ENC

ISO Quality Management System Authentication

Users' Manual

ESS200P series

Ver.2.0

SHENZHEN ENCOM ELECTRIC TECHNOLOGIES CO.,LTD.

Foreword

Dear Customer,

First of all, thank you for purchasing the ESS200P series servo drive developed and manufactured by Shenzhen Encom Electric Technologies Co., Ltd!

Shenzhen Encom Electric Technologies Co., Ltd. was established in 2004. Since 2012, it has become a national high-tech enterprise. After nearly 15 years of technical accumulation and honing, our products have undergone various complicated and harsh industrial environments. We have developed EDS series, EN series, EAS series and ESS series, industrial electric inverters, AC servo drives, synchronous servo drives. These products have been widely used in many applications, and have won the recognition, trust and praise of our customers.

The ESS200P series servo drive uses advanced control technology to achieve high-performance position control, speed control and torque control. It is a feature-rich and powerful servo drive product. The ESS200P has functions such as inertia identification, gain switching, notch filtering and vibration suppression. It can meet the application needs of machine tools, textiles, packaging, semiconductors, printing and other industries with various types of easy-to-use motors.
This series of servo products, combined with the inverter products and PLC automation products of the company, can provide integrated solutions for the customers engaged in equipment manufacturing and automation engineering, which is of great value for reducing system cost and improving system reliability. .

This manual providesinformation on installation wiring, parameter settings, troubleshooting and countermeasures, routine maintenance, and related precautions. In order to ensure the correct installation and operation of the drive and servo motor, please read this manual carefully before installation, and keep it in hand and hand it over to the end user of this servo system.

If there are any difficulties or special requirements for the use of this series of servo drives and servo motors, please contact our local offices or distributors, or contact our technical engineering department directly, we will be happy to help you.

As the company is committed to the continuous improvement of the performance of servo drive products, the contents of this manual are subject to change without notice.

Content

1 Safety information and use precautions

To ensure the safety of person and device, be sure to read this chapter carefully before using the Servo Drive.

1.1 Safety mark

There are three safety marks used in the manual as follow:

Symbol	Symbol description
	It may lead to death, serious injury or heavy property loss if operate not as requested.
	Precautions when operation, it may lead to body injured or device broken if operate not as requested.
 **Note**	Pay extra cautions during using.

1.2 Safety precautions

(1) Forbid to use it in such environments like damp, aggressive gas, inflammable gas or near the combustible materials, otherwise it may cause fire.
(2) Forbid to stretch into the inner of the driver, otherwise will get burned or an electric shock.
(3) Must assemble over-current protection device, leakage protection device, non-fused breaker, over-heat protect device, emergency-stop device to avoid electric shock, injured or fire.
(4) Emergency power-off system must be installed so that when emergency occurs, the operation can be quickly stopped in real time and the power supply can be blocked to avoid injury or electric shock, fire, error, damage and so on.
(5) Before moving the drive, installing wiring or checking the drive, the power must be cut off and left for a period of time according to the product label to avoid electric shock.
(6) Before moving the drive, installing wiring or checking the drive, the power must be cut off first. The operation should be carried out after confirming there is no risk of electric shock, so as to avoid electric shock.
(7) Wiring operation must be carried out by professional electrical technicians to avoid electric shock.
(8) Servo motor, servo driver and external brake resistor must be installed on non-flammable objects such as metal to avoid fire.
(9) After the power is disconnected for more than 5 minutes, the voltage between + and - is confirmed to be below the safe voltage with the multimeter after the power indicator is off, and then the driver can be disassembled and assembled, otherwise it will be electrocuted due to the residual voltage.
(10) Please be sure to connect electromagnetic contactor and non-fusing circuit breaker between the power supply and the main circuit of the servo driver (For single phase driver is L1, L2 and three phase driver is L1, L2 and L3). Otherwise, when the driver fails, the high current cannot be cut off to cause fire.
(11) In the drive and servo motor, don’t mix with oil, grease, screws, metal, and other combustible or conductive foreign matter, otherwise may lead to fire.

(1) Strictly prohibited to pull, squeeze, intentionally damage or apply gravity on cable to avoid electric shock, malfunction or damage.
(2) Do not touch the motor shaft when the motor is running to avoid injury.
(3) The temperature of servo motor, servo driver and external braking resistor will be rise when they work, please don’t touch them to avoid injury.
(4) Motor and encoder lines must be properly connected to avoid injury or failure or damage.
(5) During Jog operation, please follow the steps required in this manual.

1.3 Assemble precautions

⑴ Make sure the stability of fixture and assembling of the product to avoid fire or personal accident occurs when earthquake.
⑵ Forbid to change, dismantle and repair the driver privately, it may lead to injured or breakdown.
⑶ Strictly forbidden to block the suction port and the exhaust port and ensure that no foreign objects enter inside, otherwise it may cause internal components aging which lead to failure and damage.
⑷ Please ensure that the drive is kept at a specified distance from the inner surface of the cabinet and other machines when installing the drive, otherwise it will cause malfunction and damage.

(1) Please not pull the cable conductor heavily, otherwise will cause it breakdown.
(2) Please follow the specified assemble method and direction, assemble the wires rightly and safely to avoid injured or electric shock.
(3) The ambient temperature around the motor and servo driver should not over the allowable value to avoid failure.
(4) Forbid to use external pressure to drive the motor to avoid it damaged.
(5) Servo driver and motor should be grounding to avoid get electric shock.
(6) Please don’t hold the cable conductor or motor shaft to carry to avoid injured.
(7) Forbid heavy shock on the motor shaft to avoid breakdown.
(8) Strong shock on the product is strictly prohibited to avoid breakdown.
(9) Strictly forbid to connect 3PH power source to the output terminal U, V, W of the servo drive to avoid injured or cause fire.
(10) Please connect the output U, V, W of the servo drive and the U, V, W of the servo motor directly. Don’t install electromagnetic contactor between them to avoid abnormal operation and malfunction.
(11) Please not let the power cable and signal cable through the same pipe or bundle them together. When wiring, the power cable and signal cable should be separated by more than 30cm.
(12) Please check and operate after confirming that the CHARGE indicator is off.
(13) Please not power on and off frequently, when need to be switched the power source on and off repeatedly, please less than 1 times per minute.
(14) Please don’t connect 220V servo drive to 380V power source; otherwise it will lead to breakdown.

1.4 Precautions when using

(1) When error occurs, troubleshoot it first and make sure it's safe before clearing it and restarting it to avoid injury.
(2) Follow the rated voltage to use the driver to avoid electric shock, injured or fire.
(3) Follow the product instruction and rated output parameter to assemble it correctly to avoid injured or causing breakdown.
(4) Please use the motor and drive in accordance with the recommended combination to avoid fire.
(5) Don't significantly adjust or change the gain of the driver, mechanical operation, operation must be stable to avoid injury.
(6) Please don't turn on and off the main power of the driver frequently to avoid electric shock, injury, error or damage.
(7) Strictly prohibited to stand above the drive or stack sundries, otherwise will cause electric shock, injured, error or damage.
(8) Strictly prohibited to stack sundries in front of the cooling hole to avoid electrical shock or fire.

1.5 Running precautions

(1) When use the servo drive on vertical axis, please set safety device to avoid falling during warning, over-travel situation etc. Moreover, please set it stop and lock the servo driver when over-travel happening to avoid work-piece falls on abnormal cases.
(2) When power is restored after a power outage, the driver may restart suddenly, please keep away from the machine. Corresponding mechanical design must be carried out for the restart to ensure personal safety and avoid injury.
(3) To avoid accident occurs, please run the servo motor without load to avoid injury during Jog run.

(1) When use braking motor, please make sure the braking device is release during operation, otherwise it will damage the servo motor.
(2) To avoid injured, please don't touch the motor when the motor is running.
(3) When Jog run, please fix motor and ensure the actions are normal when separated from machine systems. Thereafter assemble it on mechanical system to avoid injured.
(4) When error occurs, troubleshoot it first and make sure it's safe before clearing it and starting again to avoid injury.

1.6 Definition of motor rotation direction

Forward direction and reverse direction definite as show in Fig.1-1:

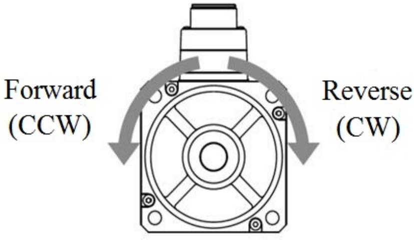


Fig.1-1

1.7 Scrap disposal precautions

When scrap servo driver and its spare parts, please note:

(1) The whole servo driver: scrap the servo driver as industrial scrap.

(2) Electrolytic capacitor: the electrolytic capacitor in the driver may explode when burning.

(3) Plastics: plastics and rubber parts will give harmful and poisonous gas, please be well protected when burning it.

2 Product information

2.1 Incoming servo Inspection

(1) Check if there is any damage during transportation and servo drive itself has damage or fall-off parts

(2) Check if the items on the packing list are all ready.

(3) Please confirm nameplate data of the servo drive is consistent with your order requirements.

Our products are guaranteed by strict quality system in manufacturing, packaging, transportation, etc. If there is some kind of omission or error, please contact our company or local agent, we will solve it as soon as possible.

2.2 Servo drive introduction

2.2.1 Servo drive type explanation

ESS200 P - 2S 101 - C

Code	Name
ESS200	Servo drive

Code	Type
P	Pulse
N	EtherCAT

Code	Type
2S	1 phase 220V
2T	3 phase 220V
4T	3 phase 380V

Code	Power(W)
101	10×10^1
201	20×10^1
…	…
552	55×10^2
752	75×10^2

Code	Accessories
C	CANOPEN

Fig.2-1 Servo type details

2.2.2 Nameplate explanation

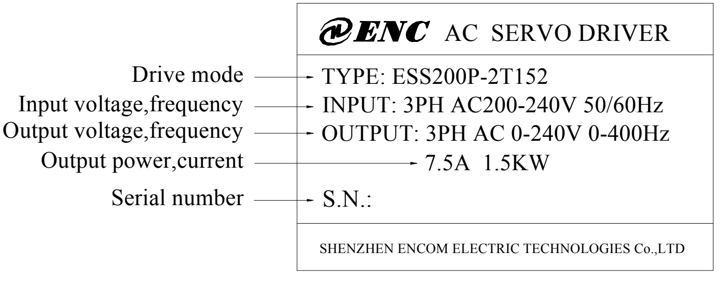
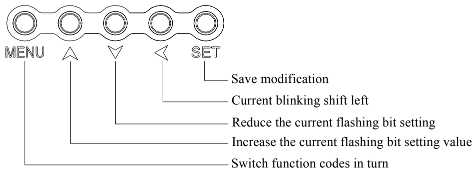


Fig.2-2 Nameplate explanation

2.2.3 Servo drive construction

Item	Function
LED	5-digit 8-segment LED digital tube for displaying servo running status and parameter setting
Key operator	
Charge **Bus voltage indicator**	Used to indicate that the bus capacitance is in a charged state. When the indicator is on, the internal capacitor may still have charge even if the main circuit power is turned off. Therefore, do not touch the power terminal when the light is on to avoid electric shock.
L1C、L2C **Control loop power input terminal**	Refer to the nameplate rated voltage level input control loop power supply
L1、L2、L3 **Main circuit power input terminal**	Refer to the nameplate rated voltage level and input the main loop power supply.
-1、-2	It is used for external reactor access, and is short-circuited by default. It is also used together with the (+) terminal for multiple servo common DC busses.
(+)、(-) **Servo bus terminal**	DC bus terminal for multiple servo common DC bus
(+)、RB、B **External brake resistor connection terminal**	By default, short wires are connected between RB and B. When the external braking resistor is connected, remove the short wiring to open the circuit between RB and B, and connect the external braking resistor before (+) and B.
U、V、W **Servo motor connection terminal**	Connect servo motor U, V, W phase
Ground terminal	Connect to the power supply and motor ground terminal for grounding
Encoder connection terminal	Connected to the motor encoder terminal
X5 control terminal	Command input signal and other ports for input and output signals
X3、X4 communication terminal	Internal parallel connection to RS485 communication command device

2.2.4 Servo drive specification

（1）Specification

Type	The main circuit power	Control circuit power	Rated output current （A）	Max output current （A）	Case type
ESS200P-2S101	1 phase 220V±10%；50/60Hz	1 phase 220V±10%；50/60Hz	1.1	3.3	A type
ESS200P-2S201			1.5	4.5	A type
ESS200P-2S401			2.7	8.1	A type
ESS200P-2S751			3.9	11.7	B type
ESS200P-2T102	3 phase 220V±10%；50/60Hz	3 phase 220V±10%；50/60Hz	5.2	15.6	B type
ESS200P-2T152			7.5	22.5	B type
ESS200P-2T202			9.5	28.5	C type
ESS200P-2T302			13.0	39	C type
ESS200P-4T102	3 phase 380V±10% 50/60Hz	1 phase 380V±10%；50/60Hz	2.8	8.4	B type
ESS200P-4T152			4.0	12	B type
ESS200P-4T202			5.5	16.5	B type
ESS200P-4T302			7.5	22.5	C type
ESS200P-4T442			10	30	C type
ESS200P-4T552			12	36	C type
ESS200P-4T752			21	63	D type

（2）Basic specification and function

<table>
<tr><th colspan="4">Item</th><th>Terminal function</th></tr>
<tr><td rowspan="8">Basic Specification</td><td colspan="3">Control mode</td><td>Vector control</td></tr>
<tr><td colspan="3">Control way</td><td>① Position control；② Speed control；③ Torque control
④ Position/speed control；⑤ Position/torque control；
⑥ Speed/ torque control</td></tr>
<tr><td colspan="3">Gain adjust mode</td><td>Manual mode, one-button parameter auto-tuning mode</td></tr>
<tr><td colspan="3">Filter function</td><td>1.Command pulse inertial filter, FIR filter;
2.Adaptive low frequency resonance filter;
3.4 sets of notch filters, 2 of which are adaptive notch filters</td></tr>
<tr><td colspan="3">Inertia self-learning function</td><td>①Off-line；②On-line</td></tr>
<tr><td colspan="3">Motor parameter self-learning function</td><td>Motor parameter self-learning, encoder information self-learning</td></tr>
<tr><td colspan="3">Support encoder</td><td>2500 line incremental encoder(9 lines, 15 lines)；
17bit, 20bit, 23bit incremental encoder；
17bit, 20bit, 23bit absolute encoder；</td></tr>
<tr><td colspan="3">Batch parameters upload download</td><td>Support external accessories for batch parameter upload and download</td></tr>
<tr><td rowspan="4">Position control mode</td><td rowspan="3">Performance</td><td colspan="2">Speed feed forward compensation</td><td>0～100.0%（Set resolution ratio 0.1%）</td></tr>
<tr><td colspan="2">Torque forward compensation</td><td>0～200.0%（Set resolution ratio 0.1%）</td></tr>
<tr><td colspan="2">Position accuracy</td><td>±1 motor encoder pulse</td></tr>
<tr><td>Input signal</td><td>Pulse instructions</td><td>Input pulse form</td><td>Contains three Instruction form: "direction + pulse", "A, B phase orthogonal pulse", "CW / CCW pulse"</td></tr>
</table>

			Input form	① Differential input；② Open collector
			Input pulse frequency	① Differential input: High speed up to 4Mpps, pulse width not less than 0.125μs. Low speed up to 500Kpps, pulse width cannot be lower than 1μs ② Open collector: up to 200Kpps, pulse width cannot be lower than 2.5μs
		Built-in collector open circuit power		+24V（Built-in 2.4kΩ resistor）
		Multi-segment position command selection		Configure 4 DIs to achieve the 1st to 16th position selection
Speed/torque control mode	Performance	Speed control range		1：5000
		Speed calibration rate		Load rating change（0～100%），max±0.01%
				Power±10%，max change ±0.01%
				Environment temperature（0～50℃），max±0.01%
		Speed loop pulse width		1000Hz
		Torque control accuracy		±5%
	Input signal	Speed command input	Command voltage	DC±10V，12 位
				Input voltage：max±12V
			Input impedance	About 9kΩ
			Circuit time parameters	About 47μs
		Torque command input	Command voltage	DC±10V，12位
				Input voltage：Max±12V
			Input impedance	About 9kΩ
			Circuit time parameters	About 47μs
		Multi-speed command	Speed selection	Configure 4 DIs to make CMD1, CMD2, CMD3, and CMD4 functions, and realize the 1st to 16th speed selection.
Input output signal	Analog input	Two channel analog input（AI1，AI2）		DC±10V，12 bits precision，input resistance value is about 9kΩ
	Analog output	Two channel analog output（AO1，AO2）		DC±10V
	Digit input signal	Signal allocated can be changed		8-channel DI (where DI8 high-speed DI input) Multiple DI functions: Servo enable, alarm reset, gain switching, forward over travel switch, reverse over travel switch, positive external torque limit, negative external torque limit, Origin switch, Original position reset enable, interrupt fixed length disable, position deviation clear , internal pulse command prohibition and other functions.
	Digit output signal	Signal allocated can be changed		5-channel DO Multiple DO functions: Servo ready, motor rotation, zero speed signal, speed consistency, positioning completion, positioning approach, torque limit, speed limit, brake output, warning output, fault

			output, interrupt fixed length completion, original position homing completion, electrical original position homing Completion, torque arrival, speed arrival, etc.
	Position output function	Output form	Phase A, Phase B: Differential Output Phase Z: differential output or open collector output
		Frequency dividing ratio	Arbitrary sub-frequency（max 240Khz）
Other function	Over travel prevention function		Stop immediately when the forward and reverse over travel switches are active
	Electronic gear ratio		0.1048576≤B/A≤419430.4
	LED indication function		Main power supply CHARGE, 5-digit LED display
	Communication function	RS485	When use MODBUS，can up to 247stand
		RS232	Support PC host computer debugging, monitoring, parameter setting, etc.
	Other	Original position reset, full-closed, gain adjustment, alarm recording, JOG operation, 16-segment position control, 16-segment multi-speed control.	
Protection function	Over current, overvoltage, under voltage, short to ground, input phase loss, overheating, driver overload, motor overload, speeding, encoder failure, excessive positional deviation, etc.		
Environment	Operating temperature		-10℃～+40℃（The ambient temperature should be derated in the range of 40℃～50℃, the average load rate cannot be higher than 80%）
	Storage temperature		-40℃～+70℃
	work humidity /storage humidity		Less than 90%RH（no condensation）
	Vibration-proof strength		Less than $4.9m/s^2$
	Impact strength		Less than $19.6m/s^2$
	Pollution grade		2 grade
	Altitude		Lower than 1000 meters
Structure	Protection grade		IP20
	Cooling mode		Forced air cooling or natural cooling
	Installation mode		Wall hanging

Note

Note 1: Please install the servo drive at the specified ambient temperature. When placed in a power cabinet, the temperature inside the cabinet should not exceed the specified value.
Note 2: The rate of change of speed is defined by:

$$Speed\ change\ rate=\frac{No\text{-}load-Full\ load}{Rated}\times 100\%$$

In fact, due to voltage changes and temperature changes, the amplifier deviation is caused, resulting in a change in the calculated resistance value. Therefore, the effect is manifested by the change in the rotational speed. The change in the rotational speed is expressed by the ratio of the rated rotational speed, and is the rate of change of the speed caused by the voltage change and the temperature change, respectively.
Note 3: Forward rotation refers to counterclockwise rotation when the motor is viewed from the load.
Note 4: The built-in open collector power supply is not electrically insulated from the control circuit in the servo drive.
Note 5: The bus protocol is the Dumochuan protocol or the Fre_Dat-B protocol of Changchun Yuheng.

2.2.5 Brake resistor specification

Servo drive type		**Build-in brake resistor**		**Min permit resistance value （Ω）**	**Capacitor absorbs maximum braking energy （J）**
		Resistance value （Ω）	**Power （W）**		
1 phase 220V	ESS200P-2S101	-	-	60	5
	ESS200P-2S201	-	-	60	10
	ESS200P-2S401	-	-	60	18
	ESS200P-2S751	30	60	30	25
3 phase 220V	ESS200P-2T102		80	30	26
	ESS200P-2T152		80	20	18
	ESS200P-2T202	15	120	15	26
	ESS200P-2T302				39
3 phase 380V	ESS200P-4T102	60	60	60	26
	ESS200P-4T152				39
	ESS200P-4T202	60	80	40	53
	ESS200P-4T302			30	79
	ESS200P-4T442	30	120	30	116
	ESS200P-4T552				145
	ESS200P-4T752	-	-	30	198

Note

(1) There are no built-in braking resistors for 2S101, 2S201, 2S401 and 4T752 models. If you need, please configure the external braking resistor yourself;
(2) Please select the external braking resistor according to the actual working conditions. For the specific braking resistor power selection, please contact our technical support.

2.3 Servo motor introduction

2.3.1 Type

EMS – 06 401 L – 30 S – 7 C 1 A

Code	Name
EMS	ESS200 series universal servo motor

Code	Bass No.
04	40mm
06	60mm
08	80mm
09	90mm
11	110mm
13	130mm
15	150mm
18	180mm

Code	Power(W)
101	10×10^{1}
201	20×10^{1}
…	…
552	55×10^{2}
752	75×10^{2}

Code	Inertia
L	Low
M	Middle
H	High

Code	Rated speed
01	100 rpm
10	1000 rpm
15	1500 rpm
20	2000 rpm
25	2500 rpm
30	3000 rpm

Code	Voltage
S	220V
T	380V

Code	Encoder type
0	2500 line incremental
1	2500 line saver
5	17-bit bus absolute
6	20-bit bus absolute
7	23-bit bus absolute

Code	Optional
1	Oil seal without brake
2	Oil-free seal without
3	Oil seal with
4	Oil-free seal with
5	Oil seal with permanent
6	Oil-free seal with

Code	Mark
A	General
B	nonstandard

Code	Shaft connection
A	Axis
B	Solid with key
C	Solid keyed with threaded
D	Solid with threaded hole

Fig.2-3 Motor type

2.3.2 Servo motor nameplate

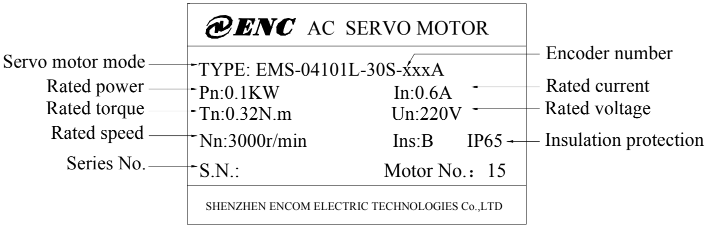


Fig.2-4 Nameplate

Note

The encoder number is stored in **[F00.21]** after power-on, and the motor number is stored in **[F00.03]**, otherwise the motor will not operate normally.

2.3.3 Servo motor

（1）Mechanical characteristics

Item	Description
Rated time	Continuous
Vibration grade	V15
Insulation resistance	DC500V，10MΩ 以上
Work environment temperature	0～40℃
Exciting mode	Magneto
Installation mode	Flange form
Temperature grade	F grade（EMS-04101L-30S-xxxA is B grade）
Isolation voltage	AC1500V/1 minute（200V） AC1800V/1 minute（400V）
Protection grade	IP65
Work environment temperature	0～40℃（unfreezing）
Continuous mode	Direct connection
Direction of rotation	Counterclockwise(CCW) rotation when viewed from the load side under forward rotation command

(2) Motor rated value

Mode	Item	Rated output (kW) *1	Rated torque (N.m)	Max torque (N.m)	Rated current (Arms)	Max current (Arms)	Rated rotate speed (rpm)	Max rotate speed (rpm)	Torque parameter (N.m/ Arms)	Rotor rotate inertia (10^{-4}kg. m²)
Voltage220V										
EMS-04101L-30S-xxxA	15	0.1	0.32	0.96	0.60	1.81	3000	6000	0.53	0.05
EMS-06201L-30S-xxxA	16	0.2	0.64	1.91	1.20	3.60	3000	6000	0.53	0.17
EMS-06201M-30S-xxxA	00	0.2	0.64	1.92	1.30	3.92	3000	6000	0.49	0.26
EMS-06401L-30S-xxxA	17	0.4	1.27	3.90	2.80	8.67	3000	6000	0.45	0.29
EMS-06401M-30S-xxxA	01	0.4	1.27	3.81	2.60	7.94	3000	6000	0.48	0.40
EMS-08401H-30S-xxxA	02	0.4	1.27	3.81	2.00	5.95	3000	5000	0.64	1.05
EMS-08731H-20S-xxxA	03	0.73	3.50	10.50	3.00	8.97	2000	2500	1.17	2.63
EMS-08751L-30S-xxxA	04	0.75	2.40	7.17	3.00	8.96	3000	4000	0.80	1.82
EMS-09751H-30S-xxxA	21	0.75	2.40	7.10	3.00	8.88	3000	4000	0.80	2.45
EMS-08102L-25S-xxxA	06	1.0	4.00	12.00	4.40	13.33	2500	3500	0.90	2.97
EMS-13102M-25S-xxxA	07	1.0	4.00	12.00	4.00	12.00	2500	3000	1.00	8.50
EMS-13102H-10S-xxxA	23	1.0	10.00	20.00	4.50	9.01	1000	1500	2.22	19.40
EMS-08122L-30S-xxxA	08	1.2	4.00	12.00	5.00	13.64	3000	4000	0.88	2.97
EMS-11152M-30S-xxxA	24	1.5	5.0	15.00	6.00	18.07	3000	3200	0.83	6.30
EMS-13152M-25S-xxxA	25	1.5	6.00	18.00	6.00	18.00	2500	3000	1.00	12.60
EMS-13152H-15S-xxxA	26	1.5	10.00	25.00	6.00	14.97	1500	2000	1.67	19.40
EMS-11182L-30S-xxxA	27	1.8	6.00	18.00	6.00	18.00	3000	3500	1.00	7.60
EMS-13202M-25S-xxxA	28	2.0	7.70	22.00	7.50	21.36	2500	3000	1.03	15.30
EMS-13262M-25S-xxxA	29	2.6	10.00	25.00	10.00	25.00	2500	3000	1.00	19.40
EMS-18292H-10S-xxxA	31	2.9	27.00	67.00	12.00	29.78	1000	1500	2.25	96.40
EMS-15302M-20S-xxxA	30	3.0	15.00	30.00	14.00	28.04	2000	3000	1.07	38.80
EMS-18302H-15S-xxxA	14	3.0	19.00	47.50	12.00	30.06	1500	2000	1.58	70.00
Voltage 380V										
EMS-13102M-25T-xxxA	44	1.0	4.00	12.00	2.60	7.79	2500	3000	1.54	8.50
EMS-13102H-10T-xxxA	32	1.0	10.00	25.00	3.00	7.51	1000	1500	3.33	19.40
EMS-13122L-30T-xxxA	33	1.2	4.00	10.00	3.00	11.24	3000	4000	0.89	8.50
EMS-13152M-25T-xxxA	46	1.5	6.00	18.00	3.70	11.11	2500	3000	1.62	12.6
EMS-13152M-15T-xxxA	34	1.5	10.00	25.00	4.20	8.77	1500	2000	2.85	19.40
EMS-13202M-25T-xxxA	47	2.0	7.70	22.00	4.70	13.41	2500	3000	1.64	15.3
EMS-13232H-15T-xxxA	35	2.3	15.00	37.50	5.00	12.50	1500	2000	3.00	27.70
EMS-13262M-25T-xxxA	36	2.6	10.00	25.00	6.00	14.97	2500	3000	1.67	19.40
EMS-18272H-15T-xxxA	48	2.7	17.20	43.00	6.50	16.23	1500	2000	2.65	65
EMS-18302H-15T-xxxA	49	3.0	19.00	47.00	7.50	18.80	1500	2000	2.50	70.00
EMS-13382L-25T-xxxA	38	3.8	15.00	37.50	8.80	22.06	2500	3000	1.70	27.70
EMS-18432M-15T-xxxA	39	4.3	27.00	67.50	10.00	25.00	1500	2000	2.70	96.40
EMS-18452M-20T-xxxA	50	4.5	21.00	53.00	9.50	23.98	2000	2500	2.21	79.6
EMS-18552M-15T-xxxA	51	5.5	35.00	70.00	12.00	23.97	1500	2000	2.92	122.50
EMS-18752M-15T-xxxA	52	7.5	48.00	96.00	20.00	40	1500	2000	2.40	167.20

Note

Reduce 10% of rated power when use on oil seal motor.

（3）Motor over load character

Load proportion（%）	Run time（S）
120	223
130	162
140	103
150	82
160	64
170	50
180	43
190	39
200	35
210	30
220	26
230	24
240	19
250	18
300	11

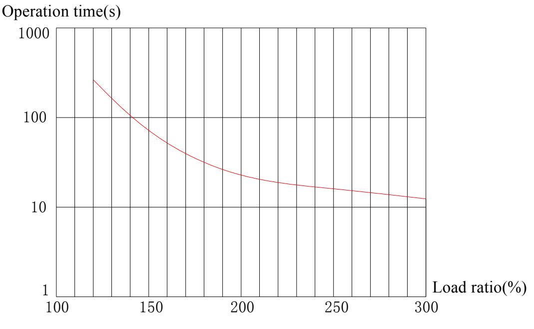


Fig.2-5 Motor over load curve

（4）Radial and axial allowable load of the motor

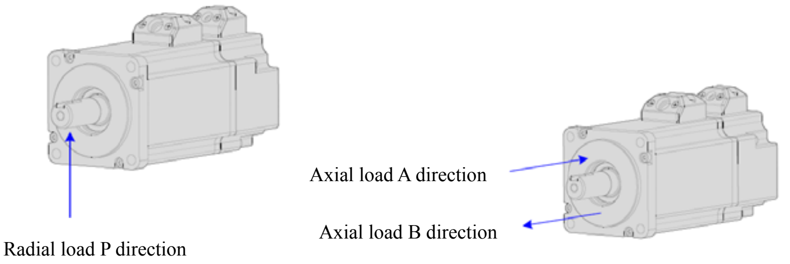


Fig.2-6 Radial and axial motor load sketch map

Motor type	Radial allowable load（N）	Axial allowable load（N）
EMS-04101L-30S-xxxA	78	54
EMS-06201L-30S-xxxA	245	74
EMS-06201M-30S-xxxA	245	74
EMS-06401L-30S-xxxA	245	74
EMS-06401M-30S-xxxA	245	74
EMS-08401H-30S-xxxA	245	74
EMS-08731H-20S-xxxA	392	74
EMS-08750L-30S-xxxA	392	74
EMS-09750H-30S-xxxA	392	74
EMS-08102L-25S-xxxA	686	196
EMS-13102M-25S-xxxA	686	196
EMS-13102H-10S-xxxA	686	196
EMS-13102M-25T-xxxA	686	196
EMS-13102H-10T-xxxA	686	196
EMS-08122L-30S-xxxA	686	343
EMS-13122L-30T-xxxA	686	343
EMS-11152M-30S-xxxA	686	196
EMS-13152M-25S-xxxA	686	196
EMS-13152H-15S-xxxA	686	196
EMS-13152M-25T-xxxA	686	196
EMS-13152M-15T-xxxA	686	196
EMS-11182L-30S-xxxA	686	196
EMS-13202M-25S-xxxA	686	196
EMS-13202M-25T-xxxA	686	196
EMS-13232H-15T-xxxA	686	196
EMS-13262M-25S-xxxA	686	196
EMS-13262M-25T-xxxA	686	196
EMS-18272H-15T-xxxA	686	196
EMS-18292H-10S-xxxA	980	392

EMS-15302M-20S-xxxA	980	392
EMS-18302H-15S-xxxA	980	392
EMS-18302H-15T-xxxA	1470	490
EMS-13382L-25T-xxxA	392	147
EMS-18432M-15T-xxxA	1470	490
EMS-18452M-20T-xxxA	1470	490
EMS-18552M-15T-xxxA	1764	588
EMS-18752M-15T-xxxA	1764	588

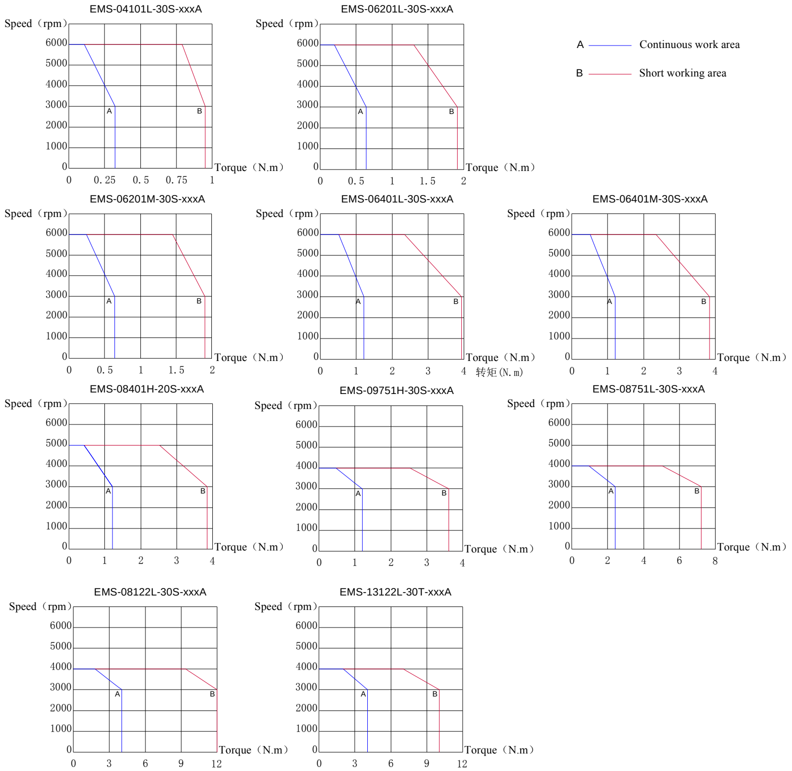
（5）Braking motor electric specification

Motor base mode	**Rated torque （Nm）**	**Supply voltage （V）±10%**	**Supply current range（A）**	**Detachment time（ms）**	**Response time （ms）**
40 base	1	24	0.23～0.27	20	8
60 base	2	24	0.40～0.50	30	10
80、90 base	4	24	0.52～0.86	55	63
Motor below 110 and 130-10N	8	24	0.68～0.85	72	87
Motor higher than 130-10N (include)	16	24	0.85～1.33	95	110
Motor below 180-35N	30	24	0.85～1.80	115	130
Motor higher than 180-35N（include）	50	24	1.47～1.70	120	135

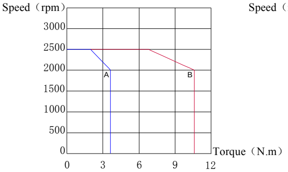
Note

⑴ The brake is forbidden to share the power with other electrical appliances to prevent the voltage or current from being lowered due to the operation of other electrical appliances, which eventually causes the brake to malfunction.
⑵ Recommend cables thicker than $0.5mm^2$.

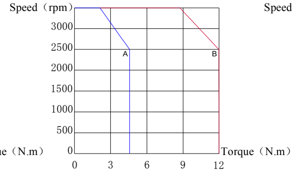
（6）Torque-speed characters of motor



EMS-08731H-20S-xxxA



EMS-08102L-25S-xxxA



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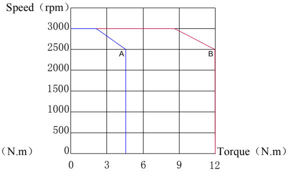
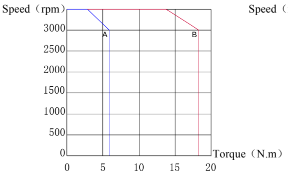
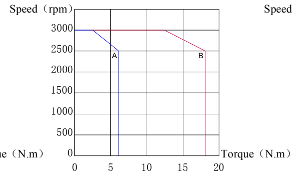


EMS-11182L-30S-xxxA



EMS-13152M-25S-xxxA



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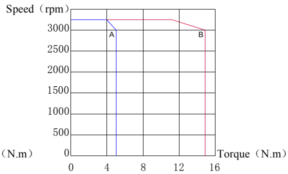

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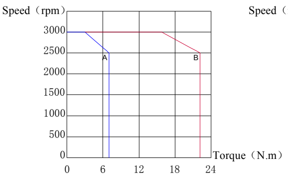
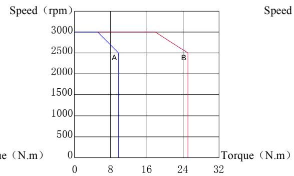
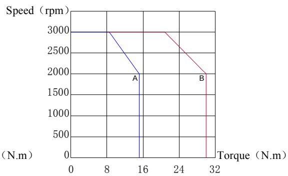


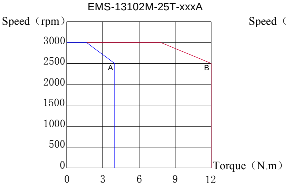
EMS-13262M-25S-xxxA



EMS-15302M-20S-xxxA



EMS-13102M-25T-xxxA



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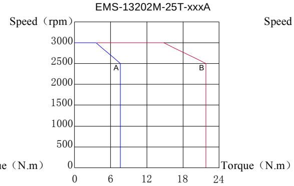

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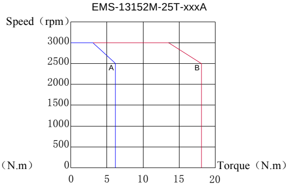
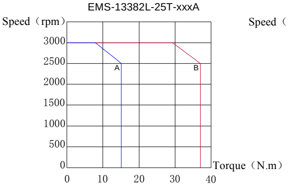
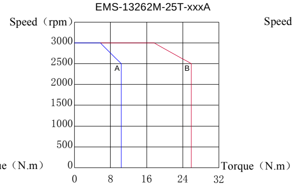


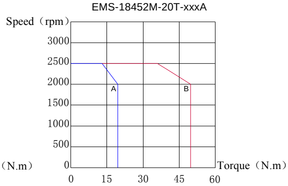
EMS-13382L-25T-xxxA



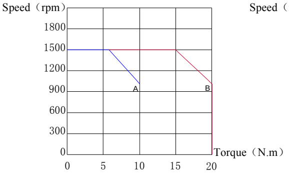
EMS-13262M-25T-xxxA



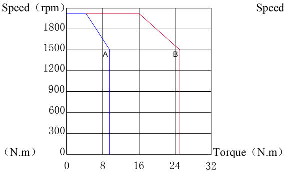
EMS-18452M-20T-xxxA



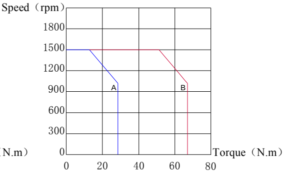
EMS-13102H-10S-xxxA



EMS-13152H-15S-xxxA



EMS-18292H-10S-xxxA



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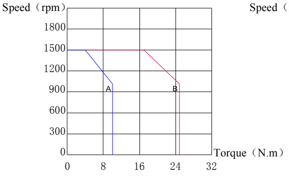
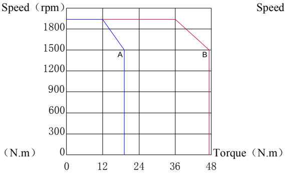
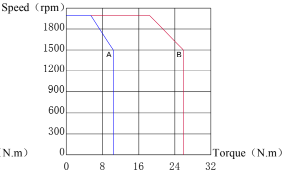


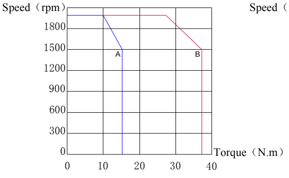
EMS-18302H-15S-xxxA



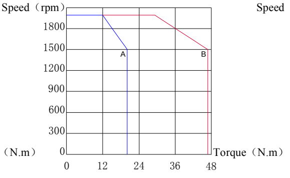
EMS-13152M-15T-xxxA



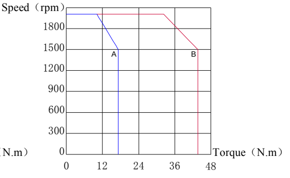
EMS-13232H-15T-xxxA



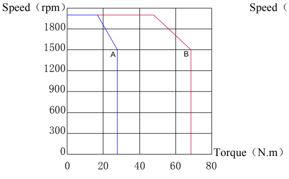
EMS-18302H-15T-xxxA



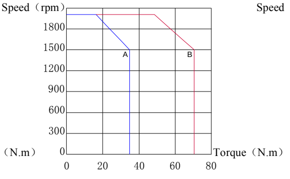
EMS-18272M-15T-xxxA



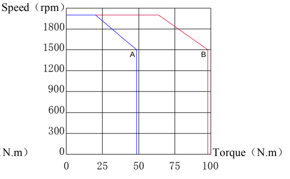
EMS-18432M-15T-xxxA



EMS-18552M-15T-xxxA



EMS-18752M-15T-xxxA



2.4 Motor system specification

Motor capacity	Rated speed	Max speed	Rated torque	Servo motor mode	Base No.	Difference	Motor No.	Servo drive mode		
								1 phase 220V	3 phase 220V	Case type
100W	3000	6000	0.32	EMS-04101L-30S-xxxA	40	Small capacity, small inertia	15	2S101	/	A
200W	3000	6000	0.64	EMS-06201L-30S-xxxA	60	Small capacity, small inertia	16	2S201	/	A
	3000	6000	0.64	EMS-06201M-30S-xxxA	60	Small capacity, medium inertia	0			
400W	3000	6000	1.27	EMS-06401L-30S-xxxA	60	Small capacity, small inertia	17	2S401	/	A
	3000	6000	1.27	EMS-06401M-30S-xxxA	60	Small capacity, medium inertia	1			
	3000	5000	1.27	EMS-08401H-30S-xxxA	80	Small capacity, big inertia	2			
730W	3000	2500	3.50	EMS-08731H-20S-xxxA	80	Small capacity, big inertia	3	2S751	/	B
750W	3000	4000	2.40	EMS-08751L-30S-xxxA	80	Small capacity, small inertia	4			
	3000	4000	2.40	EMS-09751H-30S-xxxA	90	Small capacity, big inertia	21			
1000W	2500	3500	4.00	EMS-08102L-25S-xxxA	80	Small capacity, small inertia	6	/	2T102	B
	2500	3000	4.00	EMS-13102M-25S-xxxA	130	Small capacity, medium inertia	7			
	1000	1500	10.00	EMS-13102H-10S-xxxA	130	Small capacity, big inertia	23			
1200W	3000	4000	4.00	EMS-08122L-30S-xxxA	80	Medium capacity, medium inertia	8			
1500W	3000	3200	5.00	EMS-11152M-30S-xxxA	110	Medium capacity, medium inertia	24	/	2T152	B
	2500	3000	6.00	EMS-13152M-25S-xxxA	130	Medium capacity, medium inertia	25			
	1500	2000	10.00	EMS-13152H-15S-xxxA	130	Medium capacity, large inertia	26			
1800W	3000	3500	6.00	EMS-11182L-30S-xxxA	110	Medium capacity, small inertia	27	/	2T202	C
2000W	2500	3000	7.70	EMS-13202M-25S-xxxA	130	Medium capacity, medium inertia	28			
2600W	2500	3000	10.00	EMS-13262M-25S-xxxA	130	Medium capacity, medium inertia	29			
2900W	1000	1500	27.00	EMS-18292H-10S-xxxA	180	Medium capacity, large inertia	31	/	2T302	C
3000W	2000	3000	15.00	EMS-15302M-20S-xxxA	150	Medium capacity,	30			

						medium inertia				
	1500	2000	19.00	EMS-18302H-15S-xxxA	180	Medium capacity, large inertia	14			

Motor capacity	Rated speed	Max speed	Rated torque	Servo motor mode	Base No.	Difference	Motor No.	Servo drive mode	
								1 phase 220V	Case type
1000W	2500	3000	4.00	EMS-13102M-25T-xxxA	130	Medium capacity, medium inertia	44	4T102	B
	1000	1500	10.00	EMS-13102H-10T-xxxA	130	Medium capacity, large inertia	32		
1200W	3000	4000	4.00	EMS-13122L-30T-xxxA	130	Medium capacity, small inertia	33	4T152	B
1500W	2500	3000	6.00	EMS-13152M-25T-xxxA	130	Medium capacity, medium inertia	46		
	1500	2000	10.00	EMS-13152M-15T-xxxA	130	Medium capacity, medium inertia	34		
2000W	2500	3000	7.70	EMS-13202M-25T-xxxA	130	Medium capacity, medium inertia	47	4T202	B
2300W	1500	2000	15.00	EMS-13232H-15T-xxxA	130	Medium capacity, large inertia	35		
2600W	2500	3000	10.00	EMS-13262M-25T-xxxA	130	Medium capacity, medium inertia	36	4T302	C
2700W	1500	2000	17.20	EMS-18272H-15T-xxxA	180	Medium capacity, large inertia	48		
3000W	1500	2000	19.00	EMS-18302H-15T-xxxA	180	Medium capacity, large inertia	49		
3800W	2500	3000	15.00	EMS-13382L-25T-xxxA	130	Medium capacity, small inertia	38	4T442	C
4300W	1500	2000	27.00	EMS-18432M-15T-xxxA	180	Medium capacity, medium inertia	39		
4500W	2000	2500	21.00	EMS-18452M-20T-xxxA	180	Medium capacity, medium inertia	50		
5500W	1500	2000	35.00	EMS-18552M-15T-xxxA	180	Medium capacity, medium inertia	51	4T552	C
7500W	1500	2000	48.00	EMS-18752M-15T-xxxA	180	Medium capacity, medium inertia	52	4T752	D

2.5 Cable mode

2.5.1 Servo motor main circuit cable

Motor mode	Servo motor main circuit cables		
	L=3.0m	L=5.0m	L=10.0m
EMS-04101L-30S-xxxA EMS-06201L-30S-xxxA EMS-06201M-30S-xxxA EMS-06401L-30S-xxxA EMS-06401M-30S-xxxA EMS-08401H-30S-xxxA	EN-D201-3	EN-D201-5	EN-D201-10
EMS-08731H-20S-xxxA EMS-08751L-30S-xxxA EMS-09751H-30S-xxxA EMS-08102L-25S-xxxA EMS-08122L-30S-xxxA	EN-D202-3	EN-D202-5	EN-D202-10
EMS-13102M-25S-xxxA EMS-13102H-10S-xxxA EMS-11152M-30S-xxxA EMS-13152M-25S-xxxA EMS-13152H-15S-xxxA EMS-11182L-30S-xxxA EMS-13202M-25S-xxxA EMS-13102M-25T-xxxA EMS-13102H-10T-xxxA EMS-13122L-30T-xxxA EMS-13152M-25T-xxxA EMS-13152M-15T-xxxA EMS-13202M-25T-xxxA EMS-13232H-15T-xxxA EMS-13262M-25T-xxxA	EN-D211-3	EN-D211-5	EN-D211-10
EMS-13262M-25S-xxxA EMS-15302M-20S-xxxA EMS-18302H-15S-xxxA EMS-13382L-25T-xxxA	EN-D212-3	EN-D212-5	EN-D212-10
EMS-18272H-15T-xxxA EMS-18302H-15T-xxxA	EN-D223-3	EN-D223-5	EN-D223-10
EMS-18292H-10S-xxxA EMS-18432M-15T-xxxA EMS-18452M-20T-xxxA EMS-18552M-15T-xxxA	EN-D221-3	EN-D221-5	EN-D221-10
EMS-18752M-15T-xxxA	EN-D222-3	EN-D222-5	EN-D222-10

2.5.2 17 bit、20 bit and 23 bit encoder cable

Base No.	Servo motor main encoder cables		
	L=3.0m	L=5.0m	L=10.0m
Base not more than 90	EN-M601-3	EN-M601-5	EN-M601-10
Base not more than 110	EN-M611-3	EN-M611-5	EN-M611-10

2.5.3 2500 line encoder cable

Base No.	Servo motor encoder cables		
	L=3.0m	L=5.0m	L=10.0m
Base not more than 90	EN-M602-3	EN-M602-5	EN-M602-10
Base not more than 110	EN-M612-3	EN-M612-5	EN-M612-10

2.5.4 Spare parts of communication cable

Cable type	Description	Mark
EN-M701	Servo drive PC communication cable	
EN-M702	Keyboard parameter copy cable	
EN-M401	Servo drive multi-stage parallel communication cable	
EN-M404	Servo drive communication terminal matching resistor plug	
EN-M403	Servo drive Modbus communication cable	
EN-M402	Servo drive CAN communication cable	

2.6 Servo system wiring diagram

The servo drive is directly connected to the industrial power supply and is not isolated by a power supply such as a transformer. To prevent cross-electric shock accidents in the servo system, use a fuse or wiring breaker on the input power supply. Since the drive does not have a built-in grounding protection circuit, in order to make a safer system, please use an earth leakage circuit breaker that is both overloaded and short-circuit protected, or a dedicated earth leakage circuit breaker that is equipped with a ground wire protection.

It is strictly forbidden to use the electromagnetic contactor for motor operation and stop operation. Since the motor is a large inductive component, the instantaneous high voltage generated may break through the contactor. Please pay attention to the power supply capacity when external control power supply or 24Vdc power supply. Especially when powering several drives or multi-way brakes at the same time, insufficient power supply capacity will result in insufficient supply current and failure of the drive or brake. The brake power supply is a 24V DC voltage source. The power needs to refer to the motor model and meet the brake power requirements.

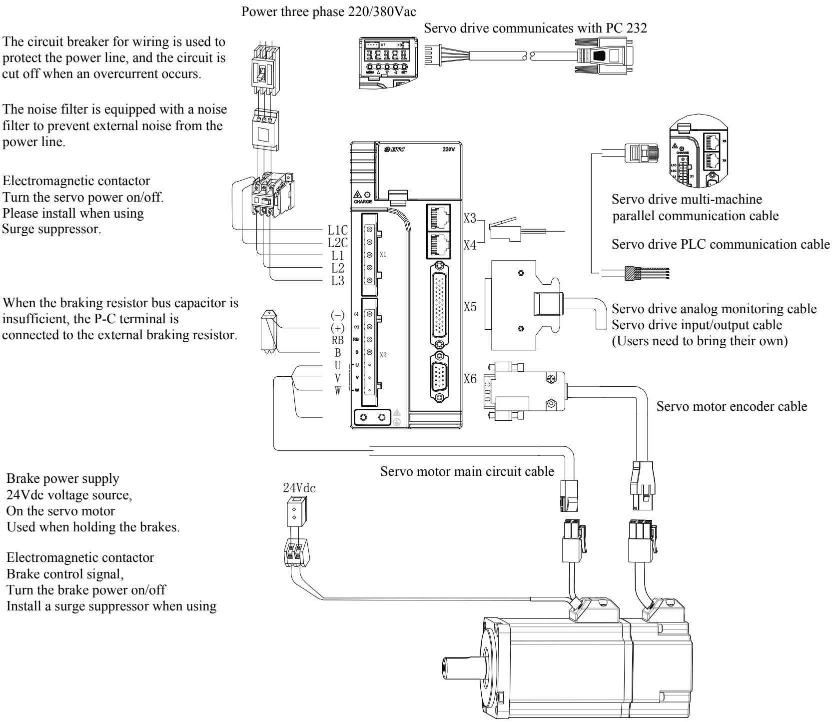


Fig.2-7 Servo system wiring

3 Installation

3.1 Installation of Servo Drive

3.1.1 Installation environment

(1) Please install Servo Drive indoor place with good ventilation and temperature requirements within - 10 ℃ to 40 ℃.When temperature over 40 ℃, external forced cooling or de-rating use needed. Preheat treatment needed when temperature below -10℃;
(2) Forbid to install in the place of direct sunlight, dust, floating fiber and metal powder.
(3) Strictly prohibited to install in places with corrosive and explosive gases;
(4) Humidity should less than 95%RH and without condensation;
(5) Vibration less than 5.9 m/s² (0.6g);
(6)Please keep away from electromagnetic interference source and other electronic equipment sensitive to electromagnetic interference;
(7)Pollution degree of installation site: PD2;

3.1.2 Installation Precautions

（1）Installation Method

Make sure the installation direction is vertical to the wall. Cool theservo drive with natural convection or via a cooling fan. Please fix the servo drive securely on the mounting surface via two to four mounting holes (number of such mounting holes depends on the capacity of the servo drive).

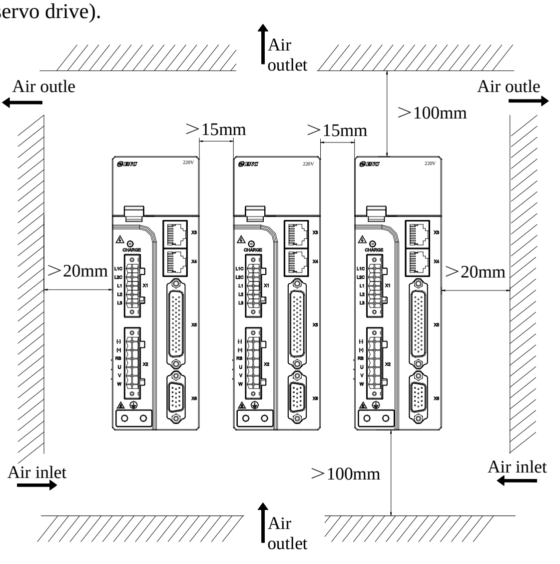


Fig.3-1 Servo Drive installation diagram

When installing, please make the front of the servo drive (the actual installation face of the operator) toward the operator and make it vertical to the wall.

（2）Cooling

As shown infig.3-1, Please keep sufficient clearances around the servo drive to ensure cooling by cooling fans or natural convection. Install cooling fans above the servo drive to avoid excessive temperature rise and maintain even temperature inside the control cabinet.

（3）Installation Side by Side

When installing servo drives side by side, please keep at least 15 mm between two servo drives (if installation space is limited, please leaving no space) and Leave more than 100mm space on each side of the longitudinal.

（4）Grounding

Be sure to ground the grounding terminal, otherwise there may be a risk of electric shock or malfunction due to interference.

（5）Requirements of cable direction

Please mount the drive with cable outlet facing downwards as show in Fig.3-2 to avoid liquid flow into the drive across cable when some liquid attached to the cable.

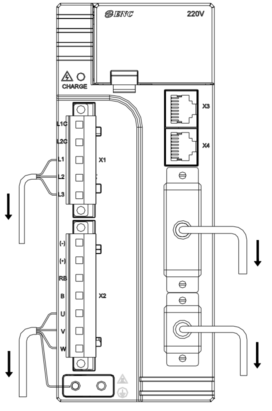


Fig.3-2 Servo Drive cable direction diagram

3.2 Servo Motor installation

3.2.1 Installation Location

（1）Please do not use this product in the vicinity of environment with corrosive or inflammable gases or combustible goods, such as hydrogen sulfide, chlorine, ammonia, sulfur, chlorinated gas, acid, soda and salt;

（2）Use the servo motor with oil sealing when the motor is to be used in a place with grinding fluid, oil spray, iron powder or cuttings;

（3）Keep the servo motor away from heat sources such as furnaces;

（4）Do not use the servo motor in an enclosed environment. Working in the enclosed environment will lead to high temperature of the servo motor and shorten its service life.

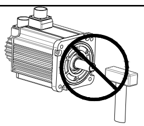
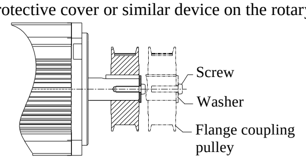
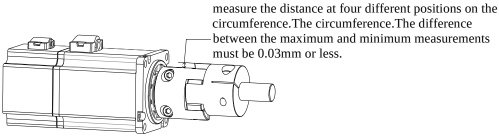
3.2.2 Environment Conditions

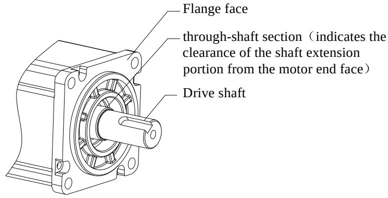
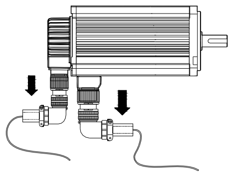
Table 3-1 Installation Environment

Item	Description
Use ambient temperature	0～40℃（non-freezing）
Use environment humidity	20%～90%RH（no condensation）
Storage temperature	-20℃～60℃（Peak temperature ensurance: 80°C for 72 hours)
Storage humidity	20%～90%RH（no condensation）
Vibration	Below 49m/s^2
Impact	Below 490m/s^2
Protection level	IP65（IP67need to be customized ）
Altitude	<1000m，de-rated using when the altitude is above 1000 m

3.2.3 Installation Precautions

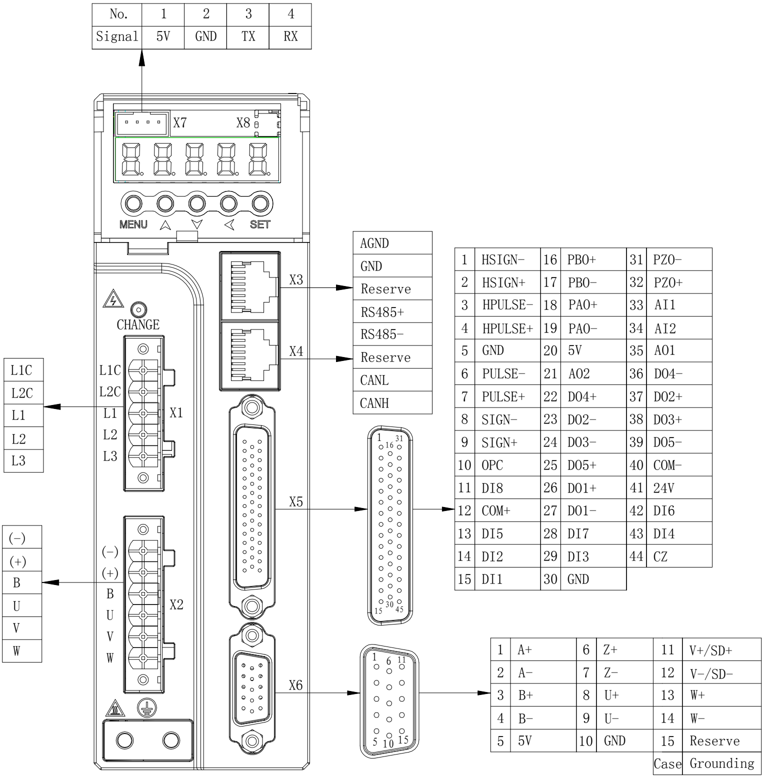
Table 3-2 Installation Precautions

Item	Description
Rust-proof treatment	Wipe up the antirust agent at the motor shaft extension before installing the servo motor, and then take rust-proof treatment.
Encoder Precautious	Do not strike the shaft extension during installation, otherwise the internal encoder will damage. 
	(1) Use the screw hole at the shaft extension when mounting a pulley to the servo motor shaft with key slots. To fit the pulley, insert a double-end screw into the screw hole of the shaft, put a washer against the coupling end, and then use a nut to push the pulley in.。 (2) For servo motor shafts with key slots, use screw holes on the shaft end to install. For the servo motor shaft without key slots, please use friction coupling or the like. (3)When removing the pulley, use a pulley remover to protect the shaft from suffering severe impact from load. (4) To ensure safety, install a protective cover or similar device on the rotary area such as the pulley mounted on the shaft. 
Alignment	Use the coupling for mechanical connection and align the axis of the servo motor with the axis of the equipment. When installing the servo motor, make sure that alignment accuracy satisfy the requirement as described in the following figure. If the axes are not properly aligned, vibration will be generated and may damage the bearings and encoder. 

Installation direction	The servo motor can be installed horizontally or vertically.
Oil and moisture countermeasure	(1) Do not submerge the motor/cable to water or oil; (2) Confirm the IP level of the servo motor when using it in a place with water drops (except for the through-shaft section).  For applications with some liquids, please mount the motor with cable outlet facing downwards as show in the following figure to avoid liquid flow to the servo motor across cable.  (3) In the environment where the through-shaft section is exposed to oil drops, please use a servo motor with oil sealing; The using conditions of the servo motor with oil sealing: ①Make sure that the oil level is lower than the oil sealing lip during using; ②Prevent oil accumulation on the oil sealing lip when the motor is installed vertically upward.
Stress status of cables	Do not bend or apply tension to the cables, especially the signal cables whose core wire is 0.2 mm or 0.3 mm which is very thick. So do not pull the cables tightly during wiring.
The treatment of connectors	About connectors, please observe the following precautions: (1) When connecting the connectors, make sure that there is no waste or sheet metal inside the connectors. (2) Connect the connectors to the power cable side of the servo mot or first, and make sure that the grounding cable of the power cables is reliably connected. If the connectors are first connected to the encoder cable side, the encoder may become faulty due to the potential differences between PE terminals. (3) Make sure the pins are correctly arranged during wiring. (4) The connectors are made up of resins. Do not strike the connectors to prevent them from being damaged. (5) Hold the servo motor body during transportation when the cables are well connected, instead of catching the cables. Otherwise, the connectors may be damaged or the cables may be broken. (6) If bent cables are used, please note that do not attach stress on the connectors during wiring. Otherwise it may lead to connectors broken.

4 Wiring

4.1 Servo drive terminals and pins description



No.	1	2	3	4
Signal	5V	GND	TX	RX

L1C
L2C
L1
L2
L3

(−)
(+)
B
U
V
W

AGND
GND
Reserve
RS485+
RS485−
Reserve
CANL
CANH

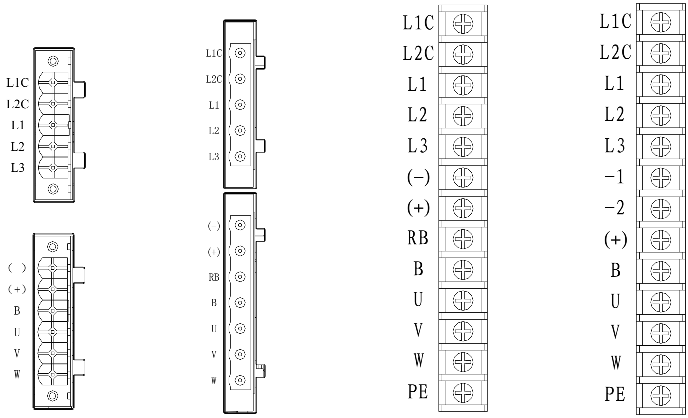
1	HSIGN−	16	PBO+	31	PZO−
2	HSIGN+	17	PBO−	32	PZO+
3	HPULSE−	18	PAO+	33	AI1
4	HPULSE+	19	PAO−	34	AI2
5	GND	20	5V	35	AO1
6	PULSE−	21	AO2	36	DO4−
7	PULSE+	22	DO4+	37	DO2+
8	SIGN−	23	DO2−	38	DO3+
9	SIGN+	24	DO3−	39	DO5−
10	OPC	25	DO5+	40	COM−
11	DI8	26	DO1+	41	24V
12	COM+	27	DO1−	42	DI6
13	DI5	28	DI7	43	DI4
14	DI2	29	DI3	44	CZ
15	DI1	30	GND		

1	A+	6	Z+	11	V+/SD+
2	A−	7	Z−	12	V−/SD−
3	B+	8	U+	13	W+
4	B−	9	U−	14	W−
5	5V	10	GND	15	Reserve
				Case	Grounding

Fig.4-1 Servo Drive terminal pin profile

4.2 Wiring of Servo Drive Main Circuit

4.2.1 Main Circuit Terminals description



A Type B Type C Type D Type

Fig.4-2 Servo Drive terminal block arrangement

Table 4-1 Names and functions of main circuit terminals of Servo Drive

Terminal Symbol	Terminal Name	Terminal Function	
L1、L2、L3	Main circuit power input terminals	1PH 220V:100W～750W	Main circuit single phase 220V power input. Can be connect to any two of L1、L2、L3.
		3PH 220V:1000W～3000W	Main circuit three phase 220V power input, Connect to L1、L2、L3.
		3PH 380V:1000W～7500W	Main circuit three phase 380V power input, Connect to L1、L2、L3.
L1C、L2C	Control power input terminals	Control circuit power input, Please refer to the rated voltage on the nameplate.	
RB、B、(+)	Terminals for connecting external braking resistor	1PH 220V:100W～400W	Connect an external regenerative resistor between (+) and B if the braking capacity is insufficient.
		1PH 220V:750W; 3PH 220V:1000W～3000W 3PH 380V:1000W～7500W	Terminal RB and B are shorted by default. When the braking capacity is insufficient, please make the circuit between RB and B open(remove the jumper between RB and B), and connect an external braking resistor between RB and B.
(+)、(-)	Common DC bus terminal	The common DC bus terminal can be connected together when multiple servo drives are used in parallel.	
U、V、W	Servo motor Connection terminals	Servo motor connection terminals connect to the U, V and W of servo motor.	

-1、-2	Terminals for connecting external reactor	Terminal -1 and -2 are shorted by default. Please remove the shorting stub and connect external reactor between -1 and -2 when need to suppress high power harmonics. Meanwhile terminal -1 and (+) could achieve in parallel busbar connection.
⏚	Ground	Respectively connect to the ground terminal of the power supply and the servo motor.

4.2.2 Wiring of braking resistor

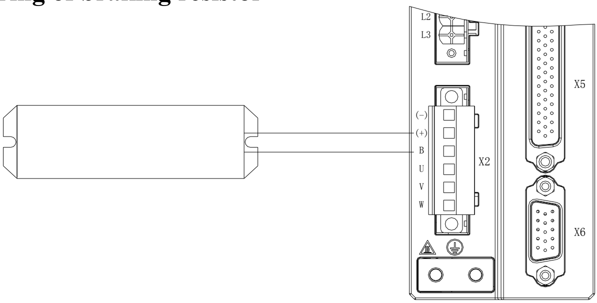


Fig.4-3 External braking resistor connection diagram

Precautions for braking resistor wiring：

（1）Please remove the short connection between (+) and (-) when using the external braking resistor. Otherwise it will lead the braking tube damage due to over-current;

（2）Do not connect the external brake resistance directly to the bus terminal (+), (-), or it may cause explosion or fire;

（3）Do not select any resistor lower than the minimum resistance value, Otherwise, Er.103 will alarm or damage the Servo Drive;

（4）Ensure that the parameters related to the braking resistor **[F01.16]**,**[F01.17]** and **[F01.18]** are accurately set before using the servo drive；

（5）Install the external braking resistor on incombustible objects like metal.

Note

Please refer to section "2.2.5 specification of brake resistor" for selection and usage of brake resistor.

4.2.3 Recommended Models and Specifications of Main Circuit Cables

Table 4-2 Servo Drive Current specification

Servo Drive case and model		Rated Output Current (A)	Max. Output current (A)	Recommended Cable
A Type	ESS200P-2S101	1.1	3.3	18AWG
	ESS200P-2S201	1.5	4.5	18AWG

	ESS200P-2S401	2.7	8.1	18AWG
B Type	ESS200P-2S751	3.9	11.7	16AWG
	ESS200P-2T102	5.2	15.6	16AWG
	ESS200P-2T152	7.5	22.5	16AWG
	ESS200P-4T102	2.8	8.4	16AWG
	ESS200P-4T152	4.0	12	16AWG
	ESS200P-4T202	5.5	16.5	16AWG
C Type	ESS200P-2T202	9.5	28.5	16AWG
	ESS200P-2T302	13.0	39	13AWG
	ESS200P-4T302	7.5	22.5	16AWG
	ESS200P-4T442	10	30	13AWG
	ESS200P-4T552	12	36	13AWG
D Type	ESS200P-4T752	21	63	10AWG

4.2.4 Example of power supply wiring

（1）Single phase 220V power supply models：ESS200P-2S101、ESS200P-2S201、ESS200P-2S401、 ESS200P-2S751

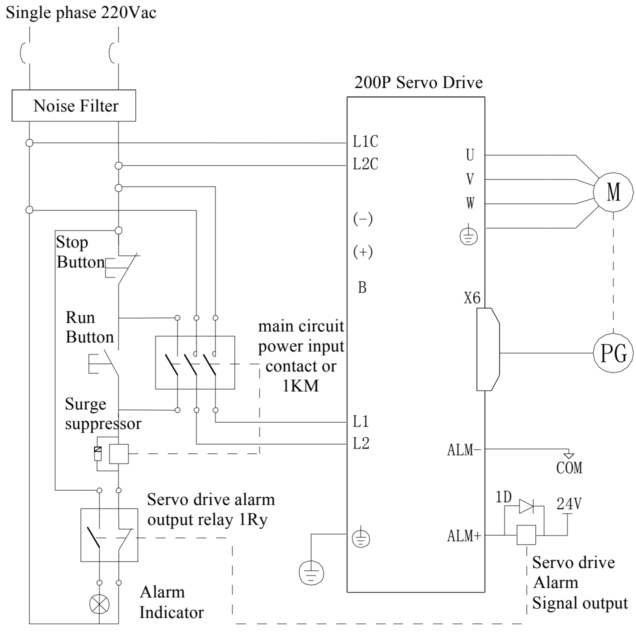


Fig.4-4 Single phase 220V Main Circuit wiring

（2）Three phase 220V power supply models：ESS200P-2T102、ESS200P-2T152、ESS200P-2T202 and ESS200P-2T302

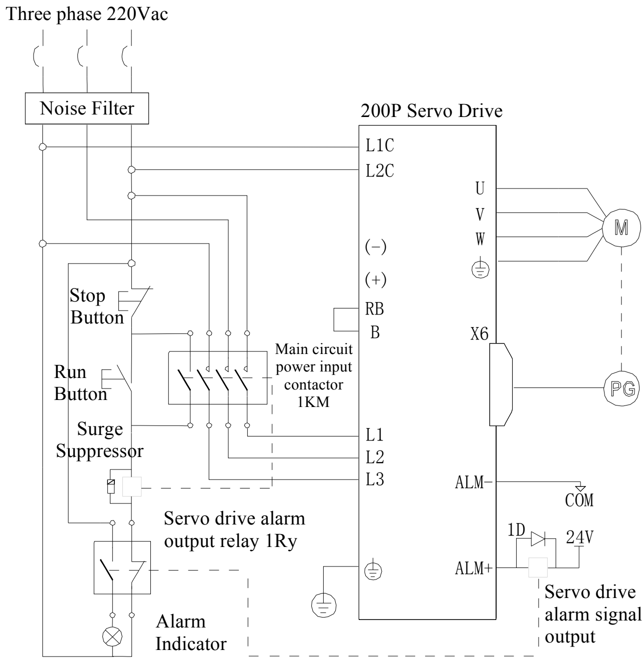


Fig.4-5 Three phase 220V Main Circuit wiring

Note

(1) 1KM: electromagnetic contactor, 1Ry: relay; 1D: flywheel diode.
(2) DO set as alarm output (ALM+/-) ; When the servo drive gives alarm, the power supply would be cut off automatically and the alarm indicator will light.

（3）Three phase 380V power supply models:ESS200P-4T102、ESS200P-4T152、ESS200P-4T202、ESS200P-4T302、ESS200P-4T442、ESS200P-4T552、ESS200P-4T752

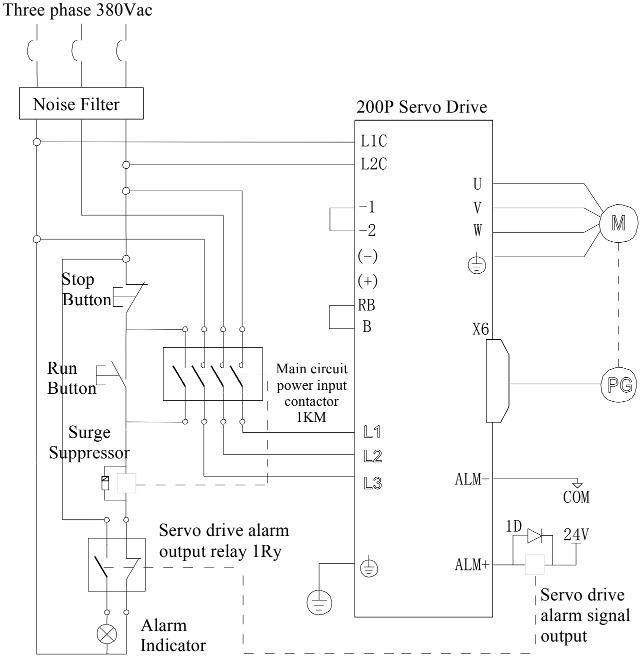


Fig.4-6 Three phase 380V Main Circuit wiring

Note

Only D type case has -1 and -2 terminal.

4.2.5 Precautions for Main Circuit Wiring

（1）Do not connect the power supply cables to the output terminals U, V and W. Otherwise it will lead to the servo drive damage.

（2）When using built-in braking resistor, RB and B must be shorted (they have been connected with a short wire before delivery).

-1 and -2 are shorted connection by default. When need to be restrict higher harmonic from the power, please remove the shorten wire and connect a DC reactor between -1 and -2.

（3）When placing cable bundle in a pipe, Please consider the allowable current reduction rate due to poor heat dissipation conditions.

When the temperature in the cabinet is higher than the temperature limit of the cable, please choose cable with a higher temperature limit, and PTFE wire is suggested. Please pay attention to the thermal protection of the cable when the surrounding is low-temperature environment. The surface of the cable is prone to hardening and breaking under the low-temperature environment.

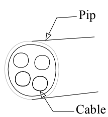
（4）The bending radius of the cable should be more than 10 times of the outer diameter of the cable to prevent the inner core of the cable from breaking due to long-term bending.

（5）Select and use cables of rated voltage above 600 VAC and rated temperature above 75°C.Under the 30°C ambient temperature and normal cooling conditions, the permissible current density of the cables shall not exceed 8 A/mm2 when the total current is below 50 A. When the total current is larger than 50A, the current density should not exceed 5A/mm^2. For high ambient temperature and cables are bunched situations, the permissible current should be adjusted properly. The permissible current density (A/mm2) is calculated as follows:

Conductor allowable current density = 8×Current reduction coefficient of conductor ×Current compensation coefficient

$$\textit{Allowable current density} = \sqrt{(\textit{Max.allowable temperature of cable} - \textit{ambient temperature})/30}$$

Table 4-3 Current reduction coefficient of conductor



Number of Cables in the Same Duct	Current Reduction Coefficient
≤3	0.7
4	0.63
5～6	0.56
7～15	0.49

（6）Do not connect the braking resistor between DC BUS terminals + and - . Otherwise it may lead to fire.

Do not cross or bundle the power cables and signal cables together from the same pipe. They should be separated by more than 30cm to avoid interference.

（7）High voltage may still remain in the servo drive when the power supply is cut off. Do not touch the power terminals within 5 minutes after power-off.

（8）Do not frequently turn ON and OFF the power supply. If the power supply needs to be turned on or off repeatedly, make sure that the time interval is at least one minute. The servo drive parts contain capacitor, high charging current will flows for 0.2 seconds when the power supply is turned OFF. Frequently turning ON and OFF the power supply will deteriorate performance of the main circuit components inside the servo drive.

（9）Use a grounding cable with the same cross-sectional area as the power cable. If the cross-sectional area of the power cable is less than 1.6 mm2, please use 2.0 mm2 grounding cable.

（10）Ground the servo drive reliably.

（11）Do not power on the servo drive when any screw of the terminal block or any cable are loose. Otherwise fire may occur easily.

4.2.6 Specifications of Main Circuit Peripheral Parts

The recommended circuit breaker and electromagnetic contactor:

Table 4-4 Recommended circuit breaker and electromagnetic contactor models

Main Circuit Power	Servo Drive models	Recommended circuit breaker		Recommended electromagnetic contactor	
		Current (A)	Schneider Model	Current (A)	Schneider Model
Single phase 220V	ESS200P-2S101	3	OSMC32N3C3	9	LC1 D09
	ESS200P-2S201	4	OSMC32N3C4	9	LC1 D09
	ESS200P-2S401	6	OSMC32N3C6	9	LC1 D09
	ESS200P-2S751	6	OSMC32N3C6	9	LC1 D09
Three phase 220V	ESS200P-2T102	6	OSMC32N3C6	9	LC1 D09
	ESS200P-2T152	10	OSMC32N3C10	9	LC1 D09
	ESS200P-2T202	10	OSMC32N3C10	9	LC1 D09
	ESS200P-2T302	16	OSMC32N3C16	12	LC1 D12
Three phase 380V	ESS200P-4T102	3	OSMC32N3C3	9	LC1 D09
	ESS200P-4T152	6	OSMC32N3C6	9	LC1 D09
	ESS200P-4T202	6	OSMC32N3C6	9	LC1 D09
	ESS200P-4T302	10	OSMC32N3C10	9	LC1 D09
	ESS200P-4T442	16	OSMC32N3C16	12	LC1 D12
	ESS200P-4T552	16	OSMC32N3C16	12	LC1 D12
	ESS200P-4T752	25	OSMC32N3C25	18	LC1 D18

4.3 Wiring of Power Cables between Servo Drive and Servo Motor

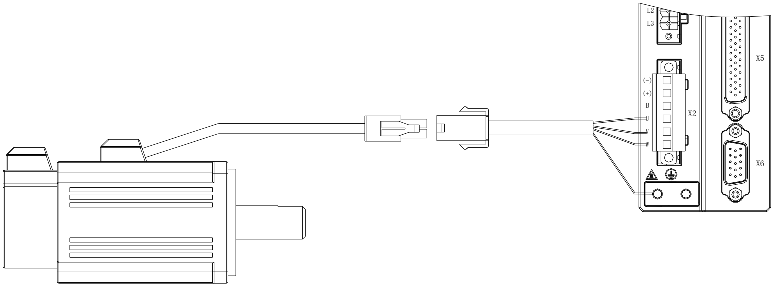
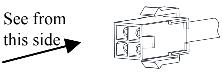
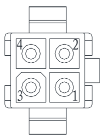
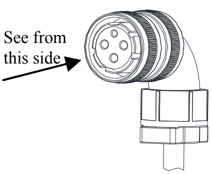
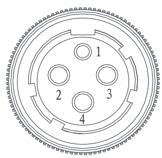
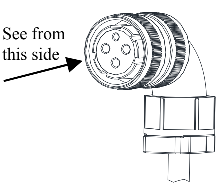
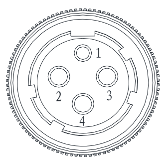


Fig.4-7 Example of servo drive output and servo motor connection

Table 4-5 Connectors of power cables on servo motor side

Connector Appearance	Terminal pin distribution	Base No.
See from this side 	 Pin No. | Signal name 1 | U 2 | V 3 | W 4 | PE Plastic case：AMP 1-172159-9；Terminal：170362-1	40 60 80 90
See from this side 	 Pin No. | Signal name 1 | PE 2 | U 3 | V 4 | W Model：YD28K4TSJ	110 130 150
See from this side 	 Pin No. | Signal name 1 | PE 2 | U 3 | V 4 | W Model：YD32K4TSJ	180

4.4 Wiring of Servo Drive and Servo Motor Encoder Cables

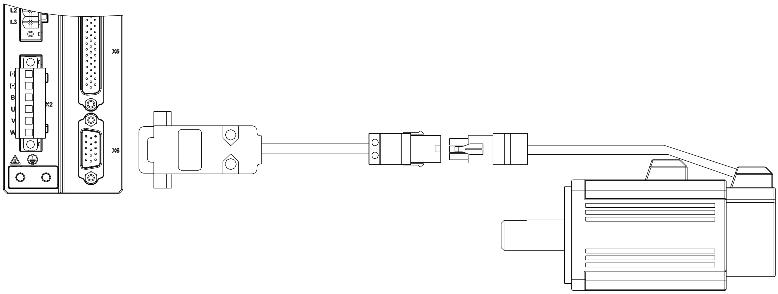
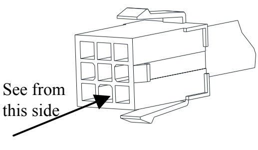
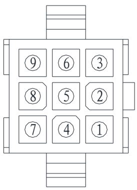
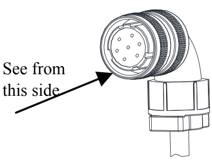
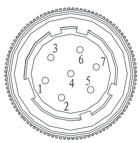


Fig.4-8 Example of connecting encoder signal cables

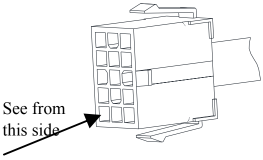
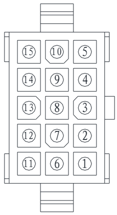
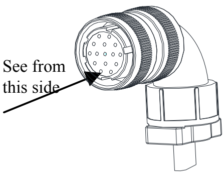
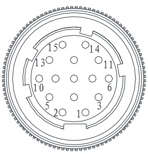
Table 4-6 Bus absolute encoder cable connector

<table>
<tr><th>Connector Appearance</th><th>Terminal pin distribution</th><th>Base No.</th></tr>
<tr><td>
</td><td>

<table>
<tr><th>Pin No.</th><th>Signal name</th></tr>
<tr><td>1</td><td>PE</td></tr>
<tr><td>2</td><td>E-</td></tr>
<tr><td>3</td><td>E+</td></tr>
<tr><td>4</td><td>SD-</td></tr>
<tr><td>5</td><td>0V</td></tr>
<tr><td>6</td><td>SD+</td></tr>
<tr><td>7</td><td>5V</td></tr>
</table>
Plastic case：AMP 1-72161-9；Terminal：170361-1</td><td>40
60
80
90</td></tr>
<tr><td>
</td><td>

<table>
<tr><th>Pin No.</th><th>Signal name</th></tr>
<tr><td>1</td><td>PE</td></tr>
<tr><td>2</td><td>E-</td></tr>
<tr><td>3</td><td>E+</td></tr>
<tr><td>4</td><td>SD-</td></tr>
<tr><td>5</td><td>0V</td></tr>
<tr><td>6</td><td>SD+</td></tr>
<tr><td>7</td><td>5V</td></tr>
</table>
Model：YD28K7TSJ</td><td>110
130
150
180</td></tr>
</table>

Table 4-7 ESS200P Series incremental photoelectric encoder cable connectors

<table>
<tr><th>Connector Appearance</th><th colspan="2">Terminal pin distribution</th><th>Base No.</th></tr>
<tr><td>
</td><td></td><td>
<table>
<tr><th>Pin No.</th><th>Signal name</th><th>Pin No.</th><th>Signal name</th></tr>
<tr><td>1</td><td>PE</td><td>9</td><td>A+</td></tr>
<tr><td>2</td><td>5V</td><td>10</td><td>V+</td></tr>
<tr><td>3</td><td>0V</td><td>11</td><td>W+</td></tr>
<tr><td>4</td><td>B+</td><td>12</td><td>V-</td></tr>
<tr><td>5</td><td>Z-</td><td>13</td><td>A-</td></tr>
<tr><td>6</td><td>U+</td><td>14</td><td>B-</td></tr>
<tr><td>7</td><td>Z+</td><td>15</td><td>W-</td></tr>
<tr><td>8</td><td>U-</td><td></td><td></td></tr>
</table>
Plastic case：AMP 1-172163-9；Terminal：17D361-1</td><td>40
60
80
90</td></tr>
<tr><td>
</td><td></td><td>
<table>
<tr><th>Pin No.</th><th>Signal name</th><th>Pin No.</th><th>Signal name</th></tr>
<tr><td>1</td><td>PE</td><td>9</td><td>Z-</td></tr>
<tr><td>2</td><td>5V</td><td>10</td><td>U+</td></tr>
<tr><td>3</td><td>0V</td><td>11</td><td>V+</td></tr>
<tr><td>4</td><td>A+</td><td>12</td><td>W+</td></tr>
<tr><td>5</td><td>B+</td><td>13</td><td>U-</td></tr>
<tr><td>6</td><td>Z+</td><td>14</td><td>V-</td></tr>
<tr><td>7</td><td>A-</td><td>15</td><td>W-</td></tr>
<tr><td>8</td><td>B-</td><td></td><td></td></tr>
</table>
Model：YD28K15TSJ</td><td>110
130
150
180</td></tr>
</table>

Precautions for cable wiring:

（1）Ground the servo drive and shielded layer of the servo motor reliably. Otherwise the servo drive will report a false alarm.

（2）Do not connect cables to the reserved pins.

（3）Please consider voltage drop caused by the cable resistance and signal attenuation caused by the distributed capacitance when determine the encoder cable length. Twisted-pair cable of size 26AWG or above (as per UL2464standard) and with a length within 10 m are recommended. For longer cable requirement, the cable diameter should be appropriately increased, as shown in the following table:

Table 4-8 Recommended cable

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

4.4.1 Wiring of Absolute Encoder

（1）Installation of the Battery Box:

Battery box parts：ESS-C100，including：

Plastic case ：1 unit

Battery：1 unit（3.6V，1800mAh）

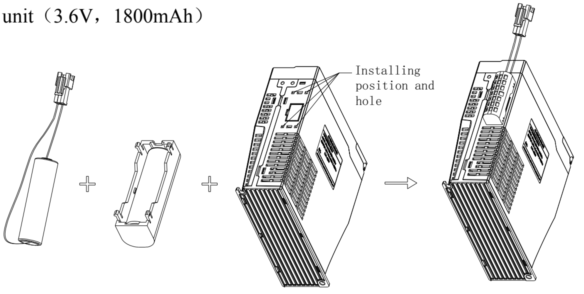


Fig.4-9 Installation example diagram of the Battery Box for the Absolute Encoder （A Type case）

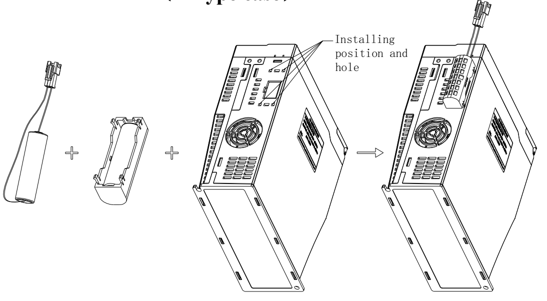


Fig.4-10 Installation example diagram of the Battery Box for the Absolute Encoder （B Type case）

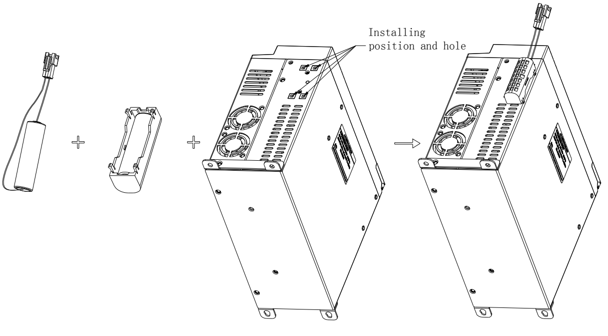


Fig.4-11 Installation example diagram of the Battery Box for the Absolute Encoder （C Type case）

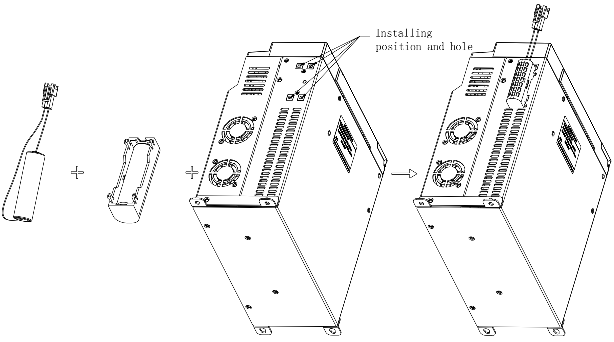


Fig.4-12 Installation example diagram of the Battery Box for the Absolute Encoder （D Type case）

(2) Removing the battery box

The battery may have leakage after a long-time use, so please replace it every two years. Remove the battery box in steps which reverse to the above steps .When closing the battery box cover, prevent the connector cables from being pinched. Avoid clamping the connector cable while closing the battery box cover:

If the battery is used incorrectly, it may result in battery leakage which corrodes the components or causes battery explosion. Please observe the following precautions:

(1) Place the battery with correct +, - polarity.

(2) Leaving a battery that has been used for a long time or is no longer useful inside the device can cause battery leakage. It not only corrodes surrounding components but also give rise to the danger of short circuit due to its electrical conductivity. If so, please replace the battery periodically (recommended period: every 2 years).

(3) Forbid to disassemble the battery as the electrolyte from flying out which resulting in the risk of personal safety accidents.

(4) Forbid to put the battery into fire. Putting the battery into fire or heating it can create a risk of explosion.

(5) Forbid to make the battery short circuit and strip the battery tube. If connect the + and – terminal of the battery by metal and so on, it may cause a high current to flow which not only weakening the battery power but also probably causing explosion of the battery due to severe heating.

(6) Forbid to charge the battery.

(7) Dispose the replaced battery according to local regulations.

（3）Battery Selection

Please refer to the following table to select an appropriate battery:

Table 4-9 Battery description for absolute encoder

Battery Spec.	Item and Unit	Rated value			Condition
		Min.	Typical	Max.	
Output: 3.6V 2500mAh	External battery voltage (V)	3.2	3.6	5	In standby mode (Note 2)
	Circuit fault voltage (V)	2.5	2.7	2.9	In standby mode
	Battery alarmvoltage (V)	2.85	3	3.15	
	Circuit consumption current (Ma)	-	2	-	Normal operation (Note 1)
		-	10	-	In standby mode, axis static
		-	80	-	In standby mode, axis rotating
	Battery using Temperature (℃)	0	-	40	Same temperature requirements as motor ambient temperature
	Battery storage temperature (℃)	-20	-	60	

The above data is measured under the 20°C ambient temperature.

Note

Note 1: During normal operation, the absolute encoder supports one-turn or multi-turn data counting and transmitting / receiving. After connecting the absolute encoder properly, turn on the power to the servo drive, the encoder will enters normal operation state and transmits/receives data after a delay of about 2s. When the encoder switches from standby state to normal operation state (power turned on), it needs the motor speed not exceed 10 RPM. Otherwise, the servo drive will give error and you need to power on the servo drive again.

Note 2: Standby mode: The servo drive without power and the external battery is used for multi-turn data counting. In this case, data transmitting/receiving is in stop state.

（4）Theoretical battery life

Assume that:

Normal operation time of servo drive during each day: T1， Motor rotating time after power-off of servo drive: T2， Motor rotating stop time after power-off: T3 (Unit: hour)

Example:

Table 4-10 Theoretical battery life of absolute encoder

Item	Time Arrangement 1	Time Arrangement 2
Days in one year with different operating conditions（Days）	313	52
T1（H）	8	0
T2（H）	0.1	0
T3（H）	15.9	24

Yearly consumption ＝（8H×2uA＋0.1H×80uA＋15.9H×10uA）× 313 ＋（0H×2uA＋0H×80uA＋24H×10uA）×52 ≈ 70mAH

Theoretical battery life＝Battery capacity/ Yearly consumption=2600mAH/70mAH=37.1 Years

（5）Wiring of absolute encoder battery box and signal wires

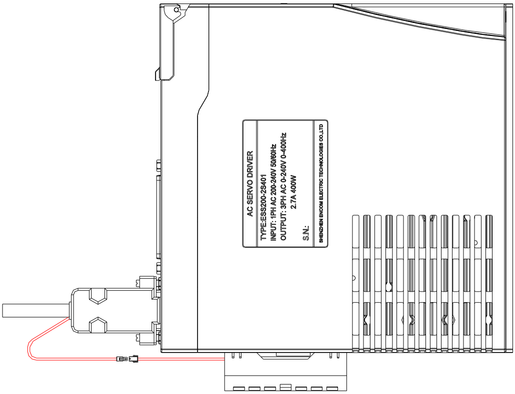


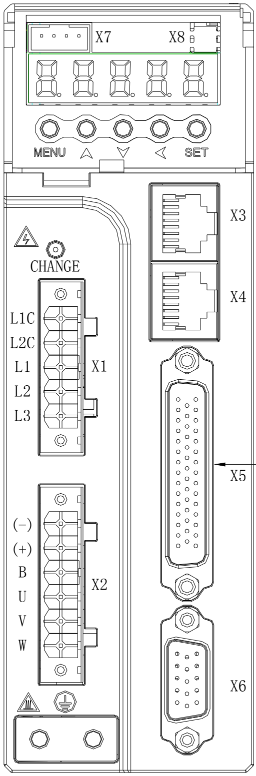
Fig.4-13 Wiring of absolute encoder battery box and signal wires diagram

Note

(1) Store the battery box in required ambient temperature and ensure the battery is in reliable contact and has sufficient capacity. Otherwise, position information loss may occur in the encoder.

(2) About the battery positive and negative connection, please refer to the mark on wires.

4.5 Wiring of control signal terminal X5 in Servo Drive



1	HSIGN-	16	PBO+	31	PZO-
2	HSIGN+	17	PBO-	32	PZO+
3	HPULSE-	18	PAO+	33	AI1
4	HPULSE+	19	PAO-	34	AI2
5	GND	20	5V	35	AO1
6	PULSE-	21	AO2	36	DO4-
7	PULSE+	22	DO4+	37	DO2+
8	SIGN-	23	DO2-	38	DO3+
9	SIGN+	24	DO3-	39	DO5-
10	OPC	25	DO5+	40	COM-
11	DI8	26	DO1+	41	24V
12	COM+	27	DO1-	42	DI6
13	DI5	28	DI7	43	DI4
14	DI2	29	DI3	44	CZ
15	DI1	30	GND		

Fig.4-14 Pin layout of control circuit terminal connector of servo drive

Note

(1) X5 terminal is three rows of GHK DB44 terminal.
(2) 24AWG to 26AWG cables are recommended.

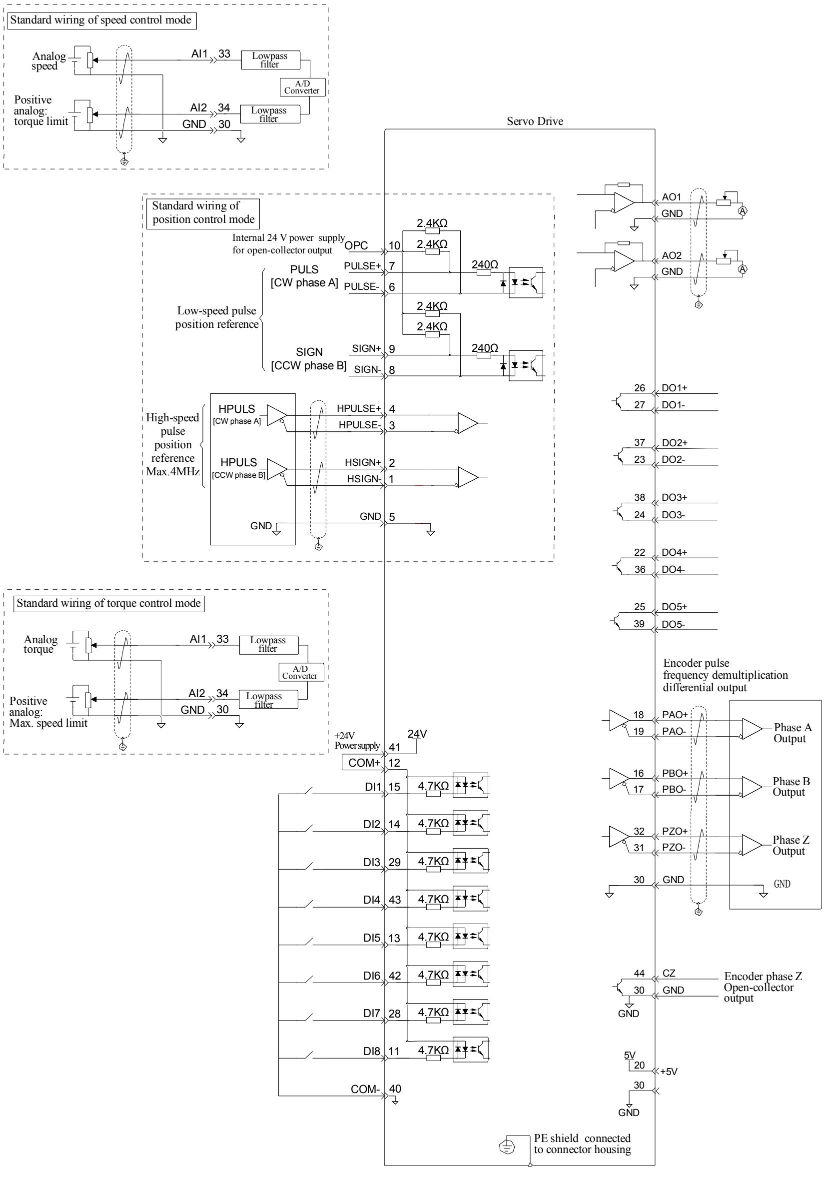


Fig.4-15 Wiring of three control modes

4.5.1 Position Command Input Signals

Table 4-11 Position command signal description

<table>
<tr><th colspan="2">Signal</th><th>Pin No.</th><th colspan="2">Function</th></tr>
<tr><td rowspan="5">Position command</td><td>PULSE+
PULSE-
SIGN+
SIGN-</td><td>7
6
9
8</td><td>Low-speed pulse command input mode：
① Differential drive mode
② OC mode</td><td>Pulse input format:
Direction + Pulse
Phase A , B orthogonality pulse
CW/CCW pulse</td></tr>
<tr><td>HPULSE+
HPULSE-</td><td>4
3</td><td colspan="2">High-speed command pulse input</td></tr>
<tr><td>HSIGN+
HSIGN-</td><td>2
1</td><td colspan="2">High-speed command pulse input</td></tr>
<tr><td>OPC</td><td>10</td><td colspan="2">External power input terminal of pulse command</td></tr>
<tr><td>GND</td><td>30</td><td colspan="2">Ground of signal</td></tr>
</table>

The command pulse and direction output circuit on the host device side can be selected in differential drive output and OC output. The maximum input frequency and Min. pulse width as showing in the following table:

Table 4-12 Correspondence between pulse input frequency and pulse width

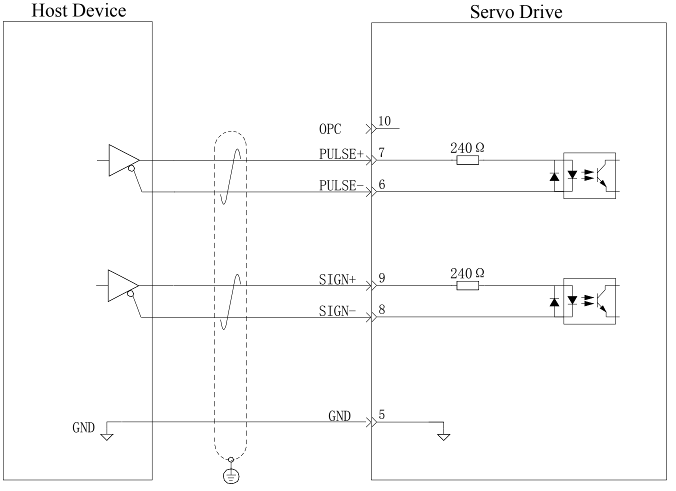
<table>
<tr><th colspan="2">Pulse mode</th><th>Max. Frequency (pps)</th><th>Min. Pulse Width (us)</th></tr>
<tr><td rowspan="2">Low speed</td><td>Differential</td><td>500k</td><td>1</td></tr>
<tr><td>OC</td><td>200k</td><td>2.5</td></tr>
<tr><td colspan="2">High-speed differential</td><td>4M</td><td>0.125</td></tr>
</table>

Note

If the output pulse width of the host device is smaller than the Min. value, it will lead to pulse receiving error in the servo drive.

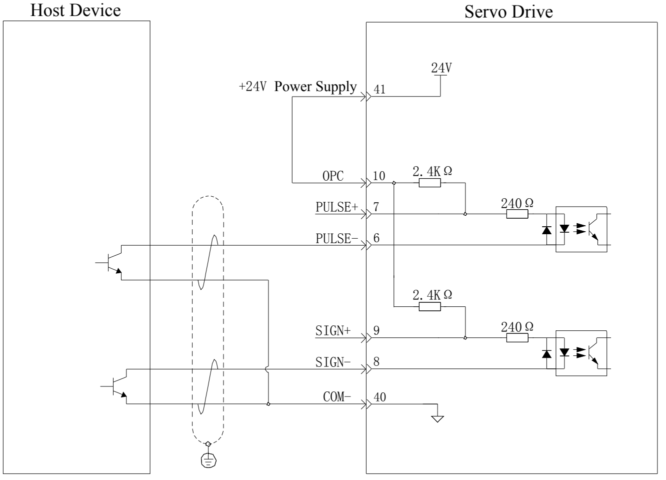
4.5.1.1 Low-speed pulse command input

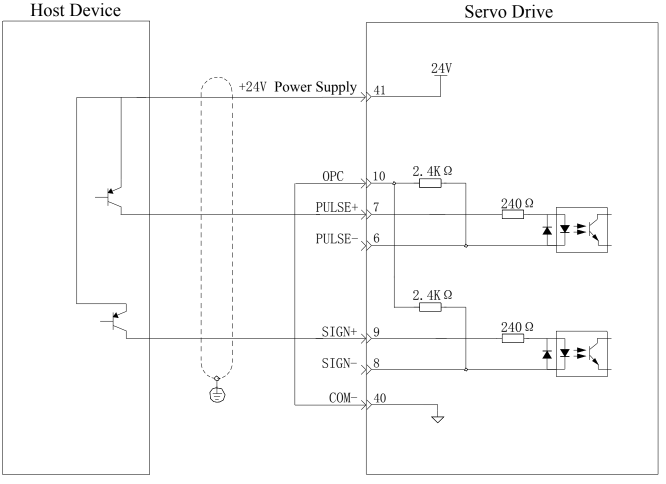
(1) Differential drive mode



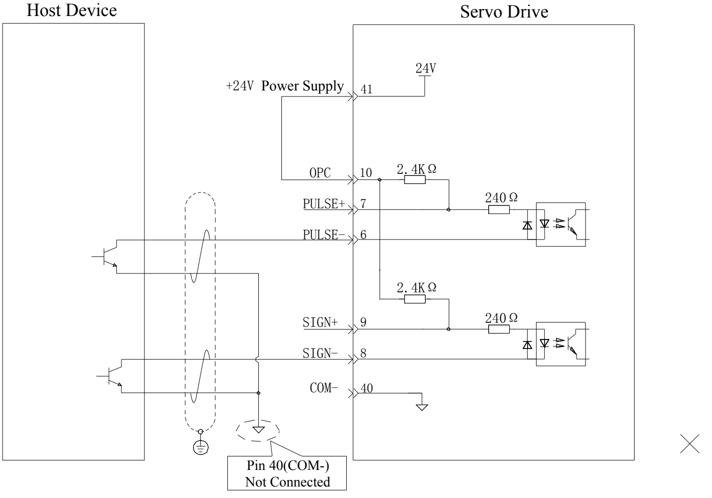
(2) OC mode

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



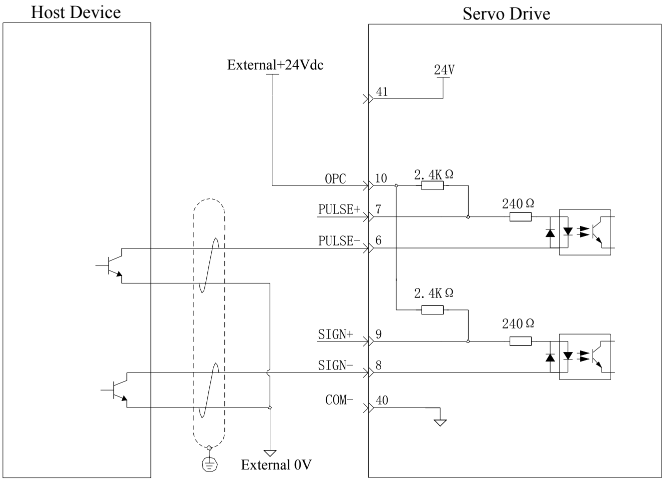


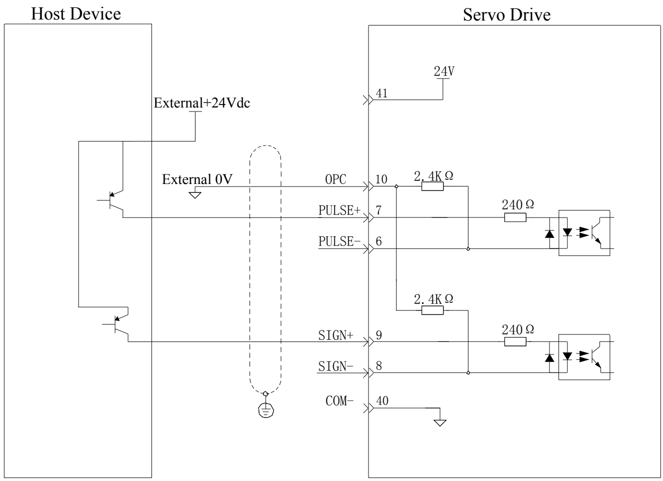
Wrong wiring: Pin 40(COM-) is not connected, which cannot form a closed-loop circuit.



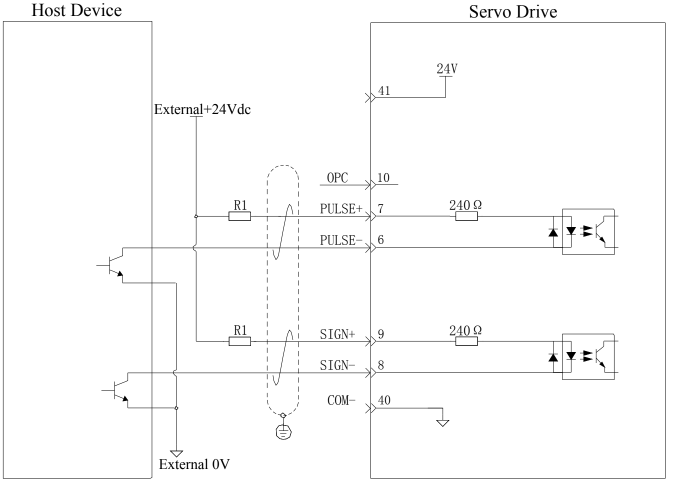
② When using external power supply:

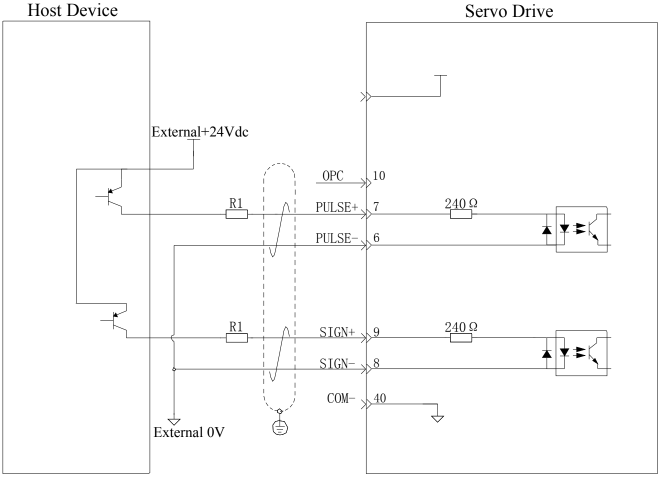
Solution 1: Using the internal resistor of the servo drive (recommended)





Solution 2: Using external resistor





The selection of R1 according to the following formula:

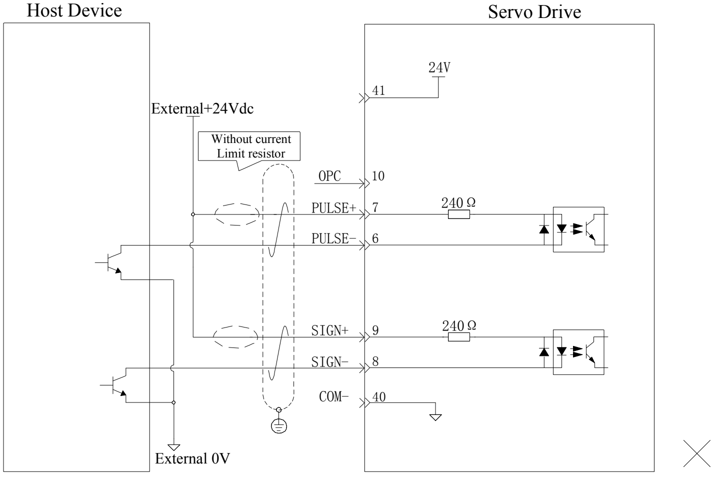
$$\frac{V_{CC}-1.5}{R1+240}=10mA$$

Table 4-13 Recommended R1 resistance

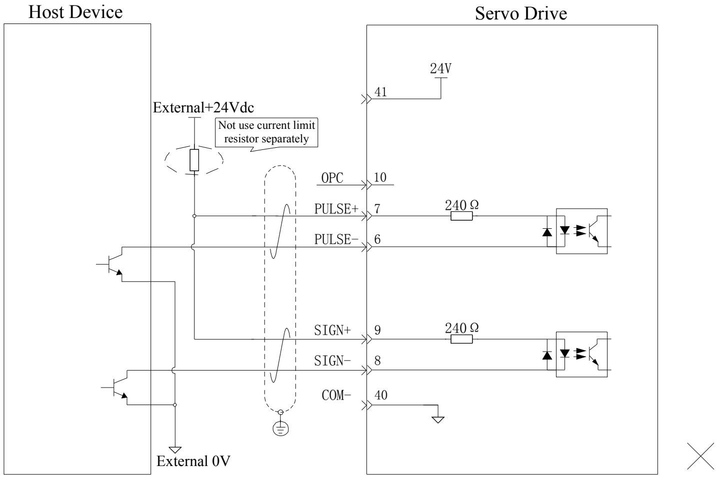
Vcc voltage	R1 resistance	The power of R1
24V	2.4KΩ	0.5W
12V	1.5KΩ	0.5W

Examples of wrong wiring:

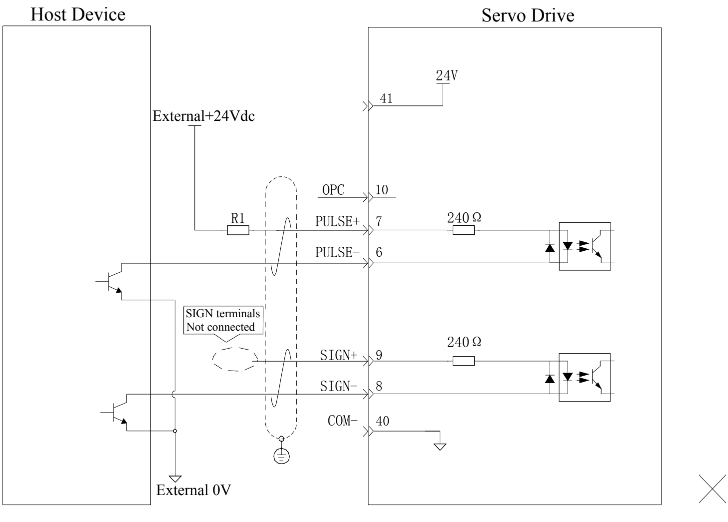
Wrong wiring 1: Not connect the current-limiting resistance resulting in burnout of terminals.



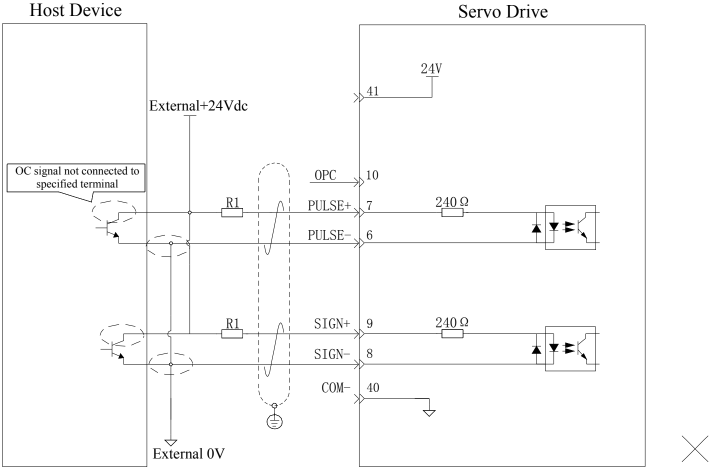
Wrong wiring 2: Multiple terminals share same current-limiting resistance, resulting in pulse receiving error.



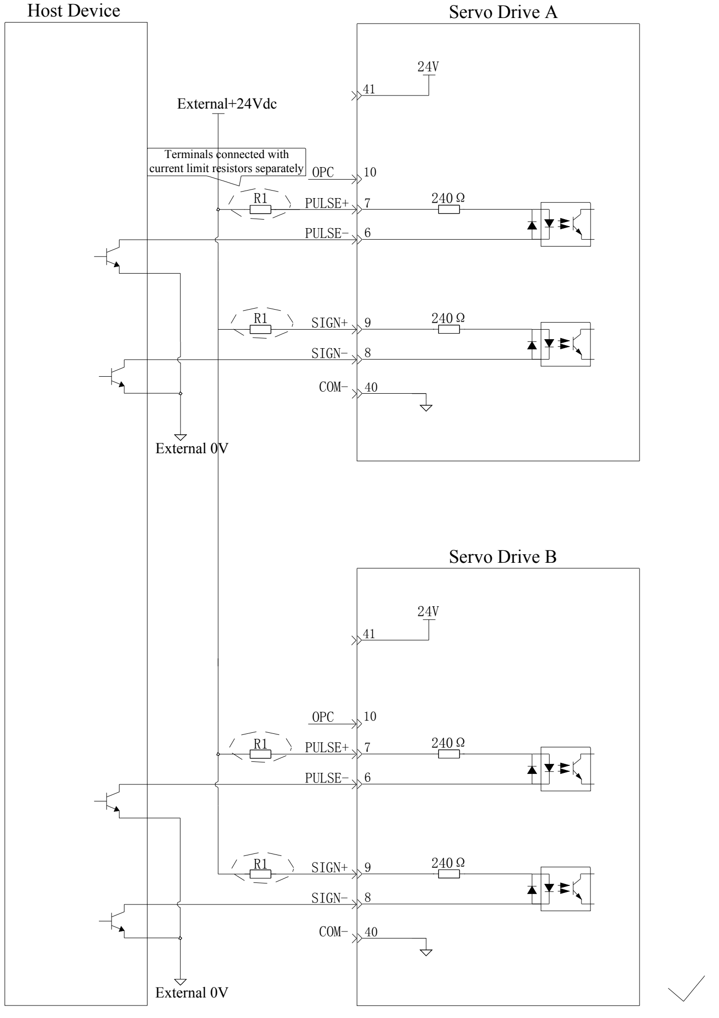
Wrong wiring 3:SIGN terminal not connected，resulting two terminals to failure to receive pulses.

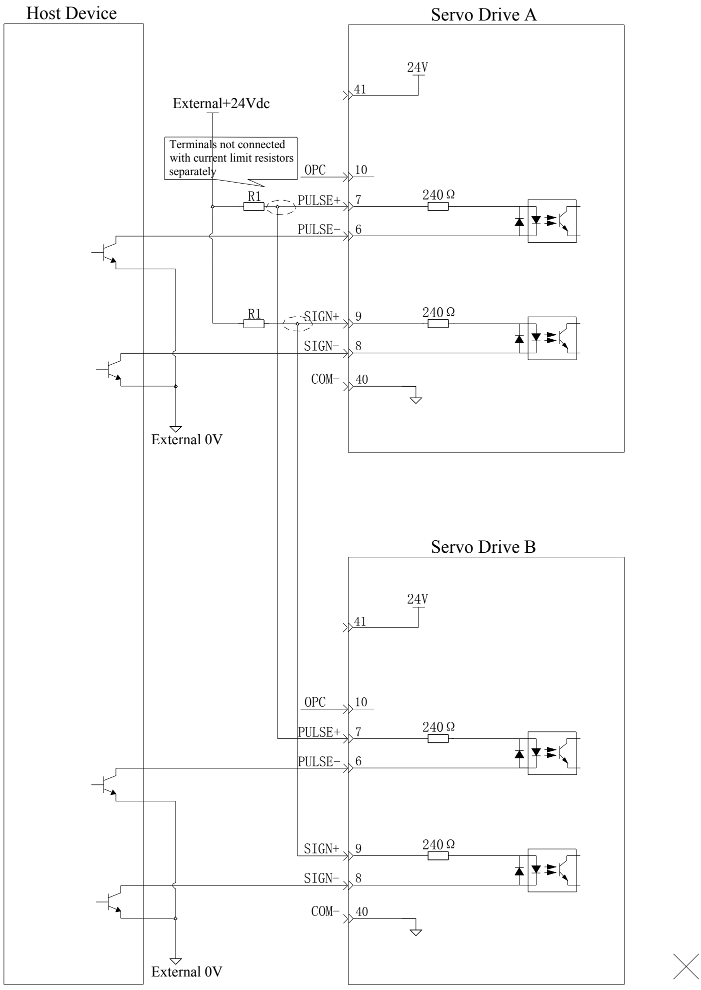


Wrong wiring 4: Wrong terminals connected results in burnout of terminals.



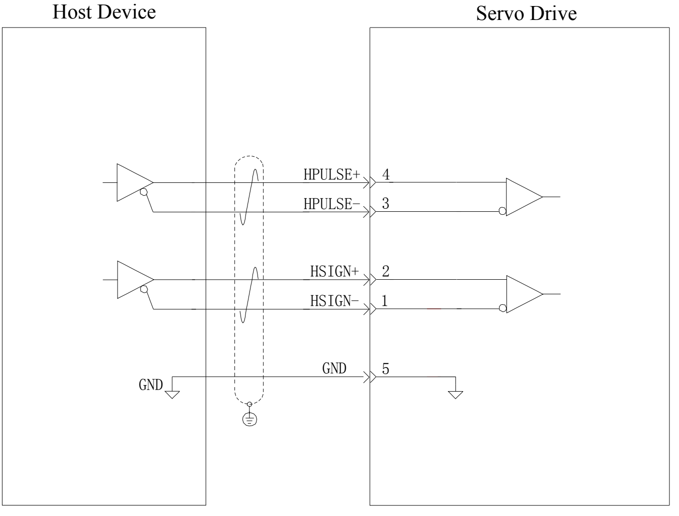
Wrong wiring 5: Multiple terminals share the same current-limiting resistance, resulting in pulse receiving error.




Host Device
Servo Drive A
24V
41
External+24Vdc
Terminals not connected with current limit resistors separately
OPC
10
R1
PULSE+
7
240Ω
PULSE-
6
R1
SIGN+
9
240Ω
SIGN-
8
COM-
40
External 0V
Servo Drive B
24V
41
OPC
10
PULSE+
7
240Ω
PULSE-
6
SIGN+
9
240Ω
SIGN-
8
COM-
40
External 0V

4.5.1.2 High-speed pulse command input

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



Note

Please make sure the differential input is 5V. Otherwise the input pulses of the servo drive unstable, which will cause:

(1) Pulse loss occurs when inputting reference pulses.

(2) The direction is reverse when inputting reference direction.

(3) Be sure to connect the ground of the host device 5V and the servo drive together to reduce noise interference

(4) Please ensure the wire for HPULSE+ and HPULSE-, HSIGH+ and HSIGN- are twisted-pair.

4.5.2 AI signals

Table 4-14 AI signal description

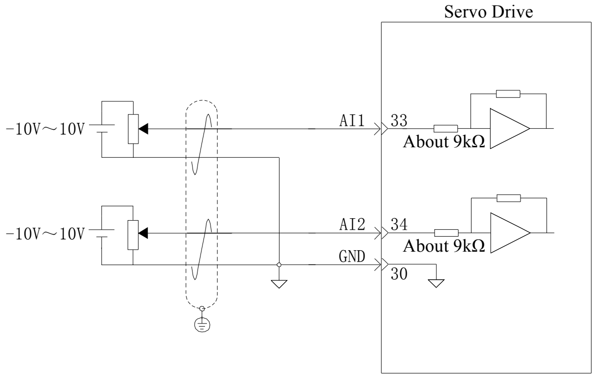
Signal	Default function	Pin No.	Function Description
Analog input	AI2	34	Ordinary analog input signal with 12 bit resolution Input voltage: Max.±12V
	AI1	33	
	GND	30	Analog signal input ground

The analog signal input terminals for speed and torque are AI1 and AI2 with 12 bit resolution. The corresponding voltage values set via group F02.

(1) The range of voltage input:-10V～+10V，12 bit resolution;

(2) Max. voltage：±12V；

(3) Input resistance: About 9kΩ



4.5.3 DI/DO signals

Table 4-15 DI/DO signal description

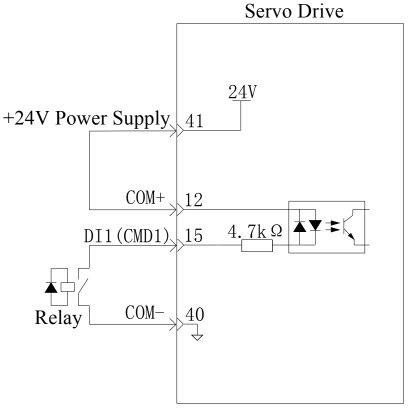
<table>
<tr><th colspan="2">Signal</th><th>Default function</th><th>Pin No.</th><th>Function description</th></tr>
<tr><td rowspan="21">General</td><td>DI1</td><td>S-ON</td><td>15</td><td>Servo on</td></tr>
<tr><td>DI2</td><td>P-OT</td><td>14</td><td>Positive limit switch</td></tr>
<tr><td>DI3</td><td>N-OT</td><td>29</td><td>Negative limit switch</td></tr>
<tr><td>DI4</td><td>INHIBIT</td><td>43</td><td>Pulse input inhibited</td></tr>
<tr><td>DI5</td><td>ALM-RST</td><td>13</td><td>Alarm reset</td></tr>
<tr><td>DI6</td><td>ZCLAMP</td><td>42</td><td>Zero speed clamp</td></tr>
<tr><td>DI7</td><td>HomingStart</td><td>28</td><td>Homing Start</td></tr>
<tr><td>DI8</td><td>Reserved</td><td>11</td><td>-</td></tr>
<tr><td colspan="2">+24V</td><td>41</td><td rowspan="2">Internal 24V power supply,voltage range:20～28V，maximum output current:200mA</td></tr>
<tr><td colspan="2">COM-</td><td>40</td></tr>
<tr><td colspan="2">COM+</td><td>12</td><td>Power input (12V～24V)</td></tr>
<tr><td>DO1+</td><td>S-RDY+</td><td>26</td><td rowspan="2">Servo ready</td></tr>
<tr><td>DO1-</td><td>S-RDY-</td><td>27</td></tr>
<tr><td>DO2+</td><td>COIN+</td><td>37</td><td rowspan="2">Position reached</td></tr>
<tr><td>DO2-</td><td>COIN-</td><td>23</td></tr>
<tr><td>DO3+</td><td>ZERO+</td><td>38</td><td rowspan="2">Zero speed</td></tr>
<tr><td>DO3-</td><td>ZERO-</td><td>24</td></tr>
<tr><td>DO4+</td><td>ALM+</td><td>22</td><td rowspan="2">Fault output</td></tr>
<tr><td>DO4-</td><td>ALM-</td><td>36</td></tr>
<tr><td>DO5+</td><td>HomeAttain+</td><td>25</td><td rowspan="2">Homing completed</td></tr>
<tr><td>DO5-</td><td>HomeAttain-</td><td>39</td></tr>
</table>

4.5.3.1 DI circuit

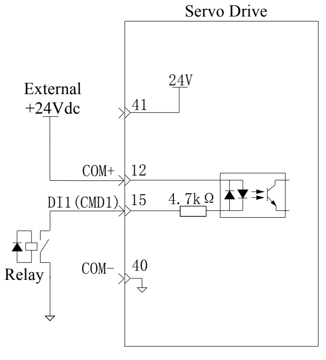
DI1 to DI9 circuits are the same. The following takes DI1 circuit as an example.

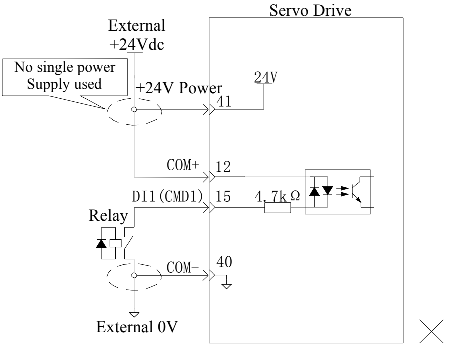
(1) The host device provides relay output signal:

① Using the internal 24Vpower supply of servo drive:



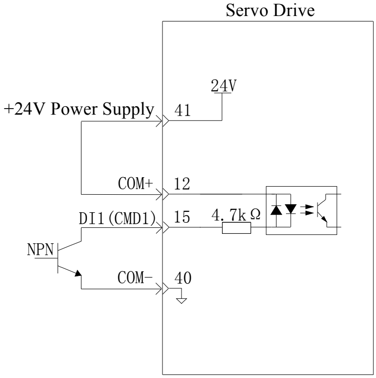
② Using external power supply:

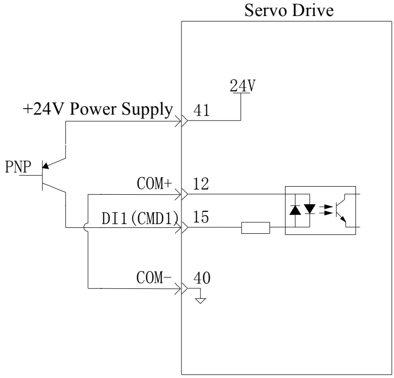




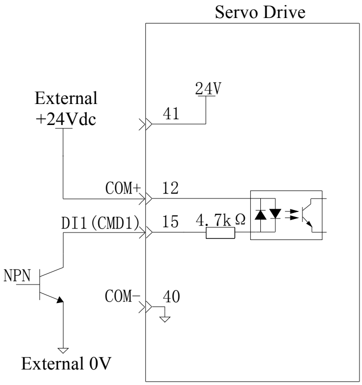
(2) The host device provides OC output signal:

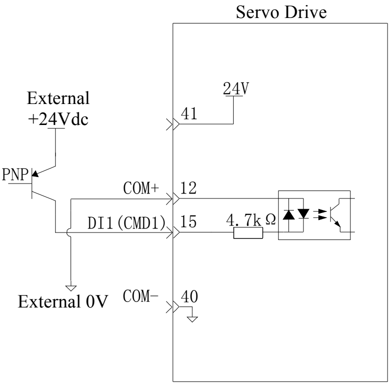
① Using the internal 24Vpower supply of servo drive:





② Using external power supply:





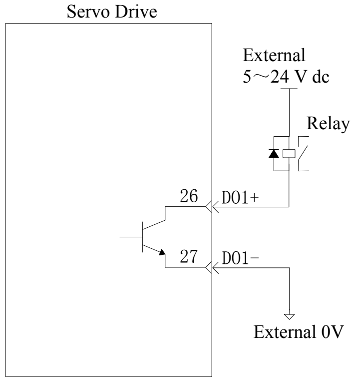
Note

Mixing the using of PNP and NPN inputs is not supported.

4.5.3.2 DO Circuit

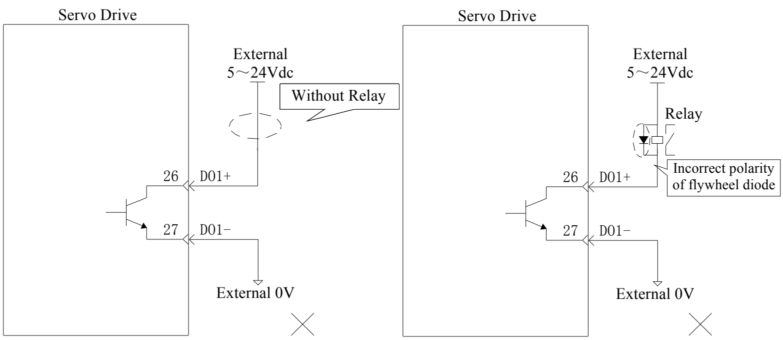
DO1 to DO5 circuits are the same. The following takes DO1 circuit as an example.

(1) The host device uses relay input:

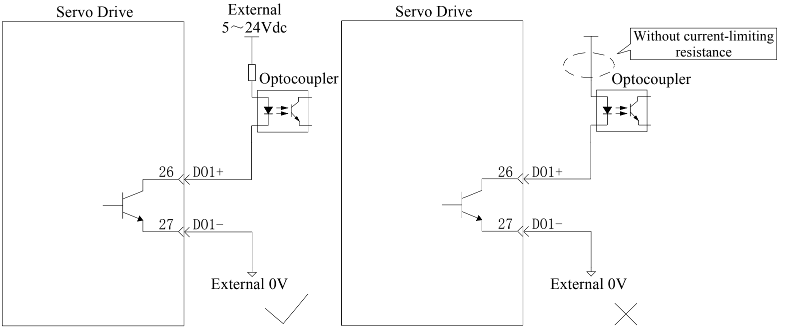


Note

When the host device uses relay input, a flywheel diode must be installed; Otherwise, DO terminals may be damaged.



