User Manual

A4S Series AC Servo Driver

◎V0.10

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SHENZHEN CO-TRUST TECHNOLOGY CO.,LTD

Contents

1

Safety Precautions

*Please do follow

1 Safety Precautions

Please be sure to comply with.

To avoid personal injury and possession damage，please read and must comply with the following instructions or precautions carefully before using the A4S servo driver.

Disclaimer: COTRUST is not responsible for the device damage or personal injury which caused by the operations against the requirements.

The following symbols are used according to the level of dangers possibly occurring if you fail to observe the instructions or precautions indicated.

Danger	Indicates operation against requirements may result in severe personal injuries or even death.
Caution	Indicates operation against requirements may result in personal injuries or device damage
Notice	Indicates necessary supplements or explanations

Danger	
The wiring must be carried out by qualified and authorized specialist.	Failing to observe these instructions could result in electrical shocks and fire.
Please comfirm if the main power is off before wiring.	
Please firmly connect the terminal of the power input and motor drive cable.	
Do not directly touch the output terminal, also do not short-connect the output line of the servo driver with housing.	
Please install safety devices such as circuit breaker to prevent external short circuit and timely cut off the power when the equipment fails.	
Do not disassemble the servo driver when powered on.	Failing to observe these instructions could result in electrical shocks.
Do not remove the wire or touch the terminal within fifteen minutes after the power off for the high voltage will remain for some time.	

Danger	
Do not use product in place with excessive vibration or shock.	Failing to observe the instruction could result in electrical shocks and fire.
Do not use the cable in oil or water.	Failing to observe the instruction could result in electrical shocks and machine damage.
Do not wire or operate with wet hands.	Failing to observe these instructions could result in electrical shocks and injury.
Do not put your hands into the servo driver.	
Do not use the product in the environment of corrosivity, inflammable gas, humidity or explosive.	Failing to observe these instructions could result in electrical shocks and fire.
Do not place combustible objects near motor, driver or regenerative resistor.	
Do not touch the motor, radiator of driver and the Regenerative resistor for its high temperature.	Failing to observe the instruction could result in electrical shocks and burn or the device damage.
The ground wire of the driver and motor must be well grounded.	Failing to observe the instruction could result in electrical shocks.
The output circuit may fail due to wiring errors and the application of different voltages.	Failing to observe these instructions could result in machine damage and personal injuries or even death.
Please wire correctly and reliably by referring the technical data.	
Please execute the switch and parameter setting consistent with the machine before starting operation.	
Do not make extreme changes to parameter settings.	
To avoid accidents, please install limit switch or baffle in the movable terminal of the machine.	
Do not enter the operating range of the machine.	Failing to observe these instructions could result in injuries.
Do not touch the servo motor and the movable part of the machine during operation.	
For it may restart suddenly when the power is restored after instantaneous power failure or under different voltage, please use mechanical design that will not cause personal injuries.	

⚠ Caution	
Do not hold the cable and motor shaft when handling the motor.	Failing to observe these instructions could result in machine damage and personal injuries.
Do not repair or maintain the product by non-professionals.	
Please follow the prescribed installation method.	
When two or more servo drivers are placed in the same cabinet, please notice the interval and heat dissipation.	
Do not use product in direct sunlight environment.	Failing to observe these instructions could result in fire.
Do not block the cooling hole of driver, and drop objects into the servo driver.	
Do not connect input power line to the U, V, W terminal.	Failing to observe these instructions could result in machine damage.
Restart machine after debugging and fully confirming the safety When equipment failure occurs.	Without safety confirmation may cause injuries.
Please cut off the driver power when failures occur.	Continuous large current may cause fire.
Please prepare external brake resistor additionally in case the necessary use. Do not touch the brake resistor when working.	Failing to observe these instructions could result in electrical shock and injuries.
The rated torque of servo motor should be larger than the actual load torque.	Failing to observe the instruction could result in machine damage.
Do not use servo driver that damaged or missing parts.	Failing to observe these instructions could result in personal injuries.
The trial operation of the servo motor should be carried out when the motor is not connected with the mechanical drive shaft	
Please cut the power off for long time nonuse.	
For the dangerous state of movement under the action of external force (gravity, etc.) when the power switch or abnormal stop occurs, safety cannot be ensured by the brake of the servo motor.At this point, be sure to install the brake structure outside to ensure safety.	

2

Specifications

*Specifications of servo system

2 Specifications

2.1 Nameplate Explanation of Servo Driver and Motor

Designation Rule of Servo

CTSD A4S-B4015-M100

CTSD	COTRUST Drives

E10	E-type servo driver
H1A	H-type servo driver
A3S	Standard servo driver
A3N	Bus servo driver
A4S	Standard servo driver
A4N	Bus servo driver

A	Voltage:380VAC
B	220VAC
C	80VDC

401	Rated power:40X10^{1}(W)

0	Supplemental identification

0	No display panel
1	With display panel

0	Support Modbus
1	Support Modbus and CAN
2	Support Modbus and EtherCAT

M	Adapt to M-type motor
S	Adapt to S-type motor
K	Adapt to K-type motor

0	9-pin general encoder
1	9-pin wire-saving encoder
2	15-pin nonwire-saving encoder
3	20-pin nonwire-saving encoder
4	Sine encoder
5	17-bit bus encoder

Designation Rule of Motor

CTSD M16-B4017-M100

CTSD	COTRUST drives

M	Motor

1	Specification:L-inertia
2	M-inertia
3	H-inertia

4	Flange:40*40mm
6	60*60mm
8	80*80mm
B	110*110mm
D	130*130mm
I	180*180mm

A	Voltage:380VAC
B	220VAC
C	80VDC

401	Rated power:40X10(W)

0	Reserved

0	No brake
1	With brake

0	Optical axis with flat
1	Solid with keys and screw hole
2	Solid with keys and screw hole
3	Solid with screw hole

M	M-type motor
S	S-type motor
K	K-type motor

0	9-pin general encoder
1	9-pin wire-saving encoder
2	15-pin nonwire-saving encoder
3	20-pin nonwire-saving encoder
4	Sine encoder
5	7-pin military spec plug 17-bit absolute encoder
6	7-pin military spec plug17-bit incremental encoder
7	9-pin AMP 17-bit absolute encoder
8	9-pin AMP 17-bit incremental encoder

2.2 Combination of the Driver and Motor

Combination of servo driver and motor

Power consumption (kW)	Power	Order No. of driver CTSD ***-*****-****	Driver SIZE	Order No. of motor CTSD ***-*****-****	Flange	Rated speed (rpm)
0.1	Single-phase /three-phase AC 220V	A4S-B1012-M100	A	M14-B1012-K100 M14-B1012-K110	40	3000
		A4S-B1015-M100	A	M14-B1017-M100 M14-B1017-M110	40	3000
0.2		A4S-B2012-M100	A	M16-B2012-M100 M16-B2012-M110	60	3000
		A4S-B2015-M100	A	M16-B2017-M100 M16-B2017-M110	60	3000
				M16-B2018-M100 M16-B2018-M110		
0.4		A4S-B4012-M100	A	M16-B4012-M100 M16-B4012-M110	60	3000
		A4S-B4015-M100	A	M16-B4017-M100 M16-B4017-M110	60	3000
				M16-B4018-M100 M16-B4018-M110		
0.75		A4S-B7512-M100	A	M18-B7512-M100 M18-B7512-M110	80	3000
		A4S-B7515-M100	A	M18-B7517-M100 M18-B7517-M110	80	3000
				M18-B7518-M100 M18-B7518-M110		
1.0		A4S-B1022-M100	A	M18-B1022-M100 M18-B1022-M110	80	2500
		A4S-B1025-M100	A	M18-B1027-M100 M18-B1027-M110	80	2500
				M18-B1028-M100 M18-B1028-M110		
		A4S-B1022-M101	A	M2D-B1022-M200 M2D-B1022-M210	130	2500
		A4S-B1025-M101	A	M2D-B1025-M200 M2D-B1025-M210	130	2500
				M2D-B1026-M200 M2D-B1026-M210		

Power consumption (kW)	Power	Order No. of driver CTSD ***-*****-****	Driver SIZE	Order No. of motor CTSD ***-*****-****	Flange	Rated speed (rpm)
1.5	Single-phase /three-phase AC 220V	A4S-B1522-M100	C	M2D-B1522-M200 M2D-B1522-M210	130 (6N.M)	2500
		A4S-B1525-M100	C	M2D-B1525-M200 M2D-B1525-M210	130 (6N.M)	2500
				M2D-B1526-M200 M2D-B1526-M210		
		A4S-B1522-M101	C	M2D-B1522-M201 M2D-B1522-M211	130 (10N.M)	1500
		A4S-B1525-M101	C	M2D-B1525-M201 M2D-B1525-M211	130 (10N.M)	1500
				M2D-B1526-M201 M2D-B1526-M211		
2.0		A4S-B2022-M100	C	M2D-B2022-M200 M2D-B2022-M210	130	2500
		A4S-B2025-M100	C	M2D-B2025-M200 M2D-B2025-M210	130	2500
2.3		A4S-B2322-M100	C	M2D-B2322-M200 M2D-B2322-M210	130	1500
		A4S-B2325-M100	C	M2D-B2325-M200 M2D-B2325-M210	130	1500
3.0		A4S-B3022-M100	C	M2D-B3022-M200 M2D-B3022-M210	130	2500
		A4S-B3025-M100	C	M2D-B3025-M200 M2D-B3025-M210	130	2500
1.5	Three-phase AC 380V	A4S-A1525-M101	C	M2D-A1525-M201	130	1500
2.3		A4S-A2325-M100	C	M2D-A2325-M200	130	1500
3.0		A4S-A3022-M100	C	M3I-A3023-M200 M3I-A3023-M210	180	1500
		A4S-A3025-M100	C	M3I-A3025-M200 M3I-A3025-M210	180	1500
4.5		A4S-A4522-M100	E	M3I-A4523-M200 M3I-A4523-M210	180	1500
		A4S-A4525-M100	E	M3I-A4525-M200 M3I-A4525-M210	180	1500
5.5		A4S-A5522-M100	E	M3I-A5523-M200 M3I-A5523-M210	180	1500
		A4S-A5525-M100	E	M3I-A5525-M200 M3I-A5525-M210	180	1500
7.5		A4S-A7525-M100	E	M3I-A7525-M200 M3I-A7525-M210	180	1500

2.3 Nameplate Explanation of Cables

Designation Rule of Motor Cable

CTSD MOL-S3C30

CTSD	CO-TRUST drives
MOL	Motor drive cable

S	Standard cable
F	Flexible cable

0	Reserved
1	4 core-wires AMP
2	4 core-wires small military spec plug
3	4 core-wires middle military spec plug
4	4 core-wires big military spec plug
5	7core-wires middle military spec plug(with brake)

A	Wire diameter: 0.75mm
B	Wire diameter: 1.0mm
C	Wire diameter: 1.5mm
D	Wire diameter: 2.5mm

3	Length：3m
5	Length：5m
7	Length：7m

Designation Rule of Encoder Cable

CTSD ENL-S3A45

CTSD	CO-TRUST drives
ENL	Encoder cable

S	Standard cable
F	Flexible cable

0	2500ppr encoder
1	Wire-saving incremental encoder
2~4	Reserved
5	17-bit absolute encoder
6	17-bit incremental encoder

1	15 core-wires AMP
2	15 core-wires middle military spec plug
3	7 core-wires small military spec plug
4	7 core-wires middle military spec plug
5	9 core-wires AMP
6	9 core-wires military spec plug

A	Wire diameter：0.15mm

3	Length：3m
5	Length：5m
7	Length：7m

Order info of cables

Motor	Order No. of cables					
	Motor cable CTSD MOL-*****			Encoder cable CTSD ENL-*****		
	3m	5m	7m	3m	5m	7m
0.1~1.0kW (40/60/80 flange, 2500 ppr)	S3A10	S5A10	S7A10	S3A10	S5A10	S7A10
0.1~1.0kW (40/60/80 flange, 17bits absolute)				S3A55	S5A55	S7A55
0.1~1.0kW (40/60/80 flange, 17bits increment)				S3A56	S5A56	S7A56
1.0~2.3kW (130 flange, 2500 ppr)	S3C30	S5C30	S7C30	S3A20	S5A20	S7A20
1.0~2.3kW (130 flange, 17bits absolute)				S3A45	S5A45	S7A45
1.0~2.3kW (130 flange, 17bits increment)				S3A46	5A46	S7A46
3.0kW (130 flange, 2500 ppr)	S3D30	S5D30	S7D30	S3A20	S5A20	S7A20
3.0kW (130 flange, 17bits absolute)				S3A45	S5A45	S7A45
3.0kW (130 flange, 17bits increment)				S3A46	S5A46	S7A46
3.0kW (180 flange, 2500 ppr)	S3D40	S5D40	S7D40	S3A20	S5A20	S7A20
3.0kW (180 flange, 17bits absolute)				S3A45	S5A45	S7A45
3.0kW (180 flange, 17bits increment)				S3A46	S5A46	S7A46
4.5~7.5kW (180 flange, 2500 ppr)	S3D41	S5D41	S7D41	S3A20	S5A20	S7A20
4.5~7.5kW (180 flange, 17bits absolute)				S3A45	S5A45	S7A45
4.5~7.5kW (180 flange, 17bits increment)				S3A46	S5A46	S7A46

2.4 Specifications of Driver

Basic spec	Dimension （W×H×D）		Size-A	50x160x173 mm
			Size-C	90x160x183 mm
			Size-E	100x250x230 mm
	Input power	Control power	Size-A	Single-phase AC200V~250V, ±10%, 50/60Hz
			Size-C	Single-phase AC200V~250V, ±10%, 50/60Hz Single-phase AC380V~440V, ±10%, 50/60Hz
			Size-E	Single-phase AC380V~440V, ±10%, 50/60Hz
		Main power	Size-A	Single-phase / Three-phase AC200V~250V, ±10%, 50/60Hz
			Size-C	Single-phase / Three-phase AC200V~250V, ±10%, 50/60Hz Three-phase AC380V~440V, ±10%, 50/60Hz
			Size-E	Three-phase AC380V~440V, ±10%, 50/60Hz
	Rated drive current		Size-A	6A(AC220V)
			Size-C	12A(AC220V) /7.4A(AC380V)
			Size-E	20A(AC380V)
	High-voltage terminal	Form		Size-A/C: pluggable terminal block Size-E: barrier terminal block
		Bit		Size-A/C:12 bits Size-E:13 bits
	Control terminal			44-pin
	Encoder feedback			Bus absolute encoder(17-bit) Optical-electricity encoder Rotary encoder(Size-C/E) interface reserved
	Communication	Standard 485 port		Modbus port, support 4.8Kbps~115.2Kbps baud rate
		Standard RJ45 port		Two 100Mbps, support CANopen protocol
	Isolation			Power/communication, encoder input and digital input/output isolated
	Built-in brake resistance		Size-A	50Ω, 50W
			Size-C	100Ω, 80W
			Size-E	40Ω, 100W
	Common DC bus			Supported by output port of driver
	Protection			Overvoltage, undervoltage, overcurrent, overload, overheating, overspeed, encoder failure etc.
	Display&buttons			Five-bit LED display, five buttons
				Lamp of common DC bus
	Parameter setting			By button or MagicWorks Tuner
	Power-off protection			Permanently reserve all the optional parameter
	Overload capacity			Support triple overload for driver of 100W~1.0kW Support double overload for driver of 1.5kW and above
	Cooling			By fan(nature cooling for size-A driver which below 750W)

Functions	Velocity variation (in rated rotate speed)	Load variation	0~100%: below 0.1%
		Voltage variation	Rated voltage ±15%: 0%
		Temperature variation	25±25℃: below ±0.1%
	Digital input(seven)		Positive/negative direction limit, latch and origin signal etc. Enable PIN by configuring parameters in software to output effective logical level
	Digital output(four)		Servo-on, alarm output, brake release, instructions completed output, speed and torque limitation reached etc. Enable PIN by configuring parameters in software to output effective logical level
	Modbus communication	Port	One RS485 communication port
		Standard	Standard ModBus RTU protocol, main station supports R/W of single or multi parameter
		Baud rate	4.8K, 9.6K, 19.2K, 38.4K, 57.6K, 115.2K
		Max stations	32 stations each part
		Isolation	Communication port isolated
	CANopen communication	Standard	CANopen protocol
		Max stations	32 stations each part
		Baud rate	4.8K, 9.6K, 19.2K, 38.4K, 57.6K, 115.2K
	Soft start/stop		Able to set 0~10s/1000rpm ACC and DEC
	Home attaining		Able to assign speed, acceleration and the 21 homing methods.
	Protection of brake resistor		Set the resistance value and power of internal and external brake resistance. The output duty cycle of limiting discharge of the brake tube is calculated automatically inside the driver to prevent and damage caused by brake resistance overheating
	Reset absolute multi-turn data		Reset by PC software or buttons on panel
	If the optional parameter should be stored into EEPROM		Change communication parameters should be able to set whether to save directly to EEPROM, so that customers can directly configure servo parameters through communication.
	Monitor		Monitor operation parameter such as speed, position and current etc. by internal oscilloscope, software on PC

Position control mode	Maximum input pulse frequency		Differential mode: 500KHz, open collector mode: 200KHz
	Form of input pulse signal		Pulse and direction, phase-A and phase-B, CW and CCW
	Instructions control mode		External pulse instruction /16 segments of communication register instruction
	Feedforward compensation		0~1000‰(set resolution as1‰)
	Error setting		0~32767 instruction units(set resolution as 1 unit)
	Electronic gear ratio	N	1~10000(2500-PPR incremental encoder); 1~65535(17-bit bus encoder) 1/200<N/M<200
		M	
Speed control mode	Analogy input	Voltage range	-10V~+10V(12-bit resolution)
		Input impedance	About 24K
		Sampling frequency	1KHz
	Control way of instruction		External analogy instruction/8 segments of internal speed instruction /32 segments of communication register instruction
	Smooth way of instruction		Low-pass filtering, smoothing time constant 0~2500(x10us)
	Torque limit		Internal parameter
Torque control mode	Analogy input	Voltage range	-10V~+10V(12-bit resolution)
		Input impedance	About 24K
		Sampling frequency	1KHz
	Control way of instruction		External analogy instruction/32 segments of communication register instruction
	Smooth way of instruction		Low-pass filtering, smoothing time constant 0~2500(x10us)
	Speed limit		Internal parameter
Working environment	Operating temperature		0℃～45℃
	Reservation temperature		-20℃～70℃
	Humidity		Operation/reservation ≤90% RH, no condensation
	IP level		IP20
	Installation environment		No corrosive gas, flammable gas, oil mist or dust, etc.
	Installation way		Vertical
	Standard height		elevation≤1000m
	Atmospheric pressure		86Kpa~106Kpa

3

Installation

*Installation of servo and motor

3 Installation

Installation of driver and motor

Please install the servo driver and motor correctly to avoid failure or accident.

3.1 Installation Precautions

- The storage and installation of products must meet the requirements of environmental conditions.
- It is a must to use fireproof material, and to prevent fire, do not install on or near inflammable material.
- The electric cabinet for servo driver should be able to prevent the invasion of dust, corrosive gas, conductive objects (such as copper dust), liquid and inflammable materials.
- The driver and motor should be prevented from vibration and impact.

3.2 Environmental Conditions of Driver

Item	Condition
Working temperature	0 °C ~ 45 °C
Storage temperature	-20 °C ~ +70 °C
Humidity	Operation/reservation ≤90% RH, no condensation
Elevation	Elevation ≤1000m
Anti-vibration	10~57Hz 3.5mm, 57~150Hz 1g
Environment	No corrosive gas, flammable gas, oil mist or dust, etc.

3.3 Mounting Dimensions of Driver

A4S servo driver enjoys backplane installation, which means the installation direction is perpendicular.

