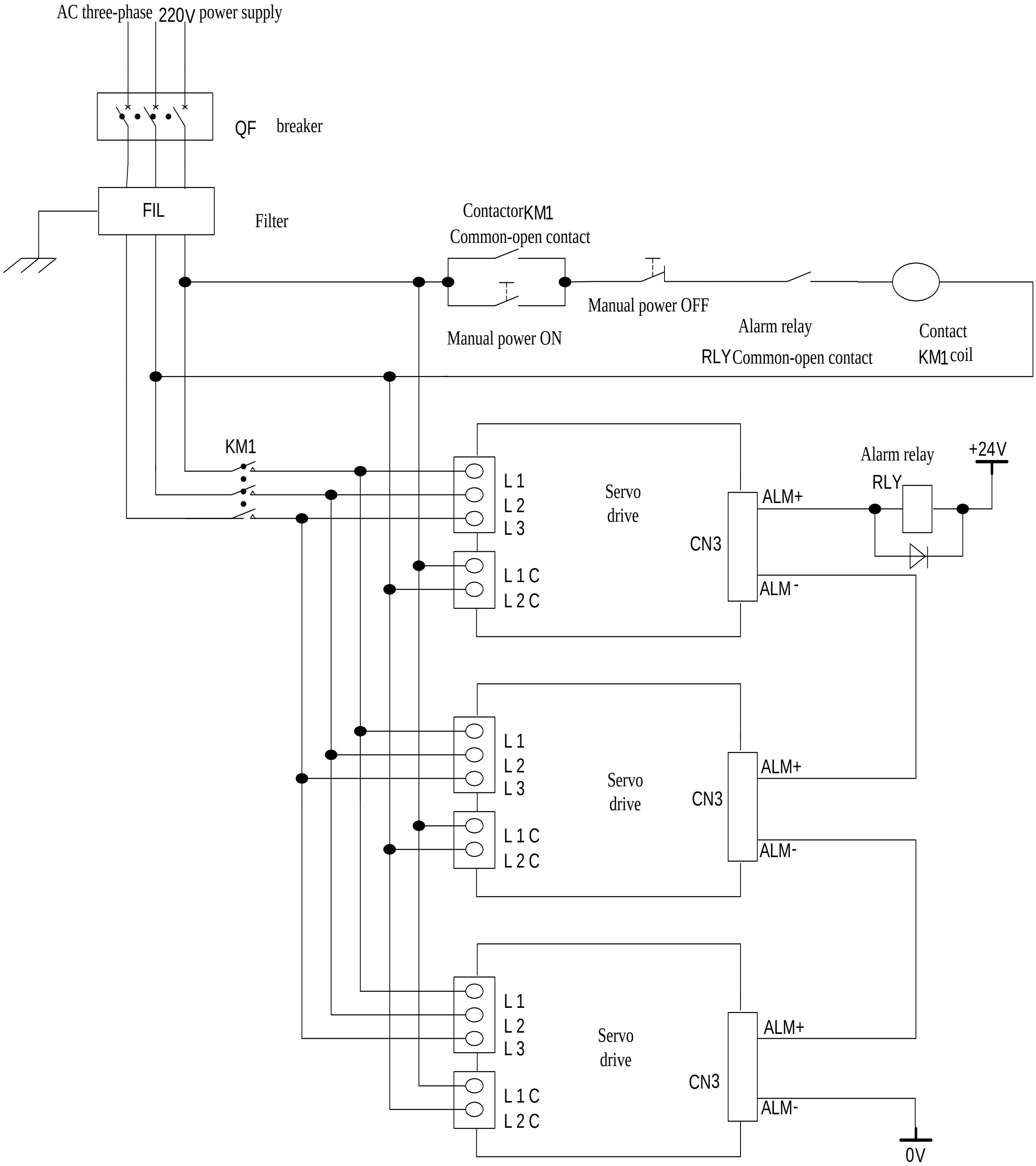


Fig 4.3.13 220V multiple online wiring

(2) Wiring for multiple 380V servo drives

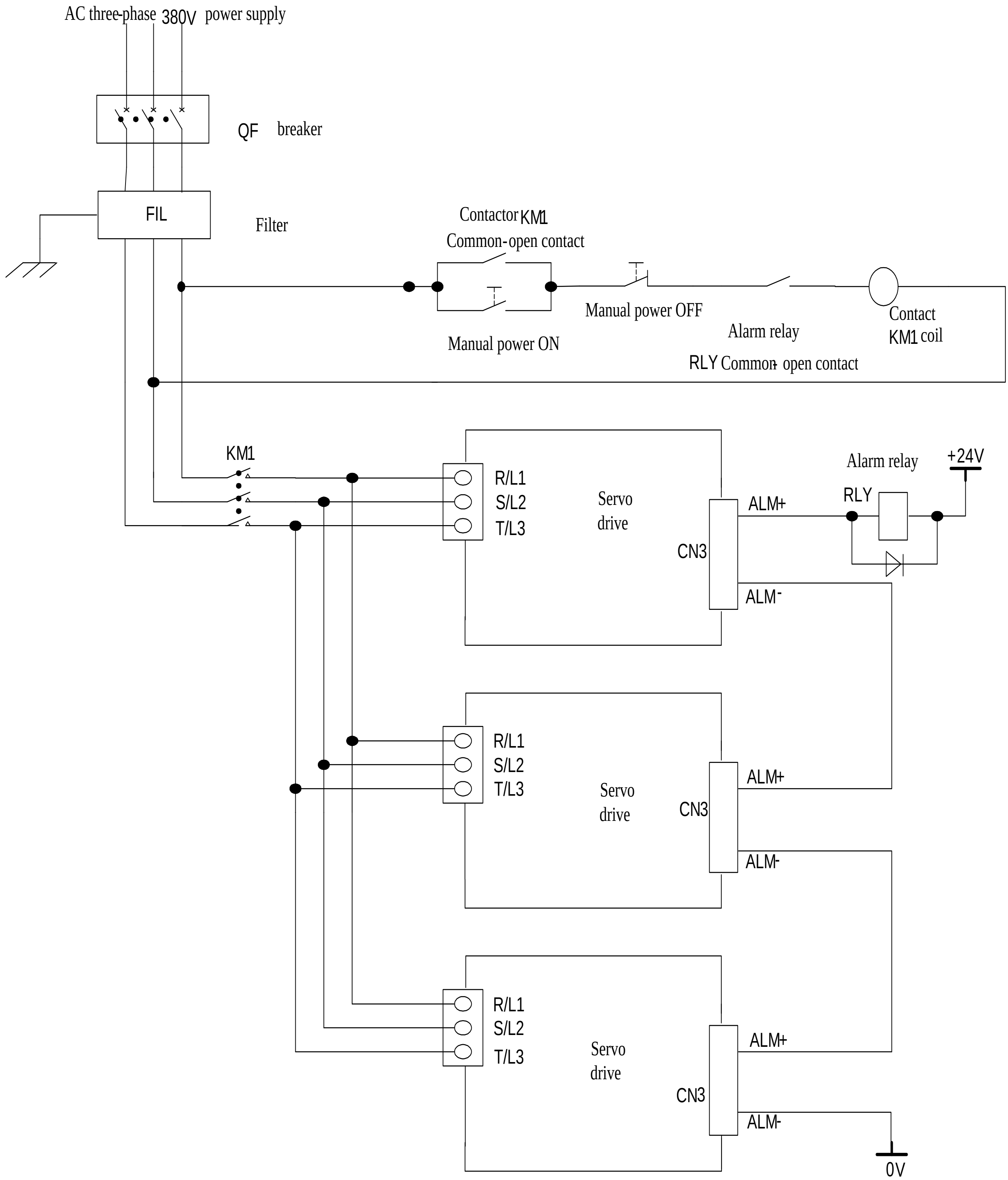


Fig 4.3.14 380V multiple online wiring

4.3.7 The usage of absolute encoder

Encoder type	Resolution ratio	Multi-turn data output range	Action when out of allowed range
17 bit absolute encoder	16-bit multiturn 17-bit single-turn	0～+65535	·Multi-turn data will turn to 0 when data exceeds upper limit (+65535) of forward direction. ·Multi-turn data will turn to 0 when data exceeds lower limit (+65535) of reverse direction.
23 bit absolute encoder	16-bit multiturn 23-bit single-turn		

User can read absolute position by MODBUS protocol. In practical control, absolute position can be read by Modbus protocol when motor is in static state (see details in 6.2), and then motor real-time position can be got by PG frequency-division output pulse count.

(1) The usage of battery

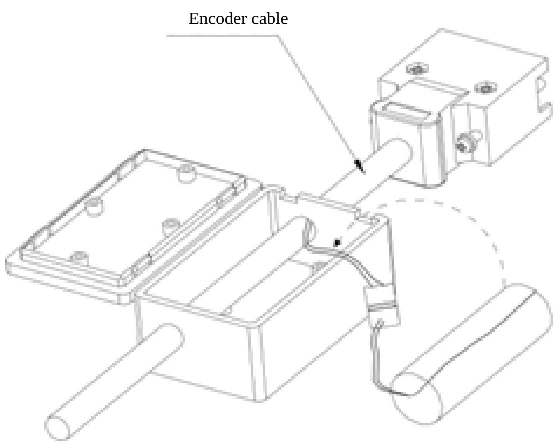
Please install battery cell in order to save position data of absolute value encoder.

Please purchase special cable and battery box of manufacture.

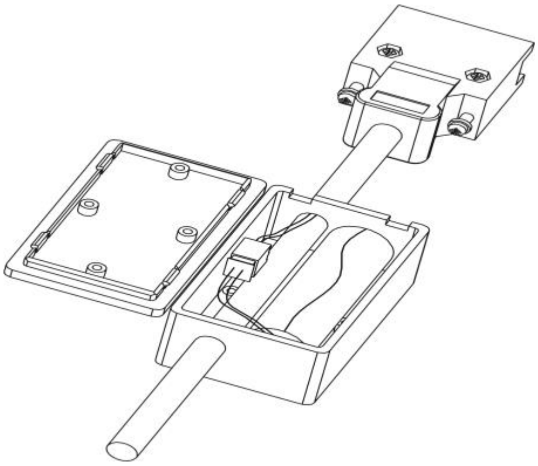
Battery installations steps:

A: open cover of battery cover.

B: Install battery as below figure:



C: Close the cover of battery cell.



(2) Battery replacement

When battery voltage drops to about 1.3V, servo drive will trip into “AL-19” (battery voltage is lower). At this time, multi-turn data still exists, but user should change battery immediately, otherwise multi-turn data will be lost when battery voltage keeps dropping. Please change battery according to the following steps:

1. Please change battery when servo drive is POWER ON.
2. After changing battery, reset servo drive by hold pressing “SET” key to clear “AL-19”.
3. Repower on the servo drive, if no abnormal situation, it means battery change succeeds.

Note:

1. When servo drive trips into AL-24 (under voltage protection), the alarm can be reset only by setting mechanical origin again.
2. If user wants to shield AL-24 alarm, please set 2008h-27h (So-38) to 0, reset encoder alarm by 2008h-2Ch (So-43), and fault reset by hold pressing “reset” key.

4.4 Wiring for servo drive and servo motor

Attention:

1. The “number” mentioned in following description means pin number of plug.
2. If the number of plug chip does not match the quantity of plug chip mentioned in user manual, user should follow the number in user manual to weld, no connection for the pin number that not mentioned in user manual
3. The bonding definition of core-saving encoder means remove U/V/W signal on the base of normal incremental encoder, the followings described in table is only for normal incremental encoder.

4.4.1 The connection of encoder cable

(1) Absolute encoder layout

Table 4.4.1 Absolute encoder plug cable sequence

No.	Name	Function
1	PE	Grounding
2	VCC	Encoder power
3	GND	Encoder power grounding
4	BAT(+)	Battery anode
5	BAT(-)	Battery cathode
6	PS	Absolute value encoder serial signal
7	/PS	Absolute value encoder serial signal

(2) Incremental encoder layout

Table 4.4.2 DB15 plug-type encoder plug cable sequence

No.	Name	Function
1	A	Encoder A phase
2	B	Encoder B phase
3	Z	Encoder Z phase
4	U	Encoder U phase
5	V	Encoder V phase
6	/A	Encoder /A phase
7	/B	Encoder /B phase
8	/Z	Encoder /Z phase
9	/U	Encoder /U phase
10	/V	Encoder /V phase
11	W	Encoder W phase
12	/W	Encoder /W phase
13	VCC	Encoder power
14	GND	Encoder grounding
15	——	No connection
	HOUSING	HOUSING

Table 4.4.3 Aviation plug encoder plug cable sequence

No.	Name	Function
1	PE	grounding
2	A	Encoder A phase
3	/A	Encoder /A phase
4	B	Encoder B phase
5	/B	Encoder /B phase
6	U	Encoder U phase

7	/U	Encoder /U phase
8	V	Encoder V phase
9	/V	Encoder /V phase
10	W	Encoder W phase
11	/W	Encoder /W phase
12	VCC	Encoder power
13	GND	Encoder grounding
14	Z	Encoder Z phase
15	/Z	Encoder /Z phase

(3) Resolver encoder cable sequence

Table 4.4.4 15-core aviation plug encoder cable sequence

No.	Name	Function
1	PE	Grounding
2	COS+	Resolver differential signal
3	NC	No connection
4	NC	No connection
5	COS-	Resolver differential signal
6	NC	No connection
7	NC	No connection
8	NC	No connection
9	NC	No connection
10	SIN+	Resolver differential signal
11	NC	No connection
12	NC	No connection
13	SIN-	Resolver differential signal
14	RE1	Resolver excitation signal
15	RE2	Resolver excitation signal

Table 4.4.5 10-core aviation plug type encoder cable sequence

No.	Name	Function
1	RE1	Resolver excitation signal
2	RE2	Resolver excitation signal
3	COS+	Resolver differential signal

4	COS-	Resolver differential signal
5	SIN+	Resolver differential signal
6	SIN-	Resolver differential signal
7	KTY+	Motor thermistor signal
8	KTY-	Motor thermistor signal
9	PE	Grounding
10	NC	No connection

4.4.2 The connection of power cable

a） 4-core power AMP plug

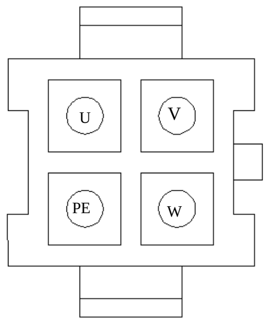


Fig 4.4.1 4-core power aviation plug sketch map

Name	Cable color	Function
U	Yellow	Drive input
V	Blue	Drive input
W	Red	Drive input
PE	Yellow-green/black	Grounding

b） 4-core power aviation plug

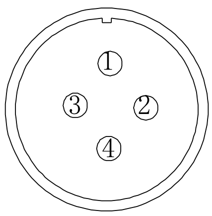


Fig 4.4.2 4-core power aviation plug sketch map

No.	Name	Function

1	PE	Grounding
2	U	Drive input
3	V	Drive input
4	W	Drive input

c） Brake cable plug

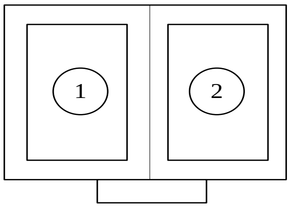


Fig 4.4.3 2-core power-off brake AMP plug sketch map

No.	Name	Function
1	+	DC 24V +
2	–	DC 24V -

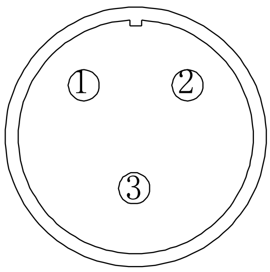


Fig 4.4.4 3-core DC 24V power-off brake plug sketch map

Plug No.	Name	Function
1	+	DC 24V +
2	–	DC 24V -
3	—	None

V. Keypad Operation and Parameters

5.1 Keypad operation

5.1.1 Keypad description

The name of keypad and each part as figure below:

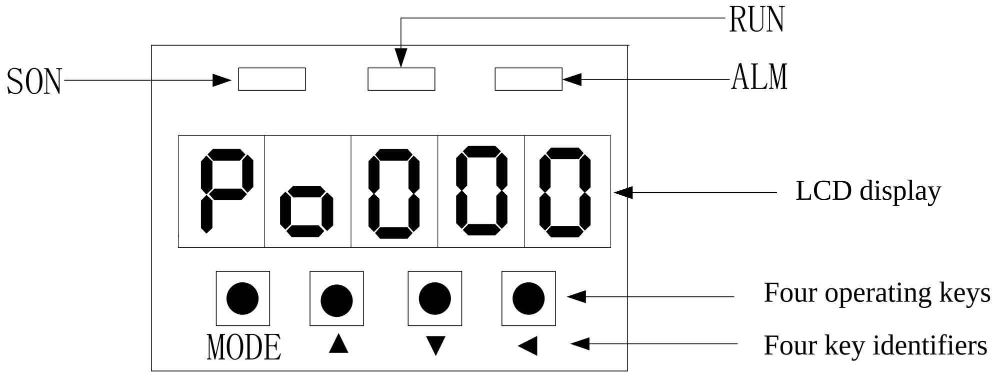


Fig 5.1.1 Keypad sketch map

Identifier	Name	Function
SON	Indicator (green)	Indicating that Servo is on.(Light on when servo on)
ALM	Indicator (red)	Indicating that malfunction occurs.(Light on when faulty occurs)
RUN	EtherCAT state indicator	EtherCAT state machine indicator
PANAL	LCD Display	The LCD display (5-digit display panel) shows the monitor codes, parameter settings and operation values of the servo drive.
MODE	Mode key	1 Switching between function groups. 2 Displaying malfunction codes in turn.
▲ （UP）	UP	1 Press the key to increase the displayed value. 2 Hold the key for 0.5s to increase setting the value slowly. 3 Hold the key for over 1s to increase setting value rapidly. 4 Used to forward start in jogging run.
▼ (DOWN)	DOWN	1 Press the key to decrease the display value. 2 Hold the key for 0.5s to decrease setting value slowly. 3 Hold the key for over 1s to decrease setting value rapidly. 4 Used to reverse start in jogging run.
▲ （SET）	shift/set	1 Hold the key for 0.5s to enter into parameter setting mode 2 Pressing the key can move the cursor to the left and then change parameter settings (blinking digits) by using arrow keys. 3 Hold the key for 0.5s to confirm and set current value into the current user parameter. 4 Hold the key for 2s to reset the malfunction.

5.2 Panel Display

5.2.1 Switchover of panel display

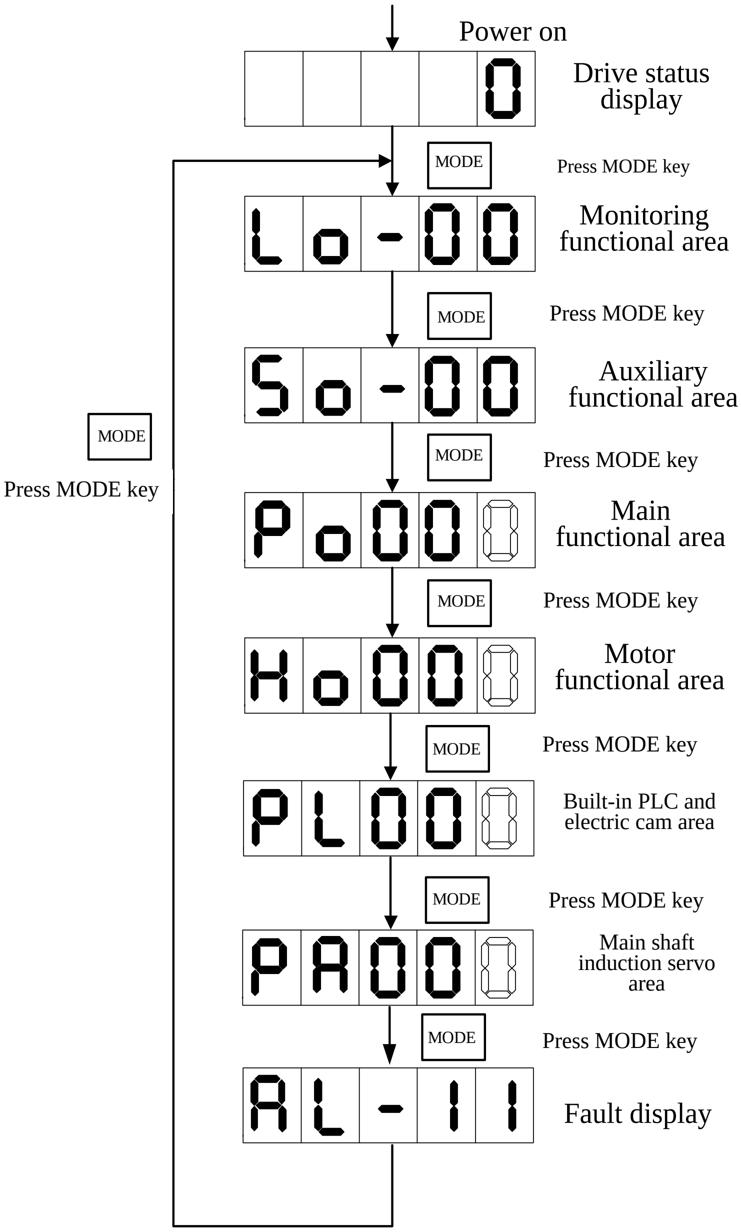
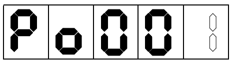


Fig 5.2.1 the switchover of user parameter area sketch map

After main circuit is powered on, servo status display So-09 is displayed in the keypad, the Mfr's value of which is servo output speed. The display content will switch among monitor functional area (Lo-□□), auxiliary functional area (So-□□), main functional area (Po□□□), motor parameters area (Ho□□□), high-speed counting area (PL□□□) and main shaft induction servo parameter area by pressing MODE key.
If fault occurs, current fault code will be displayed circularly.

5.2.2 Parameters display


The representation method in this manual is Po001.

The hollow segment code represents blinking operating digits, which is the adjustable digits.

☞In this manual, three parameters modes is adopted to introduce the parameters.

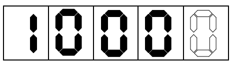
☞□□□□□ represents five operating digits in keypad.

■ **One parameter mode** (if no special instruction, the parameters belong to this mode)

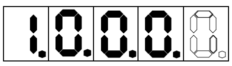
□ □ □ □ □ one parameter mode means that five digits represent one parameter.
Q

For example:

Ex 1： Ho005 Servo motor interphase resistance is 10000 mΩ，the display content is:


（The unit is 10^{-3} Ω） The quoting mode is Ho005=10000.

Ex 2： Ho018 Servo motor installation angle is -10000，the display content is:


（Unit N/A） The quoting mode is Ho018=-10000.

Note: if all decimal points are lit, the current value is negative value.

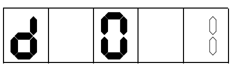
■ **Two parameters mode**

d □ □ □ □ Two-parameter mode means every two digit except the first digit is adjustable parameter.
Y X

X and Y represent an adjustable parameter digit separately.

For example:

Ex: Po407 CN3-5 terminal function is alarm-reset. The display content is:

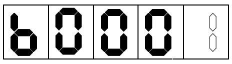

The quoting mode is Po407.X=1.

■ **Four parameters mode**

b □ □ □ □ Four parameters mode means each digit except the first digit is an adjustable parameter digit.
D C B A

A, B, C and D represents an adjustable parameter digit separately.

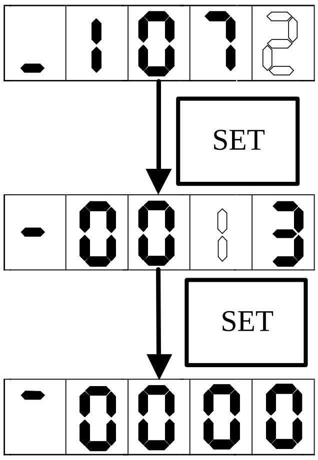
Ex: at position mode, the pulse command type of pulse +pulse is selected, and then the last digit of Po300 is set to1. The display content is:


The quoting mode is Po300.A=1.

■ **Five parameters display**

□ □ □ □ □The first digit means current page, the other digits means current value.
E D C B A

For example: set value of HOME, Po136=131072, the actual display content is as below:



Index + sub-index

User parameter name

Parameter action scope

2000h-02h	Control mode and control command input source setting			PP PV PT CSP CSV CST HM
	Setting range	Setting Unit	Mfr’s Value	When enabled
	Two-parameter	N/A	1 21	After restart
	Corresponding parameter	Mapping	Data Type	Accessibility
	Po001	N	UINT 16	RW

Note: The parameter action scope means the running mode that the parameter works.

5.3 Keypad Operating Procedure

5.3.1 Example for parameter setting of monitoring functional area

Take usage of Lo-14(DI8~DI5 status display) as the example:

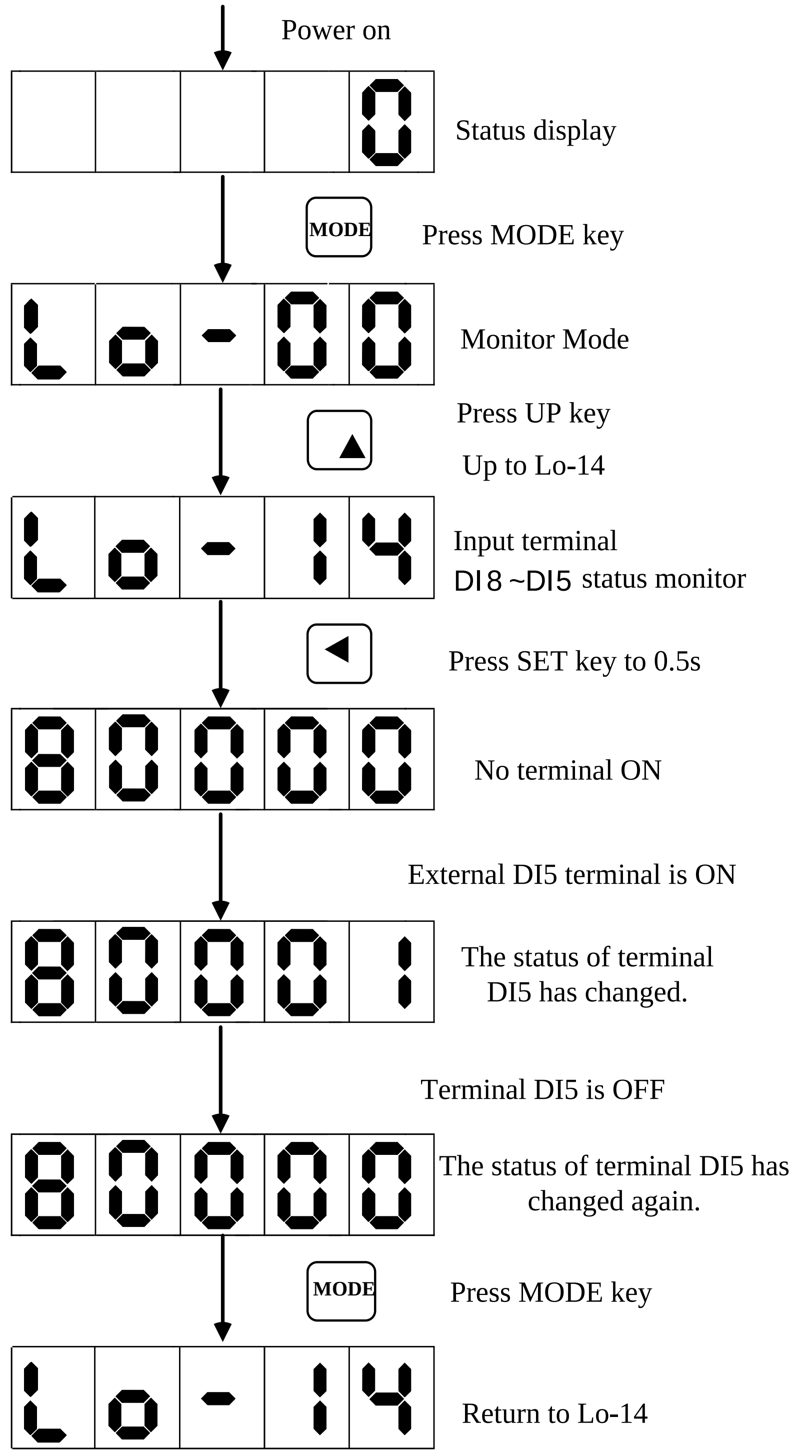


Fig 5.3.1 Terminal status monitoring sketch map

5.3.2 Example for parameter setting of auxiliary area

Take usage of So-14（JOG run）as the example:

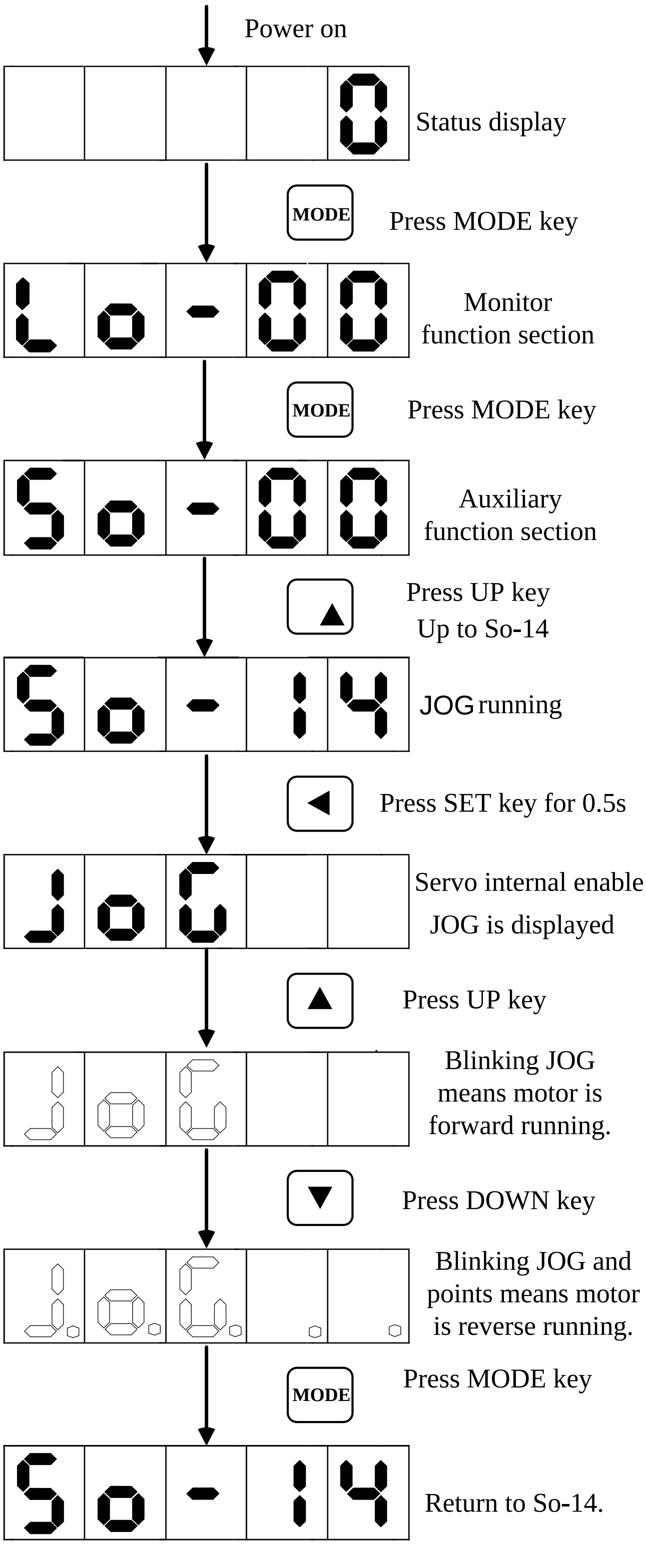


Fig 5.3.2 Jog run sketch map

5.3.3 Example of parameter setting

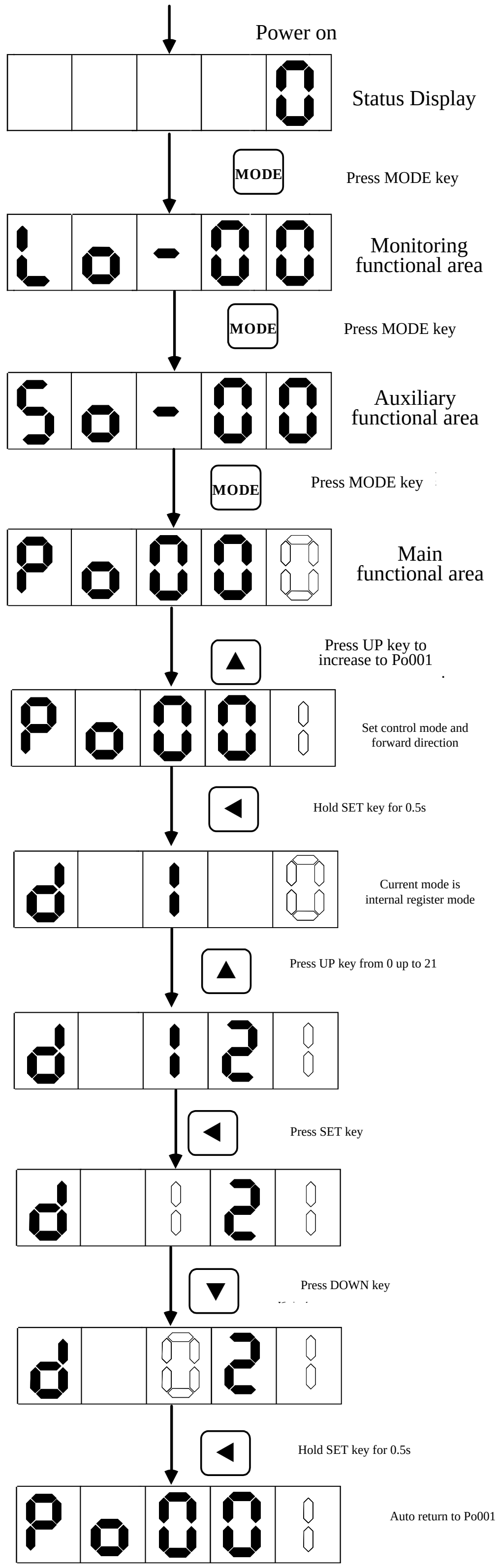


Fig 5.3.3 parameter setting sketch map

If the parameter digits are longer than 5 digits, the setting method is as below:
Take setting home searching shift pulses (Po123) to 100000000 as example:

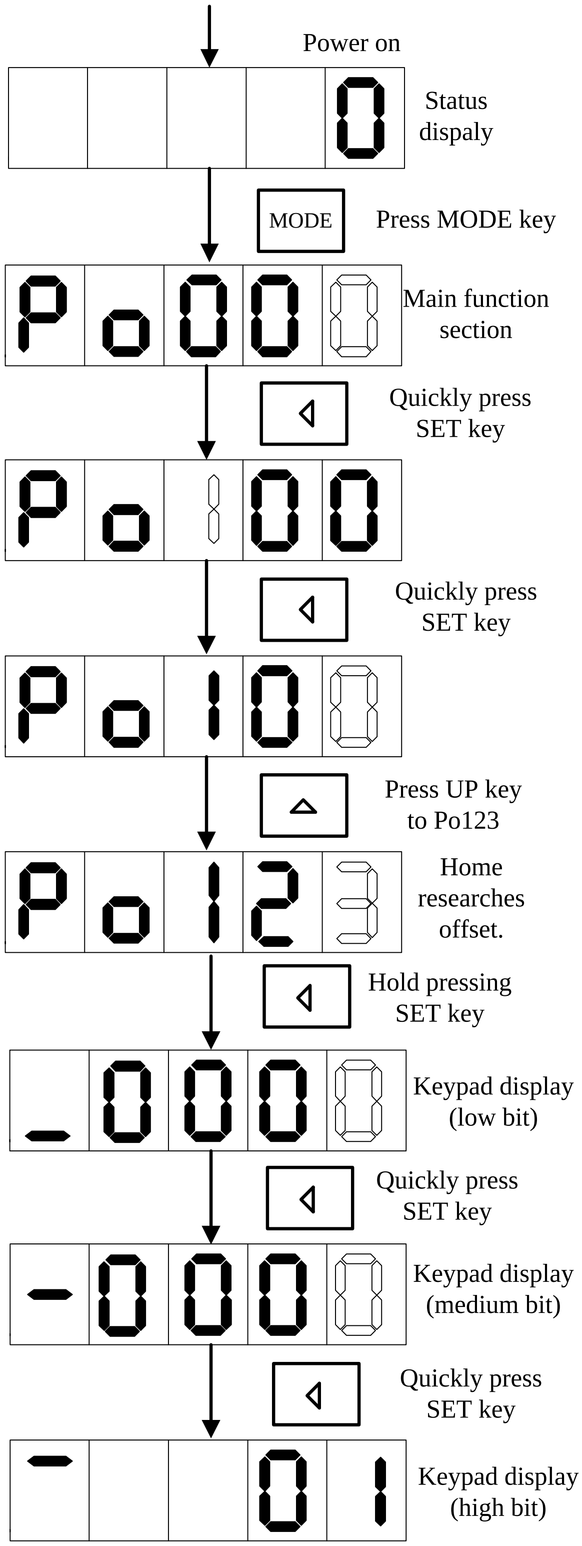


Fig 5.3.4 parameter setting sketch map

VI. Communication Function Introduction

FL20-C series servo drive supports EtherCAT and serial communication, EtherCAT supports CoE protocol, serial communication supports MODBUS protocol. The chapter mainly introduces the EtherCAT and MODBUS communication.

6.1 EtherCAT Communication

EtherCAT is a real-time Industrial Ethernet technology with the feature of high performance, low cost, flexible topology and easy operation, which can be used in industrial field high-speed I/O network. EtherCAT system consists of master station and slave station. EtherCAT uses standard Ethernet technology, and supports almost all topology type, which includes linear, tree, star etc. It uses standard Ethernet physical layer, transmission medium twisted-pair or optical fiber (100Base-TX or 100Base-FX).

Based on the field bus of Ethernet network, EtherCAT technology was launched by Germany BECKHOFF Automation Company in 2003. EtherCAT has features of high-speed and high data efficiency, supporting multiple devices to connect topological structure, which master requires standard Ethernet controller, and which slave requires special slave control chip.

The main features of EtherCAT as below:

- Wide applicability: any control unit with Ethernet controller for commercial use can be used as EtherCAT master;
- Meet Ethernet standard: according to the EtherCAT frame structure, EtherCAT data adopts for standard Ethernet frame (IEEE802.3), therefore, EtherCAT can coexist in same bus with other Ethernet device and protocol, the transmission rate can reach 2×100M bit/s;
- Flexible wiring: support varieties of topological structures such as linear, star and tree type;
- High efficiency: maximum using Ethernet bandwidth for data transmission.
- Excellent synchronization performance: realize lower than 1μs clock synchronization of each slave by accurate calibration of synchronous clock;
- To support more kinds of devices and wider application layer, EtherCAT establishes the application protocol: CoE (CANopen Over EtherCAT)

CoE (CANopen Over EtherCAT)

CANopen is originally the application layer based on the system of CAN (Control Area Network) bus. EtherCAT protocol supports profile CiA402 of CANopen protocol in application layer, called CoE. FL20-C series servo supports CoE protocol.

EtherCAT supports CANopen, meanwhile makes relevant expansion, the main features as below:

- Access CANopen object dictionary and its objects by mailbox communication to realize network initialization;
- Drive PDO message by CANopen emergency object and optional event to realize network management;
- Map process data by object dictionary, cyclic transmit command data and status data.

CoE object dictionary

CoE protocol fully comply with CANopen protocol, the definition of object dictionary is same.

Index number	Definition
0000h～0FFFh	Data type description
1000h～1FFFh	Communication object, including: Device type, identifier, PDO mapping, compatibility with CANopen; CANopen special data object EtherCAT extended data object
2000h～5FFFh	Manufacturer defined object
6000h～9FFFh	Profile defined data object
A000h～FFFFh	Reserved

CoE communication data object:

Index number	Definition
1000h	Device type, 32-bit integer Bit 0～15: used device profile Bit 16～31: Additional information based on profile
1001h	Error register, 8-bit Bit 0: general error Bit 1: current error Bit 2: voltage error Bit 3: temperature error Bit 4: communication error Bit 5: device profile defined erroe Bit 6: reserved Bit 7: manufacturer defined error
1008h	Device name

EtherCAT network connection diagram as below. There are 2 ports of IN and OUT, when using master to assign the station number automatically by default, slave number will assign by sequencing order.

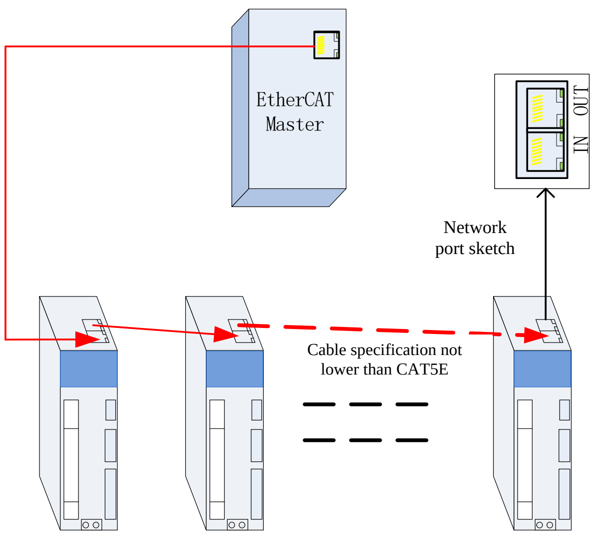


Fig 6.1.1 EtherCAT network connection sketch map

Station alias: It can be modified by changing the value of object 2008-3Ch if slave cannot match the master that does not assign station number automatically, or user wants to assign the station number of servo slave as required. After modifying successfully, read the value of configure station alia of ESC register (0012h), and set to configure station address (0010h).

2008h-3Ch	Name	Station alias			Set mode	—	Mode	ALL
	Unit	N/A	Setting range	0～65535	When enabled	Immediate	Mfr's value	0
	Parameter	So-59	accessibility	RW	Mapping	N	Data type	UINT16

In general, follow below flow chart to use EtherCAT communication function:

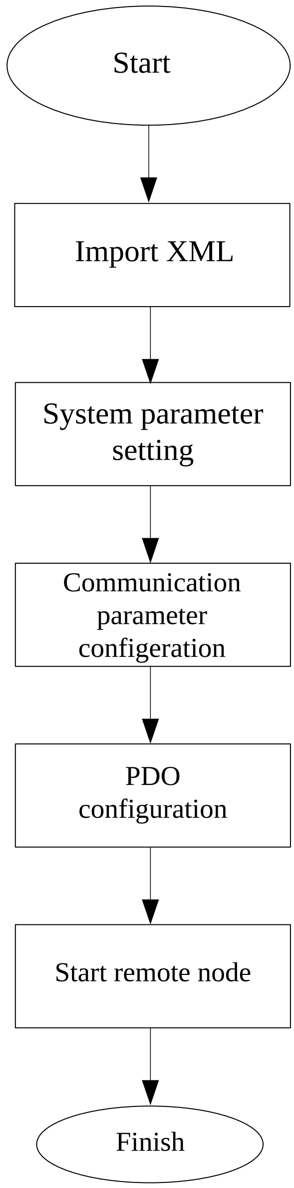


Fig 6.1.2 EtherCAT flow chart

6.1.1 System parameter setting

FL20-C series is a bus-type servo drive specially based on the development of EtherCAT bus. Po001=d 1 21 by default, which is bus control mode. User can use for bus control directly.

Object dictionary index	Sub-index	Name	Setting Range
2000h	02h	Control mode and forward/reverse direction setting	d □ □□ □□ X: Control Mode Setting 0: Internal register speed mode 1: Position pulse command mode 2: Internal register torque mode 3: Reserved 4: Reserved 5: Internal register position mode 6: Mixed mode of internal register speed and position pulse command 7: Mixed mode of internal register speed and torque 8: Reserved 9: Reserved 10: Mixed mode of internal register speed and position 11: Mixed mode of internal register torque and position pulse command 12: Reserved 13: Reserved 14: Mixed mode of position pulse command and internal register position 15: Reserved 16: Reserved 17: Mixed mode of internal register torque and position 18: Reserved 19: Reserved 20: Reserved 21: Bus mode Y: Servo motor forward direction setting 0: Clockwise rotation from motor shaft side 1: Counterclockwise rotation from motor shaft side
2005h	06h	Communication read/write running	d 0 0 X: Communication write-enable 0: Read/write enable 1: Read/write disable Y: If XML file saves to E2ROM 0: Yes 1: No

[Note]: To ensure that servo connects to the EtherCAT field bus network correctly, the parameter settings are need for servo drive.

Set 2005h-06h as the corresponding value before saving the parameters to EEPROM, otherwise, the parameter returns to default value after restart.

6.1.2 EtherCAT communication specification

Object		Specification
Communication protocol		Field bus standard: IEC 61158 Type 12, IEC 61800-7 CiA 402 Drive Profile
Application layer	SDO	SDO request, SDO reply
	PDO	Variable PDO mapping
	CIA402	Profile position mode (PP) Profile velocity mode (PV) Profile torque mode (PT) Homing mode (HM) Cyclic synchronous position mode (CSP) Cyclic synchronous velocity mode (CSV) Cyclic synchronous torque mode (CST)
Phsycial layer	Transport protocol	IEEE802.3（100BASE-TX）
	Max distance	50M
	Port	RJ45 * 2 (INT、OUT)

6.1.3 Communication Structure

Multiple protocols can be transmitted using EtherCAT. The IEC 61800-7 (CiA 402) drive profile is used for the servo drive.
The figure below shows the EtherCAT communication structure at CANopen application layer.

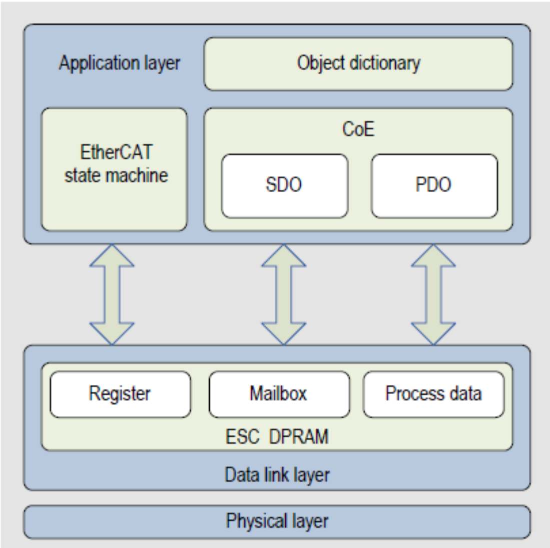


Fig 6.1.3 EtherCAT communication structure at CANopen application layer

In the structure diagram, the object dictionary in the application layer contains communication parameters, application data and PDO mapping data. The process data object (PDO) consists of the real-time data during the running process of servo drive, and cyclically reads and writes. Mailbox communications (SDO) uses non-cyclical message communications where all objects in the object dictionary can be read and written.

6.1.4 State Machine

State transition block diagram as below:

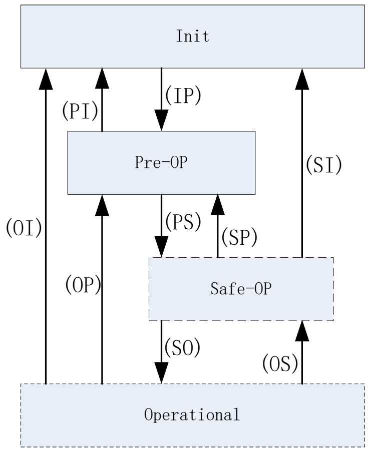


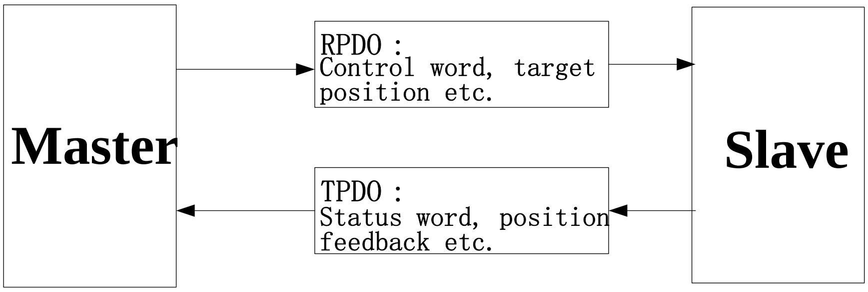
Fig 6.1.4 EtherCAT state machine

EtherCAT supports 4 states, and coordinates the state relationship between the master and slave.
Init: Initialization, short for I;
Pre-Operational: short for P;
Safe-Operational: short for S;
Operational: short for O.
The sequence of "Init→Pre-Operational→safe-Operational→Operational" must be followed step by step when transiting from Init state to Operational state. In transition from Operational state back to Init state, certain steps can be skipped. The table below shows the state transition and initialization process.

State &Transition	Operation
Init (I) Initialization	No communication in application, the master only read/write ESC register
IP: Init state transit to pre-op state	The master configures slave address register; Configure mailbox channel parameter if support mailbox communication. Configure DC related register, if support distributed clock. The master writes state control register to request "Pre-Op".
Pre-Op：Pre-Operational	Mailbox communications in application layer (SDO)
PS: Pre-Operational transit to safe-OP state	The master uses data mapping of the mailbox initialization process; The master configures the SM channel in process data communication. The master configures FMMU; The master writes state control register to request "Safe-Op".
Safe-OP:	Application layer supports mailbox communication; Process data communication is available, but allows only input and inhabits output (SDO, TPDO)
SO	The master sends valid output data; The master writes state control register to request "Op" state.
Operational	Both input and output are enabled; Mailbox communication can still be used. (SDO, TPDO, RPDO)

6.1.5 Process Data Object (PDO)

PDO data is transmitted in the producer-consumer model. PDO is divided into RPDO (receive=PDO) and TPDO (transmit-PDO). The slave receives commands from the master through RPDO and sends its status to the master through TPDO.



(1) PDO mapping parameters

PDO mapping is used to build the mapping relationship between object dictionary and PDO. 1600h~17FFh are RPDO, 1A00h~1BFFh are TPDO, there are 6 RPDO and 5 TPDO can be selected in the servo drive, see table as below:

6 RPDO	1600h	Variable mapping
	1701h～1705h	Fixed mapping
5 TPDO	1A00h	Variable mapping
	1B01h～1B04h	Fixed mapping

a） Fixed PDO mapping

FL20-C provides 5 fixed RPDO and 4 fixed TPDO. Some typical RPDO and TPDO instances are listed in the table below:

Control Mode	**PP CSP**
1701h	Mapping objects (3, 8 bytes)
	6040h (Control word) 607Ah (Target position) 60B8h (Touch probe function) 60FE (Digital output)
1B01h	Mapping objects (8, 24 bytes)
	603Fh (Error code) 6041h (Status word) 6064h (Error feedback) 6077h (Torque actual value) 60F4h (Positional deviation)） 60B9h (Touch probe status) 60Bah (Touch probe 1 rising edge position feedback) 60FDh (DI status)

<table>
<tr><th>Control Mode</th><th>PP PV PT CSP CSV CST</th></tr>
<tr><td rowspan="2">1702h</td><td>Mapping objects (7, 19 bytes)</td></tr>
<tr><td>6040h (Control word)
607Ah (Target position)
60FFh (Target velocity)
6071h (Target torque)
6060h (Mode selection)
60B8h (Touch probe function)
607Fh (Max velocity)</td></tr>
<tr><td rowspan="2">1B02h</td><td>Mapping objects (9, 25 bytes)</td></tr>
<tr><td>603Fh (Error code)
6041h (Status word)
6064h (Position feedback)
6077h (Torque actual value)
6061h (Mode display)
60B9h (Touch probe function)
60Bah (Touch probe 1 rising edge position feedback)
60BCh (Touch probe 2 rising edge position feedback)
60FDh (DI status)</td></tr>
</table>

<table>
<tr><th>Control Mode</th><th>PP PV CSP CSV</th></tr>
<tr><td rowspan="2">1703h</td><td>Mapping objects (7, 17 bytes)</td></tr>
<tr><td>6040h (Control word)
607Ah (Target position)
60FFh (Target velocity)
6060h (Mode selection)
60B8h (Touch probe function)
60E0h (Positive torque limit)
60E1h (Reverse torque limit)</td></tr>
<tr><td rowspan="2">1B03h</td><td>Mapping objects (10, 29 bytes)</td></tr>
<tr><td>603Fh (Error code)
6041h (Status word)
6064h (Position feedback)
6077h (Torque actual value)
60F4h (Position deviation)
6061h (Mode selection)
60B9h (Touch probe status)
60Bah (Touch probe 1 rising edge position feedback)
60BCh (Touch probe 2 rising edge position feedback)）
60FDh (DI status)</td></tr>
</table>

Control Mode	PP PV PT CSP CSV CST
1704h	Mapping objects (9, 23 bytes)
	6040h (Control word) 607Ah (Target position) 60FFh (Target velocity) 6071h (Target torque) 6060h (Mode selection) 60B8h (Touch probe function) 607Fh (Max velocity) 60E0h (Forward torque limit) 60E1h (Reverse torque limit)
1B02h	Mapping objects (9, 25 bytes)
	603Fh (Error code) 6041h (Status word) 6064h (Position feedback) 6077h (Torque actual value) 6061h (Mode display) 60B9h (Touch probe status) 60Bah (Touch probe 1 rising edge position feedback) 60BCh (Touch probe 2 rising edge position feedback) 60FDh (DI status)

Control Mode	PP PV CSP CSV
1705h	Mapping objects (8, 9 bytes)
	6040h (Control word) 607Ah (Target position) 60FFh (Target velocity) 6060h (Mode selection) 60B8h (Touch probe function) 60E0h (Forward torque limit) 60E1h (Reverse torque limit) 60B2h (Torque bias)
1B04h	Mapping objects (10, 29 bytes)
	603Fh (Error code) 6041h (Status word) 6064h (Position feedback) 6077h (Torque actual value) 6061h (Mode display) 60F4h (Position bias) 60B9h (Touch probe status) 60Bah (Touch probe 1 rising edge position feedback) 60BCh (Touch probe 2 rising edge position feedback) 606Ch (Velocity actual value)

b） Variable PDO mapping

The servo drive provides 1 variable RPDO and 1 variable TPDO.

Variable PDO	Index	Max Number of Mapping Objects	Max Byte Length	Default Mapping Object
RxPDO-Map	1600h	10	40	6040h (Control word) 607Ah (Target position) 6081h (Profile velocity) 6060h (Operation mode)
TxPDO-Map	1A00h	10	40	6041h (Status word) 6064h (Position feedback) 606Ch (Velocity actual value)

(2) Synchronous Management PDO assignment

Several PDO mapping objects are included during EtherCAT cyclic data communication. CoE protocol uses data object 1C10h~1C2Fh to define the PDO mapping object list of the sync manager. Multiple PDO can be mapped into different sub-index, EtherCAT bus-type servo drive supports 1 RPDO and 1 TPDO assigned for the sync manager, as below table:

Index	Sub-index	Content
1C12h	01h	One of 1600h and 1701h～1705h used as the actual RPDO
1C13h	01h	One of 1A00h and 1B01h～1B04h used as the actual TPDO

(3) PDO configuration

PDO mapping parameters include the indicators of process data for PDOs, including index, sub-index and mapping object length. The sub-index 0 indicates the number (N) of mapping objects in the PDO; the maximum length of each PDO is 4*N bytes; and one or multiple objects can be mapped. Sub-indexes 1 to N indicate the mapping content, as below table:

Bit	31	…	16	15	…	8	7	…	0
Meaning	Index			Sub-index			Object length		

The index and sub-index together defines the position of an object in the object dictionary. The object length indicates the bit length of the object, in hexadecimal, as below:

Object Length	Bit Length
08h	8-bit
10h	16-bit
20h	32-bit

Use the following procedure for PDO mapping:

1. If use TwinCAT to configure PDO, open Process Data, and rescan to take effort after addition or deletion.
2. If use CodeSys to configure PDO, open Process Data, and download the program again to power on after addition or deletion.

6.1.6 Mailbox Data SDO (service data object)

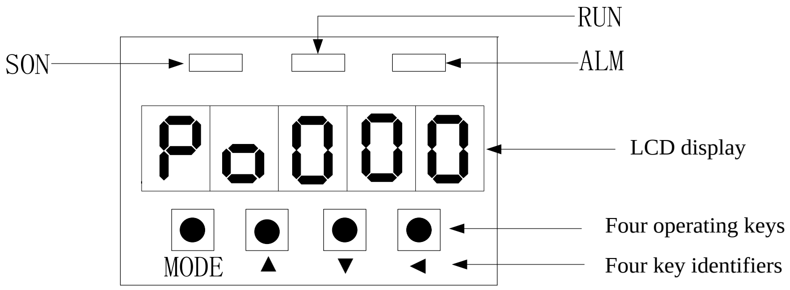
EtherCAT SDO is used to transfer non-cyclic data, such as communication parameter configuration, and servo drive running parameter configuration. The CoE service type includes: 1) emergency message, 2) SDO request, 3) SDO response, 4) TxPDO, 5) RxPDO, 6) remote TxPDO transmit request, 7) remote RxPDO transmit request, 8) SDO information.

At present, the servo drive supports 1) emergency message; 2) SDO request; 3) SDO response, 4) TxPDO; 5) RxPDO.

6.1.7 Distributed Clock (DC)

Distributed clock enables all EtherCAT devices to have the same system time and implement synchronization between devices. A slave produces the synchronization signal according to the synchronized system time. The servo drive supports the DC synchronization mode. The synchronization cycle is controlled by SYNC0.

6.1.8 Status indicator



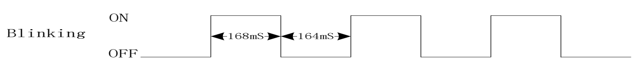
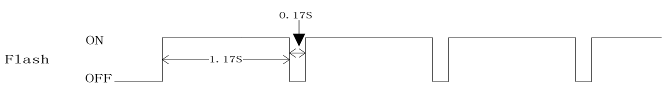
1） Communication connection status

The indicator of RJ45 reflects the connection status of RJ45:

LED indicator (green)		
Status	**Description**	**Explanation**
Off	Connection not detected	Physical layer not detect the communication connection
On	Connection succeed	Physical layer has set up the connection
Blink	Connection succeed	Servo connects with the master normally.

2） Communication running status

Both communication running status and servo enabled are displayed in the same interface; RUN indicator on servo board indicates the status of slave EtherCAT state machine.

LED indicator (green)		Explanation
Status	**Description**	
OFF	Keep off	Init. state
Blink	 RUN indicator lighten duty ratio is 50%, at interval of 336ms.	Pre-O state
Flash		Safe-O state
ON	Keep on	Operational

6.1.9Emergency Message

When alarm occurs, CoE will start an emergency message; send Error code (603Fh) and register (1001h) to the master as the emergency message form. The relation table of common failure and error code as below:

Table: Servo failure and error code relation table

Display	Failure Name	Error Code (603F)
AL-01	Over-current	2311h
AL-02	Over-voltage	3210h
AL-03	Under-voltage	3220h
AL-04	Hardware error	5210h
AL-05	Electrical angle identification error	FF05h
AL-06	Overload	3230h
AL-07	Over-speed	8400h
AL-08	Overload	2221h
AL-09	Oversize position-loop tracking error	8611h
AL-10	Encoder error	7305h
AL-11	Emergency stop	FF11h
AL-12	Overheat	4210h
AL-13	Main-circuit power supply phase-loss	3130h
AL-14	Energy-loss brake error	FF14h
AL-16	Repeat setting of input terminal	FF16h
AL-17	Encoder disconnection	FF17h
AL-18	Rotary inertia identification error	FF18h
AL-19	Encoder battery warning	FF19h
AL-20	Servo motor E^2ROM not initialization	FF20h
AL-23	Torque detuning protection	3331h
AL-24	Encoder battery alarm	FF24h
AL-25	Motor overheat protection	4210h
AL-26	Motor temperature detection disconnection protection	FF26h
AL-27	Over-travel protection	FF27h
AL-28	E^2ROM error	5530h
AL-29	Earth leakage protection	2240h
AL-30	Blocking protection	7121h
AL-31	Full-closed loop mixed error alarm	FF31h
AL-35	Back-to-zero overtime	FF35h
AL-36	Parameter copy error	FF36h
AL-37	Network initialization failure	FF37h
AL-38	OP abnormal protection	FF38h
AL-39	Sync. lost protection	FF39h
AL-40	Sync. setting error protection	FF40h

The servo drive will send emergency message to network when alarm occurs, the message format as below:

Byte	0	1	2	3	4	5
Content	Error code（603Fh）		Error register(1001h)	Reserved		

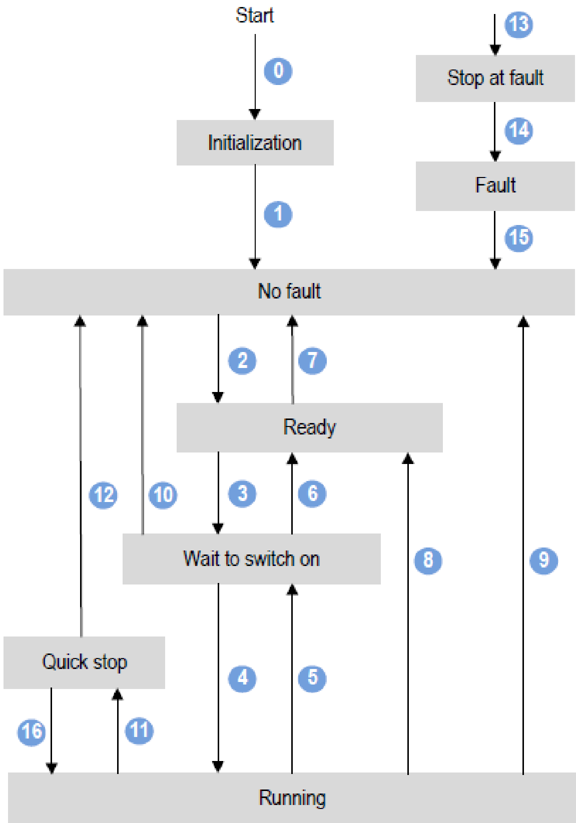
The master can also know the alarm by analyzing the emergency message, learn about the current failure matching with the codes in 60sFh, and display the alarm by low 4 bit value of 1001h. See details as below table:

Table: Error Register 1001h

1001h bit	**Content**	**Definition**	**Remarks**
Bit0	5210h FF05h 8400h 8611h 7305h FF11h FF14h FF16h FF17h FF18h FF19h FF20h 3331h FF24h FF26h FF27h 5530h 2240h 7121h FF31h FF35h FF36h	Common error	When there is data on the left of 603Fh, bit0=1 of 1001h.
Bit1	2311h 3230h 2221h	Current error	When there is data on the left of 603Fh, bit1=1 of 1001h.
Bit2	3130h 3210h 3220h	Voltage error	When there is data on the left of 603Fh, bit2=1 of 1001h.
Bit3	4210h	Temperature error	When there is data on the left of 603Fh, bit3=1 of 1001h.
Bit4	FF37h FF38h FF39h FF40h	Communication error	When there is data on the left of 603Fh, bit4=1 of 1001h.