(2) When the host device uses optocoupler input:



The maximum permissible voltage and current of the optocoupler output circuit inside the servo drive are as follows:

① Max. Voltage:DC30V

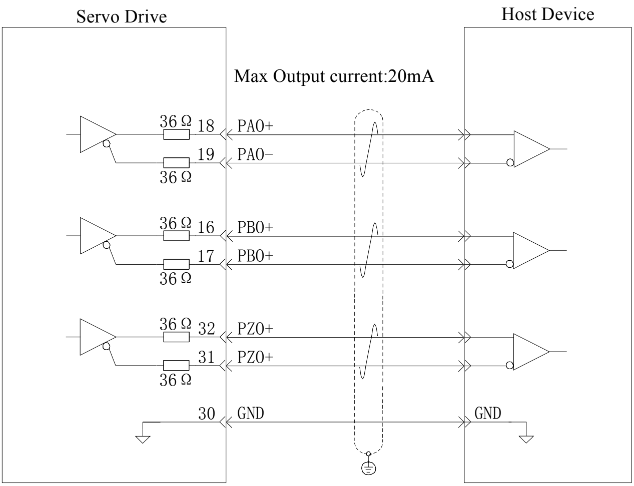
② Max. Current:DC50mA

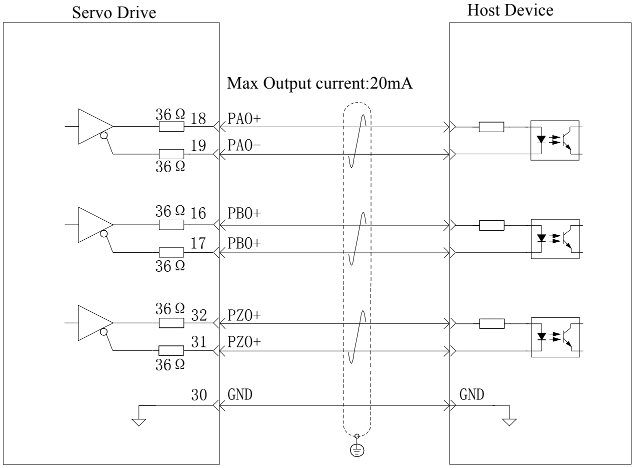
4.5.4 Encoder Frequency-Division Output Signal

Table 4-16 Encoder frequency-division output signal specifications

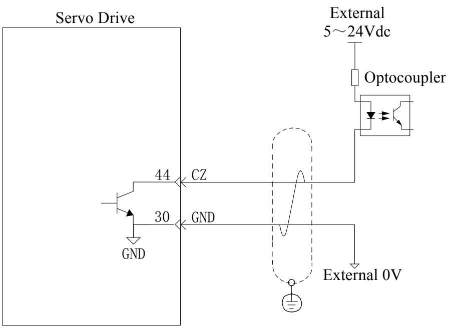
Signal	Default Function	Pin No.	Function description	
General	PAO+ PAO-	18 19	Phase A output signal	Phase A and B quadrature pulse output signal
	PBO+ PBO-	16 17	Phase B output signal	
	PZO+ PZO-	32 31	Phase Z output signal	Home pulse output signal
	CZ	44	Phase Z output signal	Home pulse OC output signal
	GND	30	Home pulse OC output signal ground	
	+5V	20	5 V internal power supply with max. output current 200mA	
	GND	5		
	PE	Case	Shield	

The encoder frequency-division output circuit outputs OC signals via the differential drive. Generally, feedback signals are provided for the host device when forming closed-loop position control system. A differential or optocoupler circuit shall be used in the host device to receive feedback signals. The maximum output current is 20mA.





The encoder phase Z output circuit outputs OC signals. Generally, feedback signals are provided for the host device when forming closed-loop position control system. An optocoupler circuit, relay circuit, or bus receiver circuit shall be used in the host controller to receive feedback signals.



Note

> Be sure to connect the 5V ground of the host device to the GND of the drive and use shielded twisted-pair wires to reduce noise interference.

The maximum permissible voltage and current of the optocoupler output circuit inside the servo drive are as follows:

(1) Max. Voltage: DC30V

(2) Max. Current: DC50mA

4.5.5 Wiring for motor brake

The brake is a mechanism that prevents the servo motor shaft from moving when the servo driver is in a non-running state and keeps the motor in a locked position so that the moving part of the machine does not move because of gravity or external force.

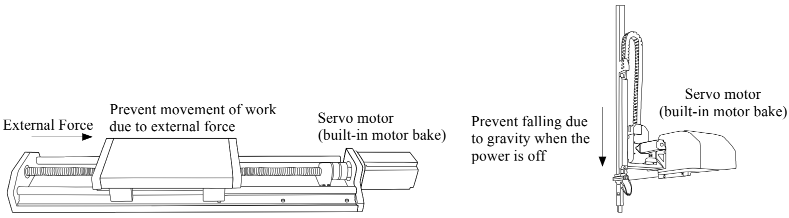


Fig.4-16 Brake application diagram

Note

(1) The brake mechanism built into the servo motor is a non-power-operated fixed special mechanism, which cannot be used for braking purposes, only used for keeping the servo motor in a stopped state.
(2) Except for permanent magnet brake, the brake coil has no polarity.
(3) The servo open signal(S-ON) must be off after the servo motor stops.
(4) When the motor with the brake built-in is running, the brake may make a sound which does not affect any functionality.
(5) When brake coils are energized (the brake is released), magnetic flux leakage may occur at the shaft end. Thus, pay special attention when using magnetic sensors around the servo motor.

The connector of the motor brake has no polarity. Customers needs to prepare 24 V external power supply. The standard wiring of the brake signal (BK) and motor brake power supply as show in Fig. 4-17：

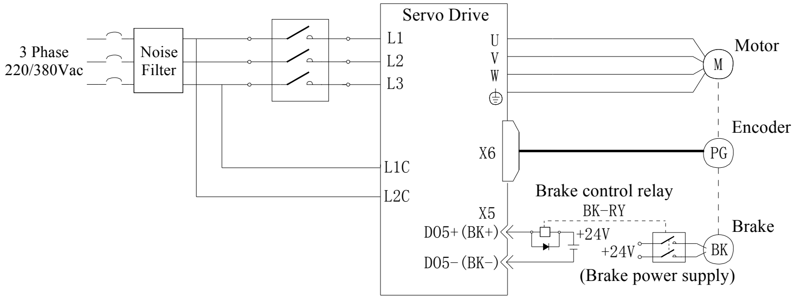


Fig.4-17 The Wiring diagram of Motor Brake

Precautions for motor brake wiring:

(1) The cable length of the motor brake shall take the voltage drop caused by the cable resistance into full consideration, and the input voltage shall be at least 21.6V to ensure the working of brake. The brake specifications of our servo motors as show in following table:

Table 4-17 Brake specifications

Servo motor module	Rated torque (Nm)	Supplied Voltage (V) ±10%	Supplied Current Range (A)	Release Time (ms)	Applying Time (ms)
40 base	1	24	0.23～0.27	20	8
60 base	2	24	0.40～0.50	30	10
80、90 base	4	24	0.52～0.86	55	63
110 and 130-10N below motor	8	24	0.68～0.85	72	87
130-10N and above motor	16	24	0.85～1.33	95	110
180-35N below motor	30	24	0.85～1.80	115	130
180-35N and above motor	50	24	1.47～1.70	120	135

(2) The brake shall not share the power supply with other devices. Otherwise, the brake may malfunction due to voltage or current drop resulted from working of other devices.

(3) Cables of 0.5 mm2 and above are recommended.

4.6 Wiring of communication signals X3, X4, and X7

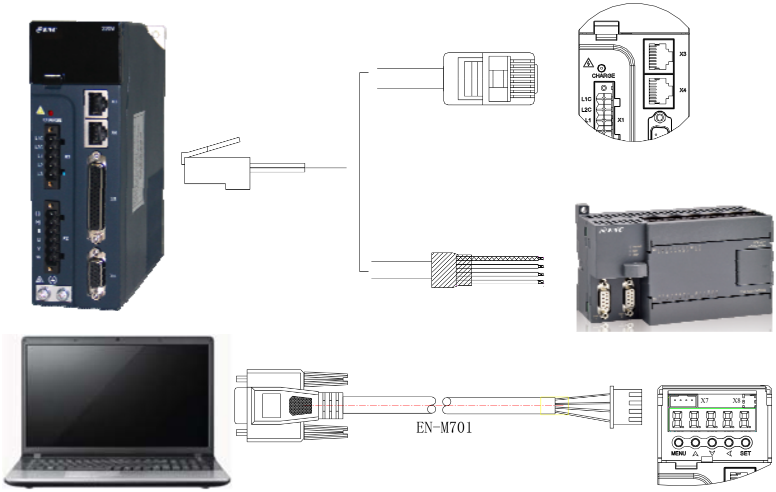


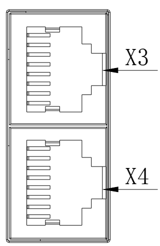
Fig.4-18 Communication wiring diagram

Communication signal connectors (X3, X4) are two universal communication signal terminal connectors connected in parallel. Do not connect wires to the reserved terminals. X7 is used to connect to the 232 communication terminal of PC.

4.6.1 Communication signal connectors

The X3/X4 terminals of the servo drive are used for communication connection between the servo drive and PC, PLC, and other servo drives. The terminal pin of X3/X4 is defined as follows:

Table 4-18 Pins definition of communication signal connectors

Pin No.	Pin	Description	Terminal pin layout
1	AGND	-	
2	GND	-	
3	Reserved	-	
4	RS485+	RS485 communication port	
5	RS485-		
6	Reserved	-	
7	CANL	CAN communication port	
8	CANH		
Case	PE	Shield	

4.6.2 CAN Communication Connection

(1) CAN Communication Connection with PLC

The connection cable EN-M402 between the servo drive and PLC under CAN communication as following shows:

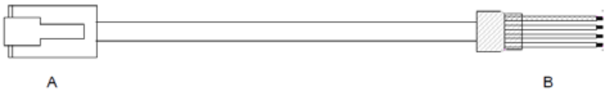


Fig.4-19 Appearance of communication cable between servo drive and PLC

Table 4-19 Pin definition of communication cable between servo drive and PLC

RJ45 on Servo Drive side (A)			PLC side (B)		
Communication type	**Signal**	**Pin No.**	**Communication type**	**Signal**	**Pin No.**
CAN	CANH	8	CAN	CANH	Depends on PLC module
	CANL	7		CANL	
	AGND	1		CGND	
-	PE (Shield)	Case	-	PE (Shield)	Case

(2) CAN Communication Connection for Multi-drive in parallel connection

The connection cable for multiple servo drives connected in parallel under CAN communication as following shows:

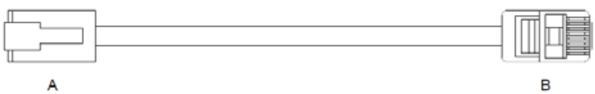


Fig.4-20 Appearance of communication cable for parallel connection of multiple servo drives

Table 4-20 Pin connection relation of communication cable for parallel connection

RJ45 on Servo Drive side (A)			RJ45 on Servo Drive side (B)		
Communication type	**Signal**	**Pin No.**	**Communication type**	**Signal**	**Pin No.**
CAN	CANH	8	CAN	CANH	8
	CANL	7		CANL	7
	AGND	1		AGND	1
-	PE（Shield）	Case	-	PE（Shield）	Case

(3) Precautions for Grounding wiring of CAN Communication

When adopt CAN Communication, please note the connection between the GND of host device and the GND of servo drive as shown in the following figure:

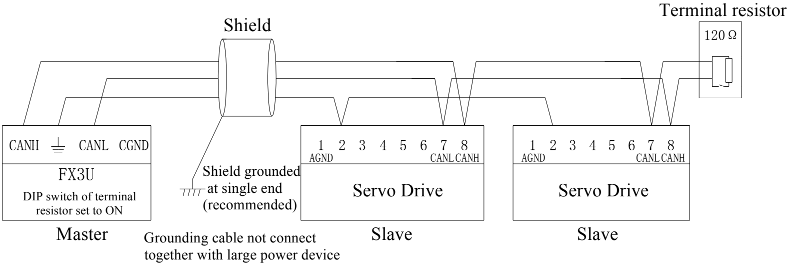


Fig.4-21 Correct CAN communication connection

Note

(1) PLC built-in terminal resistor for CAN communication, please set the related DIP switch on;
(2) The shield be grounded at single end is recommended;
(3) Do not connect the CGND of host device to the AGND of the servo drive.

4.6.3 RS485 Communication Connection

(1) Communication connection with PLC RS485

When adopt RS485 communication, the connection cable EN-M403 between the servo drive and PLC as following shows:

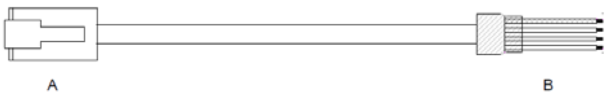


Fig.4-22 Appearance of communication cable between servo drive and PLC

Table 4-21 Pin connection relations of communication cable between servo drive and PLC

RJ45 on Servo Drive side (A)			PLC side (B)		
Communication type	**Signal**	**Pin No.**	**Communication type**	**Signal**	**Pin No.**
RS485	RS485+	4	RS485	RS485+	Depends on PLC module
	RS485-	5		RS485-	
	GND	2		GND	
-	PE (Shield)	Case	-	PE (Shield)	Case

(2) RS485 Communication Connection for Multi-drive in parallel connection

The connection cable for multiple servo drives connected in parallel under RS485 communication as following shows:

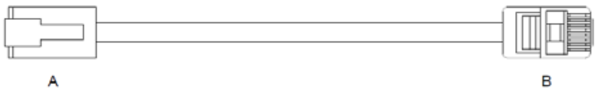


Fig.4-23 Appearance of communication cable for parallel connection of multiple servo drives

Table 4-22 Pin connection relation of communication cable for parallel connection

RJ45 on Servo Drive side (A)			RJ45 on Servo Drive side (B)		
Communication type	**Pin No.**	**Communication type**	**Communication type**	**Signal**	**Pin No.**
RS485	RS485+	4	RS485	RS485+	4
	RS485-	5		RS485-	5
	GND	2		GND	2
-	PE (Shield)	Case	-	PE (Shield)	Case

(3) Precautions for Grounding wiring of RS485 Communication

When adopt RS485 Communication, please note the connection between the GND of host device and the GND of servo drive as shown in the following figure:

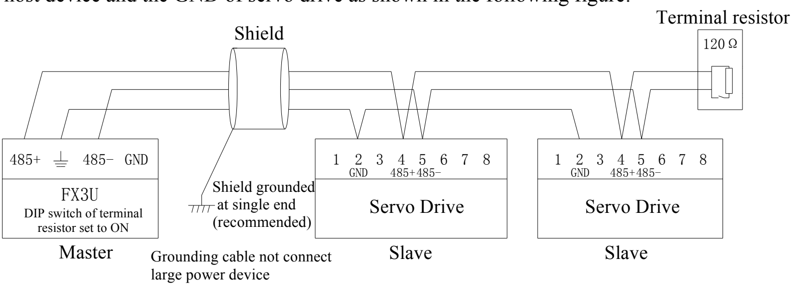


Fig.4-24 Correct RS485 communication connection

Note

(1) PLC built-in terminal resistor for CAN communication, please set the related DIP switch on;
(2) The shield be grounded at single end is recommended;
(3) Do not connect the GND of host device to the GND of the servo drive, otherwise it will damage the device and lead to the communication abnormal.

4.6.4 Communication Connection with PC (RS232)

Users can connect the servo drive and PC through PC communication cable. The common communication port RS232 is recommended. As following shows:

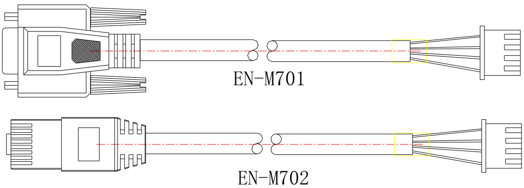


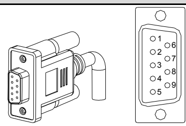
Fig.4-25 PC communication cable appearance

Table 4-23 Pin connection relation between PC communication cable and the servo drive

Servo Drive side (A)		PC side (B)	
Signal	**Pin No.**	**Signal**	**Pin No.**
RS232-TXD	3	PC-RXD	2
RS232-RXD	4	PC-TXD	3
GND	2	GND	5
PE (Shield)	Case	PE (Shield)	Case

The definition of DB9 terminal on PC side as show in following table:

Table 4-24 Pin definition of DB9 terminal on PC side (B side in above table)

Pin No.	Name	Description	Pin layout
2	PC-RXD	PC receiving end	
3	PC-TXD	PC sending end	
5	GND	Grounding	
Case	PE	Shield	

If host device not equipped with serial port and just only USB port available, you can use a serial-to-USB cable to converse it.

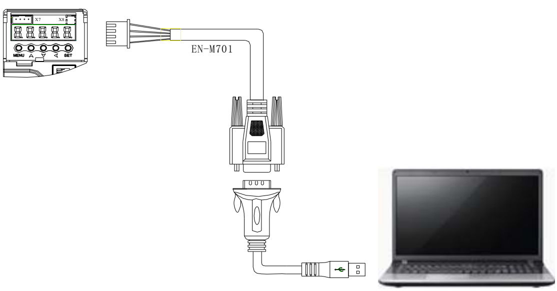


Fig.4-26 Communication Serial-to-USB conversion diagram

4.6.5 Connect to keyboard which support parameters copy (RS232)

Users can connect the servo drive and parameter copy keyboard (EN-LED7-C)through keyboard communication cable to realize the function of uploading and downloading the servo drive parameters. The connection diagram as shown in follows:

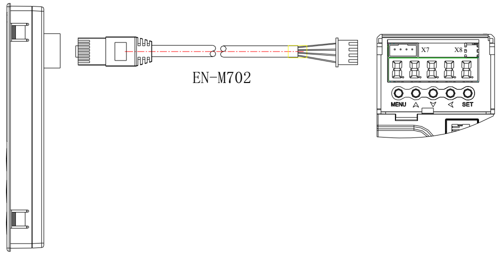
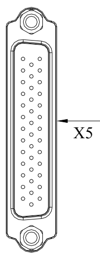


Fig.4-27 the servo drive and keyboard connection diagram

4.7 Wiring of Analog Monitoring Signal (X5)

The terminal layout of analog monitoring signal terminal connector (X5):



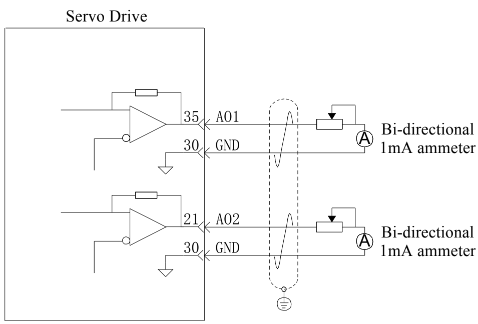
X5	No.	35	21	30
	Definition	A01	A02	GND

Fig.4-28 Analog monitoring signal terminal connector

Corresponding interface circuit:

(1) Analog output:-10V～+10V

(2) Max. Output:1mA



The objects can be monitored:

Table 4-25 Monitored objects of analog signal

Pin No.	Monitored objects
AO1	00:Motor speed,01:Motor reference,02:Torque reference,03:Position deviation (Command unit), 04:Position deviation (Encoder unit),05:Position deviation,06:Positioning completed reference, 07:Speed feed-forward, 08:AI1 voltage,09:AI2 voltage,10:Output current 1,11:Output current 2, 12:Output voltage,13:DC Bus voltage,14:Communication reference,15:Feedback torque.
AO2	

Note

After the control power turned OFF, the analog monitoring output terminal may output around 5 V voltage and lasts for Max. 50ms.It will output 10V and lasts around 250ms when turn on the servo drive. Please take full consideration when using.

4.8 Anti-interference Measures for Electrical Wiring

Take following measures to suppress interference:

(1) The length of reference input cable less than 3 m, and the length of encoder cable less than 10 m.

(2) Use thick wires as much as possible for grounding wiring（above 2.0mm²）

① D class (or higher class) grounding is recommended (grounding resistance is below 100 Ω).

② Use single point grounding for servo drive system.

(3)Use noise filter to prevent radio frequency interference. Please install noise filters at the input side of the power supply in civil environment or environment with strong interference noise.

(4)To prevent malfunction due to electromagnetic interference the following treatment methods can be adopted:

① Install surge suppressors on the coils of relay, solenoid and electromagnetic contactor.

②When wiring, please separate the strong power line from the weak power line and keep the interval above 30cm. Do not put them in the same pipe or bundle them together.

③Do not share power supply with welding machine or EDM equipment, etc. Please install noise filter on the input side of the power supply line when there is a high frequency generator nearby.

4.8.1 EMI Inhibition switch

When using servo drive, if the field environment interferes is serious, please turn on EMI switch SW1;(:Earth grounding, :Suspending)

Turn the switch and the black square indicates the position of switch. It's recommended to place the EMI switch on the grounding position only if the interference in the field environment is relatively high and the terminal must be connected to the Earth reliably.

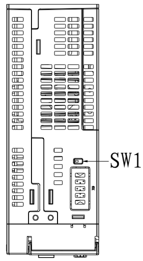


Fig.4-29 Servo drive anti-inference diagram

4.8.2 Anti-interference wiring example and grounding treatment

The main circuit of servo drive adopts high-speed switching element. Switching noise from these elements may affect normal operation of the servo drive due to improper wiring or grounding. Thus, the servo drive must be properly wired and grounded. Please add noise filter if necessary.

(1) Example of Anti-interference wiring

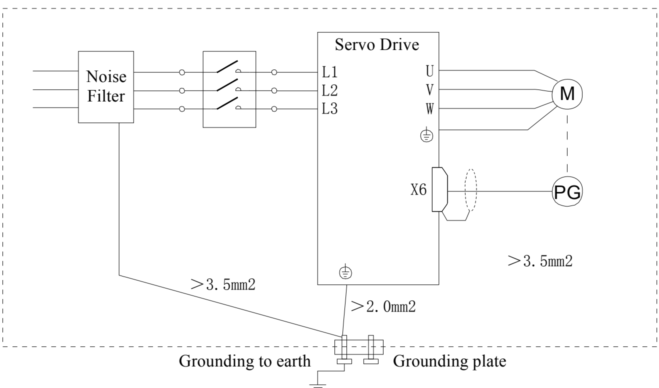


Fig.4-30 Anti-inference wiring diagram

Note

(1) Please use 3.5mm² or above cable for grounding the cabinet case (Braided wires recommended).
(2) Please observe the precautious in"4.8.3 Using methods of noise filter" when using noise filter.

(2) Grounding treatments

To avoid electromagnetic interference problems, please follow the following method for grounding:

① Grounding the servo motor case: Please connect grounding terminal of the servo motor to the PE terminal of the servo drive together and grounding the PE terminal reliably to reduce potential EMI problems.

② Grounding the shield of the encoder cable: Grounding both side of the shield of the motor encoder cable.

4.8.3 Using methods of noise filter

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

(1) Please separate the noise filter input and output wiring, do not put them in the same pipe or bundle them together.

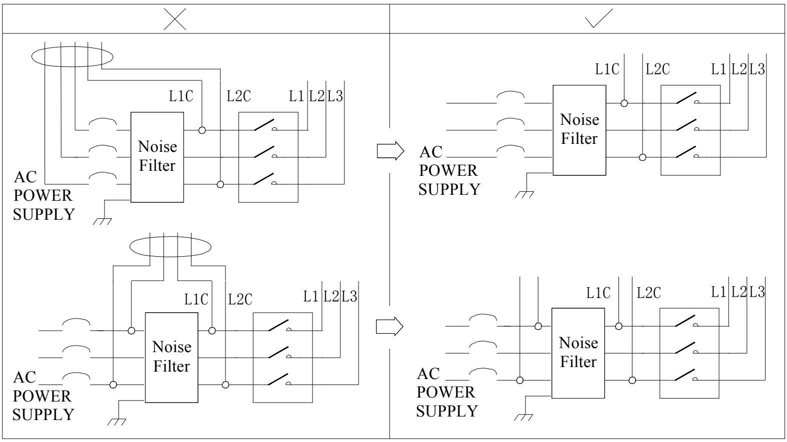


Fig.4-31 Separate wiring of noise filter input and output diagram

(2) Separate the grounding wire of noise filter from its output power supply wires.

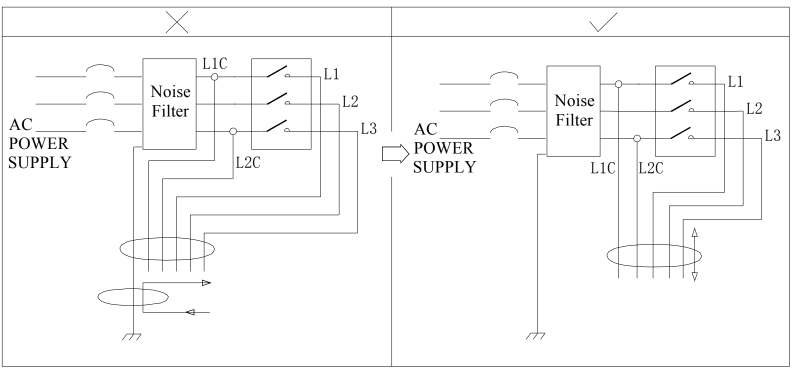


Fig.4-32 Noise filter grounding wires and output power supply wires separated diagram

(3) Use separate grounding cable as short and thick as possible for the noise filter. Do not use same grounding cable with other devices.

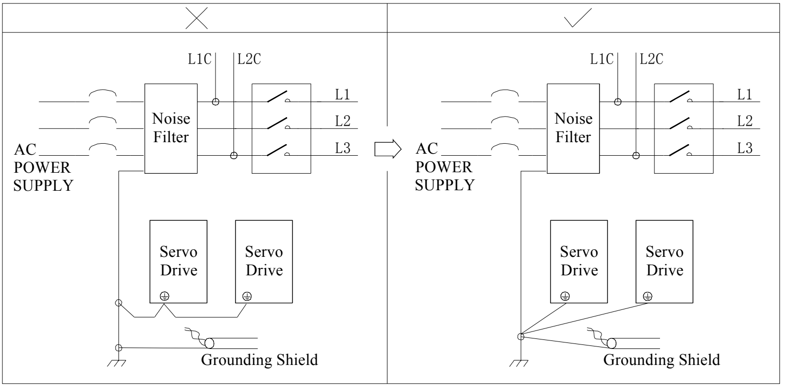


Fig.4-33 Single point grounding diagram

(4) Grounding the noise filter that inside the cabinet.

When the noise filter and the servo driver are installed in a control cabinet, it is recommended to fix the filter and the servo driver on the same metal plate. Ensure the contact part is in good conductive condition, and ground the metal plate properly.

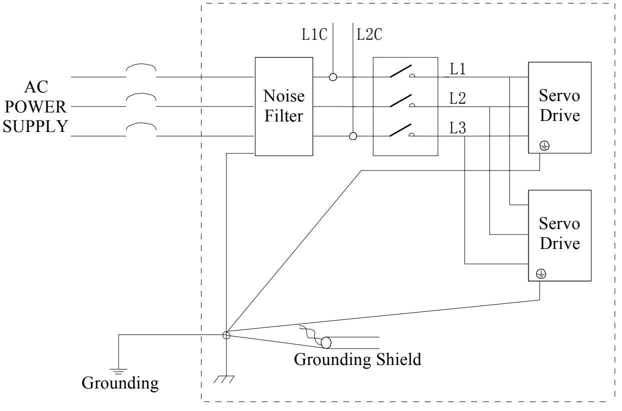


Fig.4-34 Noise filter grounding diagram

4.9 Precautions of Using Cables

(1) Do not bend or apply stress to cables. Please note that the core wire of signal cable just 0.2 or 0.3 mm in diameter which is easy to break.

(2) Please use flexible cables for the applications that need move cables. Ordinary cables are easily damaged after being bent for a long time. Cables configured together with low power servo motors cannot be moved.

(3) When using cable protection chain, please observe the followings:

① The bending radius of the cable must be at least 10 times of its outer the diameter;

② Do not fix or bundle the cables inside cable protection chain. They just can be bundled and fixed at two unmovable ends of cable protection chain;

③ Cables should not be wound or warped;

④ The space efficient in the cable protection chain must be about 60%;

⑤ Do not mix cables with large difference in size to avoid thick cables crushes thin cables. If thick and thin cables really need to be used together, place spacer plate between them.

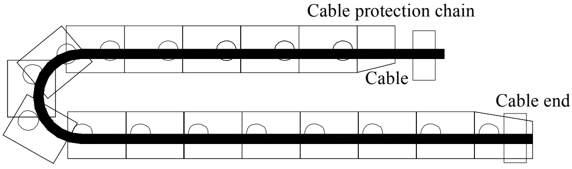


Fig.4-35 Cable protection chain diagram

4.10 Wiring of three control operation modes

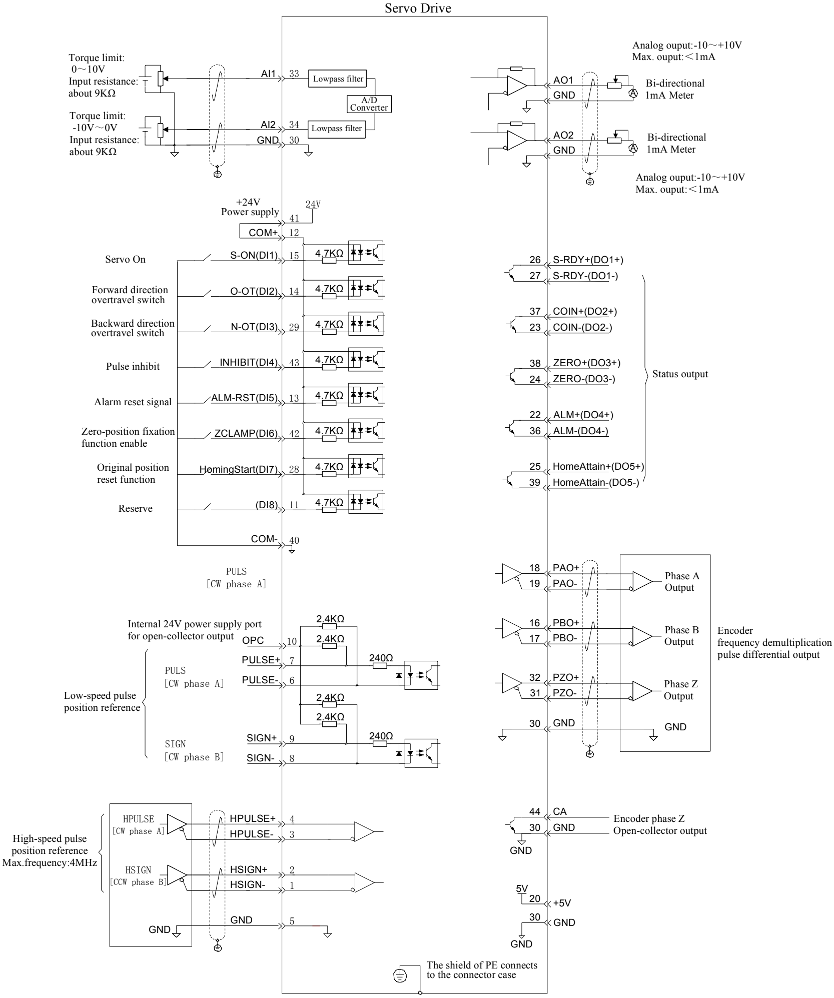


Fig.4-36 Position mode wiring diagram

Note

(1) Please use shielded twisted-pair wires as the AI/AO circuit cables and connect shield ends to PE well.

(2) The voltage range of internal +24V power is 20～28V with Max. 200mA current output.

(3) DI8 is high speed DI，please select related function to use it.

(4) Please use shielded twisted-pair wires as the cables of the high-speed and low-speed pulse terminals. Both ends of the shield need to connect to PE. Connect GND and signal ground of the host device reliably.

(5) The power supply for DO output should be prepared by customers with 5V～24V voltage range. The DO port has Max. DC30V allowable voltage and 50mA allowable current.

(6) Shielded twisted-pair wires needed for the frequency-division output of the encoder. Please connect both ends of the shield to PE and connect GND and signal ground of the host device reliably.

(7) Internal +5Vpower supply has max. 200mA current output.

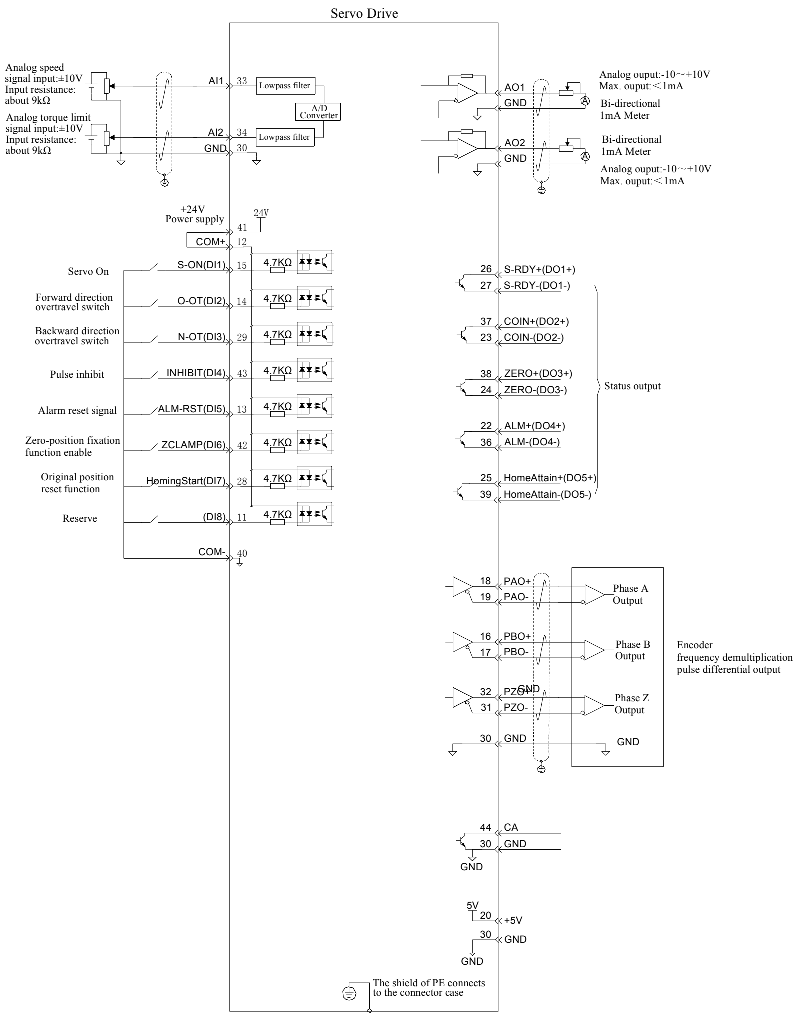


Fig.4-37 Speed control mode wiring diagram

Note

(1) Please use shielded twisted-pair wires as the AI/AO circuit cables and connect shield ends to PE well.

(2) The voltage range of internal +24V power is 20～28V with Max. 200mA current output.

(3) DI8 is high speed DI，please select related function to use it.

(4) Please use shielded twisted-pair wires as the cables of the high-speed and low-speed pulse terminals. Both ends of the shield need to connect to PE. Connect GND and signal ground of the host device reliably.

(5) The power supply for DO output should be prepared by customers with 5V～24V voltage range. The DO port has Max. DC30V allowable voltage and 50mA allowable current.

(6) Shielded twisted-pair wires needed for the frequency-division output of the encoder. Please connect both ends of the shield to PE and connect GND and signal ground of the host device reliably.

(7) Internal +5Vpower supply has max. 200mA current output.

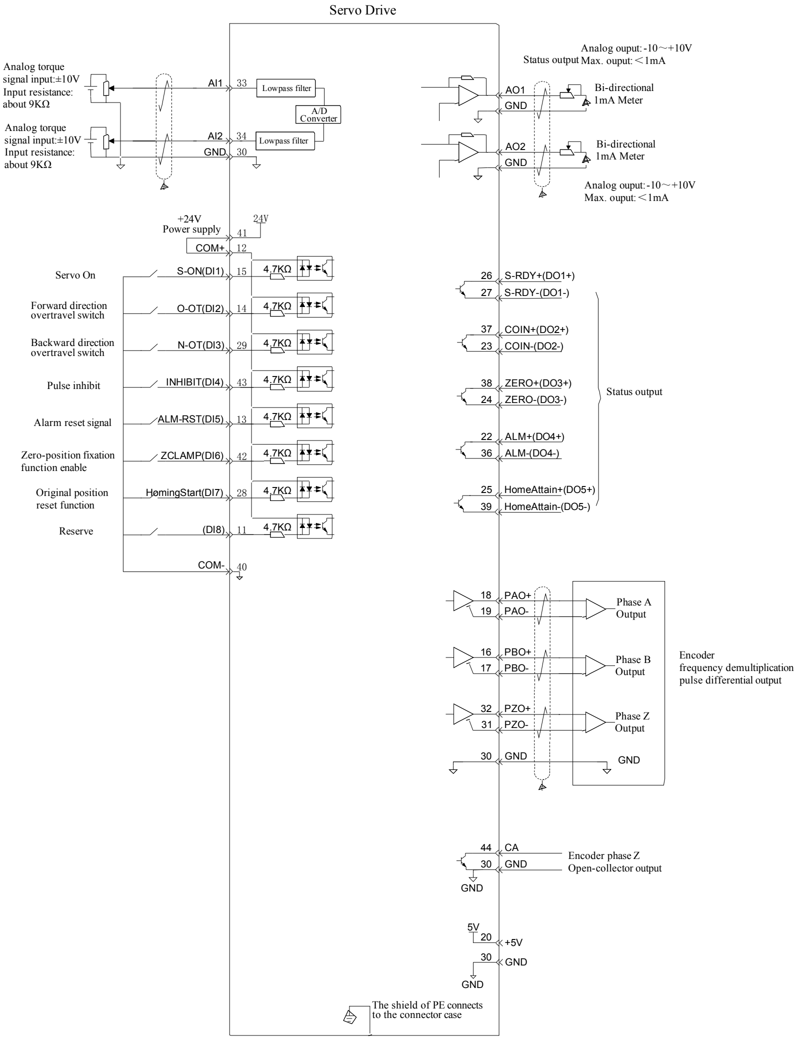


Fig.4-38 Torque control mode wiring diagram

Note

(1) Please use shielded twisted-pair wires as the AI/AO circuit cables and connect shield ends to PE well.
(2) The voltage range of internal +24V power is 20～28V with Max. 200mA current output.
(3) DI8 is high speed DI，please select related function to use it.
(4) Please use shielded twisted-pair wires as the cables of the high-speed and low-speed pulse terminals. Both ends of the shield need to connect to PE. Connect GND and signal ground of the host device reliably.
(5) The power supply for DO output should be prepared by customers with 5V～24V voltage range. The DO port has Max. DC30V allowable voltage and 50mA allowable current.
(6) Shielded twisted-pair wires needed for the frequency-division output of the encoder. Please connect both ends of the shield to PE and connect GND and signal ground of the host device reliably.
(7) Internal +5Vpower supply has max. 200mA current output.

5 Display and operation

5.1 Introduction of keypad

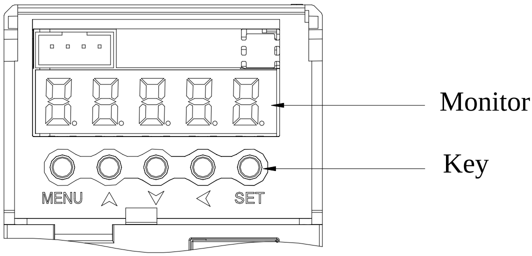


Fig.5-1 Keypad appearance

The keypad on the servo drive consists of the 5-digit 8-segment LEDs and keys. The keypad is used for display, parameter setting, user password setting and general functions operations.For example, parameter setting, the functions of the keys are described as follows:

Key	Name	Function description
MENU	MENU key	Switch between all modes. Return to the upper-level menu
△	UP key	Increase the number indicated by the blinking digit
▽	DOWN key	Decrease the number indicated by the blinking digit
◁	SHIFT key	Shift the blinking digit. View the high digits of the number consisting of more than 5 digits
SET	SET key	Enter into next level menu Execute commands such as storing parameters, setting parameters etc.

5.2 Keypad display

The keypad can display the running status, parameter, faults, and monitored information during running of the servo drive.

(1)Status display: Displays the current servo drive status, such as servo ready or running.

(2)Parameter display: Displays function codes and their values.

(3)Fault display: Displays the fault and warnings occurring in the servo drive.

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

5.2.1 Display switchover

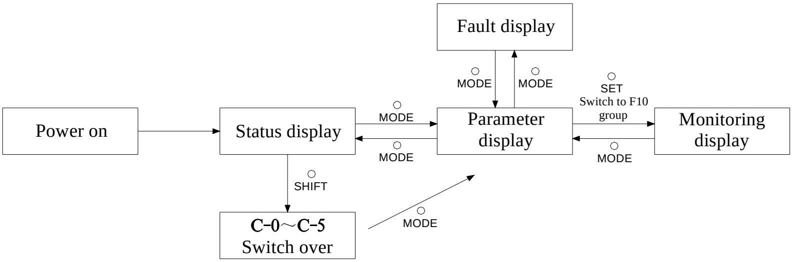


Fig.5-2 Display switchover

(1) After the power is on, the keypad enters the status display mode.

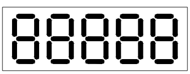
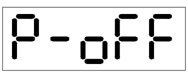
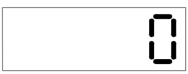
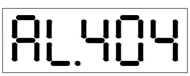
(2) Switching between different display modes by pressing “MODE” key as shown in the preceding figure.

(3) In status display mode, set **[F01.21～F01.26]** and select the monitored parameters. When the display switches to monitored parameter C-0, can check C-0～C-5 parameters by operating “SHIFT” key. Pressing “ENTER” could switch to C-0.

(4) In parameter display mode, set group F10 group and select the parameters to be monitored, and the keypad switches over to the monitoring display mode.

(5) Once a fault occurs, the keypad immediately enters the fault display mode, and all 5-digit LEDs blink. Press key MODE to switch over to the parameter display mode.

5.2.2 Status display

Display	Name	Condition	Meaning
	88888 Servo initialization	Moment when servo drive power on	The servo drive is in initialization or reset state. After initialization or reset is completed, the servo drive automatically switches over to another state
	P-OFF Servo drive is not ready	Initialization is completed, but the servo drive is not ready.	The main circuit is not powered on, and the servo drive is not ready for running. For details, refer to Chapter 9 Troubleshooting
	xxxxx Servo drive is ready	The servo drive is ready(blinking means stop status，not blinking means running status)	The servo drive is ready to run, waiting for the upper computer to give a servo enable signal.
	AL.xxx Warning	Servo is in alarm status	Servo drive is in alarm status

	Er.xxx Fault	Servo is in fault status	Servo drive is in fault status

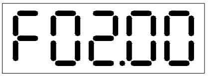
5.2.3 Parameter display

The servo drive has 21 function groups based on parameter functions. The function code can be located quickly based on the group it belongs to. Refer to Chapter 13 Description of Parameters to view the function code table.

(1) Function code group

Display	Name	Content
FXX.YY	Function code group	XX: function code group YY: function code No Function codes are unified into decimal

For example, F02.00 is displayed as follows:

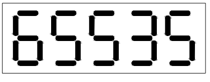
Display	Name	Content
	Function code F02.00	02: function code group 00: function code No

(2) Display data of different Lengths and negative number

① With-symbol number of 4 digits and below, or without-symbol number of 5 digits and below. Such as a number is displayed with a single page (5 LEDs). The highest digit "-" indicates the negative symbol.

For example, -9999 is displayed as follows:

For example, 65535 is displayed as follows:



② With-symbol number of 4 digits and above, or without-symbol number of 5 digits and above. The number is displayed in digits from low to high in pages. Each five digits are displayed in a page. The display method is: current page + value on current page. As shown in the following figure, hold down “SHIFT” for more than two seconds to switch to the next page.

For example, -1073741824 is displayed as follows:

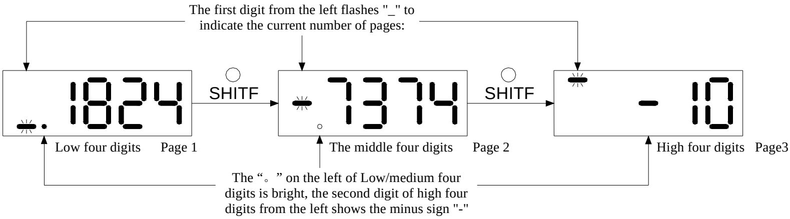


Fig.5-3 -1073741824 display

For example, 1073741824 is displayed as follows:

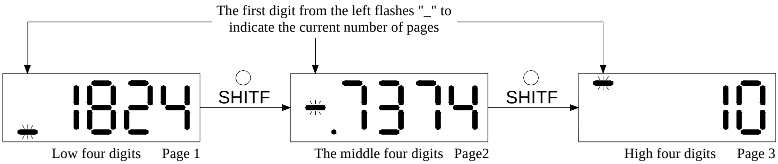
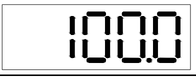


Fig.5-4 1073741824 display

(3) Decimal point display

Segment "." of the unit’s digit indicates the decimal point, and this segment does not blink.

Display	Name	Content
	Decimal point	100.0

5.2.4 Fault display

(1) The keypad displays the current or history faults and warnings code. For analysis and rectification of faults and warnings, refer to “Chapter 9 Troubleshooting”.

(2) When a single fault or warning occurs, the keypad displays the fault or warning code. When multiple faults or warnings occur, the keypad displays the fault code of the highest level.

(3) Checking detailed history fault information through checking F17 group

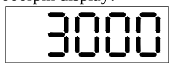
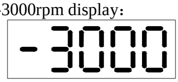
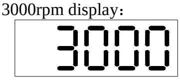
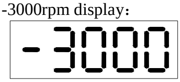
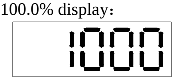
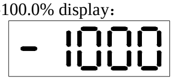
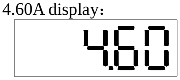
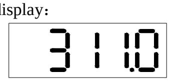
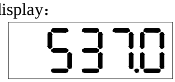
Display	Name	Content
	Current fault code	Er.: indicates fault or warning in the servo drive 301:fault or warning code

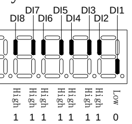
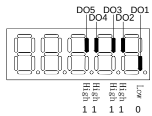
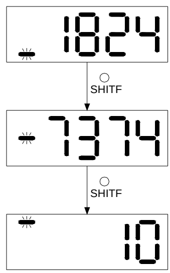
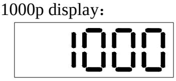
5.2.5 Monitoring display

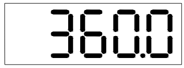
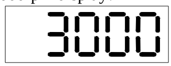
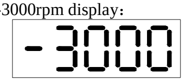
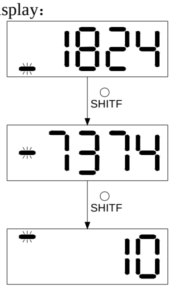
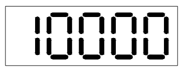
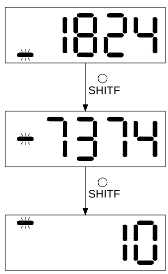
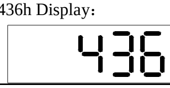
Parameter group**[F10]**: Displays the parameters for monitoring the running status of the servo drive.

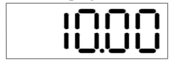
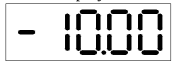
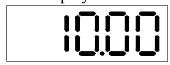
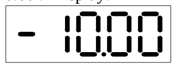
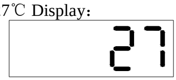
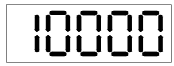
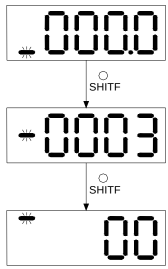
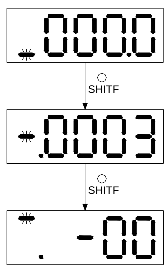
Set**[F01.21～F01.26]** (Default keypad display),In monitoring status, pressing “SHIFT” key to monitor the corresponding status. For example: set F1.21=00,F01.22=01,F01.23=02...,The keypad displays the value of F01.21 when servo drive is power on; display the value of F01.22 after pressing “SHIFT” key; display the value of F01.23 after pressing “SHIFT” key again...can display to F01.26. Display the value of parameter F01.21after pressing “ENTER” key.

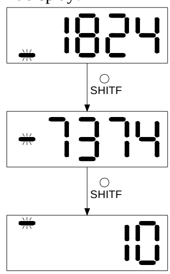
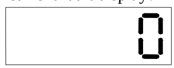
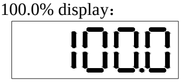
[F10 Group] Monitor display is described as follows:

Function code	Name	Unit	Meaning	Display example
F10.00	Actual motor speed	rpm	It displays the actual motor speed after round-off, in unit of 1 RPM.	3000rpm display：  -3000rpm display： 
F10.01	Speed instruction	rpm	The current speed instruction of the servo drive.	3000rpm display：  -3000rpm display： 
F10.02	Interior torque instruction	%	It displays the percentage of the actual motor output torque to the rated motor torque	100.0% display：  -100.0% display： 
F10.03	Phase current valid value	A	Phase current valid value of servo drive	4.60A display： 
F10.04	Bus voltage value	V	Main circuit DC bus voltage value, that is the voltage between (+)、(-)of servo drive	AC220V after rectification：311.0V display：  AC380V after rectification：537.0V display： 

F10.05	Monitored DI states	-	It displays the level states of the eight DI terminals: The upper LED segment ON indicates high level (Expressed by "1"). The lower LED segment ON indicates low level (Expressed by "0"). F10.05 value read by the commissioning software is a decimal number	For example, if DI1 is low level，and DI2～DI8 are high levels. The binary value is “11111110” The value of F10.05 read by the commissioning software is F10.05=254. Display as follows： 
F10.06	Monitored DO states	-	It displays the level states of the five DO terminals: The upper LED segment ON indicates high level (Expressed by "1"). The lower LED segment ON indicates low level (Expressed by "0"). F10.06 value read by the commissioning software is a decimal number	For example, if DO1 is low level and DO2～DO5 are high levels, The binary value is “11110” The value of F10.06 read by the commissioning software isF10.06=30 Display as follows： 
F10.07	Absolute position counter (32-bit decimal display)	instruction unit	It displays the current absolute motor position (instruction unit).	1073741824 Command unit display 
F10.09	Mechanical angle (starting from the pulses of home)	P	Current mechanical angle (p) The value 0 corresponds to the mechanical angle 0°. F10.09maximum value for incremental encoder: Encoder PPR ×4-1 (For example: F10.09 maximum value for 2500-PPR incremental encoder is 9999). F10.09 maximum value for absolute encoder: 65535	1000p display： 

			$\text{Actual mechanical angle}=\frac{\text{F10.09}}{\text{F10.09 Maximum value}}\ 360°$	
F10.10	Rotation angle (electrical angle)	-	It displays the current motor electric angle.	360.0°display 
F10.11	Speed corresponding to input position instruction	rpm	It displays the servo drive speed corresponding to the position instruction in a single control period.	3000rpm display：  -3000rpm display： 
F10.12	Input position instruction counter (32-bit decimal display)	Command unit	It counts and displays the number of input position instructions .	1073741824 command unit display： 
F10.14	Encoder position deviation counter (32-bit decimal display)	Encoder unit	Encoder position deviation = Input position instruction sum (encoder unit) – Total encoder feedback pluses (encoder unit)	10000 encoder unit display： 
F10.16	Feedback pulse counter (32-bit decimal display)	Encoder unit	It displays counts and displays the pulses fed back by the servo motor encoder (encoder unit)	1073741824 encoder unit display： 
F10.18	Total power on time (32-bit decimal display)	H	It displays counts and displays the total servo drive power-on time.	436h Display： 

F10.20	AI1 sampling voltage	V	It displays the voltage of analog input 1.	10.00V Display：  -10.00V Display： 
F10.21	AI2 sampling voltage	V	It displays the voltage of analog input 2.	0.00V Display：  -10.00V Display： 
F10.22	Module temperature	℃	It displays the temperature of the power module inside the servo drive.	27℃ Display： 
F10.23	Position deviation counter (32-bit decimal display)	Command unit	Position deviation = Input position instruction sum (instruction unit) – Total encoder feedback pluses (instruction unit)	10000 Instruction unit： 
F10.25	Actual motor rotate speed	rpm	Actual motor rotate speed，accurate to 0.1rpm	3000.0rpm Display：  -3000.0rpm Display： 

F10.31	Real-time input position reference counter	Instruction unit	It displays the position reference counter before divided or multiplied by the electronic gear ratio. It is irrelative to the current servo state and control mode.	1073741824 instruction unit display: 
F10.46	Current fault detailed information	-	-	0-current fault display: 
F10.48	Average load rate	%	The ratio of average load torque to motor rated torque	100.0% display: 

5.3 Parameter setting

Parameter setting can be performed on the keypad. For details on the parameters, refer to Chapter 8 Description of Parameters. The following figure shows the keypad operation of switching the position control:

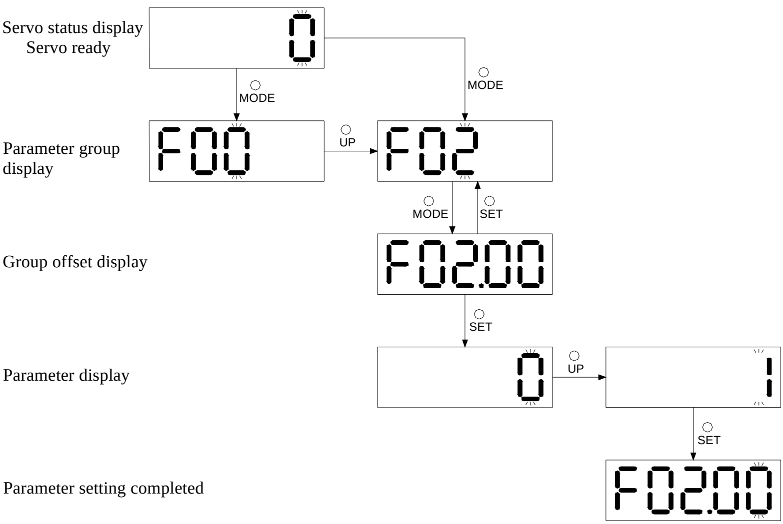


Fig.5-5 Parameter setting procedures

(1) MODE: Switch the display mode and return to the upper-level menu.

(2) UP/DOWN: Increase or decrease the value of the current blinking digit.

(3) SHIFT: Shifting the blinking digit.

(4) SET: Store the current setting value or switch to the next-level menu.

(5) After parameter setting is completed, automatically return to the parameter group display (F02.00 interface).

5.4 User password

After the user password function (F18.00) is enabled, only the authorized user has the parameter setting rights; other operations cannot operate and read any parameter except viewing the status through pressing "SHIFT" key and check the value of C-X.

Setting user password:

The following figure shows the operation procedure of setting the password to "00001".

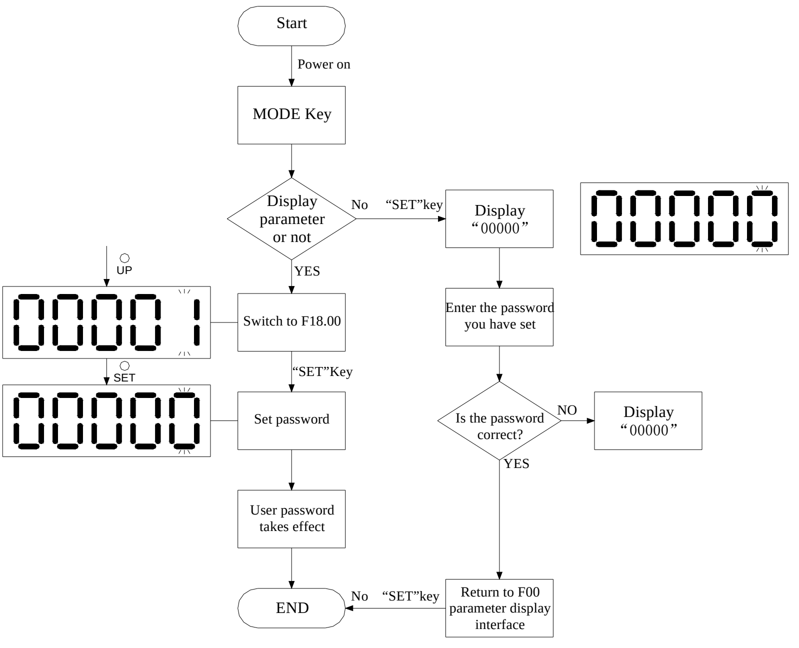


Fig.5-6 User password setting procedure

(1) Change password:

After the password is valid, first press the "MODE" button to enter the current password input interface (display 00000), input the current password, press "SET" to enable the parameter setting permission. Go to [F18.00] again to set a new password. The setting method is the same as the above figure.

(2) Cancel password

After the password is valid, first press the “MODE” button to enter the current password input interface (display 00000), input the current password, press “SET” to enable the parameter setting permission. Setting the [F18.00] parameter value to "00000" again means that the user password is canceled.

5.5 Common functions

5.5.1 Jog running

Note

When using the jog function, set the S-ON signal inactive. Otherwise, this function cannot be used.

Use the jog running function to perform trial running on the servo motor and drive.

(1) Operation Method

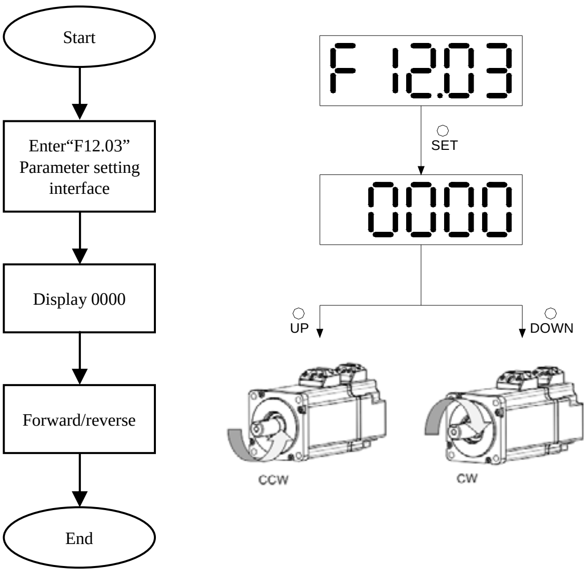


Fig.5-7 Jog running setting procedure

Note

Press “UP” or “DOWN” key to make the servo motor rotates in forward or reverse direction. After you release the key, the servo motor stops running Immediately.

(2) Exiting Jog Running

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

(3) Enter F05.05 to set the speed of joy running.

5.5.2 Forced DI/DO signal

The DI and DO signals can be allocated with functions by setting group F02 and F03 parameters via keypad or host controller communication. Then, the host controller can control functions of the servo drive via DIs and the servo drive outputs DO signals to the host controller.

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

When forced DI/DO is used, the logics of both physical DIs and VDIs are determined by forced input.

(1) Forced DI signal

After this function is enabled, all DI levels are controlled by forced input **[F12.08]**, and are irrelative to the external DI signal state. Operation method:

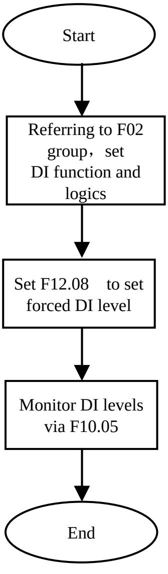


Fig.5-8 DI Signal forced input setting

Set the forced DI level via **[F12.08]**. The keypad displays the value in hexadecimal, and needs to be converted to binary for viewing: "1" indicating high level and "0" indicating low level.

Group **[F02 group]** parameters set the DI logics. **[F10.05]** monitors the DI level status. The value displayed on the keypad is directly the level and that read from the commissioning software is a decimal number.

For example:

If it is required that the DI1 function is invalid and functions allocated to DI2 to DI8 are valid (all logics of the DIs are low level active), set as follows:

"1" indicates high level and "0" indicates low level, and the binary value is 111111110, corresponding to hexadecimal “FE”. Set **[F12.08]** to "FE" on the keypad.

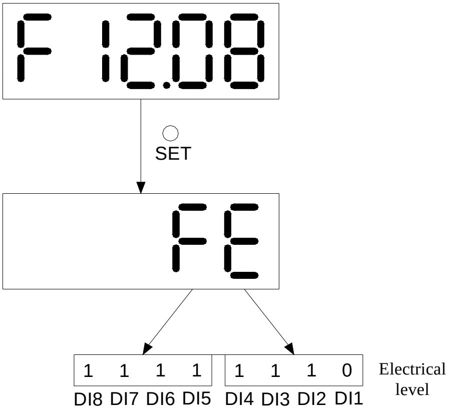


Fig.5-9 Set F12.08

[F10.05]Monitor the DI level state:

If DIs are normal, **[F10.05]** display value is always the same as **[F12.08]** display value.

That is, DI1 is low level and DI2 to DI9 are high level on the keypad display, and **[F10.05]** value read from the commissioning software is 254 (decimal).The keypad display is as follows:

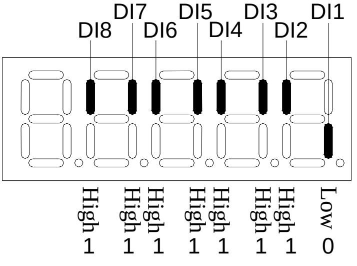


Fig.5-10 DI level states in F10.05

(2) Forced output of DO Signal

After this function is enabled, all DO levels are controlled by forced output **[F12.09]**, and are irrelative to the external DO signal state.

Note

In applications where the servo motor drives the vertical axis, when the brake output signal (DO function 9: BK) is active, the brake will be released and the load may fall. Take protection measures against falling on the machine.

Operation method:

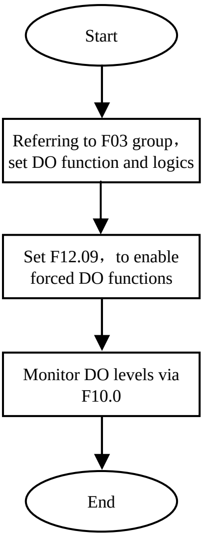


Fig.5-11 DO Signal forced output setting

[F12.09] sets whether the forced DO functions are valid. The keypad displays the value in hexadecimal, and needs to be converted to binary for viewing: "1" indicating DO function valid and "0" indicating DO function valid.

Set the DO logics via **[F03 group]** parameters. Monitor the DO level states via **[F10.06]** parameter. The value displayed on the keypad is directly the level and that read from the commissioning software is a decimal number.

Setting as follows:

"1" indicates DO function valid and "0" indicates DO function invalid, and the binary value is 11110, corresponding to hexadecimal 1E. Set **[F12.09]** to "1E" on the keypad.

Figure 5-12 Setting **[F12.09]**

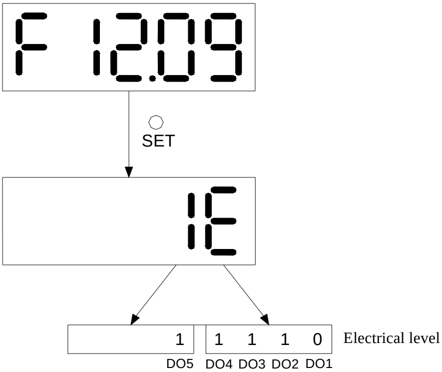


Fig.5-12 F12.09 Setting

Monitor the DO level states via **[F10.06]** as follows:

If the logics of all five DOs are low level active, DO1 is high level and DO2 to DO5 are low level, the corresponding binary is 00001 and the value of **[F10.06]** read from the commissioning software is 1 (decimal). The keypad display is as follows:

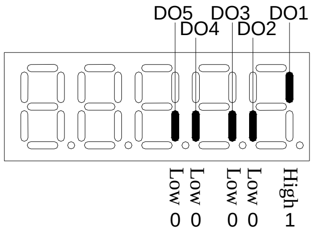


Fig.5-13 F10.06 Display when all DOs are low level active

6 Control mode

The servo system consists of three main parts: servo drive, servo motor and encoder.

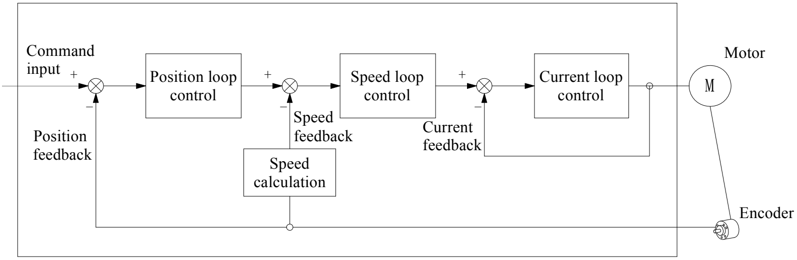


Fig.6-1 Servo system control diagram

The servo drive is the control core of the servo system. Through the processing of the input signal and the feedback signal, the servo drive can perform precise position, speed and torque control of the servo motor. Namely position, speed, torque and hybrid control mode. Among them, position control is the most important and most common control mode of the servo system.

The control operation modes are as follows：

The position control operation mode is that the position of the motor controlled by the position command. The motor target position is determined by the total number of position commands, and the position command frequency determines the motor rotation speed. The position command can be given by an external pulse input, the total number of internal positioncommands, and the speed limit combination. With an internal encoder (servo motor with encoder) or an external encoder (full closed loop control), the servo drive enables fast and precise control of the position and speed of the machine. Therefore, the position control mode is mainly used in occasions where positioning control is required, such as a robot, a mounter, an engraving and milling engraving (pulse sequence command), a numerically controlled machine tool, and the like.

The speed control mode is the speed command that controls the speed of the machine. The servo drive provides fast, precise control of the mechanical speed through digital, analog voltage or communication-given speed commands. Therefore, the speed control mode is mainly used to control the speed of the occasion, or use the host computer to achieve position control, the upper machine output as a speed command input servo drive, such as analog engraving and milling machine.

The current of the servo motor is linear with the torque. Therefore, the control of the current can achieve the control of the torque.

The torque control operation mode refers to controlling the output torque of the motor through a torque command. The torque command can be given by digital, analog voltage or communication. The torque control mode is mainly used in equipments where the stress of materials is strictly required, such as some tension control devices, rewinding and unwinding devices. The torque setting value must ensure that the material stress is not affected by the variation of the winding radius.

6.1 Basic setting

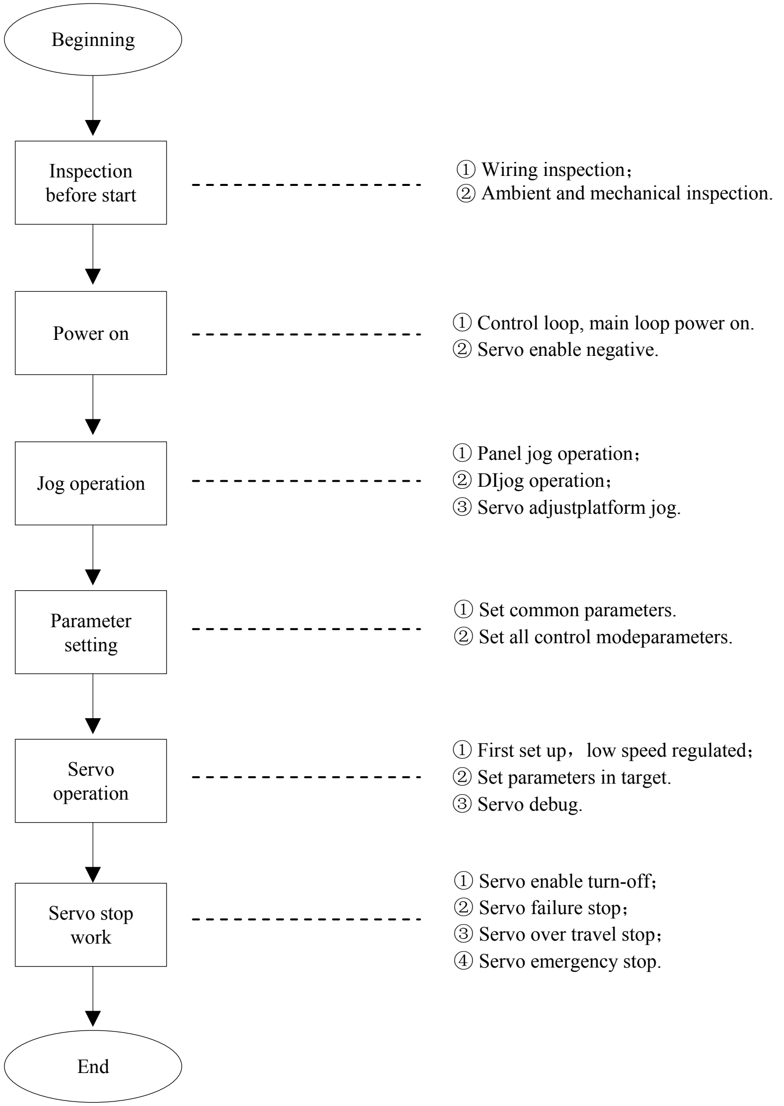


Fig.6-2 Servo Operation Process

6.1.1 Inspection before running

Check the servo drive and servo motor before running:

Table 6-1 check table parameter before running

Record	Item	Content
Wiring		
☐	1	The control circuit power input terminals (L1C, L2C) and main circuit power input terminals (L1, L2, L3) of the servo drive must be correctly connected.
☐	2	The servo drive main circuit output terminals (U, V, W) and the servo motor main circuit cable (U, V, W) must be in phase and properly connected.
☐	3	The main circuit power input terminals (L1, L2, L3) and main circuit output terminals (U, V, W) of the servo drive must not be short-circuited.
☐	4	The servo drive's control signal cables are wired correctly: external signal lines such as brake and overtravel protection are reliably connected.
☐	5	The servo drive and servo motor must be reliably grounded.
☐	6	When using an external braking resistor, the short wiring between the drivers RB and B must be removed.
☐	7	The force of all cables is within the specified range.
☐	8	The wiring terminals have been insulated.
Ambient and machinery		
☐	1	There are no foreign objects such as wire ends and metal chips that cause short-circuiting of signal wires and power wires inside and outside the servo driver.
☐	2	The servo drive and the external braking resistor are not placed on the combustibles.
☐	3	The servo motor installation, shaft and mechanical connections must be reliable.
☐	4	The servo motor and the connected machine must be in a working condition.

6.1.2 Power on

(1) Switch on control loop power and main loop power

Turn on the control loop (L1C, L2C), and the main loop power supply (L1, L2 for single-phase 220V main loop power supply terminals; L1, L2, L3 for three-phase 220V or 380V main loop power supply terminals).

① After the control loop power and main loop power are turned on, the bus voltage indicator shows no abnormality, and the panel display displays “8.8.8.8.8.” → “P.off” → “Monitor status” in sequence, indicating that the servo drive is available. In the running state, wait for the host computer to give a servo enable signal.

② If the drive panel display shows “P.off” consistently, please refer to “9.1 Fault and Warning Handling at Startup” to analyze and eliminate the cause of the fault.

③ If the drive panel display shows other fault codes, please refer to “9.2.1 Fault and Warning Code Table” to analyze and eliminate the cause of the fault.

(2) Set servo enable (S-ON) disabled (OFF)

When using servo enable, first configured one DI terminal of the servo driver as function 1 (FunIN.1: S-ON, servo enable), and determine the valid logic of the DI terminal. Then it is disabled by the host computer communication or an external switch.

Code	Item	Function item	Function
FunIN.1	S-ON	Servo enable	Disabled: servo motor power off; Valid: servo motor power on.

6.1.3 Jog running

Please use the jog operation to confirm whether the servo motor can rotate normally, and there is no abnormal vibration or abnormal sound when rotating. The jog running function can be used in three ways: panel, two external DI, and our driver debugging platform. The motor uses the current function code **[F05.05]** to store the value as the jog speed.

(1) Panel running

Enter the jog mode by panel operation **[F12.03]**. At this time, the panel displays the default value of **[F05.05]** jog speed. The UP/DOWN button can realize the forward/reverse jog operation. When you press the MENU button, you can exit the jog mode at any time. For operation and display, please refer to "5.5.1 Jog Operation"

Code	Item	Set range	Unit	Function	Setting mode	Effective mode	Factory default
F05.05	Jog speed setting	0～6000	rpm	Set the speed command value of JOG jog form	Running setting	Effective immediately	100

(2) DIjog running

Note

> The DI jog operation is not affected by the servo control mode, that is, the DI jog operation function can be performed in any control mode.

Two external DI terminals are configured, which are set to FunIN.18 and FunIN.19 respectively. After setting the **[F05.05]** jog speed value, the servo enable S-ON is turned on and the DI status is jogged.

Code	Item	Function item	Function
FunIN.18	JOGCMD+	Forward jog	Valid: input according to the given command; Invalid: Run command stops input.
FunIN.19	JOGCMD-	Negative jog	Valid: Reverse input according to the given command; Invalid: Run command stops input.

(3) Servo adjust platform jog running

Open the drive operation interface of our company's drive debugging platform, set the **[F05.05]** jog speed value, and realize the jog forward and reverse running function through the forward and reverse buttons on the interface. When the jog running interface is closed, the jog mode is exited.

6.1.4 Command pulse reverse inversion

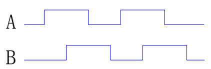
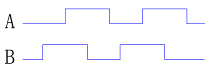
Under the position control, by setting **[F04.02: Command pulse inversion],** the selection direction of the motor can be changed without changing the polarity of the input command.

Code	Item	Setting range	Function	Setting mode	Effective mode	Factory default
F04.02	Command pulse inversion	0：Invalid 1：inverse	Command pulse inversion	Stop setting	Effective immediately	0

[F04.02] when changing, the shape of the servo driver output pulse and the positive and negative of the monitoring parameters will also change.

6.1.5 Output pulse phase selection

The output pulse of the servo driver is the A phase + B phase quadrature pulse. By setting the output pulse phase **[F04.28]**, the phase relationship between the A-phase pulse and the B-phase pulse can be changed without changing the motor rotation direction.

Code	Item	Setting range	Function	Setting mode	Effective mode	Factory default
F04.28	Pulse dividing output phase	0: A advance than B 1: A lag than B	Set output pulse phase relation A advance than B 90°  A lag B 90° 	Stop setting	Effective immediately	0

6.1.6 Brake setting

The brake is a mechanism that prevents the servo motor from moving in the non-operating state when the servo drive is in the non-operating state, so that the motor is kept in position so that the moving part of the machine does not move due to its own weight or external force.

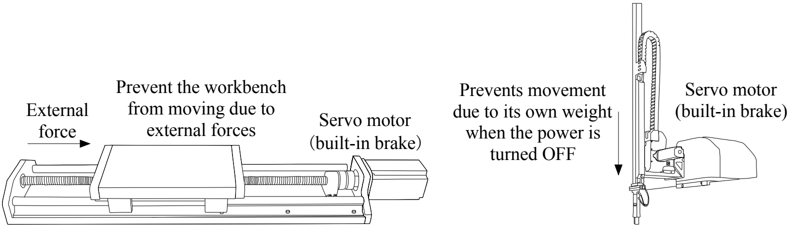


Fig.6-3 Motor brake application diagram

Note

(1) The brake mechanism built into the servo motor is a non-energized type fixed-purpose mechanism. It cannot be used for braking purposes. It is used only when the servo motor is kept in a stopped state.
(2) The electromagnetic brake coil has no polarity. When the permanent magnet brake is used, the brake coil has polarity.
(3) Servo enable (S-ON) should be turned off after the servo motor is stopped.
(4) When the motor with the built-in brake is running, the brake may be squeaky and has no effect on the function.
(5) When the brake coil is energized (the brake is open), magnetic flux leakage may occur at the shaft end or the like. Please pay attention when using an instrument such as a magnetic sensor near the motor.

6.1.6.1 Brake wiring

The brake input requires the user to prepare a 24V power supply. The standard connection example of the brake signal BK and the brake power supply is as follows:

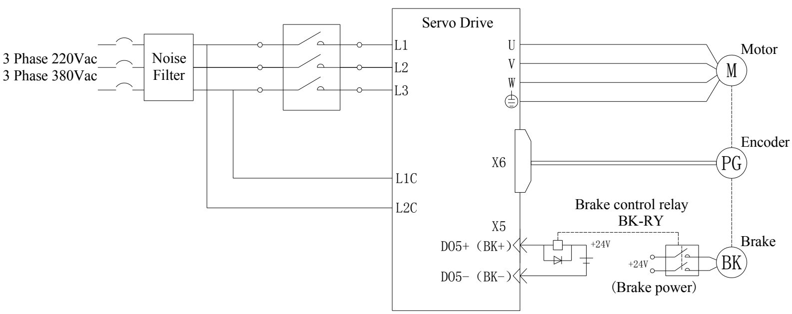


Fig.6-4 Brake wiring diagram

Brake wiring notice point：

(1) The length of the motor brake cable needs to fully consider the voltage drop caused by the cable resistance. The brake operation needs to ensure that the input voltage is at least 21.6V. The brake parameter table of our motor is shown in the following table:

Table 6-2 Brake parameter

Motor base mode	Rated torque (Nm)	Supply voltage (V) ±10%	Supply current range (A)	Break away time (ms)	Response time (ms)
40 Base	1	24	0.23～0.27	20	8
60 Base	2	24	0.40～0.50	30	10
80、90 Base	4	24	0.52～0.86	55	63
Motor smaller than110 and 130-10N	8	24	0.68～0.85	72	87
Motor bigger than 130-10N (Include)	16	24	0.85～1.33	95	110
180-35N Motor smaller	30	24	0.85～1.80	115	130
180-35N (include) Motor bigger than	50	24	1.47～1.70	120	135

(2) It is best not to share the power supply with other electrical appliances to prevent the brakes from malfunctioning due to the voltage or current reduction caused by the operation of other electrical appliances.

(3) It is recommended to use a cable of 0.5mm^2 or more.

6.1.6.2 Brake software setting

For servo motors with brakes, one DO terminal of the servo drive must be configured as function 9 (FunOUT.9: BK, brake output), and the DO logic valid logic is determined, and **[F01.06]** needs to be set to 1 , enable the brake control.

Code	Item	Function name	Function
FunOUT.9	BK	Brake output	Invalid: the brake power is turned on, the brake is actuated, and the motor is in the position lock state; Valid: the brake power supply is disconnected, the brake is released, and the motor can be rotated;
F01.06	Whether the loose brake control is effective	Whether the loose brake control is effective	0: invalid 1: valid

6.1.6.3 Servo drive state brake timing

(1) Brake timing when the servo motor is at rest

Note

(1) The brake mechanism built into the servo motor is a non-energized type fixed-purpose mechanism. It cannot be used for braking purposes. It is used only when the servo motor is kept in a stopped state.
(2) The electromagnetic brake coil has no polarity. When the permanent magnet brake is used, the brake coil has polarity.
(3) Servo enable (S-ON) should be turned off after the servo motor is stopped.
(4) When the motor with the built-in brake is running, the brake may be squeaky and has no effect on the function.
(5) When the brake coil is energized (the brake is open), magnetic flux leakage may occur at the shaft end or the like. Please pay attention when using an instrument such as a magnetic sensor near the motor.

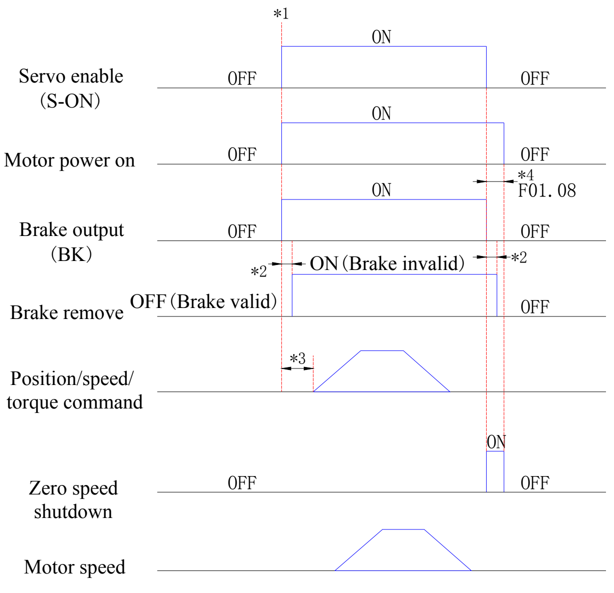


Fig.6-5 Brake timing diagramwhen the servo motor is at rest

Note

*1: When the servo enable is ON, the brake output is turned ON and the motor enters the power-on state.
*2: Refer to the motor specifications for the delay time of the brake release unit operation. For details, see "2.3.3 Servo motor specifications.
*3: When the brake output is turned on to the input instruction, please wait for **[F01.07]** or longer.
*4: When the servo motor is stationary (motor speed is lower than **[F01.09]**), when the servo is turned OFF, the brake output is turned OFF at the same time. After [F01.08], the brake output can be set OFF. The delay of the motor entering a non-energized state.

Code	Item	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F01.07	Brake output ON to command receiving delay	0～1000	ms	Setting a delay time for the servo driver to start receiving the input command from the brake output (BK) ON; F01.08 has no effect when the brake output (BK) is not assigned.	Stop setting	Effective immediately	250
F01.08	Brake output OFF to motor no power delay	1～1000	ms	Set the delay time for the motor to enter the non-energized state and the brake output (BK) OFF. When F01.06=0, F01.08 has no effect.	Run setting	Effective immediately	150

(2) Brake timing when the servo motor rotates

When the servo enable is turned from ON to OFF, if the current motor speed is greater than or equal to 20 rpm, the drive operates in the rotary brake timing.

Note

(1) When the servo enable is turned from OFF to ON, do not input the position/speed/torque command during [F01.07] time, otherwise it will cause loss or operation error;
(2) When the servo motor rotates, the servo enable is turned OFF, and the servo motor enters the zero speed stop state, but the brake output needs to be decelerated until [F01.09] is set to OFF;
(3) After the brake output changes from ON to OFF, the motor is still energized for a certain period of time to prevent the mechanical movement from moving due to its own weight or external force.

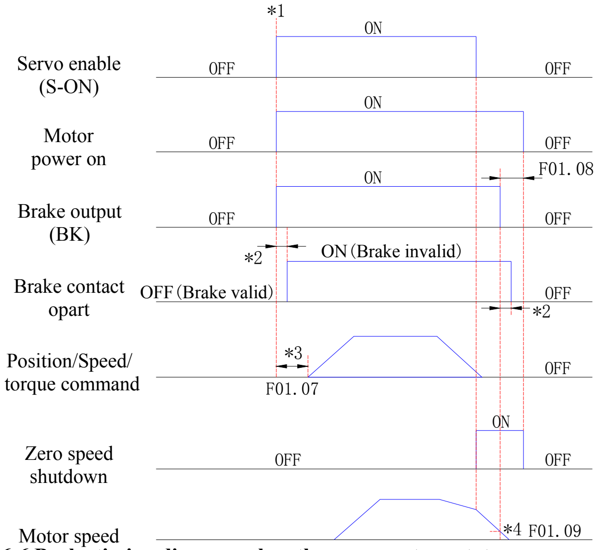


Fig.6-6 Brake timing diagram when the servo motor rotates

Note

(1) When the servo enable is ON, the brake output is turned ON and the motor enters the energized state;
(2) Refer to the motor specifications for the delay time of the brake contact operation. For details, see "2.3.3 Servo motor specifications 6" Electrical specifications of the brake motor";
(3) When the brake output is turned ON to the input command, please wait for **[F01.07]** or longer;
(4) When the servo motor is turned off and the servo is turned OFF, **[F01.09]** and **[F01.08]** can be used to set the delay of the brake output OFF after the servo enable is turned OFF, and then delay after the brake output is turned OFF. When **[F01.08]**, the motor enters the non-energized state.

Code	Item	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F01.09	Rotating state, the speed threshold when the brake output is OFF	0～3000	rpm	Set the motor speed threshold when the brake output (BK) is turned OFF when the motor is in the rotation state; F01.09 has no effect when the brake output (BK) is not assigned.	Run setting	Effective immediately	30

6.1.7 Braking setting

When the torque and speed of the motor are opposite, energy is transmitted back from the motor to the driver, causing the bus voltage to rise. When it rises to the braking point, energy can only bedissipated through the braking resistor. At this time, the braking energy must be consumed according to the braking requirements, otherwise the servo drive will be damaged. The braking resistor can be built in or externally connected. Built-in and external braking resistors cannot be used at the same time. The relevant specifications of the ESS200P driver braking resistor are as follows:

Table 6-3 ESS200P Series braking resistor specification

Drive type	Build-in braking resistor specification			External braking resistor Minimum allowable resistance value (Ω) (F01.11)
	Resistor (Ω)	Power Pr (W)	Can handle power Pa (W)	
ESS200P-2S101	-	-	-	60
ESS200P-2S201	-	-	-	60
ESS200P-2S401	-	-	-	60
ESS200P-2S751	30	60	30	30
ESS200P-2T102	30	80	40	30
ESS200P-2T152	30	80	40	20
ESS200P-2T202	15	120	60	15
ESS200P-2T302	15	120	60	15
ESS200P-4T102	60	60	30	60
ESS200P-4T152	60	60	30	60
ESS200P-4T202	60	80	40	40
ESS200P-4T302	60	80	40	30
ESS200P-4T442	30	120	60	30
ESS200P-4T552	30	120	60	30
ESS200P-4T752	-	-	-	30

(1) No external load torque

If the motor reciprocates back and forth, the kinetic energy will be converted into electric energy and fed back to the busbar capacitor. When the bus voltage exceeds the braking voltage, the braking resistor will consume excess feedback energy. Taking the motor no load from 3000 rpm to stationary, the motor speed curve is as follows:

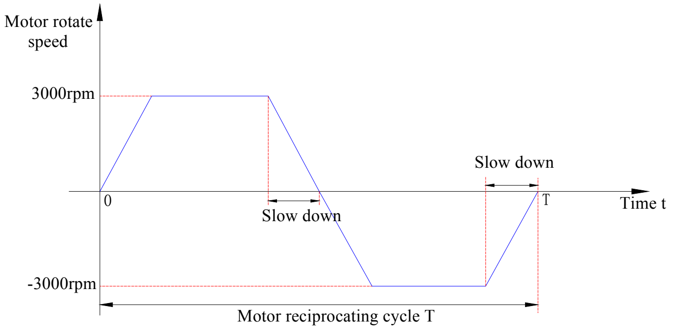


Fig.6-7 Example of motor speed curve without external load torque

(2) Energy calculation data

The energy data generated by the 220V motor from no load 3000rpm to stationary is as follows:

Capacity	Servo motor type	Classify	Rotor inertia J(10-4kgm^2)	Braking energy generated from no load at 3000 rpmEo (J)	The maximum braking energy that the capacitor can absorbEc (J)
100W	EMS-04101L-30S-xxxA	Small capacity, Small inertia	0.05	0.25	5
200W	EMS-06201L-30S-xxxA	Small capacity, Small inertia	0.17	0.84	10
	EMS-06201M-30S-xxxA	Small capacity, Medium inertia	0.26	1.28	10
400W	EMS-06401L-30S-xxxA	Small capacity, Small inertia	0.29	1.43	18
	EMS-06401M-30S-xxxA	Small capacity, Medium inertia	0.40	1.98	18
	EMS-08401H-30S-xxxA	Small capacity, Big inertia	1.05	5.19	18
730W	EMS-08731H-20S-xxxA	Small capacity, Big inertia	2.63	13.00	25
750W	EMS-08751L-30S-xxxA	Small capacity, Small inertia	1.82	9.00	25
	EMS-09751H-30S-xxxA	Small capacity, Big inertia	2.45	12.11	25
1000W	EMS-08102L-25S-xxxA	Small capacity, Small inertia	2.97	14.68	13
	EMS-13102M-25S-xxxA	Small capacity,	8.50	42.03	13

		Medium inertia			
	EMS-13102H-10S-xxxA	Small capacity, Big inertia	19.40	95.93	13
1200W	EMS-08122L-30S-xxxA	Medium capacity, Small inertia	2.97	14.68	13
1500W	EMS-11152M-30S-xxxA	Medium capacity, Mediuminertia	6.30	31.15	18
	EMS-13152M-25S-xxxA	Medium capacity, Medium inertia	12.60	62.31	18
	EMS-13152H-15S-xxxA	Medium capacity, Big inertia	19.40	95.93	18
1800W	EMS-11182L-30S-xxxA	Medium capacity, Small inertia	7.60	37.58	26
2000W	EMS-13202M-25S-xxxA	Medium capacity, Medium inertia	15.30	75.65	26
2600W	EMS-13262M-25S-xxxA	Medium capacity, Medium inertia	19.40	95.93	26
2900W	EMS-18292H-10S-xxxA	Medium capacity, Big inertia	96.40	476.70	39
3000W	EMS-15302M-20S-xxxA	Medium capacity, Medium inertia	38.80	191.87	39
	EMS-18302H-15S-xxxA	Medium capacity, Big inertia	70.70	349.61	39

The energy data generated by the 380V motor from no load 3000rpm to stationary is as follows:

Capacity	**Servo motor type**	**Classify**	**Rotor inertia J(10-4kgm^2)**	**Braking energy generated from no load at 3000 rpmEo (J)**	**The maximum braking energy that the capacitor can absorbEc (J)**
1000W	EMS-13102M-25T-xxxA	Medium capacity, Medium inertia	8.50	42.03	26
	EMS-13102H-10T-xxxA	Medium capacity, Big inertia	19.40	95.93	26
1200W	EMS-13122L-30T-xxxA	Medium capacity, Small inertia	8.50	42.03	39
1500W	EMS-13152M-25T-xxxA	Medium capacity, Medium inertia	12.6	62.31	39
	EMS-13152M-15T-xxxA	Medium capacity, Medium inertia	19.40	95.93	39
2000W	EMS-13202M-25T-xxxA	Medium capacity, Big inertia	15.30	75.65	52

2300W	EMS-13232H-15T-xxxA	Medium capacity, Medium inertia	27.70	136.97	52
2600W	EMS-13262M-25T-xxxA	Medium capacity, Medium inertia	19.40	95.93	79
2700W	EMS-18272H-15T-xxxA	Medium capacity, Big inertia	65.00	321.42	79
3000W	EMS-18302H-15T-xxxA	Medium capacity, Big inertia	70.00	346.15	79
3800W	EMS-13382L-25T-xxxA	Medium capacity, Small inertia	27.70	136.97	116
4300W	EMS-18432M-15T-xxxA	Medium capacity, Medium inertia	96.40	476.70	116
4500W	EMS-18452M-20T-xxxA	Medium capacity, Medium inertia	79.60	393.62	116
5500W	EMS-18552M-15T-xxxA	Medium capacity, Medium inertia	122.50	605.76	145
7500W	EMS-18752M-15T-xxxA	Medium capacity, Medium inertia	167.20	826.80	198

If you know the time (T) required to complete the entire braking process, you can calculate whether you need an external resistor and the power of the external resistor according to the selection process and formula in Fig.6-8.

(3) Braking resistor selection process

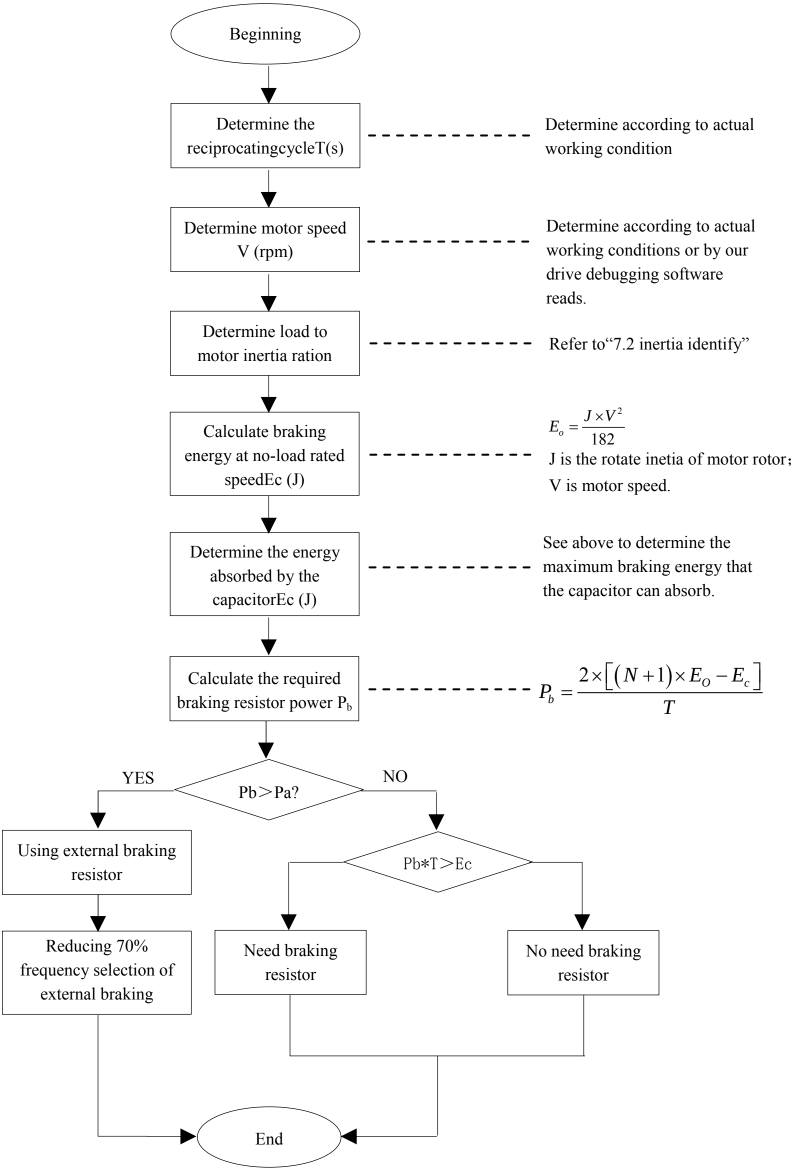


Fig.6-8 Braking resistor type selection diagram

Here, taking the motor from 3000 rpm to standstill as an example, and assuming that the load inertia is N times of the motor inertia, the braking energy is (N+1)*Eo when decelerating from 3000 rpm to 0. Excluding the energy Ec absorbed by the capacitor, the required braking resistor needs to consume (N+1)*Eo-Ec Joule. Assuming that the reciprocating cycle is T, the braking resistor power is required to be 2*[(N+1)*Eo-Ec]/T. For the Eo and Ec values of the specific motor, please refer to "6.1.7 (2) Energy calculation data".

Code	Item	Setting range	Function	Setting mode	Effective mode	Factory default
F01.16	Braking resistor setting	0: adopt build-in braking resistor 1: adopt external braking resistor 2: No need braking resistor, all absorbed by capacitor	Setting the mode that energy absorbed and released by braking resistor	Run setting	Effective immediately	0

Take the 220V 1500W medium capacity, medium inertia motor (EMS-11152M-30S-xxxA) as an example. If the reciprocating cycle is T=2s, the maximum speed is 3000rpm, and the load inertia is 0.5 times of the motor inertia, the braking resistor power is required:

$$P_b = \frac{2\times\left[\left(0.5+1\right)\times 31.15-18\right]}{2} = 28W$$

Less than the built-in braking resistor can handle the capacity Pa40W, therefore, the built-in braking resistor can meet the requirements.If the load inertia in the above assumptions is changed from 0.5 times to 4 times, and other conditions are unchanged, the braking resistor power is required:

$$P_b = \frac{2\times\left[\left(4+1\right)\times 31.15-18\right]}{2} = 137.75W$$

Greater than the built-in braking resistor can handle the power P_a40W. Therefore, an external braking resistor is required. The external braking resistor power is recommended to be P_b / (1-70%) = 459W.

(4) Braking resistor connection and setting

①Adopt external braking resistor:

When P_b>P_a, connect an external braking resistor. It is recommended to use the external braking resistor when the frequency is reduced by 70%, i.e: P_r=P_b/(1-70%), and ensure that it is greater than the minimum resistance value of the driver. The two ends of the external braking resistor are connected to "(+)" and "B" respectively, and the short wiring between the terminals "B" and "RB" is removed.

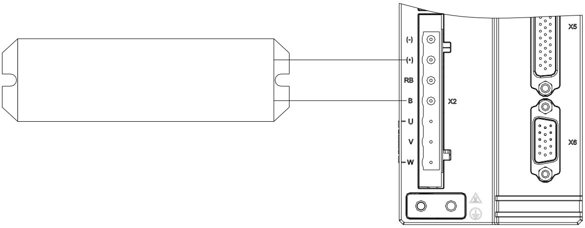


Fig.6-9 External braking resistor connection diagram

Note

For the wire specifications to be used, refer to the cable information of "RB" and "B" in "4.2.3 Recommended Models and Specifications for Main Circuit Connection Cables".

Code	Item	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F01.11	Minimum resistance of the brake resistor allowed by the drive	1～65535	Ω	Check the minimum allowable resistance of the external braking resistor.	display	-	Depend on mode
F01.17	External braking resistor power	0～65535	W	Set the power of the actual external braking resistor selected. note: The actual external braking resistor power should not less than the "brake power calculation value"	Run setting	Effective immediately	0
F01.18	External braking resistance value	1～65535	Ω	Set the resistance of the actual external braking resistor. note: The actual external braking resistor value (F01.18) should not be less than the “minimum allowable resistance (F01.11)”, otherwise Er.403 (external braking resistor too small) will occur.	Run setting	Effective immediately	65535

Note

(1) Please correctly set the resistance of the external braking resistor **[F01.18]** and power **[F01.17]**, otherwise the function will be affected.
(2) If an external braking resistor is used, determine if the resistance value meets the minimum allowable resistance limit.
(3) In the natural environment, when the braking resistor can handle the power (average value) at the rated capacity, the temperature of the resistor will rise above 120 °C (in the case of continuous braking). For safety reasons, use forced cooling to reduce the brake resistor temperature; or use a brake resistor with a thermal switch. For the load characteristics of the braking resistor, please consult the manufacturer.
(4) Finally, when using an external braking resistor, the resistance coefficient of heat dissipation must be set according to the heat dissipation conditions of the resistor.

Code	Item	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F01.15	Resistance heat dissipation coefficient	10～100	%	When using external braking resistor or internal braking, the heat dissipation coefficient (F01.15) is generally not more than 30% when the heat dissipation coefficient is naturally cooled. When forced air cooling, the heat dissipation coefficient generally does not exceed 50%.	Run setting	Effective immediately	30

Note

The greater the heat dissipation coefficient of the resistor, the higher the efficiency of braking.

②Use built-in brake resistance:

When $P_b<P_a$ and $P_b\times T>Ec$, the built-in braking resistor is required. At this time, set **[F01.16]** to 0. The drive uses a built-in braking resistor and requires a short wiring between terminals "B" and "RB".

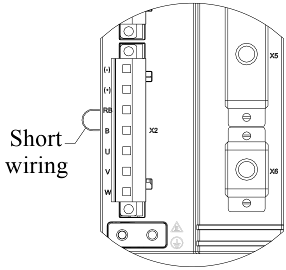


Fig.6-10 Shortwiringdiagram for built-in braking resistor

Code	Item	Setting range	Function	Setting mode	Effective mode	Factory default
F01.12	Build in braking resistor power	Can't set, depends on motor	Check build in braking resistor power	display	-	Depend on motor
F01.13	Build in braking resistance value	Can't set, depends on motor	Check build in braking resistance value (65535 means no build in resistor)	display	-	Depend on motor

③No need to use braking resistor:

1> When $P_b\times T<E_c$, there is no need to connect the braking resistor, and the braking energy can be absorbed only by the bus capacitor. In this case, set **[F01.16]** to 2.

2> There is external load torque and the motor is in power generation.

The motor torque direction is the same as the direction of rotation, and the motor outputs energy to the outside. However, in some special occasions, the motor torque output is opposite to the direction of rotation. At this time, the motor is negatively operated, and external energy is generated by the motor to be recharged to the drive.

3> When the load is in continuous power generation, it is recommended to adopt a common DC bus scheme.

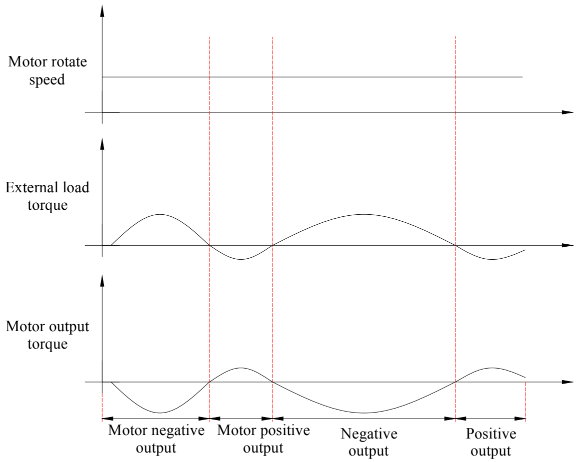


Fig.6-11 Example of curve in the presence external load torque

Taking 750W (rated torque 2.39Nm) as an example, when the external load torque is 60% of the rated torque and the speed reaches 1500 rpm, the power fed back to the driver $(60\% \times 2.39) \times (1500 \times 2\pi / 60) = 225W$ Considering that the braking resistor needs to be down-clocked by 70%, the external braking resistor power is 225/(1-70%)=750W and the resistance is 50Ω.

6.1.8 Servo operation

(1) Set servo enable (S-ON) to active (ON)

The servo drive is in the operational state and the display enters the monitoring state. However, since there is no command input at this time, the servo motor does not rotate and is in the lockedstate.

(2) After inputting the command, the servo motor rotates.

Table 6-4 Servo operation guidance

Record	Item	Content
□	1	When first running, set the appropriate commands to make the motor rotate at a low speed to confirm that the motor is rotating correctly.。
□	2	Observe that the direction of motor rotation is correct. If the motor steering is found to be opposite to the expected one, check the input command signal and command direction setting signal.
□	3	If the motor rotates in the right direction, you can use the drive panel or our drive debugging platform to observe the actual speed of the motor F10.00, average load factor F10.48 and other parameters.
□	4	After checking the above motor running condition, the relevant parameters can be adjusted to make the motor work in the expected working condition.
□	5	Refer to "Chapter 7 Adjustment" to debug the servo drive.

(3) Power on timing diagram

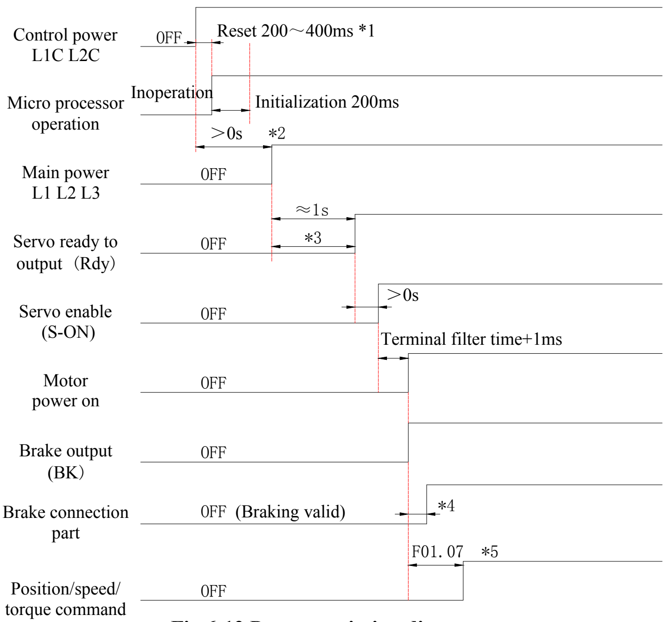


Fig.6-12 Power on timing diagram

Note

*1: Reset time, determined by the microprocessor +5V power supply setup time;
*2: 0s or more means that the time is determined by the actual main power-on action time;
*3: The charging time of the driver with different power is slightly inconsistent, from the main power supply to the servo preparation time is about 1 second;
*4: Refer to the motor related specifications for the delay time of the brake contact operation. For details, see "2.3.3 Servo motor specifications (5) Electrical specifications of the brake motor.
*5: **[F01.06=0]**, **[F01.07]** has no effect.

(4) Shutdown timing diagram when a warning or fault occurs

① Class 1 and 2 faults: free stop, keep free running

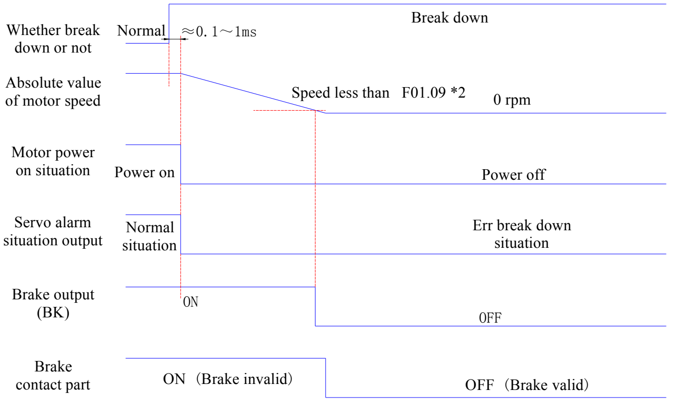


Fig.6-13 Free stop and free running state timing diagram when faults 1 and 2

② Class 2 fault non-brake: free stop, keep free running

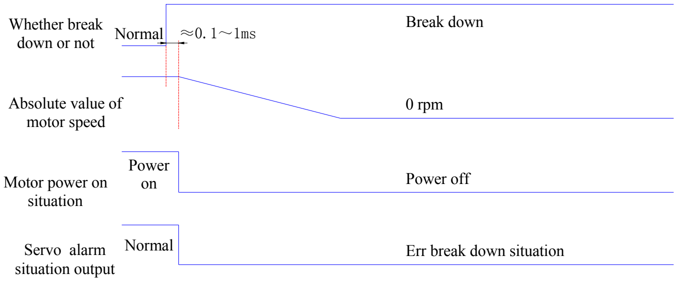


Fig.6-14 Free stop and free running state timing diagram when faults 1 and 2

③ Class 3 fault non-brake: No speed stop, keep free running

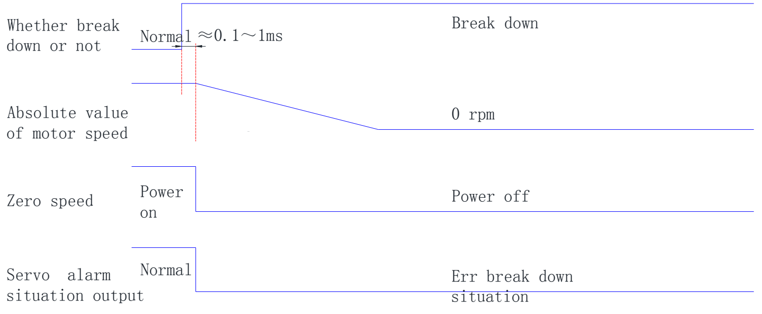


Fig.6-15 Timing diagram of zero-speed stop and free running state when fault 2 (non-brake)

④ Type 3 fault with brake: zerospeed stop, keep free running

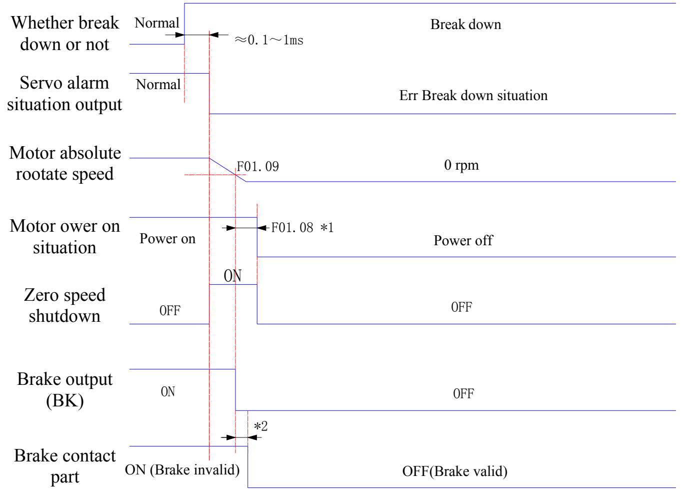


Fig.6-16 Timing diagram of zero stop mode free stop state when fault 3 (with brake)

Note

*1: When **[F01.06]** is set to 0, **[F01.08]** has no effect;
*2: Refer to the motor specifications for the delay time of the brake release operation. For details, see "2.3.3 Servo motor specifications (5) Electrical specifications of the brake motor".

The servo generates a type 4 warning: Er.405 (forward overtravel warning) and Er.406 (reverse overtravel warning), which will interrupt the current running state of the servo. The shutdown timing is as shown in 5.

⑤ Overtravel: Zero speed stop, keep position locked

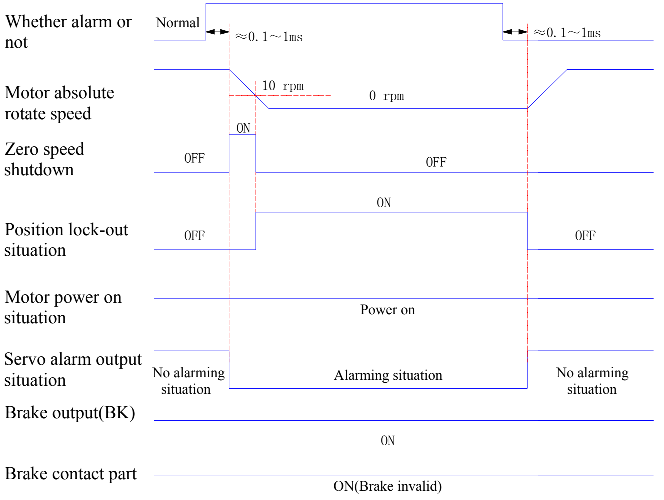


Fig.6-17 Timing diagram of the shutdown class warning

Except for the above three types of Er.402 (DI emergency shutdown alarm) and Er.408 (operation limit alarm), other warnings have no effect on the current status of the servo, as shown in Figure 6-18.

⑥ Non stop warning

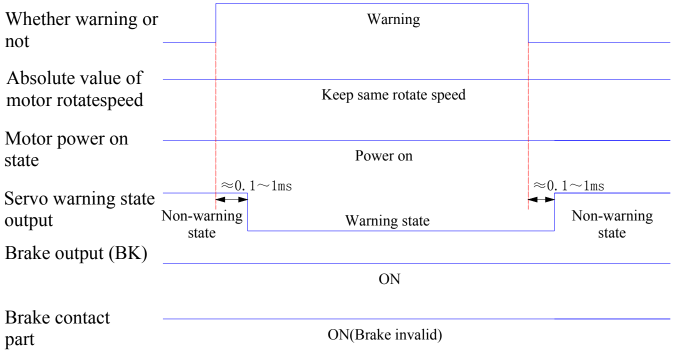


Fig.6-18 Non stop warning timing diagram

⑦ Fault reset

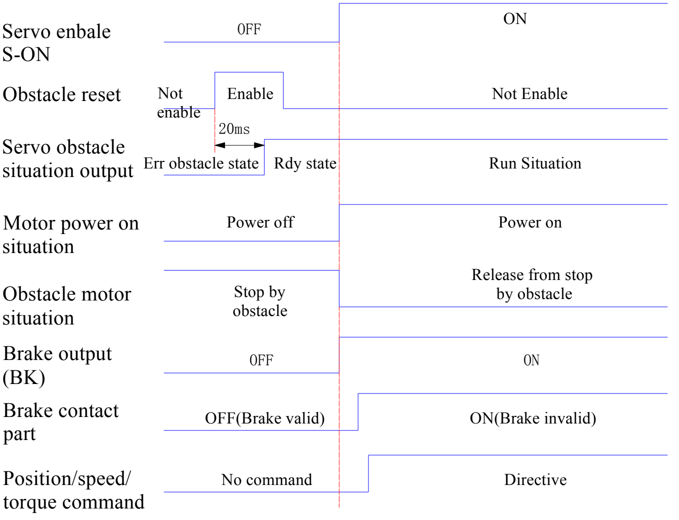


Fig.6-19 Fault reset timing diagram

6.1.9 Servo stop running

According to different stop modes, it can be divided into free stop and zero speed stop; according to the stop state, it can be divided into free running state and position keeping locked. details asfollows:

Table 6-5 Difference between them

Stop mode	Free stop	Zero speed stop
Downtime description	The servo motor is not energized and is free to decelerate to 0. The deceleration time is affected by mechanical inertia and mechanical friction.	The servo drive outputs the reverse braking torque and the motor quickly decelerates to zero.
Downtime characters	Smooth deceleration, mechanical shock is small, but the deceleration process is slow.	Rapid deceleration, there is a mechanical shock, but the deceleration process is fast.

Table 6-6 Difference between them

Free stop	Zero speed stop
After the motor stops rotating, the motor is not energized and the motor shaft can rotate freely.	After the motor stops rotating, the motor shaft is locked and cannot be rotated freely.

Servo downtime can be divided into the following categories:

(1) Servo enable (S-ON) OFF stop: Set the servo enable DI terminal to disable it.

Code	Item	Setting range	Function	Setting mode	Effective mode	Factory default
F01.03	Servo enable OFF stop mode selection	0: Free stop, keep free running 1: Zero speed stop, keep free running	When the servo enable is set to OFF, the motor stops.	Stop setting	Effective immediately	0

(2) Fault stop: The servo stop mode is different depending on the type of fault. See Chapter 9 for fault classification.

Code	Item	Setting range	Function	Setting mode	Effective mode	Factory default
F01.04	Failure NO.3 stop mode selection	0: Free stop, keep free running 1: Zero speed stop, keep free running	Set the motor stop mode when a type 3 fault occurs.	Stop setting	Effective immediately	0

(3) Overtravel stop:

Overtravel: refers to the mechanical movement beyond the safe range of motion involved.

Overtravel stop: refers to the safety function of the limit switch output level signal when the moving part of the machine exceeds the safe moving range, and the servo drive forcibly stops the servo motor.

Code	Item	Setting range	Function	Setting mode	Effective mode	Factory default
F01.05	Overtravel stop mode selection	0: Free stop, keep free running 1: Zero speed stop, keep the position locked 2: Zero speed stop, keep free running	Set the motor stop mode when an overtravel occurs.	Stop setting	Effective immediately	2

When the servo motor drives the vertical axis, if it is in the overtravel state, the work may fall. To prevent the work from falling, be sure to set the overtravel stop mode selection **[F01.05]** to "1: Zero speed stop, position lock status". In the case of linear motion, etc., be sure to connect the limit switch to prevent mechanical damage. In the overtravel state, the motor (workpiece) can be moved in reverse by inputting a reverse command.

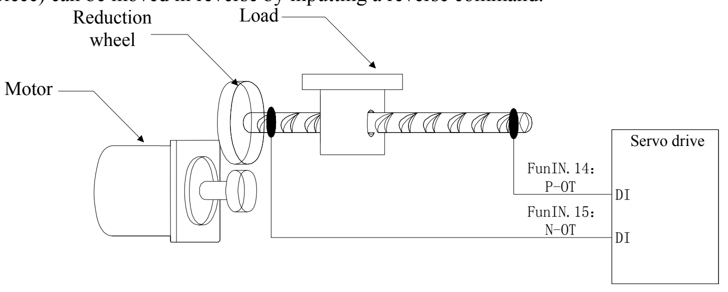


Fig.6-20 Limit switch installation diagram

When using the overtravel stop function, the two DI terminals of the servo drive should be configured as function 14 (FunIN.14: P-OT, forward overtravel switch) and function 15 (FunIN.15: N-OT, reverse). Overtravel switch) to receive the limit switch input level signal and set the DI terminal valid logic. Depending on whether the DI terminal level is valid or not, the drive will enable or disable the overtravel shutdown status.

Code	Item	Function name	Function
FunIN.14	P-OT	Positive overtravel switch	When the mechanical motion exceeds the movable range, enter the overtravel prevention function Invalid: Allow forward drive Valid: Prohibit forward drive
FunIN.15	N-OT	Negative overtravel switch	When the mechanical motion exceeds the movable range, enter the overtravel prevention function Invalid: Allow reverse drive Valid: Reverse drive is prohibited

(4) Emergency stop:

The servo has two types of emergency stop:

1 Use DI function 33: FunIN.33: EmergencyStop, brake;

2 Use the auxiliary function: Emergency stop [F12.07].

Code	Item	Function name	Function
FunIN.33	Emergency Stop	Emergency brake	Invalid: The servo drive remains in the current operating state; Valid: Stop according to F01.03 stop mode, keep free state, servo alarm AL.402 (DI emergency brake).

Code	Item	Setting range	Function	Setting mode	Effective mode	Factory default
F12.07	Emergency Stop	0: Servo drive keeps current running status 1: Enable emergency stop, the stop mode is determined by F01.03	Enable emergency stop function, the stop mode is the same as when the servo enable is OFF	Running setting	Effective immediately	0

6.2 Position control running mode

Command unit: refers to the minimum value that can be resolved from the input from the host device to the servo drive.

Encoder unit: refers to the input command, the value processed by the electronic gear ratio.

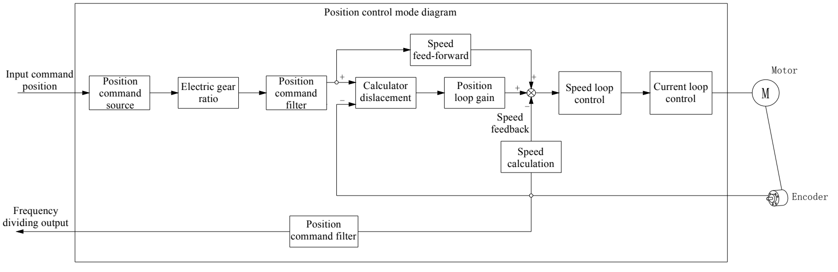


Fig.6-21 Position control diagram

The value of the parameter **[F01.00]** is set to 0 via the servo drive panel or our drive commissioning platform, and the servo drive will operate in the position control mode.

Please set the servo drive parameters according to the mechanical structure and indicators. The basic parameter settings when using the position control mode are explained below.

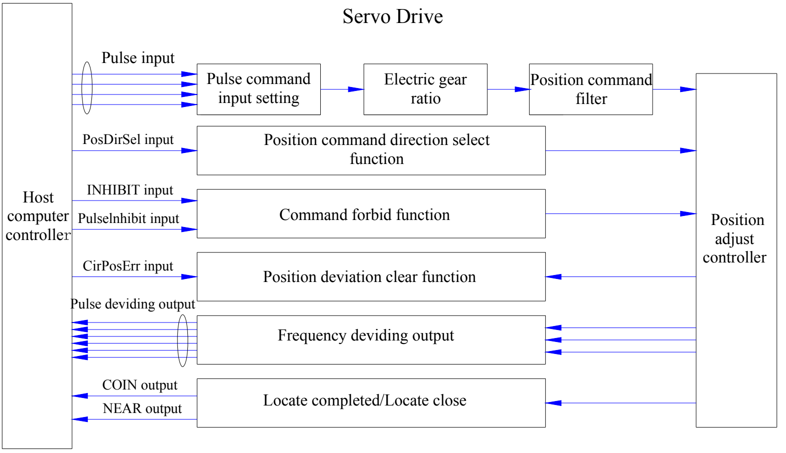


Fig.6-22 Servo drive and host controller signal interaction diagram

6.2.1 Position command input setting

The position command input settings include: position command source, position command direction, and position command prohibition.

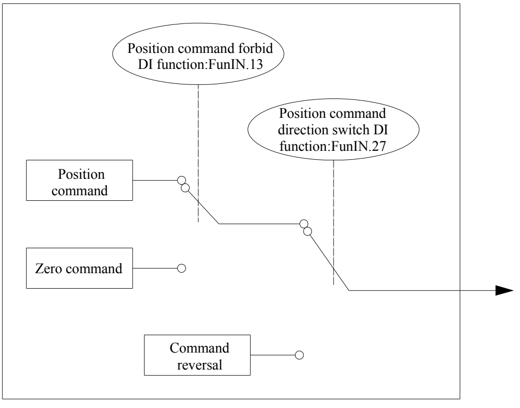


Fig.6-23 Position command input setting block diagram

6.2.1.1 Position command source

In the position control mode, the position source should be set first by function code **[F04.00]**.

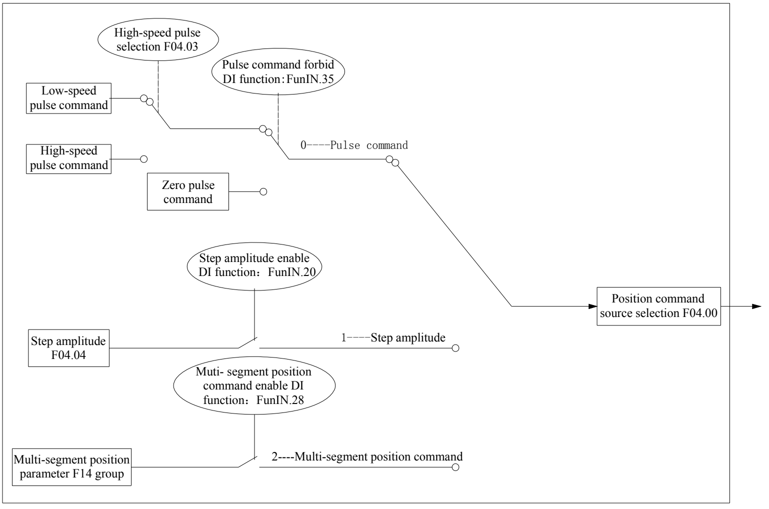


Fig.6-24 Position command source setting

Code	Item	Setting range	Function	Setting mode	Effective mode	Factory default
F04.00	Position source setting	0: pulse command 1: step amplitude 2: Multi-segment position command	Set the location command source. The pulse command is an external position command, and the step amplitude and the multi-segment position command are internal position commands.	Stop setting	Immediately setting	0

(1) Positioncommand sources from pulse commands **[F04.00=0]**

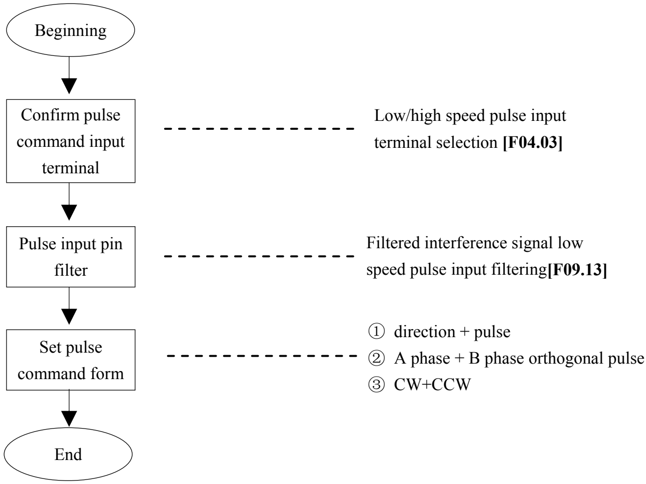
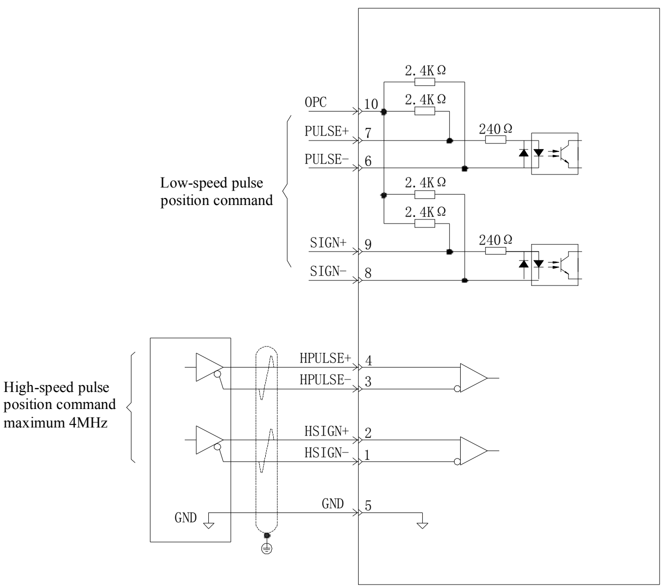


Fig.6-25 Pulse command source setting process

① Pulse commandinput terminal

Servo drive has two set pulse input terminal:



Low-speed pulse input terminals (corresponding to PULSE+, PULSE-, SIGN+, SIGN-), accept differential inputs (maximum input pulse frequency is 500kpps) and open collector input (maximum input pulse frequency is 200kpps).

High-speed pulse input terminals (corresponding to HPULSE+, HPULSE-, HSIGN+, HSIGN-), only accept differential inputs (maximum input pulse frequency is 4Mpps).

Code	Item	Setting range	Function	Setting mode	Effective mode	Factory default
F04.03	Pulse command input terminal selection	0: Low speed pulse input terminal 1: high speed pulse input terminal	Set the hardware input terminal of the pulse command	Stop setting	Effective immediately	0

Note

For details of the interface circuit, refer to "4.5.1 Position Command Input Signal".

Table 6-7 Pulse input specification

Pulse mode		Max input frequency	Voltage	Instantaneous current
High speed pulse	Differential signal	4M	5V	＜25mA
Low speed pulse	Differential signal	500K	5V	＜15mA
	Collector open circuit signal	500K	24V	＜15mA

② Pulse input pin filter

The low-speed pulse hardware input terminal needs to set a certain pin filter time to filter the input pulse command to prevent the interference signal from entering the servo driver and causing the motor to malfunction.

Code	Item	Setting range	Setting range	Function	Setting mode	Effective mode	Factory default
F09.13	Low speed pulse input pin filter time constant	0～3	-	Set the filter time constant for low speed pulses	Stop setting	Effective immediately	3

0: Filter time T_f= 20 ns.

1: Filter time T_f = 40 ns.

2: Filter time T_f= 160 ns.

3: Filter time 640ns

If the pulse input pin filter time constant is T_f and the minimum width of the input signal is t_{min}, the input signal and the filtered signal are as shown in the figure below. The filtered signal will delay T_f compared to the input signal.

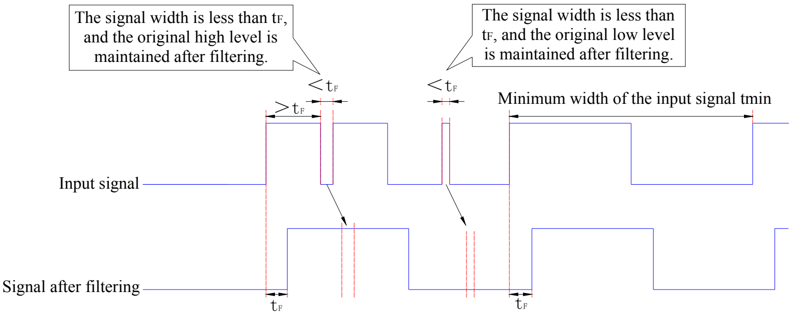


Fig.6-26 Filtered signal waveform example

The pulse input pin filter time T_f needs to satisfy: $T_f \leqslant$ (20% ~ 50%) t_{min}.

The maximum frequency (or minimum pulse width) of the input pulse is known. The recommended values for the filter parameters are shown in the table below.

Table 6-8 Recommended filter parameter table

Pulse input terminal	Corresponding function code	Input pulse Max frequency	Recommended filter parameter (Unit：25ns)
Low speed pulse input terminal	F09.13	＜250K	3
Low speed pulse input terminal	F09.13	250K～500K	2

③ Pulse command form

The pulse command that can be input by the servo drive has the following three forms:

0: direction + pulse (positive logic or negative logic)

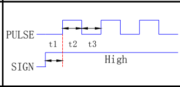
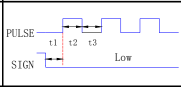
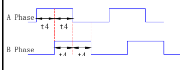
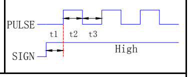
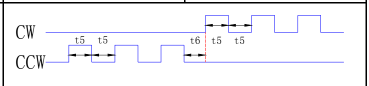
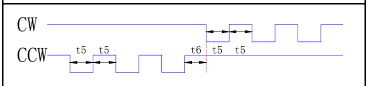
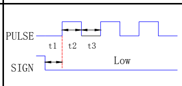
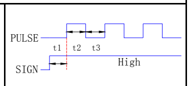
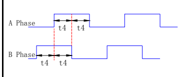
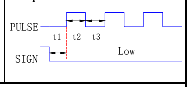
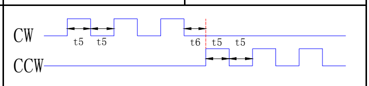
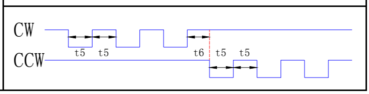
1: A phase + B phase orthogonal pulse, 4 times frequency

2: forward pulse / negative pulse (CW + CCW)

Please set the pulse shape according to the host computer or other pulse output device.

Code	Item	Setting range	Function	Setting mode	Effective mode	Factory default
F04.01	Pulse command form	0: direction + pulse 1: A phase + B phase quadrature pulse 4 times frequency 2: CW+CCW	Pulse command form selection	Stop setting	Power on again	0

Table 6-9 Pulse form details

F04.02 Pulse command reverse	F04.01 Commandform setting	Pulse form	Signal	Forward pulse diagram	Reverse pulse diagram
0	0	Pulse+ Direction	PULSE SIGN		
	1	Aphase+Bphase Quadrature pulse 4 times	PULSE (A phase) SIGN (B phase)	A phase ahead of B90° 	B phase ahead of A90° 
	2	CW+CCW	PULSE (CW) SIGN (CCW)		
					
1	0	Pulse+Direction	PULSE SIGN		
	1	A phase+B phase Quadrature pulse 4 times	PULSE (A phase) SIGN (B phase)	B phase ahead of A90° 	A phase ahead of B90° 
	2	CW+CCW	PULSE (CW) SIGN (CCW)		
					

The maximum frequency and minimum time width specifications of the position pulse command corresponding to different input terminals are as follows:

Table 6-10 Pulse command specification

Input terminal		Max frequency	Min time width/us					
			t1	t2	t3	t4	t5	t6
High speed pulse input terminal		4Mpps	0.125	0.125	0.125	0.25	0.125	0.125
Low speed pulse input terminal	Differential input	500kpps	1	1	1	2	1	1
	Collector input	200kpps	2.5	2.5	2.5	5	2.5	2.5

The rise and fall times of position pulse command should be less than0.1us.

④ Pulse command frequency

The maximum position pulse frequency can be set by function code **[F09.12]**. If the actual input pulse frequency is greater than **[F09.12],** the warning Er.304 (pulse input overspeed fault) will occur.