The dimensions(unit: mm) of A4S servo drivers show as figure 3-1, 3-2 and 3-3:

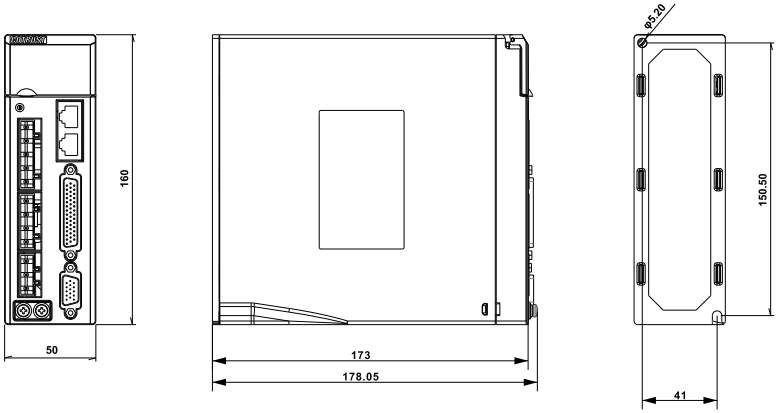


Figure 3-1 Size-A

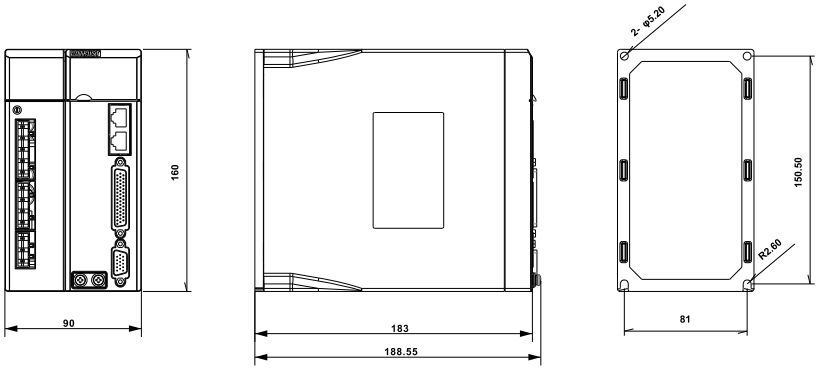


Figure 3-2 Size-C

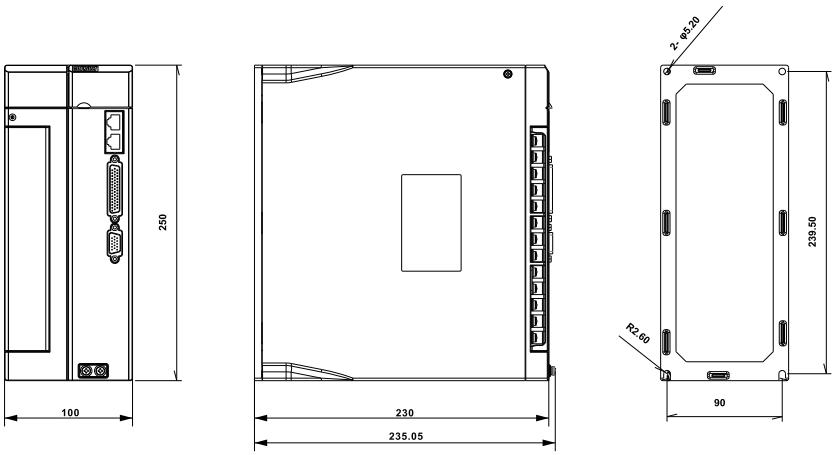


Figure 3-3 Size-E

3.4 Mounting Direction and Interval of Driver

- Please leave interval as larger as possible for heat dissipation in actual situation.
- Better to have a radiator in the electric cabinet which blows wind towards the driver to prevent the temperature around the driver from rising continuously.

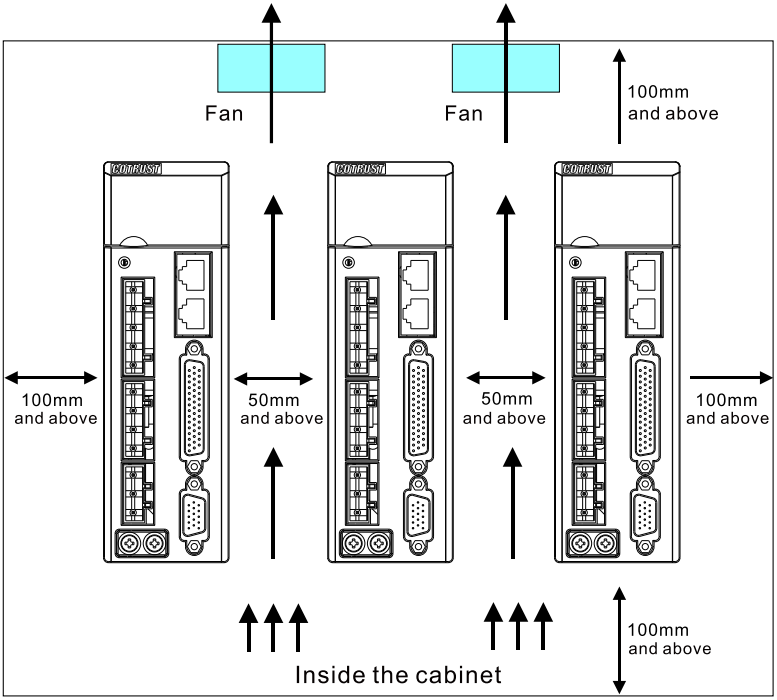


Figure 3-4 Interval between multiple servo drivers installed

3.5 Environmental Conditions of Motor

- Please avoid rain and direct sunlight.
- Do not use motor in environment with dust, corrosive gases, conductive materials, liquids and flammable materials.
- Ventilate to prevent the invasion of gas, oil and water.
- The working temperature should be maintained at 0 ~ 45℃. For the motor would heating for long time running, please force heat dissipation when the surrounding space is small or there is a heating device nearby.
- Keep the humidity lower than≤90%RH, and no condensation.

- The motor should be prevented from vibration and impact.

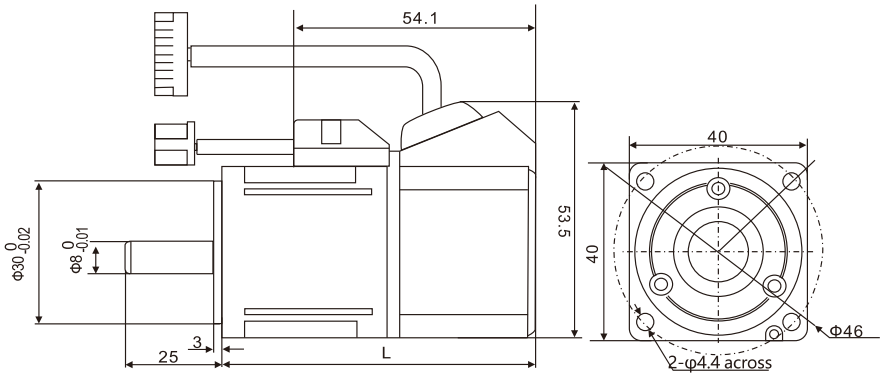
3.6 Installation of Motor

1 Installation Precautions

- Encoder is a high precision device which should be protected against knocking or collision while handling or installation.
- Do not use hammer to hit it directly when installing or disassembling the coupling at the motor shaft end.
- It is a must to be fully coaxial, otherwise vibration and noise may be caused and bearing may be damaged.
- Do not drag motor shaft, lead wire or encoder while handling motor.
- Please make the cable outlet down to avoid oil and water infiltration into the motor when installing.
- A long time overwork may damage the motor.
- There should be anti - loose measures to ensure the motor install firmly.

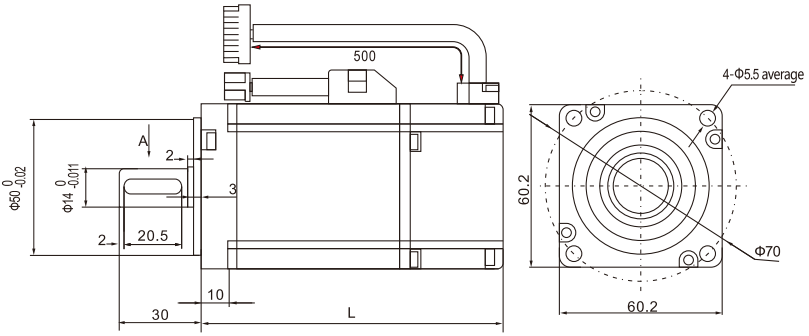
2 Dimensions

A4S servo motors can be mounted vertically or horizontally, the dimension of motors shows as figure 3-5 to figure 3-11.



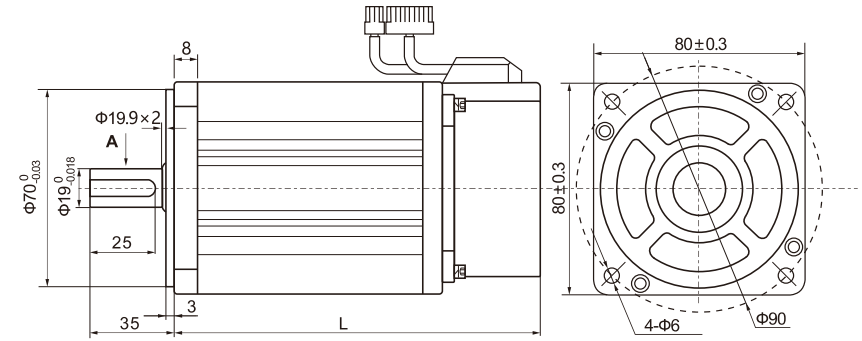
Power	0.1kW	0.1kW(With brake)
Model	CTSD M14-B101□-□100	CTSD M14-B101□-□110
L(mm)	104	141

Figure 3-5 Motor dimension of 0.1kW



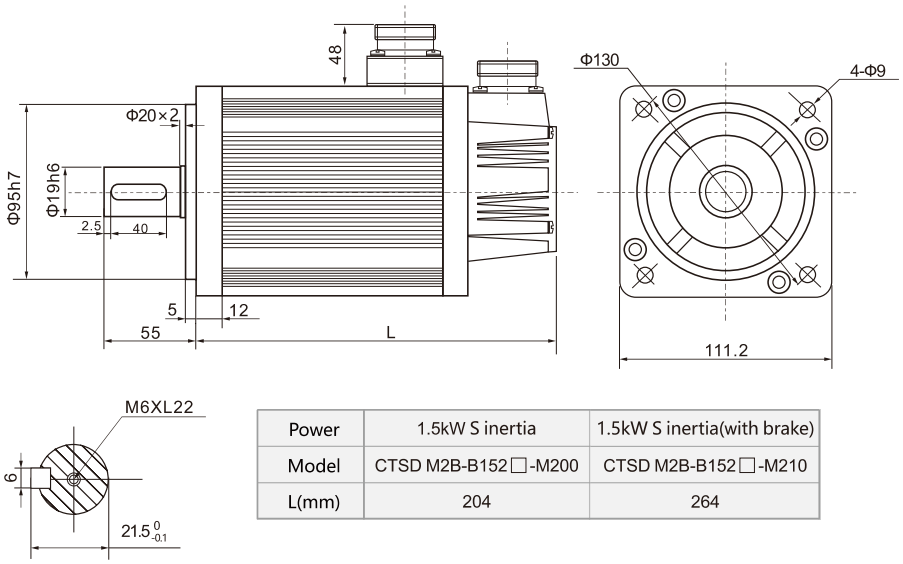
Power	0.2kW	0.4kW
Model	CTSD M16-B201□-M100	CTSD M16-B401□-M100
L(mm)	112	137
Power	0.2kW (With brake)	0.4kW(With brake)
Model	CTSD M16-B201□-M110	CTSD M16-B401□-M110
L(mm)	160	185

Figure 3-6 Motor dimension of 0.2kW/0.4kW



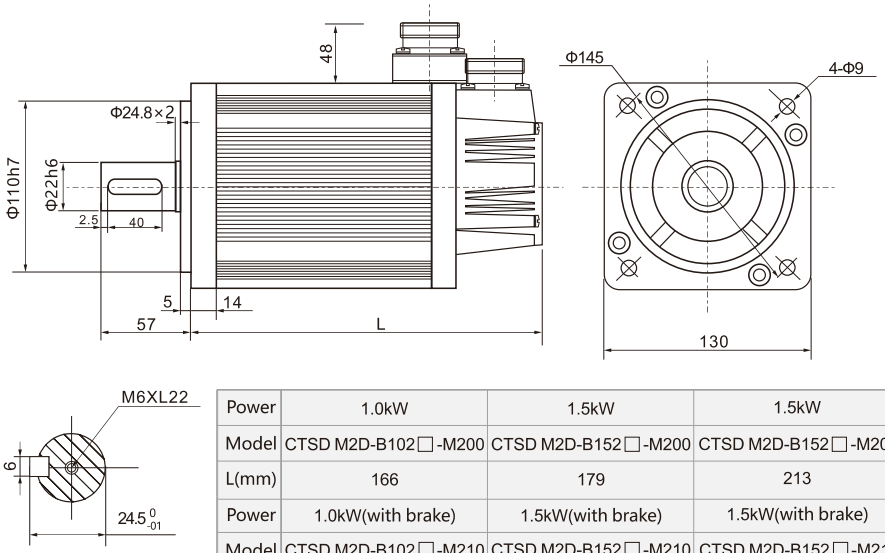
Power	0.75kW	1.0kW S inertia
Model	CTSD M18-B751□-M100	CTSD M18-B102□-M100
L(mm)	151	191
Power	0.75kW(with brake)	1.0kW S inertia(with brake)
Model	CTSD M18-B751□-M110	CTSD M18-B102□-M110
L(mm)	205	245

Figure 3-7 Motor dimension of 0.75kW/1.0kW



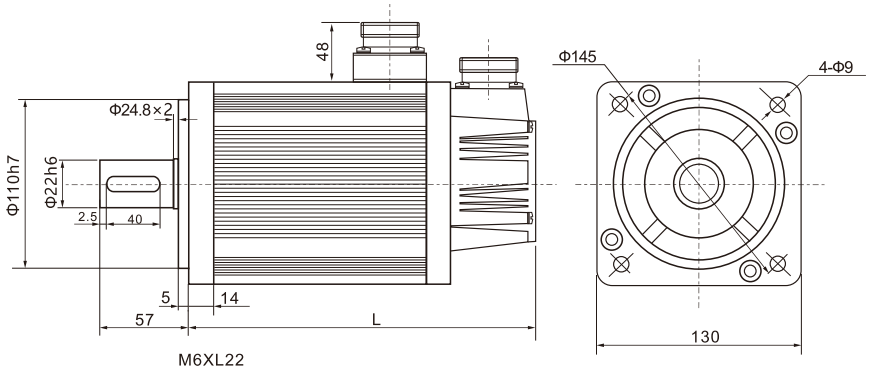
Power	1.5kW S inertia	1.5kW S inertia(with brake)
Model	CTSD M2B-B152□-M200	CTSD M2B-B152□-M210
L(mm)	204	264

Figure 3-8 Motor dimension of 1.5kW



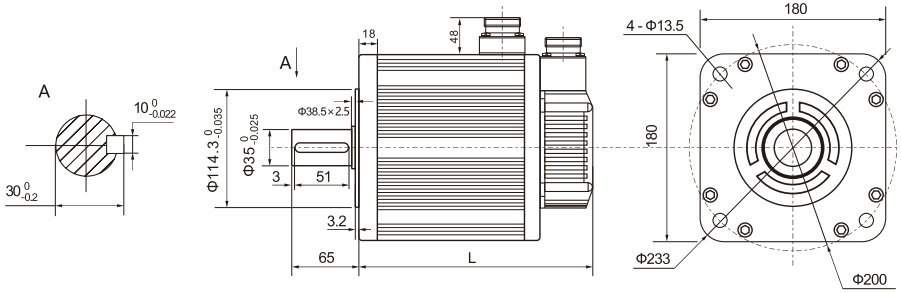
Power	1.0kW	1.5kW	1.5kW
Model	CTSD M2D-B102□-M200	CTSD M2D-B152□-M200	CTSD M2D-B152□-M201
L(mm)	166	179	213
Power	1.0kW(with brake)	1.5kW(with brake)	1.5kW(with brake)
Model	CTSD M2D-B102□-M210	CTSD M2D-B152□-M210	CTSD M2D-B152□-M211
L(mm)	236	249	283

Figure 3-9 Motor dimension of 1.0kW/1.5kW



Power	2.0kW	2.3kW	3.0kW
Model	CTSD M2D-B202□-M200	CTSD M2D-B232□-M200	CTSD M2D-B302□-M200
L(mm)	192	241	231
Power	2.0kW(with brake)	2.3kW(with brake)	3.0kW(with brake)
Model	CTSD M2D-B202□-M210	CTSD M2D-B232□-M210	CTSD M2D-B302□-M210
L(mm)	262	311	301

Figure 3-10 Motor dimension of 2.0kW/2.3kW/3.0kW



Power	3.0kW	4.5kW	5.5kW	7.5kW
Model	CTSD M3I-A302□-M200	CTSD M3I-A452□-M200	CTSD M3I-A552□-M200	CTSD M3I-A7525 -M200
L(mm)	232	262	292	346
Power	3.0kW(with brake)	4.5kW(with brake)	5kW(with brake)	7.5kW(with brake)
Model	CTSD M3I-A302□-M210	CTSD M3I-A452□-M210	CTSD M3I-A552□-M210	CTSD M3I-A7525 -M210
L(mm)	314	344	382	436

Figure 3-11 Motor dimension of 3.0kW/5.5 kW/7.5 kW

3.7 Specifications of Servo Motor

1 Specifications of 2500-PPR incremental optical encoder motor

Order no. of motor CTSD ***-*****-****	Rated power kW	Rated voltage VAC	Rated rotate speed rpm	Flange	Rated torque N·m	Rated current A	Peak torque N·m	Counter electromotive force V/Krpm	Pole-pairs	Rotor inertia Kg·m^2
M14-B1012-K100	0.1	220	3000	60	0.32	0.6	0.64	32.8	4	0.051×10^{-4}
※M14-B1012-K110										
M16-B2012-M100	0.2	220	3000	60	0.637	1.2	1.911	30.9	4	0.17×10^{-4}
※M16-B2012-M110										
M16-B4012-M100	0.4	220	3000	60	1.27	2.6	3.9	29.6	4	0.29×10^{-4}
※M16-B4012-M110										
M18-B7512-M100	0.75	220	3000	80	2.39	3	4.8	48	4	1.82×10^{-4}
※M18-B7512-M110										
M18-B1022-M100	1.0	220	2500	80	4	4.4	8	56	4	2.97×10^{-4}
※M18-B1022-M110										
M2D-B1022-M200	1.0	220	2500	60	4	4.0	8	72	4	8.5×10^{-4}
※M2D-B1022-M210										
M2D-B1522-M200	1.5	220	2500	130	6	6.0	12	65	4	12.6×10^{-4}
※M2D-B1522-M210										
M2D-B1522-M201	1.5	220	1500	130	10	6.0	20	103	4	19.4×10^{-4}
※M2D-B1522-M211										
M2D-B2022-M200	2.0	220	2500	130	7.7	7.5	15.4	68	4	1.53×10^{-3}
※M2D-B2022-M210										
M2D-B2322-M200	2.3	220	1500	130	15	7.5	30	114	4	2.77×10^{-3}
※M2D-B2322-M210										
M2D-B3022-M200	3.0	220	2500	130	11.5	13.5	23	67	4	2.77×10^{-3}
※M2D-B3022-M210										
M3I-A3022-M200	3.0	380	1500	180	19	7.5	38	158	4	3.8×10^{-3}
※M3I-A3022-M210										
M3I-A3023-M200	3.0	380	1500	180	19	7.5	38	158	4	3.8×10^{-3}
※M3I-A3023-M210										
M3I-A4522-M200	4.5	380	1500	180	27	10	67	140	4	9.64×10^{-3}
※M3I-A4522-M210										
M3I-A4523-M200	4.5	380	1500	180	27	10	67	140	4	9.64×10^{-3}
※M3I-A4523-M210										
M3I-A5522-M200	5.5	380	1500	180	35	12	70	181	4	8.6×10^{-3}
※M2D-A5522-M210										
M3I-A5523-M200	5.5	380	1500	180	35	12	70	181	4	8.6×10^{-3}
※M2D-A5523-M210										

Remark: Symbol ※, which does not belong to order no, means motor with brake.