6.1.10 CiA402 Overview

The FL20-C runs in the specified status only when it is instructed according to the flow chart defined in CiA402.



The states are described in the following table:

Initialization	Servo drive initialization and internal self-check has been done. Neither parameter setting nor drive function can be implemented.
Servo no fault	No fault in servo drive or the error has been eliminated. The parameter can be set.
Ready	The servo drive is ready. The parameter can be set.
Wait to switch on	The servo drive waits to switch on. The parameter can be set.
Servo running	The servo drive is running normally and one control mode is enabled; the motor is energized, and rotates when the command reference is not equal to 0.
Quick stop	The function is enabled, and the servo drive is executing quick stop function.
Stop at fault	Fault occurs; the servo drive is in the process of fault stop.
Fault	The stop process is completed, and all drive function are inhibited.

6.2 MODBUS Communication

6.2.1 Introduction of MODBUS communication

Servo drive provides RS485 communication. The following description shows the contents related to the communication protocol, hardware interface etc.

6.2.2 MODBUS Overview

Modbus is a serial and asynchronous communication protocol. Modbus protocol is a general language applied to PLC and other controllers. The protocol defines an information structure that can be identified and used by controller regardless of whatever network they are transmitted. Modbus protocol does not need the special interface; the typical physical interface is RS485.
User can read reference books or ask for the details of MODBUS from manufactures.

6.2.3 MODBUS Communication Protocol

I. Overall Introduction

1. Transmission Mode

(1) ASCII transmission mode

In ASCII mode, one Byte (hexadecimal format) is expressed by two ASCII characters.
For example, 31H (hexadecimal data) includes two ASCII characters'3(33H)','1(31H)'.
Common characters, ASCII characters are shown in the following table:

Characters	'0'	'1'	'2'	'3'	'4'	'5'	'6'	'7'
ASCII Code	30H	31H	32H	33H	34H	35H	36H	37H
Characters	'8'	'9'	'A'	'B'	'C'	'D'	'E'	'F'
ASCII Code	38H	39H	41H	42H	43H	44H	45H	46H

(2) RTU mode

In RTU mode, one Byte is expressed by hexadecimal format. For example, 31H is delivered to data packet directly.

2. Baud Rate

Setting range: 2400, 4800, 9600, 19200, 38400, 57600.

3. Frame Structure

(1) ASCII mode

Byte	Function
1	Start Bit (Low Level)
7	Data Bit
0/1	Parity Check Bit (None for this bit in case of no checking. Otherwise 1 bit)
1/2	Stop Bit (1 bit in case of checking, otherwise 2 bits)

(2) RTU mode

Byte	Function
1	Start Bit (Low Level)
8	Data Bit
0/1	Parity Check Bit (None for this bit in case of no checking. Otherwise 1 bit)
1/2	Stop Bit (1 bit in case of checking, otherwise 2 bits)

4. Error Check

(1) ASCII mode

Longitudinal Redundancy Check (LRC): It is performed on the ASCII message field contents excluding the 'colon' character that begins the message, and excluding the CRLF pair at the end of the message.
The LRC is calculated by adding together successive 8–bit bytes of the message, discarding any carries, and then two's complementing the result.

(2) RTU mode

CRC-16 (Cyclical Redundancy Check), please read reference books or ask for the details from manufactures.

II. Command Type& Format

1. Command types of common functional domain parameters as below:

Code	Name	Description
03	Read Holding Registers	Read the binary contents of holding registers in the slave. (Less than 10 registers once time)
06	Preset Single Register	Preset a value into holding register
16	Preset Multiple Register	Preset values into successive registers (1~120 registers) Note: In ASCII mode, register number must be less than 40. In RTU mode, register number must be less than 100.

2. Data packet mode:

(1) ASCII Mode

Start	Address	Function	Data				LRC check		End	
: (0X3A)	Servo drive Address	Function Code	Data length	Data 1	………	Data N	High-order byte of LRC	Low-order byte of LRC	Return (0X0D)	Line Feed (0X0A)

(2) RTU Mode

Start	Address	Function	Data	CRC check		End
T1-T2-T3-T4	Servo drive Address	Function Code	N data	Low-order byte of CRC	High-order byte of CRC	T1-T2-T3-T4

(3) Protocol Converter

It is easy to turn a RTU command into an ASCII command followed by the lists:

1) Use the LRC to replace the CRC.
2) Transform each byte in RTU command into a corresponding two byte ASCII. For example: transform 0x03 into 0x30, 0x33 (ASCII code for 0 and ASCII code for 3).
3) Add a 'colon' (:) character (ASCII 3A hex) at the beginning of the message.
4) End with a 'carriage return – line feed' (CRLF) pair (ASCII 0D and 0A hex).

3. Parameter address rules

The address of P group parameters is the parameter numbers.

Ex1：Communication address of Po101:

The parameter numbers of Po101 is 101, the hex format is 0065. The address of high bit is 00 and the address of low bit is 65.

Ex2：Communication address of Po407:

The parameter numbers of Po407 is 407, the hex format is 0197. The address of high bit is 01 and the address of low bit is 97.

The address of S group parameters equals to parameter numbers +800

Ex3：Communication address of So-02:

The parameter numbers of So-02 is 02, so the address of So-02 is 802 after adding 800; the hex format is 0322. The address of high bit is 03 and the address of low bit is 22.

The address of PL group parameters equals to parameter numbers +1000

Ex4：Communication address of PL101

The parameter numbers of PL101 is 101, so the address of PL101 is 1101 after adding 1000; the hex format is 044D. The high bit address is 04, the low bit address is 4D.

Part of L group data is 32-bit data, so the address is special, please refer to following table:

Address	Meaning		Address	Meaning
900	Servo drive output current low 16 bits		918	Reserved
901	Servo drive output current high16 bits		919	Reserved
902	Servo drive bus voltage low 16 bits		920	Reserved
903	Servo drive bus voltage high 16 bits		921	Reserved
904	Servo motor rotation speed low 16 bits		922	Reserved
905	Servo motor rotation speed high16 bits		923	Bit mode, low 8 bits stands for DI8~DI1 status.(Note)
906	Servo motor feedback pulse numbers low 16 bits		924	Reserved
907	Servo motor feedback pulse numbers high 16 bits.		925	Bit mode, low 8 bits stands for DO8~DO1 status.(Note)
908	Servo motor feedback rotation low 16 bits		926	Bit mode, alarm code (Note)
909	Servo motor feedback rotation high 16 bits		927	Reserved
910	Given pulse numbers low 16 bits		928	Reserved
911	Given pulse numbers high 16 bits		936	Servo motor absolution position pulse numbers high16 bits
912	Pulse counting deviation low16 bits		937	Servo motor absolution position pulse numbers low16 bits

913	Pulse counting deviation high 16 bits		938	Servo motor absolution position rotation high16 bits
914	Given speed low 16 bits		939	Servo motor absolution position rotation low 16 bits
915	Given speed high16 bits		952	Actual absolute position （bit0-bit15）
916	Given torque low 16 bits		953	Actual absolute position （bit16-bit31）
917	Given torque high 16 bits		954	Actual absolute position （bit32-bit47）
955	Actual absolute position (bit48-bit63)		957	Actual absolute position (divided by electric gear ratio) (bit6-bit31）
956	Actual absolute position (divided by electric gear ratio) (bit0-bit5)		958	Actual absolute position (divided by electric gear ratio) (bit32-bit47）
959	Actual absolute position (divided by electric gear ratio) (bit48-bit63)			

Note: please refer to 4 Reading and writing rules of parameters about bit mode.

When the master reads 900 group functions via EtherCAT, 900-group dynamically configures three as the parameter monitoring to use, the main index is 2009h, see details in below table:

Table: The definition of sub-index under the main index 2009h

Sub-index	Function
01h	First display address
02h	Second display address
03h	Third display address
04h	Corresponding value of first display address
05h	Corresponding value of second display address
06h	Corresponding value of third display address

For example: Set 01h as 902, then 04h is displayed as bus voltage value.

4. Parameter read-write rules

Except two-parameter and four-parameter, the other parameters can be read directly, the data is 16-bit integer (it is complement form).

Concerning for two-parameter and four-parameter, the written and read value is hexadecimal format (The marking bits of d and b do not occupy communication bit). Under line “_” means that the bit is not displayed.

Ex5：Two-parameter mode is d_1_10, so the hex format is 0x10A, so the read result is 266.

Ex6：Four-parameter mode is b1234, so 1234 is written, and b1234 is displayed after the order succeeds. The special instructions for 32-bit data are as the following.

Ex7: Read servo motor feedback pulse numbers. Separately read high 16-bit and low 16-bit parameters value, shift high 16-bit data 16 bits to the left, and execute OR with low 16-bit, and confirm positive and negative according to the highest bit 0 or 1. If the highest bit is 0, the data is actual servo motor feedback pulse numbers and the data is positive number. If the highest bit is 1, to negate every bit and to add 1 to them, which equals to servo motor feedback pulse numbers and it is a negative number. If high 16 bit is 65534 and low bit is 31073, the binary form of which is 1111111111111110 and 111100101100001, after shifting high 16-bit data to the left, the data becomes 1111111111111110011110010110000 1. The highest data is 1, so the data is negative. Negate the data, the data becomes 11000011010011110, and add 1 to the data, the data becomes 11000011010011111, the decimal form is 99999. Because it is a negative number, so it is -99999.

Bit mode meaning in monitor group:

The parameter meaning in address 923:

MSB	←														LSB
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
—	—	—	—	—	—	—	—	DI8	DI7	DI6	DI5	DI4	DI3	DI2	DI1

The parameter meaning in address 925:

MSB							←								LSB
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
—	—	—	—	—	—	—	—	—	—	—	ALM	DO4	DO3	DO2	DO1

The parameter meaning in address 940:

MSB	←						
16	15	14	13	12	11	10	9
AL-16	AL-15	AL-14	AL-13	AL-12	AL-11	AL-10	AL-09

The parameter meaning in address 940 (continued):

←							LSB
8	7	6	5	4	3	2	1
AL-08	AL-07	AL-06	AL-05	AL-04	AL-03	AL-02	AL-01

Note: "—" means "reserved", which is used to add new function.

5. Communication example:

(1) In RTU mode, change acceleration time (Po109) to 5ms in No. 01 servo drive.

Host query:

Address	Parameter	Register Address Hi	Register Address Lo	Write status Hi	Write status Lo	CRC Lo	CRC Hi
01	06	00	6D	00	05	D8	14

Servo1 write register Po109 5(Unit: ms) CRC check

Slave response:

Address	Parameter	Register Address Hi	Register Address Lo	Write status Hi	Write status Lo	CRC Lo	CRC Hi
01	06	00	6D	00	05	D8	14

Servo 1 write register Po109 5(Unit: ms) CRC check

(2) In RTU mode, read acceleration time (Po109) of No. 01 servo drive.

Host query:

Address	Parameter	First register Hi	First register Lo	Numbers of register Hi	Numbers of register Lo	CRC Lo	CRC Hi
01	03	00	6D	00	01	15	D7

Servo1 read register Po109 one register CRC check

Slave response:

Address	Parameter	Data numbers	Data Hi	Data Lo	CRC Lo	CRC Hi
01	03	02	00	C8	B9	D2

Servo 1 write register 2 bits 200(Unit: ms) CRC check

6.2.4 Parameters related to Communication

(1) Below parameters need to set when communicating with servo drive by MODBUS:

2005h-01h	Communication address	PP PV PT CSP CSV CST HM		
	Setting range	Setting unit	Mfr's value	When enabled
	1～254	—	1	Immediate
	Corresponding parameter	Mapping	Data type	Accessibility
	Po500	N	UINT16	RW
2005h-02h	Communication mode	PP PV PT CSP CSV CST HM		
	Setting range	Setting unit	Mfr's value	When enabled
	0～1	—	0	Immediate
	Corresponding parameter	Mapping	Data type	Accessibility
	Po501	N	UINT16	RW
2005h-03h	Stop bit settings	PP PV PT CSP CSV CST HM		
	Setting range	Setting unit	Mfr's value	When enabled
	0～1	—	0	Immediate
	Corresponding parameter	Mapping	Data type	Accessibility
	Po502	N	UINT16	RW

2005h-04h	Odd/even calibration PP PV PT CSP CSV CST HM			
	Setting range	Setting unit	Mfr's value	When enabled
	0～2	—	0	Immediate
	Corresponding parameter	Mapping	Data type	Accessibility
	Po503	N	UINT16	RW
2005h-05h	Baud rate PP PV PT CSP CSV CST HM			
	Setting range	Setting unit	Mfr's value	When enabled
	0～5	bit/s	2	Immediate
	Corresponding parameter	Mapping	Data type	Accessibility
	Po504	N	UINT16	RW
2005h-06h	Communication read/write allowed PP PV PT CSP CSV CST HM			
	Setting range	Setting unit	Mfr's value	When enabled
	—	—	d 1 1	Immediate
	Corresponding parameter	Mapping	Data type	Accessibility
	Po505	N	UINT16	RW

⚠**Note**: When remote control by PLC or other intelligent device, parameters in above table must be set correctly to make sure the accordance for parameters of both ends.
The command from PC/PLC will be written into data memory of servo drive immediately; it is not recommended to write the data into the memory continuously.

(2) Structure of field bus

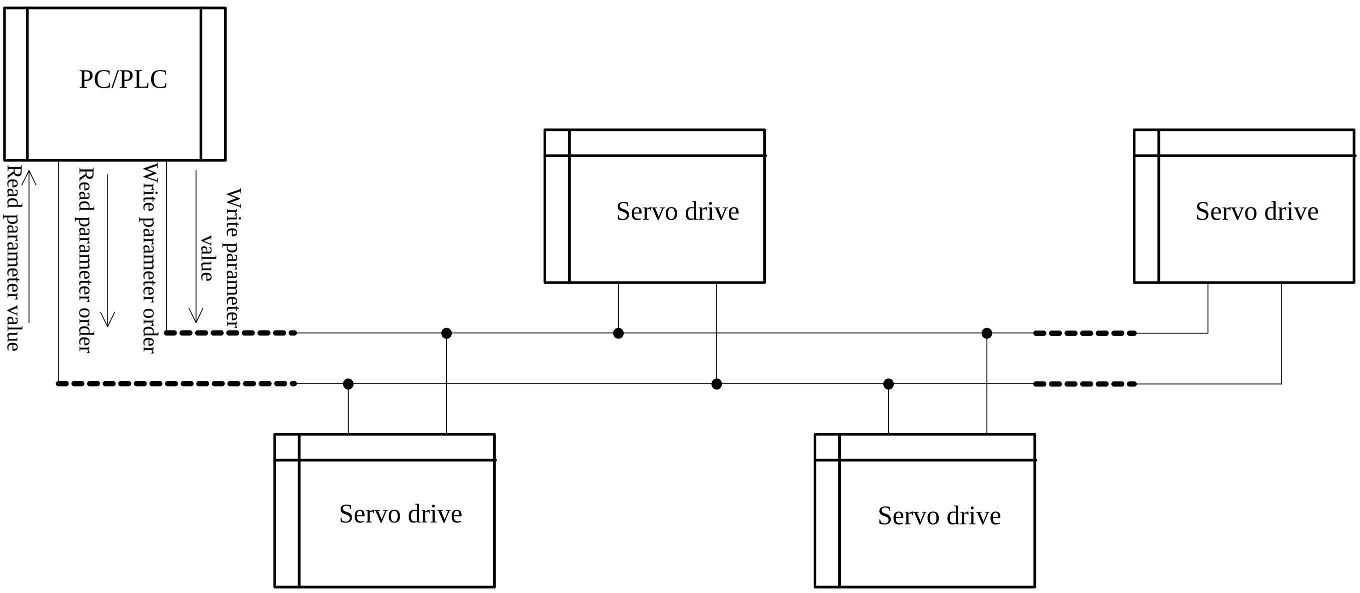
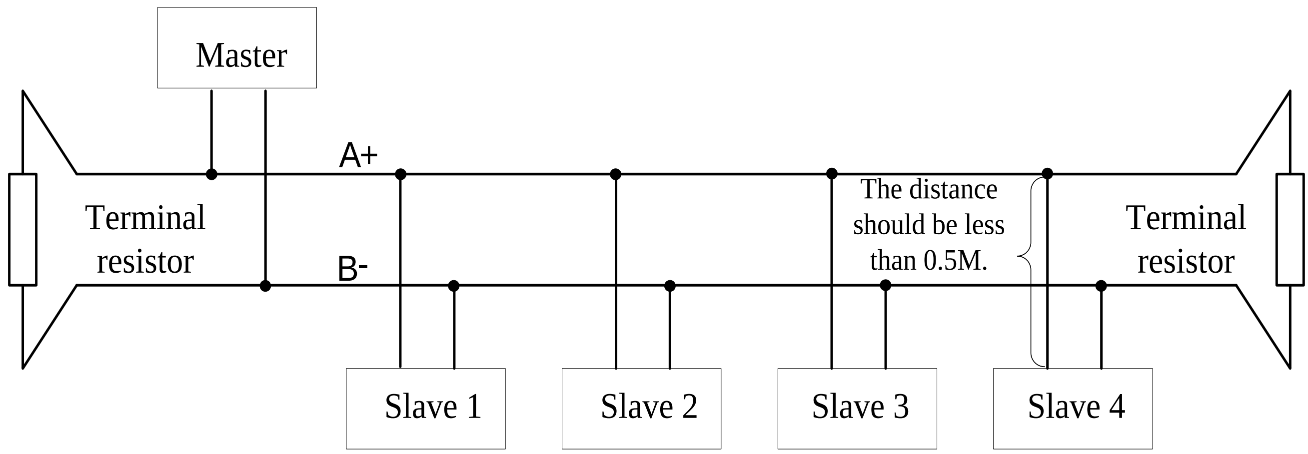


Fig 6.4.1 Field bus connection

RS485 Half-duplex communication mode is adopted for servo drive. Daisy chain structure is

adopted by 485 Bus-line. Do not use 'spur' lines or a star configuration. Reflect signals which are produced by spur lines or star configuration will interfere in 485 communications.
Shield twisted pair cable must be chosen for wiring. As far as away from strong current, do not parallel with power cable or tie up together.
Please note that for the same time in half-duplex connection, and only one inverter can have communication with PC/PLC. Should two or more than two inverters upload data at the same time, then bus competition will occur, which will not only lead to communication failure, but higher current to make certain elements damage.

(3) Grounding and terminals
Terminal resistance of 120Ω will be adopted for terminal of RS485 network, to diminish the reflection of signals. Terminal resistance shall not be used for intermediate network.
No direct grounding shall be allowed for any point of RS485 network. All the equipment in the network shall be well grounded via their own grounding terminal. Please note that grounding wires will not form closed loop in any case.



Please think over the drive capacity of PC/PLC and the distance between PC/PLC and inverter when wiring. Add a repeaters if drive capacity is not enough.

⚠ **Note**: All installations and wirings must be conducted only when servo drive is power off.

6.3 Introduction of common bus control mode

FL20-C series supports 7 servo modes, as defined in the object dictionary 6502h.

Index 6502h	**Name**	Supported servo modes		**Setting mode**	Display	**Data structure**	VAR
	Access	RO	**Mapping**	N		**Data type**	UDINT32
	Mode	ALL	**Data range**	—		**Default**	941

It indicates the supported the running modes of servo drive:

bit	Description	0: Not supported 1: Supported
0	Profile position mode (PP)	1
1	Variable velocity mode (VL)	0
2	Profile velocity (PV)	1
3	Profile torque (PT)	1
4	Reserved	Reserved
5	Homing mode (HM)	1
6	Interpolated position mode (IP)	0
7	Cyclic synchronous position mode (CSP)	1
8	Cyclic synchronous velocity mode (CSV)	1
9	Cyclic synchronous torque mode (CST)	1
10～31	Reserved	Reserved

【Note】if device supports 6502hm, the supported modes can be known in this object.

The operation mode of the servo drive is set in 6060h. The operation mode of the servo drive can be checked in 6061h.

Mode selection 6060h:

Index 6060h	**Name**	Operation mode		**Setting mode**	—	**Data structure**	VAR
	Access	RW	**Mapping**	RPDO		**Data type**	UINT16
	Mode	ALL	**Data range**	0～10		**Default**	0

It used to select the operation mode of servo drive:

Value	**Servo mode**	
0	Reserved	Reserved
1	Profile position mode (PP)	Refer to PP mode
2	Reserved	Reserved
3	Profile velocity mode (PV)	Refer to PV mode
4	Profile torque mode (PT)	Refer to PT mode
5	Reserved	Reserved
6	Homing mode (HM)	Refer to HM mode
7	Interpolated position mode (IP)	Not supported
8	Cyclic synchronous position mode (CSP)	Refer to CSP mode
9	Cyclic synchronous velocity mode (CSV)	Refer to CSV mode
10	Cyclic synchronous torque mode (CST)	Refer to CST mode

Mode display 6061h:

Index 6061h	**Name**	Operation mode of servo		**Setting mode**	—	**Data structure**	VAR
	Access	RO	**Mapping**	TPDO		**Data type**	UINT16
	Mode	ALL	**Data range**	—		**Default**	—

It displays the current operation mode of the servo drive.

bit	Operation Mode	
0	Reserved	Reserved
1	Profile position mode (PP)	Refer to PP mode
2	Reserved	Reserved
3	Profile velocity mode (PV)	Refer to PV mode
4	Profile torque mode (PT)	Refer to PT mode
5	Reserved	Reserved
6	Homing mode (HM)	Refer to HM mode
7	Interpolated position mode (IP)	Not supported
8	Cyclic synchronous position mode (CSP)	Refer to CSP mode
9	Cyclic synchronous velocity mode (CSV)	Refer to CSV mode
10	Cyclic synchronous torque mode (CST)	Refer to CST mode

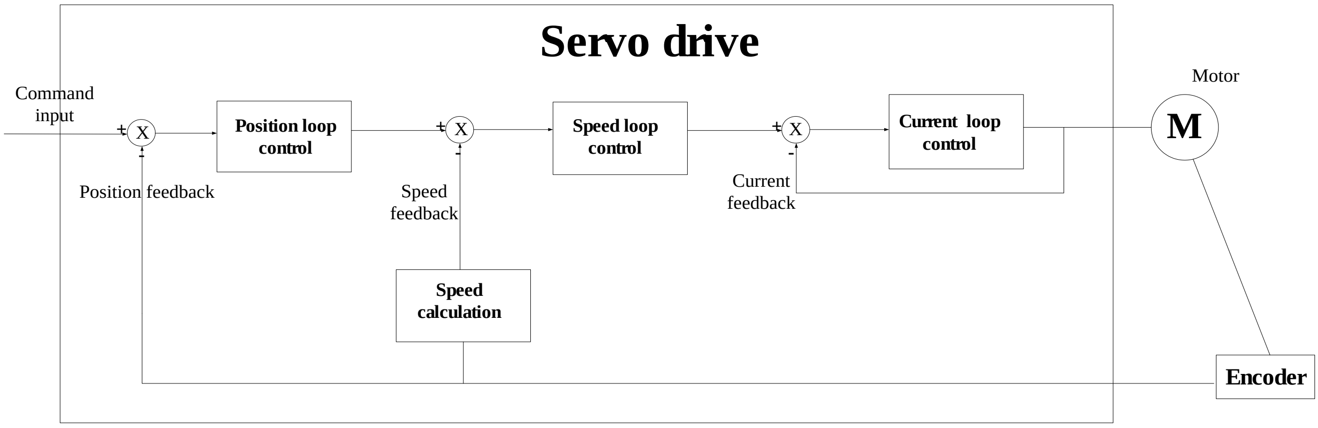
6.3.1 Mode Switchover

Observe the following precautions during mode switchover.

1. When the servo drive in any state switches over from the PP or CSP mode to another mode, the position references not executed will be abandoned.
2. When the servo drive in any state switches over from the PV, PT, CSV or CST mode to another mode, it stops at ramp before entering into that mode.
3. The servo drive cannot switch over to another mode when it is in the HM mode in running state. After homing is completed or interrupted (fault or power-off), the servo drive can then enter into another mode.
4. When the servo drive in running state switches over from a mode to the cyclic synchronous mode, send the references at an interval of at least 1 ms; otherwise, reference loss or error may occur.

VII. Control mode

Servo system includes servo drive, servo motor and encoder.

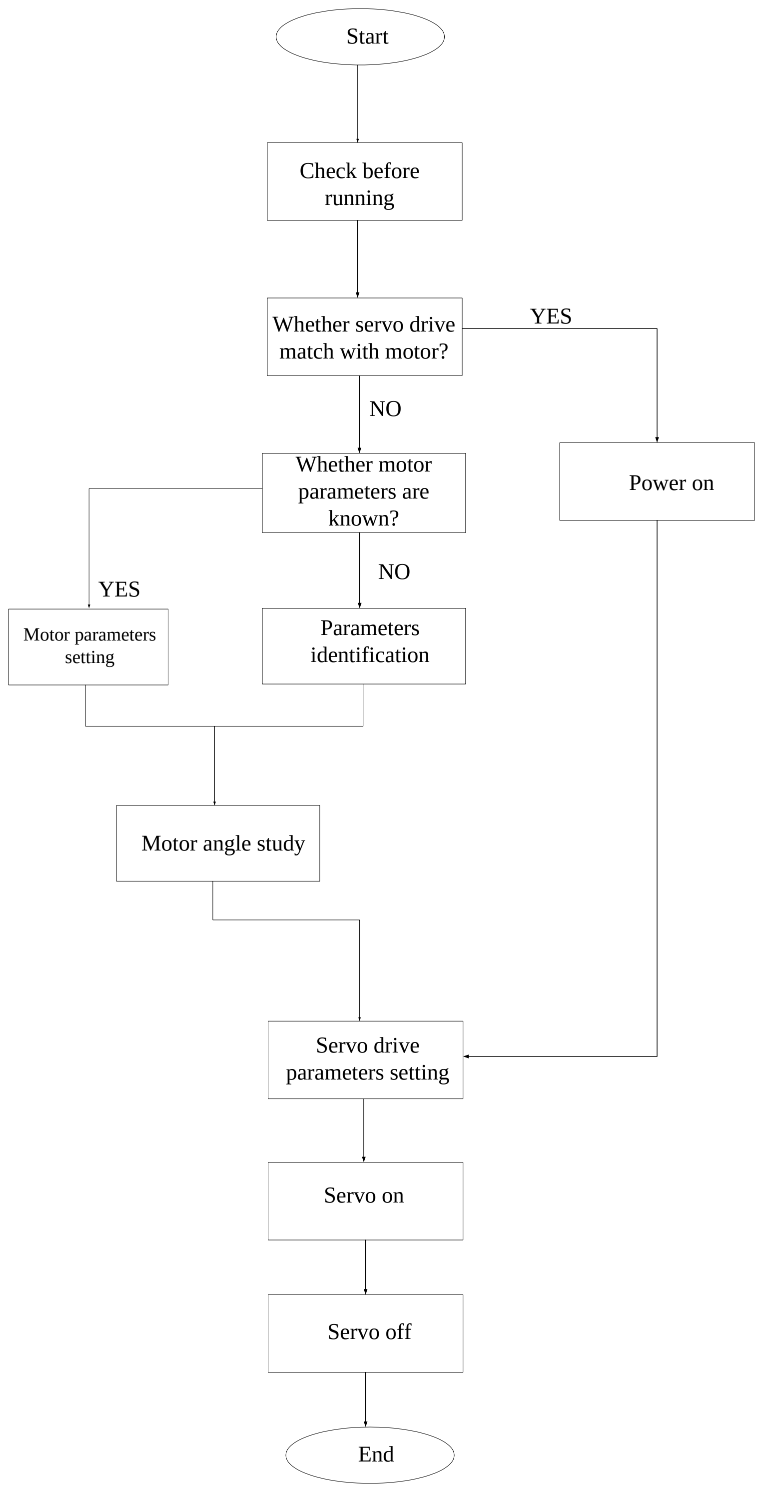


Based on the command modes and running characteristics, servo drives supports three running mode, position control, speed control and torque control.

In the position control mode, motor target position is confirmed by position command total numbers. The position control mode strictly controls the position and speed, and is often used in the positioning device. It is the most commonly used mode of the servo drive, applicable to the mechanical arm, mounter, engraving and milling machine, and computer numerical control (CNC) machine tool.

In the speed control mode, the speed is controlled by DI setting, or communication setting. It is often used in scenarios with constant speed. The host controller uses the position mode, and the servo drive uses the speed control mode.

In the torque control mode, the torque is changed by changing the address value by means of communication. This mode is mainly applied to the winding and unwinding devices with strict tension requirements.



Note:

Please make servo motor run without load, then connect load to motor.

After a servo motor is changed, if user does not know encoder electric angle and whether motor phase sequence is correct, user can make the servo motor operate normally by using electric angle indication function. Before electric angle indication, please make sure the following steps:
(1) Motor actual power.
(2) Ensure that the servomotor encoder cable is connected properly.
(3) Ensure that the servomotor is connected to zero.
(4) Ensure that the servo is in the OFF status.

When 2008h-1 Ah=3, please input motor actual power to servo drive, then identify parameters.

2006h-0Ch	Motor rated power PP PV PT CSP CSV CST PP HM			
	Setting range	Setting unit	Mfr's value	When enabled
	1～30000	0.01KW	—	Effective Immediately
	Function code	Mapping	Data type	Assessibilty
	Ho011	N	UINT16	RW

2008h-1Ah	Motor parameter identification setting PP PV PT CSP CSV CST PP HM			
	Setting range	Setting unit	Mfr's value	When enabled
	0～4	N/A	0	Effective Immediately
	Function code	Mapping	Data type	Assessibilty
	So-25	N	UINT16	RW
	0: no motor parameter indentification 1: indentify motor resistor, inductance, pole pairs numbers and encoder installation angle 2: lock motor shaft 3:indentify motor resistor, inductance and estimate motor EMF 4: indentify motor resistor, inductance, pole pairs numbers, motor EMF and encoder installation angle			

When 2008h-1Ah is set to 1, enter So-14 jogging control mode. System starts automatic testing , panel displays flashing "TEST". After indentification is finished, panel will return to So-14 interface, and electrical angle is saved in 2006h-13h. If line sequence error occurs, panel displays AL-05, please stop the motor and adjust the line sequence before next operation.

⚠: When line sequence error occurs, reverse two phases, and then repeat the electrical angle identification.

7.1 Before running

7.1.1 Wiring checking

Make sure that all wiring has been completed.

Wiring		
1	Connect L1C and L2C of servo drive to main circuit power.	L1C and L2C are forridden connected for 380V servo drive.
2	Connect U/V/W of servo drive to U/V/W of servo motor well.	
3	Check all control signal cables are connected correctly, and check the brake, overtravel and the other protrective functions for correct operation.	
4	Servo drive and servo motor must be grounded reliably.	
5	When external resistor is used, please remove short wires between B2 and B3.	
Environment and machinery		
1	There is no iron dust or foreign matter in the servo drive.	
2	There is no inflammable substance nearby servo drive and external braking resistor.	
3	Servo motor is reliably connected to mechanical equipment.	

7.1.2 Power on

1) Power on control circuit and main circuit.

Power on control circuit (L1C, L2C) and main circuit:

For 1-phase 220V servo drive, please connect power to L1 and L3.

For 3-phase 220V servo drive, please connect power to L1/L2/L3. For 3-phase 380V servo drive, please connect power to R/S/T.

- Power on control circuit and main circuit, if bus voltage indicator shows no abnormal, and “0” is displayed in the keypad, it indicates servo drive is enabled.
- If “AL-xx” is displayed in the keypad, please refer to Chapter 10.

2) Set S-ON to OFF status.

Please refer to chapter 6.1.10 CiA 402 protocal introduction.

7.1.3 Parameters setting

1) Motor parameters

The parameters of the motor include: rated voltage, rated current, encoder lines, rated rotary speed, numbers of pole pairs, phase resistance, inductance, Movement of inertia, back EMF, line voltage, etc. Please confirm that the parameter's setting value is identical to the motor's parameter to ensure motor normal operation, in case of burning servo system out. When 2008h-31h= 1, motor's parameters can be changed .The parameter functions are as follow:

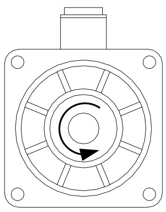
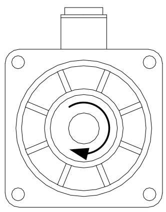
	Motor parameter setting（index 2006h）PP PV PT CSP CSV CST PP HM				
	Sub-index	Parameters (unit)	Setting range	Function	When enabled
Motor parameters	01h	Rated voltage (V)	1～30000	rated voltage	Display
	02h	Rated current (0.1A)	1～30000	rated current	Immediate
	03h	Max rotary speed (rpm)	0～32000	Max rotary speed	Immediate
	04h	Rated rotary speed (rpm)	0～32000	rated rotary speed	Immediate
	05h	Pole-pairs (pair)	1～30	pole-pairs	Immediate
	06h	Phase resistance ($10^{-3}\Omega$)	0～65535	phase resistance	Immediate
	07h	Q-axis inductance（10^{-6}H）	0～65535	D-axis inductance	Immediate
	08h	Q-axis inductance（10^{-6}H）	0～65535	Q-axis inductance	Immediate
	09h	Back EMF line voltage effective value (0.1V/1000 rpm)	0～30000	back EMF line voltage effective value	Immediate
	0Dh	Motor movement of inertia (10^{-6}Kg•m2)	0～（2^{31}-1）	motor rotary inertia	Immediate
	11h	Encoder line number	0～（2^{31}-1）	Motor encoder line number	Immediate
	13h	Encoder installation angle(pulse numbers)	-(2^{31}-1)~ +(2^{31}-1)	Encoder installation angle(pulse numbers)	Immediate
	48h	Overload sensitivity setting	1～30000	over-load sensitivity	Immediate

Motor parameters can be set according to the table, in addition, pay attention to the following points in use:

(1)When 2008h-31h=1,the H group parameters can be set. After electrical degree identification is finished, the installation angle of the encoder is saved in 2006h-13h. Please refer to chapter 6 for operating method of electrical degree identification.
(2) Different motor parameter corresponds to different servo motor, make sure the parameters are in accordance with the motor's before using.
(3) Change the value of 2006h-48h according to heat radiation of the motor. It can adjust the motor overload protection time early or delayed. The higher the parameter value is, the longer overload protection time is.
(4) Do not modify motor parameters set by the manufacturer .If the system is damaged because user sets the wrong motor parameters or use non-standard motor, user should be response for the consequence.

2） Switching the Servo motor Rotation Direction

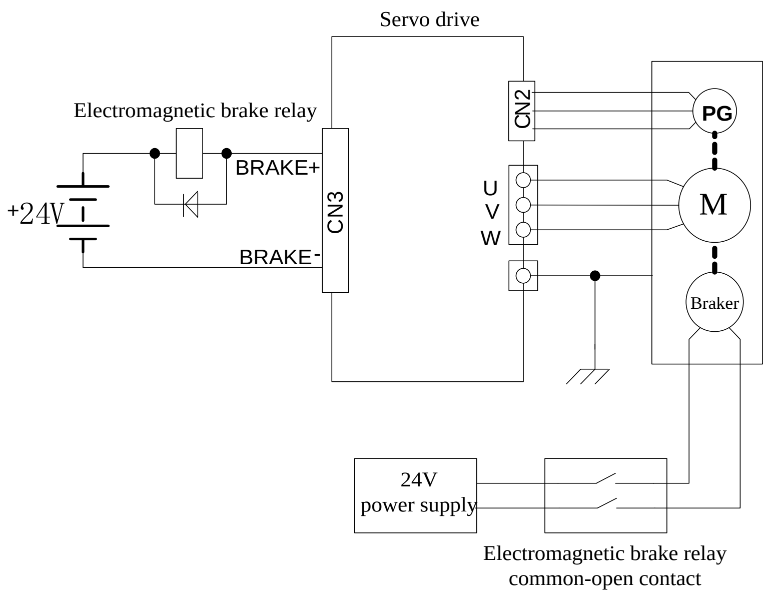
The default setting for "forward rotation" is counterclockwise as viewed from the servo motor shaft. The mfr's value of 2000h-02h.Y is 1. When 2000h-02h.Y is set to 0, the forward rotation is clockwise as viewed from the servo motor shaft.

2000h-02h.Y =1， forward rotation is counterclockwise.	2000h-02h.Y =0, forward rotation is clockwise.
	

3）Holding brake setting

The holding brake is used when the servo motr controls a vertical shaft. The servo motor with brake prevents the movable part from shifting due to gravity when the power supply fails. The holding brake function is only suitable for servo motor with brake.

a) Wiring of holding brake



Note:

1． The internal electromagnetic is only valid when servo is in the stop status.

2． The coil of electromagnetic has polarity, please distinguish them when wiring.

3．The power supply of electromagnetic is supplied by users. The voltage is 24VDC (±10%) and the current should be selected according to nameplate of brake. And electromagnetic and control signal are forbidden using one power supply.

b) Braking parameters setting

Signal name	Code	Terminals	Remarks
Electromagnetic braking control	BRAKE	BRAKE+ BRAKE -	Electromagnetic braking control output.

Braking working sequence is different with servo drive status, which includes servo normal status and servo off status.

1) When servo works in normal status.

Servo normal status includes servo motor in static status and servo motor in running status.

Static status: motor actual rotary speed is lower than 20rpm.

Running status: motor actual rotary speed is higher than 20rpm.

a) Braking when servo motor stops

2008h-03h	Delay time for servo OFF PP PV PT CSP CSV CST HM			
	Setting range	Setting unit	Mfr's value	When enabled
	0～500	10ms	0	Effective Immediately
	Function code	Mapping	Data type	Accessibility

	So-02	N	UINT16	RW

2008h-11h	Speed threshold of electromagnetic braking PP PV PT CSP CSV CST HM			
	Setting range	Setting unit	Mfr's value	When enabled
	0～30000	0.1rpm	1000	Effective Immediately
	Function code	Mapping	Data type	Accessibility
	So-16	N	UINT16	RW

Note: the value of 2008h-11h should not be set too high, please use the Mfr's value.

When servo motor stops or the motor speed is lower than So-16, if enable signal is OFF and electromagnetic braking signal is invalid, after the time set by 2008h-03h, servo will be in the disable status.

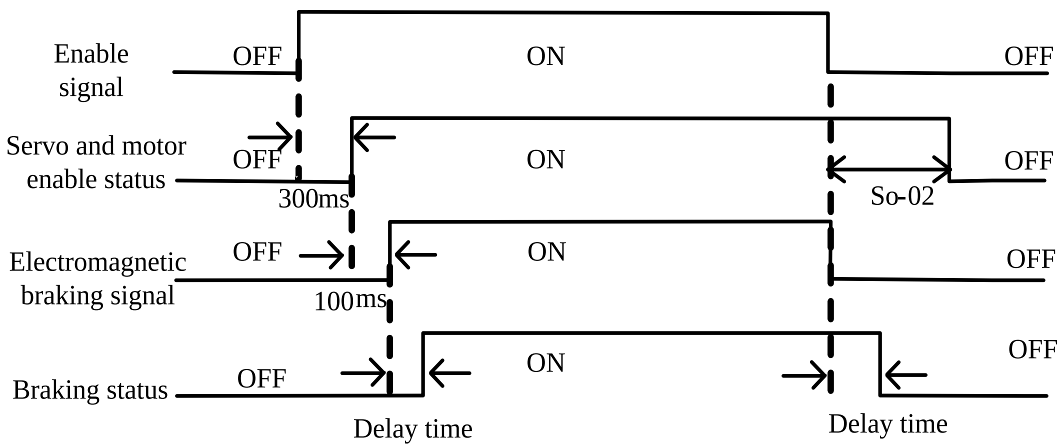


Fig 7-1-3 Electromagnetic brake sequence diagram

Note: if some alarms occur, servo will turn to disable status, 2008h-03h will be invalid.

b) Braking when servo motor is rotating

2008h-04h	Delay time for electro- magnetic braking OFF PP PV PT CSP CSV CST HM			
	Setting range	Setting unit	Mfr's value	When enabled
	10～100	10ms	50	Effective Immediately
	Function code	Mapping	Data type	Assessibilty
	So-03	N	UINT16	RW

When servo motor is rotating and speed is higher than 2008h-11h, after alarm occurs, servo drive will become disable status immediately, servo motor will free stop. When any of below items occurs, braking signal will be closed:

1. Speed decreases to setting value of 2008h-11h.

2. Servo drive becomes disabled status, and after delay time of 2008h-04h .

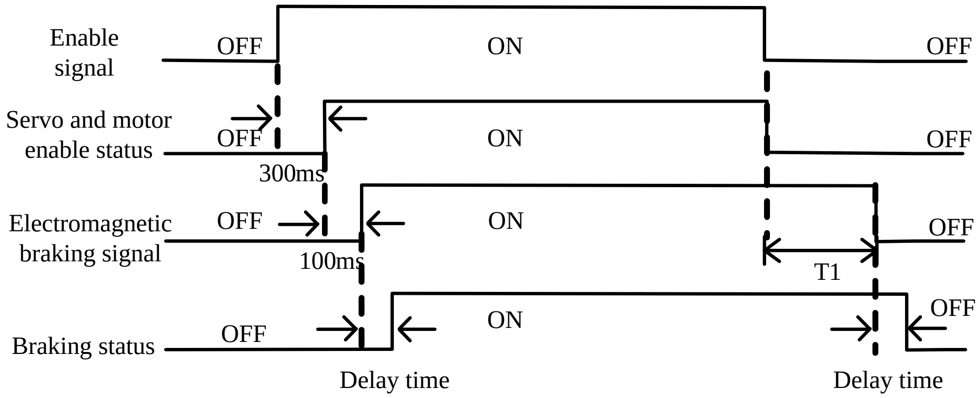


Fig 7-1-4 Electromagnetic brake sequence diagram

Note: servo enabled is off, T1 is the smaller value between 2008h-04h and the time taken by speed decreasing to 2008h-11h.

7.1.4 Setting the Overtravel Limit Function

The overtravel limit function forces movable machine parts to stop if they exceed the allowable range of motion. The function adopts a limit switch or a photoelectric switch.

1. Hardware overtravel protection function

As soon as the servo drive detects the on/off signal from the limit switch, it will force the speed in the present direction to turn to 0, but it does not work for the speed of opposite direction.

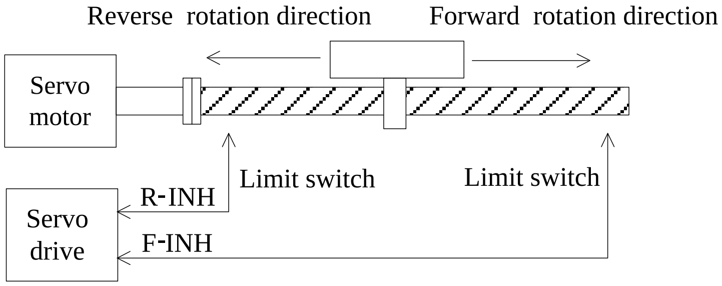


Fig 7-1-5 Overtravel Limit Function

(1) Input signal

Signal name	Code	Remarks
Forward run prohibited	F-INH	Forbidden servo drive forward run.
Reverse run prohibited	R-INH	Forbidden servo drive reverse run.

(2) Setting related parameter

2008h-12h	Forward run prohibited PP PV PT CSP CSV CST HM			
	Setting range	Setting unit	Mfr’s value	When enabled
	0: Prohibited invalid 1: Prohibited valid	N/A	1	Effective Immediately
	Function code	Mapping	Data type	Accessibility
	So-17	N	UINT16	RW

2008h-13h	Reverse run prohibited PP PV PT CSP CSV CST HM			
	Setting range	Setting unit	Mfr's value	When enabled
	0: Prohibited invalid 1: Prohibited valid	N/A	1	Effective Immediately
	Function code	Mapping	Data type	Accessibility
	So-18	N	UINT16	RW

(1) Enabled the overtravel signal

When 2008h-12h =1, 2008h-13h =0 and external control terminals with the function of F-INH and R-INH are allocated, the overtravel function is enabled. For security, the default setting of So-17 and So-18 are prohibited valid and the signal input type is common-close contact. So even malfunction occurs, the overtravel protection is still valid.

(2) Disable the overtravel signal

When 2008h-12h =0 and 2008h-13h =0, the overtravel function is disable. If the input terminals with the function of F-INH and R-INH are not allocated, the overtravel function is disabled.

(3) Setting the stop torque for overtravel

2002h-08h	Forward/reverse run prohibited and emergency stop torque PP PV PT SP CSV CST HM			
	Setting range	Setting unit	Mfr's value	When enabled
	1～300	1% of rated torque	100	Effective Immediately
	Function code	Mapping	Data type	Accessibility
	Po207	N	INT16	RW

When forward/reverse run prohibited signal or emergency stop signal is valid, the max value of instantaneous reverse stop torque of servo motor is limited by 2002h-08h. The entry-into-effect time is 100ms.

In torque mode, when motor is running, after prohibited signal is given, the torque prohibited value is limited by 2002h-11h.

2002h-11h	Forward/reverse run prohibited torque setting PP PV PT CSP CSV CST HM			
	Setting range	Setting unit	Mfr's value	When enabled
	0～1	N/A	1	Immediate
	Function code	Mapping	Data type	Accessibility
	Po216	N	INT16	RW

When 2002h-11h =0, the actual reverse limit torque is the setting torque in Po207;
When 2002h-11h =1, torque limit value is 0.

2. Software overtravel protection function

Once encoder multiturn position is detected to exceed setting range, alarm will occur. Take "Home" as initial position, servo motor can move between movement range set by forward/reverse. If servo motor exceeds movement range, servo drive will trip into AL-27. The related parameters are as below:

<table>
<tr><td rowspan="5">2001-29h</td><td colspan="4">Forward running range pulse when overtravel protection
PP PV PT CSP CSV CST HM</td></tr>
<tr><td>Setting range</td><td>Setting unit</td><td>Mfr's value</td><td>When enabled</td></tr>
<tr><td>0～2147483647</td><td>N/A</td><td>0</td><td>Immediate</td></tr>
<tr><td>Function code</td><td>Mapping</td><td>Data type</td><td>Accessibility</td></tr>
<tr><td>Po140</td><td>N</td><td>DINT32</td><td>RW</td></tr>
<tr><td rowspan="5">2001-2Bh</td><td colspan="4">Forward running range multi-loop numbers when overtravel protection
PP PV PT CSP CSV CST HM</td></tr>
<tr><td>Setting range</td><td>Setting unit</td><td>Mfr's value</td><td>When enabled</td></tr>
<tr><td>0～32000</td><td>N/A</td><td>1000</td><td>Immediate</td></tr>
<tr><td>Function code</td><td>Mapping</td><td>Data type</td><td>Accessibility</td></tr>
<tr><td>Po142</td><td>N</td><td>INT16</td><td>RW</td></tr>
<tr><td rowspan="5">2001-2Ch</td><td colspan="4">Reverse running range pulse when overtravel protection
PP PV PT CSP CSV CST HM</td></tr>
<tr><td>Setting range</td><td>Setting unit</td><td>Mfr's value</td><td>When enabled</td></tr>
<tr><td>0～2147483647</td><td>N/A</td><td>0</td><td>Effective Immediately</td></tr>
<tr><td>Function code</td><td>Mapping</td><td>Data type</td><td>Assessibilty</td></tr>
<tr><td>Po143</td><td>N</td><td>DINT32</td><td>RW</td></tr>
<tr><td rowspan="5">2001-2Eh</td><td colspan="4">Reverse running range multi-loop numbers when overtravel protection
PP PV PT CSP CSV CST HM</td></tr>
<tr><td>Setting range</td><td>Setting unit</td><td>Mfr's value</td><td>When enabled</td></tr>
<tr><td>0～32000</td><td>N/A</td><td>1000</td><td>Effective Immediately</td></tr>
<tr><td>Function code</td><td>Mapping</td><td>Data type</td><td>Assessibilty</td></tr>
<tr><td>Po145</td><td>N</td><td>INT16</td><td>RW</td></tr>
<tr><td rowspan="5">2008h-28h</td><td colspan="4">Overtravel limit function
PP PV PT CSP CSV CST HM</td></tr>
<tr><td>Setting range</td><td>Setting unit</td><td>Mfr's value</td><td>When enabled</td></tr>
<tr><td>0: Invalid 1: Valid
2: stop but no alarm</td><td>N/A</td><td>1</td><td>Effective Immediately</td></tr>
<tr><td>Function code</td><td>Mapping</td><td>Data type</td><td>Assessibilty</td></tr>
<tr><td>So-39</td><td>N</td><td>UINT16</td><td>RW</td></tr>
</table>

(1) Instructions

Set mechanical origin as initial position, and set forward/reverse motion range, which can realize overtravel protection by software.

(2) Masking overtravel protection function

To set 2008h-28h =0.

7.1.5 Jog operation procedure

1) Panel jog function

Step	Content	Remarks
1	Check wiring of main circuit and power supply of control circuit (L1C, L2C) is powered on, and power supply of main circuit (R/L1, S/L2, T/L3) is powered on.	
2	Press MODE key, to enter auxiliary function section So-□□	Please refer to 5.2.1
3	Press UP or DOWN key to find So-13 (Jog speed)	The Mfr's value is 100rpm
4	Press SET key for 0.5s to enter setting interface, to set safety value of jog speed by press UP or DOWN key.	Note: the unit of speed is 0.1rpm.
5	Press SET key for 0.5s to confirm the setting speed, and return to So-13.	
6	Press UP key to display So-14 (jog run）	
7	Press SET key for 0.5s to jog run.	JOG is displayed, servo is enabled.
8	Press UP key to jog forward run; press DOWN key to jog reverse run.	To confirm rotating direction.
9	Press MODE key, and servo is OFF, to quit JOG mode.	

2008h-0Eh	JOG speed	PP PV PT CSP CSV CST HM		
	Setting range	Setting unit	Mfr's value	When enabled
	0～30000	0.1rpm	1000	Immediate
	Function code	Mapping	Data type	Accessibility
	So-13	N	UINT16	RW

Note: 1. internal jog mode is a special speed mode, jog speed is related to decel. time Po109, Po110.

2: Internal jog mode is not limited by forward/reverse prohibited, make sure it is safe.
3: Please refer to 5.3.3 about procedure of internal jog operation.
4: The entry-into-effect time of Po109 and Po110 is 100ms

2) Terminal jog function

Signal name	Name	Default terminal	Function
Terminal FWD jog	JOGU	None	Forward jog is realized by controlling terminals.
Terminal REV jog	JOGD	None	Reverse jog is realized by controlling terminals.

Note: The priority of jog mode is higher than the other modes.

1) When servo is OFF and terminal jog signal is valid, servo will run at jog mode.
2) If terminal jog signal is valid at any modes, servo will enter jog mode

7.1.6 Sequence control

(1) Time sequence at power-on

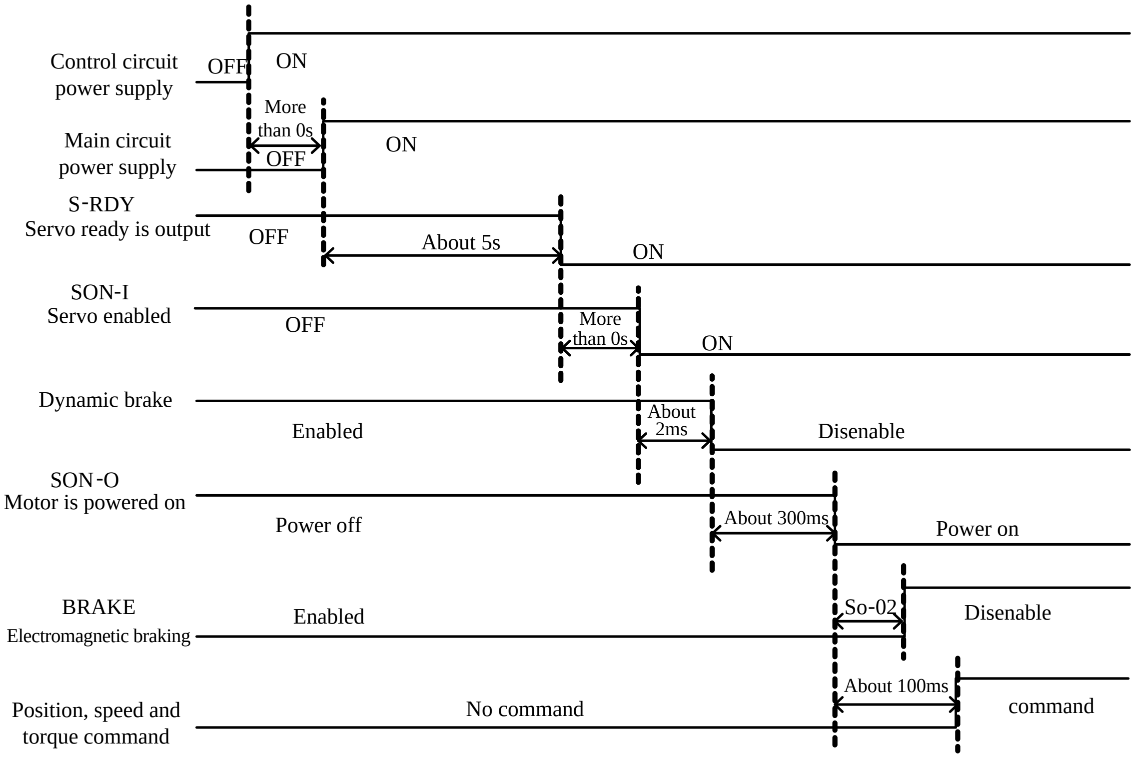


Fig 7.1.6 Time sequence at power-on

Note:

1. Above figure is time sequence at power-on with no fault.
2. Servo ready means that after CPU reset and main power supply is connected, outputs without any failures.
3. Before servo is ready, power supply should be connected and all control signals should be ignored.
4. When 2008h-08h is 0 or 1 and servo on is ready, please wait at least 100ms before sending control command. Or else, command may be ignored.

   When 2008h-08h is set to 2 and servo on is ready, please wait at least 10ms before sending control command. Or else, command may be ignored.

（2）Sequence control after alarm activated

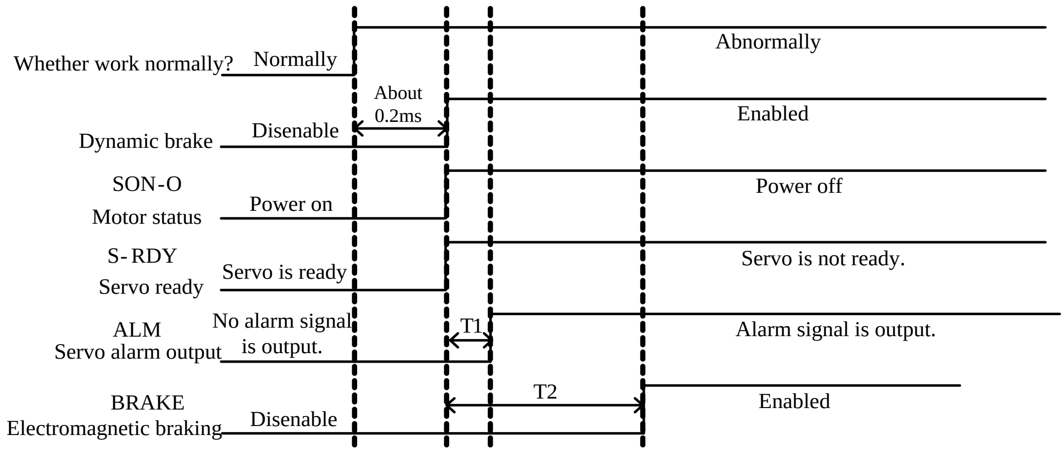


Fig 7-1-7 Sequence control of servo alarm activated

Note:

1. Above figure shows the control sequence of servo drive when alarm occurs in the running process of servo motor.
2. T1 is 0.1ms~20ms according different alarm type.
3. T2 is the smaller value between 2008h-04h and the time taken by speed reaching to 2008h-11h.

(3) Sequence control after resetting servo drive

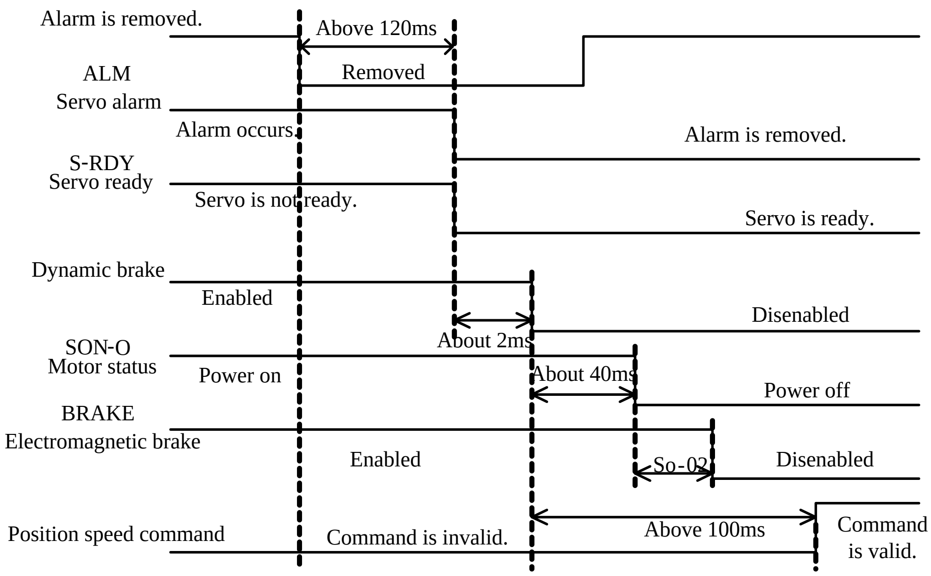


Fig 7-1-8 sequence control after resetting servo drive

7.1.7 Setting the braking

The braking types of servo drive include three kinds:
1.dynamic braking 2.energy-consumption braking 3. Electromagnetic braking.

! Caution
★ Energy-consumption braking is valid after main circuit is powered on. ★ Electromagnetic braking starts after servo OFF. If it is not, overload malfunction will occur. ★ Dynamic braking starts after servo OFF or main circuit is powered off. But if motor rotation speed is too high, dynamic braking resistor will be overheat.

(1) Dynamic braking

Dynamic braking is a common way to stop servo motor. It is a kind of special energy-consumption braking mode. The braking circuit includes dynamic braking resistor and diode. The method of dynamic braking is to short-connect drive line coil of servo motor, to shorten motor mechanical feed distance by modes of energy consumption braking finally.

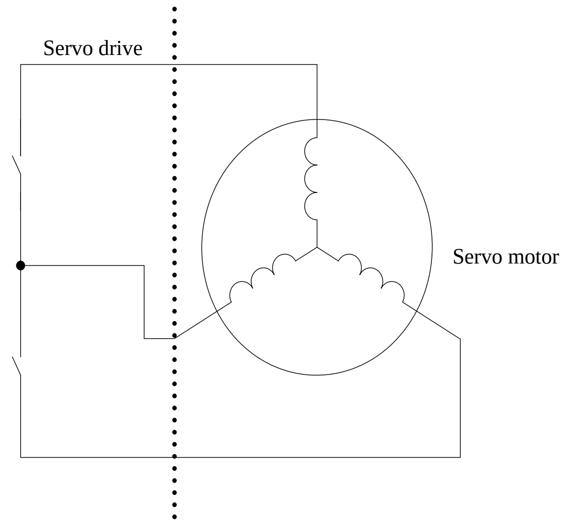


Fig 7-1-9 Dynamic braking

1）Setting function

2008h-08h	Servo OFF stop mode PP PV PT CSP CSV CST HM			
	Setting range	Setting unit	Mfr's value	When enabled
	0: Coast stop 1: Dynamic braking 2: Fast enable 3: Deceleration to stop 4: Deceleration to stop and dynamic brake 5: Deceleration to stop and fast enable	N/A	0	Effective Immediately
	Function code	Mapping	Data type	Accessibility
	So-07	N	UINT16	RW

Fast enable: after servo is power on, relay is switched on. After enable signal is valid, servo will be ON after 10ms.

2）Related parameter

2008h-09h	Dynamic braking delay time PP PV PT CSP CSV CST HM			
	Setting range	Setting unit	Mfr's value	When enabled
	100～30000	0.1ms	5000	Immediate
	Function code	Mapping	Data type	Accessibility
	So-08	N	UINT16	RW

(2) Energy consumption braking

Motor is in the state of energy regeneration during deceleration or stop process, which converts mechanical energy into electrical energy. The energy feedback works on bus line by inverting circuit, which leads to the voltage of bus line higher. When the voltage is too high, the components in the servodrive will be damaged. The method of energy consumption braking is to consume feedback energy into heat energy by braking resistor.