Code	Item	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F09.12	Max position pulse frequency	100～4000	KHz	Set the maximum frequency of the external pulse command	Stop setting	Effective immediately	4000

(2) The position command source is the step amplitude[F04.00=1]

Note

When the servo drive is in the running state (servo enable is set to ON), if the Stepping amountcommand enable is invalid, the motor is in the locked state; otherwise, if the step command is enabled, the servo motor rotates when executing **[F04 .04]** After the command is completed, the motor will also be locked when the step amount command is no longer triggered.

The servo drive has a step-and-run function, which means that the drive operates at an internal fixed speed until the positioning displacement is completed. The setting process is as follows：

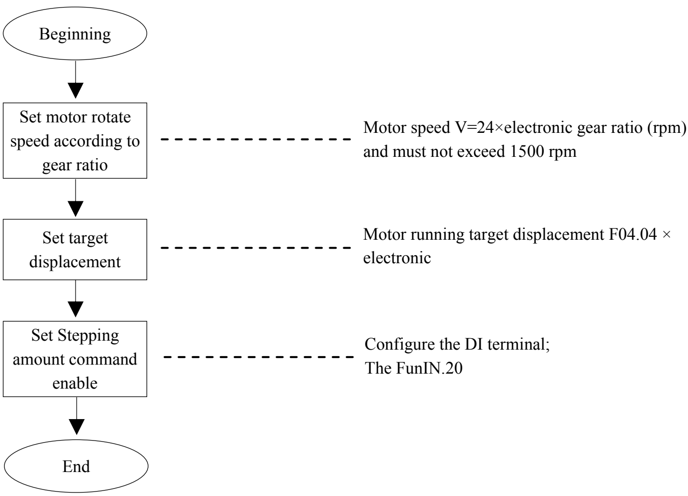


Fig.6-27 Stepamplitudecommand source setting process

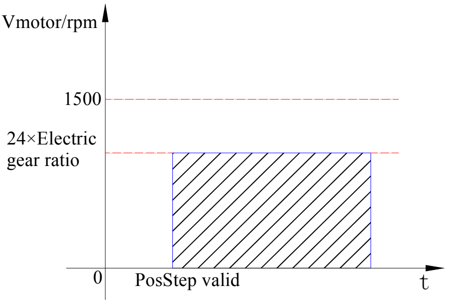


Fig.6-28 F04.00=1, Motor running curve

In the figure, the area of the shaded area is equal to the motor displacement:

F04.04 × electronic gear ratio (Encoder unit)

① The relationship between motor speed and electronic gear ratio:

When the position command source is the step amplitude, the servo motor speed cannot be directly set, but the following relationship exists with the electronic gear ratio. At the same time, the drive is limited to the motor speed not exceeding 1500 rpm.

V motor = 24 × electronic gear ratio (Rpm)

② Motor displacement:

When the position command source is the step amplitude, the total number of position commands (command units) is set by **[F04.04]**, and the positive and negative of the **[F04.04]** data determine the positive and negative of the motor speed.

Code	Item	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F04.04	Step amplitude	-9999～9999	Command unit	When F04.00=1, set the total number of position commands. The positive and negative values determine the positive and negative of the motor speed.	Stop setting	Effective immediately	50

③ Step amplitudecommand enable

When using the step amplitude as the position command source, configure one DI terminal of the servo driver as function 20 (FunIN.20: PosStep, step amplitudecommand enable), and confirm the valid logic of the DI terminal.

Code	Name	Function name	Function
FunIN.20	PosStep	Step amplitude commandenable	In the servo running state: Valid: The position command set by F04.04 is input to the servo drive, and the servo motor is running; Invalid: The servo motor is locked.

FunIN.20 (step amplitude command enable) is valid along the number, the step position positioncommand is finished, the servo motor enters the lock state; the FunIN.20 is triggered again, and the servo motor will repeat the **[F04.04]** setting. Position command.

(3) The position command source is a multi-segment position command [F04.00=2]

The servo drive has a multi-segment position operation function. It means that the servo drive stores 16 segment position commands, and the displacement, maximum running speed and acceleration/deceleration time of each segment are set separately. The waiting time and connection method between the segments can also be selected according to actual needs. The setting process is as follows:

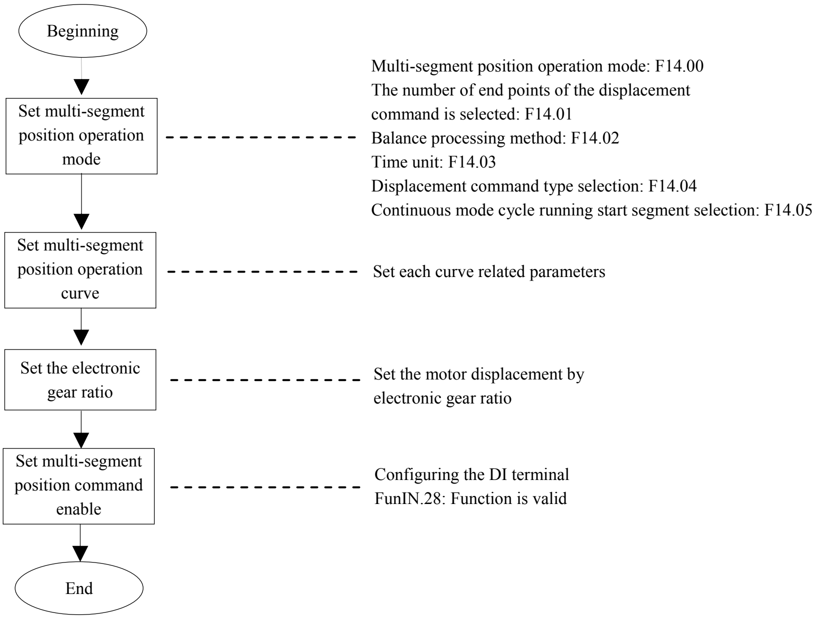


Fig.6-29 Multi-segment position command source setting process

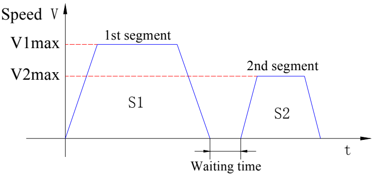
① Set multi-segment position operation mode

Code	Item	Setting range	Unit	Function	Setting mode	Effective mode
F14.00	multi-segment position operation mode	0: Single run end shutdown 1: cycle operation 2: DI switching operation 3: Run in sequence	Set the connection between segments and segments	Stop setting	Effective immediately	1

F14.01	Position command end segment number	1～16	Set the total number of segments of the multi-segment position command	Stop setting	Effective immediately	1
F14.02	Balance processing	0: continue to run the segment that has not finished 1: restart from the first paragraph	Set the servo enable ON, the start segment number of the multi-segment position operation from the interrupted to the resume operation Note: F14.02 is only valid at F14.00≠2.	Stop setting	Effective immediately	1
F14.03	Waiting time unit	0：ms 1：s	Set the acceleration/deceleration time and waiting time unit. note Waiting time is only valid when F14.00=0 or 1	Stop setting	Effective immediately	0
F14.04	Displacement instruction type selection	0: relative position command 1: absolute position command	Set the displacement instruction type	Stop setting	Effective immediately	0
F14.05	Sequence start segment selection	0～16	When F14.00=3, set the starting segment number of the multi-segment position operation after the first round. note: F14.05=0 or F14.05>F14.01 Indicates that it does not loop; F14.05>1 indicates that the starting segment number is the set value of F14.05.	Stop setting	Effective immediately	0

1> Single operation end shutdown[F14.00=0]

Table 6-11 Single operation instructions

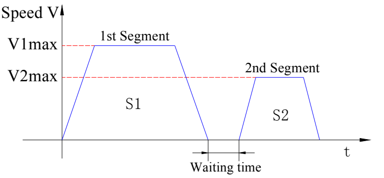
Mode description	Running curve
1. Run 1 round; 2. The segment number is automatically incremented and cut; 3. each paragraph can be set to wait for strength; 4. The multi-segment position command enable (PosInSen) signal is level active.	 V1max, V2max: the maximum running speed of the first and second segments; S1, S2: displacement of the first segment and the second segment; After each segment of operation is completed, the positioning completion signal is valid; 1. During the running process, the multi-segment position command is enabled to OFF, the servo abandons the unfinished displacement of this segment and stops, and the positioning completion signal is valid after the stop is completed; 2. The multi-segment position command is turned ON again, and the servo is selected according to the F14.02 setting to select the corresponding segment to run; 3. The servo enable OFF occurs during a certain period of operation, and the motor stops according to the servo OFF stop mode. After the stop is completed, the positioning is invalid. 4. During a certain operation, the position command direction switching DI (FunIN.27: PosDirSel) logic switching has no effect on the running direction of this segment.

Note

The total number of segments of the multi-segment position command set by the drive **[F14.01]** is called complete 1 round.

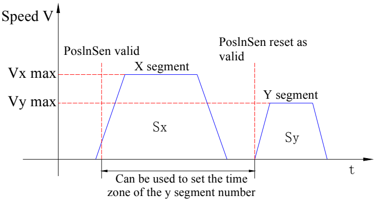
2> Cycle operation [F14.00=1]

Table 6-12 Cycle operation details

Mode description	Running curve
1, Cycle operation, the starting segment number of each round is 1; 2. The segment number is automatically incremented and switched; 3. Wait time can be set between each segment; 4, FunIN.28 (multi-segment position command enable) is valid, keep the cycle running state; 5, Multi-segment position command enable (PosInSen) signal is level effective	 V1max, V2max: the maximum running speed of the first and second segments; S1, S2: displacement of the first segment and the second segment; 1. Each segment of the operation is completed, and the positioning completion signals are valid; 2. During the running process, the multi-segment position command is enabled to OFF, the servo abandons the unfinished displacement of this segment and stops, and the positioning completion signal is valid after the stop is completed; 3. Re-enable the multi-segment position command to enable ON, and the servo will select the corresponding segment to run according to the F14.02 setting; 4. The servo enable OFF occurs during a certain period of operation, and the motor stops according to the servo OFF stop mode. After the stop is completed, the positioning is invalid. 5. During a certain operation, the position command direction switching DI (FunIN.27: PosDirSel) logic switching has no effect on the running direction of this segment.

3> Switching operation[F14.00=2]

Table 6-13 Description of DI switching operation

Mode description	Operation curve
1. When the current segment number is running, the next running segment number can be set. After the position command set by the current segment number is completed, the motor stops. After the multi-segment position command is enabled to be turned ON, the time slot number command is executed; 2. The segment number is determined by the logic of the DI terminal; 3. There is no waiting time between each segment, and the interval time is determined by the delay of the upper computer command; 4. The multi-segment position command enable (PosInSen) signal is valid for the edge number.	 V1max, V2max: the maximum running speed of the xth segment and the yth segment; S1, S2: displacement of the xth segment and the y segment; 1. Each segment is completed and the positioning completion signal is valid. 2. During the running process, the multi-segment position command is turned OFF, the servo continues to perform the displacement of the belly massage, and the positioning completion signal is output. 3. The switch segment number must be in the following order: 1 The segment number switching is invalid until the displacement of the xth segment is not completed. 2 The displacement of the xth segment during the displacement or after the positioning is completed, first y (if x=y, the servo will perform the displacement of the xth segment again); 3 After the displacement of the xth segment is completed, the multi-segment position command enable is turned ON, and the servo drive performs the y-th stage displacement. 4. The servo enable OFF occurs during a certain period of operation, and the motor stops according to the servo OFF stop mode. After the stop is completed, the positioning is invalid. 5. During a certain operation, the position command direction switching DI (FunIN.27: PosDirSel) logic switching has no effect on the running direction of this segment.

When the multi-segment position operation mode is set to DI switching operation, configure the four DI terminals of the servo driver as functions 6 to 9 (FunIN.6: CMD1 to FunIN.9: CMD4, multi-stage operation command switching), and confirm that the DI terminal is valid. logic.

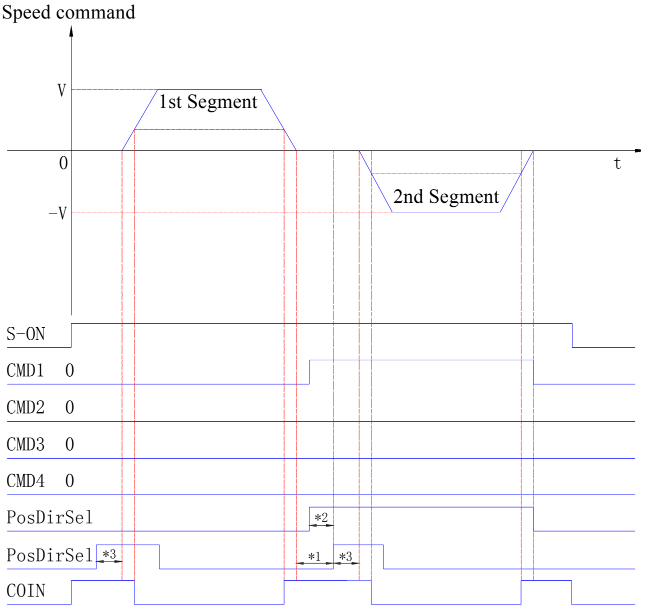


Fig.6-30 Multi-segment timing diagram

Note

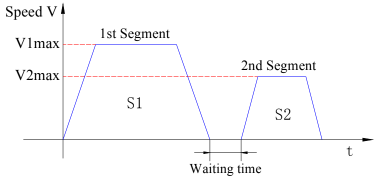
*1 Area that can be used to switch the segment number: The position command of the previous segment has been sent, and the PosInSen of the next segment has become a valid interval.
*2 When using the low-speed DI terminal, it is valid for at least 1ms.
*3 The PosInSen signal is valid for edge change. When using the normal DI terminal, the effective signal width should be at least 1ms. When using the fast DI terminal, the effective signal width should be at least 0.25m.

<table>
<tr><th>Code</th><th>Name</th><th>Function name</th><th>Function</th></tr>
<tr><td>FunIN.6</td><td>CMD1</td><td>Multi-segment run command switch 1</td><td rowspan="3">The multi-segment number is 4-bit binary, and the correspondence between CMD1 and CMD4 and the segment number is as follows:
<table>
<tr><th>CMD4</th><th>CMD3</th><th>CMD2</th><th>CMD1</th><th>CMD0</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td><td>2</td></tr>
<tr><td colspan="5">…</td></tr>
</table></td></tr>
<tr><td>FunIN.7</td><td>CMD2</td><td>Multi-segment run command switch 2</td></tr>
<tr><td>FunIN.8</td><td>CMD3</td><td>Multi-segment run command switch 3</td></tr>
</table>

FunIN.9	CMD4	Multi-segment run command switch 4	1 | 1 | 1 | 1 | 16 The DI terminal logic is level active. When the input level is valid, the CMD value is 1, otherwise it is 0.

4> Sequence operation[F14.00=3]

Table 6-14 Sequence operation details

Mode description	Operation curve
1, Can run 1 round, stop (F14.05=0 or F14.05>F14.01) 2, Can be cycled, the starting number after the first round is F14.05; 3. Automatic increment of segment number; 4. There is no waiting time between each paragraph; 5. The multi-segment position command enable (PoslnSen) signal is level effective;	V1max, V2max: the maximum running speed of the first and second segments; S1, S2: displacement of the first segment and the second segment; 1. Each segment of the operation is completed, and the positioning completion signals are valid; 2. During the operation of a certain section, the multi-segment position command is turned OFF, the servo discards the unfinished displacement of the segment and stops, and the positioning completion signal is valid after the stop is completed; 3. Re-enable the multi-segment position command to enable ON, and the servo will select the corresponding segment to run according to the F14.02 setting; 4. The servo enable OFF occurs during a certain period of operation, and the motor stops according to the servo OFF stop mode. After the stop is completed, the positioning is invalid. 5. During a certain operation, the position command direction switching DI (FunIN.27: PosDirSel) logic switching has no effect on the running direction of this segment. 

② **Multi-segment position running curve setting**

The multi-segment position operation function can set 16 different position commands. The displacement, maximum running speed, acceleration/deceleration time and waiting time between each segment can be set separately. Take the first paragraph as an example:

Code	Item	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F14.06	Stage 1 movement displacement	-1073741824 ～ 1073741824	Command unit	Set the first paragraph position command sum	Stop setting	Effective immediately	10000
F14.08	1st stage displacement maximum running speed	1～6000	rpm	Set the maximum speed of the first stage	Stop setting	Effective immediately	200
F14.09	Stage 1 displacement acceleration and deceleration time	0～65535	Ms (s)	Set the multi-stage position of the first stage motor from 0 rpm to 1000 rpm	Stop setting	Effective immediately	10
F14.10	Waiting time after the completion of the first stage displacement	0～10000	Ms (s)	Set the waiting time after the completion of the first stage of positioning	Stop setting	Effective immediately	10

According to the above settings, the actual running curve of the motor is as shown below:

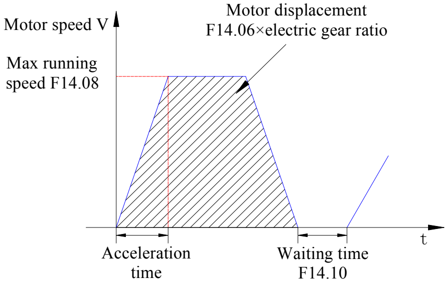


Fig.6-31 The first motor running curve

Therefore, the time t that actually accelerates to [F14.08: Maximum displacementspeed of the first stage] is:

$$t = \frac{(F14.08)}{1000} \times (F14.09)$$

Note

Please refer to Chapter 8 for the setting of the remaining 15 parameters.

③ Multi-segment position command enable

When using a multi-segment position command as the source of the position command, please configure one DI terminal of the servo drive.

(FunIN.28: PoslnSen, multi-segment position command enable), and determine the valid logic of the DI terminal.

Code	Name	Function name	Function
FunIN.28	PoslnStep	Multi-segment position command enable	Valid: The servo motor runs multiple position commands; Invalid: the servo motor is locked; note: When F14.00=0, 1, 3, the logic of the DI terminal corresponding to the PoslnSen signal is level effective; When F14.00=2, the DI terminal corresponding to the PoslnSen signal is logic-dependent.

6.2.1.2 Position command direction setting

The direction of the position command can be switched by the DI terminal to change the direction of motor rotation. Configure one DI terminal of the servo drive as function 27 (FunIN.27: PosDirSel, position command direction setting) and determine the valid logic of the DI terminal.

Code	Name	Function name	Function
FunIN.27	PosDirSel	Position command direction setting	Invalid: The actual position command direction is the same as the set position command direction; Valid: The actual position command direction is opposite to the set position command direction;

The actual motor rotation direction is related to both the position command positive and negative and the position command direction setting (FunIn.27).

Table 6-15 Motor rotation direction

Position command positive and negative	FunIN.27	Actual motor rotation direction
+	Invalid	Counterclockwise
+	Valid	Clockwise
-	Invalid	Clockwise
-	Valid	Counterclockwise

6.2.1.3 Location series instruction disable function

The servo drive has a position command inhibit function (FunIN.13: Inhibit) and a pulse command prohibit function (FunIN.35: PulseInhibit).

(1) Position command prohibition function

The position command prohibition function: that is, the position command is forcibly set to zero, the servo drive does not respond to any internal or external position command,

and the position is in the servo lock state in the position control mode. At this point, the drive can be switched to other control modes to continue running.

When the position command prohibition function is enabled, the position command counter **[F10.31]** continues to count the position command in the position control mode. However, the position command counted at this time does not respond after the position command disable function is canceled.

When using the position command prohibition function, configure one DI terminal of the servo driver as function 13 (FunIN.13: Inhibit, position command prohibition) and determine the valid logic of the DI terminal. A quick DI (DI8) terminal is recommended.

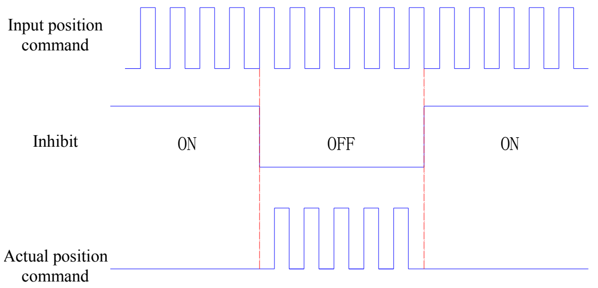


Fig.6-32 Example of position command inhibit function waveform

Code	Name	Function name	Function
FunIN.13	Inhibit	position command inhibit	Invalid: In the position control mode, the servo drive can respond to the position command; Valid: In position control mode, the servo drive does not respond to any internal or external position commands;

(2) Pulse position command inhibit

Pulse command inhibit function: that is, the pulse command is forcibly set to zero, the servo driver does not respond to the pulse command input by the pulse input terminal, and in the position control mode, the driver can respond to other forms of position command. At this point, the drive can also switch to other control modes to continue operation.

When the pulse command prohibition function is valid, if the position command mode is not switched to use another type of position command and the pulse input terminal continues to input the pulse signal, the input position command counter **[F10.31]** continues to count the pulse command, but this time When the pulse command is counted, the drive does not respond after canceling the pulse command prohibition function; in the position control mode, if it is switched to use other forms of position command, **[F10.31]** continues counting for other forms of position command and executes the position. instruction.

When using the pulse command prohibition function, configure one DI terminal of the servo driver as function 35 (FunIN.35: PulseInhibit, pulse command prohibition), and determine the valid logic of the DI terminal. A quick DI (DI8) terminal is recommended.

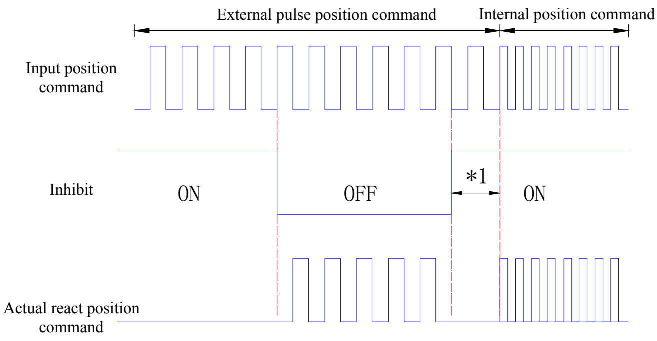


Fig.6-33 Example of pulse command inhibit function waveform

Note

(1) When using normal DI, the logic of the DI terminal is set to invalid to input other internal position commands, please wait at least 1ms;
(2) When using express DI, please input the response from the terminal signal to the response at least 0.25ms.

Code	Name	Function name	Function
FunIN.35	PulseInhibit	Pulse command inhibit	In the position control mode, the position command source is the pulse command (F04.00=0): Invalid: the servo drive can respond to the pulse command; Valid: The servo drive does not respond to the pulse command;

6.2.2 Electric gear ratio

The electronic gear ratio setting range is：

$$\frac{0.001\times \text{Encoder resolution ratio}}{10000} < \text{gear ratio} < \frac{4000\times \text{Encoder resolution ratio}}{10000},$$

Otherwise, fault Er.312 (Electronic gear ratio setting error) will occur.

An incorrect setting of the electronic gear will result in an erroneous operation. At this time, It is recommended to reset the servo drive while it is stopped.

(1) The concept of electronic gear ratio

In the position control operation mode, the input position command (Command unit) is to set the load displacement, and the motor position command (Encoder unit) is to set the motor displacement to establish the proportional relationship between the motor position command and the input position command, the introduction of electronic gear ratio function.

By the frequency division (electronic gear ratio<1) or multiplier (Electronic gear ratio >1) function of the electronic gear ratio, the actual displacement of the motor rotation or movement when the input position command is one command unit can be set. It is also possible to increase the frequency of the position command when the upper machine output pulse frequency or the function code setting range is limited and the required motor speed cannot be reached.

Note

(1) "Command unit": refers to the minimum value that can be resolved from the host device input to the servo drive.
(2) "Encoder unit": refers to the input command, the value processed by the electronic gear ratio

(2) Electronic gear ratio setting procedure

The electronic gear ratio differs depending on the mechanical structure. Please follow the steps below to set it up:

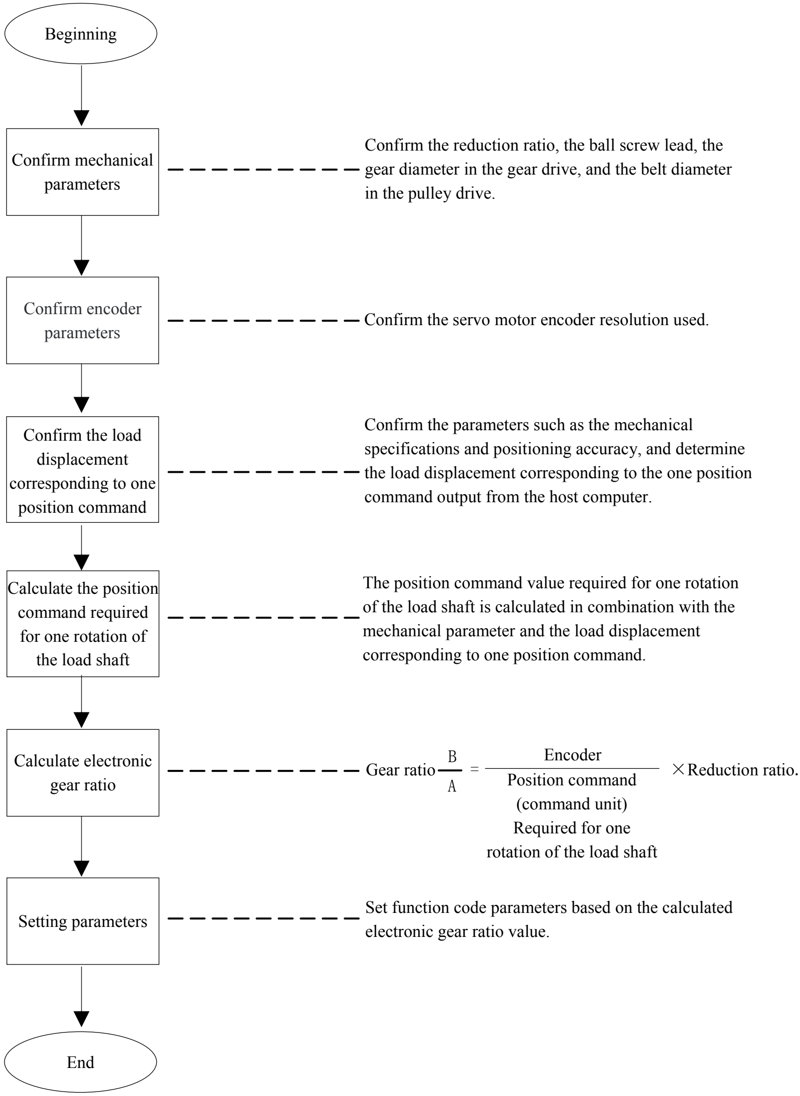


Fig.6-34 Electronic gear ratio setting procedure

Among them, the steps to set the parameters are as follows:

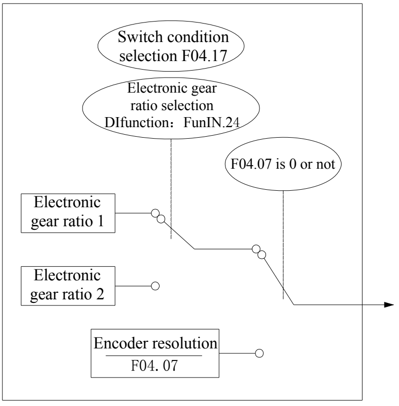


Fig.6-35 Electronic gear ratio setting operation flow

Note

[F04.07] is not 0, Electric gear $\frac{B}{A} = \frac{Encoder\ resolution}{F04.07}$, At this time, The electronic gear ratio 1 and the electronic gear ratio 2 have no effect.

6.2.2.1 Relate function code

(1) The electronic gear ratio value setting

Code	Item	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F04.07	Number of position commands per motor revolution	0～8388608	P/r	Set the number of position commands for one rotation of the motor	Stop setting	Power again	0
F04.09	Electric gear ratio 1 (numerator)	1～1072741824	-	Set the numerator of the first set of electronic gear ratios	Run setting	Effective immediately	Encoder confirm
F04.11	Electric gear ratio 1 (denominator)	1～1073741824	-	Set the denominator of the first set of electronic gear ratios	Run setting	Effective immediately	10000
F04.13	Electric gear ratio 1 (numerator)	1～1073741824	-	Set the numerator of the second set of electronic gear ratios	Run setting	Effective immediately	Encoder confirm
F04.15	Electric gear ratio 1 (denominator)	1～1073741824	-	Set the denominator of the second set of electronic gear ratios	Run setting	Effective immediately	10000

(2) Electronic gear ratio switching setting

Note

When the electronic gear ratios of the two groups are large and the difference is large, the motor speed will fluctuate greatly. At this time, the position command first-order low-pass filter function **[F04.05]** can be used to smoothly switch the position command.

When **[F04.07]** is 0, the electronic gear ratio switching function can be used. It is necessary to determine whether it is necessary to switch between the gear ratio 1 and the gear ratio 2 according to the mechanical operation condition, and set the electronic gear ratio switching condition, and there is only one set of electronic gear ratios at any one time.

Code	Item	Setting range	Function	Setting mode	Effective mode	Factory default
F04.17	Electronic gear ratio switching condition	0: The number of position commands is 0, and the duration is 2.5ms. 1: real-time switching	Set the electronic gear ratio switching condition	Stop setting	Effective immediately	0

Also, configure one DI terminal of the servo driver as function 24 (FunIN.24: GEAR_SEL, electronic gear ratio selection) and determine the valid logic of the DI terminal.

Code	Name	Function name	Function
FunIN.24	GEAR_SEL	Electronic gear ratio selection	Invalid: In the position control mode, the first set of electronic gear ratios is selected; Valid: In the position control mode, the second set of electronic gear ratios is selected;

The electronic gear ratio that the servo drive ultimately selects should refer to the table below.

Table 6-16 Electronic gear ratio

<table>
<tr><th>F04.07</th><th>F04.17</th><th>FunIN.24Corresponding DI terminal level</th><th>Electric gear $\frac{B}{A}$</th></tr>
<tr><td rowspan="4">0</td><td rowspan="2">0</td><td>Invalid</td><td>$\frac{F04.09}{F04.11}$</td></tr>
<tr><td>Valid</td><td>$\frac{F04.13}{F04.15}$</td></tr>
<tr><td rowspan="2">1</td><td>Invalid</td><td>$\frac{F04.09}{F04.11}$</td></tr>
<tr><td>Valid</td><td>$\frac{F04.13}{F04.15}$</td></tr>
<tr><td>1～1048576</td><td colspan="2">-</td><td>$\frac{Encoder\ resolution}{F04.07}$</td></tr>
</table>

For serial encoders, motor resolution = 2^n (P / r), n is the serial encoder number of bits.

For example, our 20-bit serial encoder, encoder resolution = 2^{20} (P/r) = 1048576 (P/r).

For quadrature incremental encoders, the encoder resolution = encoder line number x 4.

For example, Our orthogonal incremental encoder line number is 2500, encoder resolution = 10000 (P/r).

6.2.2.2 Electric gear ratio calculation

The relationship between position command (command unit), load displacement and electronic gear ratio is shown in the figure below:

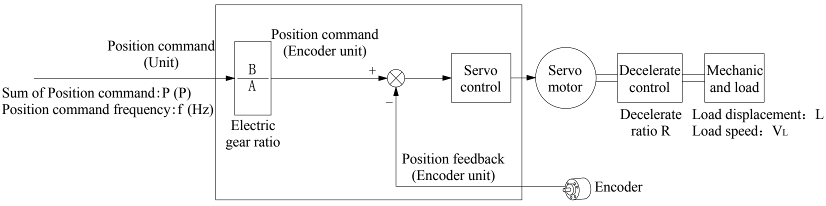


Fig.6-36 Relationship between position command (command unit), load displacement and electronic gear ratio

Take the linear motion load ball screw as an example: the lead lead is P_B (mm), the encoder resolution is P_G, and the reduction mechanism reduction ratio is R.

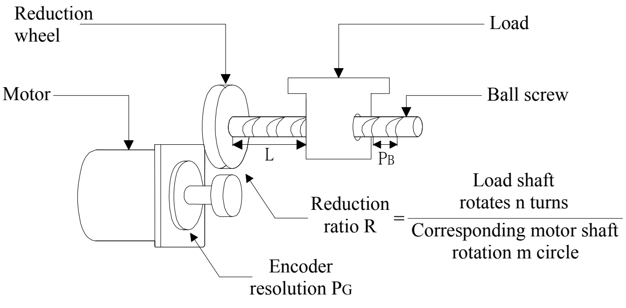


Fig.6-37 Ball screw diagram

① It is known that the input driver has 1 pulse corresponding to the load displacement of ΔL (mm)

When the mechanical displacement is △L, It corresponds to the load shaft $\frac{\Delta L}{P_B}$ rotation and the motor shaft $\frac{\Delta L}{P_B}\times\frac{1}{R}$ rotates.

Then: $P\times\frac{B}{A}=\frac{L}{P_B}\times\frac{1}{R}\times P_G$

So, electric gear ratio is $\frac{B}{A}=\frac{\Delta L}{P_B}\times\frac{1}{R}\times P_G$

② Known load displacement L (mm) and total number of position commands P (P)

When the mechanical displacement is L , It corresponds to the load shaft $\frac{L}{P_B}$ rotation and the motor shaft $\frac{L}{P_B}\times\frac{1}{R}$ rotation.

Then：

So, electric gear ratio is $\frac{B}{A}=\frac{L}{P_B}\times\frac{1}{R}\times P_G\times\frac{1}{P}$

③ known load moving speed VL (mm / s) and position command frequency f (Hz)

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

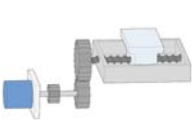
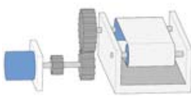
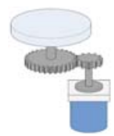
Motor speed：$V_M=\frac{V_L}{P_B}\times\frac{1}{R}(r/s)$

The relationship between the position command frequency, the electronic gear ratio and the motor speed:

So, electric gear ratio is $\frac{B}{A}=\frac{V_M\times P_G}{f}$

6.2.2.3 Example of setting the electronic gear ratio

Tabel 6-17 Example of setting the electronic gear ratio

Item	Name	Mechanical structure		
		Ball screw drive	Pulley drive	Rotate load
				
1	Mechanical parameter	Reduction ratio R：1/1 Screw lead：0.01m	Reduction ratioR：5/1 Belt pulley diameter：0.2m （Belt pulley perimeter：0.628m）	Reduction ratioR：10/1 Load shaft rotates 1 rotation load rotation angle：360°
2	Encoder resolution	20bit =1048576P/r	20bit =1048576P/r	20bit =1048576P/r
3	Load displacement corresponding to one position command (command unit)	0.0001m	0.000005m	0.01°
4	Position command (command unit) value required for one rotation of the load shaft	$\frac{0.01}{0.0001}=100$	$\frac{0.628}{0.000005}=125600$	$\frac{360}{0.01}=36000$
5	Calculate	$\frac{B}{A}=\frac{1048576}{100}\times\frac{1}{1}$	$\frac{B}{A}=\frac{1048576}{125600}\times\frac{5}{1}$	$\frac{B}{A}=\frac{1048576}{36000}\times\frac{10}{1}$

6	Setting	F04.09=1048576 F04.11=100	F04.09=5242880 F04.11=125600	F04.09=10485760 F04.11=36000

6.2.3 Position command filter

When the position command is filtered, the position command (Encoder unit) after frequency division or multiplication by the electronic gear ratio is filtered. Includes first-order low-pass filtering and average filtering.

Consider adding positional command filtering in the following situations:

(1) The position command output by the host computer is not subjected to acceleration/deceleration processing;

(2) The pulse command frequency is low;

(3) When the electronic gear ratio is 10 times or more.

Code	Item	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F04.05	First-order low-pass filtering time constant	0～1000.0	ms	Set the time constant of the first-order low-pass filter for the position command (encoder unit)	Stop setting	Effective immediately	0.0
F04.06	Average filter time constant	0～128.0	ms	Set the time constant of the average filter for the position command (encoder unit)	Stop setting	Effective immediately	0.0

Note

(1) This function has no effect on the amount of displacement (the total number of position commands).
(2) If the set value is too large, the delay of the response will increase, and the filter time constant should be set according to the actual situation.

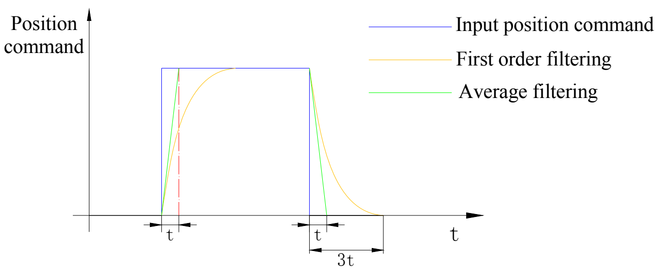


Fig.6-38 Schematic diagram of first-order filtering and average filtering for rectangular position command

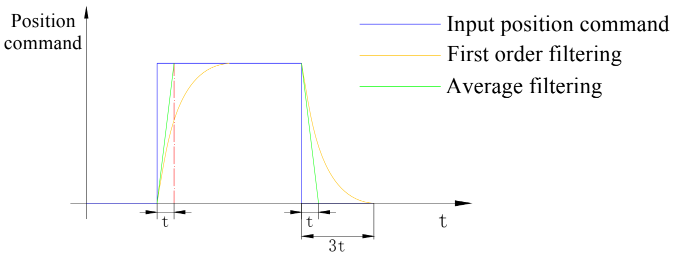


Fig.6-39 Schematic diagram of first-order filtering and average filtering for rectangular position command

6.2.4 Position deviation clear function

Position deviation = (Position command - Position feedback) (Encoder unit)

The position deviation clear function means that the position of the position can be cleared when the drive meets certain conditions **[F04.18]**.

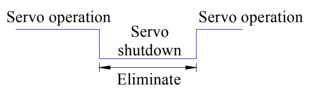
Code	Item	Setting range	Function	Setting mode	Effective mode	Factory default
F04.18	Clear operation selection	0: Servo enable OFF or position deviation when fault occurs 1: Servo enable OFF or clear position deviation pulse when a fault occurs 2: Servo enable OFF or clear the position deviation by the ClrPosErr signal input by DI	Set conditions for clearing positional deviation	Stop setting	Effective immediately	0

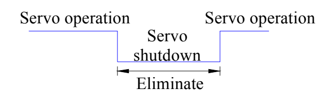
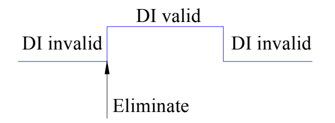
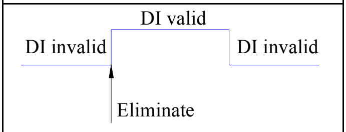
[F04.18=2], configure one DI terminal of the servo driver as function 34 (FunIN.34: ClrPosErr, clear position deviation), and determine the valid logic of the DI terminal. It is recommended to use the fast DI (DI8) terminal and set to edge valid.

Code	Name	Function name	Function
FunIN.34	ClrPosErr	Clear position deviation	Valid: clear position deviation; Invalid: No cleanup is performed.

Setting ways below:

Table 6-18 Position deviation clear setting

Setting value	Clear condition	Clear time
F04.18=0	Clear position deviation when servo OFF or servo status is faulty	

F04.18=1	Clear position deviation when servo OFF fails or warns	
F04.18=2	The position deviation is cleared when the servo OFF or clear position deviation DI terminal logic is valid. The DI terminal is recommended to be set to be effective for edge changes.	 

6.2.5 Crossover output function

Note

The divided output cannot be used in the full closed loop control mode, and the divided output terminal is used as the input terminal of the external scale signal.
Z signal frequency demultiplication output accuracy requirements for higher use, it is recommended to use the Z signal output effective change edge:
① **[F04.27=0]** The effective change edge is the rising edge;
② **[F04.27=1]** The valid change edge is the falling edge.

The frequency division output function of the servo driver means that the position command pulse or the position pulse fed back by the encoder is output as an A/B phase orthogonal pulse.

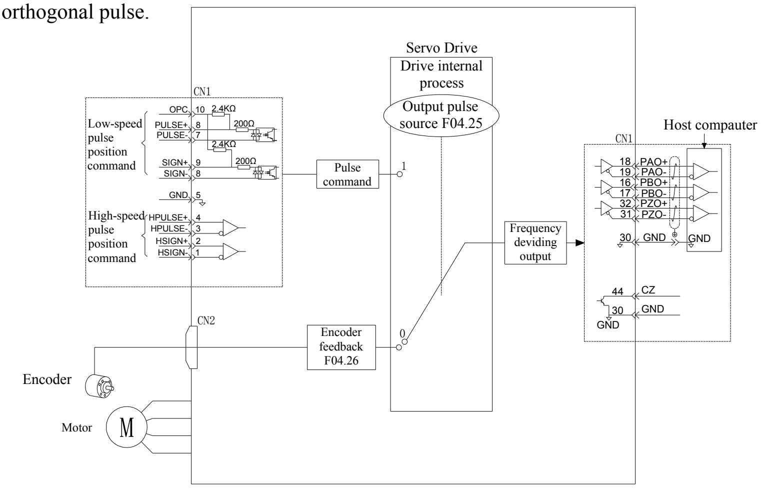


Fig.6-40 Schematic diagram of the frequency division output

Among them, when multi-axis servo pulse synchronous tracking, it is recommended to use the pulse command synchronous output mode, ie **[F04.25=1]**; when the upper computer is used as closed-loop feedback, it is recommended to use the encoder crossover output mode, i.e **[F04.25= 0]**;

The servo drive has 1 component frequency output terminal:

Phase A pulse: PAO+, PAO-, differential output, maximum output pulse frequency is 240KHZ

B phase pulse: PBO+, PBO-, differential output, maximum output pulse frequency is 240KHZ

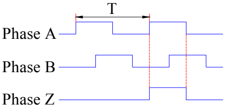
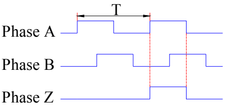
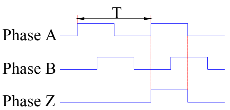
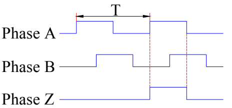
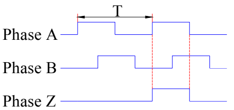
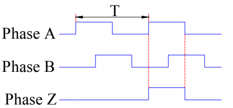
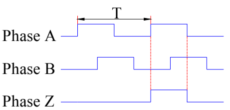
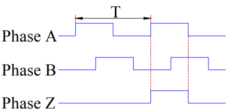
Z-phase pulse: PZO+, PZO-, differential output, maximum output pulse frequency is 240KHZ.

PZ-OUT, GND, open collector output, maximum output pulse frequency is 100Kpps.

When using the crossover output function, set the source pulse **[F04.25]**, phase **[F04.28]**, resolution **[F04.26]**, and Z phase pulse polarity **[F04.27]** as needed.

When the output source is the encoder feedback pulse **[F04.25=0]**, the motor rotates once, and the A/B phase output pulse number is determined by **[F04.26]** (encoder divided pulse number); A/B phase pulse width T is determined by the motor speed and has a width of T/4; the Z-phase signal is output once per revolution of the motor.

Table 6-19 Schematic diagram of encoder crossover output (F04.25=0) pulse

F04.28 (Output pulse phase)	F04.27 (Z pulse output polarity)	Forward rotation, pulse output schematic	Inversion, pulse output schematic
0	0		
	1		
1	0		
	1		

Code	Item	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F04.28	Output pulse phase	0: A lead B 1:A lag B	-	Set the phase relationship between the A-phase pulse and the B-phase pulse of the pulse output	Stop setting	Power again	0
F04.26	Encoder frequency division pulse number	35～40000	p/r	When F04.25=0, it is used to set the number of output pulses of the motor rotating one-turn pulse output terminal PAO or PBO. After 4 times frequency, the pulse output resolution is: motor rotation 1 pulse output resolution=(F04. 26) × 4. When F04.25=1, it is used to set the frequency division output coefficient of the command pulse, and the frequency division output coefficient is (F04.26/10000).	Stop setting	Power again	500
F04.25	Servo pulse output source selection	0: encoder crossover output 1: Pulse command synchronous output 2: Divided or synchronized output is prohibited	-	Select servo pulse output source	Stop setting	Power again	0
F04.27	Z pulse output polarity selection	0: Positive output (Z pulse is high) 1: negative polarity output (Z pulse is low)	-	Set the output level when the Z-phase pulse is active	Stop setting	Power again	1

6.2.6 Positioning completion/proximity function

The internal command completion function means that when the servo internal multi-segment position command is zero, the command transmission completion is considered complete. At this time, the servo driver can output an internal command completion signal (CmdOk), and the host computer receives the signal to confirm that the multi-segment position command transmission inside the servo driver is completed.

The positioning completion function means that the position deviation satisfies the condition set by the user **[F04.19]**, and it can be considered that the positioning is completed in the position control mode. At this time, the servo driver can output a positioning completion (COIN) signal, and the host computer receives the signal to confirm that the servo driver is positioned.

Its functional principle is shown below:

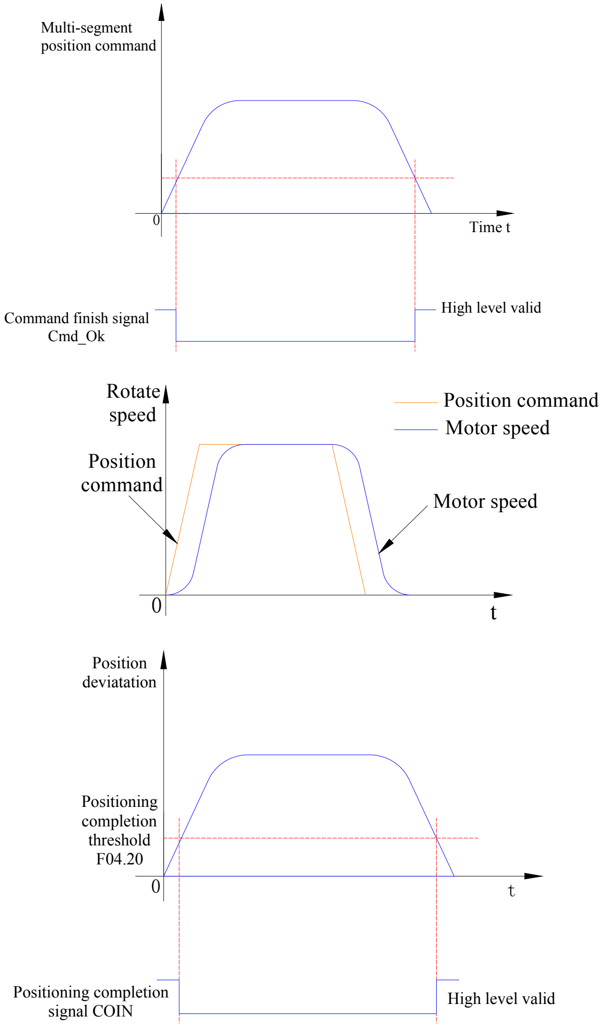


Fig.6-41 Positioning completion/proximity function description

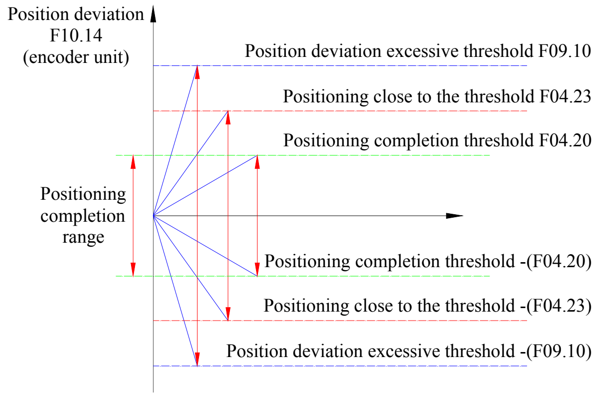


Fig.6-42 Position deviation related signal

After the positioning is completed, when the position deviation meets the condition **[F04.19]**, the servo drive can also output the positioning proximity (NEAR) signal. Usually, the upper computer can receive the positioning proximity signal before confirming the positioning completion, andprepare for the positioning completion operation. .

The positioning completion/proximity output conditions, thresholds, and window and hold time should be set before using the positioning completion/proximity function. The principle of positioning completion window time and hold time is as follows:

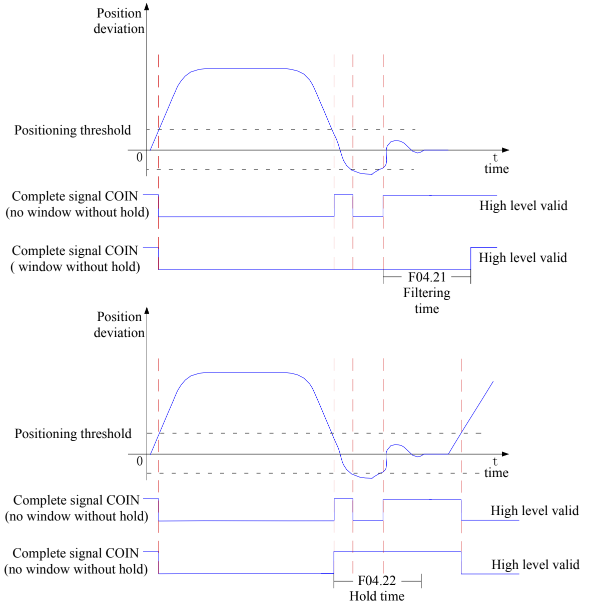


Fig.6-43 Schematic diagram of positioning completion window time and hold time

When the positioning completion output selection has a hold function, its setting value of 0 means that the positioning completion signal remains valid until the next time the position command is received.

Code	Item	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F04.19	Positioning completion/ proximity output condition	0: The absolute value of the position deviation is smaller than the positioning completion/proximity threshold 1: The absolute value of the position deviation is smaller than the positioning completion/proximity threshold, and the position command filtered command is 0. 2: The absolute value of the position deviation is smaller than the positioning completion/proximity threshold, and the output is 0 when the position command is 0. 3: The absolute value of the position deviation is less than the positioning completion/proximity threshold, and the position command is filtered to 0. The output is valid for at least the time of F04.22.	-	Set the conditions for positioning completion (COIN) / proximity (NEAR)	Run setting	Effective immediately	0
F04.20	Positioning completion threshold	1～65535	Encoder/ command unit	Set the threshold for the absolute value of the position deviation when the positioning completion (COIN) is valid	Run setting	Effective immediately	734
F04.23	Positioning close to the threshold	1～65535	Encoder/ command unit	Set the threshold for the absolute value of the position deviation when the positioning is close to (NEAR)	Run setting	Effective immediately	65535
F04.21	Positioning window time	0～30000	ms	Positioning signal filtering, filtering output effective level	Run setting	Effective immediately	0

F04.22	Positioning hold time	0～30000	ms	The positioning signal is valid for at least the time	Run setting	Effective immediately	0

Note

(1) The positioning approach threshold **[F04.23]** generally needs to be greater than the positioning completion threshold **[F04.20]**.
(2) The positioning completion threshold **[F04.20]** only reflects the threshold value of the absolute value of the position deviation when the positioning is completed, regardless of the positioning accuracy.
(3) When the speed feed forward gain **[F07.17]** setting value is greater than or low speed operation, the absolute value of the position deviation will be small. If the setting value of **[F04.20]** is too large, the positioning will be consistent and valid. Therefore, To improve the effectiveness of positioning completion, please reduce the **[F04.20]** setting.

When using internal command completion, positioning completion and positioning proximity function, the three DO terminals of the servo driver should be configured as DO function 18 (FunOUT.18: CmdOK, internal command output) DO function 5 (FunOUT.5: COIN, positioning) Complete) and DO function 6 (FunOUT.6: NEAR, positioning close), and determine the corresponding logic of the DO terminal.

Code	Name	Function name	Function
FunOUT.5	COIN	Positioning completed	Valid: In the position control mode, the absolute value of the position deviation satisfies the setting condition of F04.20, indicating that the servo positioning is completed. Invalid: In position control mode, the servo is in the process of positioning completion.
FunOUT.6	NEAR	Positioning close	Valid: In the position control mode, the absolute value of the position deviation satisfies the setting condition of F04.23, indicating that the servo positioning is close. Invalid: In position control mode, the servo is in the process of positioning close.

6.2.7 Interrupt fixed length function

(1) Features

The interrupt fixed length function refers to the current running state of the servo interrupted in the position control operation mode, and the preset fixed length command is executed. In the position control operation mode, when the servo enable is ON, after the interrupt fixed length function is triggered, the servo motor will run the position command that interrupts the fixed length function according to the motor rotation direction before the trigger.

During the interrupt fixed length operation, the drive shields any other internal and external position commands (including the interrupted fixed length position command), and the input position command counter **[F10.07]** only counts the interrupt fixed length position command; interrupts the fixed length operation. After completion, according to the user setting **[F04.34]**, the drive will keep the position command mask status, or restore the response position command, but the position command input during the interrupt fixed length operation will be discarded.

After the interrupt fixed length is completed, the servo driver simultaneously outputs the interrupt fixed length completion signal (FunOUT.12:XintCoin) and the positioning completion signal (FunOUT.5:COIN, positioning completion), and the host computer receives the interrupt fixed length completion signal to confirm the interrupt determination. Long finish. Among them, the output of the interrupt fixed length completion signal is independent of the servo enable (S-ON).

① Before the trigger interrupt is fixed, the current speed of the motor is greater than or equal to 10 rpm, or **[F04.32]** is not 0;

② Interrupt fixed length position **[F04.30]** is not zero;

③ DI function FunIN.32 (interrupt fixed length prohibition) is not used or the corresponding port logic is invalid.

Note

(1) When the zero point return function is in progress, the interrupt fixed length trigger signal is invalid.
(2) When the interrupt is fixed length, the averaging filter function is invalid.

(2) Flow diagram

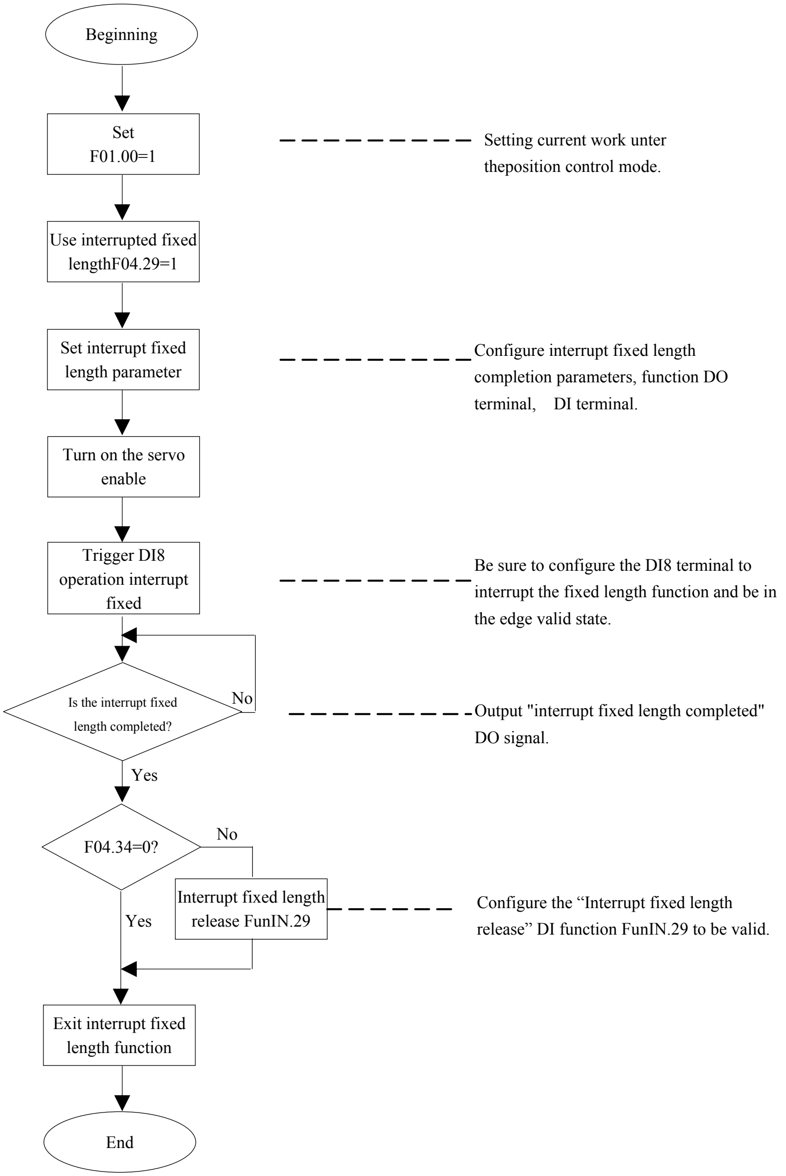


Fig.6-44 Flow chart of interrupted fixed length function

(3) Parameters setting

Code	Item	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F04.29	Interrupt fixed length enable	0: forbid 1: use	-	Set whether to enable interrupt fixed length function	Stop setting	Power again	0
F04.30	Interrupt fixed length displacement	0～1073741824	Instruction unit	Set interrupt fixed length displacement	Run setting	Effective immediately	10000
F04.32	Interrupt fixed length and constant speed	0～6000	rpm	Set the maximum motor speed when interrupting the fixed length operation, regardless of the electronic gear ratio	Run setting	Effective immediately	200
F04.33	Interrupt fixed length acceleration and deceleration time	0～1000	ms	Set the motor speed from 0 to 1000 rpm	Run setting	Effective immediately	10
F04.34	Fixed length lock release signal enable	0: Not enabled 1: Enabled	-	After setting the interrupt fixed length operation, respond to the conditions of other position commands. When F04.34=1, the DI function FunIN.29 (interrupt fixed length status release signal) must be used to unlock the state.	Run setting	Effective immediately	1

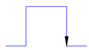
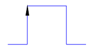
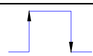
Code	Name	Function name	Function
FunIN.29	XintFree	Interrupt fixed length release	Valid: Release the interrupted fixed length lock state, the servo can respond to other position commands; Invalid: keeps interrupting the fixed length lock state, the servo does not respond to other position commands.
FunIN.32	XintlnHibit	Interrupt fixed length prohibition	Valid: Disable interrupted fixed length function Valid: Allows interrupted fixed length function

FunOUT.12	XintCoin	Interrupt fixed length completion signal	Valid: When the position is controlled, the interrupted fixed length displacement operation is completed. Invalid: When the position is controlled, the interrupted fixed length displacement is not completed.

Note

When using the interrupt fixed length function, the fast DI terminal DI8**[F02.23]** must be used as the interrupt fixed length function trigger terminal, and the terminal logic **[F02.24]** should be set to the edge change effective.

Table 6-20 DI8 effective logic when interrupting the fixed length function

F02.24	DI8 valid logic	Corresponding wave
3	Falling edge	
2	Rising edge	
4	Rising along the river	

Interrupt fixed length and constant speed:

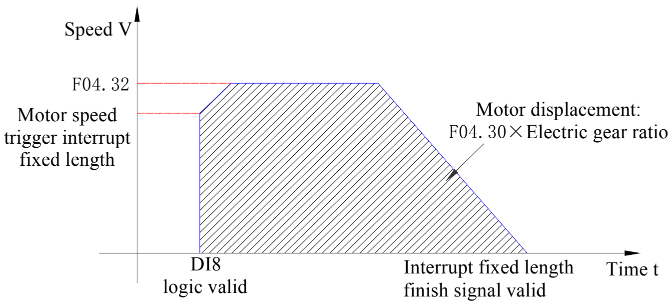


Fig.6-45 Breaking the fixed length function motor running curve

Table 6-21 Description of the interrupted fixed length motor speed

F04.32	Trigger interrupt before fixed length motor speed	Interrupt fixed length function	Interrupt fixed length and constant speed
0	<10	invalid	-
	≥10	valid	Trigger interrupt before fixed length motor speed
1～6000	-	valid	F04.32

6.2.8 Original position reset function

(1) Function introduction

Origin position: The mechanicoriginposition, which can indicate the position of the origin switch or motor Z signal, which is selected by function code **[F04.36]**.

Zero point: The positioning target point can be expressed as the origin position+ offset **([F04.41]** setting). When **[F04.41]** is set to 0, the zero point coincides with the origin.

The original homing function is the position control operation mode. When the servo enable is ON, the servo motor will actively find the original position and complete the positioning function after the home position return function is triggered.

During the homing operation, other position commands (including the re-triggered home position return enable signal) are masked; after the homing operation is completed, the servo drive can respond to other position commands.

The origin position reset function includes two modes: origin position homing and electric homing.

Origin position reset: After receiving the reset trigger signal, the servo drive actively locates the relative position of the motor shaft and the mechanic origin position according to the preset mechanic origin position. First, find the origin position, and then move the offset to the zero position based on the origin position. The originposition homing is usually used for the first time to find the zero point.

Electrical homing: After the zero position absolute position has been determined by the operation of the origin homing, the relative position is moved with the current position as the starting point.

After the originposition reset is completed (including original homing and electrical homing), the current absolute position of the motor **[F10.07]** is consistent with the mechanical origin offset **[F04.41]**.

After the original homing is completed, the servo driver outputs the homing completion signal (FunOUT.13: HomeAttain) or the electrical homing completion signal (FunOUT.14: ElecHomeAttain). The host computer receives the signal to confirm the completion of the original position reset. The original homing and the electric homing completion signal are independent of the servo mode and servo operation status.

Note

The original position reset trigger signal is masked when the interrupt fixed length function or the multi-segment position function is running.

Tabel 6-22 Difference between original homing and electric homing

Reset type	Homing mode (F04.35)	Homing direction、slowdown point、original position	Trigger signal	Total motor displacement
Original homing	0	-	-	-
	1	F04.36 decision	HomingStart signal	Decide by mechanical original position、offset displacement
	3		Servo enable	
	4		Servo enable	

	6	-	-	-
Electric homing	2	The homing direction is consistent with the motor displacement symbol and no need the deceleration point and origin position signal	HomingStart Signal	(F04.41-F10.07) ×Electric gear ratio
	5		Servo enable	

Note

When using the original position reset function, the mean filter and low pass filter function are invalid.

(2) Original homing

Note

(1) When using theoriginal position reset function, the mechanical limit switch must be set in advance. If the stop-and-return method is used and the mechanical offset is used, set the offset within the travel range to ensure no damage to machinery during the original position reset!
(2) When encounter limit switch, the servo drive generates AL.405 (forward overtravel warning) or AL.406 (reverse overtravel warning). If **[F04.43=0 or 1]**, the servo motor Stop, the stop mode is determined by **[F01.05]**!

Take the following situation as an example to illustrate the original homing:

Positive homing, deceleration position, origin position is the origin switch

Positive homing, decelerationposition, origin is motor Z signal **[F04.36=0]**;

Positive homing, the deceleration position is the origin switch, and the origin position is the motor Z signal **[F04.36=4]**;

Positive homing, deceleration position, origin positions positive overtravel switch **[F04.36=6]**;

Positive homing, the deceleration position is the positive overtravel switch, the originposition is the motor Z signal **[F04.36=8]**;

Positive homing, deceleration position, origin is mechanical limit position **[F04.36=10]**

Positive homing, the deceleration position is the mechanical limit position, and the origin position is the motor Z signal **[F04.36=12]**;

For the rest of the homing mode, only the initial homing mode is opposite to the above.

a) Original homing：Positive homing，deceleration position, origin position is the origin switch**[F04.36＝2]**;

① When the motor starts to move, the origin switch (deceleration position) signal is invalid (0: invalid; 1: valid), the whole process does not trigger the positive overtravel switch.

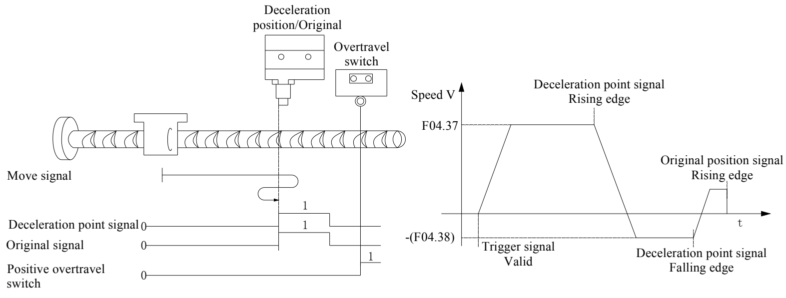


Fig.6-46 Mode 2 original homing motor operation curve①and rotate speed

The servo motor first searches for the deceleration position signal at the high speed **[F04.37]** setting value until the rising edge of the deceleration position signal is encountered, and gradually decelerates to **[-F04.38]** according to the **[F04.39]** setting, the servo The motor searches for the falling edge of the deceleration position signal at the low speed set by **[-F04.38]**, and reverses when it encounters the falling edge of the deceleration position signal, and continues to search for the rising edge of the origin signal at low speed with **[F04.38]**, and accelerates forward. Or during the forward constant running, it will stop immediately when it encounters the rising edge of the origin signal.

② The origin switch (deceleration position) signal is valid when the motor starts to move, and the forward overtravel switch is not triggered in the whole process.

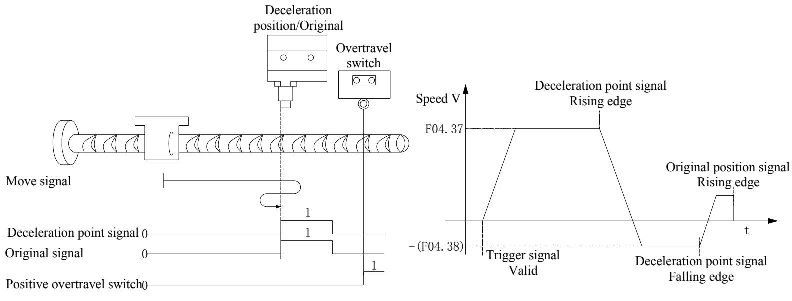


Fig.6-47 Mode 0 original homing motor running curve ② and speed description

The servo motor directly searches for the falling edge of the deceleration point signal at the low speed of **[-F04.38]** setting value, and reverses (i.e, forward direction) when the falling edge of the deceleration point signal is encountered and continues to search for the low position with **[F04.38]**. When the rising edge of the signal is in the forward acceleration or forward constant running, it will stop immediately when it encounters the rising edge of the origin signal.

③ The origin switch (deceleration position) signal is invalid when the motor starts to move, and the positive overtravel switch is activated during the process.

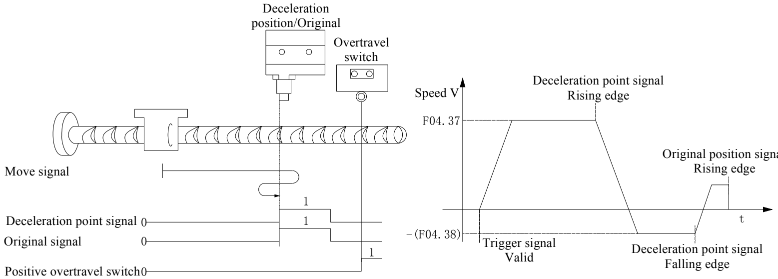


Fig.6-48 Mode 0 original homing motor running curve ③ and rotate speed description

The servo motor first searches for the deceleration position signal at the high speed **[F04.37]** setting value. After the forward overtravel switch is encountered, the driver decides to immediately be homing according to the **[F04.43]** setting **[F04.43=2 Or 3]** or stop and wait for the host computer to give the homing trigger signal **[F04.43=0 or 1]** again. After the condition is met, the drive searches for the falling edge of the deceleration position signal with **[-F04.37]** reverse high speed. After encountering the falling edge of the deceleration position signal, decelerate the reverse direction according to the **[F04.39]** setting value (i.e, return to the positive direction), and the servo motor searches for the rising edge of the origin signal with **[F04.38]** forward low speed, positive acceleration or positive During the constant speed operation, it immediately stops when it encounters the rising edge of the origin signal.

b) Original homing: positive original homing, deceleration position, origin is motor Z signal **[F04.36=0]**

Note

In the homing mode **[F04.36=0 or 1]** where the Z signal is the deceleration position and the origin, after the homing, the actual stop position of the motor may not be on the rising edge of the same side of the Z signal, and there is ±1 pulse in the stop position (Deviation of the encoder unit).

① When the motor starts to move, the Z signal is invalid (0: invalid, 1: valid), and the forward overtravel switch is not triggered in the whole process.

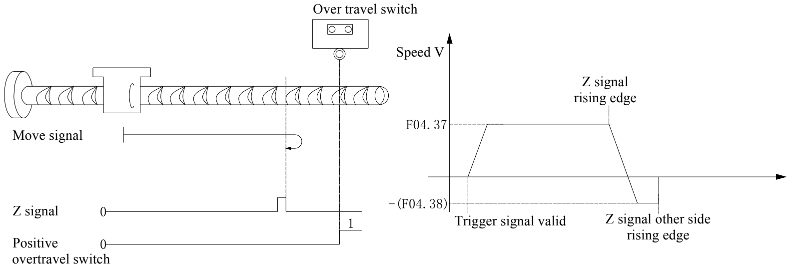


Fig.6-49 Mode 0 original homing motor running curve ①and rotate speed description

The servo motor first searches for the Z signal in the high-speed forward direction with the **[F04.37]** setting value. After the rising edge of the Z signal, it decelerates to the reverse direction according to the **[F04.39]** setting value and accelerates to **[-F04.38]**. During reverse acceleration or reverse constant speed operation, the rising edge of the other side of the motor Z signal is immediately stopped.

② The Z signal is valid when the motor starts to move, and the forward overtravel switch is not triggered in the whole process.

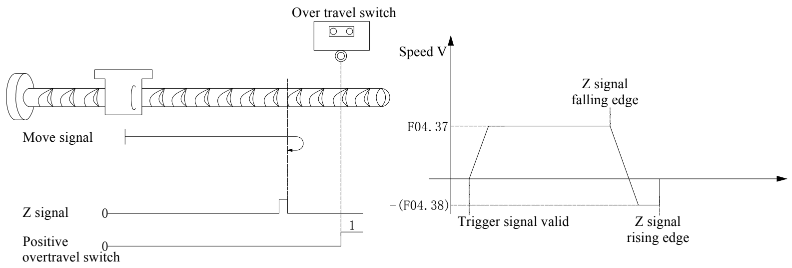


Fig.6-50 Mode 0 original homing motor running curve ②and rotate speed description

The servo motor directly searches for the falling edge of the Z signal at the low speed of **[F04.38]** set value, and reverses when it encounters the falling edge of the Z signal and continues to search for the rising edge of the Z signal at low speed with **[-F04.38]**, reverse acceleration. Or during the reverse constant speed operation, it will stop immediately when it encounters the rising edge of the Z signal.

③ The Z signal is invalid when the motor starts to move, and the positive overtravel switch is activated during the process.

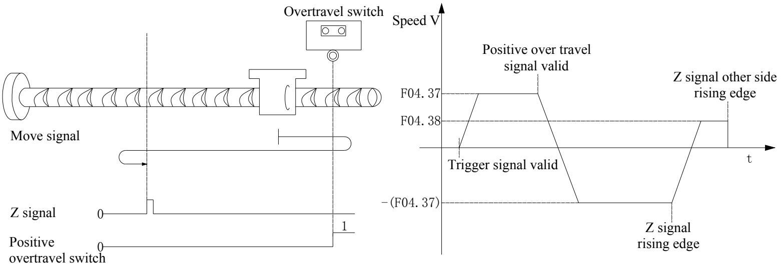


Fig.6-51 Mode 0 original homing motor running curve ③and rotate speed description

The servo motor first searches for the Z signal at the high speed with the **[F04.37]** setting value. After the forward overtravel switch is encountered, the driver decides to immediately homing according to the **[F04.43]** setting **[F04.43=2 or 3]** or stop and wait for the host computer to give the origin position reset trigger signal **[F04.43=0 or 1]**. After the condition is met, the drive searches for the Z signal in reverse **[-F04.37]** at high speed until it encounters Z. The rising edge of the signal gradually decelerates and reverses according to the set value of **[F04.39]** (ie, returns to the forward direction), and the servo motor searches for the rising edge of the other side of the Z signal with positive forward speed **[F04.38]**, positive acceleration or forward direction. During the constant speed operation, the rising edge of the other side of the Z signal is stopped immediately.

c）Origin position reset: positive homing, deceleration position is the origin switch, the origin is the motor Z signal **[F04.36=4]**.

①When the motor starts to move, the origin switch signal is invalid (0: invalid; 1: valid), the whole process does not trigger the positive overtravel switch

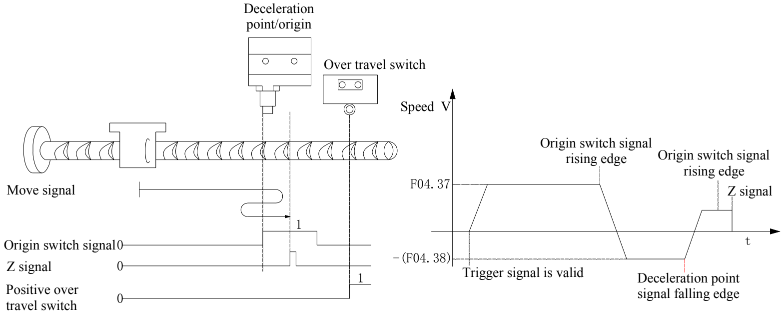


Fig.6-52 Mode 4 original homing motor running curve ①and rotate speed description

The servo motor first searches for the home switch signal at a high speed with the [F04.37] set value. After the rising edge of the home switch signal, the motor is gradually decelerated and reversed according to the **[F04.39]** setting. The servo motor is **[-F04. 38]** Set the low speed reverse search for the falling edge of the origin switch signal, encounter the falling edge of the origin switch signal to decelerate backward (ie return to the positive direction), and search for the rising edge of the origin switch signal with **[F04.38]** forward low speed. After the rising edge of the origin switch signal, continue to run, and then immediately encounter the motor Z signal immediately stops.

② The origin switch signal is valid when the motor starts to move, and the forward overtravel switch is not triggered in the whole process.

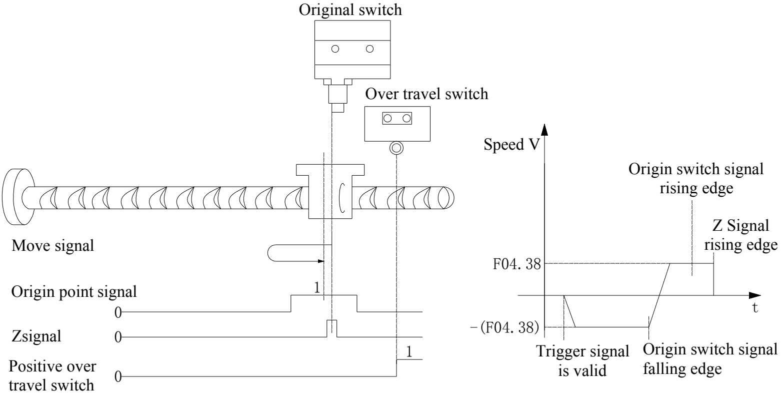


Fig.6-53 Mode 4 original homing motor running curve ②and rotate speed description

The servo motor directly searches for the falling edge of the origin switch signal with the **[-F04.38]** set value reverse low speed. After the falling edge of the origin switch signal is encountered, the deceleration is reversed (i.e, forward) to **[F04.38]** low speed forward. Search for the rising edge of the origin switch signal. After the rising edge of the origin switch signal, continue to run at **[F04.38]** forward low speed, and then stop immediately after the first Z signal rising edge.

③ The origin switch signal is invalid when the motor starts to move, and the positive overtravel switch is valid during the process.

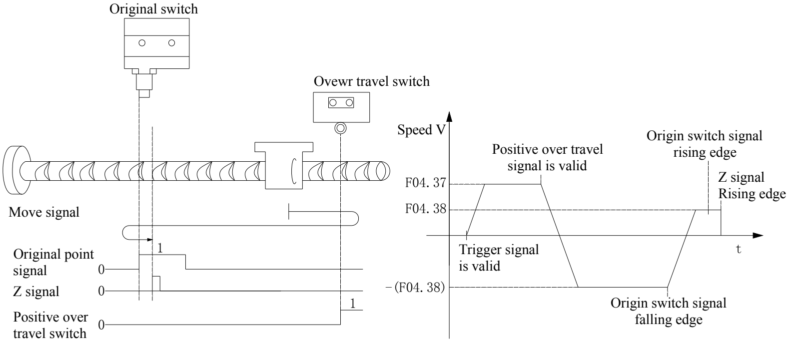


Fig.6-54 Mode 4 original homing motor running curve ③and rotate speed description

The servo motor first searches for the home switch in the high-speed direction with the **[F04.37]** setting value. After the forward overtravel switch is encountered, the driver decides to immediately return to zero according to the **[F04.43]** setting **[F04.43=2 or 3]** or stop and wait for the host computer to give the homing trigger signal **[F04.43=0 or 1]** again. After the condition is met, the drive searches for the deceleration point in the reverse direction with **[F04.37]** until the origin is encountered. When the falling edge of the switch signal is gradually decelerated and reversed according to the set value of **[F04.39]** (i.e, it returns to the positive direction), the servo motor searches for the rising edge of the origin switch signal with **[F04.38]** low speed forward, and the origin switch signal rises. After the continuation, continue to run, and immediately after the first encounter with the motor Z signal, stop immediately.

d) Original position reset: positive homing, deceleration position, origin is forward overtravel switch **[F04.36=6]**

① The forward overtravel switch signal is invalid when the motor starts moving (0: invalid, 1: valid)

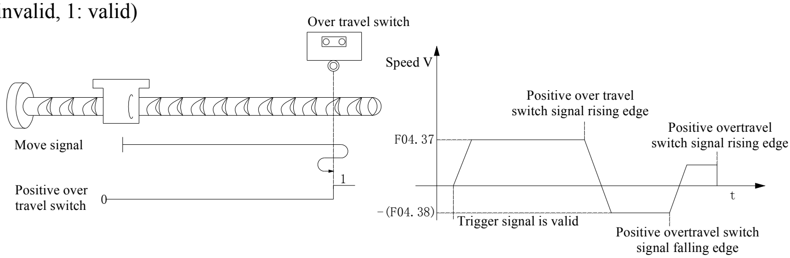


Fig.6-55 Mode 6 original homing motor running curve ①and rotate speed description

The servo motor first searches for the forward overtravel switch in the forward direction with the **[F04.37]** setting value. After the rising edge of the positive overtravel switch signal, the servo motor is gradually decelerated and reversed according to the **[F04.39]** setting. The low-speed reverse search of the forward overtravel switch signal is set at the low speed set by **[-F04.38]**, and the falling edge of the forward overtravel switch signal is decelerated and reversed (ie, the forward direction is restored), and **[F04.38]** Forward low speed search for the rising edge of the forward overtravel switch signal. During forward acceleration or forward constant speed operation, it immediately stops when it encounters the rising edge of the forward overtravel switch signal.

② The positive overtravel switch signal is valid when the motor starts moving

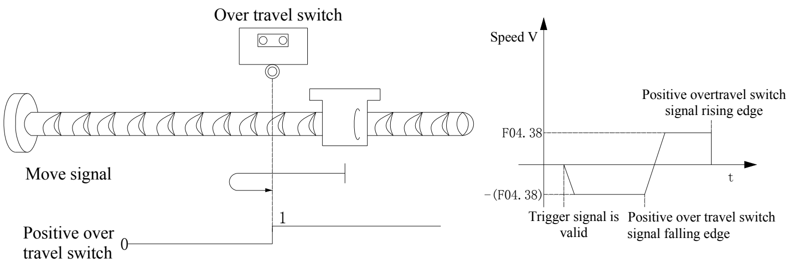


Fig.6-56 Mode 6 original homing motor running curve ②and rotate speed description

The servo motor directly searches for the falling edge of the forward overtravel switch signal with the **[-F04.38]** set value reverse low speed. After the falling edge of the positive overtravel switch signal is encountered, the deceleration is reversed (i.e, forward) to **[F04 .38]** Low-speed forward search for the rising edge of the forward overtravel switch signal. During the forward acceleration or forward constant speed operation, the positive overrun switch signal is detected and immediately stops.

e）Original homing：Positive homing, the deceleration position is the positive overtravel switch, the origin is the motor Z signal **[F04.36=8]**

① The forward overtravel switch signal is invalid when the motor starts moving (0: invalid, 1: valid)

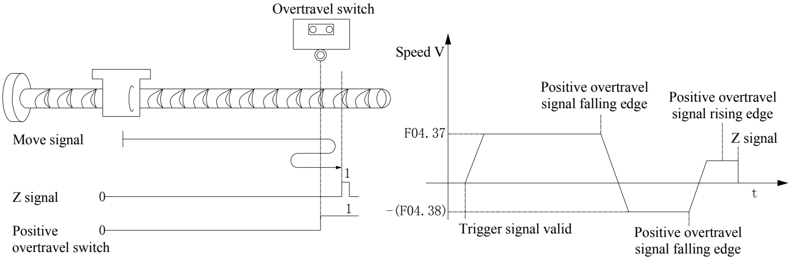


Fig. 6-57 Mode 8 original homing motor running curve ① and rotate speed description

The servo motor first searches for the forward overtravel switch in the forward direction with the **[F04.37]** setting value. After the rising edge of the positive overtravel switch signal, the servo motor is gradually decelerated and reversed according to the **[F04.39]** setting. The low-speed reverse search of the forward overtravel switch signal is set at the low speed set by **[-F04.38]**, and the falling edge of the forward overtravel switch signal is decelerated and reversed (ie, the forward direction is restored), and **[F04.38]** The positive low speed search for the rising edge of the forward overtravel switch signal, after the rising edge of the positive overtravel switch signal is encountered, continue to run, and then the motor Z signal is immediately stopped for the first time.

② The positive overtravel switch signal is valid when the motor starts moving

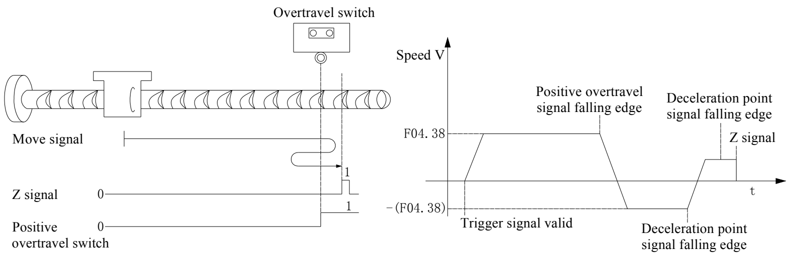


Fig.6-58 Mode 8 original homing motor running curve ②and rotate speed description

The servo motor directly searches for the falling edge of the forward overtravel switch signal with the **[-F04.38]** set value reverse low speed. After the falling edge of the positive overtravel switch signal is encountered, the deceleration is reversed (i.e, forward) to **[F04 .38]** Low-speed forward search for the rising edge of the forward overtravel switch signal. After encountering the rising edge of the positive overtravel switch signal, continue to run at **[F04.38]** forward low speed, and then encounter the Z signal rising edge for the first time. Stop immediately.

f）Original homing：Positive homing, deceleration position and origin are positive mechanical limit positions **[F04.36=10]**

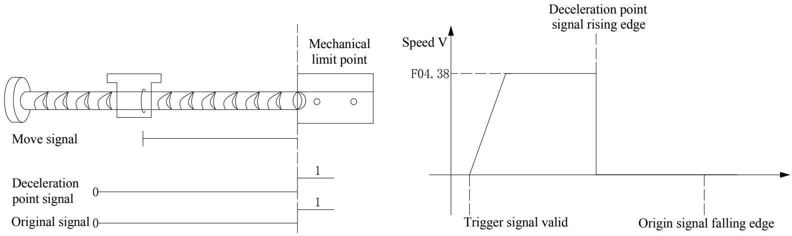


Fig.6-59 Mode 8 original homing motor running curveandrotate speed description

The servo motor first runs at a low speed in the **[F04.38]** setting. After hitting the mechanical limit position, if the torque reaches the **[F04.55]** torque upper limit and the speed is lower than the **[F04.54]** setting, after this state is maintained for a certain period of time, it is judged that the mechanical limit position is reached, and the motor immediately stops.

g）Original homing：Positive homing, the deceleration position is the positive mechanical limit position, and the origin is the motor Z signal (**[F04.36] =12**)

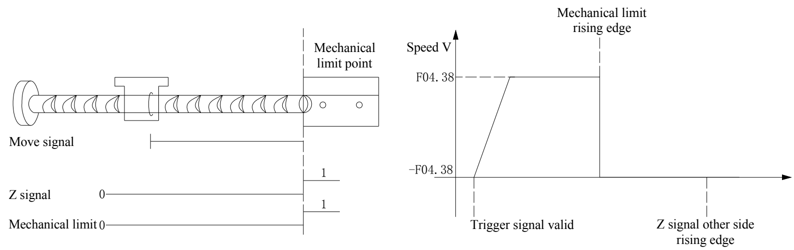


Fig.6-60 Mode 12 original homing motor running curveandrotate speed description

The servo motor first runs at the low speed with the **[F04.38]** set value. When it hits the mechanical limit position, if the torque reaches the **[F04.55]** torque upper limit and the speed is lower than the **[F04.54]** setting value. If this state is maintained for a certain period of time, it is judged that the mechanical limit position is reached, the motor runs in the reverse direction, and the reverse operation is performed at the speed of **[F04.38]**, and then the first stop of the Z signal is stopped.

(3) Electric homing: start electric homing command [**F04.35=2 or 5]**

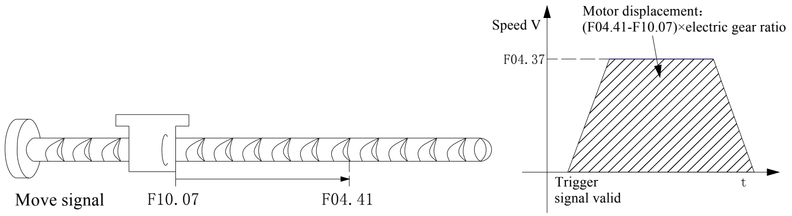


Fig.6-61 Electric homing motor running curve and speed description (electrical homing)

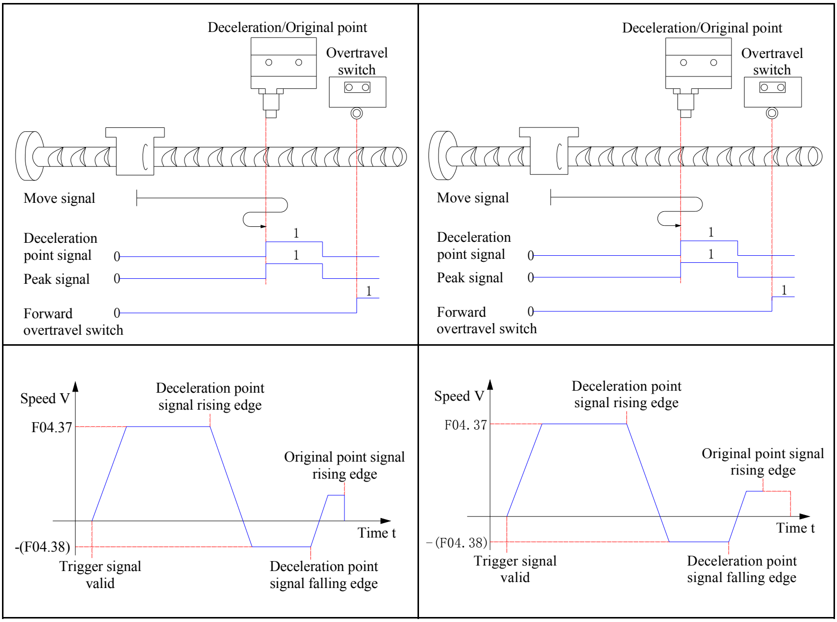
After the original homing is completed, the mechanical home position of the servo system is known. At this time, after setting **[F04.35=2 or 5]**, the servo motor can be moved from the current absolute position **[F10.07]** to the specified position **[F04.41]**. In the electric homing mode, the servo motor runs at the high-speed set by **[F04.37]**. The total motor displacement is determined by the difference between **[F04.41]** and **[F10.07]**. The running direction is positive or negative of the total displacement of the motor. It is decided that the displacement command is completed, and the motor immediately locks the axis and waits for other position command inputs.

(4) Mechanical original position and zero position

Taking **[F04.35=02]** as an example to illustrate the difference between mechanical origin and zero position

Table 6-23 Examples of mechanical origin and mechanical zero position

mechanical origin does not coincide with the mechanical zero position	mechanical origin coincide with the mechanical zero position
If the origin offset (F04.41≠0) is set and the mechanical origin does not coincide with the mechanical zero position(F04.43=0/2), during the forward acceleration or forward constant speed operation, the rising edge of the origin signal is stopped immediately. , and the current absolute position of the motor F10.07 is forced to F04.41 after the stop.	If the origin offset (F04.41≠0) is set and the machine origin coincides with the mechanical zero point (F04.43=1/3), during the forward acceleration or forward constant speed operation, the motor continues after the rising edge of the origin signal is encountered. Move until the current absolute position F10.07 is F04.41



Deceleration/Original point
Overtravel switch
Move signal
Deceleration point signal
Peak signal
Forward overtravel switch
0
1
Deceleration/Original point
Overtravel switch
Move signal
Deceleration point signal
Peak signal
Forward overtravel switch
0
1
Speed V
F04.37
-(F04.38)
Deceleration point signal rising edge
Original point signal rising edge
Time t
Trigger signal valid
Deceleration point signal falling edge
Speed V
F04. 37
－(F04. 38)
Deceleration point signal rising edge
Original point signal rising edge
Time t
Trigger signal valid
Deceleration point signal falling edge

(5) Parameter setting

a) Original position reset mode setting

Code	Name	Set range	Function	Setting mode	Effective mode	Factory default
F04.35	Original position reset enable control	0: Turn off the homing function 1: Enable the homing function by inputting the HomingStart signal by DI 2: Enable the electric homing function by inputting the HomingStart signal by DI 3: Start the homing immediately after power-on 4: Immediate return to origin 5: Start the electric homing command 6: Taking the current position as the origin	Set the homing mode and trigger signal source	Run setting	Effective immediately	0
F04.36	Original position reset mode	0; positive homing, deceleration position, origin is the origin switch 1: Reverse direction, deceleration position, origin is the origin switch 2: Positive homing, deceleration position, origin is motor Z signal 3: Reverse homing, deceleration position, origin is motor Z signal 4: Positive homing, deceleration position is the origin switch, the origin is motor Z signal 5: Reverse homing, the deceleration position is the origin switch, and the origin is the motor Z signal. 6: Forward homing, deceleration position, origin is forward overtravel switch 7: Reverse homing, deceleration position, origin is reverse overtravel switch 8: Forward homing, the deceleration position is the forward overtravel switch, and the origin is the motor Z signal. 9: Reverse homing, the deceleration position is reverse overtravel switch, the origin is motor Z signal 10: Positive homing, deceleration	Set the homing direction and the deceleration position origin when original position reset.	Stop setting	Effective immediately	0

		position, origin is mechanical limit position 11: Reverse homing, deceleration position, origin is mechanical limit position 12: Positive homing, the deceleration positionisthe mechanical limit position, and the origin is the motor Z limit number. 13: Reverse homing, the deceleration position is the mechanical limit position, and the origin is the motor Z signal.				
F04.41	Mechanical original position displacement	-1073741824～1073741824	When the original homing mode is 10 or 12, when F04.41>0, the 10th and 12th zeros cannot be started, and when F04.41<0, the 11th and 13th zeros cannot be started.	Stop setting	Effective immediately	0
F04.43	Origin offset and limit processing method selection	0: F04.41 when the original positionhoming to the coordinates, encounter the limit and re-start the homing enable the reverse to find the origin position 1: F04.41 is the relative offset after the return of the origin. After the limit is triggered again, the homing is enabled, and the reverse point is found. 2: F04.41 is the coordinate afteroriginalhoming 3: F04.41 is the relative offset after the original homing.	Set whether the machine origin is offset when the original homing; Whether to move extra distance and encounter overtravel after homing	Stop setting	Effective immediately	0

b) Original position reset operation curve setting

If the deceleration position signal is valid and the origin signal is valid without sufficient deceleration, the final positioning may be unstable. The displacement required for deceleration should be fully considered, and the deceleration point and the origin signal input position should be set. The acceleration/deceleration time [F04.39] when searching for the origin also affects the positioning stability, so it should be considered when setting.

Code	Name	Set range	Unit	Function	Setting mode	Effective mode	Factory default
F04.37	Searching for the speed of the home switch signal at high speed	0～3000	rpm	When the original position reset, the high speed value of the deceleration position signal is searched. When the electric homing, the motor always runs at high speed of F04.37.	Stop setting	Effective immediately	100
F04.38	Searching the speed of the home switch at low speed	0～1000	rpm	When the original homing, the low speed value when searching for the origin is set. The speed setting value should be low to prevent mechanical shock when the machine stops.	Stop setting	Effective immediately	10
F04.39	Acceleration/deceleration time when searching for the origin	0～1000	ms	When the original position reset, the motor is shifted from 0 to 1000 rpm.	Stop setting	Effective immediately	1000
F04.40	Limit the time to find the origin	0～65535	ms	Limit the total return time of the origin. When the timeout occurs, the warning Er.601 (the homing timeout failure) occurs.	Stop setting	Effective immediately	10000
F04.41	Mechanical original position displacement	-1073741824～1073741824	Command unit	Set the absolute position of the motor after the original homing (F10.07) value	Stop setting	Effective immediately	0

<table>
<tr><th>Code</th><th>Name</th><th>Function name</th><th>Function</th></tr>
<tr><td>FunIN.30</td><td>HomeSwitch</td><td>Origin switch</td><td>Valid：Current position is the origin
<table>
<tr><th>HomeSwitch set DI terminal logic</th><th>Actual effective level</th></tr>
<tr><td>0（Low level）</td><td>Low level</td></tr>
<tr><td>1（High level）</td><td>High level</td></tr>
<tr><td>3（Rising edge）</td><td>High level</td></tr>
<tr><td>4（Falling edge）</td><td>Low level</td></tr>
<tr><td>5（Edge change）</td><td>Low level</td></tr>
</table>
According to the output of the host computer, the DI terminal corresponding to the origin switch is logically set to high/low level.</td></tr>
<tr><td>FunIN.31</td><td>HomingStart</td><td>Original position reset enables</td><td>Valid: Enables the original homing function. During the original homing operation, the repeated enable is invalid.</td></tr>
</table>

			Invalid: The original homing function is disabled.
FunOut.13	HomeAttain	Original homing completed	Valid: When the position is controlled, the original homing is completed. Invalid: The original homing is not completed.
FunOut.14	ElecHomeAttain	Electric homing completed	Valid: When the position is controlled, the Electric homing is completed. Invalid: Electric homing is not completed.

c) Operation timing

① **[F04.35=1 or 2]**

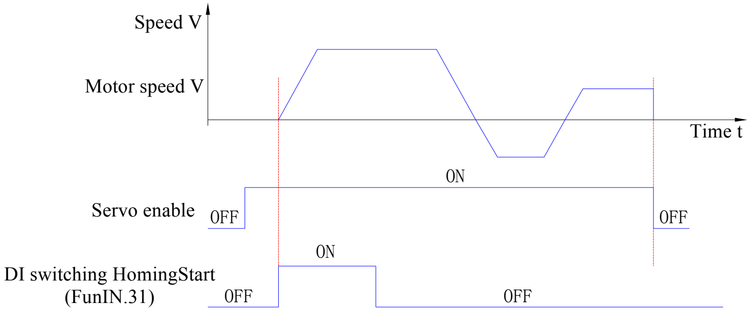


Fig.6-62 Timing diagram

1> The servo enable signal must be turned on first, then the HomingStart signal must be turned on;

2> During the original position reset, the servo enable signal remains valid and the HomingStart signal number is masked;

3> During the original position reset, the servo enable signal is disabled, the servo motor stops rotating, and the home position return is restarted. Please turn on the servo enable signal first, then turn on the HomingStart signal.

4> The original position reset timeout occurs (Er. 315), the servo motor stops rotating, and the servo enable signal is valid. When the HomingStart signal is re-triggered, the Er.315 can be reset and the home position return can be performed again.

5> The original position reset can be triggered repeatedly.

② **[F04.35=3]**

1> Perform the original position reset only when the servo enable signal is asserted for the first time after power-on;

2> The original position reset timeout occurs (Er. 315), the servo motor stops rotating, and the servo enable signal can be reset to reset Er.315;

3> Do not trigger the return of the origin repeatedly before powering on again;

③ **[F04.35=4 or 5]**

1> After the power is turned on, the servo enable signal is asserted and the original position reset is performed immediately;

2> During the original position reset, the servo enable signal is deactivated, the servo motor stops rotating, and the servo enable signal is asserted again to re-trigger the original position reset.

3> The original position reset timeout occurs (Er.315), **[F04.35]** is set to 0, the servo motor stops rotating, and the servo enable signal is invalid to reset Er.315. To re-origin the return point, it must be reset. **[F04.35]**; After the original position reset is completed, **[F04.35=0]**, if you want to perform the return-to-origin again, you must reset **[F04.35]**.

④ **[F04.35=6]**

1> When using the "Home position as origin" function and you need to implement the origin offset (**[F04.43=0 or 2]**, **[F04.41≠0]**), you must first set **[F04.41]** and **[F04. 43]**, finally set **[F04.35=6]**, otherwise **[F10.07]** is the value of the previous **[F04.41]**, not the value of the modified **[F04.41]**.

2> After the original position reset is completed **[F04.35=0]**, if you want to perform the home position return again, you must rewrite **[F04.41]** and set **[F04.35=6]**.

6.2.9 Position control operation mode functioncode diagram

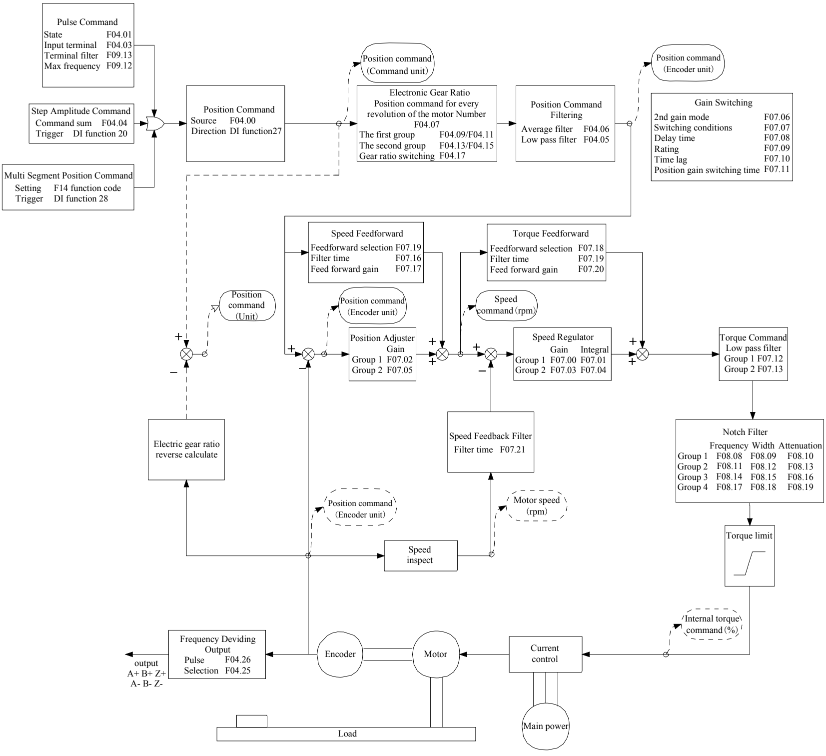


Fig.6-63 Position control function code diagram

6.3 Speed control operation mode

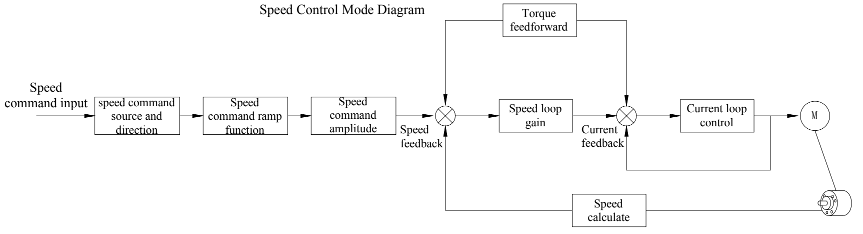


Fig.6-64 Speed control diagram

The value of parameter **[F01.00]** is set to 1 by servo drive or our drive debugging platform, and the servo drive will work in speed control mode.

Please set the servo drive parameters according to the mechanical structure and indicators. The basic parameter settings when using the speed control operation mode are explained below.

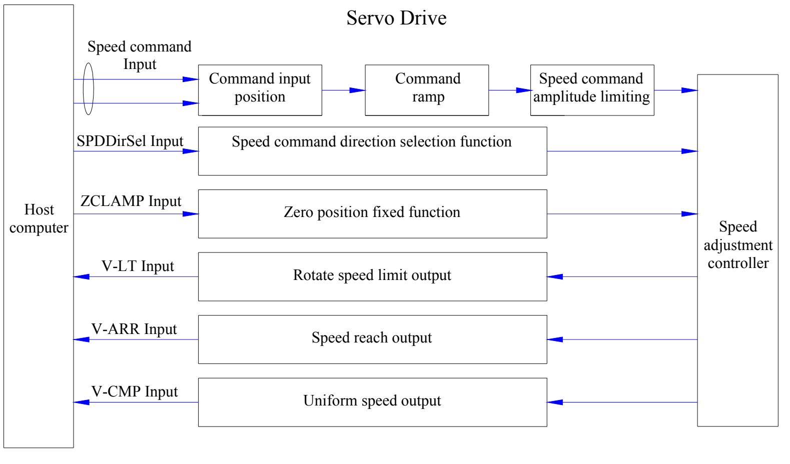


Fig.6-65 Servo drive and host computer signal interaction diagram

6.3.1 Speed command input set

(1) Speed commandsource

The speed control operation mode has the following five speed command acquisition modes, which are set by function codes **[F05.00]**, **[F05.01]**, **[F05.02]**.

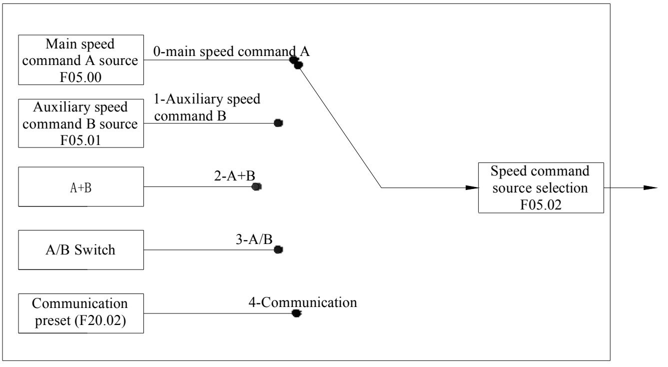


Fig.6-66 Speed command source diagram

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F05.02	Speed command selection	0: Primary speed command A source 1: Auxiliary speed command B source 2: A+B 3: A-B 4: A/B Switching	-	Select speed command resource	Run setting	Effective immediately	0

(2) Main speed command A source

The main speed command A source includes digital reference and analog voltage given two instruction forms. The digital value is given as the internal speed command, and the analog voltage is given as the external speed command.

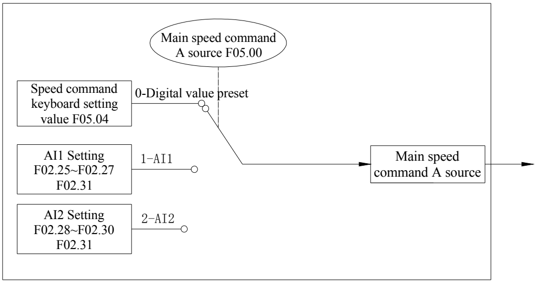


Fig.6-67 Main speed Asource diagram

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F05.00	main speed Asource	0: Digital reference (F05.04) 1: AI1 2: AI2 3: Communication given	-	Select the source of the main speed command A	Run setting	Effective immediately	0

a) Digital preset: The speed value is set by the function code **[F05.04]** and is used as the speed command.

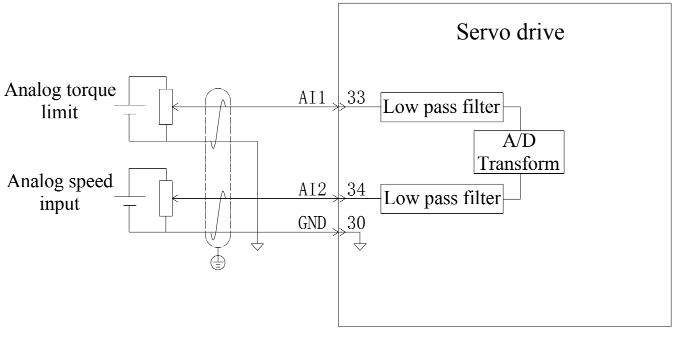
Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F05.04	Speed command keyboard setting value	-6000～6000	rpm	The internal speed command is set to a value of 1 rpm.	Run setting	Effective immediately	200

b) Analog voltage reference: refers to the analog voltage signal output by the host computer or other equipment, which is processed as a speed command.

① analog voltage input terminal

The servo driver has 2 analog inputs for power: AI1 and AI2, the maximum input voltage is ±10Vdc, and the input impedance is about 9kΩ.

Analog input circuit:



② Operation method:

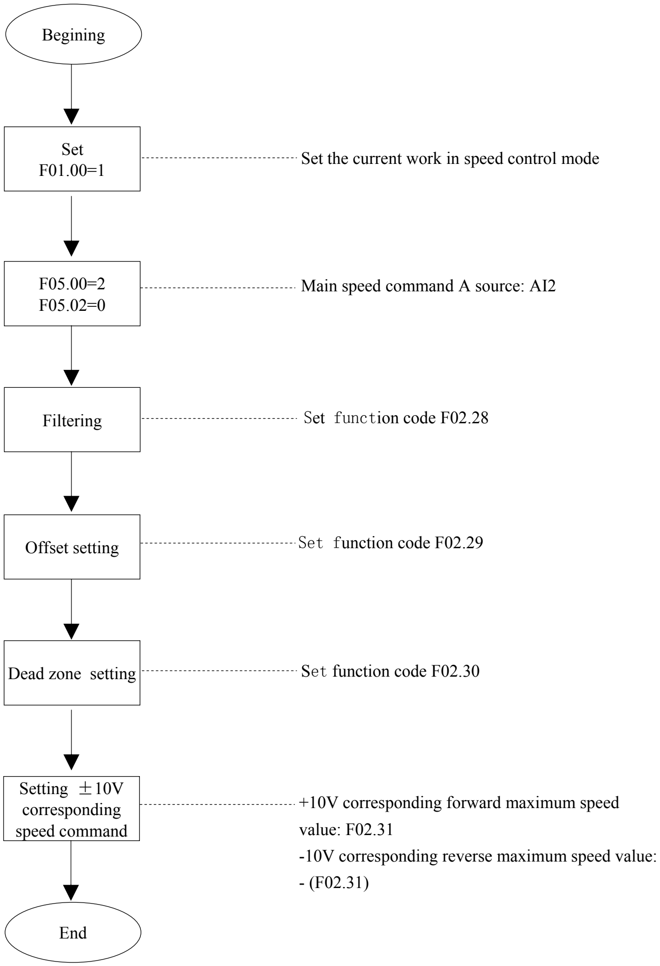


Fig.6-68 Analog voltage speed command operation flow chart

Note

Offset: refers to the value of the servo drive sampled voltage value relative to GND when the analog channel input voltage is zero.
Dead zone: refers to the input voltage range of the analog channel when the sampling voltage is zero.

The output voltage of the unprocessed analog channel is shown in Figure 6-69 y_1. After being processed internally by the servo driver, the speed command y_5 is finally obtained.

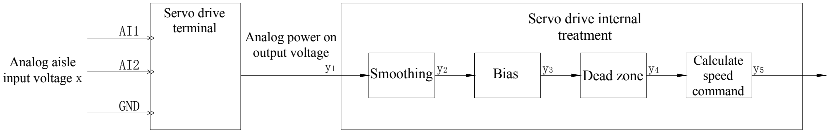


Fig.6-69 Servo driver AI processing flow

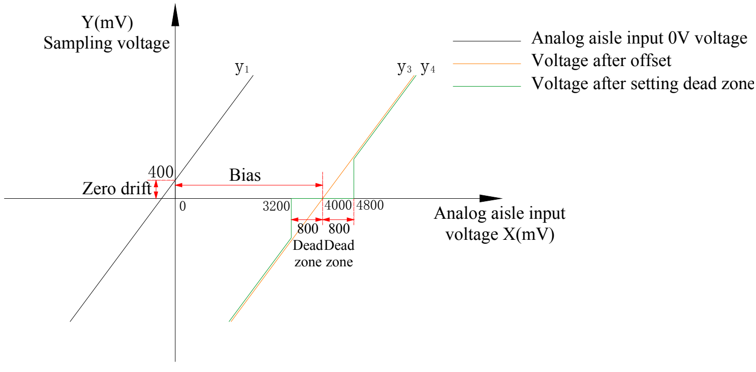


Fig.6-70 Servo driver AI processing corresponding sampling voltage example

③ Filtering:

The servo driver provides analog channel filtering. By setting the filter time constant **[F02.28]**, it can prevent the motor command fluctuation caused by the unstable analog input voltage and can also reduce the motor error caused by the interference signal. The filtering function has no elimination or suppression of the dead zone.

④ Offset settings:

Set the actual input voltage value when the sampling voltage is 0.

As shown in the figure, when the sampling voltage y4=0 is preset, the corresponding actual input voltage X=4000mV, which is called offset.

Manually set **[F02.29]** =4000(mV), after biasing, the sampling voltage y4=x-4000=y3-4000

⑤ Dead zone correction:

Limits the effective input voltage range when the drive sample voltage is not zero.

After the offset setting is completed, when the input voltage X is within 3200mV and 4800mV, the sampled voltage value is 0. This 800mV is called the dead zone.

Set **[F02.30=800.0]**, after the dead zone correction, the sampling voltage is as shown in y5.

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

⑥ Calculate the speed command:

After the offset and deadzone settings are completed, set the speed command value corresponding to 10V (10000mV) in the sampling voltage at this time by **[F02.31]**, and the actual speed command y_6:

$$y_6 = \frac{y_5}{10000} \times (F02.31)$$

This value will be used as the speed control operation mode analog speed command reference.

Among them, when there is no offset, as shown in Figure 6-71, there is an offset as shown in Figure 6-72. When the correct setting is completed, the speed command value corresponding to the input analog quantity can also be viewed by **[F10.01]**.

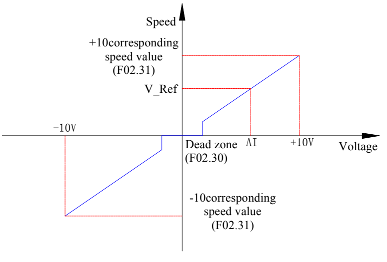


Fig.6-71 No offset AI2 diagram

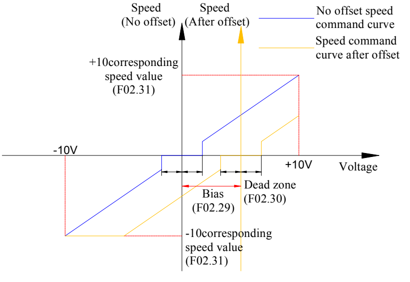


Fig.6-72 AI2 after offset diagram

The relationship between the final speed command value y6 and the input voltage x:

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

Note

B：Offset；C：deadband.

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F02.29	AI2 offset	-5000～5000	mV	Set the AI2 channel analog offset value	Run setting	Effective immediately	0
F02.28	AI2 input filter time constant	0～655.35	ms	Set the AI2 channel analog average filter time constant	Run setting	Effective immediately	2.00
F02.30	AI2deadband	0～1000.0	mV	Set the AI2 channel analog deadband value	Run setting	Effective immediately	10.0

F02.31	Analog 10V corresponding speed value	0～6000	rpm	Set the analog 10V corresponding speed value	Run setting	Effective immediately	3000

Note

When the analog AI1 input channel is selected, its setting method is similar to the above analog AI2 setting method. For related function codes, refer to the parameter descriptions of **[F02.25]~[F02.27]** in Chapter 8.

(3) Auxiliary speed command B source

The auxiliary speed command B source includes three kinds of command forms: digital reference, analog voltage reference, and multi-speed command. Among them, the digital reference, the multi-speed command is an internal command, and the analog voltage is given as an external speed command.

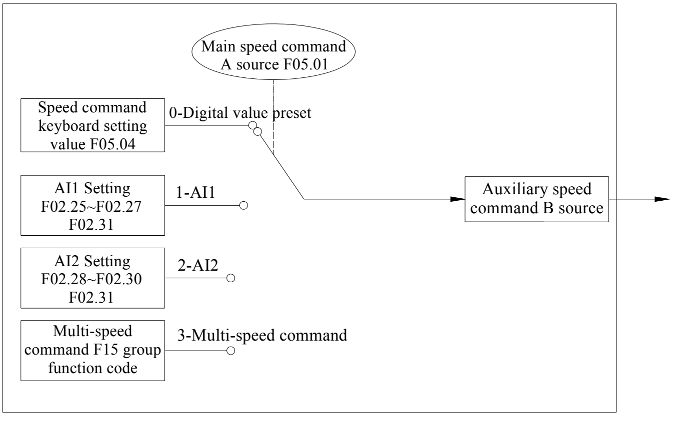


Fig.6-73 Source of auxiliary speed command B

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F05.01	Auxiliary speed command B source	0: Digital reference (F05.04) 1: AI1 2: AI2 3: multi-speed command	-	Select the auxiliary speed command B source form	Run setting	Effective immediately	1

Among them, the digital reference and analog voltage setting methods are the same as the main speed command A source. The following mainly introduces the multi-speed command.

The servo drive has a multi-speed running function. It means that the servo drive stores 16 speed commands internally, and the maximum running speed and running time of each segment can be set separately. It is equipped with 4 sets of acceleration and deceleration time to choose from. The setting process is as follows:

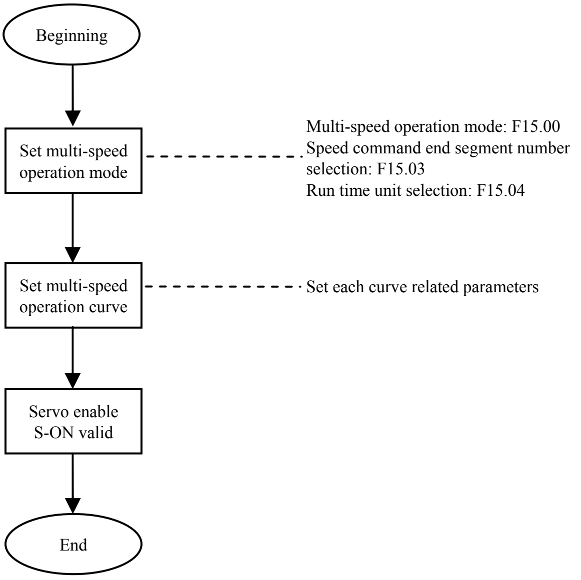


Fig.6-74 Multi-step speed setting flow diagram

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F15.00	Multi-speed operation mode	0: Single operation end stop (F15.03 number of segments selected) 1: Cycle operation (F15.03 number of segments selected) 2: Loop operation (F15.03 number of segments selected) 3: Switching by external DI	-	Set multi-speed command operation mode	Stop setting	Effective immediately	1
F15.03	Speed command end segment selection	1～16	-	Set the number of segments required for multi-speed instructions	Stop setting	Effective immediately	1
F15.04	Operating unit selection	0：Sec 1：Min		Select the unit of multi-speed command run time	Run setting	Effective immediately	1

The external DI terminal can be configured and set to function FunIN.5:DIR-SEL for multi-segment running command direction selection.

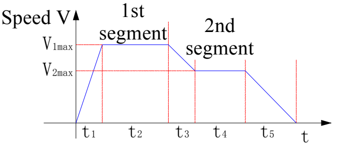
Code	Name	Function name	Function
FunIN.5	DIR-SEL	Multi-segment running command direction selection	Invalid: default command direction; Valid: the reverse direction of the instruction;

Take [F15.03=2] as an example to illustrate each mode.

① Single operation end shutdown **[F15.00=0]**

The function code **[F15.00]** is set to 0, and the single-run stop mode is selected. Set the function code **[F15.03]**, **[F15.04]** according to the total number of execution segments and the execution time unit, and set the command value, running time and acceleration/deceleration time parameters of the corresponding segment according to the requirements. The drive will follow the segment code. Run from the first segment to the Nth segment until the last segment of the run is stopped.

Table 6-24 Single run end shutdown instructions

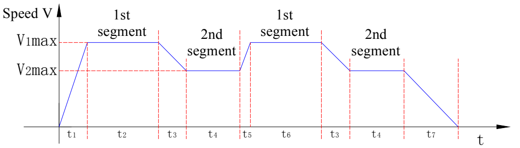
Mode description	Operation curve
1. Run 1 round; 2. The segment number is automatically incremented and switched;	 V1max, V2max: the first and second instruction speeds; T1: the actual acceleration and deceleration time of the first segment; T3, t5: the second period of time acceleration and deceleration time; A certain running time: the speed command of the previous segment is switched to the shifting time of the speed command + the constant running time of the segment (for example, the first running time in the figure is t1+t2, the second running time is t3+t4, and so on) If a certain running time is not set to 0, the drive will skip the speed command and execute the next paragraph; The actual motor speed reaches the maximum running speed set in this section, and the speed arrival signal is valid; When a certain section is evenly generated, the servo enable is OFF, and the motor stops according to the servo OFF stop mode (F01.03)

Note

The complete number of multi-segment speed commands set by the complete operation of the drive [F15.03] is called completion of one-round operation.

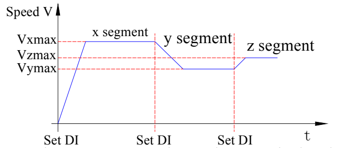
② Cycle operation**[F15.00=2]**

The function code **[F15.00]** is set to 2, and the cyclic operation mode is selected. Set the function code **[F15.03]**, **[F15.04]** according to the total number of execution segments and the execution time unit, and set the command value, running time and acceleration/deceleration time parameters of the corresponding segment according to the requirements. The module will be based on each segment. The command running time and acceleration/deceleration time are set. The drive will run according to the segment code from the first segment to the Nth segment. After the last segment is run, it will automatically jump to the first segment of the cycle.

Mode description	Operation curve
1, Cycle operation, the starting segment number of each segment is 1 2. The segment number is automatically incremented and switched; 3, The servo enable is effective, it will remain in the loop running state	 V1max, V2max: the maximum running speed of the first and second segments; A certain running time: the speed command of the previous segment is switched to the shifting time of the speed command + the constant running time of the segment (for example, the first running time in the figure is t1+t2, the second running time is t3+t4, and so on) If a certain running time is not set to 0, the drive will skip the speed command and execute the next paragraph; The actual motor speed reaches the maximum running speed set in this section, and the speed arrival signal is valid; When a certain section is evenly generated, the servo enable is OFF, and the motor stops according to the servo OFF stop mode (F01.03)

③ DIswitching operation**[F15.00=3]**

The function code **[F15.00]** is set to 3, and the external DI switching mode is selected. According to the total number of execution segments and the execution time unit, set the function code **[F15.03]**, **[F15.04]** respectively, and set the command value, running time and acceleration/deceleration time parameters of the corresponding segment according to the requirements, the drive will be based on the external DI. The ON/OFF combination of (CMDx) selects the speed command to run the corresponding segment number.

Mode description	Operation curve
1. The segment number is updated, and it can be operated continuously. 2. The segment number is determined by the logic of the DI terminal; 3. The interval between the segment and the segment is determined by the delay time of the upper computer command; 4. Multi-segment position enable is	 x, y: segment number, segment number and DI terminal and logic relationship as described below;

effective for edge change.	A certain running time is not affected by the function code setting value. If a segment number of changes during a certain speed command operation, it will immediately switch to the new segment number operation; The actual motor speed reaches the maximum running speed set in this section, and the speed arrival signal is valid; When a certain period of operation occurs, the servo enable is OFF, and the motor stops according to the servo OFF stop mode (F01.03);

When the multi-speed operation mode is set to DI switching operation, the four DI terminals of the servo driver must be configured as functions 6 to 9 (FunIN.6 to FunIN.9 multi-stage operation command switching), and the DI terminal valid logic is determined. At the same time, one DI terminal of the servo driver can be configured as function 5 (FunIN.5: DIR-SEL, multi-speed DI switching direction setting), and the speed command direction is switched.

<table>
<tr><th>Code</th><th>Name</th><th>Function name</th><th>Function</th></tr>
<tr><td>FunIN.5</td><td>DIR-SEL</td><td>Multi-speed DI switching direction setting</td><td>Used to set the speed command direction only in multi-speed DI switching mode:
Invalid: keep the original command direction;
Valid: command direction</td></tr>
<tr><td>FunIN.6</td><td>CMD1</td><td>Multi-segment operation command switching1</td><td rowspan="4">The multi-segment number is a 4-digit binary number, and the correspondence between CMD1 and CMD4 and the segment number is as shown in the following table.
<table>
<tr><th>CMD4</th><th>CMD3</th><th>CMD2</th><th>CMD1</th><th>correspondence</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td><td>2</td></tr>
<tr><td colspan="5">…</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>16</td></tr>
</table>
CMD value is 1 when the DI terminal input level is valid, otherwise 0</td></tr>
<tr><td>FunIN.7</td><td>CMD2</td><td>Multi-segment operation command switching</td></tr>
<tr><td>FunIN.8</td><td>CMD3</td><td>Multi-segment operation command switching3</td></tr>
<tr><td>FunIN.9</td><td>CMD4</td><td>Multi-segment operation command switching</td></tr>
</table>

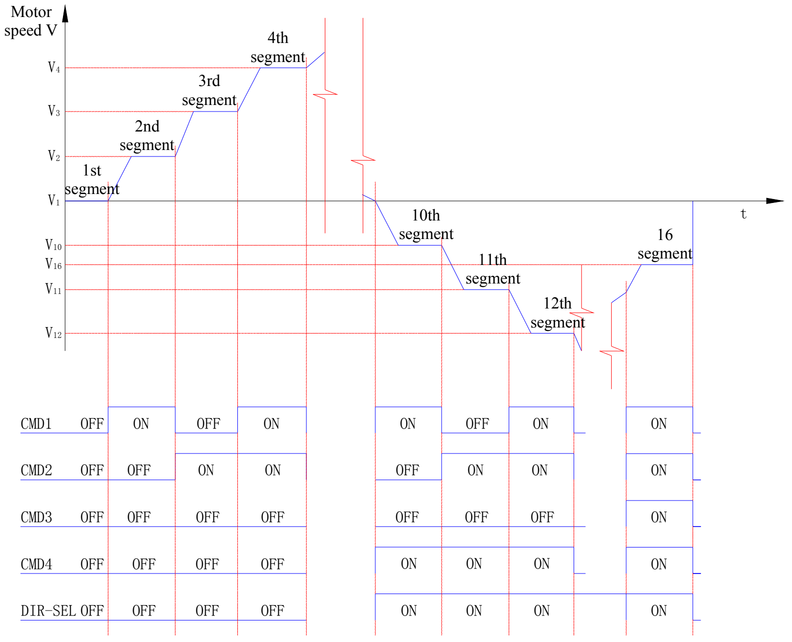


Fig.6-75 Multi-speed curve example

④ Multi-speed curve example setting

Taking the first speed command as an example, the relevant function codes are as follows:

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F15.05	Acceleration time1	0～65535	ms	Set the first group acceleration and deceleration time	Stop setting	Effective immediately	10
F15.06	Deceleration time 1	0～65535	ms		Stop setting	Effective immediately	10
F15.11	Acceleration time4	0～65535	ms	Set the 4th group acceleration and deceleration time	Stop setting	Effective immediately	150
F15.12	Deceleration time4	0～65535	ms		Stop setting	Effective immediately	150
F15.13	1st speed command	-6000～6000	rpm	Set the first group speed command	Stop setting	Effective immediately	0
F15.14	1st speed command operation time	0～6553.5	S（min）	Set the first group commandoperate time	Stop setting	Effective immediately	5.0

F15.15	The first group acceleration and deceleration time	0：acceleration and deceleration time zero 1：acceleration and deceleration time 1 2：acceleration and deceleration time 2 3：acceleration and deceleration time 3 4：acceleration and deceleration time 4	-	Select the first group acceleration and deceleration mode	Stop setting	Effective immediately	0

In addition to the 1~16 segment command value and command running time, there are 4 groups of acceleration/deceleration time to choose from. The default mode is no acceleration/deceleration time. Take the end of single operation **[F15.03=1]** in multi-speed, for example, the actual acceleration/deceleration time and running time are explained:

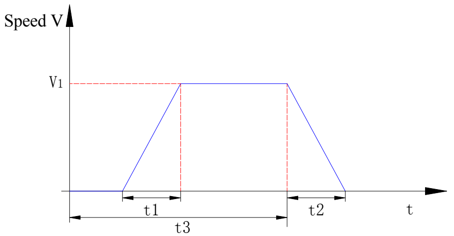


Fig.6-76 Multi-speed curve example

As shown in the figure above, the speed command is V1 and the actual acceleration time t1 is:

$$t_1 = \frac{V_1}{1000} \times \text{The acceleration time on this speed segment}$$

Actual deceleration time t_2:

$$t_2 = \frac{V_1}{1000} \times \text{The acceleration time on this speed segment}$$

Running time: The speed command of the previous segment is switched to the shifting time of the speed command + the constant running time of the segment, as shown in Figure t_3.

(4) A/B switching source

When the speed command selects "A/B switching" or function code **[F05.02=4]**, the DI function FunIN.4 needs to be assigned to the corresponding DI terminal, and the current A command source is determined according to the input signal on this DI terminal. Input valid or B command source input is valid.

Code	Name	Function name	Function
FunIN.4	CMD-SEL	Main and auxiliary operation command switching	Invalid: The current run command is A. Valid: The current running command is B.

(5) Communication preset

When the function code **[F05.01]** is set to 4, the speed command value is derived from the function code **[F20.02]** setting value, and the function code **[F20.02]** must be modified by communication, and the control panel is not visible.

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F20.02	Communication given speed command	-6000.00～6000.00	rpm	Set the speed command value for the given form of communication to 0.001 rpm	Run setting	Effective immediately	-

(6) Speed command direction setting

The speed command direction switching is realized by DI, that is, the DI function FunIN.26 is assigned to the corresponding DI terminal, and the current speed command direction is determined according to the input signal on the DI terminal, thereby satisfying the requirement of the speed command direction switching.

Code	Name	Function name	Function
FunIN.26	SPDDirSel	Speed command direction setting	Invalid: Positive direction. Valid: the opposite direction.

The actual motor rotation direction speed command direction and speed command direction DI switching (FunIN.26) are both related.

Table 6-25 Actual motor rotation direction setting in speed control mode

Positive and negative speed command	FunIN.26	Actual motor rotation direction
+	Invalid	Counterclockwise
+	Valid	Clockwise
-	Invalid	Clockwise
-	Valid	Counterclockwise

6.3.2 Ramp function setting

The ramp function setting means that the speed command with a large acceleration is converted into a speed command with a relatively gentle acceleration, that is, the acceleration/deceleration time is set to achieve the purpose of controlling the acceleration.

In the speed control operation mode, if the acceleration of the speed command is too large, the motor will jump or vibrate. At this time, increase the acceleration or deceleration time, and the motor can be smoothly shifted to avoid mechanical damage caused by the above situation.

Note

(1) When the speed command is derived from digital reference, analog voltage reference, and jog speed, the acceleration/deceleration time is set by function codes **[F05.06]** and **[F05.07]**.

(2) When the speed command is derived from multi-step speed, the acceleration/deceleration time is set by [F15 group] parameter. For details, see Chapter 8 "F15 Group: Multi-speed parameter".

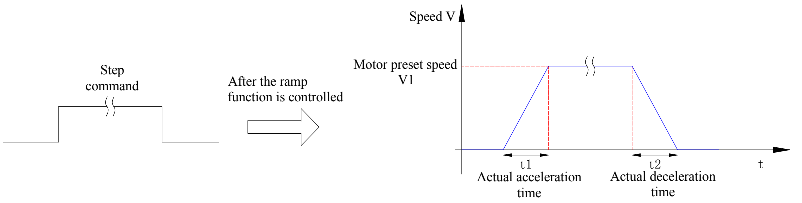


Fig.6-77 Schematic diagram of the definition of the ramp function

[F05.06]: The speed command is accelerated from 0 to 1000 rpm.

[F05.07]: Time when the speed command is decelerated from 1000 rpm to 0

Therefore, the actual acceleration and deceleration time is calculated asfollows:

$$\text{Actual acceleration time } t_1 = \frac{\text{Speed command}}{1000} \times \text{Speed command acceleration ramp time}$$

$$\text{Actual acceleration time } t_2 = \frac{\text{Speed command}}{1000} \times \text{Speed command acceleration ramp time}$$

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F05.06	Speed command acceleration ramp time constant	0～65535	ms	Used to set the speed command acceleration/deceleration time value outside the multi-speed command	Run setting	Effective immediately	0
F05.07	Speed command deceleration ramp time constant	0～65535	ms		Run setting	Effective immediately	0

6.3.3 Zeroposition fixed function

Note

(1) The zero fixed function is used in the speed control operation mode, the system where the upper device does not construct the position loop.
(2) If the servo motor oscillates in the zero-position lock state, the position loop gain can be adjusted.