2 Specifications of bus absolute encoder motor

Order no. of motor CTSD ***-*****-****	Rated power kW	Rated voltage VAC	Rated rotate speed rpm	Flange	Rated torque N·m	Rated current A	Peak torque N·m	Counter electromotive force V/Krpm	Pole-pairs	Rotor inertia Kg·m²
M14-B1017-M100	0.1	220	3000	60	0.32	0.6	0.64	32.8	4	0.051×10^{-4}
※M14-B1017-M110										
M16-B2017-M100	0.2	220	3000	60	0.63	1.2	1.91	30.9	4	0.175×10^{-4}
※M16-B2017-M110										
M16-B4017-M100	0.4	220	3000	60	1.27	2.6	3.9	29.6	4	0.29×10^{-4}
※M16-B4017-M110										
M18-B7517-M100	0.75	220	3000	80	2.4	3	4.8	48	4	1.82×10^{-4}
※M18-B7517-M110										
M18-B1027-M100	1.0	220	2500	80	4	4.4	8	56	4	2.97×10^{-4}
※M18-B1027-M110										
M2D-B1025-M200	1.0	220	2500	130	4	4.0	8	72	4	8.5×10^{-4}
※M2D-B1025-M210										
M2D-B1525-M200	1.5	220	2500	130	6	6.0	12	65	4	1.26×10^{-3}
※M2D-B1525-M210										
M2D-B1525-M201	1.5	220	1500	130	10	6.0	20	103	4	1.94×10^{-3}
※M2D-B1525-M211										
M2D-A1525-M201	1.5	380	1500	130	10	3.5	25	177	4	1.94×10^{-3}
※M2D-A1525-M211										
M2D-B2025-M200	2.0	220	2500	130	15	7.5	30	68	4	1.53×10^{-3}
※M2D-B1525-M210										
M2D-B2325-M200	2.3	220	1500	130	7.7	9.5	15.4	67	4	2.77×10^{-3}
※M2D-B2325-M210										
M2D-B3025-M200	3.0	220	2500	130	11.5	13.5	23	67	4	2.77×10^{-3}
※M2D-B3025-M210										
M3I-A3025-M200	3.0	380	1500	180	19	7.5	38	158	4	3.8×10^{-3}
※M3I-A3025-M210										
M3I-A4525-M200	4.5	380	1500	180	27	10	67	172	4	9.64×10^{-3}
※M3I-A4525-M210										
M3I-A5525-M200	5.5	380	1500	180	35	12	70	181	4	8.6×10^{-3}
※M3I-A5525-M210										
M3I-A7525-M200	7.5	380	1500	180	48	20	96	156	4	16.72×10^{-3}
※M3I-A7525-M210										

Remark: Symbol ※, which does not belong to order no, means motor with brake.

3 Specifications of bus incremental encoder motor

Order no. of motor CTSD ***-*****-****	Rated power kW	Rated voltage VAC	Rated rotate speed rpm	Flange	Rated torque N·m	Rated current A	Peak torque N·m	Counter electromotive force V/Krpm	Pole-pairs	Rotor inertia Kg·m²
M14-B1018-M100	0.1	220	3000	60	0.32	0.6	0.64	32.8	4	0.051×10^{-4}
※M14-B1018-M110										
M16-B2018-M100	0.2	220	3000	60	0.63	1.2	1.91	30.9	4	0.17×10^{-4}
※M16-B2018-M110										
M16-B4018-M100	0.4	220	3000	60	1.27	2.6	3.9	29.6	4	0.29×10^{-4}
※M16-B4018-M110										
M18-B7518-M100	0.75	220	3000	80	2.4	3	7.1	48	4	1.82×10^{-4}
※M18-B7518-M110										
M18-B1028-M100	1.0	220	2500	80	4	4.4	12	56	4	2.97×10^{-4}
※M18-B1028-M110										
M2D-B1026-M200	1.0	220	2500	130	4	4.0	12	72	4	8.5×10^{-4}
※M2D-B1026-M210										
M2D-B1526-M200	1.5	220	2500	130	6	6.0	18	65	4	12.6×10^{-4}
※M2D-B1526-M210										
M2D-B1526-M201	1.5	220	1500	130	10	6.0	25	103	4	19.4×10^{-4}
※M2D-B1526-M211										

Remark: Symbol ※, which does not belong to order no, means motor with brake.

4

Wiring

*Servo wiring

4 Wiring

⚠ The wiring or inspection, which must operate 15 minutes after power-off to avoid electric shock, are only allowed for the professionals.

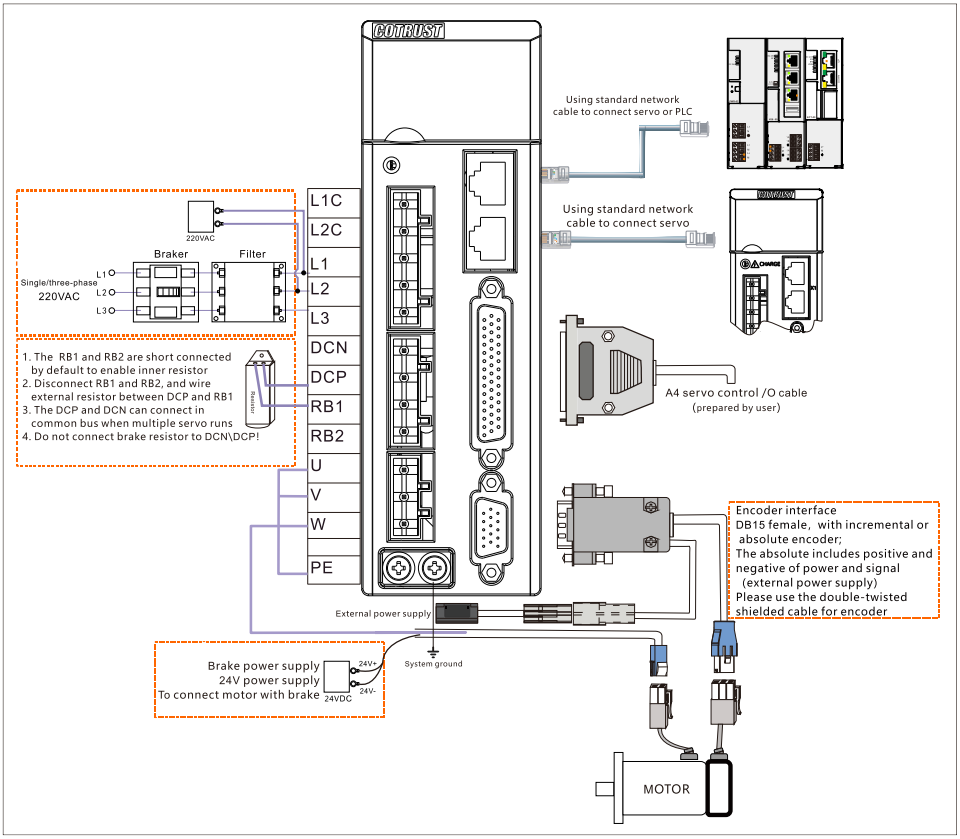


Figure 4-1 Schematic diagram of external port of size-A servo driver

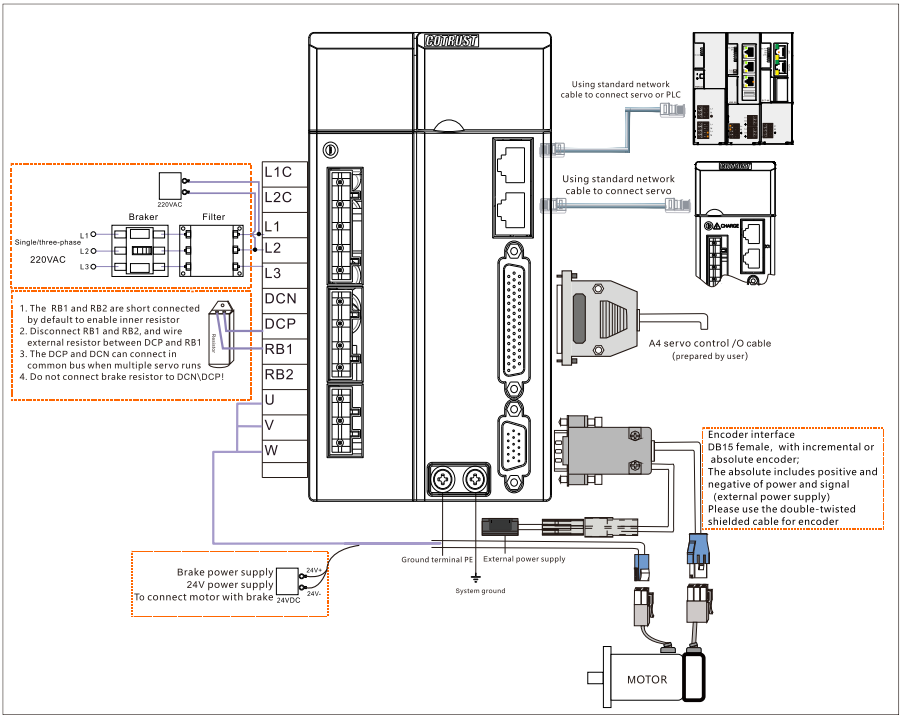


Figure 4-2 Schematic diagram of external port of size-C (220V) servo driver

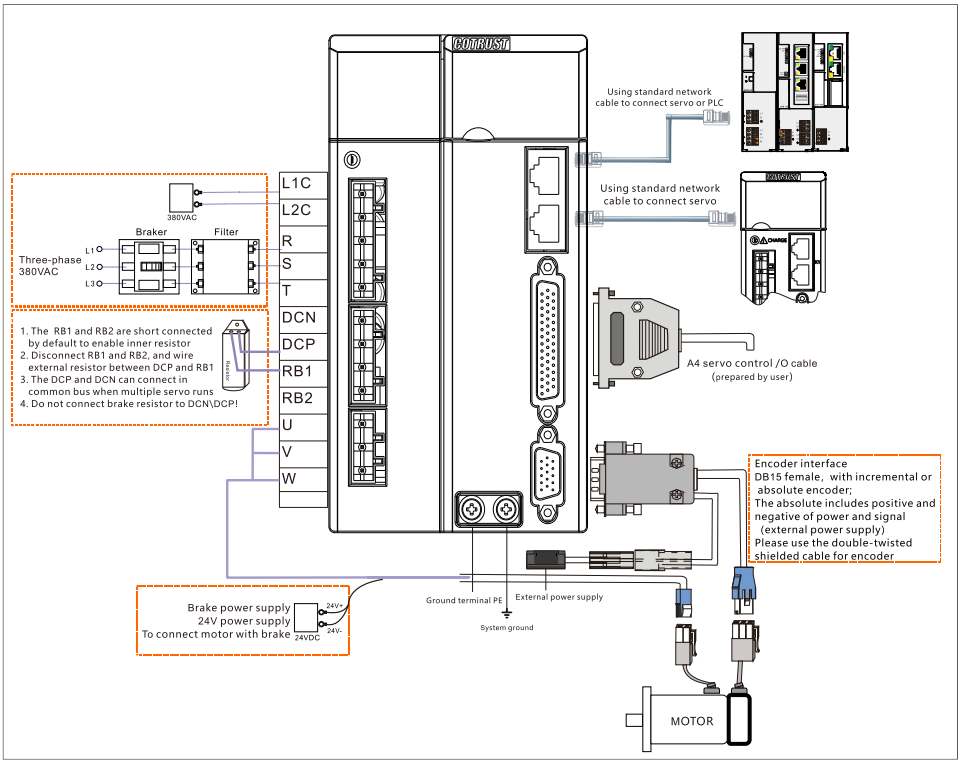


Figure 4-3 Schematic diagram of external port of size-C (380V) servo driver

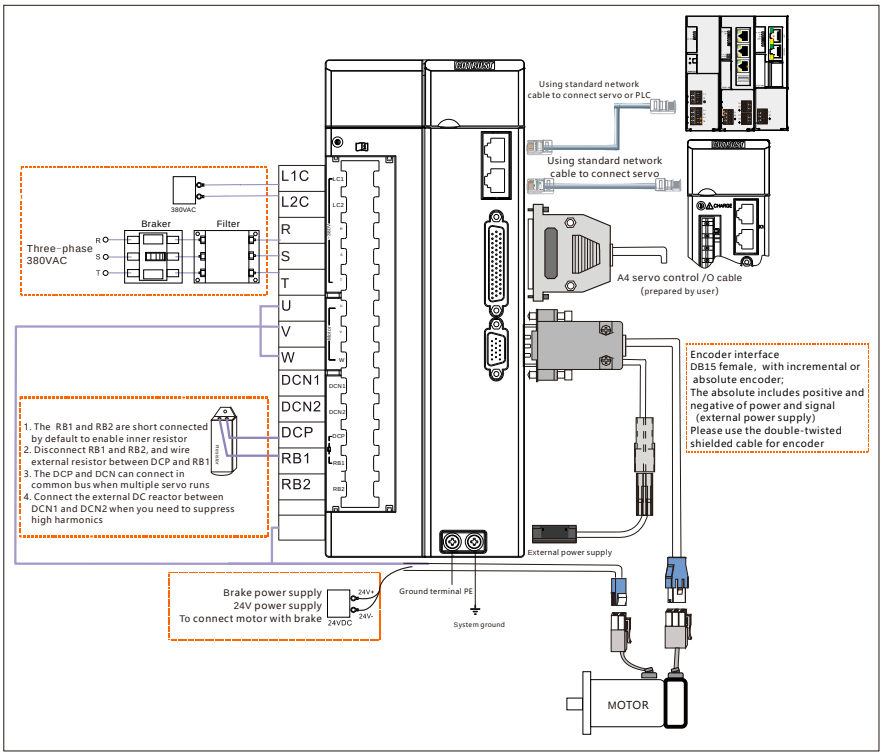
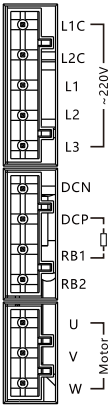


Figure 4-4 Schematic diagram of external port of size-E servo driver

4.1 Control Power Terminals

Terminals arrangement of Size-A/C (220V)

Terminal	Sign	Name	Description
	L1C	Single-phase power input of control circuit	Size-A/C(220V): Mark ~220V You can only connect L1 and L2 to AC220V for main circuit of size-A choosing single-phase power input while size-C can select any two in three phases
	L2C		
	L1	Single/three-phase power input of main circuit	
	L2		
	L3		
	DCN	DC bus negative	1 Use built-in resistance by default when RB1 and RB2 are shorted; 2 Remove the short wiring and connect the external braking resistance between DCP and RB1 when the built-in one is insufficient. 3 The DCP&DCN terminal can be connected in common bus while multiple servos running.
	DCP	DC bus positive	
	RB1	Brake resistance	
	RB2	Internal brake resistance	
	U	U phase of motor	
	V	V phase of motor	
	W	W phase of motor	

Caution

- It is suggested to filter noise for power supply to improve the anti-interference ability.
- It is suggested to install a non-fusible circuit breaker to cut off the external power supply when the driver fails.
- Use isolation transformer for power supply to avoid electric shock.
- PE terminal must be connected well with the ground of the electric cabinet. Do not connect multiple servos in series.
- Do not short connect built-in resistance between DCP and RB1/RB2, or the driver would be damaged.
- Do not short connect DCN and DCP, or the driver would be damaged.

Recommended list of external gadgets for driver:

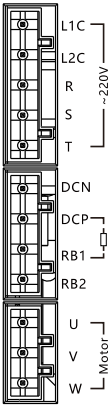
Diameter of main power cable: 1.5kW and below: ≥1mm^2/AWG17, recommend 1.6mm^2/AWG15

2.0kW/3.0kW: ≥2mm^2/AWG14, recommend 2.6mm^2/AWG13

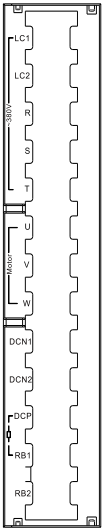
Noise filter: single/three phase filter

Rated voltage: AC 220V/380V, 50/60Hz

Terminals arrangement of size-C (380V)

<table>
<tr><th>Terminal</th><th>Sign</th><th>Name</th><th>Description</th></tr>
<tr><td rowspan="10"> 
</td><td>L1C</td><td rowspan="2">Single-phase power input of control circuit</td><td rowspan="5">Size-C(380V) : Mark ~380V</td></tr>
<tr><td>L2C</td></tr>
<tr><td>R</td><td rowspan="3">Three-phase power input of main circuit</td></tr>
<tr><td>S</td></tr>
<tr><td>T</td></tr>
<tr><td>DCN</td><td>DC bus negative</td><td rowspan="8">1 Use built-in resistance by default when RB1 and RB2 are shorted;
2 Remove the short wiring and connect the external braking resistance between DCP and RB1 when the built-in one is insufficient.
3 The DCP&DCN terminal can be connected in common bus while multiple servos running.</td></tr>
<tr><td>DCP</td><td>DC bus positive</td></tr>
<tr><td>RB1</td><td>Brake resistance</td></tr>
<tr><td>RB2</td><td>Internal brake resistance</td></tr>
<tr><td>U</td><td>U phase of motor</td></tr>
<tr><td>V</td><td>V phase of motor</td></tr>
<tr><td>W</td><td>W phase of motor</td></tr>
<tr><td>Caution</td><td colspan="3">· It is suggested to filter noise for power supply to improve the anti-interference ability.
· It is suggested to install a non - fusible circuit breaker to cut off the external power supply when the driver fails.
· Use isolation transformer for power supply to avoid electric shock.
· PE terminal must be connected well with the ground of the electric cabinet. Do not connect multiple servos in series.
· Do not short connect built-in resistance between DCP and RB1/RB2, or the driver would be damaged.
· Do not short connect DCN and DCP, or the driver would be damaged.</td></tr>
<tr><td colspan="4">Recommended list of external gadgets for driver:
Diameter of main power cable: 1.5kW and below:≥1mm^2/AWG17, recommend 1.6mm^2/AWG15
2.0kW/3.0kW: ≥2mm^2/AWG14, recommend 2.6mm^2/AWG13
Noise filter: three-phase filter
Rated voltage: AC 380V, 50/60Hz</td></tr>
</table>

Terminals arrangement of size-E

Terminal	Sign	Name	Description
	L1C	Single-phase power input of control circuit	Size-E: mark ~380V
	L2C		
	R	Three-phase power input of main circuit	
	S		
	T		
	U	U phase of motor	1 Use built-in resistance by default when RB1 and RB2 are shorted; 2 Remove the short wiring and connect the external braking resistance between DCP and RB1 when the built-in one is insufficient. 3 The DCP&DCN terminal can be connected in common bus while multiple servos running. 4 The DCN1 and DCN2 is normally shorted, when it is necessary to suppress the high harmonic of the power supply, remove the short line and connect the DC reactor externally between the two terminals.
	V	V phase of motor	
	W	W phase of motor	
	DCN1	DC bus negative 1	
	DCN2	DC bus negative 2	
	DCP	DC bus positive	
	RB1	Brake resistance	
	RB2	Internal brake resistance	

Caution	· It is suggested to filter noise for power supply to improve the anti-interference ability. · It is suggested to install a non-fusible circuit breaker to cut off the external power supply when the driver fails. · Use isolation transformer for power supply to avoid electric shock. · PE terminal must be connected well with the ground of the electric cabinet. Do not connect multiple servos in series. · Do not short connect built-in resistance between DCP and RB1/RB2, or the driver would be damaged.

Recommended list of external gadgets for driver:

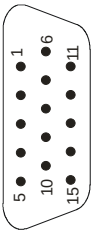
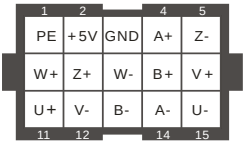
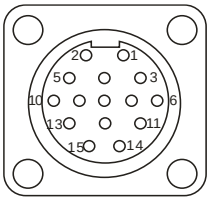
Diameter of main power cable: ≥2mm2/AWG14, recommend 2.6mm2/AWG13

Noise filter: three-phase filter

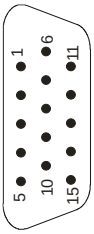
Rated voltage: AC 380V, 50/60Hz

4.2 Encoder Signal Terminal X3

The terminal arrangement of 2500-PPR incremental optical encoder motor:

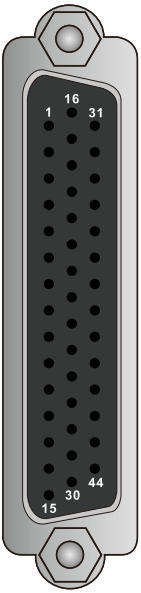
No.	Connector Terminal	Servo	Motor		Name
			Small inertia	Middle inertia	
X3	 Servo  Motor(small inertia)  Motor(middle inertia)	1	10	11	Hall signal V+
		2	6	12	Hall signal W+
		3	7	6	Encoder signal Z+
		4	4	4	Encoder signal A+
		5	9	5	Encoder signal B+
		6	12	14	Hall signal V-
		7	8	15	Hall signal W-
		8	5	9	Encoder signal Z-
		9	14	7	Encoder signal A-
		10	13	8	Encoder signal B-
		11	11	10	Hall signal U+
		12	15	13	Hall signal U-
		13	2		+5V power supply
		14	3		Power ground
		15	-		
		Shell	1		PE ground
Caution	• Do not short connect encoder PE ground wire with its signal wire, otherwise it may cause interference to servo and motor.				