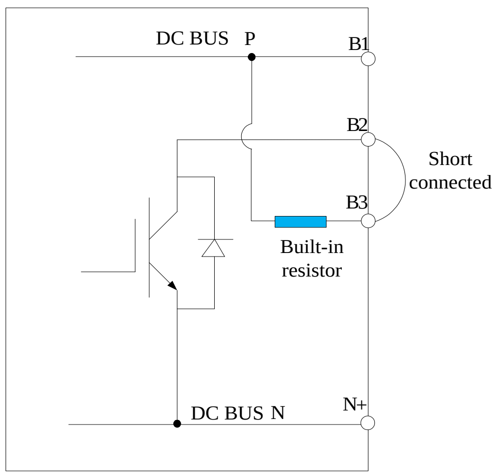


Fig 7-1-10 Wiring of energy consumption braking

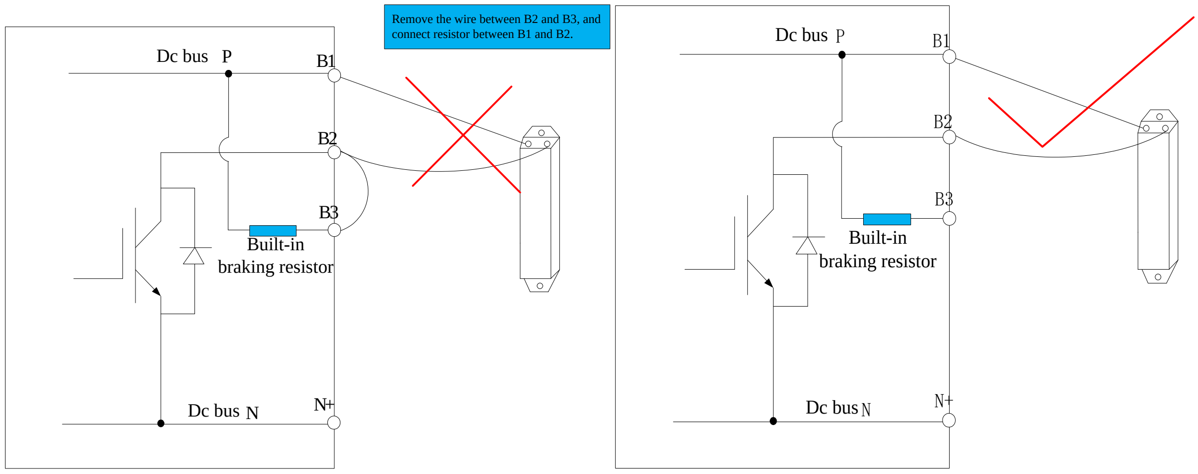


Fig 7-1-11 Wiring of braking resistor

Some servo drives have built-in braking resistor, if users need to use external braking resistor, please set the following both parameters:

2008h-05h	Braking resistor value			PP PV PT CSP CSV CST HM
	Setting range	Setting unit	Mfr's value	When enabled
	8～1000	Ω	—	Immediate
	Function code	Mapping	Data type	Accessibility
	So-04	N	UINT16	RW
2008h-06h	Discharge duty ratio			PP PV PT CSP CSV CST HM
	Setting range	Setting unit	Mfr's value	When enabled
	0～100	%	50	Immediate
	Function code	Mapping	Data type	Accessibility
	So-05	N	UINT16	RW

Please refer to next table for built-in braking resistor and min resistor value of external braking resistor for 220V servo.

Servo drive structure code	Built-in resistor value and power	Min resistor value of external braking resistor	Specification of external braking resistor
M1	None	40Ω	60Ω/200 W
M2	50W/50Ω	25Ω	40Ω/ 400 W
M3	100W/20Ω	15Ω	15Ω/ 1000 W
M4	260W/10Ω	10Ω	15Ω/ 2000 W

Please refer to next table for built-in braking resistor and min resistor value of external braking resistor for 380V servo.

Servo drive structure code	Built-in resistor value and power	Min resistor value of external braking resistor	Specification of external braking resistor
M2	50W/50Ω	50Ω	50Ω/1000W
M3	100W/60Ω	50Ω	50Ω/1000W
MM4/M4	260W/50Ω	40Ω	40Ω/1000W
M5	—	20Ω	20Ω/1000W
M6	—	20Ω	20Ω/2200W

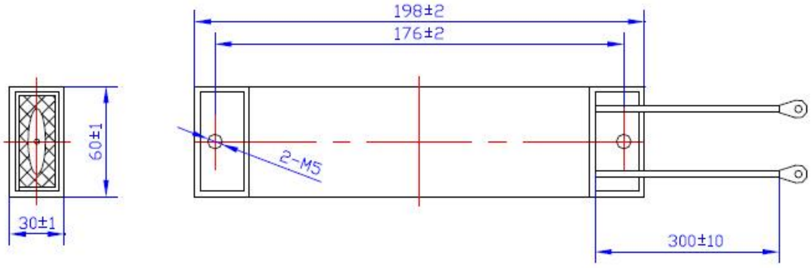


Fig 7-1-12 Wiring of braking resistor

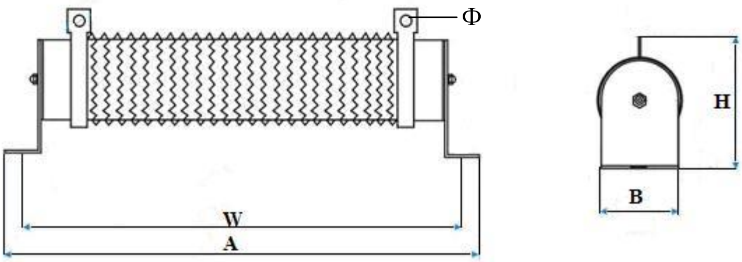


Fig 7-1-13 Wiring of braking resistor

Resistor power	External dimension (mm)			Installation dimension (mm)		Resistor type
	Length (A)	Width (B)	Height (H)	Length (W)	Aperture (Φ)	
500W	360±3.0	50±1.0	91±3.0	338±3.0	Φ6.5±0.3	Non-sense ripple porcelain tube resistor
1kW	350±3.0	60±2.0	119±3.0	325±5.0	Φ6.5±0.3	Non-sense ripple porcelain tube resistor
1.5kW	484±5.0	68±1.0	125±3.0	454±4.0	Φ6.5±0.3	Non-sense ripple porcelain tube resistor
2kW	557±5.0	60±1.0	119±3.0	532±4.0	Φ6.5±0.3	Non-sense ripple porcelain tube resistor
4kW	587±5.0	70±1.0	210±5.0	559±4.0	Φ6.5±0.3	Double tube vertical non-sense ripple porcelain tube resistor
6kW	661±5.0	70±1.0	210±5.0	633±4.0	Φ6.5±0.3	Three tube vertical non-sense ripple porcelain tube resistor
9kW	660±5.0	260±1.0	133±5.0	635±4.0	Φ6.5±0.3	Three tube lateral non-sense ripple porcelain tube resistor
4kW	562±5.0	140±1.0	119±5.0	537±4.0*80	Φ6.5±0.3	Double tube lateral non-sense ripple porcelain tube resistor
6kW	562±5.0	220±1.0	119±5.0	537±4.0*160	Φ6.5±0.3	Three tube lateral non-sense ripple porcelain tube resistor
9kW	652±5.0	300±1.0	131±5.0	627±4.0*160	Φ6.5±0.3	Four tube lateral non-sense ripple porcelain tube resistor

There are two installation mode can be selected for 4kW, 6kW and 9kW brake resistors. It is recommended to use last three kinds of brake resistors, which are adopted for horizontal fixed structure.

（3）Electromagnetic braking

Electromagnetic braking is suitable for servo motor with brake, which can make sure machine not move because of self-weight when servo is OFF.

7.1.8 Setting electronic gear

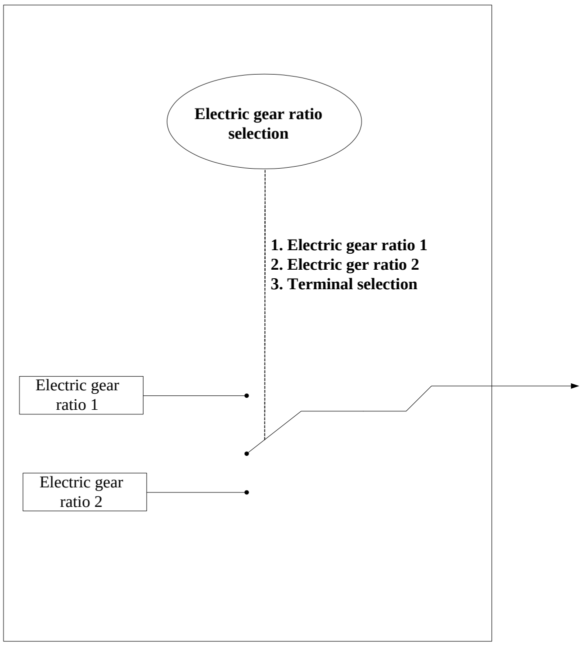
1）Electronic gear

At the position control mode, input position command (command unit) is used to set load displacement, motor position command (Encoder unit) is used to set motor displacement. Electronic gear ratio is used to set proportional relation between motor position command and input position command.

2）**Procedure for setting the electronic gear ratio**

Step	Operation	Description
1	Check machine specifications.	Check the deceleration ratio, ball screw pitch, and pulley diameter.
2	Check the number of encoder pulses.	Check the number of encoder pulses for the servo motor used.
3	Determine the command unit used.	Determine the command unit from the command controller
4	Calculate the travel distance per load shaft rotation.	Calculate the number of command units necessary to turn the load shaft one rotation based on the previously determined command units.
5	Calculate the electronic gear ratio.	Use the electronic gear ratio equation to calculate the ratio
6	Set parameters.	Set parameters using the calculated values.

Setting parameters procedure is as below:



When 2003h-05h and 6091h-01h are not 0, electronic gear ratio equals to 2003h-05h/2003h-06h (or 6091h-01h/6091h-02h). If 2003h-05h or（6091h-01h）=0, pulse numbers of motor rotating a rotation is controlled by 2003h-06h or（6091h-02h）.

1) Related parameters

① Function code

2003h-05h	First group electronic gear numerator			PP CSP
	Setting range	Setting unit	Mfr's value	When enabled
	0～65535	N/A	0	Immediate
	Function code	Mapping	Data type	Accessibility
	Po304	N	UINT16	RW
2003h-06h	First group electronic gear denominator			PP CSP
	Setting range	Setting unit	Mfr's value	When enabled
	1～65535	N/A	10000	Immediate
	Function code	Mapping	Data type	Accessibility
	Po305	N	UINT16	RW
6091h-01h	Numerator of Gear ratio			PP HM CSP
	Setting range	Setting unit	Mfr's value	When enabled
	0～（2^{31}-1）	N/A	0	Immediate
	Function code	Mapping	Data type	Accessibility
	Po344	N	DINT32	RW
6091h-02h	Denominator of electronic gear			PP HM CSP
	Setting range	Setting unit	Mfr's value	When enabled
	1～（2^{31}-1）	N/A	10000	Immediate
	Function code	Mapping	Data type	Accessibility
	Po346	N	UDINT32	RW

Note: the default gear ratio is the second electronic gear ratio.

② Electronic gear ratio switchover

If two groups of electronic gear ratio have large difference, motor speed fluctuates wildly when electronic gear ratio switchover. (2003h-07h) position command filter can smooth position switchover.

When 2003h-28h=2, electronic gear switchover function is valid. Only one group gear ratio is valid at the same moment.

2003h-28h	Electronic gear ratio selection			PP CSP
	Setting range	Setting unit	Mfr's value	When enabled
	0～2	N/A	1	Immediate
	Function code	Mapping	Data type	Accessibility
	Po339	N	INT16	RW
	0: First electronic gear ratio 1: Second electronic gear ratio 2: Two groups of electronic gear ratio switchover			

When the terminal is valid, the second electronical gear ratio is valid. When the terminal is invalid, the first electronical gear ratio is invalid. The entry-into-effect time is 100ms.

4）Instruction

The deceleration ratio is n/m, electronic gear numerator is B, and electronic gear denominator is A, so the setting value of electronic gear ratio is:

Note: The deceleration ratio is n/m where m is the rotation of the servo motor and n is the rotation of the load shaft.

B/A=Po304/ Po305=(No. of encoder pulses×4/travel distance per load shaft rotation)×（m/n）

The actual meaning of electronic gear is:

Command pulse input → $\frac{B}{A}$ → Position command

Pulses numbers are X　　$Y = X \times \frac{B}{A}$

* If the ratio is outside the setting range, reduce the fraction (both numerator and denominator) until you obtain integers within the range. Be careful not to change the electronic gear ratio (B/A).

Electronic gear ratio setting range: $0.01 \leq$ Electronic gear ratio (B/A) ≤ 100

If the electronic gear ratio is outside this range, the control precision will decrease.

Ex：The following example shows electronic gear ratio settings for ball screw which pitch is 6mm.

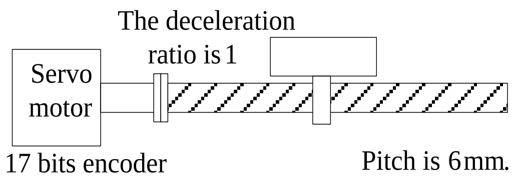


Fig 7-2-2 Setting electronic gear

Step	Operation	Calculation
1	Check machine specifications.	The deceleration ratio is 1:1 and the pitch is
2	Check the number of encoder	17 bits encoder
3	Determine the command unit used.	The command unit is 1μm.
4	Calculate the travel distance per load shaft rotation.	6000μm/1μm=6000
5	Calculate the electronic gear ratio.	B/A=(131072/6000) ×1/1
6	Set parameters.	2003h-05h=8192　2003h-06h=375

7.1.9 Position command filter

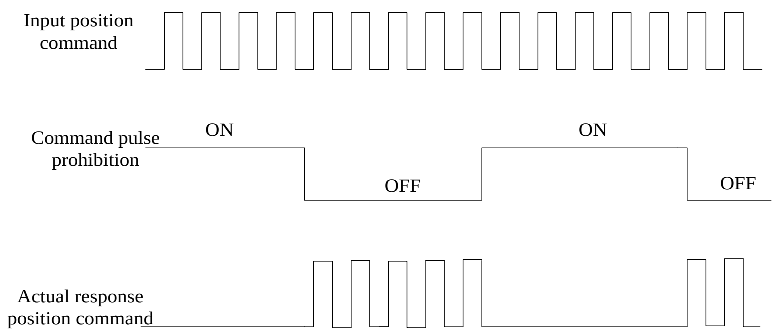
For the below situation, position command filter should be selected:
1.Position command of PC/PLC output is not dealt with by acceleration/deceleration.
2.The frequency of pulse command is high.
3.The electronic gear ratio is higher than 10 times

2003h-07h	Position loop filter time constant			PP CSP
	Setting range	Setting unit	Mfr's value	When enabled
	1～10000	ms	1	Immediate
	Function code	Mapping	Data type	Accessibility
	Po306	N	INT16	RW

Setting position loop filter time constant correctly can make motor rotate smoothly. The parameter does not affect pulse numbers.
Filter frequency is used to inhibit high-frequency of disturbance pulses. Please do not set this value too low, avoid inhibiting effective high-frequency pulse command.

7.1.10 Position command inhibit function

This function inhibits the servo drive from counting input pulses during position control.



(1) Input signal

Signal name	Code	Default terminal	Remarks
Command pulse inhibit	INH-P	Must be allocated	Inhibiting the servo drive from counting input pulses, position pulse command is invalid.

(2) Setting parameters

Parameters	Remarks
2003h-09h.A=0	Terminal of inhibiting command pulse is invalid.
2003h-09h.A=1	Terminal of inhibiting command pulse is valid.

7.1.11 Command pulse clear function

Position deviation=(position command-position feedback) (encoder unit)
This function clears position deviation register during position control.

(1) Input signal

Signal name	Code	Default terminal	Remarks
Pulse clear	CLR	CN3-37 (at the mode of position pulse)	Clearing position deviation register during position control

(2) Setting parameters

Parameters	Remarks
2003h-09h.B=0	Command pulse clear function is OFF.
2003h-09h.B=1	Command pulse clear function is ON.

7.1.12 Frequency-division output function

Encoder pulse is frequency-division processed by servo drive internal circuit, and orthogonal differential signal outputs. The frequency-division signal setting is as below:

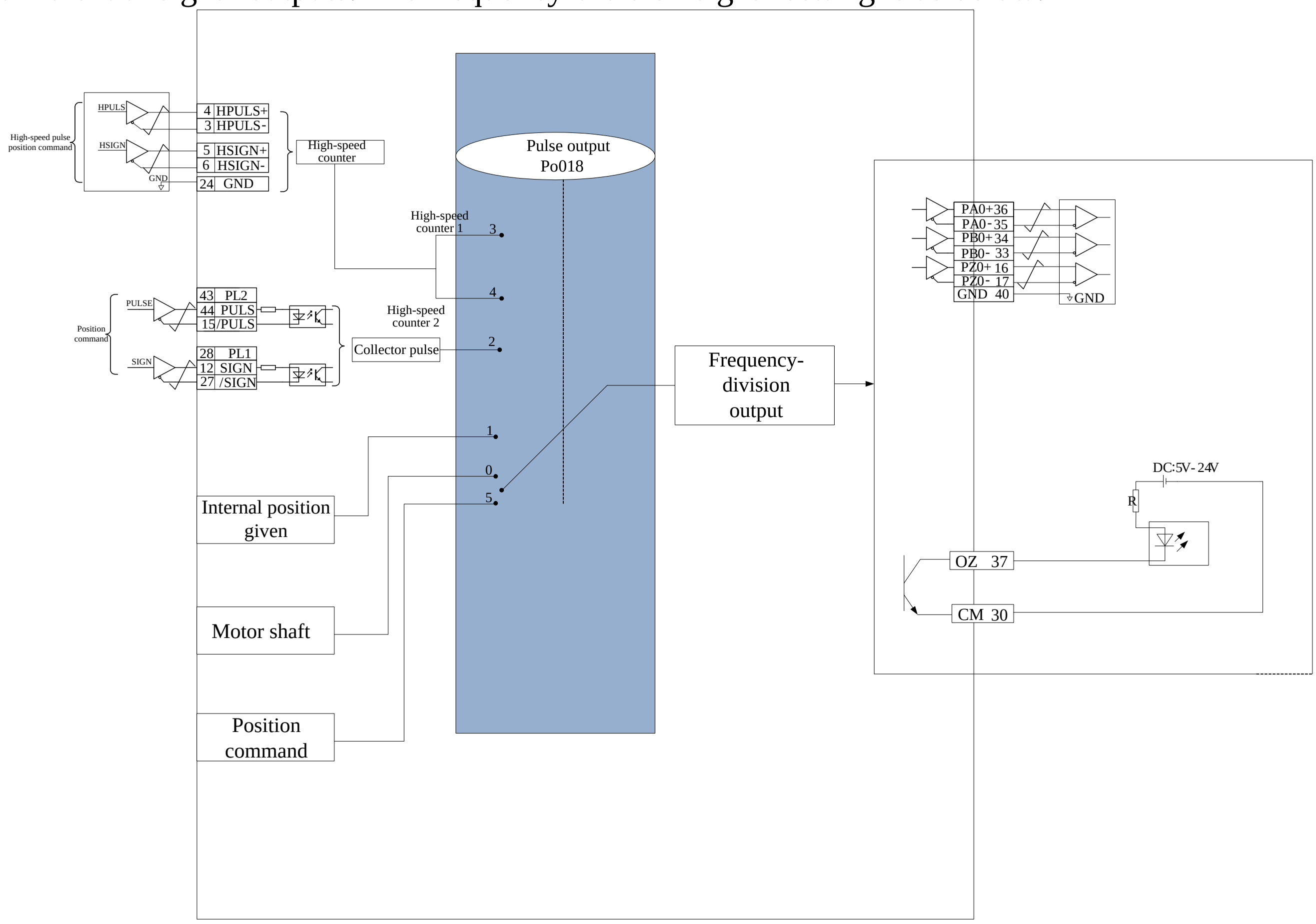


Fig 7.2.5 Frequency-division output diagram

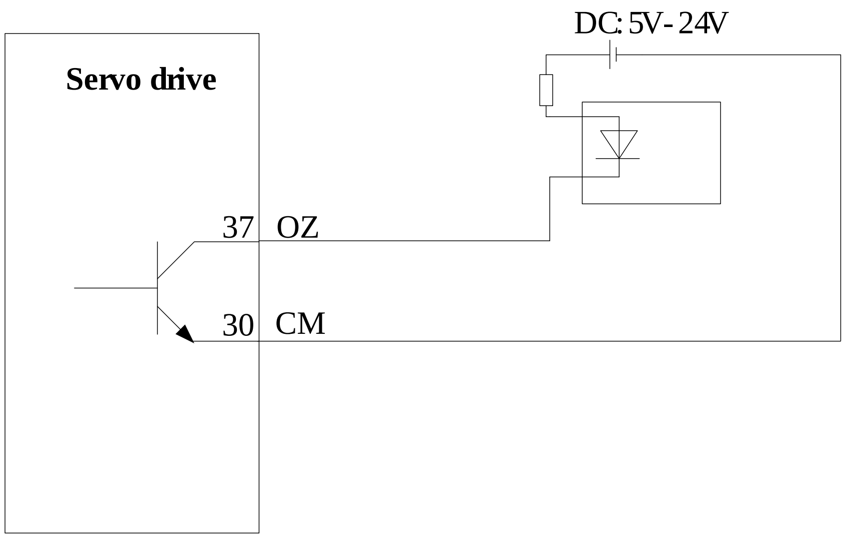
(1) Output signal

Encoder pulse frequency-division signal has three groups output terminals.

Signal name		Terminal code	Remarks
PA phase	PAO-	CN3 – 36	Encoder A phase pulse frequency-division output
	PAO+	CN3 – 35	
PB phase	PBO-	CN3 – 34	Encoder B phase pulse frequency-division output
	PBO+	CN3 – 33	
PZ phase	PZO-	CN3 – 16	Encoder Z phase home pulse output (no frequency-division)
	PZO+	CN3 – 17	
	OZ	CN3-37	Z phase open collector output

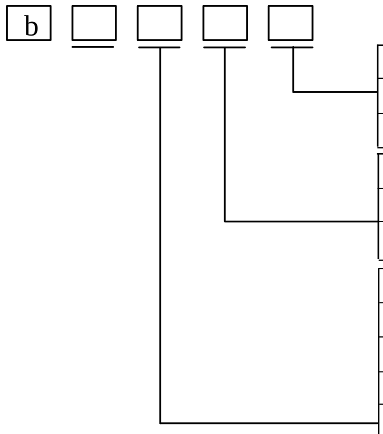
When output signal is frequency-division, output pulse source (2000h-13h) and phase (2003h-01h) should be set by actual requirement. When output source is motor shaft, and motor rotates one revolution, A/B phase output pulse numbers is controlled by 2000h-04h (Molecule of encoder frequency-division numbers), width is controlled by motor speed.

When output signal is Z phase open collector output, pulse output setting (2000h-13h) should be set by actual requirement. At high-speed, Z pulse is narrow, and it can be adjusted by 2000h-12h.



(2) Related parameters

<table>
<tr><td rowspan="5">2000h-04h</td><td colspan="4">Encoder frequency-division numbers PP PV PT CSP CSV CST HM</td></tr>
<tr><td>Setting range</td><td>Setting unit</td><td>Mfr’s value</td><td>When enabled</td></tr>
<tr><td>1～65535</td><td>N/A</td><td>—</td><td>Immediate</td></tr>
<tr><td>Function code</td><td>Mapping</td><td>Data type</td><td>Accessibility</td></tr>
<tr><td>Po003</td><td>N</td><td>UINT16</td><td>RW</td></tr>
<tr><td rowspan="5">2000h-06h</td><td colspan="4">Encoder pulse frequency-division numbers denominator
PP PV PT CSP CSV CST HM</td></tr>
<tr><td>Setting range</td><td>Setting unit</td><td>Mfr’s value</td><td>When enabled</td></tr>
<tr><td>1～2147483647</td><td>N/A</td><td>—</td><td>Immediate</td></tr>
<tr><td>Function code</td><td>Mapping</td><td>Data type</td><td>Accessibility</td></tr>
<tr><td>Po005</td><td>N</td><td>UDINT32</td><td>RW</td></tr>
<tr><td rowspan="5">2000h-12h</td><td colspan="4">Z pulse frequency-division output width PP PV PT CSP CSV CST HM</td></tr>
<tr><td>Setting range</td><td>Setting unit</td><td>Mfr’s value</td><td>When enabled</td></tr>
<tr><td>50～30000</td><td>N/A</td><td>—</td><td>Immediate</td></tr>
<tr><td>Function code</td><td>Mapping</td><td>Data type</td><td>Accessibility</td></tr>
<tr><td>Po017</td><td>N</td><td>INT16</td><td>RW</td></tr>
<tr><td rowspan="5">2000h-13h</td><td colspan="4">Pulse output configuration PP PV PT CSP CSV CST HM</td></tr>
<tr><td>Setting range</td><td>Setting unit</td><td>Mfr’s value</td><td>When enabled</td></tr>
<tr><td>Four-parameter</td><td>N/A</td><td>0001</td><td>Immediate</td></tr>
<tr><td>Function code</td><td>Mapping</td><td>Data type</td><td>Accessibility</td></tr>
<tr><td>Po018</td><td>N</td><td>UINT16</td><td>RW</td></tr>
</table>



A	Z pulse output polarity
0	Negative polarity output
1	Positive polarity output

B	Z pulse command source
0	Motor shaft
1	Virtual shaft

C	Pulse frequency-division command source
0	Motor shaft
1	Internal position given
2	Collector pulse input
3	High-speed counter 1
4	High-speed counter 2
5	Position command

Table 7.2.1 Encoder frequency-division output pulse

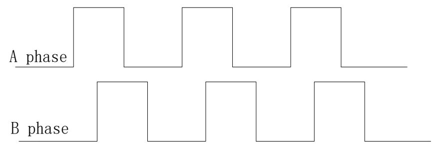
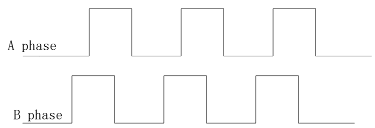
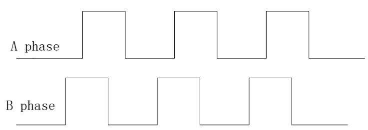
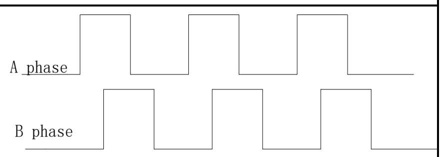
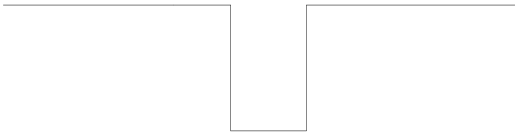
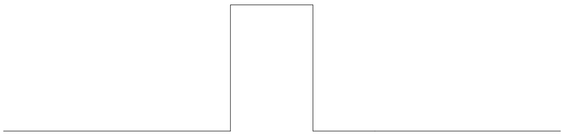
2003h-01h.D (output pulse phase)	Forward rotation Pulse output	Reverse rotation Pulse output
0	 A phase is 90 degrees ahead of B phase.	 B phase is 90 degrees ahead of A phase.
1	 B phase is 90 degrees ahead of A phase.	 A phase is 90 degrees ahead of B phase.

Table 7.2.2 Z phase open collector output

2000h-13h.A (output pulse phase)	2000h-12h (Z phase expansion)	Forward rotation Pulse output	Reverse rotation Pulse output

0	500	
1	500	

(3) **Wiring terminals**

Signal name		Terminal code	Remarks
PA phase	PAO-	CN3-35	Encoder A phase pulse frequency-division output
	PAO+	CN3-36	
PB phase	PBO-	CN3-33	Encoder B phase pulse frequency-division output
	PBO+	CN3-34	
PZ phase	PZO-	CN3-17	Encoder Z phase home pulse output (no frequency-division)
	PZO+	CN3-16	
	OZ	CN3-37	Z phase open collector output
	CM	CN3-30	

(4) **Example of pulse frequency-division signal**

Example: when 2000h-04h =16，2000h-06h =32768, the each circle and each phase output pulse numbers of encoder is 16.

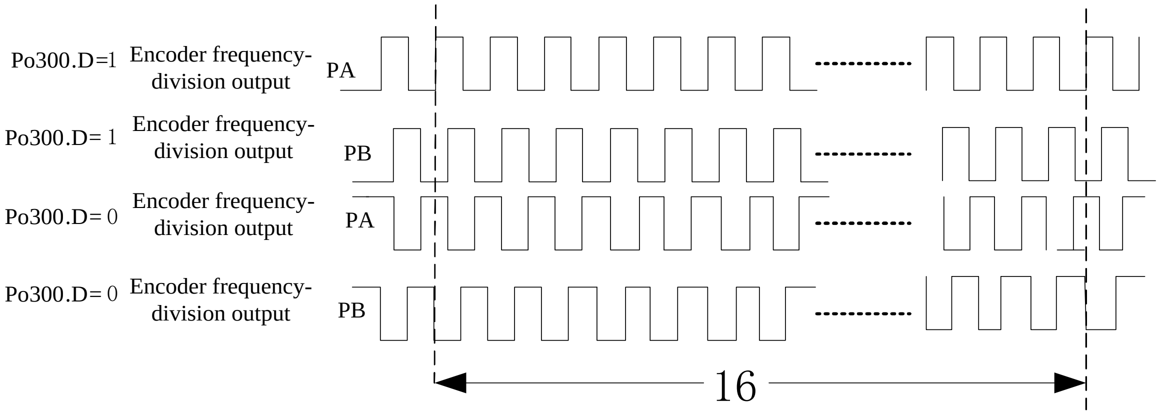


Fig 7-2-6 Encoder frequency-division output

When output signal is open collector output, frequency must not be higher than 100KHZ, 2000h-04h should not be set too high.

7.2 Servo Status Setting

Servo drive must be guided according to standard 402 protocol.

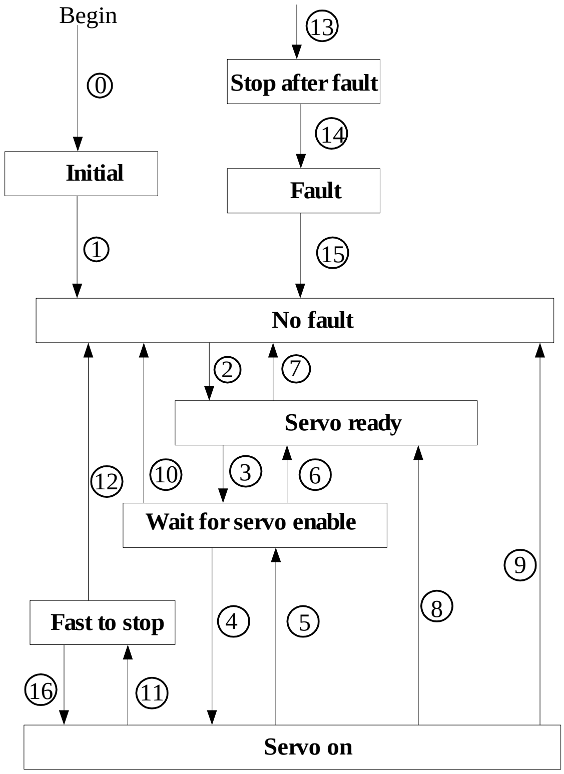


Fig 7.2.1 CiA402 status machine switchover

Status description:

Initialization	Initialization of servo drive and self-check have been done. Parameters setting or drive function cannot be implemented.
No fault	No fault exists in the servo drive or the fault is eliminated. Parameter setting of the servo drive is allowed.
Servo ready	The servo drive is ready. Parameters setting of servo drive is allowed.
Wait for servo enabled	The drive waits for servo enabled. Parameters setting of the servo drive is allowed.
Running	The servo drive is in normal running state, a certain drive mode is enabled, the motor is energized, and rotates when the reference is not 0.
Quick stop	The quick stop function is enabled, and the servo drive executes quick stop.
Stop at fault	At fault occurs, and the servo drive stops.
Fault	The stop process is completed, and all the drive function are inhibited.

Control command and state switchover.

CiA402 state switchover	Control word 6040h	Status word

			6041h bit0～bit9
0	power on → Initialization	Natural transition, control command not required	0000h
1	Initialization → No fault	Natural transition, control command not required If an error occurs during initialization, the servo drive directly goes to state 13	0270h
2	No fault → Ready	0006h	0231h
3	Ready → Wait for servo enabled	0007h	0233h
4	wait for servo enabled → running	000Fh	0237h
5	running → Wait for servo enabled	0007h	0233h
6	Wait for servo enabled → Ready	0006h	0231h
7	Ready → No fault	0000h	0250h
8	Running → Ready	0006h	0231h
9	Running → No fault	0000h	0270h
10	Wait for servo enabled → No fault	0000h	0270h
11	Running → Fast to stop	0002h	0217h
12	Fast to stop → No fault	Set 605Ah to a value among 0 to 3. Natural transition is performed after stop, and no control command is required.	0270h
13	→ Stop at fault	Once a fault occurs in any state other than "fault", the servo drive automatically switchovers over to the stop at fault state, without control command.	021Fh
14	Stop at fault → Fault	Natural transition after stop at fault, control command not required.	0238h
15	Fault → No fault	80h; Bit 7 is rising edge valid. If Bit7=1, the other control words are invalid.	0270h
16	Fast to stop → Running	Set 605h to a value among 5 to 7. After the stop process is completed, 0Fh is sent after the stop process is completed.	0237h

7.2.1 Control word 6040h

<table>
<tr><td rowspan="3">Index
6040h</td><td>Name</td><td colspan="2">Control word</td><td>Setting type</td><td>—</td><td>Data structure</td><td>VAR</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td colspan="2">RPDO</td><td>Data type</td><td>UINT16</td></tr>
<tr><td>Related mode</td><td>ALL</td><td>Data range</td><td colspan="2">0-65535</td><td>Default</td><td>0</td></tr>
</table>

It controls the state machine of the servo drive.

bit	**Name**	**Description**
0	Servo ready	1-Valid 0-Invalid
1	Switch on	1-Valid 0-Invalid
2	Fast to stop	1-Valid 0-Invalid
3	Running	1-Valid 0-Invalid
4-6		Related to the drive modes.
7	Fault reset	Falling edge is valid.
8	Halt	1-Valid 0-Invalid
9-10	NA	Reserved
11-15	Manufacturer specific	Reserved

NOTE:

1. The bits in the control word together specify a certain control commad, and are useless if set separately.
2. The meaning of bit0 to bit3 and bit7 keep the same in each control mode of the servo drive. The servo drive switches to the present state according to the CIA402 state machine only when the control words are sent in sequence. Each command indicates a state.
3. The meaning of bit4 to bit6 vary according to each control mode. For details, refer to the control command in each control mode.

7.2.2 Status word 6041h

<table>
<tr><td rowspan="3">Index 6041h</td><td>Name</td><td colspan="2">Status word</td><td>Setting mode</td><td>Display</td><td>Data structure</td><td>VAR</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td colspan="2">TPDO</td><td>Data type</td><td>UINT16</td></tr>
<tr><td>Related mode</td><td>ALL</td><td>Data range</td><td colspan="2">0-65535</td><td>Default</td><td>—</td></tr>
</table>

It indicates the state of the servo drive.

Value (Binary)	**Description**
xxxx xxxx x0xx 0000	Not ready to switch on
xxxx xxxx x1xx 0000	Switch on disabled
xxxx xxxx x01x 0001	Ready to switch on
xxxx xxxx x01x 0011	Switch on
xxxx xxxx x01x 0111	Operation enabled
xxxx xxxx x00x 0111	Quick stop active
xxxx xxxx x01x 1111	Fault reaction active
xxxx xxxx x0xx 1000	Fault

Note:

1. The bits in the control word together specify the present state of the servo drive, and are usless if set separately.
2. The meaning of bit0-bit9 keep the same in each control mode of the servo drive. This parameter indicates the state of the servo drive when the control words in 6040h are sent in sequence.
3. The meaning of bit12-bit13 vary according to each control mode. For detains, refer to the control command in each control mode.
4. The meaning of bit10, bit11 and bit15 keep the same in each control mode of the servo drive, and indicates the status after a certain control mode is implemented.

7.3 Profile position mode（PP）

In this mode of operation, host controller uses the path generation function (an operation profile calculation function) inside the servo drive to perform PTP positioning operation. It executes path generation, position control, speed control, and torque control based on the target position, profile acceleration, profile deceleration, and other information.

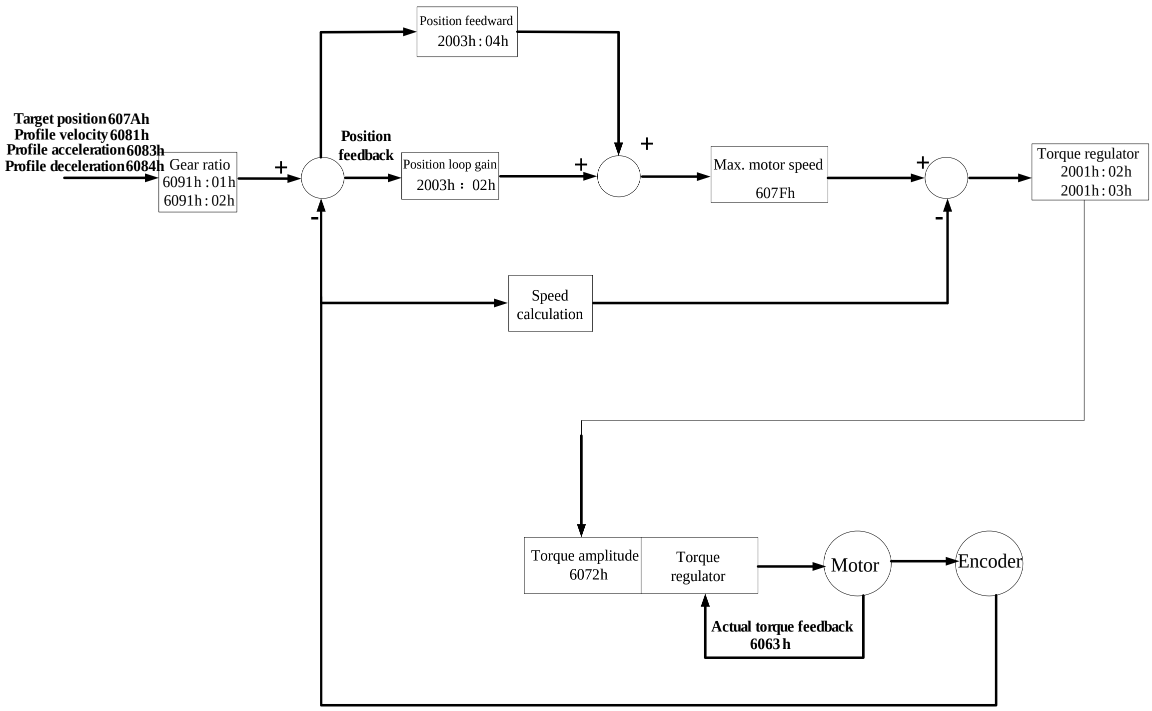


Fig 7.3.1 Block diagram for the PP mode

7.3.1 Related objects

Control word 6040h		
Bit	**Name**	**Description**
0	Switch on	If bit0 to bit3 are all 1, the servo drive starts running.
1	Enable voltage	
2	Quick stop	
3	Enable operation	
4	New set-point	Starts positioning at rising edge from 0 to 1 of the signal. In this timing, the values of 607Ah (target position), 6081h (Profile velocity), 6083h (Profile acceleration), and 6084h (Profile deceleration) are obtained.
5	Change set immediately	0: Not change set immediately. 1: Change set immediately.
6	abs/rel	0: Target position being absolute position reference.

		1: Target position being relative position reference.

Status word 6041h		
Bit	**Name**	**Description**
10	Target reached	0: Target position not reached 1: Target position reached
12	Set-point acknowledge	0: Waiting for a new Target position 1: Not update target position
13	Follow error	0: No position deviation excessive fault 1: Position deviation excessive fault present

Index	**Sub-index**	**Name**	**access**	**Date format**	**Unit**	**Setting range**	**default**
603Fh	00h	Error code	RO	UINT16	—	—	—
6040h	00h	Control word	RW	UINT16	—	0～65535	0
6041h	00h	Status word	RO	UINT16	—	0～65535	0
6060h	00h	Operation mode	RW	UINT16	—	0～10	0
6061h	00h	Mode display	RO	UINT16	—	—	—
6062h	00h	Position command	RO	DINT32	Command	—	—
6063h	00h	Position feedback	RO	DINT32	Encoder	—	—
6064h	00h	Position actual value	RO	DINT32	Command	—	—
6065h	00h	Following error window	RW	UINT16	Command unit	1～32000	—
6067h	00h	Position window	RW	DINT32	Command	1～32000	—
6068h	00h	Position window time	RW	INT16	ms	0～65535	0
606Ch	00h	Velocity actual value	RO	DINT32	0.1rpm	—	—
6077h	00h	Torque actual value	RO	INT16	1%	—	—
607Ah	00h	Target position	RW	DINT32	Command unit	-2^{31}～ +（2^{31}-1）	0
6083h	00h	profile acceleration	RW	UINT16	ms	1～32000	100
6084h	00h	profile deceleration	RW	UINT16	ms	1～32000	100
6091h	01h	numerator of gear ratio	RW	UDINT32	—	0～（2^{31}-1）	0
	02h	Denominator of gear ratio	RW	UDINT32	—	1～（2^{31}-1）	10000
60E0h	00h	Positive torque limit value	RW	UINT16	1%	0～800	100
60E1h	00h	Negative torque limit value	RW	UINT16	1%	0～800	100
60F4h	00h	Position deviation	RO	DINT32	Command	—	—
6081h	00h	Profile velocity	RW	UINT16	0.1rpm	0～65535	0

7.3.2 Related functions

1）Positioning completed:

Index	Sub-index	Name	Description
6067h	00h	Position reached threshold	When the position deviation is within ±6067h, and the time reaches 6068h, the servo drive considers that the position is reached, and sets status word 6041h bit10 = 1 in position control mode. The position reached DO signal is invalid when either of the condition is not met.
6068h	00h	Position window	

2) Following error window:

Index	Sub-index	Name	Description
6065h	00h	Following error window	When the position deviation exceeds 6065h, AL-09 is displayed on the keypad, and bit13 of the status word is set to 1.

7.3.3 Path Generator

1）Time sequence 1: change immediately

After receiving the rising edge of 6040h bit4, the dirve should execute current position reference immediately. In the mode of change immediately, the drive immediately executes the new position reference once receiving it (6041h bit12 changes from 0 to 1).

In the mode of change immediately, after detecting that 6040h bit4 changes from 1 to 0, the drive sets 6041h bit12 to 0

In the mode of change immediately, if the drive receives a new position reference ② when executing the previous position reference ①, it does not abandon the position reference not finished in ①. With a relative position reference, after new position reference ② is finished, total position increment = target position increment 607Ah of ① + target position increment 607Ah of ②.

With an absolute position reference, after new position reference ② is finished, total position increment = target position increment 607Ah of ②.

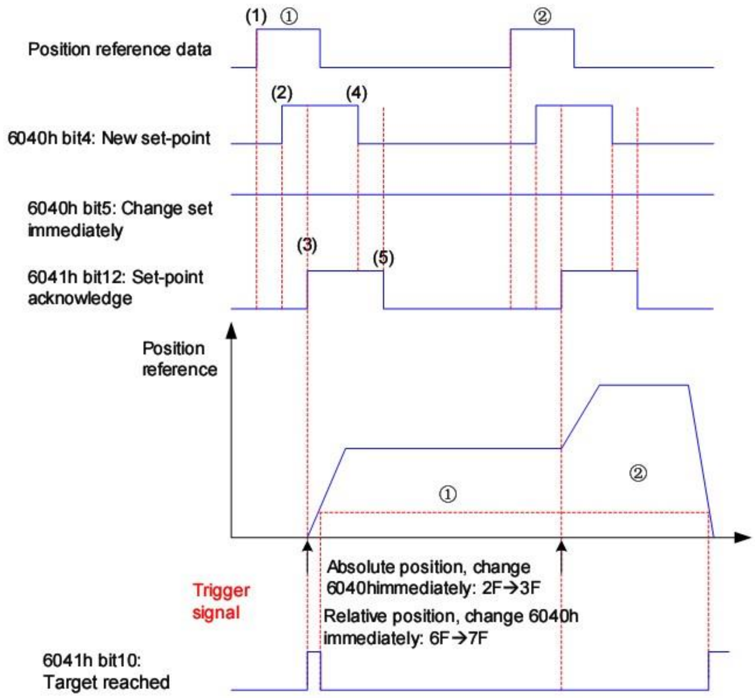


Fig 7.3.2 Time sequence and motor profile in the mode of change immediately

- Operation description:

Example: two position references, change immediately, absolute

Position reference ①:

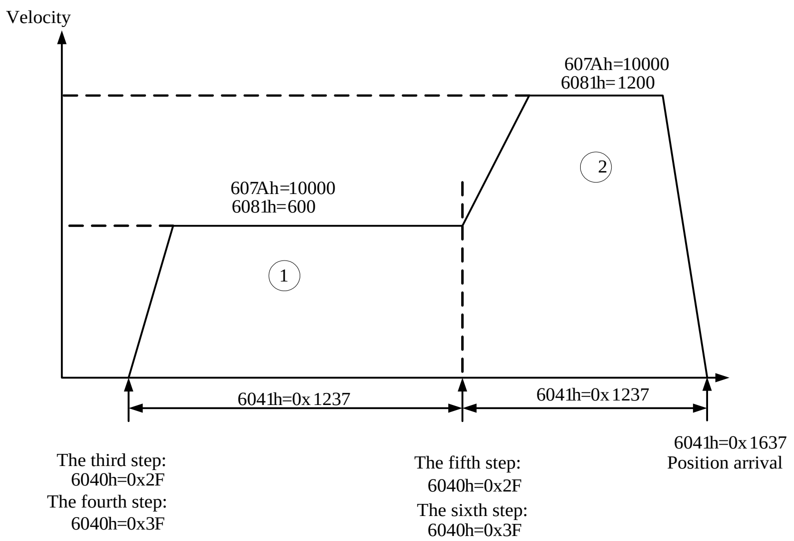
Target position 607Ah=10000

6081h=600

Position reference ②:

Target position 607Ah=10000

6081h=1200



2）Time sequence 2: Not change immediately

After last position reference is finished and position arrival, the drive will execute current position reference after receving the rising edge of bit 4. The drive will not accept new position reference before position arrival. The drive changes 6041h bit 12 to 1, which indicates the drive has received the new position reference and execute it.

In the mode of not change immediately, after detecting that 6041h changes from 1 to 0, the drive sets 6041h bit12 to 0.

In the mode of not change immediately, during the executing process of position reference ①, new position reference ② is invalid. The current target position is still unfinished target position.

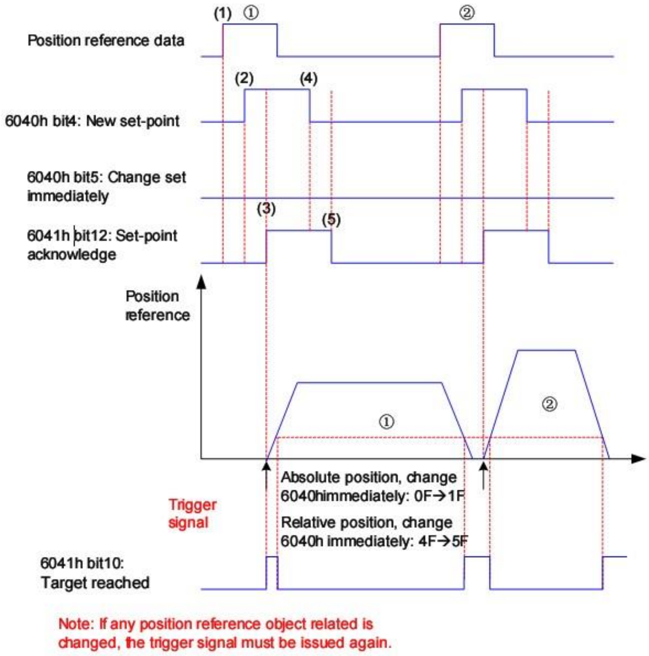


Fig 7.3.3 Time sequence motor profile in the mode of not change immediately

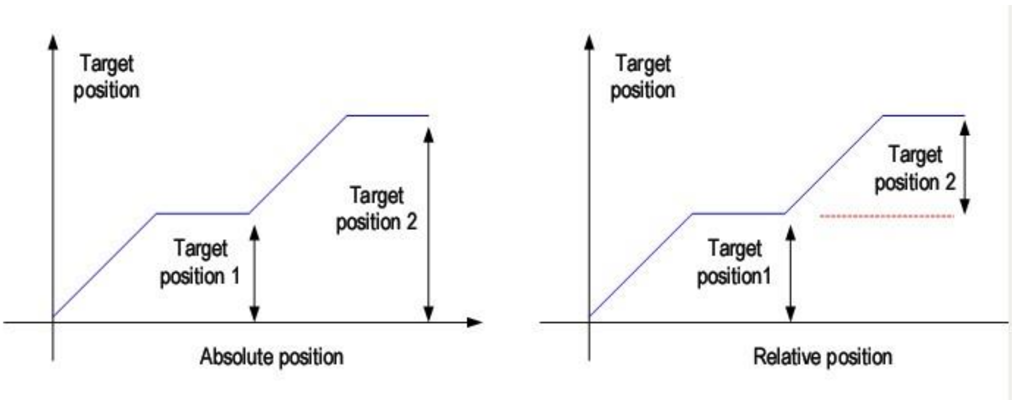


Fig 7.3.4 Difference between absolute and relative position reference

7.3.4 Recommended configuration

The basic configuration for the PP mode is described in the following table.

RPDO	TPDO	Remarks
6040h:　Control word	6041h:　Status word	Mandatory
607Ah: Target velocity	6064h:　Position actual value	Mandatory
6081h:　Profile velocity		Mandatory
6060h:　Modes of operation	6061h: Modes of operation display	Optional

7.4　Profile velocity mode（PV）

In this mode of operation, the host controller gives the target speed, acceleration, and deceleration to the servo drive. Speed control and torque control are performed by the servo drive.

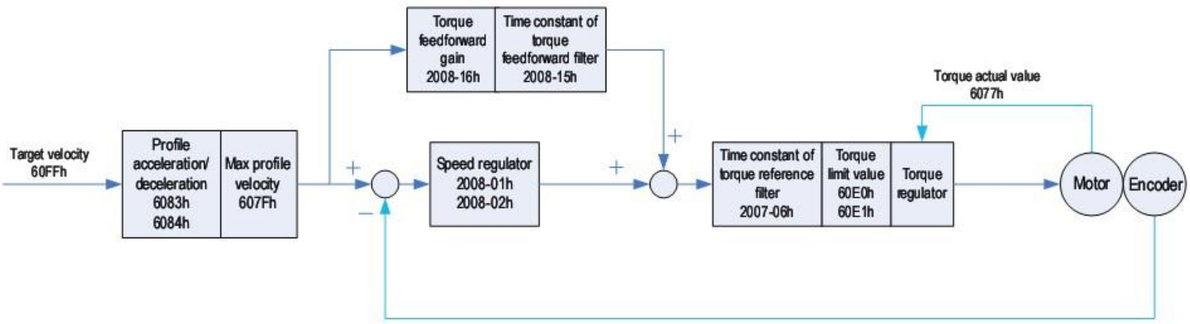


Fig 7.4.1　Block diagram for the PV mode

7.4.1 Related objects

Control word 6040h		
Bit	**Name**	**Description**
0	Switch on	If bit0 to bit3 are all 1, the servo drive starts running.
1	Enable voltage	
2	Quick stop	
3	Enable operation	
8	Halt	
Status word 6041h		
Bit	**Name**	**Description**
10	Target reach	0: Target velocity not reached 1: Target velocity reached
12	Drive follow the command value	0: The drive not follow command.

		1: The drive follow command.

Index	Sub-index	Name	access	Data format	Unit	Setting range	Default
603Fh	00h	Error code	RO	UINT16	—	—	0
6040h	00h	Control word	RW	UINT16	—	0～65535	0
6041h	00h	Status word	RO	UINT16	—	0～65535	0
6060h	00h	Operation mode	RW	UINT16	—	—	0
6061h	00h	Mode display	RO	UINT16	—	—	0
607Fh	00h	Max profile velocity	RW	UDINT32	rpm	0～13000	—
6063h	00h	Position feedback	RO	DINT32	Encoder unit	—	—
6064h	00h	Position actual value	RO	DINT32	Command unit	—	—
60FFh	00h	Target velocity	RW	DINT32	0.1rpm	-130000～130000	0
60E0h	00h	Positive torque limit value	RW	INT16	1%	0～800	100
60E1h	00h	Negative torque limit value	RW	INT16	1%	0～800	100
606Ch	00h	Velocity actual value	RO	DINT32	0.1rpm	—	—
6077h	00h	Torque actual value	RO	INT16	1%	—	—
6083h	00h	Profile acceleration time	RW	UINT16	ms	0～32000	100

6084h	00h	Profile deceleration time	RW	UINT16	ms	0～32000	100

7.4.2 Related functions

Index	Sub-index	Name	Description
606Dh	00h	Velocity threshold	When the difference between 60FFh (converted into motor speed/RPM) and actual motor speed is within ±606Dh, and the time reaches 606Eh, the servo drive considers that the speed reference is reached, sets status word 6041h bit10 = 1 and activates the speed reached DO signal. This flag bit is valid only when the S-ON signal is valid in profile position mode and cyclic synchronous velocity mode.
606Eh	00h	Velocity window	

7.4.3 Recommended configuration

RPDO	TPDO	Remarks
6040h: control word	6041h: status word	Mandatory
60FFh: target velocity		Mandatory
	6064h: position actual value	Optional
	606Ch:velocity actual value	Optional
6083h: profile acceleration		Optional
6084h: profile deceleration		Optional
6060h: modes of operation	6061h: Modes of operation display	Optional

7.5 Profile torque mode (PT)

In this mode of operation, the controller gives the target torque in 6071h to the servo drive. Torque control is performed by the servo drive. The servo drive will supply actual position value, actual velocity value and actual torque value.

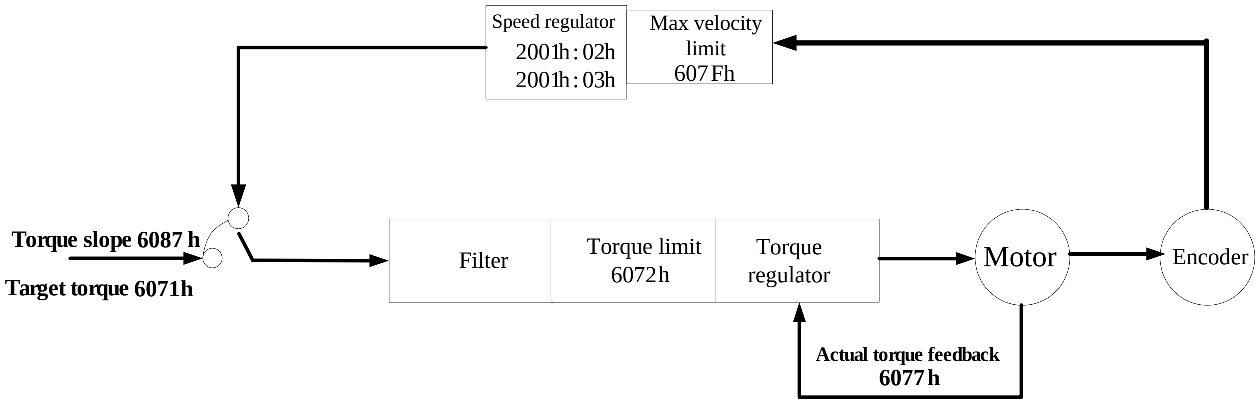


Fig 7.5.1 Block diagram for the PT mode

7.5.1 Related objects

Control word 6040h		
Bit	**Function**	**Description**
0	Switch on	If bit0 to bit3 are all 1, the servo drive starts running.
1	Enable voltage	
2	Quick stop	
3	Enable operation	
8	Halt	
Status word 6041h		
Bit	**Function**	**Description**
10	Target Reach	0: Target torque not reached 1: Target torque reached
12	Internal limit active	0: Position feedback not exceeding limit 1: Position feedback exceeding limit

Index	Sub-index	Name	Access	Data format	Unit	Setting range	Default
603Fh	00h	Error code	RO	UINT16	—	—	—
6040h	00h	Control word	RW	UINT16	—	0～65535	0
6041h	00h	Status word	RO	UINT16	—	0～65535	0
6060h	00h	Operation mode	RW	UINT16	—	—	0
6061h	00h	Mode display	RO	UINT16	—	—	—
6063h	00h	Position feedback	RO	DINT32	Encoder unit	—	—
6064h	00h	Position actual value	RO	DINT32	Command unit	—	—
6065h	00h	Position deviation threshold excessive	RW	UINT16	Command unit	1～32000	—

6067h	00h	Position arrival threshold	RW	DINT32	Command unit	1～32000	—
6068h	00h	Position arrival window	RW	INT16	ms	0～65535	0
606Ch	00h	Velocity actual value	RO	DINT32	0.1rpm	—	—
6071h	00h	Target torque	RW	INT16	1%	±800	0
6072h	00h	Max. torque	RW	UINT16	1%	0～800	200
6074h	00h	Torque demand value	RO	INT16	1%	—	—
6077h	00h	Torque actual value	RO	INT16	1%	—	—
607Fh	00h	Max profile velocity	RW	UDINT32	rpm	0～13000	—

7.5.2 Related functions

1）Torque reached.

Index	Sub-index	Name	Description
2002h	26h	Range of torque reached	When the difference between the actual torque and based value is larger than 2002h-26h, the signal of torque reached is output, and status word 6041h bit10 is set to 1. When the difference is smaller than 2002h-26h, the signal of torque reached is invalid, and status word 6041h bit10 is cleared to 0.

2）Speed Limit in torque control:

Index	Sub-index	Name	Access	Data format	Unit	Setting range	Default
2002h	0Bh	Speed limit source	RW	INT16	N/A	0～2	0

Value	Description
0	The speed limit is set in 2002h-0Ch.
1	Reserved
2	The speed limit is lower value between 607Fh and motor actual spe d.

7.5.3 Recommended configuration

The basic configuration for the PT mode is as below table:

RPDO	TPDO	备注
6040h: control word	6041h: status word	Mandatory

6071h: target torque		Mandatory
6087h: torque slope		Optional
	6064h: position actual value	Optional
	606Ch: velocity actual value	Optional
	6077h: torque actual value	Optional
6060h: modes of operation	6061h: Modes of operation display	Optional

7.6 Cyclic Synchronous Position Mode (CSP)

In this mode of operation, the host controller generates the position references and gives the target position in 607Ah to the servo drive using cyclic synchronization. Position control, speed control, and torque control are performed by the servo drive.

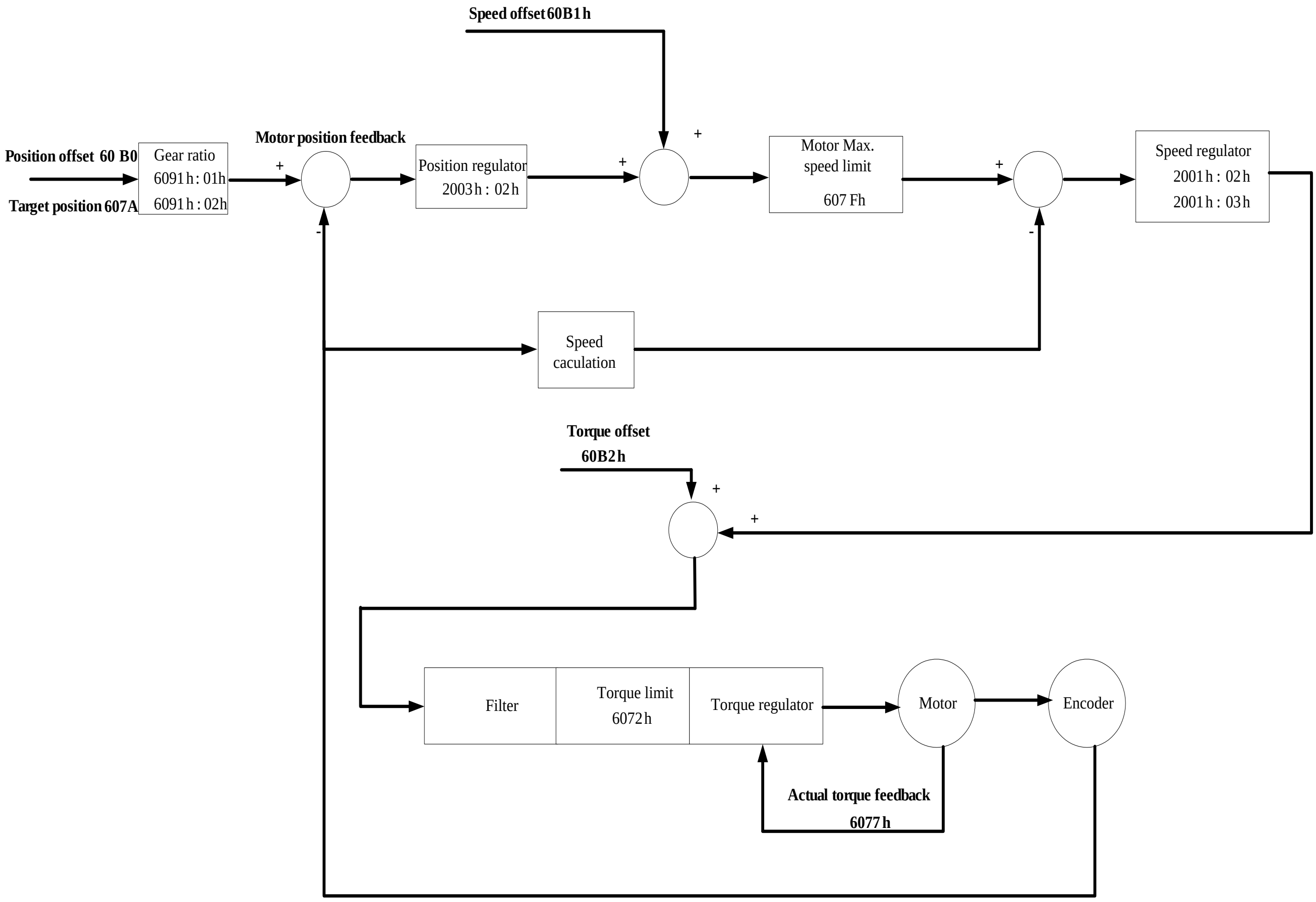


Fig 7.6.1 Configuration block diagram for CSP mode

7.6.1 Related object

<table>
<tr><th colspan="3">Control word 6040h</th></tr>
<tr><th>Bit</th><th>Function</th><th>Description</th></tr>
<tr><td>0</td><td>Switch on</td><td rowspan="5">If bit0 to bit3 are all 1, the servo drive starts running.</td></tr>
<tr><td>1</td><td>Enable voltage</td></tr>
<tr><td>2</td><td>Quick stop</td></tr>
<tr><td>3</td><td>Enable operation</td></tr>
<tr><td>8</td><td>Halt</td></tr>
<tr><th colspan="3">Status word 6041h</th></tr>
<tr><th>Bit</th><th>Function</th><th>Description</th></tr>
<tr><td>10</td><td>Target Reach</td><td>0: Target position not reached
1: Target position reached</td></tr>
<tr><td>11</td><td>Internal limit active</td><td>0: Both position references and feedback not exceeding limit
1: Position references or feedback exceeding limit</td></tr>
<tr><td>12</td><td>Drive follow the command value</td><td>0: Drive not following command
1: Drive following command
If the servo drive is in running state and starts to execute position references, this bit is set to 1, otherwise, it is set to 0.</td></tr>
<tr><td>13</td><td>Follow error</td><td>0: No position deviation excessive fault
1: Position deviation excessive fault present</td></tr>
</table>

Index	Sub-index	Name Code	access	Data type	Setting Unit	Setting range	Mfr's value
603Fh	00h	Error code	RO	UINT16	—	—	—
6040h	00h	Control word	RW	UINT16	—	0～65535	0
6041h	00h	Status word	RO	UINT16	—	0～65535	0
6060h	00h	Operation mode	RW	UINT16	—	—	0
6061h	00h	Mode display	RO	UINT16	—	—	—
6062h	00h	Actual position	RO	DINT32	Command unit	—	-
6063h	00h	Position feedback	RO	DINT32	Encoder unit	—	—
6064h	00h	Position actual value	RO	DINT32	Command unit	—	—
6065h	00h	Position deviation threshold	RW	UINT16	Command unit	1～32000	—

		excessive					
6067h	00h	Position arrival threshold	RW	DINT32	Encoder unit	0-65535	734
6068h	00h	Position arrival window	RW	UINT16	ms	0-65535	x10
606Ch	00h	Velocity actual value	RO	DINT32	0.1rpm	—	—
6072h	00h	Max torque	RW	UINT16	1%	0～800	200
6074h	00h	Torque demand value	RO	INT16	1%	—	—
6077h	00h	Torque actual value	RO	INT16	1%	—	—
607Ah	00h	Target position	RW	DINT32	Command unit	-2^{31}～+（2^{31}-1）	0
6091h	01h	Numerator of Gear ratio	RW	UDINT32	—	0～（2^{31}-1）	0
	02h	Denominator of electronic gear	RW	UDINT32	—	1～（2^{31}-1）	10000
60B0h	00h	Position offset	RW	DINT32	—	-2^{31}～+（2^{31}-1）	0
60B1h	00h	Velocity offset	RW	DINT32	0.01rpm	-1300000～1300000	0
60B2h	00h	Torque offset	RW	DINT32	0.1%	-1000～1000	0
60F4h	00h	Positional deviation	RO	DINT32	Command unit	—	—

7.6.2 Related function

1) Positioning completed:

Index	**Sub-index**	**Name**	**Description**
6067h	00h	Position arrival threshold	When the position deviation is within ±6067h, and the time reaches 6068h, the servo drive considers that the position is reached, and sets status word 6041h bit10 = 1 in position control mode. The position reached signal is invalid when either of the condition is not met.
6068h	00h	Position window	

3) Following error window:

Index	**Sub-index**	**Name**	**Description**

6065h	00h	Following error window	When the position deviation is higher than 6065h, AL-09 is displayed on the keypad, and bit13 of the status word is set to 1.