The zero fixed function is in the speed control operation mode. When the zero fixed DI signal FunIN.12 (ZCLAMP) is valid, when the speed command amplitude is less than or equal to the **[F05.11]** setting value, the servo motor enters the zero position. In the locked state, the position loop is built in the servo driver at this time, and the speed command is invalid. The servo motor is fixed within ±1 pulse of the fixed position of the zero position. Even if the external force is rotated, the zero position is fixed.

If the speed command amplitude is greater than **[F05.11]**, the servo motor exits the zero-lock state, and the servo motor continues to run according to the currently input speed command. If the zero fixed DI signal FunIN.12 (ZCLAMP) is invalid, the zero fixed function is invalid.

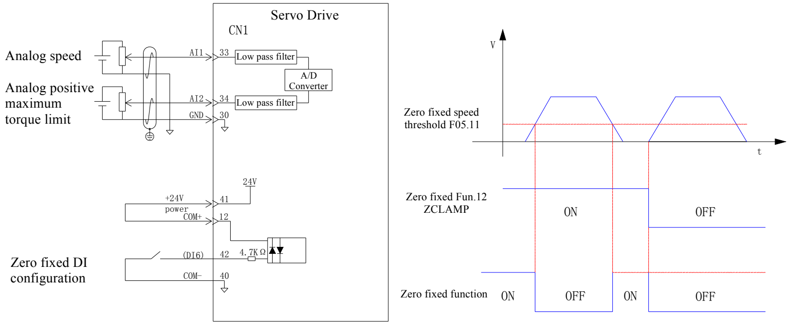


Fig.6-78 Zero fixed related wiring and waveform

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F05.11	Zero fixed speed threshold	0～6000	rpm	Set the zero-speed clamp function speed threshold	Run setting	Effective immediately	10

Code	Name	Function name	Function
FunIN.12	ZCLAMP	Zero position fixed enable	Invalid: The zero fixed function is disabled. Valid: Enable zero fixed function.

6.3.4 Speed command limit

Note

When the actual motor speed exceeds the overspeed fault threshold **[F09.09]**, the drive will have Er.500 (motor overspeed). For the setting of **[F09.09]**, please refer to Chapter 8 Parameter Details. The speed command limit value must be less than **[F09.09]**.

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

(1) **[F05.08]:** Set the amplitude limit of the positive and negative direction speed commands. If the speed command in the positive or negative direction exceeds the set value, it will be limited to this value.

(2) **[F05.09]:** Set the forward speed threshold. If the positive direction speed command exceeds the set value, it will be limited to this value.

(3) **[F05.10]:** Set the reverse speed threshold. If the negative direction speed command exceeds the set value, it will be limited to this value.

(4) Maximum motor speed (default limit point): Depends on the type of motor actually used.

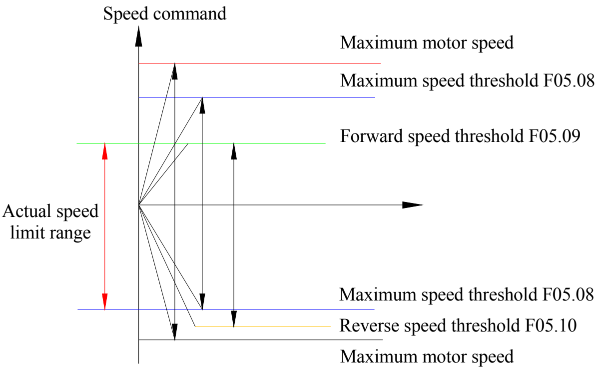


Fig.6-79 Speed command limit example

The actual motor speed limit interval is:

| The amplitude of the forward speed command | ≤ min {maximum motor speed, F05.08, F05.09}

| The amplitude of the reverse speed command | ≤ min {max motor speed, F05.08, F05.09}

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F05.08	Maximum speed threshold	0～6000	rpm	Set the maximum speed limit	Run setting	Effective immediately	4500
F05.09	Forward speed threshold	0～6000	rpm	Set the forward speed limit	Run setting	Effective immediately	4500
F05.10	Reverse speed threshold	0～6000	rpm	Set the reverse speed limit	Run setting	Effective immediately	4500

6.3.5 Speed related DO output function

After the speed feedback value is filtered, compared with different thresholds, the DO signal can be output for use by the host computer. The corresponding filter time parameter is set by **[F05.16]**.

(1) Motor rotation signal DO output

When the absolute value of the actual motor speed after filtering reaches **[F05.12]** (motor rotation speed threshold), the motor can be considered to rotate. At this time, the servo driver can output a motor rotation (FunOUT.2: TGON) signal to confirm that the motor has rotated. Conversely, when the absolute value of the actual motor speed after filtering is less than **[F05.12]**, the motor is considered not to rotate.

The judgment of the motor rotation (FunOUT.2: TGON) signal is not affected by the drive operating state and control mode.

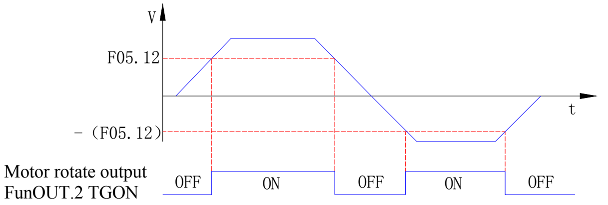


Fig.6-80 Motor rotation signal waveform

Note

In the above figure, ON means that the motor rotation DO signal is valid, and OFF means that the motor rotation DO signal is invalid.

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F05.12	Motor rotation speed threshold	0～1000	rpm	Set the motor rotation signal decision threshold	Run setting	Effective immediately	20

When using the motor rotation signal output function, assign a DO terminal of the servo drive to DO function 2 (FunOUT.2: TGon, motor rotation) and determine the DO terminal valid logic.

Code	Name	Function name	Function
FunOUT.2	TGon	Motor rotate	Invalid: The absolute value of motor speed after filtering is less than the set value of function code F05.12 Valid: The absolute value of the motor speed after filtering reaches the set value of function code F05.12

(2) Speed uniform signal DO output

In the speed control operation mode, when the absolute value of the deviation between the actual speed of the servo motor and the speed command after filtering meets a certain threshold **[F05.13]**, it is considered that the actual motor speed reaches the speed command set value, and the output speed of the drive can be consistent (FunOUT. 4: V-Cmp) signal. Conversely, if the absolute value of the deviation between the actual speed of the servo motor and the speed command exceeds the threshold after filtering, the speed coincidence signal is invalid.

The speed is consistent (FunOUT.4:V-Cmp) signal is always inactive when the drive is in non-operational or non-speed control mode.

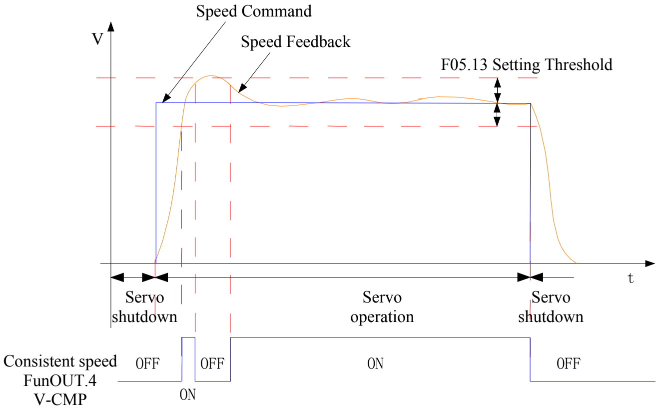


Fig.6-81 Speed Consistent Signal Waveform

Note

In the above figure, ON means that the motor rotation DO signal is valid, and OFF means that the motor rotation DO signal is invalid.

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F05.13	Speed consistent signal threshold	0～100	rpm	Set high speed consistent signal threshold	Run setting	Effective immediately	10

When using the speed-consistent signal output function, assign one DO terminal of the servo drive to DO function 4 (FunOUT.4: V-Cmp, speed uniform) and determine the valid logic of the DO terminal.

Code	Name	Function name	Function
FunOUT.4	V-Cmp	Consistent speed	Invalid: The absolute value of the actual motor speed and speed command deviation after filtering is greater than the function code F05.13. Valid: The absolute value of the actual motor speed and speed command deviation after filtering is not greater than the function code F05.13.

(3) Speed arrival signal DO output

When the absolute value of the actual speed of the servo motor exceeds a certain threshold **[F05.14]** after filtering, the actual speed of the servo motor is considered to reach the desired value. At this time, the servo driver can output the speed (FunOUT.16:V-Arr) signal. Conversely, if the absolute value of the actual speed of the servo motor after filtering is not greater than this value, the speed arrival signal is invalid.

The judgment of the speed arrival (FunOUT.16:V-Arr) signal is not affected by the operating state of the drive and the control mode.

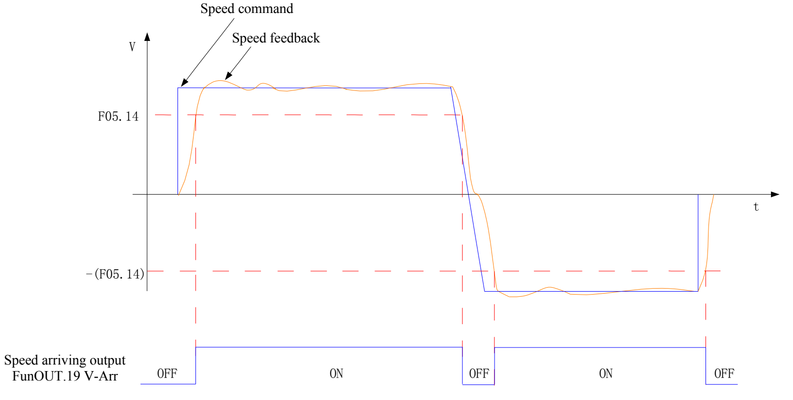


Fig.6-82 Speed arrival signal waveform

Note

In the above figure, ON means that the motor rotation DO signal is valid, and OFF means that the motor rotation DO signal is invalid.

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F05.14	Speed arrival signal threshold	1～60	rpm	Set speed arrival signal decision threshold	Run setting	Effective immediately	1000

When using the motor rotation signal output function, assign a DO terminal of the servo drive to DO function 16 (FunOUT.16: V-Arr, speed arrival) and determine the DO terminal valid logic.

Code	Name	Function name	Function
FunOUT.16	V-Arr	Speed reached	Invalid: The absolute value of the motor speed feedback after filtering is greater than the function code F05.14 Valid: The absolute value of the motor speed feedback after filtering is not greater than the function code F05.14

(4) Zero speed signal DO output

When the absolute value of the actual speed of the servo motor is less than a certain threshold **[F05.15]**, the actual speed of the servo motor is considered to be near static. At this time, the servo driver can output a zero speed (FunOUT.3: V-Zero) signal. Conversely, if the absolute value of the actual speed of the servo motor is not less than this value, the motor is considered to be not at rest and the zero speed signal is invalid.

The judgment of the zero speed (FunOUT.3: V-Zero) signal is not affected by the operating state of the drive and the control mode.

When there is interference in the speed feedback, it can be removed by the speed feedback DO filter. The corresponding filter time parameter is determined by **[F05.16]**.

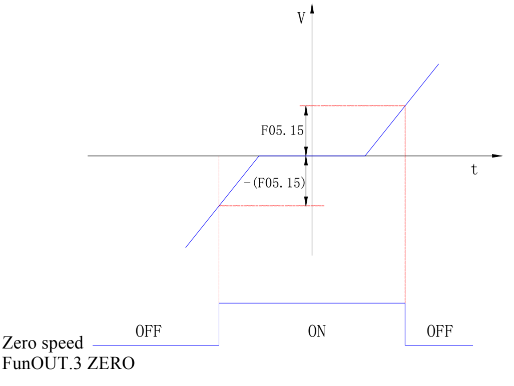


Fig.6-83 Zero speed signal wave diagram

Note

In the above figure, ON means that the motor rotation DO signal is valid, and OFF means that the motor rotation DO signal is invalid.

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F05.15	Zero speed output signal threshold	1～6000	rpm	Set the zero speedoutput signal decision threshold	Run setting	Effective immediately	10

When using the motor zero speed signal output function, assign a DO segment of the servo drive to DO function 3 (FunOUT.3: V-Zero, zero speed) and determine the valid logic of the DO terminal.

Code	Name	Function name	Function
FunOUT.3	V-Zero	Zero speed	Invalid: When the motor speed feedback and the given difference are greater than the setting value of function code F05.15; Valid: When the speed feedback of the motor and the given difference are not greater than the setting value of function code F05.15.

6.3.6 Speed control operation mode function code block diagram

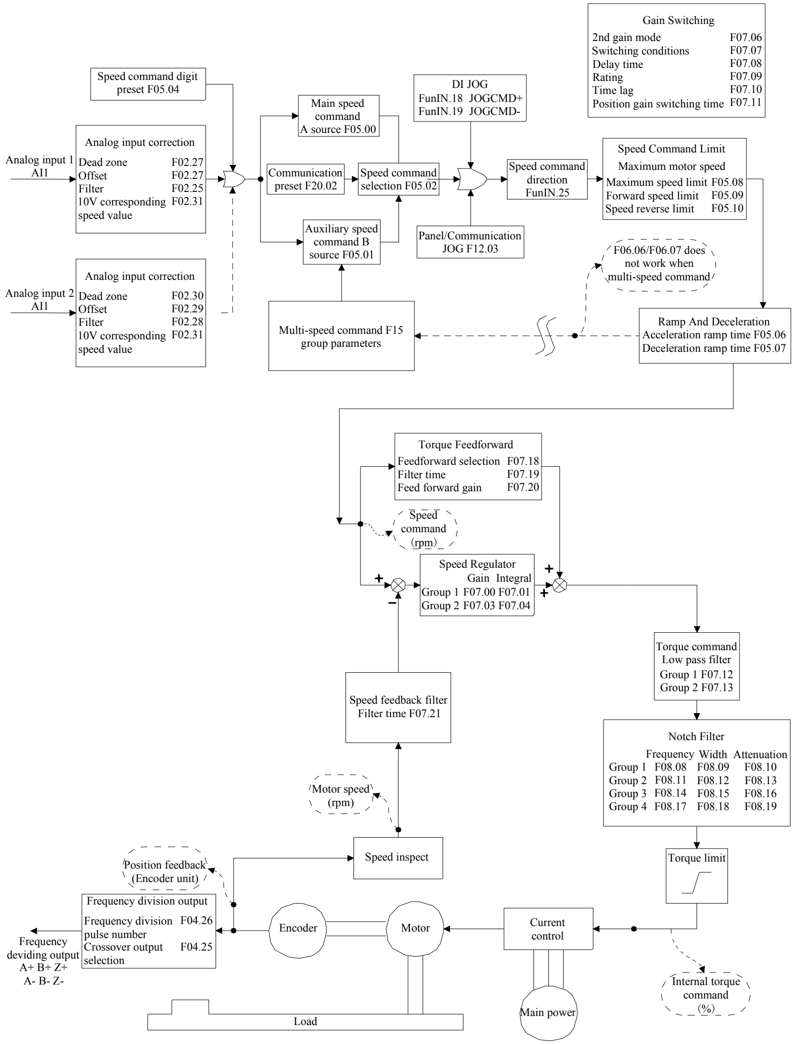


Fig.6-84 Speed Control Function Code Block Diagram

6.4 Torque control mode

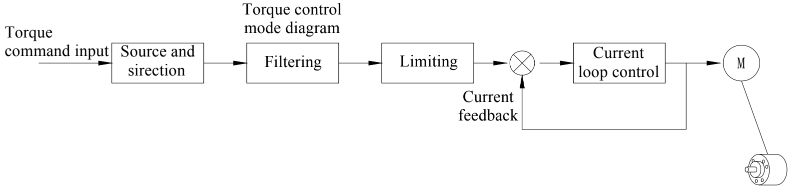


Fig.6-85 Torque control diagram

The value of the parameter **[F01.00]** is set to 2 via the servo driver panel or our drive commissioning platform, and the servo drive will operate in the torque control mode. Please set the servo drive parameters according to the mechanical structure and indicators. The basic parameter settings when using the torque control mode are explained below.

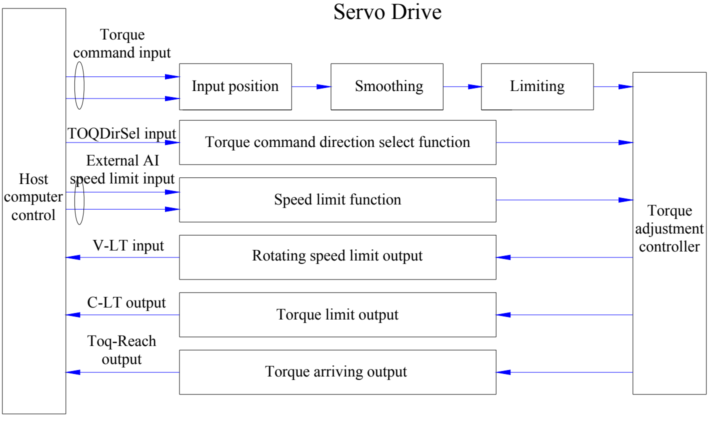


Fig.6-86 Signal interaction between the servo driver and the host computer

6.4.1 Torque command input setting

(1) Torque command source

The torque control mode has the following five torque command command acquisition modes, which are determined by the function code **[F06.02]**.

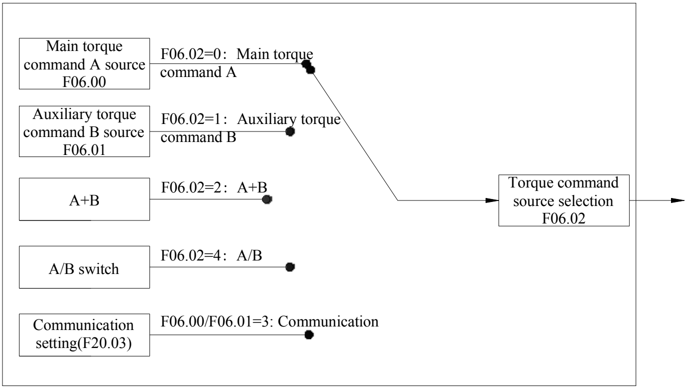


Fig.6-87 Torque command source diagram

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F06.02	Select torque command	0: main torque command A source 1: assist torque command B 2: A+B source 3: Communication given	-	Select torque command source	Run setting	Effective immediately	0

(2) Main torque command A source

The main torque command A source includes digital reference and analog voltage given two command forms, wherein the digital reference is an internal torque command and the analog voltage is given as an external torque command.

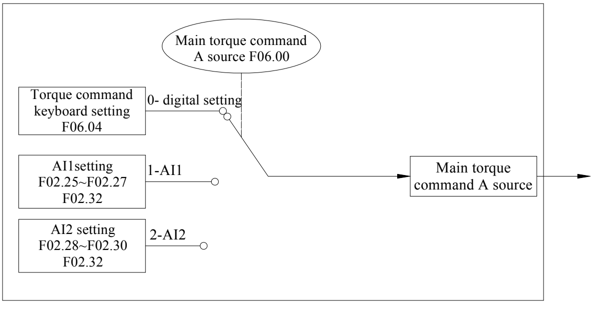


Fig.6-88 Main torque command A source details

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F06.00	Main torque command Asource	0：Digit preset (F06.04) 1：AI1 2：AI2	-	Main torque command Asource selection	Run setting	Effective immediately	0

a) Digital reference: refers to the percentage of command torque relative to the rated motor torque set by function code **[F06.04]**.

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F06.04	Torque command keyboard setting	-300.0～300.0	%	Numerical setting of internal torque command Its accuracy is 0.1%	Run setting	Effective immediately	0

b) Analog voltage reference: refers to the analog voltage signal output by the host computer or other equipment, which is processed as a torque command.

①Analog voltage input terminal

The servo driver has two analog input channels: AI1 and AI2, the maximum input voltage is ±10Vdc, and the input impedance is about 9KΩ.

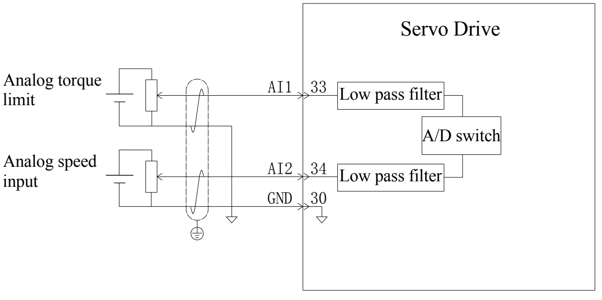


Fig.6-89 Analog Input Circuit

② Operation method: Take AI1 as an example to explain the analog voltage setting torque command method.

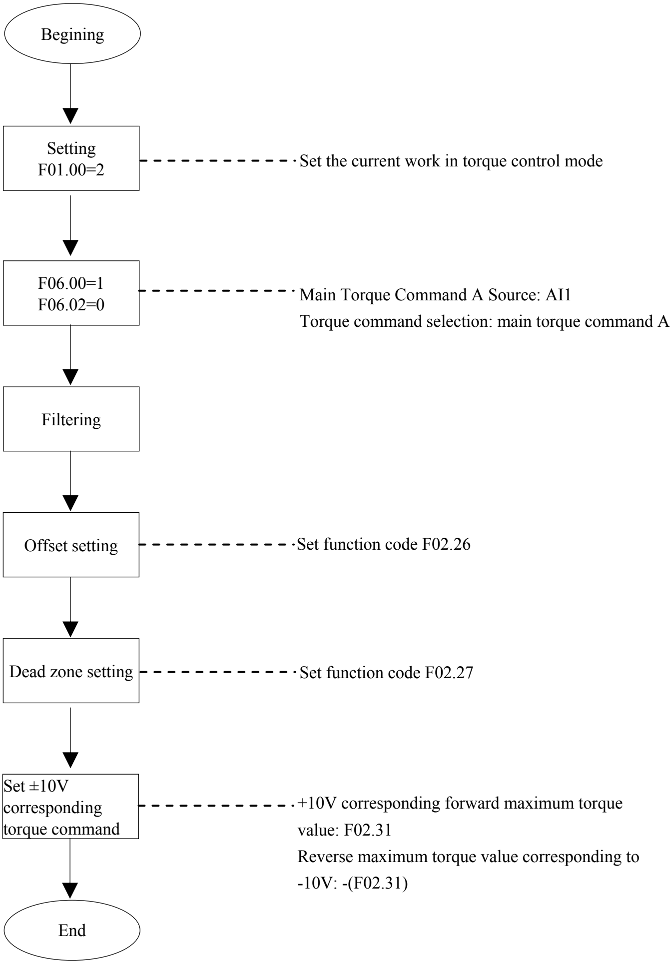


Fig.6-90 Flow chart of analog voltage torque command operation

Note

Offset: refers to the analog channel input voltage value when the sampling voltage is zero after zero drift correction.
Dead zone: refers to the input voltage range of the analog channel when the sampling voltage is zero.

The unprocessed analog channel output voltage is shown in Figure 6-91 y_1. After being processed internally by the servo driver, the torque command y_6 is finally obtained.

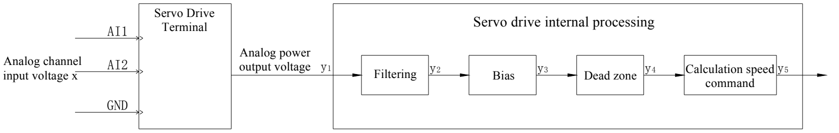


Fig.6-91 Servo driver AI processing flow

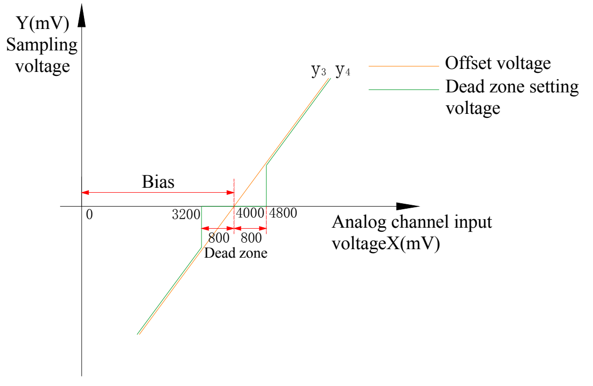


Fig.6-92 Example of servo drive AI processing corresponding sampling voltage

1> Filtering:

The servo driver provides analog channel filtering. By setting the filter time constant **[F02.25]**, It can prevent the motor command fluctuation caused by the unstable analog input voltage, and can also reduce the motor error caused by the interference signal. The filtering function has no elimination or suppression of zero drift and dead zone.

2> Offset setting:

Set the actual input voltage value corresponding to the sampling voltage being 0.

As shown in the figure, when the sampling voltage $y_3=0$ is preset, the corresponding actual input voltage x=4000mV, which is called offset.

Manually set **[F02.26]** = 4000 (mV), after biasing, the sampling voltage is shown as y_4.$y_4=y_3+4000$.

3> Dead zone correction:

Limits the effective input voltage range when the drive sample voltage is not zero.

After the offset setting is completed, when the input voltage x is within 3200mv and 4800mv, the sampled voltage value is 0. This 800mV is called the dead zone.

Set **[F02.27]**=800. After the dead zone is corrected, the sampling voltage is as shown in y_5.

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

Calculation speed command:

After zero drift, offset, and dead zone setting, set the torque command value corresponding to 10V (10000mV) in the sampling voltage at this time through **[F02.32]**, the actual torque commandy_6:

$$y_6 = \frac{y_6}{10000} \times (F02.32)$$

This value will be used as the torque control operating mode analog torque command reference.

Among them, when there is no offset, as shown in Figure 6-93, there is an offset as shown in Figure 6-94. When the correct setting is completed, the entered analog torque command value can be viewed in real time through **[F02.32].**

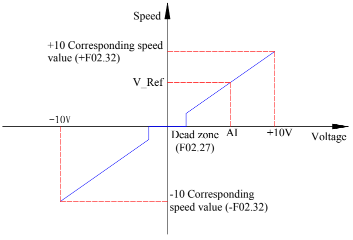


Fig.6-93 Schematic diagram of unbiased AI2 Fig.

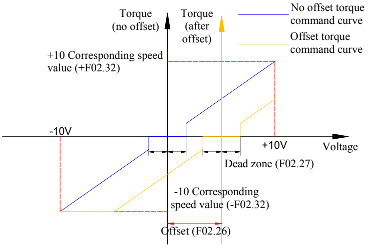


Fig.6-94 Schematic diagram of AI2 after offse

The relationship between the final torque command value y6 and the input voltage x:

$$y_6 = \begin{cases} 0 & B-C \leqslant x \leqslant B+C \\ (X-B) \times \dfrac{F02.31}{10} & B+C \leqslant x \leqslant 10000 \text{ or } -10000 \leqslant x < B-C \end{cases}$$

Where: B: offset; C: dead zone.

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F02.26	AI1offset	-5000～5000	mV	Set the analog offset value of the AI1 channel	Run setting	Effective immediately	0
F02.25	AI1 Input filter time constant	0～655.35	ms	Set the AI1 channel analog average filter time constant	Run setting	Effective immediately	2.00

F02.27	AI1dead zone	0～10000.0	mV	Set the analog deadband value of the AI1 channel	Run setting	Effective immediately	10.0
F02.32	Analog 10V corresponding torque value	1.00～8.00times rated torque	times	Set the analog 10V corresponding torque value	Stop setting	Effective immediately	1.00

Note

When the analog AI2 input channel is selected, its setting method is similar to the above analog AI1 setting method. For related function codes, refer to Chapter 8 for the function code description of **[F02.28]~[F02.30]**.

(3) Auxiliary Torque Command B Source

The auxiliary torque command B source usage method is the same as the main torque command A source. For details of the parameters, refer to the “Chapter 8 [F06 Group]: Torque Control Parameters”.

(4) A/B switching source

When the torque command selects “A/B switching” or function code **[F06.02=4]**, the DI function FunIN.4 needs to be assigned to the corresponding DI terminal, and the current A command is determined according to the input signal on this DI terminal. The source input is valid or the B command source input is valid.

Code	Name	Function name	Function
FunIN.4	CMD-SEL	Run command switching	OFF: The current running command is A. ON: The current running command is B.

(5) Communication given

When the current function code **[F06.01]** is set to 3, the torque command is derived from the function code **[F20.03]** setting value, and the function code **[F20.03]** must be modified by communication, and the control panel is not visible.

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F20.03	Communication given torque command	-300.000～300.000	%	Set the torque command value of the given form of communication with an accuracy of 0.001%	Run setting	Effective immediately	-

(6) Torque command direction setting

The torque command direction is switched by the DI terminal, that is, the DI function FunIN.25 is assigned to the corresponding DI terminal, and the current torque command direction is determined according to the input signal on the DI terminal, thereby satisfying the requirement of the torque command direction switching.

Code	Name	Function name	Function
FunIN.25	ToqDirSel	Torque command direction setting	Invalid: The actual torque command direction is the same as the set direction. Valid: The actual torque command direction is opposite to the set direction.

The actual motor rotation direction is related to both the torque command direction and the torque command direction DI switching (FunIN.25).

Table 6-26 Actual motor rotation direction setting in torque control mode

Torque command positive and negative	FunIN.25	Actual motor rotation direction
+	Invalid	Counterclockwise
+	Valid	Clockwise
-	Invalid	Clockwise
-	Valid	Counterclockwise

6.4.2 Torque command filtering

Note

If the filter time constant setting value is too large, the responsiveness will be lowered. Please set it while confirming the responsiveness.

In position, speed, torque, and hybrid control modes, the servo drive provides low-pass filtering of the torque command, making the command smoother and less vibration.

The servo driver provides two torque command low-pass filters, and the filter 1 is used by default;

Use the gain switching function (**[F07.06=1]** and **[F07.07≠0]**) to switch to filter 2 when the **[F07.07]** setting condition is satisfied.

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F07.12	Torque command filter time constant	0～30.00	ms	Set the first group torque command low pass filter time constant	Run setting	Effective immediately	0.79
F07.13	Second torque command filtering time constant	0～30.00	ms	Set the second group torque command low pass filter time constant	Run setting	Effective immediately	0.79

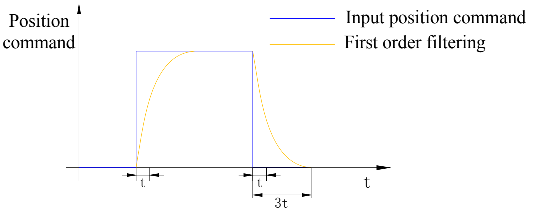


Fig.6-95 Schematic diagram of first-order filtering of rectangular torque command

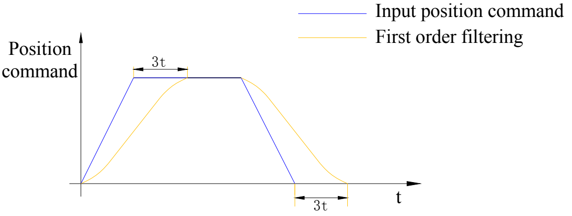
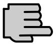


Fig.6-96 Schematic diagram of first-order filtering of trapezoidal torque command

6.4.3 Torque command limit


Note

Torque command limits are valid in position control, speed control, torque control, and hybrid control modes and must be set.

To protect the drive and motor, limit the torque command.

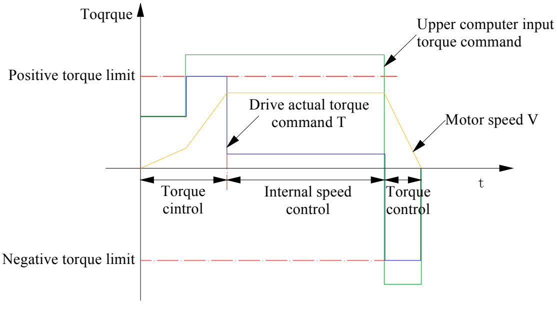


Fig.6-97 Torque Reference and Torque Limit

When the absolute value of the torque command output by the upper computer input or speed regulator is greater than the absolute value of the torque command limit, the actual drive torque command is limited to the torque command limit value; otherwise, it is equal to the upper computer Input or torque command output value of the speed regulator.

At any one time, there is and only one torque limit value is valid. And the positive and negative torque limit values do not exceed the maximum torque of the drive and motor and ±300.0% of rated torque.

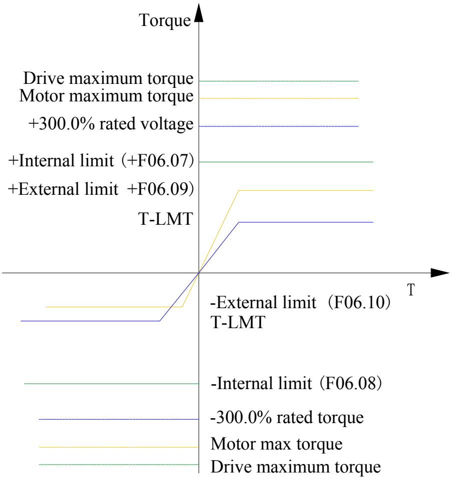


Fig.6-98 Example of torque limit

(1) Set the source of torque limits

The torque limit source can be set by function code **[F06.05]**. After the torque limit is set, the drive torque command will be limited to the torque limit value. When the torque limit value is reached, the motor will run with the torque limit value as the torque command. The torque limit value should be set according to the load operation requirements. If the setting is too small, the motor's acceleration and deceleration capability may be weakened. When the constant torque is running, the actual motor speed value will not reach the required value.

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F06.05	Torque limit source	0: positive and negative internal torque limit 1: positive and negative external torque limit 2: External T-LMT torque limit 3: Positive and negative external	-	Select torque source	Run setting	Effective immediately	0

		torque limit and torque limit switching of external T-LMT						

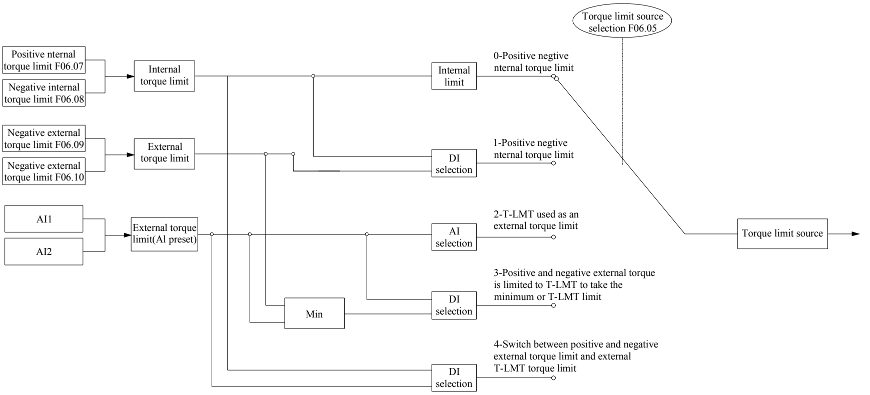


Fig.6-99 Torque Limit Source

As shown in the figure below, in the torque mode, the absolute value of the torque command input by the host computer is greater than the absolute value of the torque limit value.

a) **[F06.05=0]:** positive and negative internal torque limit

The torque command limit value is determined only by the internal function codes **[F06.07]** and **[F06.08]**.

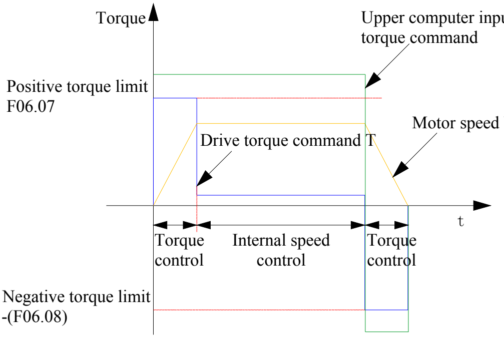


Fig.6-100 F06.05=0 Torque limit curve

b) **[F06.05=1]:** Positive and negative external torque limit

The torque command limit value is rotated according to the logic state of the external DI signal. The positive torque limit value is rotated between function codes **[F06.07]** and **[F06.09]**; the negative torque limit value is rotated between function codes **[F06.08]** and **[F06.10]**.

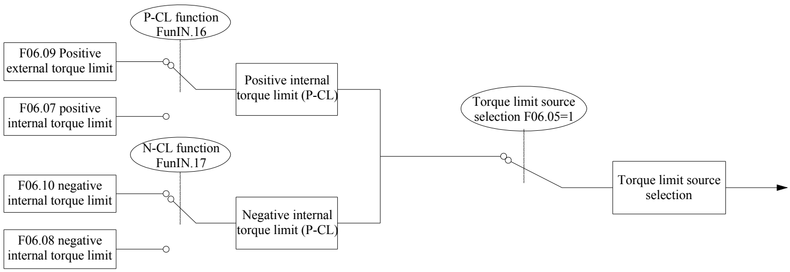
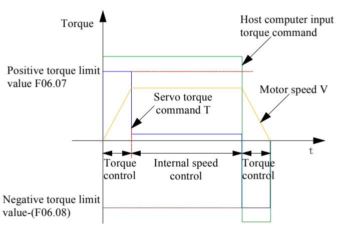
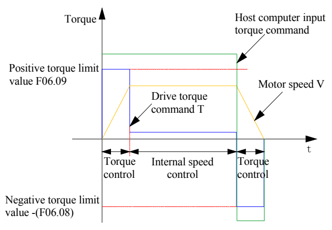
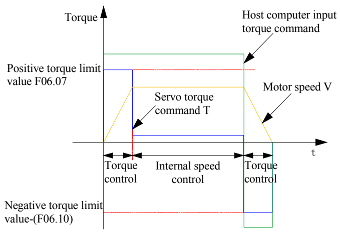
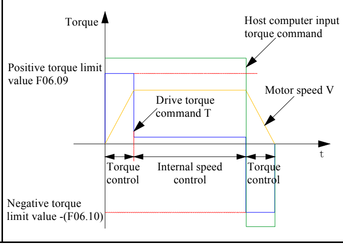


Fig.6-101 F06.05=1 Torque Limit Source

Table 6-27 F06.05=1 Description

<table>
<tr><th colspan="2" rowspan="2">DI function state</th><th colspan="2">P-CL</th></tr>
<tr><th>OFF</th><th>ON</th></tr>
<tr><td rowspan="2">N-CL</td><td>OFF</td>
<td>
</td>
<td>
</td></tr>
<tr><td>ON</td>
<td>
</td>
<td>
</td></tr>
</table>

At this time, the two DI terminals of the distribution driver are DI function FunIN.16 (P-CL: positive external torque limit) and FunIN.17: (N-CL: negative external torque limit), and determine the DI terminal logic.

Code	Name	Function name	Function
FunIN.16	P-CL	Positive external torque limit	According to the selection of F06.05, the torque limit source is switched. When F06.05=1:

			Valid: Forward external torque limit is valid; Invalid: The forward internal torque limit is valid. When F06.05=3 and the AI limit value is greater than the forward limit external limit value: Valid: Forward external torque limit is valid; invalid: AI torque limit is valid.
FunIN.17	N-CL	Negative external torque limit	According to the selection of F06.05, the torque limit source is switched. When F06.05=1: Valid: Reverse external torque limit is valid; Invalid: Reverse internal torque limit is valid. F06.05=3 and the AI limit value is less than the reverse external limit value: Valid: Reverse external torque limit is valid; invalid: AI torque limit is valid.

c) **[F06.05=2]:** External T-LMT torque limit

After selecting the external analog channel according to **[F06.06]**, the torque command limit value is determined by the torque value corresponding to the input voltage of the AI terminal.

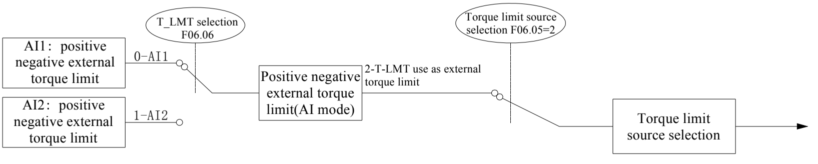


Fig.6-102 F06.05=2 Torque Limit Source

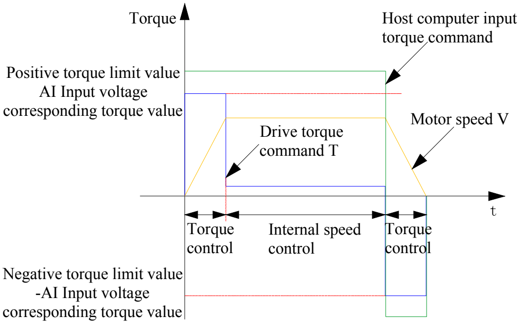
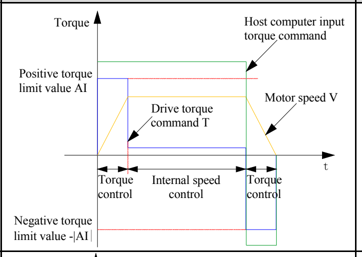
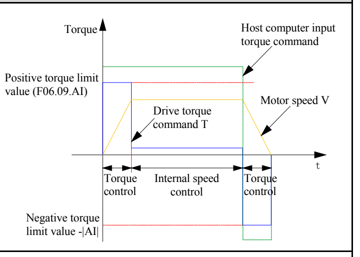
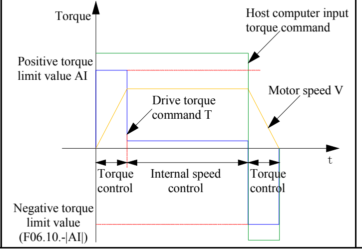
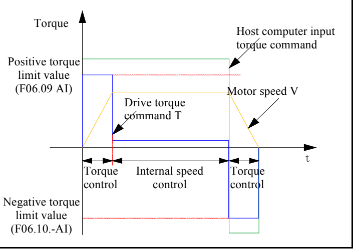


Fig. 6-103 F06.05=2 Torque Limit Graph

For the setting of analog input terminals AI1 and AI2, refer to Chapter 8 for the parameter descriptions of **[F02.26]** to **[F02.28]** and **[F02.32]**, and set the correspondence between torque and analog voltage.

Table 6-28 F06.05=3 Description

DI function state		P-CL	
		OFF	ON
N-CL	OFF		
	ON		

d) **[F06.05=3]:** Positive and negative internal torque limit and torque limit switching of external T-LMT

Positive torque limit: after selecting the external analog channel according to **[F06.06]**

When the external DI signal (P-CL) logic is invalid, the positive torque limit value is determined by the function code **[F06.07]**;

When the external DI signal (P-CL) logic is valid, the positive torque limit value is determined by the torque value corresponding to the input voltage of the AI terminal.

Negative torque limit: after selecting the external analog channel according to **[F06.06]**

When the external DI signal (N-CL) logic is invalid, the negative torque limit value is determined by the function code **[F06.08]**;

When the external DI signal (N-CL) logic is valid, the negative torque limit value is determined by the torque value corresponding to the input voltage of the AI terminal.

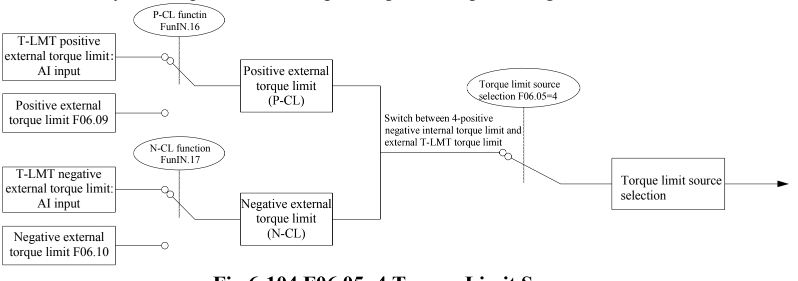
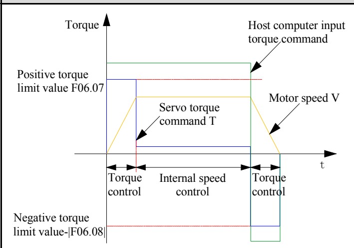
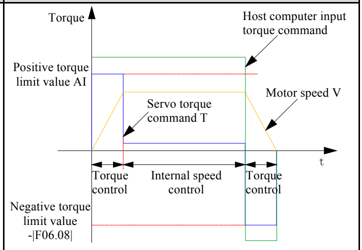
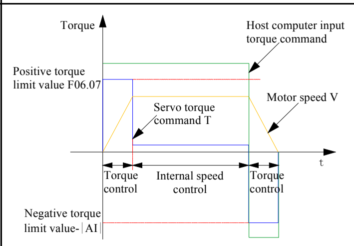
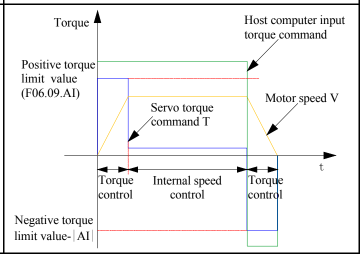


Fig.6-104 F06.05=4 Torque Limit Source

Table 6-29 F06.05=4 Description

<table>
<tr><th colspan="2" rowspan="2">DIfunction state</th><th colspan="2">P-CL</th></tr>
<tr><th>OFF</th><th>ON</th></tr>
<tr><td rowspan="2">N-CL</td><td>OFF</td><td>
</td><td>
</td></tr>
<tr><td>ON</td><td>
</td><td>
</td></tr>
</table>

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F06.06	T-LMTselection	0: AI1 1: AI2	-	Select the analog input channel of the torque limit signal	Run setting	Effective immediately	0
F06.07	Positive internal torque limit	0～300.0	%	Set internal positive and negative torque limit values (100% corresponds to 1 times rated torque)	Run setting	Effective immediately	300.0
F06.08	Negative internal torque limit	0～300.0	%		Run setting	Effective immediately	300.0
F06.09	Positive external torque limit	0～300.0	%	Set the external positive and negative torque limit value	Run setting	Effective immediately	300.0
F06.10	Negative external torque limit	0～300.0	%		Run setting	Effective immediately	300.0

(2) Set the torque limit DO output signal

When the torque command reaches the torque limit value, the driver outputs a torque limit signal (FunOUT.7: T-LMT, torque limit signal) for use by the host computer. In this case, assign one DO terminal of the drive to the DO function FunOUT.7, and determine the DO terminal logic.

Code	Name	Function name	Function
FunOUT.7	T-LMT	Torque limit signal	Valid: The drive torque command reaches the torque limit value and is limited to the limit value. Invalid: The drive torque command has not reached the limit.

6.4.4 Speed limit in torque mode

In the torque control mode, if the given torque command is too large and greater than the mechanical side load torque; the motor will continue to accelerate, overspeed may occur, and the mechanical equipment may be damaged. Therefore, in order to protect the machine, the speed of the motor must be limited.

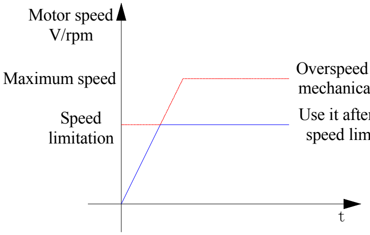


Fig.6-105 Schematic diagram of torque mode speed limit

(1) Set the speed limit source

In torque mode, the selection of the speed limit source can be set by function codes **[F06.13]** and **[F06.14]**. After the speed limit is set, the actual motor speed will be limited to the speed limit. After the speed limit is reached, the motor runs at a constant speed limit. The speed limit value should be set according to the load operation requirements

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F06.13	Torque control forward speed source selection	0：Determined by F06.15 1：AI1 2：AI2	-	Speed limit source in torque mode	Run setting	Effective immediately	0
F06.14	Torque control reverse speed source selection	0：Determined by F06.16 1：AI1 2：AI2	-	Speed limit source in torque mode	Run setting	Effective immediately	0

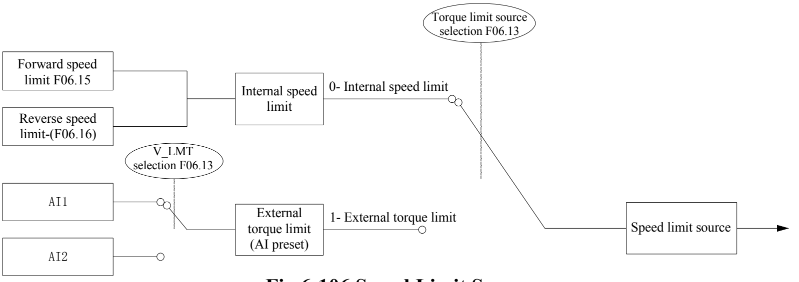


Fig.6-106 Speed Limit Source

a) **[F06.13=0], [F06.14=0]:** internal speed limit

When the motor rotates in different directions, the speed is determined only by the internal function codes **[F06.15]** and **[F06.16]**.

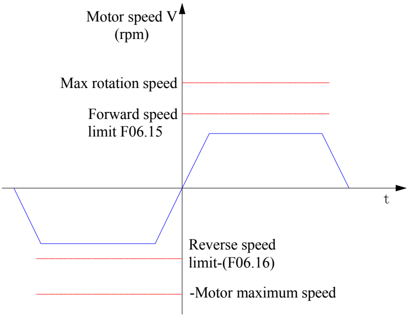


Fig.6-107 F06.13=0 speed limit graph

b) **[F06.13=1], [F06.14=1]:** External speed limit

When the motor rotates in different directions, the external analog channel 1 is the voltage corresponding to the input speed limit. The motor speed limit is determined by the speed corresponding to the AI1 input voltage.

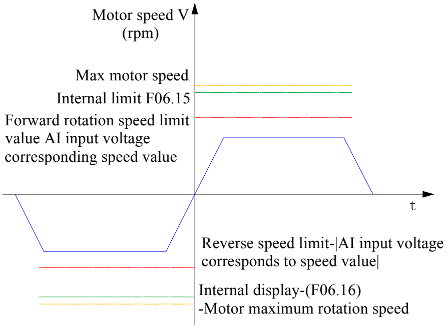
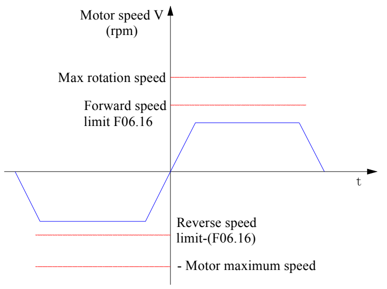
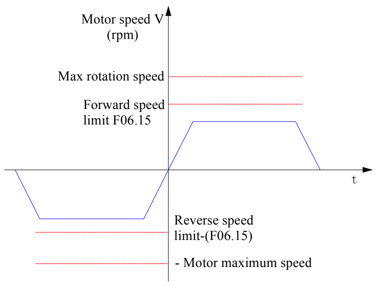


Fig.6-108 F06.13=1 speed limit graph

c) **[F06.13], [F06.14=2]:** External speed limit 2

When the motor rotates in different directions, the external analog channel 2 is the voltage corresponding to the input speed limit. The motor speed limit is determined by the speed corresponding to the AI2 input voltage.

Table 6-30 Speed limit description

V_LmitSel	
OFF	**ON**
	

(2) Set speed limit DO output signal

In the torque mode, the absolute value of the actual speed of the servo motor exceeds the speed limit value, and when the time reaches **[F06.20]**, the actual speed of the servo motor is considered to be limited. At this time, the output speed of the servo drive is limited (FunOUT.8:V- LT) signal for use by the host computer. Conversely, if either condition is not met, the speed limited signal is invalid.

The speed limited (FunOUT.8: V-LT) signal is judged only in the torque mode and servo operation.

One DO terminal to which the servo drive should be assigned is the DO function FunOUT.8, and the DO terminal logic is set.

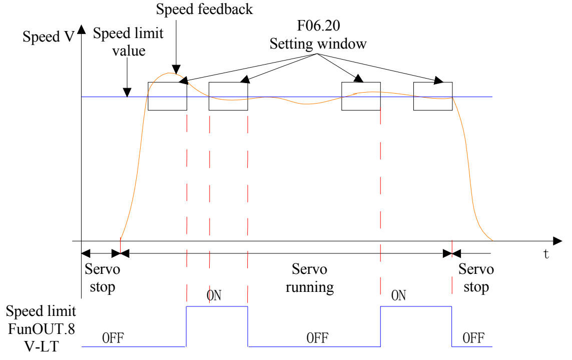


Fig.6-109 Speed Limit DO Output Waveform Example

Code	Name	Function name	Function
FunOUT.8	V-LT	Speed limit	Invalid: The motor speed has not reached the speed limit. Valid: The motor speed reaches the speed limit value, and the speed limit is the speed command, and the internal speed loop is built.

6.4.5 Torque arrival output

The torque arrival function is used to determine whether the actual torque command has reached the set interval. When the actual torque command reaches the torque command threshold, the driver can output the corresponding DO signal (FunOUT.15: ToqReach, torque arrival) for the host computer to use.

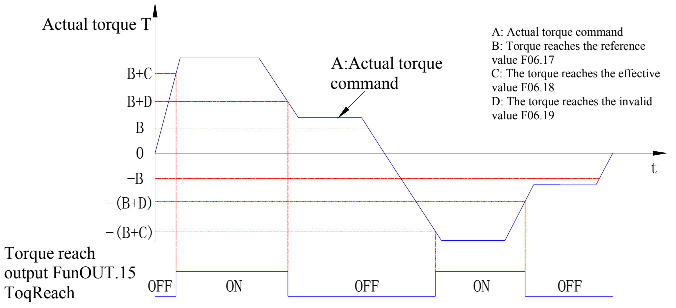


Fig.6-110 Example of torque arrival output waveform

Actual torque command (can be viewed by **[F10.02]):** A;

The torque reaches the reference value **[F06.17]:** B;

The torque reaches the effective value **[F06.18]:** C;

Torque arrival invalid value **[F06.19]:** D;

Where C and D are offsets on a B basis.

Therefore, when the torque reaches the DO signal from invalid to active, the actual torque command must satisfy:

$$|A| \geq B+C$$

Otherwise, the torque reaching DO signal remains inactive.

Conversely, when the torque reaches the DO signal from active to inactive, the actual torque command must satisfy:

$$|A| < B+D$$

Otherwise, the torque reaching DO signal remains active.

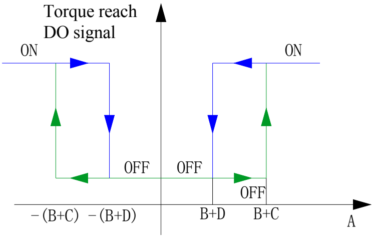


Fig.6-111 Effective description of torque arrival output

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F06.17	Torque reaches the reference value	0～300.0	%	Set the torque arrival command reference value (100% corresponds to double rated torque)	Run setting	Effective immediately	0
F06.18	Torque reaches RMS	0～300.0	%	Set the torque to reach the effective offset threshold (100% corresponds to double rated torque)	Run setting	Effective immediately	20.0
F06.19	Torque reaches invalid value	0～300.0	%	Set torque to invalid offset threshold (100% corresponds to double rated torque)	Run setting	Effective immediately	10.0

When using torque to reach the DO signal, assign one DO terminal of the servo drive to DO function 15 (FunOUT.15: ToqReach, torque arrival) and determine the DO terminal logic.

Code	Name	Function name	Function
FunOUT.15	ToqReach	Torque arrival	Valid: The absolute value of the torque command reaches the set value. Invalid: The absolute value of the torque command is less than the set value.

6.4.6 Torque control mode function code block diagram

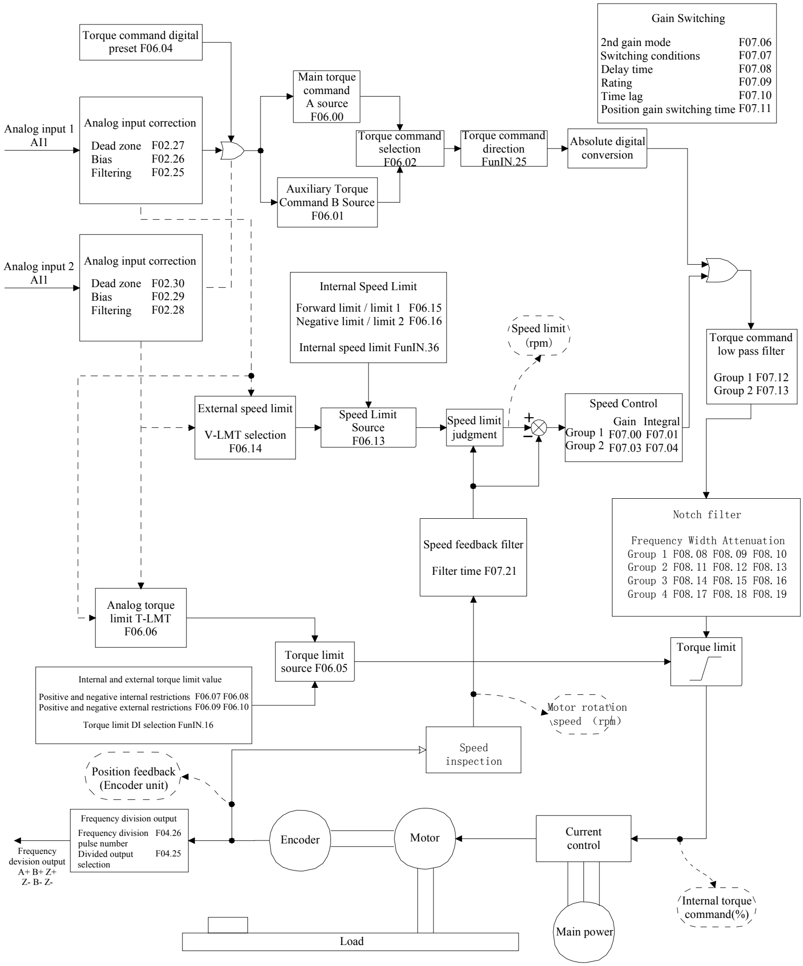


Fig.6-112 Torque control function code block diagram

6.5 Mixed control mode

The hybrid control mode means that when the servo enable is ON and the servo state is "run", the servo drive's operating mode can be switched between different control modes.

There are four types of hybrid control modes.

① Torque mode ↔ speed mode

② speed mode ↔ position mode

③ Torque mode ↔ position mode

④ speed mode ↔ position mode ↔ torque mode

The servo drive will work in the hybrid control mode by setting the function code **[F01.00]** through the panel or our drive debugging platform.

Code	Name	Setting range	Function	Setting mode	Effective mode	Factory default
F01.00	Control mode selection	0: speed mode 1: position mode 2: Torque mode 3: Torque mode ↔ speed mode 4: speed mode ↔ position mode 5: Torque mode ↔ position mode	Set the servo drive control mode	Stop setting	Effective immediately	1

Please set the servo drive parameters in different control modes according to the mechanical structure and indicators. Refer to Chapter 8 for the parameter description of [F01.00] for the setting method.

[F01.00=3/4/5], configure one DI terminal of the servo driver as function 10 (FunIN.10: M1_SEL, mode switching 1), and determine the valid logic of the DI terminal.

<table>
<tr><th>Code</th><th>Name</th><th>Function name</th><th>Function</th></tr>
<tr><td>FunIN.10</td><td>M1_SEL</td><td>Mode switch 1</td><td>Used to set the current control mode of the drive when the servo status is "run" in the hybrid control mode.
<table>
<tr><th>F01.00</th><th>M1_SELterminal logical</th><th>Control mode</th></tr>
<tr><td rowspan="2">3</td><td>Invalid</td><td>Torque mode</td></tr>
<tr><td>Valid</td><td>Speed mode</td></tr>
<tr><td rowspan="2">4</td><td>Invalid</td><td>Speed mode</td></tr>
<tr><td>Valid</td><td>Position mode</td></tr>
<tr><td rowspan="2">5</td><td>Invalid</td><td>Torque mode</td></tr>
<tr><td>Valid</td><td>Position mode</td></tr>
</table>
</td></tr>
</table>

6.6 Absolute value system instructions

6.6.1 Overview

The absolute encoder not only detects the position of the motor within one week of rotation, but also counts the number of revolutions of the motor. The single-turn resolution is determined by the number of encoder bits. For example, the 23-bit encoder is 8388608 (223), which can remember 16 bits. Multiple laps of data. Absolute value systems using absolute encoders currently have absolute position linear mode, which can be used in position, speed and torque control modes. When the drive is powered off, the encoder backs up the data through the battery. After power-on, the drive passes the encoder absolutely. The position is calculated from the absolute position of the machine, eliminating the need to repeat the mechanical home position return operation.

When the ESS200P series servo drive is matched with the absolute encoder, set the **[F00.21]** parameter according to the number of encoders and set **[F01.01]** according to the actual application (absolute value system selection). AL.401 (encoder battery alarm) will occur when the battery is turned on for the first time. You need to set **[F12.02=1]** to reset the encoder fault, and then perform the home position return operation.

Note

When the **[F12.02]** (absolute encoder reset enable) operation is modified, the absolute position of the encoder will be abrupt, causing the mechanical absolute position reference to change, so the mechanical zero point return operation is required. When the internal zero point return function of the drive is used, the absolute position of the machine and the absolute position deviation of the encoder are automatically calculated inside the drive after the home return is completed and stored in the E2PROM of the drive.

6.6.2 Related function code setting

(1) Absolute value system setting

According to the encoder setting **[F00.21]** of the motor (5=17 digits or 6=20 digits or 7=23 digits), the relative position mode is selected by **[F01.01]**. **[F01.01=0]** (Incremental Position Linear Mode), the encoder does not require additional battery power and is only used as a single-turn absolute encoder. When **[F01.01=1]** (absolute position mode), the encoder's E+/E- must be additionally powered by a 3.6V battery.

Code	Name	Setting range	Function	Setting mode	Effective mode	Factory default
F00.21	Encoder code	0: 2500 line encoder -15 line encoder 1:2500 line encoder -9 line encoder 2~4: Reserved 5: 17-bit bus absolute value encoding (Tama River	Set parameters according to motor coding type	Stop setting	Power again	7

		Protocol) 6: 20-bit bus absolute value encoding (Tama River Protocol) 7: 23-bit bus absolute value encoding (Tamakawa protocol)				
F01.01	Absolute value system selection	0: incremental position mode 1: absolute position linear mode	Select absolute position mode	Stop setting	Power again	0

Note

In the absolute position mode, the system automatically detects whether the motor number is an absolute value of the encoder motor. If the setting is incorrect, "Er.101 position mode and encoder matching fault" occurs.

(2) Absolute position linear mode

Code	Name	Setting range	Function	Setting mode	Effective mode	Factory default
F10.07	Absolute position counter	-	In position mode, the current absolute position of the motor (command unit) is displayed.	display	-	0
F10.27	Mechanical absolute position (low 32 bits)	-	In absolute position linear mode, the load position is converted to the position of the motor end	display	-	0
F10.29	Mechanical absolute position (high 32 bits)	-		display	-	0
F10.36	Absolute encoder absolute position (low 32 bits)	-	Absolute encoder feedback absolute position	display	-	0
F10.38	Absolute encoder absolute position (high 32 bits)	-		display	-	0

This mode is mainly used when the load range of the device is fixed and the encoder does not overflow the multi-turn data, as shown in the following figure.

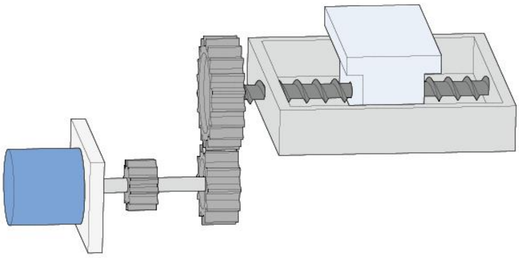


Fig.6-113 Schematic diagram of the ball screw drive mechanism

Assume that the mechanical absolute position (**[F10.27]** and **[F10.29]**) is PM, the absolute position of the encoder is PE [PE range is -2^{38}~$(2^{38}-1)$], and the absolute position linear mode position is offset (**[F04 .44]** and **[F04.46]**) are PO, then the relationship between the three is PM = PE - PO.

Assuming that the electronic gear ratio is , the absolute position counter **[F10.07]** indicates the current absolute position of the machine (command unit), **[F10.07]** = PM / (B / A). Absolute position linear mode position offset **[F04.44]** and **[F04.46]** default to 0, enabling the drive home position return function. After the home position return is completed, the drive automatically calculates the absolute position of the encoder and the mechanical absolute position deviation, and assigns it to **[F04. 44]** and **[F04.46]** are saved in the E^2PROM.

The absolute position linear mode encoder multi-turn data range is -32768~32767. If the forward rotation number is greater than 32767 or the reverse rotation number is less than -32768, the Er.308 encoder multi-turn count overflow fault will occur, which can be set by [F09. 18] Mask the fault.

(3) Encoder feedback data

Absolute encoder feedback data can be divided into encoder rotation lap data and encoder position within one revolution, incremental position mode without encoder selection lap data feedback.

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F10.33	Absolute encoder rotation number data	-	r	The number of revolutions fed back by the absolute encoder.	display	-	0
F10.34	One-turn position of the absolute encoder	-	Encoder unit	Absolute encoder encoder feedback within 1 revolution absolute position	display	-	0

(4) Encoder multi-turn overflow fault selection

In the absolute position linear mode, the multi-turn overflow fault of the encoder is masked by setting **[F09.18]**.

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F09.18	Encoder multi-turn overflow fault selection	0: no mask 1: shielded	-	Absolute position linear mode by setting F09.18 shielded code multi-turn overflow fault	Stop setting	Effective immediately	0

(5) Absolute encoder reset operation

Reset the encoder internal fault or reset the encoder feedback multi-turn data by setting **[F12.02]**.

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F12.02	Absolute encoder reset enable	0: no operation 1: reset fault 2: Reset fault and multi-turn data	-	Reset the encoder internal fault or reset the encoder feedback multi-turn data by setting F12.02	Stop setting	Effective immediately	0

Note

After performing the reset encoder feedback multi-turn data operation, the absolute position oftheencoder is abrupt, and the power-down restart and the mechanical origin return operation arerequired.

6.6.3 Absolute value system battery box use precautions

AL.401 (encoder battery alarm) will occur when the battery is turned on for the first time. It is necessary to set **[F12.02=1]** to reset the encoder fault and then perform absolute position system operation.

When the detected battery voltage is less than 3.0V, AL.401 (encoder battery alarm) will occur. Please replace the battery. The replacement method is as follows:

The first step: the drive is powered on, in a non-operating state;

Step 2: Replace the battery;

Step 3: After the drive automatically releases AL.401 (encoder battery alarm), there is no other abnormal warning and it can run normally.

Note

(1) In case of servo power failure, AL.401 (encoder battery failure) will occur when the battery is replaced again, and the multi-turn data will be abrupt. Please set [F12.02=1] to reset the encoder fault and re-origin the return-to-origin function. operating.
(2) When the drive is powered off, please ensure that the maximum motor speed does not exceed 6000 rpm to ensure that the encoder position information is accurately recorded;
(3) Store at the specified ambient temperature during storage, and ensure that the battery is stored reliably and the power is sufficient. Otherwise, the encoder position information may be lost.

6.6.4 Soft limit function

Traditional hardware limit function: In the traditional mode, the limit can only be given by an external signal, and the external sensor signal is connected to the servo drive X5 interface.

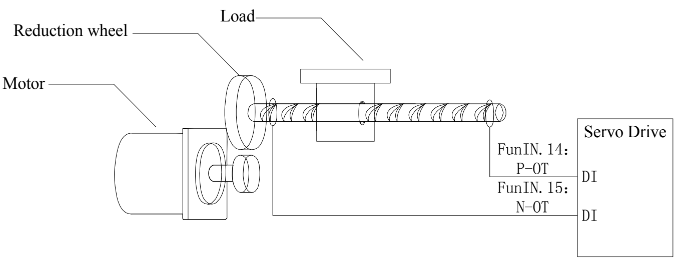


Fig.6-114 Installation diagram of the limit switch

Soft limit function: It refers to the comparison between the internal position feedback of the drive and the set limit value. When the limit value is exceeded, it will alarm immediately and stop the operation. This function can be used in both absolute position mode and incremental position mode. Incremental position mode needs to be set **[F09.19=2]**. After the drive is powered on, first perform home position return to find the machine origin, and then enable the software limit function.

Comparison of advantages and disadvantages between traditional hardware limit and soft limit function.

Traditional hardware limit function		Soft limit function	
1	Can only be limited to linear motion, single-turn motion	1	Not only for linear motion, but also for rotary mode
2	Externally mounted mechanical limit switch required	2	No hardware wiring is required to prevent malfunction due to poor line contact
3	Unable to judge mechanical slip abnormality	3	Comparison of internal position to prevent mechanical slippage and abnormal operation
4	When the power is cut off, the machine moves out of the limit and cannot judge or alarm.		

Soft limit related function code

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F09.19	Soft limit setting	0: Do not enable the software limit 1: Enable the software limit immediately after power-on. 2: Enable the soft limit after the zero return to the origin	1	Soft limit function selection	Stop setting	Effective immediately	0
F09.20	Absolute position limit maximum	-214783648 ～ 214783647	Command unit	Soft limit function absolute position limit maximum	Stop setting	Effective immediately	2147483647
F09.22	Absolute position limit minimum	-214783648 ～ 214783647	Command unit	Soft limit function absolute position limit minimum	Stop setting	Effective immediately	-2147483648

(1) When **[F09.19=0]**, the software limit function is not enabled;

(2) When **[F09.19=1]**, the software limit function is enabled immediately after the drive is powered on. When the absolute position counter **[F10.07]** is greater than **[F09.20]** AL.405 warning occurs, the forward overtravel stop is executed; when the absolute position counter **[F10.07]** is less than **[F09.22]** AL.406 warning occurs, execution Negative overtime shutdown;

(3) When **[F09.19=2]**, the software limit is not enabled before the home position is restored after the drive is powered on. When the home position is reset, the absolute position counter **[F10.07]** is greater than **[F09.20]**, and the AL.405 warning occurs. The forward overtravel stop is executed; when the absolute position counter **[F10.07]** is less than **[F09.22]** after the return of the origin, the AL.406 warning occurs and the negative overtravel is executed;

(4) When **[F09.20]**<**[F09.22]**, the two values will be interchanged.

6.7 Accessibility

To ensure proper operation of the servo system, the drive provides the following auxiliary functions.

6.7.1 Software reset function

When the servo drive does not have a type 1 non-resettable fault, in the non-operating state, if the field device does not allow random power loss, but the drive needs to be powered back on, the software reset function can be used.

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode
F12.00	Software reset	0: no operation 1: enable	After the software reset function is enabled, the program in the drive is automatically reset without power loss (similar to the power-on program reset operation).	Stop setting	Effective immediately	0

6.7.2 Motor protection function

(1) Motor overload protection

When the servo motor is energized, heat is continuously generated due to the thermal effect of the current, and heat is released to the surrounding environment. When the generated heat exceeds the released heat, the motor temperature is too high and the temperature is too high, which will cause the motor to burn out. Therefore, the drive provides motor overload protection to prevent the motor from burning due to excessive temperature.

The motor overload fault (Er.300) can be adjusted by setting the motor overload protection gain **[F19.08]**. **[F19.08]** Generally keeps the default value, but it can be changed according to the actual heat of the motor when the following conditions occur:

① When the working temperature of the servo motor is high;

② Servo motor cyclic motion, and a single motion cycle is short, frequent acceleration and deceleration.

In the case where the motor is not burned, the motor overload can also be shielded **[F19.08=800].**

Note

Use the motor overload shielding function carefully, otherwise the motor will burn out!

Code	Name	Setting range	Unit	Function	Setting mode	Effective mode	Code
F19.08	Motor overload protection gain	50～800	%	Set the time reported by the motor overload fault (Er.300)	Stop setting	Effective immediately	100

(2) Motor blocked over temperature protection

When the servo motor is blocked, the motor speed is almost zero, and the actual current is very large. At this time, the motor is seriously heated! The servo motor has a certain blocking operation, but if it exceeds the allowable time, the motor will burn out due to excessive temperature. Therefore, the driver provides a motor stall and over-temperature protection function to prevent the temperature from being too high and burned when the motor is blocked.

By setting the motor stall over-temperature protection time threshold **[F09.17]**, you can change the time reported by the motor stall over-temperature fault (Er. 305). When **[F09.17=65535]**, you can shield the motor from over-temperature. Protected, enabled by default.

Note

Use the motor to block the over-temperature protection shielding function carefully, otherwise the motor will burn out!

Code	Item	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F09.17	Blocking over temperature protection time window	10～65535	ms	Set the motor stall over temperature fault (Er. 305) to report the time	Run setting	Effective immediately	500

(3) Motor speed protection

Excessive servo motor speed will result in motor damage or mechanical damage. Therefore, the servo drive provides motor overspeed protection. Overspeed fault threshold: **[F09.09=0]**, overspeed protection is invalid。

Note

(1) The servo drive also provides the flying protection function to prevent the motor from losing control and stalling.

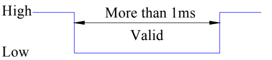
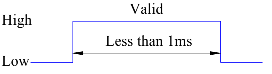
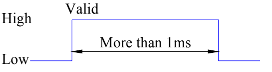
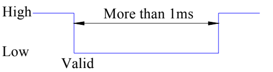
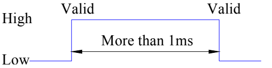
(2) Use the flying protection shielding function cautiously. When it is in vertical or towed load application, please set **[F09.03]** to zero to shield the flying fault detection.

Code	Item	Setting range	Unit	Function	Setting mode	Effective mode	Factory default
F09.09	Overspeed fault threshold	0～10000	rpm	Set the motor speed threshold when the motor coaster fault (Er. 302) is reported	Run setting	Effective immediately	0
F09.03	Speed protection function enabled	0：Shielding speed protection 1: Turn on the coast protection function	-	Set whether to enable the coaster protection function	Run setting	Effective immediately	1

6.7.3 DI terminal filter time setting

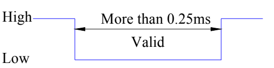
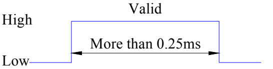
The servo driver provides 8 hardware DI terminals, of which DI1~DI7 are common DI terminals and DI8 is fast DI terminals. Low speed DI terminal, effective signal diagram:

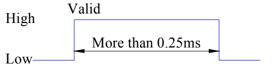
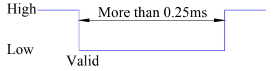
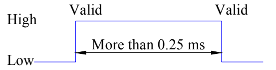
Table 6-31 Ordinary DI terminal description.

Setting	DI terminal logic when function is active	Mark
0	Low level	
1	High level	
2	Rising edge	
3	Falling edge	
4	Rising and falling edge	

High speed DIterminal，Effective signal icon：

Table 6-32 High speed DIterminal specification

Setting value	DI terminal logic when DI function is active	Mark
0	Low level	
1	High level	

2	Rising edge	
3	Falling edge	
4	Rising and falling edge	

(1) Servo enable (S-ON) filter setting

When using a servo drive, be sure to use the DI function 1:FunIN1:S-ON, servo enable. When using the hardware DI terminal for servo enable control, if there is interference in the servo enable signal, the filter can be set by the filter time **[F02 Group]** parameter of the corresponding terminal. At this time, it should be noted that the valid time width of the servo enable signal must be greater than (Filter time) +1ms set value, otherwise, servo enable is invalid.

(2) Fast DI terminal filter setting

The servo driver provides a fast DI terminal with an input signal frequency of up to 4 kHz. When there is interference in the signal, the filter can be set by **[F02.22]**.

Code	**Item**	**Setting range**	**Unit**	Function	**Setting mode**	**Effective mode**	**Factory default**
F02.22	DI8 terminal filter time	0～50	125us	Set the pin for the fast DI terminal DI8 filter time constant	Run setting	Effective immediately	2

6.7.4 Brake protection detection function

When the brake is closed, check whether the brake is closed. If the motor rotates two times after the brake is closed, it will report Er.218.

Code	**Item**	**Setting range**	**Unit**	**Function**	**Setting mode**	**Effective mode**	**Factory default**
F09.05	Brake protection detection enable	0: disable 1: enable	-	Set whether to enable the brake protection detection function	Run setting	Effective immediately	0

7 Adjustment

7.1 Overview

The servo drive needs to drive the motor as quickly and accurately as possible to track commands from the host computer or internal settings. To achieve this, the servo gain must be adjusted properly.

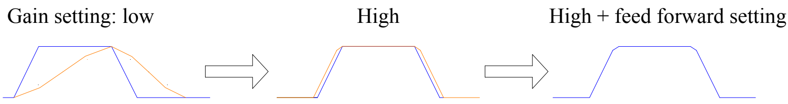


Fig.7-1 Gain setting example

Position loop gain：	520.0rad/s	628.0rad/s	628.0rad/s
Speed loop gain：	100.0Hz	250.0Hz	250.0Hz
Integral time constant：	100.00ms	50.00ms	50.00ms
Speed feed forward gain：	0	0	50.0%
Load inertia ratio：	30	30	30

The servo gain is set by a combination of multiple parameters (position loop gain, speed loop gain, filter, load moment of inertia ratio, etc.), which affect each other. Therefore, the setting of the servo gain must take into account the balance between the individual parameter settings.

Note

> Before performing gain adjustment, it is recommended to perform a jog test to confirm that the motor can operate normally!

The general process of gain adjustment is shown in the figure below:

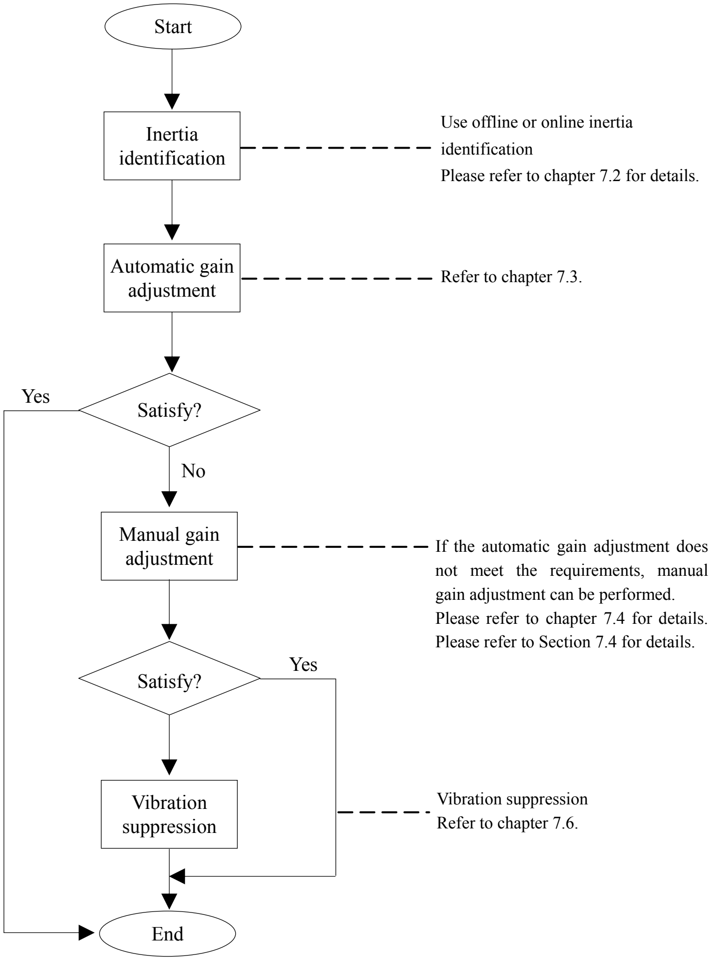


Fig.7-2 Gain adjustment process

Table 7-1 Gain adjustment process description

Gain adjustment process			Function	Chapter
1	Inertia identification	Offline	Using the drive's own management identification function, the drive automatically calculates the load inertia ratio	7.2.1
		Online	The motion command is generated by the upper controller to rotate the servo motor, and the driver calculates the load inertia ratio in real time.	7.2.2
2	Automatic gain adjustment		Under the premise that the inertia ratio is correctly set, the driver automatically adjusts a set of matching gain parameters.	7.3
3	Manual gain adjustment	Basic gain	Based on the automatic gain adjustment, if the expected effect is not achieved, manually adjust the gain to optimize the effect.	7.4
		Instruction filtering	Filter settings for position, speed, and torque commands	7.4.3
		Feed forward gain	Enable feed forward for improved ability of following up.	7.4.4
4	Vibration suppression	Mechanical resonance	Enable notch filter function to suppress mechanical resonance	7.6.1
		Low frequency resonance	Enable low frequency resonance suppression filter function to suppress low frequency resonance	7.6.2

7.2 Inertia identification

Load inertia ratio **[F07.14]** is:

$$Load\ inertia\ ratio = \frac{Mechanical\ load\ total\ moment\ of\ inertia}{motor's\ own\ moment\ of\ inertia}$$

The load inertia ratio is an important parameter of the servo system. Correct setting of the load inertia ratio can help to complete the debugging quickly.

The load inertia ratio can be set manually or automatically by the servo drive's inertia identification function. Servo driver provides automatic identification method for offline inertia identification: The load inertia ratio can be set manually or automatically by the servo drive's inertia identification function. The servo drive provides automatic identification methods for offline and online inertia identification:

(1) Offline inertia identification

Using **[F12.04:Offline inertia identification]**,the motor is rotated by operating the buttons on the servo driver panel to realize the inertia identification, which is the offline inertia identification without the intervention of the host computer.

Note

(1) Using the inertia identification function, in order to accurately calculate the load inertia ratio, the following conditions must be met:

① The actual motor maximum speed is higher than 150rpm;

② When the actual motor accelerates and decelerates, the acceleration is above 3000rpm/s;

③ The load torque is relatively stable and cannot be changed drastically;

④ The actual load inertia ratio does not exceed 200 times;

(2) If the actual load inertia ratio is large and the drive gain is low, the motor action will be slow, and the motor maximum speed requirement and acceleration requirement cannot be reached. At this time, the speed loop gain **[F07.00]** should be increased and then re-run the inertia identification.

(3) If vibration occurs during the identification process, the inertia identification should be stopped immediately to reduce the gain.

(4) In addition, the large backlash of the transmission mechanism may cause the inertia identification to fail.

(2) Online inertia identification

The motion command is generated by the upper controller, so that the servo motor responds to the motion command to drive the load motion, and the driver completes the real-time identification of the system inertia and the automatic adjustment of the gain.

Note

When using the online inertia identification mode **[F08.25≠0]** , the servo drive is automatically set to **[F07.14]** , which cannot be set manually. When the online inertia identification **[F08.25=0]** is turned off, it can be set manually.

7.2.1 Offline inertia identification

Before running offline inertia identification, first confirm the following:

(1) The motor's runnable stroke should meet three requirements.

① There is a runnable stroke of one or more turns between the mechanical limit switches.

Before running offline inertia identification, please ensure that the limit switch is installed on the machine, and ensure that the motor has a runnable stroke of more than one rotation of each side of the motor to prevent over-stroke in the process of inertia identification, resulting in an accident!

② Meet **[F08.07]** (to complete the single inertia identification requires the number of motor rotations).

View the current inertia identification maximum speed **[F08.04]**, accelerate to maximum speed time **[F08.05]** during inertia identification, and the number of motor rotations required to complete inertia identification **[F08.07]**, to ensure that the motor's runnable stroke at this stop position is greater than the **[F08.07]**setting, otherwise the **[F08.04]** or **[F08.05]**setting should be appropriately reduced until this requirement is met.

③ According to the limitation of the running direction of the machine, the offline inertia identification mode **[F08.03]** can be selected to realize forward and reverse identification, forward rotation identification and reverse rotation identification.

(2) Estimate load inertia ratio **[F07.14]**

If **[F07.14]** is the default value（0.00）and the actual load inertia ratio is greater than 30.00, the motor may be slow to cause the identification failure. In this case, the following two measures can be taken:

① Preset **[F07.14]** to be a large initial value.

The preset value is recommended to be 5.00 times as the starting value, and gradually increase until the panel display value is updated in the identification process.

② Increase the drive rigidity level **[F08.01]** appropriately so that the actual motor speed can reach the maximum speed of inertia identification **[F08.04].**

(3) The general operation process of offline inertia identification is as follows:

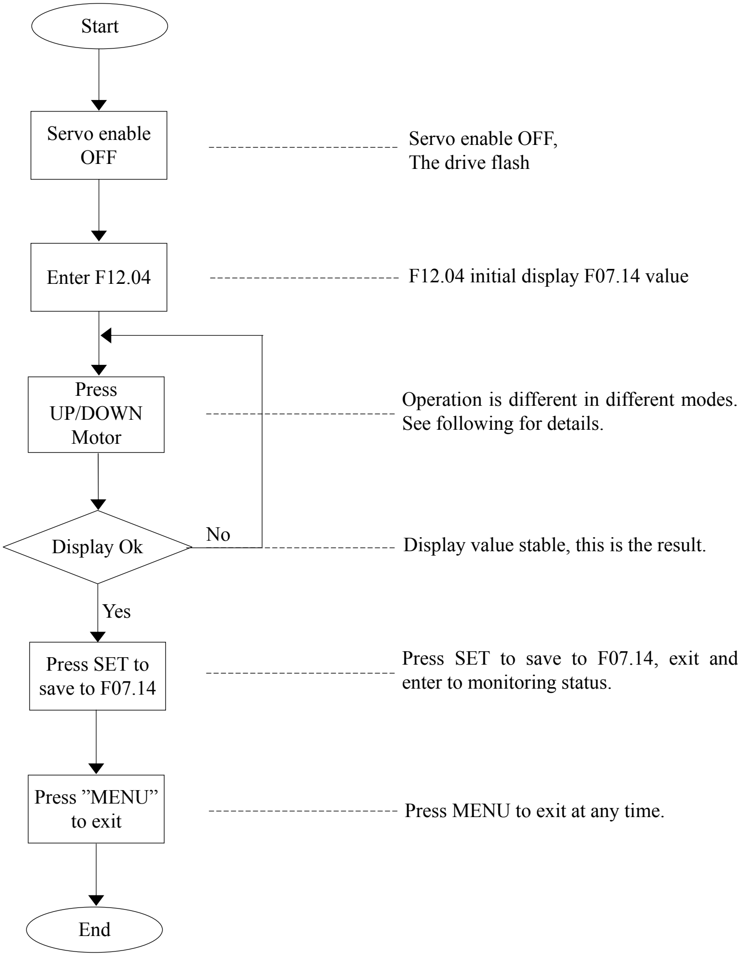
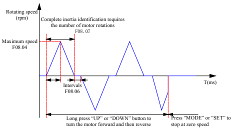
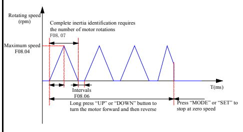
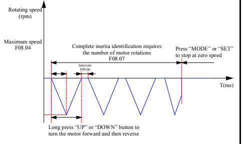


Fig.7-3 Offline inertia identification flow chart

(4) Offline inertia identification is divided into three modes: positive and negative triangular wave mode, forward rotation mode and reverse rotation mode. The command modes of the three modes are different.

Table 7-2 Comparison of three modes of offline inertia identification

Item	Positive and negative triangle wave form(F08.03=0)	Forward rotation mode (F08.03=1)	Reverse rotation mode (F08.03=2)
Instruction form	Symmetric triangle wave 	Positive triangle wave 	Negative triangle wave 
Max speed	F08.04	F08.04	F08.04
Acc/dec time	F08.05	F08.05	F08.05
Buttons	Press UP or DOWN button: the motor forward first and then reverse Press MENU: to exit the identification status	Press the UP or DOWN button: The motor is forward first and then zero speed locked. Press MENU: to exit the identification status	Press the UP or DOWN button: The motor is reverse first and then zero speed locked. Press MENU: to exit the identification status
Intervals	F08.06	F08.06	F08.06
Number of motor rotations	≤F08.07	Manually control	Manually control
Applications	Motor stroke is short and can be forward and reverse	Motor stroke is long, can be manually controlled and can only be rotated forward	Motor stroke is long, can be manually controlled and can only be rotated reverse

Function code	Name	Setting range	Unit	Function	Setup way	Effective way	Default value
F08.03	Offline inertia identification mode	0: Positive and negative triangle wave mode 1: Forward mode 2: Reverse mode	-	Set offline inertia identification mode	Downtime set	Effective instantly	0
F08.04	Inertia identification max. Speed	50～6000	rpm	Set the maximum speed command for offline inertia identification	Downtime set	Effective instantly	500
F08.05	Acc/dec time when inertia identification	2～2000	ms	Set the interval between two consecutive speed commands when the forward and reverse triangle modes are used for offline inertia identification.	Downtime set	Effective instantly	125
F08.06	Interval after an inertia identification	20～10000	Ms	When setting the offline inertia identification function, the time interval between two consecutive	Run time set	Effective instantly	1000

				speed commands, extending this time is beneficial to improve the identification accuracy.			
F08.07	Motor rotations for an inertia identification	-	r	Display the number of motor rotations required for a single offline inertia identification.	-	-	0.52

7.2.2 Online inertia identification

The servo drive provides online inertia identification. Online inertia identification general operation process:

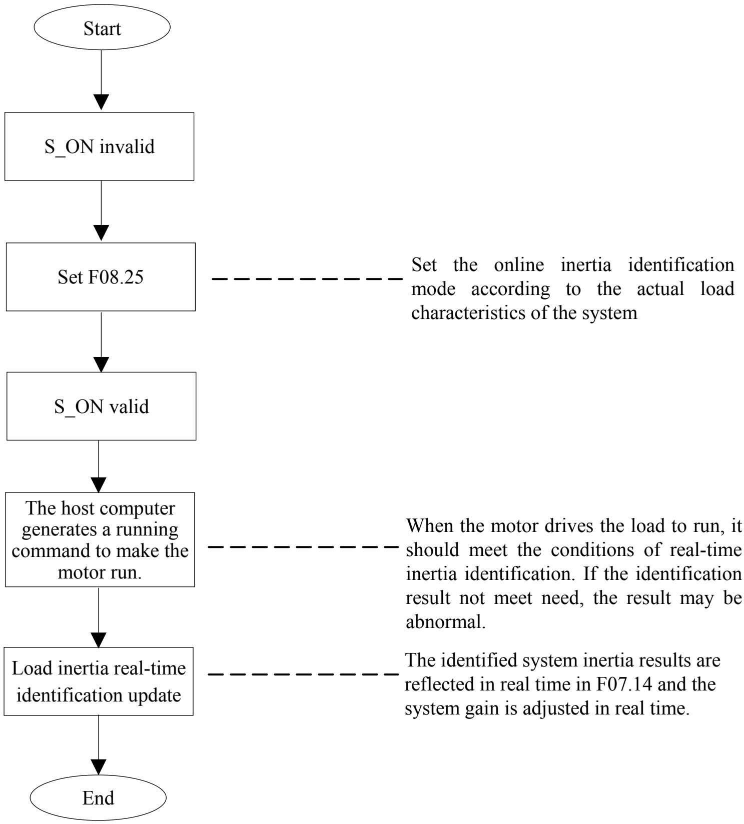


Fig.7-4 Online inertia identification operation flow

Function code	Name	Setting range	Unit	Function	Setup way	Effective way	Default value
F08.25	Online inertia identification mode	0: Turn off online identification 1: Turn on online inertia identification, the load characteristics are basically unchanged 2: Turn on online inertia identification, and the load characteristics change slowly. 3: Turn on online inertia identification, the load characteristics change drastically	-	-	Effective Instantly	Down time set	0

Under the following conditions, the online identification inertia function may fail. In this case, change the mechanical load condition and motion command, or use offline inertia identification.

(1) When the speed is less than 150r/min and the low speed is continuously used;

(2) When the acceleration and deceleration is less than 350ms (acceleration from 0r/min to 1000r/min);

(3) When the torque is too small during acceleration/deceleration or the load torque changes drastically;

(4) When the load inertia ratio exceeds 200 times;

(5) When the rigidity of the mechanical equipment is too low or there is a nonlinear characteristic such as a gap.

Note

(1) **[F08.25≠0]** , online inertia identification is enabled, the identification result will be reflected in **[F07.14],** and the system gain will be adjusted in real time. If you are satisfied with the identification result, you can set **[F08.25=0]** , when you exit the online inertia identification, it will automatically save **[F07.14: Current identification result]** ; if **[F08.25]** is not 0, the current identification result will be saved automatically to **[F07.14]** when the servo is powered off. After power-on again, the system inertia value **[F07.14]** is the inertia identification value before power off.

(2) If the inertia of the actual system is large, or the servo rigidity level gain **[F08.01]** is set small, the motor operation does not meet the online inertia identification condition. At this time, could set **[F08.25=0]**. Set the estimated inertia for **[F07.14]** according to the actual system inertia, or increase **[F08.01]** appropriately, and then restart the online inertia identification.

(3) If continuous vibration or noise occurs during the online inertia identification process, the inertia identification value will be an abnormal value. At this time, the online inertia identification should be stopped immediately and could set **[F08.25=0].** Set the estimated inertia for **[F07.14]** according to the actual system inertia, or reduce **[F08.01]** appropriately, and then restart the online inertia identification.

(4) If you are not satisfied with the online inertia identification effect, you can perform offline inertia identification or manually calculate the system inertia value.

7.3 Automatic gain adjustment

Automatic gain adjustment refers to the rigid level selection function **[F08.01]**, the servo driver will automatically generate a set of matching gain parameters to meet the requirements of speed and stability.

Note

Be sure to get the load inertia ratio correctly before using the automatic gain adjustment function!

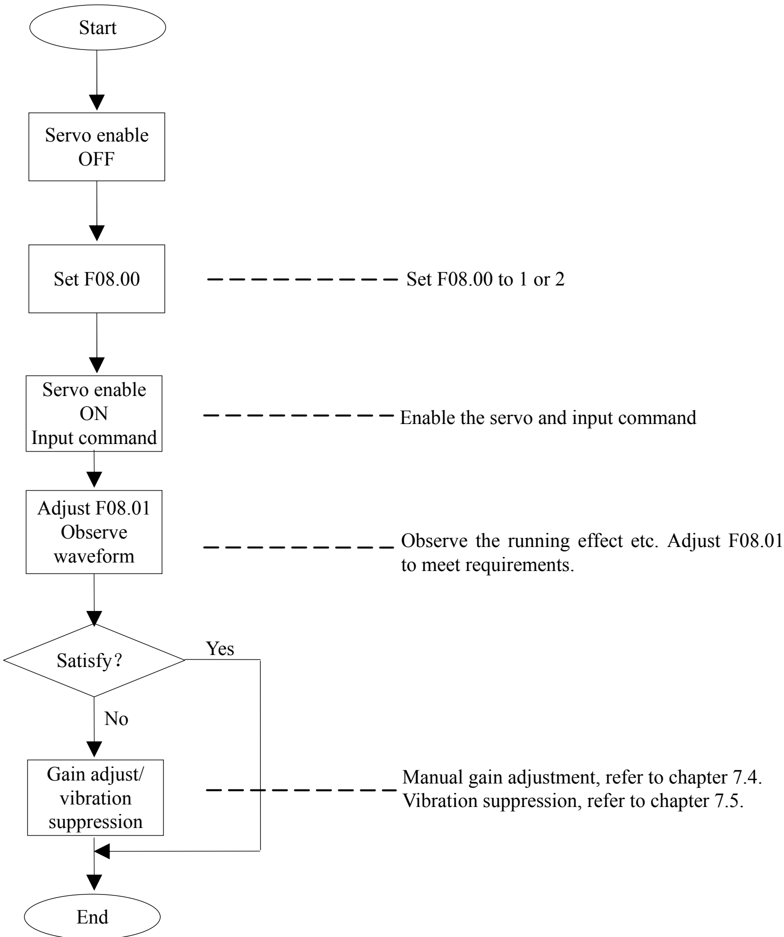


Fig.7-5 Automatic gain adjustment step

The rigidity level **[F08.01]** ranges from 0 to 31.The 0-level corresponds to the weakest stiffness and the smallest gain; the 31-level corresponds to the strongest stiffness and the largest gain. The following empirical values are available for reference depending on the type of load:

Table 7-3 Rigid level reference

Recommended rigidity level	Load mechanism type
4～8	Some large machinery
8～15	Low rigidity applications such as belts
15～20	Highly rigid applications such as ball screws and straight connections

The servo drive provides two automatic gain adjustment modes:

Note

The parameter self-adjustment mode **[F08.00=1]** is suitable for most occasions. When the positioning fastness is very high, the positioning mode **[F08.00=2]**can be used.

(1) Parameter self-adjustment mode **[F08.00=1]**

First gain (**[F07.00]～[F07.02]**、**[F07.12]**) parameters, according to the rigidity level set by **[F08.01]**, it is automatically updated and stored in the corresponding function code:

Table 7-4 Parameter self-adjustment mode automatically updates parameters

Function code	Name	Function code	Name
F07.00	Speed loop gain	F07.01	Speed loop integral time constant
F07.02	Position loop gain	F07.12	Torque command filter time constant

(2) Positioning mode **[F08.00=2]**

① On the basis of Table 7-4, the second gain **[F07.03～F07.05、F07.13]** parameters are automatically updated with the rigiditylevel set according to **[F08.01]** the corresponding function code is stored, and the position loop gain of the second gain parameter is one level higher than the first gain parameter.

Table 7-5 Positioning mode automatically updates parameters

Function code	Name	Description
F07.03	Second speed loop gain	Consistent with the first gain
F07.04	Second speed loop integral time constant	Consistent with the first gain
F07.05	Second position loop gain	One level higher than the first gain
F07.13	Second torque command filtering time constant	Consistent with the first gain

② Speed feed forward related parameters are set to fixed values:

Table 7-6 Positioning mode fixed parameter

Function code	Name	Value
F07.17	Speed feed forward gain	30.0%
F07.16	Speed feed forward filter time constant	0.50ms

③ The gain switching related parameter is set to a fixed value, and in the positioning mode, the gain switching function is automatically turned on.

Function code	Name	Value	Description
F07.06	Second gain mode setting	1	In the positioning mode, the first gain (F07.00~F07.02, F07.12) and the second gain (F07.03~F07.05, F07.13) are switched effectively; Outside the positioning mode, keep the original settings.
F07.07	Gain switching condition selection	10	In the positioning mode, the gain switching condition is F07.07=10; Outside the positioning mode, keep the original settings.
F07.08	Gain switching delay time	5.0ms	In the positioning mode, the gain switching delay time is 5.0 ms; Outside the positioning mode, keep the original settings.
F07.09	Gain switching level	50	In the positioning mode, the gain switching level is 50; Outside the positioning mode, keep the original settings.
F07.10	Gain switching time lag	30	In the positioning mode, the gain switching level is 30; Outside the positioning mode, keep the original settings.

Note

In the automatic gain adjustment mode, the parameters that are automatically updated as therigidity level **[F08.01]** and the parameters that are fixed cannot be manually modified. To modify, you must set **[F08.00]** to 0 to exit the self-adjustment mode.

Function code	Name	Setting range	Unit	Function	Setup way	Effective way	Default value
F08.00	Self-adjustment mode selection	0: Manual adjust parameters 1: Parameter self-adjustment mode, automatically adjust gain parameters with rigid table 2: Positioning mode, automaticly adjust gain parameters with rigid table	-	Set the self-adjustment mode	Run time set	Effective Instantly	0
F08.01	Rigid level	0～31	-	Set the level of the rigid	Run time set	Effective Instantly	12

7.4 Manual gain adjustment

7.4.1 Basic parameters

The gain can be fine-tuned manually when the automatic gain adjustment does not achieve the desired results. Optimize the effect with more detailed adjustments.

The servo system consists of three control loops, from the outside to the inside are position loop, the speed loop and the current loop. The basic control block diagram is as follows:

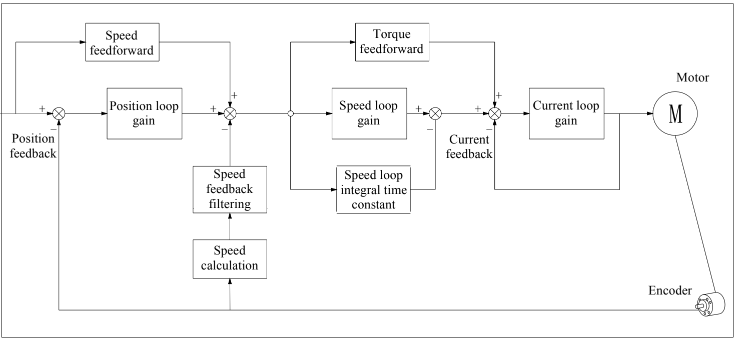


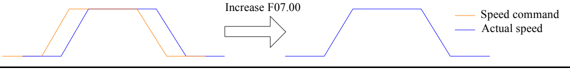
Fig.7-6 Manual gain basic description block diagram

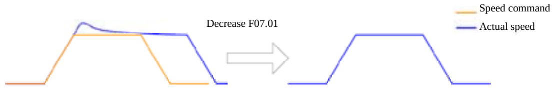
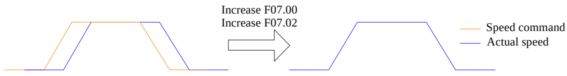
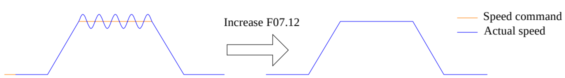
The more inner loop, the higher responsiveness is required. Not to follow this principle may result in system instability!

The servo drive's default current loop gain ensures adequate responsiveness and generally no need to adjust. Only position loop gain, speed loop gain, and other auxiliary gains need to be adjusted. Therefore, when the gain adjustment is performed in the position control mode, in order to ensure the stability of the system and increase the position loop gain, the speed loop gain needs to be increased, and the response of the position loop is lower than the response of the speed loop.

The basic gain parameter adjustment method is as follows.

Table 7-7 Gain parameter adjustment instructions

Step	Function code	Name	Adjustment instructions
1	F07.00	Speed loop gain	Parameter function: Determine the maximum frequency that the speed loop can follow, changing the speed command. Under the premise that the load inertia ratio average (F07.14) is set correctly, it can be: Speed loop highest following frequency = F07.00 

			Adjustment method: Increasing this parameter within the range where noise and vibration do not occur can speed up the positioning time and bring better speed stability and followability; If noise occurs, the parameter setting value should be lowered; When mechanical vibration occurs, refer to "7.6 Vibration suppression" using the mechanical resonance suppression function.
2	F07.01	Speed loop integral	Parameter function: Eliminate the speed loop deviation.  Time constant It is recommended to take the following values: 500≤F07.00×F07.01≤10000 For example, when the speed loop gain F07.00=40.0 Hz, the speed loop integral time constant should satisfy: 12.50ms≤F07.01≤25.00ms。 Decreasing the set value can enhance the integral action and speed up the positioning time, but if the set value is too small, it's easily cause mechanical vibration. If the set value is too high, the speed loop deviation always can't return to zero..
3	F07.02	Position loop gain	Parameter function: Determine the maximum frequency that the speed loop can follow, changing the speed command. Position loop highest following frequency = F07.02  Adjustment method: In order to ensure the stability of the system, it should be ensured that the highest following frequency of the speed loop is 3 to 5 times the highest following frequency of the position loop, so: $3 \leqslant \frac{2\times\pi\times F07.00}{F07.02} \leqslant 5$ For example, when the speed loop gain F07.00=40.Hz, the position loop gain should satisfy: 50.2rad/s≤F07.02≤83.7rad/s Adjust according to the positioning time. Increasing this parameter speeds up the positioning time and increases the ability of the motor to resist external disturbances while stationary. If the set value is too high, the system may be unstable and oscillate.
4	F07.12	Torque command filter time constant	Parameter function: Eliminate high frequency noise and suppress mechanical resonance. 

			Adjustment method: It should be ensured that the cutoff frequency of the torque command low-pass filter is higher than 4 times the highest following frequency of the speed loop, so: $$\frac{1000}{2\times\pi\times F07.12}\geqslant(F07.00)\times 4$$ For example, when the speed loop gain F07.00=40.0Hz, the torque command filtering time constant should satisfy: F07.12≤1.00ms。 When the vibration of F07.00 is increased, the vibration can be suppressed by adjusting F07.12. For details, please refer to "7.6 Vibration suppression". If the set value is too large, the response of the current loop will decrease. To suppress the vibration during shutdown, try to increase F07.00 and reduce F07.12; If the motor vibrating too much in stop status, try reducing the F07.12 setting value.

Function code	Name	Setting value	Unit	Function	Setup way	Effective way	Default value
F07.00	Speed loop gain	0.1～1000.0	Hz	Set speed loop proportional gain	Run time set	Effective instantly	25.0
F07.01	Speed loop integration time constant	0.36～512.00	ms	Set the integral time constant of the speed loop	Run time set	Effective instantly	31.83
F07.02	Position loop gain	0.00～1570.0	rad/s	Set position loop proportional gain	Run time set	Effective instantly	40.0
F07.12	Torque command filter time constant	0.00～30.00	ms	Set torque command filter time constant	Run time set	Effective instantly	0.79

7.4.2 Gain switching

The gain switching function can be triggered by the servo internal state or by an external DI. Using gain switching can have the following effects:

① It is possible to switch to a lower gain in the motor stationary (Servo enable) state to suppress vibration;

② It is possible to switch to a higher gain while the motor is stationary to shorten the positioning time;

③ It is possible to switch to higher gain in motor running state for better command tracking performance;

④ Different gain settings can be switched by external signals depending on the load device.

(1) F07.06=0:

Fixed to the first gain (**[F07.00]**～**[F07.02]**、**[F07.12]**) ,But the speed loop can be switched by proportional and proportional integral control through DIFunction3 (FunIN.3：GAIN_SEL, gain switching).

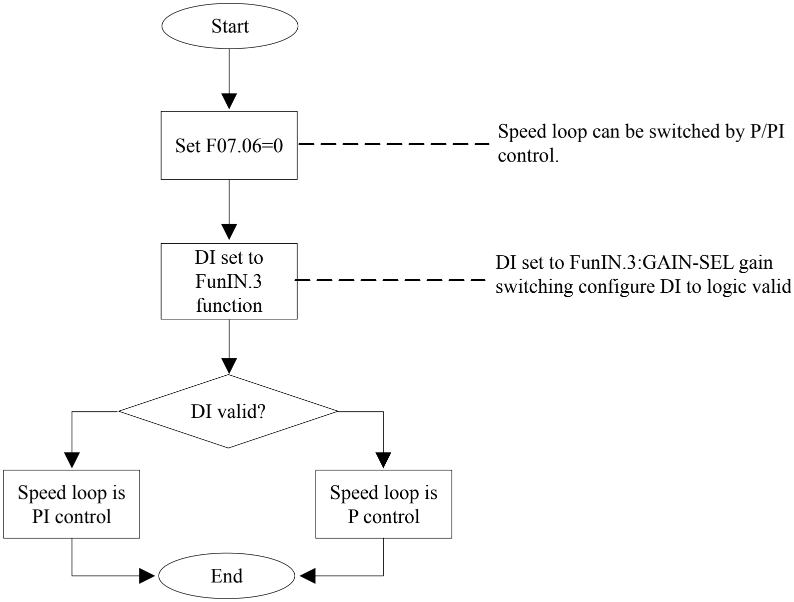


Fig.7-7 F07.06=0 Gain switching flow chart

(2) F07.06=1

Switching between the first gain (**[F07.00]**～**[F07.02]**、**[F07.12]**) and the second gain **([F07.03]**～**[F07.05]**、**[F07.13])** can be achieved. The switching conditions should be set via **[F07.07]**.

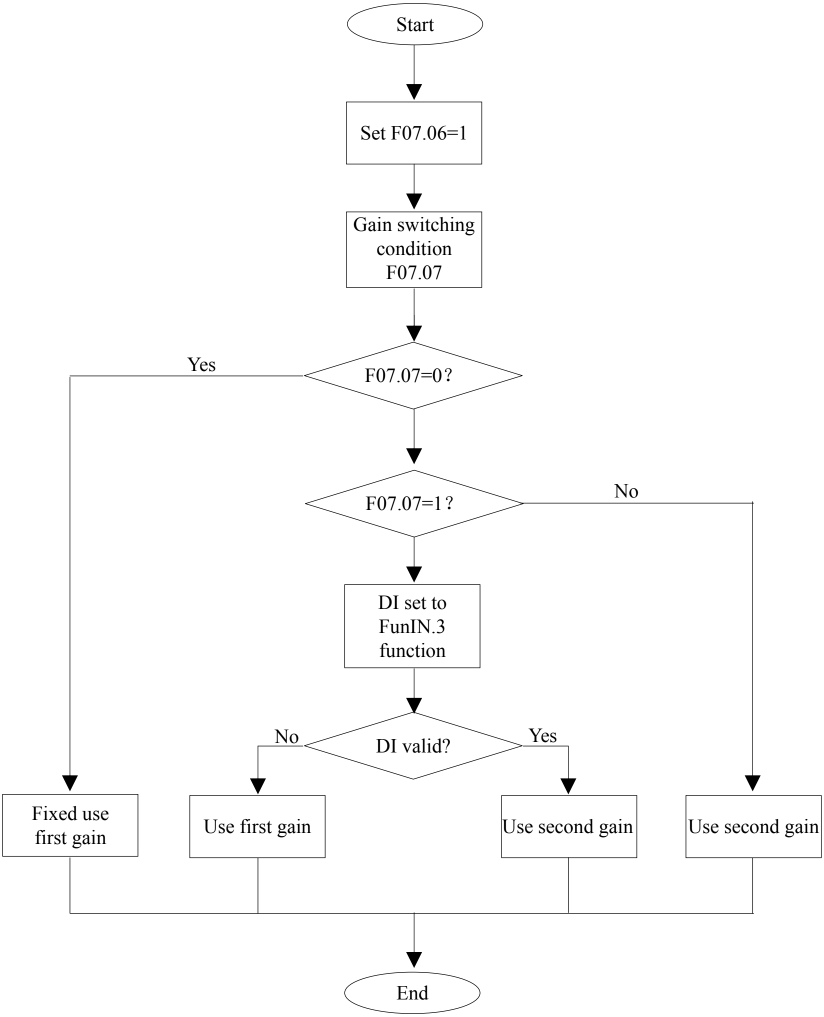
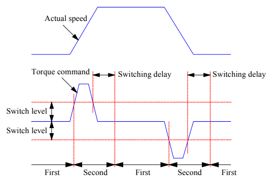
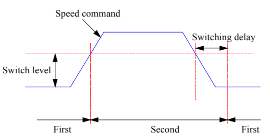
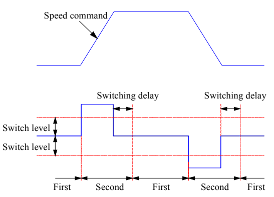
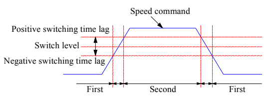
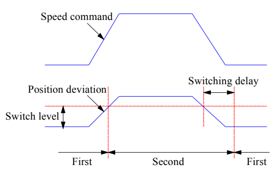
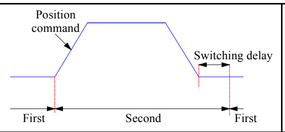
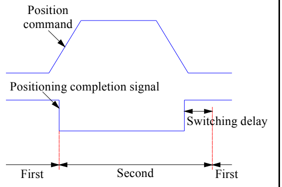
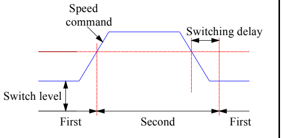


Fig.7-8 F07.06=1 Gain switching flow chart

The second gain switching condition has a total of 11 modes. Schematic diagrams and related parameters for different modes are shown in the table below.

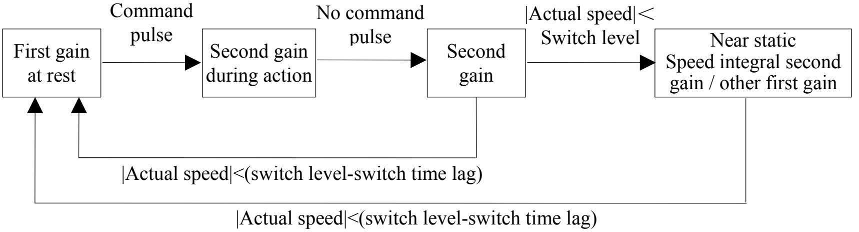
Table 7-8 Description of gain switching conditions

Gain switching condition setting			Related parameters		
F07.07	**Condition**	**Schematic diagram**	**Delay (F07.08)**	**Switch level (F07.09)**	**Switching time lag (F07.10)**
0	First gain fixed	-	Invalid	Invalid	Invalid
1	Using external DI to switch	-	Invalid	Invalid	Invalid
2	Torque command		Valid	Valid (%)	Valid (%)
3	Speed command		Valid	Valid	Valid
4	Speed command rate of change		Valid	Valid (100rpm/s)	Valid (100rpm/s)
5	Speed command high and low speed threshold		Invalid	Valid (rpm)	Valid (rpm)
6	Position deviation		Valid	Valid (Encoder Unit)	Valid (Encoder Unit)

7	Position command		Valid	Invalid	Invalid
8	Positioning completed		Valid	Invalid	Invalid
9	Actual speed		Valid	Valid (rpm)	Valid (rpm)
10	Position command ＋actual speed	See the note for details	Valid	Valid (rpm)	Valid (rpm)

Note

The delay time F07.08" is valid only when the second gain is switched to the first gain.



Function code	Name	Setting value	Unit	Function	Setup way	Effective way	Default value
F07.06	2nd gain mode set	0: The 1st gain is fixed, and the external DI is used for P/PI switching. 1: Use gain switching according to the condition setting of F07.07	-	Set the mode of the second gain	Run time set	Effective instantly	1
F07.07	Gain switching condition selection	0: 1st gain fixed (PS) 1: Use external DI switching (PS) 2: Torque command is large (PS) 3: Speed command is large (PS) 4: Speed command change rate is large (PS) 5: Speed command high and low speed threshold (PS) 6: Large positional deviation (P) 7: With position command (P) 8: Positioning completed (P) 9: Actual speed is large (P) 10: With position command + actual speed (P)	-	Set the conditions for gain switching	Run time set	Effective instantly	0
F07.08	Gain switching delay	0～6000	125us	Set the delay time of gain switching	Run time set	Effective instantly	40
F07.09	Gain switching level	1～1000	According to the switching conditions	Set the level of gain switching	Run time set	Effective instantly	50
F07.10	Gain switching time lag	0～20000	According to the switching conditions	Set the time lag of gain switching	Run time set	Effective instantly	30
F07.11	Position gain switching time	0～60000	125us	Set the switching time of the position loop gain	Run time set	Effective instantly	24

7.4.3 Filter comparison

Name	Function	Occasions	Filtering too large effects	Index
Pulse input pin filter	Prevent the number of servo receiving pulses from being inaccurate which resulted from interference.	System wiring is not standardized Strong environmental interference	The number of pulses received by the servo is less than or greater than the number of pulses sent by the host computer.	Section 6.2.1
Position command filtering	Position command filtering is to filter the position command (encoder unit) after frequency division or multiplication by electronic gear ratio to make the motor run smoother and reduce the impact on the machine.	The position command output by the host computer is not accelerated or decelerated. The pulse command frequency is low; When the electronic gear ratio is 10 times or more	Increased response delay	Section 6.2.3
Analog input filtering	Prevent motor command fluctuations caused by unstable analog input voltage, and also reduce motor error caused by interference signals.	System wiring is not standardized Strong environmental interference	Increased response delay	Section 6.3.1 / Section 6.4.1

7.4.4 Feed forward gain

(1) Speed feed forward

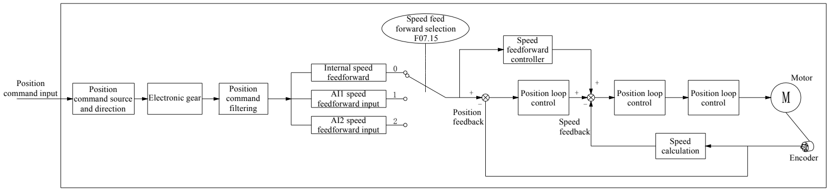


Fig.7-9 Speed feed forward control operation diagram

Speed feed forward can be applied to position control mode and full-closed function. Using the speed feed forward function, you can increase the speed command response and reduce the position deviation at a fixed speed. Speed feed forward function operation steps:

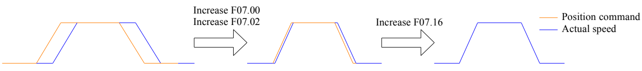
① Set the speed feed forward signal source:

[F07.15] (speed feed forward control selection) is set to a non-zero value, the speed feed forward function is effective, and the corresponding signal source is selected;

Function code	Function	Setting value	Remark
F07.15	Speed feed forward control selection	0:Internal speed feed forward	The speed information corresponding to the position command (encoder unit) is used as the source of the speed feed forward signal.
		1:Use AI1 as speed feed forward input	The speed value corresponding to the analog value by the analog channel AI1 is used as the source of the speed feed forward signal. For the AI1 parameter setting, please refer to: "F02.31", "F02.26", "F02.25", "F02.27"
		2:Use AI2 as speed feed forward input	The speed value corresponding to the analog value by the analog channel AI2 is used as the source of the speed feed forward signal. For the AI2 parameter setting, please refer to: "F02.31", "F02.28", "F02.29", "F02.30"

② Set the speed feed forward parameter;

Including speed feed forward gain **[F07.17]** and speed feed forward filter time constant **[F07.16]**.

<table>
<tr><th>Function code</th><th>Function</th><th>Adjustment instructions</th></tr>
<tr><td>F07.16</td><td>Speed feed forward filter time constant</td><td rowspan="2">

Parameter function:
Increasing F07.17 can improve the response, but speed overshoot may occur during acceleration and deceleration;
Decrease F07.16 to suppress the speed overshoot during acceleration and deceleration; increase F07.16 to suppress the noise in the case where the position command update period is longer than the drive control period and the pulse frequency of the position command is not uniform, etc. Suppressing the jitter of the positioning completion signal.
Adjustment method:
When adjusting, first set F07.16 to a fixed value; then, gradually increase the set value of F07.17 from 0 to a certain set value until the speed feed forward have good effect.
When adjusting, you should adjust F07.16 and F07.17 repeatedly to find a good balance setting.</td></tr>
<tr><td>F07.17</td><td>Speed feed forward gain</td></tr>
</table>

(2) Torque feed forward:

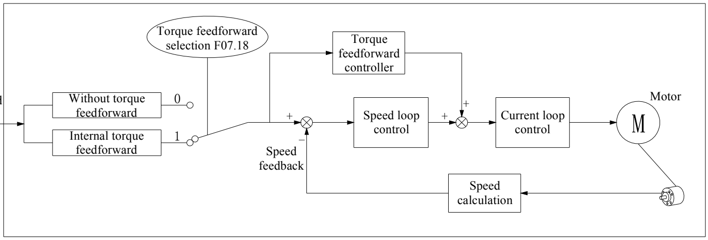


Fig.7-10 Torque feed forward control operation diagram

The position control mode adopts torque feed forward to improve the torque command response and reduce the position deviation of the fixed acceleration/deceleration time. The speed control mode uses torque feed forward to improve the torque command response and reduce the speed deviation of fixed speed.

Torque feed forward function operation steps:

① Set the source of the torque feed forward signal.

Set **[F07.18]** (torque feed forward control selection) to 1, the torque feed forward function takes effect, and the source of the response signal is selected;

Function code	Name	Setting value	Remark
F07.18	Torque feed forward control selection	0：without torque feed forward	-
		1：internal torque feed forward	Use the speed command as the source of the torque feed forward signal. In position control mode, the speed command is derived from the output of the position controller.

② Set the torque feed forward parameter;

Function code	Name	Remark
F07.19	Torque feed forward filter time constant	(1) Parameter function: Increasing F07.20 can improve the response, but overshoot may occur during acceleration and deceleration; Decrease F07.19 to suppress overshoot during acceleration and deceleration; increase F07.19 to suppress noise; (2) Adjustment method: When adjusting, first, keep F07.19 as the default value; then, gradually increase the F07.20 setting value from 0 until a certain setting value, the torque feed forward effect is obtained. When adjusting, you should adjust F07.19 and F07.20 repeatedly to find a good balance setting.
F07.20	Torque feed forward gain	For details, please refer to "7.4.4 Feed forward Gain"

7.5 Parameter adjustment in different control modes

The parameter adjustment in different control modes must be in the order of "Inertia Identification" ==> "Automatic Gain Adjustment" ==> "Manual Gain Adjustment".

7.5.1 Parameter adjustment in position mode

(1) Obtain the load inertia ratio by inertia identification **[F07.14]**:

(2) Gain parameters in position mode:

① First gain:

Function code	Name	Function	Default value
F07.12	Torque command filter time constant	Set torque command filter time constant	0.79ms
F07.00	Speed loop gain	Set the speed loop proportional gain	25.0Hz
F07.01	Speed loop integral time constant	Set the integral time constant of the speed loop	31.83ms
F07.02	Position loop gain	Set position loop proportional gain	40.0rad/s

② Second gain：

Function code	Name	Function	Default value
F07.13	Second torque command filtering time constant	Set torque command filter time constant	0.79ms
F07.03	Second speed loop gain	Set the speed loop proportional gain	40.0Hz
F07.04	Second speed loop integral time constant	Set the integral time constant of the speed loop	40.00ms
F07.05	Second position loop gain	Set position loop proportional gain	64.0rad/s
F07.06	Second gain mode setting	Set the mode of the second gain	1
F07.07	Gain switching condition selection	Set the conditions for gain switching	0
F07.08	Gain switching delay time	Set the delay time of gain switching	5000us
F07.09	Gain switching level	Set the level of gain switching	50
F07.10	Gain switching time lag	Set the time lag of gain switching	30
F07.11	Position gain switching time	Set the switching time of the position loop gain	3000us

③ Common gain：

Function code	Name	Function	Default value
F07.16	Speed feed forward filter time constant	Set the filter time constant of the speed feed forward signal	1.00ms

F07.17	Speed feed forward gain	Set the speed feed forward gain	0.0%
F07.19	Torque feed forward filter time constant	Set the filter time constant of the torque feed forward signal	1.00ms
F07.20	Torque feed forward gain	Set the torque feed forward gain	0.0%
F07.21	Speed feedback filter time	Set the speed feedback filter function	0
F07.22	Position error deviation limit	Set position control minimum control accuracy	Determined by encoder
F08.22	Low frequency resonance suppression mode selection	Set the mode of low frequency resonance suppression	0
F08.23	Low frequency resonance frequency	Set the frequency of the low frequency resonance suppression filter	100.0Hz
F08.24	Low frequency resonance frequency	Set low frequency resonance frequency	2

(3) The initial value of first gain (or second gain) and the common gain are obtained by automatic gain adjustment

(4) Manually fine tune the following gains:

Function code	**Name**	**Function**	**Default value**
F07.12	Torque command filter time constant	Set torque command filter time constant	-
F07.00	Speed loop gain	Set the speed loop proportional gain	-
F07.01	Speed loop integral time constant	Set the integral time constant of the speed loop	-
F07.02	Position loop gain	Set position loop proportional gain	-
F07.17	Speed feed forward gain	Set the speed feed forward gain	-

7.5.2 Parameter adjustment in speed mode

The parameter adjustment in the speed control mode is the same as in the position control mode. In addition to the position loop gain(**[F07.02]**、**[F07.05]**), please adjust according to 7.5.1.

7.5.3 Parameter adjustment in torque mode

Parameter adjustment in torque control mode needs to be differentiated as follows:

① The actual speed reaches the speed limit value (refer to Chapter 6 for the speed limit in torque mode), and the adjustment method is the same as the parameter adjustment in speed mode 7.5.2.

② The actual speed does not reach the speed limit value. Except for the position speed loop gain and the speed loop integral time constant, the adjustment method is the same as the parameter adjustment in speed mode 7.5.2.

7.6 Vibration suppression

7.6.1 Mechanical resonance suppression

The mechanical system has a certain resonance frequency. When the servo gain is increased, resonance may occur near the mechanical resonance frequency, and the gain cannot be continuously improved. There are 2 ways to suppress mechanical resonance:

(1) Torque command filtering (**[F07.12]** , **[F07.13]**)

By setting the filter time constant, the torque command is attenuated in the high frequency band above the cutoff frequency, and the purpose of suppressing mechanical resonance is achieved.

$$Filter\ cutoff\ frequency f_c\left(Hz\right)=1/\left[2\pi\times F07.12\left(ms\right)\times 0.001\right]$$

(2) Notch filter

The notch filter can achieve the purpose of suppressing mechanical resonance by reducing the gain at a specific frequency. After the notch filter is properly set, the vibration can be effectively suppressed, and you can try to continue to increase the servo gain. The principle of the notch filter is shown below.

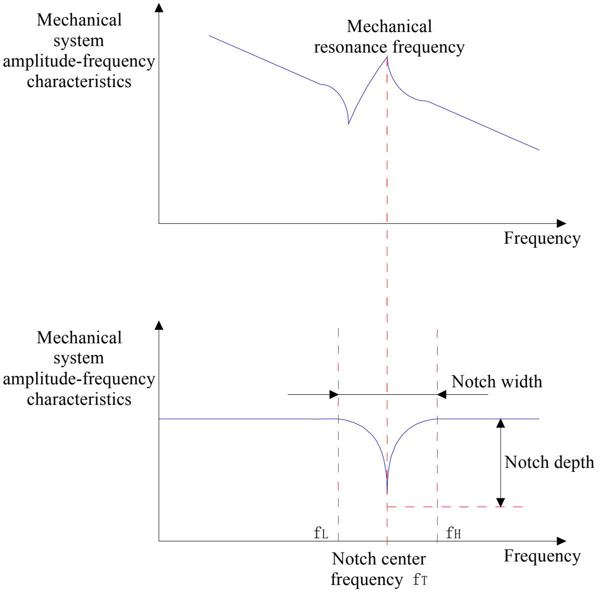


Fig.7-11 Suppression principle of notch filter

There are 4 sets of notch filters in the servo drive. Each set of notch filter has 3 parameters, which are notch filter frequency, width level and depth level. The first and second sets of notch filters are manual notch filters, and the parameters are manually set by the user; the third and fourth sets of notch filter parameters can be manually set or configured as adaptive notch filter [F08.02=1 or 2], at this time each parameter is automatically set by the drive.

Table 7-9 Notch filter description

Item	Manual notch filter		Manual/adaptive notch filter	
	First set of notch filter	Second set of notch filter	Third set of notch filter	Fourth set of notch filter
Frequency	F08.08	F08.11	F08.14	F08.17
Width level	F08.09	F08.12	F08.15	F08.18
Depth level	F08.10	F08.13	F08.16	F08.19

Note

(1) When "Frequency" is the default value of 4000 Hz, the notch is invalid.
(2) If a notch is required for resonance, use the adaptive notch first. When the adaptive notch is invalid or not working well, then try using a manual notch.

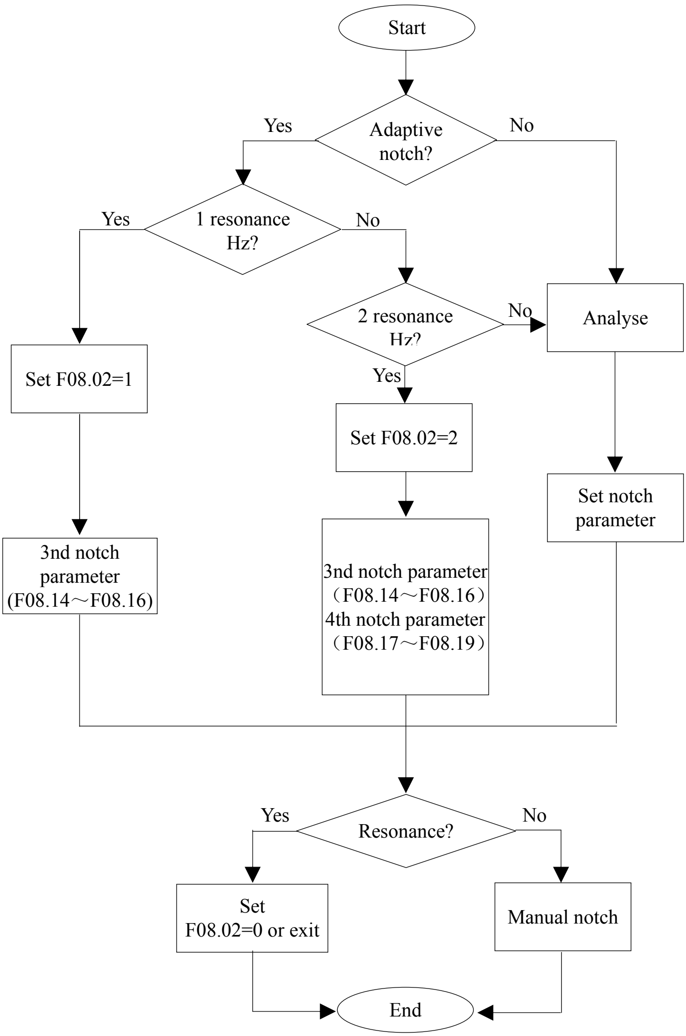


Fig.7-12 Notch filter steps for usage

① Adaptive notch filter use steps:

1> Set **[F08.02]** (adaptive notch filter mode selection) to 1 or 2 according to the number of resonance points;

When resonance occurs, first set **[F08.02]** to 1, and turn on an adaptive notch filter. After the gain adjustment, if a new resonance occurs, set **[F08.02]** to 2 to start two self adaptive notch filters.

2> When the servo is running, the third or fourth set of notch filter parameters are automatically updated, and the set of function codes is automatically stored once the identification is completed.

3> If the resonance is suppressed, it means adaptive notch filter has effect. After waiting for the servo to run stably for a period of time, when **[F08.02]** is set to 0, the adaptive notch filter parameter is fixed to the last updated value. If the system does not detect vibration during the automatic identification process, **[F08.02]**will also be automatically set to 0. This step prevents the notch filter parameter from being updated to an incorrect value due to a malfunction during servo operation, which in turn exacerbates the vibration condition.

4> If the vibration cannot be eliminated for a long time, please turn off the servo enable in time.

If the resonance frequency exceeds 2, the adaptive notch filter cannot meet the requirements, and the manual notch filter can be used at the same time. The four notch filters can also be used as the manual notch filter **[F08.02=0]**。

Note

When the resonance frequency is below 300 Hz, the effect of the adaptive notch filter will be reduced.