The terminal arrangement of bus incremental/absolute encoder motor:

No.	Connector Terminal	Servo	Motor		Name
			Incremental	Absolute	
X3	 Servo  Motor(small inertia)  Motor(middle inertia)	1	6		SD signal+
		2	-		
		3	-		
		4	-		
		5	-	3	Battery BAT+
		6	4		SD signal-
		7	-		
		8	-		
		9	-		
		10	-	2	Battery BAT-
		11	-		
		12	-		
		13	7		+5V power supply
		14	5		Power ground 0V
		15	-		
		Shell	1		PE ground
Caution	• Do not short connect encoder PE ground wire with its signal wire, otherwise it may cause interference to servo and motor.				

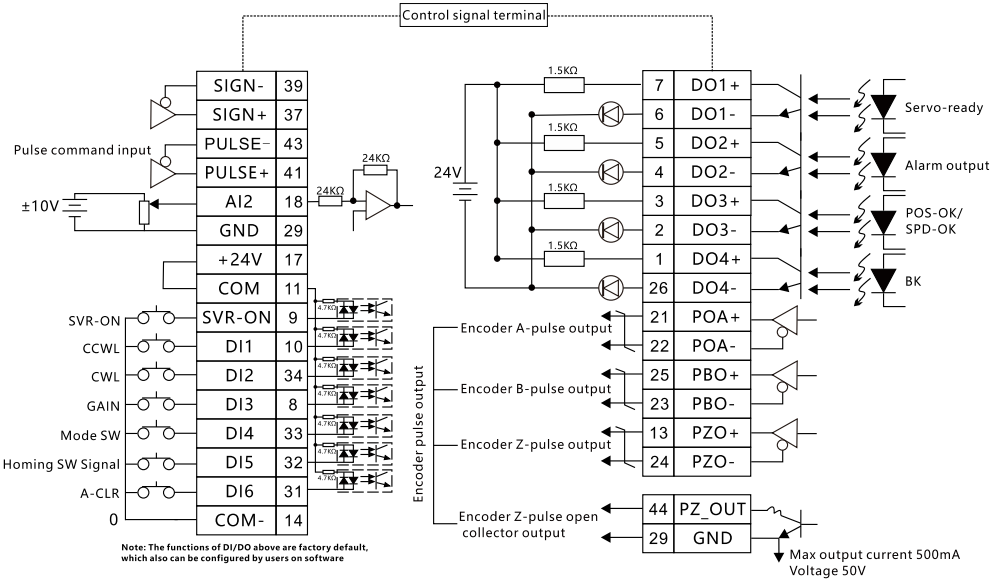
4.3 Control Signal Terminal X2

PIN definition of A4S series servo control signal terminal

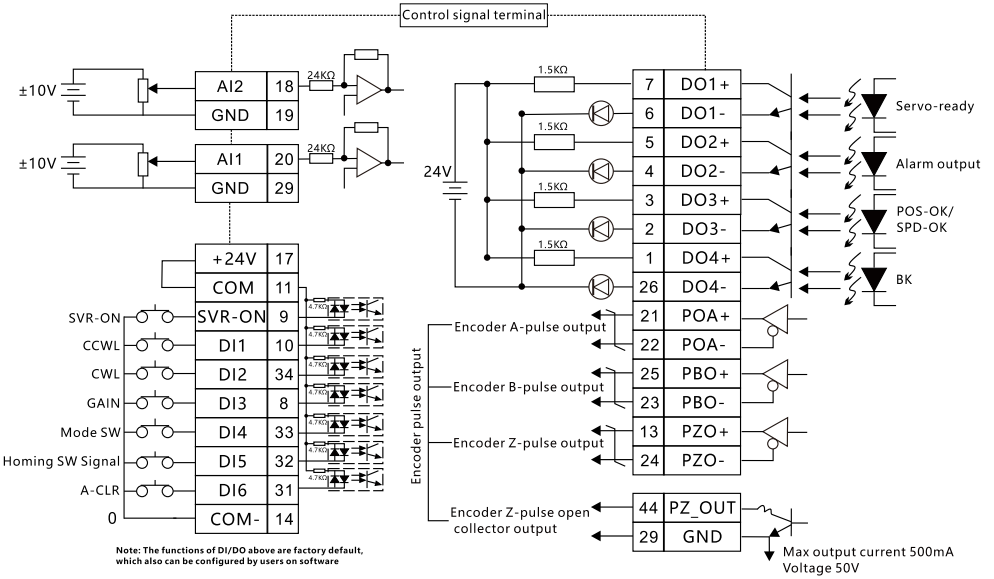
Terminal	PIN	Name	Definition	PIN	Name	Definition
	1	DO4+	Digital output 4+	23	PBO-	Encoder B-pulse output -
	2	DO3-	Digital output 3-	24	PZO-	Encoder Z-pulse output -
	3	DO3+	Digital output 3+	25	PBO+	Encoder B-pulse output +
	4	DO2-	Digital output 2-	26	DO4-	Digital output 4-
	5	DO2+	Digital output 2+	27	-	-
	6	DO1-	Digital output 1-	28	-	-
	7	DO1+	Digital output 1+	29	GND	Encoder Z pulse open collector output ground
	8	DI3	Digital input 3	30	-	-
	9	SRV-ON	Servo-on input	31	DI6	Digital input 6
	10	DI1	Digital input 1	32	DI5	Digital input 5
	11	COM	Common digital input	33	DI4	Digital input 4
	12	-	-	34	DI2	Digital input 2
	13	PZO+	Encoder Z-pulse output+	35	PULLHI	Command pulse power input
	14	COM-	Internal power supply 0V	36	-	-
	15	-	-	37	SIGN+	Pulse input direction +
	16	-	-	38	-	-
	17	+24V	Internal power supply +24V	39	SIGN-	Pulse input direction -
	18	AI2	Analogy input signal 2	40	-	-
	19	GND	Analogy input ground	41	PULSE+	Pulse input signal +
	20	AI1	Analogy input signal 1	42	-	-
	21	PAO+	Encoder A-pulse output +	43	PULSE-	Pulse input signal -
	22	PAO-	Encoder A-pulse output -	44	PZ_OUT	Encoder Z-pulse open collector output

4.3.1 Wiring of Servo System

Wiring diagram of position control mode (pulse input):



Wiring diagram of speed/torque control mode:



Notice

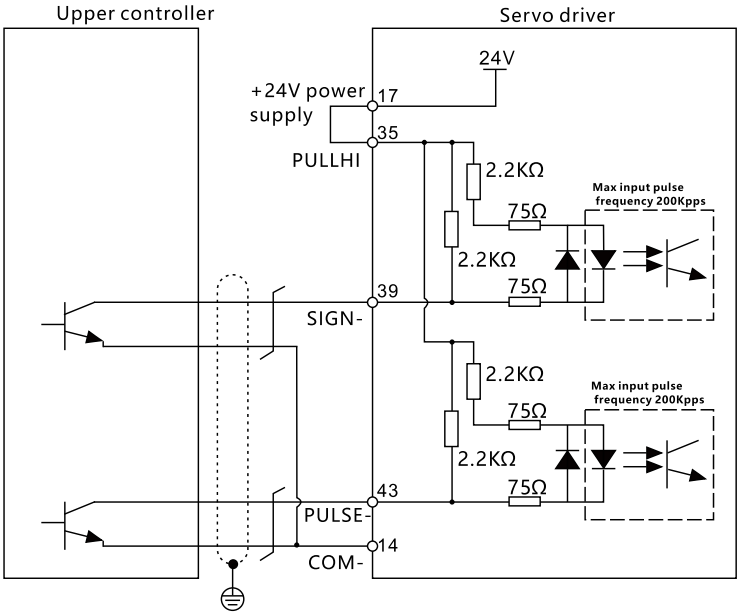
- The function of DIN in wiring diagram above is factory default, which also can be configured by user via software on PC, please refer to chapter 5.2 Definition and Configuration of Control Signal for more details.
- The allowable range of internal power +24V ranges from 20 to 28V and the maximum working current is 200mA.
- The DO output power, whose voltage ranges from 5 to 24V and the maximum allowable current is 200mA, should be provided by yourself.
- Please choose twisted shielded pair for the encoder frequency division output cable, and both ends of shielding must be grounded.

4.3.2 Pulse Command Input

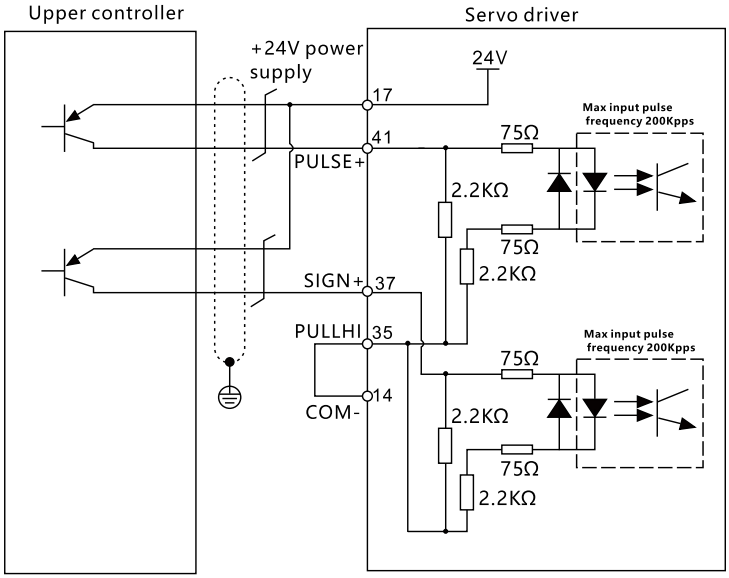
The mode of pulse command input can be open collector and differential drive, the maximum input pulse frequency of open collector mode is 200Kpps, and that of the latter is 500Kpps.

1. Open collector mode (wiring that use internal power is recommended)

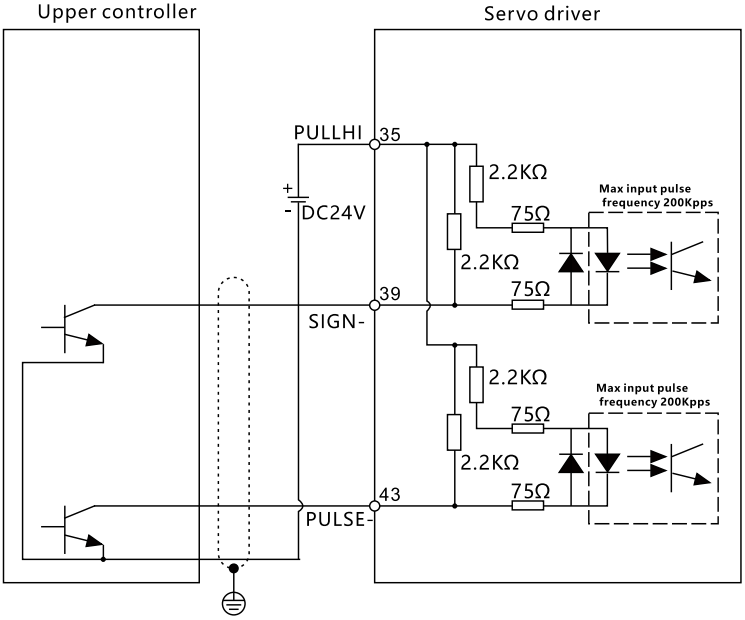
When host controller is type of OC NPN and with internal 24V power of servo:



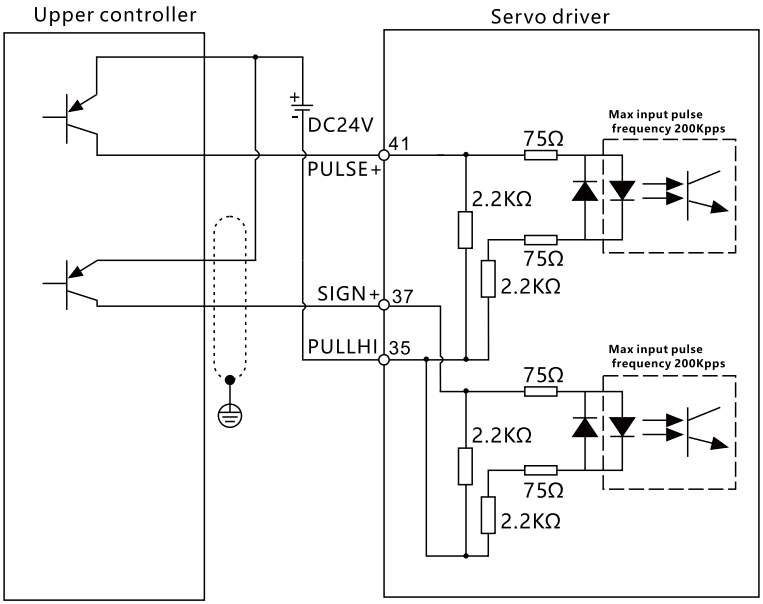
When host controller is type of OC PNP and with internal 24V power of servo:



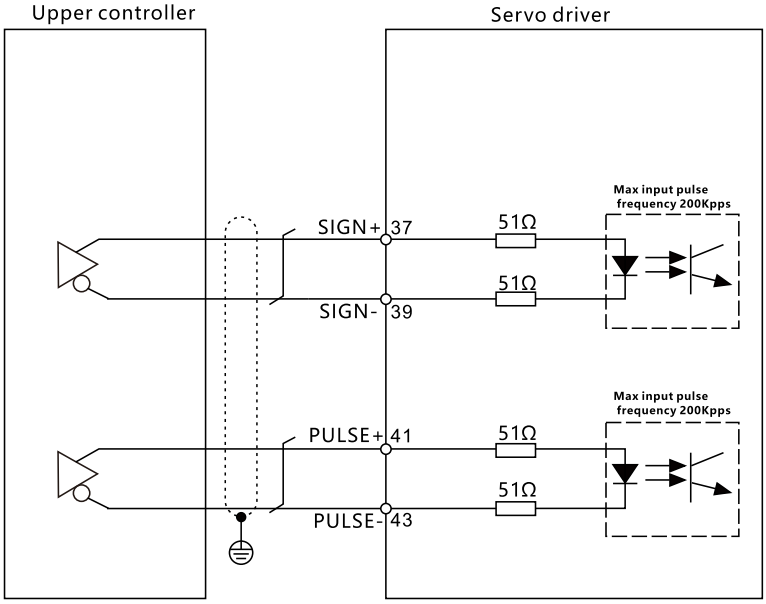
When host controller is type of OC NPN and with external 24V power of servo:



When host controller is type of OC PNP and with external 24V power of servo:



2. Differential drive mode (do not input 24V power for the system is 5V)

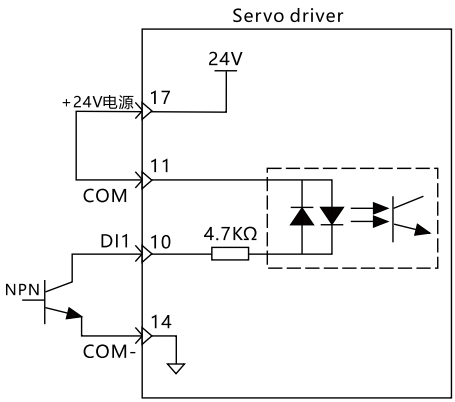


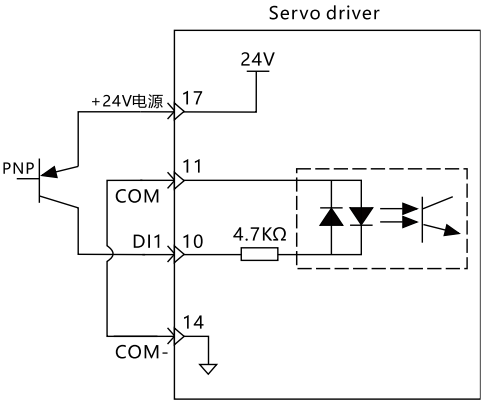
4.3.3 Digital Input and Output

The input voltage range between COM and the signal point is 12V~24V (for contact input, please use special switch and relay for microcurrent to avoid bad contact) to ensure the effective of control signal input. The maximum output voltage of transistor is 30V, 100mA and the recommended current output is 10mA.

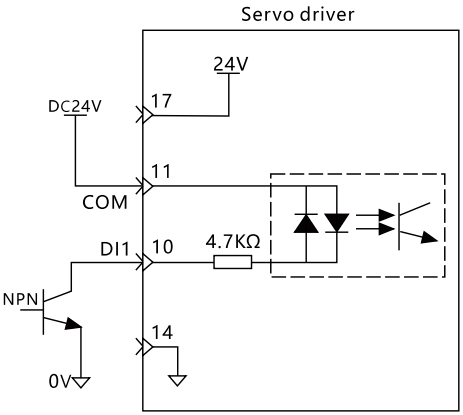
1. DI circuit

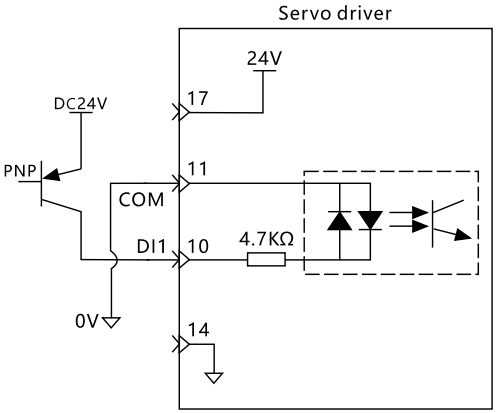
With internal 24V power:



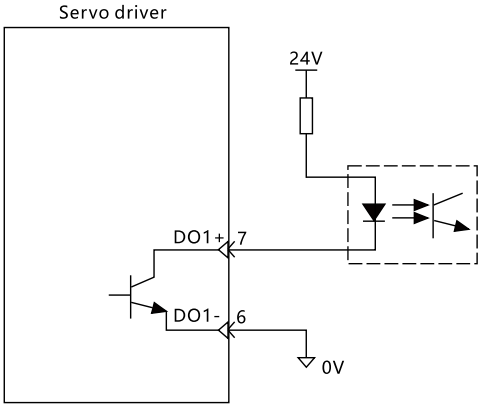


With external 24V power:





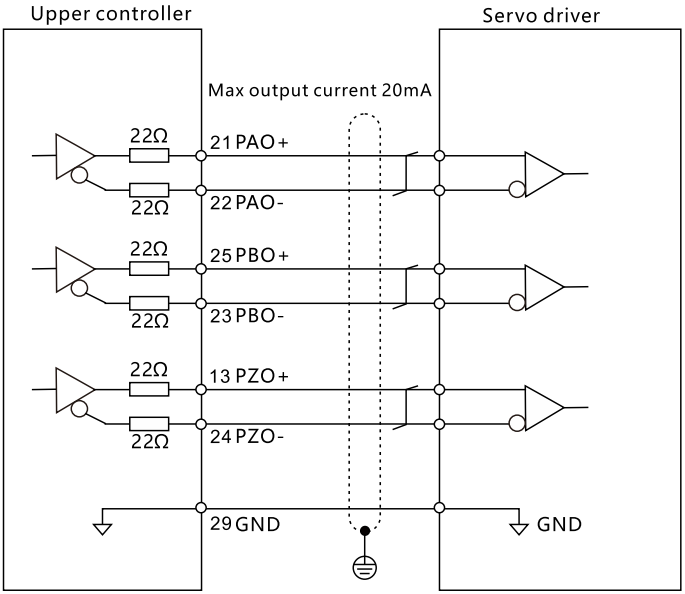
2. DO circuit(take DO1 as an example)



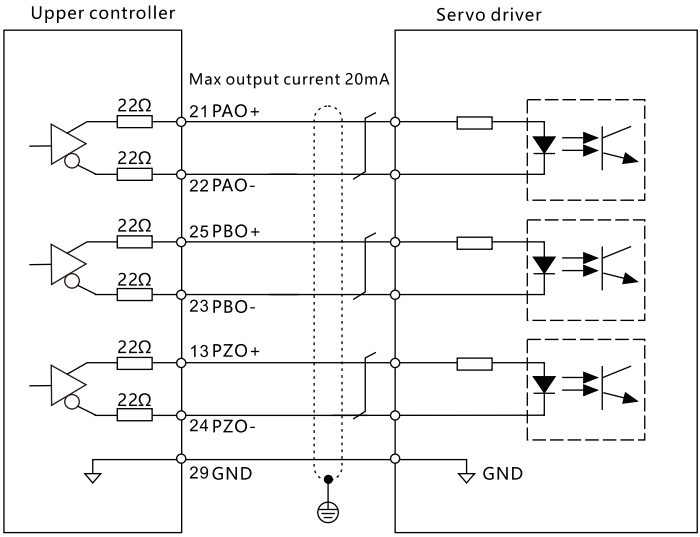
4.3.4 Encoder Frequency-division Output

The encoder frequency-division output circuit outputs the differential signal through the differential driver, which provides feedback signal when forming the position control system for the upper device. Differential or optocoupler receiving circuits are used to receive signals in the upper device, with the maximum of 20mA.