7.6.3 Recommended configuration

The basic configuration for the CSP mode is described in the following table:

RPDO	TPDO	Remarks
6040h: control word	6041h: status word	Mandatory
607Ah: target velocity	6064h: position actual value	Mandatory
6060h: modes of operation	6061h: Modes of operation display	Optional

7.7 Cyclic Synchronous Velocity Mode（CSV）

In this mode of operation, the host controller gives the target speed in 60FFh to the servo drive using cyclic synchronization. Speed control and torque control are performed by the servo drive.

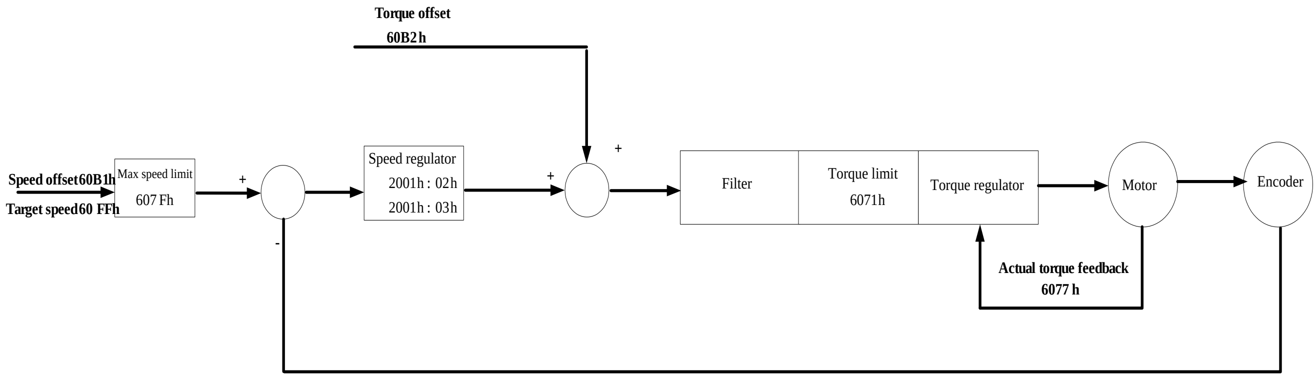


Fig 7.7.1 Configuration block diagram for CSV mode

7.7.1 Related objects

Control Word 6040		
Bit	**Name**	**Description**
0	Switch on	If bit0 to bit3 are all 1, the servo drive starts running.
1	Enable voltage	
2	Quick stop	
3	Enable operation	
8	Halt	

Status word 6041		
Bit	**Name**	**Description**
10	Target Reached	0: Target velocity not reached 1: Target velocity reached
12	Drive follow the command value	0: Drive not following command 1: Drive following command

Index	Sub-index	Name code	Access	Data type	Setting unit	Setting range	Mfr's value
603Fh	00h	Error code	RO	UINT16	—	—	—
6040h	00h	Control word	RW	UINT16	—	0～65535	0
6041h	00h	Status word	RO	UINT16	—	0～65535	0
6060h	00h	Operation mode	RW	UINT16	—	—	0
6061h	00h	Mode display	RO	UINT16	—	—	—
6063h	00h	Position feedback value	RO	DINT32	Encoder unit	—	—
6064h	00h	Position actual value	RO	DINT32	Command unit	—	—
606Ch	00h	Velocity actual value	RO	DINT32	0.1rpm	—	—
6077h	00h	Torque actual value	RO	INT16	1%	—	—
607Fh	00h	Max profile velocity	RW	UDINT32	rpm	0～13000	—
6083h	00h	Profile accel time	RW	UINT16	ms	0～32000	100
6084h	00h	Profile decel time	RW	UINT16	ms	0～32000	100
60B1h	00h	Velocity offset	RW	DINT32	0.01rpm	-1300000～1300000	0
60B2h	00h	Torque offset	RW	DINT32	0.1%	-1000～1000	0
60E0h	00h	Forward torque limit	RW	INT16	1%	0～800	100
60FFh	00h	Target velocity	RW	DINT32	0.1rpm	-130000～130000	0

7.7.2 Related functions

Index	Sub-index	Name	Description
606Dh	00	Velocity arrival threshold	When the difference between 60FFh (converted into motor speed/RPM) and actual motor speed is within ±606Dh, and the time reaches 606Eh, the servo drive considers that the speed reference is reached, sets status word 6041h bit10 = 1 and activates the speed reached DO signal. This flag bit is valid only when S-ON signal is valid in profile position mode and cyclic synchronous velocity mode.
606Eh	00	Velocity window	

7.7.3 Recommended configuration

The basic configuration for the CSV mode is described in the following table:

RPDO	TPDO	Remarks
6040h: control word	6041h: status word	Mandatory
60FFh: target velocity		Mandatory
	6064h: position actual value	Optional
	606Ch: velocity actual value	Optional
6060h: modes of operation	6061h: Modes of operation display	Optional

7.8 Cyclic Synchronous Torque Mode（CST）

In this mode of operation, host controller gives the target torque in 6071h to the servo drive using cyclic synchronization. Torque control is performed by the servo drive. The servo drive will supply actual position value, actual speed value and actual torque value.

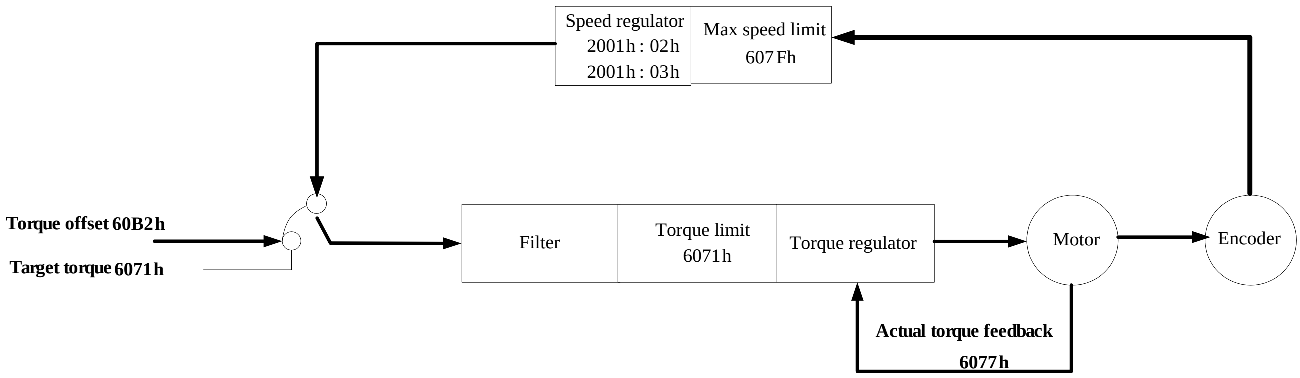


Fig 7.8.1 Configuration block diagram for CST mode

7.8.1 Related objects

Control Word 6040h		
Bit	**Name**	**Description**

0	Switch on	If bit0 to bit3 are all 1, the servo drive starts running.
1	Enable voltage	
2	Quick stop	
3	Enable operation	
8	Halt	
Status word 6041h		
Bit	**Name**	**Description**
10	Target Reached	0: Target torque not reached 1: Target torque reached
12	Drive follow the command value	0: Drive not following command 1: Drive following command

Index	Sub -index	Name code	access	Data type	Setting unit	Setting range	Mfr's value
603Fh	00h	Error code	RO	UINT16	—	—	—
6040h	00h	Control word	RW	UINT16	—	0～65535	0
6041h	00h	Status word	RO	UINT16	—	0～65535	0
6060h	00h	Operation mode	RW	UINT16	—	—	0
6061h	00h	Mode display	RO	UINT16	—	—	—
6063h	00h	Position feedback value	RO	DINT32	Encoder unit	—	—
6064h	00h	Position actual value	RO	DINT32	Command unit	—	—
606Ch	00h	Velocity actual value	RO	DINT32	0.1rpm	—	—
6071h	00h	Target torque	RW	INT16	1%	±800	0
6072h	00h	Max torque	RW	UINT16	1%	0～800	200
6074h	00h	Torque demand value	RO	INT16	1%	—	—
6077h	00h	Torque actual value	RO	INT16	1%	—	—
607Fh	00h	Max profile velocity	RW	UDINT32	rpm	0～13000	—
60B2h	00h	Torque offset	RW	DINT32	0.1%	-1000 ～1000	0
60E0h	00h	Forward torque limit	RW	INT16	1%	0～800	100

7.8.2 Related functions

1）Torque reached

Index	Sub-index	Name	Description

2002h	26h	Torque reached range	When the difference between the actual torque and based value is larger than 2002h-26h, the torque reached signal is output, and status word 6041h bit10 is set to 1. When the difference is smaller than 2002h-26h, the torque reached signal is invalid, and status word 6041h bit10 is cleared to 0.

7.8.3 Recommended configuration

The basic configuration for the CST mode is described in the following table:

RPDO	TPDO	Remarks
6040h: control word	6041h: status word	Mandatory
6071h: target torque		Mandatory
	6064h: position actual value	Optional
	606Ch: velocity actual value	Optional
	6077h:torque actual value	Optional
6060h: modes of operation	6061h: Modes of operation display	Optional

7.9 Homing mode (HM)

This mode searches for home and determines the position relationship between home and zero.
Home: mechanical home reference point, that is, the motor Z signal.
Zero: absolute zero point in the machine
After homing is completed, the motor stops at the home. The relationship between home and zero is set in 607Ch.
Home = Zero + 607Ch (Home offset)
When 607Ch = 0, the zero is the same as the home.

7.9.1 Related objects

<table>
<tr><th colspan="4">Control Word 6040h</th></tr>
<tr><th>Bit</th><th>Name</th><th colspan="2">Description</th></tr>
<tr><td>0</td><td>Switch on</td><td>1: Valid, 0: Invalid</td><td rowspan="4">If bit0 to bit3 are all 1, the servo
drive starts running.</td></tr>
<tr><td>1</td><td>Enable voltage</td><td>1: Valid, 0: Invalid</td></tr>
<tr><td>2</td><td>Quick stop</td><td>1: Valid, 0: Invalid</td></tr>
<tr><td>3</td><td>Enable operation</td><td>1: Valid, 0: Invalid</td></tr>
<tr><td>4</td><td>Homing star</td><td colspan="2">0->1： Homing start
1： Homing ongoing
1->0： Homing end</td></tr>
<tr><td>8</td><td>Halt</td><td colspan="2">0: The servo drive determines whether to start homing</td></tr>
</table>

Bit	Name	Description
		according to bit4 setting. 1: The servo drive halts according to 605Dh.
Status word 6041h		
Bit	**Name**	**Description**
10	Target reached	0: Target position not reached 1: Target position reached
12	Homing attained	0: Homing failed 1: Homing successful This flag bit is valid when the drive is in homing mode in running state and the target reached signal is active.
13	Homing error	0: No homing error 1: Homing timeout or deviation excessive

Index	Sub-index	Name	Access	Data format	Unit	Setting range	Default
603Fh	00h	Error code	RO	UINT16	—	0-65535	0
6040h	00h	Control word	RW	UINT16	—	0-65535	0
6041h	00h	Status word	RO	UINT16	—	0-xFFFF	0
6060h	00h	Operation mode	RW	INT8	—	0-10	0
6061h	00h	Mode display	RO	INT8	—	0-10	0
6062h	00h	Actual position	RO	DINT32	Command unit	—	-
6064h	00h	Position feedback	RO	DINT32	Command unit	—	-
6067h	00h	Position reached threshold	RW	DINT32	Encoder unit	0-65535	734
6068h	00h	Position window	RW	INT16	ms	0-65535	x10
6077h	00h	Torque actual value	RO	INT16	0.1%	—	0
606Ch	00h	Speed actual value	RO	DINT32	0.1rpm	—	-
6098h	00h	Homing method	RW	INT16	—	-1-35	0
6099h	01h	First speed during search for zero	RW	UINT16	0.1rpm	0-20000	500
	02h	Second speed	RW	UINT16	0.1rpm	0-10000	200

		during search for zero					
609Ah	00h	Acceleration time	RW	UINT16	ms	0-1000	0
2001h	1Eh	Deceleration time	RW	UINT16	ms	100-65535	10000
60F4h	00h	Position deviation	RO	DINT32	Command unit	—	—

7.9.2 Related functions

1）Homing timeout

Index	Sub-index	name	Description
2001h	1Eh	Duration limit of homing	If homing is not completed within the duration, AL-35 will be detected, indicating homing timeout.

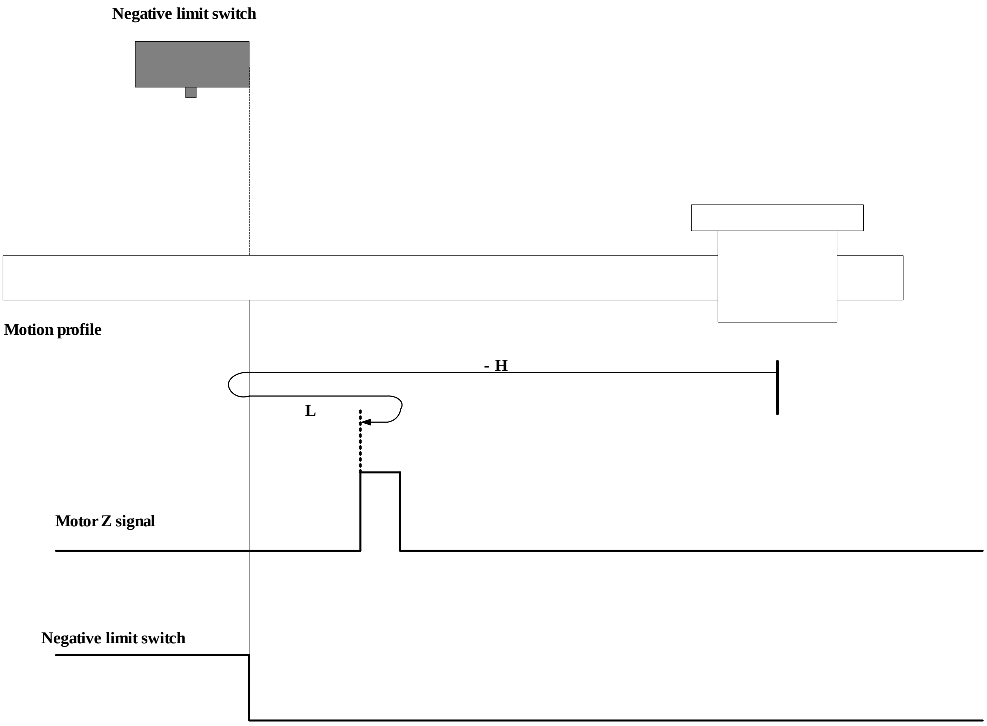
7.9.3 Homing operation

1）6098h=1

Home: motor Z signal

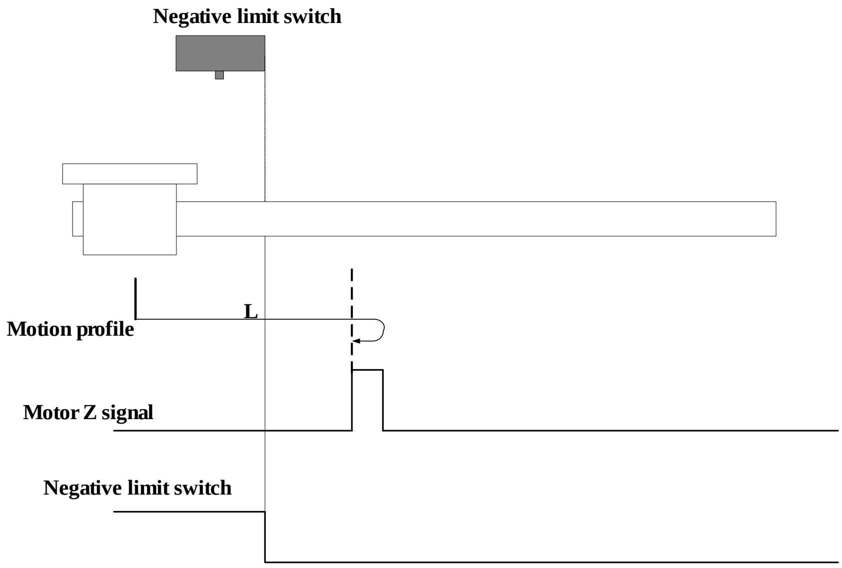
Deceleration point: negative limit switch

a） Deceleration point signal inactive at homing start



Note: in the figure, “H” represents high speed, “L” represents low speed.
When homing starts and R-INH=0, the motor starts homing in negative direction at high speed. After reaching the rising edge of the R-INH signal, the motor decelerates and changes to run in positive direction at low speed. After reaching the falling edge of the R-INH signal, the motor stops at the first motor Z signal.

b) Deceleration point signal active at homing start



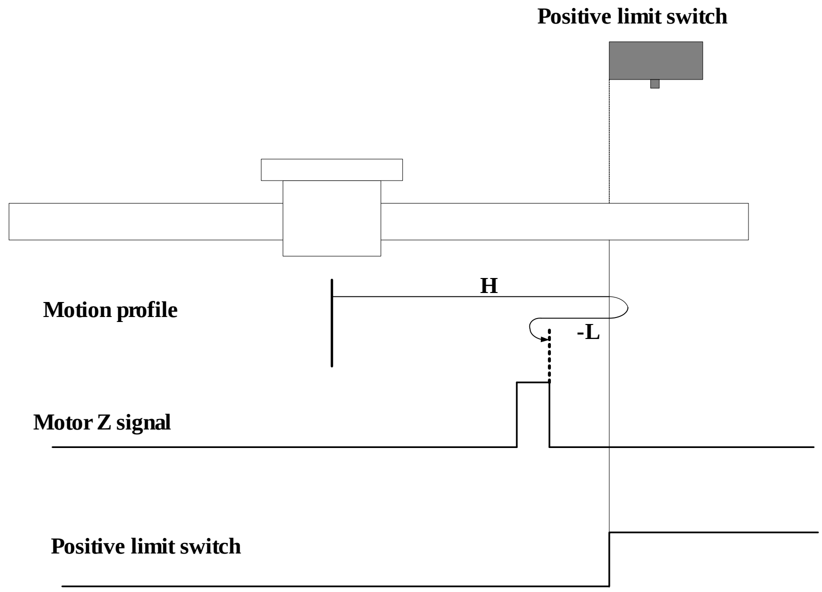
When homing starts and R-INH=1, the motor directly starts homing in positive direction at low speed. After reaching the falling edge of the R-INH signal, motor stops at first motor Z signal.

2)6098h=2

Home: motor Z signal

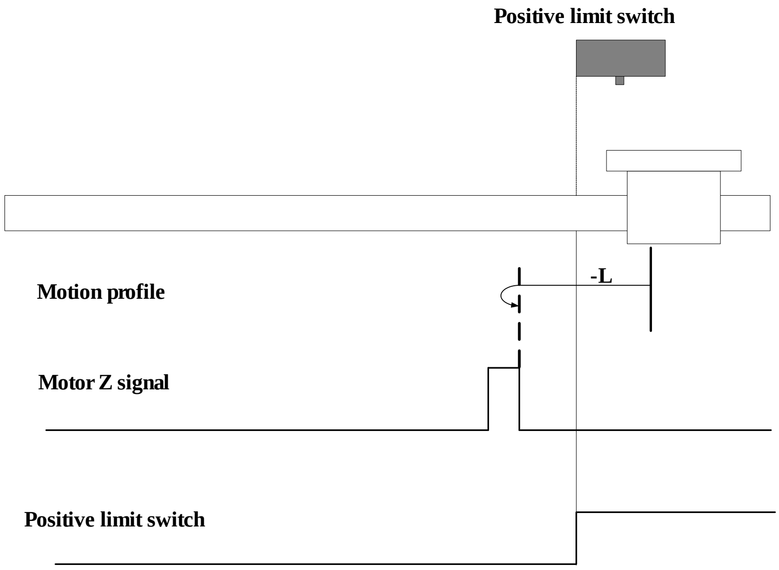
Deceleration point: positive limit switch

a） Deceleration point signal inactive at homing start



When homing starts and F-INH=0, the motor starts homing in positive direction at high speed. After reaching the rising edge of the F-INH signal, the motor decelerates and changes to run in negative direction at low speed. After reaching the falling edge of the F-INH signal, the motor stops at the first motor Z signal.

b） Deceleration point signal active at homing start



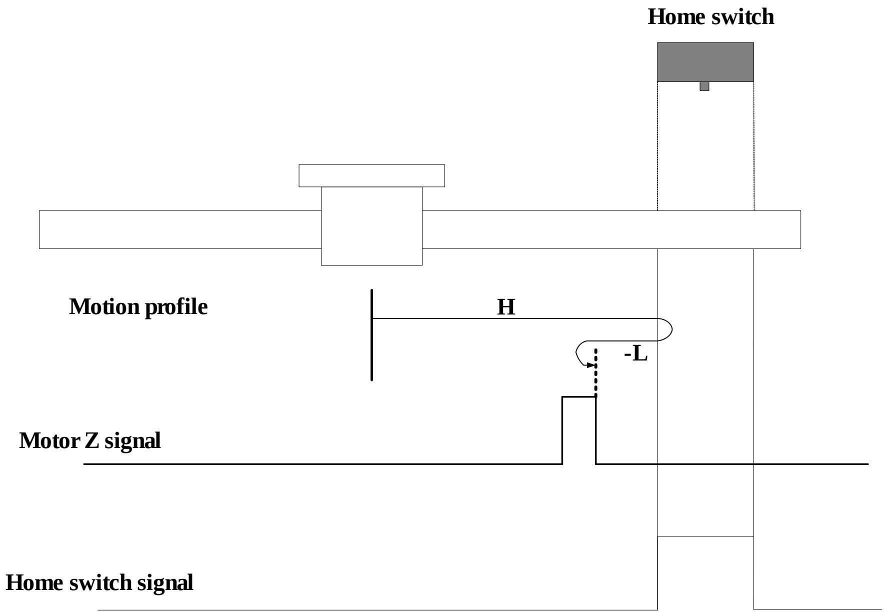
When homing starts and F-INH=1, the motor directly starts homing in positive direction at low speed. After reaching the falling edge of F-INH signal, motor stops at the first motor Z signal.

3）6098h=3

Home: motor Z signal

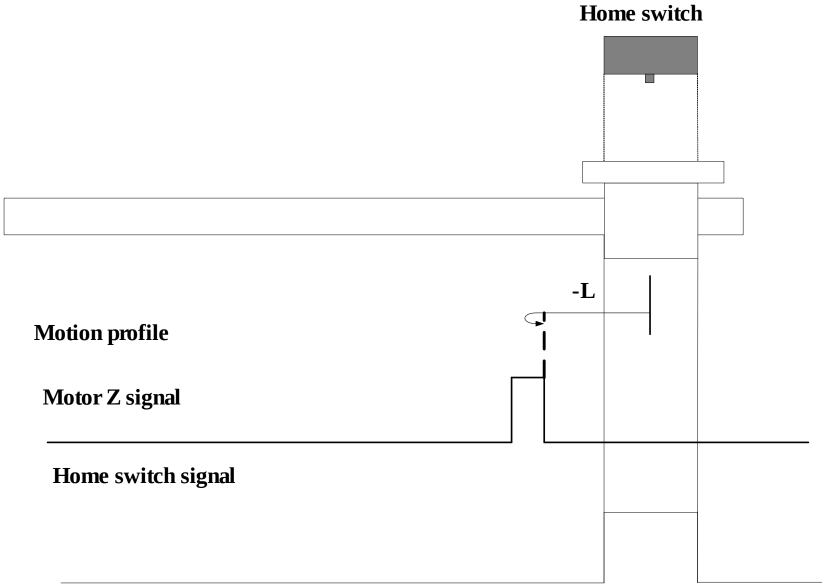
Deceleration point: home switch

a） Deceleration point signal inactive at homing start



When homing starts and ORGP=0, the motor starts homing in positive direction at high speed. After reaching the rising edge of the ORGP signal, the motor decelerates and changes to run in negative direction at low speed. After reaching the falling edge of the ORGP signal, the motor stops at the first motor Z signal.

b）Deceleration point signal active at homing start



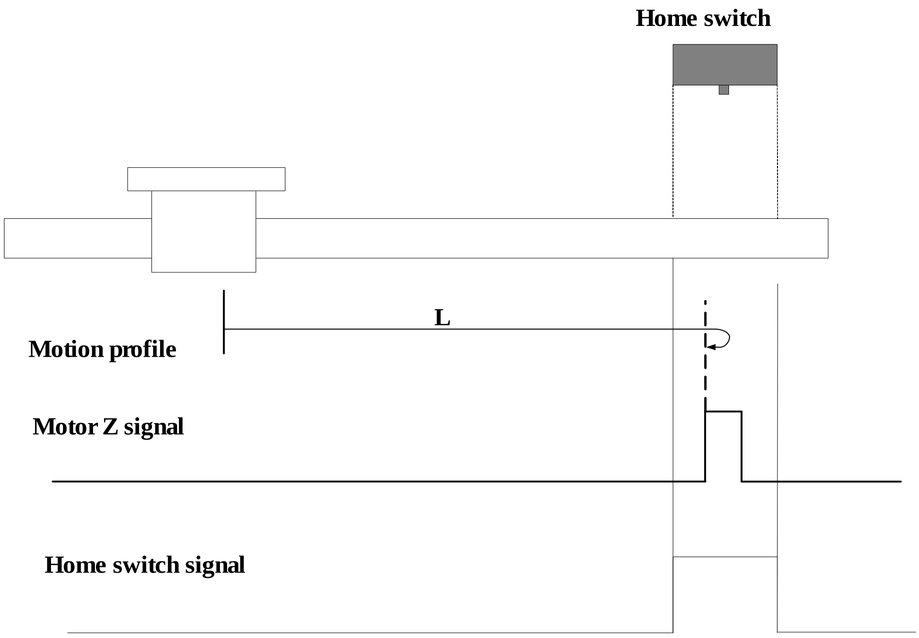
When homing starts and ORGP=1, the motor directly starts homing in positive direction at low speed. After reaching the falling edge of the ORGP signal, the motor stops at the first motor Z signal

4）6098h=4

Home: motor Z signal

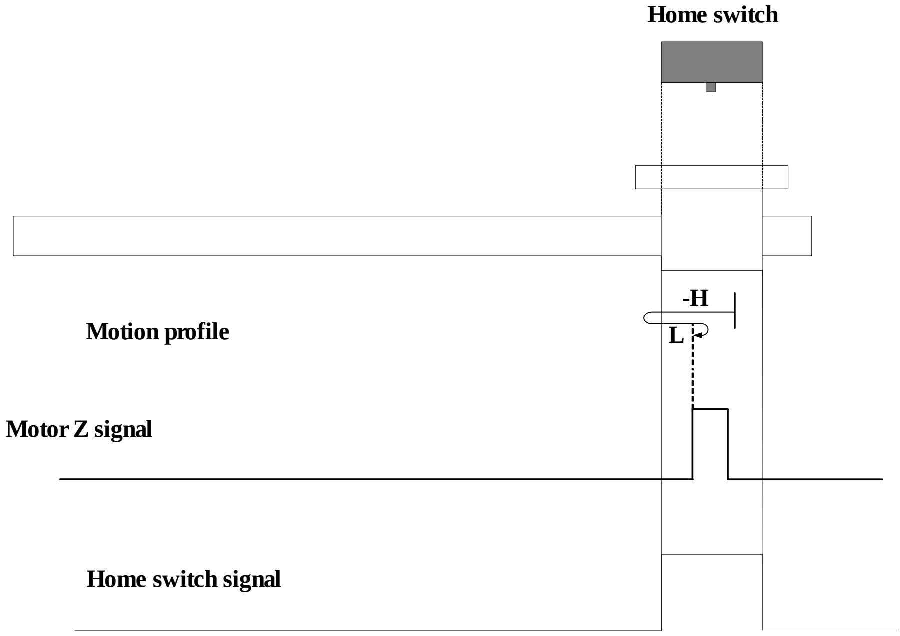
Deceleration point: home switch

a） Deceleration point signal inactive at homing start



When homing starts and ORGP=0, the motor directly starts homing in positive direction at low speed. After reaching the rising edge of the ORGP signal, motor stops at first motor Z signal.

b） Deceleration point signal active at homing start



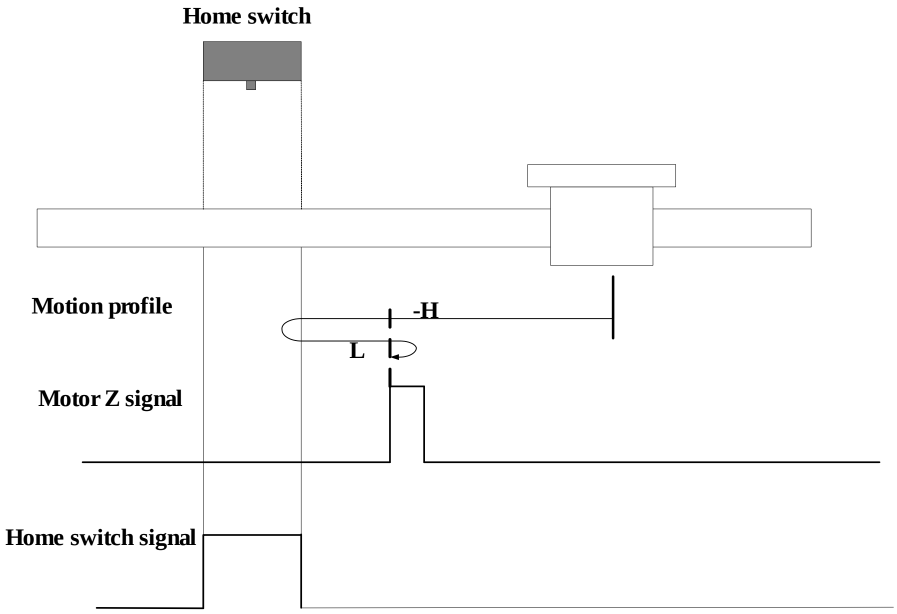
When homing starts and ORGP=1, the motor directly starts homing in negative direction at high speed. After reaching the falling edge of the ORGP signal, the motor decelerates and changes to run in negative direction at low speed. After reaching the rising edge of the ORGP signal, the motor stops at the first motor Z signal.

5) 6098h=5

Home: motor Z signal

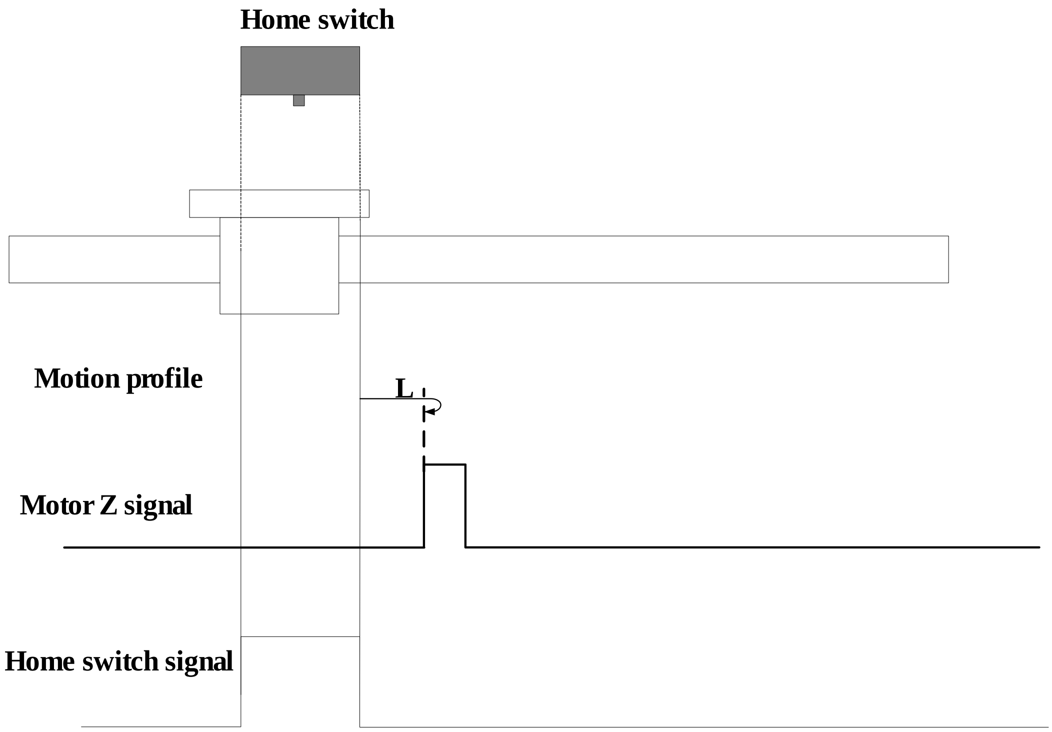
Deceleration point: home switch

a） Deceleration point signal inactive at homing start



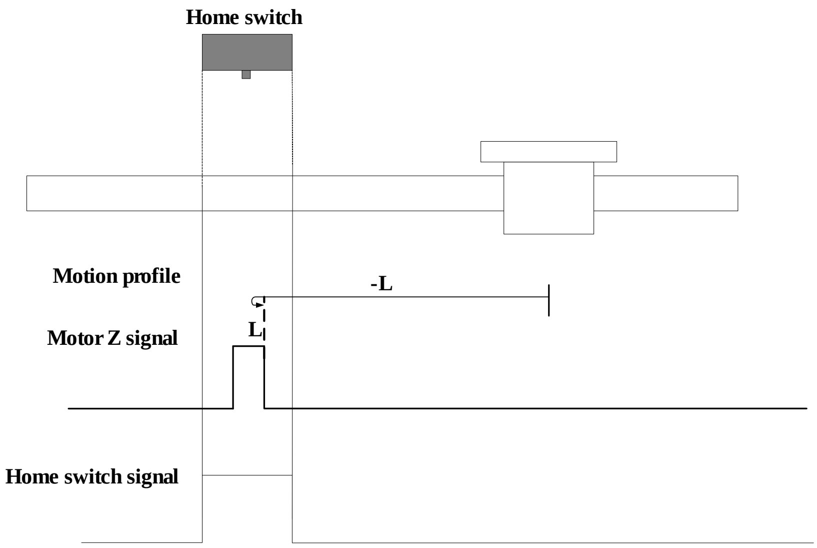
When homing starts and ORGP=0, the motor directly starts homing in negative direction at high speed. After reaching the rising edge of the ORGP signal, the motor decelerates and changes to run in positive direction at low speed. After reaching the falling edge of the ORGP signal, the motor stops at the first motor Z signal.

b） Deceleration point signal active at homing start



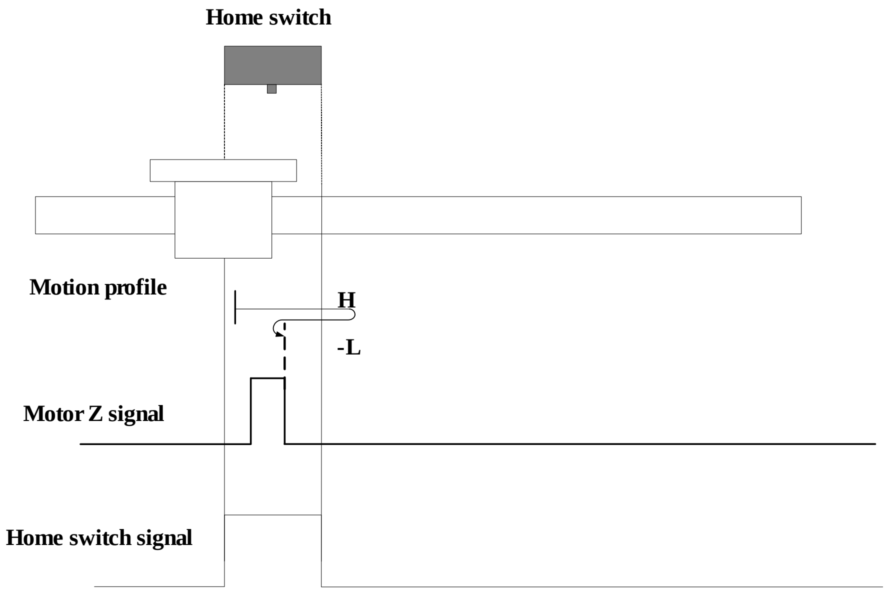
When homing starts and ORGP=1, the motor directly starts homing in positive direction at low speed. After reaching the falling edge of the ORGP signal, the motor stops at the first motor Z signal.

6）6098h=6
Home: motor Z signal
Deceleration point: home switch
a） Deceleration point signal inactive at homing start



When homing starts and ORGP=0, the motor directly starts homing in positive direction at low speed. After reaching the rising edge of the ORGP signal, the motor stops at the first motor Z signal.

b） Deceleration point signal active at homing start



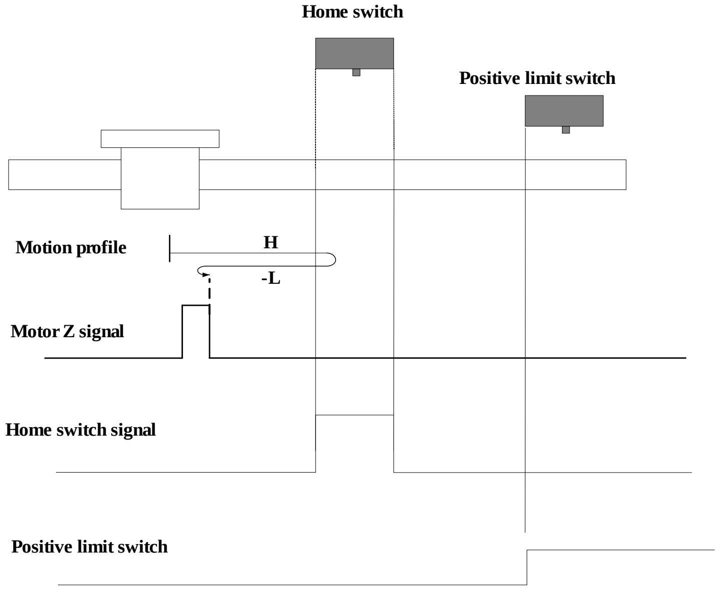
When homing starts and ORGP=1, the motor directly starts homing in positive direction at high speed. After reaching the falling edge of the ORGP signal, the motor decelerates and changes to run in negative direction at low speed. After reaching the rising edge of the ORGP signal, the motor stops at the first motor Z signal.

7）6098h=7

Home: motor Z signal

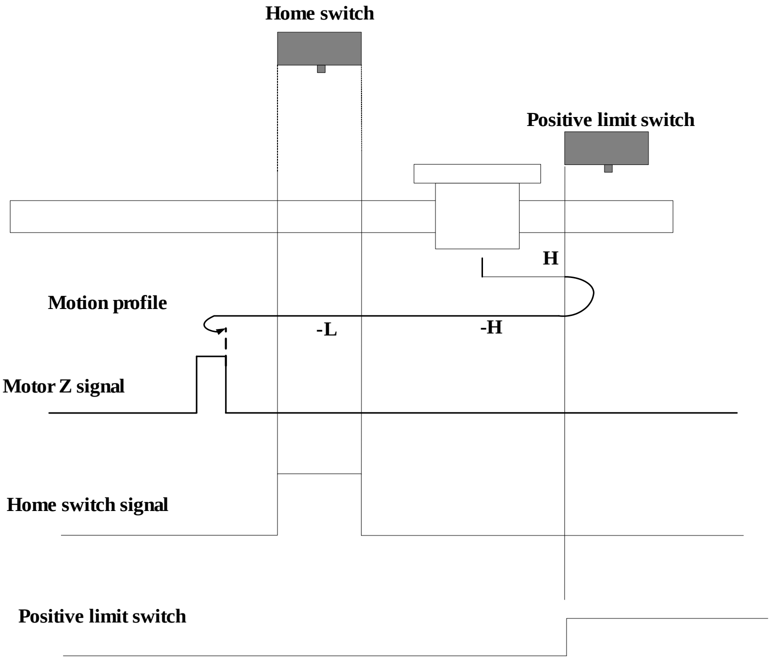
Deceleration point: home switch

a） Deceleration point signal inactive at homing start, not reaching positive limit switch



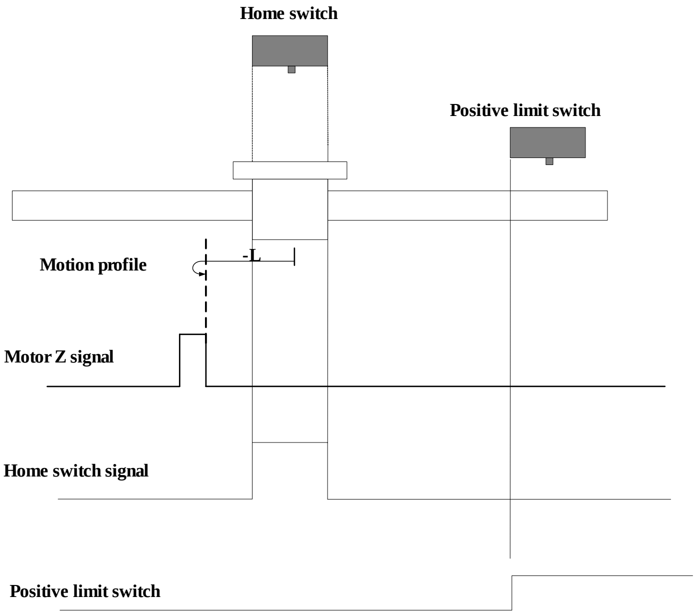
When homing starts and ORGP=0, the motor directly starts homing in positive direction at high speed. If the motor does not reach the limit switch, it decelerates and changes to run in negative direction at low speed after reaching rising edge of the ORGP signal. After reaching falling edge of the ORGP signal, the motor stops at first motor Z signal.

b） Deceleration point signal inactive at homing start, reaching positive limit switch



When homing starts and ORGP=0, the motor directly starts homing in positive direction at high speed. If the motor does not reach the limit switch, it automatically changes to run in negative direction at high speed. After reaching the rising edge of the ORGP signal, the motor decelerates and continues to run in negative direction at low speed. After reaching the falling edge of ORGP signal, the motor stops at first motor Z signal.

c） Deceleration point signal active at homing start



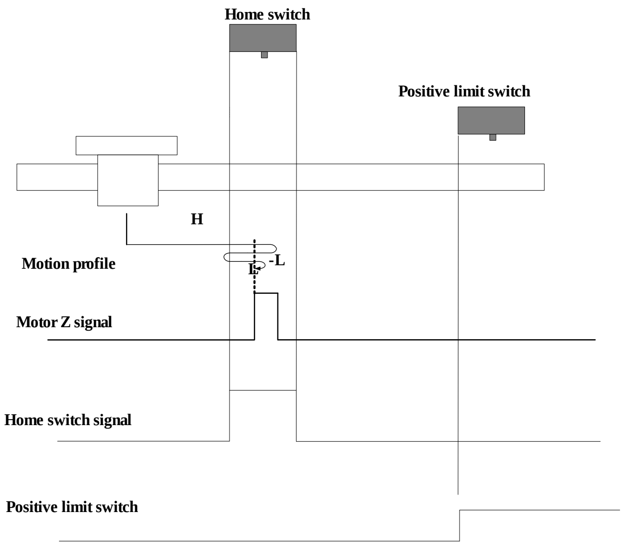
When homing starts and ORGP=1, the motor directly starts homing in negative direction at low speed. After reaching the falling edge of the ORGP signal, the motor stops at the first motor Z signal.

8）6098h=8

Home: motor Z signal

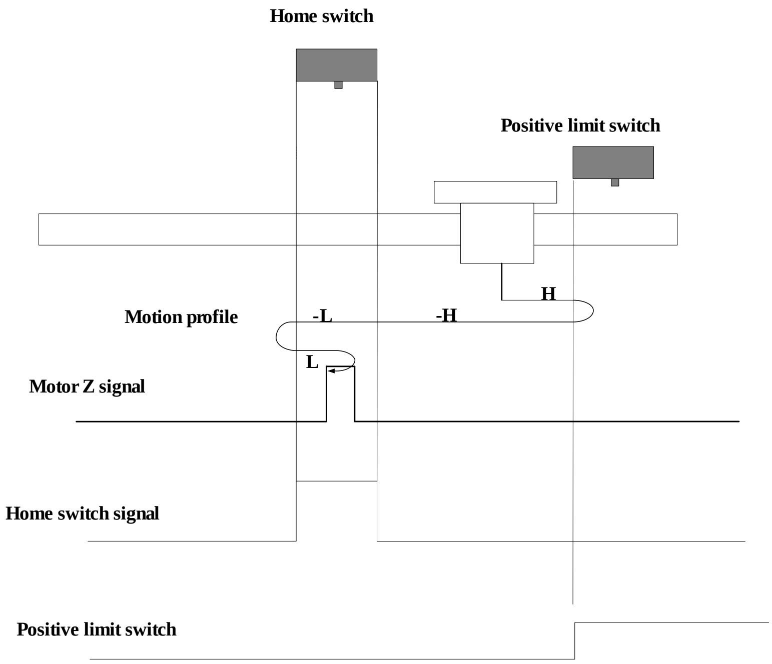
Deceleration point: home switch

a) Deceleration point signal inactive at homing start, not reaching positive limit switch



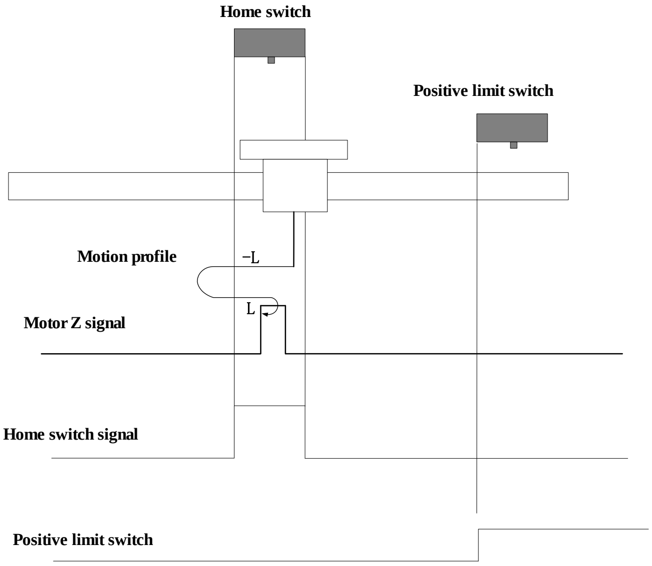
When homing starts and ORGP=0, the motor directly starts homing in positive direction at high speed. If the motor does not reach the limit switch, it decelerates and changes to run in negative direction at low speed after reaching the rising edge of the ORGP signal. After reaching the falling edge of the ORGP signal, the motor changes to run in positive direction at low speed. After reaching the rising edge of the ORGP signal, the motor stops at the first motor Z signal.

b) Deceleration point signal inactive at homing start, reaching positive limit switch



When homing starts and ORGP=0, the motor directly starts homing in positive direction at high speed. If the motor reaches the limit switch, it automatically changes to run in negative direction at high speed. After reaching the rising edge of the ORGP signal, the motor decelerates in negative direction at low speed. After reaching the falling edge of the ORGP signal, the motor changes to run in positive direction at low speed. After reaching the rising edge of the ORGP signal, the motor stops at the first motor Z signal.

c）Deceleration point signal active at homing start, not reaching positive limit switch



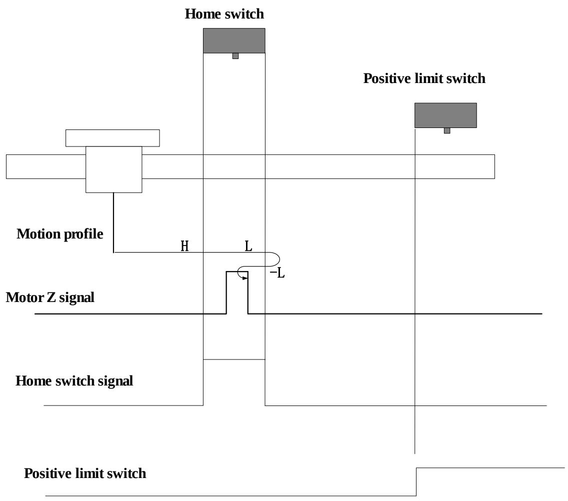
When homing starts and ORGP=1, the motor directly starts homing in negative direction at low speed. The motor changes to run in positive direction at low speed after reaching the falling edge of the ORGP signal. After reaching the rising edge of the ORGP signal, the motor stops at the first motor Z signal.

9）6098h=9

Home: motor Z signal

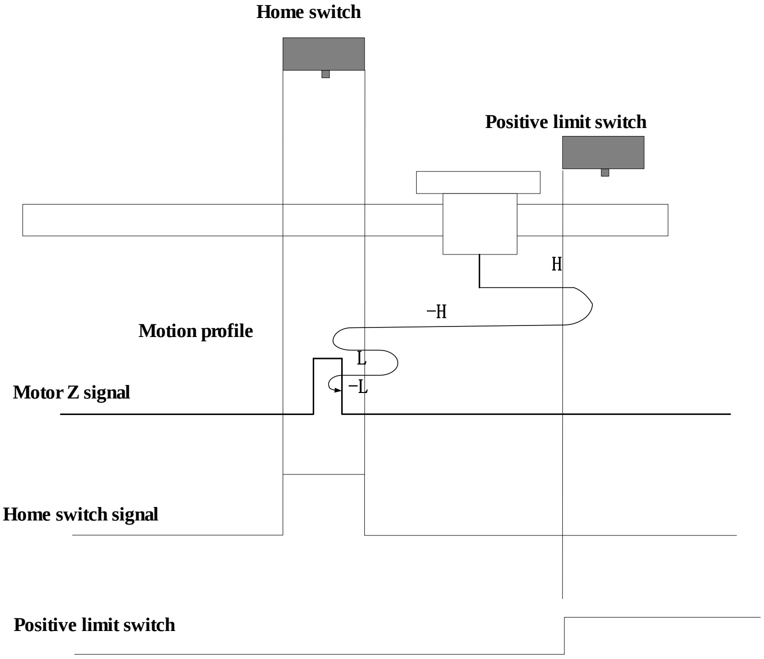
Deceleration point: home switch

a）Deceleration point signal inactive at homing start, not reaching positive limit switch



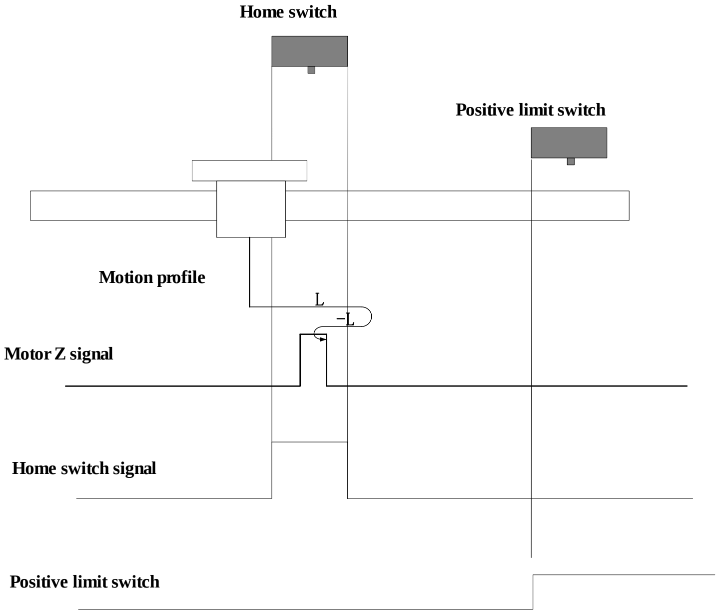
When homing starts and ORGP=0, the motor directly starts homing in positive direction at high speed. If the motor does not reach the limit switch, the motor decelerates in positive direction at low speed after reaching the rising edge of the ORGP signal. After reaching the falling edge of the ORGP signal, the motor changes to run in positive direction at low speed. After reaching the rising edge of the ORGP signal, the motor stops at the first motor Z signal.

b）Deceleration point signal inactive at homing start, reaching positive limit switch



When homing starts and ORGP=0, the motor directly starts homing in positive direction at high speed. If the motor reaches the limit switch, it automatically changes to run in negative direction at high speed. After reaching the rising edge of the ORGP signal, the motor decelerates in positive direction at low speed. After reaching the falling edge of the ORGP signal, the motor changes to run in negative direction at low speed. After reaching the rising edge of the ORGP signal, the motor stops at the first motor Z signal.

c）Deceleration point signal active at homing start



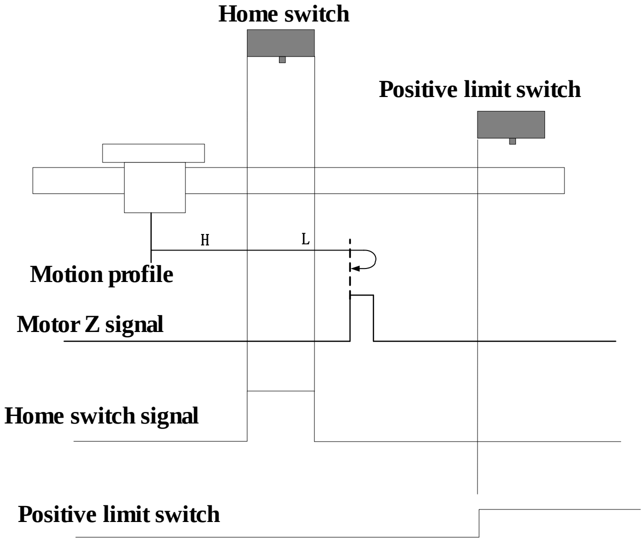
When homing starts and ORGP=1, the motor directly starts homing in positive direction at low speed. After reaching the falling edge of the ORGP signal, the motor changes to run in negative direction at low speed. After reaching the rising edge of the ORGP signal, the motor stops at the first motor Z signal

10）6098h=10

Home: motor Z signal

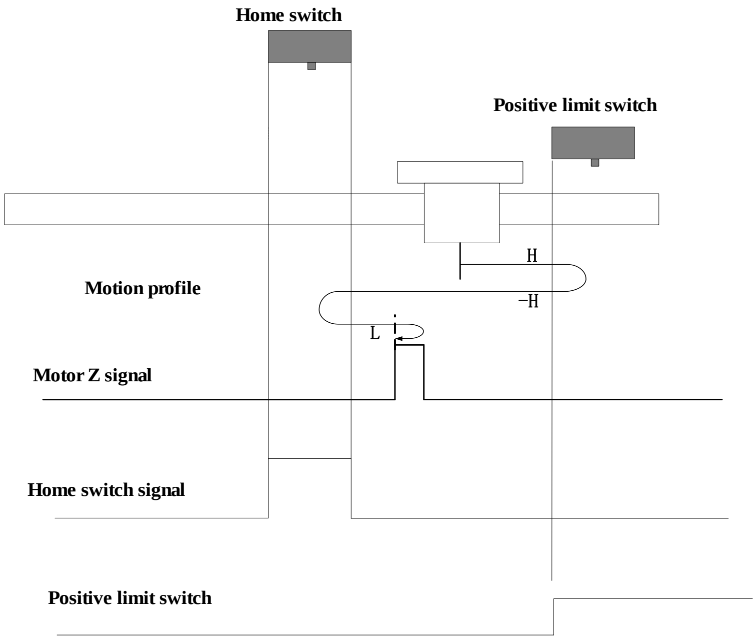
Deceleration point: home switch

a）Deceleration point signal inactive at homing start, not reaching positive limit switch



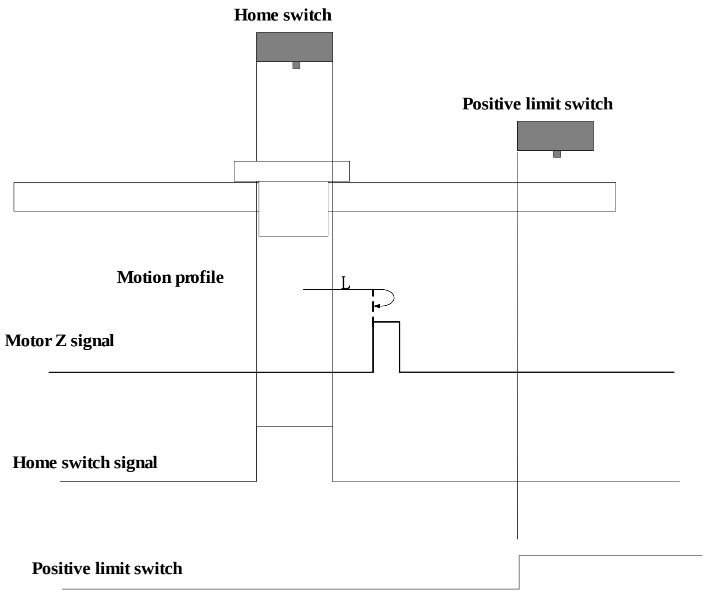
When homing starts and ORGP=0, the motor directly starts homing in positive direction at high speed. If the motor does not reach the limit switch, the motor decelerates in positive direction at low speed after reaching the rising edge of the ORGP signal. After reaching the falling edge of the ORGP signal, the motor continues running in positive direction at low speed and the motor stops at the first motor Z signal.

b）Deceleration point signal inactive at homing start, reaching positive limit switch



When homing starts and ORGP=0, the motor directly starts homing in positive direction at high speed. If the motor reaches the limit switch, it automatically changes to run in negative direction at high speed. After reaching the rising edge of the ORGP signal, the motor decelerates and resumes to run in positive direction at low speed. After reaching the falling edge of the ORGP signal, the motor stops at the first motor Z signal.

c）Deceleration point signal active at homing start



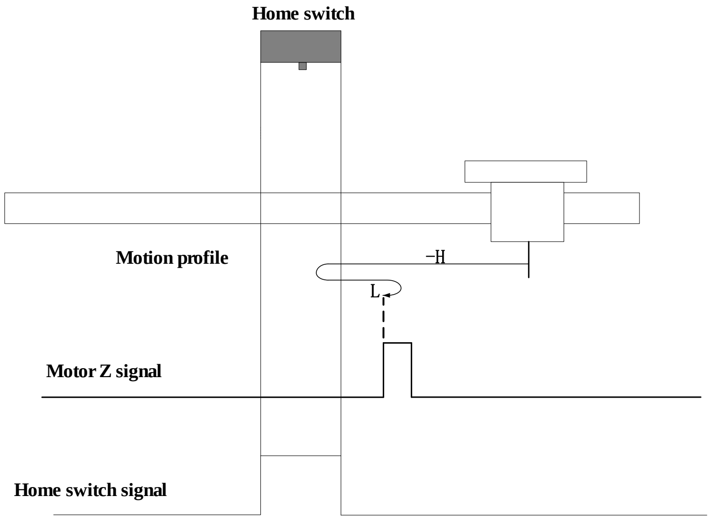
When homing starts and ORGP=1, and the motor directly starts homing in positive direction at low speed. After reaching the falling edge of the ORGP signal, the motor stops at the first motor Z signal.