② Manual notch filter use steps:

1> Analyze the resonance frequency; when using the manual notch filter, the frequency of the notch filter needs to be set to the actual resonance frequency. How to obtain the resonance frequency:

a) Obtained by the “FFT Analysis” of our driver and debugging platform;

b) Collect the command torque (02 monitoring item) or the motor output torque (45 monitoring item) through the oscilloscope function of our drive debugging platform. After the “FFT analysis” of the collected data, the resonance frequency is found by the FFT image. The sampling "timestamp" of the virtual oscilloscope is set to 3 for accurate analysis during sampling.

c) By [F08.02=3], when the servo is running, the resonance frequency and amplitude are automatically tested and the test results are saved in [F08.20] and [F08.21]

2> Input the resonance frequency and depth information obtained in step 1> into the width level of this set of notch filter;

3> If the resonance is suppressed, it means the notch filter is effective, and the gain can be continuously adjusted. After the gain is increased, if a new resonance occurs, repeat steps

1>～2>;

4> If the vibration cannot be eliminated for a long time, please turn off the servo enable in time.

③ Notch filter width level

The notch filter width level is used to represent the ratio of the notch filter width to the notch filter center frequency:

$$Notch\ \ widch\ \ class = \frac{f_H - f_L}{f_T}$$

Where: Ft: notch filter center frequency, ie mechanical resonance frequency

f_H-F_l: notch filter width, indicating the frequency bandwidth relative to the notch filter center frequency, the amplitude attenuation rate is -3dB.

The corresponding relationship is shown in Figure7-11. Generally, you can keep the Default value2.

④ Notch filter depth level

Notch filter depth level

The notch filter depth level represents the ratio relationship between input and output at the center frequency.

When the notch filter depth level is 0, the input is completely suppressed at the center frequency; when the notch filter depth level is 100, the input is completely passable at the center frequency. Therefore, the smaller the notch filter depth level setting, the deeper the notch depth, and the stronger the suppression of mechanical resonance, but it may cause the system to be unstable and be careful when using it.

The specific correspondence is shown in the following figure:

Note

If there is no obvious spike in the amplitude-frequency characteristic curve obtained by the FFT analysis tool, and vibration actually occurs, the vibration may not be mechanical resonance, but may reach the limit gain of the servo. This vibration cannot be suppressed by the notch and can only be improved by reducing the gain or reducing the torque command filtering time.

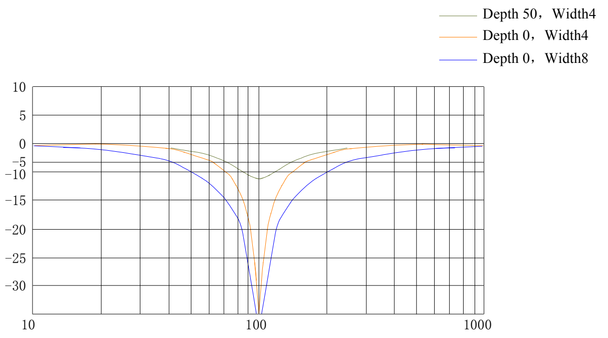


Fig.7-13 Notch filter frequency characteristic

Function code	Name	Setting value	Unit	Function	Setup way	Effective way	Default value
F08.02	Adaptive notch mode selection	0: Adaptive notch is no longer updated 1:1 adaptive notch filter is valid(3rd notch filter) 2: 2 adaptive notch filters are valid (3rd and 4th notch filter) 3: Only test the resonance point, F08.20-F08.21 display 4: Restore 3rd and 4th notch filter to Default value	-	Set the mode of the adaptive notch filter	Run time set	Effective instantly	0
F08.08	1st notch frequency	100～4000	Hz	Set the frequency of the first set of notch filter	Run time set	Effective instantly	4000
F08.09	1st notch width level	0～10	-	Set the width level of the first set of notch filter	Run time set	Effective instantly	2
F08.10	1st notch depth level	0～99	-	Set the attenuation level of the first set of notch filter	Run time set	Effective instantly	0
F08.11	2nd notch frequency	100～4000	Hz	Set the frequency of the second set of notch filter	Run time set	Effective instantly	4000

F08.12	2nd notch width level	0～10	-	Set the width level of the second set of notch filter	Run time set	Effective instantly	2
F08.13	2nd notch depth level	0～99	-	Set the attenuation level of the second set of notch filter	Run time set	Effective instantly	0
F08.14	3rd notch frequency	100～4000	Hz	Set the frequency of the third set of notch filter	Run time set	Effective instantly	4000
F08.15	3rd notch width level	0～10	-	Set the width level of the third set of notch filter	Run time set	Effective instantly	2
F08.16	3rd notch depth level	0～99	-	Set the attenuation level of the third set of notch filter	Run time set	Effective instantly	0
F08.17	4th notch frequency	100～4000	Hz	Set the frequency of the fourth set of notch filter	Run time set	Effective instantly	4000
F08.18	4th notch width level	0～10	-	Set the width level of the fourth set of notch filter	Run time set	Effective instantly	2
F08.19	4th notch depth level	0～9	-	Set the attenuation level of the fourth set of notch filter	Run time set	Effective instantly	0
F08.20	Resonance frequency identification result (frequency)	100～4000	Hz	Resonance frequency identification result when display F08.02=3	-	-	-
F08.21	Resonance frequency identification result (depth level)	0～99	-	Depth identification result of resonance frequency when display F08.02=3	-	-	-

7.6.2 Low frequency resonance suppression

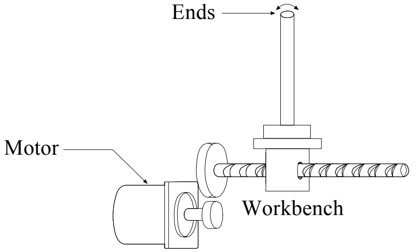


Fig.7-14 Schematic diagram of low frequency resonance

If the end of the mechanical load is long and heavy, the end vibration is likely to occur during an emergency stop, which affects the positioning effect. The frequency of this vibration is generally within 100 Hz, which is called low frequency resonance compared to mechanical resonance frequency of 7.6.1. This vibration can be effectively reduced by the low frequency resonance suppression function.

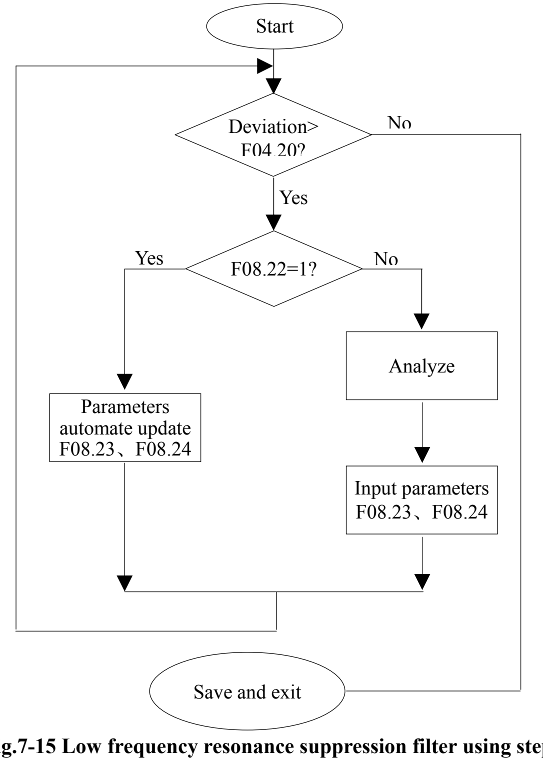


Fig.7-15 Low frequency resonance suppression filter using steps

(1) Set the low frequency resonance suppression mode **[F08.22]**:

The servo drive provides two low frequency resonance suppression methods, and the automatic setting is preferred:

① **[F08.22=1]**, self-setting low frequency resonance frequency and vibration times parameter;

The system runs, and the keyboard interface displays “TUNE4” during the identification process. After the identification is completed, it enters the normal monitoring state. The servo driver automatically detects the frequency and number of low frequency resonances and automatically set **[F08.23]** (low frequency resonance frequency) and **[F08.24]** (low frequency resonance number).

② **[F08.22=0]**, manually set the low frequency resonance frequency and vibration times parameters:

First, use the oscilloscope function of our driver debugging platform to collect the waveform of the position deviation of the motor in the positioning state, calculate the fluctuation frequency of the position deviation, which is the low frequency resonance frequency; or measure the vibration frequency and the number of vibrations by means of an external photoelectric sensing device. Then manually input **[F08.23]** (low frequency resonance frequency), **[F08.24]** (low frequency resonance number).

(2) Observe whether the positional deviation still exceeds **[F04.20]** after using the low-frequency resonance suppression filter:

If so, repeat steps (1) to (2); if not, the effect of low frequency resonance suppression is obtained. Or directly observe whether the mechanical vibration has improved.

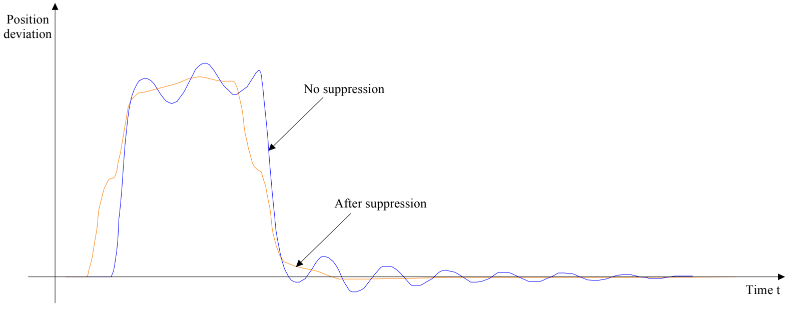


Fig.7-16 Low frequency resonance suppression effect diagram

Function code	Name	Setting value	Unit	Function	Setup way	Effective way	Default value
F08.22	Low frequency resonance suppression mode selection	0：Manual setting 1：Self-turning setting	-	Set the mode of low frequency resonance suppression	Downtime set	Effective instantly	0
F08.23	Low frequency resonance frequency	4.0～100.0	Hz	Set the frequency of the low frequency resonance suppression filter	Downtime set	Effective instantly	100.0
F08.24	Low frequency resonance times	1～15	-	Set the number of low frequency resonance	Downtime set	Effective instantly	2

7.7 Advanced tuning

When the motor driven by the drive is not the servo motor provided by our company or the drive performance is poor, there is over current, overload, running direction error, you can try to further improve drive performance with the motor and encoder self-learning features provided with this drive. When the servo motor is not the servo motor supplied by our company, it is necessary to ensure the following electrical characteristics are correct.

(1) Ensure that the rated voltage of the motor matches the drive and ensure that the rated current of the motor is less than the drive current.

(2) For incremental encoder: ensure that the A, B, Z, U, V, W signals are wired according to the encoder interface signal provided by our company (refer to chapter 4.3 for details). The UVW signal and the ABZ signal cannot be connected incorrectly. For the bus encoder: ensure that the encoder is using the Tamagawa bus serial protocol, and the encoder power and data line signals are wired correctly. Refer to chapter 4.3 for details.

7.7.1 Incremental encoder motor tuning process

Incremental encoder motors (eg 2500 lines encoder motor) follow the steps below.

(1) Connect the power supply cable, the UVW cables of the motor, and the encoder cable.

(2) If the motor is our company servo motor, please confirm the corresponding information inside the motor nameplate are correct to **[F00.03]** and **[F00.21]**. If it is not our servo motor, please determine the motor related parameters from **[F00.04]** to **[F00.12]**according to the motor nameplate, and determine the encoder single-turn accuracy according to the encoder information **[F00.22]**, 2500 line encoder single-turn precision It is 2500*4=10000. The accuracy of 5000 line single circle is 5000*4=20000.

(3) Set **[F12.05=1]**, press SET button to carry out encoder installation information and UVW drive phase sequence self-learning. During the learning process, observe whether the running direction of the motor is counterclockwise (view from the shaft end), if it appears Run clockwise, switch off any two of the UVW drive lines after power off, and repeat the above steps. If the motor runs in the correct direction during the learning process, if the

Er.205 fault occurs during the learning process, the **[F00.25]**parameter can be adjusted. If this parameter is 0, it will be changed to 1, if it is 1, it will be changed to 0. After modifying the **[F00.25]**parameter, reset **[F12.05=1]** to self-learn the encoder installation information.

(4) Set **[F12.05=2 or3]** to self-learn the electrical parameters of the motor. If Er.204 fault occurs during the learning process, please re-confirm the motor parameters **[F00.04]** to **[F00.12]**and restart (4) step. After the self-learning is completed, the system will automatically exit the self-learning process and enter the monitoring interface.

7.7.2 Bus encoder motor tuning process

The bus type encoder motor is operated as follows.

(1) Connect the power supply cable, the UVW cables of the motor, and the encoder cable.

(2) If the motor is our servo motor, please confirm the corresponding information inside the motor nameplate are correct to **[F00.03]** and **[F00.21].**If it is not our servo motor, please confirm according to the motor nameplate **[F00.04]** to **[F00.12]** motor related parameters, according to the encoder information to determine the encoder single-turn accuracy **[F00.22]**, 20-bit bus encoder single-turn accuracy is 2^{20}=1048676, 23-bit is 2^{23}=8388608, and 17-bit is 2^{17}=131072

(3) Set **[F12.06=1]**, press the UP button once, and wait for the system to automatically exit. If there is a fault after the process ends, please power on again.

(4) Set **[F12.05=1]**, press SET button to carry out encoder installation information and UVW drive phase sequence self-learning. During the learning process, observe whether the running direction of the motor is counterclockwise (from the axis end) direction. Run clockwise or Er.205 fault, replace any two of the UVW drive lines after power off, and repeat steps (2) and (3).

(5) Set **[F12.05=2 or 3]** to self-learn the electrical parameters of the motor. If Er.204 fault occurs during the learning process, please re-confirm the motor parameters **[F00.04]** to **[F00.12]** and restart (5) step. After the self-learning is completed, the system will automatically exit the self-learning process and enter the monitoring interface.

Function code	Name	Setting value	Unit	Function	Setup way	Effective way	Default value
F00.03	Motor code	0～83(See the motor selection table for details.)	-	Set corresponding code according to servo motor	Power on again	Downtime set	-
F00.04	Motor rated power	0.01～655.35	KW	Motor determination	Effective instantly	Downtime set	-
F00.05	Motor rated voltage	100～480	V	Motor determination	Effective instantly	Downtime set	-
F00.06	Motor rated current	0.01～655.35	A	Motor determination	Effective instantly	Downtime set	-
F00.07	Motor rated	0.01～655.35	Nm	Motor	Effective	Downtime	-

	torque			determination	instantly	set	
F00.08	Motor max. torque	0.01～655.35	Nm	Motor determination	Effective instantly	Downtime set	-
F00.09	Motor rated rotate speed	100～6000	rpm	Motor determination	Effective instantly	Downtime set	-
F00.10	Motor max. rotate speed	100～6000	rpm	Motor determination	Effective instantly	Downtime set	-
F00.11	Rotor inertia Jm	0.01～655.35	$Kg•cm^2$	Motor determination	Effective instantly	Downtime set	-
F00.12	Pole pairs number of PMSM Np	2～360	Pole pairs	Motor determination	Effective instantly	Downtime set	-
F00.21	Encoder code	0:2500 lines encoder-15 lines encoder 1:2500 lines wires simplified encoder-9 lines encoder 2～4:Reserved 5:17-bit bus absolute value encoding(Tamagawa protocol) 6:20-bit bus absolute value encoding(Tamagawa protocol) 7:23-bit bus absolute value encoding(Tamagawa protocol) 8～15:Reserved	-	Determine the code based on the encoder type	Power on again	Downtime set	-
F00.22	Encoder fine	1000～8388608	P/r	Encoder determination	Effective instantly	Downtime set	-
F00.25	Encoder direction negative	0: invalid 1: reverse Note: valid only for photoelectric encoders		Encoder AB phase inversion	Effective instantly	Downtime set	-
F12.05	Motor parameters self-learning	0: no operation 1: Encoder self-learning---motor UWV power cable phase sequence and EncoderAB phase sequence self-learning, installation angle learning (Z signal and UVW signal) 2: Motor parameter static self-learning 3: Motor parameter rotation self-learning	-	0	Effective instantly	Downtime set	-

		F12.05 is not 0. Press SET button to start identification. In the process of identification, you can press MENU to exit self-learning.					
F12.06	Fixed angle output	After pressing SET, press UP to start, press MENU to exit - internal global variable display	-	-	Effective instantly	Downtime set	-

7.8 Auxiliary rigid adjustment function

When the user adjusts the servo gain of the rigidity level, there is no need for upper computer to give the running command. It only needs to set the **[F12.12]** rigid test auxiliary parameter (you need to determine the appropriate load moment of inertia ratio **[F07.14]** in advance to make the motor follow the command mode generated internally by the drive runs, and the **[F08.01]** rigidity level selection is changed while the motor is running, so that the appropriate rigidity level is determined according to the actual operation of the device.

The specific steps are as follows:

(1) Select the appropriate rigidity test auxiliary parameter setting **[F12.12]**according to the working mode and the actual operation of the equipment：

① If it is speed mode, you can choose 1 or 2 according to the operating conditions or operating limits allowed by the device;

② If it is the position mode, set the number of motor running cycles **[F07.23]** and the running direction selection **[F12.12]** according to the operating conditions or operating limits allowed by the device.

(2) According to the actual operating requirements or operating limits of the equipment, determine the maximum speed of the appropriate running command, acceleration and deceleration time and waiting time (multiplexed inertia identification parameters) and parameter settings;

(3) Enter the **[F12.12]** parameter setting interface, set the value determined in step (1), and then press the “SET” button, the motor will run according to the set operation mode, and the keyboard display content will automatically switch to the servo current rigidity level **[F08.01]**。

(4) The user can observe the actual running effect of the device, and adjust the rigidity level **[F08.01]** through the “Up” and “Down” buttons until the appropriate rigidity level is determined.

(5) After determining the appropriate rigidity level, press the “SET” button to save the current rigidity level **[F08.01]**, and then press the “MENU button” to exit the gain adjustment. If the gain is not set properly and the device vibrates or is noisy, you can quickly exit the gain adjustment by pressing the “MENU button” to make the motor servo OFF.

Function code	Name	Setting value	Unit	Function	Setup way	Effective way	Default value
F12.12	Rigid test auxiliary parameter	0: No operation 1: Forward speed debugging (multiplexing inertia identification parameters) 2: Reverse speed debugging (multiplexing inertia identification parameters) 3: Number of revolutions: F07.23 laps, direction of rotation: forward → reverse 4: Number of revolutions: F07.23 laps, direction of rotation: reverse → forward 5: Number of revolutions: F07.23 laps, direction of rotation: forward → forward 6: Number of revolutions: F07.23 laps, direction of rotation: reverse → reverse	-	Rigid learning	Effective instantly	Downtime set	-
F08.04	Inertia identification max. Speed	50～6000	Rpm	Set the maximum speed of position control	Effective instantly	Run time set	500
F08.05	Acc/dec time when inertia identification	2～2000	Ms	Set the acceleration time of pulse given	Effective instantly	Run time set	125
F08.06	Interval after an inertia identification	20～10000	Ms	Set the waiting time for the position action and the next position action	Effective instantly	Run time set	1000
F07.23	Rigid test running circles	1～100	Rev	Set the number of motor revolutions during the test	Effective instantly	Downtime set	2

8 Description of parameters

8.1 F00 group:Servo motor parameters

F00.00	**Parameter name**	Rated power of servo drive			**Property**	Only read	**Control Mode**	-
	Setting range	0.01～655.35	**Unit**	KW	**Effective time**	-	**Default**	Depends on servo drive type

It displays rated power of servo drive.

F00.01	**Parameter name**	Rated current of servo drive			**Property**	Only read	**Control mode**	-
	Setting range	0.01～655.35	**Unit**	A	**Effective time**	-	**Default**	Depends on servo drive type

It displays rated current of servo drive.

F00.02	**Parameter name**	Rated voltage of servo drive			**Property**	Only read	**Control mode**	-
	Setting range	100～480	**Unit**	V	**Effective time**	-	**Default**	Depends on servo drive type

It displays the rated voltage of servo drive.

F00.03	**Parameter name**	Motor code			**Property**	At stop	**Control mode**	-
	Setting range	0～83	**Unit**	-	**Effective time**	Power-on again	**Default**	Depends on servo drive type

This parameter is used to set the servo motor type controlled by servo drive.ESS200P supports many kinds of servo motors, if setting is wrong, will occurs Er.100(Motor and drive matching fault). For more details, please refer to chapter “2.3.3 (2) Motor rating specifications”.

F00.04	**Parameter name**	Rated power of servo motor			**Property**	At stop	**Control mode**	-
	Setting range	0.01～655.35	**Unit**	KW	**Effective time**	Immediate	**Default**	Depends on motor type

F00.05	**Parameter name**	Rated voltage of servo motor			**Property**	At stop	**Control mode**	-
	Setting range	100～480	**Unit**	V	**Effective time**	Immediate	**Default**	Depends on motor type

F00.06	Parameter name	Rated current of servo motor			Property	At stop	Control mode	-
	Setting range	0.01～655.35	Unit	A	Effective time	Immediate	Default	Depends on motor type

F00.07	Parameter name	Rated torque of servo motor			Property	At stop	Control mode	-
	Setting range	0.01～655.35	Unit	Nm	Effective time	Immediate	Default	Depends on motor type

F00.08	Parameter name	Maximum torque of servo motor			Property	At stop	Control mode	-
	Setting range	0.01～655.35	Unit	Nm	Effective time	Immediate	Default	Depends on motor type

F00.09	Parameter name	Rated rotate speed of servo motor			Property	At stop	Control mode	-
	Setting range	100～6000	Unit	Rpm	Effective time	Immediate	Default	Depends on motor type

F00.10	Parameter name	Maximum rotate speed of servo motor			Property	At stop	Control mode	-
	Setting range	100～6000	Unit	Rpm	Effective time	Immediate	Default	Depends on motor type

If No-load, rated input voltage(220V level is 220V input, 380V level is 380V input), the maximum rotate speed the servo motor could reach to.

F00.11	Parameter name	Rotational inertia Jm			Property	At stop	Control mode	-
	Setting range	0.01～655.35	Unit	$Kgcm^2$	Effective time	Immediate	Default	Depends on motor type

F00.12	Parameter name	Number of pole pairs of PMSM			Property	At stop	Control mode	-
	Setting range	2～360	Unit	Pole-pair	Effective time	Immediate	Default	Depends on motor type

F00.13	Parameter name	Stator resistance			Property	At stop	Control mode	-
	Setting range	0.001～65.535 (motor power is 3KW and higher than 3kw, 0.0001～6.5535）	Unit	Ω	Effective time	Immediate	Default	Depends on motor type

F00.14	Parameter name	Stator inductance Lq			Property	At stop	Control mode	-
	Setting range	0.01～655.35(Motor power is 3KW and higher than 3kw,the precision is 0.001mH）	Unit	mH	Effective time	Immediate	Default	Depends on motor type

F00.15	Parameter name	Stator inductance Ld			Property	At stop	Control mode	-
	Setting range	0.01～655.35（Motor power is 3KW and higher than 3kw,the precision is 0.001mH）	Unit	mH	Effective time	Immediate	Default	Depends on motor type

F00.16	Parameter name	Line back EMF coefficientKe			Property	At stop	Control mode	-
	Setting range	0.01～655.35	Unit	V/Krpm	Effective time	Immediate	Default	Depends on motor type

F00.17	Parameter name	Torque coefficientKt			Property	At stop	Control mode	-
	Setting range	0.01～655.35	Unit	Nm/Arms	Effective time	Immediate	Default	Depends on motor type

The parameters from **[F00.04]** to **[F00.17]** are depended on motor code**[F00.03]**, or depended on motor nameplate parameters.

F00.18～F00.20	Parameter name	Reserved			Property	-	Control mode	-
	Setting range	-	Unit	-	Effective time	-	Default	-

F00.21	Parameter name	Encoder code			Property	At stop	Control mode	-
	Setting range	0～15	Unit	1	Effective time	Power-on again	Default	Depends on servo drive type

0: 2500 line encoder-15 line encoder

1: 2500 line encoder -9 line encoder

2～4: Reserved

5: 17 bits bus communication absolute encoder (Tamagawa aggrement)

6: 20 bits bus communication absolute encoder (Tamagawa aggrement)

7: 23 bits bus communication absolute encoder (Tamagawa aggrement)

8～15: Reserved

F00.22	Parameter name	Encoder single-turn accuracy			Property	At stop	Control mode	-
	Setting range	1000～8388608	Unit	P/r	Effective time	Immediate	Default	Depends on encoder type

F00.24	Parameter name	Electrical angle of signal Z			Property	At stop	Control mode	-
	Setting range	0.0～360.0	Unit	°	Effective time	Immediate	Default	Depends on motor type

F00.25	Parameter name	The reserved encoder direction			Property	At stop	Control mode	-
	Setting range	0～1	Unit	-	Effective time	Immediate	Default	0

0: invalid

1: Valid

F00.26	Parameter name	Absolute code wheel mounting angle			Property	At stop	Control mode	-
	Setting range	0.0～360.0	Unit	°	Effective time	Immediate	Default	Depends on motor type

F00.27	Parameter name	Bus communication delay time			Property	At stop	Control mode	-
	Setting range	0.0～360.0	Unit	us	Effective time	Immediate	Default	Depends on encoder type

F00.28	Parameter name	U、V、W=001 corresponding electrical angle			Property	At stop	Control mode	-
	Setting range	0.0～360.0	Unit	°	Effective time	Immediate	Default	Depends on motor type
F00.29	Parameter name	U、V、W =010 corresponding electrical angle			Property	At stop	Control mode	-
	Setting range	0.0～360.0	Unit	°	Effective time	Immediate	Default	Depends on motor type
F00.30	Parameter name	U、V、W =011 corresponding electrical angle			Property	At stop	Control mode	-
	Setting range	0.0～360.0	Unit	°	Effective time	Immediate	Default	Depends on motor type
F00.31	Parameter name	U、V、W =100 corresponding electrical angle			Property	At stop	Control mode	-
	Setting range	0.0～360.0	Unit	°	Effective time	Immediate	Default	Depends on motor type
F00.32	Parameter name	U、V、W =101 corresponding electrical angle			Property	At stop	Control mode	-
	Setting range	0.0～360.0	Unit	°	Effective time	Immediate	Default	Depends on motor type

F00.33	**Parameter name**	U、V、W =110 corresponding electrical angle			**Property**	At stop	**Control mode**	-
	Setting range	0.0～360.0	**Unit**	°	**Effective time**	Immediate	**Default**	Depends on motor type

8.2 F01 group: Basic control parameters

F01.00	**Parameter name**	Control mode selection			**Property**	At stop	**Control mode**	-
	Setting range	0～5	**Unit**	-	**Effective time**	Immediate	**Default**	0

It sets control mode of the servo drive.

<table>
<tr><th>Value</th><th>Control mode</th><th>Description</th></tr>
<tr><td>0</td><td>Position mode</td><td>For parameter settings in speed mode, refer to 6.2 Speed Control Mode</td></tr>
<tr><td>1</td><td>Speed mode</td><td>For parameter settings in speed mode, refer to 6.3 Speed Control Mode.</td></tr>
<tr><td>2</td><td>Torque mode</td><td>For parameter settings in torque mode, refer to 6.4 Torque Control Mode.</td></tr>
<tr><td>3</td><td>Torque mode↔speed mode</td><td>Set a DI terminal for FunIN.10: M1_SEL (Mode switchover 1) and determine terminal logic.
<table>
<tr><th>M1_SEL Terminal logics</th><th>Control mode</th></tr>
<tr><td>invalid</td><td>Torque mode</td></tr>
<tr><td>valid</td><td>Speed mode</td></tr>
</table></td></tr>
<tr><td>4</td><td>Speed mode↔ positionmode</td><td>Set a DI terminal for FunIN.10: M1_SEL (Mode switchover 1) and determine terminal logic.
<table>
<tr><th>M1_SEL Terminal logics</th><th>Control mode</th></tr>
<tr><td>invalid</td><td>Speed mode</td></tr>
<tr><td>Valid</td><td>Position mode</td></tr>
</table></td></tr>
<tr><td>5</td><td>Torque mode↔position mode</td><td>Set a DI terminal for FunIN.10: M1_SEL (Mode switchover 1) and determine terminal logic.
<table>
<tr><th>M1_SEL Terminal logics</th><th>Control mode</th></tr>
<tr><td>Invalid</td><td>Torque mode</td></tr>
<tr><td>valid</td><td>Position mode</td></tr>
</table></td></tr>
</table>

When [F01.00=3/4/5], please refer to “6.5 Mixed control mode”to set parameters.

F01.01	**Parameter name**	Absolute value system selection			**Property**	At stop	**Control mode**	PST
	Setting range	0～2	**Unit**	1	**Effective time**	Power-on again	**Default**	0

Select the drive absolute position function.

Value	Control mode	Description
0	Incremental position mode	Afterdriving, it is necessary to perform the home position return to confirm the machine origin, and there is no position memory function after the power is turned off.

1	Absolute position linear mode	Applicable to the absolute encoder motor. When the drive is powered off, the encoder backs up the data through the battery. After power-on, the driver passes the absolute position of the encoder in the absolute position of the computer. See “6.6 Absolute Value System Instructions” for details.
2	Reserved	

F01.02	**Parameter name**	Reserved		**Property**	-	**Control mode**	-
	Setting range	-	**Unit** -	**Effective time**	-	**Default**	-

F01.03	**Parameter name**	Servo enable OFF stop mode selection			**Property**	At stop	**Control mode**	PST
	Setting range	0～1	**Unit**	-	**Effective time**	Immediate	**Default**	0

When the servo enable (S-ON) is OFF, set the motor stop mode and state.

Value	Stop mode
0	Coast to stop, keeping de-energized state
1	Emergency stop, keeping de-energized state

The appropriate shutdown method should be set according to the mechanical status and operation requirements.

For the comparison of the stop mode, please refer to "6.1.9 Servo Stop".

F01.04	**Parameter name**	Fault No.3 stop mode selection			**Property**	At stop	**Control mode**	PST
	Setting range	0～1	**Unit**	-	**Effective time**	Immediate	**Default**	0

Set motor stop mode and state after deceleration when the servo drive generates third type fault.

Value	Stop mode
0	Coast to stop, keeping de-energized state
1	Emergency stop, keeping de-energized state

For details of fault, please refer to "Chapter 9 Troubleshooting".

For the comparison of stop mode, please refer to “chapter 6.1.9 Servo Stop".

F01.05	**Parameter name**	Stop mode at limit switch signal			**Property**	At stop	**Control mode**	PST
	Setting range	0～2	**Unit**	-	**Effective time**	Immediate	**Default**	0

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

Value	Stop mode
0	Coast to stop, keeping de-energized state
1	Emergency stop, keeping position locking state
2	Emergency stop, keeping de-energized state

When servo motor drives vertical axis, you should set **[F01.05=1]** to make motor axis in position locking state after the limit switch signal is active to ensure safety.For comparison of stop modes, refer to “chapter 6.1.9 Servo stop”.

F01.06	**Parameter name**	Whether the loose brake control is effective			**Property**	At stop	**Control mode**	PST
	Setting range	0～1	**Unit**	-	**Effective time**	Immediate	**Default**	0

This parameter needs to be set to 1 when the selected servo motor has a brake.

F01.07	**Parameter name**	The delay time from release to starting receiving input signal			**Property**	At stop	**Control mode**	PST
	Setting range	0～1000	**Unit**	ms	**Effective time**	Immediate	**Default**	250

After the servo drive is powered on, set the delay time from the servo drive starts to receive the input command to the brake output (BK) is turned ON. During the time of **[F01.07]**, the servo does not receive the position/speed/torque command.

Please refer to "6.1.6 Brake Settings" for the timing diagram of the motor brake.

F01.08	**Parameter name**	The delay time from braking to motor no power delay			**Property**	At stop	**Control mode**	PST
	Setting range	1～1000	**Unit**	ms	**Effective time**	Immediate	**Default**	150

Set the delay time from the motor entering the non-energized state to the brake output (BK) is OFF. This parameter must match the deceleration stop mode. This function does not work if set to free stop or if a serious fault occurs.

Please refer to "6.1.6 Brake Settings" for the "Motor Brake Timing Diagram".

F01.09	**Parameter name**	Speed threshold when motor brake			**Property**	At stop	**Control mode**	PST
	Setting range	0～3000	**Unit**	Rpm	**Effective time**	Immediate	**Default**	30

Set the motor speed threshold when the brake output (BK) is set to OFF and the motor is in the rotary state.

Please refer to "6.1.6 Brake Settings" for the "Motor Brake Timing Diagram".

F01.10	**Parameter name**	Reserved			**Property**	-	**Control mode**	-
	Setting range	-	**Unit**	-	**Effective time**	-	**Default**	-

F01.11	**Parameter name**	The minimum value of brake resistanceallowed by the servo drive			**Property**	At display	**Control mode**	-
	Setting range	1～65535	**Unit**	Ω	**Effective time**	-	**Default**	Depends on type

It displays the minimum value of rake resistance.When external braking resistor is used, the selected resistance should not be less than this value. Otherwise,it will occurs A-403 alarm (external braking resistor too small alarm) or even damage the servo drive.

F01.12	**Parameter name**	Power of built-in braking resistor			**Property**	At display	**Control mode**	-
	Setting range	0～65535	**Unit**	W	**Effective time**	-	**Default**	Depends on type

Checking the built-in braking resistor power of servo drive. It matched with the servo drive type, can not be changed.

F01.13	**Parameter name**	Resistance of built-in braking resistor			**Property**	At display	**Control mode**	-
	Setting range	1～65535	**Unit**	Ω	**Effective time**	-	**Default**	Depends on type

Check the built-in braking resistor resistance of a certain model servo drive, which can't be changed, only related to the servo drive model.

If the maximum braking energy that the bus capacitor can absorb is less than the maximum braking energy calculated value,a braking resistor is required.

When using the built-in braking resistor, connect the terminals "RB" and "B" directly with short wires.

The 65535 represents no built-in braking resistor, and there is no built-in braking resistor for servo drives of 400W or less.

F01.14	**Parameter name**	Built-in brake voltage			**Property**	During running	**Control mode**	-
	Setting range	300.0～1100.0	**Unit**	V	**Effective time**	Immediate	**Default**	Depends on type

Set the brake voltage point of the built-in energy brake, and adjust this parameter to meet the braking requirements.

The 220V rating is: 380.0V; the 380V rating is: 690.0V.

F01.15	**Parameter name**	Resistance heat dissipation coefficient			**Property**	During running	**Control mode**	-
	Setting range	10～100	**Unit**	%	**Effective time**	Immediate	**Default**	30

When setting the braking resistor, the heat dissipation coefficient of the resistor is valid for both the built-in and external braking resistors.

Set **[F01.15]** (resistance heat dissipation coefficient) according to the actual heat dissipation condition of the resistor.

Note

(1) Generally, the setting of **[F01.15]** does not exceed 30% for naturally ventilated.
(2) The setting of **[F01.15]** does not exceed 50% for forcible cooling.

F01.16	Parameter name	Braking resistor type			Property	During running	Control mode	-
	Setting range	0～2	Unit	-	Effective time	Immediate	Default	0

It sets the mode of absorbing and releasing braking energy.

Value	Mode of Absorbing and Releasing Braking Energy	Description
0	Built-in	It is used when calculated value of maximum braking energy > maximum braking energy absorbed by capacitors and calculated value of braking power ≤ built-in regenerative resistor power
1	Using external braking resistor	It is used when calculated value of maximum braking energy > maximum braking energy absorbed by capacitors and calculated value of braking power > built-in braking resistor power
2	No braking resistor, rely on capacitance absorption	It is used when calculated value of maximum braking energy ≤ maximum braking energy absorbed by capacitors

Please refer to "6.1.7 Brake Settings" to select the appropriate braking method.

F01.17	Parameter name	Power of external braking resistor			Property	During running	Control mode	-
	Setting range	0～65535	Unit	W	Effective time	Immediate	Default	0

It sets the power of the external braking resistor of a certain type of drive.

Note: The external braking resistor power **[F01.17]** cannot be less than the calculated value of braking power .

F01.18	Parameter name	Resistance of external braking resistor			Property	During running	Control mode	-
	Setting range	1～65535	Unit	Ω	Effective time	Immediate	Default	0

It sets the resistance of external braking resistor of a certain type of drive.

When calculated value of maximum braking energy > maximum braking energy absorbed by capacitors and calculated value of braking power > built-in braking resistor power, need to use external braking resistor.

When the setting of **[F01.17]** is too large, Er.400 (Main circuit overvoltage) will be detected;when the value of **[F01.17]**is less than the value of**[F01.11]**, AL.403 will occur (the external braking resistor is too small) and will damage the drive if you continue to use it. The external braking resistor and the built-in braking resistor cannot be used at the same time! When using an external braking resistor, remove the short wiring between the terminals "RB" and "B" and connect the two ends of the braking resistor to "(+)" and "B" respectively.

F01.19	Parameter name	Parameter operation control			Property	At stop	Control mode	-
	Setting range	0～2	Unit	Ω	Effective time	Immediate	Default	2

Value	Operation	Description
0	All parameters are allowed to be modified	-
1	Except for this parameter, all other parameters are not allowed to be modified.	-
2	Except for the F00 group parameters, all other parameters are allowed to be modified.	-

F01.20	**Parameter name**	Parameter initialization			**Property**	At stop	**Control mode**	-
	Setting range	0～5	**Unit**	-	**Effective time**	Power-on again	**Default**	0

It is used to restore parameter default setting or clear fault records.

Value	Operation	Description
0	No operation	-
1	Except the motor parameters, all other parameters are restored to the factory defaults.	Does not include F00 and F17 parameters
2	The fault record is restored to the factory value.	Only F17 group
3	All parameters are restored to factory defaults	Does not include group F00

If necessary, please use our driver debugging platform software or parameter copyer to back up and download the parameters except **[F00 Group]**.

F01.21	**Parameter name**	Content of monitor status C-0			**Property**	During running	**Control mode**	-
	Setting range	0～66	**Unit**	-	**Effective time**	Immediate	**Default**	0
F01.22	**Parameter name**	Content of monitor status C-1			**Property**	During running	**Control mode**	-
	Setting range	0～66	**Unit**	-	**Effective time**	Immediate	**Default**	3
F01.23	**Parameter name**	Content of monitor status C-2			**Property**	During running	**Control mode**	-
	Setting range	0～66	**Unit**	-	**Effective time**	Immediate	**Default**	4
F01.24	**Parameter name**	Content of monitor status C-3			**Property**	During running	**Control mode**	-
	Setting range	0～66	**Unit**	-	**Effective time**	Immediate	**Default**	5
F01.25	**Parameter name**	Content of monitor status C-4			**Property**	During running	**Control mode**	-
	Setting range	0～66	**Unit**	-	**Effective time**	Immediate	**Default**	14
F01.26	**Parameter name**	Content of monitor status C-5			**Property**	During running	**Control mode**	-
	Setting range	0～66	**Unit**	-	**Effective time**	Immediate	**Default**	50

Above parameters decide the display of servo drive LED digital tube under monitor mode.0~66 corresponds with **[F10.00]~[F10.66]**.

F01.27	Parameter name	Panel display refresh rate			Property	During running	Control mode	-
	Setting range	1～20	Unit	10ms	Effective time	Immediate	Default	4

It is used to improve the display effect of the servo drive LED digital tube. The smaller the parameter, the faster the response.

F01.28	Parameter name	Bus voltage adjustment factor			Property	During running	Control mode	-
	Setting range	0.900～1.100	Unit	-	Effective time	Immediate	Default	1.000

The bus voltage can be adjusted by this parameter to make the drive bus voltage detection match the actual.

F01.29	Parameter name	Encryption time			Property	During running	Control mode	-
	Setting range	0～65535	Unit	H	Effective time	Immediate	Default	0

When the value of **[F01.29>1]**, the encryption is valid. When the drive running time **[F10.19]** exceeds the time defined by **[F01.29]**, the drive will stop according to the set stop mode, and the keyboard display A-408. Drive can start again only after decrypted.

F01.30	Parameter name	Cooling fan control selection			Property	During running	Control mode	-
	Setting range	0～2	Unit	-	Effective time	Immediate	Default	0

Value	Cooling fan control selection	Description
0	Smart fan	The drive automatically controls the fan to start and stop based on the detected temperature and drive status.
1	Always running after power-on	It runs continuously after power-on and can be used when the ambient temperature is high.
2	Fan is forbidden to run	Automatically run when the temperature is greater than 75degrees

F01.31	Parameter name	LED warning display selection			Property	At stop	Control mode	PST
	Setting range	0～1	Unit	-	Effective time	Immediate	Default	0

Value	Stop mode	Description
0	Immediately output a warning message	When a warning occurs, the panel displays the warning code in real time.
1	Do not output warning messages	The panel only displays Type 1 to Type 3 faults and does not display Type 4 warnings. When theType 4 of alarm information occurs, the alarm information is not stored in the F17 group

For details of the Type 4 warning, please refer to "Chapter 9 Troubleshooting".

F01.33	Parameter name	Fault reset selection			Property	During running	Control mode	PST
	Setting range	0～1	Unit	-	Effective time	Immediate	Default	0

Value	Fault reset selection	Remark
0	Fault reset when servo enable is invalid	-
1	When the servo enable is invalid and valid, it can be reset.	-

8.3 Group F02: terminal input parameters

F02.00	Parameter name	DI source selection			Property	During running	Control mode	-
	Setting range	0～FF	Unit	-	Effective time	Immediate	Default	0

F02.00 valid bit	Function name
Bit0	0：DI1 status is depended on DI1 1：DI1 status is depended on the Bit0 of F20.00
Bit1	0：DI2 status is depended on DI2 1：DI2 status is depended on the Bit1 of F20.00
Bit2	0：DI3 status is depended on DI3 1：DI3 status is depended on the Bit2 of F20.00
Bit3	0：DI4 status is depended on DI4 1：DI4 status is depended on the Bit3 of F20.00
Bit4	0：DI5 status is depended on DI5 1：DI5 status is depended on the Bit4 of F20.00
Bit5	0：DI6 status is depended on DI6 1：DI6 status is depended on the Bit5 of F20.00
Bit6	0：DI7 status is depended on DI7 1：DI7 status is depended on the Bit6 of F20.00
Bit7	0：DI8 status is depended on DI8 1：DI8 status is depended on the Bit7 of F20.00

F02.01	Parameter name	DI1 terminal filter time			Property	During running	Control mode	-
	Setting range	0～50	Unit	125us	Effective time	Immediate	Default	8

By setting the terminal filtering time of DI1, the anti-interference ability of the corresponding terminal is improved, but the longer the filtering time, the slower the response.

F02.02	Parameter name	DI1 terminal function selection			Property	During running	Control mode	-
	Setting range	0～63	Unit	-	Effective time	Immediate	Default	1

Set the DI function corresponding to the DI1 terminal.

For the DI function, please refer to "DID0 Basic Function Definition".

ON（servo system） should be distributed. Otherwise, the servo drive cannot work，DI1 the default assignment isFunIN.1：S-ON.

Please refer to the table below for parameter value setting.

Value	DI terminal function	Value	DI terminal function
0	Do not distribute DI function	20	PosStep(enable step amplitude)
1	S-ON (servo enable)	21	Reserved
2	ALM-RST(fault and warning reset)	22	Reserved
3	GAIN-SEL(gain switch)	23	Reserved
4	CMD-SEL(main and auxiliary operation command switching)	24	GEAR_SEL(electronic gear selection)
5	DIR-SEL(multi-segment running command direction selection)	25	ToqDirSel (torque command direction setting)
6	CMD1(multi-segment operation command switching1)	26	SpdDirSel (speed command direction setting)
7	CMD2(multi-segment operation command switching2)	27	PosDirSel (position command direction setting)
8	CMD3(multi-segment operation command switching3)	28	PosInSen (multi-segment position command enable)
9	CMD4(multi-segment operation command switching4)	29	XintFree (interrupt fixed length release)
10	M1-SEL(mode switching1)	30	HomeSwitcF (origin switch)
11	Out-Fault (external device fault input)	31	FomingStart (origin return enable)
12	ZCLAMP(zero fixed enable)	32	XintInFibit (interrupt fixed length prohibition)
13	INFIBIT(position instruction prohibited)	33	EmergencyStop (emergency stop)
14	P-OT(positive overtravel switch)	34	ClrPosErr(clear position deviation)
15	N-OT(reverse overtravel switch)	35	PulseInFibit(pulse command prohibition)
16	P-CL(positive external torque limit)	36	Plc_Stop（simple PLC pause）
17	N-CL(negative external torque limit)	37	Plc_Reset （simple PLC status reset）
18	JOGCMD+(positive jog)	38	XIntScale（interrupt fixed length trigger）
19	JOGCMD-(reverse jog)	-	-

Note: [F03.02] Do not set a value not in the above table.

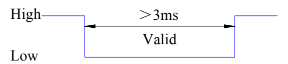
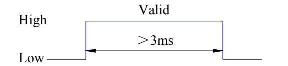
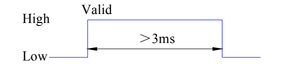
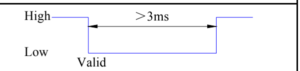
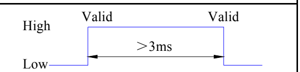
Do not cancel the DI function assignment after assigned a DI function and set the DI logic to valid.Otherwise the DI function will remain valid! DI1~DI7 belong to ordinary DI, and the input signal width should be greater than 1ms. DI8 is a fast DI and the input signal width should be greater than 0.25ms. The DI signal in the oscilloscope of the universal drive debugging platform is the signal after filtering (the normal DI filter time constant is 1ms, the fast DI filter time constant is 0.25ms), and the signal whose width is smaller than the filter time constant is not displayed. When using the interrupt fixed length function, try to use DI8 as the interrupt fixed length trigger switch to improve the response speed.

F02.03	**Parameter name**	DI1 terminal logic selection			**Property**	During running	**Control mode**	-
	Setting range	0～4	**Unit**	-	**Effective time**	Immediate	**Default**	0

Set the level logic of the hardware DI1 terminal to make the DI function selected by

DI1 valid.

Please set the effective level logic correctly according to the host computer and peripheral circuits. For the input signal width, please refer to the following table.

Value	DI terminal logic when DI function is active	Description
0	Low level	
1	High level	
2	Rising edge	
3	Falling edge	
4	Rising edge and falling edge	

When the low-speed DI is assigned to the servo enable (S-ON) function, the effective signal width must be greater than the defined time of **[F02.01]** +1ms.

F02.04	**Parameter name**	DI2 terminal filter time			**Property**	During running	**Control mode**	-
	Setting range	0～50	**Unit**	125us	**Effective time**	Immediate	**Default**	8

F02.05	**Parameter name**	DI2 terminal function selection			**Property**	During running	**Control mode**	-
	Setting range	0～63	**Unit**	-	**Effective time**	Immediate	**Default**	14

F02.06	**Parameter name**	DI2 terminal logic selection			**Property**	During running	**Control mode**	-
	Setting range	0～4	**Unit**	-	**Effective time**	Immediate	**Default**	0

F02.07	**Parameter name**	DI3 terminal filter time			**Property**	During running	**Control mode**	-
	Setting range	0～50	**Unit**	125us	**Effective time**	Immediate	**Default**	8

F02.08	**Parameter name**	DI3 terminal function selection			**Property**	During running	**Control mode**	-
	Setting range	0～63	**Unit**	-	**Effective time**	Immediate	**Default**	15

F02.09	**Parameter name**	DI3 terminal logic selection			**Property**	During running	**Control mode**	-
	Setting range	0～4	**Unit**	-	**Effective time**	Immediate	**Default**	0

F02.10	**Parameter name**	DI4 terminal filter time			**Property**	During running	**Control mode**	-
	Setting range	0～50	**Unit**	125us	**Effective time**	Immediate	**Default**	8

F02.11	**Parameter name**	DI4 terminal function selection			**Property**	During running	**Control mode**	-
	Setting range	0～63	**Unit**	-	**Effective time**	Immediate	**Default**	13

F02.12	**Parameter name**	DI4 terminal logic selection			**Property**	During running	**Control mode**	-
	Setting range	0～4	**Unit**	-	**Effective time**	Immediate	**Default**	0

F02.13	**Parameter name**	DI5 terminal filter time			**Property**	During running	**Control mode**	-
	Setting range	0～50	**Unit**	125us	**Effective time**	Immediate	**Default**	8

F02.14	**Parameter name**	DI5 terminal function selection			**Property**	During running	**Control mode**	-
	Setting range	0～63	**Unit**	-	**Effective time**	Immediate	**Default**	2

F02.15	**Parameter name**	DI5 terminal logic selection			**Property**	During running	**Control mode**	-
	Setting range	0～4	**Unit**	-	**Effective time**	Immediate	**Default**	0

F02.16	**Parameter name**	DI6 terminal filter time			**Property**	During running	**Control mode**	-
	Setting range	0～50	**Unit**	125us	**Effective time**	Immediate	**Default**	8

F02.17	**Parameter name**	DI6 terminal function selection			**Property**	During running	**Control mode**	-
	Setting range	0～63	**Unit**	-	**Effective time**	Immediate	**Default**	12

F02.18	**Parameter**	DI6 terminal logic selection	**Property**	During	**Control**	-

	name					running	**mode**	
	Setting range	0～4	**Unit**	-	**Effective time**	Immediate	**Default**	0

F02.19	**Parameter name**	DI7 terminal filter time			**Property**	During running	**Control mode**	-
	Setting range	0～50	**Unit**	125us	**Effective time**	Immediate	**Default**	8

F02.20	**Parameter name**	DI7 terminal function selection			**Property**	During running	**Control mode**	-
	Setting range	0～63	**Unit**	-	**Effective time**	Immediate	**Default**	31

F02.21	**Parameter name**	DI7 terminal logic selection			**Property**	During running	**Control mode**	-
	Setting range	0～4	**Unit**	-	**Effective time**	Immediate	**Default**	0

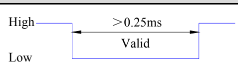
F02.22	**Parameter name**	DI8 terminal filter time			**Property**	During running	**Control mode**	-
	Setting range	0～50	**Unit**	125us	**Effective time**	Immediate	**Default**	2

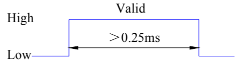
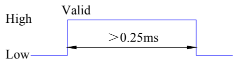
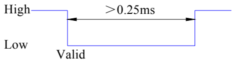
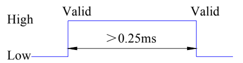
F02.23	**Parameter name**	DI8 terminal function selection			**Property**	During running	**Control mode**	-
	Setting range	0～63	**Unit**	-	**Effective time**	Immediate	**Default**	0

F02.24	**Parameter name**	DI8 terminal logic selection			**Property**	During running	**Control mode**	-
	Setting range	0～4	**Unit**	-	**Effective time**	Immediate	**Default**	0

Set level logic of the hardware DI8 terminal to make the DI function selected by DI8 valid.

DI8 is fast DI and the input signal width should be greater than 0.25ms. Please set the effective level logic correctly according to the host computer and peripheral circuits. For the input signal width, please refer to the following table.

Value	**DI terminal logic when DI function is active**	**Description**
0	Low level	

1	High level	
2	Rising edge	
3	Falling edge	
4	Rising edge and falling edge	

F02.25	**Parameter name**	AI1 filter time constant			**Property**	During running	**Control mode**	-
	Setting range	0～655.35	**Unit**	ms	**Effective time**	Immediate	**Default**	2.00

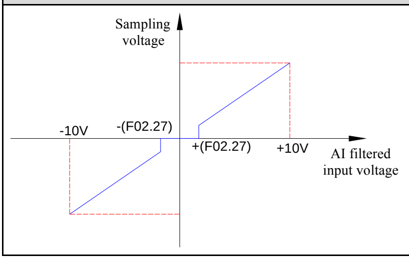
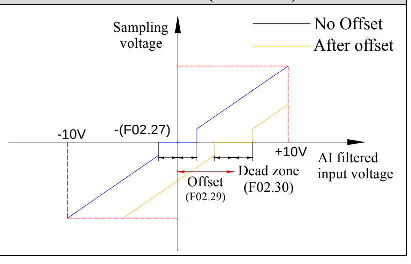
Set the software filter time constant for the AI1 input voltage signal. By setting **[F02.25]**, motor command fluctuations due to unstable analog input voltage can be prevented, and motor malfunction caused by interference signals can be reduced. The filtering function has no elimination or suppression of zero drift and dead zone.

F02.26	**Parameter name**	AI1 bias			**Property**	During running	**Control mode**	-
	Setting range	-5000～5000	**Unit**	mV	**Effective time**	Immediate	**Default**	0

It sets the AI1 actual input the voltage when the driver sampling voltage value is 0 after zero drift correction.

F02.27	**Parameter name**	AI1dead zone			**Property**	During running	**Control mode**	-
	Setting range	0～1000.0	**Unit**	mV	**Effective time**	Immediate	**Default**	10.0

It sets the AI1 input voltage interval when the drive sampling voltage value is 0.

Relationship Between Sampling Voltage and AI Input Voltage after Filter	
No offset	**With offset (offset > 0)**
	

If sampling voltage is larger than the value defined by **[F09.07]**(default 12.00V) Er.309 (AD sampling overvoltage) will occur.

In torque control, if the torque reference source is analog voltage, refer to "6.4.1" torque Reference Input Setting for details on the setting of AI1.

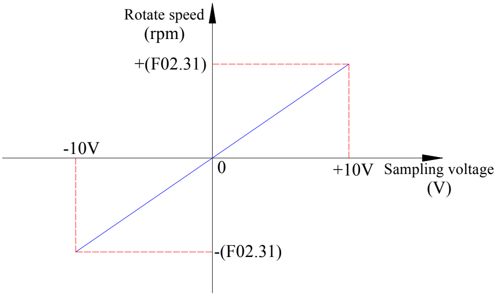
F02.28	**Parameter name**	AI2 filter time constant			**Property**	During running	**Control mode**	-
	Setting range	0～655.35	**Unit**	ms	**Effective time**	Immediate	**Default**	2.00

F02.29	**Parameter name**	AI2 bias			**Property**	During running	**Control mode**	-
	Setting range	-5000～5000	**Unit**	mV	**Effective time**	Immediate	**Default**	0

F02.30	**Parameter name**	AI2 dead zone			**Property**	During running	**Control mode**	-
	Setting range	0～1000.0	**Unit**	mV	**Effective time**	Immediate	**Default**	10.0

F02.31	**Parameter name**	Speed corresponding to 10 V			**Property**	During running	**Control mode**	-
	Setting range	0～6000	**Unit**	Rpm	**Effective time**	Immediate	**Default**	3000

It sets corresponding motor speed when sampling voltage is 10 V.



$$Given\ \ speed\ \ value = \frac{Sampling\ \ voltage}{10} \times (F02.31)$$

When speed feedforward is used and feedforward source is AI1 or AI2,**[F07.15=1 or 2]**;

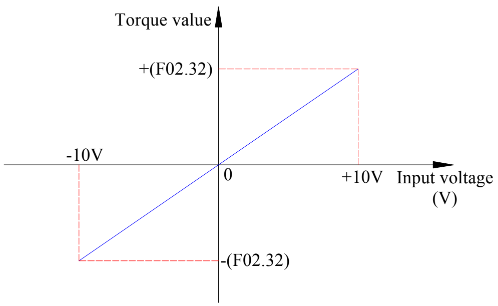
When speed reference source is AI in speed control,**[F05.00/F05.01=1 or 2]**;

When speed limit source is AI in torque control,**[F06.13/F06.14=1 or 2].**

F02.32	Parameter name	Torque corresponding to 10 V			Property	During running	Control mode	-
	Setting range	1.00～8.00	Unit	Times	Effective time	Immediate	Default	1.00

It sets the torque level corresponding to sampling voltage 10 V.

The torque value is expressed as a multiple of the rated torque of the motor:1.00 time indicates one time of rated motor torque.



$$Given\ \ torque\ \ value = \frac{Sampling\ \ voltage}{10} \times (F02.32)$$

When torque reference source is AI **[F06.00/F06.01=1 or 2]** in speed control;

When torque limit source is AI **[F06.05=1 or 2]** in torque control.

8.4 F03 Group:Output terminal parameters

F03.00	Parameter name	DO1 terminal function selection			Property	During running	Control mode	-
	Setting range	0～31	Unit	-	Effective time	Immediate	Default	1

It sets DO1 for the required DO function.For details of DO functions, refer to “DI/DO Function Definitions”.

The DO functions are described in the following table:

Value	DO function	Value	DO function
0	No function	10	WARN: Warning output
1	S-RDY: Servo ready	11	ALM: Fault output
2	TGON: Motor rotation output	12	Xintcoin: Position change on fly completed
3	ZERO: Zero speed signal	13	HomeAttain: Home attaining output
4	V-CMP: Speed consistent	14	ElecHomeAttain: Electrical home attaining output
5	COIN: Positioning completed	15	ToqReacF: Torque reached
6	NEAR: Positioning near	16	V-Arr: Speed reached
7	C-LT: Torque limit	17	DB: DB braking output

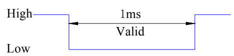
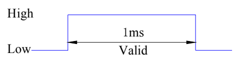
8	V-LT: Speed limit	18	CmdOk: Internal reference output
9	BK: Brake output	-	-

Set **[F03.00]**to the value recommended in the preceding table. Do not set other value. The same DO function can be assigned to different DO terminals.

F03.01	**Parameter name**	DO1 logic selection			**Property**	During running	**Control mode**	-
	Setting range	0～1	**Unit**	-	**Effective time**	Immediate	**Default**	0

It sets the DO1 logic when DO function allocated to DO1 is enabled.

DO1 to DO5 are low-speed DO terminals and the output signal width is 1 ms at minimum. The host computer must have correct design and ensure that valid DO logic change is received.

Value	DO1 Logic when DO1 Function Enabled	Transistor State	Remark
0	Low level	ON	
1	High level	OFF	

View the setting of **[F03.10:DO resource]** before receiving DO logic change to check whether DO output level is determined by the drive status or communication.

F03.02	**Parameter name**	DO2 function selection			**Property**	During running	**Control mode**	-
	Setting range	0～31	**Unit**	-	**Effective time**	Immediate	**Default**	5

F03.03	**Parameter name**	DO2 logic selection			**Property**	During running	**Control mode**	-
	Setting range	0～1	**Unit**	-	**Effective time**	Immediate	**Default**	0

F03.04	**Parameter name**	DO3 function selection			**Property**	During running	**Control mode**	-
	Setting range	0～31	**Unit**	-	**Effective time**	Immediate	**Default**	3

F03.05	**Parameter name**	DO3 logic selection			**Property**	During running	**Control mode**	-
	Setting range	0～1	**Unit**	-	**Effective time**	Immediate	**Default**	0

F03.06	**Parameter name**	DO4 function selection			**Property**	During running	**Control mode**	-

	Setting range	0～31	**Unit**	-	**Effective time**	Immediate	**Default**	11

F03.07	**Parameter name**	DO4 logic selection			**Property**	During running	**Control mode**	-
	Setting range	0～1	**Unit**	-	**Effective time**	Immediate	**Default**	0

F03.08	**Parameter name**	DO5 function selection			**Property**	During running	**Control mode**	-
	Setting range	0～31	**Unit**	-	**Effective time**	Immediate	**Default**	13

F03.09	**Parameter name**	DO5 logic selection			**Property**	During running	**Control mode**	-
	Setting range	0～1	**Unit**	-	**Effective time**	Immediate	**Default**	0

F03.10	**Parameter name**	DO source selection			**Property**	During running	**Control mode**	-
	Setting range	0～31	**Unit**	-	**Effective time**	Immediate	**Default**	0

It sets whether the logic of DO terminals is determined by the drive status or communication.

[F03.10] is displayed in decimal on the keypad. After converting to binary,

①Bit(n) = 0 in **[F03.10]** indicates that DO (n+1) logic is determined by the drive status.

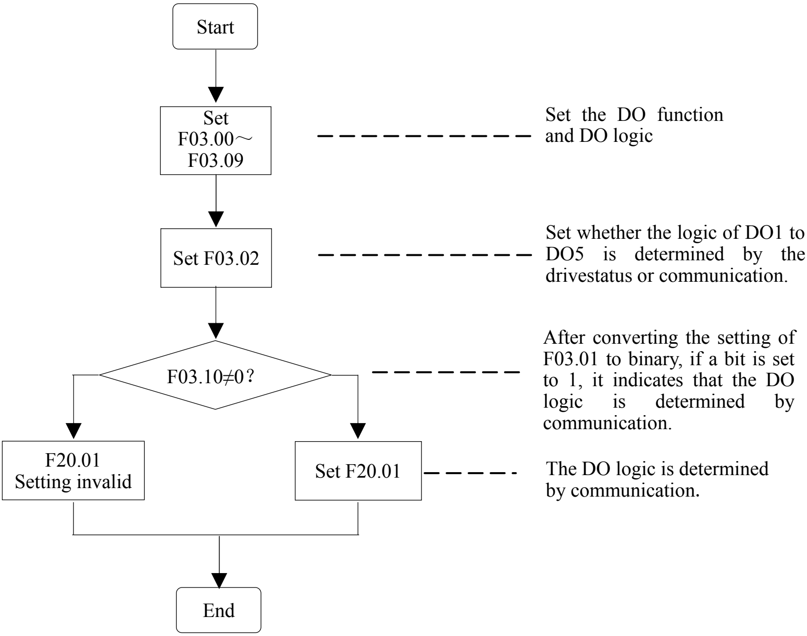
②Bit(n) = 1 in **[F03.10]** indicates that DO(n+1) logic is determined by communication **[F20.01]**.

Value （Decimal）	**Value (Binary) DO logic determined by**					**DO logic determined by**	
	Bit4	**Bit3**	**Bit2**	**Bit1**	**Bit0**	**Drive Status**	**Communication (F20.01) setting**
0	0	0	0	0	0	DO1～DO5	No
1	0	0	0	0	1	DO2～DO5	DO1
…	…	…	…	…	…	…	…
31	1	1	1	1	1	No	DO1～DO5

Please do not set any other value to **[F20.01]** except recommended value in the preceding table.

Be cautious of determining logic of the DO terminal set for function FunOUT.9:BK by communication

Use DO according to the following procedure.



Note

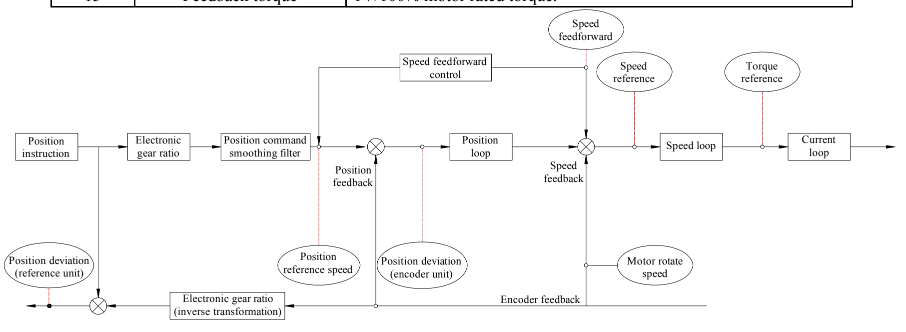
(1) **[F20.01]** is invisible on the keypad and can only be modified via communication. Bit(n) = 1 in **[F20.01]** indicates that DO(n+1) logic is valid. Bit(n) = 0 in **[F20.01]** indicates that DO(n+1) logic is invalid.
(2) The DO output state can be read via monitoring parameter, please refer to **[F10.06]** more for details.

F03.11	**Parameter name**	AO1 signal selection			**Property**	During running	**Control mode**	-
	Setting range	0～15	**Unit**	-	**Effective time**	Immediate	**Default**	0

It sets the terminal 1 (AO1) output signal.

Value	AO1 signal	Description
0	Motor speed (1V/1000rpm)	When actual motor speed is 1000 RPM, the AO1 output voltage in 1 V in theory.
1	Speed reference (1V/1000rpm)	The motor speed reference indicates the speed loop input reference, including: ①Position loop output in position control ②Speed reference in speed control When speed reference is 1000 RPM, AO1 output voltage.

2	Torque reference (1 V/1 time of rated motor torque)	Motor torque reference, including: ①Speed loop output in position or speed control ②Torque reference in torque control When torque reference is one time of rated motor torque, AO1 output voltage is 1 V in theory.
3	Position deviation (0.05 V/1 reference unit)	Position deviation without electronic gear ratio When position deviation is one reference unit, AO1 output voltage is 0.05 V in theory.
4	Position deviation (0.05 V/1 encoder unit)	Position deviation with electronic gear ratio When position deviation is one encoder unit, AO1 output voltage is 0.05 V in theory.
5	Position reference speed (1V/1000 RPM)	It indicates the motor speed corresponding to the position reference output by each position loop cyclically in position control. When speed reference is 1000 RPM, AO1 output voltage in 1 V in theory.
6	Positioning completed	Positioning completed (COIN) signal Active: AO1 output voltage is 5 V. Inactive: AO1 output voltage is 0 V.
7	Speed feedforward （1V/1000rpm）	In position control, the output signal of speed feedforward control corresponds to some speed reference sources. When speed reference of speed feedforward control output is 1000 RPM, AO1 output voltage is 1 V in theory.
8	AI1 voltage	AI1 sampling voltage
9	AI2 voltage	AI2 sampling voltage
10	Output current1	0～4 times of motor rated current
11	Output current2	0～4 times of drive rated current
12	The output voltage	0～1.2 times motor rated voltage
13	Busbar voltage	0～1.5 times of rated busbar voltage
14	Communication given	Determined by F20.05.
15	Feedback torque	1V/100% motor rated torque.



F03.12	**Parameter name**	AO1 filter time			**Property**	During running	**Control mode**	-
	Setting range	0～655.35	**Unit**	ms	**Effective time**	Immediate	**Default**	0

It sets the filter time of AO1.

F03.13	**Parameter name**	AO1 bias voltage			**Property**	During running	**Control mode**	-
	Setting range	-10000～10000	**Unit**	mV	**Effective time**	Immediate	**Default**	0

It sets the AO1 actually outputs the voltage value after being biased when the theoretical output voltage is set to 0V.

F03.14	**Parameter name**	AO1 times			**Property**	During running	**Control mode**	-
	Setting range	-99.99～99.99	**Unit**	Times	**Effective time**	Immediate	**Default**	1.00

It sets AO1 actually outputs the voltage value after amplification when the he theoretical output voltage is set to 1V.

Take **[F03.11=0]** (AO1 output signal is the motor speed) as an example:

When the pre-designed motor speed x varies between ±3000 rpm, the AO1 output voltage ranges from 0 to 5000 mV, then:

$$\begin{cases} -3000xk+b=0 \\ 3000xk+b=5000 \end{cases}$$

In the preceding formula, k=0.83，b=2500，Thus F03.13=2500(mV)，F03.14=0.83（time).

F03.15	**Parameter name**	AO2signal selection			**Property**	During running	**Control mode**	-
	Setting range	0～15	**Unit**	-	**Effective time**	Immediate	**Default**	0

F03.16	**Parameter name**	AO2 filter time			**Property**	During running	**Control mode**	-
	Setting range	0～655.35	**Unit**	ms	**Effective time**	Immediate	**Default**	0

F03.17	**Parameter name**	AO2 bias voltage			**Property**	During running	**Control mode**	-
	Setting range	-10000～10000	**Unit**	mV	**Effective time**	Immediate	**Default**	0

F03.18	**Parameter name**	AO2multiplying factor			**Property**	During running	**Control mode**	-
	Setting range	-99.99～99.99	**Unit**	times	**Effective time**	Immediate	**Default**	1.00

8.5 F04 Group:Position control parameters

F04.00	**Parameter name**	Position reference source			**Property**	At stop	**Control mode**	P
	Setting range	0～2	**Unit**	-	**Effective time**	Immediate	**Default**	0

It selects the position reference source in position control.

Value	Reference source	Reference acquisition method
0	Pulse input	The host computer or other pulse generating device generates a position pulse command and inputs it to the servo driver through the hardware terminal. The hardware terminals are selected by F04.03.
1	Step setting	The step offset is set by parameter F04.04. The step settingreference is triggered by the DI function FunIN.20.
2	Multi-position reference	The operation mode of the multi-position function is set by the F14 group parameter. A multi-position reference is triggered by the DI function FunIN.28.

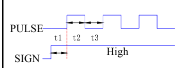
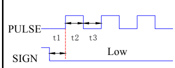
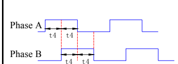
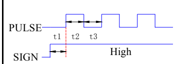
The pulse input is external position reference. The step reference and multi-position reference are internal position references.

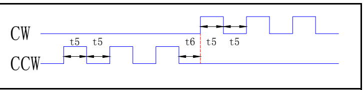
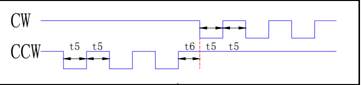
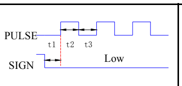
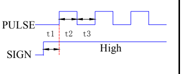
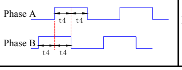
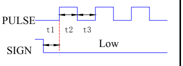
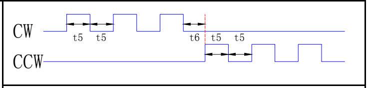
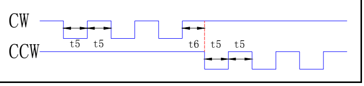
F04.01	**Parameter name**	Pulse referenceformat			**Property**	At stop	**Control mode**	P
	Setting range	0～2	**Unit**	-	**Effective time**	Power off again	**Default**	0

F04.02	**Parameter name**	Pulse reference inversion			**Property**	At stop	**Control mode**	P
	Setting range	0～1	**Unit**	-	**Effective time**	Immediate	**Default**	0

It sets the input pulse format when the main position reference source is pulse reference **[F04.00=0]**.

The maximum frequency and minimum time width of the position pulse command corresponding to different input terminals are as follows:

F04.02 reference pulse inversion	F04.01 reference format setting	Pulse format	Signal	Forward pulse schematic diagram	Reverse pulse schematic diagram
0	0	Pulse+ direction	PULSE SIGN		
	1	A phase+B phase quadrature pulse 4 times	PULSE （A phase） SIGN （B phase）	Phase A leads the phase B 90° 	Phase B leads A phase 90° 

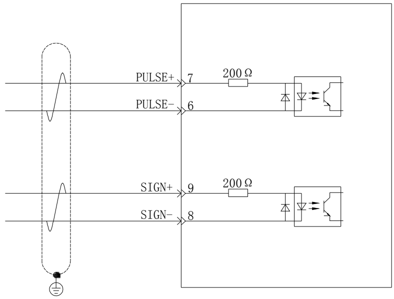
<table>
<tr><td rowspan="2"></td><td rowspan="2">2</td><td rowspan="2">CW+CCW</td><td rowspan="2">PULSE（CW）
SIGN（CCW）</td><td colspan="2">
</td></tr>
<tr><td colspan="2">
</td></tr>
<tr><td rowspan="4">1</td><td>0</td><td>Pulse+
direction</td><td>PULSE
SIGN</td><td>
</td><td>
</td></tr>
<tr><td>1</td><td>Phase A + B phase quadrature pulse 4 times</td><td>PULSE
（A phase）
SIGN
（B phase）</td><td>Phase B leads A phase 90°

</td><td>Phase A leads the phase B 90°

</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">CW+CCW</td><td rowspan="2">PULSE（CW）
SIGN（CCW）</td><td colspan="2">
</td></tr>
<tr><td colspan="2">
</td></tr>
</table>

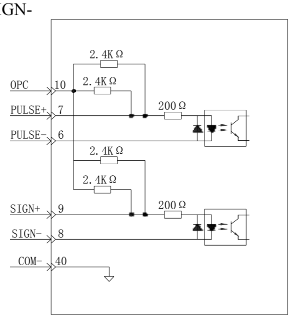
<table>
<tr><th colspan="2" rowspan="2">Input terminal</th><th rowspan="2">Max. frequency</th><th colspan="6">Minimum time width/us</th></tr>
<tr><th>t_1</th><th>t_2</th><th>t_3</th><th>t_4</th><th>t_5</th><th>t_6</th></tr>
<tr><td colspan="2">High speed pulse input terminal</td><td>4Mpps</td><td>0.125</td><td>0.125</td><td>0.125</td><td>0.25</td><td>0.125</td><td>0.125</td></tr>
<tr><td rowspan="2">Low speed pulse input terminal</td><td>Differential input</td><td>500kpps</td><td>1</td><td>1</td><td>1</td><td>2</td><td>1</td><td>1</td></tr>
<tr><td>Collector input</td><td>200kpps</td><td>2.5</td><td>2.5</td><td>2.5</td><td>5</td><td>2.5</td><td>2.5</td></tr>
</table>

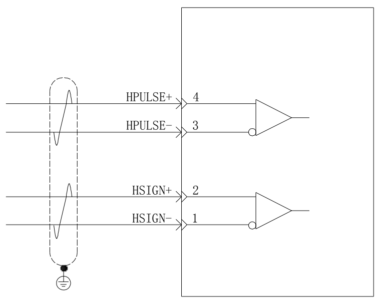
The rise and fall time of the position pulse reference should be less than 0.1us.

<table>
<tr><td rowspan="2">F04.03</td><td>Parameter name</td><td colspan="2">Pulse reference input terminal selection</td><td>Property</td><td>At stop</td><td>Control mode</td><td>P</td></tr>
<tr><td>Setting range</td><td>0～1</td><td>Unit</td><td>-</td><td>Effective time</td><td>Immediate</td><td>Default</td><td>0</td></tr>
</table>

In the position control mode, when the position command source is the pulse command **[F05.00=0]**, the hardware input terminal is selected according to the frequency of the input pulse.

<table>
<tr><th>Value</th><th>Input terminal</th><th>Hardware interface</th></tr>
<tr><td rowspan="2">0</td><td rowspan="2">Low speed</td><td>Differential input terminal：PULSE+、PULSE-、SIGN+、SIGN-


Maximum pulse frequency 500kpps。</td></tr>
<tr><td>Open collector input terminal：PULLFI、PULSE+、PULSE-、SIGN+、SIGN-


Maximum pulse frequency 200kpps</td></tr>
<tr><td>1</td><td>High speed</td><td>Differential input terminal：HPULSE+、HPULSE-、HSIGN+、HSIGN-


Maximum pulse frequency4Mpps.</td></tr>
</table>

F04.04	Parameter name	step amplitude			Property	At stop	Control mode	P
	Setting range	-9999～9999	Unit	Reference Unit	Effective time	Immediate	Default	50

Set the total number of position references when the main position command source is the step amount **[F04.00=1]**.

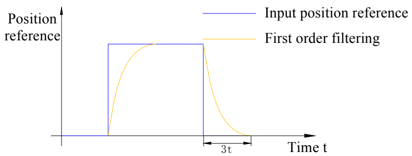
Motor displacement = F04.04×Electronic gear ratio

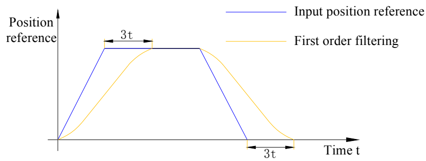
The positive and negative of **[F04.04]** values determine the positive and negative of motor speed.

F04.05	Parameter name	Position first order low pass filtering time constant			Property	At stop	Control mode	P
	Setting range	0～1000.0	Unit	ms	Effective time	Immediate	Default	0.0

It sets the first-order low-pass filter time constant of the position reference (Encoder Unit).

For the position command P, it is a rectangular wave and a trapezoidal wave. The position reference after the first-order low-pass filtering is as follows:



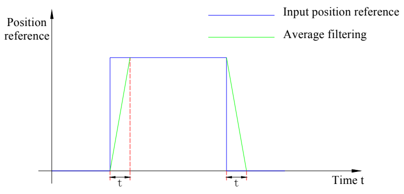
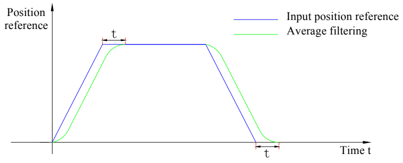


This function has no effect on the amount of displacement (the total number of position references).

If the set value is too large, the delay of the response will increase, and the filter time constant should be set according to the actual situation.

F04.06	Parameter name	Average filter time constant			Property	At stop	Control mode	P
	Setting range	0～128.0	Unit	ms	Effective time	Immediate	Default	0.0

It sets the average filter time constant of the position reference (Encoder Unit). When the position reference P is a rectangular wave and a trapezoidal wave, and the positional reference after the average value filtering is as follows:

Position reference is a rectangular wave	Position reference is trapezoidal
	

F04.07	Parameter name	Number of position references per motor revolution			Property	At stop	Control mode	P
	Setting range	0～8388608	Unit	P/r	Effective time	Power-on again	Default	0

It sets the number of position references per motor revolution

When **[F04.07=0]**, the parameters of electronic gear ratio 1, 2 and Electronic gear ratio switching condition setting **[F04.17]**is valid.

When **[F04.07≠0]**, Electronic gear ratio $\frac{B}{A}=\frac{\text{Encoder resolution}}{F04.07}$, The the parameters of electronic gear ratio 1, 2 is invalid.

F04.09	Parameter name	Electronic gear ratio 1（molecule）			Property	During running	Control mode	P
	Setting range	0～1073741824	Unit	-	Effective time	Immediate	Default	Depends on encoder type

For 23-bit encoder, the default is 8388608; for 2500 line encoder, the default value is 10000.

Set the molecule of electronic gear ratio 1 for the position referencedivision frequency (reference unit).

When**[F04.07：Number of position references per motor revolution＝0],**it is valid.

F04.11	Parameter name	Electronic gear ratio 1（denominator）			Property	During running	Control mode	P
	Setting range	0～1073741824	Unit	-	Effective time	Immediate	Default	10000

Set the denominator of electronic gear ratio 1 for the position referencedivision frequency(reference unit).When**[F04.07：Number of position references per motor revolution＝0],**it is valid.

F04.13	Parameter name	Electronic gear ratio 2（molecule）			Property	During running	Control mode	P
	Setting range	0～1073741824	Unit	-	Effective time	Immediate	Default	Depends on encoder type

For 23-bit encoder, the default is 8388608; for 2500 line encoder, the default value is

10000.

Set the molecule of electronic gear ratio 1 for the position referencedivision frequency (reference unit).

When**[F04.07:Number of position references per motor revolution＝0],** it is valid.

F04.15	Parameter name	Electronic gear ratio 1（denominator）			Property	During running	Control mode	P
	Setting range	0～1073741824	Unit	-	Effective time	Immediate	Default	10000

Set the molecule of electronic gear ratio 1 for the position referencedivision frequency (reference unit).

When**[F04.07：Number of position references per motor revolution＝0]**,it is valid.

F04.17	Parameter name	Electronic gear ratio switching condition			Property	At stop	Control mode	P
	Setting range	0～1	Unit	-	Effective time	Immediate	Default	0

Set the electronic gear ratio switching condition:

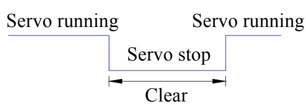
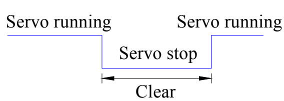
Value	Switching condition	Remark
0	Position reference（reference Unit）=0 and switch after 2.5ms	Must set one DI terminal, DI function 24 (FunIN.24：GEAR_SEL，electronic gear ratio selection)
1	Real-time switching	

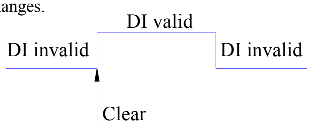
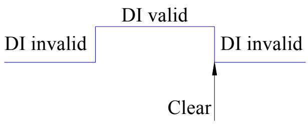
When**[F04.07：Number of position references per motor revolution＝0]**,it is valid.

F04.18	Parameter name	Position error clear action selection			Property	At stop	Control mode	P
	Setting range	0～2	Unit	-	Effective time	Immediate	Default	0

It sets the conditions for clearing the position deviation.

Position deviation＝(Position reference－Position feedback)(Encoder unit)

Value	Clear condition	Remark
0	Clear positional deviation servo enable OFF orwhen a fault occurs	
1	Clear positional deviation servo enable OFF orwhen a fault occurs	

<table>
<tr><td rowspan="2">2</td><td rowspan="2">Clear the position deviation servo enable OFF or input ClrPosErr signal by the DI terminal.</td><td>Should set 1 DI terminal for DI function 34 (FunIN.34: ClrPosErr, clear position deviation),
The DI terminal is recommended to select the fast DI terminal and the recommended logic is set to be effective for edge changes.

(Valid on rising edge)</td></tr>
<tr><td>
(Valid on falling edge)</td></tr>
</table>

If the absolute value of the position deviation is greater than **[F09.10: Position deviation excessive threshold]**, Er.310 (Excessive position deviation) will occur.

F04.19	**Parameter name**	Positioning completion output condition			**Property**	At stop	**Control mode**	P
	Setting range	0～3	**Unit**	-	**Effective time**	Immediate	**Default**	0

In the position control mode, when the servo is running, the absolute value of the position deviation is within thesetting value of **[F04.20: Positioning completion threshold]** , the servo can output the positioning completion (FunOUT.5: COIN) signal, and the output condition of the positioning completion signal can be set through **[F04.19].**

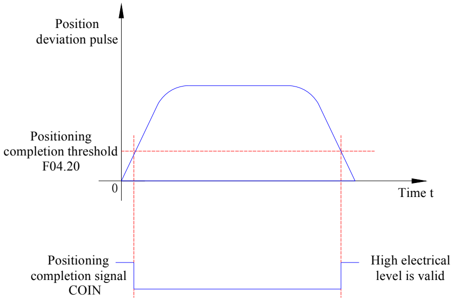
Value	Output condition
0	Absolute value of the position deviation is less than F04.20
1	Absolute value of position deviation is smaller than F04.20 and position reference after filter is 0
2	Absolute value of position deviation is smaller than F04.20 and position reference before filter is 0
3	Absolute value of position deviation is smaller than the value ofposition completed and position reference is 0, and keep the setting time of F04.22 valid.

F04.20	**Parameter name**	Position deviation threshold of positioning completed			**Property**	At stop	**Control mode**	P
	Setting range	1～65535	**Unit**	Encoder unit	**Effective time**	Immediate	**Default**	Determined by encoder

The default value for the 23-bit encoder is 5872, and the default value for the 2500 line encoder is 7.

Set the threshold for the absolute value of the position deviation when the servo drive outputs the positioning completion signal (COIN).

Positioning completion signal: DO function 5 (FunOUT.5: COIN, positioning completion signal).



The positioning completion signal is valid only when the servo drive is in the position control mode and in the running state.

F04.21	Parameter name	Time threshold of positioning completed		Property	During running	Control mode	P
	Setting range	0～30000	Unit / ms	Effective time	Immediate	Default	1

If the position deviation remains smaller than the position deviation threshold of positioning completed for more than the time set in this parameter, the positioning completed signal can output the valid state.

F04.22	Parameter name	Positioning completed holding time		Property	During running	Control mode	P
	Setting range	0～30000	Unit / ms	Effective time	Immediate	Default	0

It sets the valid time of the positioning completed signal (COIN) signal when **[F04.19=3]**. During the time, the positioning completed signal (COIN) signal becomes invalid if the position reference is not 0.

F04.23	Parameter name	Position deviation threshold of positioning near		Property	At stop	Control mode	P
	Setting range	1～1073741824	Unit / Encoder Unit	Effective time	Immediate	Default	Depends on encoder type

The default value for the 23-bit encoder is 524280, and the default value for the 2500 line encoder is 600.

Set the threshold for the absolute value of the position deviation when the servo drive outputs the positioning proximity signal (NEAR).

Positioning proximity signal: DO function 6 (FunOUT.6: NEAR, positioning proximity signal).

Note

(1) The setting of**[F04.23]** must be larger than that of **[F04.20]** normally.
(2) **[F04.20]** (Threshold of positioning completed) indicates thresholdof position deviation absolute when positioning completed is valid. It is unrelated to positioning accuracy.
(3) Too large setting of **[F07.17]** (Speed feedforward gain) or drive running at low speed will result in small position deviation absolute value. If the setting of **[F04.20]** is too large, positioning completed will be always valid. In this case,, could decrease the setting of **[F04.20]** to improve efficiency of positioning completed.
(4) On the condition that the setting of **[F04.20]** is small and position deviation isalso small, change output condition of positioning completed signal by setting **[F04.19]**.

F04.25	**Parameter name**	Servo pulse output source selection			**Property**	At stop	**Control mode**	P
	Setting range	0～2	**Unit**	-	**Effective time**	Power-on again	**Default**	0

It sets the output source of the pulse output port.

The divided output function cannot be used in the full closed loop control mode. At this time, the divided output terminal is used as the input terminal of the external scale signal.

Value	Output source	Remark
0	Encoder frequency-division output	When the motor rotates, the encoder feedback signal is divided according to the set value of F04.26 and output. When the host computer is used as closed-loop feedback, it is recommended to use the encoder frequency-division output mode.
1	Pulse command synchronous output	The input pulse command is output synchronously only when F04.00=0. When multi-axis servo pulse synchronous tracking is used, it is recommended to use the pulse command synchronous output mode.
2	Divided or synchronized output prohibited	There is no output at the pulse output terminal. At this time, the frequency division output terminal can be used as the input terminal of the full-closed external scale signal.

Pulse output hardware terminal:

Signal parameter name	Output format	Output terminal	Maximum pulse frequency
A phase signal	Differential output	PAO+、PAO-	0.24Mpps
B phase signal	Differential output	PBO+、PBO-	0.24Mpps
Z phase signal	Differential output	PZO+、PZO-	0.24Mpps
	Open collector output	PZ-OUT、GND	100kpps

The signal width of the A/B phase pulse is determined by the motor speed, and the signal width of the Z phase pulse is half the width of the A/B phase pulse signal.

The Z phase signal output polarity is set by **[F04.27]** (Z Pulse Output Polarity Select).

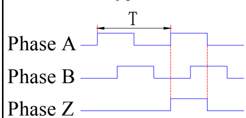
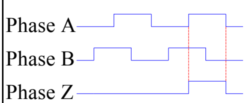
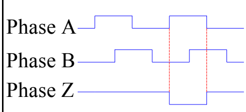
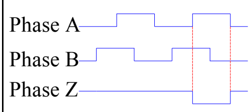
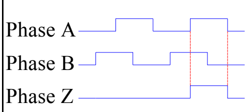
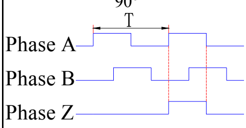
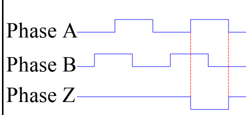
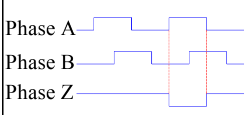
F04.26	**Parameter name**	Encoder frequency division pulse number		**Property**	At stop	**Control mode**	-
	Setting range	35～40000	**Unit** P/r	**Effective time**	Power-on again	**Default**	500

When **[F04.25=0]**, it is used to set the number of output pulses of the motor's one-turn pulse output terminal PAO or PBO. After 4 times the frequency, the pulseoutput resolution is:Pulse output resolution when the motor rotates 1 turn ＝ (F04.26) × 4

When **[F04.25=1]**， it used to set the divided output coefficient of the command pulse, and the divided output coefficient is**[F04.26=10000]**.

F04.27	**Parameter name**	Z pulse output polarity selection		**Property**	At stop	**Control mode**	P
	Setting range	0～1	**Unit** -	**Effective time**	Power-on again	**Default**	1

It sets the output level when the pulse output terminal Z pulse is active.

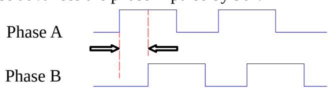
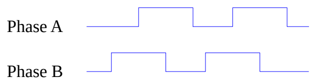
F04.28 (Output pulse phase)	F04.27 (Z pulse output polarity)	Forward, pulse output schematic	Reverse, pulse output schematic
0	0	Phase A advancing phase B by 90° 	Phase B advancing phase A by 90° 
	1	Phase A advancing phase B by 90° 	Phase B advancing phase A by 90° 
1	0	Phase B advancing phase A by 90° 	Phase A advancing phase B by 90° 
	1	Phase B advancing phase A by 90° 	Phase A advancing phase B by 90° 

For applications where the Z-signal frequency-division output accuracy is high, it is recommended to use the valid change edge of the Z-signal output.

Value	Z pulse output polarity selection	Remark
0	Positive polarity (high level when Z pulse is active)	The valid edge is falling edge
1	Negative polarity (low level when Z pulse is active)	The valid edge is rising edge

F04.28	Parameter name	Frequency division pulse output phase			Property	At stop	Control mode	P
	Setting range	0～1	Unit	-	Effective time	Power-on again	Default	0

It sets the phase relationship between the A-phase pulse and the B-phase when using pulse output function and the motor rotation direction does not change.

Value	Output pulse phase	Remark
0	A is in ahead of B	The A phase pulse of the encoder provision-frequency output pulse advances the phase B pulse by 90°. 
1	A lags behind of B	The A phase pulse of the encoder provision-frequency output pulse lags behind the B phase pulse by 90°. 

F04.29	Parameter name	Position change on fly			Property	At stop	Control mode	P
	Setting range	0～1	Unit	-	Effective time	Power-on again	Default	0

It sets whether to enable position change on fly.

Value	Position change on fly	Value	Position change on fly
0	Disabled	1	Enabled

When the homing function is enabled, the position change on fly signal is shielded.

When the servo motor is running at position change on fly state, the other internal and external position references are shielded.

Once it is disabled, the condition of responding to the other position references is determined by the setting of **[F04.34]**.

F04.30	Parameter name	Displacement of position change on fly			Property	At stop	Control mode	P
	Setting range	0～1073741824	Unit	Reference unit	Effective time	Immediate	Default	1000

It sets the position reference for position change on fly.

If**[F04.30]**, the position changes on fly function is disabled.

Actual position reference (encoder unit) for position change on fly = F04.30 x electronic gear ratio.

If position deviation is very large before position change on fly is enabled and the setting of **[F04.30]** is too small, the motor will reverse.

F04.32	**Parameter name**	Constant speed for position change on fly property during runningcontrolmode			**Property**	At stop	**Control mode**	P
	Setting range	0～6000	**Unit**	Rpm	**Effective time**	Immediate	**Default**	200

It sets maximum motor speed for position change on fly.

Value	Motor speed before enabling position change on fly	Max. speed for position change on fly	Motor rotating direction for position change on fly
0	<1	1	-
	≥1	Motor speed before enabling position change on fly	Consistent with motor rotating direction before enabling position change on fly
1～6000	-	Setting of F04.32	Consistent with motor rotating direction before enabling position change on fly

F04.33	**Parameter name**	Acceleration/Deceleration time of position change on fly			**Property**	At stop	**Control mode**	P
	Setting range	0～1000	**Unit**	ms	**Effective time**	Immediate	**Default**	10

It sets the time for motor to accelerate from 0 to 1000 RPM or decelerate from 1000 RPM to 0 for position change on fly.

Thus actual motor acceleration time "t" during position change on fly is:

$$t = \frac{\left|F04.32 - \text{motor speed before Interrupting fixed length}\right|}{1000} \times (F04.33)$$

F04.34	**Parameter name**	Position change on fly unlock			**Property**	At stop	**Control mode**	P
	Setting range	0～1	**Unit**	-	**Effective time**	Immediate	**Default**	1

It sets whether to unlock position change on fly signal

Value	Position change on fly unlock signal	Remark
0	Disabled	After the running of position change on fly is completed, the servo drive directly responds to the other position references.
1	Enabled	After the running of position change on fly is completed, the servo drive does not respond to the other position references. After you enable the DI function (FunIN.29: XintFree, position change on fly unlock), the servo drive can respond to the other position references.

Note

Set **[F04.34=1]**normally, Which helps to prevent motor maloperation due to input of interference position reference after positioning of position change on fly is completed**.**

F04.35	Parameter name	Homing enabling method			Property	During running	Control mode	P
	Setting range	0～6	Unit	-	Effective time	Immediate	Default	0

It sets the method of enabling the homing function and trigger signal source.

Value	Trigger source	Remark	
		Homing	Signal Source
0	Disabled	The homing function is disabled.	
1	Input HomingStart signal from DI to enable homing.	Home attaining	DI function FunIN.31: HomingStart, homing function
2	Input HomingStart signal from DI to enable electrical home attaining	Electrical home attaining	DI function FunIN.31: HomingStart, homing function
3	Start homing immediately upon power-on	Home attaining	In position mode, power on again, the first servo enable signal
4	Perform homing immediately	Home attaining	In position mode, after the servo enable signal returns to zero successfully, Set F04.35=0.
5	Start electrical home attaining	Electrical home attaining	In position mode, After the servo enable signal returns to zero successfully, Set F04.35=0.
6	Take the current position as the origin	Home attaining	The signal is not require，After the operation is successful,set F04.35=0.

For details on the homing function, refer to “6.2.8 Homing”.

F04.36	Parameter name	Homing mode			Property	At stop	Control mode	P
	Setting range	0～13	Unit	-	Effective time	Immediate	Default	0

It sets the default motor rotating direction, deceleration point and home for home attaining:

Value	Homing Mode			Remark
	Homing direction	Deceleration Point Home	Home	
0	Forward	Motor Z signal	Motor Z signal	-
1	Reverse	Motor Z signal	Motor Z signal	-
2	Forward	Home switch	Home switch	DI function FunIN.30(HomeSwitcF)
3	Reverse	Home switch	Home switch	
4	Forward	Home switch	Motor Z signal	-
5	Reverse	Home switch	Motor Z signal	-
6	Forward	Forward limit switch	Forward limit switch	DI function FunIN.14(P-OT)
7	Reverse	Reverse limit switch	Reverse limit switch	DI function FunIN.15(N-OT)
8	Forward	Forward limit switch	Motor Z signal	-
9	Reverse	Reverse limit switch	Motor Z signal	-
10	Forward	Mechanical final	Mechanical final limit	-

		limit position	position	
11	Reverse	Mechanical final limit position	Mechanical final limit position	-
12	Forward	Mechanical final limit position	Motor Z signal	-
13	Reverse	Mechanical final limit position	Motor Z signal	-

F04.37	**Parameter name**	Searching for the speed of the home switch signal at high speed			**Property**	At stop	**Control mode**	P
	Setting range	0～3000	**Unit**	Rpm	**Effective time**	Immediate	**Default**	100

It sets motor speed at searching the deceleration point signal when**[F04.36=1/3/4].**

It sets maximum motor speed when**[F04.36=2/5].**

Too small setting of speed will cause too long time on searching home switch signal. In this case, Er.315 will occur.

F04.38	**Parameter name**	Searching for the speed of the home switch signal at low speed			**Property**	At stop	**Control mode**	P
	Setting range	0～1000	**Unit**	Rpm	**Effective time**	Immediate	**Default**	10

It sets motor speed at searching the home signal when **[F04.36=1/3/4].**

If the motor has been close to home switch, it will immediately search the home at low speed set in **[F04.38]** once the homing function is enabled.

[F04.38] should be set as low as you can to avoid mechanical shock at stop.

F04.39	**Parameter name**	Acceleration/Deceleration time of homing			**Property**	At stop	**Control mode**	P
	Setting range	0～6000	**Unit**	ms	**Effective time**	Immediate	**Default**	1000

It sets the time for the motor to accelerate from 0 to 1000 RPM or decelerate from 1000 RPM to 0 when**[F04.36=1/2/3/4/5].**

Thus actual motor acceleration time t during homing is:

$$t = \frac{F04.37}{1000} \times (F04.39)$$

F04.40	**Parameter name**	Duration limit of homing			**Property**	At stop	**Control mode**	P
	Setting range	0～65535	**Unit**	ms	**Effective time**	Immediate	**Default**	10000

It sets maximum time for searching the home.

If the setting of **[F04.40]** is too small or the home is not found within the time Er.315

will occur.

F04.41	Parameter name	Mechanical home offset			Property	At stop	Control mode	P
	Setting range	-1073741824～1073741824	Unit	Reference unit	Effective time	Immediate	Default	0

It sets motor absolute position value **[F10.07]** after homing.

It sets the position relationship of mechanical home reference point and mechanical zero according to the setting of **[F04.43].**

It sets the displacement of target position from mechanical home reference point when electrical homing attaining is enabled.

F04.43	Parameter name	Mechanical home offset and action after reaching limit switch			Property	At stop	Control mode	P
	Setting range	0～3	Unit	-	Effective time	Immediate	Default	0

It sets the offset of mechanical home reference point and mechanical zero and action after reaching limit switch during the homing operation.

Value	Mechanical home offset and action after reaching limit switch	Remark	
		Mechanical home reference point	Action after reaching limit switch
0	F04.41as coordinate for homing, trigger homing and find home reversely after reaching limit switch	Mechanical zero different from mechanical homereference point. After home attaining is completed, the motor stop at mechanical home reference point and the home coordinate is forced to F04.41.	After the homing enable signal is sent again, the servo drive performs homing reversely
1	F04.41as relative offset for homing, trigger homing and find home reversely after reaching limit switch	Mechanical zero same as mechanical home reference point. After positioning mechanical home reference point, the motor continues to move according to the setting of H0-36 and then stops.	After the homing enable signal is sent again, the servo drive performs homing reversely.
2	F04.41as coordinate for homing, automatically find zero reversely after reaching limit switch	Mechanical zero different from mechanical home reference point. After home attaining is completed, the motor stops at mechanical home and the home coordinate is forced toF04.41.	The servo drive automatically continues to perform homing Reversely.
3	F04.41as relative offset for homing, automatically find zero reversely after reaching limit switch	Mechanical zero same as mechanical home reference point. After positioning mechanical home reference point, the motor continues to move according to the setting of H0-36 and then stops.	The servo drive automatically continues to perform homing reversely.

After the homing operation (including home attaining and electrical home attaining) is completed, the absolute motor position **[F10.07]** is consistent with **[F04.41]**.

Home attaining completed signal (FunOUT.13: HomeAttain) or electrical home attaining signal (FunOUT.14: ElecHomeAttain) is output only after **[F10.07=F04.41]**and is irrelevant to status of the S-ON signal.

F04.44	Parameter name	Position offset in absolute position linear mode (low 32 bits)			Property	At stop	Control mode	PST
	Setting range	-2147483648～2147483647	Unit	Encoder unit	Effective time	Power-on again	Default	0

F04.46	Parameter name	Position offset in absolute position linear mode (high 32 bits)			Property	At stop	Control mode	PST
	Setting range	-2147483648～2147483647	Unit	Encoder unit	Effective time	Power-on again	Default	0

When **[F01.01=1]** (absolute position linear mode), position offset in absolute position linear mode equals difference of current encoder absolute position and mechanical position (encoder unit).

F04.54	Parameter name	Judgment threshold of homing with hit & stop			Property	During running	Control mode	P
	Setting range	0～1000	Unit	rpm	Effective time	Immediate	Default	2

It sets the speed threshold for judging whether the load reaches the mechanical final limit position when the homing with hit & stop function is used.

F04.55	Parameter name	Torque limit of homing with hit & stop			Property	During running	Control mode	P
	Setting range	0～300.0	Unit	%	Effective time	Immediate	Default	100.0

It sets the positive/negative maximum torque limit when homing with hit & stop function is used.

8.6 F05 Group: Speed control parameters

F05.00	Parameter name	Main speed reference A source			Property	During running	Control mode	S
	Setting range	0～3	Unit	-	Effective time	Immediate	Default	0

It sets the source of main speed reference A.

Value	Reference source	ReferenceAcquisition method
0	Digital setting	Main speed reference A is set byF05.04.
1	AI1	Main speed reference A is input from AI1. Correspondence between analog voltage and speed reference is determined byF02.26、F02.27、F02.31.
2	AI2	Main speed reference A is input from AI2. Correspondence between analog voltage and speed reference is determined byF02.29、F02.30、F02.31.
3	Communication given	The speed reference A source is determined by the communication modification F20.02 parameter.

F05.01	Parameter name	Auxiliary speed reference B source			Property	During running	Control mode	S
	Setting range	0～4	Unit	-	Effective time	Immediate	Default	1

It sets the source of auxiliary speed reference B.

Value	Reference source	ReferenceAcquisition method
0	Digital setting	Main speed reference A is set byF05.04.
1	AI1	Main speed reference A is input from AI1. Correspondence between analog voltage and speed reference is determined byF02.26、F02.27、F02.31.
2	AI2	Main speed reference A is input from AI2. Correspondence between analog voltage and speed reference is determined byF02.29、F02.30、F02.31.
3	Multi-speed reference	The auxiliary speed reference B source is planned by the internal multi-step speed reference. For the related setting of multi-step speed, please refer to the F15 group parameters.
4	Communication given	The speed reference A source is determined by the communication modification F20.02 parameter.

Note

The digital given and multi-speed are internal speed references, the AI1 and AI2 references are external speed references, and the AI1 and AI2 hardware interfaces are referred to in Chapter 4 Wiring.

F05.02	Parameter name	Speed reference source selection			Property	During running	Control mode	S
	Setting range	0～4	Unit	-	Effective time	Immediate	Default	0

It selects speed reference source.

<table>
<tr><th>Value</th><th>Control mode</th><th>Remark</th></tr>
<tr><td>0</td><td>Main speed reference A source</td><td>The actual input reference source is selected by function code F05.00.</td></tr>
<tr><td>1</td><td>Auxiliary speed reference B source</td><td>The actual input reference source is selected by function code F05.01.</td></tr>
<tr><td>2</td><td>A + B</td><td>Add the reference source selected by function code F05.00 and F05.01 as the motor speed reference.</td></tr>
<tr><td>3</td><td>Main speed reference A source －Auxiliary speed reference B source</td><td>The reference source selected by function code F05.00 and F05.01 is subtracted as the motor speed reference.</td></tr>
<tr><td>4</td><td>A/B switchover</td><td>A/B switchover is implemented through DI function FunIN.4:Cmd_SEL.
<table><tr><th>FunIN.4(Cmd_SEL) status</th><th>Speed reference selection</th></tr><tr><td>Invalid</td><td>Main speed Reference A source</td></tr><tr><td>Valid</td><td>Auxiliary speed Reference B source</td></tr></table></td></tr>
</table>

F05.03	Parameter name	Speed reference logic inversion			Property	During running	Control mode	S
	Setting range	0～1	Unit	-	Effective time	Immediate	Default	0

This parameter can be used to set the polarity of the given speed after the main and auxiliary selections, thus changing the steering of the motor.

F05.04	Parameter name	Keypad setting value of speed reference			Property	During running	Control mode	S
	Setting range	-6000～6000	Unit	rpm	Effective time	Immediate	Default	200

It sets the speed reference via **[F05.04]**when **[F05.00]**/**[F05.01]** =1

F05.05	Parameter name	Jog speed setting value			Property	During running	Control mode	PST
	Setting range	0～6000	Unit	rpm	Effective time	Immediate	Default	100

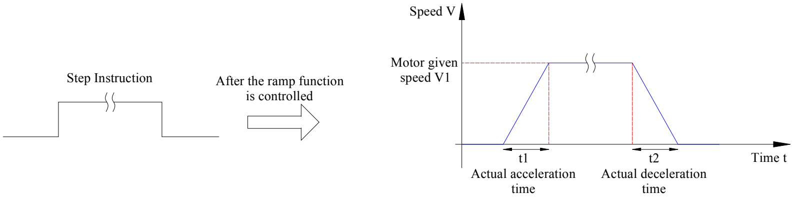
It sets jog speed reference when DI jog function is used.

DI jog function can be enabled in normal drive running status. It is unrelated to control mode.

F05.06	Parameter name	Acceleration ramp time constant of speed reference			Property	During running	Control mode	S
	Setting range	0～65535	Unit	ms	Effective time	Immediate	Default	0

F05.07	Parameter name	Deceleration ramp time constant of speed reference			Property	During running	Control mode	S
	Setting range	0～65535	Unit	ms	Effective time	Immediate	Default	0

It sets the deceleration ramp time constant of speed reference only. The acceleration/deceleration ramp time constant is determined by parameters in group **[F15 Group]**.



[F05.06]: Time for speed reference to accelerate from 0 to 1000 RPM.

[F05.07]: Time for speed reference to decelerate from 1000 RPM to 0.

Thus, actual acceleration/deceleration time calculation formulas are asfollows:

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

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

F05.08	Parameter name	Maximum speed threshold			Property	During running	Control mode	PST
	Setting range	0～6000	Unit	Rpm	Effective time	Immediate	Default	4500

F05.09	Parameter name	Forward speed threshold			Property	During running	Control mode	PST
	Setting range	0～6000	Unit	Rpm	Effective time	Immediate	Default	4500

F05.10	Parameter name	Reverse speedthreshold			Property	During running	Control mode	PST
	Setting range	0～6000	Unit	Rpm	Effective time	Immediate	Default	4500

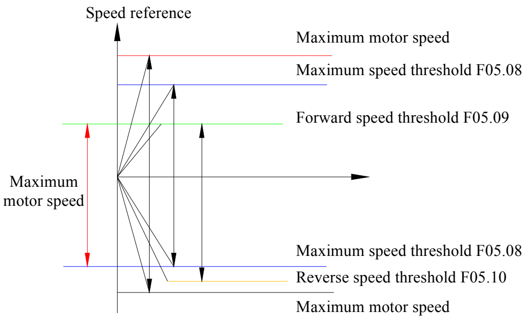
It sets speed reference limit in speed control. The speed reference limit sources are as follows:

[F05.08]: It sets both the positive and negative speed limits of speed reference. If speed reference exceeds the setting of**[F05.08]** , the speed reference will be limited as this value.

[F05.09]: It sets the positive speed limit. If positive speed reference exceeds the setting of **[F05.09]**, the reference will be limited as this value.

[F05.10]: It sets the negative speed limit. If negative speed reference exceeds the setting of **[F05.10]**, the reference will be limited as this value.

Max. motor speed (default limit) is determined by motor model.



Thus, motor speed in positive/negative direction is limited as below:

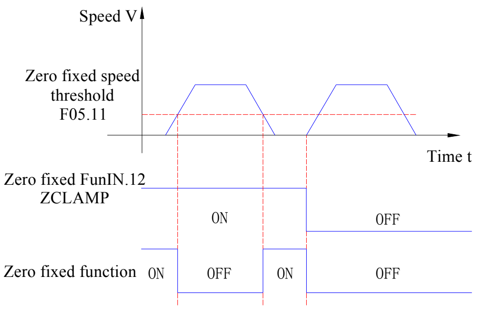
|Positive speed limit|≤min{maximum motor speed, F05.08, F05.09}

|Negative speed limit|≤min{motor rotational speed, F05.08, F05.10}

F05.11	Parameter name	Speed threshold for zero speed clamp			Property	During running	Control mode	S
	Setting range	0～6000	**Unit**	Rpm	**Effective time**	Immediate	**Default**	10

The zero fixed function means that when the zero fixed DI signal FunIN.12 (ZCLAMP) is valid in the speed control mode, when the speed command amplitude is less than or equal to **[F05.15]**Value, the servo motor enters the zero speed lock state, the speed reference is invalid; if the speed reference amplitude is greater than [F05.11], the servo motor exits the zero speed lock state, and the servo motor continues to run according to the currently input speed reference.

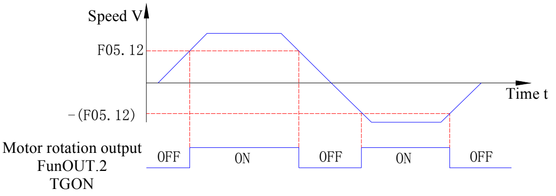
If the zero fixed DI signal FunIN.12 (ZCLAMP) is invalid, the zero speed fixed function is invalid.



F05.12	Parameter name	Speed threshold of motor rotation			Property	During running	Control mode	PST
	Setting range	0～1000	**Unit**	Rpm	**Effective time**	Immediate	**Default**	20

When the absolute value of the filtered actual motor speed reaches **[F05.12: Motor rotation speed threshold]**, the motor can be considered to rotate. At this time, the servo drive can output a motor rotation (FunOUT.2: TGON) signal to confirm that the motor has rotated. Conversely, when the absolute value of the filtered actual motor speed is less than [F05.12], the motor is considered not to rotate.

The judgment of the motor rotation (FunOUT.2: TGON) signal is not affected by the drive operating state and control mode.



Note:

In the above figure, ON means that the motor rotation DO signal is valid, and OFF means that the motor rotation DO signal is invalid.

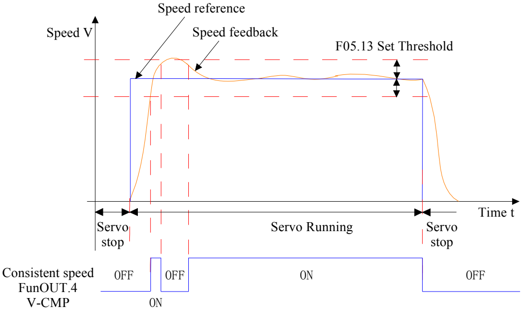
The filter time constant for the actual motor speed can be set by **[F05.16: Speed DO filter time constant]**.

F05.13	**Parameter name**	Threshold of speed consistent signal		**Property**	During running	**Control mode**	S
	Setting range	0～100	**Unit** Rpm	**Effective time**	Immediate	**Default**	10

In the speed control mode, when the deviationabsolute value between the actual servo motor speed and the speed reference after filtering meets a certain threshold [F05.13], it is considered that the actual motor speed reaches the speed command value, and the output speed of the drivecan be consistent (FunOUT.4: V-Cmp) signal. Conversely, if the deviation absolute value between the filtered servo motor actual speed and the speed command exceeds the threshold, the speed coincidence signal is invalid.

The speed is consistent (FunOUT.4:V-Cmp) signal is always inactive when the drive is in non-operational or non-speed control mode.

The filter time constant for the actual motor speed can be set by **[F05.16: Speed DO filter time constant].**



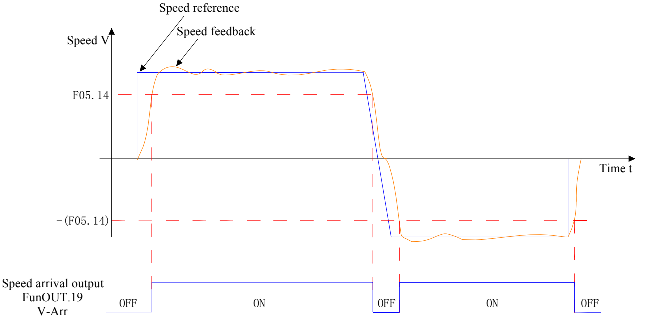
Note

ON represents the speed and speed consistent DO signal is valid, OFF represents the speed consistent DO signal is nvalid.

F05.14	Parameter name	Threshold of speed reached signal		Property	During running	Control mode	S
	Setting range	10～6000	Unit: Rpm	Effective time	Immediate	Default	1000

When the absolute value of the actual servo motor speed exceeds a certain threshold **[F05.14]**, the actual servo motor speed is considered to reach the expected value. At this time, the servo drive can output the speed arrival (FunOUT.16: V-Arr) signal. Conversely, if the absolute value of the actual servo motor speed after filtering is not greater than this value, the speed arrival signal is invalid.

The judgment of the speed arrival (FunOUT.16:V-Arr) signal is not affected by the operating state of the drive and the control mode.



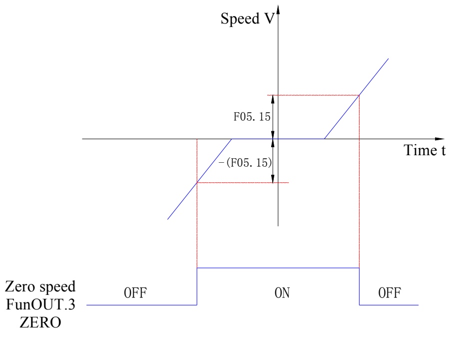
Note

(1) ON means that the speed arrival DO signal is valid, and OFF means that the speed arrival DO signal is invalid.
(2) The filter time constant for the actual motor speed can be set by [F05.16: Speed DO filter time constant].

F05.15	Parameter name	Threshold of zero speed output signal			Property	During running	Control mode	S
	Setting range	1～6000	Unit	Rpm	Effective time	Immediate	Default	10

When the absolute value of the actual servo motor speed after filtering is less than a certain threshold **[F05.15]**, the actual servo motor speed is considered to be near static. At this time, the servo driver can output the zero speed (FunOUT.3: V-Zero) signal. Conversely, if the absolute value of the actual servo motor speed after filtering is not greater than this value, the motor is considered to be not at rest and the zero speed signal is invalid.

The judgment of the zero speed (FunOUT.3: V-Zero) signal is not affected by the operating state of the drive and the control mode.



Note

(1) ON means the zero speed DO signal is valid, and OFF means the zero speed DO signal is invalid.
(2) The filter time constant for the actual motor speed can be set by [F05.16: Speed DO filter time constant].

F05.16	Parameter name	Speed DO filter time constant			Property	During running	Control mode	-
	Setting range	0～500.00	Unit	Ms	Effective time	Immediate	Default	10.00

Set the low-pass filter time constant for the speed feedback and speed information corresponding to the position reference.

The **[F05.16]** can be set to determine the speed-dependent DO output for the speed feedback signal (motor rotation signals TGON, speed coincidence V-CMP, speed reaches V-ARR, zero speed signal ZERO). For the description of 4 DO signals, please refer to "6.3 .5 speed related DO output function".

The filter time constant when the position reference is converted into speed information can be set by **[F05.16].**

8.7 F06 Group: Torque control parameter

F06.00	**Parameter name**	Main torque reference A source			**Property**	During running	**Control mode**	T
	Setting range	0～3	**Unit**	-	**Effective time**	Immediate	**Default**	0

It sets the main torque reference A source.

Value	Reference source	Reference acquisition method
0	Digital given	Torque reference A source is set by F06.03
1	AI1	Torque reference A is input from AI1. Correspondence between voltage input from AI1 and speed reference is determined by F02.26、F02.27、F02.32. For details, refer to “6.4.1 Torque Reference Input Setting”.
2	AI2	Torque reference A is input from AI2. Correspondence between voltage input from AI2 and speed reference is determined by F02.28、F02.29、F02.32. For details, refer to“6.4.1 Torque Reference Input Setting”.
3	Communication given	The torque reference A source is set by F20.03.

F06.01	**Parameter name**	Auxiliary Torque reference B Source			**Property**	During running	**Control mode**	T
	Setting range	0～3	**Unit**	-	**Effective time**	Immediate	**Default**	1

It sets the torque reference source of the auxiliary torque reference B.

Value	Reference source	Reference acquisition method
0	Digital given	Torque referenceB source is set by F06.03
1	AI1	Torque reference B is input from AI1. Correspondence between voltage input from AI1 and speed reference is determined by F02.26、F02.27、F02.32. For details, refer to “6.4.1 Torque Reference Input Setting”.
2	AI2	Torque reference B is input from AI2. Correspondence between voltage input from AI2 and speed reference is determined by F02.28、F02.29、F02.32. For details, refer to“6.4.1 Torque Reference Input Setting”.
3	Communication given	The torque referenceB source is set by F20.03.

Note

The digital given belongs to the internal torque reference, the AI1 and AI2 references belong to the external torque references, and the AI1 and AI2 hardware interfaces refer to "Chapter 4 Wiring".

F06.02	Parameter name	Torque reference selection			Property	During running	Control mode	T
	Setting range	0～3	Unit	-	Effective time	Immediate	Default	0

It set torque reference source.

<table>
<tr><th>Value</th><th>Control mode</th><th>Remark</th></tr>
<tr><td>0</td><td>Main speed reference A source</td><td>The actual input reference source is selected by function code F06.00.</td></tr>
<tr><td>1</td><td>Auxiliary speed reference B source</td><td>The actual input reference source is selected by function code F06.01.</td></tr>
<tr><td>2</td><td>A + B</td><td>Add the reference source selected by function code F06.00 and F06.01 as the motor speed reference.</td></tr>
<tr><td>3</td><td>Main speed reference A source －Auxiliary speed reference B source</td><td>The reference source selected by function code F06.00 and F06.01 is subtracted as the motor speed reference.</td></tr>
<tr><td>4</td><td>A/B switchover</td><td>A/B switchover is implemented through DI function FunIN.4:Cmd_SEL.
<table>
<tr><th>FunIN.4(Cmd_SEL) status</th><th>Speed Reference Selection</th></tr>
<tr><td>Invalid</td><td>Main speed reference A source</td></tr>
<tr><td>Valid</td><td>Auxiliary speed reference B source</td></tr>
</table></td></tr>
</table>

F06.03	Parameter name	Torque reference logic inversion			Property	During running	Control mode	T
	Setting range	0～1	Unit	-	Effective time	Immediate	Default	0

This parameter can be used to change the polarity of the torque reference after the main and auxiliary selections.

F06.04	Parameter name	The setting value of torque reference			Property	During running	Control mode	T
	Setting range	-300.0～300.0	Unit	%	Effective time	Immediate	Default	0

When **[F06.00]** or **[F06.01] =1,** set the required torque reference value via **[F06.04].** 100.0% corresponds to 1 time of motor rated torque.

F06.05	Parameter name	Torque limit source			Property	During running	Control mode	PST
	Setting range	0～3	Unit	-	Effective time	Immediate	Default	0

It set torque limit source. For details, please refer to “6.4.3 Torque reference limit”

Value	Torque limit source	Value	Torque limit source
0	Positive and negative internal torque limit	2	T-LMTas an external torque limit input
1	Positive and negative external torque limit (Via P-CL,N-CL)	3	Switchover between internal positive/negative torque limit and T-LMT torque limit (Via P-CL, N-CL)

Note

The torque limit function is valid for position, speed, torque, and hybrid control modes.

F06.06	Parameter name	T-LMT selection			Property	During running	Control mode	PST
	Setting range	0～1	Unit	-	Effective time	Immediate	Default	0

When the external torque limit enable **[F06.07=2/3/4]**, select the analog input channel of torque limit value:

Value	Reference source	Remark
0	AI1	Analog channel AI1 is used as the external torque limit value input source, and 10V corresponds to 3 times the motor rated torque.
1	AI2	Analog channel AI2 is used as the external torque limit value input source, and 10V corresponds to 3 times the motor rated torque.

F06.07	Parameter name	Internal positive torque limit			Property	During running	Control mode	PST
	Setting range	0.0～300.0	Unit	%	Effective time	Immediate	Default	300.0

F06.08	Parameter name	Internal negative torque limit			Property	During running	Control mode	PST
	Setting range	0.0～300.0	Unit	%	Effective time	Immediate	Default	300.0

It sets the internal positive/negative torque limit value when **[F06.05=0 or 3].** 100.0% corresponds to one time of rated motor torque.

Note

(1) If the setting of **[F06.07]**、**[F06.08]** is too small, insufficient torque may occur during acceleration/deceleration of servo motor.
(2) If the setting exceeds maximum torque of the servo drive and servo motor, actual torque will be limited within the maximum torque.
(3) For final torque limit, refer to“6.4.3 torque reference limit”.

F06.09	Parameter name	Positive external torque limit			Property	During running	Control mode	PST
	Setting	0.0～300.0	Unit	%	Effective	Immediate	Default	300.0

	range				**time**			

F06.10	**Parameter name**	Negative external torque limit			**Property**	During running	**Control mode**	PST
	Setting range	0.0～300.0	**Unit**	%	**Effective time**	Immediate	**Default**	300.0

It sets the external positive/negative torque limit value when **[F06.05=1]**. 100.0% corresponds to one time of rated motor torque. For final torque limit, refer to “6.4.3 torque reference limit”.

F06.11	**Parameter name**	Torque compensation			**Property**	During running	**Control mode**	T
	Setting range	0.0～150.0	**Unit**	%	**Effective time**	Immediate	**Default**	0.0

It sets the amount of torque compensation. It is usually necessary to adjust the torque compensation when the torque loss caused by the mechanical loss of motor is large. Generally, it is not necessary to set the value. When the value is 100%, it corresponds to the rated torque of the motor. When the given torque is less than 1.1% of the rated torque, the torque compensation amount defined by **[F06.11]** is invalid**.**

F06.12	**Parameter name**	Torque compensation cutoff speed			**Property**	During running	**Control mode**	T
	Setting range	0～6000	**Unit**	Rpm	**Effective time**	Immediate	**Default**	1000

When the motor speed exceeds the speed defined by **[F06.12]**, the torque compensation amount defined by **[F06.11]** is 0. The actual compensation torque decreases linearly between the motor speed from 0 to the speed defined by **[F06.12]**.

F06.13	**Parameter name**	Torque control forward speed limit source selection			**Property**	During running	**Control mode**	T
	Setting range	0～2	**Unit**	-	**Effective time**	Immediate	**Default**	0

It sets the speed limit source for the forward rotation of the motor in torque control mode.

After the speed limit is set, the actual motor speed will be limited to the speed limit. After reached the speed limit, the motor runs at constant speed limit.

Value	Limit resource	Description
0	Determined by F06.15	The forward speed limit is determined by F06.15.
1	AI1	The forward rotation speed limit is determined by AI1, and the correspondence between the analog voltage and the speed limit value is set by function codes F02.26, F02.27, and F02.31.
2	AI2	The forward rotation speed limit is determined by AI2, and the correspondence between the analog voltage and the speed limit value is set by function codes F02.26, F02.27, and F02.31.

F06.14	**Parameter name**	Torque control reverse speed limit source selection		**Property**	During running	**Control mode**	T
	Setting range	0～2	**Unit**	-	**Effective time**	Immediate	**Default**	0

It sets the speed limit source for motor reversal in torque control mode.

After the speed limit is set, the actual motor speed will be limited to the speed limit. After reached speed limit, the motor runs at constant speed limit.

Value	Limit resource	Description
0	Determined by F06.16	The forward speed limit is determined by F06.16.
1	AI1	The forward rotation speed limit is determined by AI1, and the correspondence between the analog voltage and the speed limit value is set by function codes F02.26, F02.27, and F02.31.
2	AI2	The forward rotation speed limit is determined by AI2, and the correspondence between the analog voltage and the speed limit value is set by function codes F02.26, F02.27, and F02.31.

F06.15	**Parameter name**	Torque control forward speed limit			**Property**	During running	**Control mode**	T
	Setting range	0～6000	**Unit**	Rpm	**Effective time**	Immediate	**Default**	3000

F06.16	**Parameter name**	Torque control reverse speed limit			**Property**	During running	**Control mode**	T
	Setting range	0～6000	**Unit**	Rpm	**Effective time**	Immediate	**Default**	3000

It sets the speed limit digital given value in torque mode.

Note

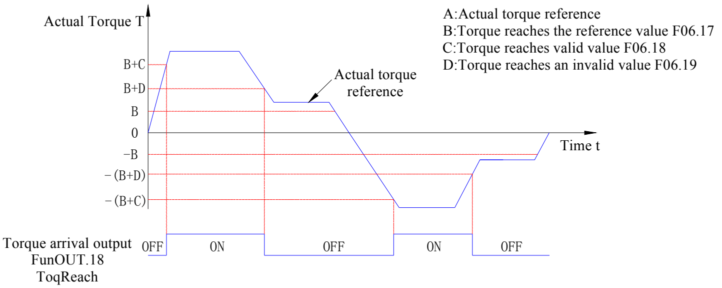
For torque limit in torque mode, see "6.4.4 Speed Limit in Torque Mode".

F06.17	**Parameter name**	Base value for torque reached			**Property**	During running	**Control mode**	PST
	Setting range	0.0～300.0	**Unit**	%	**Effective time**	Immediate	**Default**	0.0

F06.18	**Parameter name**	Torque reached valid value			**Property**	During running	**Control mode**	PST
	Setting range	0.0～300.0	**Unit**	%	**Effective time**	Immediate	**Default**	20.0

F06.19	**Parameter name**	Torque reached invalid value			**Property**	During running	**Control mode**	PST
	Setting range	0.0～300.0	**Unit**	%	**Effective time**	Immediate	**Default**	10.0

The torque arrival function (FunOUT.15: ToqReacF, torque arrival) is used to determine whether the actual torque reference reaches the torque reaching effective value interval. When the interval is satisfied, the drive can output the corresponding DO signal for use by the host computer.



Actual torque reference (can be viewed by [F10.02]: A;

Torque reaches the reference value**[F06.17]**: B;

Torque reaches the valid value **[F06.18]**: C;

Torque reaches invalid value**[F06.19]**: D;

Where C and D are offsets on a B basis.

Therefore, when the torque reaches the DO signal from inactive to active, the actual torque reference must satisfy: |A|≥B+C

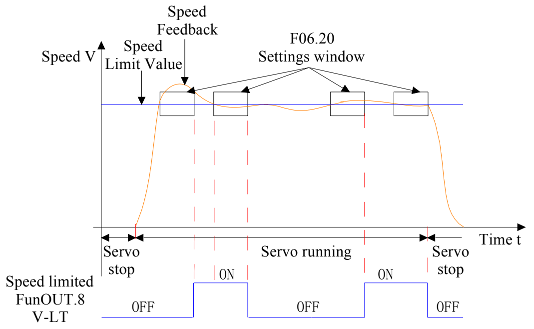
Otherwise, the torque reaching DO signal remains inactive.

Conversely, when the torque reaches the DO signal from active to inactive, the actual torque reference must satisfy: |A|<B+D

F06.20	**Parameter name**	Speed limited window in torque mode			**Property**	During running	**Control mode**	T
	Setting range	0～1000	**Unit**	Ms	**Effective time**	Immediate	**Default**	1

In the torque mode, the absolute value of the actual speed of the servo motor exceeds the speed limit value (refer to "6.4.4 Speed limit in torque mode"), and when the time reaches **[F06.40]**, the actual speed of the servo motor is considered to be limited. The servo drive can output a speed limited (FunOUT.8:V-LT) signal. Conversely, if either condition is not met, the speed limited signal is invalid.

The speed limited (FunOUT.8: V-LMT) signal is judged only in the torque mode and servo operation.



Note

ON means the speed limited DO signal is active, and OFF means the speed limited DO signal is invalid.

F06.21	**Parameter name**	Gravity load detection value			**Property**	At stop	**Control mode**	PS
	Setting range	-300.0～300.0	**Unit**	%	**Effective time**	Immediate	**Default**	0.0

Enter the **[F12.16]** parameter and press the UP button to open the Z-axis gravity load identification function. After the successful identification, the keyboard displays stable gravity detection value; the identification condition is that the servo is enabled and the brake is open, the input reference is 0 and the speed is less than 10 rpm., for a few seconds, after the successful identification, the result is saved in the **[F06.21]** function code, and this value can also be set manually.

8.8 F07 Group: Gain parameters

F07.00	**Parameter name**	Speed loop gain			**Property**	During running	**Control mode**	PS
	Setting range	0.1～1000.0	**Unit**	Hz	**Effective time**	Immediate	**Default**	25.0

It sets proportional gain of speed loop.

This parameter determines response of speed loop. The larger the setting is, the quicker response will be. But too large setting may cause vibration.If position loop gain need be increased in position control, it is necessary to increase speed loop gain simultaneously. The speed loop gain is only Unity in Hz if the load inertia is accurate.

F07.01	**Parameter name**	Time constant of speed loop integration			**Property**	During running	**Control mode**	PS
	Setting range	0.36～512.0	**Unit**	ms	**Effective time**	Immediate	**Default**	31.83

It sets the time constant of speed loop integration.

The smaller the setting is, the better integration effect will be obtained and the deviation value at stop will be close to 0 more quickly.

F07.02	**Parameter name**	Position loop gain			**Property**	During running	**Control mode**	P
	Setting range	0.0～1570.0	**Unit**	rad/s	**Effective time**	Immediate	**Default**	40.0

It sets proportional gain of position loop.

This parameter determines response of position loop. A large position loop gain can reduce positioning time. But too large setting may cause vibration.

[F07.00]、**[F07.01]**、**[F07.02]** and **[F07.12]**(Time constant of torque reference filter) are called the 1st gain.

F07.03	**Parameter name**	2nd gain of speed loop			**Property**	During running	**Control mode**	PS
	Setting range	0.1～1000.0	**Unit**	Hz	**Effective time**	Immediate	**Default**	40.0

F07.04	**Parameter name**	2nd time constant of speed loop integration			**Property**	During running	**Control mode**	PS
	Setting range	0.36～512.0	**Unit**	ms	**Effective time**	Immediate	**Default**	40.0

F07.05	**Parameter name**	2nd gain of position loop			**Property**	During running	**Control mode**	P
	Setting range	0.0～1570.0	**Unit**	rad/s	**Effective time**	Immediate	**Default**	64.0

It sets the 2nd gain of position loop and speed loop. **[F07.03]**、**[F07.04]**、**[F07.05]** and **[F07.13]** (2nd time constant of torque reference filter) are called the 2nd gain.

For details on gain switchover, refer to “7.4.2 Gain Switchover”.

F07.06	**Parameter name**	2nd gain mode setting			**Property**	During running	**Control mode**	PST
	Setting range	0～1	**Unit**	-	**Effective time**	Immediate	**Default**	1

It sets switchover mode of the 2nd gain.

Value	2nd Gain Mode
0	1st gain fixed. P/PI of speed control is switched over via DI function FunIN.3: GAIN_SEL. GAIN_SEL invalid: PI control GAIN_SEL valid: P control
1	1st gain (F07.00～F07.02,F07.12) and 2nd gain(F07.03～F07.05,F07.13) switchover is valid,The switching condition isF07.07.