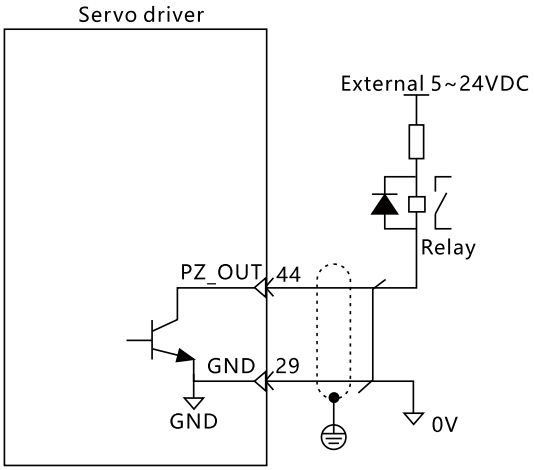
Signal received by differential circuit:



Signal received by optocoupler circuit:



Encoder Z-phase division output circuit outputs signal through open collector which provides feedback signal to upper device when forming position control system. Please use optical coupling circuit, relay circuit or bus receiving circuit to receive.



4.4 Communication Ports and Switch of Terminal Resistor

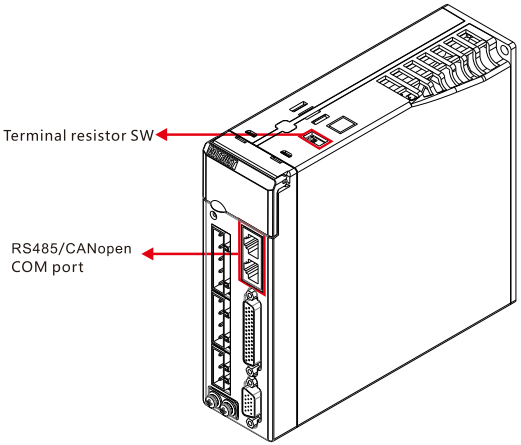


Figure 4-5 communication ports and switch of terminal resistor

The physical communication serial port of A4S series servo is RJ45 port which supports protocol of Modbus and CANopen, refer to the table below for PIN definition:

RJ45 PIN	CAN signal	Definition
1	CAN_H	CAN signalling+
2	CAN_L	CAN signalling -
Shell	PE	Shell ground
RJ45 PIN	**RS485 signal**	**Definition**
4	RS485+	RS485 signalling +
5	RS485-	RS485 signalling -
Shell	PE	Shell ground

notice

To prevent communication failure, please set the check value to odd or even parity and avoid setting it to no check when choosing RS485 communication.

How to make standard network cable connector

The connector of network cable is made according to 568B standard, which use the blue and white-blue lines for RS485 communication (the longest communication distance of double-twisted network cable is up to 500m, but 300m is recommended for normal use).

Similarly, use white-orange and orange for CANopen communication at the other end. The maximum communication distance of baud rate set by P11 (CANopen baud rate configuration) shows as the following table:

Setting of P11	Communication speed(Kbit/s)	Max. communication distance(m)
1	1000	25
2(reserved)	800	50
3	500	100
4	250	250
5	125	500
6	50	1000
7(reserved)	20	2500

Notice

- Baud rates of 20kbps and 800kbps are not supported now.
- The max. communication distance in table above may be shorter for external factors.

See figure 4-7 for the way to make CANopen/RS485 cable connector:

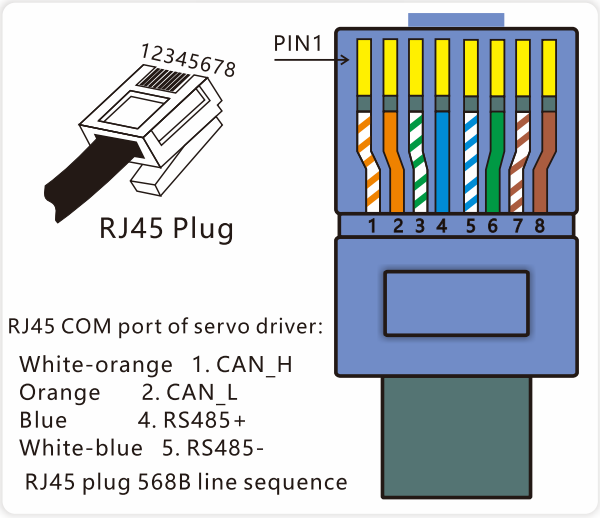
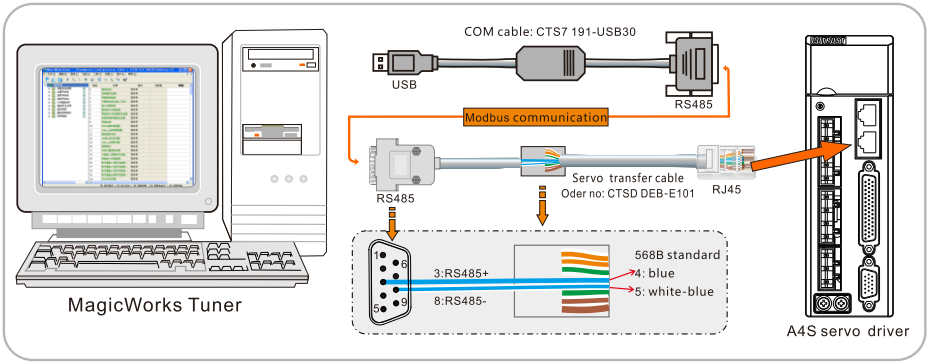


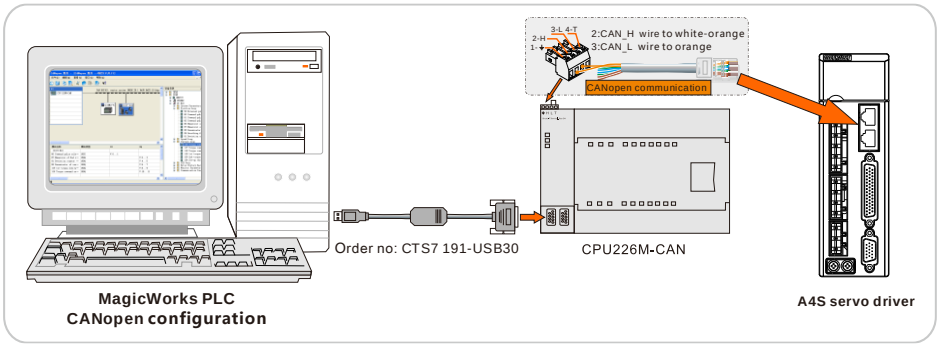
Figure 4-7 CANopen/RS485 cable connector

Connecting host controller with A4S servo

◆ Wiring of Modbus communication

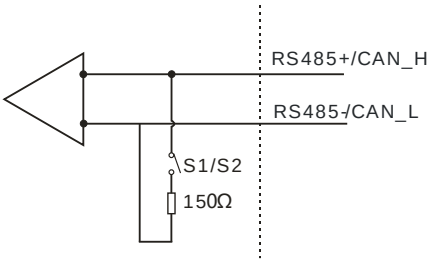


◆ Wiring of CANopen communication



Setting terminal resistor

Matching terminal resistor is to eliminate or shield the signal reflection caused by discontinuity or mismatch of impedance in communication cable. S2 is the terminal resistor of CANopen communication while S1 is that of RS485, see picture below:



To improve the reliability of the communication, the two ends of the communication bus cable must be limited and parallel a terminal resistor between the servo CAN_L and CAN_H when constructing CANopen network. The figure below shows how to set terminal resistor between A4S servo and the CPU 226M-CAN of COTRUST.

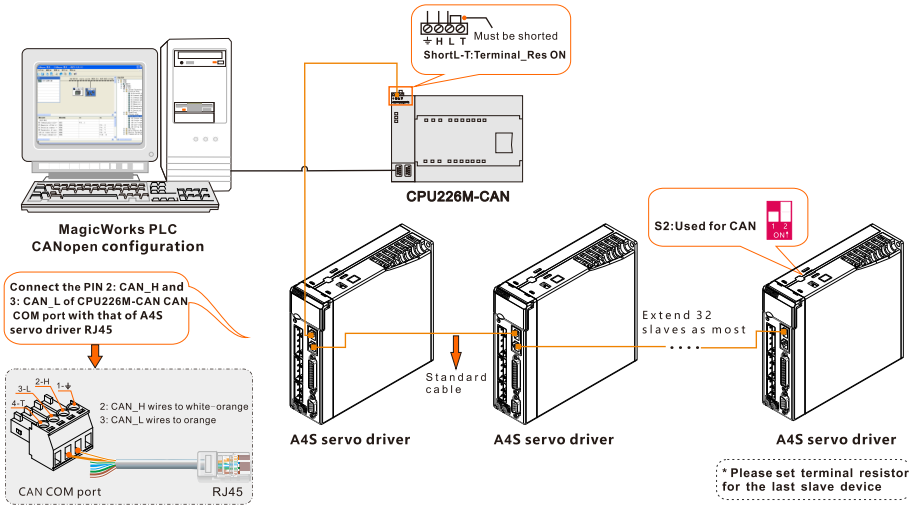
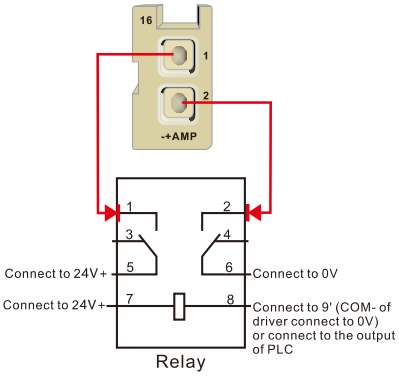
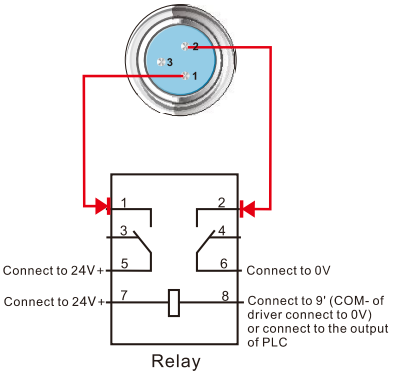


Figure 4-8 Set the terminal resistor

4.5 Wiring of Motor Brake

Motor specifications	Wiring diagram
Power consumption: 100W/200W/400W Voltage: 24V Wiring: 1→24V, 2→0V	
Power consumption: 750W/1.0kW/1.5kW/2.3kW/ 3.0kW (AC 380V)/4.5kW/5.5kW/7.5kW Voltage: 24V Wiring: 1→24V, 2→0V, 3→none	

Notice

Please connect the control end of the brake by relay (control end: DC24V, with load capacity greater than or equal to 1A) and parallel a Schottky diode (recommend model 1N4148, package: DO-35 glass, inserted) at the control end of the relay. Refer to chapter 4.3.1 Wiring of Servo System for wiring

5

The Given Control Signal

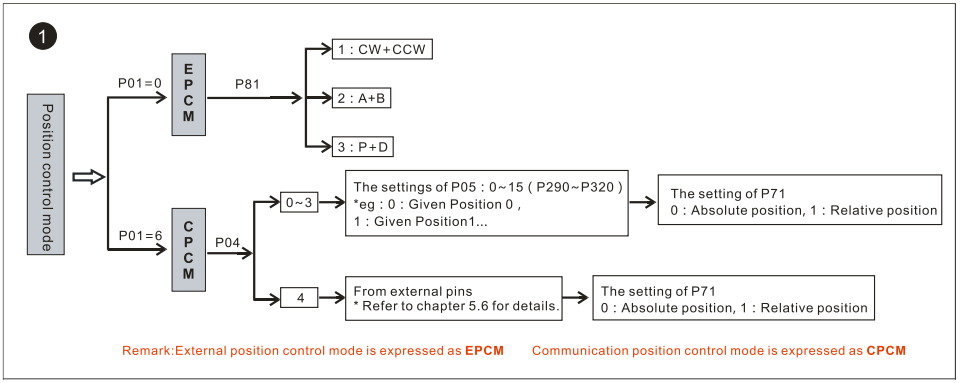
*I/O signal, communication and external command

5 The Given Control Signal

DI/DO signals, communication/external command and its function

5.1 Input of Given Command

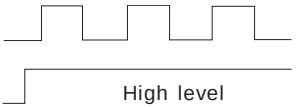
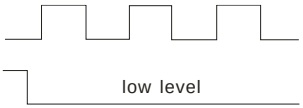
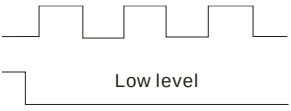
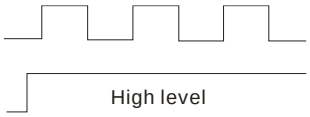
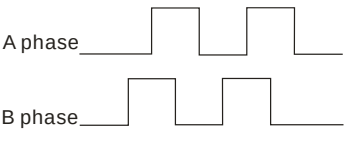
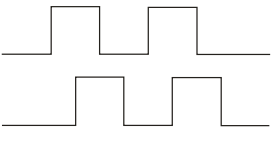
◆ Position control mode:



Note:

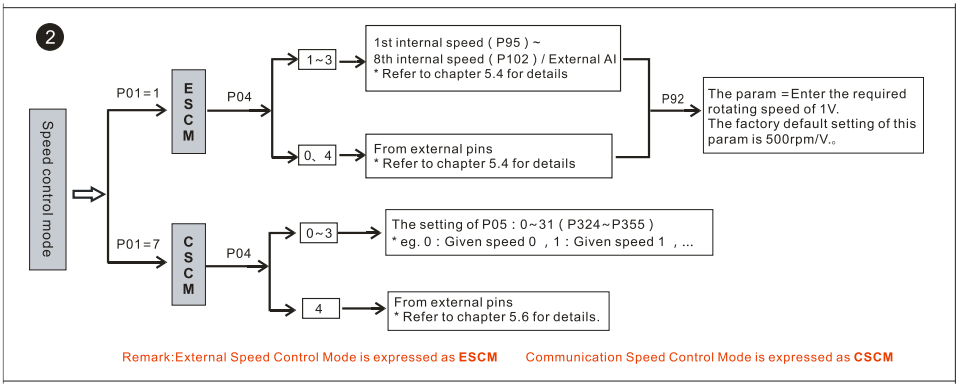
1) First trigger start-signal to have the given position command to take effect when selecting relative position control.

2) Set the corresponding direction and form of pulse according to the type of input instruction pulse:

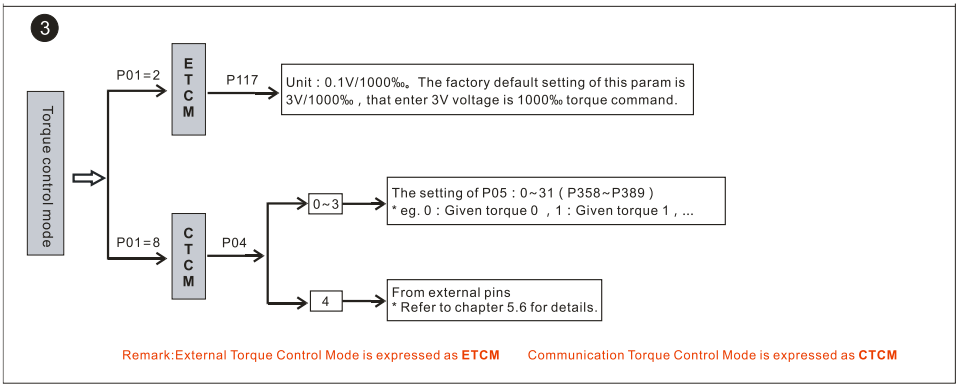
P81	P80	CCW	CW
3	0		
	1		
2	0		

P81	P80	CCW	CW
2	1	A phase B phase B-phase delays from A-phase by 90 degrees	B-phase advances A-phase by 90 degrees
1	0	CW CCW	
	1	CW CCW	

◆ Speed control mode:



◆ Torque control mode:



5.2 Definition and Configuration of Control Signal

The configuration of DI/DO signals and the command sources of external and communication control mode are described in detail below.

5.2.1 Function Selection of DI

Parameter P73 decides the distribution of PIN and the source of command.

No.	Definition	Value	Definition of parameter		Remark
			Communication control	External control	
P73	Source of command	0	From P281 communication extension control Word (Default)	From external DI signal (Default)	Related to control mode
		1	From external DI signal (Default)	From external DI signal (Default)	Unrelated to control mode
		2	From external DI signal (Decide by P75/76/77/78)	From external DI signal (Decide by P75/76/77/78)	
		3	From P281 communication extension control (Default)	From P281 communication extension control (Default)	
		4	From external DI signal or P281 (Decide by P75/76/77/78)	From external DI signal or P281 (Decide by P75/76/77/78)	

P73 is mainly used to select some of the control command source of both external(P01=0~5) and communication (P01=6~11) position/speed/torque control mode, which include Alarm-clear, C-mode, ZSPD(ST)/Pos LCK(P), DIV(DiP)/M-CMD Startup(Cm), Homing CMD, INH(DiP)/INSPD4(Cm), GAIN, CL(P), INSPD1~ INSPD3 and TL-SEL. The sensor signals include CCW and CW overtravel inhibit signal, which must come from the external DI input instead of given by communication.

<Note> The value of P73 makes no difference on both sensor signal and servo-on.

◆ When P73=0, the command of external control mode is from outside DI signal, and the PIN function is assigned by default. The command for communication control mode comes from P281 (communication extension control word).

◆ When P73=1 or 2, the command of both external and communication mode comes from outside DI signal while the P281 is ineffective. There is difference of PIN distribution when setting P73 as 1 and 2, the PIN distributed by default when P73=1 but decided by P75\76\77\78 when P73=2.

◆When P73=3, the command of both external and communication mode comes from outside DI signal or P281(communication extension control word), but the input signal of sensor(CCW and CW overtravel inhibit signal) is still from outside with PIN distributed by default.

◆When P73=4, the command of both external and communication mode comes from P281(communication extension control word), the function works for any one of them. For example, when P73=4, set P78_Bit0~7 to 16#07 as the PIN contribution decided by P75\76\77\78 which means to distribute DIN1 as homing command input, the servo will be in homing mode when DIN1 input is effective. The homing mode also can be reached when writing 1 to P281_Bit7, homing command works for any of the control command.

1) Default configuration of DI

PIN	Name	Position mode	Speed mode	Torque mode
9	SERV-ON	SERV-ON		
10	DIN1	CCW overtravel inhibit signal		
34	DIN2	CW overtravel inhibit signal		
8	DIN3	GAIN		
33	DIN4	Homing CMD		
32	DIN5	Homing SW signal		
31	DIN6	Alarm-clear		

2) Configuration decided by P75\76\77\78

When P73=2 or 4, the high 8-bit and low 8-bit of P75, P76, P77 and P78 determine 7 PIN functions, which be configured by writing the corresponding function codes to the high and low bytes of these four parameters. Each byte must be set correctly so that the function can be implemented normally.