11）6098h=11

Home: motor Z signal

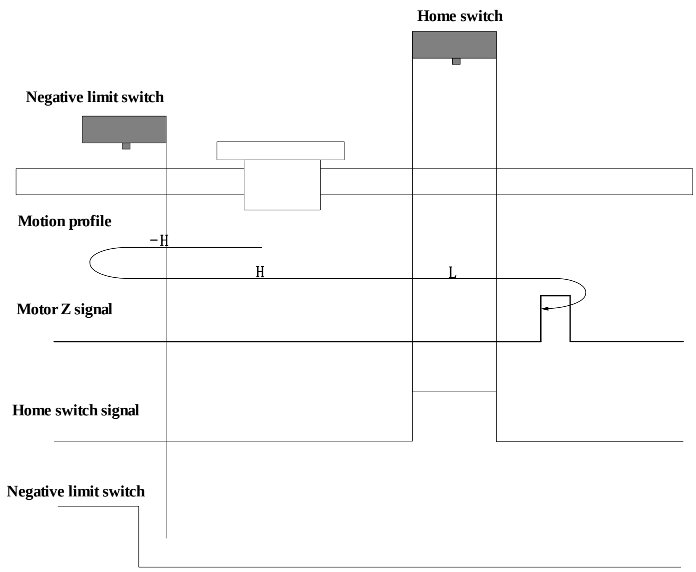
Deceleration point: home switch

a）Deceleration point signal inactive at homing start, not reaching negative limit switch



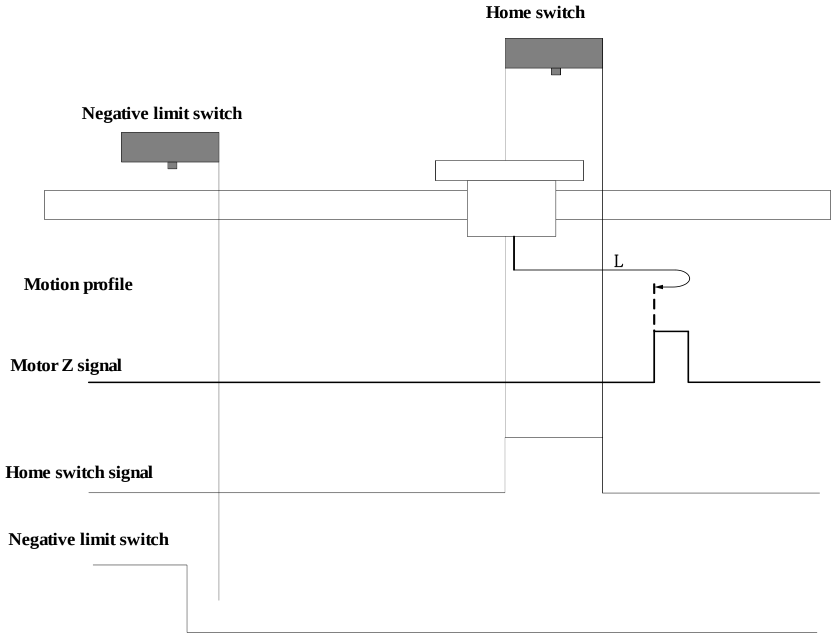
When homing starts and ORGP=0, the motor directly starts homing in negative direction at high speed. If the motor does not reach the limit switch, the motor decelerates and runs in negative direction at low speed after reaching the rising edge of the ORGP signal. After reaching the falling edge of ORGP signal, the motor stops at first motor Z signal.

b）Deceleration point signal inactive at homing start, reaching negative limit switch



When homing starts and ORGP=0, the motor directly starts homing in negative direction at high speed. If the motor reaches the limit switch, the motor automatically changes to run in positive direction at high speed. After reaching the rising edge of the ORGP signal, the motor decelerates and continues to run in negative direction at low speed. After reaching the falling edge of the ORGP signal, the motor stops at the first motor Z signal.

c）Deceleration point signal active at homing start



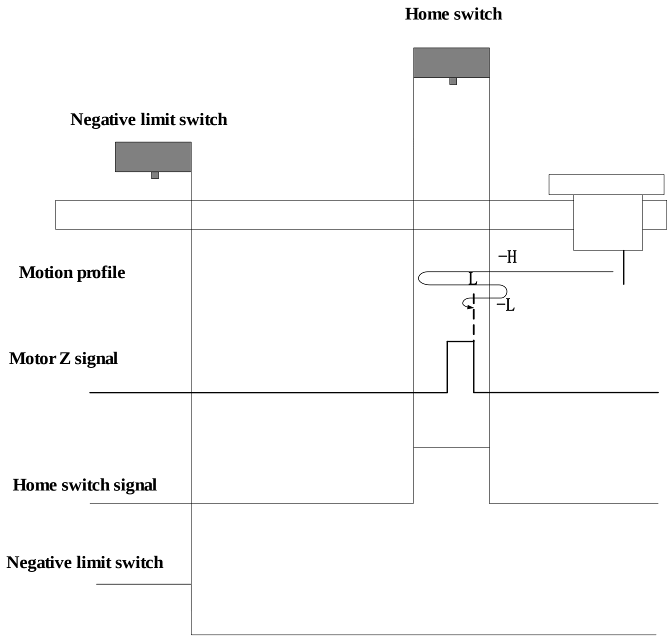
When homing starts and ORGP=1, and the motor directly starts homing in positive direction at low speed. After reaching the falling edge of the ORGP signal, the motor stops at the first motor Z signal.

12）6098h=12

Home: motor Z signal

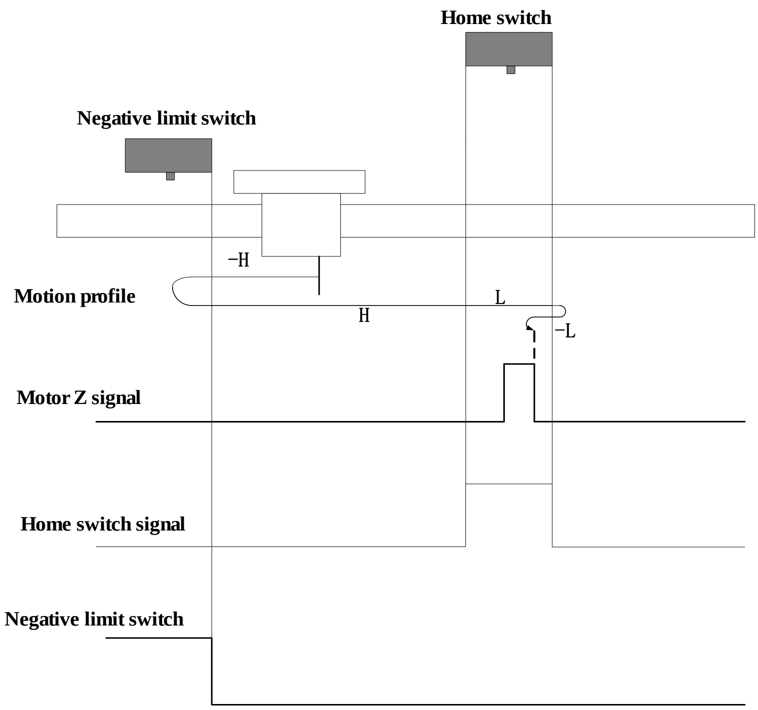
Deceleration point: home switch

a）Deceleration point signal inactive at homing start, not reaching negative limit switch



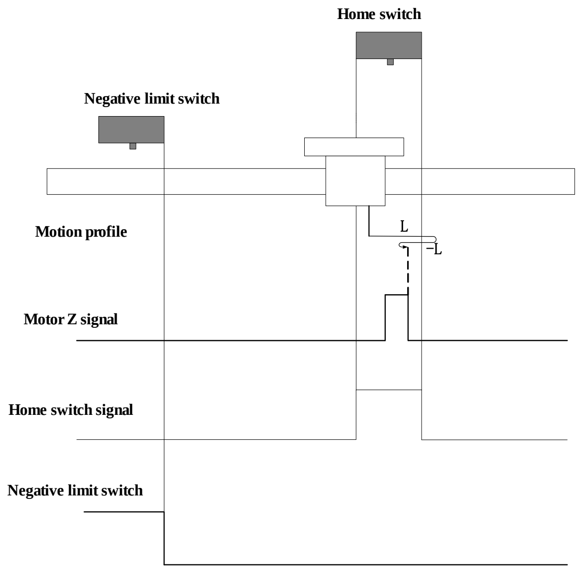
When homing starts and ORGP=0, the motor starts homing in negative direction at high speed. If the motor does not reach the limit switch, the motor decelerates and changes to run in positive direction at low speed after reaching the rising edge of the ORGP signal. After reaching the falling edge of the ORGP signal, the motor changes to run in negative direction at low speed. After reaching the rising edge of the ORGP signal, the motor stops at the first motor Z signal.

b）Deceleration point signal inactive at homing start, reaching positive limit switch



When homing starts and ORGP=0, the motor starts homing in negative direction at high speed. If the motor reaches the limit switch, the motor automatically changes to run in positive direction at high speed. After reaching the rising edge of the ORGP signal, the motor decelerates and runs in positive direction at low speed. After reaching the falling edge of the ORGP signal, the motor changes to run in negative direction at low speed. After reaching the rising edge of ORGP signal, the motor stops at first motor Z signal.

c）Deceleration point signal active at homing start



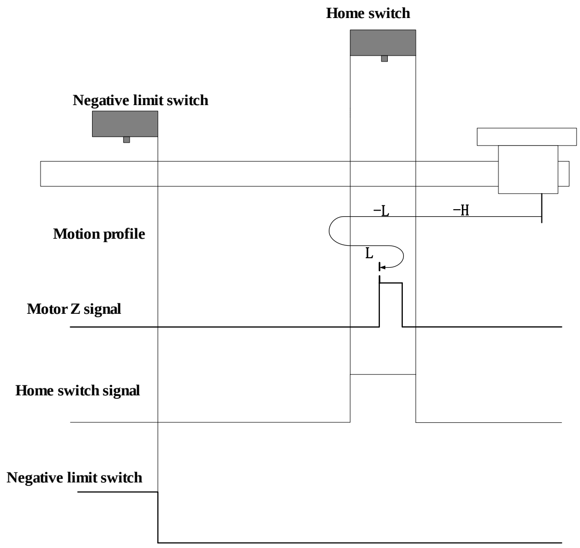
When homing starts and ORGP=1, the motor starts homing in positive direction at low speed. After reaching the falling edge of the ORGP signal, the motor changes to run in negative direction at low speed. After reaching the rising edge of the ORGP signal, the motor stops at the first motor Z signal.

13）6098h=13

Home: motor Z signal

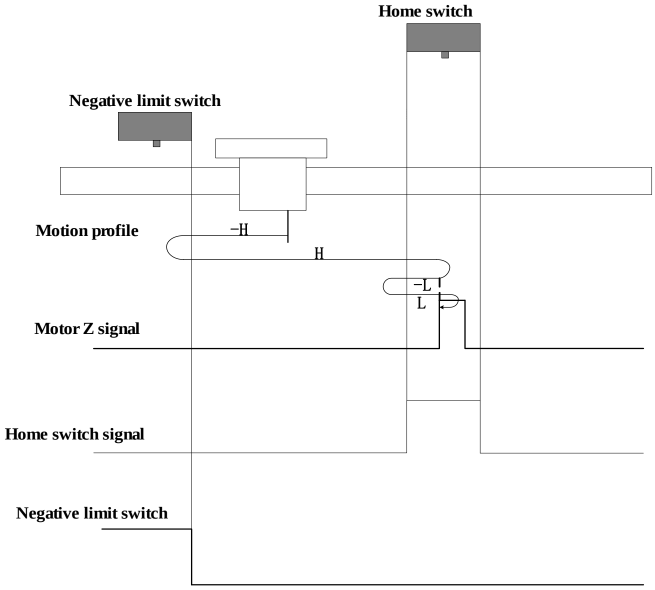
Deceleration point: home switch

b) Deceleration point signal inactive at homing start, not reaching negative limit switch



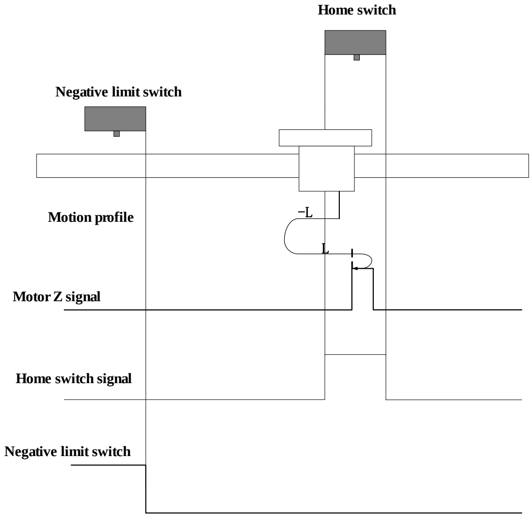
When homing starts and ORGP=0, the motor starts homing in negative direction at high speed. If the motor does not reach the limit switch, the motor decelerates and runs in negative direction at low speed after reaching the rising edge of the ORGP signal. After reaching the falling edge of the ORGP signal, the motor changes to run in positive direction at low speed. After reaching the rising edge of the ORGP signal, the motor stops at the first motor Z signal.

c) Deceleration point signal inactive at homing start, reaching negative limit switch



When homing starts and ORGP=0, the motor starts homing in negative direction at high speed. If the motor reaches the limit switch, the motor automatically changes the direction and runs in positive direction at high speed. After reaching the rising edge of the ORGP signal, the motor decelerates and changes to run in positive direction at low speed. After reaching the falling edge of the ORGP signal, the motor changes to run in positive direction at low speed. After reaching the rising edge of the OPGP signal, the motor stops at the first motor Z signal.

c）Deceleration point signal active at homing start



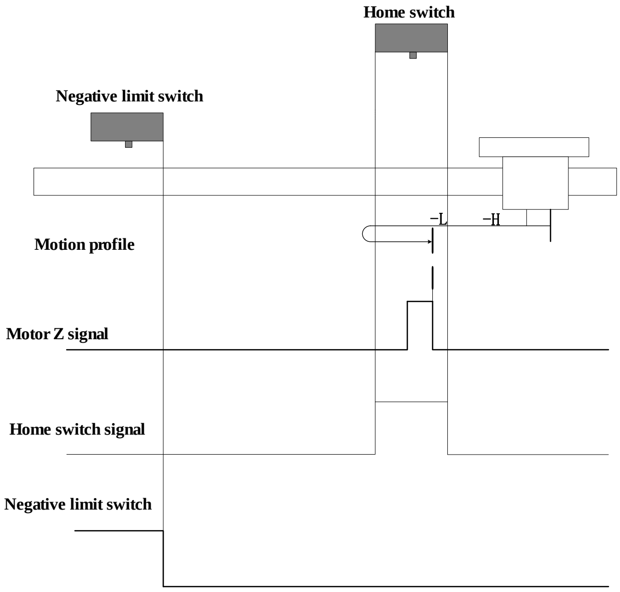
When homing starts and ORGP=1, the motor directly starts homing in positive direction at low speed. After reaching the falling edge of the ORGP signal, the motor changes to run in positive direction at low speed. After reaching the rising edge of ORGP signal, motor stops at first motor Z signal.

14）6098h=14

Home: motor Z signal

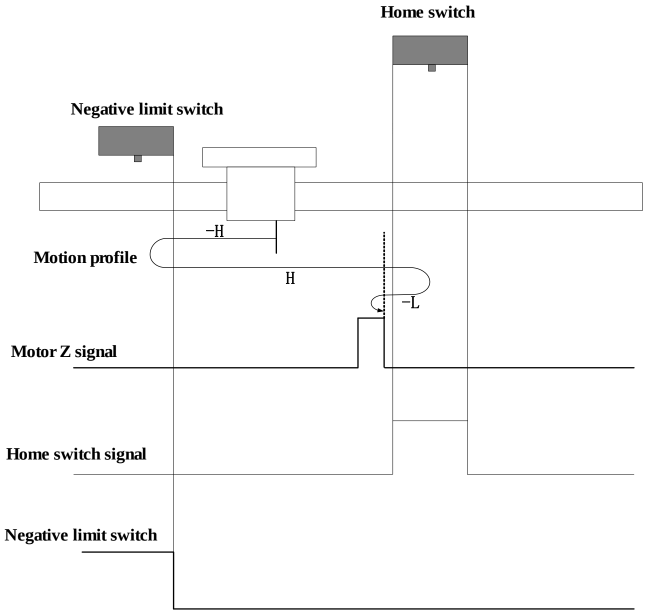
Deceleration point: home switch

a) Deceleration point signal inactive at homing start, not reaching negative limit switch



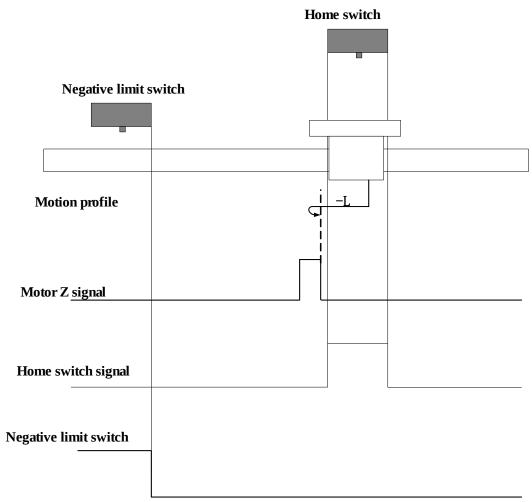
When homing starts and ORGP=0, the motor starts homing in negative direction at high speed. If the motor does not reach the limit switch, the motor decelerates and runs in negative direction at low speed after reaching the rising edge of the ORGP signal. After reaching the falling edge of the ORGP signal, the motor continues to run in negative direction at low speed, then the motor stops at the first motor Z signal.

b）Deceleration point signal inactive at homing start, reaching negative limit switch



When homing starts and ORGP=0, the motor starts homing in negative direction at high speed. If the motor reaches the limit switch, the motor automatically changes the direction and runs in positive direction at high speed. The motor decelerates and runs in negative direction at low speed after reaching the rising edge of the ORGP signal. After reaching the falling edge of the ORGP signal, the motor stops at the first motor Z signal.

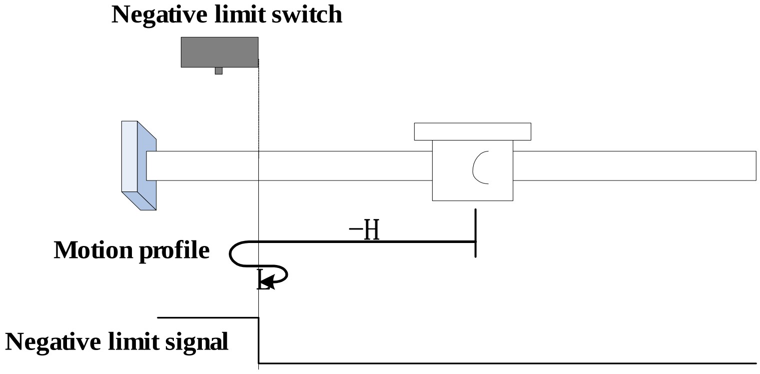
c）Deceleration point signal active at homing start



When homing starts and ORGP=1, the motor starts homing in negative direction at low speed. After reaching the falling edge of the ORGP signal, the motor stops at the first motor Z signal.

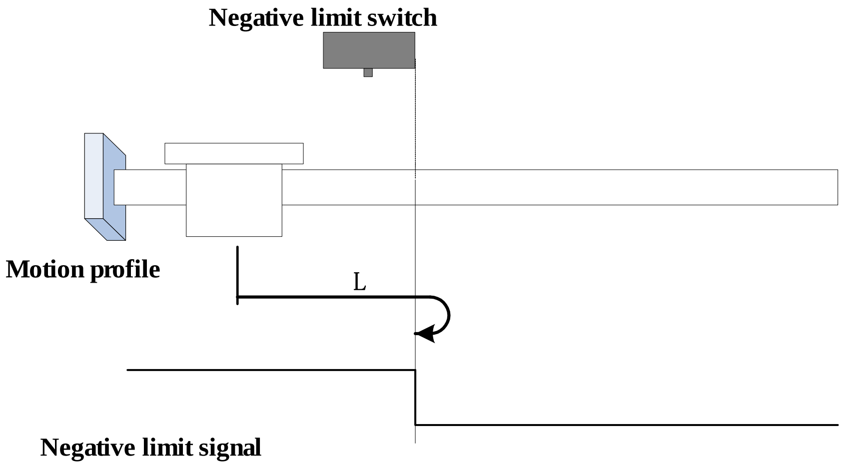
15）6098h=17

Home: negative limit switch
Deceleration point: negative limit switch
a）Deceleration point signal inactive at homing start



The R-INH signal is inactive initially. The motor starts homing in negative direction at high speed. After reaching the rising edge of the R-INH signal, the motor decelerates and changes to run in positive direction at low speed. After reaching the falling edge of the R-INH signal, the motor stops.

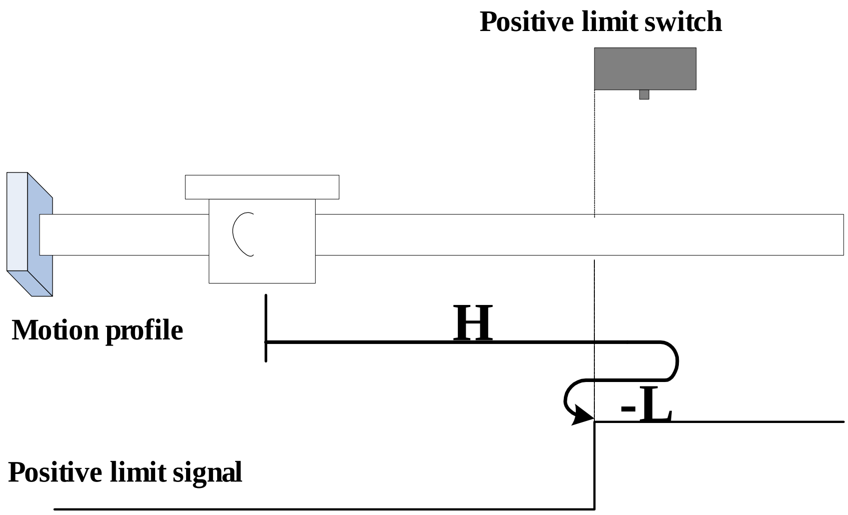
b）Deceleration point signal active at homing start



The R-INH signal is active initially, and the motor directly starts homing in positive direction at low speed.

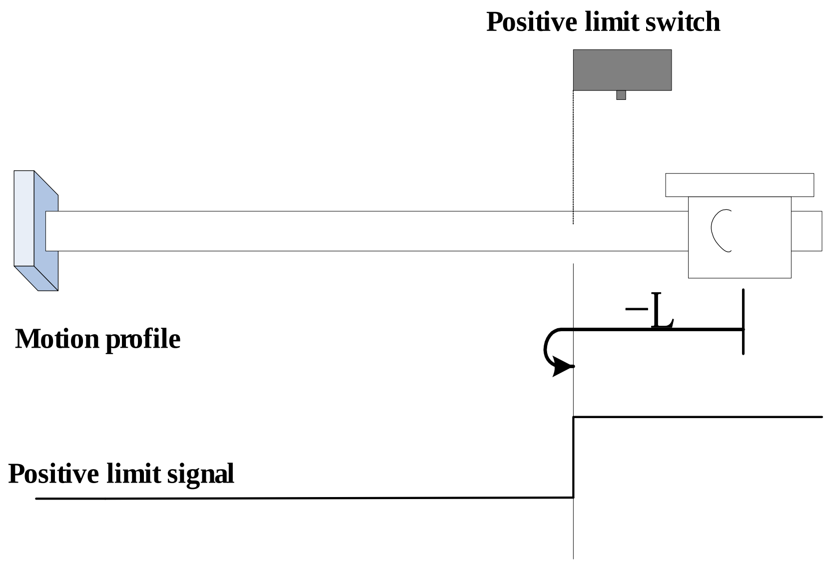
After reaching the falling edge of the R-INH signal, the motor stops.

16）6098h=18
Home: positive limit switch
Deceleration point: positive limit switch
a）Deceleration point signal inactive at homing start



The F-INH signal is inactive initially. The motor starts homing in positive direction at high speed.
After reaching the rising edge of the F-INH signal, the motor decelerates and changes to run in negative direction at low speed. After reaching the falling edge of the F-INH signal, the motor stops.

b）Deceleration point signal active at homing start

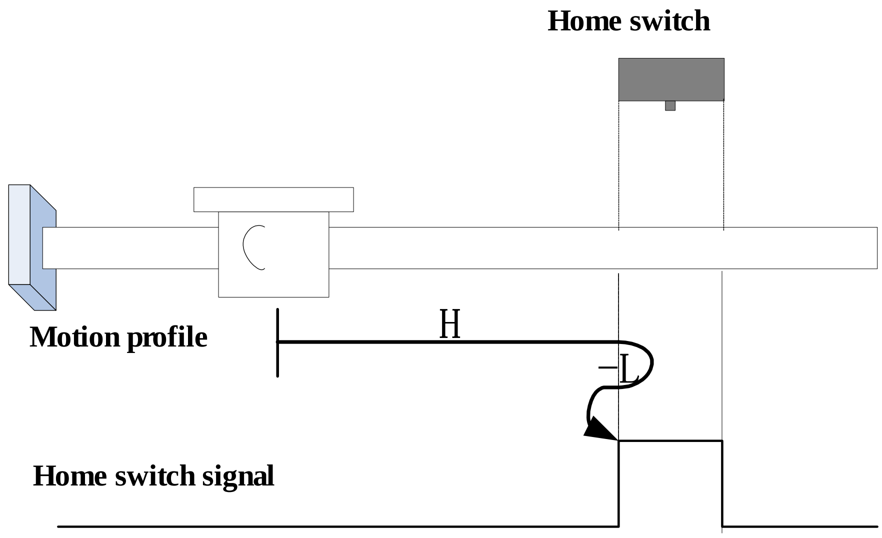


The F-INH signal is active initially, and the motor directly starts homing in negative direction at low speed.
After reaching the falling edge of the F-INH signal, the motor stops.

17）6098h=19

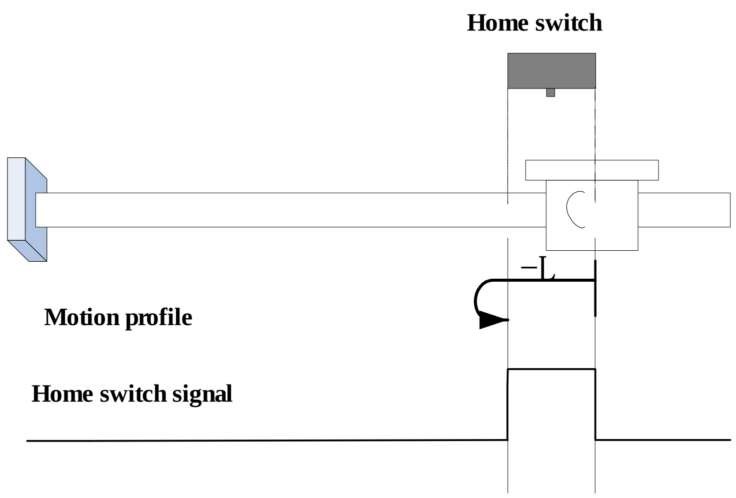
Home: home switch
Deceleration point: home switch

a）Deceleration point signal inactive at homing start



The ORGP signal is inactive initially. The motor starts homing in positive direction at high speed. After reaching the rising edge of the ORGP signal, the motor decelerates and changes to run in negative direction at low speed. After reaching the falling edge of the ORGP signal, the motor stops.

b）Deceleration point signal active at homing start

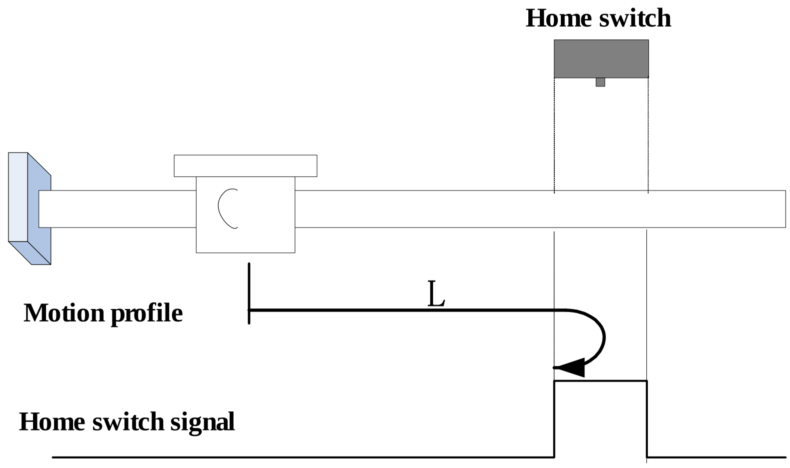


The ORGP signal is active initially, and the motor directly starts homing in negative direction at low speed.

After reaching the falling edge of the ORGP signal, the motor stops.

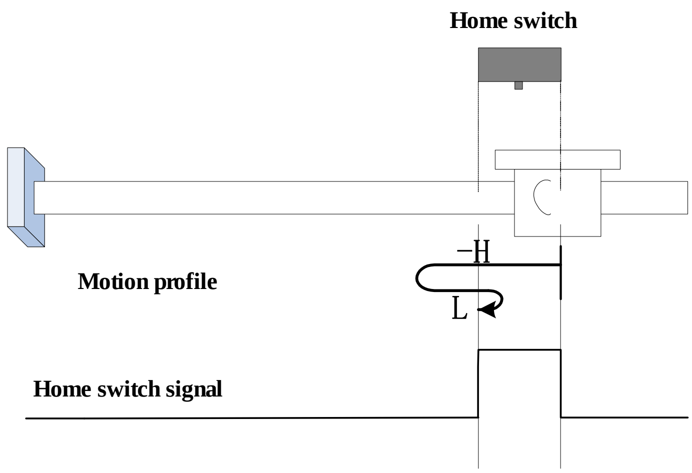
18）6098h=20

Home: home switch
Deceleration point: home switch
a）Deceleration point signal inactive at homing start



The ORGP signal is inactive initially, and the motor starts homing in positive direction at low speed.
After reaching the rising edge of the ORGP signal, the motor stops.

b）Deceleration point signal active at homing start



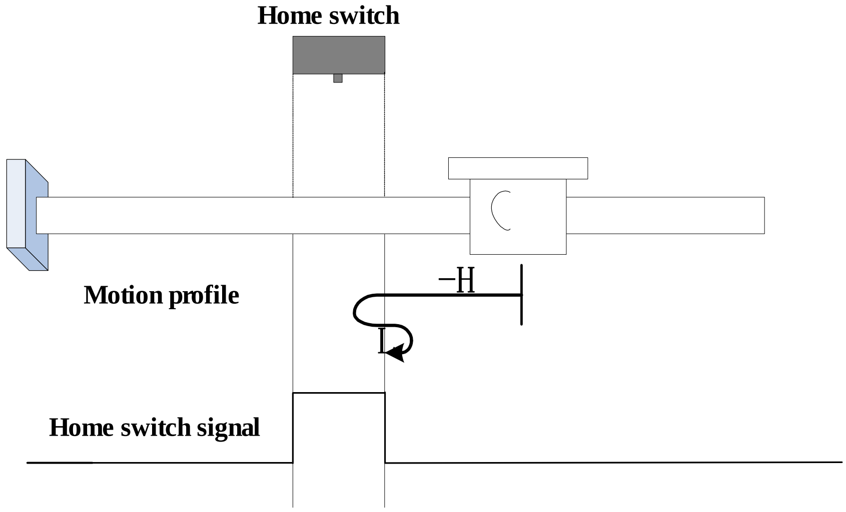
The ORGP signal is active initially. The motor starts homing in negative direction at high speed.
After reaching the falling edge of the ORGP signal, the motor decelerates and changes to run in positive direction at low speed.
After reaching the rising edge of the ORGP signal, the motor stops.

19）6098h=21

Home: home switch

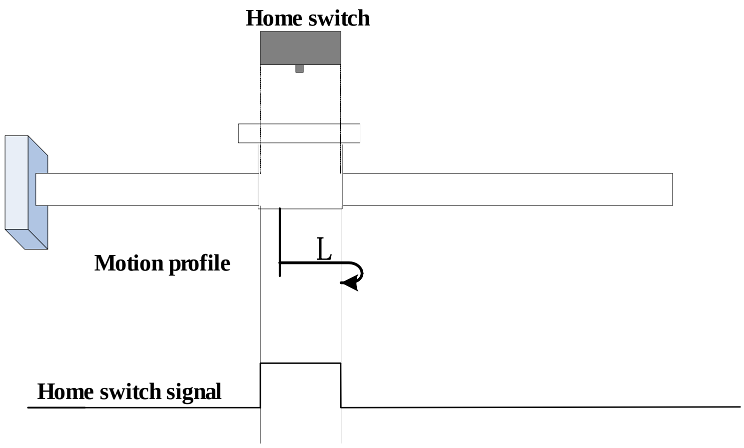
Deceleration point: home switch

a）Deceleration point signal inactive at homing start



The ORGP signal is inactive initially. The motor starts homing in negative direction at high speed. After reaching the rising edge of the ORGP signal, the motor decelerates and changes to run in positive direction at low speed. After reaching the falling edge of the ORGP signal, the motor stops.

b）Deceleration point signal active at homing start



The ORGP signal is active initially, and the motor directly starts homing in positive direction at low speed.

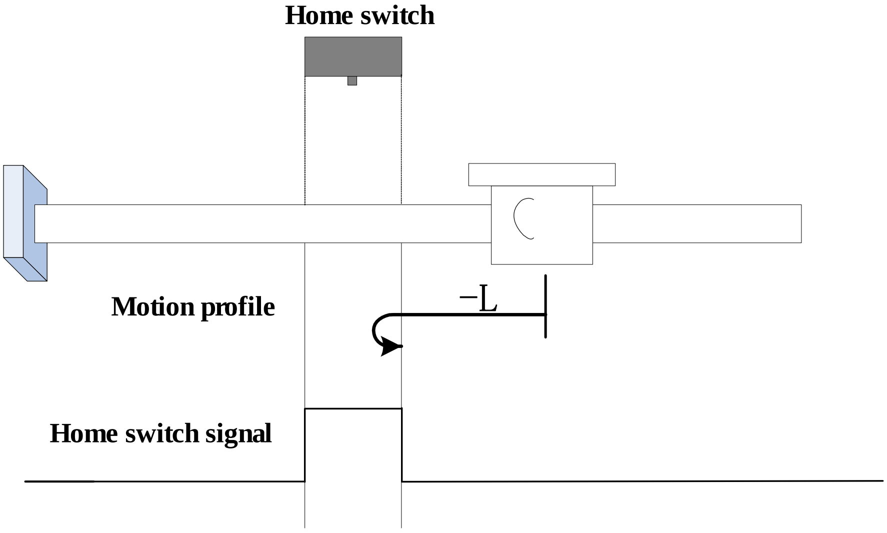
After reaching the falling edge of the ORGP signal, the motor stops.

20）6098h=22

Home: home switch

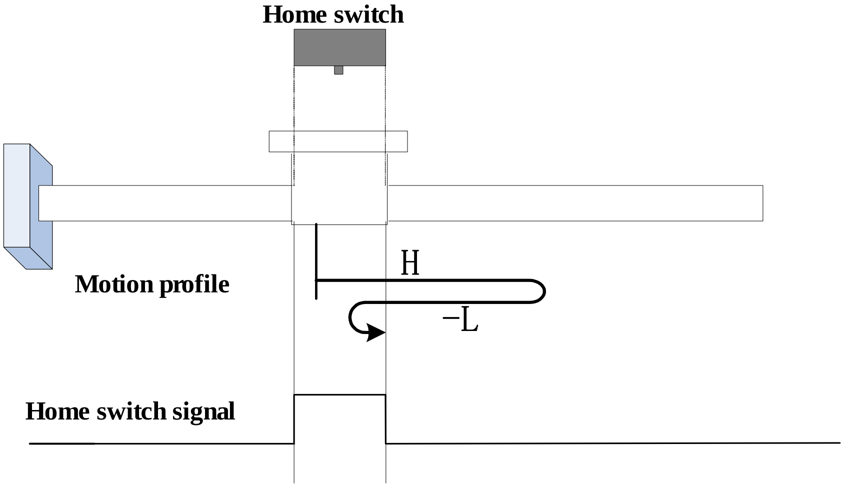
Deceleration point: home switch

a）Deceleration point signal inactive at homing start



The ORGP signal is inactive initially, and the motor directly starts homing in negative direction at low speed.
After reaching the rising edge of the ORGP signal, the motor stops.

b）Deceleration point signal active at homing start



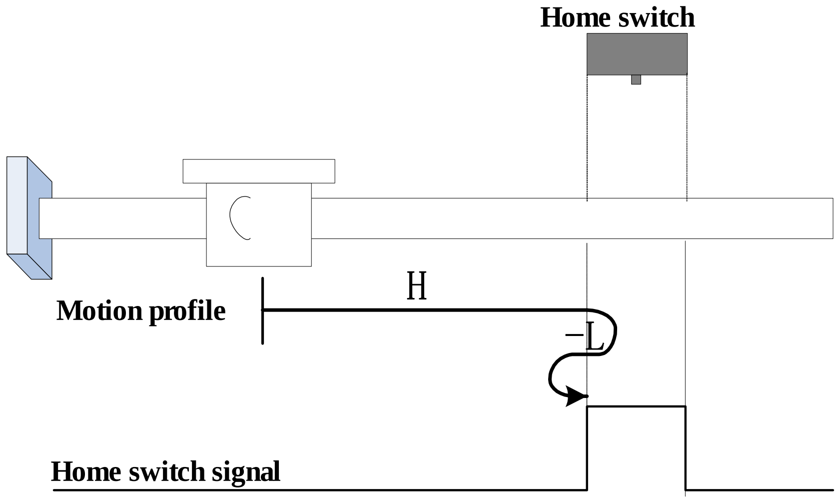
The ORGP signal is active initially. The motor starts homing in positive direction at high speed. After reaching the falling edge of the ORGP signal, the motor decelerates and changes to run in negative direction at low speed. After reaching the rising edge of the ORGP signal, the motor stops.

21）6098h=23

Home: home switch

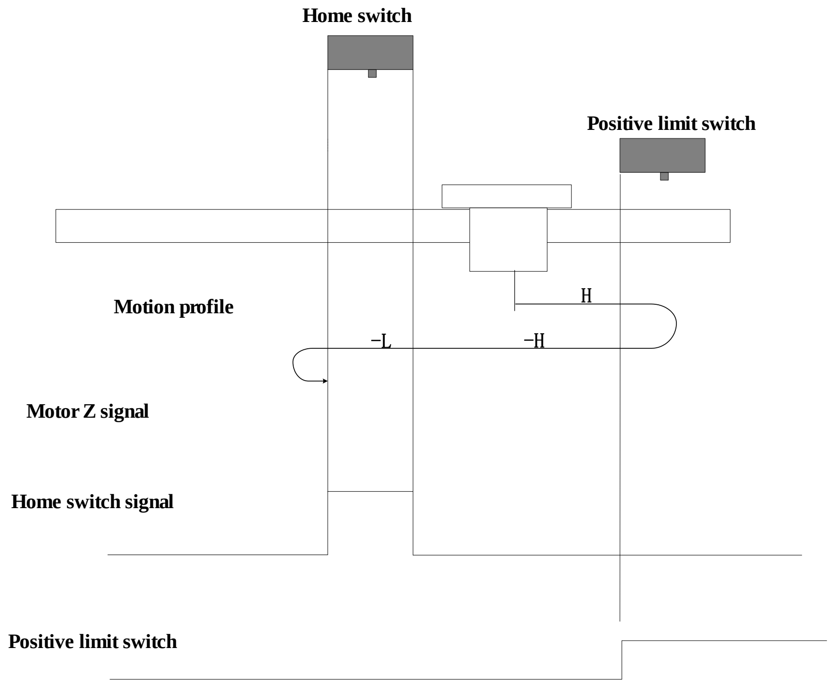
Deceleration point: home switch

a）Deceleration point signal inactive at homing start, not reaching positive limit switch



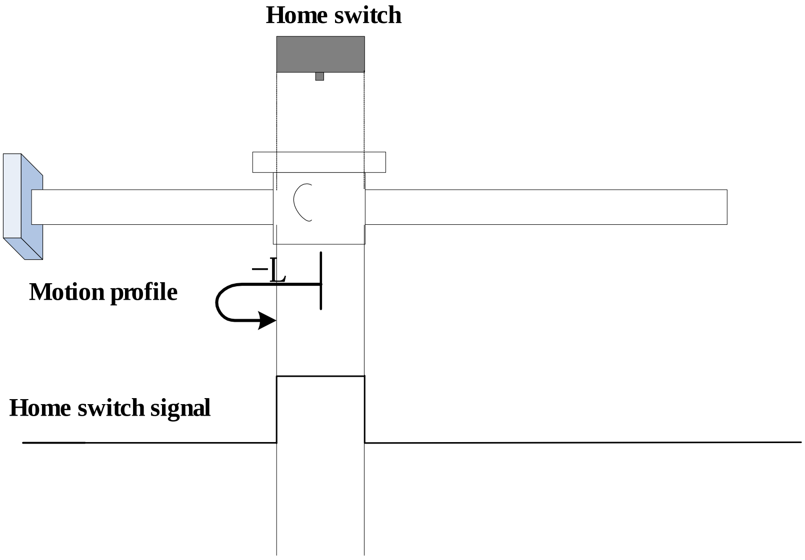
The ORGP signal is inactive initially. The motor starts homing in positive direction at high speed. If the motor does not reach the limit switch, it decelerates and changes to run in negative direction at low speed after reaching the rising edge of the ORGP signal. After reaching the falling edge of the ORGP signal, the motor stops.

b）Deceleration point signal inactive at homing start, reaching positive limit switch



The ORGP signal is inactive initially, and the motor starts homing in positive direction at high speed. If the motor reaches the limit switch, it automatically changes to run in negative direction at high speed. After reaching the rising edge of the ORGP signal, the motor decelerates and continues to run in negative direction at low speed. After reaching the falling edge of the ORGP signal, the motor stops.

c）Deceleration point signal active at homing start



The ORGP signal is active initially, and the motor directly starts homing in negative direction at low speed.

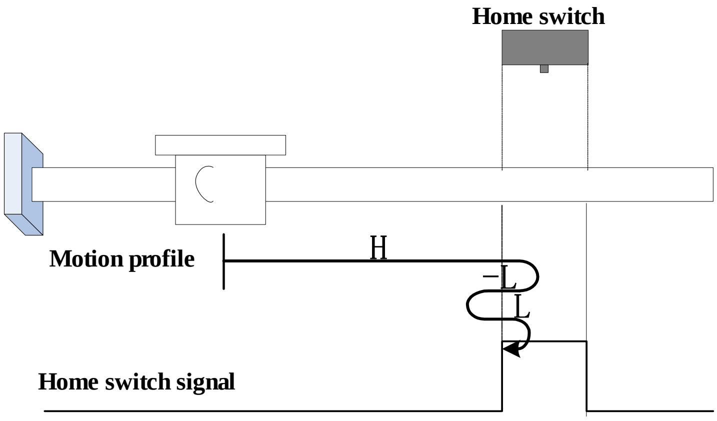
After reaching the falling edge of the ORGP signal, the motor stops.

22）6098h=24

Home: home switch

Deceleration point: home switch

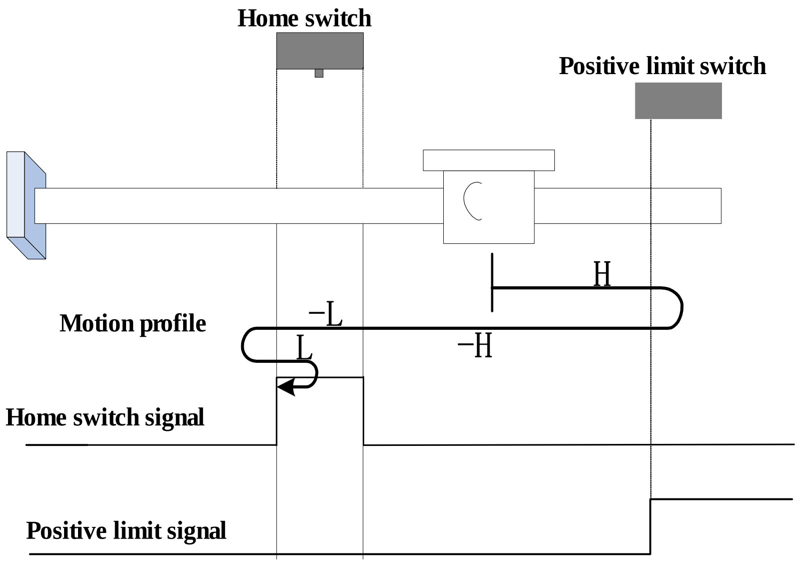
a）Deceleration point signal inactive at homing start, not reaching positive limit switch



The ORGP signal is inactive initially, and the motor starts homing in positive direction at high speed.

If the motor does not reach the limit switch, it decelerates and changes to run in negative direction at low speed after reaching the rising edge of the ORGP signal. After reaching the falling edge of the ORGP signal, the motor changes to run in positive direction at low speed, and stops at the rising edge of the ORGP signal.

c） Deceleration point signal inactive at homing start, reaching positive limit switch

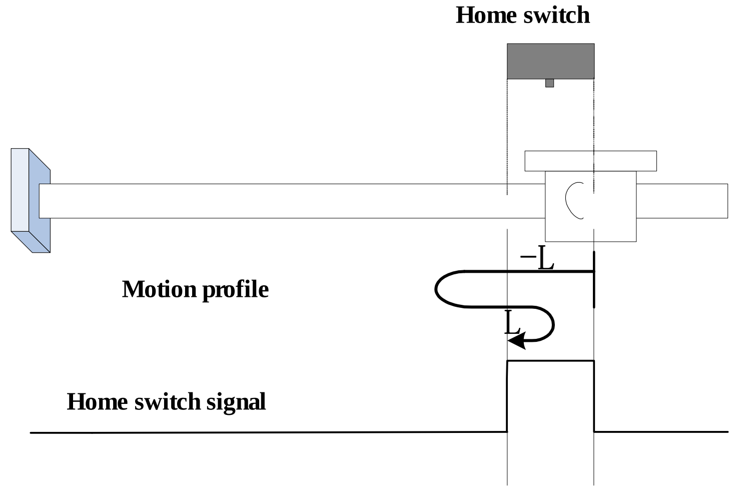


The ORGP signal is inactive initially, and the motor starts homing in positive direction at high speed.

If the motor reaches the limit switch, it automatically changes to run in negative direction at high speed.

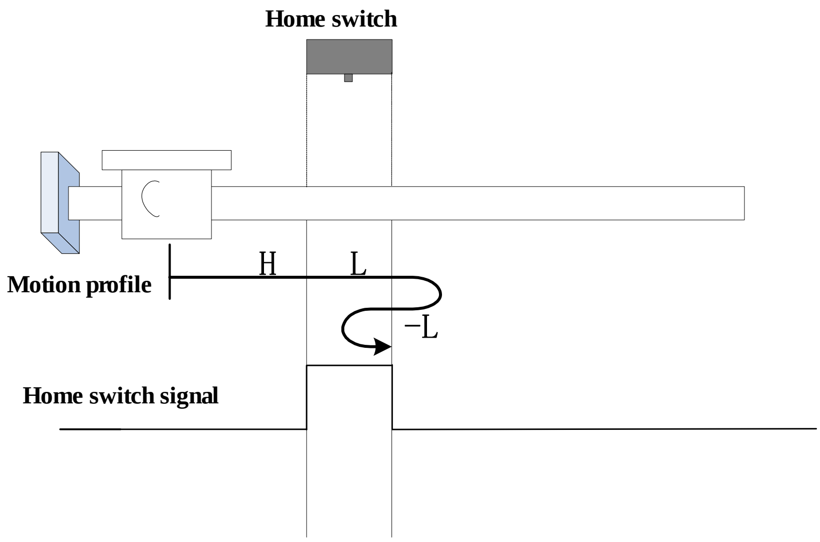
After reaching the rising edge of the ORGP signal, the motor decelerates and continues to run in negative direction at low speed. After reaching the falling edge of the ORGP signal, the motor changes to run in positive direction at low speed, and stops at the rising edge of the ORGP signal.

c）Deceleration point signal active at homing start



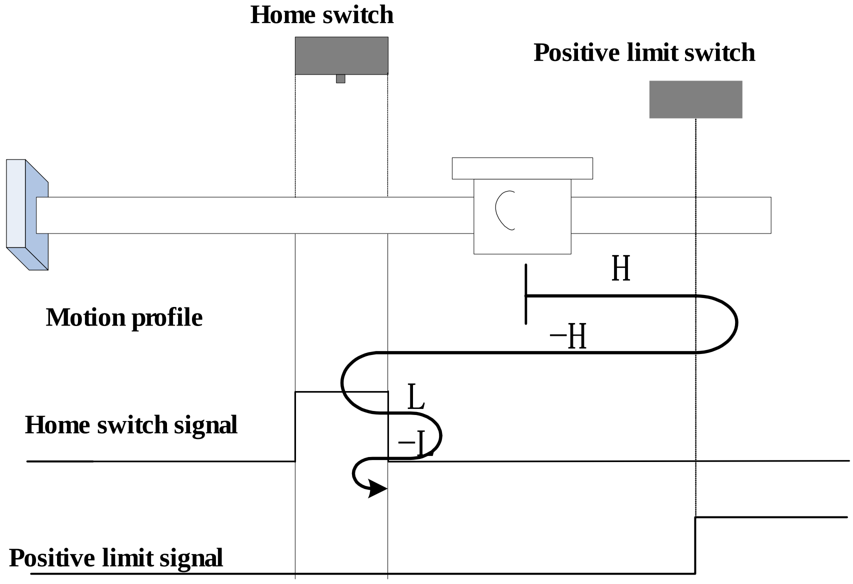
The ORGP signal is active initially, and the motor directly starts homing in negative direction at low speed.
After reaching the falling edge of the ORGP signal, the motor changes to run in positive direction at low speed.
After reaching the rising edge of the ORGP signal, the motor stops.

23）6098h=25
Home: home switch
Deceleration point: home switch
a）Deceleration point signal inactive at homing start, not reaching positive limit switch



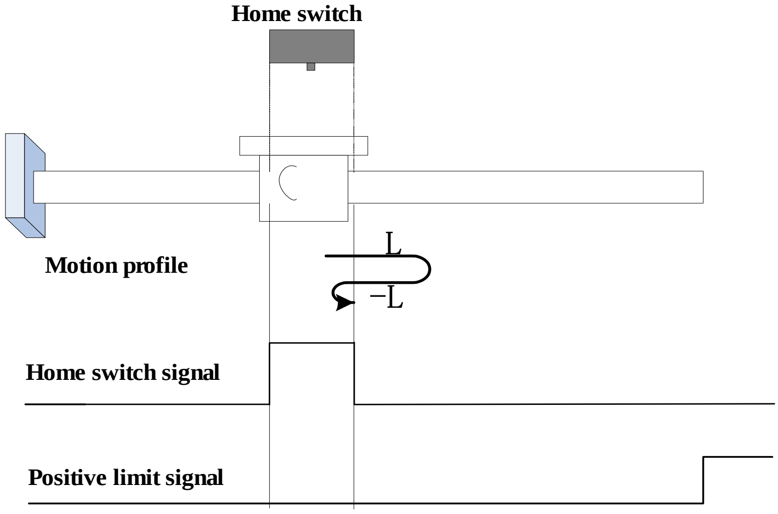
The ORGP signal is inactive initially, and the motor starts homing in positive direction at high speed. If the motor does not reach the limit switch, it decelerates and continues to run in positive direction at low speed after reaching the rising edge of the ORGP signal. After reaching the falling edge of the ORGP signal, the motor changes to run in negative direction at low speed, and stops at the rising edge of the ORGP signal.

b）. Deceleration point signal inactive at homing start, reaching positive limit switch



The ORGP signal is inactive initially, and the motor starts homing in positive direction at high speed. If the motor reaches the limit switch, it automatically changes to run in negative direction at high speed. After reaching the rising edge of the ORGP signal, the motor decelerates and resumes to run in positive direction at low speed. After reaching the falling edge of the ORGP signal, the motor changes to run in negative direction at low speed, and stops at the rising edge of the ORGP signal.

c）Deceleration point signal active at homing start



The ORGP signal is active initially, and the motor directly starts homing in positive direction at low speed.

After reaching the falling edge of the ORGP signal, the motor changes to run in negative direction at low speed.

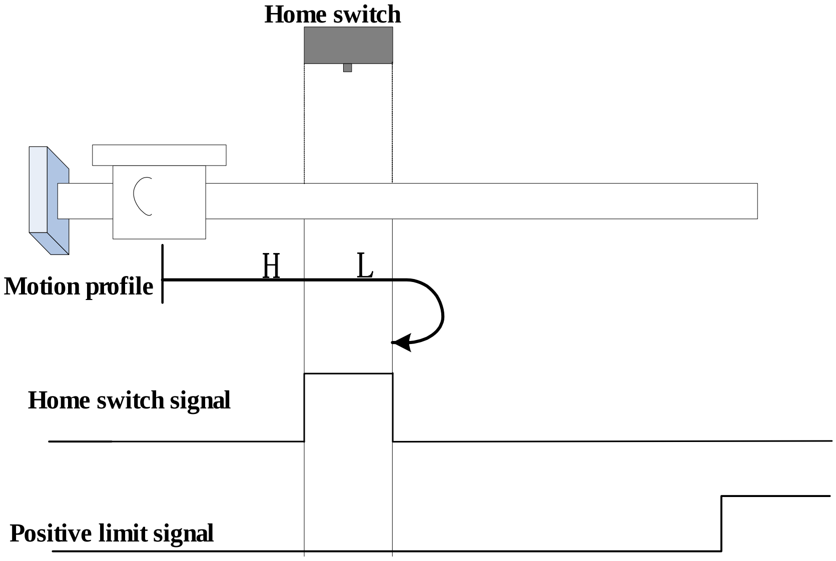
After reaching the rising edge of the ORGP signal, the motor stops.

24）6098h=26

Home: home switch

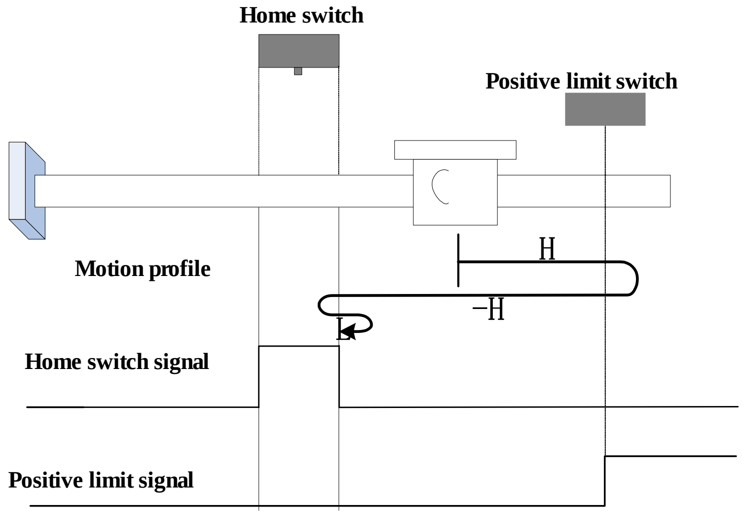
Deceleration point: home switch

a）Deceleration point signal inactive at homing start, not reaching positive limit switch



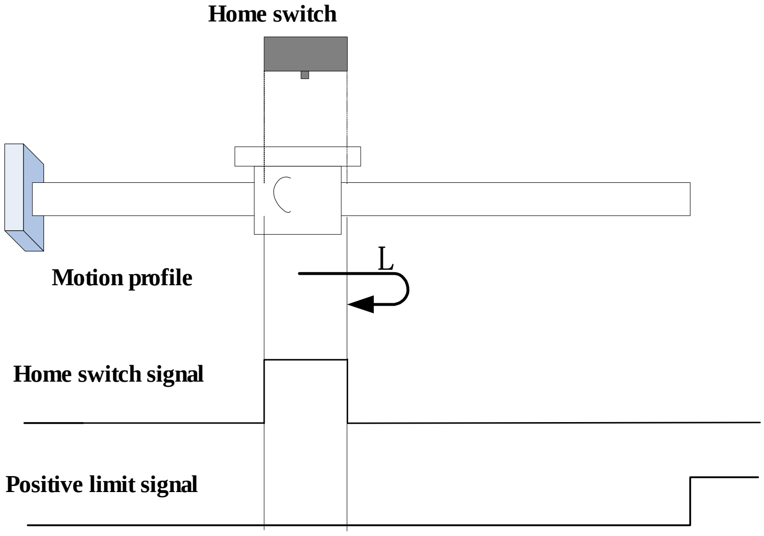
The ORGP signal is inactive initially. The motor starts homing in positive direction at high speed. If the motor does not reach the limit switch, it decelerates and continues to run in positive direction at low speed after reaching the rising edge of the ORGP signal. After reaching the falling edge of the ORGP signal, the motor stops.

b）Deceleration point signal inactive at homing start, reaching positive limit switch



The ORGP signal is inactive initially, and the motor starts homing in positive direction at high speed. If the motor reaches the limit switch, it automatically changes to run in negative direction at high speed. After reaching the rising edge of the ORGP signal, the motor decelerates and resumes to run in positive direction at low speed. After reaching the falling edge of the ORGP signal, the motor stops.

c）Deceleration point signal active at homing start



The ORGP signal is active initially, and the motor directly starts homing in positive direction at low speed.

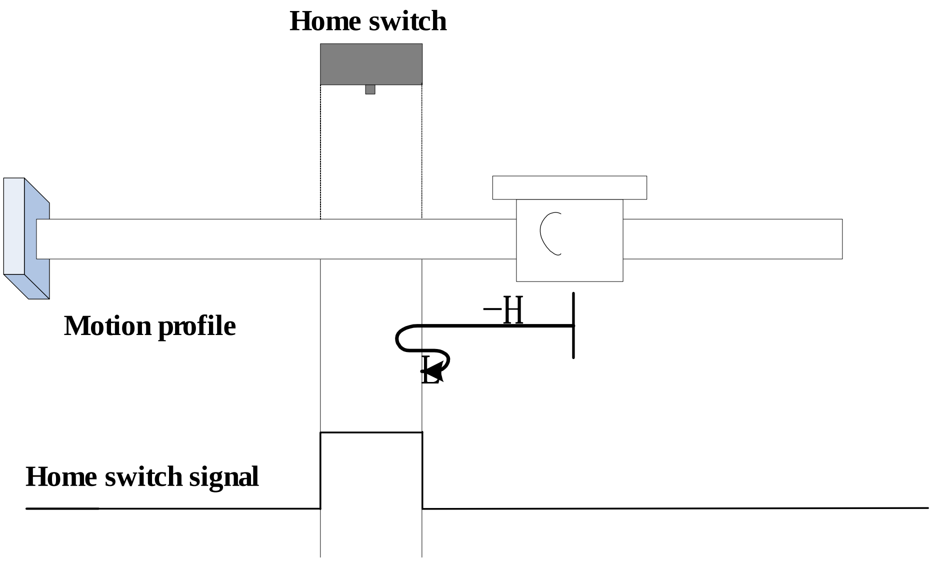
After reaching the falling edge of the ORGP signal, the motor stops.

25）6098h=27

Home: home switch

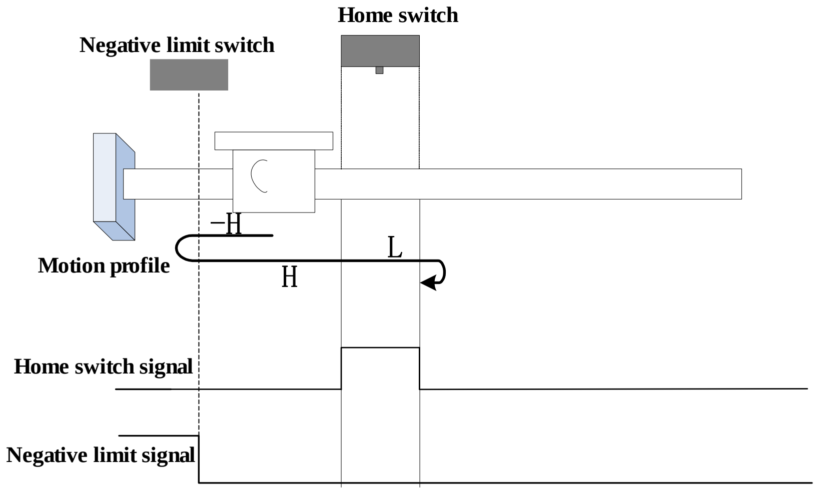
Deceleration point: home switch

a）Deceleration point signal inactive at homing start



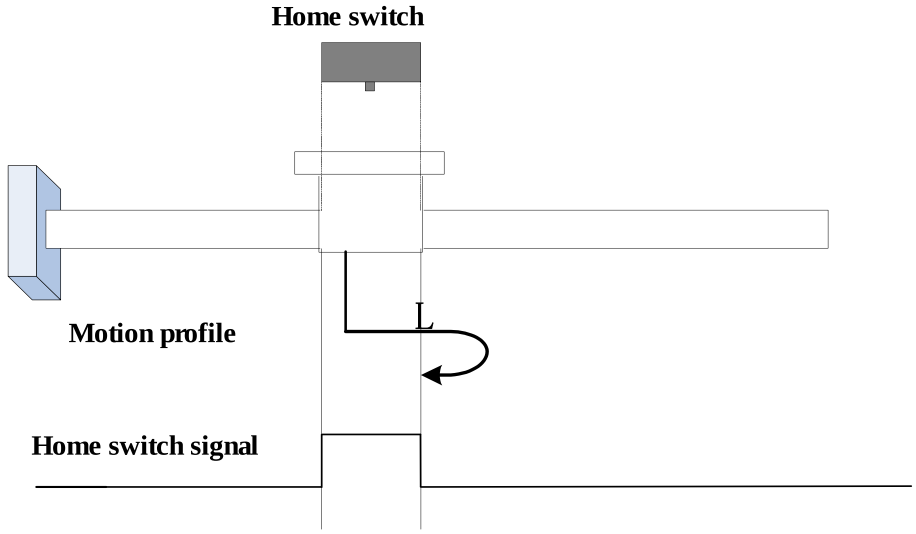
The ORGP signal is inactive initially. The motor starts homing in negative direction at high speed. If the motor does not reach the limit switch, it decelerates and changes to run in positive direction at low speed after reaching the rising edge of the ORGP signal. After reaching the falling edge of the ORGP signal, the motor stops.

b）Deceleration point signal inactive at homing start, reaching negative limit switch



The ORGP signal is inactive initially, and the motor starts homing in negative direction at high speed. If the motor reaches the limit switch, it automatically changes to run in positive direction at high speed. After reaching the rising edge of the ORGP signal, the motor decelerates and continues to run in positive direction at low speed. After reaching the falling edge of the ORGP signal, the motor stops.

c）Deceleration point signal active at homing start

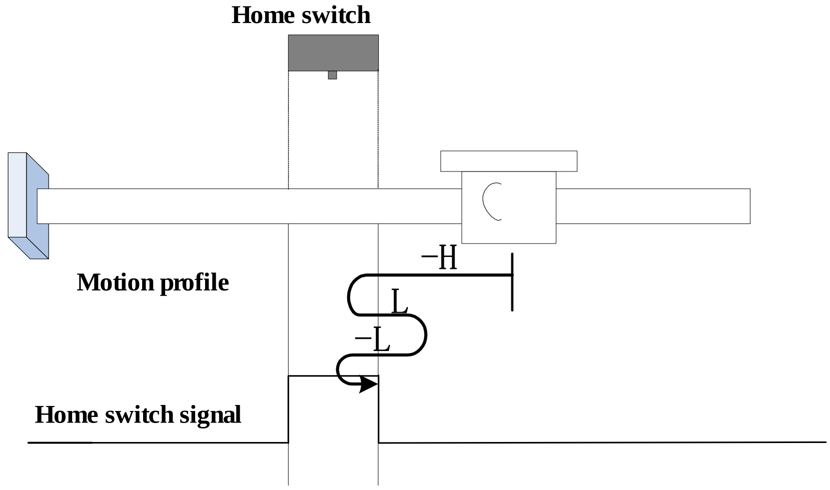


The ORGP signal is active initially, and the motor directly starts homing in positive direction at low speed.