F07.07	**Parameter name**	Gain switchover condition			**Property**	During running	**Control mode**	PST
	Setting range	0～10	**Unit**	-	**Effective time**	Immediate	**Default**	0

It sets the condition for gain switchover:

Value	Gain switchover condition	Remark
0	Fixed at 1st gain	Fixed at 1st gain
1	Switchover via DI	The gain is switched over by using the GAIN-SEL signal. GAIN-SEL signal invalid: 1st gain (F07.00～F07.02，F07.12) GAIN-SEL signal valid: 2nd gain (F07.03～F07.05，F07.13) If the GAIN-SEL signal cannot be allocated to a DI terminal, always use the 1st gain.
2	Torque reference being large	When absolute value of torque reference exceeds (level + hysteresis, %) in the 1st gain, the drive switches over to the 2nd gain. When absolute value of torque reference is smaller than or equal to (level – hysteresis, %) and this status lasts within the delay （F07.08) in the 2nd gain, the drive returns to the 1st gain.
3	Speed reference being large	When absolute value of speed reference exceeds (level + hysteresis, RPM) in the 1st gain, the drive switches over to the 2nd gain. When absolute value of speed reference is smaller than or equal to (level - hysteresis, RPM) and this status lasts within the delay (F07.08) in the 2nd gain, the drive returns to the 1st gain.
4	Speed reference change rate being large	It is valid only in non-speed control. When absolute value of speed reference change rate exceeds (level + hysteresis, 10 RPM/s) in the 1st gain, the drive switches over to the 2nd gain. When absolute value of speed reference change rate is smaller than or equal to (level – hysteresis, 10 RPM/s) and this status last within the delay (F07.08) in the 2nd gain, the drive returns to the 1st gain. The drive always uses the 1st gain in speed control.
5	Speed reference high-speed/low-speed	When absolute value of speed reference exceeds (level – hysteresis, RPM) in the 1st gain, the drive starts to switch over to the 2nd gain and the gain

	thresholds	changes gradually. When absolute value of speed reference exceeds (level + hysteresis, RPM), the drive completely switches over to the 2nd gain. When absolute value of speed reference is smaller than (level + hysteresis, RPM) in the 2nd gain, the drive starts to return to the 1st gain and the gain changes gradually. When absolute value of speed reference reaches (level – hysteresis, RPM), the drive completely returns to the 1st gain.
6	Position deviation being large	It is valid only in position control and full closed-loop control. When absolute value of position deviation exceeds (level + hysteresis, encoder unit) in the 1st gain, the drive switches over to the 2nd gain. When absolute value of position deviation is smaller than (level - hysteresis, encoder unit) and this status lasts within the delay (F07.08) in the 2nd gain, the drive returns to the 1st gain. The drive always uses the 1st gain if the drive is not in position control or full closed-loop control.
7	Position reference available	It is valid only in position control and full closed-loop control. When position reference is not 0 in the 1st gain, the drive switches over to the 2nd gain. When position reference is 0 and this status lasts within the delay (F07.08) in the 2nd gain, the drive returns to the 1st gain. The drive always uses the 1st gain if the drive is not in position control or full closed-loop control.
8	Positioning completion	It is valid only in position control and full closed-loop control. When positioning is not completed in the 1st gain, the drive switches over to the 2nd gain. When positioning is not completed and this status lasts within the delay (F07.08) in the 2nd gain, the drive returns to the 1st gain. The drive always uses the 1st gain if the drive is not in position control or full closed-loop control.
9	Motor speed being large	It is valid only in position control and full closed-loop control. When absolute value of motor speed exceeds (level + hysteresis, RPM) in the 1st gain, the drive switches over to the 2nd gain. When absolute value of motor speed is smaller than or equal to (level - hysteresis, RPM) and this status lasts within the delay time in the 2nd gain, the drive returns to the 1st gain. The drive always uses the 1st gain if the drive is not in position control or full closed-loop control.
10	Position reference available + Motor speed	It is valid only in position control and full closed-loop control. When position reference is not 0 in the 1st gain, the drive switches over to the 2nd gain. When position reference is 0 and this status lasts within the delay (F07.08) in the 2nd gain, the drive still uses the 2nd gain. When position reference is 0 and the delay (F07.08) is reached, if absolute value of motor speed is smaller than (level, RPM), the speed loop integration time constant is fixed at the setting of F07.04 (2nd time constant of speed loop integration), the drive returns to the 1st gain on the other aspects. If absolute value of motor speed does not reach (level - hysteresis, RPM), the speed loop integration time constant returns to the setting of F07.01 (Time constant of speed loop integration). The drive always uses the 1st gain if the drive is not in position control or full closed-loop control.

F07.08	Parameter name	Gain switchover delay			Property	During running	Control mode	PST
	Setting range	0～6000	Unit	125us	Effective time	Immediate	Default	40

It sets the delay when the servo drive returns to the 1st gain from the 2nd gain.

F07.09	Parameter name	Gain switchover level			Property	During running	Control mode	PST
	Setting range	0～20000	Unit	Based on switchover condition	Effective time	Immediate	Default	50

It sets the level for gain switchover.

Switchover is influenced by both level and hysteresis. For details, see description of **[F07.07]**. The unit of gain switchover level varies with switchover condition.

F07.10	Parameter name	Gain switchover hysteresis			Property	During running	Control mode	PST
	Setting range	0～20000	Unit	Based on switchover condition	Effective time	Immediate	Default	30

It sets the hysteresis for gain switchover.

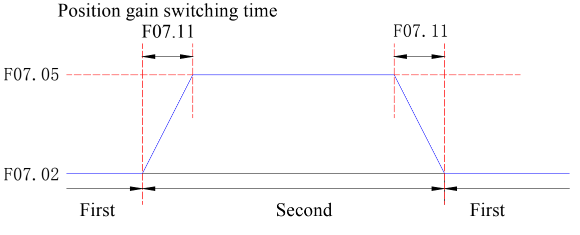
Switchover is influenced by both level and hysteresis. For details, see description of **[F07.07]**. The unit of gain switchover hysteresis varies with switchover condition.

Note:Please set **F07.09≥F07.10.**

F07.11	Parameter name	Position gain switchover time			Property	During running	Control mode	PS
	Setting range	0～60000	Unit	125us	Effective time	Immediate	Default	24

If **F07.05** (2nd position loop gain) is much larger than **F07.02** (Position loop gain), set the time of switching over from **[F07.02]** to **[F07.05]**.

This parameter can reduce the impact of an increase in position loop gain.



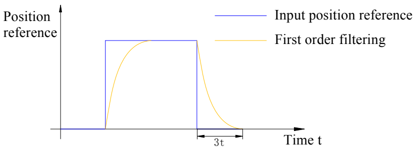
F07.12	Parameter name	1st time constant of torque reference filter			Property	During running	Control mode	PST
	Setting range	0～30.00	Unit	ms	Effective time	Immediate	Default	0.79

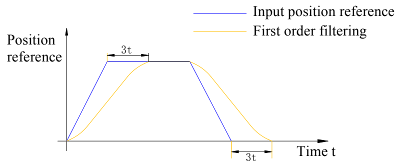
F07.13	Parameter name	2nd time constant of torque reference filter			Property	During running	Control mode	PST
	Setting range	0～30.00	Unit	ms	Effective time	Immediate	Default	0.79

It sets the time constant of torque reference filter.

Low-pass filter of torque reference helps to make torque reference more smooth and reduce vibration.

Too large setting of this parameter will slow response.





Note

(1) The servo drive provides two torque reference low-pass filters. Filter 1 is used by default.

(2) In position or speed control, gain switchover can be used. Once certain conditions are satisfied, the drive switches over to filter 2. For details on gain switchover, refer to “7.4.2 Gain Switchover”.

F07.14	Parameter name	Inertia ratio			Property	During running	Control mode	PST
	Setting range	0.00～200.00	Unit	Times	Effective time	Immediate	Default	0.00

It sets the mechanical load inertia ratio relative to the motor's own moment of inertia.

$$\text{Load transmission inertia ratio} = \frac{\text{Rotational inertia of mechanical load}}{\text{Motor's own rotational inertia}}$$

[F07.14=0] indicates that the motor does not have a load; **[F07.14=1]** indicates that the mechanical load inertia is equal to the motor's own moment of inertia. Using the inertia identification function, the drive can automatically calculate and update thevalue of**[F07.14]** parameter.

When using the online inertia identification mode [F08.25≠0], the servo drive automatically sets this parameter, which cannot be set manually. When the online inertia identification [F08.25=0] is turned off, it can be set manually.

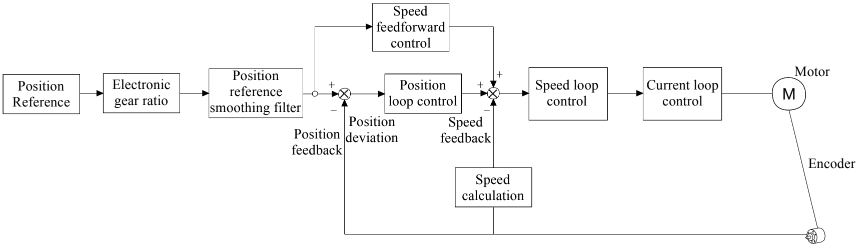
Note

When the parameter value of **[F07.14]** is equal to the actual inertia ratio, the value of the speed loop gain **[F07.00/F07.03]** can represent the maximum following frequency of the actual speed loop.

F07.15	Parameter name	Speed feedforward control selection			Property	During running	Control mode	P
	Setting range	0～2	Unit	-	Effective time	Immediate	Default	0

It sets the source of the speed loop feed forward signal.

In position control mode, speed feedforward control is used to increase the position reference response speed.



Value	Speed feedforward source	Remark
0	Internal speed feedforward	The speed information corresponding to the reference position (encoder unit) is used as the speed loop feed forward source.
1	Speed feedforward input via AI1	The speed value corresponding to the analog input by the analog channel AI1 is used as the speed loop feedforward source. For the AI1 parameter setting, please refer toF02.26、F02.27、F02.31.
2	Speed feedforward input via AI2	The speed value corresponding to the analog input by the analog channel AI2 is used as the speed loop feedforward source. For the AI2 parameter setting, please refer toF02.29、F02.30、F02.31.

Speed feedforward control parameters include**[F07.16：Speed feedforward filter time constant] and [F07.17：Speed feed forward gain].**For the parameter settings, please refer to "Chapter 7 Adjustment".

F07.16	Parameter name	Speed feedforward filter time constant			Property	During running	Control mode	P
	Setting range	0.00～64.00	Unit	ms	Effective time	Immediate	Default	1.00

It sets speed feedforward filter time constant.

F07.17	Parameter name	Speed feed forward gain			Property	During running	Control mode	P
	Setting range	0.0～100.0	Unit	%	Effective time	Immediate	Default	0.0

In the position control mode and the full-closed function, the speed feedforward signal is multiplied by **[F07.17]**, and the result is called speed feedforward as part of the speed reference.

Increasing this parameter can improve the position reference response and reduce the positional deviation at a fixed speed.

When adjusting, first set **[F07.16]** to a fixed value; then gradually increase the **[F07.17]** Value from 0 until a certain value, the speed feed forwards gets a good result.

When adjusting, you should adjust **[F07.16]** and **[F07.18]** repeatedly to find a setting with good balance.

Note

Speed feed forward function enable and speed feed forward signal selection please refer to **[F07.15: Speed feedforward control selection].**

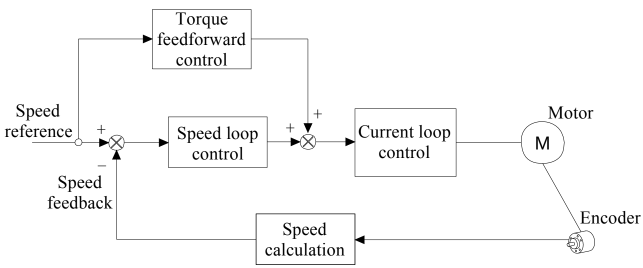
F07.18	Parameter name	Torque feedforward control selection			Property	During running	Control mode	PS
	Setting range	0～1	Unit	-	Effective time	Immediate	Default	1

It sets whether the internal torque feed forward function is enabled or not in the non-torque control mode.

Using the torque feed forward function, the torque reference response speed can be increased and the positional deviation during fixed acceleration and deceleration can be reduced.

Value	Torque feedforward control selection	Remark
0	No	-
1	Internal torque feedforward	The torque feedforward signal source is the speed reference: In position mode, the resource comes from the output of the position controller. In speed mode, the resource comes from the speed reference given from the user.

The torque feedforward function parameters include torque feedforward gain **[F07.20]** and torque feedforward filter time constant **[F07.19]**. Please refer to "7.4.4 Feedforward Gain" for setting.



F07.19	Parameter name	Torque feedforward filter time constant			Property	During running	Control mode	PS
	Setting range	0.00～64.00	Unit	ms	Effective time	Immediate	Default	1.00

It sets the filter time constant of torque feedforward.

F07.20	**Parameter name**	Torque feed forward gain			**Property**	During running	**Control mode**	PS
	Setting range	0.0～200.0	**Unit**	%	**Effective time**	Immediate	**Default**	0.0

In the non-torque control mode, the torque feedforward signal is multiplied by **[F07.20]**, and the result is called torque feedforward as part of the torque reference.

Increasing this parameter increases the responsiveness to changing speed references.

Increasing this parameter can improve the position reference response and reduce the positional deviation at a fixed speed.

When adjusting the torque feedforward parameter, first keep **[F07.19: Torque feedforward filter time constant]** as the default value and gradually increase the value of **[F07.20]** to increase the effect of torque feedforward; When rushing, keep **[F07.20]** unchanged and increase **[F07.19]**. When adjusting, you should adjust **[F07.19]** and **[F07.20]** repeatedly to find a setting with good balance.

Note

For torque feedforward function enable and torque feedforward signal selection, please refer to**[F07.18: torque feedforward control selection].**

F07.21	**Parameter name**	Speed feedback filter time			**Property**	During running	**Control mode**	PST
	Setting range	0～30.00	**Unit**	ms	**Effective time**	Immediate	**Default**	0.00

It sets the time for first-order low-pass filtering of the speed feedback.

Note

The larger the setting, the smaller the speed feedback fluctuation, but the greater the feedback delay; when set to 0, there is no filtering effect.

F07.22	**Parameter name**	Position error deviation limit			**Property**	During running	**Control mode**	PS
	Setting range	0～65535	**Unit**	Encoder Unit	**Effective time**	Immediate	**Default**	Depends on encoder type

By adjusting this parameter during position control, the stability of the motor at zero speed can be improved.

F07.23	**Parameter name**	Rigid test running laps			**Property**	At stop	**Control mode**	PS
	Setting range	1～100	**Unit**	Rev	**Effective time**	Immediate	**Default**	2

In conjunction with the **[F12.12]** rigid test action selection, the customer can set the number of motor running cycles for the test action according to the actual situation.

8.9 F08 Group: Automatic gain tuning parameters

F08.00	Parameter name	Automatic gain tuning mode selection			Property	During running	Control mode	PST
	Setting range	0～2	Unit	-	Effective time	Immediate	Default	1

It sets gain tuning mode. Related gain parameters can be set manually or be automatically tuned according to stiffness table.

Value	Automatic gain tuning mode	Remark
0	Disabled. Gain parameters set manually	-
1	Automatic gain tuning mode, gain parameters tuned automatically based on stiffness table	The 2nd gain does not follow stiffness table to change automatically.
2	Positioning mode, gain parameters tuned automatically based on stiffness table	The 2nd gain follows stiffness table to change automatically. It is one stiffness level higher than the 1st gain but does not exceed the highest stiffness level.

F08.01	Parameter name	Stiffness level selection			Property	During running	Control mode	PST
	Setting range	0～31	Unit	-	Effective time	Immediate	Default	12

It sets the stiffness level of servo system. The higher the stiffness level is, the stronger gain and quicker response will be obtained. But too strong stiffness will cause vibration.

0 indicates the weakest stiffness, and 31 indicate the strongest stiffness.

F08.02	Parameter name	Mode selection of adaptive notch			Property	During running	Control mode	PST
	Setting range	0～4	Unit	-	Effective time	Immediate	Default	0

It sets the working mode of adaptive notch.

Value	Work mode of adaptive notch
0	The third and fourth sets of adaptive notch parameters are no longer automatically updated, but can be entered manually.
1	One adaptive notch filter is valid, and the third set of notch parameters are updated in real time according to the vibration condition, and can be manually input after the automatic identification is completed.
2	Two adaptive notches are valid, and the third and fourth sets of notch parameters are updated in real time according to the vibration condition, and can be manually input after the automatic identification is completed.
3	Only the resonant frequency and amplitude are tested and are shown in F08.20, F08.21.
4	Clear the adaptive notch and restore the values of Group 3 and Group 4 to default.

F08.03	**Parameter name**	Offline inertia identification mode selection			**Property**	At stop	**Control mode**	PST
	Setting range	0～2	**Unit**	-	**Effective time**	Immediate	**Default**	0

It sets the mode of offline inertia identification. The offline inertia identification function can be enabled by function code **[F12.04]**.

Value	Offline inertia identification mode	Remark
0	Forward and reverse mode	Suitable for applications where the motor can be reversed.
1	Forward mode	Suitable for applications where the motor can only be rotated forward.
2	Reverse mode	Suitable for applications where the motor can only be reversed.

For the offline inertia identification operation, please refer to "7.2.1 Offline Inertia Identification".

F08.04	**Parameter name**	Inertia recognition maximum speed			**Property**	During running	**Control mode**	PST
	Setting range	50～6000	**Unit**	Rpm	**Effective time**	Immediate	**Default**	500

It sets the maximum motor speed reference allowed in the offline inertia identification mode.

The greater the speeds of inertia identification, the more accurate the identification result, usually do not need to change this value.

F08.05	**Parameter name**	Acceleration time during inertia identification			**Property**	During running	**Control mode**	PST
	Setting range	2～2000	**Unit**	ms	**Effective time**	Immediate	**Default**	125

It sets the time for the motor to accelerate from 0 rpm to 1000 rpm under offline inertia identification.

F08.06	**Parameter name**	Waiting time after completion of single inertia identification			**Property**	During running	**Control mode**	PST
	Setting range	20～10000	**Unit**	ms	**Effective time**	Immediate	**Default**	1000

It sets the time interval between two consecutive speed references when setting the offline inertia identification function, extending this time is beneficial to improve the identification accuracy.

F08.07	**Parameter name**	motor rotation of completing the single inertia identification			**Property**	At display	**Control mode**	PST
	Setting range	0.00～655.35	**Unit**	r	**Effective time**	-	**Default**	-

It displays the number of turns required for the motor to rotate when the single offline inertia identification function is displayed.

Note

When using the offline inertia identification function, make sure that the motor's runnable stroke at this stop position is greater than the **[F08.07]** setting. Otherwise, the **[F08.04]** or **[F08.05]** setting should be appropriately reduced until it meets the request.

F08.08	**Parameter name**	1st notch frequency			**Property**	During running	**Control mode**	PST
	Setting range	100～4000	**Unit**	Hz	**Effective time**	Immediate	**Default**	4000

It sets center frequency of the 1st notch, that is, mechanical resonance frequency.

F08.09	**Parameter name**	1st notch width level			**Property**	During running	**Control mode**	PST
	Setting range	0～10	**Unit**	-	**Effective time**	Immediate	**Default**	2

It sets width level of the notch. Keep default value normally.

Width level of notch is the ratio of notch width and notch center frequency.

F08.10	**Parameter name**	1st notch depth level			**Property**	During running	**Control mode**	PST
	Setting range	0～99	**Unit**	-	**Effective time**	Immediate	**Default**	0

It sets depth level of the 1st notch.Depth level of notch is the ratio of input and output at notch center frequency.

The larger the setting of this parameter is, the smaller the notch depth is and the weaker suppression result on mechanical resonance will be. But too large setting may cause system instability.

For the use of notch, refer to Chapter "7.6 Vibration suppression".

F08.11	**Parameter name**	2nd notch frequency			**Property**	During running	**Control mode**	PST
	Setting range	100～4000	**Unit**	Hz	**Effective time**	Immediate	**Default**	4000

F08.12	**Parameter name**	2nd notch width level			**Property**	During running	**Control mode**	PST
	Setting range	0～10	**Unit**	-	**Effective time**	Immediate	**Default**	2

F08.13	**Parameter name**	2nd notch depth level			**Property**	During running	**Control mode**	PST
	Setting range	0～99	**Unit**	-	**Effective time**	Immediate	**Default**	0

Description of the 2nd group of notch parameters is the same as that of the 1st group of notch parameters.

F08.14	Parameter name	3rd notch frequency			Property	During running	Control mode	PST
	Setting range	50～4000	Unit	Hz	Effective time	Immediate	Default	4000

F08.15	Parameter name	3rd notch width level			Property	During running	Control mode	PST
	Setting range	0～10	Unit	-	Effective time	Immediate	Default	2

F08.16	Parameter name	3rd notch depth level			Property	During running	Control mode	PST
	Setting range	0～99	Unit	-	Effective time	Immediate	Default	0

Refer to **[F08.11]**、**[F08.12]**、**[F08.13]** to understand the third group of notch parameters.

Note: The 3rd notch can be configured as adaptive notch **[F08.02=1 or 2]**. In this case, notch parameters are updated automatically by the servo drive and cannot be modified manually. If notch frequency is 4000 Hz, the notch function is disabled.

F08.17	Parameter name	4th notch frequency			Property	During running	Control mode	PST
	Setting range	100～4000	Unit	Hz	Effective time	Immediate	Default	4000

F08.18	Parameter name	4th notch width level			Property	During running	Control mode	PST
	Setting range	0～10	Unit	-	Effective time	Immediate	Default	2

F08.19	Parameter name	4th notch depth level			Property	During running	Control mode	PST
	Setting range	0～99	Unit	-	Effective time	Immediate	Default	0

Refer to **[F08.11]**、**[F08.12]**、**[F08.13]** to understand the fourth group of notch parameters.

Note:The 3rd notch can be configured as adaptive notch **[F08.02=1 or 2]**. In this case, notch parameters are updated automatically by the servo drive and cannot be modified manually. If notch frequency is 4000 Hz, the notch function is disabled.

F08.20	Parameter name	Obtained resonance frequency（Resonance frequency）			Property	At display	Control mode	PST
	Setting range	100～4000	Unit	Hz	Effective time	-	Default	4000

When **[F08.02: Adaptive notch mode selection=3],** displays the current mechanical resonance frequency.

F08.21	Parameter name	Resonance frequency identification result (depth level)			Property	At display	Control mode	PST
	Setting range	0～99	Unit	-	Effective time	-	Default	0

When **[F08.02: Adaptive notch mode selection=3], d**isplays the current mechanical resonance depth level.

F08.22	Parameter name	Low frequency resonance suppression mode selection			Property	At stop	Control mode	P
	Setting range	0～1	Unit	-	Effective time	Immediate	Default	0

It sets the mode for low frequency resonance suppression.

Value	Low frequency resonance suppression mode
0	Manually set the parameters of the low frequency resonance suppression filter（F08.23 and F08.24）
1	Automatically set the parameters of the low frequency resonance suppression filter（F08.23 and F08.24）

F08.23	Parameter name	Low frequency resonance frequency			Property	At stop	Control mode	P
	Setting range	4.0～100.0	Unit	Hz	Effective time	Immediate	Default	100.0

In the position control and full-closed functions, it sets the frequency of the low-frequency resonance suppression filter. When it is set to 100.0 Hz, the filter is invalid.

When **[F08.22=1: Automatic parametersetting of low frequency resonance suppression]**, this parameter is automatically set by the servo drive. In some screw conveying equipment, it is difficult to transmitthe vibration of the components on the worktable to the encoder and the drive through the screw. At this time, the identified result may have difference from the actual vibration frequency. Under this situation, it is required to using external photoelectric switch and other equipment to test the frequency and input this parameter after the test.

F08.24	Parameter name	The frequency of Low frequency resonance			Property	At stop	Control mode	P
	Setting range	1～20	Unit	-	Effective time	Immediate	Default	2

The low frequency resonance frequency can be obtained by the automatic recognition of the host computer or the drive or by the external photoelectric sensor vibration tester.

<table>
<tr><td rowspan="2">F08.25</td><td>Parameter name</td><td colspan="3">Online inertia identification mode</td><td>Property</td><td>At stop</td><td>Control mode</td><td>PST</td></tr>
<tr><td>Setting range</td><td>0～3</td><td>Unit</td><td>-</td><td>Effective time</td><td>Immediate</td><td>Default</td><td>0</td></tr>
</table>

This parameter sets whether to enable the online inertia identification function and the speed of system inertia update during inertia identification.

When the online automatic adjustment is enabled, the larger the set value, the faster the follow-up speed of the load characteristic change, but the larger the identification value fluctuation, the identification result will be saved once when the servo drive is powered off.

Value	Online inertia mode
0	Turn off online identification
1	Open online inertia identification, the load characteristics are basically unchanged
2	Turn on online inertia identification, load characteristics change slowly
3	Turn on online inertia identification, load characteristics change drastically

For online inertia identification, please refer to "7.2.2 Online Inertia Identification".

8.10 F09 Group: Protection parameters

<table>
<tr><td rowspan="2">F09.00</td><td>Parameter name</td><td colspan="3">Power input phase loss protection</td><td>Property</td><td>During running</td><td>Control mode</td><td>-</td></tr>
<tr><td>Setting range</td><td>0～1</td><td>Unit</td><td>-</td><td>Effective time</td><td>Immediate</td><td>Default</td><td>1</td></tr>
</table>

The main circuit power specifications vary according to the servo drive model.

Our company provides servo drives of single-phase 220 V, three-phase 220 V, and three-phase 380 V voltage classes. When there is large fluctuation to the input voltage or phase loss occurs, the servo drive flexibly selects the protection mode based on the setting of**[F09.00]** parameter.

Value	Phase loss protection mode	Remark
0	Disable	Shield input phase loss detection.
1	Failure, free stop	When a serious imbalance in the three-phase input is detected or the input phase is missing will occur Er.301 fault.

Note

When**[F09.00=0]**, Since the phase loss fault detection cannot be performed, it is necessary to ensure that the three-phase input is normal, otherwise the module may be damaged.

F09.01	**Parameter name**	Short circuit detection in operation			**Property**	During running	**Control mode**	-
	Setting range	0～1	**Unit**	-	**Effective time**	Immediate	**Default**	1

Value	Phase loss protection mode	Remark
0	Disable	Shielding short-circuit detection to ground during operation。
1	Failure, free stop	When the output short circuit fault is detected, will occur Er.104 fault. At this time, it is necessary to perform power failure check to see if there is an output short circuit.

Note

When **[F09.01=0],** since the short-circuit detection to the ground during operation cannot be performed, it is necessary to ensure that the three-phase output is normal, otherwise the module may be damaged.

F09.02	**Parameter name**	Output phase loss detection during operation			**Property**	During running	**Control mode**	-
	Setting range	0～1	**Unit**	-	**Effective time**	Immediate	**Default**	1

Value	Phase loss protection mode	Remark
0	Disable	Shield output phase loss detection during operation.
1	Failure, free stop	When a running phase loss fault is detected, will occur Er.215 fault and the machine is free to stop.

Note

When **[F09.02=0]**，since the output phase loss cannot be performed, it is necessary to ensure that the three-phase output is normal, otherwise the module may be damaged.

F09.03	**Parameter name**	Runaway protection function			**Property**	During running	**Control mode**	-
	Setting range	0～1	**Unit**	-	**Effective time**	Immediate	**Default**	1

Runaway protection function:

Value	Function	Remark
0	Disabled	In the applications where the motor drives vertical axis or is driven by load, set F09.03 to 0 to disable runaway fault (Er.102) detection.
1	Enabled	Enable the runaway protection function.

F09.04	Parameter name	Encoder disconnection detection enabled			Property	During running	Control mode	-
	Setting range	0～1	Unit	-	Effective time	Immediate	Default	1

Enable bus type encoder or photoelectric incremental encoder disconnection protection.

Value	Function	Remark
0	Disabled	Shied Er.109、Er110 fault。
1	Enabled	Enable incremental pulse type encoder disconnection detection function.

F09.05	Parameter name	Brake protection detection enable			Property	During running	Control mode	-
	Setting range	0～1	Unit	-	Effective time	Immediate	Default	0

When the brake motor is used, the brake can be detected and protected. When the value of **[09.05]** is equal to 0, the brake protection detection function is not enabled; when the setting value is equal to 1, the brake protection detection function is enabled.

F09.07	Parameter name	AD sampling overvoltage point			Property	During running	Control mode	PST
	Setting range	5000～12000	Unit	mV	Effective time	Immediate	Default	12000

This parameter is used to set the protection threshold of the analog voltage input to the AI1 and AI2 terminals. When the input voltage exceeds the voltage defined by **[09.07]**,will occur Er.309 (AD sampling overvoltage fault), it willshield this faultwhen **[F09.07=12000].**

F09.08	Parameter name	Motor overload protection gain			Property	During running	Control mode	-
	Setting range	50～800	Unit	%	Effective time	Immediate	Default	100

It sets the time reported by the motor overload fault Er.300 via **[F09.08]**.

Changing this value according to the heating condition of the motor can advance or delay the motor's overload protection fault, 50% can reduce the time by half, and 150% can increase to 1.5 times. The setting of this value should be based on the actual heat of the motor and should be used with caution!

F09.09	Parameter name	Overspeed fault threshold			Property	During running	Control mode	PST
	Setting range	0～10000	Unit	Rpm	Effective time	Immediate	Default	0

It sets the motor speed threshold when the drive has an overspeed fault. When the detected motor speed is greater than the speed defined by **[F09.09]**, the drive will report Er.302 (overspeed fault). When **[F09.09]** is defined as 0, the protection is invalid.

F09.10	Parameter name	Position deviation excessive fault threshold			Property	During running	Control mode	P
	Setting range	1～1073741824	Unit	Encoder unit	Effective time	Immediate	Default	Depends on encoder type

The factory values are different under different encoders. Corresponding to the 23-bit encoder, the value is 25165824, corresponding to the 2500 line encoder, the value is 30000.

It sets the position deviation too large fault threshold in position control mode.

When the position deviation is greater than the threshold, the servo drive will have Er.310 (the position deviation is too large).

F09.12	Parameter name	Maximum position pulse frequency			Property	At stop	Control mode	P
	Setting range	100～4000	Unit	kHz	Effective time	Immediate	Default	4000

In the position control mode, when the position reference source is the pulse command **[F04.00=0]**, input the maximum frequency of the pulse.

When the actual pulse input frequency is greater than **[F09.12]** Value, the servo drive will generate Er.304 (pulse input overspeed fault).

F09.13	Parameter name	Low speed pulse input pin filter constant			Property	At stop	Control mode	-
	Setting range	0～3	Unit	-	Effective time	Immediate	Default	3

In the position control mode, the position reference source is the pulse reference **[F04.00=0]**, and the low-speed pulse input terminal **[F04.03=0]** is selected, it sets the filter time constant for the low-speed pulse input terminal.

When there is spike interference at the low-speed pulse input terminal, the spike interference can be suppressed by setting **[F09.13]** to prevent the interference signal from entering the servo driver and causing the motor to malfunction or inaccurate. The larger the value, the stronger the filtering is.

F09.14	Parameter name	Quadrature encoder input pin filter constant			Property	At stop	Control mode	-
	Setting range	0～3	Unit	-	Effective time	Immediate	Default	2

The input port of the quadrature encoder is a digital input port. When there is spike interference in the external input signal, the peak interference can be filtered out by setting **[F09.14]** to prevent the interference signal from entering the servo drive and causing the motor to malfunction or inaccurate. The larger the value, the stronger the filtering is.

F09.16	Parameter name	Bus encoder interface filter constant			Property	At stop	Control mode	-
	Setting range	0～1	Unit	-	Effective time	Immediate	Default	1

The bus encoder input port is a high-speed digital port. When there is spike interference in the external input signal, the peak interference can be filtered out by setting **[F09.16]** to prevent the interference signal from entering the servo driver and causing the motor to malfunction or inaccurate. When **[F09.16=0]**, the filter is invalid.

F09.17	Parameter name	Locked rotor protection time			Property	At stop	Control mode	-
	Setting range	10～65535	Unit	ms	Effective time	Immediate	Default	500

It sets the time threshold for the servo drive to detect locked rotor over temperature fault (Er. 305).

The sensitivity of the locked rotor over temperature fault detection can be adjusted by changing **[F09.17]**. When **[F09.17=65535]**, the locked rotor protection is invalid.

F09.18	Parameter name	Encoder multi-turn overflow fault selection			Property	At stop	Control mode	PST
	Setting range	0～1	Unit	-	Effective time	Immediate	Default	1

Non-position mode, absolute position increment mode **[F01.01=0]**, when there is no need to detect the encoder multi-turn overflow fault, set **[F09.18=1]** to shield the multi-turn overflow fault.

Value	Function
0	Enable
1	Shield

F09.19	Parameter name	Soft limit function			Property	At stop	Control mode	PST
	Setting range	0～2	Unit	1	Effective time	Immediate	Default	0

Value	Function
0	Disabled
1	Enable after power-on
2	Enable after zero return at the origin

F09.20	Parameter name	Soft limit maximum value			Property	At stop	Control mode	PST
	Setting range	-2147483648～2147483647	Unit	Reference unit	Effective time	Immediate	Default	2147483647

F09.22	Parameter name	Soft limit minimum value			Property	At stop	Control mode	PST
	Setting range	-2147483648～2147483647	Unit	Reference unit	Effective time	Immediate	Default	-2147483648

Soft limit function settings:

When **[F09.19=0]**, the software limit function is not enabled.

[F09.19=1], the software limit function is enabled immediately after the drive is powered on. When the absolute position counter **[F10.07]** is greater than **[F09.20]**, AL.405 warning occurs, the forward overtravel stop is executed; when the absolute position counter **[F10.07]** is less than **[F09.22]**, AL.406 warning occurs, execution negative overtime shutdown.

[F09.19=2], the software limit function is not enabled before the home position is restored after the drive is powered on. After the home position return, when the absolute position counter **[F10.07]** is greater than **[F09.20]**, the AL.405 warning occurs, and the forward overtravel stop is executed; when the absolute position counter **[F10.07]** is smaller than **[F09.22]**, AL.406 occurs. Warning, perform a negative overtravel shutdown.

F09.24	Parameter name	Overvoltage suppression coefficient			Property	During running	Control mode	PST
	Setting range	0.0～100.0	Unit	%	Effective time	Immediate	Default	0.0

The larger the value of **[F09.24]** , the more obvious the suppression effect, but the slower the response to the power generation load.

8.11 F10 Group: Monitoring parameter

F10.00	Parameter name	Actual motor speed			Type	At display	Control mode	PST
	Setting range	-	Unit	Rpm			Default	-

It displays the actual motor speed, In unit of 1rpm.

F10.01	Parameter name	Speed reference			Type	At display	Control mode	PS
	Setting range	-	Unit	Rpm			Default	-

It displays the current speed reference of the drive (in unit of 1 RPM) in the position and speed modes.

F10.02	Parameter name	Internal torque reference			Type	At display	Control mode	PST
	Setting range	-	Unit	%			Default	-

It displays the current torque reference, in unit of 0.1%. 100.0% corresponds to the rated motor torque.

F10.03	**Parameter name**	Current valid value			**Type**	At display	**Control mode**	PST
	Setting range	-	**Unit**	A			**Default**	-

It displays the servo motor current valid value, displayaccuracy is 0.01A.

F10.04	**Parameter name**	Bus voltage value			**Type**	At display	**Control mode**	PST
	Setting range	-	**Unit**	V			**Default**	-

It displays the DC bus voltage value of the input voltage of the main circuit of the driver after rectified, the display accuracy is 0.1V.

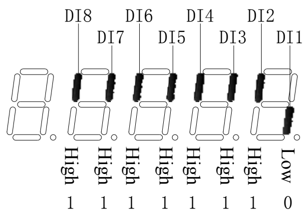
F10.05	**Parameter name**	Input signal（DI signal）monitor			**Type**	At display	**Control mode**	PST
	Setting range	-	**Unit**	-			**Default**	-

It displays the current level status of the 8 hardware DI terminals without filtered.

Display mode: The upper part of the digital tube is bright to indicate high level ("1"); the lower half is bright to indicate low level ("0").

The DI1 terminal is low level, and the DI2~DI8 terminal is high level. For example, the corresponding binary code is “11111110”. Our drive debugging platform software can read **[F10.05],** the current decimal value is: 254.

The keypad is displayed as follows:



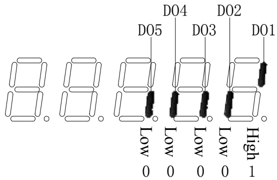
F10.06	**Parameter name**	Output signal (DO signal) monitor			**Type**	At display	**Control mode**	PST
	Setting range	-	**Unit**	-			**Default**	-

It displays the current level status of the 5 hardware DO terminals without filtered.

Display mode: The upper part of the digital tube is bright to indicate high level ("1"); the lower half is bright to indicate low level ("0").

The DO1 terminal is low level, and the DO2~DO5 terminal is low level. For example, the corresponding binary code is “00001”. Our drive debugging platform software can read **[F10.06],** the current decimal value is: 1.

The keypad is displayed as follows:



F10.07	Parameter name	Absolute value counter			Type	At display	Control mode	PST
	Setting range	-	Unit	Reference unit			Default	-

In position mode, the current absolute position of the motor (Reference unit) is displayed.

The function code is 32 bits and the value is displayed as decimal data.

F10.09	Parameter name	Mechanical angle			Type	At display	Control mode	PST
	Setting range	-	Unit	Encoder unit			Default	-

It displays the actual mechanical angle of the motor (Encoder unit), 0 corresponding to a mechanical angle of 0°.

$$\text{Actual mechanical angle} = \frac{F10.09}{65535} \times 360.0°$$

F10.10	Parameter name	Electrical angle			Type	At display	Control mode	PST
	Setting range	-	Unit	°			Default	-

It displays the current electrical angle of the motor, display accuracy is 0.1°.

When the motor rotates, the electrical angle varies by ±360.0°. When the motor is 4 pairs, the motor will change from 0° to 359° every time it rotates. Similarly, when the motor is 5 pairs, the motor electrical angle of each revolution will change from 0° to 359° five times.

F10.11	Parameter name	Input position reference corresponding speed information			Type	At display	Control mode	P
	Setting range	-	Unit	Rpm			Default	-

It displays the speed value corresponding to the position reference of the drive's single position control cycle in position mode.

The filter time constant when the position reference is converted into speed information can be set by **[F05.16]**.

F10.12	**Parameter name**	Input position reference pulse counter			**Type**	At display	**Control mode**	P
	Setting range	-	**Unit**	Reference unit			**Default**	-

In the position mode, it counts and displays the number of position reference that has not been multiplied by the electronic gear ratio during servo operation.

The function code is 32 bits and the value is displayed as decimal data.

F10.14	**Parameter name**	Encoder position deviation counter			**Type**	At display	**Control mode**	P
	Setting range	-	**Unit**	Encoder unit			**Default**	-

It counts and displays the position deviation value after the multiplier of the electronic gear ratio in position mode.

The function code is 32 bits, and the value is displayed as decimal data.

Note: When met the **[F04.18: Position Deviation Clear Condition]** setting condition, the value of **[F10.14]** can be cleared.

F10.16	**Parameter name**	Motor encoder feedback pulse counter			**Type**	At display	**Control mode**	PST
	Setting range	-	**Unit**	Encoder unit			**Default**	-

It counts the position pulse feedback by the built-in encoder in any mode,

The function code is 32 bits and the value is displayed as decimal data.

F10.18	**Parameter name**	Total power-on time			**Type**	At display	**Control mode**	PST
	Setting range	-	**Unit**	H			**Default**	-

This function code is used to record the total power-on time of the servo drive.

F10.19	**Parameter name**	Total running time			**Type**	At display	**Control mode**	PST
	Setting range	-	**Unit**	H			**Default**	-

This function code is used to record the total running time of the servo drive.

F10.20	**Parameter name**	AI1 sampling voltage value			**Type**	At display	**Control mode**	PST
	Setting range	-	**Unit**	V			**Default**	-

It displays analog channel 1 actual sample voltage value, accuracy is 0.01V.

F10.21	**Parameter name**	AI2 sampling voltage value			**Type**	At display	**Control mode**	PST
	Setting range	-	**Unit**	V			**Default**	-

It displays analog channel 2 actual sample voltage value, accuracy is 0.01V.

F10.22	**Parameter name**	Module temperature value			**Type**	At display	**Control mode**	PST
	Setting range	-	**Unit**	℃			**Default**	-

It displays the internal module temperature value, and this value can be used as a reference for the actual temperature of the current drive. Some drives without temperature sensing devices display 30 °C all the time.

F10.23	**Parameter name**	Position deviation counter			**Type**	At display	**Control mode**	P
	Setting range	-	**Unit**	Reference unit			**Default**	-

It displays the position deviation not processed by the electronic gear ration in the position control mode.The setting is 32-bit data, and the keypad display is a decimal.

The position deviation (reference unit) is the value after the encoder position deviation is converted. When the division operation is performed, there is a loss of precision.

F10.25	**Parameter name**	Actual motor speed			**Type**	At display	**Control mode**	PST
	Setting range	-	**Unit**	Rpm			**Default**	-

It displays the actual motor speed, in unit of 0.1 RPM.

The setting is 32-bit data, and the keypad display is a decimal.

F10.27	**Parameter name**	Mechanical absolute position (low 32 bits)			**Type**	At display	**Control mode**	PST
	Setting range	-	**Unit**	Encoder unit			**Default**	0

It displays the low 32-bit data of the mechanical position feedback (encoder unit) when the absolute encoder is used.

F10.29	**Parameter name**	Mechanical absolute position (high 32 bits)			**Type**	At display	**Control mode**	PST
	Setting range	-	**Unit**	Encoder unit			**Default**	0

It displays the high 32-bit data of the mechanical position feedback (encoder unit) when the absolute encoder is used.

F10.31	Parameter name	Real-time input position reference counter			Type	At display	Control mode	PST
	Setting range	-	Unit	Reference unit			Default	-

It displays the position reference counter before being divided or multiplied by the electronic gear ratio. It is irrelative to the current servo state and control mode.

F10.33	Parameter name	Number of absolute encoder turns			Type	At display	Control mode	PST
	Setting range	-	Unit	1Rev			Default	-

It displays the number of absolute encoder turns.

F10.34	Parameter name	Position of absolute encoder within one turn			Type	At display	Control mode	PST
	Setting range	-	Unit	Encoder unit			Default	-

It displays the position feedback of the absolute encoder within one turn.

F10.36	Parameter name	Absolute position (low 32 bits) of absolute encoder			Type	At display	Control mode	PST
	Setting range	-	Unit	Encoder unit			Default	-

It displays the low 32-bit data of the position feedback of the absolute encoder.

F10.38	Parameter name	Absolute position (high 32 bits) of absolute encoder			Type	At display	Control mode	PST
	Setting range	-	Unit	Encoder unit			Default	-

It displays the high 32-bit data of the position feedback of the absolute encoder.

F10.42	Parameter name	Positioning completion time			Type	At display	Control mode	P
	Setting range	-	Unit	Ms			Default	-

It displays the positioning completion time in the positioning mode.

F10.43	Parameter name	Number of pulses			Type	At display	Control mode	P
	Setting range	-	Unit	Encoder unit			Default	-

It displays the maximum pulse overshoot during positioning in the positioning mode.

F10.45	Parameter name	Motor output torque			Type	At display	Control mode	PST
	Setting range	-	Unit	%			Default	-

It displays actual measured torque value of the current motor output, accuracy is 0.1%, 100.0% corresponds to 1 times of motor rated torque.

F10.46	Parameter name	Current fault details			Type	At display	Control mode	PST
	Setting range	-	Unit	-			Default	-

Views detailed fault classification information of the current fault via this parameter. For details, see Chapter 9;

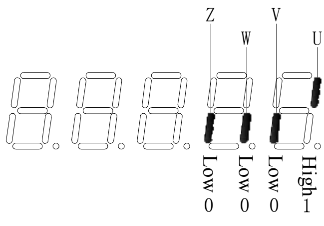
F10.47	Parameter name	Encoder Z、U、V、W status			Type	At display	Control mode	PST
	Setting range	-	Unit	-			Default	-

When installing or inspecting the 15-wire photoelectric incremental encoder, by slowly rotating the motor, you can check whether the Z, U, V, W wiring signals is normal by the **[F10.47]** parameter.

Display mode: The upper part of the digital tube is lit high (indicates by "1"); the lower half is lit low (indicated by "0").

The U terminal is high level, and the V, W, and Z terminals are low level. For example, the corresponding binary code is “0001”. Our drive debugging platform software can read **[F10.47]**, the current decimal value is: 1.

The keypad is displayed as follows:



F10.48	Parameter name	Average torque			Type	At display	Control mode	PST
	Setting range	-	Unit	%			Default	-

It displays the percentage of average load torque accounts for rated motor torque, accuracy is 0.1%, and 100.0% corresponds to 1 motor rated torque.

F10.49	Parameter name	Peak torque			Type	At display	Control mode	PST
	Setting range	-	Unit	%			Default	-

It displays the maximum torque of the drive output in the past 10 seconds, accuracy is 0.1% and 100.0% corresponds to 1 time of motor rated torque.

F10.50	Parameter name	Output power			Type	At display	Control mode	PST
	Setting range	-	Unit	W			Default	-

It displays the effective power of the current drive output, accuracy is 1W.

F10.51	Parameter name	The reason of servo motor not rotating			Type	At display	Control mode	PST
	Setting range	-	Unit	-			Default	-

This parameter is used to help customers analyze, find problems, and solve the problem that the motor does not turn.

Value	Possible reason	Solution
0	Unknown reason	Look for service from manufacturer
1	Reaching the running limit time	Look for service from manufacturer
2	Terminal emergency stop reference is valid	Release terminal emergency stop status
3	F12.07 emergency stop is effective	Set F12.07=0
4	The current fault has not been released	Reset current fault
5	The current fault has not been released	Reset current fault
6	Current mains voltage is too low	220V drive：Check if the bus voltage is lower than160V； 380V drive：Check if the bus voltage is lower than360V.
7	Multi-speed single operation end stop	Restart
8	Servo enable signal is invalid	Check if the servo enable signal is valid by DI monitoring
9	Release receiving reference during the delay start	Check if the delayed receiving parameter (**F01.07**) is set correctly
10	The position reference is given as0	Check position given channel
11	The speed reference is given as0	Check speed given channel
12	Torque given too small	Check the torque reference channel

F10.54	Parameter name	Output voltage			Type	At display	Control mode	PST
	Setting range	-	Unit	V			Default	-

It displays the line voltage of the current drive output, accuracy is 1V.

8.12 F11 Group: Communication parameter

F11.00	Parameter name	Protocol selection			Property	At stop	Control mode	PST
	Setting range	0～1	Unit	-	Effective time	Immediate	Default	0

It sets the drive communication protocol.

0: Standard Modbus protocol.

1: Reserved.

F11.01	Parameter name	Drive axis address			Property	During running	Control mode	PST
	Setting range	1～247	Unit	-	Effective time	Immediate	Default	1

It sets the drive axis address.

0: Broadcast address, the upper computer can operate all the drives through the broadcast address, and the drive receives the frame of the broadcast address to perform corresponding operations, but does not respond.

1~247: When multiple servo drives are connected to the network, each drive can only have a unique address. Otherwise, communication may be abnormal or communication may not be possible.

F11.02	Parameter name	Serial port baud rate setting			Property	During running	Control mode	PST
	Setting range	0～7	Unit	-	Effective time	Immediate	Default	6

It sets the communication rate between the drive and the host computer.

Value	Baud rate setting	Value	Baud rate setting
0	2400 Kbp/s	4	38400 Kbp/s
1	4800 Kbp/s	5	57600 Kbp/s
2	9600 Kbp/s	6	115200Kbp/s
3	19200 Kbp/s	7	230400Kbp/s

The communication speed of the servo drive must be the same as the communication rate of the host computer, otherwise it can not communicate.

F11.03	Parameter name	MODBUS data format			Property	During running	Control mode	PST
	Setting range	0～3	Unit	-	Effective time	Immediate	Default	0

It sets the data verification mode when the drive communicates with the host computer.

Value	Data format	Value	Baud rate setting
0	No check, 2 stop bits	2	Odd parity check, 1 stop bit
1	Even parity check, 1 stop bit	3	No check, 1 stop bit

F11.04	Parameter name	MODBUS reference response delayed time			Property	During running	Control mode	PST
	Setting range	0～5000	Unit	ms	Effective time	Immediate	Default	1

It sets the delay of the slave to answer the host computer after receiving the host computer's reference.

F11.07	Parameter name	Communication timeout checkout time			Property	During running	Control mode	PST
	Setting range	0.0～1000.0	Unit	s	Effective time	Immediate	Default	0.0

When the serial port communication is unsuccessful and its duration exceeds the value of this function code, the drive determines that it is a communication failure. When Value is 0, the drivedoes not detect the serial port communication signal, that is, this function is invalid.

F11.08	Parameter name	Communication error detection time			Property	During running	Control mode	PST
	Setting range	0.0～1000.0	Unit	s	Effective time	Immediate	Default	0.0

When the serial port communication error occurs, the drive will judge the communication error as the duration exceeds the value of this function code. When Value is 0, the drive does not detect the serial port communication signal, that is, this function is invalid.

8.13 F12 Group: Auxiliary function parameter

F12.00	Parameter name	Software reset			Property	At stop	Control mode	-
	Setting range	0～1	Unit	-	Effective time	Immediate	Default	0

Software reset operation selection:

Value	Function	Remark
0	No operation	-
1	Enable	After the software reset is enabled, the program in the drive is automatically reset without power loss (similar to the program reset operation at power-on).

Effective condition: servo non-enable state;

F12.01	Parameter name	Fault reset			Property	At stop	Control mode	-
	Setting range	0～1	Unit	-	Effective time	Immediate	Default	0

Fault reset operation selection:

Value	Function	Remark
0	No operation	-
1	Enable	The second type and the third type can reset the fault. In the non-operating state of the servo, after the cause is released, the fault can be stopped by enabling the fault reset function.

Note:

For fault classification, please refer to "Chapter 9 Troubleshooting".

The fault reset function only make keypad stop displaying fault, which does not mean that the parameter change takes effect.

This function is not valid for non-resettable faults and is used with caution when the cause of the fault has not been resolved.

F12.02	Parameter name	Absolute encoder reset enable			Property	At stop	Control mode	-
	Setting range	0～2	Unit	-	Effective time	Immediate	Default	0

It sets whether to reset encoder internal faults or multi-turn data.

Note: If the encoder feedback multi-turn data is reset, the absolute position of the encoder changes greatly, and the mechanical homing operation is required in this case.

Value	Function
0	Disabled
1	Reset fault
2	Reset faults and multi-turn data

F12.03	Parameter name	JOG function			Property	-	Control mode	-
	Setting range	-	Unit	-	Effective time	-	Default	-

In parameter setting mode, after you switch to **[F12.03]** and press key SET, jog running is enabled. For details, refer to “5.5.1 Jog Running”.

This function is irrelevant to the servo control mode.

F12.04	Parameter name	Offline inertia auto-tuning enable			Property	At stop	Control mode	-
	Setting range	-	Unit	-	Effective time	Immediate	Default	-

Panel offline inertia identification function operation entry. In the parameter display mode, after switching to the **[F12.04]** function code, press the “SET” button and then press the UP or DOWN button, it will start offline inertia identification, you can press the “MENU” button to exit the identification at any time during the identification process. In the identification interface, press the SET button a few long times, the current displayed inertia value will be stored in the **[F07.14]** parameter.

For details on offline inertia identification, please refer to "7.2.1 Offline Inertia Identification".

<table>
<tr><td rowspan="2">F12.05</td><td>Parameter name</td><td colspan="3">Motor parameter self-learning</td><td>Property</td><td>At stop</td><td>Control mode</td><td>-</td></tr>
<tr><td>Setting range</td><td>0～3</td><td>Unit</td><td>-</td><td>Effective time</td><td>Immediate</td><td>Default</td><td>-</td></tr>
</table>

Panel motor parameter self-learning function operation entry. After switching to the **[F12.05]** function code, select the function code and press the “SET” key, the motor parameter self-learning will be enable.You can press the “MENU” button to exit the identification at any time during the identification process.

Value	Function	Remark
0	Disabled	-
1	Encoder self-learning	Motor UWV power line phase sequence and encoder AB phase sequence self-learning, encoder installation angle learning (z signal and UVW signal); if Er.205 appears during learning, and when the current fault details (F10.46)=2051, need to adjust the UVW power line phase sequence or AB phase sequence. The results of the encoder learning are automatically stored in F00.24 and F00.28 ~ F00.33.
2	Motor parameter static self-learning	Learn the electrical parameters of the motor and store it in F00.13, F00.14, and F00.15.
3	Motor parameter rotation self-learning	Learn the electrical parameters of the motor and store it in F00.13, F00.14, F00.15, F00.16, and F00.17.

Note

(1) The parameters of the motor provided by our company have been rigorously tested, no need to operate the motor and the encoder learning. If the motor is not supplied by our company, then it is necessary to operate the motor and encoder self-learning, otherwise the control may fail.
(2) If self-learning is required, it is recommended to perform encoder self-learning first to ensure that the direction of rotation of the motor is counterclockwise (CCW direction). After encoder self-learning, start the electrical parameters self-learning, it is recommended that remove the motor’s load and then rotate. After learning, the current loop control of motor can reach optimal state.

<table>
<tr><td rowspan="2">F12.06</td><td>Parameter name</td><td colspan="3">Fixed angle output</td><td>Property</td><td>At stop</td><td>Control mode</td><td>-</td></tr>
<tr><td>Setting range</td><td>-</td><td>Unit</td><td>-</td><td>Effective time</td><td>Immediate</td><td>Default</td><td>-</td></tr>
</table>

The function operation entry for the panel installation code. After switching to the **[F12.06]** function code, the encoder installation function will be enabling when pressing the “SET” button. For the 15-wire incremental bus encoder, you need to pre-tighten the encoder first, and then ensure that the encoder is fixed after installing the error pulse. After fixing, press the “MENU” button to exit the installation mode; for bus communication absolute encoder can be directly installed and fixed, and make this function enabled one more time, the system will automatically complete the calibration and exit.

F12.07	Parameter name	Emergency stop			Property	During running	Control mode	-
	Setting range	0～1	Unit	-	Effective time	Immediate	Default	0

Emergency stop operation selection:

Value	Function
0	Disabled
1	Enabled

Regardless of the operating state of the drive, when this function is enabled, the servo drive immediately stops according to the servo OFF stop mode **[F01.03]**. The host computer can implement emergency stop by modifying this parameter.

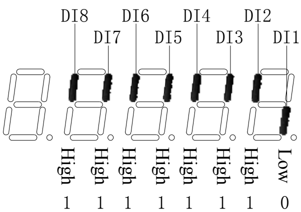
F12.08	Parameter name	DI forced input given			Property	During running	Control mode	-
	Setting range	0～0xFF	Unit	-	Effective time	Immediate	Default	0x00

This parameter sets the level logic of the DI function assigned by **[F02 Group]**.

[F12.08] is displayed in hexadecimal on the panel. When converted to binary, bit (n)=1 indicates that the level logic of the DI function is low, and bit(n)=0 indicates the level logic of the DI function is high.

E.g:

The parametervalue of **[F12.08]** is 0x01, which is converted to binary as "00000001". Therefore, DI1 is low level, DI2~DI8 port is high level, and 8 DI port levels can also be monitored by **[F10.05]** status information.



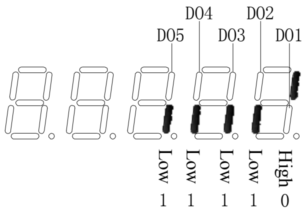
Whether the DI function is valid depended on this parameter and logic of the DI terminal set by the **[F02 group]**.

F12.09	Parameter name	DO forced output given			Property	During running	Control mode	-
	Setting range	0～0x001F	Unit	-	Effective time	Immediate	Default	0

It sets whether the DO function assigned by **[F03 Group]** is valid via this parameter.

[F12.09] is displayed in hexadecimal on the panel. When converted to binary, bit (n) =1, it means the DO function is valid, and bit (n)=0 means the DO function is invalid. For example, the **[F12.09]** parameter value is 0x1E, and the conversion to binary is "11110". Therefore, the DO function of the DO1 port configuration is invalid, the DO function of the DO2~DI5 port configuration is valid, and then output corresponding DO port level afterprocessing level setting information according to the **[F03 group]** DO logic. Assume that the logical power average of the **[F04 group]** DO1 to DO5 terminals is:

0: Output L low when valid, then the result is displayedin **[F10.06]** as follows:



F12.10	**Parameter name**	In-plant debugging parameters			**Property**	During running	**Control mode**	-
	Setting range	0～1	**Unit**	-	**Effective time**	Immediate	**Default**	0

This parameter is used for in-plant debugging.

Value	Function
0	Disabled
1	AllLED tubesare lit

F12.11	**Parameter name**	Store all parameters again			**Property**	At stop	**Control mode**	-
	Setting range	0～1	**Unit**	-	**Effective time**	Immediate	**Default**	0

The parameters changed by communication or our host computer debugging software will not be stored in the E^2PROM memory of the drive in real time, because if the function code value changed in large quantities for a long time is stored in the E^2PROM, the E^2PROM will be damaged and the drive will occurs Er. 211 fault (E^2PROM read and write error). If you need to modify the parameters after the drive is powered off and restarted, you need to set this parameter to 1. The drive automatically stores the parameters once and **[F12.11]** returns to 0.

F12.12	**Parameter name**	Rigid test auxiliary parameter			**Property**	At stop	**Control mode**	-
	Setting range	0～10	**Unit**	-	**Effective time**	Immediate	**Default**	0

After selecting the debugging action required by the appropriate system, press SET button for a few times to start the system rigid debugging. You can press MENU to exit at any time during the debugging process. When debugging, the keypad displays the current rigid level and the user can adjust the rigidity level through the UP/DOWN keys of the keyboard, and observe whether the load movement track meets the user's rigidity requirement. When it meets requirements, the current rigid level value can be directly stored to [F08.01] by pressing the SET button. The position reference acceleration/deceleration speed and waiting time are multiplexed **[F08.04], [F08.05], [F08.06]** parameters, and the number of laps of the motor can be set via **[F07.23].**

Value	Function
0	Disabled
1	Forward speed adjustment (acceleration and deceleration time and speed are determined by F08.04 and F08.05)
2	Reverse speed adjustment (acceleration and deceleration time and speed are determined by F08.04 and F08.05)
3	Number of revolutions: F07.23 laps, direction of rotation: forward → reverse
4	Number of revolutions: F07.23 laps, direction of rotation: reverse → forward
5	Number of revolutions: F07.23 laps, direction of rotation: forward → forward
6	Number of revolutions: F07.23 laps, direction of rotation: reverse → reverse

<table>
<tr><td rowspan="2">F12.13</td><td>Parameter name</td><td colspan="3">Fixed angle (for in-plant debugging)</td><td>Property</td><td>At stop</td><td>Control mode</td><td>-</td></tr>
<tr><td>Setting range</td><td>0.0～360.0</td><td>Unit</td><td>°</td><td>Effective time</td><td>Immediate</td><td>Default</td><td>0.0</td></tr>
</table>

<table>
<tr><td rowspan="2">F12.14</td><td>Parameter name</td><td colspan="3">Fixed current (for in-plant debugging)</td><td>Property</td><td>At stop</td><td>Control mode</td><td>-</td></tr>
<tr><td>Setting range</td><td>10～300</td><td>Unit</td><td>%</td><td>Effective time</td><td>Immediate</td><td>Default</td><td>100</td></tr>
</table>

<table>
<tr><td rowspan="2">F12.16</td><td>Parameter name</td><td colspan="3">Gravity load identification</td><td>Property</td><td>At stop</td><td>Control mode</td><td>-</td></tr>
<tr><td>Setting range</td><td>-</td><td>Unit</td><td>-</td><td>Effective time</td><td>Immediate</td><td>Default</td><td>0.0</td></tr>
</table>

Enter the **[F12.16]** parameter and press the UP button to open the Z-axis gravity load identification function. After successful identification, the keyboard displays currently stable gravity detection value; the identification condition is that the servo is enabled and the brake is open, the input reference is 0 and the speed is less than 10 rpm. For a few seconds, after the successful identification, the result is stored in the **[F06.21]** function code, and this value can also be set manually.

8.14 F13 Group: Full closed loop function parameter

F13.00	**Parameter name**	Encoder feedback mode			**Property**	At stop	**Control mode**	P
	Setting range	0～2	**Unit**	-	**Effective time**	Immediate	**Default**	0

It sets the encoder feedback signal source in full closed-loop control

Value	Encoder feedback mode	Description
0	Internal encoder feedback	The position feedback signals come from the internal encoder of the motor.
1	External encoder feedback	The position feedback signals come from the full closed-loop external encoder. 1st electronic gear ratio is used.
2	Internal/External switchover at electronic gear ratio switchover	The DI with function 24 (FunIN.24: GEAR_SEL) is used to control switchover.DI function: Invalid: internal encoder feedback, using 1st electronic gear ratio. Valid: internal encoder feedback, using 2nd electronic gear ratio.

Note

When using the full-closed function, when the position reference source is the internal position reference, the speed setting unit is for the internal encoder. Please pay attention to the conversion before setting the speed value, otherwise it will cause an operation error.

F13.01	**Parameter name**	External encoder usage			**Property**	At stop	**Control mode**	P
	Setting range	0～1	**Unit**	-	**Effective time**	Immediate	**Default**	0

When the full-closed function is set, the internal and external encoders feed back the pulse counting direction during motor rotation.

Value	Method of using external position sensor	Description
0	Use in standard operating direction	During the motor rotation, the internal encoder pulse feedback counters (**F10.16**) and the external encoder pulse feedback counter (**F13.09**) count in the same direction.
1	Use in reverse direction	The internal encoder pulse feedback counters (**F10.16**) and the external encoder pulse feedback counter (**F13.09**) count in the opposite direction during motor rotation.

Note

(1) Before running the motor, be sure to test before the test run. For details, see "**6.1.1 Pre-operation test**".
(2) The function code must be set correctly, otherwise it will cause a flying accident!

F13.02	**Parameter name**	The number of external encoder feedback pulses per onemotor revolution			**Property**	At stop	**Control mode**	P
	Setting range	1～1373741824	**Unit**	External encoder unit	**Effective time**	Power-on again	**Default**	10000

It sets the pulses per motor revolutionfeedback by the external encoder.

Could set count relationship between feedback pulses from the external encoder and those from the internal encoder through setting this parameter.

Calculate the value based on analysis of mechanical parameters. When it is rigid coupling between the motor and the external encoder (scale), you can also set as below:

1) Manually rotate the motor and observe **F10.16** (**Feedback pulse counter of internal encoder**) meanwhile. After ensuring that the motor rotates for a turn (**F10.16:** servo motor resolution), calculate the change of**F13.09** (Feedback pulse counter of external encoder).

The change value is the value of **[F13.02].**

2) If **[F10.16]** = X1, **[F13.09]** = Y1 before rotating the motor, and **[F10.16]**= X2, **[F13.09]**= Y2 after rotating the motor, thus:

F13.02 = Servo motor resolution x (Y2 – Y1)/(X2 – X1)

The calculated data must be positive; if not, perform the first step again.

There is a deviation with the data calculated by using this method for non-rigid connection.

Note:

Ensure correct setting of H0F-04. Otherwise, Er.B02 may occur after servo running.

Note

Ensure correct setting of **[F13.02]**. Otherwise, Er.311 may occur after servo running.

F13.04	**Parameter name**	Full closed-loop position deviation excess threshold			**Property**	At stop	**Control mode**	P
	Setting range	0～1373741824	**Unit**	External encoder unit	**Effective time**	Immediate	**Default**	10000

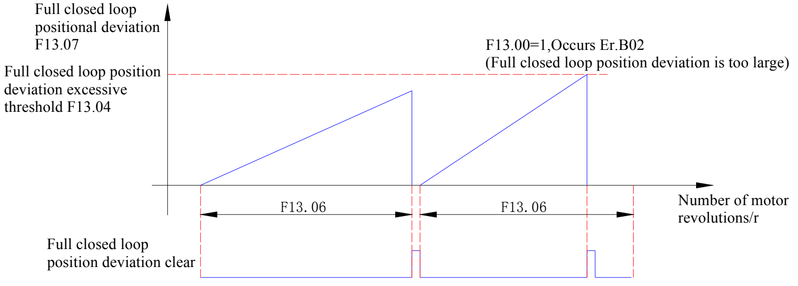
It sets the position deviation threshold at which the servo drive detects fault Er.311 indicating that the position deviation is excessive.

When **[F13.04=0]**, the servo drive does not detect Er.311 and always clears the full closed-loop position deviation.

F13.06	**Parameter name**	Full closed-loop position deviation clear setting			**Property**	At stop	**Control mode**	P
	Setting range	0～100	**Unit**	r	**Effective time**	Immediate	**Default**	0

As the motor turns the number of revolutions set by this parameter, the servo drive clears the full closed-loop position deviation to 0. The number of revolutions is expressed by the internal encoder feedback pulses in **[F10.16].**

Value	Full closed-loop position deviation clear setting
0	The servo drive always clears the full closed-loop position deviation.
1～100	If the position deviation remains smaller than F13.04 after the motor turns n revolutions, the servo drive clears the position deviation at the nth resolution, and counts the position deviation and number of motor revolutions from 0 again.
	Once the position deviation becomes larger than F13.04 after the motor turns n revolutions, the servo drive immediately clears the position deviation. If external encoder feedback (F13.00= 1 or 2) is used, Er.311 will occur.



Note:

The number of motor revolutions will not be cleared to 0 when the servo drive is not in running state.

For example, assume that **F13.06** = 10:

If the motor turns for five revolutions when the S-ON signal becomes inactive, the servo drive clears the data to 0 when the motor turns for another five revolution after the S-ON signal resumes active.Then, the servo drive clears the value for each 10 motor revolutions.

F13.07	Parameter name	Full closed-loop position deviation counter			Property	At display	Control mode	P
	Setting range	-1073741824～1073741824	Unit	External encoder unit	Effective time		Default	0

It counts and displays the position deviation absolute value in full closed-loop control.

Full closed-loop position deviation = Absolute position feedback of external encoder – Converted value of absolute position feedback of internal encoder

Note:

"Hybrid control pulse deviation" displayed in servo commissioning software has the same definition as **[F13.07]**.

If internal encoder feedback is used, **[F13.04=0]** or **[F13.06=0]**,**[F13.07]** value is always 0.

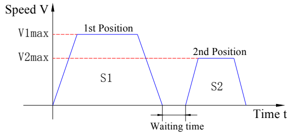
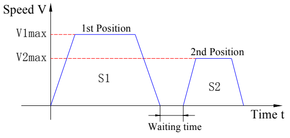
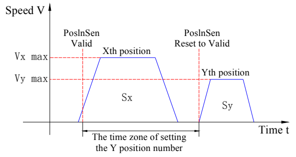
F13.09	**Parameter name**	Feedback pulse counter of external encoder		**Property**	At display	**Control mode**	P
	Setting range	-1073741824～1073741824	**Unit** External encoder unit	**Effective time**	-	**Default**	-

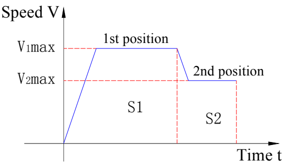
It counts and displays the feedback pulses of the external encoder (after divided or multiplied by electronic gear ratio, in external encoder unit).

8.15 F14 Group: Multi-position function parameters

F14.00	**Parameter name**	Multi-position running mode		**Property**	At stop	**Control mode**	P
	Setting range	0～3	**Unit** -	**Effective time**	Immediate	**Default**	1

It sets the multi-position running mode when the main position reference source is multi-position (**F04.00=2**) in position control mode

Value	Running mode	Remark	Running waveform
0	Stop after running single cycle	Stop after one round of operation; The position number is automatically incremented and switched; The waiting time can be set between position and position; Multi-positionenable is level effective;	V1max、V2max：Position 1、position 2 Max running speed； S1、S2：position1、position 2 displacement； 
1	Cyclic running	Cyclic running, the starting position t number after the first round is 1; The position number is automatically incremented and switched; The waiting time can be set between position and position; Multi-positionenable is level effective;	
2	DIswitchover running	The position number is updated and it is sustainable The position number is deternínded by the logic of DI terminal; The interval between position and position is determined by the delay time of the upper computer reference; Multi-position enable is effective for edge change.	

3	Sequential running	Stop after one round running; cyclic running, and the starting position number after the first round is F14.05; Position number auto increment function There is no waiting time between the segment and the segment; Multi-segment position enable is level effective	

When using the multi- position function, one DI port must be set to DI function 28 (FunIN.28: PosInSen, multi-position enable). For the setting method, please refer to **[F02 group: terminal input parameter]**.

When each displacement reference is completed, the positioning completion (COIN) is valid. If it is used to judge whether a certain displacement is completed, please use DO function 5 (FunOUT.5: COIN, positioning completion). For the setting method, please refer to **[F03 group: Terminal output parameter]**.

During each period of operation, the servo enable must be valid. Otherwise, the drive will immediately stop according to the servo enable OFF mode set in **[F01.03]**, and the positioning completion (COIN) will be invalid after stop;

In the DI switching operation mode, the servo enable is valid during a certain period of operation. If multi-position is disabled, the servo will abandon the unsent displacement reference in this segment and stop. After stop, the positioning completion (COIN) is valid. Re-open the multi-position enable function. The running position number is determinded by **[F14.02].**

<table>
<tr><td rowspan="2">F14.01</td><td>Parameter name</td><td colspan="3">Number of position reference profile</td><td>Property</td><td>At stop</td><td>Control mode</td><td>P</td></tr>
<tr><td>Setting range</td><td>1～16</td><td>Unit</td><td>-</td><td>Effective time</td><td>Immediate</td><td>Default</td><td>1</td></tr>
</table>

It sets the total number of position reference profile. You can set different displacements, running speed, and acceleration/deceleration time for each position.

[F14.00≠2], switchover between positions No. is performed automatically, with the sequence from 1, 2... to**[F14.01]**.

[F14.00＝2], set four DIs (hardware DI or VDI) with functions 6 to 9 (FunIN.6:CMD1 to FunIN.9:CMD4) and control the DI logics on the host controller to implement switchover between position No. The position No. is a 4-bit binary value, and the relationship between CMD1 to CMD4 and the position No. is listed in the following table.

FunIN.9 CMD4	FunIN.8 CMD3	FunIN.7 CMD2	FunIN.6 CMD1	Position Number
0	0	0	0	1
0	0	0	1	2
……				
1	1	1	1	16

CMD (n) is 1 when the DI terminal logic is valid andCMD (n) is 0 when the DI terminal logic is invalid

F14.02	Parameter name	Margin processing method			Property	At stop	Control mode	P
	Setting range	0～1	Unit	-	Effective time	Immediate	Default	0

It sets the start position No. when the multi-function running recovers after a pause.

Pause:

1. The servo drive switches over to another control mode or the position change on fly function is enabled during multi-position running.

2. The internal multi-position enable signal (FunIN.28: PosInSen) changes from active from inactive.

Value	Margin processing method	Remark
0	Complete the remaining distance	For example, if F14.01 =16 and the servo drive pauses when running to the 2nd position, it starts running from the 3rd position after restoring the multi-position running.
1	Start running again from 1st position	For example, if F14.01 =16 and the servo drive pauses when running to the 2nd position, it starts running from the 1st position after restoring the multi-position running.

Note:

Once the servo drive pauses during the multi-position running, it discards the uncompleted distance in the current position reference.

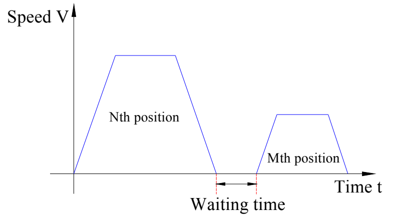
F14.00=2 (DI switchover), pause is permissible only when the servo drive switches over to another control mode or the position change on fly function is enabled during running of the current position. The start position No. is determined by FunIN.6 to FunIN.9 after the multi-position running is restored

F14.03	Parameter name	Time unit			Property	At stop	Control mode	P
	Setting range	0～1	Unit	-	Effective time	Immediate	Default	0

It sets the unit of the acceleration/deceleration time and waiting time during the multi-position running.

Acceleration/Deceleration: time for the servo motor to change from 0 RPM to 1000 RPM or the reverse.

Waiting time: time interval from ending of the current position reference to starting of the next position reference.

Value	Waiting time unit	Remark
0	ms	
1	s	

When F14.00=3 (Sequential running), F14.03 is invalid, and there is no waiting time between positions.

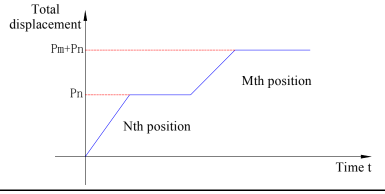
When F14.00=2 (DI switchover), F14.03 is invalid, and the time interval between positions is determined by the delay time command from the host controller

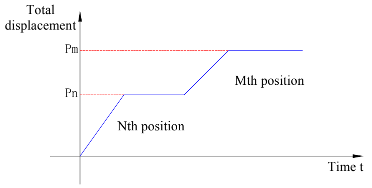
F14.04	**Parameter name**	Displacement reference type			**Property**	At stop	**Control mode**	P
	Setting range	0～1	**Unit**	-	**Effective time**	Immediate	**Default**	0

It sets the displacement reference type when the multi-position function is used.

Displacement reference: sum of position references in a certain time period.

Relative displacement: position increment of the target position relative to the current motor position.Absolute displacement: position increment of the target position relative to the motor home position.For example, the displacements of the nth position and mth position are respectively Pn (Pn > 0) and Pm (Pm > 0), And assume Pm＞Pn, comparison as follows:

Value	Displacement reference type	Remark
0	Relative displacement reference	The actual displacement at mth position：Pm 

1	Absolute displacement reference	The actual displacement at mth position：Pm-Pn 

When the actual displacement is negative, the motor runs in the reverse direction.

F14.05	Parameter name	Start position of sequential running		Property	At stop	Control mode	P
	Setting range	0～16	Unit	-	Effective time	Immediate	Default	0

It sets whether to carry on cyclic running and the start position No. after the first round of running when the multi-position sequential running is enabled (**F14.00=3**).

Value	Start position of sequential running	Description
0	Not cyclic	The servo drive runs positions set in F14.01 only once and stops after the running is completed. Then, the motor becomes in locked state.
1	1～16	Cyclic running is performed. The servo drive starts from the position No. set in F14.05 after the first round of running. And F14.05 ≤ F14.01.

Note: [F14.05]>**[F14.01]**, **[F14.05]** will be forced to set to 0.

F14.06	Parameter name	1st displacement		Property	During running	Control mode	P
	Setting range	-1073741824～1073741824	Unit	Reference unit	Effective time	Immediate	Default	10000

It sets the 1st displacement in multi-position (in reference unit).

F14.08	Parameter name	Maximum running speed of 1st displacement		Property	During running	Control mode	P
	Setting range	1～6000	Unit	Rpm	Effective time	Immediate	Default	200

It sets the maximum running speed of the 1st position in multi-position.

The maximum running speed is the average running speed when the motor is not in acceleration/deceleration. If **[F14.12]** is too small, the actual motor speed will be smaller than**[F14.14].**

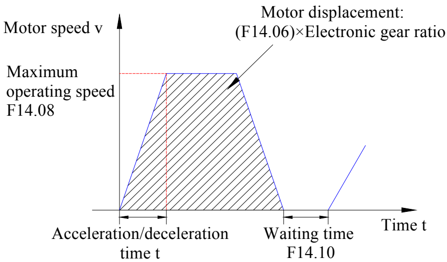
F14.09	Parameter name	Acceleration/Deceleration time of 1st displacement		Property	During running	Control mode	P
	Setting range	0～65535	Unit	Ms（s）	Effective time	Immediate	Default	10

It sets the time for the servo motor to change from 0 RPM to 1000 RPM or the reverse for the 1st displacement.

Actual time of accelerating to **[F14.14].**

F14.10	**Parameter name**	Waiting time after 1st displacement			**Property**	During running	**Control mode**	P
	Setting range	0～10000	**Unit**	Ms（s）	**Effective time**	Immediate	**Default**	10

It sets the waiting time from completion of the 1st displacement to start the next displacement.



F14.11	**Parameter name**	2nd displacement			**Property**	During running	**Control mode**	P
	Setting range	-1073741824～1073741824	**Unit**	Reference unit	**Effective time**	Immediate	**Default**	10000

F14.13	**Parameter name**	Maximum running speed of 2nd displacement			**Property**	During running	**Control mode**	P
	Setting range	1～6000	**Unit**	Rpm	**Effective time**	Immediate	**Default**	200

F14.14	**Parameter name**	Acceleration/Deceleration time of 2nd displacement			**Property**	During running	**Control mode**	P
	Setting range	0～65535	**Unit**	ms（S）	**Effective time**	Immediate	**Default**	10

F14.15	**Parameter name**	Waiting time after 2nd displacement			**Property**	During running	**Control mode**	P
	Setting range	0～10000	**Unit**	ms（S）	**Effective time**	Immediate	**Default**	10

F14.16	**Parameter name**	3rd displacement			**Property**	During running	**Control mode**	P
	Setting range	-1073741824～1073741824	**Unit**	Reference unit	**Effective time**	Immediate	**Default**	10000

F14.17	Parameter name	Maximum running speed of 3rd displacement			Property	During running	Control mode	P
	Setting range	1～6000	Unit	Rpm	Effective time	Immediate	Default	200

F14.19	Parameter name	Acceleration/Deceleration time of 3rd displacement			Property	During running	Control mode	P
	Setting range	0～65535	Unit	ms（S）	Effective time	Immediate	Default	10

F14.20	Parameter name	Waiting time after 3rd displacement			Property	During running	Control mode	P
	Setting range	0～10000	Unit	ms（S）	Effective time	Immediate	Default	10

F14.21	Parameter name	Fourth displacement			Property	During running	Control mode	P
	Setting range	-1073741824～10741824	Unit	Reference unit	Effective time	Immediate	Default	10000

F14.23	Parameter name	Maximum running speed of fourth displacement			Property	During running	Control mode	P
	Setting range	1～6000	Unit	rpm	Effective time	Immediate	Default	200

F14.24	Parameter name	Acceleration/Deceleration time of fourth displacement			Property	During running	Control mode	P
	Setting range	0～65535	Unit	Ms（S）	Effective time	Immediate	Default	10

F14.25	Parameter name	Waiting time after fourth displacement			Property	During running	Control mode	P
	Setting range	0～10000	Unit	Ms（S）	Effective time	Immediate	Default	10

F14.26	Parameter name	Fifth displacement			Property	During running	Control mode	P
	Setting range	-1073741824～1073741824	Unit	Reference unit	Effective time	Immediate	Default	10000

F14.28	Parameter name	Maximum running speed of fifth displacement			Property	During running	Control mode	P
	Setting range	1～6000	Unit	Rpm	Effective time	Immediate	Default	200

F14.29	Parameter name	Acceleration/Deceleration time of fifth displacement			Property	During running	Control mode	P
	Setting range	0～65535	Unit	Ms（S）	Effective time	Immediate	Default	10

F14.30	Parameter name	Waiting time after fifth displacement			Property	During running	Control mode	P
	Setting range	0～10000	Unit	Ms（S）	Effective time	Immediate	Default	10

F14.31	Parameter name	Sixth displacement			Property	During running	Control mode	P
	Setting range	-1073741824～1073741824	Unit	Reference unit	Effective time	Immediate	Default	10000

F14.33	Parameter name	Maximum running speed of sixth displacement			Property	During running	Control mode	P
	Setting range	1～6000	Unit	Rpm	Effective time	Immediate	Default	200

F14.34	Parameter name	Acceleration/Deceleration time of sixth displacement			Property	During running	Control mode	P
	Setting range	0～65535	Unit	Ms（S）	Effective time	Immediate	Default	10

F14.35	Parameter name	Waiting time after sixth displacement			Property	During running	Control mode	P
	Setting range	0～10000	Unit	Ms（S）	Effective time	Immediate	Default	10

F14.36	Parameter name	Seventh displacement			Property	During running	Control mode	P
	Setting range	-1073741824～1073741824	Unit	Reference unit	Effective time	Immediate	Default	10000

F14.38	Parameter name	Maximum running speed of seventh displacement			Property	During running	Control mode	P
	Setting range	1～6000	Unit	Rpm	Effective time	Immediate	Default	200

F14.39	Parameter name	Acceleration/Deceleration time of seventh displacement			Property	During running	Control mode	P
	Setting range	0～65535	Unit	Ms（S）	Effective time	Immediate	Default	10

F14.40	**Parameter name**	Waiting time after seventh displacement			**Property**	During running	**Control mode**	P
	Setting range	0～10000	**Unit**	Ms（S）	**Effective time**	Immediate	**Default**	10

F14.41	**Parameter name**	Eighth displacement			**Property**	During running	**Control mode**	P
	Setting range	-1073741824～1073741824	**Unit**	Reference unit	**Effective time**	Immediate	**Default**	10000

F14.43	**Parameter name**	Maximum running speed of eighth displacement			**Property**	During running	**Control mode**	P
	Setting range	1～6000	**Unit**	Rpm	**Effective time**	Immediate	**Default**	200

F14.44	**Parameter name**	Acceleration/Deceleration time of eighth displacement			**Property**	During running	**Control mode**	P
	Setting range	0～65535	**Unit**	Ms（S）	**Effective time**	Immediate	**Default**	10

F14.45	**Parameter name**	Waiting time after eighth displacement			**Property**	During running	**Control mode**	P
	Setting range	0～10000	**Unit**	Ms（S）	**Effective time**	Immediate	**Default**	10

F14.46	**Parameter name**	Ninth displacement			**Property**	During running	**Control mode**	P
	Setting range	-1073741824～1073741824	**Unit**	Reference unit	**Effective time**	Immediate	**Default**	10000

F14.48	**Parameter name**	Maximum running speed of ninth displacement			**Property**	During running	**Control mode**	P
	Setting range	1～6000	**Unit**	Rpm	**Effective time**	Immediate	**Default**	200

F14.49	**Parameter name**	Acceleration/Deceleration time of ninth displacement			**Property**	During running	**Control mode**	P
	Setting range	0～65535	**Unit**	Ms（S）	**Effective time**	Immediate	**Default**	10

F14.50	**Parameter name**	Waiting time after ninth displacement			**Property**	During running	**Control mode**	P
	Setting range	0～10000	**Unit**	Ms（S）	**Effective time**	Immediate	**Default**	10

F14.51	Parameter name	Tenth displacement			Property	During running	Control mode	P
	Setting range	-1073741824～1073741824	Unit	Reference unit	Effective time	Immediate	Default	10000

F14.53	Parameter name	Maximum running speed of tenth displacement			Property	During running	Control mode	P
	Setting range	1～6000	Unit	Rpm	Effective time	Immediate	Default	200

F14.54	Parameter name	Acceleration/Deceleration time of tenth displacement			Property	During running	Control mode	P
	Setting range	0～65535	Unit	Ms（S）	Effective time	Immediate	Default	10

F14.55	Parameter name	Waiting time after tenth displacement			Property	During running	Control mode	P
	Setting range	0～10000	Unit	Ms（S）	Effective time	Immediate	Default	10

F14.56	Parameter name	Eleventh displacement			Property	During running	Control mode	P
	Setting range	-1073741824～1073741824	Unit	Reference unit	Effective time	Immediate	Default	10000

F14.58	Parameter name	Maximum running speed of eleventh displacement			Property	During running	Control mode	P
	Setting range	1～6000	Unit	Rpm	Effective time	Immediate	Default	200

F14.59	Parameter name	Acceleration/Deceleration time of eleventh displacement			Property	During running	Control mode	P
	Setting range	0～65535	Unit	Ms（S）	Effective time	Immediate	Default	10

F14.60	Parameter name	Waiting time after eleventh displacement			Property	During running	Control mode	P
	Setting range	0～10000	Unit	Ms（S）	Effective time	Immediate	Default	10

F14.61	Parameter name	Twelfth displacement			Property	During running	Control mode	P
	Setting range	-1073741824～1073741824	Unit	Reference unit	Effective time	Immediate	Default	10000

F14.63	Parameter name	Maximum running speed of twelfth displacement			Property	During running	Control mode	P
	Setting range	1～6000	Unit	Rpm	Effective time	Immediate	Default	200

F14.64	Parameter name	Acceleration/Deceleration time of twelfth displacement			Property	During running	Control mode	P
	Setting range	0～65535	Unit	Ms（S）	Effective time	Immediate	Default	10

F14.65	Parameter name	Waiting time after twelfth displacement			Property	During running	Control mode	P
	Setting range	0～10000	Unit	Ms（S）	Effective time	Immediate	Default	10

F14.66	Parameter name	Thirteenth displacement			Property	During running	Control mode	P
	Setting range	-1073741824～1073741824	Unit	Reference unit	Effective time	Immediate	Default	10000

F14.68	Parameter name	Maximum running speed of thirteenth displacement			Property	During running	Control mode	P
	Setting range	1～6000	Unit	Rpm	Effective time	Immediate	Default	200

F14.69	Parameter name	Acceleration/Deceleration time of thirteenth displacement			Property	During running	Control mode	P
	Setting range	0～65535	Unit	Ms（S）	Effective time	Immediate	Default	10

F14.70	Parameter name	Waiting time after thirteenth displacement			Property	During running	Control mode	P
	Setting range	0～10000	Unit	Ms（S）	Effective time	Immediate	Default	10

F14.71	Parameter name	Fourteenth displacement			Property	During running	Control mode	P
	Setting range	-1073741824～1073741824	Unit	Reference unit	Effective time	Immediate	Default	10000

F14.73	Parameter name	Maximum running speed of fourteenth displacement			Property	During running	Control mode	P
	Setting range	1～6000	Unit	Rpm	Effective time	Immediate	Default	200

F14.74	**Parameter name**	Acceleration/Deceleration time of fourteenth displacement			**Property**	During running	**Control mode**	P
	Setting range	0～65535	**Unit**	Ms（S）	**Effective time**	Immediate	**Default**	10

F14.75	**Parameter name**	Waiting time after fourteenth displacement			**Property**	During running	**Control mode**	P
	Setting range	0～10000	**Unit**	Ms（S）	**Effective time**	Immediate	**Default**	10

F14.76	**Parameter name**	Fifteenth displacement			**Property**	During running	**Control mode**	P
	Setting range	-1073741824～1073741824	**Unit**	Reference unit	**Effective time**	Immediate	**Default**	10000

F14.78	**Parameter name**	Maximum running speed of fifteenth displacement			**Property**	During running	**Control mode**	P
	Setting range	1～6000	**Unit**	Rpm	**Effective time**	Immediate	**Default**	200

F14.79	**Parameter name**	Acceleration/Deceleration time of fifteenth displacement			**Property**	During running	**Control mode**	P
	Setting range	0～65535	**Unit**	Ms（S）	**Effective time**	Immediate	**Default**	10

F14.80	**Parameter name**	Waiting time after fifteenth displacement			**Property**	During running	**Control mode**	P
	Setting range	0～10000	**Unit**	Ms（S）	**Effective time**	Immediate	**Default**	10

F14.81	**Parameter name**	Sixteenth displacement			**Property**	During running	**Control mode**	P
	Setting range	-1073741824～1073741824	**Unit**	Reference unit	**Effective time**	Immediate	**Default**	10000

F14.83	**Parameter name**	Maximum running speed of sixteenth displacement			**Property**	During running	**Control mode**	P
	Setting range	1～6000	**Unit**	Rpm	**Effective time**	Immediate	**Default**	200

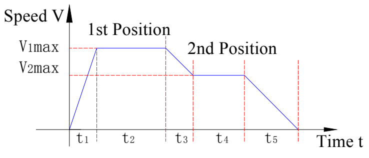
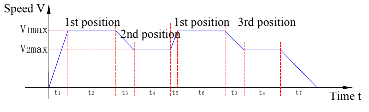
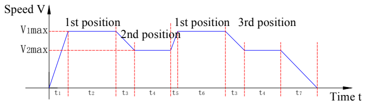
F14.84	**Parameter name**	Acceleration/Deceleration time of sixteenth displacement			**Property**	During running	**Control mode**	P
	Setting range	0～65535	**Unit**	Ms（S）	**Effective time**	Immediate	**Default**	10

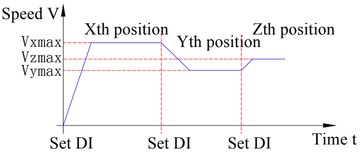
F14.85	**Parameter name**	Waiting time after sixteenth displacement			**Property**	During running	**Control mode**	P
	Setting range	0～10000	**Unit**	Ms（S）	**Effective time**	Immediate	**Default**	10

8.16 F15 Group: Multi-speed function parameters

F15.00	**Parameter name**	Multi-speed running mode			**Property**	At stop	**Control mode**	S
	Setting range	0～3	**Unit**	-	**Effective time**	Immediate	**Default**	2

It sets the multi-speed reference running mode when the speed reference source is multi-speed (**F05.01=3，F05.02=1/2/3/4**) in speed control mode.

Value	Running mode	Remark	Running waveform
0	Stop after running single cycle	Stop after running single cycle； Position number auto-increment switching；	V1max、V2max：1st position、2nd position speed reference； t_1：The actual acceleration and deceleration time of the 1st position； t_3、t_5：The actual acceleration and deceleration time of 2nd position. 
1	Keep the final value after a single cycle	Keep running at the final value after a single cycle；	
2	Cyclic running	Cyclic running，the starting position number of each cycle is 1: The position number is automatically incremented and switched; When the servo enable is enabled, it will remain in the loop running state.	V1max、V2max：1st position、2nd position maximum operating speed。 

<table>
<tr>
<td>3</td>
<td>Switching via external DI</td>
<td>Servo enable is effective and sustainable;
The position number is determined by the logic of the DI terminal;
The running time of each speed reference is only determined by the position number switching interval;
Speed reference direction switching can be achieved using FunIN.5 (DIR-SEL).</td>
<td>x， y： Position number, for the logical relationship between the position number and the DI terminal, please refer to F15.03.；
V_x、V_y： Xth、Yth position speed reference；
The position numberdetermined by DI does not change, and the speed reference runs continuously, does not affected by the reference running time.

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

During each speed reference operation, the servo enable must be valid. Otherwise, the drive will immediately stop according to the servo enable OFF mode set by **[F01.03]**.

When a certain speed reference reaches value, the speed arrival (FunOUT.16: V-Arr) signal is valid.

F15.01	**Parameter name**	Interrupt run restart mode			**Property**	At stop	**Control mode**	S
	Setting range	0～2	**Unit**	-	**Effective time**	Immediate	**Default**	0

Value	Interrupt run restart mode	Description
0	Start again from the first position	The operation is interrupted by the stop reference, fault or power failure, the drive starts from the first position after restarting.
1	Continuouslyrun from the position ofinterruption	The operation is interrupted by the stop reference, fault, the drive automatically records the run time at the current position, and then automatically enters the position after starting, and continuously runs at the speed defined by the position during the remaining time.
2	Continue running from the running speed at the time of interruption	The operation is interrupted by the stop reference, fault, the drive not only automatically records the running time at current position but also records the running frequency when the drive stop. After restarting, it firstly restores the running frequency to the stop time and continues the rest of the operation.

F15.02	**Parameter name**	Power-down storage option			**Property**	At stop	**Control mode**	S
	Setting range	0～1	**Unit**	-	**Effective time**	Immediate	**Default**	0

Value	Interrupt run restart mode	Description
0	No restore	Do not record the PLC running status when power off. After power-on, it starts to run from the first position.
1	Power-down storage is valid	Record PLC running status when power is off, including powerdown time, running frequency, the time that has been run. After power-on, it runs

		according to the 10-bit defined PLC interrupt operation restart mode.

F15.03	Parameter name	Speed reference end position selection			Property	At stop	Control mode	S
	Setting range	1～16	Unit	-	Effective time	Immediate	Default	16

It sets the total position numbers of the speed reference. Different positions can be set with different speeds and running times, and there are 4 sets of acceleration time to choose from.

[F15.00≠3], the multi-position number is automatically incremented and switched, and the switching sequence is 1, 2..., F15.03.

[F15.00=3], set 4 DIs to DI function 6~9 (FunIN.6: CMD1~FunIN.9: CMD4), and control the DI logic through the host computer to realize the position number switching. The multi-position number is a 4-digit binary number, and the correspondence between CMD1 and CMD4 and the position number is expressed as follows.

FunIN.9	FunIN.8	FunIN.7	FunIN.6	Position Number
CMD4	CMD3	CMD2	CMD1	
0	0	0	0	1
0	0	0	1	2
……				
1	1	1	1	16

The CMD(n) value is 1 when the DI terminal logic is active, otherwise it is 0.

F15.04	Parameter name	Run time unit selection			Property	At stop	Control mode	S
	Setting range	0～1	Unit	-	Effective time	Immediate	Default	0

Multi-position running time unit selection：

Value	Unit selection
0	second
1	minute

F15.05	Parameter name	Acceleration time1			Property	At stop	Control mode	S
	Setting range	0～65535	Unit	ms	Effective time	Immediate	Default	10

F15.06	Parameter name	Deceleration time1			Property	At stop	Control mode	S
	Setting range	0～65535	Unit	ms	Effective time	Immediate	Default	10

F15.07	**Parameter name**	Acceleration time2			**Property**	At stop	**Control mode**	S
	Setting range	0～65535	**Unit**	ms	**Effective time**	Immediate	**Default**	50

F15.08	**Parameter name**	Deceleration time2			**Property**	At stop	**Control mode**	S
	Setting range	0～65535	**Unit**	ms	**Effective time**	Immediate	**Default**	50

F15.09	**Parameter name**	Acceleration time3			**Property**	At stop	**Control mode**	S
	Setting range	0～65535	**Unit**	ms	**Effective time**	Immediate	**Default**	100

F15.10	**Parameter name**	Deceleration time3			**Property**	At stop	**Control mode**	S
	Setting range	0～65535	**Unit**	ms	**Effective time**	Immediate	**Default**	100

F15.11	**Parameter name**	Acceleration time4			**Property**	At stop	**Control mode**	S
	Setting range	0～65535	**Unit**	ms	**Effective time**	Immediate	**Default**	150

F15.12	**Parameter name**	Deceleration time4			**Property**	At stop	**Control mode**	S
	Setting range	0～65535	**Unit**	ms	**Effective time**	Immediate	**Default**	150

Four sets of acceleration/deceleration time are available for each multi-speed reference.

Acceleration time: The servo motor accelerates from 0 rpm to 1000 rpm;

Deceleration time: The time when the servo motor is decelerated from 1000 rpm to 0 rpm.

F15.13	**Parameter name**	1stspeed reference			**Property**	At stop	**Control mode**	S
	Setting range	-6000～6000	**Unit**	rpm	**Effective time**	Immediate	**Default**	0

F15.14	**Parameter name**	The 1stspeed reference run time			**Property**	At stop	**Control mode**	S
	Setting range	0～6553.5	**Unit**	s（min）	**Effective time**	Immediate	**Default**	5.0

Set the running time of the first speed reference.

Running time: The shifting time of switching from previous reference position speed to current position speed reference+ the constant running time at current position.

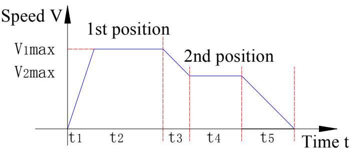
If the run time is set to 0, the drive will automatically skip the speed reference.

[F15.00=3], as long as the position number determined by the external DI does not change, the speed reference will continue to run without being affected by the reference running time.

F15.15	**Parameter name**	The 1st position acceleration and deceleration time			**Property**	At stop	**Control mode**	S
	Setting range	0～4	**Unit**	-	**Effective time**	Immediate	**Default**	0

It sets the 1st position acceleration and deceleration time.

Value	**Acceleration and deceleration time**	**Remark**
0	No acceleration and deceleration time	Acceleration time：0 Deceleration time：0
1	Acceleration and deceleration time1	Acceleration time：F15.05 Deceleration time：F15.06
2	Acceleration and deceleration time2	Acceleration time：F15.07 Deceleration time：F15.08
3	Acceleration and deceleration time3	Acceleration time：F15.09 Deceleration time：F15.10
4	Acceleration and deceleration time4	Acceleration time：F15.11 Deceleration time：F15.12



V_{1max}、V_{2max}: 1st. 2nd position speed reference；

t_1: The actual acceleration/deceleration time at first position；

t_3、t_5: The actual acceleration/deceleration time at second position；

A certain position running time: The shifting time of switching from previous positionspeed reference to current position speed reference+ the constant running time at current position. (For example, the first running time in the figure is t1+t2, the second running time is t3+t4, and so on)

If a certain running time is not set to 0, the drive will skip the speed reference and execute the next position;

$$t_1 = \frac{V1}{1000} \times \text{The acceleration time set for this position}$$

$$t_3 = \frac{|V_2 - V_1|}{1000} \times \text{Acceleration time set for 2nd position}$$

F15.16	**Parameter name**	2nd speed reference			**Property**	At stop	**Control mode**	S
	Setting range	-6000～6000	**Unit**	Rpm	**Effective time**	Immediate	**Default**	100

F15.17	**Parameter name**	The 2nd reference run time			**Property**	At stop	**Control mode**	S
	Setting range	0～6553.5	**Unit**	S（min）	**Effective time**	Immediate	**Default**	5.0

F15.18	**Parameter name**	The 2nd position acceleration and deceleration time			**Property**	At stop	**Control mode**	S
	Setting range	0～4	**Unit**	-	**Effective time**	Immediate	**Default**	0

F15.19	**Parameter name**	3rd speed reference			**Property**	At stop	**Control mode**	S
	Setting range	-6000～6000	**Unit**	rpm	**Effective time**	Immediate	**Default**	300

F15.20	**Parameter name**	The 3rd reference run time			**Property**	At stop	**Control mode**	S
	Setting range	0～6553.5	**Unit**	s（min）	**Effective time**	Immediate	**Default**	5.0

F15.21	**Parameter name**	The 3rd position acceleration and deceleration time			**Property**	At stop	**Control mode**	S
	Setting range	0～4	**Unit**	-	**Effective time**	Immediate	**Default**	0

F15.22	**Parameter name**	4th speed reference			**Property**	At stop	**Control mode**	S
	Setting range	-6000～6000	**Unit**	rpm	**Effective time**	Immediate	**Default**	500

F15.23	**Parameter name**	The 4th reference run time			**Property**	At stop	**Control mode**	S
	Setting range	0～6553.5	**Unit**	s（min）	**Effective time**	Immediate	**Default**	5.0

F15.24	**Parameter name**	The 4th position acceleration and deceleration time			**Property**	At stop	**Control mode**	S
	Setting range	0～4	**Unit**	-	**Effective time**	Immediate	**Default**	0

F15.25	**Parameter name**	5th speed reference			**Property**	At stop	**Control mode**	S
	Setting range	-6000～6000	**Unit**	rpm	**Effective time**	Immediate	**Default**	700

F15.26	Parameter name	The 5th reference run time			Property	At stop	Control mode	S
	Setting range	0～6553.5	Unit	s（min）	Effective time	Immediate	Default	5.0

F15.27	Parameter name	The 5th position acceleration and deceleration time			Property	At stop	Control mode	S
	Setting range	0～4	Unit	-	Effective time	Immediate	Default	0

F15.28	Parameter name	6th speed reference			Property	At stop	Control mode	S
	Setting range	-6000～6000	Unit	rpm	Effective time	Immediate	Default	900

F15.29	Parameter name	The 6th reference run time			Property	At stop	Control mode	S
	Setting range	0～6553.5	Unit	s（min）	Effective time	Immediate	Default	5.0

F15.30	Parameter name	The 6th position acceleration and deceleration time			Property	At stop	Control mode	S
	Setting range	0～4	Unit	-	Effective time	Immediate	Default	0

F15.31	Parameter name	7th speed reference			Property	At stop	Control mode	S
	Setting range	-6000～6000	Unit	rpm	Effective time	Immediate	Default	600

F15.32	Parameter name	The 7th reference run time			Property	At stop	Control mode	S
	Setting range	0～6553.5	Unit	s（min）	Effective time	Immediate	Default	5.0

F15.33	Parameter name	The 7th position acceleration and deceleration time			Property	At stop	Control mode	S
	Setting range	0～4	Unit	-	Effective time	Immediate	Default	0

F15.34	Parameter name	8th speed reference			Property	At stop	Control mode	S
	Setting range	-6000～6000	Unit	rpm	Effective time	Immediate	Default	300

F15.35	Parameter name	The 8th reference run time			Property	At stop	Control mode	S
	Setting range	0～6553.5	Unit	s（min）	Effective time	Immediate	Default	5.0

F15.36	Parameter name	The 8th position acceleration and deceleration time			Property	At stop	Control mode	S
	Setting range	0～4	Unit	-	Effective time	Immediate	Default	0

F15.37	Parameter name	9th speed reference			Property	At stop	Control mode	S
	Setting range	-6000～6000	Unit	rpm	Effective time	Immediate	Default	100

F15.38	Parameter name	The 9th reference run time			Property	At stop	Control mode	S
	Setting range	0～6553.5	Unit	s（min）	Effective time	Immediate	Default	5.0

F15.39	Parameter name	The 9th position acceleration and deceleration time			Property	At stop	Control mode	S
	Setting range	0～4	Unit	-	Effective time	Immediate	Default	0

F15.40	Parameter name	10th speed reference			Property	At stop	Control mode	S
	Setting range	-6000～6000	Unit	rpm	Effective time	Immediate	Default	-100

F15.41	Parameter name	The 10th reference run time			Property	At stop	Control mode	S
	Setting range	0～6553.5	Unit	s（min）	Effective time	Immediate	Default	5.0

F15.42	Parameter name	The 10th paragraph acceleration and deceleration time			Property	At stop	Control mode	S
	Setting range	0～4	Unit	-	Effective time	Immediate	Default	0

F15.43	Parameter name	11th speed reference			Property	At stop	Control mode	S
	Setting range	-6000～6000	Unit	rpm	Effective time	Immediate	Default	-300

F15.44	**Parameter name**	11th reference run time			**Property**	At stop	**Control mode**	S
	Setting range	0～6553.5	**Unit**	s（min）	**Effective time**	Immediate	**Default**	5.0

F15.45	**Parameter name**	The 11th position acceleration and deceleration time			**Property**	At stop	**Control mode**	S
	Setting range	0～4	**Unit**	-	**Effective time**	Immediate	**Default**	0

F15.46	**Parameter name**	12th speed reference			**Property**	At stop	**Control mode**	S
	Setting range	-6000～6000	**Unit**	rpm	**Effective time**	Immediate	**Default**	-500

F15.47	**Parameter name**	The 12th reference run time			**Property**	At stop	**Control mode**	S
	Setting range	0～6553.5	**Unit**	s（min）	**Effective time**	Immediate	**Default**	5.0

F15.48	**Parameter name**	The 12th position acceleration and deceleration time			**Property**	At stop	**Control mode**	S
	Setting range	0～4	**Unit**	-	**Effective time**	Immediate	**Default**	0

F15.49	**Parameter name**	13th speed reference			**Property**	At stop	**Control mode**	S
	Setting range	-6000～6000	**Unit**	rpm	**Effective time**	Immediate	**Default**	-700

F15.50	**Parameter name**	The 13th reference run time			**Property**	At stop	**Control mode**	S
	Setting range	0～6553.5	**Unit**	s（min）	**Effective time**	Immediate	**Default**	5.0

F15.51	**Parameter name**	The 13th position acceleration and deceleration time			**Property**	At stop	**Control mode**	S
	Setting range	0～4	**Unit**	-	**Effective time**	Immediate	**Default**	0

F15.52	**Parameter name**	14th speed reference			**Property**	At stop	**Control mode**	S
	Setting range	-6000～6000	**Unit**	rpm	**Effective time**	Immediate	**Default**	-900

F15.53	Parameter name	The 14th reference run time		Property	At stop	Control mode	S
	Setting range	0～6553.5	Unit: s（min）	Effective time	Immediate	Default	5.0

F15.54	Parameter name	The 14th position acceleration and deceleration time		Property	At stop	Control mode	S
	Setting range	0～4	Unit: -	Effective time	Immediate	Default	0

F15.55	Parameter name	15th speed reference		Property	At stop	Control mode	S
	Setting range	-6000～6000	Unit: rpm	Effective time	Immediate	Default	-600

F15.56	Parameter name	The 15th reference run time		Property	At stop	Control mode	S
	Setting range	0～6553.5	Unit: s（min）	Effective time	Immediate	Default	5.0

F15.57	Parameter name	The 15th position acceleration and deceleration time		Property	At stop	Control mode	S
	Setting range	0～4	Unit: -	Effective time	Immediate	Default	0

F15.58	Parameter name	16th speed reference		Property	At stop	Control mode	S
	Setting range	-6000～6000	Unit: rpm	Effective time	Immediate	Default	-300

F15.59	Parameter name	The 16th reference run time		Property	At stop	Control mode	S
	Setting range	0～6553.5	Unit: s（min）	Effective time	Immediate	Default	5.0

F15.60	Parameter name	The 16th position acceleration and deceleration time		Property	At stop	Control mode	S
	Setting range	0～4	Unit: -	Effective time	Immediate	Default	0

8.17 F16 Group: Reserved

F16.00 ～ F16.99	**Parameter name**	Reserved			**Property**	-	**Control mode**	-
	Setting range	-	**Unit**	-	**Effective time**	-	**Default**	-

8.18 F17 Group:Fault record parameter group

F17.00	**Parameter name**	Previous one failure record			**Property**	At display	**Control mode**	-
	Setting range	0～499	**Unit**	-	**Effective time**		**Default**	-
F17.01	**Parameter name**	Previous two failure record			**Property**	At display	**Control mode**	-
	Setting range	0～499	**Unit**	-	**Effective time**		**Default**	-
F17.02	**Parameter name**	Previous three failure record			**Property**	At display	**Control mode**	-
	Setting range	0～499	**Unit**	-	**Effective time**		**Default**	-
F17.03	**Parameter name**	Previous four failure record			**Property**	At display	**Control mode**	-
	Setting range	0～499	**Unit**	-	**Effective time**		**Default**	-
F17.04	**Parameter name**	Previous five failure record			**Property**	At display	**Control mode**	-
	Setting range	0～499	**Unit**	-	**Effective time**		**Default**	-
F17.05	**Parameter name**	Previous six failure record			**Property**	At display	**Control mode**	-
	Setting range	0～499	**Unit**	-	**Effective time**		**Default**	-

The current 6 fault records are displayed, and the most recent fault is recorded in **[F17.00]**. For detailed fault information, please refer to "Chapter 9 Troubleshooting".

F17.06	**Parameter name**	Motor speed at previous failure			**Category**	At display	**Control mode**	-
	Setting range	-	**Unit**	Rpm			**Default**	-

F17.07	**Parameter name**	Output current at previous failure			**Category**	At display	**Control mode**	-
	Setting range	-	**Unit**	A			**Default**	-

F17.08	**Parameter name**	Bus voltage at the previous fault			**Category**	At display	**Control mode**	-
	Setting range	-	**Unit**	V			**Default**	-

F17.09	**Parameter name**	Module temperature at the previous fault			**Category**	At display	**Control mode**	-
	Setting range	-	**Unit**	℃			**Default**	-

F17.10	**Parameter name**	Input terminal status in the previous fault			**Category**	At display	**Control mode**	-
	Setting range	-	**Unit**	-			**Default**	-

F17.11	**Parameter name**	Run time at the previous failure			**Category**	At display	**Control mode**	-
	Setting range	-	**Unit**	min			**Default**	-

[F17.06]~[F17.11]is the corresponding fault details when viewing the previous fault record **[F17.00].**

F17.12	**Parameter name**	Motor speed at previous two failure			**Category**	At display	**Control mode**	-
	Setting range	-	**Unit**	Rpm			**Default**	-

F17.13	**Parameter name**	Output current at previous two failure			**Category**	At display	**Control mode**	-
	Setting range	-	**Unit**	A			**Default**	-

F17.14	**Parameter name**	Bus voltage at the previous two fault			**Category**	At display	**Control mode**	-
	Setting range	-	**Unit**	V			**Default**	-

F17.15	**Parameter name**	Module temperature at the previous two fault			**Category**	At display	**Control mode**	-
	Setting range	-	**Unit**	℃			**Default**	-

F17.16	**Parameter name**	Input terminal status in the previous two fault			**Category**	At display	**Control mode**	-
	Setting range	-	**Unit**	-			**Default**	-

F17.17	**Parameter name**	Run time at the previous two failure			**Category**	At display	**Control mode**	-
	Setting range	-	**Unit**	min			**Default**	-

[F17.12]~[F17.17]is the corresponding fault details when viewing the previous two fault record **[F17.01].**

8.19 F18 Group: Manufacturer parameter group

F18.00	**Parameter name**	User password			**Property**	During running	**Control mode**	-
	Setting range	0～65535	**Unit**	-	**Effective time**	Immediate	**Default**	-

The user password setting function is used to prohibit unauthorized personnel from accessing and modifying function parameters.

When the user password function is not required, the function code is set to 00000.

When the user password function is required, first enter five digits number as the user password, press the "SET" key to confirm the password immediately.

Password change:

Press the “MODE” button to enter the password verification state, enter the original five-digit password correctly and then enter the parameter editing state, select [F18.00] (F18.00=00000 at this time), enter the new password, and press the button to confirm the password Immediately .

Cancel password:

Press “MODE” to enter the password verification state, enter the original five-digit password correctly and enter the parameter editing state, select **[F18.00]** (F18.00=00000 at this time), directly press “SET” to confirm, then you can cancel password.

Note

Users must be sure to save the set password. If lost the password, please consult the manufacturer.

F18.01	**Parameter name**	Manufacturer password			**Property**	During running	**Control mode**	-
	Setting range	0～65535	**Unit**	-	**Effective time**	Immediate	**Default**	-

The manufacturer sets the function and the user is prohibited from modifying it.

8.20 F19 Group: Communication read servo related variables

F19.00	Parameter name	Communication read servo status			Property	Only read via communication	Control mode	PST
	Setting range	-	Unit	-	Effective time	-	Default	-

The communication reads the servo running status.

[F19.00] is a hexadecimal number, which is not visible on the panel. When read the parameter via the communication, it must be converted to binary. Different bits indicate different meanings.

Bit	Servo status	Remark
Bit0	Bus voltage status	1=Bus voltage has been established
Bit1	Run reference status	1=Run reference is valid
Bit2	Drive operating status	1=Drive is running
Bit3	Servo ON reference status	1=Servo On reference is valid
Bit4	Motor running direction	1=The current running direction is reverse
Bit5	Reserved	-
Bit6	Reserved	-
Bit7	Alarm status	1=The alarm is valid
Bit8	Fault status	1=The fault is valid
Bit9	No3Fault status	1=No3fault is valid
Bit10	Servo ready status	1=Servo is ready
Bit12	Position reference status	1=Position reference changes
Bit13	Self-tuning status	1=Motor self-tuning
Bit14	Positioning close state	1=Positioning close is valid
Bit15	Positioning completion status	1=Positioning completion is valid

F19.01	Parameter name	Communication read DO function status1			Property	Communication read only	Control mode	PST
	Setting range	-	Unit	-	Effective time	-	Default	-

The communication reads the status of the DO function 1 to 16 functions in the order in which the DO function list is arranged.

[F19.01] is a hexadecimal number that is not visible on the panel. When the parameter is read via communication, it must be converted to binary.

Bit	DO function	Remark
bit0	DO function 1 (FunOUT.1：S-RDY，servo is ready)	0: Servo not ready 1: Servo ready
……		
bit15	DO function 16 (FunOUT.16：V-Arr，speed arrival output)	0: Speed not arrived 1: Speed arrival

Note: Function 9 (brake output) is not configured on the DO port, and FunOUT.9 in **[F19.01]** will be invalid.

F19.02	Parameter name	Communication read DO function status2			Property	Communication read only	Control mode	PST
	Setting range	-	Unit	-	Effective time	-	Default	-

The communication reads the function status of the DO function 17 to 31 in the order in which the DO function list is arranged.

[F19.02] is a hexadecimal number that is not visible on the panel. When the parameter is read via the communication, it must be converted to binary.

Bit	DO function	Remark
bit0	DO function 17(FunOUT.17：DB，DBBrake output)	0: Energy brake is invalid 1: Energy consumption braking
……		
bit15	Reserved	

F19.03	Parameter name	Communication read input pulse reference sample value			Property	At display	Control mode	PST
	Setting range	-	Unit	-	Effective time	-	Default	-

The communication reads the current alarm code. For details of the alarm code, please refer to Chapter 9.

F19.04	Parameter name	Communication reads the current fault code			Property	At display	Control mode	PST
	Setting range	-	Unit	-	Effective time	-	Default	-

The communication reads the current fault code. For details of the fault code, please refer to Chapter 9.

8.21 F20 Group: Communication given servo related variables

F20.00	Parameter name	Communication given DI input status			Property	During running	Control mode	PST
	Setting range	0～255	Unit	-	Effective time	Immediate	Default	0

When using communication to set the DI status, it can be realized by the communication setting **[F20.00]** parameter, **[F20.00]** is a decimal number, which is not visible on the panel and can only be given by communication. If using this function, need to select the **[F02.00]** parameter with the DI source, as detailed below.

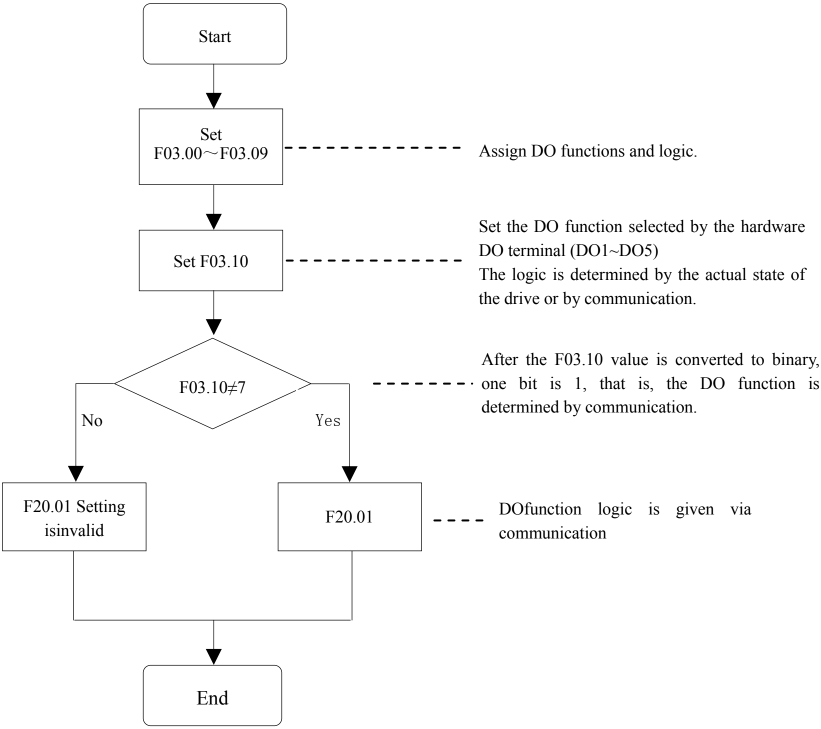
F02.00 Valid bit	Function parameter name
Bit0	0：DI1 status is determined by terminal DI1 1：DI1status is determined by Bit0 of the F20.00 parameter.
Bit1	0：DI2 status is determined by terminal DI2 1：DI2status is determined by Bit1 of the F20.00 parameter.
Bit2	0：DI3 status is determined by terminal DI3 1：DI3status is determined by Bit2 of the F20.00 parameter.
Bit3	0：DI4 status is determined by terminal DI4 1：DI4status is determined by Bit3 of the F20.00 parameter.
Bit4	0：DI5 status is determined by terminal DI5 1：DI5status is determined by Bit4 of the F20.00 parameter.
Bit5	0：DI6 status is determined by terminal DI6 1：DI6status is determined by Bit5 of the F20.00 parameter.
Bit6	0：DI7 status is determined by terminal DI7 1：DI7status is determined by Bit6 of the F20.00 parameter.
Bit7	0：DI8 status is determined by terminal DI8 1：DI8status is determined by Bit7 of the F20.00 parameter.

F20.01	Parameter name	Communication given DO output status			Property	During running	Control mode	PST
	Setting range	0～31	Unit	-	Effective time	Immediate	Default	0

When using DO function:set the DO output status via communication according to the setting of function code **[F03.10]**.

[F20.01] is a decimal number, not visible on the panel, and can only be given by communication.

Please follow the steps below to use DO:



F20.02	Parameter name	Communication given speed reference		Property	During running	Control mode	S
	Setting range	-6000～6000	Unit: Rpm	Effective time	Immediate	Default	0

In the speed control mode, the speed reference source is the communication given, and the speed reference value is set with an accuracy of 1 rpm.

[F20.02] is a 16-bit function code, which is not visible on the panel and can only be given by communication.

F20.03	Parameter name	Communication given torque reference		Property	During running	Control mode	T
	Setting range	-300.0～300.0	Unit: %	Effective time	Immediate	Default	0

In the torque control mode, the torque reference source is the communication given, and the torque reference value is set with an accuracy of 0.1%.

100.0% corresponds to 1x motor rated torque.

[F20.03] is a 16-bit function code, which is not visible on the panel and can only be given by communication.

F20.04	Parameter name	Modbus communication reference			Property	During running	Control mode	-
	Setting range	0～8	Unit	%	Effective time	Immediate	Default	0

Modify the **[F20.04]** by Modbus to realize different actions of the serve. The 4, 5, 6, 7, and 8 references need to be used with our servo debugging platform. When the servo drive is faulty, send 1 to **[F12.01]** to implement the fault reset operation.

F02.04	Function parameter name
0	When the communication allows the servo to receive any reference, it can send 0 to F20.04 to terminate the previous action.
1	Reserved
2	Servo ON
3	Communication jog forward reference
4	Communication jog reverse reference
5	Communication inertia identification reference
6	Communication rigidity test reference
7	Current loop test reference
8	Mechanical property test reference

F20.05	Parameter name	AO1 given			Property	During running	Control mode	-
	Setting range	-10000～10000	Unit	mv	Effective time	Immediate	Default	0

When**[F03.11=14]**, could modify the value of **[F20.05]**viaModbus to realize the control to the AO1 output voltage by Modbus communication.

F20.06	Parameter name	AO2 given			Property	During running	Control mode	-
	Setting range	-10000～10000	Unit	mv	Effective time	Immediate	Default	0

When**[F03.15=14]**, could modify the value of **[F20.06]**viaModbus to realize the control to the AO2 output voltage by Modbus communication.

9 Troubleshooting

9.1 Failure and warning handling when startup

9.1.1 Position control operation mode

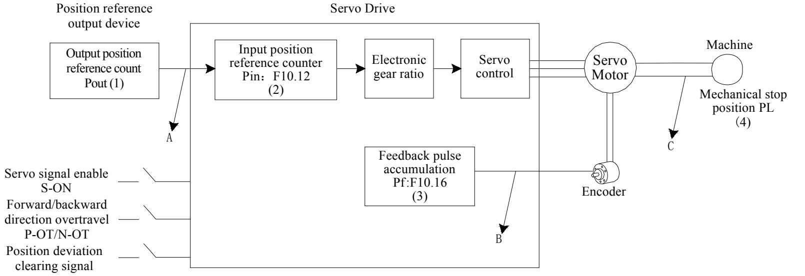
(1)Failure checking

Startup process	Fault symptom	Causes	Confirming methods
Connect control power supply (L1C L2C) Main power supply (L1 L2 L3)	The LED not light or without value in display	1、Control power supply voltage problem	1、After disconnect X5,X6,X3 and X4,the fault still occurs; 2、Measure the AC voltage between L1C and L2C.
		2、Main power supply voltage problem	1、For single-phase 220 V model, measure AC voltage between L1 and L2. The DC bus voltage between (+) and (-) lowerthan 190V, LED displays “P.off”. 2、For three-phase 220/380V model, measure the AC voltage between L1,L2 and L3. The DC bus voltage between (+) and (-),for 380V grade lower than 390V，220V grade lower than190V and LED displays “P.off”.
		3、Servo Drive problem	-
	The operation panel displays “Er.xxx”	Refer to “9.2 Failure and warning handling during operation”, Finding the causes and troubleshooting.	
	After the preceding causes are removed, the panel should display monitored objects.		
Servo enable signal(S-ON is ON)	The operation panel displays “Er.xxx”	Refer to “9.2 Failure and warning handling during operation”, Finding the causes and troubleshooting.	
	Servo motor shaft in free running status	1、Servo enable signal invalid	1、Set operation panel to servo status display and check whether the operation panel blinking displays monitored objects; 2、Check it whether setup servo enable signal parameters in group F02(DI function 1：S-ON)，If it has been setup, please check the corresponding terminal logic valid or not. If still not setup, please refer to Chapter 8“F02 Group：Terminal input parameters” to setup and make the terminal valid. 3、If the servo enable signal has been setup in F02 Group and the corresponding terminal has valid logic but the operation panel still blinking display monitored objects, please refer to "Chapter 4:Wiring instructions and check the wiring of DI is correct or not.
		2、Incorrect selection of control mode	Check the value of F01.00 is 0 or not. If it has been incorrect setup as 2(Torque control), Servo motor shaft also will be in free running status due to the default torque reference is 0.
	After the preceding causes are removed, the panel should display monitored objects.		

Input position reference	Servo motor not rotates	Input position reference counter (F10.12)is 0	High/low-speed pulse input terminal wired incorrectly. When F04.00=0(pulse position reference), Please refer to Chapter 4: Wiring instructions and check the wiring of high/low-speed is correct or not. Also check the settings ofF04.03 matched or not. Not input position reference 1. Whether used DI function No.13 (FunIN.13:Inhibit,Inhibit position reference) or DI function No. 37 (FunIN.35：Pulse Inhibit,Inhibit pulse reference); 2. When F04.00=0 (pulse position reference), The host device and other pulse devices not output pulses. Please refer to Chapter 4:Wiring and use oscilloscope to check whether the high/low-speed pulse port has pulse input or not; 3. When F04.00=1(Steps reference), check the value of F04.04 is 0 or not. If not 0,please check it whether it has been setup as DI function No. 20(FunIN.20：PosStep，Steps reference enable)and the corresponding terminal is valid or not; 4. When F04.00=2(Multi-step position reference), please check the settings in F14 correct or not. If correctly, please check whether it has been setup as DI function No.28(FunIN.28 ： PosInSen, Internal multi-step position enable)and the corresponding terminal valid or not; 5. If used the Interrupt fixed-length function, please check the value of F04.34 is 1 or not, (After complete the interrupt fixed-length whether response to other position reference).If it's 1, please ensure that whether using DI function No.29(FunIN.29: XintFree, Relieve the interrupt fixed-length status)to relieve it.
	Servo moor reverse rotates	Input position reference counter (F10.12) is negative	1. When F04.00=0 (pulse position reference), Please check whether the settings in F04.01 (pulse reference form) corresponds to the actual input pulse or not. Otherwise, it means incorrect settings of F04.01or wrong terminals wiring; 2. When F04.00=1(Steps reference), check the value of F04.04 is positive or negative; 3. When F04.00=2(Multi-step position reference), check t he positive and negative of each displacement in F14 Group; 4. Check if it has been setup as DI function No. 27 (FunIN.27: PosDirSel, position reference direction setting) and the corresponding terminal valid or not;
	After the preceding causes are removed, the servo motor can rotate.		
Slow rotation not	Speed not stable	Improperly Gain setting	Please refer to "7.3 Automatic gain tuning"

smooth	during slow rotation		to adjust it.
	Motor shaft vibrates left and right	The load inertia ratio (F07.14) too large	If it can be run safely, perform inertia auto-tuning in accordance with "7.2 Inertia Identification"; Please refer to "7.3 Automatic gain tuning" to perform automatic gain tuning.
	After the preceding causes are removed, the servo motor can rotate.		
Normally operation	Positioning inaccurate	Unsatisfactory position deviation occurs	Confirm input position reference pulse counter (F10.12), feedback pulse counter (F10.16) and mechanical stop position according to the following steps.

(2)The procedure of checking the causes of positioning inaccurate is as follows:



When inaccurate positioning occurs, please check 4 signals in above figure:

① Output position reference counter Pout in position reference output device (Host device or internal parameters in servo drive);

②Input reference pulse counter Pin that received by the servo drive, corresponding to parameter **[F10.12]**;

③ Feedback pulses accumulation of the encoder in servo motor Pf, which corresponding to parameter **[F10.16]**;

④ Mechanical stop position PL.

There are 3 causes resulting in inaccurate positioning, corresponding to A, B and C in the figure:

Cause A:

➢ Counting of input position reference incorrect which caused by the noise in the wiring between position reference output device(Host device) and servo drive;

➢Input position reference is interrupted during motor running. The causes are Servo enable signal is set to invalid(S-ON is OFF), the forward/backward direction overtravel switch signal (P-OT or N-OT) valid and the position deviation clearing signal (ClrPosErr) is valid.

Cause B:

Wrong encoder feedback position signal (signal suffers interference);

Cause C:

Mechanical position slides between machine and servo motor.

In the ideal state without position deviation, the following relationship is established:

① Pout=Pin, Output position reference counter value = Input position reference counter value

② Pin× Electronic gear ratio =Pf, Input position reference counter value× Electronic gear ratio=Feedback pulses accumulation

③ Pf ×△L=PL, Feedback pulses accumulation× corresponding load displacement of one position reference=Mechanical stop position

In case of inaccurate positioning, please follow the below inspection methods:

① Pout ≠ Pin

Fault cause: A

Debug methods and procedures:

Please check whether the pulses input terminal(Low-speed or high-speed pulses input terminal, for more details refer to Chapter 4 Wiring) adopted shielded twisted pair cables;

Please change it into differential input mode if open-collector input of low-speed pulse input terminal mode is used;

The wiring of pulses input terminals should be separated from the wiring of main circuit (L1C、L2C、L1、L2、L3、U、V、W);

When using low-speed pulse input terminal, please increase the filter time constant of low-speed pulses input pin in **[F09.13]**.

② Pin× Electronic gear ratio ≠ Pf:

Fault cause: B

Debug methods and procedures:

Please whether check any alarms occurs during the operation which leads to the stop of the servo when the instruction is not fully executed;

If the cause is position deviation clearing signal (ClrPosErr) is valid, please check the position deviation clearing method in [F04.18] is correct or not.

9.1.2 Speed control operation mode

Startup process	Fault symptom	Causes	Confirming methods
Connect control power supply (L1C L2C) Main power supply (L1 L2 L3)	The LED not light or without value in display	1.Control power supply voltage problem	1.After disconnect X5,X6,X3 and X4,the fault still occurs; 2. Measure the AC voltage between L1C and L2C.
		2.Main power supply voltage problem	1.For single-phase 220 V model, measure AC voltage between L1 and L2. The DC bus voltage between (+) and (-) lower than 190V，LED displays “P.off”. 2.For three-phase 220/380 V model, measure the AC voltage between L1,L2 and L3. The DC bus voltage between (+) and

			(-),for 380V grade lower than 390V，220V grade lower than190V and LED displays “P.off”.
		3.Servo Drive problem	-
	The operation panel displays “Er.xxx”	Refer to “9.2 Failure and warning handling during operation”, Finding the causes and troubleshooting.	
	After the preceding causes are removed, the panel should display monitored objects.		
Servo enable signal(S-ON is ON)	The operation panel displays “Er.xxx”	Refer to “9.2 Failure and warning handling during operation”, Finding the causes and troubleshooting.	
	Servo motor shaft in free running status	1.Servo enable signal invalid	1.Set operation panel to servo status display and check whether the operation panel blinking displays monitored objects; 2.Check it whether setup servo enable signal parameters in group F02(DI function 1：S-ON)，If it has been setup, please check the corresponding terminal logic valid or not. If still not setup, please refer to Chapter 8“F02 Group：Terminal input parameters” to setup and make the terminal valid. 3.If the servo enable signal has been setup in F02 Group and the corresponding terminal has valid logic but the operation panel still blinking display monitored objects, please refer to Chapter 4:Wiring instructions and check the wiring of DI is correct or not.
		2.Incorrect selection of control mode	Check the value of F01.00 is 0 or not. If it has been incorrect setup as 2(Torque control)，servo motor shaft also will be in free running status due to the default torque reference is 0.
	After the preceding causes are removed, the panel should display monitored objects.		
Input speed reference	Servo motor not rotates or the servo motor speed abnormal	Speed reference(F10.01)is 0	Wrong wiring of AI When select analog speed input reference, please check the selection of AI analog input channels is correct or not in advance. Then check the wiring of AI terminal correct or not. For more details please refer to Chapter 4: Wiring. Wrong selection of speed reference, check the setting of F05.02 correct or not. Without speed reference or speed reference abnormal 1. When select analog speed input reference, please check the settings of AI related parameters in F02 group are correct or not in advance. Then check the input voltage of external signal source correct or not by the observing of scope or reading of F10.20 or F10.21； 2. When select digital setting reference，check the setting of F05.04 is correct or not； 3. When select multi-step speed reference，

			check the settings of F15 group parameters are correct or not; 4.When communication reference used, check the setting of F20.02 is correct or not; 5. When Jog speed reference used, please check the value of F05.05. Also check the effective logic of DI function No.18 and No.19 matches with the predicted rotating direction. 6.Check the settings of Acc/Dec time in F05.06 and F05.07are correct or not; 7.Check whether the zero-position fixation function has been wrong used, wrong setup of DI function No.12 and whether the valid logic of corresponding DI terminal is correct or not.
Input speed reference	Servo motor reverse rotates	Speed reference(F10.01)is negative	1.When select analog input reference, please check whether the positive or negative polarity of the input signal is reverse or not; 2.When select digital setting reference, please check whether the value of F05.04 less than 0 or not; 3.When select multi-step speed reference, please check the positive and negative of each speed reference in F15 group; 4.When communication reference used, please check whether the value of F20.02 less than 0 or not; 5. When Jog speed reference used, please check the value of F05.05. Also check the valid logic of DI function No.18 and No.19 matches with the predicted rotating direction. 6.Check whether setup DI function No.26 (FunIN.26:SpdDirSel , Speed reference direction setup) and the corresponding terminal valid or not;
	After the preceding causes are removed, the servo motor can rotate.		
Slow rotation not smooth	Speed not stable during slow rotation	Improperly gain setting	Please refer to “7.3 Automatic gain tuning” to adjust it.
	Motor shaft vibrates left and right	Load rotation inertia ratio(F07.14)is too large	If it can be run safely, perform inertia auto-tuning in accordance with “7.2 Inertia Identification”; Please refer to “7.3 Automatic gain tuning” to perform automatic gain tuning.