Parameter	Bit No.	PIN	Name	Function code
P75	B0~B7	9	SRV_ON	16#00: No distribution 16#01: Alarm-clear 16#02: CCW overtravel inhibit signal 16#03: CW overtravel inhibit signal 16#04: C-mode 16#05: ZSPD(ST)/Pos LCK(P) 16#06: DIV(DiP)/M-CMD Startup(Cm)
P76	B8~B15	31	DIN6	
	B0~B7	32	DIN5	

Parameter	Bit No.	PIN	Name	Function code
P77	B8~B15	33	DIN4	16#07: Homing CMD 16#08: INH(DiP)/INSPD4(Cm) 16#09: GAIN 16#0A: CL(P) RotateDir(mode of speed and torque) 16#0B: Homing SW signal 16#0C: INSPD1 16#0D: INSPD 2 16#0E: INSPD 3 16#0F: TL-SEL 16#10: Communication(P) 16#12: JOG run in CW 16#13: JOG run in CCW **<Note>** P75 is effective only when P16=1, it is just used for SRV_ON when P16=0.
	B0~B7	8	DIN3	
P78	B8~B15	34	DIN2	
	B0~B7	10	DIN1	

※Example:

Set the function of DIN1~DIN4 as CCW overtravel inhibit signal, CW overtravel inhibit signal, Homing SW signal and Homing CMD respectively in external position control mode. Find the function code in the table above to match the low-bit with high-bit, and write P77 into 16#070B, write P78 into 16#0302.

Notice

1) The servo will alarm if some PINs being distributed same function (P202 error code is 16).

2) Zero bytes for any of the parameters does not assign the corresponding control function to the pin when setting P75~P78, it is allowed to assign multiple PINs 0.

5.2.2 Configuration for DI Signal to Take Effect

1) Default Servo-on of external control mode: servo on if the external DI SRV_ON PIN input is valid; default Servo-on of communication control mode: servo on if P16=1 (enable the moment power on) or P282_Bit0=1. In order to force servo to shutdown when the communication is abnormal, please refer to the table below for setting method:

<table>
<tr><th colspan="2">Parameter</th><th>Bit0</th><th>Communication control mode</th><th>External control mode</th></tr>
<tr><td rowspan="2">P16=0</td><td rowspan="2">P72</td><td>0</td><td>
<table>
<tr><th>Servo on (Pin9)</th><th>Enable COM (P282_bit0)</th><th>Servo status</th></tr>
<tr><td>0</td><td>0</td><td>Off</td></tr>
<tr><td>0</td><td>1</td><td>On</td></tr>
<tr><td>1</td><td>0</td><td>Off</td></tr>
<tr><td>1</td><td>1</td><td>Off</td></tr>
</table>
</td><td>
<table>
<tr><th>Servo on (Pin9)</th><th>Enable COM (P282_bit0)</th><th>Servo status</th></tr>
<tr><td>0</td><td>0</td><td>Off</td></tr>
<tr><td>0</td><td>1</td><td>Off</td></tr>
<tr><td>1</td><td>0</td><td>On</td></tr>
<tr><td>1</td><td>1</td><td>Off</td></tr>
</table>
</td></tr>
<tr><td>1</td><td>
<table>
<tr><th>Servo on (Pin9)</th><th>Enable COM (P282_bit0)</th><th>Servo status</th></tr>
<tr><td>0</td><td>0</td><td>Off</td></tr>
<tr><td>0</td><td>1</td><td>Off</td></tr>
<tr><td>1</td><td>0</td><td>Off</td></tr>
<tr><td>1</td><td>1</td><td>On</td></tr>
</table>
</td><td>
<table>
<tr><th>Servo on (Pin9)</th><th>Enable COM (P282_bit0)</th><th>Servo status</th></tr>
<tr><td>0</td><td>0</td><td>Off</td></tr>
<tr><td>0</td><td>1</td><td>Off</td></tr>
<tr><td>1</td><td>0</td><td>On</td></tr>
<tr><td>1</td><td>1</td><td>On</td></tr>
</table>
</td></tr>
<tr><td>P16=1</td><td>/</td><td>/</td><td colspan="2">Servo on the moment power on, you can also write 1 to P281_Bit0 by communication mode to make servo off.</td></tr>
</table>

※Example:

Servo on when P72_Bit0=0 and P282_Bit0=1(but off when the input of PIN9 is effective) or when P72_Bit0=1 and P282_Bit0=1 as well as the input is effective in communication control mode.

2) P72 that offers the configuration for DI signal to take effect is provided in order to be compatible with different sensors.

DI signal configured by P72:

Parameter	Bit	Function	Definition	Default
P72	0	Servo-on	0: The communication and PIN can't enable at the same time. 1: Enable PIN for any mode, enable communication on communication mode.	0
	2	CCW overtravel inhibit signal	0: External input-off is effective 1: External input-on is effective	0
	3	CW overtravel inhibit signal		0
	5	ZSPD(ST)		0
	8	INH(DiP)		0
	11	Homing SW signal	0: External input-on is effective; 1: External input-off is effective	0

※Example:

The external CCW and CW overtravel inhibit signal, ZSPD(ST), INH(DiP) and Homing SW signal are all conduction effective, then just set Bit2 of P72 as 2#1, Bit3 as 2#1, Bit5 as 2#1, Bit8 as 2#1 and Bit11 as 2#0.

5.2.3 Function Selection of DO

The DO PIN configurations in chapter above are factory default, you can also configure function of DOUT1~DOUT4 by software on PC or servo. Different from DI, the function of DO can just be set by P79, table below shows the function code of its Bit:

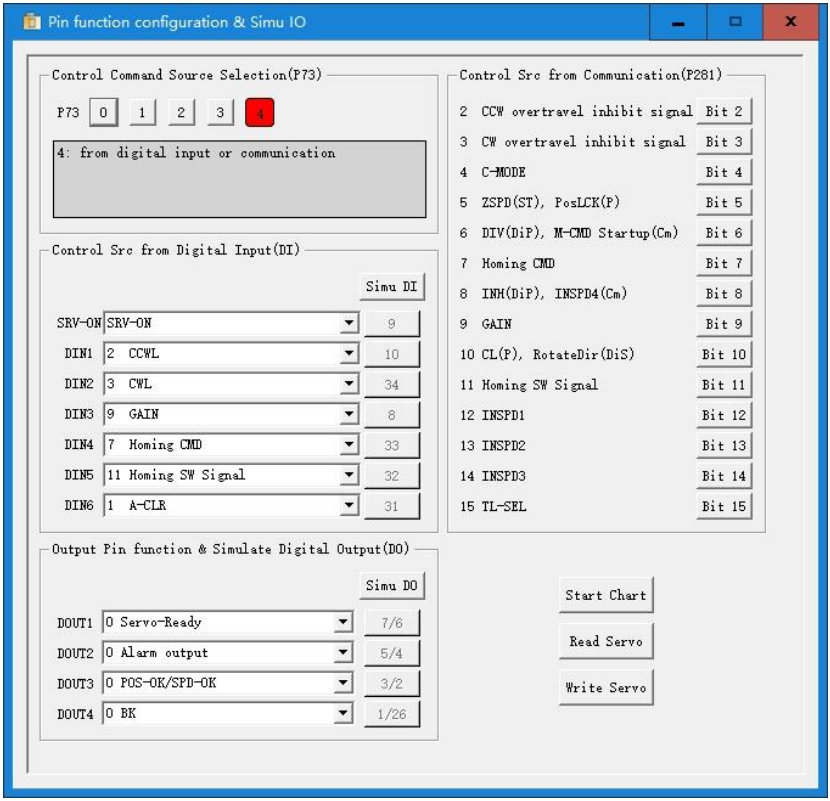
Definition of DO function					
Parameter	**Bit No.**	**PIN**	**Name**	**Position mode**	**Speed/torque mode**
P79	Bit0~1	6/7	DOUT1	0: Servo on	
	Bit2~3	5/4	DOUT2	0: Alarm output 1: Setting of P8	
	Bit4~5	3/2	DOUT3	0: POS-OK	0: SPD-OK
	Bit6~7	1/26	DOUT4	0: BK release 1: Setting of P9	

Note: Please refer to parameter P8 and P9 to configure TLC and ZSP.

5.2.4 Configuration of PIN and Analogy IO

Steps to configure PIN and analogy IO of servo by MagicWorks Tuner shows as below:

Step 1: Choose “I/O” in the menu of main interface to open the configuration window:



Step 2: Select the PIN contribution and command source by P73:

No.	Definition	Value	Definition of parameter		Remark
			Communication control	External control	
P73	Source of command	0	From P281 communication extension control Word (Default)	From external DI signal (Default)	Related to control mode
		1	From external DI signal (Default)	From external DI signal (Default)	Unrelated to control mode
		2	From external DI signal (Decide by P75/76/77/78)	From external DI signal (Decide by P75/76/77/78)	
		3	From P281 communication extension control (Default)	From P281 communication extension control (Default)	
		4	From external DI signal or P281 (Decide by P75/76/77/78)	From external DI signal or P281 (Decide by P75/76/77/78)	

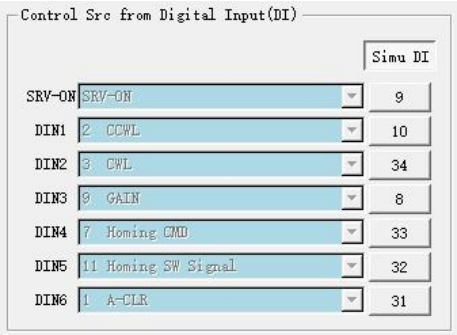
Step 3: Please refer to chapter 5.2.1 Function Selection of DI for configuration of

DIN1~DIN6 and chapter 5.2.3 Function Selection of DO for configuration of DOUT1~DOUT4.

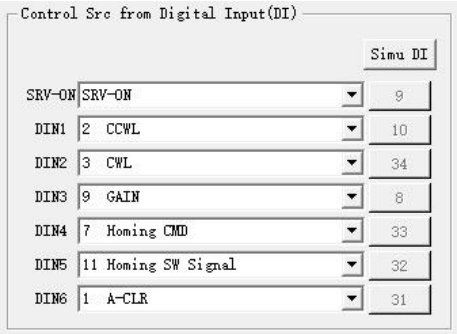
Step 4: Click the "Write Servo" to write the configuration into corresponding parameter after setting the PIN function, so that the function becomes effective.

Step 5: Click "Simu DI" or "Simu DO" to start the analogy function, meanwhile the option becomes unchangeable.

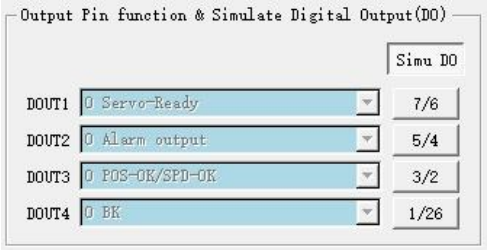
The fixed PIN (9, 10, 34, 8, 33, 32 and 31) can be clicked after starting "Simu DI", which effect the input of DIN1~DIN6.



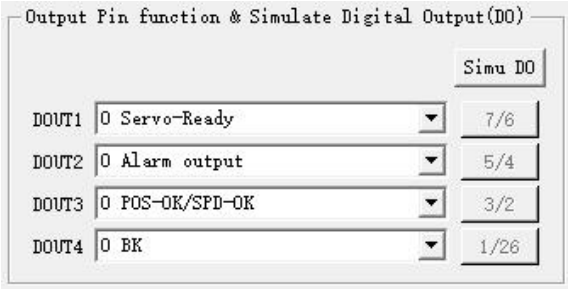
Stop "Simu DI", the inputs of DIN1~DIN6 come from external PIN.



The fixed PIN (7/6, 5/4, 3/2 and 1/26) can be clicked after starting "Simu DO", which effects the output of DOUT1~DOUT4.



Stop “Simu DO”, the outputs of DOUT1~DOUT4 vary from current condition of servo.



Note:

- Clicking “Start Chart” to monitor in real-time when the analogy DI or DO is off.
- Clicking “Read Servo” to read the configuration of control mode and PINs function from target device.
- Clicking “Write Servo” to write all the configuration into the target device.

5.3 Control Signal

The details of two different control methods of A4S series servo, which are external and communication, show as below:

Signal	Name	Status Bit	Function
Power of control signal	COM	/	● Common port of control signal Input voltage range: DC12V~24V
	COM-	/	● Common port of positive of control signal
Servo on	SRV-ON	P282_Bit0 P16	● To enable servo ● Use external IO to control servo on when it is external control mode. ● Use P282_Bit0 to control servo on when it is communication control mode. ● Servo on the moment power on when P16=1. ● Do not use this signal to start or stop motor ● The protection setting is added for easier to control servo, see details in chapter 5.2.2 Configuration for DI Signal to Take Effect ● The P216 user coordinate position will be written into P212 total pulse action in the status of servo-on to prevent motor rotation.

<table>
<tr><th>Signal</th><th>Name</th><th>Status Bit</th><th>Function</th></tr>
<tr><td>CCW overtravel inhibit signal</td><td>CCWL</td><td>P281_Bit2</td><td>● The limits of outside and communication are both controlled by external IO.
● To input the limit signal of CCW direction.
● To set the low and high level of effective input, see chapter 5.2.2 Configuration for DI Signal to Take Effect for details.
● The limit is ineffective when P03=1.
● Use P126 to select the action when CCWL input is effective.
● The alarm of limit come into force the moment servo on</td></tr>
<tr><td>CW overtravel inhibit signal</td><td>CWL</td><td>P281_Bit3</td><td>● The limits of outside and communication are both controlled by external IO, set Bit2~3 of P78 to 0 first
● To input the limit signal of CW direction.
● To set the low and high level of effective input, see chapter 5.2.2 Configuration for DI Signal to Take Effect for details.
● The limit is ineffective when P03=1.
● Use P126 to select the action when CWL input is effective.
● The alarm of limit come into force the moment servo on</td></tr>
<tr><td>DIV(DiP)</td><td>DIV</td><td>P281_Bit6</td><td>● The first or second molecule of DIV (DiP) can be selected in position control mode. When effective, the molecule becomes P87 (the 2nd) from P86 (the first).
● Ineffective when it is communication control mode.</td></tr>
<tr><td>Gain switch input</td><td>GAIN</td><td>P281_Bit9</td><td>Use P60 to set function of this signal. See chapter 12.5 Gain Switching for details.
<table>
<tr><th>P60</th><th>DI/Bit9</th><th>Function</th></tr>
<tr><td rowspan="2">0</td><td>Invalid /0</td><td>Speed circle: PI action</td></tr>
<tr><td>Valid /1</td><td>Speed circle: P action</td></tr>
<tr><td rowspan="3">1</td><td colspan="2">When P61=2:</td></tr>
<tr><td>Invalid /0</td><td>Select the first setting</td></tr>
<tr><td>Valid /1</td><td>Select the second setting</td></tr>
</table></td></tr>
<tr><td>Torque limit selection</td><td>TL-SEL</td><td>P281_Bit15</td><td>● To input the signal of TL-SEL
● Invalid when P02 (torque limit selection) =3 while P119 (the first limit) is effective; P120 (the second torque limit) is valid if the signal is effective.</td></tr>
</table>

<table>
<tr><th>Signal</th><th>Name</th><th>Status Bit</th><th>Function</th></tr>
<tr><td>Pulse prohibit</td><td>INH</td><td>/</td><td>● To prohibit the input of INH signal.
● The input of INH signal will be shielded when signal is invalid.
● Invalid when P82(invalid set of INH) =1
Note: Invalid in communication control mode.</td></tr>
<tr><td>Origin switch input</td><td>ORG_SW</td><td>P281_Bit11</td><td>● Origin switch input when starting homing.
● To set the low and high level of effective input, see chapter 5.2.2 Configuration for DI Signal to Take Effect for details.
● Servo will enter homing mode when the signal is valid in status of servo-on, see chapter 10.1 Homing Function for details</td></tr>
<tr><td>Control mode switch</td><td>C-MODE</td><td>P281_Bit4</td><td>● Please refer to table below for control modes switch if P01(control mode selection) is set as 3~5 or 9~11:
<table>
<tr><th>P01</th><th>DI ineffective
Select the first mode</th><th>DI effective
Select the second mode</th></tr>
<tr><td>3</td><td rowspan="2">External position control</td><td>External SPD control</td></tr>
<tr><td>4</td><td rowspan="2">External Torque control</td></tr>
<tr><td>5</td><td>SPD control</td></tr>
<tr><td></td><td>Select first mode when P281_Bit4=0</td><td>Select second mode when P281_Bit4=1</td></tr>
<tr><td>9</td><td rowspan="2">Communication position control</td><td>Communication SPD control</td></tr>
<tr><td>10</td><td rowspan="2">Communication Torque control</td></tr>
<tr><td>11</td><td>Communication SPD control</td></tr>
</table></td></tr>
<tr><td>Position error clear</td><td>CL</td><td>P281_Bit10</td><td>● To clear deviation counter when effective
● Ways to reset by P91
<table>
<tr><th>P91</th><th>Function</th></tr>
<tr><td>0</td><td>Reset when short connect CL with COM- or P281_Bit10=1</td></tr>
<tr><td>1</td><td>Reset for one time when short connect CL with COM- or P281_Bit10=1</td></tr>
<tr><td>2</td><td>Exclude this function</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Signal</th><th>Name</th><th>Status Bit</th><th>Function</th></tr>
<tr><td>Homing command</td><td>Homing</td><td>P281_Bit7</td><td>

Use to enter homing for servo
Valid when inputting rising edge, and it is invalid when the servo is off.
Output status bit after homing finished and P204_Bit10 will be set as 1
The host controller must clear homing command after it finished then the servo allows instruction input.
Select homing mode by P59, see chapter 10.1 Homing Function

</td></tr>
<tr><td>ZeroSPD</td><td>ZeroSPD</td><td>P281_Bit5</td><td>

Valid in the mode of speed and torque control mode
To input the ZeroSPD, and the servo torque is 0

<table>
<tr><th>P06</th><th>DI</th><th>Function</th></tr>
<tr><td>0</td><td>/</td><td>Invalid signal</td></tr>
<tr><td rowspan="2">1</td><td>Invalid</td><td>SPD command is 0</td></tr>
<tr><td>Valid</td><td>Running</td></tr>
</table>
</td></tr>
<tr><td>Position lock</td><td>PosLock</td><td>P281_Bit5</td><td>

Valid only in communication position control mode
To input position-lock, the servo rotate speed is 0

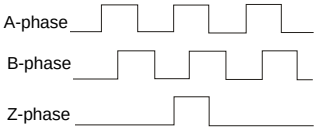
<table>
<tr><th>P06</th><th>DI</th><th>Function</th></tr>
<tr><td>0</td><td>/</td><td>Invalid signal</td></tr>
<tr><td rowspan="2">1</td><td>Invalid</td><td>Position lock</td></tr>
<tr><td>Valid</td><td>Running</td></tr>
</table>
</td></tr>
<tr><td>Start signal</td><td>Pos_Start</td><td>P281_Bit6</td><td>

Trigger to upgrade commands by rising edge of this signal for the commands of position/speed/torque come from external DI in communication mode
Be triggered to make given position command valid in relative position control.
Please refer to chapter 10.2 Internal Multi-Position/Speed/Torque Control for details of Multistage position control

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

<table>
<tr><th>Signal</th><th>Name</th><th>Status Bit</th><th>Function</th></tr>
<tr><td>Select speed position</td><td>SPD_dir</td><td>P281_Bit10</td><td>
To select the direction of input command of speed control mode
Effective only when the external AI as speed/torque commands
<table>
<tr><th>P93</th><th>DI / P281_Bit10</th><th>Function</th></tr>
<tr><td>0~1</td><td>/</td><td>Invalid</td></tr>
<tr><td rowspan="2">2</td><td>Invalid /0</td><td>Positive direction of speed command</td></tr>
<tr><td>Valid /1</td><td>Negative direction of speed command</td></tr>
<tr><th>P118</th><th>DI / P281_Bit10</th><th>Function</th></tr>
<tr><td>0~1</td><td>/</td><td>Invalid</td></tr>
<tr><td rowspan="2">2</td><td>Invalid /0</td><td>Positive direction of torque command</td></tr>
<tr><td>Valid /1</td><td>Negative direction of torque command</td></tr>
</table>
</td></tr>
<tr><td>Alarm clear</td><td>A-CLR</td><td>P282_Bit1</td><td>Short connect this terminal with COM- for more than 120ms to clear alarm in external control mode.
Some alarms cannot be deactivated by this method, you should restart. See chapter 11 Alarms and Protections</td></tr>
<tr><td>Servo ready</td><td>S-RDY</td><td>P204_Bit0</td><td>Valid when control power on and without alarm</td></tr>
<tr><td>Alarm output</td><td>ALM</td><td>P206_Bit1</td><td>Output signal of alarm status
Valid when output is normal, shutdown when alarms
Note: Reverse from the output logical level in alarm status of TLC and ZSP</td></tr>
<tr><td>Torque limit output</td><td>TLC</td><td>P204 multiple- bit</td><td>Use P08 to select the output of this terminal
The default of P08 is 0 which output torque limit control signal
Select different outputs by this signal, see chapter 5.6 Output of Torque Limit(TLC) and Zero-speed Detection(ZSP)</td></tr>
<tr><td>Position located</td><td>POS-OK</td><td>P204_Bit2</td><td>Valid only when position control mode
Valid when position variation less than setting of P121
Use P124 to set the output condition</td></tr>
<tr><td>Speed arrive</td><td>SPD-OK</td><td>P204_Bit8</td><td>Valid only in speed and torque control mode
Valid if the actual rotate speed of motor is equal to or over the setting of P123</td></tr>
</table>