After reaching the falling edge of the ORGP signal, the motor stops.

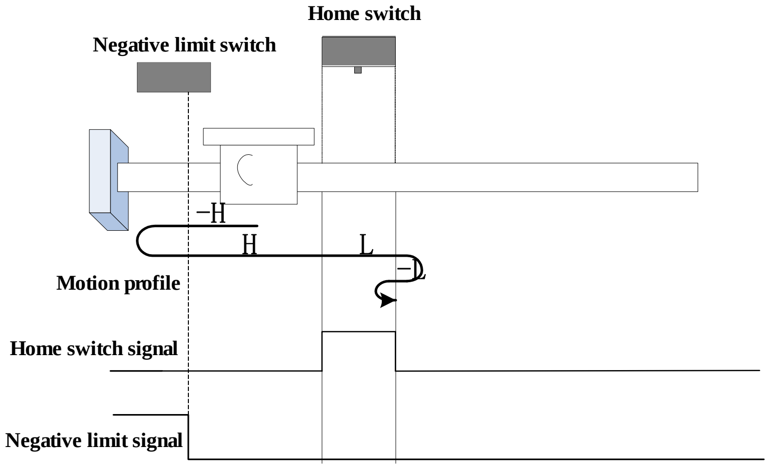
26）6098h=28

Home: home switch
Deceleration point: home switch
a）Deceleration point signal inactive at homing start



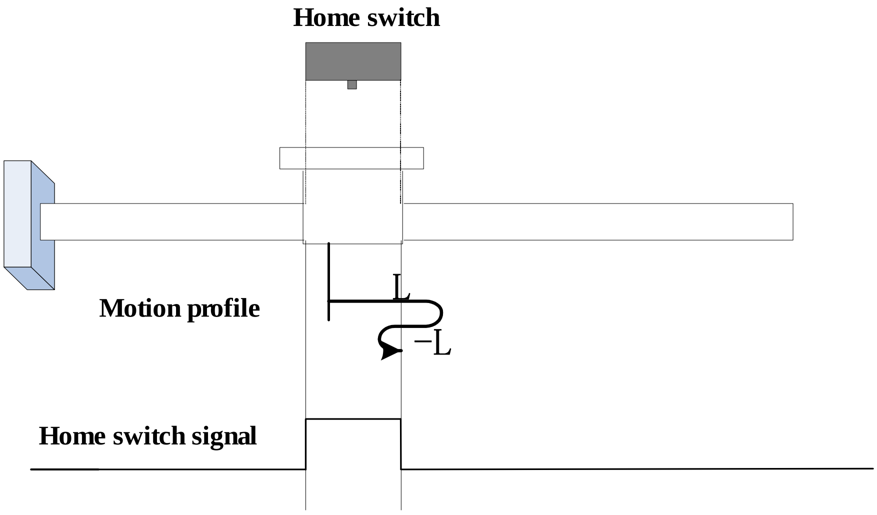
The ORGP signal is inactive initially, and the motor starts homing in negative direction at high speed. If the motor does not reach the limit switch, it decelerates and changes to run in positive direction at low speed after reaching the rising edge of the ORGP signal. After reaching the falling edge of the ORGP signal, the motor changes to run in negative direction at low speed, and stops at the rising edge of the ORGP signal.

b）Deceleration point signal inactive at homing start, reaching positive limit switch



The ORGP signal is inactive initially, and the motor starts homing in negative direction at high speed. If the motor reaches the limit switch, it automatically changes to run in positive direction at high speed. After reaching the rising edge of the ORGP signal, the motor decelerates and continues to run in positive direction at low speed. After reaching the falling edge of the ORGP signal, the motor changes to run in negative direction at low speed, and stops at the rising edge of the ORGP signal.

c）Deceleration point signal active at homing start



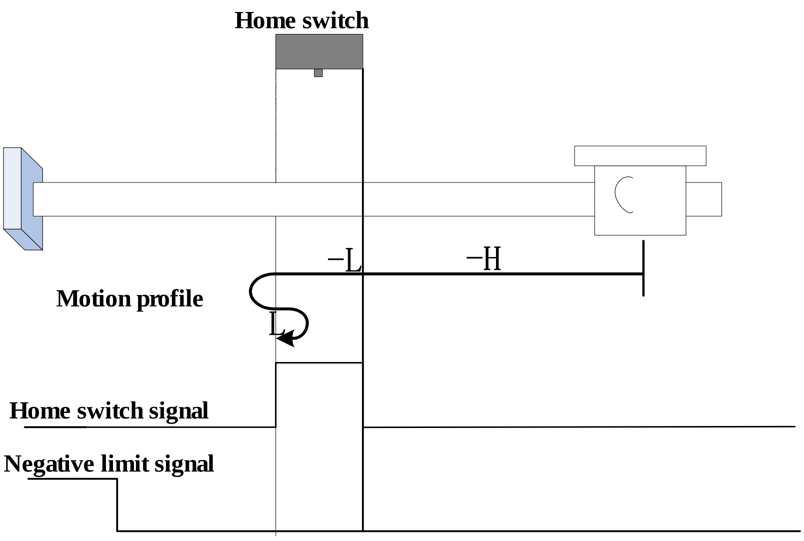
The ORGP signal is active initially, and motor directly starts homing in positive direction at low speed. After reaching the falling edge of the ORGP signal, the motor changes to run in negative direction at low speed. After reaching the rising edge of the ORGP signal, the motor stops.

27）6098h=29

Home: home switch

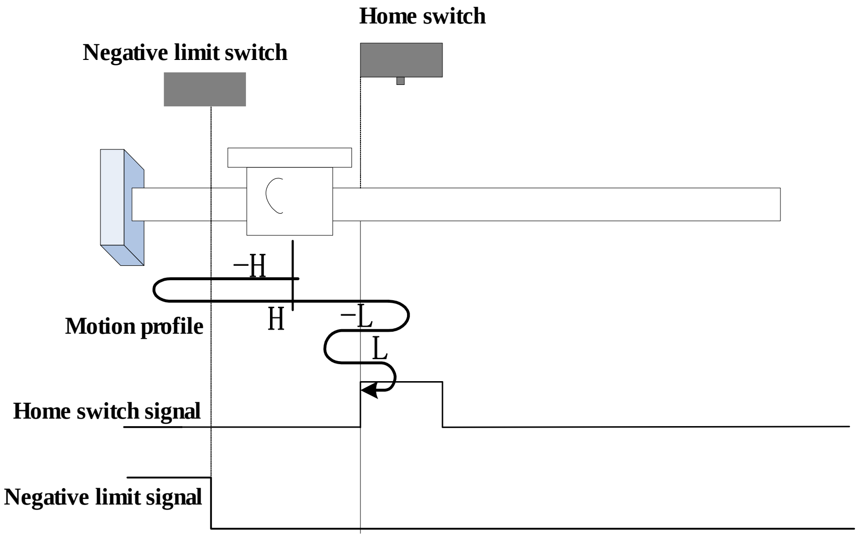
Deceleration point: home switch

a）Deceleration point signal inactive at homing start, not reaching negative limit switch



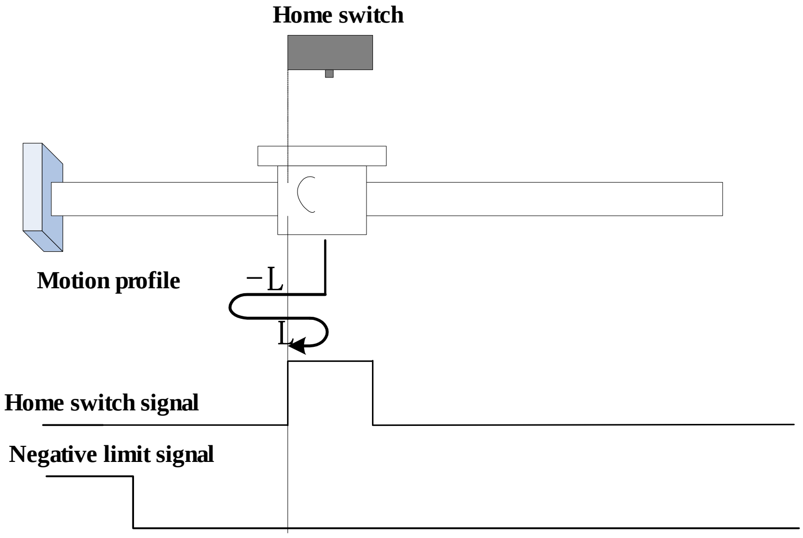
The ORGP signal is inactive initially, and the motor starts homing in negative direction at high speed. If the motor does not reach the limit switch, it decelerates and continues to run in negative direction at low speed after reaching the rising edge of the ORGP signal. After reaching the falling edge of the ORGP signal, the motor changes to run in positive direction at low speed, and stops at the rising edge of the ORGP signal.

b）Deceleration point signal inactive at homing start, reaching negative limit switch



The ORGP signal is inactive initially, and the motor starts homing in negative direction at high speed. If the motor reaches the limit switch, it automatically changes to run in positive direction at high speed. After reaching the rising edge of the ORGP signal, the motor decelerates and changes to run in negative direction at low speed. After reaching the falling edge of the ORGP signal, the motor changes to run in positive direction at low speed, and stops at the rising edge of the ORGP signal.

c）Deceleration point signal active at homing start



The ORGP signal is active initially, and the motor directly starts homing in negative direction at low speed.

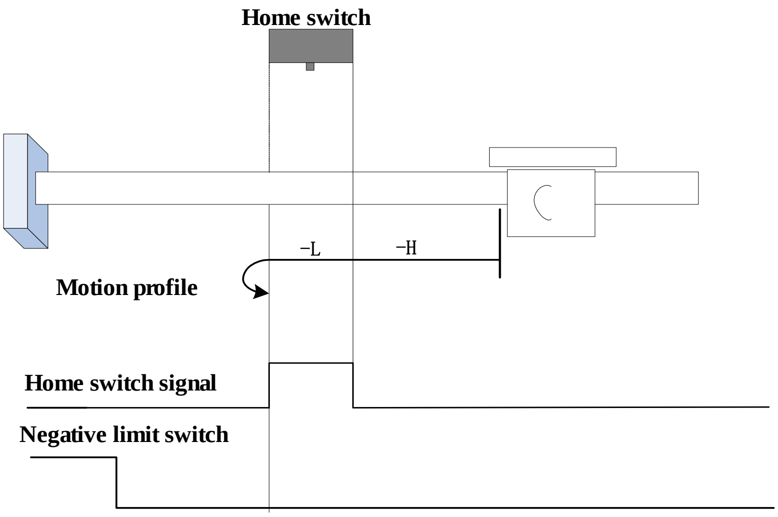
After reaching the falling edge of the ORGP signal, the motor changes to run in positive direction at low speed.

After reaching the rising edge of the ORGP signal, the motor stops.

28）6098h=30

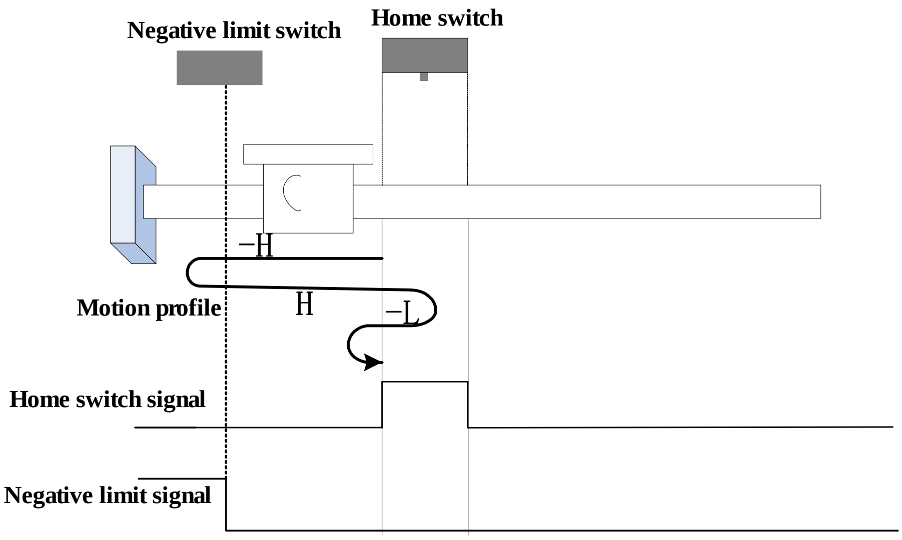
Home: home switch

Deceleration point: home switch



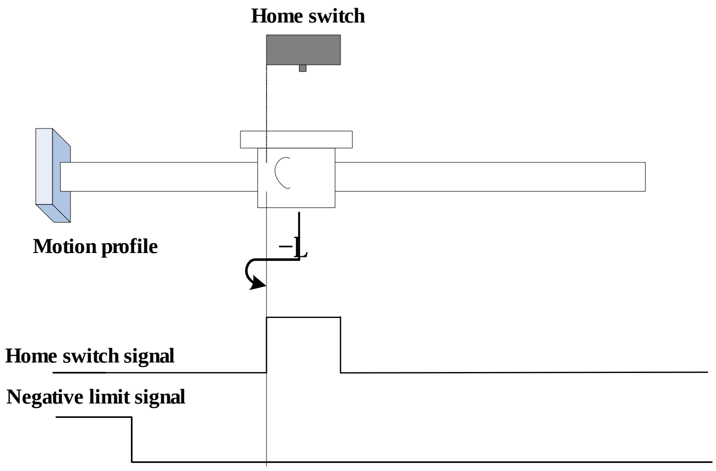
The ORGP signal is inactive initially. The motor starts homing in negative direction at high speed. If the motor does not reach the limit switch, it decelerates and continues to run in negative direction at low speed after reaching the rising edge of the ORGP signal. After reaching the falling edge of the ORGP signal, the motor stops.

b）Deceleration point signal inactive at homing start, reaching negative limit switch



The ORGP signal is inactive initially, and the motor starts homing in negative direction at high speed. If the motor reaches the limit switch, it automatically changes to run in positive direction at high speed. After reaching the rising edge of the ORGP signal, the motor decelerates and changes to run in negative direction at low speed.
After reaching the falling edge of the ORGP signal, the motor stops.

c）Deceleration point signal active at homing start



The ORGP signal is active initially, and the motor directly starts homing in negative direction at low speed.

After reaching the falling edge of the ORGP signal, the motor stops.

29）6098h=31-32

These modes are not defined in CiA402.

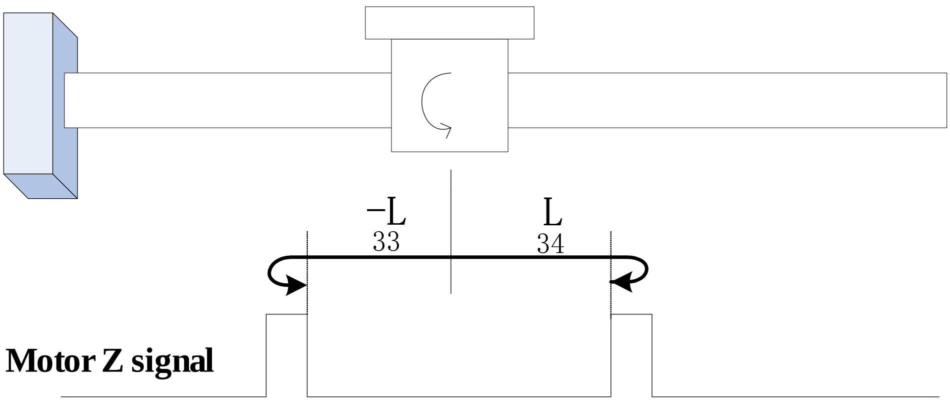
30）6098h=33-34

Home: Z signal

Deceleration point: None

Homing method 33: The motor runs in negative direction at low speed, and stops at the first motor Z signal.

Homing method 34: The motor runs in positive direction at low speed, and stops at the first motor Z signal.



31）6098h=35

The current position is the home. The motor starts homing after the homing signal is triggered.

32) 6098h=-1

Motor starts homing after the homing signal is triggered, which mechanical home is recorded when 6098h=35.

7.9.4 Recommended configuration

RPDO	TPDO	Remark

6040h：control word	6041h：status word	Required
6098h：Homing method		Optional
609Ah：Homing acceleration		Optional
	6064h：position actual value	Optional
6060h：modes of operation	6061h: Modes of operation display	Optional

7.10 Auxiliary Function

Servo drives supply auxiliary function in order to make sure system work correctly.

7.10.1 Setting password

2008h-02h	Setting password PP PV PT CSP CSV CST HM (Avoid modifying parameters by mistake）			
	Setting range	Setting unit	Mfr's value	When enabled
	0~9999	N/A	0	Restart
	Function code	Mapping	Data type	Accessibility
	So-01	N	UINT16	RW

Setting password is used to avoid modifying parameters by mistake. The mfr's value is 0, which means password is invalid and users can modify parameters anytime. If users want to use this function, please set a password for this parameter and restart servo, then this function is valid. Except monitor function parameters, most auxiliary function and main function parameters can be modified when the password is input into this parameter. If password is not input, err will occur. Master station is used to operate SDO to return to stop code.

7.10.2 Servo drive status display

2008h-0Ah	Servo drive status display PP PV PT CSP CSV CST HM			
	Setting range	Setting unit	Mfr's value	When enabled
	0~38	N/A	2	Immediate
	Function code	Mapping	Data type	Accessibility
	So-09	N	UINT16	RW

The parameter is to set default display content in keypad. Refer to next table about the display item:

Setting value	Definition	Setting value	Definition
0	Servo drive output current	**14**	DI8~DI5 status display
1	Servo drive bus voltage	**15**	DI4~DI1status display
2	Servo motor rotating speed	**16**	Other output interface status display
3	Servo motor feedback pulse displays high 5 digits.	**17**	DO4~DO1 status display
4	Servo motor feedback pulse displays low 5 digits	**18**	Drive current temperature display
5	Servo motor feedback speed displays high 5 digits	**19**	Rotating inertia display

6	Servo motor feedback speed displays low 5 digits	**20**	Output torque display
7	Given command pulse numbers display high 5digits	**21**	Current gain group
8	Given command pulse numbers display low 5 digits	**22**	Discharge time
9	Given command pulse error numbers	**23**	Encoder absolute position high digit pulse
10	Given speed	**24**	Encoder absolute position low digit pulse
11	Given torque	**25**	High 5 digits of number of turns of encoder absolute position
12	Reserved	**26**	Low 5 digits of number of turns of encoder absolute position
13	Reserved	**27-37**	Reserved

7.10.3 Fan setting

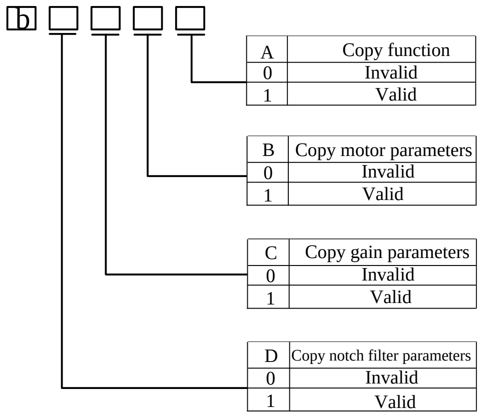
2008h-1Bh	Fan control PP PV PT CSP CSV CST HM			
	Setting range	Setting unit	Mfr's value	When enabled
	0~2	N/A	2	Immediate
	Function code	Mapping	Data type	Accessibility
	So-26	N	UINT16	RW
	0: Fan is controlled by temperature. 1: As soon as power on, fan starts to run. 2: Fan is controlled by servo drive			

So-26=0, when radiator temperature reaches setting temperature, fan starts to run; when radiator temperature is lower than So-27-5℃, fan stops running.
So-26=2, fan starts to run when servo drive is running or temperature is higher than 45℃;
When servo drive is stopped or radiator temperature is lower than 40℃;, fan will keep running for 500ms before stop.

2008h-1Ch	Fan temperature setting PP PV PT CSP CSV CST HM			
	Setting range	Setting unit	Mfr's value	When enabled
	10~100	℃	45	Immediate
	Function code	Mapping	Data type	Accessibility
	So-27	N	UINT16	RW

7.10.4 Parameter copy

2008h-2Dh	Parameter copy PP PV PT CSP CSV CST HM			
	Setting range	Setting unit	Mfr's value	When enabled
	Four-parameter	N/A	0000	Immediate
	Function code	Mapping	Data type	Accessibility
	So-44	N	UINT16	RW



7.10.5 Reverting to Mfr's Value

When there is disorder with parameters, mfr's value needs to be reset**.**

Related Parameters

2008h-32h	Reverting to Mfr's value PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0~1	N/A	0	Restart
	Function code	Mapping	Data type	Accessibility
	So-49	N	UINT16	RW

The procedure is: set So-49=1 and holding press SET key for 0.5s, "00000" is displayed. After 5 seconds, all parameters revert to mfr's value automatically.

7.10.6 Motor Protection Function

(1) Motor Overload Protection

Servo motor output current continuously generates heat, and releases heat into surroundings. When generated heat is more than released heat, motor temperature will rise. Over-high temperature can lead to motor excitation-loss and damage. Servo drive provides motor overload protection in case of over-high temperature.

Setting motor overload protection (2008h-26h) can set motor overload fault （AL-06）time. In general, 2008h-26h remains default value. Under below condition, 2008h-26h can be modified by motor heating state.

● the occasion of higher operating ambient temperature for servo motor;

● the occasion that servo motor runs circularly, one-time motion period is short and frequent switching;

(1) **Related Parameter**

2008h-26h	Motor overload coefficient setting	PP PV PT CSP CSV CST HM		
	Setting Range	Setting Unit	Mfr’s Value	Effect
	1~500	%	100	Immediate
	Function code	Mapping	Data type	Accessibility
	So-37	N	UINT16	RW

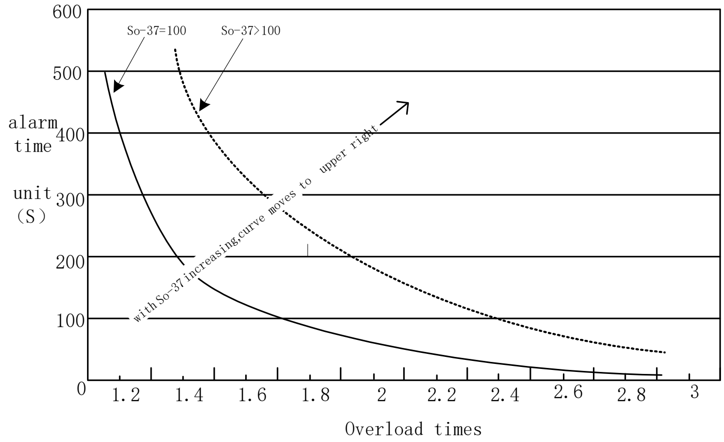


Fig 7.10.1Motor overload curve and alarm time curve graph

(2) Motor lock-rotor protection

Motor speed is almost 0 when servo-motor lock-rotor occurs, but actual current is very high, servo drive and servo motor may be damaged because of long time lock-rotor, therefore, servo drive provides the motor lock-rotor protection to prevent the damage from excessive temperature in the situation of motor lock-rotor.

Related Parameter

2008h-23h	Motor lock-rotor protection	PP PV PT CSP CSV CST HM		
	Setting Range	Setting Unit	Mfr’s Value	Effect
	0~1	N/A	1	Immediate
	Function code	Mapping	Data type	Accessibility
	So-34	N	UINT16	RW
2008h-29h	Delay time of lock-rotor protection	PP PV PT CSP CSV CST HM		
	Setting Range	Setting Unit	Mfr’s Value	Effect
	10~1000	10ms	100	Immediate
	Function code	Mapping	Data type	Accessibility
	So-40	N	UINT16	RW

(3) Motor overheat protection

2008h-33h	Motor overheat protection	PP PV PT CSP CSV CST HM		
	Setting range	Setting unit	Mfr’s value	When enabled

	0~1	N/A	0	Immediate
	Function code	Mapping	Data type	Accessibility
	So-50	N	UINT16	RW
	0: Invalid 1: Valid			

2008h-34h	Motor disconnected protection of temperature detection PP V PT CSP CSV CST HM			
	Setting range	Setting unit	Mfr's value	When enabled
	0~1	N/A	1	Immediate
	Function code	Mapping	Data type	Accessibility
	So-51	N	UINT16	RW
	0: Invalid 1: Valid			

7.10.7 DI Terminals Filter Function

Servo drive has 8 DI terminals.

DI terminal filter setting: if terminal signal has interference, users can carry on filter processing by setting 2008h-27h～2008h-2Eh.

2008h-27h	DI1 filter time PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0~30000	N/A	2	Immediate
	Function code	Mapping	Data type	Accessibility
	Po438	N	UINT16	RW
2008h-28h	DI2 filter time PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0~30000	N/A	2	Immediate
	Function code	Mapping	Data type	Accessibility
	Po439	N	UINT16	RW
2008h-29h	DI3 filter time PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0~30000	N/A	2	Immediate
	Function code	Mapping	Data type	Accessibility
	Po440	N	UINT16	RW

2008h-2Ah	DI4 filter time PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0~30000	N/A	2	Immediate
	Function code	Mapping	Data type	Accessibility
	Po441	N	UINT16	RW
2008h-2Bh	DI5 filter time PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0~30000	N/A	2	Immediate
	Function code	Mapping	Data type	Accessibility
	Po442	N	UINT16	RW
2008h-2Ch	DI6 filter time PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0~30000	N/A	2	Immediate
	Function code	Mapping	Data type	Accessibility
	Po443	N	UINT16	RW
2008h-2Dh	DI7 filter time PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0~30000	N/A	2	Immediate
	Function code	Mapping	Data type	Accessibility
	Po444	N	UINT16	RW
2008h-2Eh	DI8 filter time PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0~30000	N/A	2	Immediate
	Function code	Mapping	Data type	Accessibility
	Po445	N	UINT16	RW

7.10.8 Touch probe function

Touch probe function is position latch function, which can latch position when DI or motor Z signal is changing.

1） **Related objects**

Index	Sub-index	**Name**	Access	**Data type**	**Unit**	**Setting Range**	Mfr's Value
2004h	0Eh	DI7terminal function	RW	UINT16	-	Two-parameter	d1 34

2004h	0Fh	DI8 terminal function	RW	UINT16	-	Two-parameter	d1 35
60B8h	00h	Touch probe function	RW	UINT16		0~ 65535	0
60B9h	00h	Touch probe state	RO	UINT16		-	
60BAh	00h	Touch probe pos1 position value	RO	DINT	Command unit	-	0
60BBh	00h	Touch probe neg1 position value	RO	DINT	Command unit	-	0
60BCh	00h	Touch probe pos2 position value	RO	DINT	Command unit	-	0
60BDh	00h	Touch probe neg2 position value	RO	DINT	Command unit	-	0

2) Set touch probe（60B8h）

Definition for each bit:

Bit	Definition	
0	Touch probe 1 setting 0—disabled；1—enabled	Bit0-bit5：Touch probe 1 setting
1	Touch probe 1 trigger mode 0—single-shot trigger, only trigger when trigger signal is value for the first time 1—continue trigger	
2	Touch probe 1 signal 0—DI7；1—Z signal	
4	Touch probe pos1 0— not latch；1—latch	
5	Touch probe neg1 0—not latch；1—latch	
8	Touch probe 2 setting 0-- disabled；1—enabled	Bit8-bit13：Touch probe 2 setting
9	Touch probe 2 trigger mode 0—single-shot trigger, only trigger when trigger signa is value for the first time 1—continue trigger	
10	Touch probe 2 signal 0—DI8；1—Z signal	

12	Touch probe pos 2 0—not latch；1—latch	
13	Touch probe neg 2 0—not latch；1—latch	

3) Set touch probe（60B9h）

Bit	Definition	
0	Touch probe 1 setting 0—disabled；1—enabled	Bit0-bit5：Touch probe 1 setting Bit8-bit13：Touch probe 2 setting
1	**Touch probe pos1** 1— not latch；1—latch	
2	Touch probe 2 setting 0-- disabled；1—enabled	
8	Touch probe 2 setting 0-- disabled；1—enabled	
9	**Touch probe pos 2** 0—not latch；1—latch	
10	**Touch probe neg** 2 0—not latch；1—latch	

7.10.9 Digital I/O signal function

Digital signal includes input (DI) and output (DO) signal. User can use keypad or (PLC /PC communication) to set DI, DO function and terminal logic. So PC/PLC can control servo drive by DI terminal, or servo driveDO signal is applied by PC/PLC.

Besides, servo drive has mandatory I/O function, mandatory DI input can be used to test drive DI function, mandatory DO output can be used to check the connection between PC/PLC and drive DO signal.

1) DI signal mandatory input

When the function is valid, every DI signal is only controlled by mandatory input 2008h-3Ah (So-57), not related to external DI signal.

Sub-index 3Ah	**Name**	Forced input setting of DI			**setting**	—	**Mode**	ALL
	unit	N/A	**Range**	0~255	**effect**	Immediate	**Mfr's value**	0
	parameter	So-57	**Access**	RW	**Mapping**	N	**Data type**	UINT16
This data represents the current terminal status, see details in Chapter 7.10.9								

Operation process

2. Set DI function and logic referring to PO407-Po414
3. Set So-58, select mandatory DI or DO
4. Set So-57, set mandatory DI high level and low level.
5. Monitor DI terminal level by Lo-14, Lo-15

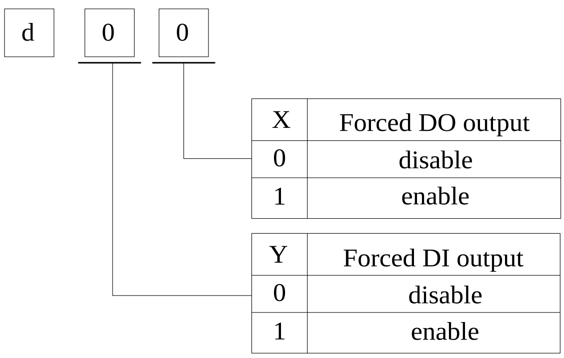
Related parameter:

2008h-3Ah	Forced input setting of DI PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	-	N/A	0	Immediate
	Function code	Mapping	Data type	Accessibility
	So-57	N	UINT16	RW

2008h-3Ah (So-57) setting value is decimal, convert it to 8 bit binary number, which is corresponding to DI1-DI8 (high bit is ahead, low bit is after). For example, if mandatory DI1ouput is required, binary number of DI1-DI8 is 00000001; corresponding decimal number is 1, just set 2008h-3Ah (So-57) as 1 of decimal.

2008h-3Bh	Overload pre-alarm filter time PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	-	N/A	d 0 0	Immediate
	Function code	Mapping	Data type	Accessibility
	So-58	N	UINT16	RW

The parameter setting format of 2008h-3Bh as below:



Master station can monitor DI state by reading 60FDh bit state.

60FDh definition is as following table:

Table 7.10.1 60FDh definition

Bit	**definition**	
0	Reverse run prohibited	
1	Forward run prohibited	

2	Home switch	
3-15	Reserved	
16-23	DI8-DI1	
25-31	Reserved	

Quit function

DI signal mandatory input is not remembered in the face of power loss; restart can return to normal DI, setting So-58 also can quit mandatory DI function.

2) DO signal mandatory output

Operation process

1. Set DO function and logic referring to PO421-Po425
2. Set So-58, select mandatory DO
3. Set DO referring to 60Feh definition
4. Monitor DO terminal level by Lo-16, Lo-17

Quit function

DO signal mandatory output is not remembered in the face of power loss, restart can return to normal DO, setting So-58 also can return to normal DO function.

Table 7.10.2 60FEh definition

Bit	**Definition**	
0	Brake	
1-15	Reserved	
16-19	DO1-DO4	
20	Alarm	
21-24	Reserved	

Terminal output state is set by setting corresponding bit. If one of Bit16- Bit19 is set brake function, Bit 0 is prior.

7.10.10 Other Output Signals

(1) Servo Alarm Terminal Output

ALM is activated when the servo drive has detected a fault condition. ON signal is output when servo works well, OFF signal is output when there is a malfunction.

Signal Name	Name	Terminals	Remarks
Servo Alarm Output	ALM	ALM- ALM+	Servo alarm output signal, can provide failure indication

(2) Servo Ready Output

Signal Name	Name	Terminals	Remarks

SRDY	SRDY	SRDY+	Servo ready output
		SRDY-	

Output ON means that the servo drive is ready to receive signal, control circuit and main circuit power supply are normal, there is no servo alarms. Output OFF means that servo drive is not ready.

● Overload pre-alarm signal output

When servo output current reaches or exceeds overload pre-alarm current, and after overload pre-alarm filter time, the output current still reachers or higher than pre-alarm current, then this signal is output.

Signal Name	Default terminal	Remarks
OL-W	Allocated by users	Pre-alarm signal of overload

Related parameters:

2008h-24h	Overload pre-alarm current PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0~800	%	120	Immediate
	Function code	Mapping	Data type	Accessibility
	So-35	N	UINT16	RW
2008h-25h	Overload pre-alarm filter time PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0~1000	10ms	10	Power on again
	Function code	Mapping	Data type	Accessibility
	So-36	N	UINT16	RW

● **Signal output in speed limit**

When rotate speed is limited, DO outputs this signal, and not related to motor rotation but valid for forward/reverse .It should allocate 1 DO terminal(speed limiting) to servo drive and set DO terminal logic.

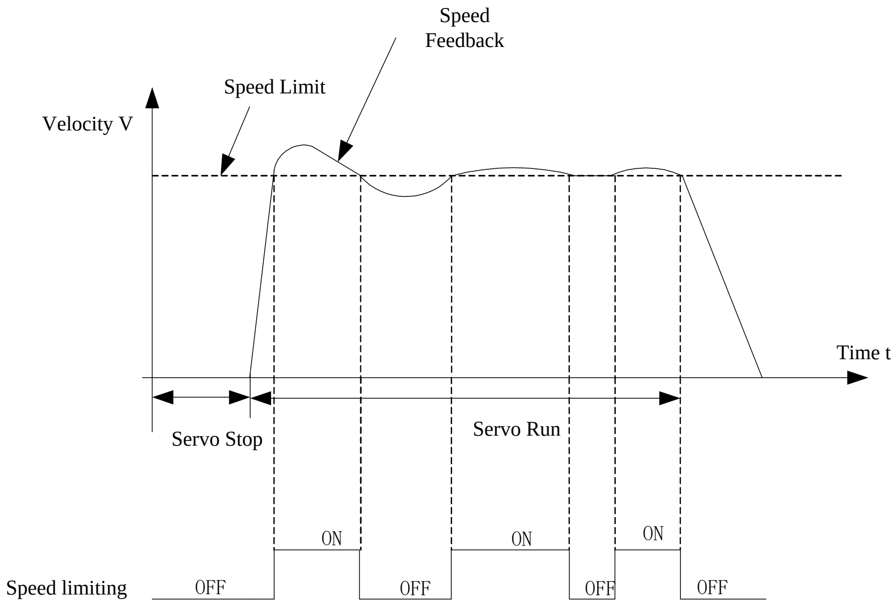


Fig 7.10.2 Output in speed limit under torque mode sketch map

VIII. Object dictionary and parameter list

8.1 Object dictionary classification

Object dictionary is most important part in equipment specifications, which is a set of parameters and variables. Object dictionary includes equipment description and all parameters of network state. It can be accessed by sequential predefined method.

Servo drive object has below items:

- Index Sub-index
- Data type Accessibility
- Mapping Setting method
- Mode Setting range
- Mfr's value Function code

★**Word explanation:**

In parameter list, object dictionary address is assigned by index and sub-index.

Index assigns the address of objects of the same type, represented by hexadecimal.

Sub-index assigns each object address under the same index.

Data type: Refer to below table:

Data type	Setting range	length	DS301vaule
SINT8	-128～+127	1byte	0002h
INT16	-32768～+32767	2 bytes	0003h
DINT32	-2147483647～+2147483647	4 bytes	0004h
UINT8	0～255	1 byte	0005h
UINT16	0～65535	2 bytes	0006h
UDINT32	0～4294967295	4 bytes	0007h
STRING	ASCII	—	0009h

Accessibility: Refer to below table:

Accessibility	Definition
RW	Read-write
WO	Write only
RO	Read only
CONST	Constant ， read only

Mapping: Refer to below table:

Mapping	Definition
NO	No mapping in PDO
RPDO	Write only
TPDO	Read only

Master station sets parameter by SDO.
If setting value is larger than upper limit, drive returns to abort message 13h.
If setting value is smaller than lower limit, drive returns to abort message 14h.
If user modifies parameter that is not allowed to be modified in running state, drive returns to 1Ah.
If user password is not entered, drive returns to abort message 19h.

8.2 Communication parameter (1000h~1FFFh)

Index 1000h	**Device type** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	N/A	**N/A**	00020192h	—
	Function code	Mapping	Data type	Accessibility
	—	N	UDINT32	**RO**
Index 1001h	Error register PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	N/A	**N/A**	—	—
	Function code	Mapping	Data type	Accessibility
	—	N	USINT8	RO
Index 1009h	Hardware version PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	N/A	**N/A**	—	—
	Function code	Mapping	Data type	Accessibility
	—	N	STRING24	RO
Index 100Ah	Software version PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect

	N/A	**N/A**	—	—
	Function code	Mapping	Data type	Accessibility
	So-00	N	STRING40	RO
Index 1018h-01h	Vendor ID	PP PV PT	CSP CSV	CST HM
	Setting Range	Setting Unit	Mfr's Value	Effect
	N/A	**N/A**	768h	—
	Function code	Mapping	Data type	Accessibility
	—	N	UDINT32	RO
Index 1018h-02h	Product code	PP PV PT	CSP CSV	CST HM
	Setting Range	Setting Unit	Mfr's Value	Effect
	N/A	**N/A**	1h	—
	Function code	Mapping	Data type	Accessibility
	—	N	UDINT32	RO
Index 1018h-03h	**Revision**	PP PV PT	CSP CSV	CST HM
	Setting Range	Setting Unit	Mfr's Value	Effect
	N/A	**N/A**	64h	—
	Function code	Mapping	Data type	Accessibility
	—	N	UDINT32	RO
Index 1018h-04h	Serial Number	PP PV PT	CSP CSV	CST HM
	Setting Range	Setting Unit	Mfr's Value	Effect
	N/A	**N/A**	01h	—
	Function code	Mapping	Data type	Accessibility
	—	N	UDINT32	**RO**
Index 1C00h-01h	Communication type SM0		PP PV PT CSP	CSV CST HM
	Setting Range	Setting Unit	Mfr's Value	Effect
	N/A	**N/A**	01h	—
	Function code	Mapping	Data type	Accessibility
	—	N	USINT8	**RO**
Index 1C00h-02h	Communication type SM1		PP PV PT CSP	CSV CST HM
	Setting Range	Setting Unit	Mfr's Value	Effect
	N/A	**N/A**	02h	—
	Function code	Mapping	Data type	Accessibility

	—	N	USINT8	RO
Index 1C00h-03h	Communication type SM2	PP PV PT CSP CSV CST HM		
	Setting Range	Setting Unit	Mfr's Value	Effect
	N/A	**N/A**	03h	—
	Function code	Mapping	Data type	Accessibility
	—	N	USINT8	RO
Index 1C00h-04h	Communication type SM3	PP PV PT CSP CSV CST HM		
	Setting Range	Setting Unit	Mfr's Value	Effect
	N/A	**N/A**	04h	—
	Function code	Mapping	Data type	Accessibility
	—	N	USINT8	**RO**
Index 1C32h-01h	Synchronization type	PP PV PT CSP CSV CST HM		
	Setting Range	Setting Unit	Mfr's Value	Effect
	N/A	**N/A**	2	—
	Function code	Mapping	Data type	Accessibility
	—	N	UINT16	RO
Index 1C32h-02h	Cycle time	PP PV PT CSP CSV CST HM		
	Setting Range	Setting Unit	Mfr's Value	Effect
	N/A	**ns**	0	—
	Function code	Mapping	Data type	Accessibility
	—	N	UDINT32	RO
Index 1C32h-04h	Synchronization types supported	PP PV PT CSP CSV CST HM		
	Setting Range	Setting Unit	Mfr's Value	Effect
	N/A	**N/A**	4	—
	Function code	Mapping	Data type	Accessibility
	—	N	UINT16	RO
Index 1C32h-05h	Minimum cycle time	PP PV PT CSP CSV CST HM		
	Setting Range	Setting Unit	Mfr's Value	Effect
	N/A	**N/A**	500000	—
	Function code	Mapping	Data type	Accessibility
	—	N	UDINT32	RO
Index 1C32h-20h	Sync error	PP PV PT CSP CSV CST HM		
	Setting Range	Setting Unit	Mfr's Value	Effect

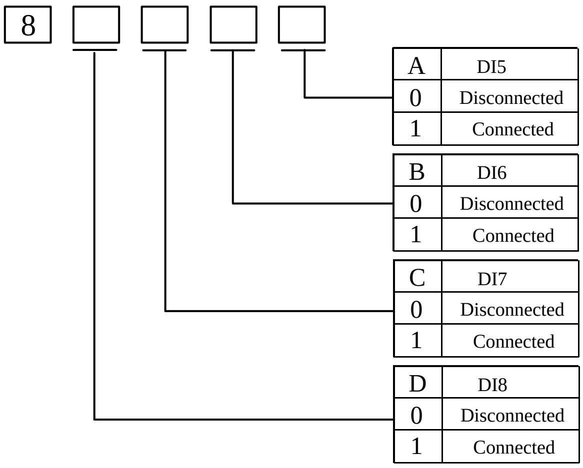
	N/A	**N/A**	0	—
	Function code	Mapping	Data type	Accessibility
	—	N	BOOL	RO
Index 1C33h-01h	Synchronization type PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	N/A	**N/A**	2	—
	Function code	Mapping	Data type	Accessibility
	—	N	UINT16	RO
Index 1C33h-02h	Cycle time PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	N/A	**ns**	0	—
	Function code	Mapping	Data type	Accessibility
	—	N	UDINT32	RO
Index 1C33h-04h	Synchronization types supported PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	N/A	**N/A**	4	—
	Function code	Mapping	Data type	Accessibility
	—	N	UINT16	RO
Index 1C33h-05h	Minimum cycle time PP PV PT SP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	N/A	**N/A**	500000	—
	Function code	Mapping	Data type	Accessibility
	—	N	UDINT32	RO
Index 1C33h-20h	Sync error PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	N/A	**N/A**	0	—
	Function code	Mapping	Data type	Accessibility
	—	N	BOOL	RO

8.3 Manufacturer defined parameters

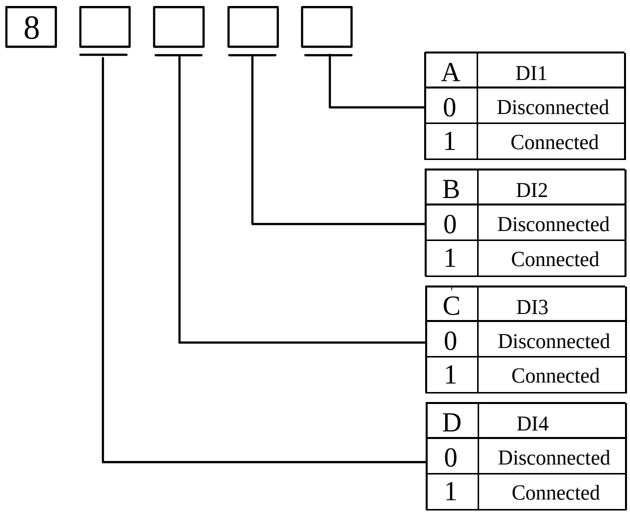
8.3.1 Monitor parameter（Lo-□□）

User can monitor servo drive command and internal state by monitor parameter

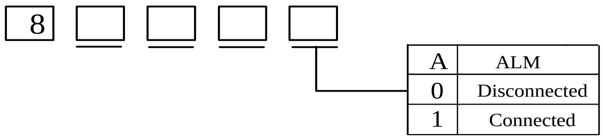
Parameter	Display content	Unit	Remark
Lo-00	Servo drive output current	0.1A	
Lo-01	Servo drive bus voltage	V	
Lo-02	Servo motor speed	0.1rpm	
Lo-03	Servo motor feedback pulse displays high 5 digits.	100000	
Lo-04	Servo motor feedback pulse displays low 5 digits	Command unit	
Lo-05	Servo motor feedback rotation displays high 5 digits	100000	
Lo-06	Servo motor feedback rotation displays low 5 digits	Command unit	
Lo-07	Given command pulse displays high 5 digits	Command unit	Valid in position mode.
Lo-08	Given command pulse displays low 5 digits	Command unit	Valid in position mode.
Lo-09	Command pulse deviation counting	Command unit	Valid in position mode.
Lo-10	Given speed	0.1rpm	Valid in speed mode.
Lo-11	Given torque	1% of rated torque	Valid in torque mode.
Lo-12	Reserved		
Lo-13	Reserved		
Lo-14	DI8~DI5 state	None	



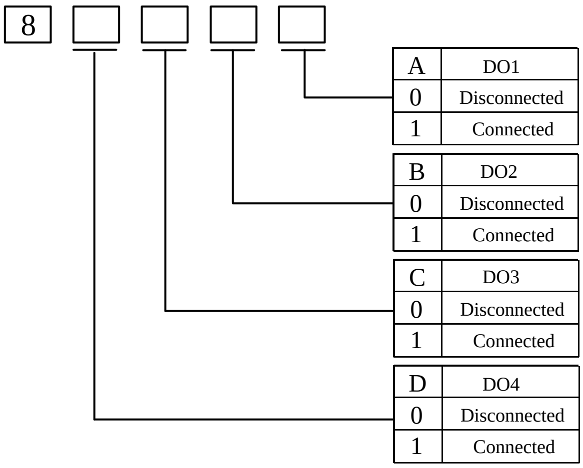
Lo-15	DI4~DI1 state	None	



Lo-16	Other output terminal state	None	



Lo-17	DO4~DO1 state	None	



Lo-18	Servo drive current temperature	℃	
Lo-19	Rotation inertia ratio display	0.01	
Lo-20	Current output torque	%	
Lo-21	Current gain group	N/A	
Lo-22	Discharge time	10ms	
Lo-23	One-loop pulse high 5 digits of motor absolute position	100000	

Lo-24	One-loop pulse low 5 digits of motor absolute position	Command unit	
Lo-25	Multi-loop pulse high 5 digits of motor absolute position	100000	
Lo-26	Multi-loop pulse low 5 digits of motor absolute position	Command unit	
Lo-27	Reserved		
Lo-28	Reserved		
Lo-29	Reserved		
Lo-30	Reserved		
Lo-31	Reserved		
Lo-32	Reserved		
Lo-33	Pulse numbers of high-speed counter 1	Command unit	
Lo-34	Pulse numbers of high-speed counter 2	Command unit	
Lo-36	Temperature of motor	℃	

Note: This group of parameters can only be checked, not be set.

8.3.2 Index segment 2000h (function code Po0□□)

Sub-index 01h	Motor Code PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	—	**N/A**	—	—
	Function code	Mapping o	Data type	Accessibility
	Po000	N	UINT16	**RO**
Sub-index 02h	**Control mode and forward direction setting** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	Two-parameter	**N/A**	1 21	Restart
	Function code	Mapping o	Data type	Accessibility
	Po001	N	UINT16	RW

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X	Control mode setting
0	Internal register speed mode
1	Position pulse mode
2	Internal register torque mode
3	Reserved
4	Reserved
5	Internal register position mode
6	Mix mode of internal register speed and position pulse
7	Mix mode of internal register speed and internal register torque
8	Reserved
9	Reserved
10	Mix mode of internal register speed and internal register position
11	Mix mode of internal register torque and position pulse
12	Reserved
13	Reserved
14	Mix mode of position pulse and internal register position
15	Reserved
16	Reserved
17	Mix mode of internal register torque and internal register position
18	Reserved
19	Reserved
20	Reserved
21	Bus mode

Y	Motor forward direction setting
0	Clockwise as viewed from servo motor shaft
1	Counterclockwise as viewed from servo motor shaft

Sub-index 04h	**Encoder frequency-division numbers** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～65535	**N/A**	—	immediate
	Function code	Mapping o	Data type	Accessibility
	Po003	N	UINT16	RW

Po003 is used to set frequency-division numbers for each phase.
The entry-into-effect time is 100ms.

Sub-index 06h	**Encoder pulse frequency-division numbers denominator** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect

	1～（2^{31}-1）	**N/A**	—	immediate
	Function code	Mapping o	Data type	Accessibility
	Po005	N	UDINT32	**RW**
Po005 is used to set frequency-division numbers for each motor				
Sub-index 08h	**Motion range for movement of inertia recognition** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～100	**N/A**	10	immediate
	Function code	Mapping	Data type	Accessibility
	Po007	N	INT16	RW
Sub-index 09h	**Inertia recognition mode selection** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～3	**N/A**	0	immediate
	Function code	Mapping	Data type	Accessibility
	Po008	N	INT16	**RW**
Po008=0：Not start rotational inertia identification function. Po008=1：Offline fwd/rev direction identification, which is suitable for the equipment with limit motion range. Po008=2：Offline single direction identification, suitable for the equipment, which cannot reverse. Po008=3：Online automatic inertia identification; in this mode, servo drive maintains online automatic identification status, when jog running, it displays not "JOG", but the value of current rotational inertia.				
Sub-index 0Ah	**Movement of inertia recognition gap time** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	10～2000	**ms**	100	immediate
	Function code	Mapping	Data type	Accessibility
	Po009	N	INT16	**RW**
Sub-index 0Bh	**Rigidity selection** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～30	**N/A**	6	immediate
	Function code	Mapping	Data type	Accessibility

	Po010	N	INT16	**RW**
Po010 is used to set servo drive rigidity. Please refer to 9.3.				
Sub-index 0Eh	**Rotation inertia ratio** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～30000	**0.01**	200	immediate
	Function code	Mapping	Data type	Accessibility
	Po013	N	INT16	**RW**
Please refer to 9.3.				
Sub-index 0Fh	Movement of inertia acele/decel time PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	200～5000	**ms**	1000	immediate
	Function code	Mapping	Data type	Accessibility
	Po014	N	INT16	RW
Please refer to 9.3.				
Sub-index 10h	**Motion range of off-line inertia recognition** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	200～（2^{31}-1）	**N/A**	—	immediate
	Function code	Mapping	Data type	Accessibility
	Po015	N	DINT32	RW
Please refer to 9.3.				
Sub-index 12h	**Z pulse frequency-division output width** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	50～30000	**N/A**	—	immediate
	Function code	Mapping	Data type	Accessibility
	Po017	N	INT16	**RW**
Please refer to 7.1.12.				
Sub-index 13h	**Pulse output configuration** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	Four-parameter	**N/A**	0001	immediate
	Function code	Mapping	Data type	Accessibility

	Po018	N	INT16	RW

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A	Z pulse output polarity
0	Negative polarity output
1	Positive polarity output

B	Z pulse command source
0	Motor shaft
1	Virtual shaft

C	Pulse frequency-division command source
0	Motor shaft
1	Internal position given
2	Collector pulse input
3	High-speed counter 1
4	High-speed counter 2
5	Position command

Sub-index 14h	**Virtual Z output period** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～（2^{31}-1）	**N/A**	10000	immediate
	Function code	Mapping	Data type	Accessibility
	Po019	N	DINT32	RW
One Z pulse is output per number of Po019 pulse, output pulse source is set by Po018.				

8.3.3 Index segment 2001h (function code Po1□□)

Sub-index 02h	**First speed loop proportional gain** PP PV CSP CSV			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～30000	**0.1Hz**	600	immediate
	Function code	Mapping	Data type	Accessibility
	Po101	N	INT16	RW
Please refer to 9.3.3				
Sub-index 03h	**First speed loop integral time** PP PV CSP CSV			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～10000	**0.1ms**	500	immediate

	Function code	Mapping	Data type	Accessibility
	Po102	N	INT16	RW
Please refer to 9.3.3				
Sub-index 04h	**Second speed loop proportional gain** PP PV CSP CSV			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～30000	**0.1Hz**	240	immediate
	Function code	Mapping	Data type	Accessibility
	Po103	N	INT16	RW
Please refer to 9.3.3				
Sub-index 05h	**Second speed loop integral time** PP PV CSP CSV			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～30000	**0.1ms**	1250	immediate
	Function code	Mapping	Data type	Accessibility
	Po104	N	INT16	RW
Please refer to 9.3.3				

Index segment 2001h (function code Po1□□)

Sub-index 06h	**First speed loop filter time constant** PP PV CSP CSV			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～20000	**0.01ms**	—	immediate
	Function code	Mapping	Data type	Accessibility
	Po105	N	INT16	RW
Please refer to 9.3.3				
Sub-index 07h	**Second speed loop filter time constant** PP PV CSP CSV			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～20000	**0.01ms**	—	immediate
	Function code	Mapping	Data type	Accessibility
	Po106	N	INT16	RW

Please refer to 9.3.3				
Sub-index 08h	**Torque feed forward gain** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～1000	**N/A**	0	immediate
	Function code	Mapping	Data type	Accessibility
	Po107	N	INT16	RW
Under non- torque mode, multiply feedforward signal by Po107 to get torque feedforward gain. As a part of torque command, increasing this parameter can improve response to changing speed, improve position command response and decrease position deviation at constant speed.				
Sub-index 09h	**Torque feedforward gain filter** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～30000	**0.01ms**	100	immediate
	Function code	Mapping	Data type	Accessibility
	Po108	N	INT16	RW
Please refer to 9.3.3				

Index segment 2001h (function code Po1□□)

Sub-index 0Ch	**S curve accele/decele time** PV CSV			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～15000	**1ms**	100	immediate
	Function code	Mapping	Data type	Accessibility
	Po111	N	INT16	RW
Sub-index 0Dh	**S curve starting indication** PV CSV			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～1	**N/A**	0	immediate
	Function code	Mapping	Data type	Accessibility
	Po112	N	INT16	RW

0: disabled 1: enabled				
Sub-index 13h	**Rotation detection value** PV CSV			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～30000	**0.1rpm**	300	immediate
	Function code	Mapping	Data type	Accessibility
	Po118	N	INT16	RW
When absolute value of speed is higher than the parameter, rotation detection signals outputs.				
Sub-index 1Bh	Speed value in the zero clamp PV CSV			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～30000	**0.1rpm**	50	immediate
	Function code	Mapping	Data type	Accessibility
	Po126	N	UINT16	RW
Sub-index 1Ch	Zero clamp enabled PV CSV			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～1	**N/A**	0	immediate
	Function code	Mapping	Data type	Accessibility
	Po127	N	UINT16	RW
0: disabled 1: enabled				

Index segment 2001h (function code Po1□□)

Sub-index 1Dh	Duration time of home searching signal PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～30000	**10ms**	100	immediate
	Function code	Mapping	Data type	Accessibility
	Po128	N	INT16	RW
If home searches signal in the time set by Po128, the signal **i**s output. If not, home found signal isn't output. The entry-into-effect time is 10ms.				
Sub-index 1Eh	Delay time of home searching PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect

	10～65535	**ms**	10000	Immediate
	Function code	Mapping	Data type	Accessibility
	Po129	N	UINT16	RW
If home searching time is more than Po129, servo drive will trip into AL-35. The entry-into-effect time is 10ms.				
Sub-index 1Fh	Gain switchover mode	PP PV CSP CSV		
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～6	**N/A**	0	Immediate
	Function code	Mapping	Data type	Accessibility
	Po130	N	INT16	RW
Please refer to 9.3.4				
Sub-index 20h	Gain switchover speed	PP PV CSP CSV		
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～32000	**0.1rpm**	100	Immediate
	Function code	Mapping	Data type	Accessibility
	Po131	N	INT16	RW
Please refer to 9.3.4				

Index segment 2001h (function code Po1□□)

Sub-index 21h	Gain switching pulse	PP PV CSP CSV		
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～32000	N/A	100	Immediate
	Function code	Mapping	Data type	Accessibility
	Po132	N	INT16	RW
Please refer to 9.3.4.				
Sub-index 22h	Position loop gain switching time	PP PV CSP CSV		
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～32000	0.1ms	20	Immediate
	Function code	Mapping	Data type	Accessibility
	Po133	N	INT16	RW

Please refer to 9.3.4.				
Sub-index 23h	Speed loop gain switching time PP PV CSP CSV			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～20000	**0.1ms**	100	Immediate
	Function code	Mapping	Data type	Accessibility
	Po134	N	INT16	RW
Please refer to 9.3.4				
Sub-index 24h	Gain switchover delay time (from gain 2 to 1) PP PV CSP CSV			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～32000	**0.1ms**	1000	Immediate
	Function code	Mapping	Data type	Accessibility
	Po135	N	INT16	RW
Please refer to 9.3.4				
Sub-index 25h	**Mechanical home one-loop** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～2^{31}	**N/A**	0	Power on again
	Function code	Mapping	Data type	Accessibility
	Po136	N	DINT32	RW
Sub-index 27h	Mechanical home multi-loop PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～2^{31}	N/A	0	Immediate
	Function code	Mapping	Data type	Accessibility
	Po138	N	DINT32	RW
Sub-index 29h	Forward running range pulse when overtravel protection PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～2^{31}	**N/A**	0	Immediate
	Function code	Mapping	Data type	Accessibility
	Po140	N	DINT32	RW

Sub-index 2Bh	Forward running range multi-loop numbers when overtravel protection PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～32000	N/A	1000	Immediate
	Function code	Mapping	Data type	Accessibility
	Po142	N	RW	INT16
Sub-index 2Ch	Reverse running range pulse when overtravel protection PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～2^{31}	N/A	0	Immediate
	Function code	Mapping	Data type	Accessibility
	Po143	N	DINT32	RW
Sub-index 2Eh	Reverse running range multi-loop numbers when overtravel protection PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～32000	N/A	1000	Immediate
	Function code	Mapping	Data type	Accessibility
	Po145	N	RW	INT16

8.3.4 Index segment 2002h (function code Po2□□)

Sub-index 01h	First current loop bandwidth PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	10～3000	Hz	—	Immediate
	Function code	Mapping	Data type	Accessibility
	Po200	N	INT16	RW
Please refer to 9.3.3.				
Sub-index 02h	Second current loop bandwidth PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	10～3000	Hz	—	Immediate
	Function code	Mapping	Data type	Accessibility

	Po201	N	INT16	RW
Please refer to 9.3.3.				
Sub-index 08h	Forward/reverse run prohibited and emergency stop torque PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～300	1% of rated torque	100	Immediate
	Function code	Mapping	Data type	Accessibility
	Po207	N	INT16	RW
When forward/reverse run prohibited signal or emergency stop signal is valid, servo motor instant reverse stop torque is limited by Po207. Po207 is absolute value, which is valid for forward/reverse run. The entry-into-effect time is 100ms				
Sub-index 0Fh	First torque loop filter time constant PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～30000	0.01ms	—	Immediate
	Function code	Mapping	Data type	Accessibility
	Po214	N	RW	INT16
Please refer to 9.3.3.				
Sub-index 10h	Second torque loop filter time constant PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～30000	0.01ms	—	Immediate
	Function code	Mapping	Data type	Accessibility
	Po215	N	INT16	RW
Please refer to 9.3.3.				
Sub-index 11h	Forward/reverse run prohibited torque setting PT CST			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～1	**N/A**	1	Immediate
	Function code	Mapping	Data type	Accessibility
	Po216	N	INT16	RW
0: prohibited torque is Po207 1: prohibited torque is 0.				
Sub-index 12h	The first notch filter center frequency			

	PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	50～30000	**Hz**	2000	Immediate
	Function code	Mapping	Data type	Accessibility
	Po217	N	INT16	RW
Please refer to 9.4.				
Sub-index 13h	The first notch filter width PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～30000	**Hz**	5	Immediate
	Function code	Mapping	Data type	Accessibility
	Po218	N	INT16	RW
Please refer to 9.4.				
Sub-index 14h	The first notch filter depth PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～100	**N/A**	0	Immediate
	Function code	Mapping	Data type	Accessibility
	Po219	N	INT16	RW
Please refer to 9.4.				
Sub-index 15h	The second notch filter center frequency PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	50～30000	**Hz**	2000	Immediate
	Function code	Mapping	Data type	Accessibility
	Po220	N	INT16	RW
Please refer to 9.4.				
Sub-index 16h	The second notch filter width PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～30000	**Hz**	5	Immediate
	Function code	Mapping	Data type	Accessibility

	Po221	N	INT16	**RW**
Please refer to 9.4.				
Sub-index 17h	The second notch filter depth PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～100	**N/A**	0	Immediate
	Function code	Mapping	Data type	Accessibility
	Po222	N	INT16	RW
Please refer to 9.4.				
Sub-index 18h	The third notch filter center frequency PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	50～30000	**Hz**	2000	Immediate
	Function code	Mapping	Data type	Accessibility
	Po223	N	INT16	RW
Please refer to 9.4.				
Sub-index 19h	The third notch filter width PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～30000	**Hz**	5	Immediate
	Function code	Mapping	Data type	Accessibility
	Po224	N	INT16	RW
Please refer to 9.4.				
Sub-index 1Ah	The third notch filter depth PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～100	**N/A**	0	Immediate
	Function code	Mapping	Data type	Accessibility
	Po225	N	INT16	RW
Please refer to 9.4.				
Sub-index 1Bh	The fourth notch filter center frequency PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect

	50～30000	**Hz**	2000	Immediate
	Function code	Mapping	Data type	Accessibility
	Po226	N	INT16	RW
Please refer to 9.4.				