9.1.3 Torque control operation mode

Startup process	Fault symptom	Causes	Confirming methods
Connect control power supply (L1C L2C)	The LED not light or without value in display	1.Control power supply voltage problem	1.After disconnect X5,X6,X3 and X4,the fault still occurs; 2. Measure the AC voltage between L1C and L2C.

Main power supply (L1 L2 L3)		2.Main power supply voltage problem	1.For single-phase 220 V model, measure AC voltage between L1 and L2. The DC bus voltage between (+) and (-) lower than 190V，LED displays "P.off". 2.For three-phase 220/380 V model, measure the AC voltage between L1,L2 and L3. The DC bus voltage between (+) and (-),for 380V grade lower than 390V，220V grade lower than190V and LED displays "P.off".
		3.Servo Drive problem	-
	The operation panel displays "Er.xxx"	Refer to "9.2 Failure and warning handling during operation", Finding the causes and troubleshooting.	
	After the preceding causes are removed, the panel should display monitored objects.		
Servo enable signal valid(S-ON is ON)	The operation panel displays "Er.xxx"	Refer to "9.2 Failure and warning handling during operation", Finding the causes and troubleshooting.	
	Servo motor shaft in free running status	Servo enable signal invalid	1.Set operation panel to servo status display and check whether the operation panel blinking displays monitored objects; 2.Check it whether setup servo enable signal parameters in group F02(DI function 1：S-ON)，If it has been setup, please check the corresponding terminal logic valid or not. If still not setup, please refer to Chapter 8"F02 Group：Terminal input parameters" to setup and make the terminal valid. 3.If the servo enable signal has been setup in F02 Group and the corresponding terminal has valid logic but the operation panel still blinking display monitored objects, please refer to Chapter 4:Wiring instructions and check the wiring of DI is correct or not.
	After the preceding causes are removed, the panel should display monitored objects.		
Input torque reference	Servo motor not rotates	Internal torque reference (F10.02) is 0	Wrong wring of AI When select analog torque input reference, please check the wiring of AI is correct or not and refer to Chapter 4: Wiring. Wrong selection of torque reference Check the setting of F06.02 correct or not. Without input torque reference 1. When select analog torque input reference, please check the settings of AI related parameters in F02 group are correct or not in advance. Then check whether the input voltage signal of external signal source is correct or not by oscilloscope observing or reading the value of F10.20 or F10.21. 2.When select digital setting reference，check the value of F06.04 is 0 or not； 3.When select communication reference，check the value of F20.03 is 0 or not.
	Servo motor reverse	Internal torque reference	1. When select analog torque input

	rotates	(F10.02) is negative	reference, Whether the polarity of external signal source input voltage is reverse or not can be check by oscilloscope or the value of F10.20 or F10.21. 2.When select digital setting reference，check whether F06.04 is less than 0 or not. 3.When select communication reference，check whether F20.03 is less than 0 or not. 4.Check whether has setup DI function No.25 (FunIN.25：ToqDirSel，Torque reference direction setup) and the corresponding terminal valid or not;
	After the preceding causes are removed, the servo motor can rotate.		
Slow rotation not smooth	Speed not stable during slow rotation	Improperly gain setting	Please refer to “7.3 Automatic gain tuning” to adjust it.
	Motor shaft vibrates left and right	The load inertia ratio (F07.14) too large	If it can be run safely, perform inertia auto-tuning in accordance with “7.2 Inertia Identification”; Please refer to “7.3 Automatic gain tuning” to perform automatic gain tuning.

9.2 Fault and warning handling during operation

9.2.1 Fault and warning code list

(1)Fault and warning grading

Faults and alarms of servo drive are graded into the following four grades，No.1,No.2, No.3, and No.4，the serious degree of each grade: No.1＞No.2＞No.3＞No.4, details as following:

NO.1: Non-resettable fault;

NO.2: Resettable fault;

NO.3: Resettable fault;

NO.4: Resettable warning.

“Resettable” means that the fault/warning display state of operation panel can be stopped by input “reset signal”.

Operation methods：Setup parameter **[F12.01=1]** (Fault reset) or use DI function No.2(FunIN.2：ALM-RST，Fault reset) and makes the terminal logic valid so as to stops the fault display on operation panel.

The reset method for NO.2、NO.3 resettable faults: Turn off servo enable signal first(S-ON set as OFF)，then setup **[F12.01=1]** or use DI function No. 2.

The reset method for NO.4 resettable warnings: the program detects warnings status and exits automatically.

Note

For some faults/warnings, you must change some settings and remove the problem causes first, thereafter you can reset it. But the reset does not mean the modification takes effect. For modifications that need to be recharged (L1C, L2C) to take effect, please recharge control power supply. For modifications that require turning off the servo drive to take effect, the servo enable signal must be turned off. After it takes effect, the servo drive will work properly.

Function code	Name	Setup range	Function	Modification	Valid mode	Default
F12.01	Fault reset	0: No operation 1: Fault reset	For resettable faults and warnings, using operation panel to stops fault display. After the reset completed, it recovers to 0:No operation.	At stop	Immediate	0

Code	Name	Function name	Function
FunIN.2	ALM-RST	Fault reset signal	Edge valid mode recommended, according to the alarm types, after reset some faults and warnings, the servo drive can keep working. Invalid: Not reset faults and warnings; Valid: Reset faults and warnings;

(2)Fault record

Servo drive has fault recording function, it can record names of recent 6 faults and the servo drive status parameters of recent 2 faults when faults or warnings occurring.

After reset the fault, the fault record will still reserve the fault and warning;

Using the “Recover to factory default operation” **[F01.20=3]** can clear fault and warning record.

Servo drive status parameters when fault or warning occurs can be check in **[F17.06]**～**[F17.11]**, For more details about parameters please refer to Chapter 8: Parameters description.

The previous secondservo drive status parameters when fault or warning occurs can be check in **[F17.12]**～**[F17.17]** for more details about parameters please refer to Chapter 8: Parameters description.

When No.4 warnings occur, Warning code and status parameters of servo drive when warning occurs not save record.

When fault occurs, Fault code can be check by parameter **[F10.46]** with more fault classification information.

When reading **[F19.04]** through our servo drive debugging platform software or communication, the value is in decimal and no need to convert it.

The operation panel displays fault or warning “Er.xxx”	F19.04(Decimal)	Description
Er.101	101	0: No.1 Non-resettable fault 101: Fault code
Er.211	211	2: No.2 Resettable fault 211: Fault code
Er.311	311	6: No.3 Resettable fault 311: Fault code
Er.401	401	E: No.4 Resettable fault 401: Warning code

(3)Fault output

①NO.1 Non-resettable fault:

Display	Fault name	Fault type	Resettable
Er.100	Non-matched fault between motor and servo drive	NO.1	No
Er.101	Non-matched fault between position mode and encoder	NO.1	No
Er.102	Speed uncontrollable fault	NO.1	No
Er.103	IGBT protection	NO.1	No
Er.104	Grounding to earth during operation	NO.1	No
Er.105	Encoder fault(The angle that corresponding to Z signal changes too large)	NO.1	No
Er.106	Bus type encoder data validation error	NO.1	No
Er.107	Z pulse lost fault	NO.1	No
Er.108	Wrong reading of increment encoder UVW(Including BUS increment encoder)	NO.1	No
Er.109	Break wire of increment pulse encoder	NO.1	No
Er.110	Bus type encoder break wire	NO.1	No

②NO.2 Resettable fault:

Display	Fault name	Fault type	Resettable
Er.200	Servo drive overload protection	NO.2	Yes
Er.201	Over-current fault	NO.2	Yes
Er.202	Main circuit overvoltage	NO.2	Yes
Er.203	Main circuit under-voltage during operation	NO.2	Yes
Er.204	Motor parameter self-learning fault	NO.2	Yes
Er.205	Encoder self-turning (Includes wrong phase sequence of UVW power wires, wrong UVW signal wires and not found Z pulse etc.)	NO.2	Yes
Er.206	Break wire of temperature detection	NO.2	Yes
Er.207	Internal fault 1	NO.2	Yes
Er.208	Internal fault 2	NO.2	Yes
Er.209	Internal fault 3	NO.2	Yes
Er.210	Reserve	NO.2	Yes
Er.211	E^2PROM Read/write error	NO.2	Yes
Er.212	External device fault	NO.2	Yes
Er.213	Command conflict fault	NO.2	Yes
Er.214	Control circuit under-voltage during operation	NO.2	Yes

Er.215	Output loss phase fault	NO.2	Yes
Er.216	Heatsink overheat	NO.2	Yes
Er.217	Current detection circuit fault	NO.2	Yes
Er.218	Brake abnormal open	NO.2	Yes

③ NO.3 Resettable fault:

Display	Fault name	Fault type	Resettable
Er.300	Servo motor overload protection	NO.3	Yes
Er.301	Main circuit input loss phase	NO.3	Yes
Er.302	Over-speed protection	NO.3	Yes
Er.303	Pulse output over speed	NO.3	Yes
Er.304	Pulse input over speed	NO.3	Yes
Er.305	Motor blocked	NO.3	Yes
Er.306	Encoder battery failure	NO.3	Yes
Er.307	Encoder multi-cycle counting error	NO.3	Yes
Er.308	Encoder multi-cycle counting overflow	NO.3	Yes
Er.309	AD sampling overvoltage	NO.3	Yes
Er.310	Too large position deviation	NO.3	Yes
Er.311	Too large position deviation of full closed-loop	NO.3	Yes
Er.312	The settings of electronic gear ratio exceed limitation	NO.3	Yes
Er.313	Modbus communication fault	NO.3	Yes
Er.314	Braking resistor overload protection	NO.3	Yes
Er.315	Original position reset overtime fault	NO.3	Yes
Er.316	Original position reset abnormal	NO.3	Yes

④ Warnings, resettable automatically:

Display	Fault name	Fault type	Resettable
AL.400	Reserved	NO.4	Yes
AL.401	Encoder battery warning	NO.4	Yes
AL.402	DI emergency stop warning	NO.4	Yes
AL.403	Too small of external braking resistor connecting warning	NO.4	Yes
AL.404	Recharging need after parameters modification warning	NO.4	Yes
AL.405	Forward direction overtravel warning	NO.4	Yes
AL.406	Backward direction overtravel warning	NO.4	Yes
AL.407	IGBT overheat warning	NO.4	Yes
Er.408	Runninglimit time warning	NO.4	Yes

9.2.2 Troubleshooting of Faults

Fault code	Fault type	Principle of causing	Possible causes of failure	Countermeasures
Er.100	Mismatch fault between motor and servo drive	The rated current of motor larger than the rated current of servo drive	Product (motor or drive) serial No. not exist	When adopt our ESS200Pdrive and servo motor, please ensure the No. in F00.03 matches with motor nameplate.
			The rated current and voltage of motor and drive not exist	Please refer to "2.4 Servo system specifications" to replace unmatched product and ensure the rated voltage and rated current of the selected motor are less than the rated parameters of drive.
Er.101	Mismatch fault between position mode and encoder	Absolute position mode motor mismatch or wrong motor No. settings	Detected motor mismatch under absolute position mode or wrong motor No. settings	Reset F00.03 (Motor No.)According to motor nameplate or replace matched motor or set correct value in F00.21 (Encoder code).
Er.102	Speed uncontrollable fault	The torque reference direction reverses to the speed feedback direction under torque control mode； The speed reference direction reverses to the speed feedback direction under speed or position control mode；	Incorrect wiring of U,V and W phase sequence	Wiring according to correct U, V and W phase sequence.
			When power on, the signal disturbed and lead to wrong detection of motor shaft initial phase position	Recharge.
			Wrong encoder type or wrong wiring	Replaced matched drive and motor. When adopt our drive and motor, please ensure correct setting of F00.03. Reconfirm motor type, encoder type and wring of encoder.
			Wrong wiring or aging corrosion of encoder, loosening of encoder connector	Weld, fasten, or replace the encoder cable again.
			Gravity load too heavy in vertical axis working condition	Decrease the load of vertical axis, increase rigidity or disabled this fault if it not make influence on safety and using.
Er.103	IGBT protection	Short circuit signal detected by hardware	Braking resistor too small or short circuit	If internal braking resistor used and the value is "65535", please change to using external braking resistor (F01.16=1/2) and removed the wire between RB and B. The resistance value and power can be chosen in accordance with the internal brake resistor specification; If used external braking resistor and the resistance value is less than the value in F01.11，please refer to "6.1.7 Braking resistor settings", replace a new resistor and connect it between(+) and

				B.
			Poor motor cable contact	Tighten loose and detached wires
			Motor cable grounding	Replace motor when bad insulation
			Motor U V W cables short circuit	Connect motor cable correctly
			Servo motor burn out	Replace motor when unbalance of motor wires
			Wrong wiring or aging corrosion of encoder, loosening of encoder connector	Weld, fasten, or replace the encoder cable again.
			Servo drive fault	Replace servo drive
Er.104	Grounding to earth during operation	Short circuit signal detected by software	Poor motor cable contact	Tighten loose and detached wires
			Servo drive power cable of (U V W) short circuit to earth	Rewiring or replace servo drive power cable
			Motor cable grounding	Replace motor when bad insulation
			Motor U V W cables short circuit	Connect motor cable correctly
			Servo motor burn out	Replace motor when unbalance of motor wires
			Servo drive fault	Replace servo drive
Er.105	Encoder fault	Encoder Z signal be disturbed and lead to too large electrical angle that Z signal corresponding	Wrong wiring of encoder	Rewiring according to correct wiring diagram
			Loosing of encoder wires	Rewire and ensure the encoder terminals are tightly connected.
			Encoder Z signal be disturbed	Priority to use our standard cable; If non-standard wiring, please check whether the cables conform to the requirements of the specification, whether or not to use twisted-pair shielded wire, etc. As possible to separate the wring of strong and weak current lines. Do not tie and bound motor cables and encoder cable together. Ensure good contact of the ground of motor and drive. Check it whether the both ends of the encoder plug contact is good and whether any needles retract or not and so on.
			Encoder error	Replace encoder wires that can work normal. If no problem of encoder cables, so it's mainly encoder

				problem and need to replace servo motor.
Er.106	Bus type encoder data validation error	Abnormal of encoder internal parameters	Serial encoder cable break or loosen	Ensure whether the encoder cables break or in bad contact etc. If the motor cable and encoder cable are tied and bounded together, please separate the wring of them.
			Reading abnormal of serial encoder parameters	Replace servo motor.
Er.107	Z pulse lost fault	2500 lines increment encoder Z signal lost	Encoder failure leads to Z signal lost	Replace servo motor.
			Poor or wrong wiring leads to Z signal lost	Check the encoder cable contact well or not, rewiring or replace cables.
			Serious disturb on encoder signal	Adopt encoder connection cables that we provided and separate them from the wiring of power cables.
Er.108	Wrong reading of increment encoder UVW	After power on, wrong reading of 2500 lines increment encoder initial phase position information	Mismatch of drive and motor type	Replace matched motor and drive
			Encoder cables break	Replace encoder cables and tighten connects.
Er.109	Break wire of increment pulse encoder	Hardware detected AB signal of 2500 lines increment encode lost	Encoder failure leads to AB signal lost	Replace servo motor.
			Poor or wrong wiring leads to AB signal lost	Check the encoder cable contact well or not, rewiring or replace cables.
			Serious disturb on encoder signal	Adopt encoder connection cables that we provided and separate them from the wiring of power cables.
Er.110	Bus type encoder break wire	Hardware detected BUS type encode communication signal lost	Encoder failure leads to communication signal lost	Replace servo motor.
			Serious disturb on encoder signal	Adopt encoder connection cables that we provided and separate them from the wiring of power cables.
Er.200	Drive overload	The accumulated heat of the drive is too high and reached the fault threshold.	Wrong settings of parameters	Please contact us when the value of F00.00 not matches with drive nameplate; Adjust gain parameters properly according to current feedback effect.
			High load rate of drive(load inertia large)	Reselect drive with larger power
			High load rate of drive(Mechanical stuck and stop)	Remove mechanical stuck and stop

			Motor blocked	Refer to Er.305 troubleshooting measures
Er.201	Over-current fault	Software detected over-current	Input reference synchronizes with servo on or too fast	Instruction sequencing：After the operation panel of servo drive displays normally, please turn on the servo enable signal (S-ON) first, then input instruction. Add instruction filter time constant or increase Acc/Dec time when allowable.
			Braking resistor too small or short circuit	If internal braking resistor used and the value is “65535”，please change to using external braking resistor (F01.16=1/2) and removed the wire between RB and B. The resistance value and power can be chosen in accordance with the internal brake resistor specification; If used external braking resistor and the resistance value is less than the value in F01.11，please refer to “6.1.7 Braking resistor settings”, replace a new resistor and connect it between(+) and B.
			Poor contact of motor cables	Tighten loose and detached wires
			Motor cable grounding	Replace motor when bad insulation
			Motor U V W cables short circuit	Connect motor cable correctly
			Servo motor burn out	Replace motor when unbalance of motor wires
			Improper gain settings makes motor to oscillate	Refer to “7.2 Inertia Identification” and adjust gain.
			Wrong wiring or aging corrosion of encoder, loosening of encoder connector	Weld, fasten, or replace the encoder cable again.
			Servo drive fault	Replace servo drive
Er.202	Main circuit overvoltage	DC BUS voltage between + and – over fault threshold	High voltage input of main circuit	Change or adjust voltage according to below specifications: 220V drive: Effective value: 220V～240V Allowable deviation:-10%～+10%(198V～264V) 380V drive： Effective value: 380V～440V Allowable deviation:-10%～+10%(342V～484V)
			Power source not stable or	After connect the surge

			influenced by lightning stroke	suppressor, turn on the control power and the main circuit power. If the fault still occurs, please replace the servo drive.
			Braking resistor failure	If the resistance value is "∞" (infinite), braking resistor broken inside. If used internal braking resistor, please change it to use external braking resistor (F01.16=1/2) and removed the wire between RB and B. The resistance value and power can be chosen in accordance with the internal brake resistor specification; If used external braking resistor, please replace a new resistor and connect it between (+) and B. Be sure to set F01.17 (external braking resistor power) and F01.18 (external braking resistor resistance value) consistent with specifications of the actual used external braking resistor.
			External braking resistor value is too large and maximum braking energy cannot be fully absorbed	Replace another external braking resistor which has recommended value and reconnect it between (+) and B. Be sure to set F01.17 (external braking resistor power) and F01.18 (external braking resistor resistance value) consistent with specifications of the actual used external braking resistor.
			Motor runs in the state of rapid acceleration and deceleration, and the maximum braking energy exceeds the absorbable value	Ensure the main circuit input voltage is in specification range firstly. Then increase Acc/Dec time if it's allowable.
			The sampling value of DC BUS voltage has large deviation	Consult our technical support.
			Servo drive fault	Replace servo drive
Er.203	Main circuit under-voltage during operation	DC BUS voltage between + and – under fault threshold	Main circuit power source not stable or power off	Increase power source capacity, for more details please refer to "2.4 Servo system specifications"
			Interrupt power-supply	
			Power source voltage decreases during operation	
			Loss phase: The drive runs with single phase input but actually 3 phase power source needed.	Replace cables and wiring main circuit power cables correctly: Three phase:L1、L2、L3

				Single phase:L1、L2
			Servo drive fault	Replace servo drive
Er.204	Motor parameter self-learning fault	The drive occurs fault during servo motor parameters self-learning	Poor contact of three phase output cables	Replace cables and wiring them correctly
			Current abnormal during self-learning	Select motor matches with drive
			If F10.46=2041, fault occurs during stator identification	Restart identification after confirm the output cables are normal.
			If F10.46=2042 or F10.46=2043 ,fault occurs during inductance identification	Restart identification after confirm the output cables are normal and select matched servo motor with drive.
			Incorrect settings of carrier frequency during identification	If F10.46 is 2044, please contact with manufacture
Er.205	Encoder self-turning fault	Fault occurs in the drive during self-learning of 2500 lines optical-electricity encoder installing information and motor UVW wiring sequence	Incorrect sequence wiring of motor power terminals UVW	1. If the motor runs clockwise during self-learning, exchange any two phases of the UVW power line and restart self-learning after exchanged. 2. If the motor runs counterclockwise during self-learning and the motor encoder is 2500 lines optical-electricity type, exchange the wiring of encoder A and B signals. Restart self-learning after exchanged. 3. If the motor runs counterclockwise during self-learning and the motor encoder is BUS type, it means the encoder is mismatch, please contact manufacture to replace motor.
			Not found Z signal	Restart identification after confirm the wiring of 2500 lines encoder is reliable.
			The UVW signal wires of 2500 lines optical-electricity encoder have problem	Restart identification after confirm the wiring of 2500 lines encoder is reliable.
Er.206	Break wire of temperature detection	Software detected temperature circuit occurred fault	IGBT temperature detection circuit fault	Replace servo drive
Er.207	Internal fault 1	Internal watchdog fault	Internal watchdog trigger	Consult our technical support.
Er.208	Internal fault 2			
Er.209	Internal fault 3	Internal timing error		
Er.211	EEPROM Read/write fault	① Can't write parameters value into E^2PROM; ②Can't read parameters value	Abnormal when writing parameters	After modify some parameters, recharge the drive and check whether the settings of the parameters saved or not. If still be saved and the fault
			Abnormal when reading parameters	

		from E^2PROM;		still exist, please replace drive.
Er.212	External device fault		External device fault	Disconnect the external device fault terminal after the external fault has been handled.
Er.213	Command conflict fault	Redundant servo command signal occurs when the drive is executing a command	When internal enable signal valid, the external servo enable signal(S-ON)is valid	The servo drive can only execute one command of the auxiliary function or serve ON command at any time.
Er.214	Control circuit under-voltage during operation	For 220V drive: Normal value: 310V, Fault value: 160V; For 380V drive: Normal value: 540V, Fault value: 350V.	Control circuit power source not stable or instantaneous power failure occurs	Recharge the drive. In case of abnormal power loss, please ensure the power source is stable and increase the power source capacity.
			Poor contact of control cables	Rewiring or replace cables
Er.215	Output loss phase fault	Motor output loss phase detected by the drive	Poor contact of motor cables	Tighten loose and detached wires
			Motor cables grounding	Replace motor when bad insulation
			Motor U V W cables short circuit	Connect motor cable correctly
			Servo motor burn out	Replace motor when unbalance of motor wires
			If the above problems not exist, please disable function of the output loss phase detection during operation (F09.02=0).	
Er.216	Heatsink overheat	The temperature of the drive power IGBT is higher than high temperature protection point	Ambient temperature is too high.	Improve cooling conditions of servo drive and reduce ambient temperature.
			When overload occurs, Power off the servo drive to reset overload fault many times	Change reset method of fault. After overload occurs, wait 30s and then reset it. Increase capacity of servo drive and motor, increase Acc/Dec time and reduce load.
			Fans broken	Replace drive
			The installation direction of servo drive and the separation from other servo drives are unreasonable	Install servo drive according to mounting requirements.
			Servo drive failure	Replace drive
Er.217	Current detection circuit fault	Current detection circuit fault detected by drive	Control board connection or plug-in loose	Rewiring and then power on again
			Auxiliary power failure	Seek service from manufacturers or agents.
			Current detection parts failure	
			Amplify circuit abnormal	
Er.218	Brake abnormal open	After brake protection is	Motor brake abnormal open	Rewiring according to correct wring or replace the motor.

		enabled, the brake output signal is inactive, but detected that the motor rotates for two revolutions.		
Er.300	Motor overload protection	Heat accumulation of the motor is too high and reaches the fault level.	Wiring of motor and encoder is incorrect or poor	Connect cables according to correct wiring diagram; Priority to use our standard configured cables; Self-made cable used, please make and connect them according to hardware wiring guidance.
			The load is too heavy and the motor keeps output effective torque which higher than rated torque for a long time.	Replace servo drive with larger power and matched servo motor or reduce the load and increase Acc/Dec time.
			Acceleration or deceleration is too frequent or the load inertia is too large.	Increase Acc/Dec time during each operation.
			The gain is Improper or rigidity is too high.	Adjust the gain by referring to “7.2 Inertia identification”.
			The drive or motor model set incorrectly.	Check drive and motor nameplate and set correct drive type and motor type according to “2.4 Servo system specifications”.
			Locked-rotor occurs due to mechanical factors lead to motor blocked and resulting in much heavy load during operation.	Eliminate mechanical factors.
			Servo drive failure	Replace drive
Er.301	Main circuit input loss phase	Three phase drive loss phase	Poor wiring of three phase input cables	Replace cables and wiring main circuit cables correctly.
			Single phase power is applied to three phase specification drive.	If input voltage satisfies specification requirements, please set F09.00 as 0 (Disable input loss phase detection); In other cases, if input voltage does not satisfy specification requirements, replace or adjust power source.
			Three phase power source unbalanced or voltages of all three phases too low.	
Er.302	Over-speed protection	The actual speed of the servo motor exceeds the fault threshold	Motor cables UVW phase sequence incorrect.	Connect UVW cables according to correct phase sequence.
			Incorrect setting of F09.09 parameter	Reset over-speed fault threshold according to mechanical requirement
			Input reference exceeds the fault threshold.	Position control mode: When the position reference is

				pulse reference,: on the premise of ensuring the accuracy of the final positioning, please reduce the pulse reference frequency or reduce the electronic gear ratio if the operating speed is allowed; Speed control mode: check the input speed reference value or speed limitation value in (F05.08～F05.10) and ensure them within the range of over speed fault threshold; Torque control mode: please set the speed limitation threshold within the over speed fault threshold and the speed limitation in torque control mode please refer to "6.4 Torque control mode".
			Motor speed overshoot	Refer to "7.2 Inertia identification" to adjust gain or adjust the operating conditions of machinery.
			Servo drive failure	Replace servo drive
Er.303	Pulse output over speed	When pulse output function used (F04.25=0 or 1), the frequency of output pulses exceeds frequency upper limit allowed by the hardware (392KHz).	The frequency of output pulses exceeds frequency upper limit allowed by the hardware(240KHz)	① When F04.25=0，decrease F04.26(Encoder Frequency demultiplication pulses)，making output pulse frequency below frequency upper limit allowed by hardware in the speed range required by mechanical condition. ② When F04.25=1，Decrease input pulse frequency to within frequency upper limit allowed by hardware. In this case, if not modify electronic gear ratio, motor speed will be slow. If input pulse frequency is very high but is still within frequency upper limit allowed by hardware, take anti-interference measures(use shielded twisted pair cables for pulses input and set pin filter parameters F09.13 or F09.16), which prevents interference pulse adding to actual pulse and resulting in fault misreported.
Er.304	Pulse input over speed	Input pulses frequency higher than Max. position pulses frequency(F09.12)	Input pulses frequency higher than Max. position pulses frequency(F09.12)	Reset F09.12 according to the maximum position pulses frequency that required for normal operation of the machine.

				If output pulse frequency of host computer is higher than 4 MHz, it has to be decreased.
			Input pulses disturbed	Firstly, use shielded twisted pair cables for pulses input and separate pulse input cable from servo drive power cables. Secondly, if differential input is selected on the condition of using low-speed pulse input terminal (F04.03=0), host computer ground must be connected to GND of servo drive reliably. If open-collector input is selected, host computer ground must be connected to COM of servo drive reliably. Only differential input can be selected on the condition of using high-speed pulse input terminal (F04.03=1), host computer ground must be connected to GND of servo drive reliably. Finally, according to selected hardware input terminal, increase pin filter time of pulse input terminal in F09.13.
Er.305	Motor blocked	Actual motor speed lower than 10 rpm but torque reference reaches the limit and the duration reaches the value set in F09.17	Drive U,V,W output loss phase or wrong phase sequence connection	Connect cables correctly again or replace them.
			Drive U,V,W output cables or encoder cables break wire	
			Mechanical factors caused motor blocked	Eliminate mechanical factors.
Er.306	Encoder battery failure	The voltage of absolute encoder battery lower than 3.0V	Battery not connected during power off period	Set F12.02 as 1to clear fault
			Encoder battery voltage too low	Replace new battery with matched voltage
Er.307	Encoder multi-cycle counting error	Encoder multi-cycle counting error	Encoder failure	Replace motor
Er.308	Encoder multi-cycle counting overflow	Encoder multi-cycle counting overflow detected	When F09.18=0, encoder multi-cycle counting overflow detected	Replace motor
Er.309	AD sampling overvoltage	AI sampling value is larger than the voltage value in F09.07	Input voltage of AI channel is high	Adjust input voltage and check the sampling voltage until sampling voltage not exceeds the set voltage in F09.07.
			Wrong wiring of AI channel or interference exists	Use shielded twisted pair cable and choose shorten length

				cable. Increase AI filter time constant: AI1 filter time constant：F02.25 AI2 filter time constant：F02.28
Er.310/ Er.311	Too large position deviation/ Too large position deviation of full closed-loop	Position deviation larger than the setting value in F09.10 in position control mode	Drive U,V,W output loss phase or wrong phase sequence connection	Connect cables correctly again or replace them.
			Drive U,V,W output cables or encoder cables break wire	Rewiring and power cables UVW of servo motor and power cables UVW of servo drive must be one to one correspondence. Replace the cable if necessary and ensure its reliable connection.
			Mechanical factors caused motor blocked	Eliminate mechanical factors.
			Servo drive gain is low	Refer to Chapter 7 adjust gain manually or automatic auto-tuning
			High frequency of input pulses	Reduce position reference frequency or decrease electronic gear ratio. When host computer is used to output position pulses, set the Acc/Dec time in host computer. If host computer not allowed to set Acc/Dec time, please increase parameters F04.05 and F04.06 to increase smoothen parameters of position reference.
			According to operation condition, fault value in (F09.10)too small	Increase the value in F09.10
			Servo drive or motor failure	If the position reference is not 0 but the position feedback is always 0, please replace the servo drive or motor.
Er.312	The settings of electronic gear ratio exceed limitation	Any group of electronic gear ratio exceeds the limit value	The set value of electronic gear ratio beyond the above range	Make the ratio value of encoder resolution/F04.07, F04.09/F04.11 and F04.13/F04.15 set within the limit.
			Parameter modify order problems	Use the fault reset function or power on again
Er.313	Modbus communication fault	Communication occurs problems	Incorrect Baud rate setting	Setup Baud rate properly
			Incorrect setting of fault and warning parameters	Set proper values according to the communication of the upper computer.
			Interference is too large	Rewiring

9.2.3 Troubleshooting of warnings

Fault code	Fault type	Principle of causing	Possible causes of failure	Countermeasures
AL.400	Reserved			
AL.401	Encoder battery warning	The voltage of absolute encoder battery is lower than 3.0V	The voltage of absolute encoder battery is lower than 3.0V	Replace new battery with matched voltage
AL.402	DI emergency stop warning	DI function No.33(FunIN.33：Brake，Emergency)	DI function No.33，Brake is triggered	Check the operation mode ,after confirm the safety then remove the DI brake valid signal
AL.403	Too small of external braking resistor connecting warning	F01.18(external braking resistor resistance value) less than F01.11(The Min. value of external braking resistor for drive operation)	When using external braking resistor (F01.16=1),the resistance value less than minimum value allowed by the drive	① When the external resistor resistance value less than F01.11，replace resistor that match with the drive. After set the selected resistance value in F01.18, please connect the resistor between + and B. ② If the external resistor resistance value larger than F01.11，set the resistance value of the actual external resistor in F01.18.
AL.404	Recharging needed after parameters modification warning	When the valid mode of servo drive function code is “valid after power on again”, the value of the parameters has been changed, the drive reminds the user to power on again.	Modify parameters which is valid after power on again	Power on again
AL.405	Forward direction over-travel warning	Forward direction over-travel signal occurs	DI function No.14: Forbid forward direction drive used and the terminal is valid	Check the operation mode. After confirm it is safety, send a reverse reference or turn around the motor and make the terminal logic of “Forward direction over-travel” invalid.
			Maximum value of software limit over range	Check the value of F10.07 whether out of the limit of F09.20，if out of range, please adjust F09.20.
AL.406	Backward direction over-travel warning	Backward direction over-travel signal occurs	DI function No.15: Forbid reverse direction drive used and the terminal is valid	Check the operation mode. After confirm it is safety, send a forward reference or turn around the motor and make the terminal logic of “reverse direction over-travel” invalid.
			Minimum value of software limit over range	Check the value of F10.07 whether out of the limit of F09.20，if out of range, please

				adjust F09.20.
AL.407	IGBT overheat warning	Drive detected IGBT temperature exceeds warning level	Ambient temperature is too high.	Improve cooling conditions of servo drive and reduce ambient temperature.
			After warning occurs, Power off the servo drive to reset warnings many times	Increase capacity of servo drive and motor, increase Acc/Dec time and reduce load.
			Fans broken	Replace servo drive
			The installation direction of servo drive and the separation from other servo drives are unreasonable	Install servo drive according to mounting requirements.
			Servo drive failure	Replace servo drive
AL.408	Running limit time warning	The running limit time arrived	Drive limit time of running arrived	Please contact supplier

9.2.4 Operation panel communication fault

Fault code	Fault type	Principle of causing	Possible causes of failure	Countermeasures
Er.999	Operation panel communication fault	Operation panel CPU has communication fault with host computer CPU	Operation panel CPU has communication fault with host computer CPU	Replace drive or control board

10 Communication

The servo drive has Modbus (RS-232, RS-485) communication function, and the host computer communication software can realize many functions such as parameter modification, parameter query and servo drive status monitoring.

10.1 MODBUS communication

The RS-485 communication protocol adopts single-master multi-slave communication mode, which can support multiple servo drives to network. The RS-232 communication protocol does not support networking of multiple servo drives.

10.1.1 Hardware wiring and EMC precautions

(1) RS-232 connection diagram

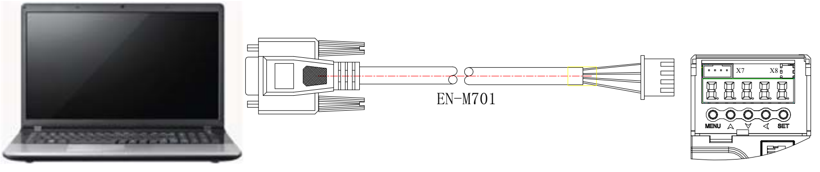


Fig.10-1 RS-232 connection diagram

(2) RS-485 connection diagram

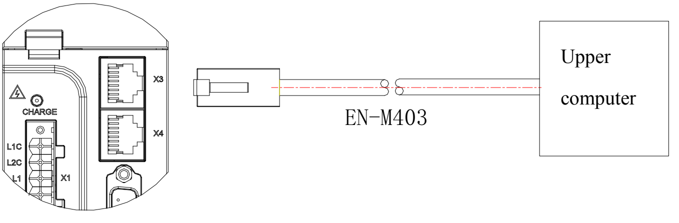


Fig.10-2 RS-485 connection diagram

(3) When the number of nodes is large, the RS-485 bus recommends a hand-held bus structure.

If a branch line connection is required, the branch length between the bus and the node is as short as possible, and it is recommended not to exceed 3 m. Resolutely put an end to star connections. A schematic diagram of common bus structure is as follows:

① Recommended solution: hand-held connection structure

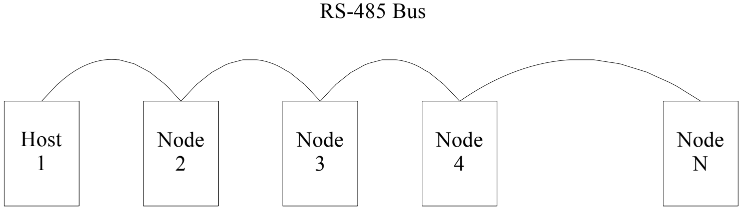


Fig.10-3 Recommended hand-hand connection structure diagram

② General solution: branch line connection structure

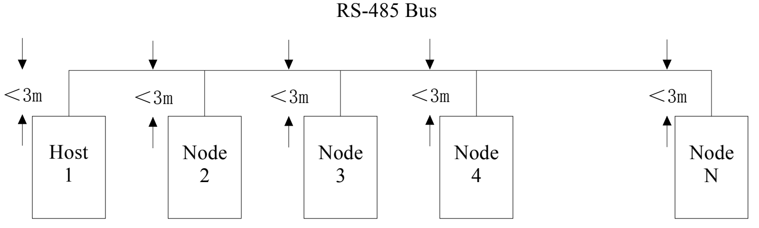


Fig.10-4 Branch line connection structure diagram

③ Wrong solution: star connection structure

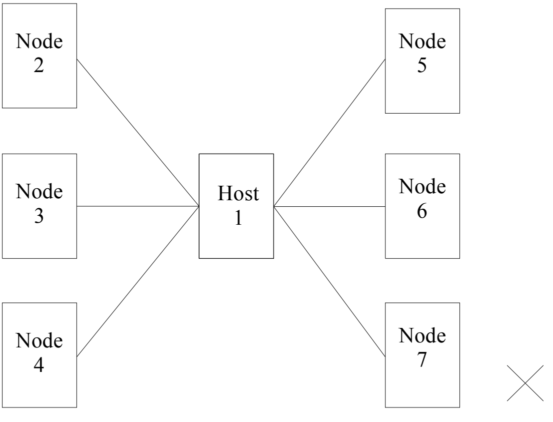


Fig.10-5 Wrong star connection

Note

(1) Connect the correct terminating resistor. Refer to question 1 for details.
(2) RS-485 communication must use cables with twisted pairs;
(3) Connect the 485 circuit reference ground GND of each node through the third cable, wherein the 485 ground reference ground of the ESS200P servo drive is GND;
(4) When shielded cables are used in the field, it is recommended to connect PEs at both ends of the shield. Do not connect GND to one end, connect PE to the other end, or connect GND to both ends. Otherwise, the port will be damaged.
(5) Using the hand-holding method for bus layout, refer to question 3 for details;
(6) Connect the PE of each node with an additional grounding wire. Refer to "10.1.2 EMC Layout Requirements".
(7) The RS-485 bus needs to be arranged separately from other interference cables. Refer to "10.1.2 EMC Layout Requirements".

10.1.2 EMC layout requirements

(1) Layout requirements on site

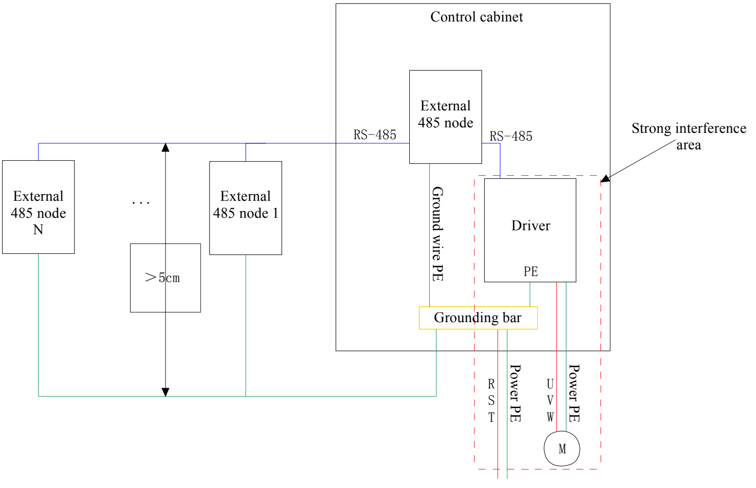


Fig.10-6 Layoutschematic diagram

Note

(1) The source of interference is isolated from sensitive equipment.
(2) Interference equipment and cables occupy the smallest area, such as near the outlet.

(2) Ground wire PE connection requirements

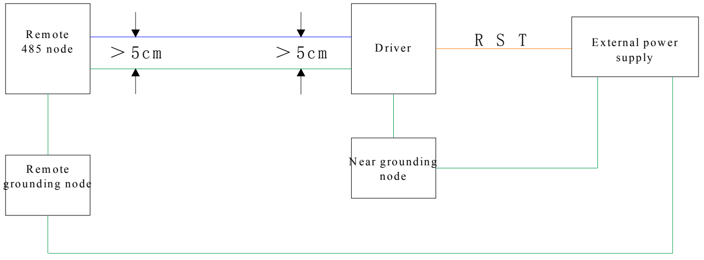


Fig.10-7 Ground wire PE wiring diagram

Note

(1) Ground wire PE must use a cable thicker than AWG12.
(2) The ground wire PE is connected to the ground terminal of the node or the ground bar of the cabinet where the node is located.
(3) The distance between the ground wire PE and the bus is greater than 5cm.

（3）Cable layout requirements

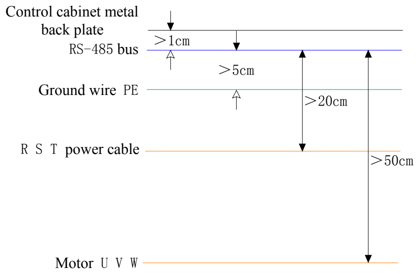


Fig.10-8 Cable layout diagram

Note

(1) The RS-485 bus and the strong electric cable maintain a distance of more than 20cm;
(2) The RS-485 bus and the motor UVW power cable maintain a distance of 50cm or more;
(3) The RS-485 bus and on site ground wire maintain a distance of more than 5 cm;
(4) The RS-485 bus and metal cabinet back plate maintain a distance of more than 1cm.

10.1.3 485 Interface field application transmission distance, node and transmission rate relationship

No	Rate	Transmission distance	Number of nodes	Wire diameter
1	57.6kpbs	100m	128	AWG26
2	19.2kbps	1000m	128	AWG26

Note

(1) Generally, RS-485 can connect 32 servo drives at the same time. To connect more servo drives, an amplifier must be installed to expand up to 247 servo drives.
(2) When using RS-485 communication, if the host computer only supports RS-232, it can be connected through RS-232/RS-485 converter.

10.1.4 Communication parameter setting

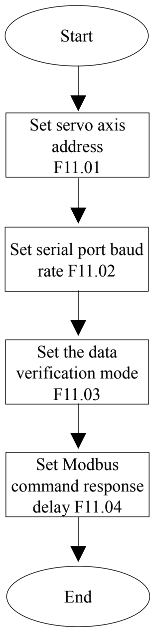


Fig.10-9 Communication parameter setting process

(1) Set the drive axis address**[F11.01]**

When multiple servo drives are networked, each drive can only have a unique address, otherwise communication will be abnormal and communication will not be possible. Among them:

0： Broadcast address

1～247： Slave address

The host computer can write to all slave drives through the broadcast address, and the slave drive receives the frame of the broadcast address to operate, but does not respond.

(2) Set the communication rate between the drive and the host computer**[F11.02]**

The communication rate of the servo drive must be the same as the communication rate of the host computer, otherwise communication will not be possible.

When multiple servo drives are connected, if the communication baud rate of one drive is inconsistent with the host, it will cause communication error of the axis or affect other axis communication.

(3) Set the data verification mode when the drive communicates with the host computer**[F11.03]**

ESS200P provides two kinds of data verification methods: even check**[F11.03=1]** and odd check**[F11.03=2]**, also could use no check**[F11.03=0]**.

① **Even check or odd check**

The actual bits of per frame data is 11 bits: 1 bit start bit, 8 bits data bit, 1 bit check bit, 1 bit end bit.

10	9	8～1	0
End bit	Check bit	Data bit	Start bit

② **No check**

Select no check mode, data frames are available in two formats:

a）The actual bits of per frame data is 11 bits, including 1 start bit, 8 data bits, and 2 end bits.

10～9	8～1	0
End bit	Data bit	Start bit

b）The actual bits per byte is 11 bits, including 1 start bit, 8 data bits, and 1 end bit.

10	9	8～1	0
Invalid bit	Check bit	Data bit	Start bit

The data bits are in hexadecimal.

Note

The host computer data frame format must conform to the above format, otherwise it will not be able to communicate with the drive.

Note

(1) The E^2PROM device inside the drive has a limit on the number of times of storage. When writing the function code parameters, it will be stored in the E^2PROM in real time. In operation, the function code should be prevented from being frequently modified, resulting in frequent operation of the E^2PROM.

(2) After the E2PROM is damaged, the drive will have other non-resettable faults!

(4) Set MODBUS communication response delay**[F11.04]**

The function code **[F11.04]** adds delay to the servo response. After receiving the command, the servo delays the time set by **[F11.04]** and then response to the host.

If the data range of the function code is within -65536 to +65535, it is a 16-bit function code, which occupies only one function code group offset, and only occupies one address. For example, **[F02.01]**, its communication address is 0x0201, **[F12.10]**, its communication address is 0x0C0A.

If the data range of the function code exceeds -65536 to +65535, it belongs to the 32-bit function code, occupies two consecutive function code group offset numbers, occupies 2 consecutive addresses. However, the communication address is determined only by the address with the lower offset number. In the communication, the lower 16 bits are in the front and the high 16 bits are in the behind.

For example, [F14.06], occupying two consecutive function code group offset numbers, respectively [F14.06] and [F14.07], the communication address with lower offset number [F14.06] inside the drive 0x0E06 stores the lower 16 bits of the function code value, and the higher offset number [F14.07], the communication address 0x0E07 stores the higher 16 bits of the function code value.

When the "1st segment movement displacement" is set to 0x40000000 (1073741824 in decimal), the value of [F14.06] should be set to 0x0000, and the value of [F14.07] should be 0x4000. When writing the function code, it is determined in the communication frame that "0x0000" is in the front and "0x4000" is in the behind. The reading and writing of all 32-bit registers is unified to the lower 16 bits first and the higher 16 bits later.

Note

(1) Do not operate the higher 16 bits of the 32-bit function code of the servo drive separately!

(2) When using the communication to modify the function code, you need to pay attention to the setting range, unit, effective time, setting category, positive and negative hexadecimal conversion of the function code. For details, please refer to the description of the function code.

Note

(1) Some manufacturers' PLC/touch screen MODBUS command programming address is not equal to the actual register address, but equal to the actual register address plus 1, because the starting address of the standard MODBUS command register is 1, but many devices actual register address starts from 0 (for example, this servo drive). When such PLC/touch screen and MODBUS communication are performed with the servo drive, the programmer needs to be clear about this in order to correctly read and write the function code of the servo drive.

(2) If it is not possible to determine whether the register address of the PLC/touch screen MODBUS command is equal to the actual register address, select two adjacent function codes with different values, and read a larger function code with 0x03 (read) command, if the value of the function code read is equal to the smaller code value of the function code, the register address of programming is equal to the actual register address plus 1.

Function code	Name	Setting range	Unit	Function	Setup way	Effective way	Default value
F11.01	Servo axis address	1～247	-	Set the drive axis address	Run time set	Effective instantly	1
F11.02	Serial port baud rate setting	0：2400 1：4800 2：9600 3：19200 4：38400 5：57600 6：115200 7：230400	Kbp/s	Set the communication rate between the drive and the host computer	Run time set	Effective instantly	6
F11.03	MODBUS data format	0: no check, 2 end bits 1: even check, 1 end bit 2: odd check, 1 end bit 3: no check, 1 end bit	-	Set the data verification mode when the drive communicates with the host computer.	Run time set	Effective instantly	0
F11.04	MODBUS command response delay	0～5000	ms		Run time set	Effective instantly	1

10.1.5 MODBUS communication protocol

The function code of the servo driver is divided into 16 bits and 32 bits according to the data length. The MODBUS RTU protocol can read and write data to the function code. When writing the function code data, the command code is different according to the data length.

Operating	Command code
Read 16/32 bit function code	0x03
Write 16-bit function code	0x06
Write 32-bit function code	0x10

(1) Read function code：0x03

In the MODBUS RTU protocol, reading 16-bit and 32-bit function codes, all using command codes:

0x03request frame format:

START	Greater than or equal to 3.5 characters idle time, indicating the start of a frame
ADDR	Servo axis address 1~247 Note: 1 to 247 are decimal numbers, which are converted to hexadecimal numbers when ADDR is filled.
CMD	Command code: 0x03
DATA[0]	The starting function code group number, such as function code F06.11, 06 is the group number. Note: Here the 06 are decimal numbers, and the DATA conversion is required when

	filling in DATA[0].
DATA[1]	The offset within the starting function code group, such as function code F06.11, 11 is the offset. Note: 11 here is a decimal number. When DATA[1] is injected, it should be changed to hexadecimal 0x0B.
DATA[2]	Read the number of function codes (high 8 bits), hexadecimal
DATA[3]	Read the number of function codes (lower 8 bits), hexadecimal
CRCL	CRC check valid characters (low 8 bits)
CRCH	CRC check valid characters (high 8 bits)
END	Greater than or equal to 3.5 characters idle time, one frame ends

Response frame format:

START	Greater than or equal to 3.5 characters idle time, indicating the start of a frame
ADDR	Servo axis address, hexadecimal
CMD	Command code: 0x03
DATALENGTH	The number of function code bytes is equal to the number of read function codes N*2
DATA[0]	Starting function code value, high 8 bits
DATA[1]	Starting function code value, lower 8 bits
DATA[…]	
DATA[N*2-1]	Last function code value, lower 8 bits
CRCL	CRC check valid character
CRCH	CRC check valid character
END	Greater than or equal to 3.5 characters idle time, one frame ends

In the MODBUS RTU protocol, the 16-bit function code is written with the command code: 0x06; the 32-bit function code is written with the command code: 0x10.

(2) Write 16-bit function code: 0x06

Note

It is forbidden to use 0X06 to write to 32-bit function code, otherwise unpredictable error will occur!

Request frame format:

START	Greater than or equal to 3.5 characters idle time, indicating the start of a frame
ADDR	Servo axis address 1~247 Note: 1 to 247 are decimal numbers, which are converted to hexadecimal numbers when ADDR is filled.
CMD	Command code: 0x06
DATA[0]	The starting function code group number, such as the write function code F06.11, 06 is the group number. Note: Here 06 is a decimal number. When DATA[0] is filled in, a hex conversion is required.
DATA[1]	The function code is offset, such as the write function code F06.11, 11 is the offset. Note: 11 here is a decimal number. When writing DATA[1], it should be changed to

	hexadecimal 0x0B.
DATA[2]	Write data high byte, hexadecimal
DATA[3]	Write data low byte, hexadecimal
CRCL	CRC check valid character
CRCH	CRC check valid character
END	Greater than or equal to 3.5 characters idle time, one frame ends

Response frame format:

START	Greater than or equal to 3.5 characters idle time, indicating the start of a frame
ADDR	Servo axis address, hexadecimal
CMD	Command code: 0x06
DATA[0]	The function code group number is written, such as writing function code F06.11, it is 0x06
DATA[1]	Writing function code offset, such as write function code F06.11, then 0x0B
DATA[2]	Write data high byte, hexadecimal
DATA[3]	Write data low byte, hexadecimal
CRCL	CRC check low valid character
CRCH	CRC check high effective characters
END	Greater than or equal to 3.5 characters idle time, one frame ends

(3) Write 32-bit function code: 0x10

Note

It is forbidden to use 0x10 to write to 16-bit function code, otherwise unpredictable error will occur!

Request frame format:

START	Greater than or equal to 3.5 characters idle time, indicating the start of a frame
ADDR	Servo axis address 1~247 Note: 1 to 247 are decimal numbers, which are converted to hexadecimal numbers when ADDR is filled.
CMD	Command code: 0x10
DATA[0]	The starting function code group number is written, for example, the function code group F11.12, 11 is the function code group. Note: 11 is a decimal number. When DATA[0] is filled in, it needs to be converted to 0x0B.
DATA[1]	The written initial function code offset, such as write function code F11.12, 12 is the group offset. Note: 12 here is a decimal number. When DATA[1] is filled, it should be changed to hexadecimal 0x0C.
DATA[2]	The number of function codes high 8 bits M (H)
DATA[3]	The number of function codes low 8 bits M (L), and the length of 32-bit function code is 2
DATA[4]	The number of function codes corresponds to the number of bytes M*2
DATA[5]	Write the high 8 bits of the start function code, hexadecimal

DATA[6]	Write the low 8 bits of the start function code, hexadecimal
DATA[7]	Write the high 8 bits of the offset +1 in the start function code group, hexadecimal
DATA[8]	Write the low 8 bits of the offset +1 in the start function code group, hexadecimal
CRCL	CRC check low valid character
CRCH	CRC check high valid character
END	Greater than or equal to 3.5 characters idle time, one frame ends

Response frame format:

START	Greater than or equal to 3.5 characters idle time, indicating the start of a frame
ADDR	Servo axis address, hexadecimal data
CMD	Command code: 0x10
DATA[0]	Written start function code group number, such as writing function code F11.12, then 0x0B
DATA[1]	Written start function code offset, such as writing function code F11.12, then 0x0C
DATA[2]	The number of written function codes high 8 digits.
DATA[3]	The number of written function codes low 8 digits.
CRCL	CRC check low valid character
CRCH	CRC check high valid character
END	Greater than or equal to 3.5 characters idle time, one frame ends

(4) Error response frame

Error frame response format:

START	Greater than or equal to 3.5 characters idle time, indicating the start of a frame
ADDR	Servo axis address, hexadecimal
CMD	Command code +0x80
DATA[0]	Error code
CRCL	CRC check low valid byte
CRCH	CRC check high valid byte
END	Greater than or equal to 3.5 characters idle time, one frame ends

Error code:

Error code	Code description
0x01	CRC check error
0x02	Illegal command
0x03	Illegal address
0x04	Write register value illegal
0x05	Parameters are not modifiable when read-only or in running status
0x06	Read registers numbers is illegal(more than 10)

(5) Communication example (read F02.02 and F02.03)

① Host sends request frame

01	03	02	02	00	02	CRCL	CRCH

The request frame indicates: Read 0x0002 word length of data from the start register from the function code [F02.02] whose axis address is 01.

Slave response frame:

01	03	04	00	01	00	00	CRCL	CRCH

The response frame indicates that the slave returns 2 words length(4 bytes) of data, and the data contents are 0x0001, 0x0000.

If the slave response frame is:

01	83	02	CRCL	CRCH

The response frame indicates that the communication has an error, the error code is 0x02; 0x83 indicates an error.

② The host sends request frame:

01	06	02	02	00	01	CRCL	CRCH

The request frame indicates that 0x0001 is written to the function code [F02.02] whose axis address is 01.

Slave response axis:

01	06	02	02	00	01	CRCL	CRCH

The response frame indicates that the host write function code succeed.

If the slave response frame is:

01	86	02	CRCL	CRCH

The response frame indicates that the communication has an error, the error code is 0x02; 0x86 indicates an error.

③ Read the 32-bit function code F04.09:

Host request frame:

01	03	04	05	00	02	CRCL	CRCH

Slave response frame：

01	03	04	00	01	00	00	CRCL	CRCH

The response frame indicates that the value of the function code [F04.09] is 0x00000001.

Note

(1) The E2PROM device inside the drive has a limit on the number of times of storage. When writing the function code parameters, it will be stored in the E2PROM in real time. In operation, the function code should be prevented from being frequently modified, resulting in frequent operation of the E2PROM.

(2) When writing the [F12 group] and [F20 group] function code, the parameters will not be stored in the E2PROM after power-off. After other parameters are modified by communication, they can be stored in the E2PROM inside the drive in real time.

(6) 32-bit function code addressing

When reading and writing a 32-bit function code with the MODBUS command, the communication address is determined by the address with the lower offset number in the function code group, and the offset number in the two function code groups is operated at a time.

For example, the MODBUS command to read "1st segment movement displacement" [F14.06] is:

Servo axis address	03	0E	06	00	02	CRCL	CRCH

If the “1st segment movement displacement” is known to be 0x40000000 (decimal is 1073741824):

(The default lower 16 bits in the front and the higher 16 bits in the behind), then the response frame is:

Servo axis address	03	04	00	00	40	00	CRCL	CRCH

For example, write 32-bit function code [F04.09] such data bit 0x00100000 (decimal is 1048576):

The request frame is:

Servo axis address	10	04	09	00	02	04	00	00	00	10	CRCL	CRCH

The response frame is:

Servo axis address	10	04	09	00	02	CRCL	CRCH

(7) CRC check

The communication between the host computer and the servo drive must use a consistent CRC check algorithm,otherwise a CRC check error will be generated. The servo drive uses a 16-bit CRC with the low byte first and the high byte followed. The CRC function is as follows:

```
Uint16 COMM_CrcValueCalc(const Uint16 *data, Uint16 length)
{
  Uint16 crcValue = 0xffff;
```

```
        int16 i;
        while (length--)
        {
            crcValue ^= *data++;
            for (i = 0; i < 8; i++)
            {
                if (crcValue & 0x0001)
                {
                    crcValue = (crcValue >> 1) ^ 0xA001;
                }
                else
                {
                    crcValue = crcValue >> 1;
                }
            }
        }
        return (crcValue);
    }
```

(8) Hexadecimal representation of signed numbers

When a signed function code (including 16-bit and 32-bit) is written, the pre-written data needs to be converted to a hexadecimal complement code.

① **16-bit function code**

a) The data is positive or 0: complement code = original code

b) The data is negative: complement code = 0xFFFF - the complement code of the absolute value of the data + 0x0001

For example:

The 16-bit signed positive number +100, the original code is 0x0064, therefore, the complement code is also: 0x0064;

The 16-bit signed negative number -100, its hexadecimal complement code is: 0xFFFF – 0x0064 + 0x0001=FF9C

② **32-bit function code**

a) The data is greater than or equal to 0: complement = original code

b) The data is negative: complement = 0xFFFFFFFF - the complement of the absolute value of the data + 0x00000001

For example:

32-bit 100, the original code is 0x00000064, therefore, the complement code is also: 0x00000064;

32-bit-100, its hexadecimal complement is: 0xFFFFFFFF-the complement code of the absolute value of the data +0x00000001

For example:

32-bit 100, the original code is 0x00000064, therefore, the complement code is also: 0x00000064;

32-bit-100, its hexadecimal complement code is:

0xffffffff-0x00000064+0x00000001=FFFFFF9C

10.1.6 485Common problems and handling of communication sites

(1) Question 1: The correct terminal resistor access method

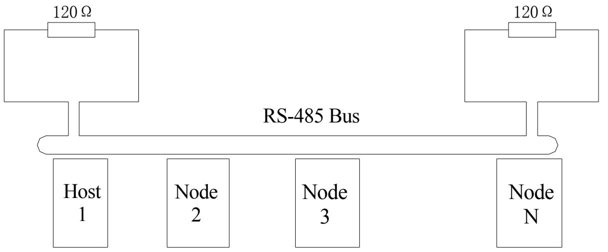


Fig. 10-10 Terminal resistor access method diagram

Note

(1) Only matched resistors can be connected at both ends;

(2) The primary station is recommended to be placed at one end of the bus;

(3) The multimeter ohmmeter measures the resistance between the 485 bus (when measuring, the device needs to be powered off). If the measured value shows about 60Ω, it is normal. If the display is less than 50Ω, please check except the bus ends if there are other nodes added matched resistors, disconnect the resistors. If 0Ω is displayed, please check if have short circuit or node damage situation.

(2) Question 2: Correct wiring (for some nodes without GND wiring points)

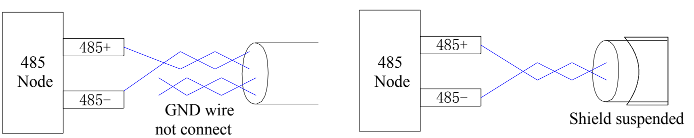


Fig. 10-11 Wiring diagram when without GND

① Solution 1：Look for a reference point shared with the 485 circuit on the other ports of the node, and if so, GND is connected to the reference point. Special attention should be given to the fact that the shielding layer can not be connected to the reference point, otherwise it will damage the 485 port.

② Solution 2：Look for the reference ground shared with the 485 circuit on this node board. If so, GND is connected to this reference ground. In particular, the shield cannot be connected to the reference ground, otherwise the 485 port will be damaged.

③ Solution 3: If the reference ground of the 485 circuit cannot be found, please hang the GND line as shown in Fig10-11, and ensure that the ground wire PE is reliably connected.

④ Solution 4: When the number of nodes is less, add a filter capacitor between 485+ and 485-, refer to question 6.

(3) Question 3: The correct multi-node connection

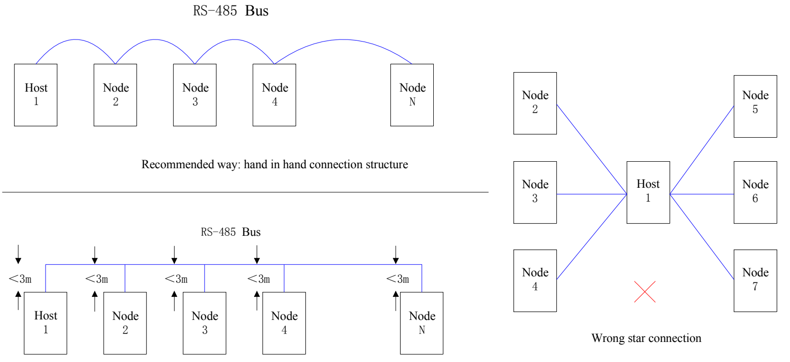


Fig. 10-12 Three types of multi-node connection diagram

(4) Question 4: Measures to suppress external interference of the system

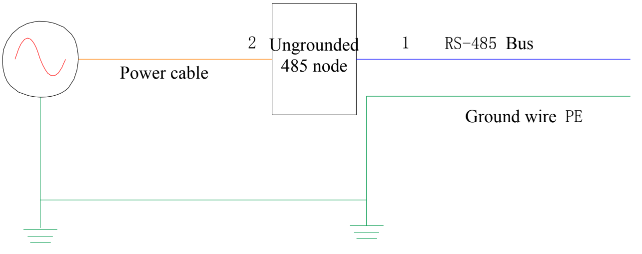


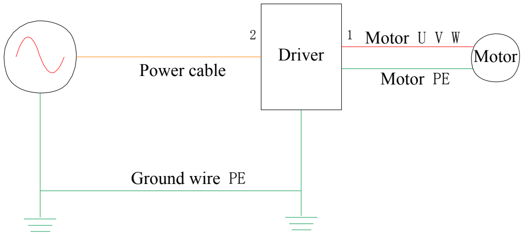
Fig. 10-13 Suppress external interference diagram

Note

Treatment method 1: winding the magnetic ring at position 1 can effectively suppress external interference. This method is recommended.

Treatment method 2: winding the magnetic ring at position 2 can also suppress external interference of the system.

(5) Question 5: Drive interference suppression measures



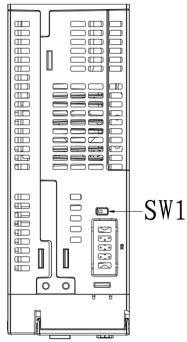


Fig. a **Fig. b**

Fig. 10-14 Drive interference suppression diagram

When using this drive, if the on-site environment is seriously interfered, turn on the EMI switch SW1;(: Grounding; : Hanging)Toggle switch, black square indicates the toggle position of the switch; only when the interference of the field environment is relatively large, it is recommended to place the EMI DIP switch in the ground position, and the terminal must be connected to the ground reliably (Fig b).

Note

(1) Treatment method 1: Add the filter magnetic ring at position 1, and pass the UVW three wires (excluding the ground wire PE) through the magnetic ring at the same time. This method is the preferred solution and works best (Fig. a).

(2) Treatment method 2: Add the filter magnetic ring at position 2, and pass the UVW three wires (excluding the ground wire PE) through the magnetic ring at the same time (Fig. a).

Fieldproblem locate flow chart：

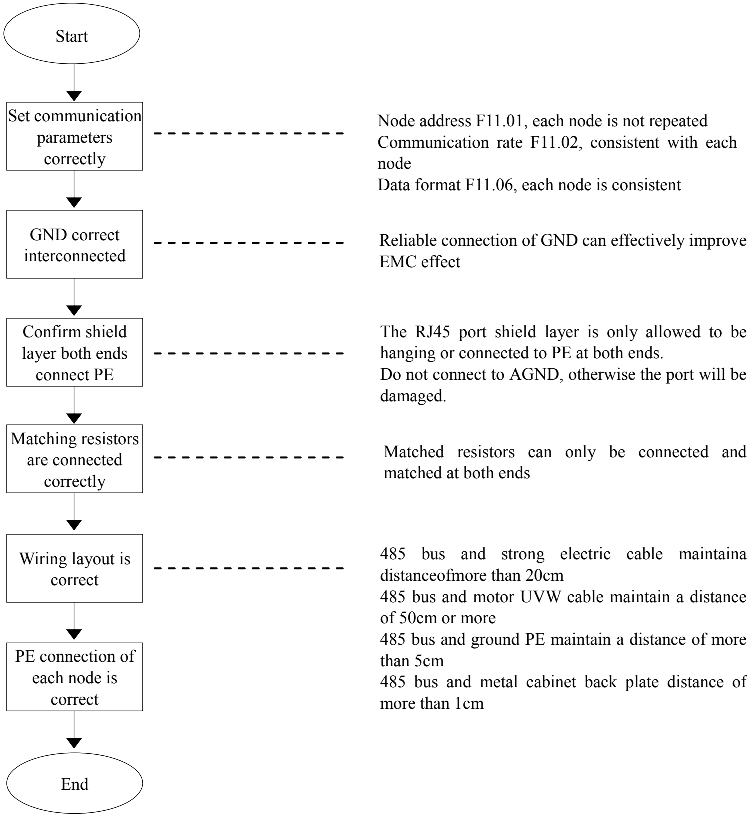


Fig.10-15 485 communication field problem locate flow chart

11 Application Case

11.1 Application 1Typical pulse sequence positioning control (PLC series)

11.1.1 Project description

This case mainly describes ESS200P can be applied to positioning control with PLC such as Siemens S7-200, our UN280 series, Mitsubishi FX3U series, Omron CP1H series, etc., so that it realizes servo normal forward and reverse positioning and zero return operation.

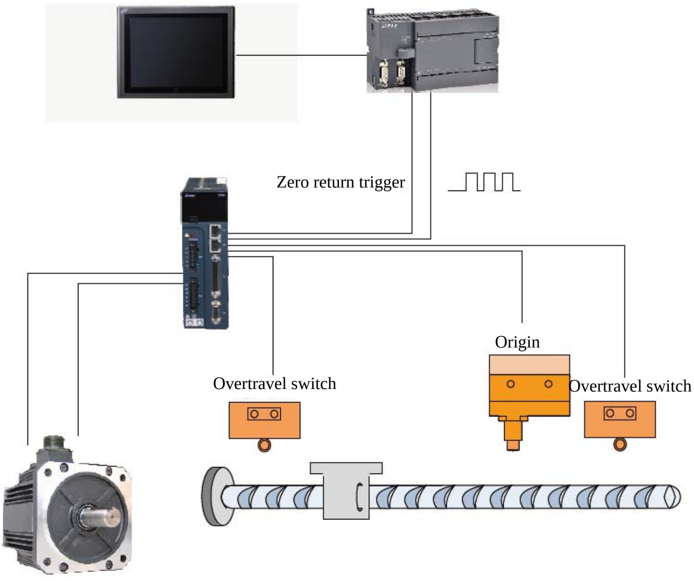


Fig.11-1 Case schematic

11.1.2 Product selection and wiring

(1) UN280 and ESS200P

PLC selects the transistor output type. The PLC selected in this example comes with high-speed pulse output, and integrates relevant positioning instructions. The servo positioning control can be realized by the pulse output of PLC.

The ESS200P servo drive comes with a zero return function, and the external zero signal and the forward and reverse limit signals can be directly input to the servo drive DI terminal, saving the input signal point of the PLC. During operation, the drive feeds back to the PLC positioning completion signal and the servo fault signal.

Product name	Type	Quantity	Description
UN280	UN280-CPU226	1 piece	-
ESS200P servo	ESS200P-2S751 EMS-08751L-30S-xxxA	1 set	Motor encoder is 23bit

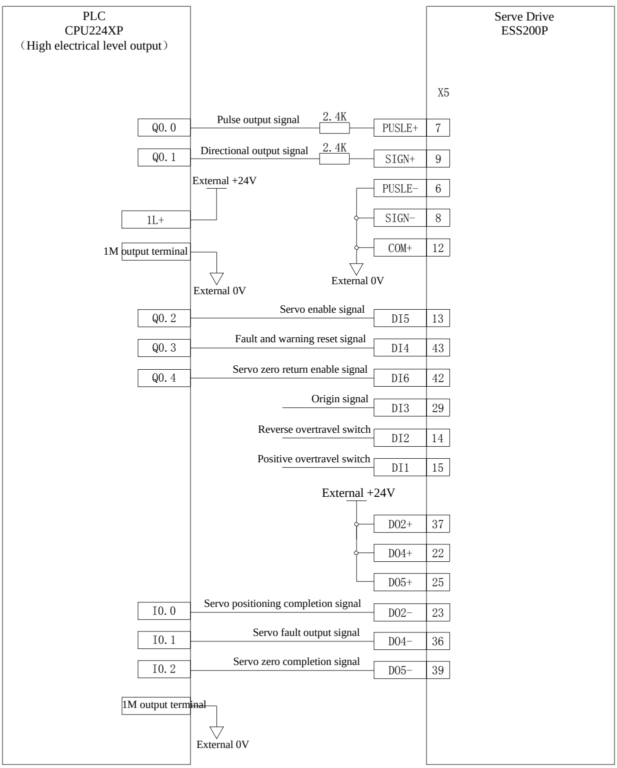


Fig.11-2 UN280 and ESS200P wiring

(2) Mitsubishi PLC and ESS200P

Product name	Type	Quantity	Description
MitsubishiFX3U	FX3U-32MT	1 piece	-
ESS200P	ESS200P-2S751 EMS-08751M-30S-xxxA	1 set	-

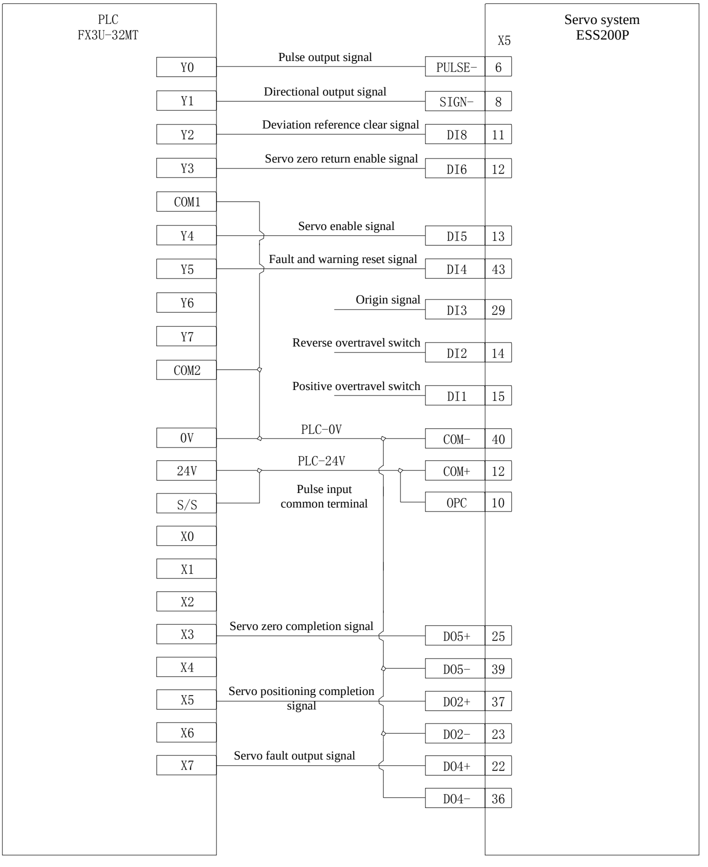


Fig.11-3 Mitsubishi PLC and ESS200P wiring

(3) Omron PLC and ESS200P

Product name	Type	Quantity	Description
Omron	CP1H-X40DT-D	1 piece	-
ESS200P	ESS200P-2S751 EMS-08751L-30S-xxxA	1 set	-

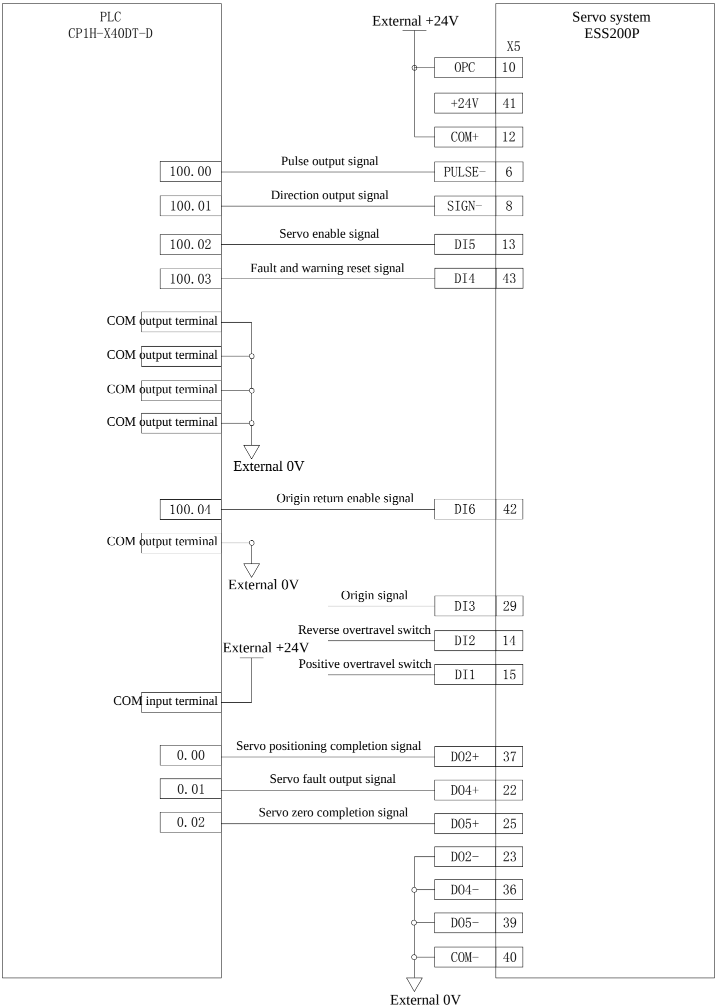


Fig.11-4 Omron PLC and ESS200P wiring

11.1.3 Servo parameter setting

Parameter	Value	Description	Remark
F01.00	0	Position mode control	-
F02.02	14	DI1 function is “Forward direction overtravel switch”	DefaultF02.03=0，low level is valid
F02.05	15	DI2 function is “Backward direction overtravel”	DefaultF02.06=0，low level is valid
F02.08	30	DI3 function is “Origin switch”	DefaultF02.09=0，low level is valid
F02.11	2	DI4 function is “Fault and warning reset”	DefaultF02.12=0，low level is valid
F02.14	1	DI5 function is “Servo enable”	DefaultF02.15=0，low level is valid
F02.17	31	DI6 function is “Original position reset enable”	DefaultF02.18=0，low level is valid
F03.02	5	DO2 output “Positioning completed” signal	-
F03.06	11	DO4 output “Fault output” signal	-
F03.08	13	DO5 output “original position homing completed” signal	-
F04.09	8388608	Electronic gear ratio numerator	Set according to actual needs
F04.11	10000	Electronic gear ratio denominator	Set according to actual needs
F08.00	1	Parameter self-adjustment mode, automatic adjustment of gain parameters with rigid table	-
F08.01	16	Rigidity grade selection	Set according to the debugging effect

11.1.4 Gain adjustment

For details on gain adjustment, please refer to “Chapter 7 Adjustment” in this manual. The main performance parameters of this design are as follows:

(1) [F07.14] Load inertia ratio:

When the servo is not enabled, enter the [F12.04] function code. After pressing the “UP” and “DOWN” keys to measure a relatively stable value, press the “SET” key to measure the measured load inertia ratio. Set to [F07.14].

(2) Set the automatic rigidity level table. After setting [F08.00] to 1, set the value of [F08.01]:

The higher the value, the higher the rigidity of the motor, and the faster the servo responds to the PLC to send a pulse command. However, if the value is set too high, it will cause the motor howling and vibration. In this example, set the rigidity level to 16.

(3) Vibration suppression:

If you have to set a higher motor rigidity level in some occasions, but the motor whistle and vibrate at this time, you can try to open the servo automatic trap filter function [F08.02], generally you can set it to 1 (open an automatic trap filter), let the motor run forward and reverse for a period of time, if the howling and vibration disappear, then meet the requirements, otherwise you can try to open two trap filters (set[F08.02] to 2), then let the motor run after a period of time, observe whether it is effective.

11.2 Typical pulse sequence positioning control (CNC controller)

11.2.1 Project description

This case mainly describes the SYNTEC CNC and POU YUEN CNC performs semi-closed loop control on our ESS200P series servo to realize servo forward and reverse positioning.

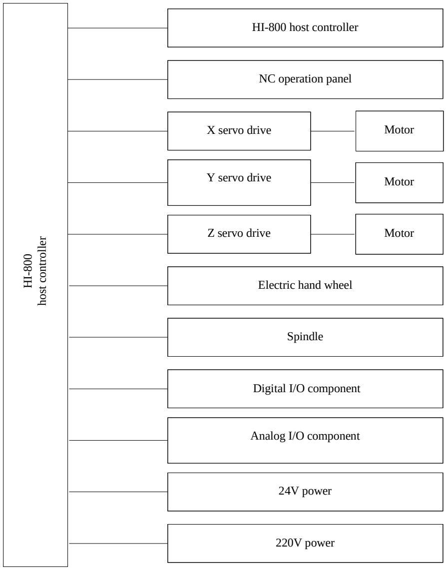


Fig.11-5 System control diagram

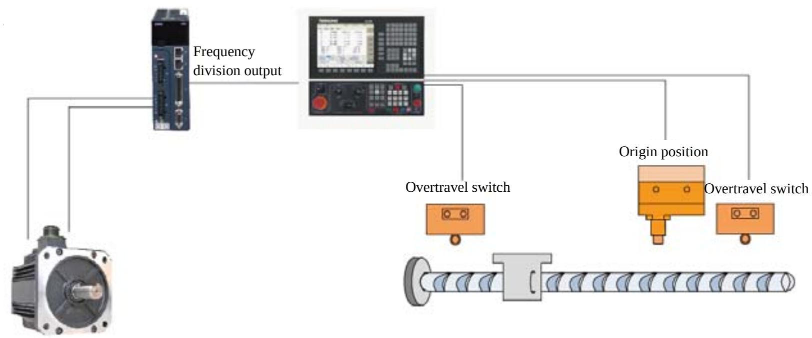


Fig.11-6 Case schematic

11.2.2 Product selection and wiring

SYNTECCNC system configuration and description:

Product name	Type	Quantity	Remark
SYNTECCNC system	SYNTEC CNC 10B	1 piece	Support for up to 8 axes of control
ESS200P	ESS200P-2S751	1～8 sets	Motor encoder is 23bit

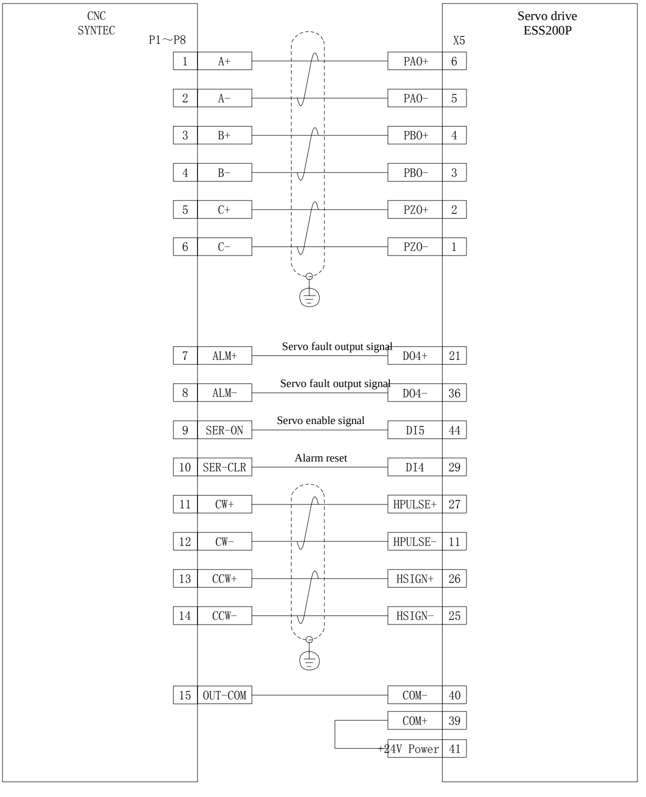


Fig.11-7 SYNTECCNC and ESS200P diagram

11.2.3 Servo parameter setting

Parameter	Value	Description	Remark
F01.00	0	Position mode control	-
F02.11	2	DI4 function is “Fault and warning reset”	DefaultF02.12=0，low level is valid
F02.14	1	DI5 function is “Servo enable”	DefaultF02.15=0，low level is valid
F03.06	11	DO4 output “Fault output” signal	-
F04.09	8388608	Electronic gear ratio numerator	Set according to actual needs
F04.11	10000	Electronic gear ratio denominator	Set according to actual needs
F04.01	1	Pulse form	Set according to actual needs
F04.26	500	Encoder frequency division pulse number	Set according to actual needs
F08.00	1	Parameter self-adjustment mode, automatic adjustment of gain parameters with rigid table	-
F08.01	16	Rigidity grade selection	Set according to the debugging effect

11.2.4 Gain adjustment

If the CNC command direction is opposite to the servo running direction, you need to modify [F04.02=1] (factory default 0); please refer to “Chapter 7 Adjustment”. The main performance parameters involved in this case are as follows:

(1) [F07.14] Load inertia ratio:

When the servo is not enabled, enter the [F12.04] function code. After pressing the “UP” and “DOWN” keys to measure a relatively stable value, press the “SET” key to measure the measured load inertia ratio. Set to [F07.14].

(2) Set the automatic rigidity level table. After setting [F08.00] to 1, set the value of [F08.01]:

The higher the value, the higher the rigidity of the motor, and the faster the servo responds to the PLC to send a pulse command. However, if the value is set too high, it will cause the motor howling and vibration. In this example, set the rigidity level to 16.

(3) Vibration suppression:

If you have to set a higher motor rigidity level in some occasions, but the motor whistle and vibrate at this time, you can try to open the servo automatic trap filter function [F08.02], generally you can set it to 1 (open an automatic trap filter), let the motor run forward and reverse for a period of time, if the howling and vibration disappear, then meet the requirements, otherwise you can try to open two trap filters (set[F08.02] to 2), then let the motor run after a period of time, observe whether it is effective.

11.3 ESS200P SERVO MODBUS RTU Communication Configuration

11.3.1 Project description

This case mainly describes the MODBUS RTU communication connection between Siemens S7200PLC and our ESS200P. It can be implemented by either a table or a program.

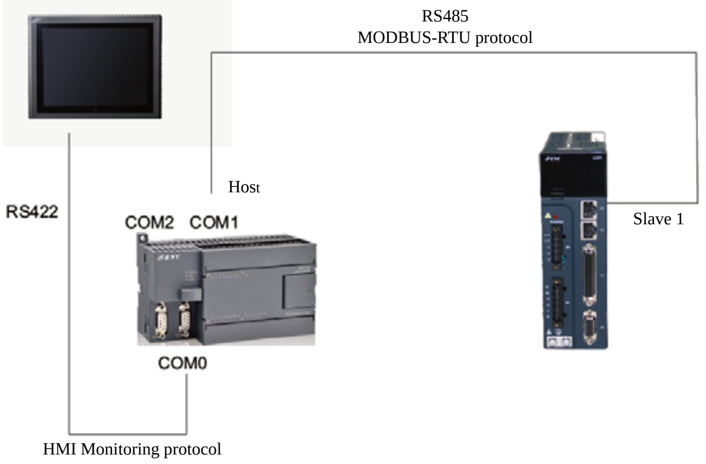


Fig.11-8 Case principle and wiring diagram

11.3.2 Product selection and wiring

(1) UN280 and ESS200P

Product name	Type	Quantity	Remark
PLC	UN280-CPU226	1 piece	-
ESS200P	ESS200P-2S751 EMS-08751L-30S-xxxA	1 set	-

PLC side COM1 terminal sorting		Servo drive side X3/X4 terminal sorting	
Signal name	**Pin number**	**Signal name**	**Pin number**
RS485+	3	RS485+	4
RS485-	8	RS485-	5
-	-	PE（Shielded mesh layer）	case

(2) SIEMENS PLC and ESS200P

SIEMENS **S7200PLC**		**Servo drive side X3/X4 terminal sorting**	
PLC PORT0-RS485 9 Pin	**Pin number**	**Signal name**	**Pin number**
Data+	3	RS485+	4
Data-	8	RS485-	5
PE（Shielded mesh layer）	case	PE（Shielded mesh layer）	case

(3) MitsubishiFX3U and ESS200P

MitsubishiFX3U PLC		**Servo drive side X3/X4 terminal sorting**	
FX3U-485-BD	**Pin number**	**Signal name**	**Pin number**
SDA	Short connection	RS485+	4
RDA			
SDB	Short connection	RS485-	5
RDB			
SG	case	PE（Shielded mesh layer）	case

(4) Omron PLC and ESS200P

OmronCP1L		**Servo drive side X3/X4 terminal sorting**	
PLC PORT0-RS485 9Pin	**Pin number**	**Signal name**	**Pin number**
SDB+	-	RS485+	4
SDA-	-	RS485-	5
PE（Shielded mesh layer）	case	PE（Shielded mesh layer）	case

Note

The DIP switch setting on the back of the PLC communication card is 2, 3, 4, 5 is ON, and the rest is OFF.

11.3.3 Servo parameter setting

Parameter	Value	Description	Remark
F11.01	1	Drive axis address	-
F11.02	6	Serial port baud rate setting	6-115200

11.4 Servo non-standard application (interrupt fixed length)

11.4.1 Project description

This case mainly describes the application of interrupted fixed length by a dual servo pipe cutter.

The core of the double servo pipe cutting machine is the cyclic matching action of the axial axis of the carriage and the cutting axis of the cutter. The axial axis of the carriage is mainly used for the positioning of the circle length. The cutter feed servo is similar to the feed of the lathe, and is used to control the position and speed of the cutter feed to complete the cutting.

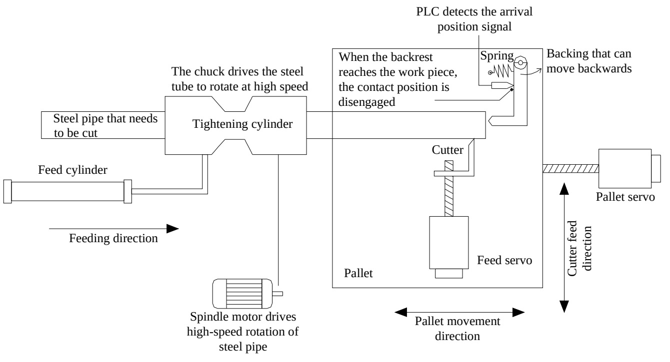


Fig.11-9 Double servo pipe cutting machine process description

The main operation process of the machine is as follows:

(1) The carriage is running at a high speed in the direction of the section of the cut steel pipe. When the movable backrest is pressed against the surface of the steel pipe, the position of the detection probe is disengaged, and this position is the starting position of the first work piece to be cut. This signal triggers the servo interrupt fixed length function, and controls the carriage servo motor to take a fixed length position on the basis of this position, and the cutter quickly runs to the outer surface of the cut steel pipe;

(2) The positioning of the carriage is completed, and the cutter also runs to the vicinity of the outer surface of the steel pipe, and the cutter speed is changed to the working speed, and the work enters the specified distance;

(3) After the cutter completes the working distance, it changes to the speed of slow forward and slows to the preset distance;

(4) After the cutter is slowly advanced, it will quickly return to the origin, and the axial direction will continue to repeat the actions of (1), (2), (3), (4) until the end of the pipe feeding, that is, the limit position, the axial direction. Return to the starting point, then feed, and the feeding is completed.

(5) In the process of control, the length of the pipe should be ensured during the control process. When the backing signal hits the surface of the steel pipe, the internal stop function of the servo is directly triggered, and the servo motor acts according to the compensation displacement to ensure the pipe cutting precision.

11.4.2 Product selection and wiring

Product name	Type	Quantity	Remark
Omron	CP1H-X40DT-D	1 piece	Comes with 3 high-speed pulse outputs
ESS200P	ESS200P-2S751 EMS-08751L-302-xxxA	1 set	Motor encoder is 23bit

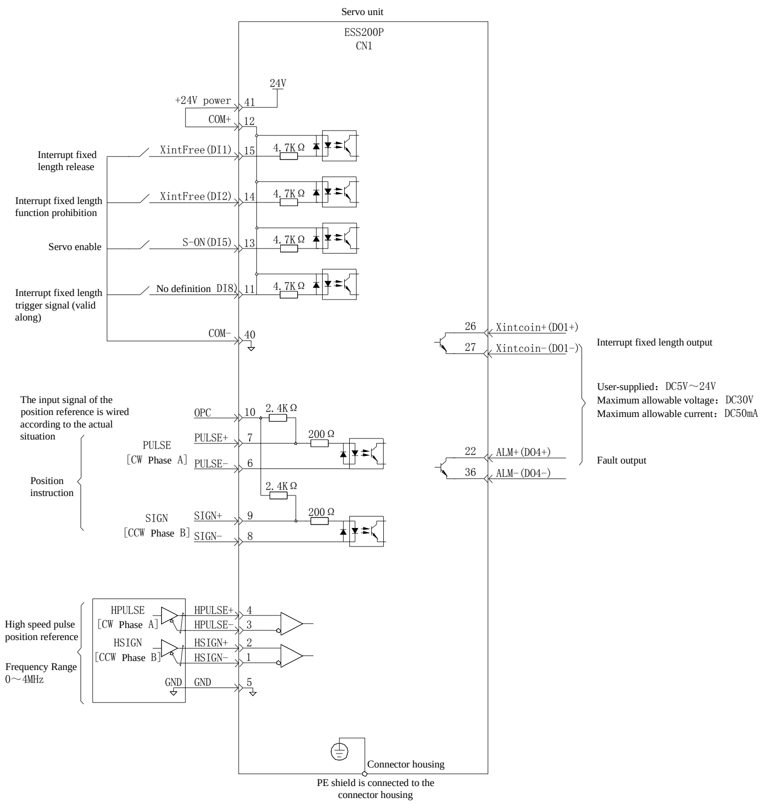


Fig.11-10 Case wiring instructions

11.4.3 Servo parameter setting

Axial servo		Cutter servo	
Parameter	**Description**	**Parameter**	**Description**
F00.03=04	Motor No.	F00.03=74	Motor No.
F02.02=29	The DI1 function is "interrupt fixed length release"	F02.14=1	The DI5 function is "servo enable"
F02.24=3	DI9 function (interrupt fixed length) falling edge is valid	F07.14=3.16	Load rotational inertia ratio
F03.00=12	DO1 output "interrupt fixed length completion"	F08.00=1	Parameter self-adjustment mode, automatic adjustment of gain parameters with rigid table
F04.29=1	Interrupt fixed length enable	F08.01=16	Rigid level selection
F04.30=10000	Interrupt fixed length displacement	-	-
F04.33=20	Interrupt fixed length acceleration and deceleration time	-	-
F08.00=1	Parameter self-adjustment mode, automatic adjustment of gain parameters with rigid level table	-	-
F11.01=34	Drive axis address	-	-
F04.32=1000	Interrupt fixed length constant speed running time	-	-
F04.34=1	Interrupt fixed length release signal enable	-	-
F08.01=17	Rigid level selection	-	-
F11.02=4	Serial port baud rate	-	-

Note

When using the interrupt fixed length function, the drive uses the DI8 trigger, [F02.23] must be set to 38, and [F02.24] is set to the rising or falling edge.

11.4.4 Interrupt fixed length description

When using the interrupt fixed length, the internal parameter **[F04.29=1]** must be valid first. When the external interrupt fixed length trigger signal **(DI8)** is valid, the interrupt fixed length function is activated. The length of the interrupted fixed length can be determined according to the interrupted fixed length displacement **[F04.30]**.

The running speed is set by interrupting the fixed length constant speed running speed **[F04.32]**. If **[F04.32=0]**, it means that the fixed-length running speed of the interrupt is the pre-interrupt speed, not 0. And the fixed-length constant-speed running speed value before the electronic gear ratio conversion. Therefore, the electronic gear ratio should be adjusted accordingly to avoid disoperation.

After the execution of the interrupt of the fixed length is completed, the interrupt fixed length completion signal is output to the host computer. At this time, the interrupt completion signal can be connected to the interrupt release signal input terminal to form an internal closed loop, thereby realizing the function of releasing the interrupt fixed length. It is also possible to disable the interrupt fixed length release signal enable **[F04.34]**, that is, the interrupt fixed length function is automatically released after the interrupt fixed length is completed.

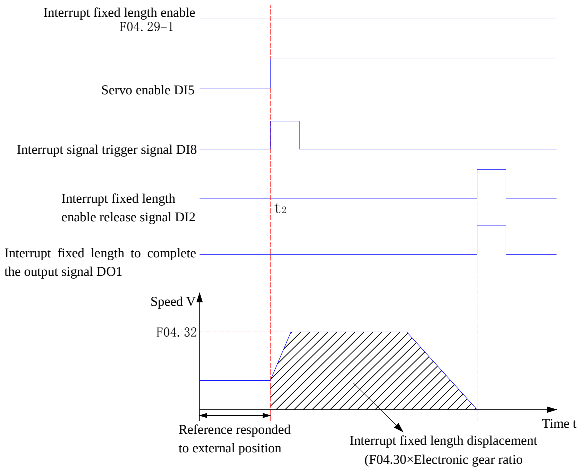


Fig.11-11 Timing description

t1 is the turn-on time of the interrupt fixed length enable. After the interrupt fixed length is enabled, the external DI8 is allowed to trigger an interrupt. During the interrupt, the servo drive does not respond to any external pulse signal.

t2 is the DI8 trigger enable time point. The servo enters the interrupt fixed length function by the input signal in response to the external position reference, and does not respond to the external pulse signal, but is controlled according to the displacement and speed set by the drive. In particular, when the set operating speed is 0, the motor operates at the previous operating speed instead of zero speed.

t2~t3 are the running time of the interrupt fixed length.

t3 is the time of the interrupt fixed length completion and the servo output interrupts the fixed length completion signal. If the internal DO is shorted to DI, when the interrupt completion signal is output, the interrupt fixed length release signal is directly asserted, and the interrupt fixed length is released. If the interrupt fixed length release enable signal is controlled by an external signal, the interrupt fixed length release enable signal can be effectively processed after the fixed length completion signal is interrupted.

Note

When [F04.32=0]，Indicates that the fixed-length running speed is consistent with the speed before the interruption.

11.5 Double PG full closed loop

11.5.1 Project description

The full-closed control method is to install the position detecting device (grating scale, encoder, etc.) on the moving parts, and provide real-time feedback on the position of the moving parts, so that the working part of the final control is not subject to external mechanical errors, temperature deformation and other environmental factors. The impact ultimately reaches the overall correspondingly high precision positioning system (micron level control).

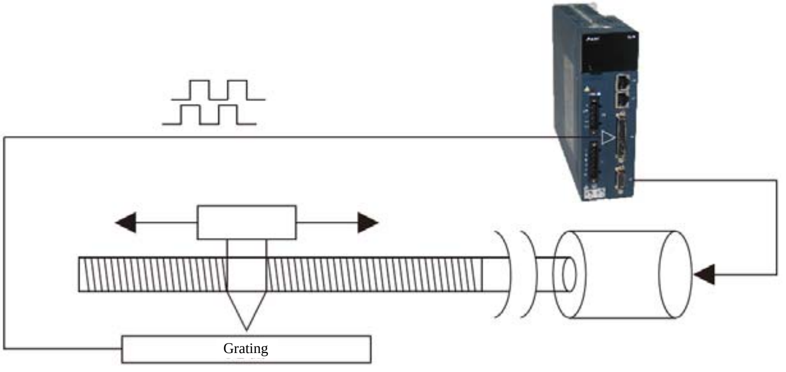


Fig.11-12 Case schematic

Transmission mode: motor + gearbox; reduction ratio: 1:20;
Use occasion: steel plate opener.

Note

Used in AB phase quadrature differential pulse output types.

11.5.2 Product selection and wiring

Product name	Type	Quantity	Remark
PLC	UN280-CPU226	1 piece	3-way high-speed pulse output
ESS200P	ESS200P-2S751 EMS-08751L-30S-xxxA	1 set	Encoder 23bit

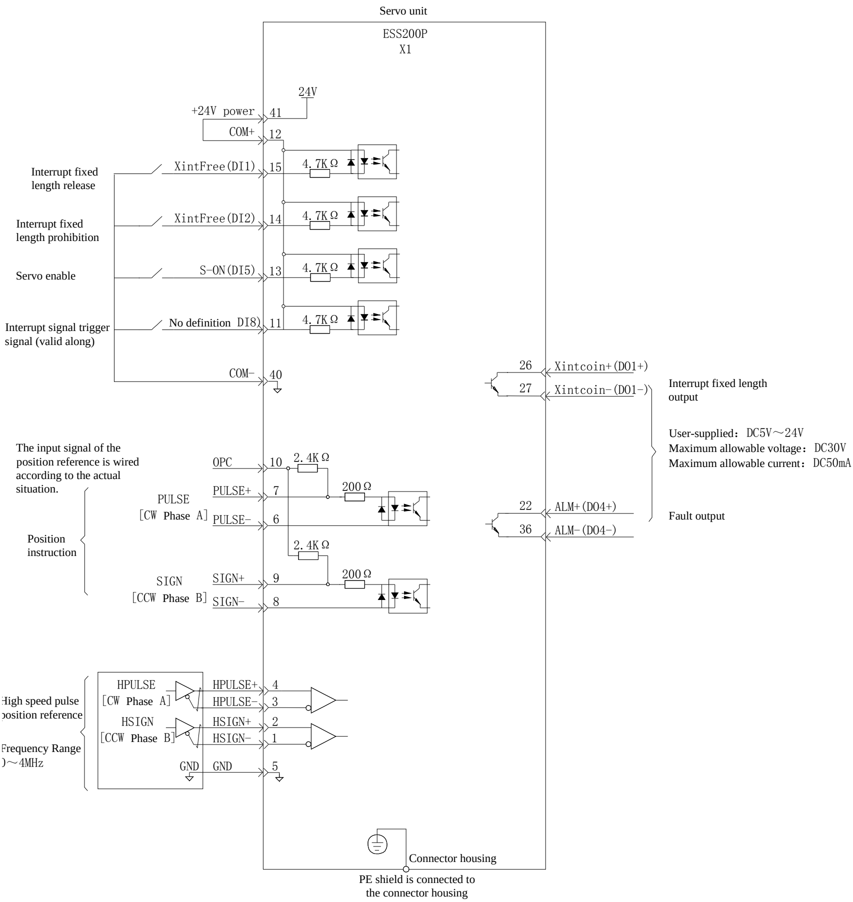


Fig.11-13 Hardware connection diagram

11.5.3 Servo parameter setting

Parameter	Value	Description	Remark
F01.00	1	Position control mode	-
F02.14	1	The DI5 function is "servo enable"	-
F03.00	1	DO1 output "servo ready" signal	-
F03.02	11	DO2 outputs "fault output" signal	-

F04.09	8388608	Electronic gear ratio molecule	Set according to the number of PLC pulses in the field
F04.11	10000	Electronic gear ratio denominator	
F04.01	0	Burst shape	-
F04.25	2	There is no output from the pulse output terminal. At this time, the frequency-divided output terminal can be used as an input terminal for the full-closed external scale signal.	-

11.5.4 Gain adjustment

(1) First, if the full-closed function is not used, check whether the basic settings of the host computer and the servo are correct, and check whether the connection of the mechanical mechanism is normal.

(2) The load inertia ratio is identified by reference **[F12.04]**. At this time, the motor repeats the forward rotation and reverse rotation operation and displays the value of the load inertia ratio.

(3) After the displayed load inertia ratio is basically stable, write the parameters to the respective drive function codes **[F07.14]** (when the load on the mechanical mechanism is asymmetrical, the respective inertia ratios will be different);

(4) After obtaining the load inertia ratio, adjust the parameters as described below. The load inertia ratio is the basis for the stable operation of the servo motor. Please try to ensure that this is worthy of accuracy.

11.5.5 Full closed loop parameter setting

After the above basic gain parameters are set, it is necessary to ensure that the servo can run smoothly, without overshoot and overshoot during operation and no abnormal sound after stopping. After the basic operating conditions are met, the full closed loop parameter setting is performed. The setting steps are as follows:

(1) Confirm the running direction of the external encoder

It is used to judge whether the running direction of the external encoder and the internal encoder are the same. If they are not the same, a positive feedback effect will occur, causing the speed uncontrollable phenomenon.

Parameter	Name	Value	Function	Setting method	Effective time	Default
F13.01	External encoder usage	0：Use in standard operating direction 1：Use in reverse direction	When the full-closed function is set, the internal and external encoders feed back the pulse counting direction during motor rotation.	Stop setting	Effective immediately	0

Enter JOG mode (see "5.5.1 Jog operation"), jog operation at low speed in the same direction, observe internal encoder pulse feedback display **[F10.16]** and external encoder pulse feedback display **[F13.09]**. If the trend of the two changes is the same (increasing or decreasing at the same time), then **[F13.01=0]**; if not, then **[F13.01=1]**.

Note

(1) Before running the motor, be sure to check before the test run. For details, see "6.1.1 Check before operation".
(2) The function code must be set correctly, otherwise it will cause a speed uncontrollable phenomenon!

(2) Determine the resolution of the external encoder (one rotation of the motor corresponds to the number of pulses of the external encoder)

Parameter	Name	Value	Function	Setting method	Effective time	Default
F13.02	The number of external encoder feedback pulses is rotated one revolution of the motor	0～1073741824	Set the number of external encoder feedback pulses when the servo motor rotates one revolution.	Stop setting	Power on again	10000

Rotate the motor and observe the internal encoder pulse feedback display **[F10.16]** to determine the change of the external encoder pulse feedback display **[F13.09]** after the motor rotates a full turn. The absolute value of the change is placed in the motor. Rotate one revolution of the external encoder pulse **[F13.02]**.
Note: It can also be calculated as follows: before turning the motor, the current value of **[F10.16]** is X1, the current value of **[F13.09]** is Y1; after turning the motor, the current value of **[F10.16]** is X2, **[F13.09]** The current value is Y2.

$$F13.02\text{=The number of internal encoder pulses in one revolution of the motor}\times\frac{Y_2-Y_1}{X_2-X_1}$$

The result of this calculation must be positive; otherwise the **[F13.01]** setting may be incorrect and need to be reconfirmed.
Be sure to set **[F13.02]** correctly, otherwise the servo operation may cause a false alarm of excessive position deviation Er.310.

(3) External encoder electronic gear ratio setting
If [F13.00=1], the setting object is [F04.09/F04.11];
If [F13.00=2], the setting object is [F04.13/F04.15].
For the electronic gear ratio setting method, please refer to "6.2.2 Electronic Gear Ratio". The gear ratio is calculated as follows:
Assume that the full-closed device control requirement is: for each X1 pulse reference sent by the host computer, the corresponding external mechanical displacement is Y1.
Operate as follows:
1.Set the electronic gear ratio to 1:1;
2. The host computer sends X2 pulses, and the external mechanical displacement is measured as Y2, then the electronic gear ratio is $\frac{X_2\times Y_1}{X_1\times Y_2}$ and could meet requirements.

Note

(1) When switch the mode between internal and external position closed loop, need to make the electric gear ratio diverter switch Gear_Sel to external closed loop status and then set the full closed loop electric gear ratio.
(2) This method is also suitable for internal closed loop, should assure present status is same with internal closed loop status.
(3) Please set the electric gear ratio correctly, otherwise it will cause mechanical deviation.

(4) Set alarm detection: The alarm detection setting **[F13.04, F13.06]** is as follows.

① Setting of mixed control deviation excessive value **[F13.04]**

Parameter	Name	Value	Function	Setting method	Effective time	Default
F13.04	Full closed loop position deviation excessive threshold	0～107741824	Set the position deviation threshold when the full closed loop position deviation excessive fault Er.B02	During running	Effective immediately	10000

The mixed control deviation excessive value **[F13.04]** is used to set the allowable tolerance of the current position of the motor and the current position of the external encoder. The unit of this function code is 1 reference unit (same as 1 external encoder unit).

Example: Setting **[F13.04]** to 1000 means that when the displacement of the motor-driven mechanical motion and the displacement of the external encoder to measure the mechanical motion (ie, the mixing deviation) exceed the displacement amount corresponding to 1000 external encoder pulses, output "Motor-load position deviation excessive fault Er.310".

Note

(1) When "0" is set, do not output "Motor-load position deviation excessive fault Er.310" .
(2) The **[F13.04]** setting should be less than **[F13.02]**×**[F13.06]**
(Eg: F13.02×F13.06×50%), otherwise the alarm cannot be output.

② Hybrid control deviation clear **[F13.06]** setting.

Parameter	Name	Value	Function	Setting method	Effective time	Default
F13.06	Full closed loop position deviation clear setting	0～100	Set the revolution number of the motor to clear the full closed loop position deviation of once time when the drive is under running mode	During running	Effective immediately	0

[F13.06] sets the revolution number of the motor to make the hybrid control deviation cleared.

Note

When the set value is 0, the hybrid control deviation is not cleared.

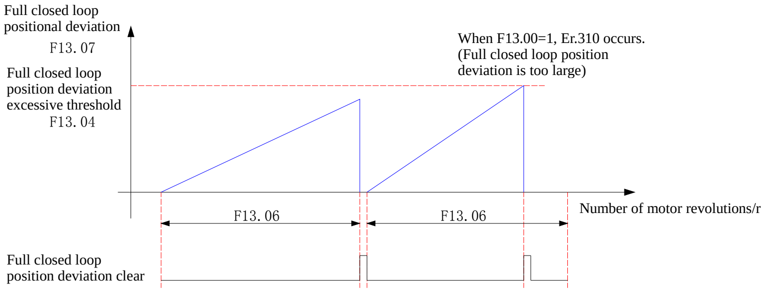


Fig.11-14 Full closed loop position deviation clearing description

Note: The rotation number of the hybrid control deviation clear setting **[F13.06]** is detected by the internal encoder feedback pulse.

For example: When **[F13.06=50]** is set, it indicates whether the mixing deviation exceeds the pulse unit set by **[F13.04]** during the motor rotation for 50 revolutions. If yes, alarm; otherwise, when the motor rotates more than 50 revolutions, the deviation is cleared and restarts to monitor.

Note

(1) When using the hybrid control deviation clear, be sure to set **[F13.06]** to an appropriate value. For the setting value of **[F13.04]**, if **[F13.06]** is set to a minimum value, the protection against the excessive misalignment of the hybrid control cannot be achieved.
(2) Please pay attention to the safety operation such as setting the limit sensor when operate.
(3) The alarm must be set effectively, otherwise it will cause a malfunction such as a speed uncontrollable fault!

11.5.6 Full closed loop setting is valid

After the above full-closed parameter setting is completed, observe the feedback of the internal and external encoders through **[F10.16]** and **[F13.09]**, and judge whether the setting of the full-closed wiring and the external encoder is correct, and then enter the full-closed functional steps.

The related synchronized parameter settings:

<table>
<tr><th>Parameter</th><th>Value</th><th>Parameter description</th><th>Remark</th></tr>
<tr><td>F13.00</td><td>0～2</td><td>Encoder feedback mode</td><td>
<table>
<tr><th>Value</th><th>Encoder feedback mode</th><th>Description</th></tr>
<tr><td>0</td><td>Internal encoder feedback</td><td>The position feedback signal comes from the servo motor's own encoder</td></tr>
<tr><td>1</td><td>External encoder feedback</td><td>Position feedback signal from full-closed external encoder
Use Group 1 electronic gear ratio (F04.09/F04.11)</td></tr>
<tr><td>2</td><td>Internal and external encoder feedback switching when electronic gear ratio switching</td><td>Use the DI function 24 (FunIN.24: GEAR_SEL, electronic gear switching)
Closed-loop switching of internal and external positions, DI function
Invalid: internal encoder feedback, using Group 1 electronic gear ratio
Valid: External encoder feedback, using Group 2 electronic gear ratio</td></tr>
</table>
</td></tr>
<tr><td>F02.02</td><td>24</td><td>DI1 function is "Electronic gear selection"</td><td>This parameter can only switch the inner and outer ring electronic gear ratios when F13.00 is set to 2, thus switching between full-closed and semi-closed-loop control.</td></tr>
</table>

11.6 Servo non-standard application (Total DC bus)

11.6.1 Project description

This case mainly describes the application of the ESS200P series servos on the common DC bus. In the transmission system, due to the large inertia of some mechanical parts, the load affects each other, causing the motor state change between electric and power generation. The common DC bus technology is to make energy flow through the busbar, which can save energy, and the external braking resistor can be reduced to one, saving cost and control cabinet space.

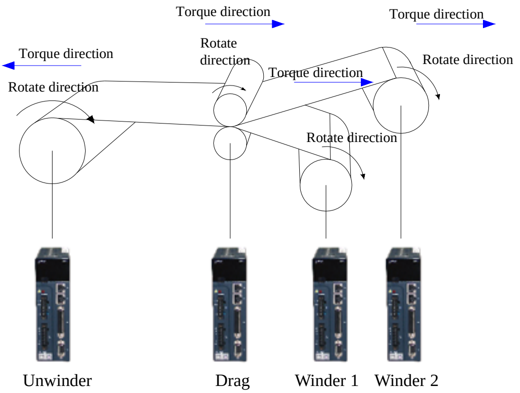


Fig.11-15 Case schematic

11.6.2 Product selection and wiring

Product name	Type	Quantity	Remark
ESS200P	ESS200P-4T152 EMS-13152M-15T-xxxA	2 sets	Winding work in speed mode
ESS200P	ESS200P-4T152 EMS-13152M-15T-xxxA	1 set	Traction work in speed mode
ESS200P	ESS200P-4T302 EMS-18302H-15T-xxxA	1 set	Unwinding work in torque mode

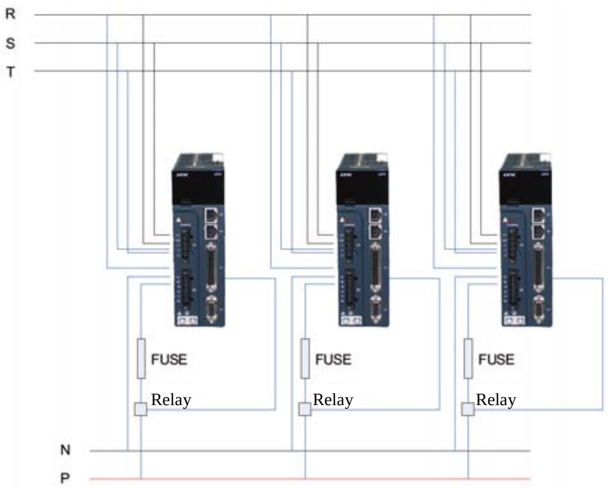


Fig. 11-16 Hardware connection diagram (servo drive picture)

11.6.3 Application description and precautions

The drive voltage level and RST phase sequence of all common busses must be the same, otherwise the drive may be damaged and cause a fire.

Please pay special attention to the single-phase 220V driver. The main circuit power supplies L1 and L2 should be taken from the same power supply. If they come from different power sources, all the common bus drivers may explode, causing fire!

After the drive is powered on, when the drive normally displays the number, the DO output of the drive is ready, and the control relay is pulled in to achieve a common bus connection.

When the drive is in the deceleration state, the energy generated by the motor is fed back to the busbar. It is necessary to select the appropriate braking resistor and access the system. Refer to "6.1.7 Brake Settings" for the selection of braking resistors.

The driver power of the common busbar is as close as possible, and it is not allowed to have a common busbar like ESS200P-4T102 and ESS200P-4T442. Otherwise, the life of the main circuit component of the drive with lower power will be greatly reduced.

When the drive PN is connected to the bus, in order to avoid excessive current when a single driver is abnormal, connect the FU between the busbars.

FU is a semiconductor fast-blow fuse. The rated voltage is usually 700Vdc. The rated current can reach 125% of the rated load under normal conditions.