Signal	Name	Status Bit	Function
Brake release	BK	P204_Bit3	● Please first set motor timing of mechanical brake action P130 and P131 before using ● Valid when hold-brake release **Note:** Please connect the control end of the brake by relay (control end: DC24V, with load capacity greater than or equal to 1A) and parallel a Schottky diode (recommend model 1N4148, package: DO-35 glass, inserted) at the control end of the relay. Refer to chapter 4.3.1 Wiring of Servo System for wiring
Output of zero speed detection	ZSP	P204 multiple-bit	● Use P09 to select the output ● The default of P09 is 1 which output the ZSP ● Select the output by this signal
Internal command switch 1~4	INTSPD 1~4	P203 multiple-bit	● Select internal speed of 1~8 by INTSPD1~3, see chapter 5.4 Internal Speed Switchover in External Speed Control Mode for details ● Select the given command source of communication control mode(P4=4) by INTSPD1~4, see chapter 5.5 Commands Switchover (P4=4) in Communication Control Mode for details
Command pulse +input	PULS+	14	● The pulse command of servo receiving single-ended or differential which is invalid in the mode of external speed and torque ⚠ **Caution**: ● The servo only receives 5V pulse. Any voltage used higher than 5V must put appropriate resistance in series between the PIN of control signal pulse input and pulse direction respectively to prevent excessive current from burning out the servo. ● See chapter 6.2 Details of Parameter for the description of P80 and P81 ● The DIR signal in special speed position mode is used for external switch signal, which is different from this
Command pulse -input	PULS-	1	
Command direction +input	DIR+	15	
Command direction -input	DIR-	2	
Reserved	AI+	22	Reserved
Reserved	AGND	10	

Signal	Name	PIN	Function
Encoder A-phase negative output	PAO-	22	● The feedback signal encoder outputted is 5V differential orthogonal which needed to be transformed into single - end signal by conversion device. ● Use P56(Output pulse fractional-octave numerator) and P57(Output pulse fractional-octave denominator) to set the frequency division ratio of the output pulse signal ● P55 can be used to set the logical relationship of the output B-phase respect to A-phase ● The encoder feedback signal outputs 2500 pulses every circle by default, and the motor output one Z-phase signal every circle. 
Encoder B-phase negative output	PBO-	23	
Encoder Z-phase negative output	PZO-	24	
Encoder A-phase positive output	PAO+	21	
Encoder B-phase positive	PBO+	25	
Encoder Z-phase positive output	PZO+	13	

5.4 Internal Speed Switchover in External Speed Control Mode

X1-internal command input			P04(internal/external speed selection)			
Switch3	Switch2	Switch1	0/4	1	2	3
0	0	0	Analogy input command	The first internal speed P95		
0	0	1		The second internal speed P96		
0	1	0		The third internal speed P97		
0	1	1		The fourth internal speed P98	Analogy input command	The fourth internal speed P98
1	0	0		The first internal speed P95		The fifth internal speed P99
1	0	1		The second internal speed P96		The sixth internal speed P100
1	1	0		The third internal speed P97		The seventh internal speed P101
1	1	1		The fourth internal speed P98	Analogy input command	The eighteenth internal speed P102

Note:

● Table above is valid when P04=0~4 in external speed control mode.

● “0” represents invalid and “1” represents valid.

5.5 Commands Switchover (P4=4) in Communication Control Mode

Internal command input				The given command source		
Switch4	Switch3	Switch2	Switch1	Position mode	Speed mode	Torque mode
0	0	0	0	Given position 0 (P290)	Given speed 0 (P324)	Given torque 0 (P358)
0	0	0	1	Given position 1 (P292)	Given speed 1 (P325)	Given torque 1 （P359）
0	0	1	0	Given position 2 (P294)	Given speed 2 (P326)	Given torque 2 (P360)
0	0	1	1	Given position 3 (P296)	Given speed 3 (P327)	Given torque 3 (P361)
0	1	0	0	Given position 4 (P298)	Given speed 4 (P328)	Given torque 4 (P362)
0	1	0	1	Given position 5 (P300)	Given speed 5 (P329)	Given torque 5 (P363)
0	1	1	0	Given position 6 (P302)	Given speed 6 (P330)	Given torque 6 (P364)
0	1	1	1	Given position 7 (P304)	Given speed 7 (P331)	Given torque 7 (P365)
1	0	0	0	Given position 8 (P306)	Given speed 8 (P332)	Given torque 8 (P366)
1	0	0	1	Given position 9 (P308)	Given speed 9 (P333)	Given torque 9 (P367)
1	0	1	0	Given position 10 (P310)	Given speed 10 (P334)	Given torque 10 (P368)
1	0	1	1	Given position 11 (P314)	Given speed 11 (P335)	Given torque 11 (P369)
1	1	0	0	Given position 12 (P314)	Given speed 12 (P336)	Given torque 12 (P370)
1	1	0	1	Given position 13 (P316)	Given speed 13 (P337)	Given torque 13 (P371)
1	1	1	0	Given position 14 (P318)	Given speed 14 (P338)	Given torque 14 (P372)
1	1	1	1	Given position 15 (P320)	Given speed 15 (P339)	Given torque 15 (P373)

Note: “0” - invalid, “1” -valid.

5.6 Output of Torque Limit (TLC) and Zero-speed Detection (ZSP)

P08 or P09	TLC Output Signal	ZSP Output Signal
0	**Torque limit signal.** The output transistor turns ON While torque command is limited at Servo-ON status.	
1	**Zero-speed detection signal.** The output transistor turns ON when motor revolving speed is lower than the preset value of P122.	
2	**Alarm status signal (**P204_Bit1**).** The output transistor turns ON when any one of the alarms is triggered. **Note:** Reversed with the alarm output signal (P206_Bit1).	
3	**Overload alarm of regenerative discharge resistance.** The output transistor turns ON when the Loading rate of Discharging resistance exceeds rated load.	
4	**Overload alarm.** The output transistor turns ON when the overload alarm is triggered.	
5	**Speed consistency output.** The output transistor turns ON when the value of actual speed and speed command are less than the preset range of P122. **Note:** Valid only at the speed and torque control mode.	
6	**Homing complete output.** Servo outputs Homing complete status after homing was finished.	

5.7 Bus-absolute Encoder

1) Overview

Bus-absolute encoder will record the number of rotation cycles while detecting the position of the motor within one turn. The single-turn resolution of COTRUST motor is 131072 which can record 16-bit multi-turn value. The encoder will backup the data through the battery when the bus-absolute servo driver is power off, and calculate the position after power on so there is no need to repeat the mechanical reset.

You can choose the type of encoder usage (the default is incremental) by setting P41 (bus-absolute encoder setting) When matching with the absolute servo driver the absolute encoder. And if you choose absolute type, there may be error No. 6 (P244_Bit6 = 1) for first power-on, then set P282=16 to clear the error and power (control power supply) on again for solution.

Remarks: When modifying P282_Bit3 (communication control word), first write 272 into

P280 where the absolute position of encoder will change suddenly, resulting in the change of the absolute position reference of machinery. Therefore, the operation of mechanical origin restoration is required. The driver will automatically calculate the deviation of absolute position of mechanical and the encoder, and store it in the EEPROM after the homing complete.

2) The setting of corresponding parameters

No.	Name	Description
41	Bus-absolute encoder setting	0: Use as multi-turn bus-absolute encode 1: Use as bus incremental encoder 2: Use as single-circle absolute encoder
42	The origin offset of bus-absolute encoder	Set the offset between the origin of bus-absolute encoder and mechanical coordinate position, 32-bit
214	Total feedback pulses	32-bit, equivalent to P240 + P242 × 131072
216	User position coordinate	32-bit, equivalent to P214 - P42
240	Single-circle position of bus-absolute encoder	Record the value in single circle for bus-absolute encoder, range: 0~131071
242	Circle of encoder	Record the circle number of bus-absolute encoder range: -16384~16383
244	Alarms of encoder	Bit0: Overspeed Bit1: Absolute status error Bit2: Count error Bit3: Count overflow Bit4: Overheating Bit5: Multi-turn error Bit6: Battery error Bit7: Battery warning Bit8: Reserved Bit11: Reserved Bit12: Count error Bit13: “OR” for Bit4-Bi7 Bit14: Communication check error Bit15: The symbol delimit communication error
282	Communication control Word	Valid bit of absolute encoder: Bit3: Reset multi-turn value and clear error Bit4: Clear error that P244 indicates

The reason of servo battery error (P244 Bit6=1):

• First power on

• Encoder cable damaged

• Encoder interface damaged

• Encoder cable is not tightened with servo interface

• The battery interface in the encoder cable is loose or cable in the battery box is broken due to environmental reasons

• The battery in battery box is 3.6V which will fall to 3.0V when error occurs

Please check the hardware or refer to P244 (Alarms of encoder) to debug when battery error occurs.

Encoder battery error will trigger alarm where you need to power off to replace the battery on the encoder cable, and then power on; Write 8 (reset multi-turn value and clear error) or 16 (clear encoder error) to P282 to clear alarm (such as P282 write 8, P280 must be written to 272 first). After the alarm clear, power off and on again (only on the control power). And reset the multi-turn value and remove the error for the device to reset the mechanical origin.

3) Notes for battery box

The encoder battery goes wrong (P244_Bit6=1) when first power on where you need to set P282_Bit4 to clear error before operating again.

The encoder battery alarms (P244_Bit7=1) when detection voltage is lower than 3.0V.

Please replace battery as steps below:

Step 1: Servo power on at the non-operational state

Step 2: Replace battery

Step 3: After the alarm removed and there is no any other error, servo can run

⚠ **Caution**:

● The encoder battery goes wrong and multi-turn data change suddenly when battery was replaced and power on again under the circumstance of servo power off. Please set the P282_Bit3/Bit4 reset encoder fault (for example, first write 272 into P280 before setting P282_Bit3) to reset the homing-complete. Before this, use F-cAb on display for help.

● Please keep the maximum motor speed lower than 6000 RPM to ensure that the encoder position information is accurately recorded when the driver power off.

●Please store products in appropriate temperature, and ensure that the battery contact is reliable as well as sufficient, otherwise the encoder position information may be lost.

6

Parameter

*Parameter introduction

6 Parameters

Descriptions of Parameters

6.1 Parameter Checklist

Address	Name		Address	Name
00	Communication Address※		25	Velocity feed forward
01	Control mode setup※		26	Velocity feedforward filter time constant
02	Torque limitation selection		27	The 2nd position loop gain
03	Overtravel Inhibit input invalid setting※		28	The 2nd velocity loop gain
04	Communication command source selection		29	The 2nd velocity loop integration time constant
05	Zero-speed clamp selection		30	The 2nd speed detection filter
06	Torque limitation control output select		31	The 2nd torque filter time constant
08	Zero-speed detection		32	Inertia ratio
09	RS485 Baud rate configuration※		33	PDO inhibit time※
10	CANopen baud rate configuration※		34	CANopen Alarm setup※
11	Communication command source selection		41	Absolute encoder settings※
12	Communication timeout		42	Absolute encoder origin offset
13	Lock setup on operational panel※		44	Encoder overheating alarm threshold
14	LED initial status※		46	Enable capturing of interrupted POS※
16	Configuration of servo power-on※		47	Pulse input filter time selection for the encoder A/B-phase
18	Current loop gain		48	Pulse input filter time selection for the encoder Z-phase
19	Current loop integration time constant		49	Time of External DI filter time※
20	The first position-loop gain		50	Interpolation selection in communication position mode
21	The first velocity-loop gain		51	Selection of phase missing detection
22	The first velocity loop integration time constant		54	Coordinate clear of origin signal
23	The first velocity detection filter		55	External feedback pulse logic inversion※
24	The first torque filter time constant		56	Numerator of command pulse ratio of External feedback pulse※

Address	Name		Address	Name
57	Denominator of command pulse ratio of External feedback pulse※		90	Selection of motor Positive rotating direction in communication mode※
58	External pulse input filter time select※		91	Deviation Counter clear input method
59	Homing mode		92	Analog Speed command scale factor
60	Gain switching action setup		93	Speed command logic inversion
61	Gain switching action mode		94	Analog input command zero-drift adjustment
62	Control switching delay time		95	The 1st internal speed
65	Position loop gain switching time		96	The 2nd internal speed
66	Input filter selection for Probe1 and Probe2 signal※		97	The 3rd internal speed
68	Bus voltage check		98	The 4th internal speed
69	Torque slope		99	The 5th internal speed
70	JOG speed setting		100	The 6th internal speed
71	Communication position control method		101	The 7th internal speed
72	External input logic level selection		102	The 8th internal speed
73	Control command source selection		112	Speed command filter
75	Digital input multiplexing function register 4		113	Acceleration time setup
76	Digital input multiplexing function register 3		114	Deceleration time setup
77	Digital input multiplexing function register 2		115	Speed limitation of external pulse
78	Digital input multiplexing function register 1		117	Analog Torque command scale factor
79	Digital output Multiplexing function register		118	Torque command logic inversion
80	Command pulse direction- select setup ※		119	The 1st torque limitation
81	Command pulse input method※		120	The 2th torque limitation
82	Command pulse inhibit input invalidation setting		121	Positioning complete range
86	Numerator of 1st command pulse ratio		122	Zero-speed detection range
87	Numerator of 2nd command pulse ratio		123	Arrival speed
88	Denominator of command pulse ratio		124	Positioning complete signal output setup
89	Smoothing filter		126	Sequence at over-travel inhibition※

Address	Name		Address	Name
128	Position increment during homing		218	Command pulse deviation
130	Mechanical brake delay time at motor standstill		220	Command speed
131	Mechanical brake delay time at motor in motion		221	Feedback speed
132	External brake resistance setting※		222	Velocity deviation
134	Torque setup at motor emergency stop		223	Torque command
135	Switch of motor runaway estimation		224	Actual torque
136	Excessive level of position deviation		225	Torque deviation
137	Excessive level of Analog command		226	Busbar voltage
138	Over-load level		228	Alarm status
139	Over-speed level		229	Torque output loading rate
140~149	Historical record 1~25		230	Discharge resistance loading rate
174	Number setting of circle		231	Overload rate
177	Output threshold of torque reached		234	Motor automatic identification function
178	Output offset threshold of reached torque		235	Factor of "No-Motor Running"
180	Software version		236	CANopen state
181~194	Parameter of manufacturer		237	EtherCAT state Word
197	Logic version number		238	Input of second encoder
200	System status		240	Single-turn position for absolute encoder
201	Current Control mode		242	The circle number of absolute encoder
202	Type of error		248	Given position of error 1
203	Command status		250	Feedback position of error 1
204	Output state		252	Given speed of error 1
205	Input IO signal state		253	Feedback speed of error 1
206	Output IO signal state		254	Given torque of error 1
207	Analog input command value		255	Feedback torque of error 1
208	CCWTL analog input command value		256	Bus voltage of error 1
212	Sum of command pulses		257	Bus voltage of error 2
214	Sum of Feedback pulses		258	Given position of error 2
216	User position coordinates		260	Feedback position of error 2

Address	Name		Address	Name
262	Given speed of error 2		504	Load torque output filter
263	Feedback speed of error 2		505	The torque observer compensation dead zone
264	Given torque of error 2		506	Switch of rigidity level
265	Feedback torque of error 2		507	Rigidity level
274	Increment of given position		508	Velocity differential antecedent gain
279	CANopen communication control Word		509	Torque feedforward gain
280	Communication function code		510	Time constant of torque feedforward filter
281	Communication extended control word		514	Speed-loop nonlinear PI switch
282	Communication control word		515	Switch and speed selection of on-line inertia identification
284	Pulse filter 1		516	Second proportional degree of freedom of speed-loop PI
286	Pulse filter 2		517	Second integral degree of freedom of speed-loop PI
288	Pulse Alarm		526	Operation days
290~320	Given position 0~31		527	Operation time
324~355	Given speed 0~31		532	Speed level of low-frequency vibration detection
358~389	Given torque 0~31		533	Selection of low-frequency vibration suppression mode
432	Feedback the Rising edge for Probe1		534	Frequency value of low-frequency vibration suppression
434	Feedback the Falling edge for Probe1		535	Notch depth of low-frequency vibration suppression
436	Feedback the Rising edge for Probe2		536	Automatically updated threshold of Low-frequency vibration suppression frequency
438	Feedback the Falling edge for Probe2		567	Rated torque of motor
502	S-curve mode of given speed※		568	Inertia of motor body
503	Load torque compensation output gain			

6.2 Details of Parameter

⚠ **Be sure to know the Parameters' meaning before adjustment for incorrect settings may result in equipment malfunction.**

⚠ **You can try to restore the factory default parameters while servo failure occurs.**

⚠ **It is recommended to adjust parameters under no-load situation.**

Addr	Name	Control mode	Range	Function	Read-write	Default
00	Communication Address※	ALL	1~127	Used for serial-port communication that set slave address. **<Note>** 0 is used for MODBUS radio of Master station, which cannot be set to slave address.	R/W	1
01	Control mode setup※	ALL	0~15	Select the control mode of servo driver : 0: External Position control-P 1: External Speed control-S 2: External Torque control-T 3: External Position/Speed control 4: External Position/Torque control 5: External Speed /Torque control 6: Communication Position control-P 7: Communication Speed control-S 8: Communication Torque control-T 9: Communication Position/Speed control 10: Communication Position/Torque control 11: Communication Speed /Torque control 13: Special Speed-Position mode 15: CiA DSP_402 control mode **<Note>** ● Speed is limited by the 3rd internal speed (P97) in Communication position control mode. ● Speed is limited by the 4th internal speed (P98) in Communication / External torque control mode. ● Please enable the servo first before sending pulse in mode 0.	R/W	0

<table>
<tr><th>Addr</th><th>Name</th><th>Control mode</th><th>Range</th><th>Function</th><th>Read-write</th><th>Default</th></tr>
<tr><td>02</td><td>Torque limitation selection</td><td>P/S</td><td>0~3</td><td>Set the torque limit signal of CCW and CW:
<table><tr><th>Value</th><th>CCW (Counterclockwise)</th><th>CW (Clockwise)</th></tr><tr><td>0</td><td colspan="2">External Analog Absolute Value</td></tr><tr><td>1</td><td colspan="2">The 1st torque limitation P119</td></tr><tr><td>2</td><td>The 1st torque limitation P119</td><td>The 2nd torque limitation P120</td></tr><tr><td>3</td><td colspan="2">The 1st torque limitation P119 or 2nd torque limitation P120 is associated with TL-SEL PIN (External control) or P281 bit15 (Communication control).</td></tr></table><Note>
1) If the value = 3, it is associated with TL-SEL PIN (External control) or P281 bit15.
2) Torque limitation value is controlled by P119 in torque control mode, taking no account of the parameter value.
3) It is recommended not to set register as 0
4) At overtravel Inhibition mode, overtravel inhibit is valid at the direction which the torque limitation value will be controlled by P134.</td><td>R/W</td><td>1</td></tr>
<tr><td>03</td><td>Overtravel Inhibit input invalid setting※</td><td>ALL</td><td>0~2</td><td>Set the validity of overtravel Inhibit signal of CCW/CW.
0: Valid; 1: Invalid.
2: The servo alarm is triggered by overtravel Inhibit of any directions.
<Note>
● 0 means to follow the specific timing action set by P126 after limit being effective
● When P59(homing mode)=7~14, there may be wrong homing action caused by invalid limit if the parameter not set as 0
● Use P72 to configure the high and low logic level of valid limitation</td><td>R/W</td><td>1</td></tr>
<tr><td>04</td><td>Command source selection</td><td>ALL</td><td>0~4</td><td>To select the command source of external speed control and communication control mode.
0: Analog input command
1: Internal Command (the 1st~4th internal command)
2: Internal Command (the 1st~3rd internal command; Analog input command)
3: Internal Command (the 1st~8th internal command)
4: Analog input command
Value in communication control mode:
0~3: decided by P05
4: decided by INTSPD1~INTSPD4.
<Note>Please refer to 5.4 Internal Speed Switchover in External Speed Control Mode for more details.</td><td>R/W</td><td>0</td></tr>
</table>