Sub-index 1Ch	The fourth notch filter width PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～30000	**Hz**	5	Immediate
	Function code	Mapping	Data type	Accessibility
	Po227	N	INT16	RW
Please refer to 9.4.				
Sub-index 1Dh	The fourth notch filter depth PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～100	**N/A**	0	Immediate
	Function code	Mapping	Data type	Accessibility
	Po228	N	INT16	RW
Please refer to 9.4.				
Sub-index 1Eh	Notch filter function enabled PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～3	**N/A**	0	Immediate
	Function code	Mapping	Data type	Accessibility
	Po229	N	INT16	RW
0: Notch filter function disabled 1: Notch filter function enabled 2: Notch filter is being auto-configured. 3: Clear filter data				
Sub-index 1Fh	No. of notch filter PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～4	**N/A**	2	Immediate
	Function code	Mapping	Data type	Accessibility
	Po230	N	INT16	RW
Sub-index 23h	Load observer gain PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect

	0～1000	**N/A**	0	Immediate
	Function code	Mapping	Data type	Accessibility
	Po234	N	INT16	RW
The compensation for load torque can improve system rigidity. But if the parameter is set too high, there is noise.				
Sub-index 24h	Filter time of load observer PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～30000	**0.01ms**	1000	Immediate
	Function code	Mapping	Data type	Accessibility
	Po235	N	INT16	RW
Setting Po235 can compensate load torque, which can improve system rigidity. If the parameter is set too small, there is noise.				
Sub-index 25h	Back EMF compensation coefficient PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～1000	**0.1%**	500	Power on again
	Function code	Mapping	Data type	Accessibility
	Po236	N	INT16	RW
Sub-index 26h	Target torque range PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～50	1%	2	Immediate
	Function code	Mapping	Data type	Accessibility
	Po237	N	INT16	RW
Sub-index 27h	Torque filter frequency PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～1000	0.1Hz	10	Immediate
	Function code	Mapping	Data type	Accessibility
	Po238	N	INT16	RW
Sub-index 29h	Center frequency of jitter inhibition PP PV PT CSP CSV CST HM			

	Setting Range	Setting Unit	Mfr's Value	Effect
	50～2000	**0.1Hz**	2000	Immediate
	Function code	Mapping	Data type	Accessibility
	Po240	N	INT16	RW
Sub-index 2Bh	Intensity of jitter inhibition PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～100	**N/A**	0	Immediate
	Function code	Mapping	Data type	Accessibility
	Po242	N	INT16	RW

8.3.5 Index segment 2003h (function code Po3□□)

Sub-index 01h	Pulse command setting PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	Four-parameter	**N/A**	1000	Immediate
	Function code	Mapping	Data type	Accessibility
	Po300	N	INT16	RW

b □ □ □ □

A	Pulse mode
0	Pulse+direction
1	Pulse+pulse
2	Orthogonal (fourfold frequency)

B	Filter frequency
0	4MHz
1	2MHz
2	1MHz
3	500KHz
4	200KHz
5	150KHz
6	80 KHz

C	Pulse input logic
0	PULS negative,SIGN negative
1	PULS positive,SIGN positive
2	PULS negative,SIGN positive
3	PULS positive, SIGN negative
4	PULS exchanges with SIGN

D	Frequency-division output phase
0	Negative phase output
1	Positive phase output

Sub-index 02h	First position loop gain			PP CSP
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～30000	**N/A**	—	Immediate
	Function code	Mapping	Data type	Accessibility
	Po301	N	INT16	RW
Please refer to 9.3.3				
Sub-index 03h	Second position loop gain			PP CSP
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～30000	**N/A**	—	Immediate
	Function code	Mapping	Data type	Accessibility

	Po302	N	INT16	RW
Please refer to 9.3.3				
Sub-index 04h	Position loop feed forward gain PP CSP			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～1000	**N/A**	0	Immediate
	Function code	Mapping	Data type	Accessibility
	Po303	N	INT16	RW
Please refer to 9.3.3				
Sub-index 05h	First group electronic gear numerator PP CSP			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～65535	**N/A**	0	Immediate
	Function code	Mapping	Data type	Accessibility
	Po304	N	INT16	RW
The entry-into-effect time is 100ms.				
Sub-index 06h	First group electronic gear denominator PP CSP			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～65535	**N/A**	10000	Immediate
	Function code	Mapping	Data type	Accessibility
	Po305	N	INT16	RW
The entry-into-effect time is 100ms.				
Sub-index 07h	Position loop filter time constant PP CSP			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～10000	**ms**	1	Immediate
	Function code	Mapping	Data type	Accessibility
	Po306	N	INT16	RW
Please refer to 9.3.3				
Sub-index 09h	Command pulse clear function PP CSP			
	Setting Range	Setting Unit	Mfr's Value	Effect
	Four-parameter	**N/A**	—	Immediate
	Function code	Mapping	Data type	Accessibility
	Po308	N	INT16	RW

b □ □ □ □

A	Terminal of inhibiting pulse signal
0	Invalid
1	Valid(INH-P port must be allocated)

B	Command pulse clear
0	Invalid
1	Valid(CLR port must be allocated)

C	Alarm unit for position loop tracking error
0	1 pulse
1	100 pulses

D	Caution unit for position loop tracking error
0	1 pulse
1	100 pulses

Sub-index 1Bh	Filter time constant of position feedforward PP CSP			
	Setting Range	Setting Unit	Mfr’s Value	Effect
	1～32000	**0.01ms**	1000	Immediate
	Function code	Mapping	Data type	Accessibility
	Po326	N	UINT16	RW

Sub-index 1Ch	Filter time constant of position feedforward PP CSP			
	Setting Range	Setting Unit	Mfr’s Value	Effect
	1～30000	**N/A**	—	Immediate
	Function code	Mapping	Data type	Accessibility
	Po327	N	UINT16	RW

Sub-index 27h	Internal position given speed unit PP CSP			
	Setting Range	Setting Unit	Mfr’s Value	Effect
	0～1	**N/A**	0	Immediate
	Function code	Mapping	Data type	Accessibility
	Po338	N	INT16	RW

0: Motor actual speed, no related to electronic gear ratio, unit is 0.1rpm
1:0.01KHz, frequency division processing is done by electronic gear ratio.

Sub-index 28h	Electronic gear selection PP CSP			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～2	**N/A**	1	Immediate
	Function code	Mapping	Data type	Accessibility
	Po339	N	INT16	RW
The entry-into-effect time is 100ms. 0: The first electronic gear ratio 1: The second electronic gear ratio 3: DI terminal selection				
Sub-index 4Dh	Position feedback source PP CSP			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～2	**N/A**	0	Immediate
	Function code	Mapping	Data type	Accessibility
	Po376	N	INT16	RW
0: encoder 1: high-speed counter 1 3: high-speed counter 2				
Sub-index 4Eh	External encoder proportion numerator PP CSP			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～65535	**N/A**	1	Immediate
	Function code	Mapping	Data type	Accessibility
	Po377	N	UINT16	RW
Sub-index 4Fh	External encoder proportion denominator PP CSP			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～65535	**N/A**	1	Immediate
	Function code	Mapping	Data type	Accessibility
	Po378	N	UINT16	RW
Sub-index 50h	Mixed error clear cycles PP CSP			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～32000	**N/A**	0	Immediate
	Function code	Mapping	Data type	Accessibility
	Po379	N	INT16	RW

Sub-index 51h	Mixed error alarm value PP CSP			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～65535	**N/A**	1000	Immediate
	Function code	Mapping	Data type	Accessibility
	Po380	N	UINT16	RW
Sub-index 5Eh	**OP abnormal protection time** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0~65535	**10ms**	20	Immediate
	Function code	Mapping	Data type	Accessibility
	Po393	N	UINT16	RW

8.3.6 Index segment 2004h (function code Po4□□)

Sub-index 08h	DI1 terminal function selection PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	Two-parameter	N/A	—	Restart
	Function code	Mapping	Data type	Accessibility
	Po407	N	UINT16	RW
Please refer to 8.3.10				
Sub-index 09h	DI2 terminal function selection PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	Two-parameter	N/A	—	Restart
	Function code	Mapping	Data type	Accessibility
	Po408	N	UINT16	RW
Please refer to 8.3.10				
Sub-index 0Ah	DI3 terminal function selection PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	Two-parameter	N/A	—	Restart
	Function code	Mapping	Data type	Accessibility
	Po409	N	UINT16	RW
Please refer to 8.3.10				

Sub-index 0Bh	DI4 terminal function selection PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	Two-parameter	N/A	—	Restart
	Function code	Mapping	Data type	Accessibility
	Po410	N	UINT16	RW
Please refer to 8.3.10				
Sub-index 0Ch	DI5 terminal function selection PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	Two-parameter	N/A	—	Restart
	Function code	Mapping	Data type	Accessibility
	Po411	N	UINT16	RW
Please refer to 8.3.10				
Sub-index 0Dh	DI6 terminal function selection PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	Two-parameter	N/A	—	Restart
	Function code	Mapping	Data type	Accessibility
	Po412	N	UINT16	RW
Please refer to 8.3.10				
Sub-index 0Eh	DI7 terminal function selection PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	Two-parameter	N/A	—	Restart
	Function code	Mapping	Data type	Accessibility
	Po413	N	UINT16	RW
Please refer to 8.3.10				
Sub-index 0Fh	DI8 terminal function selection PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	Two-parameter	N/A	—	Restart
	Function code	Mapping	Data type	Accessibility
	Po414	N	UINT16	RW
Please refer to 8.3.10				
Sub-index 16h	DO1 terminal function selection PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect

	Two-parameter	N/A	—	Restart
	Function code	Mapping	Data type	Accessibility
	Po421	N	UINT16	RW
Please refer to 8.3.10				
Sub-index 17h	DO2 terminal function selection PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	Two-parameter	N/A	—	Restart
	Function code	Mapping	Data type	Accessibility
	Po422	N	UINT16	RW
Please refer to 8.3.10				
Sub-index 18h	DO3 terminal function selection PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	Two-parameter	N/A	—	Restart
	Function code	Mapping	Data type	Accessibility
	Po423	N	UINT16	RW
Please refer to 8.3.10				
Sub-index 19h	DO4 terminal function selection PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	Two-parameter	N/A	—	Restart
	Function code	Mapping	Data type	Accessibility
	Po424	N	UINT16	RW
Please refer to 8.3.10				
Sub-index 1Ah	ALM terminal function selection PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	Two-parameter	N/A	—	Restart
	Function code	Mapping	Data type	Accessibility
	Po425	N	UINT16	RW
Please refer to 8.3.10				
Sub-index 27h	DI1 filter time PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～30000	N/A	2	Immediate
	Function code	Mapping	Data type	Accessibility
	Po438	N	UINT16	RW

<table>
<tr><td colspan="5"></td></tr>
<tr><td rowspan="5">Sub-index 28h</td><td colspan="4">DI2 filter time PP PV PT CSP CSV CST HM</td></tr>
<tr><td>Setting Range</td><td>Setting Unit</td><td>Mfr’s Value</td><td>Effect</td></tr>
<tr><td>0～30000</td><td>N/A</td><td>2</td><td>Immediate</td></tr>
<tr><td>Function code</td><td>Mapping</td><td>Data type</td><td>Accessibility</td></tr>
<tr><td>Po439</td><td>N</td><td>UINT16</td><td>RW</td></tr>
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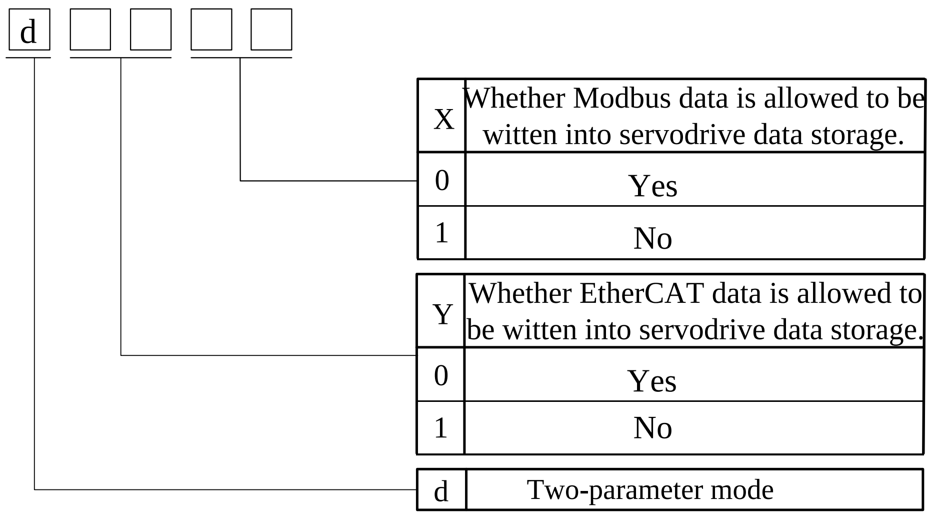
<tr><td rowspan="5">Sub-index 29h</td><td colspan="4">DI3 filter time PP PV PT CSP CSV CST HM</td></tr>
<tr><td>Setting Range</td><td>Setting Unit</td><td>Mfr’s Value</td><td>Effect</td></tr>
<tr><td>0～30000</td><td>N/A</td><td>2</td><td>Immediate</td></tr>
<tr><td>Function code</td><td>Mapping</td><td>Data type</td><td>Accessibility</td></tr>
<tr><td>Po440</td><td>N</td><td>UINT16</td><td>RW</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td rowspan="5">Sub-index 2Ah</td><td colspan="4">DI4 filter time PP PV PT CSP CSV CST HM</td></tr>
<tr><td>Setting Range</td><td>Setting Unit</td><td>Mfr’s Value</td><td>Effect</td></tr>
<tr><td>0～30000</td><td>N/A</td><td>2</td><td>Immediate</td></tr>
<tr><td>Function code</td><td>Mapping</td><td>Data type</td><td>Accessibility</td></tr>
<tr><td>Po441</td><td>N</td><td>UINT16</td><td>RW</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td rowspan="5">Sub-index 2Bh</td><td colspan="4">DI5 filter time PP PV PT CSP CSV CST HM</td></tr>
<tr><td>Setting Range</td><td>Setting Unit</td><td>Mfr’s Value</td><td>Effect</td></tr>
<tr><td>0～30000</td><td>N/A</td><td>2</td><td>Immediate</td></tr>
<tr><td>Function code</td><td>Mapping</td><td>Data type</td><td>Accessibility</td></tr>
<tr><td>Po442</td><td>N</td><td>UINT16</td><td>RW</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td rowspan="5">Sub-index 2Ch</td><td colspan="4">DI6 filter time PP PV PT CSP CSV CST HM</td></tr>
<tr><td>Setting Range</td><td>Setting Unit</td><td>Mfr’s Value</td><td>Effect</td></tr>
<tr><td>0～30000</td><td>N/A</td><td>2</td><td>Immediate</td></tr>
<tr><td>Function code</td><td>Mapping</td><td>Data type</td><td>Accessibility</td></tr>
<tr><td>Po443</td><td>N</td><td>UINT16</td><td>RW</td></tr>
<tr><td colspan="5"></td></tr>
</table>

Sub-index 2Dh	DI7 filter time PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～30000	N/A	2	Immediate
	Function code	Mapping	Data type	Accessibility
	Po444	N	UINT16	RW
Sub-index 2Eh	DI8 filter time PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～30000	N/A	2	Immediate
	Function code	Mapping	Data type	Accessibility
	Po445	N	UINT16	RW

8.3.7 Index segment 2005h (function code Po5□□)

Sub-index 01h	Communication address PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～254	N/A	1	Immediate
	Function code	Mapping	Data type	Accessibility
	Po500	N	UINT16	RW
Please refer to 6.2. The entry-into-effect time is 1000ms.				
Sub-index 02h	Communication mode PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～1	N/A	0	Immediate
	Function code	Mapping	Data type	Accessibility
	Po501	N	UINT16	RW
Please refer to 6.2. The entry-into-effect time is 1000ms.				
Sub-index 03h	Stop bit settings PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～1	N/A	0	Immediate
	Function code	Mapping	Data type	Accessibility
	Po502	N	UINT16	RW
0: one stop bit 1: two stop bit				
Sub-index 04h	Odd/even calibration PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect

	0～2	N/A	0	Immediate
	Function code	Mapping	Data type	Accessibility
	Po503	N	UINT16	RW
0: no calibration 1: odd calibration 2: even calibration The entry-into-effect time is 1000ms.				
Sub-index 05h	Baud rate	PP PV PT CSP CSV CST HM		
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～5	bit/s	2	Immediate
	Function code	Mapping	Data type	Accessibility
	Po504	N	UINT16	RW
0: 2400 1:4800 2: 9600 3: 19200 4:38400 5: 57600 Please refer to 6.2				
Sub-index 06h	Whether communication is valid	PP PV PT CSP CSV CST HM		
	Setting Range	Setting Unit	Mfr's Value	Effect
	Two-parameter	**N/A**	1	Immediate
	Function code	Mapping	Data type	Accessibility
	Po505	N	UINT16	RW



Please refer to 6.2. The entry-into-effect time is 1000ms.

Sub-index 07h	Time interval of serial data packet	PP PV PT CSP CSV CST HM		
	Setting Range	Setting Unit	Mfr's Value	Effect
	-20~2000	**0.1rpm**	0	Immediate
	Function code	Mapping	Data type	Accessibility

	Po506	N	INT16	RW

8.3.8 Index segment 2006h (function code Ho□□□)

Sub-index 01h	**Rated voltage** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～30000	V	—	—
	Function code	Mapping	Data type	Accessibility
	Ho000	N	UINT16	RO
Sub-index 02h	**Rated current** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～30000	**0.1A**	—	Immediate
	Function code	Mapping	Data type	Accessibility
	Ho001	N	UINT16	RW
Sub-index 03h	**Max rotary speed** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～32000	**rpm**	—	Immediate
	Function code	Mapping	Data type	Accessibility
	Ho002	N	UINT16	RW
Sub-index 04h	**Rated rotary speed** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～32000	**rpm**	—	Immediate
	Function code	Mapping	Data type	Accessibility
	Ho003	N	UINT16	RW
Sub-index 05h	**Motor pole pairs** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～30	**Pairs**	—	Immediate
	Function code	Mapping	Data type	Accessibility
	Ho004	N	UINT16	RW

For example, if motor pole number is 8, pole pairs is 4.				
Sub-index 06h	**Resistance between phases** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～65535	$10^{-3}\Omega$	—	Immediate
	Function code	Mapping	Data type	Accessibility
	Ho005	N	UINT16	RW
Sub-index 07h	**D-axis inductance** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～65535	10^{-6}H	—	Immediate
	Function code	Mapping	Data type	Accessibility
	Ho006	N	UINT16	RW
Sub-index 08h	**Q-axis inductance** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～65535	10^{-6}H	—	Immediate
	Function code	Mapping	Data type	Accessibility
	Ho007	N	UINT16	RW
Sub-index 09h	**Back EMF line voltage value** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～30000	0.1V/1000rpm	—	Immediate
	Function code	Mapping	Data type	Accessibility
	Ho008	N	UINT16	RW
Sub-index 0Ch	**Motor rated power** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～30000	0.01Kw	—	Immediate
	Function code	Mapping	Data type	Accessibility
	Ho011	N	UINT16	RW
Sub-index 0Dh	**Motor movement inertia** PP PV PT CSP CSV CST HM			

	Setting Range	Setting Unit	Mfr's Value	Effect
	0～（2^{31}-1）	10^{-6}Kg•m^2	—	Immediate
	Function code	Mapping	Data type	Accessibility
	Ho012	N	UINT16	RW
Sub-index 11h	**Encoder line number** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～（2^{31}-1）	**PPR**	—	Immediate
	Function code	Mapping	Data type	Accessibility
	Ho016	N	DINT32	RW
Sub-index 13h	**Encoder installation angle (number of pulses)** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	-（2^{31}-1）～+（2^{31}-1）)	N/A	—	Immediate
	Function code	Mapping	Data type	Accessibility
	Ho018	N	DINT32	RW
Sub-index 48h	**Overload sensitivity setting** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～30000	N/A	500	Immediate
	Function code	Mapping	Data type	Accessibility
	Ho121	N	INT16	RW

8.3.9 Index segment 2008h (function code So-□□)

Sub-index 01h	**Software version of firmware 1** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	N/A	N/A	—	—
	Function code	Mapping	Data type	Accessibility
	So-00	N	UINT16	RO

So-00 displays software version of firmware 1. For example, 100 is 1.00 version.				
Sub-index 02h	User's password(Avoid modifying parameters by mistake) PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～9999	N/A	—	Restart
	Function code	Mapping	Data type	Accessibility
	So-01	N	UINT16	RW
Please refer to 7.10.1.				
Sub-index 03h	Delay time for servo OFF PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～500	**10ms**	0	Immediate
	Function code	Mapping	Data type	Accessibility
	So-02	N	UINT16	RW
Please refer to 7.1.3. The entry-into-effect time is 100ms.				
Sub-index 04h	Delay time for electro-magnetic braking OFF PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	10～100	**10ms**	50	Immediate
	Function code	Mapping	Data type	Accessibility
	So-03	N	UINT16	RW
Please refer to 7.1.3. The entry-into-effect time is 100ms.				
Sub-index 05h	**Braking resistor value** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	8～1000	Ω	—	Immediate
	Function code	Mapping	Data type	Accessibility
	So-04	N	UINT16	RW
So-04 is used to set servo drive external resistor value. External resistor and internal resistor cannot be used at the same time. If user select external resistor, please remove the jumper between terminal B1 and B2. Please refer to 7.1.7.				
Sub-index 06h	**Discharge duty ratio** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～100	**%**	50	Immediate
	Function code	Mapping	Data type	Accessibility
	So-05	N	UINT16	RW

The higher the discharge duty ratio, the fast the discharge speed.				
Sub-index 07h	**Input power phase-loss protection** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～1	**N/A**	—	Immediate
	Function code	Mapping	Data type	Accessibility
	So-06	N	UINT16	RW
0: disabled 1; enabled				
Sub-index 08h	**Servo OFF stop mode** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～5	**N/A**	0	Immediate
	Function code	Mapping	Data type	Accessibility
	So-07	N	UINT16	RW
0: Free stop 1: Dynamic brake, only valid for servo drive with dynamic brake. 2**:** Fast enabled. When servo drive is power on and receives enable signal, after 10ms delay, servo is on. 3: Deceleration stop. 4: Deceleration stop and dynamic brake. 5: Deceleration stop and fast enabled.				
Sub-index 09h	**Dynamic braking delay time** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	100～30000	**0.1ms**	5000	Immediate
	Function code	Mapping	Data type	Accessibility
	So-08	N	UINT16	RW
Sub-index 0Ah	**Servo drive status display** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～38	**N/A**	2	Immediate
	Function code	Mapping	Data type	Accessibility
	So-09	N	UINT16	RW
Please refer to 7.10.2.				
Sub-index 0Bh	**Record of the latest malfunction type** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect

	N/A	**N/A**	—	—
	Function code	Mapping	Data type	Accessibility
	So-10	N	UINT16	RO
So-10 can only be checked, but cannot be modified.				
Sub-index 0Ch	**Record of malfunction type for the last second time** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	N/A	**N/A**	—	—
	Function code	Mapping	Data type	Accessibility
	So-11	N	UINT16	RO
So-11 can only be checked, but cannot be modified.				
Sub-index 0Dh	**Record of malfunction type for the last third time** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	N/A	**N/A**	—	—
	Function code	Mapping	Data type	Accessibility
	So-12	N	UINT16	RO
So-12 can only be checked, but cannot be modified.				
Sub-index 0Eh	**Jog speed** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～30000	**0.1rpm**	1000	Immediate
	Function code	Mapping	Data type	Accessibility
	So-13	N	UINT16	RW
So-13 can only be checked, but cannot be modified. The entry-into-effect time is 10ms.				
Sub-index 10h	**Encoder disconnection protection** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～1	**N/A**	1	Immediate
	Function code	Mapping	Data type	Accessibility
	So-15	N	UINT16	RW
0: Invalid 1: Valid The entry-into-effect time is 10ms.				
Sub-index 11h	**Speed threshold of electromagnetic braking**			

	PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～30000	**0.1rpm**	1000	Immediate
	Function code	Mapping	Data type	Accessibility
	So-16	N	UINT16	RW
Please refer to 7.1.3				
Sub-index 12h	**Forward run prohibited**		PP PV PT CSP CSV CST HM	
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～1	N/A	1	Immediate
	Function code	Mapping	Data type	Accessibility
	So-17	N	UINT16	RW
0: invaid 1: valid When So-17=1, So-18=1 and terminals with the function of F-INH and R-INH are allocated, user can use overtravel function by external terminal. For security, Mfr's setting of So-17 and So-18 is valid and common-close contact is selected to ensure protection in case of malfunction.				
Sub-index 13h	**Reverse run prohibited**		PP PV PT CSP CSV CST HM	
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～1	N/A	1	Immediate
	Function code	Mapping	Data type	Accessibility
	So-18	N	UINT16	RW
0: invalid 1: valid When So-17=1, So-18=1 and terminals with the function of F-INH and R-INH are allocated, user can use overtravel function by external terminal. For security, Mfr's setting of So-17 and So-18 is valid and common-close contact is selected to ensure protection in case of malfunction.				
Sub-index 14h	**Analog monitor channel 1**		PP PV PT CSP CSV CST HM	
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～3	N/A	0	Immediate
	Function code	Mapping	Data type	Accessibility
	So-19	N	UINT16	RW

0: servo drive output current. Servo drive output current corresponding to 10V is set by So-20. 1: servo drive output voltage. Servo drive max voltage corresponding to 10V is set by So-21. 2: servo motor speed. Max rotation speed corresponding to 10V is set by So-22. 3: Output voltage 0V+offset. Offset voltage is set by So-24.				
Sub-index 15h	**Servo drive output current corresponding to 10V** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～1000	0.1A	200	Immediate
	Function code	Mapping	Data type	Accessibility
	So-20	N	UINT16	RW
The entry-into-effect time is 1000ms.				
Sub-index 16h	**Servo drive max voltage corresponding to 10V** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～500	1V	500	Immediate
	Function code	Mapping	Data type	Accessibility
	So-21	N	UINT16	RW
The entry-into-effect time is 1000ms.				
Sub-index 17h	**Max rotation speed corresponding to 10V** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～32000	0.1rpm	30000	Immediate
	Function code	Mapping	Data type	Accessibility
	So-22	N	UINT16	RW
The entry-into-effect time is 1000ms.				
Sub-index 18h	**Motor parameter storing location** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～1	**N/A**	1	Immediate
	Function code	Mapping	Data type	Accessibility
	So-23	N	UINT16	RW
0: When servo drive finishes auto-tuning motor parameter, motor parameters are stored in servo drive. 1: When servo drive finishes studying motor parameter, motor parameters are stored in encoder. (Only for encoder with EEPROM)				

Sub-index 19h	**Analog monitor voltage compensation 1** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	-10000~10000	mv	0	Immediate
	Function code	Mapping	Data type	Accessibility
	So-24	N	INT16	RW
The entry-into-effect time is 1000ms.				
Sub-index 1Ah	Motor parameter identification setting PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～4	N/A	0	Immediate
	Function code	Mapping	Data type	Accessibility
	So-25	N	UINT16	RW
Please refer to chapter 7.				
Sub-index 1Bh	**Fan control** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～2	N/A	2	Immediate
	Function code	Mapping	Data type	Accessibility
	So-26	N	UINT16	RW
Sub-index 1Ch	**Fan temperature setting** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	10～100	°C	45	Immediate
	Function code	Mapping	Data type	Accessibility
	So-27	N	UINT16	RW
Sub-index 1Dh	**Power off and braking** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～1	N/A	1	Immediate
	Function code	Mapping	Data type	Accessibility
	So-28	N	UINT16	RW
0: disabled 1: enabled				

Sub-index 1Eh	**Time of power off and braking** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	500～30000	0.1ms	1000	Immediate
	Function code	Mapping	Data type	Accessibility
	So-29	N	UINT16	RW

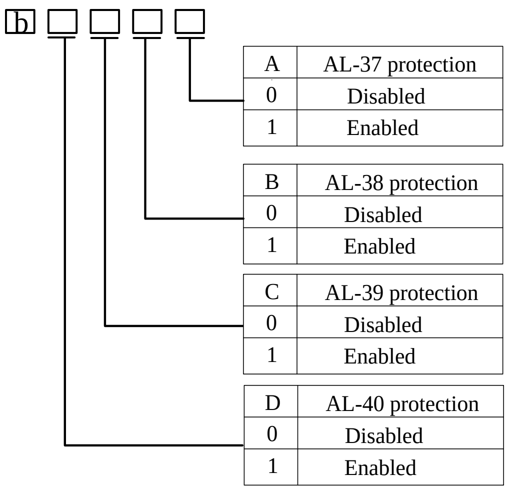
The entry-into-effect time is 100ms.

Sub-index 1Fh	**Setting of absolute position and relative position** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～1	N/A	—	Immediate
	Function code	Mapping	Data type	Accessibility
	So-30	N	UINT16	RW

0: Absolute position. Under internal position absolute mode, encoder feedback absolute position is adopted.
1: Relative position. Under internal position absolute mode, encoder feedback absolute position is not adopted. Battery protection is shielded.

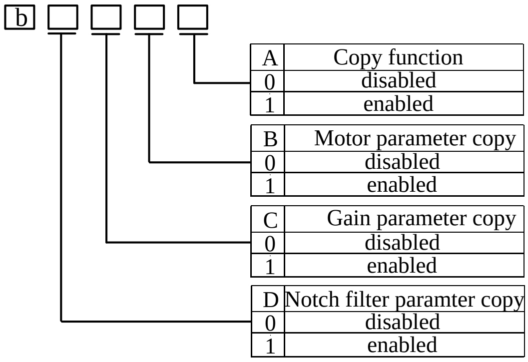
Sub-index 20h	**Communication related error** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	-	N/A	b 1 1 1 1	Immediate
	Function code	Mapping	Data type	Accessibility
	So-31	N	UINT16	RW

So-31 is used to set related EtherCAT protection.



Sub-index 23h	**Motor lock-rotor protection function** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～1	N/A	1	Immediate
	Function code	Mapping	Data type	Accessibility
	So-34	N	UINT16	RW
0: disabled 1: enabled				
Sub-index 24h	**Overload pre-alarm current** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～800	%	120	Immediate
	Function code	Mapping	Data type	Accessibility
	So-35	N	UINT16	RW
Sub-index 25h	**Overload pre-alarm filter time** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～1000	10ms	10	Power on again
	Function code	Mapping	Data type	Accessibility
	So-36	N	UINT16	RW
Sub-index 26h	**Motor overload coefficient setting** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～500	%	100	Immediate
	Function code	Mapping	Data type	Accessibility
	So-37	N	UINT16	RW
Please refer to 7.10.6.				
Sub-index 27h	**Under voltage protection of LI battery** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～1	**N/A**	1	Immediate
	Function code	Mapping	Data type	Accessibility
	So-38	N	UINT16	RW
0: disabled 1: enabled				

Sub-index 28h	**Overtravel limit function** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～2	**N/A**	**-**	Immediate
	Function code	Mapping	Data type	Accessibility
	So-39	N	UINT16	RW
0: disabled 1: enabled 2: stop but no alarm				
Sub-index 29h	**Delay time of lock-rotor protection** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	10～1000	**10ms**	**100**	Immediate
	Function code	Mapping	Data type	Accessibility
	So-40	N	UINT16	RW
Sub-index 2Bh	**Alarm output duty ratio** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～100	**%**	**100**	Immediate
	Function code	Mapping	Data type	Accessibility
	So-42	N	UINT16	RW
Sub-index 2Ch	**Encoder reset** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～1	**N/A**	**0**	Immediate
	Function code	Mapping	Data type	Accessibility
	So-43	N	UINT16	RW
0: encoder cannot be reset when alarm occurs. 1: encoder can be reset when alarm occurs. Encoder reset is used to reset when encoder alarm occurs. User needs to long press SET key for panel reset.				
Sub-index 2Dh	**Parameter copy** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	Four-parameter	**N/A**	**0000**	Immediate
	Function code	Mapping	Data type	Accessibility
	So-44	N	UINT16	RW



Sub-index 2Fh	**FPGA software version** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	—	**N/A**	—	Immediate
	Function code	Mapping	Data type	Accessibility
	So-46	N	UINT16	RW

For example, 100 is 1.00 version

Sub-index 31h	**Motor parameters setting area password** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～9999	**N/A**	0	Immediate
	Function code	Mapping	Data type	Accessibility
	So-48	N	UINT16	RW

When So-48=1, motor parameter can be set.

Sub-index 32h	**Revert to Mfr's value** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～1	**N/A**	0	Restart
	Function code	Mapping	Data type	Accessibility
	So-49	N	UINT16	RW

Sub-index 33h	**Motor overheat protection** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～1	**N/A**	0	Immediate
	Function code	Mapping	Data type	Accessibility
	So-50	N	UINT16	RW

0: disabled 1: enabled

<table>
<tr><td rowspan="5">Sub-index 34h</td><td colspan="4">Motor disconnected protection of temperature detection
PP PV PT CSP CSV CST HM</td></tr>
<tr><td>Setting Range</td><td>Setting Unit</td><td>Mfr's Value</td><td>Effect</td></tr>
<tr><td>0～1</td><td>N/A</td><td>1</td><td>Immediate</td></tr>
<tr><td>Function code</td><td>Mapping</td><td>Data type</td><td>Accessibility</td></tr>
<tr><td>So-51</td><td>N</td><td>UINT16</td><td>RW</td></tr>
<tr><td colspan="5">0: disabled 1: enabled</td></tr>
<tr><td rowspan="5">Sub-index 37h</td><td colspan="4">Torque detuning protection PP PV PT CSP CSV CST HM</td></tr>
<tr><td>Setting Range</td><td>Setting Unit</td><td>Mfr's Value</td><td>Effect</td></tr>
<tr><td>0～1</td><td>N/A</td><td>1</td><td>Immediate</td></tr>
<tr><td>Function code</td><td>Mapping</td><td>Data type</td><td>Accessibility</td></tr>
<tr><td>So-54</td><td>N</td><td>UINT16</td><td>RW</td></tr>
<tr><td colspan="5">0: disabled 1: enabled
When So-54 is valid, motor is phase-loss or disconnected servo drive trips into AL-23.</td></tr>
<tr><td rowspan="5">Sub-index 38h</td><td colspan="4">Torque detuning protection filter time
PP PV PT CSP CSV CST HM</td></tr>
<tr><td>Setting Range</td><td>Setting Unit</td><td>Mfr's Value</td><td>Effect</td></tr>
<tr><td>1～100</td><td>10ms</td><td>10</td><td>Immediate</td></tr>
<tr><td>Function code</td><td>Mapping</td><td>Data type</td><td>Accessibility</td></tr>
<tr><td>So-55</td><td>N</td><td>UINT16</td><td>RW</td></tr>
<tr><td colspan="5">Motor cable disconnected protection time.</td></tr>
<tr><td rowspan="5">Sub-index 39h</td><td colspan="4">Air-cooling motor mode selection PP PV PT CSP CSV CST HM</td></tr>
<tr><td>Setting Range</td><td>Setting Unit</td><td>Mfr's Value</td><td>Effect</td></tr>
<tr><td>0～1</td><td>N/A</td><td>0</td><td>Immediate</td></tr>
<tr><td>Function code</td><td>Mapping</td><td>Data type</td><td>Accessibility</td></tr>
<tr><td>So-56</td><td>N</td><td>UINT16</td><td>RW</td></tr>
<tr><td colspan="5">0: self-cooling 1: air-cooling</td></tr>
<tr><td rowspan="5">Sub-index 3Ah</td><td colspan="4">Forced input setting of DI PP PV PT CSP CSV CST HM</td></tr>
<tr><td>Setting Range</td><td>Setting Unit</td><td>Mfr's Value</td><td>Effect</td></tr>
<tr><td>—</td><td>N/A</td><td>0</td><td>Immediate</td></tr>
<tr><td>Function code</td><td>Mapping</td><td>Data type</td><td>Accessibility</td></tr>
<tr><td>So-57</td><td>N</td><td>UINT16</td><td>RW</td></tr>
</table>

Please refer to 7.10.9.				
Sub-index 3Bh	**Forced input and output mode of DI/DO** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	—	**N/A**	d00	Immediate
	Function code	Mapping	Data type	Accessibility
	So-58	N	UINT16	RW
Please refer to 7.10.9.				
Sub-index 3Ch	**Station alias** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～65535	**N/A**	0	Immediate
	Function code	Mapping	Data type	Accessibility
	So-59	N	UINT16	RW
Sub-index 3Dh	**The version of firmware 3** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	—	**N/A**	100	Immediate
	Function code	Mapping	Data type	Accessibility
	So-60	N	UINT16	RO

Index segment 2008h (Parameter So-□□)

Sub-index 3Eh	**Name**	Analog monitor channel 2		**Setting mode**	—	**Mode**	ALL
	Unit	N/A	**Setting range**	0～3	**Effect**	Immediate	**Mfr's value**	0
	Parameter	So-61	**Access**	RW	**Mapping**	N	**Data type**	UINT16

Analogue monitoring function selection setting:

Value	Definition	Remark
0	Servo drive output current	10V corresponding servo drive output current is determined by So-20.
1	Servo drive output voltage	10V corresponding servo drive output voltage is determined by So-21.
2	Servo motor speed	10V corresponding servo motor speed is determined by So-22.
3	Output 0V voltage+offset	The offset voltage is decided by So-62.

Sub-index 3Fh	**Name**	Analog monitor voltage compensation 2		**Setting mode**	—	**Mode**	ALL
	Unit	mv	**Setting range**	-10000～10000	**Effect**	Immediate	**Mfr's value**	0
	parameter	So-62	**Access**	RW	**Mapping**	N	**Data type**	INT16

Analog monitor voltage compensation. The entry-into-effect time is 1000ms.

8.3.10 Index segment 2009h (communication monitor group)

Sub-index 01h	**LoParam 1 address**		PP PV PT CSP CSV CST HM	
	Setting Range	Setting Unit	Mfr's Value	Effect
	—	**N/A**	900	Immediate
	Function code	Mapping	Data type	Accessibility
	—	N	UINT16	RW
Please refer to 6.2.3.				
Sub-index 02h	**LoParam 2 address**		PP PV PT CSP CSV CST HM	
	Setting Range	Setting Unit	Mfr's Value	Effect
	—	**N/A**	923	Immediate
	Function code	Mapping	Data type	Accessibility
	—	N	UINT16	RW
Please refer to 6.2.3.				
Sub-index 03h	**LoParam 3 address**		PP PV PT CSP CSV CST HM	
	Setting Range	Setting Unit	Mfr's Value	Effect
	—	**N/A**	925	Immediate
	Function code	Mapping	Data type	Accessibility
	—	N	UINT16	RW
Please refer to 6.2.3.				
Sub-index 04h	**LoParam 1 value**		PP PV PT CSP CSV CST HM	
	Setting Range	Setting Unit	Mfr's Value	Effect
	—	**N/A**	—	Immediate
	Function code	Mapping	Data type	Accessibility
	—	N	UINT16	RO
Please refer to 6.2.3.				
Sub-index 05h	**LoParam 2 value**		PP PV PT CSP CSV CST HM	
	Setting Range	Setting Unit	Mfr's Value	Effect
	—	**N/A**	—	Immediate
	Function code	Mapping	Data type	Accessibility
	—	N	UINT16	RO
Please refer to 6.2.3.				
Sub-index 06h	**LoParam 3 value**		PP PV PT CSP CSV CST HM	
	Setting Range	Setting Unit	Mfr's Value	Effect
	—	**N/A**	—	Immediate
	Function code	Mapping	Data type	Accessibility
	—	N	UINT16	RO
Please refer to 6.2.3.				

8.3.11 Function setting of DI and DO

Programmable terminals include DI1~DI8. (Related parameters are from Po407 to Po414). Common-open or common-close contact can be selected by input contact selection. For example, for servo drive safety stop, when malfunction occurs, user should select common-close switch.

⚠ Servo drive must be restarted after terminal function is set.

d □ □ □ □

X	Function	Name
0	Reserved	Reserved
1	Alarm reset	AL-RST
2-7	Reserved	Reserved
8	Gain switchover	GAINUP
9	Reserved	Reserved
10	Pulse clear	CLR
11	Common pulse prohibited	INH-P
12	Emergency stop	ESP
13	Reverse running prohibited	R-INH
14	Forward running prohibited	F-INH
15-21	Reserved	Reserved
22	External reference origin	ORGP
23	Reserved	Reserved
24	Reserved	Reserved
25	Reserved	Reserved
26	Forward jogging by terminal	JOGU
27	Reverse jogging by terminal	JOGD
28	Motor overheat	M-SEL
29-33	Reserved	Reserved
34	Touchprobe-1	Touchprobe-1
35	Touchprobe-2	Touchprobe-2

Y	Input contactor type
0	Open switch is valid (common-close)
1	Close switch is valid (common-open)

d	Two-parameter mode, refer to 5.2.2

Fig 8.1.1 Programmable input terminal function

Setting value	Function	Name	Instruction	Signal type
0	Reserved	Reserved	Reserved	
1	Alarm reset	AL-RST	A number of faults (Alarms) can be cleared by activating AL-RST.	Edge trigger
2~7	Reserved	Reserved	Reserved	
8	Gain switchover	GAIN-SEL	Gain switchover	Level trigger
9	Reserved	Reserved	Reserved	
10	Pulse clear	CLR	Position deviation register returns to 0 at the position mode.	Edge trigger
11	Command pulse prohibited	INH-P	External pulse command is invalid at the position mode.	Level trigger
12	Emergency stop	ESP	Motor stops urgently.	Level trigger
13	Reverse run prohibited	R-INH	Motor is forbidden reverse run.	Level trigger
14	Forward run prohibited	F-INH	Motor is forbidden forward run.	Level trigger
15~21	Reserved	Reserved	Reserved	
22	External reference origin	ORGP	ORGP is external reference origin.	Edge trigger
23	Reserved	Reserved	Reserved	
24	Reserved	Reserved	Reserved	
25	Reserved	Reserved	Reserved	
26	Terminal forward jogging	JOGU	Realized by controlling terminal.	Level trigger
27	Terminal reverse jogging	JOGD	Realized by controlling terminal.	Level trigger
28	Motor overheat	HOT	Realized by controlling terminal.	Level trigger
29~33	Reserved	Reserved	Reserved	
34	Touchprobe-1	Touchprobe-1	Touchprobe-1	Level trigger
35	Touchprobe-2	Touchprobe-2	Touchprobe-2	Level trigger

Programmable output terminals include DO1 ~ DO4 (Related parameters are Po421~ Po424), ALM (Related parameter is Po425).

⚠ Servo drive must be restarted after terminal function is set.

X	Function	Name
0	Servo ready	S-RDY
1	Servo on	SON-O
2	Rotation Detection	TGON
3	At speed reached	V-CMP
4	At position reached	P-CMP
5	At torque limit	T-LT
6	Servo alarm activated	ALM
7	Electromagnetic brake control	BRAKE
8	Overload warning	OL-W
9	At speed limit	S-LT
10	Reserved	–
11	Large position deviation pre-warning	PER-W
12	Homing completed	HOME
13-15	Reserved	Reserved
16	Dynamic brake	DRN-BR

Y	Output contact type
0	Output contact is common-close
1	Output contact is common-open

d	Two-parameter mode

Fig 8.1.2 Programmable output terminal function

Function instruction of programmable output terminal:

Setting value	Function	Name	Instructions
0	Servo ready	S-RDY	S-RDY is activated when the servo drive is ready to run. All fault and alarm conditions, if present, have been cleared.
1	Servo on	SON-O	SON-O is activated when the servo motor is ON.
2	Rotation Detection	TGON	When the absolute value of speed is higher than the value of at rotation detection, TGON is activated.
3	At speed reached	V-CMP	V-CMP is activated when the servo motor has reached the target rotation speed.

4	At position reached	P-CMP	Position completed
5	At torque limit	T-LT	T-LT is activated when toque is limited.
6	Servo alarm activated	ALM	ALM is activated when the drive has detected a fault condition.
7	Electromagnetic brake control	BRAKE	BRAKE is activated actuation of motor brake.
8	Overload warning	OL-W	Overload pre-alarm signal
9	At speed limit	S-LT	S-LT is activated when speed is limited.
10	Reserved	Reserved	Reserved
11	Large position deviation pre-warning	PER-W	PER-W is activated when position deviation is too large.
12	Homing completed	HOME	HOME is activated when the servo drive has detected that the HOME sensor has been detected.
13-15	Reserved	Reserved	Reserved
16	Dynamic brake	DRN_BR	Dynamic brake is valid, output this signal.

8.4 Parameters defined by sub-protocol (6000h)

Index 603Fh	**Error code** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	—	—	—	—
	Function code	Mapping	Data type	Accessibility
	—	**TPDO**	UINT16	RO
Please refer to 6.1.9.				
Index 6040h	**Control word** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～65535	—	**0**	**immediate**
	Function code	Mapping	Data type	Accessibility
	—	**RPDO**	UINT16	RW
Please refer to 7.2.1.				

Index 6041h	**Status word** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	—	—	—	—
	Function code	Mapping	Data type	Accessibility
	—	**TPDO**	UINT16	RO
Please refer to 7.2.2.				
Index 605Ah	**Quick stop option code** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～7	—	**2**	**immediate**
	Function code	Mapping	Data type	Accessibility
	—	**N**	INT16	RW
Index 605Dh	**Halt option code** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～7	—	**1**	**immediate**
	Function code	Mapping	Data type	Accessibility
	—	**N**	INT16	RW
Index 6060h	**Modes of operation** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～10	—	—	**immediate**
	Function code	Mapping	Data type	Accessibility
	—	**RPDO**	UINT16	RW

0: NA
1: profile position mode(PP)
2: NA
3: profile velocity mode(PV)
4: profile torque mode(PT)
5: NA
6: home mode (HM)
7: interpolation mode(IP)
8: cycle synchronous position mode(CSP)
9: cycle synchronous velocity mode(CSP)
10: cycle synchronous torque mode(CST)
Please refer to mode instruction.
Note: IP mode is not supported in this product.

Index 6061h	**Modes of operation display** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	—	—	—	—
	Function code	Mapping	Data type	Accessibility
	—	**TPDO**	UINT16	RO
Index 6062h	**Position demand value** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	—	Command unit	**0**	—
	Function code	Mapping	Data type	Accessibility
	—	**TPDO**	DINT32	RO
Index 6063h	**Position feedback value** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	—	**Encoder unit**	—	—
	Function code	Mapping	Data type	Accessibility
	—	**TPDO**	DINT32	RO
Reflect motor absolute position.				
Index 6064h	**Position actual value** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	—	command unit	—	—
	Function code	Mapping	Data type	Accessibility
	—	**TPDO**	DINT32	RO
Reflect real time user absolute position. 6064h*6091h=6063h				
Index 6065h	**Following error window** PP CSP HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～32000	**encoder unit**	—	**Immediate**
	Function code	Mapping	Data type	Accessibility
	—	**N**	UINT16	RW

Index 6067h	**Position window** PP CSP HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～32000	**—**	**—**	**Immediate**
	Function code	Mapping	Data type	Accessibility
	—	**N**	DINT32	RW

Index 6068h	**Position window time** PP CSP HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～65535	**ms**	**0**	**Immediate**
	Function code	Mapping	Data type	Accessibility
	—	**N**	UINT16	RW

Index 606Ch	**Velocity actual value** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	—	—	—	—
	Function code	Mapping	Data type	Accessibility
	—	**TPDO**	DINT32	RO

Index 606Dh	**Velocity window** PV CSV			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～30000	0.1rpm	300	**Immediate**
	Function code	Mapping	Data type	Accessibility
	—	**N**	UINT16	RW

Index 606Eh	**Velocity window time** PV CSV			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～65535	ms	0	**Immediate**
	Function code	Mapping	Data type	Accessibility
	—	**N**	UINT16	RW

Index 6071h	**Target Torque** PV CST			
	Setting Range	Setting Unit	Mfr's Value	Effect
	-800~800	—	—	**Immediate**
	Function code	Mapping	Data type	Accessibility
	—	**RPDO**	INT16	RW
Index 6072h	**Max Torque** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～800	—	—	**Immediate**
	Function code	Mapping	Data type	Accessibility
	Po202	**N**	UINT16	RW
The entry-into-effect time is 100ms.				
Index 6074h	**Torque Demand Value** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1%	—	—	—
	Function code	Mapping	Data type	Accessibility
	—	**TPDO**	INT16	RO
Index 6077h	**Torque Demand Value** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1%	—	—	—
	Function code	Mapping	Data type	Accessibility
	—	**TPDO**	INT16	RO
Index 607Ah	**Position Target Value** PP CSP			
	Setting Range	Setting Unit	Mfr's Value	Effect
	-（2^{31}-1）～ +（2^{31}-1）	—	**0**	Immediate
	Function code	Mapping	Data type	Accessibility
	Po350	**RPDO**	DINT32	RW

Index 607Ch	**Home offset** HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	$-(2^{31}-1)$ ～ $+(2^{31}-1)$	—	**0**	Immediate
	Function code	Mapping	Data type	Accessibility
	Po123	**RPDO**	DINT32	RW

The entry-into-effect time is 100ms.
The effect condition: finish homing operation in this running, bit15=1 of status word 6041h.

Index 607Eh	**Polarity** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	00～FF	—	—	**Immediate**
	Function code	Mapping	Data type	Accessibility
	—	**RPDO**	UINT16	RW

607Eh is used to set polarity of position command, velocity command and torque command.

Bit	Definition
0~4	None
5	Torque command polarity: 0: keep existing value 1: command X(-1) PT: converse target torque 6071h **CST:** converse torque command(6071h+60B2h)
6	Velocity command polarity: 0: keep existing value 1: command X(-1) PV: converse target velocity 60FFh CSV: converse velocity command(60FFh+60B1h)
7	Position command polarity 0: keep existing value 1: command X(-1) PP: converse target position 607Ah CSP: converse position command (607Ah+60B0h)

Index 607Fh	**Max profile velocity** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～13000	rpm	—	**Immediate**
	Function code	Mapping	Data type	Accessibility
	—	**N**	UDINT32	RW
The entry-into-effect time is 100ms.				
Index 6081h	**Profile velocity** PP			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～65535	0.1rpm	**0**	**Immediate**
	Function code	Mapping	Data type	Accessibility
	—	**RPDO**	UINT16	RW
Index 6083h	**Profile acceleration** PP PV			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～65535	ms	—	**Immediate**
	Function code	Mapping	Data type	Accessibility
	—	**N**	UINT16	RW
The entry-into-effect time is 100ms.				
Index 6084h	**Profile deceleration** PP PV			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～65535	ms	—	**Immediate**
	Function code	Mapping	Data type	Accessibility
	Po311	**N**	UINT16	RW
The entry-into-effect time is 100ms.				
Index 6085h	**Quick stop deceleration** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～65535	ms	—	**Immediate**
	Function code	Mapping	Data type	Accessibility
	—	**N**	UINT16	RW
Under PP, CSV, PV, HM mode, quick stop option code （605Ah）is equal to 2 or 6 and quick stop command is valid, 6085h is slope deceleration time. Under PP, CSV, PV, HM mode, halt option code (605Dh) is equal to 2 and halt command is valid, 6085h is slope deceleration time.				

Index 6087h	**Torque slope**			PT
	Setting Range	Setting Unit	Mfr’s Value	Effect
	0～65535	0.1ms	—	**Immediate**
	Function code	Mapping	Data type	Accessibility
	—	**N**	UINT16	RW

Index 6091h-01h	**Numerator of Gear ratio**			PP CSP HM
	Setting Range	Setting Unit	Mfr’s Value	Effect
	0～（2^{31}-1）	N/A	0	**Immediate**
	Function code	Mapping	Data type	Accessibility
	Po344	**N**	UDINT32	RW
The entry-into-effect time is 100ms				

Index 6091h-02h	**Denominator of Gear ratio**			PP CSP HM
	Setting Range	Setting Unit	Mfr’s Value	Effect
	1～（2^{31}−1）	N/A	1000	**Immediate**
	Function code	Mapping	Data type	Accessibility
	Po346	**N**	UDINT32	RW
The entry-into-effect time is 100ms				

Index 6098h	**Homing method**			HM
	Setting Range	Setting Unit	Mfr’s Value	Effect
	-1～35	—	0	**Immediate**
	Function code	Mapping	Data type	Accessibility
	—	**N**	INT16	RW

Index 6099h-01h	**First Homing speed**			HM
	Setting Range	Setting Unit	Mfr’s Value	Effect
	0～20000	0.1rpm	500	**Immediate**
	Function code	Mapping	Data type	Accessibility
	Po120	**N**	UINT16	RW
The entry-into-effect time is 100ms.				

Index 6099h-02h	**Second Homing speed** HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～20000	0.1rpm	200	**Immediate**
	Function code	Mapping	Data type	Accessibility
	Po121	**N**	UINT16	RW
The entry-into-effect time is 100ms.				
Index 609Ah	**Homing acceleration** HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～1000	ms	0	**Immediate**
	Function code	Mapping	Data type	Accessibility
	—	**N**	UINT16	RW
Index 60B0h	**Position offset** CSP			
	Setting Range	Setting Unit	Mfr's Value	Effect
	-2^{31}~（2^{32}-1）	Command unit	0	**Immediate**
	Function code	Mapping	Data type	Accessibility
	—	**RPDO**	DINT32	RW
The entry-into-effect time is 100ms.				
Index 60B1h	**Velocity offset** CSP CSV			
	Setting Range	Setting Unit	Mfr's Value	Effect
	-1300000～1300000	0.01rpm	0	**Immediate**
	Function code	Mapping	Data type	Accessibility
	—	**RPDO**	DINT32	RW
Index 60B2h	**Torque offset** CST CSP CSV			
	Setting Range	Setting Unit	Mfr's Value	Effect
	-1000~1000	0.1%	0	**Immediate**
	Function code	Mapping	Data type	Accessibility
	—	**RPDO**	INT16	RW

Index 60B8h	**Touch probe function** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～65535	—	—	**Immediate**
	Function code	Mapping	Data type	Accessibility
	—	**RPDO**	UINT16	RW
Index 60B9h	**Touch probe status** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	—	—	—	—
	Function code	Mapping	Data type	Accessibility
	—	**RPDO**	UINT16	RO
Index 60BAh	**Touch probe pos1 position value** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	Command unit	-2^31~2^31-1	—	—
	Function code	Mapping	Data type	Accessibility
	—	**TPDO**	DINT32	RO
Index 60BBh	**Touch probe neg1 position value** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	Command unit	-2^31~2^31-1	—	—
	Function code	Mapping	Data type	Accessibility
	—	**TPDO**	DINT32	RO
Index 60BCh	**Touch probe pos2 position value** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	Command unit	-2^31~2^31-1	—	—
	Function code	Mapping	Data type	Accessibility
	—	**TPDO**	DINT32	RO

Index 60BDh	**Touch probe neg2 position value** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	Command unit	-2^31~2^31-1	—	—
	Function code	Mapping	Data type	Accessibility
	—	**TPDO**	DINT32	RO
Index 60E0h	**Forward Direction Torque Limit Value** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～800	%	—	Immediate
	Function code	Mapping	Data type	Accessibility
	Po208	**RPDO**	UINT16	RW
The entry-into-effect time is 100ms.				
Index 60E1h	**Reverse Direction Torque Limit Value** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～800	%	—	Immediate
	Function code	Mapping	Data type	Accessibility
	Po209	**RPDO**	UINT16	RW
The entry-into-effect time is 100ms.				
Index 60F4h	**Following error actual value** PP CSP			
	Setting Range	Setting Unit	Mfr's Value	Effect
	-2^31~2^31-1	Command unit	—	—
	Function code	Mapping	Data type	Accessibility
	—	**TPDO**	DINT32	RO
Index 60FDh	**Digital Input** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～2^32	—	—	—
	Function code	Mapping	Data type	Accessibility
	—	**TPDO**	UDINT32	RO

Index 60FEh	**Digital Output** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0～2^32	—	—	Immediate
	Function code	Mapping	Data type	Accessibility
	—	**RPDO**	UDINT32	RW

Index 60FFh	**Target velocity** PV CSV			
	Setting Range	Setting Unit	Mfr's Value	Effect
	-130000~130000	0.1rpm	—	Immediate
	Function code	Mapping	Data type	Accessibility
	—	**RPDO**	DINT32	RW

Index 6502h	**Supported drive modes** PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	—	—	—	—
	Function code	Mapping	Data type	Accessibility
	—	**N**	UDINT32	**RO**

IX Adjustments

9.1 Summary

The servo drive is required to run the motor in least time delay and as faithful as possible against commands from the host controller or internal setting. Gain adjustment needs to be performed to meet the requirements.

Gain adjustment process:

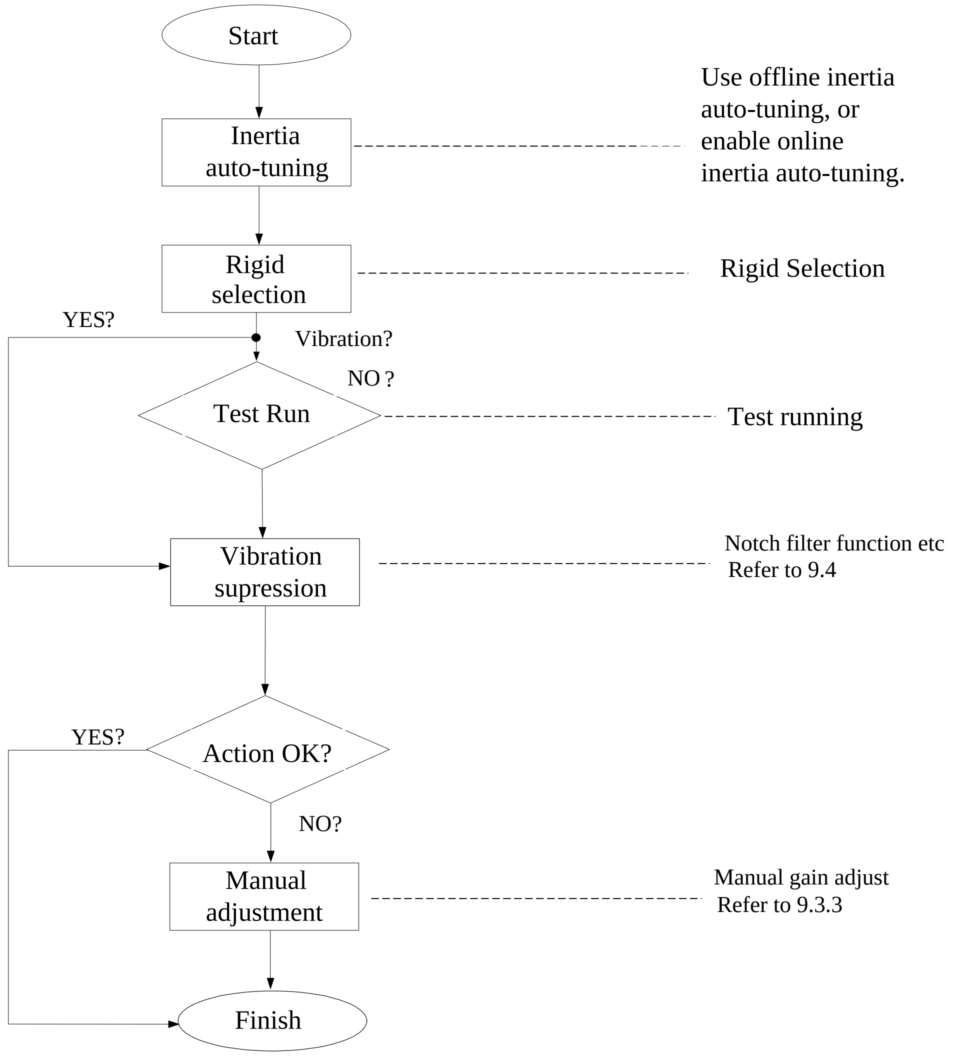


Fig 9.1.1Gain adjustment flow chart

Note:

●Jog test running is recommended firstly before gain adjustment to ensure motor runs normally.

●Servo gain can be set by combination of multi-parameter (position-loop, speed-loop, filter, load rotational inertia ratio etc.), these parameters interact on each other. Therefore, balance of parameters must be considered.

9.2 Inertia Identification

When motor is connected to machine or load simulator, before normal production, servo drive must “study” the rotational inertia of machine, which is convenient for user to adjust related parameters and make sure servo system run in proper inertia.

Inertia ratio=Total load inertia of machine/Motor rotor inertia

The inertia ratio is an important parameter of the servo system, and quick commissioning can be implemented with the correct setting of this parameter. It can be set manually or auto-tuned automatically by the servo drive.

The servo drive supports two identification methods:

1) Offline identification

When the offline inertia identification function is enabled in (Po008), press the keys on the keypad of the servo drive to run the motor and obtain the inertia ratio.

2) Online identification

The servo drive obtains the inertia ratio through load situation and writes the value to **“rotational inertia ratio (Po013)”.**

CAUTION

1. If the actual inertia ratio is very large the drive gain is low, motor action will be slow, which cannot meet the requirements for maximum motor speed and actual acceleration rate. In this case, increase **rigidity** in **Po010** and perform inertia identification again.

2. If vibration occurs during identification, stop identification immediately and decrease the gain.

9.2.1 Offline Identification

Servo drive can drive the load running by servo motor according to forward/reverse curve to calculate the rotational inertia ratio of load and confirm the rotational inertia.