12 Appendix

12.1 Servo drive mounting size

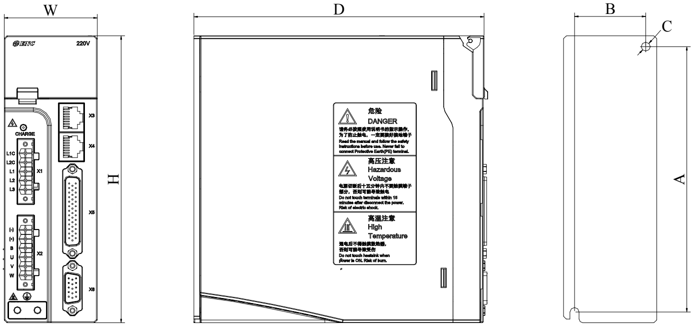


Fig.12-1 A type servo drive outline drawing

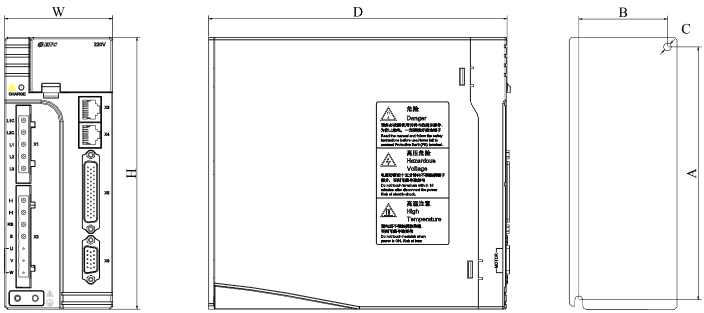


Fig.12-2 B type servo drive outline drawing

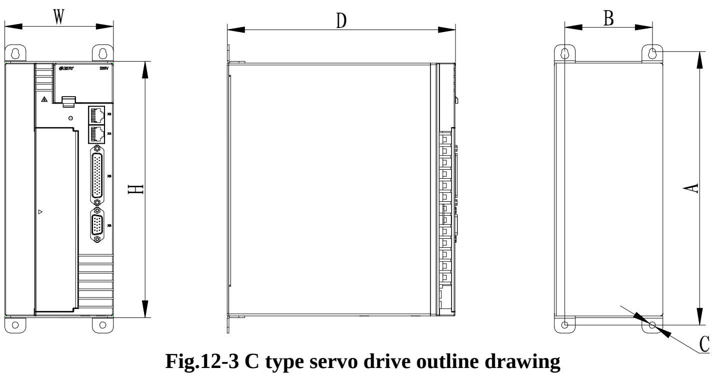


Fig.12-3 C type servo drive outline drawing

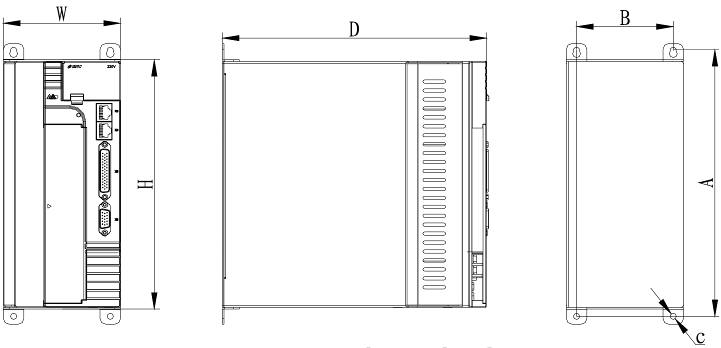


Fig.12-4 D type servo drive outline drawing

Table 12-1 Servo drive series installation size

Servo drive model	Chassis type	A (mm)	B (mm)	W (mm)	H (mm)	D (mm)	C (mm)	Fig. number
ESS200P-2S101	A type	36	148	51	160	159	5	Fig.12-1
ESS200P-2S201								
ESS200P-2S401								
ESS200P-2S751	B type	55	160	67	172	185	5	Fig.12-2
ESS200P-2T102								
ESS200P-2T152								
ESS200P-4T102								
ESS200P-4T152								
ESS200P-4T202								
ESS200P-2T202	C type	238	72	93	223	195.5	5.5	Fig.12-3
ESS200P-2T302								
ESS200P-4T302								
ESS200P-4T442								
ESS200P-4T552								
ESS200P-4T752	C type	238	94	115	223	232.5	5.5	Fig.12-4

12.2 Servo motor parameters and installation dimensions

12.2.1 40Base servo motor parameters and installation dimensions

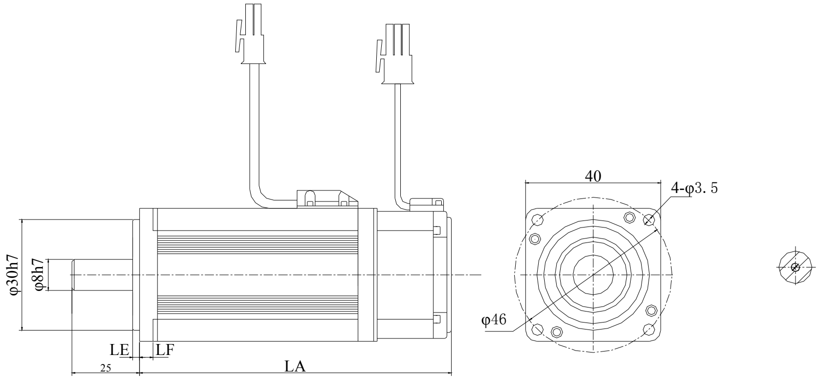


Fig.12-5 40Base outline drawing

Type	LE（mm)	LF(mm)	LA(mm)	LA(mm) with brake
EMS-04101L-30S-xxxA	3	6	90	124

12.2.2 60Base servo motor parameters and installation dimensions

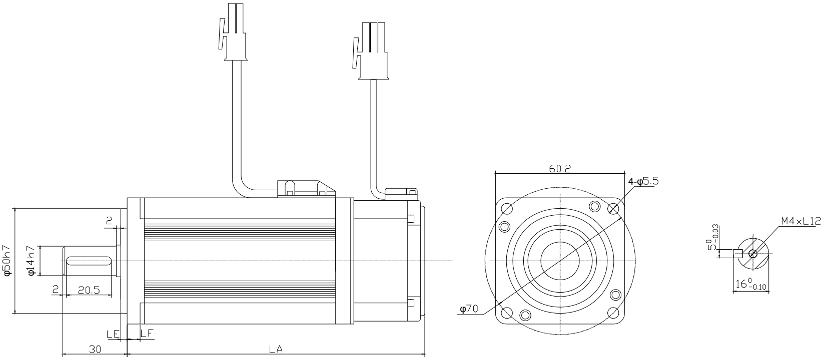


Fig.12-6 60Base outline drawing

Type	LE（mm)	LF(mm)	LA(mm)	LA(mm) with brake
EMS-06201L-30S-xxxA	3	7.5	116	164
EMS-06201M-30S-xxxA	3	7	109	157
EMS-06401L-30S-xxxA	3	7.5	141	189
EMS-06401M-30S-xxxA	3	7	133	181

12.2.3 80Base servo motor parameters and installation dimensions

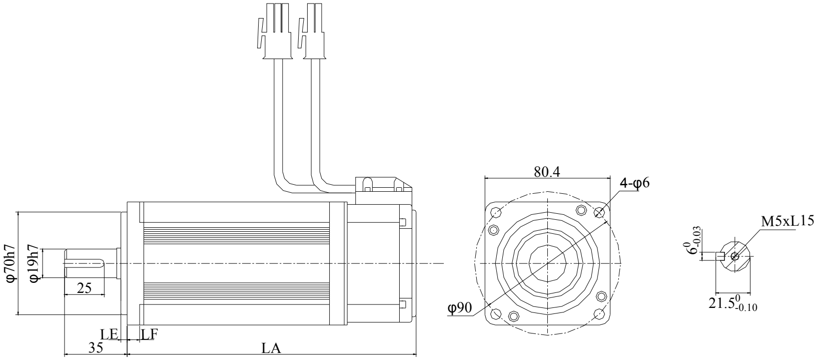


Fig.12-7 80Base outline drawing

Type	LE（mm)	LF(mm)	LA(mm)	LA(mm) with brake
EMS-08401H-30S-xxxA	3	8	124	166
EMS-08731H-20S-xxxA	3	8	179	221
EMS-08751L-30S-xxxA	3	8	151	193
EMS-08102L-25S-xxxA	3	8	191	233
EMS-08122L-30S-xxxA	3	8	191	233

12.2.4 90Base servo motor parameters and installation dimensions

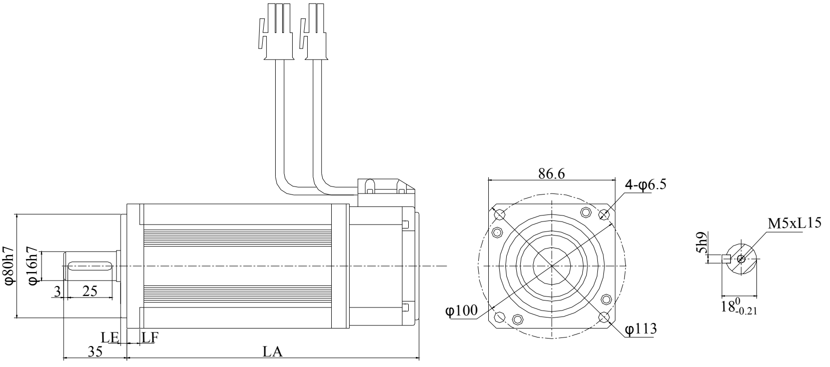


Fig.12-8 90Base outline drawing

Type	LE（mm)	LF(mm)	LA(mm)	LA(mm) with brake
EMS-09751H-30S-xxxA	3	10	150	198

12.2.5 110Base servo motor parameters and installation dimensions

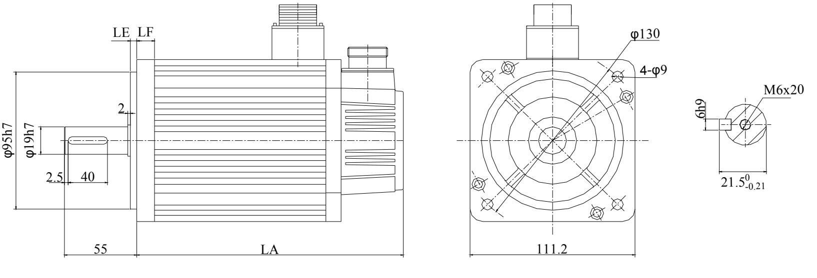


Fig.12-9 110Base outline drawing

Type	LE（mm)	LF(mm)	LA(mm)	LA(mm) with brake
EMS-11152M-30S-xxxA	5	12	204	278
EMS-11182L-30S-xxxA	5	12	219	293

12.2.6 130Base servo motor parameters and installation dimensions

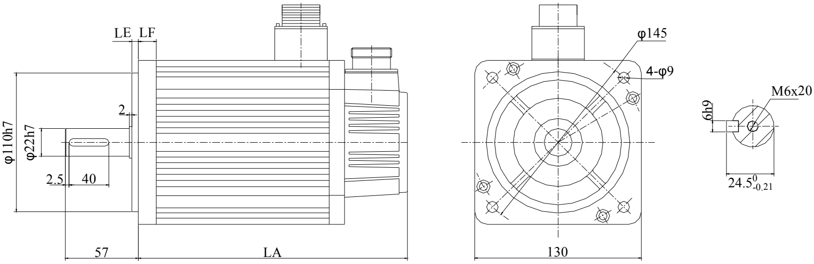


Fig. 12-10 130Base outline drawing

Type	LE（mm)	LF(mm)	LA(mm)	LA(mm) with brake
EMS-13152M-25S-xxxA	5	14	179	236
EMS-13102H-10S-xxxA	5	14	213	294
EMS-13152H-15S-xxxA	5	14	213	294
EMS-13202M-25S-xxxA	5	14	192	249
EMS-13262M-25S-xxxA	5	14	209	290
EMS-13102M-25T-xxxA	5	14	166	223
EMS-13152M-25T-xxxA	5	14	179	236
EMS-13202M-25T-xxxA	5	14	192	249
EMS-13102M-25S-xxxA	5	14	166	229
EMS-13102H-10T-xxxA	5	14	213	294
EMS-13122L-30T-xxxA	5	14	166	229
EMS-13152M-15T-xxxA	5	14	213	276
EMS-13232H-15T-xxxA	5	14	241	322
EMS-13262M-25T-xxxA	5	14	209	290
EMS-13382L-25T-xxxA	5	14	231	312

12.2.7 150Base servo motor parameters and installation dimensions

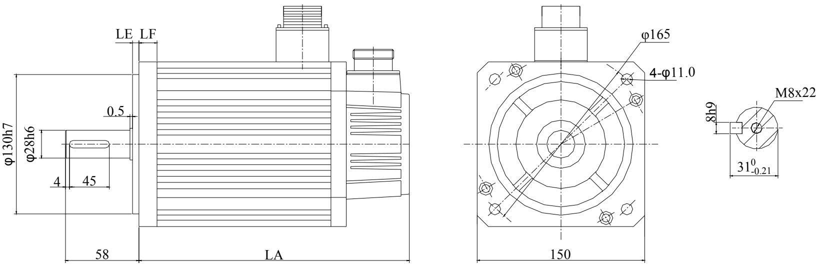


Fig. 12-11 150Base outline drawing

Type	LE（mm)	LF(mm)	LA(mm)	LA(mm) with brake
EMS-15302M-20S-xxxA	5	14	230	303

12.2.8 180Base servo motor parameters and installation dimensions

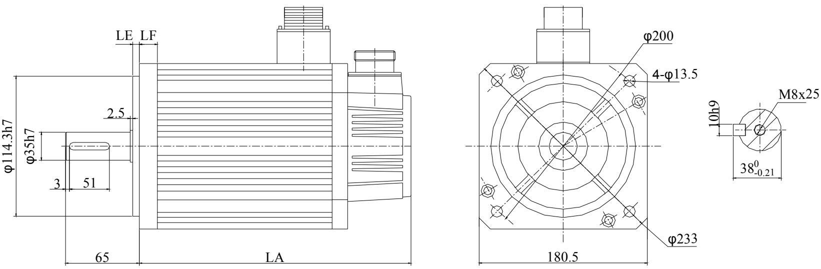
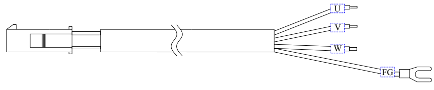
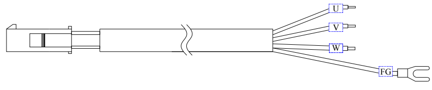
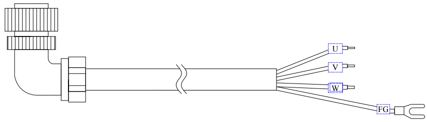
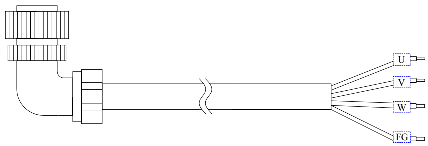
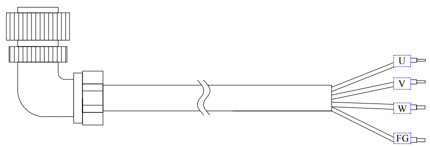
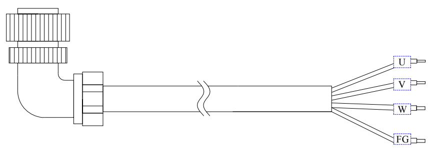
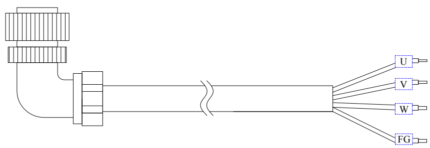
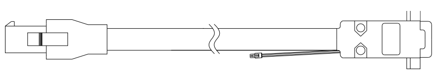
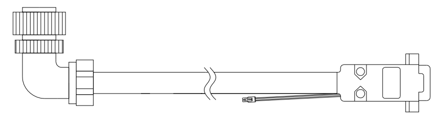
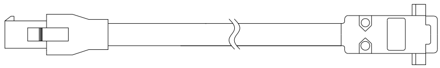
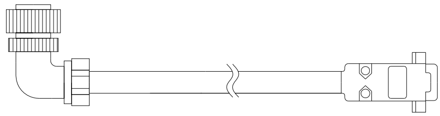
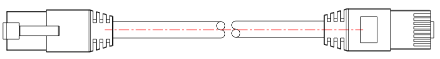
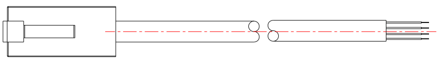
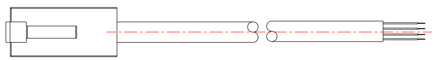
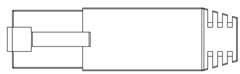
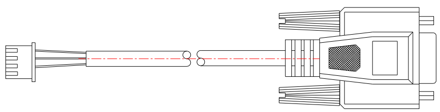
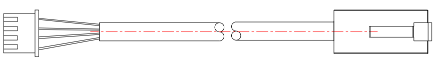


Fig. 12-12 180Base outline drawing

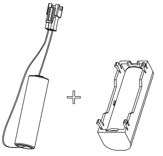
Type	LE（mm)	LF(mm)	LA(mm)	LA(mm) with brake
EMS-18292H-10S-xxxA	3.2	18	262	334
EMS-18272H-15T-xxxA	3.2	18	226	298
EMS-18302H-15T-xxxA	3.2	18	232	304
EMS-18452M-20T-xxxA	3.2	18	243	315
EMS-18552M-15T-xxxA	3.2	18	292	364
EMS-18752M-15T-xxxA	3.2	18	346	418
EMS-18302H-15S-xxxA	3.5	18	232	304
EMS-18432M-15T-xxxA	3.5	18	262	334

12.3 Cable model description

Cable name	Cable type	Cable length L（M）	Cable appearance
Servo motor main circuit cable	EN-D201	3M	
		5M	
		10M	
	EN-D202	3M	
		5M	
		10M	
	EN-D211	3M	
		5M	
		10M	
	EN-D212	3M	
		5M	
		10M	
	EN-D221	3M	
		5M	
		10M	
	EN-D222	3M	
		5M	
		10M	
	EN-D223	3M	
		5M	
		10M	
Servo motor encoder cable	EN-M601	3M	
		5M	
		10M	

	EN-M611	3M 5M 10M	
	EN-M602	3M 5M 10M	
	EN-M612	3M 5M 10M	
Servo drive multi-machine parallel cable	EN-M401	0.3M	
Servo drive CAN communication cable	EN-M402	2M	
Servo drive 485 communication cable	EN-M403	2M	
Servo driver termination matching resistor	EN-M404	-	
Servo drive PC 232 communication cable	EN-M701	1.5M	
Servo drive keyboard copy parameter communication cable	EN-M702	1.5M	

12.4 Absolute encoder battery box kit

Name	Type	Appearance
Battery box kit	ESS-C100	

13 Function code parameter list

13.1 Symbol description in the table

P ---- Position mode
S ---- Speed mode
T ---- Torque mode

13.2 Function code directory

Function code group	Parameter group summary	Function code group	Parameter group summary
F00	Servo motor parameters	F11	Communication parameters
F01	Basic control parameters	F12	Auxiliary function parameters
F02	Input terminal parameters	F13	Full closed-loop function parameters
F03	Output terminal parameters	F14	Multi-position function parameters
F04	Position control parameters	F15	Multi-speed function parameters
F05	Speed control parameters	F16	Reserved parameters
F06	Torque control parameters	F17	Fault record parameters
F07	Gain parameters	F18	Manufacturer parameters
F08	Automatic gainadjustmentparameters	F19	Servo variables reading via communication(keypad not display)
F09	Protection parameters	F20	Servo variables setting via communication(keypad not display)
F10	Monitoring parameters	-	-

13.3 Function code parameter list

F00-Servo motor parameters							
Function code	**Name**	**Setting range**	**Unit**	**Default value**	**Effective way**	**Setup way**	**Operating mode**
F00.00	Driver rated power	0.01～655.35	KW	Model determination	-	Display	-
F00.01	Driver rated current	0.01～655.35	A	Model determination	-	Display	-
F00.02	Driver rated voltage	100～480	V	Model determination	-	Display	-
F00.03	Motor code	0～83(See the motor selection table for details.)	-	Model determination	Power on again	Down time sset	-
F00.04	Motor rated power	0.01～655.35	KW	Model determination	Effective instan	Down time set	-

					tly		
F00.05	Motor rated voltage	100～480	V	Model determination	Effective instantly	Down time set	-
F00.06	Motor rated current	0.01～655.35	A	Model determination	Effective instantly	Down time set	-
F00.07	Motor rated torque	0.01～655.35	Nm	Model determination	Effective instantly	Down time set	-
F00.08	Motor max. torque	0.01～655.35	Nm	Model determination	Effective instantly	Down time set	-
F00.09	Motor rated rotate speed	100～6000	rpm	Model determination	Effective instantly	Down time set	-
F00.10	Motor max. rotate speed	100～6000	rpm	Model determination	Effective instantly	Down time set	-
F00.11	Rotor inertia Jm	0.01～655.35	$Kg.cm^2$	Model determination	Effective instantly	Down time set	-
F00.12	Pole pairs number of PMSM Np	2～360	Pole pairs	Model determination	Effective instantly	Down time set	-
F00.13	Stator resistance Rs	0.001～65.535 (Motor power of 3KW and above accuracy is 0.0001Ω）	Ω	Model determination	Effective instantly	Down time set	-
F00.14	Stator inductance Ld	0.01～655.35 (Motor power of 3KW and above accuracy is 0.001mH）	mH	Model determination	Effective instantly	Down time set	-
F00.15	Stator inductance Lq	0.01～655.35 (Motor power of 3KW and above accuracy is 0.001mH）	mH	Model determination	Effective instantly	Down time set	-
F00.16	Linear back EMF coefficient Ke	0.01～655.35 (Line voltage valid value）	V/Krpm	Model determination	Effective instantly	Down time set	-
F00.17	Torque coefficient Kt	0.01～655.35	Nm/Arms	Model determination	Effective instantly	Down time set	-
F00.18～F00.20	Reserved						

F00.21	Encoder code	0：2500 lines encoder-15 lines encoder 1：2500 lines wires simplified encoder-9 lines encoder 2～4：Reserved 5：17-bit bus absolute value encoding(Tamagawa protocol) 6：20-bit bus absolute value encoding(Tamagawa protocol) 7：23-bit bus absolute value encoding(Tamagawa protocol) 8～15：Reserved	-	Model determination	Power on again	Down time set	-
F00.22	Encoder fine	1000～8388608	P/r	Encoder determination	Effective instantly	Down time set	-
F00.24	Electrical angle of signal Z	0.0～360.0	°	Model determination	Effective instantly	Down time set	-
F00.25	Encoder direction negative	0：invalid 1：reverse Note: valid only for photoelectric encoders	-	0	Effective instantly	Down time set	-
F00.26	Abs. encoder angle of installation	0.0～360.0	°	Model determination	Effective instantly	Down time set	-
F00.27	Delay time of encoder	0.0～360.0	us	Encoder determination	Effective instantly	Down time set	-
F00.28	Electrical angle of U、V、W=001	0.0～360.0	°	Model determination	Effective instantly	Down time set	-
F00.29	Electrical angle of U、V、W=010	0.0～360.0	°	Model determination	Effective instantly	Down time set	-
F00.30	Electrical angle of U、V、W=011	0.0～360.0	°	Model determination	Effective instantly	Down time set	-
F00.31	Electrical angle of U、V、W=100	0.0～360.0	°	Model determination	Effective instantly	Down time set	-
F00.32	Electrical angle of U、V、W=101	0.0～360.0	°	Model determination	Effective instantly	Down time set	-
F00.33	Electrical angle of U、V、W=110	0.0～360.0	°	Model determination	Effective instantly	Down time set	-
F00.34	Manufacturer						

～ F00.60	parameters						

F01-Basic control parameters

Function code	Name	Setting range	Unit	Default value	Effective way	Setup way	Operating mode
F01.00	Control mode selection	0：Position mode 1：Speed mode 2：Torque mode 3：Torque mode⟷Speed mode 4：Speed mode⟷ Position mode 5：Torque mode⟷ Position mode	-	0	Effective instantly	Down time set	-
F01.01	Absolute system selection	0：Incremental position mode 1：Absolute position linear mode 2：Reserved	-	0	Power on again	Down time set	PST
F01.02	Reserved						
F01.03	S-ON OFF stop mode selection	0: Free stop, keep free running 1：Slow down, keep free running	-	0	Effective instantly	Down time set	PST
F01.04	Fault No3 stop mode selection	0：Free stop, keep free running 1：Deceleration stop, keep free running	-	0	Effective instantly	Down time set	PST
F01.05	over-stroke stop mode selection	0：Free stop, keep free running 1：Zero speed stop, position remains locked 2：Zero speed stop, keep free running	-	2	Effective instantly	Down time set	PST
F01.06	Brake control selection	0：Invalid 1：Valid	-	0	Effective instantly	Down time set	PST
F01.07	Release braketo command receive delay	0～1000 (The position/speed/torque command is 0 during this time)	ms	250	Effective instantly	Down time set	PST
F01.08	Brake to motor no power on delay	1～1000 Note: This parameter must match the deceleration stop mode.	ms	150	Effective instantly	Down time set	PST
F01.09	Speed threshold for motor brake	0～3000	rpm	30	Effective instantly	Down time set	PST
F01.10	Reserved						
F01.11	Min. resistance of braking resistor allowed by driver	1～65535	Ω	Model determination	-	Display	-
F01.12	Power of built in braking resistor	0～65535	W	Model determinatio	-	Display	-

				n			
F01.13	Resistance of built in braking resistor	1～65535 (65535represents no built-in resistor)	Ω	Model determination	-	Display	-
F01.14	Voltage value of built in braking	300.0～1100.0	V	380.0/690.0	Effective instantly	Run time set	-
F01.15	Resistor heat dissipation coefficient	10～100	%	30	Effective instantly	Run time set	-
F01.16	Braking resistor setting	0：Use built-in braking resistor 1：Use external braking resistor 2：Without using braking resistor, rely on capacitor absorption	-	0	Effective instantly	Run time set	-
F01.17	Power of external braking resistor	0～65535	W	0	Effective instantly	Run time set	-
F01.18	Resistance of external braking resistor	1～65535	Ω	65535	Effective instantly	Run time set	-
F01.19	Parameters operation control	0: All parameters are allowed to be modified 1: Except for this parameter, all other parameters are not allowed to be modified 2: Except for the F00 group parameters, all other parameters are allowed to be modified	-	2	Effective instantly	Down time set	-
F01.20	Reset to default value	0: no action 1: All parameters except the motor parameters are restored to the Default value (excluding the F00 and F17 parameters) 2: The fault record restores the Default value (only F17 group) 3: All parameters are restored to the Default value of 1 (excluding the F00 group) 6666: All parameters are restored to the Default value of 2 (excluding the F17 group parameters) 7777: All parameters are restored to the Default value of 3 (all parameters)	-	0	Power on again	Down time set	-
F01.21	Monitoring status C-0 selection	0～66 Note 1: The monitoring interface includes two types: parameter editing interface and monitoring interface. Note 2: Parameter editing interface: auxiliary operation interface of each level and special	-	0	Effective instantly	Run time set	-

		monitoring parameters (motor test run shows current running speed, inertia learning shows current inertia, three self-learning operation shows turn1, 2, 3 fixed angle output shows current specific Z state and electrical angle variables), the rigid table adjust display interface. In the auxiliary operation interface, the alarm, alarm interface, and bus undervoltage interface are also displayed preferentially. Note 3: The priority of the monitoring interface is as follows: Power-on display 88888--not flashing display; Alarm and alarm interface--flashing display; Busbar undervoltage interface--flashing display; LED full light indication interface - no flashing; C-X monitoring interface--C-X content is displayed when the machine is stopped. When the servo is on, the content of C-X is displayed without flashing. When Shift is pressed, C-X is displayed first, and then the corresponding content is displayed.					
F01.22	Monitoring status C-1 selection	0～66		3	Effective instantly	Run time set	-
F01.23	Monitoring status C-2 selection	0～66		4	Effective instantly	Run time set	-
F01.24	Monitoring status C-3 selection	0～66		5	Effective instantly	Run time set	-
F01.25	Monitoring status C-4 selection	0～66		14	Effective instantly	Run time set	-
F01.26	Monitoring status C-5 selection	0～66		50	Effective instantly	Run time set	-
F01.27	Refresh time of display	1～20	10ms	4	Effective instantly	Run time set	-
F01.28	Bus voltage adjust	0.900～1.100	-	1.000	Effective	Run time	-

	coefficient				instantly	set	
F01.29	Encryption time	0～65535	h	0	Effective instantly	Run time set	-
F01.30	Cooling fan control selection	0：Intelligent fan 1：Always running after power-on 2：The fan is forbidden to run,but automatically running when the temperature is higher than 75 degrees	-	0	Effective instantly	Run time set	-
F01.31	LED alarm display selection	0：Immediately output warning information 1：Do not output warning information	-	0	Effective instantly	Run time set	PST
F01.32	Reserved						
F01.33	Fault reset selection setting	0：Fault reset when servo enable is invalid 1：Fault reset when servo enable is invalid and valid	-	0	Effective instantly	Run time set	PST
F01.34	Reserved						
F01.35	Reserved						

F02-Input terminal parameters

Function code	Name	Setting range	Unit	Default value	Effective way	Setup way	Operating mode
F02.00	DI source selection	0～FF (2^8,The corresponding bit is 1, which is derived from the communication given F20.00)	-	0	Effective instantly	Run time set	-
F02.01	DI1 filter time	0～50	125us	8	Effective instantly	Run time set	-
F02.02	DI1 function selection	0: No function 1: Servo enable 2: Fault and warning reset 3: Gain switching 4: Main and auxiliary operation command switching 5: Multi-speed DI switching direction setting 6: Multi-segment running command switch 1 7: Multi-segment running command switch 2 8: Multi-segment running command switch 3 9: Multi-segment running command switch 4 10: Control mode switching 11: External device fault input	-	1	Effective instantly	Run time set	-

		12: Zero fixed enable 13: Position command is forbidden 14: Forward over-stroke switch 15: Reverse over-stroke switch 16: positive external torque limit 17: Negative external torque limit 18: Forward jog 19: Reverse jog 20: Step enable 21~23: Reserved 24: Electronic gear selection 25: Torque command direction setting 26: Speed command direction setting 27: Position command direction setting 28: Multi- position command enable 29: Interrupt fixed length state release (edge valid) 30: Origin switch 31: Origin return enable (edge valid) 32: Interrupt fixed length prohibition 33: Emergency stop 34: Clear position deviation (edge valid) 35: Pulse command prohibition 36: Simple PLC pause 37: Simple PLC status reset 38: Interrupt fixed length trigger switch 39～63：Reserved					
F02.03	DI1 logic selection	Input polarity: 0~4 0： low level is valid 1： high level is valid 2： rising edge is valid 3： falling edge is valid 4： both rising and falling edges are valid	-	0	Effective instantly	Run time set	-
F02.04	DI2 filter time	0～50	125us	8	Effective instantly	Run time set	-
F02.05	DI2 function selection	Same as F02.02	-	14	Effective instantly	Run time set	-
F02.06	DI2 logic selection	Input polarity: 0~4 0： low level is valid 1： high level is valid 2： rising edge is valid 3： falling edge is valid 4： both rising and falling edges are valid	-	0	Effective instantly	Run time set	-

F02.07	DI3 filter time	0～50	125us	8	Effective instantly	Run time set	-
F02.08	DI3 function selection	Same as F02.02	-	15	Effective instantly	Run time set	-
F02.09	DI3 logic selection	Input polarity: 0~4 0： low level is valid 1： high level is valid 2： rising edge is valid 3： falling edge is valid 4： both rising and falling edges are valid	-	0	Effective instantly	Run time set	-
F02.10	DI4 filter time	0～50	125us	8	Effective instantly	Run time set	-
F02.11	DI4 function selection	Same as F02.02	-	13	Effective instantly	Run time set	-
F02.12	DI4 logic selection	Input polarity: 0~4 0： low level is valid 1： high level is valid 2： rising edge is valid 3： falling edge is valid 4： both rising and falling edges are valid	-	0	Effective instantly	Run time set	-
F02.13	DI5 filter time	0～50	125us	8	Effective instantly	Run time set	-
F02.14	DI5 function selection	Same as F02.02	-	2	Effective instantly	Run time set	-
F02.15	DI5 logic selection	Input polarity: 0~4 0： low level is valid 1： high level is valid 2： rising edge is valid 3： falling edge is valid 4： both rising and falling edges are valid	-	0	Effective instantly	Run time set	-
F02.16	DI6 filter time	0～50	125us	8	Effective instantly	Run time set	-
F02.17	DI6 function selection	Same as F02.02	-	12	Effective instantly	Run time set	-
F02.18	DI6 logic selection	Input polarity: 0~4 0： low level is valid 1： high level is valid 2： rising edge is valid	-	0	Effective instantly	Run time set	-

		3： falling edge is valid 4： both rising and falling edges are valid					
F02.19	DI7 filter time	0～50	125us	8	Effective instantly	Run time set	-
F02.20	DI7 function selection	Same as F02.02	-	31	Effective instantly	Run time set	-
F02.21	DI7 logic selection	Input polarity: 0~4 0： low level is valid 1： high level is valid 2： rising edge is valid 3： falling edge is valid 4： both rising and falling edges are valid	-	0	Effective instantly	Run time set	-
F02.22	DI8 filter time	0～50	125us	2	Effective instantly	Run time set	-
F02.23	DI8 function selection	Same as F02.02(high speed input terminal)	-	0	Effective instantly	Run time set	-
F02.24	DI8 logic selection	Input polarity: 0~4 0： low level is valid 1： high level is valid 2： rising edge is valid 3： falling edge is valid 4： both rising and falling edges are valid	-	0	Effective instantly	Run time set	-
F02.25	AI1 filter time	0～655.35	ms	2.00	Effective instantly	Run time set	-
F02.26	AI1 offset	-5000～5000	mV	0	Effective instantly	Run time set	-
F02.27	AI1 dead zone	0～1000.0	mV	10.0	Effective instantly	Run time set	-
F02.28	AI2 filter time	0～655.35	ms	2.00	Effective instantly	Run time set	-
F02.29	AI2 offset	-5000～5000	mV	0	Effective instantly	Run time set	-
F02.30	AI2 dead zone	0～1000.0	mV	10.0	Effective instantly	Run time set	-

F02.31	Speed corresponding to 10V	0～6000	rpm	3000	Effective instantly	Run time set	-
F02.32	Torque corresponding to 10V	0.10 times～8.00 times rated torque	Times	1.00	Effective instantly	Run time set	-

F03-Output terminal parameters							
Function code	**Name**	**Setting range**	**Unit**	**Default value**	**Effective way**	**Setup way**	**Operating mode**
F03.00	DO1 function selection	0: No function 1: Servo ready 2: Motor rotation output 3: Zero speed 4: Consistent speed 5: Positioning completed 6: Positioning is close 7: Torque limit 8: Speed limit 9: Brake output 10: Warning output 11: Fault output 12: Interrupt fixed length is completed 13: Origin return output 14: Electrical zero return output 15: Torque reach output 16: Speed reach output 17: DB braking output 18: Internal command output 19～31：Reserved	-	1	Effective instantly	Run time set	-
F03.01	DO1 logic selection	Output polarity inversion setting: 0~1 0：output low level when valid (optocoupler conduction) 1：output high level when valid (optocoupler off)	-	0	Effective instantly	Run time set	-
F03.02	DO2 function selection	Same as F03.00	-	5	Effective instantly	Run time set	-
F03.03	DO2 logic selection	Output polarity inversion setting: 0~1 0：output low level when valid (optocoupler conduction) 1：output high level when valid (optocoupler off)	-	0	Effective instantly	Run time set	-
F03.04	DO3 function selection	Same as F03.00	-	3	Effective instantly	Run time set	-
F03.05	DO3 logic	Output polarity inversion setting:	-	0	Effect	Run	-

	selection	0~1 0：output low level when valid (optocoupler conduction) 1：output high level when valid (optocoupler off)			ive instan tly	time set	
F03.06	DO4 function selection	Same as F03.00	-	11	Effect ive instan tly	Run time set	-
F03.07	DO4 logic selection	Output polarity inversion setting: 0~1 0：output low level when valid (optocoupler conduction) 1：output high level when valid (optocoupler off)	-	0	Effect ive instan tly	Run time set	-
F03.08	DO5 function selection	Same as F03.00	-	13	Effect ive instan tly	Run time set	-
F03.09	DO5 logic selection	Output polarity inversion setting: 0~1 0：output low level when valid (optocoupler conduction) 1：output high level when valid (optocoupler off)	-	0	Effect ive instan tly	Run time set	-
F03.10	DO source selection	0～1F (2^5, The corresponding bit is 1, which is derived from the communication given F20.01)	-	0	Effect ive instan tly	Run time set	-
F03.11	AO1 signal selection	00: Motor speed (1V/1000rpm) 01: Speed command (1V/1000rpm) 02: Torque command (1V/100%) 03: Position deviation (0.05V/instruction Unit) 04: Position deviation (0.05V/encoder Unit) 05: Position command speed (1V/1000rpm) 06: Positioning completion command (positioning completed: 5V; positioning is not completed: 0V) 07: Speed feed forward (1V/1000rpm) 08: AI1 voltage 09: AI2 voltage 10: Output current 1 (0 to 4 times rated motor current) 11: Output current 2 (0 to 4 times rated driver current) 12: Output voltage (0 to 1.2 times rated motor voltage) 13: Bus voltage (0 to 1.5 times rated bus voltage) 14: Communication given (determined by F20.05)	-	0	Effect ive instan tly	Run time set	-

		15: Feedback torque (1V/100%)					
F03.12	AO1 filter time	0～655.35	ms	0.00	Effective instantly	Run time set	-
F03.13	AO1 offset voltage	-9999～9999	mV	0	Effective instantly	Run time set	-
F03.14	AO1 gain	-99.99～99.99	Times	1.00	Effective instantly	Run time set	-
F03.15	AO2 signal selection	Same as F03.11	-	0	Effective instantly	Run time set	-
F03.16	AO2 filter time	0～655.35	ms	0.00	Effective instantly	Run time set	-
F03.17	AO2 offset voltage	-9999～9999	mV	0	Effective instantly	Run time set	-
F03.18	AO2 gain	-99.99～99.99	Times	1.00	Effective instantly	Run time set	-

F04-Position control parameters

Function code	Name	Setting range	Unit	Default value	Effective way	Setup way	Operating mode
F04.00	Position command source	Interrupt fixed length origin return operation 0: pulse command 1: step amount given 2: Multi-position command given	-	0	Effective instantly	Down time set	P
F04.01	Pulse command form	0: pulse + direction 1: A phase + B phase orthogonal pulse, 4 times frequency 2: CW+CCW	-	0	Power on again	Down time set	P
F04.02	Instruction pulse inversion	0：invalid 1：invert	-	0	Effective instantly	Down time set	P
F04.03	Pulse input terminal selection	0：low speed 1：high speed	-	0	Effective instantly	Down time set	P
F04.04	Step amount	-9999～9999	Command Unit	50	Effective instantly	Down time set	P

F04.05	Position first order low pass filter time	0～1000.0	ms	0.0	Effective instantly	Down time set	P
F04.06	Average value filter time	0.0～128.0	ms	0.0	Effective instantly	Down time set	P
F04.07	Number of position commands per motor revolution	0～8388608（2^{23}）	P/r	0	Power on again	Down time set	P
F04.09	Electronic gear ratio 1 (numerator)	1～1073741824	-	Determined by encoder	Effective instantly	Run time set	P
F04.11	Electronic gear ratio 1 (denominator)	1～1073741824	-	10000	Effective instantly	Run time set	P
F04.13	Electronic gear ratio 2 (numerator)	1～1073741824	-	Determined by encoder	Effective instantly	Run time set	P
F04.15	Electronic gear ratio 2 (denominator)	1～1073741824	-	10000	Effective instantly	Run time set	P
F04.17	Electronic gear ratio switchover condition	0: The position command (command unit) is 0. And switch after 2.5ms 1: real-time switching	-	0	Effective instantly	Down time set	P
F04.18	Position deviation clear action selection	0: Servo enable OFF or when a fault occurs, Clear position deviation 1: When the enable is turned OFF or a fault occurs, Clear position deviation pulse 2: Enable OFF or DI input ClrPosErr signal clears position deviation	-	0	Effective instantly	Down time set	P
F04.19	Output condition of positioning completed	0：output when the absolute value of the position deviation is less than F04.20 1：output when the absolute value of position deviation is less than F04.20 and position command is 0 after filter 2：output when the absolute value of position deviation is less than F04.20 and position command is 0 before filter 3：output when the absolute value of position deviation is less than F04.20 and position command is 0 before filter.Keep the time set by F04.21 valid	-	0	Effective instantly	Down time set	P

F04.20	Positioning completion threshold	1 ～65535	Encoder Unit	Determined by encoder	Effective instantly	Down time set	P
F04.21	Positioning completion window time	0 ～30000	ms	1	Effective instantly	Run time set	P
F04.22	Positioning completion retention time	0 ～30000	ms	0	Effective instantly	Run time set	P
F04.23	Positioning close to the threshold	1～1073741824	Encoder Unit	Determined by encoder	Effective instantly	Down time set	P
F04.25	Servo pulse output source selection	0：Encoder frequency division output 1: Pulse command synchronous output 2：Frequency division or synchronous output prohibit	-	0	Power on again	Down time set	P
F04.26	Encoder frequency division pulse number	35～40000	P/r	500	Power on again	Down time set	P
F04.27	Z pulse output polarity selection	0: Positive output (Z pulse is high level) 1: Negative polarity output (Z pulse is low level)	-	1	Power on again	Down time set	P
F04.28	Frequency division pulse output phase	0: A is ahead of B 1:B is ahead of A	-	0	Power on again	Down time set	P
F04.29	Interrupt fixed length enable	0：Forbid interrupt fixed length function 1：Use interrupt fixed length function	-	0	Power on again	Down time set	P
F04.30	Interrupt fixed length displacement	0～1073741824	Command Unit	1000	Effective instantly	Down time set	P
F04.32	Interrupt fixed length constant speed	0～6000	rpm	200	Effective instantly	Down time set	P
F04.33	Interrupt fixed length acceleration and deceleration time	0～1000	ms	10	Effective instantly	Down time set	P
F04.34	Fixed length lock /release signal enable	0: not enabled 1: enable	-	1	Effective instantly	Down time set	P
F04.35	Origin return enable control	0: Turn off the origin return 1: Input Homming Start signal by DI, enable origin return function 2: Input Homming Start signal by	-	0	Effective instantly	Run time set	P

		DI, enable electrical zero return 3: Start origin return immediately after power on 4: Immediate execute origin return 5: Start the electrical zero return command 6: Taking the current position as the origin					
F04.36	Origin return mode	0: Forward zero return, deceleration point, origin is motor Z signal 1: Reverse zero return, deceleration point, origin is motor Z signal 2: Forward zero return, deceleration point, origin is the origin switch 3: Reverse zero return, deceleration point, origin is the origin switch 4: Forward zero return, deceleration point is the origin switch, the origin is motor Z signal 5: Reverse zero return, the deceleration point is the origin switch, and the origin is the motor Z signal. 6: Forward zero return, deceleration point, origin is forward overtravel switch 7: Reverse zero return, deceleration point, origin is reverse overtravel switch 8: Forward zero return, the deceleration point is the forward overstroke switch, and the origin is the motor Z signal. 9: Reverse zero return, the deceleration point is reverse overstroke switch, the origin is motor Z signal 10: Forward zero return, deceleration point, origin is mechanical limit position 11: Reverse zero return, deceleration point, origin is mechanical limit position 12: Forward zero return, deceleration point is mechanical limit position, origin is motor Z signal 13: Reverse zero return, the deceleration point is the mechanical limit position, and the origin is the motor Z signal.	-	0	Effect ive instan tly	Down time set	P
F04.37	High speed search origin	0～3000	rpm	100	Effect ive	Down time	P

	switching signal speed				instantly	set	
F04.38	Low speed search origin switching signal speed	0～1000	rpm	10	Effective instantly	Down time set	P
F04.39	Acceleration/deceleration time when searching for the origin	0～6000	ms	1000	Effective instantly	Down time set	P
F04.40	Limit the time to find the origin	0～65535	ms	10000	Effective instantly	Down time set	P
F04.41	Mechanical origin offset	-1073741824 ～1073741824	Command Unit	0	Effective instantly	Down time set	P
F04.43	Mechanical origin offset and processing when a limit is encountered	0:F04.41 is the coordinate after the origin return.After encountering limit re-trigger the origin return enable,then reverse to find the origin. 1:F04.41 is the relative offset after the origin return. After encountering limit re-trigger the origin return enable,then reverse to find the origin. 2:F04.41 is the coordinate after the origin return. Automatically reverse to find zero after encountering Limit. 3:F04.41 is the relative offset after the origin return. Automatically reverse to find zero after encountering Limit.	-	0	Effective instantly	Down time set	P
F04.44	Absolute position linear mode position offset (low 32 bits)	-2147483648～2147483647	Encoder Unit	0	Power on again	Down time set	P
F04.46	Absolute position linear mode position offset (high 32 bits)	-2147483648～2147483647	Encoder Unit	0	Power on again	Down time set	P
F04.48～F04.52	Reserved						
F04.54	Touch stop to zero speed judgment threshold	0～1000	rpm	2	Effective instantly	Run time set	P
F04.55	Touch stop to zero speed torque limit	0～300.0	%	100.0	Effective instan	Run time set	P

					tly		
F04.56 ～ F04.58	Reserved						

F05-Speed control parameters							
Function code	**Name**	**Setting range**	**Unit**	**Default value**	**Effective way**	**Setup way**	**Operating mode**
F05.00	Main speed command A source	0: Digital given (F05.04) 1: AI1 2: AI2 3: Communication given	-	0	Effective instantly	Run time set	S
F05.01	Auxiliary speed command B source	0: Digital given (F05.04) 1: AI1 2: AI2 3: Multi-speed command 4: Communication given	-	1	Effective instantly	Run time set	S
F05.02	Speed command selection	0: Main speed command A source 1: Auxiliary speed command B source 2: A+B 3: A-B 4: A/B switching	-	0	Effective instantly	Run time set	S
F05.03	Speed command logic inversion	0: positive logic 1: negative logic	-	0	Effective instantly	Run time set	S
F05.04	Speed command keyboard setting value	-6000～6000	rpm	200	Effective instantly	Run time set	S
F05.05	Jog speed setting value	0～6000	rpm	100	Effective instantly	Run time set	PST
F05.06	Speed command acceleration ramp time constant	0～65535	ms	0	Effective instantly	Run time set	S
F05.07	Speed command deceleration ramp timeconstant	0～65535	ms	0	Effective instantly	Run time set	S
F05.08	Maximum speed threshold	0～6000	rpm	4500	Effective instantly	Run time set	PST
F05.09	Forward speed threshold	0～6000	rpm	4500	Effective instantly	Run time set	PST
F05.10	Reverse speed threshold	0～6000	rpm	4500	Effective instan	Run time set	PST

					tly		
F05.11	Zero position fixed speed threshold	0～6000	rpm	10	Effective instantly	Run time set	S
F05.12	Motor rotation speed threshold	0～1000	rpm	20	Effective instantly	Run time set	PST
F05.13	Speed consistent signal threshold	0～100	rpm	10	Effective instantly	Run time set	S
F05.14	Speed arrival signal threshold	10～6000	rpm	1000	Effective instantly	Run time set	S
F05.15	Zero speed output signal threshold	1～6000	rpm	10	Effective instantly	Run time set	S
F05.16	Speed DO filter time constant	0～500.00	ms	10.00	Effective instantly	Run time set	S
F05.17	Reserved						
F05.18	Reserved						

F06-Torque control parameters

Function code	Name	Setting range	Unit	Default value	Effective way	Setup way	Operating mode
F06.00	Main torque command A source	0: Digital given (F06.04) 1: AI1 2: AI2 3: Communication given	-	0	Effective instantly	Run time set	T
F06.01	Auxiliary torque command B source	0: Digital given (F06.04) 1: AI1 2: AI2 3: Communication given	-	1	Effective instantly	Run time set	T
F06.02	Torque command selection	0: Main torque command A source 1: Auxiliary torque command B source 2: Main command A source + auxiliary command B source 3: Main command A source - auxiliary command B source 4: Main command A source / auxiliary command B source switching	-	0	Effective instantly	Run time set	T
F06.03	Torque command logicinversion	0：positive logic 1：negative logic	-	0	Effective instantly	Run time set	T

F06.04	Torque command keyboard setting value	-300.0～300.0(motor rated torque)	%	0	Effective instantly	Run time set	T
F06.05	Torque limit source	0: positive and negative internal torque limit 1: positive and negative external torque limit (Using P-CL, N-CL selection) 2: T-LMT is used as external torque limit input 3: Switch between positive/ negative internal torque limit and T-LMT torque limit (using P-CL, N-CL selection)	-	0	Effective instantly	Run time set	PST
F06.06	T-LMT selection	0：AI1 1：AI2	-	0	Effective instantly	Run time set	PST
F06.07	Positive internal torque limit	0.0～300.0(motor rated torque)	%	300.0	Effective instantly	Run time set	PST
F06.08	Negative internal torque limit	0.0～300.0(motor rated torque)	%	300.0	Effective instantly	Run time set	PST
F06.09	Positive external torque limit	0.0～300.0(motor rated torque)	%	300.0	Effective instantly	Run time set	PST
F06.10	Negative external torque limit	0.0～300.0(motor rated torque)	%	300.0	Effective instantly	Run time set	PST
F06.11	Torque compensation	0.0～150.0(motor rated torque)	%	0.0	Effective instantly	Run time set	T
F06.12	Torque compensation cutoffspeed	0～6000	rpm	1000	Effective instantly	Run time set	T
F06.13	Torque control forward speed limit source selection	0：determined by F06.15 1：AI1 2：AI2	-	0	Effective instantly	Run time set	T
F06.14	Torque control reverse speed limit source selection	0：determined by F06.16 1：AI1 2：AI2	-	0	Effective instantly	Run time set	T
F06.15	Torque control forward speed limit value	0～6000	rpm	3000	Effective instantly	Run time set	T
F06.16	Torque control reverse speed	0～6000	rpm	3000	Effective	Run time	T

	limit value				instan tly	set	
F06.17	Torque arrival reference value	0.0～300.0	%	0.0	Effective instantly	Run time set	PST
F06.18	Torque arrival valid value	0.0～300.0	%	20.0	Effective instantly	Run time set	PST
F06.19	Torque arrival invalid value	0.0～300.0	%	10.0	Effective instantly	Run time set	PST
F06.20	Speed limited window time in Torque mode	0～1000	ms	1	Effective instantly	Run time set	T
F06.21	Gravity load detection value	-300.0～300.0	%	0.0	Effective instantly	Down time set	PS
F06.22	Reserved						
F06.23	Reserved						

F07-Gain parameters							
Function code	**Name**	**Setting range**	**Unit**	**Default value**	**Effective way**	**Setup way**	**Operating mode**
F07.00	1st speed loop gain	0.1～1000.0	Hz	25.0	Effective instantly	Run time set	PS
F07.01	1st speed loop integration time	0.36～512.00	ms	31.83	Effective instantly	Run time set	PS
F07.02	1st position loop gain	0.0～1570.0	rad/s	40.0	Effective instantly	Run time set	P
F07.03	2nd speed loop gain	0.1～1000.0	Hz	40.0	Effective instantly	Run time set	PS
F07.04	2nd speed loop integration time	0. 36～512.00	ms	40.00	Effective instantly	Run time set	PS
F07.05	2nd position loop gain	0.0～1570.0	rad/s	64.0	Effective instantly	Run time set	P

F07.06	2nd gain mode set	0: The 1st gain is fixed, and the external DI is used for P/PI switching. 1: Use gain switching according to the condition setting of F07.07	-	1	Effective instantly	Run time set	PST
F07.07	Gain switchover condition selection	0: 1st gain fixed (PS) 1: Use external DI switchover(PS) 2: Torque command is large (PS) 3: Speed command is large (PS) 4: Speed command change rate is large (PS) 5: Speed command high and low speed threshold (PS) 6: Large positional deviation (P) 7: With position command (P) 8: Positioning completed (P) 9: Actual speed is large (P) 10: With position command + actual speed (P)	-	0	Effective instantly	Run time set	PST
F07.08	Gain switchover delay	0～6000(two-way delay, linearly varying according to time)	125us	40	Effective instantly	Run time set	PST
F07.09	Gain switchover level	0～20000	According to the switching condition	50	Effective instantly	Run time set	PST
F07.10	Gain switchover time lag	0～20000	According to the switching condition	30	Effective instantly	Run time set	PST
F07.11	Position gain switchover time	0～60000	125us	24	Effective instantly	Run time set	PS
F07.12	1st torque command filter time	0～30.00	ms	0.79	Effective instantly	Run time set	PST
F07.13	2nd torque command filter time	0～30.00	ms	0.79	Effective instantly	Run time set	PST
F07.14	Load inertia ratio	0.00～200.00	Times	0.00	Effective instantly	Run time set	PST
F07.15	Speed feed forward selection	0: internal speed feedforward 1: Use AI1 as speed feedforward input 2: Use AI2 as speed feedforward input	-	0	Effective instantly	Run time set	P
F07.16	Speed feed	0.00～64.00	ms	1.00	Effect	Run	P

	forward filter time constant				ive instan tly	time set	
F07.17	Speed feed forward gain	0.0～100.0	%	0.0	Effect ive instan tly	Run time set	P
F07.18	Torque feed forward selection	0: no torque feedforward 1: Internal torque feedforward	-	1	Effect ive instan tly	Run time set	PS
F07.19	Torque feed forward filter time constant	0.00～64.00	ms	1.00	Effect ive instan tly	Run time set	PS
F07.20	Torque feed forward gain	0.0～200.0	%	0	Effect ive instan tly	Run time set	PS
F07.21	Speed feedback filter time	0～30.00	ms	0.00	Effect ive instan tly	Run time set	PST
F07.22	Position deviation limit	0～65535	Encoder Unit	Determine d by encoder	Effect ive instan tly	Run time set	P
F07.23	Rigid test running circles	1～100	Rev	2	Effect ive instan tly	Down time set	PS

F08-Automatic gain turning parameters							
Functio n code	**Name**	**Setting range**	**Unit**	**Default value**	**Effect ive way**	**Setup way**	**Oper ating mode**
F08.00	Self-adjustmentm ode selection	0: Manual adjust parameters 1: Parameter self-adjustmentmode, automatic adjust gain parameters with rigid table 2: Positioning mode, automatic adjust gain parameters with rigid table	-	1	Effect ive instan tly	Run time set	PST
F08.01	Rigid levelselection	0～31	-	12	Effect ive instan tly	Run time set	PST
F08.02	Adaptive notch mode selection	0: Adaptive notch is no longer updated 1:1 adaptive notch filter is valid(3rd notch filter) 2: 2 adaptive notch filters are valid (3rd and 4th notch filter) 3: Only test the resonance point, F08.20-F08.21 display	-	0	Effect ive instan tly	Run time set	PST

		4: Restore 3rd and 4th notch filter to Default value					
F08.03	Offline inertia identification mode	0: Positive and negative triangle wave mode 1: Forward mode 2: Reverse mode	-	0	Effective instantly	Down time set	PST
F08.04	Inertia identificationmax. Speed	50～6000	rpm	500	Effective instantly	Run time set	PST
F08.05	Acc/dec time when inertia identification	2～2000	ms	125	Effective instantly	Run time set	PST
F08.06	Interval after an inertia identification	20～10000	ms	1000	Effective instantly	Run time set	PST
F08.07	Motor revolutions for an inertia identification	0.00～655.35	r	-	Effective instantly	Display	PST
F08.08	1st notch frequency	100～4000	Hz	4000	Effective instantly	Run time set	PST
F08.09	1st notch width level	0～10	-	2	Effective instantly	Run time set	PST
F08.10	1st notch depth level	0～99	-	0	Effective instantly	Run time set	PST
F08.11	2nd notch frequency	100～4000	Hz	4000	Effective instantly	Run time set	PST
F08.12	2nd notch width level	0～10	-	2	Effective instantly	Run time set	PST
F08.13	2nd notch depth level	0～99	-	0	Effective instantly	Run time set	PST
F08.14	3rd notch frequency	100～4000	Hz	4000	Effective instantly	Run time set	PST
F08.15	3rd notch width level	0～10	-	2	Effective instantly	Run time set	PST
F08.16	3rd notch depth level	0～99	-	0	Effective instan	Run time set	PST

					tly		
F08.17	4th notch frequency	100～4000	Hz	4000	Effective instantly	Run time set	PST
F08.18	4th notch width level	0～10	-	2	Effective instantly	Run time set	PST
F08.19	4th notch depth level	0～99	-	0	Effective instantly	Run time set	PST
F08.20	Resonance frequency identification result (frequency)	100～4000	Hz	-	-	Display	PST
F08.21	Resonance frequency identification result (depth level)	0～99	-	-	-	Display	PST
F08.22	Low frequency resonance suppression mode selection	0：Manual setting 1：Self-turning setting	-	0	Effective instantly	Down time set	P
F08.23	Low frequency resonance frequency	4.0～100.0	Hz	100.0	Effective instantly	Down time set	P
F08.24	Low frequency resonance times	1～15	-	2	Effective instantly	Down time set	P
F08.25	Online inertia identification mode	0～3	-	0	Effective instantly	Down time set	PST
F08.26～F08.32	Reserved						

F09-Protection parameters							
Function code	**Name**	**Setting range**	**Unit**	**Default value**	**Effective way**	**Setup way**	**Operating mode**
F09.00	Input phase loss protection	0: no detection 1: fault, free stop	-	1	Effective instantly	Run time set	-
F09.01	Short circuitto PE detection in operation	0: no detection 1: fault, free stop	-	1	Effective instantly	Run time set	-

F09.02	Output phase loss detection in operation	0: no detection 1: fault, free stop	-	1	Effective instantly	Run time set	-
F09.03	Speed protection function	0: no detection 1: fault, free stop	-	1	Effective instantly	Run time set	-
F09.04	Encoder cable break detection	0: no detection 1: fault, free stop	-	1	Effective instantly	Run time set	-
F09.05	Brake protection detection	0: no detection 1: Enable detection of brake protection	-	0	Effective instantly	Run time set	-
F09.06	Reserved						
F09.07	AD sampling overvoltage point	5000～12000(Not detected at 12000)	mV	12000	Effective instantly	Run time set	PST
F09.08	Motor overload protection gain	50～800(Not detected at 800)	%	100	Effective instantly	Run time set	-
F09.09	Overspeed fault threshold	0～10000(0 means no detection)	rpm	0	Effective instantly	Run time set	PST
F09.10	Position deviation too large fault threshold	1～1073741824	Encoder Unit	Determined by encoder	Effective instantly	Run time set	P
F09.12	Max. position pulse frequency	100～4000	kHz	4000	Power on again	Down time set	P
F09.13	Low speed pulse input pin filter constant	0～3	-	3	Effective instantly	Down time set	-
F09.14	Quadrature encoder input pin filter constant	0～3	-	2	Effective instantly	Down time set	-
F09.15	Reserved						
F09.16	Bus encoder interface filter constant	0～1	-	1	Effective instantly	Down time set	-
F09.17	Stall protection time	10～65535(Not detected at 65535)	ms	500	Effective instantly	Down time set	-
F09.18	Encoder multi-turn overflow fault	0: not shielded 1: shielded Note: Automatic shielding in	-	1	Effective instan	Down time set	-

	selection	speed and torque mode			tly		
F09.19	Soft limit setting	0: Do not enable the soft limit 1: Enable the soft limit immediately after power-on. 2: Enable the soft limit after the origin returns to zero	-	0	Effective instantly	Down time set	PST
F09.20	Soft limit max. value	-2147483648～2147483647（2^31）	Command Unit	2147483647	Effective instantly	Down time set	PST
F09.22	Soft limit min. value	-2147483648～2147483647（2^31）	Command Unit	-2147483648	Effective instantly	Down time set	PST
F09.24	Overvoltage suppression coefficient	0～100.0%	%	0.0	Effective instantly	Run time set	PST
F09.25	Reserved						
F09.26	Reserved						

F10-Monitoring parameters

Function code	Name	Setting range	Unit	Default value	Effective way	Setup way	Operating mode
F10.00	Actual motor speed (1 rpm)	-	rpm	-	-	Display	PST
F10.01	Speed command	-	rpm	-	-	Display	PS
F10.02	Internal torque command	-	%	-	-	Display	PST
F10.03	Current effective value	0.00～655.35	A	-	-	Display	PST
F10.04	Bus voltage value	-	V	-	-	Display	PST
F10.05	Input signal (DI signal) monitoring	-	-	-	-	Display	PST
F10.06	Output signal (DO signal) monitoring	-	-	-	-	Display	PST
F10.07	Absolute position counter (32-bit decimal display)	-	Command Unit	-	-	Display	PST
F10.09	Mechanical angle (number of pulses starting from 0 to 65535 at the origin)	-	Encoder Unit	-	-	Display	PST
F10.10	Electrical angle (0.0 ~ 360.0)	-	°	-	-	Display	PST
F10.11	Input position command corresponding speed information	-	rpm	-	-	Display	P
F10.12	Input command pulse counter (32-bit decimal display)	-	Command Unit	-	-	Display	P

F10.14	Encoder position deviation counter (32-bit decimal display)	-	Encoder Unit	-	-	Display	P
F10.16	Motor encoder reverse pulse counter (32-bit decimal display)	-	Encoder Unit	-	-	Display	PST
F10.18	Total power-on time	-	H	-	-	Display	PST
F10.19	Total running time	-	H	-	-	Display	PST
F10.20	AI1 sampling voltage value	-	V	-	-	Display	PST
F10.21	AI2 sampling voltage value	-	V	-	-	Display	PST
F10.22	Module temperature	-	℃	-	-	Display	PST
F10.23	Position deviation counter	-	Command Unit	-	-	Display	P
F10.25	Actual motor speed (0.1rpm)	-	rpm	-	-	Display	PST
F10.27	Mechanical absolute position (low 32 bits)	-	Encoder Unit	-	-	Display	PST
F10.29	Mechanical absolute position (high 32 bits)	-	Encoder Unit	-	-	Display	PST
F10.31	Real-time input position command counter	-	Command Unit	-	-	Display	PST
F10.33	Absolute encoder rotation laps data	-	R	-	-	Display	PST
F10.34	Absolute encoder position within 1 lap	-	Encoder Unit	-	-	Display	PST
F10.36	Absolute encoder absolute position (low 32 bits)	-	Encoder Unit	-	-	Display	PST
F10.38	Absolute encoder absolute position (high 32 bits)	-	Encoder Unit	-	-	Display	PST
F10.40	Reserved						
F10.41	Reserved						
F10.42	Positioning completion time	-	ms	-	-	Display	P
F10.43	Over pulse numbers	-	Encoder Unit	-	-	Display	P
F10.45	Motor output torque	-	%	-	-	Display	PST
F10.46	Current fault details	-	-	-	-	Display	PST
F10.47	Encoder Z,U,V,W status	-	-	-	-	Display	PST
F10.48	Average torque	-	%	-	-	Display	PST
F10.49	Peak torque (maximum torque in the past 10 seconds)	-	%	-	-	Display	PST
F10.50	Output power (1W)	-	W	-	-	Display	PST

F10.51	The reason why the servo motor does not turn	-	-	-	-	Display	PST
F10.52	Reserved	-					
F10.53	Reserved						
F10.54	Output voltage	-	V	-	-	Display	PST
F10.55～F10.64	Reserved	-					

F11-Communication parameters							
Function code	**Name**	**Setting range**	**Unit**	**Default value**	**Effective way**	**Setup way**	**Operating mode**
F11.00	Protocol selection	0：Modbus 1：Reserved	-	0	Effective instantly	Downtime set	PST
F11.01	Servo axis address	1~247, 0 is the broadcast address	-	1	Effective instantly	Run time set	PST
F11.02	Serial port baud rate setting	0：2400Kbp/s 1：4800Kbp/s 2：9600Kbp/s 3：19200Kbp/s 4：38400Kbp/s 5：57600Kbp/s 6：115200Kbp/s 7：230400Kbp/s	-	6	Effective instantly	Run time set	PST
F11.03	MODBUS data format	0: no check, 2 end bits - RTU 1: even check, 1 end bit - RTU 2: odd check, 1 end bit - RTU 3: no check, 1 end bit - RTU	-	0	Effective instantly	Run time set	PST
F11.04	MODBUS command response delay	0～5000	ms	1	Effective instantly	Run time set	PST
F11.05	Reserved						
F11.06	Reserved						
F11.07	Communication timeout checkout time	0.0～1000.0	s	0.0	Effective instantly	Run time set	PST
F11.08	Communication error checkout time	0.0～1000.0	s	0.0	Effective instantly	Run time set	PST
F11.09～F11.24	Reserved						

F12-Auxiliary function parameters							
Function code	**Name**	**Setting range**	**Unit**	**Default value**	**Effec tive way**	**Setu p way**	**Oper ating mode**
F12.00	Software rest	0: No operation 1: Enable	-	0	Effec tive instan tly	Dow ntime set	-
F12.01	Fault reset	0: No operation 1: Enable	-	0	Effec tive instan tly	Dow ntime set	-
F12.02	Absolute encoder reset	0: No operation 1: Reset fault 2: Reset fault and multi-turn data	-	0	Effec tive instan tly	Dow ntime set	-
F12.03	JOG trial run function	Press SET to start and keep zero speed, UP forward, DOWN reverse, press MENU to exit; press SET to display the rotation speed.	-	-	-	-	-
F12.04	Offline inertia identification	Press SET to enter the identification display interface, press UP or DOWN button to start identification, press MENU to exit identification. In the identification interface, long press SET and store to F07.14.	-	-	Effec tive instan tly	Dow ntime set	-
F12.05	Motor parameters self-learning	0: no operation 1: Encoder self-learning---motor UWV power cable phase sequence and EncoderAB phase sequence self-learning, installation angle learning (Z signal and UVW signal) 2: Motor parameter static self-learning 3: Motor parameter rotation self-learning F12.05 is not 0. Press SET button to start identification. In the process of identification, you can press MENU to exit self-learning.	-	0	Effec tive instan tly	Dow ntime set	-
F12.06	Fixed angle output	After pressing SET, press UP to start, press MENU to exit - internal global variable display	-	-	Effec tive instan tly	Dow ntime set	-
F12.07	Emergency stop	0: No operation 1: Enable emergency stop	-	0	Effec tive instan tly	Run time set	-
F12.08	DI force input	0～0xFF(0 means invalid)	-	0x00	Effec tive instan tly	Run time set	-

F12.09	DO force output	0～0x1F(0 means invalid)	-	0x00	Effective instantly	Run time set	-
F12.10	In-plantDebugging parameters	0: No operation 1: LED is fully illuminated	-	0	Effective instantly	Run time set	-
F12.11	Store all parameters	0: No operation 1: Valid	-	0	Effective instantly	Downtime set	-
F12.12	Rigid test auxiliary parameter	0: No operation 1: Forward speed debugging (multiplexing inertia identification parameters) 2: Reverse speed debugging (multiplexing inertia identification parameters) 3: Number of revolutions: F07.23 laps, direction of rotation: forward → reverse 4: Number of revolutions: F07.23 laps, direction of rotation: reverse → forward 5: Number of revolutions: F07.23 laps, direction of rotation: forward → forward 6: Number of revolutions: F07.23 laps, direction of rotation: reverse → reverse	-	0	Effective instantly	Downtime set	-
F12.13	Fixed angle (for In-plantdebugging)	0.0～360.0	°	0.0	Effective instantly	Downtime set	-
F12.14	Fixed current (for In-plantdebugging)	10～300	%	100	Effective instantly	Downtime set	-
F12.15	Reserved						

F13-Full closed-loop function parameters							
Function code	**Name**	**Setting range**	**Unit**	**Default value**	**Effective way**	**Setup way**	**Operating mode**
F13.00	Encoder feedback mode	0: Internal encoder feedback 1: Position feedback signal from full-closed external encoder using Group 1 electronic gear ratio 2: Closed-loop switching of internal and external positions using electronic gears. Invalid, internal encoder feedback, using Group 1 electronic gear ratio;	-	0	Effective instantly	Downtime set	P

		Valid, external encoder feedback, using Group 2 electronic gear ratio					
F13.01	External encoder usage	0: Use in standard running direction 1: Use in reverse running direction	-	0	Effective instantly	Downtime set	P
F13.02	The number of external encoder pulses per revolution of the motor	1 ～1073741824	External encode Unit	10000	Power on again	Downtime set	P
F13.04	Full closed loop hybrid position deviation excessive threshold	0 ～1073741824	External encode Unit	10000	Effective instantly	Downtime set	P
F13.06	Full closed loop hybrid position deviation clear setting	0～100	r	0	Effective instantly	Downtime set	P
F13.07	Full closed loop hybrid position deviation counter	-1073741824～1073741824	External encode Unit	-	-	Display	P
F13.09	External encoder feedback pulse counter	-1073741824～1073741824	External encode Unit	-	-	Display	P
F13.11 ～ F13.15	Reserved						

F14-Multi-position function parameters

Function code	Name	Setting range	Unit	Default value	Effective way	Setup way	Operating mode
F14.00	Mult-position running mode	0: Single run end shutdown (F14.01 selects the number of segments) 1: Cycle operation (F14.01 selects the number of segments) 2: DI switching operation (selected by DI) 3: Run in sequence (F14.01 selects the number of segments)	-	1	Effective instantly	Downtime set	P
F14.01	Number of the displacement command end points	1～16	-	1	Effective instantly	Downtime set	P
F14.02	Balance processing	Valid in the other three modes except DI mode 0: Continue to run the segment	-	0	Effective instan	Downtime set	P

		that has not finished 1: Restart from the first segment			tly		
F14.03	Time unit	0：ms 1：s	-	0	Effective instantly	Downtime set	P
F14.04	Displacement command type	0: Relative displacement command 1: Absolute displacement command	-	0	Effective instantly	Downtime set	P
F14.05	Sequence running start segment selection	0～16	-	0	Effective instantly	Downtime set	P
F14.06	1st segment movement displacement	-1073741824 ～1073741824	Command Unit	10000	Effective instantly	Run time set	P
F14.08	1st displacement maximum running speed	1～6000	rpm	200	Effective instantly	Run time set	P
F14.09	1st displacement acceleration and deceleration time	0～65535	ms(s)	10	Effective instantly	Run time set	P
F14.10	1st displacement waiting time after the completion	0～10000	ms(s)	10	Effective instantly	Run time set	P
F14.11	2nd segment movement displacement	-1073741824 ～1073741824	Command Unit	10000	Effective instantly	Run time set	P
F14.13	2nd displacement maximum running speed	1～6000	rpm	200	Effective instantly	Run time set	P
F14.14	2nd displacement acceleration and deceleration time	0～65535	ms(s)	10	Effective instantly	Run time set	P
F14.15	2nd displacement waiting time after the completion	0～10000	ms(s)	10	Effective instantly	Run time set	P
F14.16	3rd segment movement displacement	-1073741824 ～1073741824	Command Unit	10000	Effective instantly	Run time set	P
F14.18	3rd displacement maximum running speed	1～6000	rpm	200	Effective instantly	Run time set	P
F14.19	3rd	0～65535	ms(s)	10	Effec	Run	P

	displacement acceleration and deceleration time				tive instantly	time set	
F14.20	3rd displacement waiting time after the completion	0～10000	ms(s)	10	Effective instantly	Run time set	P
F14.21	4th segment movement displacement	-1073741824 ～1073741824	Command Unit	10000	Effective instantly	Run time set	P
F14.23	4th displacement maximum running speed	1～6000	rpm	200	Effective instantly	Run time set	P
F14.24	4th displacement acceleration and deceleration time	0～65535	ms(s)	10	Effective instantly	Run time set	P
F14.25	4th displacement waiting time after the completion	0～10000	ms(s)	10	Effective instantly	Run time set	P
F14.26	5th segment movement displacement	-1073741824 ～1073741824	Command Unit	10000	Effective instantly	Run time set	P
F14.28	5th displacement maximum running speed	1～6000	rpm	200	Effective instantly	Run time set	P
F14.29	5th displacement acceleration and deceleration time	0～65535	ms(s)	10	Effective instantly	Run time set	P
F14.30	5th displacement waiting time after the completion	0～10000	ms(s)	10	Effective instantly	Run time set	P
F14.31	6th segment movement displacement	-1073741824 ～1073741824	Command Unit	10000	Effective instantly	Run time set	P
F14.33	6th displacement maximum running speed	1～6000	rpm	200	Effective instantly	Run time set	P
F14.34	6th displacement acceleration and deceleration	0～65535	ms(s)	10	Effective instantly	Run time set	P

	time						
F14.35	6th displacement waiting time after the completion	0～10000	ms(s)	10	Effective instantly	Run time set	P
F14.36	7th segment movement displacement	-1073741824 ～1073741824	Command Unit	10000	Effective instantly	Run time set	P
F14.38	7th displacement maximum running speed	1～6000	rpm	200	Effective instantly	Run time set	P
F14.39	7th displacement acceleration and deceleration time	0～65535	ms(s)	10	Effective instantly	Run time set	P
F14.40	7th displacement waiting time after the completion	0～10000	ms(s)	10	Effective instantly	Run time set	P
F14.41	8th segment movement displacement	-1073741824 ～1073741824	Command Unit	10000	Effective instantly	Run time set	P
F14.43	8th displacement maximum running speed	1～6000	rpm	200	Effective instantly	Run time set	P
F14.44	8th displacement acceleration and deceleration time	0～65535	ms(s)	10	Effective instantly	Run time set	P
F14.45	8th displacement waiting time after the completion	0～10000	ms(s)	10	Effective instantly	Run time set	P
F14.46	9th segment movement displacement	-1073741824 ～1073741824	Command Unit	10000	Effective instantly	Run time set	P
F14.48	9th displacement maximum running speed	1～6000	rpm	200	Effective instantly	Run time set	P
F14.49	9th displacement acceleration and deceleration time	0～65535	ms(s)	10	Effective instantly	Run time set	P
F14.50	9th displacement	0～10000	ms(s)	10	Effective	Run time	P

	waiting time after the completion				instantly	set	
F14.51	10th segment movement displacement	-1073741824 ～1073741824	Command Unit	10000	Effective instantly	Run time set	P
F14.53	10th displacement maximum running speed	1～6000	rpm	200	Effective instantly	Run time set	P
F14.54	10th displacement acceleration and deceleration time	0～65535	ms(s)	10	Effective instantly	Run time set	P
F14.55	10th displacement waiting time after the completion	0～10000	ms(s)	10	Effective instantly	Run time set	P
F14.56	11th segment movement displacement	-1073741824 ～1073741824	Command Unit	10000	Effective instantly	Run time set	P
F14.58	11th displacement maximum running speed	1～6000	rpm	200	Effective instantly	Run time set	P
F14.59	11th displacement acceleration and deceleration time	0～65535	ms(s)	10	Effective instantly	Run time set	P
F14.60	11th displacement waiting time after the completion	0～10000	ms(s)	10	Effective instantly	Run time set	P
F14.61	12th segment movement displacement	-1073741824 ～1073741824	Command Unit	10000	Effective instantly	Run time set	P
F14.63	12th displacement maximum running speed	1～6000	rpm	200	Effective instantly	Run time set	P
F14.64	12th displacement acceleration and deceleration time	0～65535	ms(s)	10	Effective instantly	Run time set	P
F14.65	12th displacement waiting time after the completion	0～10000	ms(s)	10	Effective instantly	Run time set	P

F14.66	13th segment movement displacement	-1073741824 ～1073741824	Command Unit	10000	Effective instantly	Run time set	P
F14.68	13th displacement maximum running speed	1～6000	rpm	200	Effective instantly	Run time set	P
F14.69	13th displacement acceleration and deceleration time	0～65535	ms(s)	10	Effective instantly	Run time set	P
F14.70	13th displacement waiting time after the completion	0～10000	ms(s)	10	Effective instantly	Run time set	P
F14.71	14th segment movement displacement	-1073741824 ～1073741824	Command Unit	10000	Effective instantly	Run time set	P
F14.73	14th displacement maximum running speed	1～6000	rpm	200	Effective instantly	Run time set	P
F14.74	14th displacement acceleration and deceleration time	0～65535	ms(s)	10	Effective instantly	Run time set	P
F14.75	14th displacement waiting time after the completion	0～10000	ms(s)	10	Effective instantly	Run time set	P
F14.76	15th segment movement displacement	-1073741824 ～1073741824	Command Unit	10000	Effective instantly	Run time set	P
F14.78	15th displacement maximum running speed	1～6000	rpm	200	Effective instantly	Run time set	P
F14.79	15th displacement acceleration and deceleration time	0～65535	ms(s)	10	Effective instantly	Run time set	P
F14.80	15th displacement waiting time after the completion	0～10000	ms(s)	10	Effective instantly	Run time set	P
F14.81	16th segment movement displacement	-1073741824 ～1073741824	Command Unit	10000	Effective instan	Run time set	P

					tly		
F14.83	16th displacement maximum running speed	1～6000	rpm	200	Effective instantly	Run time set	P
F14.84	16th displacement acceleration and deceleration time	0～65535	ms(s)	10	Effective instantly	Run time set	P
F14.85	16th displacement waiting time after the completion	0～10000	ms(s)	10	Effective instantly	Run time set	P

F15-Multi-speed function parameters							
Function code	**Name**	**Setting range**	**Unit**	**Default value**	**Effective way**	**Setup way**	**Operating mode**
F15.00	Multi-speed command operation mode	0: Single run end shutdown (F15.03 for segment number selection) 1: Keep the final value after a single cycle 2: Continuous cycle operation (F15.03 for segment number selection) 3: Switching by external DI	-	2	Effective instantly	Downtime set	S
F15.01	Interrupt run restart mode	0: Restart from the 1st segment 1: Continue to run from the phase of the interruption moment 2: Continue to run from the running speed of the interruption moment	-	0	Effective instantly	Downtime set	S
F15.02	Power-down storage option	0: No storage 1: Power-down storage is valid	-	0	Effective instantly	Downtime set	S
F15.03	Speed command end segment selection	1～16	-	16	Effective instantly	Downtime set	S
F15.04	Run time unit selection	0～sec 1～min	-	0	Effective instantly	Downtime set	S
F15.05	Acceleration time 1	0～65535	ms	10	Effective instantly	Downtime set	S
F15.06	Deceleration time 1	0～65535	ms	10	Effective instantly	Downtime set	S

F15.07	Acceleration time 2	0～65535	ms	50	Effective instantly	Downtime set	S
F15.08	Deceleration time 2	0～65535	ms	50	Effective instantly	Downtime set	S
F15.09	Acceleration time 3	0～65535	ms	100	Effective instantly	Downtime set	S
F15.10	Deceleration time 3	0～65535	ms	100	Effective instantly	Downtime set	S
F15.11	Acceleration time 4	0～65535	ms	150	Effective instantly	Downtime set	S
F15.12	Deceleration time 4	0～65535	ms	150	Effective instantly	Downtime set	S
F15.13	1st segment speed command	-6000～6000	rpm	0	Effective instantly	Downtime set	S
F15.14	1st segment command run time	0～6553.5	s(min)	5.0	Effective instantly	Downtime set	S
F15.15	1st segment acc. and dec. time	0: Zero acceleration and deceleration time 1: Acceleration and deceleration time 1 2: Acceleration and deceleration time 2 3: Acceleration and deceleration time 3 4: Acceleration and deceleration time 4	-	0	Effective instantly	Downtime set	S
F15.16	2nd segment speed command	-6000～6000	rpm	100	Effective instantly	Downtime set	S
F15.17	2nd segment command run time	0～6553.5	s(min)	5.0	Effective instantly	Downtime set	S
F15.18	2nd segment acc. and dec. time	0: Zero acceleration and deceleration time 1: Acceleration and deceleration time 1 2: Acceleration and deceleration time 2 3: Acceleration and deceleration	-	0	Effective instantly	Downtime set	S

		time 3 4: Acceleration and deceleration time 4					
F15.19	3rd segment speed command	-6000～6000	rpm	300	Effective instantly	Downtime set	S
F15.20	3rd segment command run time	0～6553.5	s(min)	5.0	Effective instantly	Downtime set	S
F15.21	3rd segment acc. and dec. time	0: Zero acceleration and deceleration time 1: Acceleration and deceleration time 1 2: Acceleration and deceleration time 2 3: Acceleration and deceleration time 3 4: Acceleration and deceleration time 4	-	0	Effective instantly	Downtime set	S
F15.22	4th segment speed command	-6000～6000	rpm	500	Effective instantly	Downtime set	S
F15.23	4th segment command run time	0～6553.5	s(min)	5.0	Effective instantly	Downtime set	S
F15.24	4th segment acc. and dec. time	0: Zero acceleration and deceleration time 1: Acceleration and deceleration time 1 2: Acceleration and deceleration time 2 3: Acceleration and deceleration time 3 4: Acceleration and deceleration time 4	-	0	Effective instantly	Downtime set	S
F15.25	5th segment speed command	-6000～6000	rpm	700	Effective instantly	Downtime set	S
F15.26	5th segment command run time	0～6553.5	s(min)	5.0	Effective instantly	Downtime set	S
F15.27	5th segment acc. and dec. time	0: Zero acceleration and deceleration time 1: Acceleration and deceleration time 1 2: Acceleration and deceleration time 2 3: Acceleration and deceleration time 3 4: Acceleration and deceleration time 4	-	0	Effective instantly	Downtime set	S

F15.28	6th segment speed command	-6000～6000	rpm	900	Effective instantly	Downtime set	S
F15.29	6th segment command run time	0～6553.5	s(min)	5.0	Effective instantly	Downtime set	S
F15.30	6th segment acc. and dec. time	0: Zero acceleration and deceleration time 1: Acceleration and deceleration time 1 2: Acceleration and deceleration time 2 3: Acceleration and deceleration time 3 4: Acceleration and deceleration time 4	-	0	Effective instantly	Downtime set	S
F15.31	7th segment speed command	-6000～6000	rpm	600	Effective instantly	Downtime set	S
F15.32	7th segment command run time	0～6553.5	s(min)	5.0	Effective instantly	Downtime set	S
F15.33	7th segment acc. and dec. time	0: Zero acceleration and deceleration time 1: Acceleration and deceleration time 1 2: Acceleration and deceleration time 2 3: Acceleration and deceleration time 3 4: Acceleration and deceleration time 4	-	0	Effective instantly	Downtime set	S
F15.34	8th segment speed command	-6000～6000	rpm	300	Effective instantly	Downtime set	S
F15.35	8th segment command run time	0～6553.5	s(min)	5.0	Effective instantly	Downtime set	S
F15.36	8th segment acc. and dec. time	0: Zero acceleration and deceleration time 1: Acceleration and deceleration time 1 2: Acceleration and deceleration time 2 3: Acceleration and deceleration time 3 4: Acceleration and deceleration time 4	-	0	Effective instantly	Downtime set	S
F15.37	9th segment speed command	-6000～6000	rpm	100	Effective instan	Downtime set	S

					tly		
F15.38	9th segment command run time	0～6553.5	s(min)	5.0	Effec tive instan tly	Dow ntime set	S
F15.39	9th segment acc. and dec. time	0: Zero acceleration and deceleration time 1: Acceleration and deceleration time 1 2: Acceleration and deceleration time 2 3: Acceleration and deceleration time 3 4: Acceleration and deceleration time 4	-	0	Effec tive instan tly	Dow ntime set	S
F15.40	10th segment speed command	-6000～6000	rpm	-100	Effec tive instan tly	Dow ntime set	S
F15.41	10th segment command run time	0～6553.5	s(min)	5.0	Effec tive instan tly	Dow ntime set	S
F15.42	10th segment acc. and dec. time	0: Zero acceleration and deceleration time 1: Acceleration and deceleration time 1 2: Acceleration and deceleration time 2 3: Acceleration and deceleration time 3 4: Acceleration and deceleration time 4	-	0	Effec tive instan tly	Dow ntime set	S
F15.43	11th segment speed command	-6000～6000	rpm	-300	Effec tive instan tly	Dow ntime set	S
F15.44	11th segment command run time	0～6553.5	s(min)	5.0	Effec tive instan tly	Dow ntime set	S
F15.45	11th segment acc. and dec. time	0: Zero acceleration and deceleration time 1: Acceleration and deceleration time 1 2: Acceleration and deceleration time 2 3: Acceleration and deceleration time 3 4: Acceleration and deceleration time 4	-	0	Effec tive instan tly	Dow ntime set	S
F15.46	12th segment speed command	-6000～6000	rpm	-500	Effec tive instan tly	Dow ntime set	S
F15.47	12th segment command run	0～6553.5	s(min)	5.0	Effec tive	Dow ntime	S

	time				instantly	set	
F15.48	12th segment acc. and dec. time	0: Zero acceleration and deceleration time 1: Acceleration and deceleration time 1 2: Acceleration and deceleration time 2 3: Acceleration and deceleration time 3 4: Acceleration and deceleration time 4	-	0	Effective instantly	Downtime set	S
F15.49	13th segment speed command	-6000～6000	rpm	-700	Effective instantly	Downtime set	S
F15.50	13th segment command run time	0～6553.5	s(min)	5.0	Effective instantly	Downtime set	S
F15.51	13th segment acc. and dec. time	0: Zero acceleration and deceleration time 1: Acceleration and deceleration time 1 2: Acceleration and deceleration time 2 3: Acceleration and deceleration time 3 4: Acceleration and deceleration time 4	-	0	Effective instantly	Downtime set	S
F15.52	14th segment speed command	-6000～6000	rpm	-900	Effective instantly	Downtime set	S
F15.53	14th segment command run time	0～6553.5	s(min)	5.0	Effective instantly	Downtime set	S
F15.54	14th segment acc. and dec. time	0: Zero acceleration and deceleration time 1: Acceleration and deceleration time 1 2: Acceleration and deceleration time 2 3: Acceleration and deceleration time 3 4: Acceleration and deceleration time 4	-	0	Effective instantly	Downtime set	S
F15.55	15th segment speed command	-6000～6000	rpm	-600	Effective instantly	Downtime set	S
F15.56	15th segment command run time	0～6553.5	s(min)	5.0	Effective instantly	Downtime set	S
F15.57	15th segment	0: Zero acceleration and	-	0	Effec	Dow	S

	acc. and dec. time	deceleration time 1: Acceleration and deceleration time 1 2: Acceleration and deceleration time 2 3: Acceleration and deceleration time 3 4: Acceleration and deceleration time 4			tive instantly	ntime set	
F15.58	16th segment speed command	-6000～6000	rpm	-300	Effective instantly	Downtime set	S
F15.59	16th segment command run time	0～6553.5	s(min)	5.0	Effective instantly	Downtime set	S
F15.60	16th segment acc. and dec. time	0: Zero acceleration and deceleration time 1: Acceleration and deceleration time 1 2: Acceleration and deceleration time 2 3: Acceleration and deceleration time 3 4: Acceleration and deceleration time 4	-	0	Effective instantly	Downtime set	S

F17-Fault record parameters							
Function code	**Name**	**Setting range**	**Unit**	**Default value**	**Effective way**	**Setup way**	**Operating mode**
F17.00	Last1st fault record	000: No fault **No1: Non-resettable fault** 100: Motor and drive match fault 101: Position mode and encoder match fault 102: Speeding fault 103: Inverter module protection 104: Short circuit to ground during operation 105: Encoder fault (the angle corresponding to the Z signal changes too much) 106: Bus encoder data verification error 107: Z pulse loss failure 108: Incremental encoder UVW read error (including bus incremental encoding) 109: Incremental pulse type encoder disconnection 110: Bus type encoder disconnection	-	-	-	Display	-

		No2: Resettable fault 200: Drive overload protection 201: Overcurrent fault 202: Main circuit overvoltage 203: Undervoltage in main circuit operation 204: Motor parameter self-learning failure 205: Encoder self-tuning fault (including UVW power line phase sequence error, UVW signal cable error, Z pulse not found, etc.) 206: Temperature detection disconnection 207: In-plant failure 1 208: In-plant failure 2 209: In-plant failure 3 210: Reserved 211: E2PROM read and write error 212: External device failure 213: Command conflict failure 214: Undervoltage in the control loop operation 215: Output phase loss fault 216: The radiator is overheated 217: Current detection circuit failure 218: Brake is open unnormally **No3: Resettable fault** 300: Motor overload protection 301: Main circuit input phase loss 302: Overspeed protection 303: Pulse output overspeed 304: Pulse input overspeed 305: Motor stall 306: Encoder battery failed 307: Encoder multi-turn count error 308: Encoder multi-turn count overflow 309: AD sampling overvoltage 310: The position deviation is too large 311: Full-closed hybrid position deviation is too large 312: Electronic gear ratio setting exceeds limit 313: Modbus communication failure 314: Braking resistor overload 315: Back to origin timeout failure 316: Origin return to zero unnormally						

		No4: Resettable alarm: 400: Reserved 401: Encoder battery alarm 402: DI emergency shutdown alarm 403: External brake resistor too small alarm 404: Change parameters need to be powered on again. 405: Forward overstroke alarm 406: Reverse overstroke alarm 407: Module overheat alarm 408: Run limit alarm					
F17.01	Last 2nd fault record	-	-	-	-	Display	-
F17.02	Last 3rd fault record	-	-	-	-	Display	-
F17.03	Last 4th fault record	-	-	-	-	Display	-
F17.04	Last 5th fault record	-	-	-	-	Display	-
F17.05	Last 6th fault record	-	-	-	-	Display	-
F17.06	Motor speed in last 1st fault	-	rpm	-	-	Display	-
F17.07	Output current in last 1st fault	-	0.01A	-	-	Display	-
F17.08	Bus voltage in last 1st fault	-	0.1V	-	-	Display	-
F17.09	Module temperature in last 1st fault	-	℃	-	-	Display	-
F17.10	Input terminals status in last 1st fault	-	-	-	-	Display	-
F17.11	Running time in last 1st fault	-	min	-	-	Display	-
F17.12	Motor speed in last 2nd fault	-	rpm	-	-	Display	-
F17.13	Output current in last 2nd fault	-	0.01A	-	-	Display	-
F17.14	Bus voltage in last 2nd fault	-	0.1V	-	-	Display	-
F17.15	Module temperature in last 2nd fault	-	℃	-	-	Display	-
F17.16	Input terminals status in last 2nd fault	-	-	-	-	Display	-
F17.17	Running time in last 2nd fault	-	min	-	-	Display	-
F17.18 ～ F17.23	Manufacturer parameters	-	-	-	-	Display	-

F20-Manufacturer parameters							
Function code	**Name**	**Setting range**	**Unit**	**Default value**	**Effective way**	**Setup way**	**Operating mode**
F18.00	User password	0～65535	-	-	Effective instantly	Run time set	-
F18.01	Reserved						
F18.02	Software version	0～65535	-	-	-	Display	-
F18.03～F18.47	Reserved						

F19-Servo variables reading via communication							
Function code	**Name**	**Setting range**	**Unit**	**Default value**	**Effective way**	**Setup way**	**Operating mode**
F19.00	Servo status read via communication	Bit0://1=Bus voltage has been established Bit1://1=Run command is valid Bit2://1=Drive is running Bit3://1=Servo On command is valid Bit4://1=The current running direction is reverse Bit5://1=The direction of the running command is reverse Bit6://1=Accelerating Bit7://1=Decelerating Bit8://1=The alarm is valid. Bit9://1=The fault is valid Bit10://1=NO3 fault is valid Bit11://1=Servo ready Bit12://1=The position command has changed Bit13://1=Motor auto-tuning Bit14://1=Position is close to valid Bit15://1=Location is complete	-	-	-	Communication read only	PST
F19.01	DO function status 1 read via communication	-	-	-	-	Communication read only	PST
F19.02	DO function status 2 read via communication	-	-	-	-	Communication read	PST

						only	
F19.03	Current alarm code read via communication	-	-	-	-	Communication read only	PST
F19.04	Current fault code read via communication	-	-	-	-	Communication read only	PST
F19.05～F19.06	Reserved						

F20-Servo variables setting via communication							
Function code	**Name**	**Setting range**	**Unit**	**Default value**	**Effective way**	**Setup way**	**Operating mode**
F20.00	DI status set via communication	0～0xFF	-	0	Effective instantly	Run time set	PST
F20.01	DO status set via communication	0～0x1F	-	0	Effective instantly	Run time set	PST
F20.02	Speed command set via communication	-6000～6000	rpm	0	Effective instantly	Run time set	S
F20.03	Torque command set via communication	-100.0～100.0	%	0	Effective instantly	Run time set	T
F20.04	Modbus communication command	0: no command 1:Reserved 2: Servo ON 3: Communication jog forward command 4: Communication jog reverse command 5: Communication inertia identification command 6: Communication rigidity test command 7: Current loop test command	-	-	-	-	-

		8: Mechanical characteristic test command					
F20.05	AO1 set	-10000～10000	mv	0	Effective instantly	Run time set	-
F20.06	AO2 set	-10000～10000	mv	0	Effective instantly	Run time set	-
F20.07～F20.12	Reserved						

Input terminal function list				
FunIN.0	NoUse			
FunIN.1	S-ON	Servo enable	Invalid: Servo motor enable is disabled; Valid: Servo motor enable when power on	The logic selection of the corresponding terminal must be set to: Level active.
FunIN.2	ALM-RST	Fault reset	Invalid: disable Valid: Enable	The logic selection of the corresponding terminal is recommended to be set to: edge valid. According to the type of alarm, the servo can continue to work after some alarms are reset.
FunIN.3	GAIN-SEL	Gain switching	F07.06=0: Invalid: the speed control loop is controlled by PI; Valid: The speed control loop is controlled by P. F07.06=1, F07.07=1: Invalid: fixed to the 1st gain; Valid: Fixed to the 2nd gain.	The logic selection of the corresponding terminal is recommended to be set to: Level active.
FunIN.4	CMD-SEL	Main and auxiliary operation command switching	Invalid: The current running command is A; Valid: The current running command is B.	The logic selection of the corresponding terminal is recommended to be set to: Level active.
FunIN.5	DIR-SEL	Multi-speed DI switching direction setting	Invalid: Default command direction; Valid: The command is in the opposite direction.	The logic selection of the corresponding terminal is recommended to be set to: Level active.
FunIN.6	CMD1	Multi-segment run command switch 1	16-segment command selection.	The logic selection of the corresponding terminal is recommended to be set to: Level active.
FunIN.7	CMD2	Multi-segment run	16-segment command	The logic selection of

		command switch 2	selection.	the corresponding terminal is recommended to be set to: Level active.
FunIN.8	CMD3	Multi-segment run command switch 3	16-segment command selection.	The logic selection of the corresponding terminal is recommended to be set to: Level active.
FunIN.9	CMD4	Multi-segment run command switch 4	16-segment command selection.	The logic selection of the corresponding terminal is recommended to be set to: Level active.
FunIN.10	M1-SEL	Control mode switching	Switching between speed, position, and torque is performed according to the selected control mode (3, 4, 5).	The logic selection of the corresponding terminal is recommended to be set to: Level active.
FunIN.11	Out-Fault	External device fault input	Invalid: Current external without fault; Valid: There is a fault in the current external.	The logic selection of the corresponding terminal is recommended to be set to: Level active.
FunIN.12	ZCLAMP	Zero position fixed enable	Valid: Enable zero position fixed function; Invalid: The zero position fixed function is disabled.	The logic selection of the corresponding terminal is recommended to be set to: Level active.
FunIN.13	INFIBIT	Position command prohibited	Valid: Prohibit command pulse input; Invalid: Allow command pulse input.	The position command is forbidden and contains internal and external position commands. The logic selection of the corresponding terminal must be set to: level effective。
FunIN.14	P-OT	Forward overstroke switch	Valid: Prohibit forward drive; Invalid: Allow forward drive.	When the mechanical motion exceeds the movable range, enter the overtravel prevention function: The logic selection of the corresponding terminal is recommended to be set to: Level active.
FunIN.15	N-OT	Reverse overstroke switch	When the mechanical motion exceeds the movable range, enter theoverstrokeprevention function: Valid: Prohibit forward drive; Invalid: Allow forward drive.	The logic selection of the corresponding terminal is recommended to be set to: Level active.
FunIN.16	P-CL	Positive external torque limit	According to the selection of F06.05, the torque limit source is switched.	The logic selection of the corresponding terminal is

			F06.05 =1: Valid: Forward external torque limit is valid; Invalid: Forward internal torque limit is valid. F06.05 = 3: Valid: AI torque limit is valid; Invalid: Forward internal torque limit is valid.	recommended to be set to: Level active.
FunIN.17	N-CL	Negative external torque limit	According to the selection of F06.05, the torque limit source is switched. F06.05 =1: Valid: Reverse external torque limit is valid; Invalid: Reverse internal torque limit is valid. F06.05 = 3 and the AI limit value is less than the reverse external limit value: Valid: Reverse external torque limit is valid. Invalid: AI torque limit is valid. F06.05 = 4: Valid: AI torque limit is valid; Invalid: Reverse internal torque limit is valid.	The logic selection of the corresponding terminal is recommended to be set to: Level active.
FunIN.18	JOGCMD+	Forward jog	Valid: Input according to the given command; Invalid: Run command stops input.	The logic selection of the corresponding terminal is recommended to be set to: Level active.
FunIN.19	JOGCMD-	Reverse jog	Valid: Reverse input according to the given command; Invalid: Run command stops input.	The logic selection of the corresponding terminal is recommended to be set to: Level active.
FunIN.20	POSSTEP	Step size enable	Valid: Execute step size command; Invalid: The command is zero, which is the positioning state.	The logic selection of the corresponding terminal is recommended to be set to: Level active.
FunIN.24	GEAR_SEL	Electronic gear selection	Invalid: Electronic gear ratio 1; Valid: Electronic gear ratio 2.	The logic selection of the corresponding terminal is recommended to be set to: Level active.
FunIN.25	TOQDirSel	Torque command direction setting	Invalid: forward direction; Valid: reverse direction.	The logic selection of the corresponding terminal is recommended to be set to: Level active.
FunIN.26	SPDDirSel	Speed command direction setting	Invalid: forward direction; Valid: reverse direction.	The logic selection of the corresponding terminal is recommended to be set

				to: Level active.
FunIN.27	POSDirSel	Position command direction setting	Invalid: forward direction; Valid: reverse direction.	The logic selection of the corresponding terminal is recommended to be set to: Level active.
FunIN.28	PosInSen	Multi- position command enable	Edge valid Invalid: Ignore internal multi-segment command; Valid: Start internal multi-segment.	The logic selection of the corresponding terminal is recommended to be set to: Level active.
FunIN.29	XintFree	Interrupt fixed length release (edge valid function)	Invalid: prohibited; Valid: Enable.	The logic selection of the corresponding terminal must be set to: Edge valid.
FunIN.30	HomeSwitcF	Origin switch	Invalid: not triggered; Valid: Trigger.	The logic selection of the corresponding terminal must be set to: Level active. It is recommended to assign it to the fast DI terminal.
FunIN.31	HomingStart	Origin return enable (edge valid function)	Invalid: prohibited; Valid: Enable.	The logic selection of the corresponding terminal must be set to: Edge valid.
FunIN.32	XintInFibit	Interrupt fixed length prohibition	Valid: It is forbidden to interrupt the fixed length; Invalid: Allows to interrupt the fixed length.	The logic selection of the corresponding terminal must be set to: Level active.
FunIN.33	EmergencyStop	Emergency stop	Valid: Position lock after zero speed stop; Invalid: no effect on current running status	The logic selection of the corresponding terminal is recommended to be set to: Level active.
FunIN.34	ClrPosErr	Clear position deviation (edge valid function)	Valid: the position deviation is cleared; Invalid: The position deviation is not cleared.	The logic selection of the corresponding terminal must be set to: edge valid. It is recommended to assign it to the fast DI terminal.
FunIN.35	PulselnFibit	Pulse command prohibition	In the position control mode, when the position command source is the pulse command (F04.00=0): Invalid: can respond to pulse command; Valid: can't respond to pulse command.	The logic selection of the corresponding terminal is recommended to be set to: Level active.
FunIN.36	Plc_Stop	Simple PLC pause	Valid: PLC operation is invalid; Invalid: No effect on the current running state.	The logic selection of the corresponding terminal is recommended to be set to: Level active.
FunIN.37	Plc_Reset	Simple PLC status reset	Valid: PLC status reset; Invalid: No effect on the	The logic selection of the corresponding

			current running state.	terminal is recommended to be set to: Level active.
FunIN.38	XIntScale	Interrupt fixed length trigger switch	Valid: Interrupt fixed length is valid; Invalid: No effect on the current running state.	The logic selection of the corresponding terminal is recommended to be set to: edge active.
FunIN.39 ～ FunIN.63				
Output terminal function list				
FunOUT.0	NoUse	No function		
FunOUT.1	S-RDY	Servo ready	The servo status is ready to receive the S-ON valid signal: Valid: the servo is ready; Invalid: The servo is not ready.	-
FunOUT.2	TGON	Motor rotation output	When the servo motor speed is higher than the speed threshold F05.12: Valid: The motor rotation signal is valid; Invalid: The motor rotation signal is invalid.	-
FunOUT.3	ZERO	Zero speed	The signal output when the servo motor speed is lower than the zero threshold value F05.15: Valid: motor speed is zero; Invalid: motor speed is not zero.	-
FunOUT.4	V-CMP	Consistent speed	In the speed control, valid when the absolute value of the difference between the servo motor speed and the speed command is less than the F05.13 speed deviation setting value.	-
FunOUT.5	COIN	Positioning completed	In the position control, the position deviation pulse is valid when it reaches the positioning completion range F04.20.	-
FunOUT.6	NEAR	Positioning close	In the position control, the position deviation pulse is valid when it reaches the set value close to the signal amplitude F04.23.	-
FunOUT.7	T-LMT	Torque limit	Confirmation signal for torque limit: Valid: motor torque is limited; Invalid: motor torque is not limited.	-
FunOUT.8	V-LMT	Speed limit	Confirmation signal for speed limitduring torque control: Valid: motor speed is limited;	-

			Invalid: motor speed is not limited.	
FunOUT.9	BRK	Brake output	Brake signal output: Valid: close, release the brake; Invalid: Start the brake.	-
FunOUT.10	WARN	Warning output	The warning output signal is valid.	-
FunOUT.11	ALM	Fault output detect	The status is valid when the fault is detected.	-
FunOUT.12	Xintcoin	Interrupt fixed length completed	Valid: Interrupt fixed length positioning is completed; Invalid: Interrupt fixed length positioning is not completed.	-
FunOUT.13	FomeAttain	Origin return to zero output	Origin return to zero status: Valid: Origin return to zero; Invalid: Origin not return to zero.	-
FunOUT.14	ElecFomeAttain	Electrical zero return output	Electrical zero return status: Valid: the electrical origin returns to zero; Invalid: The electrical origin does not return to zero.	-
FunOUT.15	ToqReacF	Torque arrival output	Valid: The absolute value of the torque reaches the set value; Invalid: The absolute value of the torque is less than the set value.	-
FunOUT.16	V-Arr	Speed arrival output	Valid: Speed feedback reaches the set value; Invalid: Speed feedback does not reached the set value.	-
FunOUT.17	DB	DB brake output	Valid: Energy braking is valid Invalid: Energy braking is invalid	-
FunOUT.18	CmdOk	Internal command output	Valid: internal command completed Invalid: internal command not completed	-
FunOUT.19 ～ FunOUT.31	Reserved			

14 Model and capacity selection

14.1 Motor capacity selection Formula

In this chapter, we will learn the steps to choose the motor capacity. How to introduce the formula and the configuration of the motor that drives the moving part with a motor as shown in Figure 14-1. Explain below.

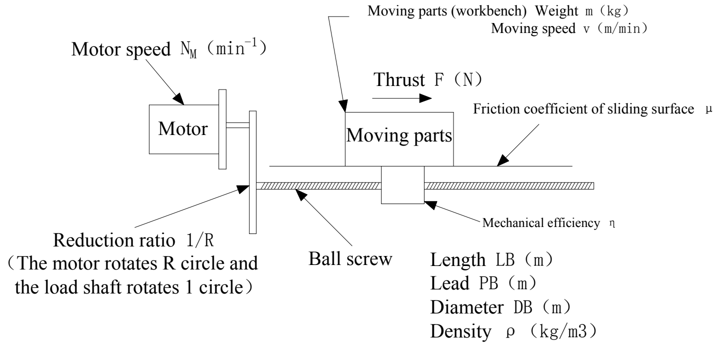


Fig.14-1 Imaginary machine

14.1.1 Motor required speed N_M (min^{-1})

The Formula for the required speed NL of the ball screw when the table is moved at the speed V (m/min) is as follows:

$$N_L = \frac{V}{P_B} \qquad \text{(Formula 14-1)}$$

Therefore, the Formula for the required speed of the motor NM is as follows:

$$N_M = R \bullet N_L = \frac{R \bullet V}{P_B} \qquad \text{(Formula 14-2)}$$

14.1.2 Motor shaft conversion load torque T_L (N•m)

The twice motor output power (power = torque x angular velocity) is equal to the moving power of the table (force x speed), and the motor shaft converted load torque TL (N•m) can be derived as follows.

Thrust is the force required to counter the cutting reaction force during metal machining and is the force required to move the table. F=0 only when the table is moved.

$$T_L \frac{2\pi}{60} N_m \eta = (9.8 m\mu + F)\frac{V}{60} \qquad \text{(Formula 14-3)}$$

Therefore, the Formula for the motor shaft to convert the load torque TL is as follows:

$$T_L = (9.8m\mu + F)\frac{V}{2\pi N_m \eta} \qquad \text{(Formula 14-4)}$$

In addition, from (Formula 14-2):

$$N_M = \frac{R \bullet V}{P_B} \qquad \text{(Formula 14-5)}$$

Lead to

$$\frac{V}{N_m} = \frac{P_B}{R} \qquad \text{(Formula 14-6)}$$

So from

$$T_L = (9.8m\mu + F)\frac{P_B}{2\pi R \eta} \qquad \text{(Formula 14-7)}$$

The load torque is obtained.

14.1.3 Motor shaft conversion moving part (workbench) moment of inertia JL1（kg•m²）

The rotational kinetic energy generated by the motor is changed into the linear kinetic energy of the table movement, and the motor shaft is converted into the worktable moment of inertia J_{L1}（kg•m²）

$$\frac{1}{2}J_{L1}\left(\frac{2\pi}{60}N_m\right)^2 = \frac{1}{2}\mathrm{m}\left(\frac{V}{60}\right)^2 \qquad \text{(Formula 14-8)}$$

Therefore

$$J_{L1} = m\left(\frac{V}{2\pi N_m}\right)^2 \qquad \text{(Formula 14-9)}$$

Or

$$J_{L1} = m\left(\frac{P_B}{2\pi R}\right)^2 \qquad \text{(Formula 14-10)}$$

14.1.4 Moment of inertia of the ball screw J_B（kg•m²）

The mass m (kg) is concentrated on the distance from the center of rotation. The moment of inertia of the object at the radius R(m) is mR².The axial moment of inertia J_B（kg•m²）of a solid cylinder which mass distribution is average such as a ball screw can be obtained by the following equation.

(1) When the mass of the ball screw M_B is known

$$J_B = \frac{1}{2} M_B \left(\frac{1}{2} D_B \right)^2 = \frac{1}{8} M_B D_B^2 \qquad \text{(Formula 14-11)}$$

(2) When the length of the ball screw L_B（m）, diameter D_B（m）, and the material density ρ（kg/m^3）are known

$$J_B = \frac{1}{2}\left(\pi \left(\frac{1}{2} D_B \right)^2 L_B \rho \right)\left(\frac{1}{2} D_B \right)^2 = \frac{\pi}{32} \rho L_B D_B^4 \qquad \text{(Formula 14-12)}$$

(3) The motor shaft of the ball screw converts the moment of inertia J_{L3}
The Formula of the kinetic energy of J_B rotating at N rotations per minute is as follows：

$$J_B\text{'s kinetic energy} = \frac{1}{2} J_B \left(\frac{2\pi}{60} N_L \right)^2 \qquad \text{(Formula 14-13)}$$

The motor must supply kinetic energy equivalent to this.
At this point, the motor rotates RN_L, so

$$\frac{1}{2} J_{L3} \left(\frac{2\pi}{60} RN_L \right)^2 = \frac{1}{2} J_B \left(\frac{2\pi}{60} N_L \right)^2 \qquad \text{(Formula 14-14)}$$

Therefore

$$J_{L3} = \left(\frac{1}{R} \right)^2 J_B \qquad \text{(Formula 14-15)}$$

That is, the moment of inertia of the ball screw converted by the motor shaft is 1 of the square of the reduction ratio.

In Fig. 14-1, in addition to this, it is necessary to calculate the motor shaft conversion moment of inertia of the coupling and the reduction body.

In general, the purchased reducer provides the moment of inertia seen from the input shaft (motor shaft side).

General formula of moment of inertia

The moment of inertia J of an object or area with respect to an axis refers to the sum of the mass (or area) dm of the minute portion of the object (or area) and the square of the distance r from the axis. That is:

$$J = \int r^2 dm \qquad \text{(Formula 14-16)}$$

Assume that the entire mass (or the entire area) of the object (or area) is M，

$J = MK^2$, then K has a unit of length.

Although having the same moment of inertia, K means that the entire mass (or the entire area) can be considered as the radius concentrated at that point.

14.1.5 Starting time t_a（s）, braking time t_d（s）

The maximum torque（T_{MAX}）that a servo motor can produce is limited.

Under the action of the maximum torque, the time (second) required to accelerate to the required rotational speed (starting time t_a（s）), and the time from the predetermined rotational speed to the stop (braking time t_d）can be obtained by the following method (Fig. 14-2).

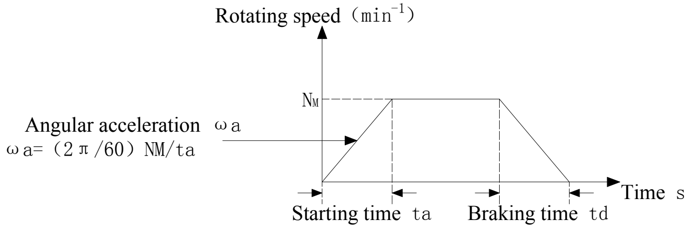


Fig.14-2 Starting time, braking time

According to the basic formula of rotational motion T＝J*ωa, it is assumed that the moment of inertia of the motor is J_M, motor shaft conversion full load moment of inertia is J_L, the maximum torque that the motor can generate is T_{MAX}, motor shaft conversion load torque is T_L, then（T_{MAX}－T_L）is the torque that contributes to acceleration, and the following formula established.

At this time, as shown in Fig. 14-2, the time required to accelerate to N_M（min^{-1}）is t_a（s）, so the formula of the angular acceleration ωa（s^{-2}）is as follows:

$$\omega_a = \frac{2\pi}{60} \mathrm{N}_m \frac{1}{t_a} \qquad (\text{Formula } 14-17)$$

$$t_a = \frac{2\pi N_m (J_M + J_L)}{60(T_{MAX} - T_L)} \qquad (\text{Formula } 14-18)$$

When braking, the load torque helps to brake, so:

$$t_d = \frac{2\pi N_m (J_M + J_L)}{60(T_{MAX} + T_L)} \qquad (\text{Formula } 14-19)$$

However, the use of this formula must meet the conditions that the N_M value must be high enough to ensure that the servo unit continuously inputs T_{MAX} before the motor starts to start up to N_M.

When N_M is low, after the speed loop gain is specified, the time required to reach 63.2% of the command value at the step speed command input is independent of the magnitude of the command value, and is expressed as a fixed value. Therefore, the time to reach the command value is also constant.

The time required to reach 95% of the command value is three times the time parameter, and the time required to reach 99% of the command value is approximately five times the time parameter.

When the N_M reaches more than 1/3 of the rated speed, the method of calculating the rated speed to (Formula 14-18) and calculating it can be said to be for safety reasons.

If it is necessary to start in t_a seconds and brake in t_d seconds, and determine how much starting torque T_p and how much braking torque T_s, are required, the following formula can be derived according to (Formula 14-18) and (Formula 14-19).

$$T_P = \frac{2\pi N_m}{60}\frac{(J_M + J_L)}{t_a} + T_L \qquad \text{(Formula 14-20)}$$

$$T_S = \frac{2\pi N_m}{60}\frac{(J_M + J_L)}{t_d} - T_L \qquad \text{(Formula 14-21)}$$

14.2 Considerations and steps when selecting a model

When selecting the model, capacity (output), etc. of the servo drive, the items and steps to be considered are as follows.

14.2.1 Servo motor selection

Follow the steps below to select the motor.

(1) Required speed of the motor:

Calculate the motor speed based on the machine configuration and operating conditions to select the model.

(2) Motor shaft conversion load torque:

Calculate the motor shaft converted load torque when moving at constant speed, and preselect the motor whose rated torque is greater than this value.

At this time, the load moving power is P_L, and the load acceleration power is P_a (for the calculation Formula , see Equation 14-24), and the preselected motor power (output) P can be obtained by the following equation.

$$P = (0.5 \sim 1) \times (P_L + P_a) \qquad \text{(Formula 14-22)}$$

However, if this method is used, when the P_L is small or the cycle time is long, a motor with a high power is selected, so it is sometimes necessary to consider whether a motor of a low-level capacity can be used.

(3) Motor shaft conversion full load moment of inertia:

Calculate the motor shaft to convert the full load moment of inertia and check if the value is lower than the allowable load moment of inertia ratio of the preselected motor.

If it is higher than this value, select a motor with a higher capacity.

(4) Maximum torque:

According to the motor shaft, the full load moment of inertia and the required starting time/braking time are calculated, and the required starting torque and braking torque are determined to check whether it is lower than the maximum torque of the preselected motor.

If it is higher than this value, select a motor with a higher capacity.

(5) RMS (Root Mean Square) torque or effective torque:

According to the starting torque, braking torque, motor shaft converted load torque and speed line diagram at constant speed movement, the RMS torque (hereinafter referred to as effective torque) is obtained, and it is detected whether it is lower than the rated motor torque.

If it is higher than this value, select a motor with a higher level and check again.

See the supplement on the next page for effective torque.

14.2.2 Selection of servo unit and regeneration considerations

Once the motor is selected, the corresponding servo unit is determined. At this time, it must be considered whether the servo unit has sufficient regenerative capacity for the use of the motor.

For regeneration, please refer to 6.1.7 (Brake setting).

14.2.3 Encoder selection

According to the specifications of the machine, select the type of encoder and the encoder with the required number of pulses.

14.2.4 Matching with the host controller

Check whether the selected servo amplifier is electrically and logically connected to the host controller.

In addition, it is also necessary to consider whether or not the positioning command pulse output from the upper controller can be received on the servo unit side.

Additional instructions:

Motor shaft conversion full load moment of inertia:

From the perspective of the motor, there are various situations in the mechanical construction of the drive object. There is a direct connection between the ball screw, a reducer between the motor and the ball screw, or a variety of forms such as pulley and belt drive, rack and pinion drive.

At this time, the moment of inertia of each of the mechanism portions is obtained, and then converted into a value seen from the motor shaft, and the total value is referred to as the motor shaft conversion full load moment of inertia.

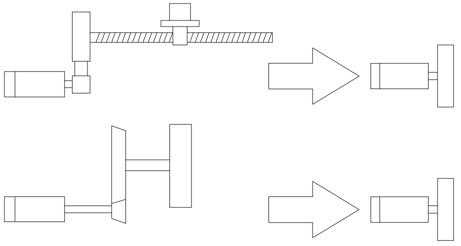


Fig.14-3 Motor shaft conversion full load moment of inertia

Load moving power P_L and load acceleration power P_a

Power refers to the rate of work done (motor output, capacity), which is force×speed in linear motion and torque×angular velocity in rotational motion. Therefore, the formula for load moving power P_L is as follows:

$$P_L = T_L \times \left(\frac{2\pi}{60} N_M\right) \qquad \text{(Formula 14-23)}$$

Further, the load acceleration torque $T_e = J_L \times \omega a$, angular acceleration $\omega_a = (2\pi/60) N_M \times (1/t_a)$, so the Formula of the load acceleration power P_a is as follows.

$$P_a = T_a \times \omega = J_L \times \omega_a \times \omega = J_L \times \left(\frac{2\pi}{60} N_M\right)^2 \times \frac{1}{t_a} \qquad \text{(Formula 14-24)}$$

In the Formula ,

T_L: Motor shaft conversion (when moving at constant speed) Load torque (N•m)

N_M: required motor speed (min^{-1})

T_a: load acceleration torque (N•m)

J_L: Motor shaft conversion full load moment of inertia (kg•m²)

ω: required motor angular velocity (s^{-1})

ω_a: required motor angular acceleration (s^{-2})

t_a: required acceleration time (s)

Additional instructions:

Valid values:

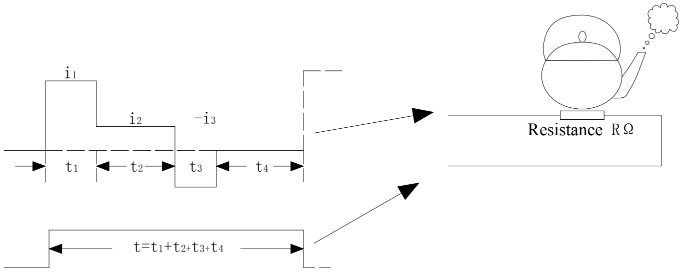
The value of the direct current having the same heating effect as an alternating current is referred to as the effective value of the alternating current.

The alternating current is a current in which the positive current and the negative current alternately change. When the current flows through the resistor, even if the current is negative, the resistor generates heat, which can be understood by straightness.

In the general Formula , when the current I is expressed as the periodic function I (t) of time, the square root of the squared mean of t in one period of the time waveform is called the effective value I_{RMS}, ie:

$$I_{RMS} = \frac{\int_0^t I^2(t)dt}{t} \qquad (\text{Formula } 14-25)$$

When the current shown in the Figure below flows through the same amount of heat as the heat of the electric heater having the resistance value R, the heat generation amount Q is:



$$Q = i_1^2 R t_1 + i_2^2 R t_2 + (-i_3)^2 R t_3 = I^2 R t \qquad (\text{Formula } 14-26)$$

$$I = \sqrt{\frac{i_1^2 t_1 + i_2^2 t_2 + i_3^2 t_3}{t}} \qquad (\text{Formula } 14-27)$$

We have learned that the torque and current of the servo motor are proportional. Therefore, when selecting a motor, the effective value of the torque must be considered, and the calculation is performed in the same manner as the effective value of the current. If it is lower than the rated torque, the motor is heat-resistant.

14.3 Servo motor selection

14.3.1 Selection Steps

(1) Speed line diagram

When starting the selection, first, the speed line diagram of the required running stop period is depicted for the moving part of the machine, as shown in Fig.14-4.

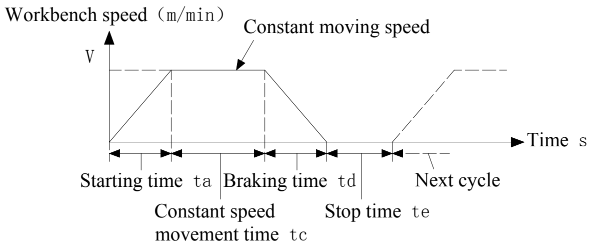


Fig.14-4 Speed line diagram

(2) Required speed of the motor N_M（min^{-1}）

The required torque N_M of the motor can be obtained from (Formula 14-2）.

This determines the model (rated speed) of the motor.

The rated speed of the motor is N_R (R is the initial letter of Rated), when the maximum motor speed is N_{MAX}, in general, both must meet: $N_M \leqslant N_R$

If $N_{MAX} \geqslant N_M \geqslant N_R$, the torque should be reduced and then used along the continuous working maximum torque line of the corresponding motor (2.3.3 (6) regarding the torque speed characteristics of the motor).

(3) Motor shaft conversion load torque T_L（N•m）

Motor shaft conversion load torque T_L can be obtained by the aforementioned (Formula 14-3) or (Formula 14-7). The capacity (output) of the motor is thus preselected.

When the rated torque of the motor is T_R and the highest torque is T_{MAX}, in general, both must be satisfied: $T_L \leqslant T_R$

However, even if $T_{MAX} \geqslant T_L \geqslant T_R$, if the T_L satisfies the overload characteristic and the effective torque is lower than T_R, the selected motor can be used.

(4) Motor shaft conversion full load moment of inertia J_L（kg•m²）

When the moment of inertia of the rotor of the motor is J_M and the allowable load moment of inertia ratio is n, in general, both must satisfy: $J_L \leqslant nJ_M$。

The value of n is listed in the product catalog and must be noted depending on the model and capacity of the motor.

The load moment of inertia is not only the moment of inertia of the motor shaft converted by the moving body, but also the moment of inertia of the ball screw, reducer and coupling. After obtaining the respective motor shaft conversion values, the total value is the motor shaft. Convert the full load moment of inertia.

Check if the value is lower than the allowable load moment of inertia ratio of the preselected motor. If it is higher than this value, select a motor with a higher capacity of 1 level.

(5) Starting time t_a（s）, braking time t_d（s）

The required starting time and braking time are obtained based on the known table moving speed and the moving distance of one cycle.

Start time and braking time can be set to the same（$t_a=t_d$）unless otherwise specified.

(6) Starting torque T_P（N•m）, braking torque T_S（N•m）

The starting torque T_P and the braking torque T_S are obtained from the starting time (t_a), the braking time (t_d), the usage (Formula 14-20), and the (Formula 14-21) obtained from (5).

(7) Effective torque T_{RMS}（N•m）

Based on the results of the above analysis, the torque line diagram shown in Fig.14-5 can be drawn. Then use the formula to obtain the effective torque T_{RMS}

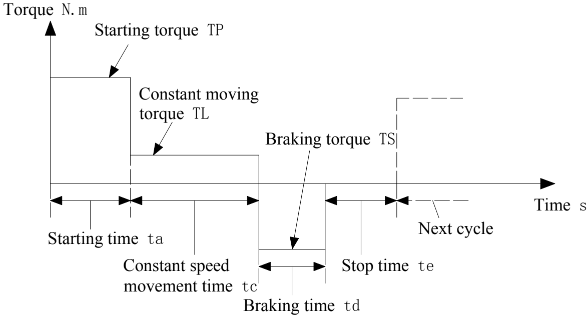


Fig.14-5 Torque line figure

$$T_{RMS} = \sqrt{\frac{T_P{}^2 \times t_a + T_L{}^2 \times t_c + T_S{}^2 \times t_d}{t_a + t_c + t_d + t_e}} \qquad \text{(Formula 14-28)}$$

If the T_{RMS} meets $T_{RMS} < T_R$, the selected motor can be used.

However, servo application examples are rare. Therefore, if T_P is 300% of the rated value and t_a exceeds 3 seconds, determine whether the selected motor meets the requirements according to the torque and speed characteristics of the motor in Chapter 2.3.4. .

14.3.2 Selection example

For the imaginary machine of Figure 14-1, assuming the specific values of the parameters, an example of selecting a motor is as follows:

The mass of the moving body m：50（kg）

The required thrust of the moving body F：2（N）

Friction coefficient with the sliding surface and rolling surface of the moving body μ：0.2

Comprehensive efficiency η：0.9

The speed of the moving body v：12（m/min）

Ball screw lead P_B：6（mm）

Ball screw diameter D_B：25（mm）

Ball screw length L_B：1（m）

Ball screw density ρ：7.87×10^3（kg/ m²）

Reduction ratio 1/R：1/2 (ball screw speed / motor speed)

Moment of inertia of coupling and reducer J_{L2}:0.45（kg•cm²）

1 cycle moving distance l：50（mm）

1 cycle time t：1.0（s）

50mm positioning time tm：0.3（s）

Rest time t_e：0.7（s）

(1) Mechanical speed line diagram

According to the specifications of the machine, the speed line diagram shown in Fig.14-6 can be drawn.

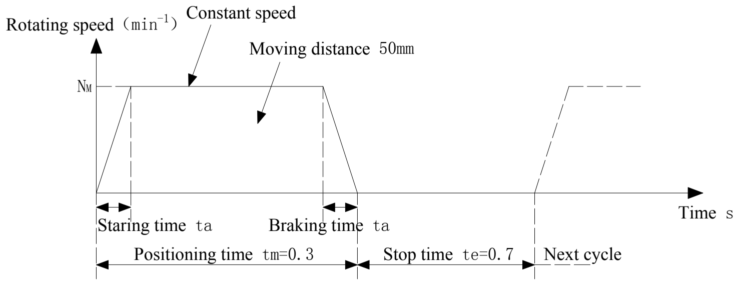


Fig.14-6 Imaginary mechanical speed line figure

(2) Required speed of the motor N_M (min^{-1})

N_M is available from (Formula 14-2):

$$N_M = \frac{12\times 2}{0.006} = 4000\,\text{min}^{-1} \qquad (\text{Formula } 14-29)$$

The motor speed is $4000min^{-1}$, it can be seen that it is more appropriate to select a model with a rated speed of $3000min^{-1}$.In addition, since the speed exceed rated speed during use, the continuous torque must be lower than the rated torque.

(3) Motor shaft conversion load torque T_L (N•m)

The motor shaft converted load torque T_L of the moving body can be obtained.

$$T_L = \frac{(9.8\times \mu m + F)V}{2\pi N_M \eta} = \frac{(9.8\times 0.2\times 50 + 2)\times 12}{2\times 3.14\times 4000\times 0.9} = 0.0530(N\bullet m) \qquad (\text{Formula } 14-30)$$

Of course, the result of using (Formula 14-7) is the same.

$$T_L = \frac{(9.8\times \mu m + F)P_B}{2\pi R\eta} = \frac{(9.8\times 0.2\times 50 + 2)\times 0.006}{2\times 3.14\times 2\times 0.9} = 0.0530(N\bullet m) \qquad (\text{Formula } 14-31)$$

It is assumed here that the coefficient of friction is 0.2 and the efficiency is 0.9. In a high-precision machine driven by a ball screw, such a setting is more suitable. In the case of the lead screw drive and the rack pinion drive, the efficiency is also lowered, and the friction coefficient is also changed by the roughness of the sliding surface. The motor shaft conversion load torque is 0.0530N•m, and the motor capacity (output) reaches 30W, which is enough. However, in this case, since the starting and braking time is short, the starting and braking torque will be large. Since the cycle time is short (the operating frequency is high), the effective torque is also large. According to this, the motor shaft can be converted into full load moment of inertia, and the moment of inertia of the motor rotor should be calculated according to its value and the allowable moment of inertia ratio (motor shaft converted full load moment of inertia / motor rotor moment of inertia), and should be based on its valuetoPreselect the candidate motor.

(4) Motor shaft conversion full load moment of inertia J_L（kg•m² or kg•cm²）

The motor shaft conversion moment of inertia J_{L1} of the moving body can be obtained by (Formula 14-9) or (Formula 14-10), and the moment of inertia J_{L3} of the ball screw can be obtained by (Formula 14-14).

$$J_{L1}=m\left(\frac{P}{2\pi R}\right)^2=50\left(\frac{0.006}{2\times3.14\times2}\right)^2=0.114\times10^{-4}kg\bullet m^2=0.114\left(kg\bullet m^2\right) \quad \text{(Formula 14-32)}$$

$$J_{L3}=\frac{\pi}{32}\rho L_B D_B{}^4=\frac{3.14}{32}\times7.87\times10^3\times1\times0.025^4=3.02\times10^{-4}\left(kg\bullet m^2\right)=3.02\left(kg\bullet cm^2\right) \quad \text{(Formula 14-33)}$$

Therefore, motor shaft conversion full load moment of inertia J_L can be obtained by the following formula.

$$\begin{aligned} J_L&=J_{L1}+J_{L2}+\left(\frac{1}{R}\right)^2\times J_{L3} \\ &=0.114+0.45+\left(\frac{1}{2}\right)^2\times3.02\left(kg\bullet cm^2\right) \\ &\approx1.32\left(kg\bullet cm^2\right) \end{aligned} \quad \text{(Formula 14-34)}$$

Here, it should be noted that J_{L3} is multiplied by（1/R）^{2}, because J_{L2} is the moment of inertia of the coupling on the motor side and the reducer, and J_{L1} is the moment of inertia of the motor shaft, so it can be directly added，but the reduction gear and the ball screw on the load side need to multiplied by(1/R)^2.That is, if there is a reducer between the motor and the load, it means that the motor shaft converts the moment of inertia only by a factor of a square of the reduction ratio. Here, J_{L2} and J_{L3} are known，, but if the ball screw, gear material, diameter and length (thickness) are known and the moment of inertia is unknown,it can be calculated by (Formula 14-11), (Formula 14-14).

J_L is 1.32kg•cm^2， according to the allowable load rotation inertia ratio of the motor,the motor is preferred EMS-06201L-30S-xxx-A（200W）.In addition, refer to "2.3.3 (2) Motor rating specifications" to know that the motor has a moment of inertia of 0.17kg•cm^2.

（5）Starting time t_a（s）, braking time t_d（s）(in Figure 14-6 $t_a = t_d$）

It must move 50mm within 0.3 seconds. Accordingly, if the starting time and the braking time are t_a, and the constant speed moving time is t_c, the following formula is established.

$$\frac{12000}{60}\left(\frac{1}{2}t_a+t_c+\frac{1}{2}t_a\right)=50 \quad \text{(Formula 14-35)}$$

$$2t_a+t_c=0.3 \quad \text{(Formula 14-36)}$$

According to the above two formulas, t_a and t_c can be obtained.

$$t_c = 0.2 \qquad t_a = 0.05$$

(6) Starting torque T_P, braking torque T_S（N•m）

The starting torque T_P and the braking torque T_S can be obtained by (Formula 14-20) and (Formula 14-21).

$$T_P = \frac{2\pi N_M\left(J_M + J_L\right)}{60t_a} + T_L$$

$$= \frac{6.28 \times 4000\left(0.17 + 1.32\right) \times 10^{-4}}{60 \times 0.05} + 0.0531 = 1.30N \bullet m \qquad \left(\text{Formula } 14-37\right)$$

$$T_S = \frac{2\pi N_M\left(J_M + J_L\right)}{60t_a} - T_L$$

$$= \frac{6.28 \times 4000\left(0.17 + 1.32\right) \times 10^{-4}}{60 \times 0.05} - 0.0531 = 1.194N \bullet m \qquad \left(\text{Formula } 14-38\right)$$

(7) Effective torque

The torque line diagram drawn from the above calculation is shown in Fig.14-7.

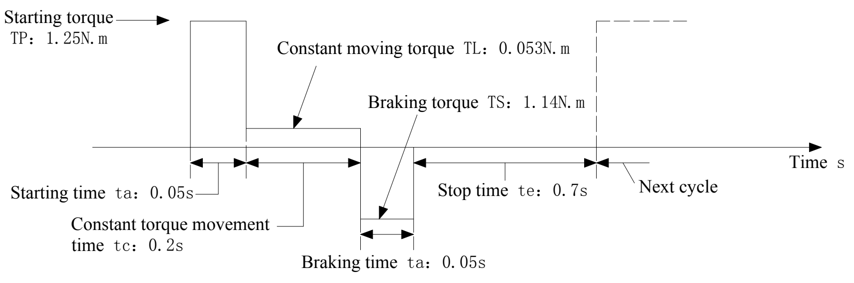


Fig.14-7 Imaginary mechanical torque line figure

Through the torque line diagram, the effective torque T_{rms} can be obtained using the following formula.

$$T_{rms} = \sqrt{\frac{T_P{}^2 \times t_a + T_L{}^2 \times t_c + T_s^2 \times t_a}{t_a + t_c + t_a + t_e}}$$

$$= \sqrt{\frac{1.3^2 \times 0.05 + 0.053^2 \times 0.2 + 1.194^2 \times 0.05}{0.05 + 0.2 + 0.05 + 0.7}}$$

$$= 0.395N \bullet M \qquad \left(\text{Formula } 14-39\right)$$

This value is 62% of the rated torque of the selected motor of 0.637N•m (referred to as the load factor).

In this case, the required rotational speed of the motor is 4000min^{-1}, which exceeds the rated rotational speed of 3000min^{-1}. Therefore, it cannot be judged that it can be used immediately from the point that the effective torque is lower than the rated value.

In this case, you need to lower the rating and use it. On the other hand, from "2.3.3 (6) Torque-speed characteristics of the motor", it can be seen from the torque-speed characteristic diagram of the motor that the load factor is 62%, which is within the usable range, so the motor can be used.

14.4 Servo unit selection

14.4.1 Analysis of the regeneration of the servo unit (or refer to the brake settings in Chapter 6)

Once the motor is selected, the corresponding servo unit can be found in the catalog. Although the selection operation of the servo unit is not performed, it is necessary to analyze whether or not the servo unit has the regeneration capability described above.

When the motor is dragged by the load, the load is called a negative load or a suspended load.

For example, as shown in Fig.14-8, there is no counterweight (or balanced load), and the mechanical load that moves up and down is the suspended load.

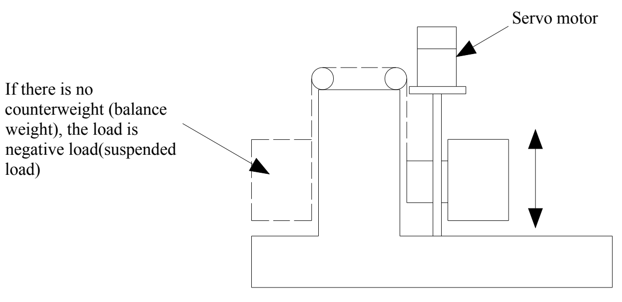


Fig.14-8 Suspension load example

In this case, the direction of the motor output torque is opposite to the direction of rotation, and the motor acts as a generator. The mode at this time is called the regeneration mode.

As shown in Fig.14-9, even in horizontal motion, the braking behavior is as follows: the torque direction is opposite to the rotation direction and is in the regeneration mode.

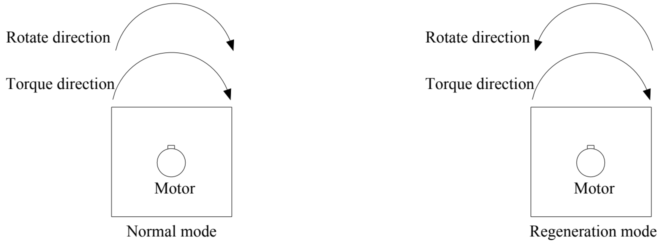


Fig.14-9 Normal mode and regeneration mode

In the servo, the electric energy (regeneration energy) generated at this time is absorbed and converted into thermal energy by the smoothing capacitor and the built-in regenerative resistor (in the small capacity servo, the resistor is not built in.) In the large capacity model, the external resistor is recommended. See manual).

However, if the moment of inertia of the load is large, the regenerative energy will also become large, and the capacitor and the resistor may not be completely absorbed. If this condition is ignored, the DC voltage of the converter section becomes abnormally high, which may burn out the resistor and cause the servo unit to malfunction. In this case, the servo unit will give an alarm for overvoltage and regeneration abnormality.

Therefore, it is necessary to analyze whether or not the regenerative energy can be absorbed by the smoothing capacitor and the regenerative resistor depending on the load conditions. This process is called regeneration analysis.

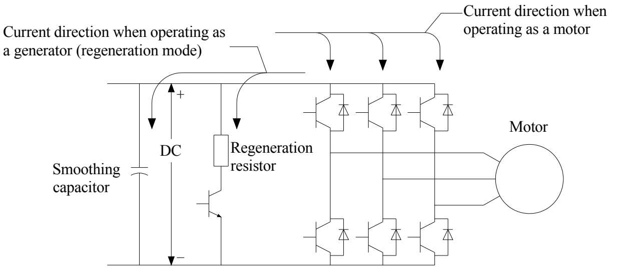


Fig.14-10 Current direction in regeneration mode

As mentioned earlier, the analyticalitems are as follows.

① Motor rotation energy in regeneration mode

② Energy consumed by the resistance of the motor winding and energy absorbed by the built-in capacitor

③ The energy consumed by the friction of the load

④ Energy consumed by the built-in resistor of the servo unit

14.4.2 Calculation step of regeneration analysis

The calculation of the regeneration analysis is shown in the following table and can be divided into six cases.

Servo unit capacity	Below 400W Without regenerative resistor	750W～5.5KW Built-in regenerative resistor	7.5KWor above Without regenerative resistor
Horizontal drive direction	（1）'s a	（1）'s b	（1）'s c
Vertical drive direction	（2）'s a	（2）'s b	（2）'s c

Note: The ESS200P series servo unit is taken as an example to distinguish the built-in and non-built-in resistor.

The following parameters are used in the calculation.

Parameters Symbol[Unit]	Parameters Symbol[Unit]
•Motor rated torque …………………… T_R[N•m] •Motor moment of inertia …………… J_M[kg•m²] •Motor speed …………………………… N_M[min-1] •Loaded motor shaft converting moment of inertia …………………………………… J_L[kg•m] •Motor shaft conversion load torque… T_L[N•m] •Required starting time …………………… ta[s] •Required braking time …………………… td[s] •Continuous movement time ………………… tc[s] •1 cycle time ………………………………… t[s] •Peak torque required at start-up …… T_{ps}[N•m] •Peak torque required at braking …… T_{pd}[N•m]	•Regeneration energy when the servo system start (only vertical axis) ……………… E_{s1}[J] •Regeneration energy when the servo system start (both horizontal and vertical)…… E_{s2}[J] •Load energy consumption during braking (horizontal axis only)…………………… E_{sL}[J] •Energy absorbed by the smoothing capacitor……………………………………… Ec[J] •Resistance loss of the motor winding …… Wm[W] •Regeneration energy during continuous descent………………………………………… E_G[J] •Built-in regenerative resistor capacity W_R[W] •External regenerative resistor capacity W_R[W] •Comprehensive regenerative energy …… E_K[J]

Note: For details on T_{ps}、T_{pd} (horizontal axis), J_L、T_L、t_a、t_d etc., refer to the section "14.1 Importing Motor Capacity Selection Formula". T_{ps}、 T_{pd} in the vertical axis are described later.

14.4.2.1 Horizontal drive

(1) Servo unit below 400W

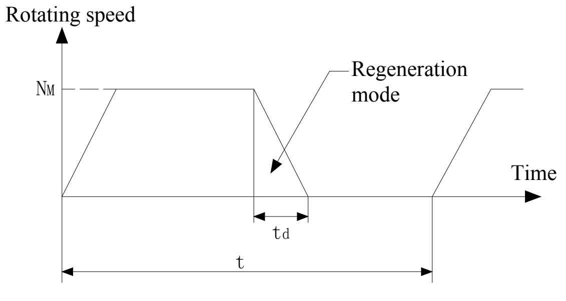


Fig.14-11 Horizontal drive application regeneration mode speed curve

① The kinetic energy E_{S2} at the time of braking is obtained by the following calculation formula.

$$E_{S2}=\frac{1}{2}(J_M+J_L)\left(\frac{2\pi}{60}N_M\right)^2 \qquad \text{(Formula 14-40)}$$

② Use the following calculation formula to obtain the load energy consumption during braking E_{SL}。

$$E_{SL}=\frac{1}{2}\left(\frac{2\pi}{60}N_M\right)T_L t_d \qquad \text{(Formula 14-41)}$$

③ According to the user manual, the absorbable energy E_C of the smoothing capacitor of the servo unit at the working power supply voltage is obtained.

④ Calculate（T_{pd}/T_R）and find the resistance loss W_M of the winding at that time based on this value and the user manual.

⑤ Calculate $E_K = E_{S2} -（E_{SL} + E_C + W_M \times t_d）$ and obtain the comprehensive regenerative energy E_K.

⑥ When E_K is negative, no external regenerative resistor is required.

When it is positive, an external resistor is required, and the resistor capacity must reach the following calculated value (refer to the user manual for the resistance value).

$$W_k = 3.3 \times E_K / t_d\,[W] \qquad \text{(Formula 14-42)}$$

Note： 1. 3.3 is the safety factor. It is recommended to install a resistor with a capacity of 3.3 times the calculated value.

2. After installing the resistor, be sure to set the capacity value in the user parameter **[F01.17]** of the servo unit in units of 1W.

(2) Servo unit 750W ~ 5.5KW

① Perform the same calculation as ①～⑤ in (a) of (1).

② If W_K（$=3.3\times E_K/t$）＜W_R，no external resistor is required.

If W_K（$=3.3\times E_K/t$）＞W_R，external resistor capacity W_K is required.

At this time,

a) After installing the resistor, be sure to set the capacity value in **[F01.17]** in units of 1W.

b）Be sure to remove the short-circuit between the RB and B terminals of the servo.

(3) Servo unit 7.5KW or more

① There is no built-in regenerative resistor for servo units above 7.5KW. Be sure to install the recommended regenerative resistor.

② Assuming that the resistor capacity of the unit is W_R, perform the same calculation as ①～⑤ in (a) of (1).

③ If W_K（$= 3.3\times E_K/t$）＜W_R，use W_R directly.

If W_K（$= 3.3\times E_K/t$）＞W_R，external resistor capacity W_K is required.

After installing the resistor, be sure to set the capacity value in **[F01.17]** in units of 1W.

14.4.2.2 Vertical drive

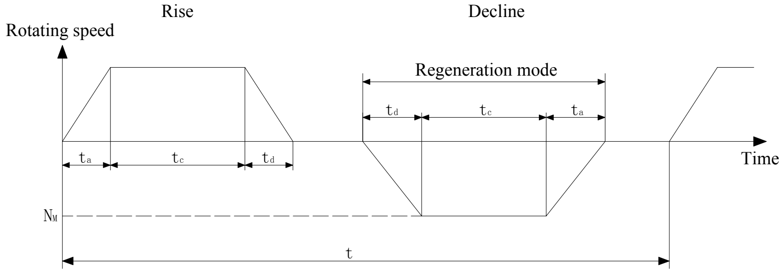


Fig.14-12 Vertical drive application regeneration mode speed curve

(1) Servo unit below 400W

① Use the following calculation formula to obtain the starting peak torque T_{ps} at the start of the descent.

$$T_{PS} = \frac{2\pi}{60}\frac{\left(J_M + J_L\right)N_M}{t_d} - T_L \qquad \text{(Formula 14-43)}$$

When the value is negative, it is not the regeneration mode (because the direction of rotation of the motor and the direction of the torque are both negative). In this case, it’s regeneration mode when deceleration in rise. Therefore, the absolute value of this value can be taken to calculate the next regenerative energy.

② Thus, the regenerative energy E_{Sl} at the time of the start of the lowering can be obtained as follows.

$$E_{S1} = \frac{1}{2}\left(\frac{2\pi}{60}N_M\right)T_{PS} \times t_d \qquad \text{(Formula 14-44)}$$

③ Calculate（T_{PS}/T_R）, based on this value and the user manual, to find the resistance loss W_{MS} of the motor winding at that time, and then calculate the resistance consumption energy E_{MS}

$$E_{MS} = W_{MS} \times t_d \qquad \text{(Formula 14-45)}$$

④ Use the following formula to find the regenerative energy during continuous descent

$$E_G = \left(\frac{2\pi}{60}N_M\right) \times T_L \times t_c \qquad \text{(Formula 14-46)}$$

⑤ is same as ③, according to the value of（T_L/T_R）and the user's manual, the resistance loss W_{MG} of the motor winding at that time is obtained, and then the motor consumption energy E_{MG} is obtained.

$$E_{MG} = W_{MG} \times t_c \qquad \text{(Formula 14-47)}$$

⑥ Use the following formula to find the brake peak torque T_{pd}

$$T_{pd} = \frac{2\pi}{60} \frac{(J_M + J_L) N_M}{T_a} + T_L \qquad \text{(Formula 14-48)}$$

⑦ Thus, the regenerative energy E_{S2} at the time of the braking can be obtained.

$$E_{S2} = \frac{1}{2}\left(\frac{2\pi}{60} N_M\right) T_{pd} \times t_a \qquad \text{(Formula 14-49)}$$

⑧ Calculate（T_{pd}/T_R）, according to the value and user manual, find the resistance loss W_{Md} of the motor winding at that time, and then calculate the motor consumption energy E_{Md}.

$$E_{md} = W_{md} \times t_s \qquad \text{(Formula 14-50)}$$

⑨ According to the user manual, the absorbable energy E_C of the balanced capacitor of the servo unit at the operating supply voltage is obtained.

⑩ Calculate $E_K = E_{S1} + E_G + E_{S2} - (E_{ms} + E_{MG} + E_{Md} + E_C)$ and find the comprehensive regenerative energy E_K.

⑪ When E_K is negative, no external regenerative resistor is required.

When it is positive, an external resistor is required, and the resistor capacity must reach the following calculated value (refer to the user manual for the resistance value).

$$W_K = 3.3 \times E_K/t \text{ [W]}$$

Note： 1. 3.3 is the safety factor. It is recommended to install a resistor with a capacity of 3.3 times the calculated value.

2. After installing the resistor, be sure to set the capacity value in **[F01.17]** in units of 1W.

(2) Servo unit 750W ~ 5.5KW

① Perform the same calculation as ①～⑩ of (a) in (2).

② If W_K（$=5\times E_K/t$）$< W_R$, no external resistor is required.

If W_K（$=5\times E_K/t$）$> W_R$， the external resistor capacity W_K is required.

In this case, after installing the resistor, be sure to set the capacity value in **[F01.17]** in units of 1W.

(3) Servo unit 7.5KW or more

① There is no built-in regenerative resistor for servo units above 7.5KW. Be sure to install the recommended regeneration unit.

② Assuming that the resistor capacity of this unit is $W_{R,}$, perform the same calculation as ①～⑩ of (a) in (2).

③ If W_K（$=3.3\times E_K/t$）$< W_R$, use directly

If W_K（$=3.3\times E_K/t$）$> W_R$， the external resistor capacity is W_K.

In this case, after installing the resistor, be sure to set the capacity value in **[F01.17]** in units of 1W.

Note: Even if it is vertical drive, when the sliding surface of the moving body is subjected to preloading, friction load, etc., the corresponding energy consumption (corresponding to ② in (1) of 14.4.2.1) is subtracted from the regenerative energy.

14.5 Encoder selection

The motor and encoder are assembled as a single unit, and we can also see the encoder specifications on the motor nameplate.

It can be known that the selection of the encoder does not require much time. The incremental encoder or absolute encoder is selected according to the specifications of the machine. In the case of incremental encoders, conventional encoders such as 2500 line bits are available, if it’s bus absolute encoder, 17-bit, 20-bit, 23-bit encoders could be chosen.

For details on the number of pulses required per revolution of the selected encoder, refer to "6.2.2 Electronic Gear Ratio", depending on the command unit required for the machine (movement per pulse) and the mechanical structure.

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