Confirm the following before performing offline identification:

1) The movement travel of the motor meet the following requirements:

Ensure that the limit switches have been installed and required movement travel is reserved to prevent overtravel which may cause accidents during identification; Ensure that the movement travel for the motor in stop position is larger than Po015. If not, user can increase it properly.

2) Evaluate the value of Po013

a) Preset a large initial value for Po013.

The recommended preset value is 400. Increase Po013 gradually till the value on the keypad is updated.

b） Increase the rigidity level of the servo drive properly:

Increase the rigidity level (Po010) properly to meet the requirements of inertia identification.

The following figure shows the offline inertia identification flowchart.

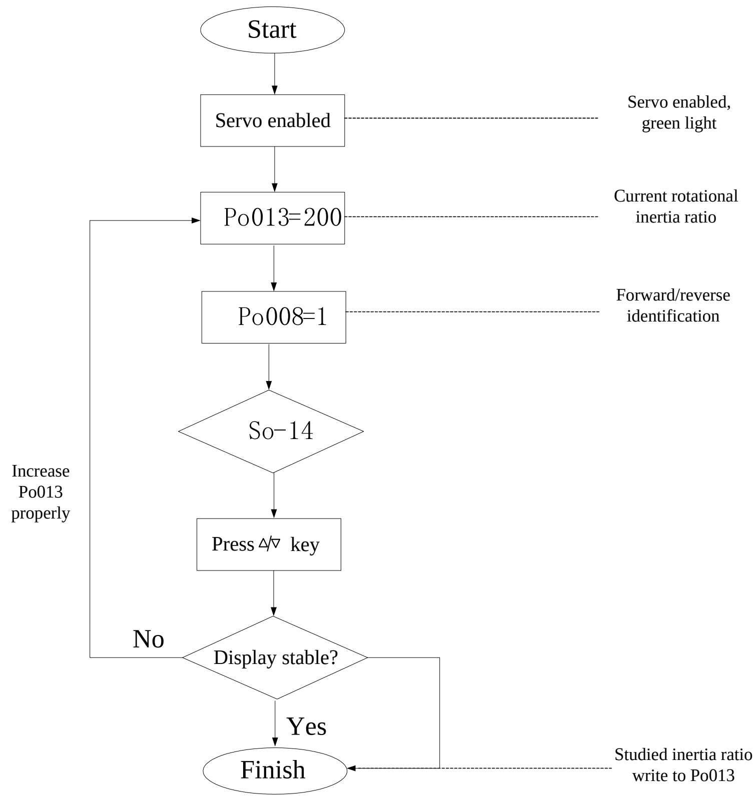


Fig 9.2.1 Offline inertia identification flowchart

Related Parameters:

1) Motion range of offline inertia identification (pulse)

Signal Name	Parameter	Setting Range	Mfr's value	Content
Motion range	2000h-10h	200～（2^{31}-1）	—	Approximate value, One-time identification action finished in setting pulse range.
	Function code	Mapping	Data type	Accessibility

	Po015	N	DINT32	RW

2) Inertia identification mode selection

2000h-09h	Inertia identification mode selection PP PV PT CSP CSV CST HM			
	Setting Range	Unit	Mfr's Value	Effect
	0：Disabled 1：Offline fwd/rev direction identification. 2: Offline single direction identification. 3: Online auto inertia identification	N/A	0	Immediate effect Lost if power's off
	Function code	Mapping	Data type	Accessibility
	Po008	N	INT16	RW

Illustration:

(1) Po008=0：Inertia identification is disabled.

(2) Po008=1：Offline fwd/rev identification, suitable for the equipment with limit motion range.

(3) Po008=2：Offline single direction identification, suitable for the equipment that cannot run reversely.

(4) Po008=3：Online inertia auto identification, servo drive always keeps online auto identification, if servo drive is jog running, inertia is displayed, not JOG".

3) Offline inertia identification action gap time

2000h-0Ah	Offline rotational inertia identification action gap time PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1~2000	ms	100	Immediate
	Function code	Mapping	Data type	Accessibility
	Po009	N	INT16	RW

4) Motor accel/decel time at offline inertia identification

2000h-0Fh	Movement of inertia acele/decel time PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	200~5000	ms	1000	Immediate

	Function code	Mapping	Data type	Accessibility
	Po014	N	INT16	RW

5) Inertia ratio

2000h-0Eh	Rotation inertia ratio PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
2000h-0Eh	1~30000	0.01	200	Immediate
	Function code	Mapping	Data type	Accessibility
	Po013	N	INT16	RW

Note: Rotation inertia identification just measures inertia ratio, but doesn't match with speed position parameter. After finishing inertia identification, please make sure to select rigidity.

9.2.2 Online Inertia Identification

Online inertia automatic identification: Po008=3, servo drive enters inertia online automatic identification state and identifies inertia automatically according to load situation.

Note: The condition of online automatic inertia identification shows as below:

● Max rotary speed is higher than 200rpm in the motion process of servomotor.
● The acceleration/deceleration of servomotor is higher than 3000rpm/s.
● The machinery that rigid load is not easy to generate small vibration.
● Slow changing of load inertia
● Mechanical clearance is not big in the motor process

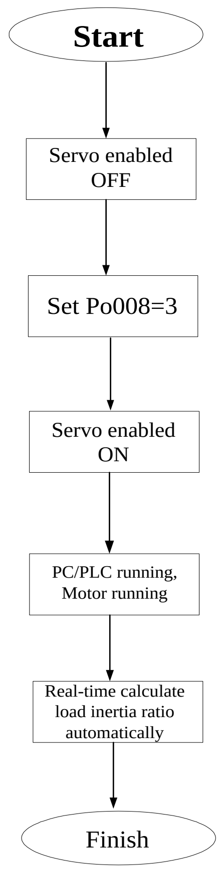


Fig 9.2.2 online rotational inertia setting flow chart

9.3 Gain Adjustment

9.3.1 Summary

User needs to adjust servo gain to improve servo drive response, which requires setting parameter combinations, which influence each other. Therefore, parameter relation must be considered for gain adjustment.

In general, response of high rigidity machine can be improved by increasing servo gain. But for low rigidity machine, vibration may occur when servo gain increases. Therefore, if high response is required, high rigidity machine is required to avoid vibration.

Response frequency of position or speed must be selected according to the machine rigidity and application.

In general, high precise machining requires high response frequency, but high response frequency may bring vibration. If allowable response frequency is unknown, user can increase gain gradually to raise response frequency until vibration occurs and then decrease gain. Gain adjustment principle is as following:

Servo rigidity is the ability that motor rotor withstands load inertia, which is self-locking ability of motor rotor. The stronger the servo rigidity, the larger the corresponding speed-loop gain, the faster the system response.

Servo rigidity must be used along with the load rotational inertia, the larger the load inertia, the lower the allowable rigidity level. If servo rigidity is higher than inertia ratio, high-frequency self-excited oscillation will occur. Otherwise, motor response is slow, motor takes long time to reach specified location.

The servo system consists of three control loops, namely, position loop, speed loop, and current loop from external to internal. The following figure shows the basic control block diagram.

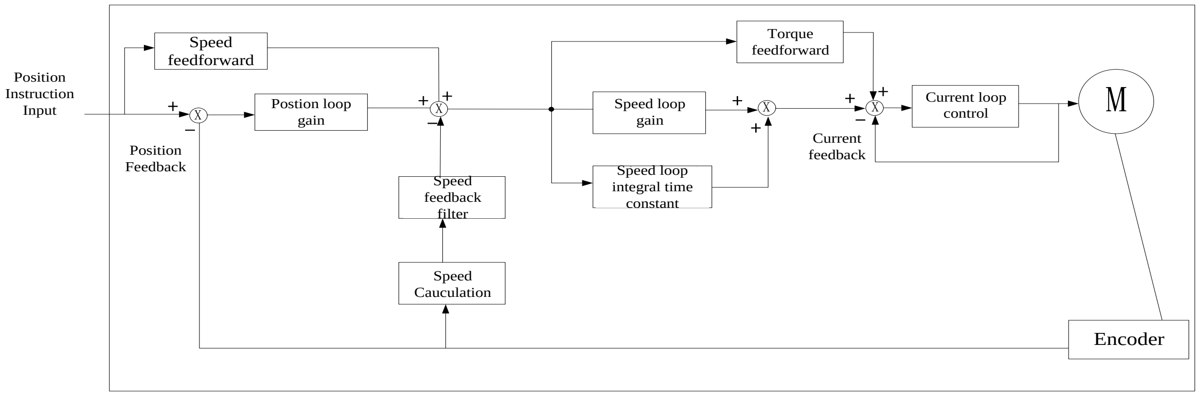


Fig 9.3.1 Servo drive internal frame diagram

The most internal loop must have the highest response. If it is not observed, the system may be unstable.

The default current loop gain of the servo drive ensures the response, and need not be adjusted. You only need to adjust the position loop gain, speed loop gain and other auxiliary gains.

9.3.2 Automatic Gain Adjustment

Automatic gain adjustment means that the servo drive automatically produces the matching gain parameters based on the setting of Po010 (Rigidity level selection) to achieve fast response and stability.

CAUTION:

Ensure that the correct inertia ratio has been obtained before enabling automatic gain adjustment.

Related Parameter:

2000h-0Bh	Rigidity Selection			PP PV PT CSP CSV CST HM
	Setting Range	Setting Unit	Mfr’s Value	Effect
	1~30	N/A	6	Immediate
	Function code	Mapping	Data type	Accessibility

	Po010	N	INT16	RW

The setting range of Po010 (Rigidity selection) is 0–19. the bigger value is, stronger rigidity is. System will generate first group parameters of gain. The first gain group includes: first position loop gain Po301, first speed loop proportional gain Po101, first speed loop integral time Po102, first speed filter time constant Po105, first torque filter time constant Po214, first current loop bandwidth Po200.

Setting method of rigidity level:

1) Confirm that inertia identification has been executed and the inertia ratio is reasonable, estimate proper rigidity level Po010 according to inertia ratio and drive connection mode (the bigger mechanical load is, the lower rigidity level is).

2) So-14 enters jog test running, check the normal operation and noise. Reduce rigidity level Po010 properly if there is any noise. Otherwise, user can try to improve the rigidity level and test running again until satisfying the system requirement.

When changing rigidity level, speed loop gain and position loop gain will change too. After setting rigidity level, user can still make a fine-tuning for the first gain group (not influence rigidity Po010).

The data of table above is related to the parameter of Po010 rigidity level, check the table above for reference when rigidity selection.

Note: The entry-into-effect time of the parameter is 100ms.

9.3.3 Manual Gain Adjustment

User can make fine adjustment manually when the automatic gain adjustment cannot reach the expected effect.

Table 9.3.2Manual Gain Adjustment Parameter Table

Parameter	Name		Parameter	Name
Po101	1stSpeed loop proportional gain		Po135	Gain 2 switch to gain 1 delay time
Po102	1stSpeed loop integral time		Po200	1st current loop bandwidth
Po103	2ndSpeed loop proportional gain		Po201	2ndcurrent loop bandwidth
Po104	2ndSpeed loop integral time		Po214	1st torque filter time constant
Po105	1stSpeed loop time constant		Po215	2nd torque filter time constant
Po106	2ndSpeed loop filter time constant		Po301	1st position loop gain
Po107	Torque feedforward gain		Po302	2nd position loop gain
Po108	Torque feedforward gain filter		Po303	Position loop feedforward gain

Po130	Gain switching mode		Po306	Position loop filter time constant
Po131	Gain switching speed		Po343	Position mode acel/decel time
Po132	Gain switching pulse		Po229	Notch filter start
Po133	Position loop gain switching time		Po217	1st Notch filter center frequency
Po134	Speed loop gain switching time		Po218	1st Notch filter width
Po219	1stNotch filter depth		Po220	2nd Notch filter center frequency
Po221	2ndNotch filter width		Po222	2nd Notch filter depth
Po223	3rdNotch filter center frequency		Po224	3rd Notch filter width
Po225	3rdNotch filter depth		Po226	4th Notch filter center frequency
Po227	4thNotch filter width		Po228	4th Notch filter depth
Po240	Low-frequency vibration abatement center frequency		Po241	Low-frequency vibration abatement width
Po242	Low-frequency vibration abatement intensity			

(1) User Parameter Illustration

A) Position Loop Gain

2003h-02h	1st position loop gain PP CSP			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～30000	N/A	-	Immediate
	Function code	Mapping	Data type	Accessibility
	Po301	N	INT16	RW
2003h-03h	2nd position loop gain PP CSP			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1～30000	N/A	-	Immediate
	Function code	Mapping	Data type	Accessibility
	Po302	N	INT16	RW
2003h-04h	Position loop feedforward gain PP CSP			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0~1000	N/A	0	Immediate
	Function code	Mapping	Data type	Accessibility
	Po303	N	INT16	RW
2003h-07h	Position filter time constant PP CSP			
	Setting Range	Setting Unit	Mfr's Value	Effect

	1~10000	1ms	1	Immediate
	Function code	Mapping	Data type	Accessibility
	Po306	N	INT16	RW

Position loop gain determines position control response. The bigger the setting value, the higher the gain, the larger the rigidity, the better the following feature of position instruction for same frequency pulse, the lower the position error, the shorter the positioning time. But overlarge setting value could cause vibration or position overshoot. Internal servo drive uses feedforward compensation for position control to decrease positioning time, but if the setting value is overlarge, mechanical vibration may occur.

If position control command changes smoothly, increasing gain can reduce position following error; if position control command does not change smoothly, decreasing gain can reduce system vibration.

B) Speed Loop Gain

2001h-02h	1st Speed loop proportional gain PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0~30000	0.1Hz	600	Immediate
	Function code	Mapping	Data type	Accessibility
	Po101	N	INT16	RW
2001h-03h	1st Speed loop integral time PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0~10000	0.1ms	500	Immediate
	Function code	Mapping	Data type	Accessibility
	Po102	N	INT16	RW
2001h-04h	2nd Speed loop proportional gain PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0~30000	0.1Hz	240	Immediate
	Function code	Mapping	Data type	Accessibility
	Po103	N	INT16	RW
2001h-05h	2nd Speed loop integral time PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0~30000	0.1ms	1250	Immediate
	Function code	Mapping	Data type	Accessibility
	Po104	N	INT16	RW
2001h-06h	1st Speed loop time constant PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect

	1~20000	0.01ms	—	Immediate
	Function code	Mapping	Data type	Accessibility
	Po105	N	INT16	RW
2001h-07h	2ndSpeed loop filter time constant PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	1~20000	0.01ms	—	Immediate
	Function code	Mapping	Data type	Accessibility
	Po106	N	INT16	RW

Speed loop proportional gain determines position control response. The bigger the setting value is, the higher the gain is, the better the following feature of speed instruction is, but ovelarge setting could cause mechanical resonance. The frequency in speed mode control is 4~6 times higher than that in position mode control, when position response frequency is higher than speed response frequency, machine may have shaken or position overshoot. When inertia ratio becomes larger, speed response of control system goes down and becomes unstable, the solution is to increase speed loop gain, but if speed loop gain is too large, motor may have vibration in running or stop status (abnormal sound). Therefore, user must set speed loop gain at 50%~80% of vibration gain. Increasing integral time can reduce acel/decel overshoot; reducing integral time can improve rotation stability. Reducing speed control integral time can improve speed response and narrow speed control error. But too small value may cause vibration and noise.
Reduce the noises in speed mode and position mode; Increasing filter time constant can reduce noise but response may become slow.

C) Torque Loop Gain

2002h-01h	1st current loop bandwidth PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	10~3000	HZ	—	Immediate
	Function code	Mapping	Data type	Accessibility
	Po200	N	INT16	RW
2002h-02h	2ndcurrent loop bandwidth PP PV PT CSP CSV CST HM			
	Setting Range	Setting Unit	Mfr's Value	Effect
	10~3000	HZ	—	Immediate
	Function code	Mapping	Data type	Accessibility
	Po201	N	INT16	RW
2002h-0Fh	1st torque filter time constant PP PV PT CSP CSV CST HM			

	Setting Range	Setting Unit	Mfr's Value	Effect
	0~30000	0.01ms	—	Immediate
	Function code	Mapping	Data type	Accessibility
	Po214	N	INT16	RW
2002h-10h	2nd torque filter time constant		PP PV PT CSP CSV CST HM	
	Setting Range	Setting Unit	Mfr's Value	Effect
	0~30000	0.01ms	0	Immediate
	Function code	Mapping	Data type	Accessibility
	Po215	N	INT16	RW

The larger the current loop bandwidth is, the faster the system response is, but noise may be louder conversely.

9.3.4 Gain Switchover

Gain switchover can be triggered by servo drive inside or external DI, which has following effect:

- Switch to lower gain for vibration inhibition in motor standstill state (servo enabled);
- Switch to higher gain to narrow positioning time in motor standstill state;
- Switch to higher gain for obtaining better instruction tracking performance in running state;
- Switch to different gain setting by external signal according to the load condition.

(1) **User Parameter**

2002h-20h	Gain switching mode		PP PV CSP CSV	
	Setting Range	Setting Unit	Mfr's Value	Effect
	0~6	N/A	0	Immediate
	Function code	Mapping	Data type	Accessibility
	Po130	N	INT16	RW

The setting of Po130 can realize switchover between gain 1 and gain 2 according to different conditions.
Gain 1 includes speed loop proportional gain 1(Po101), speed loop integral time 1(Po102) and position loop proportional gain 1(Po301).
Gain 2 includes speed loop proportional gain 2(Po103), speed loop integral time 2 (Po104) and position loop proportional gain 2(Po346).

Parameter	Content

Po130=0	No switch, default to use gain 1
Po130=1	No switch, default to use gain 2
Po130=2	Switch to gain 2 immediately when speed is higher than the setting value of Po131, if speed is lower than Po131, after delay the setting time of Po135(0.1ms), switch to gain 1.
Po130=3	Switch terminal control, use gain 1 if the switching terminal defined in CN3 is invalid; use gain 2 if valid.
Po130=4	Switch to gain 2 immediately when position error is higher than the setting value of Po132; If lower than Po131, delay the setting time of Po135 (0.1ms), switch to gain 1.
Po130=5	Switch to gain 2 immediately if there is pulse input; if there is no pulse input, delay the setting time of Po135(0.1ms), then switch to gain 1.
Po130=6	Switch to gain 2 immediately if there is pulse input; If there is no pulse input and the speed is lower than Po131, delay the setting time of Po135(0.1ms), then switch to gain 1.

2001h-20h	Gain switching speed	PP PV CSP CSV		
	Setting Range	Setting Unit	Mfr's Value	Effect
	1~32000	0.1rpm	100	Immediate
	Function code	Mapping	Data type	Accessibility
	Po131	N	INT16	RW
2001h-21h	Gain switching pulse	PP PV CSP CSV		
	Setting Range	Setting Unit	Mfr's Value	Effect
	1~32000	N/A	100	Immediate
	Function code	Mapping	Data type	Accessibility
	Po132	N	INT16	RW
2001h-22h	Positon loop gain switching time	PP PV CSP CSV		
	Setting Range	Setting Unit	Mfr's Value	Effect

	1~32000	0.1ms	20	Immediate
	Function code	Mapping	Data type	Accessibility
	Po133	N	INT16	RW
	The time from one gain switching to another gain smoothly.			
2001h-23h	Speed loop gain switching time PP PV CSP CSV			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0~20000	0.1ms	100	Immediate
	Function code	Mapping	Data type	Accessibility
	Po134	N	INT16	RW
	The time from one gain switching to another gain smoothly.			
2001h-24h	Gain 2 switch to gain 1 delay time PP PV CSP CSV			
	Setting Range	Setting Unit	Mfr's Value	Effect
	0~32000	0.1ms	1000	Immediate
	Function code	Mapping	Data type	Accessibility
	Po135	N	INT16	RW
	When gain 2 switches to gain 1, delay the time set by Po135, then switch the time according to the setting of Po133.			

9.4 Vibration Suppression

9.4.1 Vibration Suppression Function

Resonance may produce at about the mechanical resonance frequency when the servo gain is increased, making the gain cannot be increased further.

Mechanical resonance can be suppressed in the following two ways:

1) Torque reference filter (2002h-0Fh and 2002h-10h)

Set the filter time constant to make the torque reference attenuates at above the cutoff frequency, suppressing mechanical resonance.

2) Notch filter

The notch reduces the gain at certain frequency to suppress mechanical resonance. After resonance is suppressed with correct setting of the notch, attempt to increase the gain gradually. The following figure shows the principle of the notch.

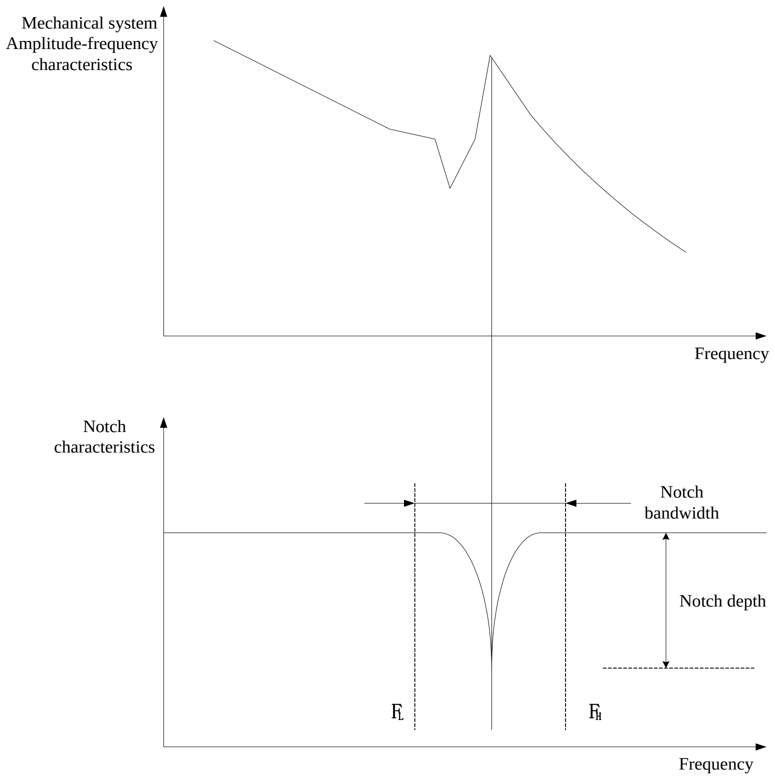


Fig 7.4.1Inhibition principle of notch filter

A total of four notches can be used, and each is defined by three parameters, frequency, width level, and depth level. The four notches can be set manually or set as adaptive notches. When they are used as adaptive notches, their parameters are automatically set by the servo drive.

Object	1st Notch Filter	2nd Notch Filter	3rd Notch Filter	4th Notch Filter
Frequency	2002h-12h	2002h-15h	2002h-18h	2002h-1Bh
Width level	2002h-13h	2002h-16h	2002h-19h	2002h-1Ch
Depth level	2002h-14h	2002h-17h	2002h-1Ah	2002h-1Dh

9.4.2 Suppression of Low-frequency Resonance

If the mechanical load end is long and heavy, vibration may easily occur in this part at emergency stop, affecting the positioning. The frequency of such vibration does not exceed 100 Hz, lower than the mechanical resonance frequency, and is called low frequency resonance. Use the low-frequency resonance suppression function to reduce.

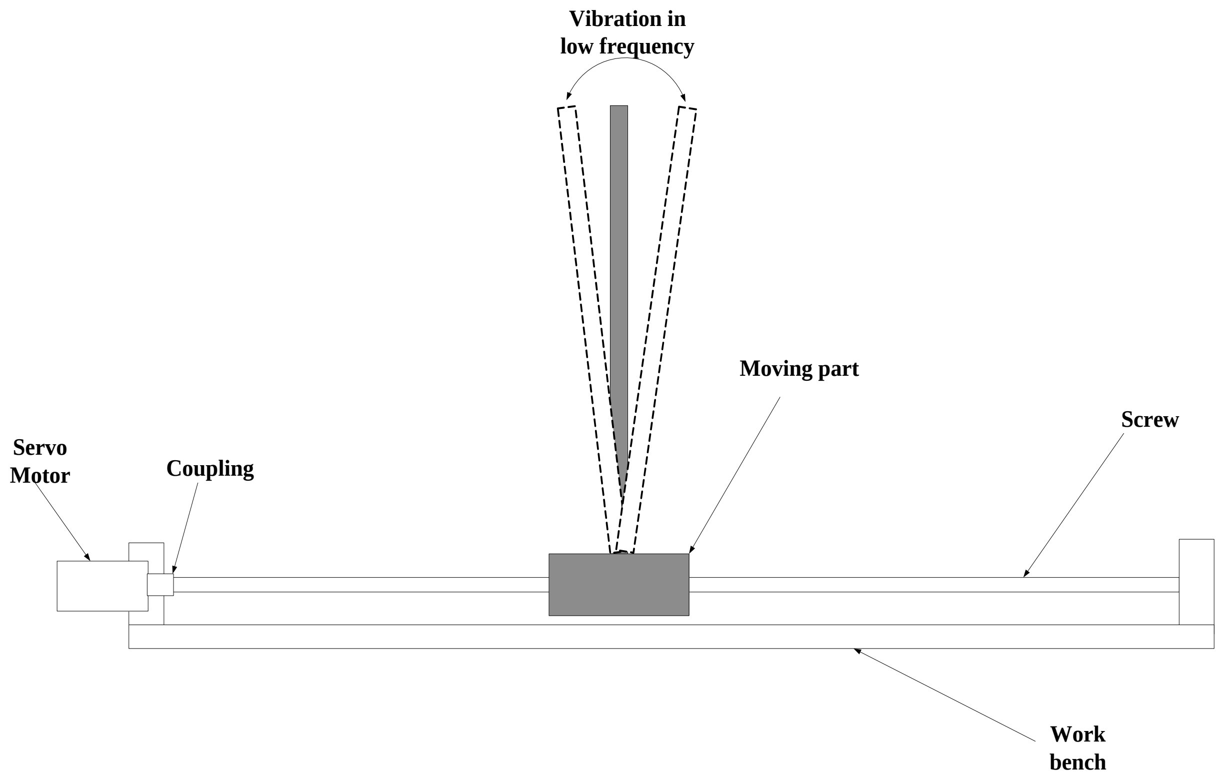


Fig 7.4.2 Low frequency resonance sketch map

(1) User Parameter

<table>
<tr><td rowspan="5">2002h-29h</td><td colspan="4">Center frequency of jitter inhibition PP CSP</td></tr>
<tr><td>Setting Range</td><td>Setting Unit</td><td>Mfr’s Value</td><td>Effect</td></tr>
<tr><td>50~2000</td><td>0.1Hz</td><td>2000</td><td>Immediate</td></tr>
<tr><td>Function code</td><td>Mapping</td><td>Data type</td><td>Accessibility</td></tr>
<tr><td>Po240</td><td>N</td><td>INT16</td><td>RW</td></tr>
<tr><td rowspan="5">2002h-2Bh</td><td colspan="4">Intensity of jitter inhibition PP CSP</td></tr>
<tr><td>Setting Range</td><td>Setting Unit</td><td>Mfr’s Value</td><td>Effect</td></tr>
<tr><td>0~100</td><td>N/A</td><td>0</td><td>Immediate</td></tr>
<tr><td>Function code</td><td>Mapping</td><td>Data type</td><td>Accessibility</td></tr>
<tr><td>Po242</td><td>N</td><td>INT16</td><td>RW</td></tr>
</table>

X. Maintenance and Inspection

10.1 Alarm and Trouble shooting at start

10.1.1 Position control mode

Start-up process	Description	Cause	Countermeasures
Connect control power supply（L1C　L2C）, main power supply（R S T）	Digital tube is not on or green light is not on	1.Control terminal is disconnected	■ Rewiring ■ Connect L1C/L2C power cable to socket separately.
		2.Control power supply fault	■ Check the voltage between L1C and L2C Note: 380V servo drive should connect to main power supply directly, no need to connect to L1C and L2C.
		3. Servo drive fault	Please contact with manufacturer.
	Keypad panel displays ’AL-XXX’	Refer to chapter 10.2 to find the cause and solve the problem.	
Servo drive is enabled by control word	Keypad panel displays ’AL-XXX’	Refer to chapter 10.2 to find the cause and solve the problem.	
	Servo motor is in unlocked state	1. Control word is invalid	■ Check whether green light is on, if it is not on, taking following step. ■ Check whether RUN green light is lighted, if light is flashing or off, OP mode is not arrived. ■ Check whether master and slave XML document is set correctly.
		2. Control mode is wrong	■ Select communication mode.
	Servo motor is galloping.		■ Encoder cable fault 1. Check whether Lo-04 value is correct when motor rotates 1 revolution. 2. Check whether servo drive trips into AL-17 ■ U/V/W motor cable fault. 1. Check whether U/V/W wiring is correct. 2. If wiring is correct, please study motor angle.
Rotation is not smooth at low speed.	Low speed rotation is not stable.	Gain is set improperly.	■ Adjust gain according to chapter 9.
	Motor shaft vibrates side to side.	Rotation inertia ratio (Po013) is too high.	■ If servo drive runs safely, please recognize inertia again according to chapter 9.2. ■ Adjust gain according chapter 9.

Normal run	Location is not accurate.	There is position error.	■ Pulse received by Lo-08 is not same as the one sent by PC/PLC.. 1. Check whether servo grounding is reliable. 2. Check whether signal cable is twisted-pair shield cable, whether shielding layer is connected to housing correctly. ■ Check whether motor shaft coupler is locked tightly. ■ Check whether device has vibration. Adjust the gain according to chapter 9.

10.2 Alarm code and possible cause

Code	Alarm code	Alarm name	Possible Cause
1	AL-01	Overcurrent	Output short-circuit or module malfunction
2	AL-02	Overvlotage	Main circuit DC voltage is too high.
3	AL-03	Undervoltage	Main circuit DC voltage is too low
4	AL-04	Hardware failure	Hardware failure inside drive
5	AL-05	Electric angle recognition error	Motor cable sequence error
6	AL-06	Motor Overload	High current is output for long time.
7	AL-07	Overspeed	Speed is too high
8	AL-08	Servo drive overload	High current is output for long time.
9	AL-09	Position loop trace error overflow	Position loop trace error overflow
10	AL-10	Encoder abnormal	Servo motor encoder is damaged.
11	AL-11	Emergency stop	External emergency stop terminal is valid
12	AL-12	Servo drive overheat	Temperature of servo drive radiator is too high
13	AL-13	Power supply phase loss of main circuit	In the state of power supply connection of main circuit, the voltage of one phase in three-phase power supply is too low.
14	AL-14	Energy consumption error	Brake parameters aren’t set correct or continuous brake time is too long.
15	AL-15	——	——
16	AL-16	Wrong setting of input terminal	Duplicate definition of input terminals
17	AL-17	Disconnection of encoder cable	Disconnection of servo encoder cable

18	AL-18	Rotation inertia recognition wrong	Alarm when wrong rotary inertia recognition
19	AL-19	Alarm of encoder battery	Battery alarm of servo encoder
20	AL-20	Uninitialized of E2ROM	Uninitialized of E2ROM for servo motor
21	AL-21	——	——
22	AL-22	——	——
23	AL-23	Torque unreached protection	The deviation between given torque and output torque is too large.
24	AL-24	Battery undervoltage	Battery undervoltage alarm
25	AL-25	——	——
26	AL-26	——	——
27	AL-27	Overtravel	Overtravel alarm
28	AL-28	E^2ROM	E2ROM error
29	AL-29	Leakage protection	Servo drive or motor has electric leakage.
30	AL-30	Motor locked-rotor protection	Motor is locked-rotor.
31	AL-31	Mixed error of full closed-loop	Mixed error of full closed-loop is too large
32	AL-32	——	——
33	AL-33	——	——
34	AL-34	——	——
35	AL-35	Home searching overtime	Homing search is overtime
36	AL-36	Parameter copy error	Parameter copy error
37	AL-37	Network initialization failed	EEPROM is writen or hardware fault
38	AL-38	OP abnormal protection	Communication abnormal protection in OP mode
39	AL-39	Synchronous signal loss	Synchronous signal loss
40	AL-40	Synchronous period setting fault	Synchronous period setting fault

10.3 Alarm Code and Trouble shooting

CAUTION
★ Do not reset immediately when servo drive malfunctions. At first find the causation and eliminate completely. ★ Process failure according to the manual when drive or servo motor malfunctions. Please contact with distributors or manufacturer directly if problem still cannot be solved. Do not maintain without authorization.

Alarm Code	Alarm Name	Possible Cause	Treatment
AL-01	Overcurrent	Main circuit wiring error	Modify wiring
		Output short-circuit	Cable may be short-circuit, repair or replace it.
		Short-circuit inside of servo drive or grounding short-circuit	Repair or replace servo drive
		Malfunction because of interference	Adopt anti-interference method, improve wiring.
		Servo drive malfunction	Repair or replace servo drive
AL-02	Overvoltage	Power supply is too high	Check rated voltage.
		Load rotation inertia is too large	Prolong deceleration time
			Select external brake resistor
			Reduce load
			Increase capacity of drive
AL-03	Under-voltage	Input voltage is low	Check power supply
			Check if power supply of main circuit is powered on.
AL-04	Hardware fault	Hardware fault inside drive	Contact with manufacturer
AL-05	Electric angle recognition error	Motor cable sequence error	Adjust cable sequences, exchange two of phases.

AL-06	Servo motor overload	Poor contact of servo motor wiring or encoder wiring	Check servo motor and encoder wiring
		Mechanical factors	Check the transmission ratio of machine.
		With electromagnetic brake unreleased, servo motor is running	Check the wiring of electromagnetic brake.
		Load too heavy	Reduce load
			Increase the capacity of drive
AL-07	Over-speed	Servo motor speed is higher than max speed	Servo motor cable or encoder cable wiring is wrong, please check it.
AL-08	Servo drive overload	High current is output for long time.	Check servo motor and encoder wiring. Decrease load. Increase servo drive capacity
AL-09	Position loop trace error overflow	Servo motor U, V, W or encoder wiring is wrong, or connector is not connected well	Check the wiring.
		Servo drive gain is low.	Increase gain, adjust speed and position gain
		The frequency of position pulse command is too high	Reduce pulse frequency or adjust electronic gear
AL-10	Encoder abnormal	Encoder disconnected or servo motor locked-rotor	Check encoder wiring.
		Servo motor failure	Power on again, if alarm still occurs, please contact with manufacture.
AL-11	Emergency stop	Input terminal logic is not corresponding to wiring	Check wiring or modify terminal logic
		Hardware damage of input terminal with ESP function	Set the function to other input terminal or contact with manufacturer

AL-12	Servo drive overheat	Environment temperature is too high	Improve ventilation
		Dirty radiator.	Clean air outlet and radiator.
		Foreign matters in fan	Clear out foreign matters
		Fan damage	Replace fan
		Improper installation of drive, such as poor ventilation or wrong installation direction.	Install as required
		Too heavy load	
		Discharge energy is too large	
AL-13	Power supply phase loss of main circuit	When main circuit is powered on, one phase voltage of three is too low.	Check phase loss of input power supply.
		Use single-phase power supply.	Check parameter setting
AL-14	Energy consumption error	Wrong braking resistor parameter	Modify parameter value
		Continuous brake time is too long	Check load, servo drive only can drive non-potential energy load.
AL-16	Duplicate setting of input terminal	Duplicate definition of input terminals	Reset to avoid duplicate definition
AL-17	Encoder cable disconnected	Encoder cable disconnected	Encoder cable disconnected
AL-18	Rotation inertia recognition fault	Rotation inertia recognition fault	Turn up Po013 manually
AL-19	Alarm of encoder battery	Battery alarm of encoder	1. Check whether encoder cable is connected normally. If cable is disconnected, connect again and reset alarm. 2. Check whether battery capacity is 3.6V. If it is lower than 3.2V, change battery and reset alarm when servo drive control power is ON state. 3. Shielding AL-19: So-38=1，So-43=1 reset alarm. 4. Check whether the wiring of battery is reliable if user makes cable by himself.

AL-20	Uninitialized of E2ROM	Uninitialized of E2ROM for servo motor	Uninitialized process for encoder of servo motor, learn motor angle manually.
AL-21	Reserved		
AL-22	Reserved		
AL-23	Torque unreached protection	Motor cable or power cable disconnected	Please check motor cable or encoder cable wiring.
AL-24	Battery undervoltage	Battery undervoltage alarm	1. If users don't replace a new battery in time or power supply of encoder is abnormal, alarm of AL-24 will happen and encoder current position will be lost. User must reset mechanical origin to eliminate it. 2. Shielding AL-24: So-48=1，So-41=1(set current position as mechanical origin), So-43=1 reset alarm, PC/PLC will reset mechanical origin.
AL-25	Motor overheat	Motor temperature is too high.	Improve ventilation
AL-26	Temperature detection circuit is disconnected	Temperature detection circuit is disconnected	Check the connection.
AL-27	Overtravel	Overtravel alarm	Setting range of FWD/FEV for overtravel protection.
AL-28	E^2ROM error	E2ROM error	Contact with manufacturer
AL-29	Leakage protectio n	Leakage protection	Servo drive or motor has electric leakage.
AL-30	Motor locked-rotor protection	Locked-rotor in motor running state	1. Check whether mechanical structure is blocked; 2. Check whether motor power cable is loosened; 3. Locked-tutor 4. Load is too heavy, exceeding motor allowed torque; 5. Wiring of motor power cable is wrong

AL-31	Mixed error of full closed-loop is too large	Po377, Po378 and Po380 is not suitable.	Check Po377, Po378 and Po380 value.
		Mechanical transmission part has large gap or not fastened	Check mechanical transmission part
		Servo motor U, V, W terminal or encoder wiring is wrong or connector contact is poor	Check the wiring of servo motor and encoder
		Lack or wrong wiring of mechanical terminal encoder	Check the wiring of mechanical terminal encoder
		Servo drive gain is low	Increase gain, refer to the gain of speed and position
		Mechanical termination encoder wiring is not well	Check mechanical termination encoder wiring.
AL-32	Reserved		
AL-33	Reserved		
AL-34	Reserved		
AL-35	Home searching overtime	Home searching overtime	Check wiring.
			Check servo drive.
AL-36	Parameter copy error	Parameter copy error	Check the parameter setting.
AL-37	Network initialization failed	EEPROM is written or hardware fault	Check E^2PROM
AL-38	OP abnormal protection	Communication abnormal protection in OP mode	Check the link
AL-39	Synchronous signal loss	Synchronous signal loss	Synchronous signal loss
AL-40	Synchronous period setting fault	Synchronous period is too small	Increase synchronous period

10.3.1 Other malfunctions

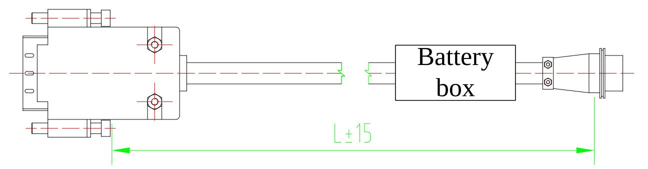
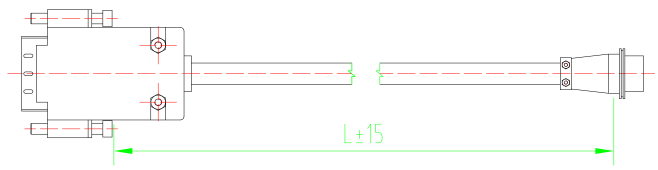
Malfunction	Cause	Measure
Servo motor does not run.	Main circuit power supply is disconnected.	Check the wiring.
	Control circuit power supply is disconnected.	Check the wiring.
	The wiring of I/O terminal is wrong.	Check the wiring.
	The wiring of servo motor or encoder is wrong.	Check the wiring.
	Control command is not input.	Input control command correctly.
	Some wrong using of input/output terminal. For example: servo on terminal is disconnected or it is defined wrong.	Define and use control terminal correctly.
	Forward/reverse rotation prohibited.	Make the function of forward/reverse rotation prohibited invalid.
	Torque limited.	Check the parameters and interface of torque limited function.
	Servo drive fault.	Maintain or replace servo drive.
Servo motor moves instantaneously and then stops	Servo motor wiring is wrong.	Check the wiring.
	Servo drive fault.	Please contact with manufacturer.
Abnormal noise from servo motor	Mounting not secured	Check mounting screws and tighten
		Align the couplings.
	Wrong parameters setting	Check servo drive parameters.
	Defective bearings	Replace servo motor.
	Driven machine fault	Check whether there are any foreign matters, damages or deformation on the machine section.
	Encoder fault	Check whether encoder cable is damaged.

XI Appendix

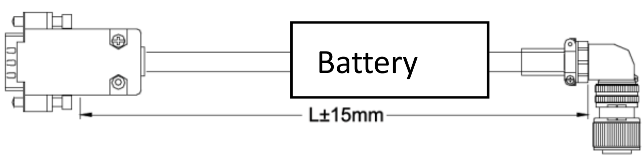
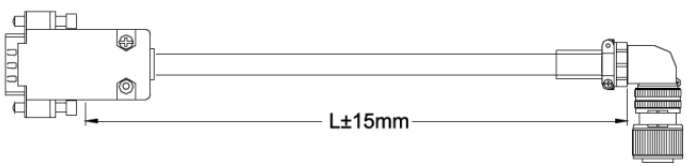
11.1 Encoder cable selection

11.1.1 Absolute encoder cable

Encoder cable with round plug（applicable for 80 flange and below 80 flange servo motor）

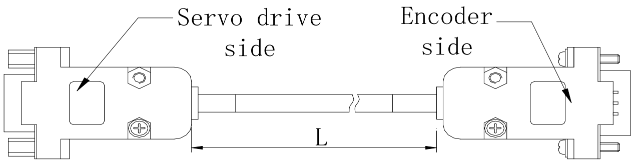
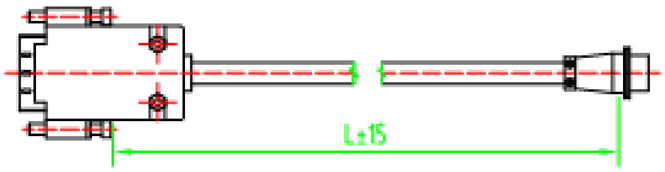
Name	Model	Length	Cable appearance
Encoder cable (for function code D7, D71)	DB9-4BS02-3M-0.2	3M	
	DB9-4BS02-5M-0.2	5M	
	DB9-4BS02-10M-0.2	10M	
	DB9-4GS02-3M-0.2	3M	
	DB9-4GS02-5M-0.2	5M	
	DB9-4GS02-10M-0.2	10M	

Encoder cable with L aviation plug（applicable for 110, 130 and 180 flange servo motor）

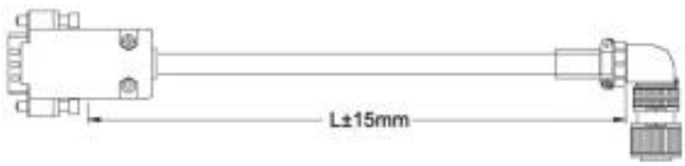
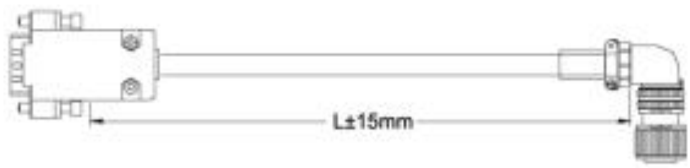
Name	Model	Length	Cable appearance
Encoder cable (for function code D7, D71)	DB9-4BS03-3M-0.2	3M	
	DB9-4BS03-5M-0.2	5M	
	DB9-4BS03-10M-0.2	10M	
	DB9-4GS03-3M-0.2	3M	

11.1.2 Incremental encoder cable

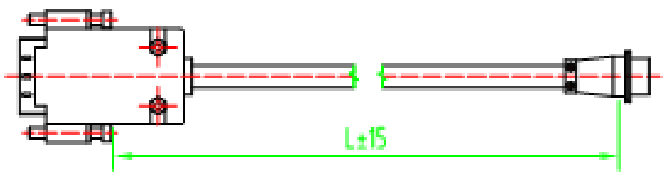
Encoder cable with DB plug（applicable for 80 flange and below 80 flange servo motor ）

Name	Model	Length	Cable appearance
15-core encoder cable (for D5)	DB15-15GP02-3M-0.2	3M	
	DB15-15GP02-5M-0.2	5M	
	DB15-15GP02-10M-0.2	10M	
8-core encoder cable (for D51)	DB15-8GP02-3M-0.2	3M	
	DB15-8GP02-5M-0.2	5M	
	DB15-8GP02-10M-0.2	10M	
4-core encoder cable (for D52)	DB9-4GS02-3M-0.2	3M	
	DB9-4GS02-5M-0.2	5M	
	DB9-4GS02-10M-0.2	10M	

Encoder cable with L aviation plug（applicable for 110, 130 and 180 flange servo motor）

Name	Model	Length	Cable appearance
15-core encoder cable (for D5)	DB15-15GP01-3M-0.2	3M	
	DB15-15GP01-5M-0.2	5M	
	DB15-15GP01-10M-0.2	10M	
8-core encoder cable (for D51)	DB15-8GP01-3M-0.2	3M	
	DB15-8GP01-5M-0.2	5M	
	DB15-8GP01-10M-0.2	10M	
4-core encoder cable (for D52)	DB9-4GS03-3M-0.2	3M	
	DB9-4GS03-5M-0.2	5M	
	DB9-4GS03-10M-0.2	10M	

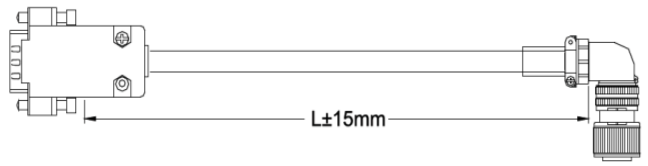
Encoder cable with I aviation plug (applicable for servo motor with base No.E,F)

Name	Model	Length	Cable appearance
15-core encoder cable (for D5)	DB15-15GP03-3M-0.2	3M	
	DB15-15GP03-5M-0.2	5M	
	DB15-15GP03-10M-0.2	10M	
8-core	DB15-8GP03-3M-0.2	3M	

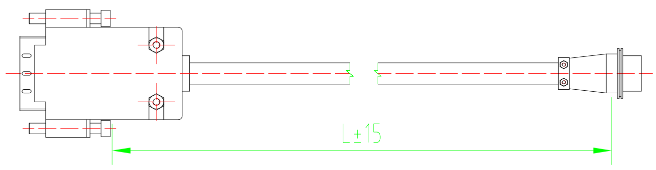
encoder cable (for D51)	DB15-8GP03-5M-0.2	5M	
	DB15-8GP03-10M-0.2	10M	

11.1.3 Resolver encoder cable

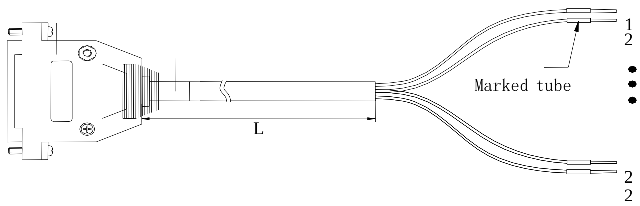
Encoder cable with Laviationplug (applicable for 180 flange and below 180 flange motor)

Name	Model	Length	Cable appearance
Encoder cable (for D2)	DB9-8GR01-3M-0.2	3M	
	DB9-8GR01-5M-0.2	5M	
	DB9-8GR01-10M-0.2	10M	

Encoder cable with I aviationplug (applicable for servo motor with base No. E, F)

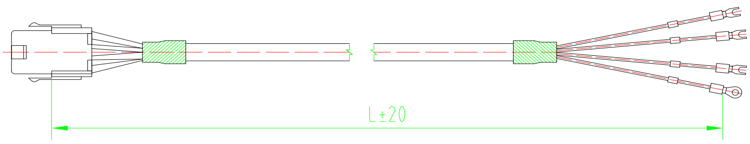
Name	Model	Length	Cable appearance
Encoder cable (for D2)	DB9-8GR02-3M-0.2	3M	
	DB9-8GR02-5M-0.2	5M	
	DB9-8GR02-10M-0.2	10M	

11.2 Control cable

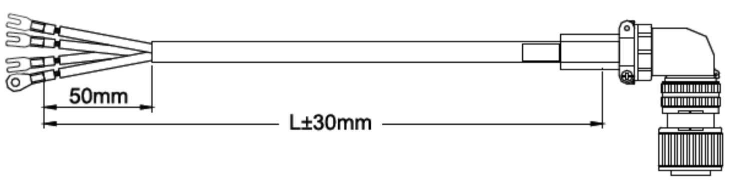
Name	Model	Length	Appearance
Control cable	DB44-15PC-1M-0.2	1M	
	DB44-15PC-2M-0.2	2M	
	DB44-15PC-3M-0.2	3M	

11.3 Power cable

Applicable for flange≤80 servo motor

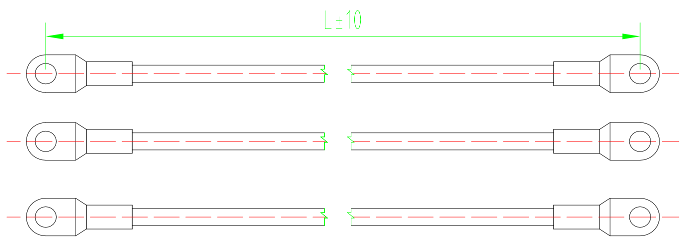
Name	**Model**	**Length**	**Appearance**
Power cable	DB4-4PO-*M-diameter	*M means length	

Applicable for flange 110,130,180 servo motor

Power cable	HK4A-4PO-*M – diameter HK4B-4PO-*M – diameter	*M means length	

Note: aviation plug is used for servo motor with flange above 110. Servo motor with 180 flange has large current, so the line diameter should be larger, named as “HK4B-4P0-*M-diameter”. Except servo motor with 180 flange, other cables are named as “HK4A-4P0-*M-diameter”. For M1 and M2 structure of 220V servo drive, the name of cable should add –B, for M2 structure of 380V servo drive, the name of cable should add –H.

Applicable for 180 spigpot and 250 spigpot servo motor

Name	**Model**	**Length**	**Appearance**
Power cable	ZL4-4PO-*M-diameter	*M means length	

Note:

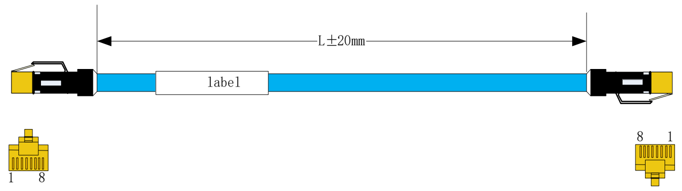
★ ZL4-4PO-XXX is single strand cable, grounding cable is yellow-green cable of 2.5 mm^2.

★ 180 spigpot and 250 spigpot servo motors have copper terminal for spare part, if user purchases copper terminal, please refer to following data:

Motor	Copper terminal
Motor rated power 11KW	6-8
Motor rated power 15KW-18.5KW	10-8
Motor rated power 22KW-30KW	16-8
Motor rated power 37KW	25-8

11.4 Shielded network cable

EtherCAT communication rate can reach to 100MB frequency. To make sure communication reliability, we recommend following EtherCAT communication cable:

Name	Model	Length	Appearance
Shielded network cable	SC-ECT**M-C	According to requirement	

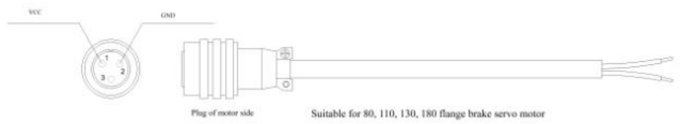
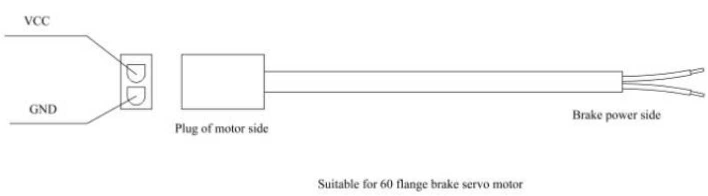
In cable model, **M means ** meter, user can select cable length. As shown in the figure, cable length is L (unit is cm), error is ±2cm. For example, 30cm cable model is SC-ECT0.3M-C.
Ethernet Category 5 (100BASE-TX) network cable or high-strength shielded network cable is used as the EtherCAT communication cable. The double-layer shielded network cable is recommended for servo drive. When EtherCAT communication is selected, the single network cable between any two of servo drive should not be longer than 50 meters; good network cable can improve anti-interference capability between master station and servo drive.
Direct-through or crossover Ethernet cables are allowable. Cable characteristic impedance is 100Ω±5%（characteristic frequency below 1000MHz）. The double-layer shielded 100M-Ethernet enhanced category 5 or better network cable is recommended.

11.5 Other cable

Communication cable

Name	Model	Length	Appearance
Communication cable	1394-2TR-*M-0.3	*M means length	None

Motor brake cable

Name	Model	Length	Appearance
Brake cable	HK3-2BR-*M-0.75	Actual length	
Brake cable	DB2-2BR-*M-0.75	Actual length	

11.6 Motor and matched cable

（1）220V servo motor series

Motor model		Servo drive model		Power cable model
FMS series 3000r/min	FMSA-201*32***	FL20-C201S2M1	FL20-C201T2M1	DB4-4PO-*M-0.75-B
	FMSA-401*32***	FL20-C401S2M1	FL20-C401T2M1	
	FMSA-751*33***	FL20-C751S2M1	FL20-C751T2M1	
	FMSA-102*33***	FL20-C102S2M2	FL20-C102T2M2	DB4-4PO-*M -1.0-B
	FMSA-122*35***	FL20-C122S2M2	FL20-C122T2M2	
	FMSA-152*37***	FL20-C182S2M2	FL20-C182T2M2	HK4A-4PO-*M-1.5-B
	FMSA-182*35***			HK4A-4PO-*M-2.5-B
	FMSA-232*37***	—	FL20-C302T2M3	HK4A-4PO-*M-2.5
	FMSA-302*37***	—	FL20-C452T2M3	HK4A-4PO-*M-4.0
FMM series 2000r/min	FMMA-801*35**	FL20-C102S2M2	FL20-C102T2M2	HK4A-4PO-*M-0.75-B
	FMMA-851*37**			HK4A-4PO-*M-1.0-B
	FMMA-102*37**	FL20-C122S2M2	FL20-C122T2M2	HK4A-4PO-*M-1.0-B
	FMMA-122*35**			
	FMMA-132*37**	FL20-C182S2M2	FL20-C182T2M2	HK4A-4PO-*M-1.5-B
	FMMA-152*37**			
	FMMA-202*37**	—	FL20-C302T2M3	HK4A-4PO-*M-2.5
	FMMA-312*37**	—	FL20-C452T2M3	HK4B-4PO-*M-4.0
	FMMA-352*3A**	—		
FMM series 1500r/min	FMMB-122*37**	FL20-C122S2M2	FL20-C122T2M2	HK4A-4PO-*M-1.0-B
	FMMB-152*37**	FL20-C182S2M2	FL20-C182T2M2	HK4A-4PO-*M-1.5-B
	FMMB-232*37**	—	FL20-C302T2M3	HK4A-4PO-*M-2.5
	FMMB-272*3A**	—		HK4B-4PO-*M-2.5
	FMMB-302*3A**	—	FL20-C452T2M3	HK4B-4PO-*M-4.0
	FMMB-432*3A**	—	FL20-C452T2M3	
FML series 1000r/min	FMLA-102*37**	FL20-C102S2M2	FL20-C102T2M2	HK4A-4PO-*M-1.0-B
	FMLA-152*37**	FL20-C182S2M2	FL20-C182T2M2	HK4A-4PO-*M-1.5-B
	FMLA-292*3A**	—	FL20-C302T2M3	HK4B-4PO-*M-2.5
	FMLA-372*3A**	—	FL20-C452T2M3	HK4B-4PO-*M-4.0

(2) 380V servo motor series

<table>
<tr><th colspan="2">Motor model</th><th>Servo drive model</th><th>Power cable model</th></tr>
<tr><td rowspan="7">FMS series 3000r/min</td><td>FMSA-751*63***</td><td rowspan="2">FL20-C102T3M2</td><td rowspan="2">DB4-4PO-*M-0.75-H</td></tr>
<tr><td>FMSA-102*63***</td></tr>
<tr><td>FMSA-122*65***</td><td rowspan="3">FL20-C202T3M3</td><td>HK4A-4PO-*M-1.0</td></tr>
<tr><td>FMSA-152*67***</td><td>HK4A-4PO-*M-1.0</td></tr>
<tr><td>FMSA-182*65***</td><td>HK4A-4PO-*M-1.5</td></tr>
<tr><td>FMSA-232*67***</td><td>FL20-C302T3M3</td><td>HK4A-4PO-*M-1.5</td></tr>
<tr><td>FMSA-302*67***</td><td>FL20-C452T3M3</td><td>HK4A-4PO-*M-2.5</td></tr>
<tr><td rowspan="14">MM series 2000r/min</td><td>FMMA-801*65**</td><td rowspan="3">FL20-C102T3M2</td><td rowspan="5">HK4A-4PO-*M-0.75-H</td></tr>
<tr><td>FMMA-851*67**</td></tr>
<tr><td>FMMA-102*67**</td></tr>
<tr><td>FMMA-122*65**</td><td rowspan="2">FL20-C152T3M2</td></tr>
<tr><td>FMMA-132*67**</td></tr>
<tr><td>FMMA-152*67**</td><td rowspan="3">FL20-C202T3M3</td><td rowspan="2">HK4A-4PO-*M-1.0</td></tr>
<tr><td rowspan="2">FMMA-202*67**</td></tr>
<tr><td>HK4A-4PO-*M-1.5</td></tr>
<tr><td>FMMA-312*67**</td><td rowspan="3">FL20-C452T3M3</td><td>HK4A-4PO-*M-2.5</td></tr>
<tr><td>FMMA-352*6A**</td><td>HK4B-4PO-*M-2.5</td></tr>
<tr><td>FMMA-452*6A**</td><td>HK4B-4PO-*M-2.5</td></tr>
<tr><td>FMMA-602*6A**</td><td rowspan="2">FL20-C752T3MM4</td><td rowspan="2">HK4B-4PO-*M-4.0</td></tr>
<tr><td>FMMA-802*6A**</td></tr>
<tr><td>FMMA-103*6A**</td><td>FL20-C153T3M4</td><td>HK4B-4PO-*M-6.0</td></tr>
<tr><td rowspan="8">FMM series 1500r/min</td><td>FMMB-122*67**</td><td rowspan="3">FL20-C202T3M3</td><td rowspan="2">HK4A-4PO-*M-1.0</td></tr>
<tr><td>FMMB-152*67**</td></tr>
<tr><td>FMMB-232*67**</td><td>HK4A-4PO-*M-1.5</td></tr>
<tr><td>FMMB-302*67**</td><td>FL20-C302T3M3</td><td>HK4A-4PO-*M-2.5</td></tr>
<tr><td>FMMB-272*6A**</td><td>FL20-C302T3M3</td><td rowspan="4">HK4B-4PO-*M-2.5</td></tr>
<tr><td>FMMB-302*6A**</td><td>FL20-C302T3M3</td></tr>
<tr><td>FMMB-432*6A**</td><td>FL20-C452T3M3</td></tr>
<tr><td>FMMB-552*6A**</td><td>FL20-C552T3M3</td></tr>
</table>

	FMMB-752*6A**	FL20-C752T3MM4	HK4B-4PO-*M-4.0
	FM15-0082*6EE*FL	FL20-C752T3MM4	ZL4-4PO-*M-4.0
	FM15-0100*6EE*FL	FL20-C113T3MM4	ZL4-4PO-*M-6.0
	FM15-0124*6EE*FL	FL20-C153T3M4	ZL4-4PO-*M-6.0
	FM15-0160*6EE*FL	FL20-C183T3M5	ZL4-4PO-*M-10.0
	FM15-0180*6EE*FL		ZL4-4PO-*M-10.0
	FM15-0210*6FE*FL	FL20-C223T3M5	ZL4-4PO-*M-10.0
	FM15-0240*6EE*FL	FL20-C303T3M6	ZL4-4PO-*M-16.0
	FM15-0290*6FE*FL	FL20-C303T3M6	ZL4-4PO-*M-16.0
	FM15-0350*6FE*FL	FL20-C373T3M6	ZL4-4PO-*M-25.0
FML series 1000r/min	FMLA-372*6A**	FL20-C452T3M3	HK4B-4PO-*M-2.5
	FMLA-102*67**	FL20-C152T3M2	HK4B-4PO-*M-0.75-B
	FMLA-292*6A**	FL20-C302T3M3	HK4B-4PO-*M-1.5
FMM series 1700r/min	FM17-0075*6EE*FL	FL20-C752T3MM4	ZL4-4PO-*M-4.0
	FM17-0092*6EE*FL	FL20-C113T3MM4	ZL4-4PO-*M-6.0
	FM17-0110*6EE*FL	FL20-C113T3MM4	ZL4-4PO-*M-6.0
	FM17-0140*6EE*FL	FL20-C153T3M4	ZL4-4PO-*M-6.0
	FM17-0180*6EE*FL	FL20-C183T3M5	ZL4-4PO-*M-10.0
	FM17-0210*6FE*FL	FL20-C223T3M5	ZL4-4PO-*M-10.0
	FM17-0240*6EE*FL	FL20-C303T3M6	ZL4-4PO-*M-16.0
	FM17-0270*6EE*FL	FL20-C303T3M6	ZL4-4PO-*M-16.0
	FM17-0330*6FE*FL	FL20-C373T3M6	ZL4-4PO-*M-25.0
FMM series 2000r/min	FM20-0070*6EE*FL	FL20-C752T3MM4	ZL4-4PO-*M-4.0
	FM20-0100*6EE*FL	FL20-C113T3MM4	ZL4-4PO-*M-6.0
	FM20-0140*6EE*FL	FL20-C153T3M4	ZL4-4PO-*M-6.0
	FM20-0180*6EE*FL	FL20-C183T3M5	ZL4-4PO-*M-10.0
	FM20-0220*6EE*FL	FL20-C223T3M5	ZL4-4PO-*M-10.0
	FM20-0250*6EE*FL	FL20-C303T3M6	ZL4-4PO-*M-16.0
	FM20-0280*6EE*FL		ZL4-4PO-*M-16.0
	FM20-0300*6EE*FL	FL20-C373T3M6	ZL4-4PO-*M-16.0
	FM20-0360*6FE*FL		ZL4-4PO-*M-25.0

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