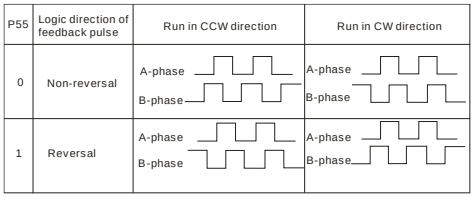
Addr	Name	Control mode	Range	Function	Read-write	Default
05	Communication command source selection	ALL	0~31	The command source in communication position /speed /torque control mode: 0~15: Select communication given position command. 0~31: Select communication given speed/torque command. **<Notes>** 1) Valid when P04 ≠ 4. 2) Switch the command source of the corresponding control mode by setting this parameter. **Example:** when P05=1 in communication speed control mode, P325 (Given speed 1) will be the command speed of motor; while P05=31, it is P355 (Given speed 31).	R/W	0
06	Zero-speed clamp selection	S/T	0~1	Function of external or P281 zero-speed clamp signal: 0: Function invalid. 1: Function valid.	R/W	0
08	Torque limitation control output selection	ALL	0~9	Output of Torque limitation control signal. 0: Torque limitation control 1: Zero-speed detection 2: Alarm status 3: Overload alarm of discharge resistance 4: Overload alarm 5: Speed consistency output 6: Homing complete 9: Torque complete **<Note>** Please refer to chapter 5.6 Output of Torque Limit(TLC) and Zero-speed Detection(ZSP)	R/W	0
09	Zero-speed detection	ALL	0~9	Output of zero-speed limitation control signal. 0: Torque limitation control 1: Zero-speed detection 2: Alarm status 3: Overload alarm of discharge resistance 4: Overload alarm 5: Speed consistency output 6: Homing complete 9: Torque complete **<Note>** Please refer to chapter 5.6 Output of Torque Limit(TLC) and Zero-speed Detection(ZSP)	R/W	1
10	RS485 Baud rate configuration ※	ALL	0~5	To set the communication speed of RS485 0: 4800bps 1: 9600bps 2: 19200bps 3: 38400bps 4: 57600bps 5: 115200bps **<Note>**Please set communication check value to odd or even parity.	R/W	2

Addr	Name	Control mode	Range	Function	Read-write	Default
11	CANopen baud rate configuration ※	ALL	0~7	To set communication speed of CANopen 0: Not using CANopen bus 1: 1000Kbps 2: 800Kbps(not support now) 3: 500Kbps 4: 250Kbps 5: 125Kbps 6: 50Kbps 7: 20Kbps(not support now) **<Note>** Value of this parameter will affect the max communication distance, please refer to chapter 4.4 Communication Ports and Switch of Terminal Resistor for more details	R/W	1
12	Communication timeout		0~2000	Unit: ×100ms, 0 means to cancel this function There may be abnormal communication error if the correct message is not received beyond the time set after first successful communication.	R/W	0
13	Lock setting of operation panel※	ALL	0~1	0: Unlock 1: Lock	R/W	0
14	LED initial status※	ALL	0~18	Select the data to be displayed on the LED panel after power on: 0: Sum of position deviation pulses 1: Motor revolving speed 2: Torque output loading rate 3: Control mode 4: I/O signal state 5: Alarm code/ historical record 6: Software version 7: Alarm status 8: The loading rate of discharge resistance 9: Overload rate 10: Inertia ratio 11: Sum of feedback pulses 12: Sum of command pulses 16: Analogy command input value 17: Factor of “No-Motor Running” 18: Servo status	R/W	1

Addr	Name	Control mode	Range	Function	Read-write	Default
16	Selection of servo-on once power on ※		0~1	0: servo on invalid 1: servo on valid(configure Pin9 to any other signal) **<Note>** Please save and reboot that the modifications of the parameter could be effective.	R/W	0
18	Current loop gain	ALL	0~3000	To define the size of current loop gain	R/W	160
19	Current loop integration time constant	ALL	0~5000	Define the response characteristics of integration action. Time unit: ×100us	R/W	20
20	The 1st position loop gain	P	0~3000	Define the size of position loop gain. Unit:1/s The servo rigidity of position loop control is better if the gain enlarged, but over-high gain will result in vibration.	R/W	80
21	The 1st velocity loop gain	ALL	1~3500	Define the size of speed loop gain. Unit: Hz Higher the gain you set, quicker the response speed you can obtain.	R/W	20
22	The 1st speed loop integration time constant	ALL	1~1000	To define the response characteristics of integration action. Reducing the setting, you can accelerate the integration action. Unit: ms	R/W	50
23	The 1st velocity Detection filter	ALL	0~5	Set the type of velocity Detection filter. The higher value you set, the smaller noise you can obtain, the response, however, will be slower.	R/W	3
24	The 1st torque filter time constant	ALL	0~2500	Define the time constant of the primary delay filter that inserted to the torque command portion. Unit: 10us	R/W	3
25	Velocity feed forward	P	-2000~ 2000	Set the velocity feed forward value. The smaller position deviation will reach faster response, especially in situation that needs high response.	R/W	500
26	Velocity feedforward filter time constant	P	0~6400	Set the time constant of the velocity feed forward primary delay filter. Unit : ms	R/W	3
27	The 2nd position loop gain	P	0~3000	Define the size of position loop gain. Unit: 1/s Higher the gain you set, better the servo rigidity of position loop control you can obtain, but over-high gain will result in vibration.	R/W	100
28	The 2nd velocity loop gain	ALL	1~3500	Define the size of speed loop gain. Unit: Hz Higher the gain you set, quicker the response speed you can obtain.	R/W	20

Addr	Name	Control mode	Range	Function	Read-write	Default
29	The 2nd speed loop integration time constant	ALL	1~1000	Define the response characteristics of integration action. Reducing the parameter can accelerate the integration action. Unit: ms	R/W	500
30	The 2nd speed detection filter	ALL	0~5	Set the type of velocity Detection filter. The higher the value you set, the smaller the noise you can obtain, the response, however, will be slower.	R/W	3
31	The 2nd torque filter time constant	ALL	0~2500	Define the time constant of the primary delay filter that inserted to the torque command portion. Unit:10us	R/W	3
32	Inertia ratio	ALL	0~ 10000	Set the ratio of load inertia against or of the rotor inertia. (Load inertia/Rotor inertia of motor) ×100%	R/W	100
33	PDO inhibit time*	ALL	0~ 32767	Set the PDO inhibit time to restrict the abnormalities caused by frequently CANopen communication. Unit: 0.1ms **<Note>** To restrict too frequent of CANopen communication, as abnormalities would occur due to jamming communication.	R/W	100
34	CANopen alarm setup*	ALL	0~1	Action setting when CANopen communication abnormal: 0: No alarm; 1: Alarm and stop running	R/W	1
41	Absolute encoder settings※	ALL	0~2	0: Use as multi-turn absolute encoder 1: Use as incremental encoder 2: Use as single-turn absolute encoder	R/W	1
42	Absolute encoder origin offset	ALL	-2^{31}-1~ $+2^{31}$	Use to set the offset between absolute encoder origin and mechanical coordinate position.	R/W	0
44	Encoder overheating alarm threshold※	ALL	0~127	Use as alarm threshold of absolute encoder overheating, 0 represents overheating alarm.	R/W	120
46	Enable capturing of interrupted position※	ALL	0~3	0: Disable to capture interruption position 1: Enable probe 1 to capture interruption position 2: Enable probe 2 to capture interruption position 3: Enable both probe 1 and probe 2 to capture interruption position	R/W	0

Addr	Name	Control mode	Range	Function	Read -write	Default
47	Pulse input filter time selection of encoder A/B-phase	ALL	0~13	Parameter that only 2500 incremental optical encoder owns: 0: 222ns 1: 444ns 2: 666ns 3: 888ns 4: 1.333us 5: 1.777us 6: 2.666us 7: 3.555us 8: 4.444us 9: 5.333us 10: 7.111us 11: 8.888us 12: 10.666us 13: 14.222us		
48	Pulse input filter time selection of encoder Z	ALL	0~7	Parameter that only 2500 PPR incremental optical encoder owns: 0: 0.55us 1: 1.05us 2: 1.56us 3: 2.06us 4: 2.56us 5: 3.08us 6: 3.56us 7: 4.08us		
49	Selection of External DI filter time※		0~6	Select the external DI filter time: 0: 0.5ms 1: 1ms 2: 2ms 3: 4ms 4: 8ms 5: 16ms 6: 32ms 7~32: 32ms 33~8000: 33~8000ms	R/W	3
50	Interpolation selection in communication position mode	P	0~ 32767	Enable or disable the interpolation command in communication control mode(P01 = 6): 0: Normal communication position mode, motor rotating speed is determined by P97. 1: Communication position S-curve design 2: Enable the pulse adjustment which correspond to value of P290 512: Enable Interpolation mode, the motor rotating speed is determined by controller, P97 takes no effect.	R/W	0

<table>
<tr><th>Addr</th><th>Name</th><th>Control mode</th><th>Range</th><th>Function</th><th>Read -write</th><th>Default</th></tr>
<tr><td>54</td><td>Origin signal clear coordinate</td><td>ALL</td><td>0~1</td><td>0: Invalid
1: Valid</td><td>R/W</td><td>0</td></tr>
<tr><td>55</td><td>External feedback pulse logic inversion ※</td><td>ALL</td><td>0~1</td><td>Set the B-phase logic of pulse output.
Change the phase relation between A and B phase by inverting the logic of the B-phase pulse.
 
</td><td>R/W</td><td>0</td></tr>
<tr><td>56</td><td>Numerator of command pulse ratio of External feedback pulse※</td><td>ALL</td><td>1~ 32767</td><td rowspan="2">Set the output pulses number from feedback interface per turn of motor.
① P57 = 0: Feedback pulses each turn = P56×4
② P57≠0: Feedback pulses each turn = (P56 / P57) × Encoder resolution×4
<Notes>
· Encoder resolution: 2500p/r
· The pulses number each turn could not over the encoder resolution, it would account as 1 once excessed 1.
· Motor output one Z-phase signal each turn.
Z-phase pulse width varies from the setting of frequency dividing ratio.</td><td>R/W</td><td>1</td></tr>
<tr><td>57</td><td>Denominator of command pulse ratio of External feedback pulse※</td><td>ALL</td><td>0~ 32767</td><td>R/W</td><td>1</td></tr>
</table>

Addr	Name	Control mode	Range	Function	Read -write	Default
58	External pulse input filter time selection※	P	0~13	Set software filter time of input pulse count 0: 222ns 1: 444ns 2: 666ns 3: 888ns 4: 1.333us 5: 1.777us 6: 2.666us 7: 3.555us 8: 4.444us 9: 5.333us 10: 7.111us 11: 8.888us 12: 10.666us 13: 14.222us **<Notes>** 1. The higher value you set, the more favorable effect you can obtain, but the max input pulse frequency would fall subsequently. It is recommended to use default value. 2. when P50=0, power off then power on to be valid after modifying P58 while it takes effect the moment after modify if P50=512 3. Use as periodic time filter processing in communication position interpolation mode which is valid only when P50=512, it is recommended to set as the PC communication scan time. Unit: ms 0: 0ms 1: 1ms 2: 2ms 3: 3ms ……	R/W	2

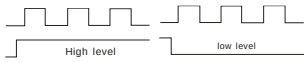
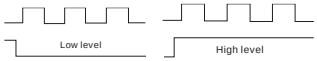
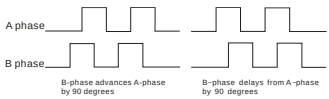
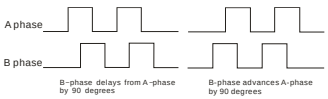
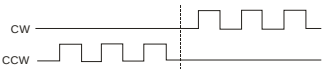
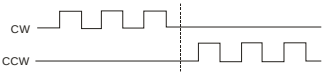
Addr	Name	Control mode	Range	Function	Read-write	Default
59	Homing mode	ALL	1~20, 35	Select the homing mode: **0:** Reset the P216 (User position coordinates) by triggering the DI signal **1:** Refer to both the negative original switch and Z-phase signal mode. **2:** Refer to both the positive original switch and Z-phase signal mode. **3:** Refer to the negative original switch only **4:** Refer to the positive original switch only **5:** Refer to Z-phase signal (Homing towards negative direction) only **6:** Refer to Z-phase signal (Homing towards positive direction) only **7:** Refer to original switch/positive limit switch/Z-phase signal (on the left of the left edge of the original switch) **8:** Refer to original switch/positive limit switch/Z-phase signal (on the right of the left edge of the original switch) **9:** Refer to original switch/positive limit switch/Z-phase signal (on the left of the right edge of the original switch) **10:** Refer to original switch/positive limit switch/Z-phase signal (on the right of the right edge of the original SW) **11:** Refer to original switch/negative limit switch/Z-phase signal (on the right of the right edge of the original switch) **12:** Refer to original switch/negative limit switch/Z-phase signal (on the left of the right edge of the original switch) **13:** Refer to original switch/negative limit switch/Z-phase signal (on the right of the left edge of the original switch) **14:** Refer to original switch/negative limit switch/Z-phase signal (on the left of the left edge of the original switch) **15:** Refer to the negative original switch and position increment **16:** Refer to the positive original switch and position increment **17:** Refer to the homing switch/positive limit switch(on the left edge of homing switch) **18:** Refer to the homing switch/positive limit switch(on the right edge of homing switch) **19:** Refer to the homing switch/negative limit switch(on the right edge of homing switch) **20**: Refer to the homing switch/negative limit switch(on the left edge of homing switch) **35:** Set current position as origin **<Note>** For the details of Homing, please refer to chapter 10.1 Homing Function.	R/W	0

<table>
<tr><th>Addr</th><th>Name</th><th>Control mode</th><th>Range</th><th>Function</th><th>Read-write</th><th>Default</th></tr>
<tr><td>60</td><td>Gain switching action setup</td><td>ALL</td><td>0~1</td><td>Select the condition of switch between the two gains.
0: PI/P can be switched by selecting the 1st gain.
1: You can switch between the 1st and 2nd gain.
<Note> It is related to GAIN PIN (External control) or P281 bit9 (Communication control mode).</td><td>R/W</td><td>1</td></tr>
<tr><td>61</td><td>Gain switching action mode</td><td>ALL</td><td>0~3</td><td>The trigger condition for gain switch.
<table>
<tr><th>Register Value</th><th>Conditions for gain switching</th></tr>
<tr><td>0</td><td>Fixed to the 1st gain</td></tr>
<tr><td>1</td><td>Fixed to the 2nd gain</td></tr>
<tr><td>2</td><td>Decided by GAIN PIN (External control) or P281 bit9 (Communication control).</td></tr>
<tr><td>3</td><td>Decided by fixed position signal.
Position fixed: the 1st gain
Position unfixed: the 2nd gain</td></tr>
</table></td><td>R/W</td><td>0</td></tr>
<tr><td>62</td><td>Control switching delay time</td><td>ALL</td><td>0~ 10000</td><td>Set the delay time for switching from the 1st to 2nd gain (or 2nd to 1st). Unit: 250us</td><td>R/W</td><td>1000</td></tr>
<tr><td>65</td><td>Position loop gain switching time</td><td>P</td><td>0~ 10000</td><td>In gain switching mode, if a great change caused by two different position loop switching, you can use the parameter to set switching delay time for position loop gain to restrain the rapid shock during switching.
Unit:250us</td><td>R/W</td><td>100</td></tr>
<tr><td>66</td><td>Input filter selection of probe 1 and probe 2 signal※</td><td>ALL</td><td>0~20</td><td>The input filter selection of probe 1 and 2 which will take effect after re-up the power.
0: 222ns
1: 444ns
2: 666ns
3: 888ns
4: 1.333us
5: 1.777us
6: 2.666us
7: 3.555us
8: 4.444us
9: 5.333us
10: 7.111us
11: 8.888us
12: 10.666us
13: 14.222us
14~20: Reserved</td><td>R/W</td><td>2</td></tr>
<tr><td>68</td><td>Calibration of bus voltage</td><td>ALL</td><td>-100~ 100</td><td>3.0kW and below. Unit: V
(Servos of 5.5kW and above are coefficient of multiple which default as 1000)</td><td>R/W</td><td>0</td></tr>
</table>

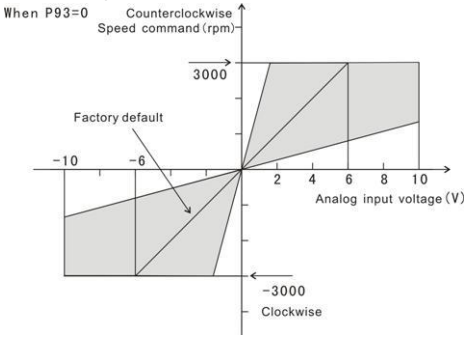
Addr	Name	Control mode	Range	Function	Read-write	Default
69	Torque slope	ALL	0~1000	Max adjustment range each turn. Unit: ‰	R/W	100
70	JOG speed setting	ALL	0~5000	Set the JOG (Test run) speed. Unit: rpm	R/W	200
71	Communication position control mode	P	0~1	**Bit0:** Absolute/relative position selection, 0: absolute, 1: relative **Bit1:** Deviation counter reset and return to the original operation whether to modify the position instruction selection. 0: allow, 1: not allowed **Bit3:** Multi-position correspond to multi-speed, 0: speed selection P97; 1: multi-position P290~P320 correspond to multi-speed P324~P339 **Bit4:** If to modify internal given position after servo on in communication position control mode. 0: allow, 1: not allowed **Example of Bit0:** The difference between position of absolute and relative is that the former calculates the distance from the origin (if the original operation is not carried out, the default position of power on is the origin) while the latter calculates from the current position. For example, the current position is 10000 and the target position is 25000. For absolute position control, the given position is 25000 which is, however, 15,000 for relative position, the actual running position would be 15,000 + 10,000 = 25,000. **Example of Bit4:** If the of P216 user position coordinates are not equal to the given position P290 when enabling in communication position control mode, you can set whether the servo internal is allowed to modify P290 of the given position by P71_Bit4. If it is not allowed, the servo electric machine will automatically rotate to the given position P290 after enabling. **<Notes>** 1) The parameter is valid only in communication position mode and owns two control modes regardless the command source come from PIN or P5. 2) Relative position need start signal to trigger; The command source of Absolute position also needs start signal to activate when it is determined by pins (P04=4).	R/W	0

<table>
<tr><th>Addr</th><th>Name</th><th>Control mode</th><th>Range</th><th>Function</th><th>Read-write</th><th>Default</th></tr>
<tr><td>72</td><td>DI signal activation configuration</td><td>ALL</td><td>Any</td><td>Logic level selection of external DI
Bit0: the way servo on
0: You can not enable the communication and PIN functions at the same time.
1: Enable PIN for all modes, and communication should be enabled under communication mode as well.
Bit2: CCW overtravel inhibit signal active level
0: Low level on, 1: High level on
Bit3: CW overtravel inhibit signal active level
0: Low level on, 1: High level on
Bit5: Zero-speed clamp
1: Low level on, 0: High level on
Bit8: Valid level of command pulse inhibit
1: Low level on, 0: High level on
Bit11: Original switch signal active level
1: Low level on, 0: High level on
<Note> The DI signal which supported logic level selection only satisfy above items, the details please refer to chapter 5.2.2 Configuration for DI Signal to Take Effect.</td><td>R/W</td><td>0</td></tr>
<tr><td>73</td><td>Control command source selection</td><td>ALL</td><td>0~4</td><td>Select the source of PIN contribution and control command:
<table>
<tr><th>Value</th><th>Communication control mode</th><th>External control mode</th></tr>
<tr><td>0</td><td>From P281 Communication extended control word (Default)</td><td>From external DI signal (Default)</td></tr>
<tr><td>1</td><td colspan="2">From external DI signal (Default allocation)</td></tr>
<tr><td>2</td><td colspan="2">From external DI signal (Decided by P75/76/77/78)</td></tr>
<tr><td>3</td><td colspan="2">From P281 Communication extended control word (Default)</td></tr>
<tr><td>4</td><td colspan="2">From external DI or P281 Communication extended control word (Decided by P75/76/77/78)</td></tr>
</table>
<Note>
Please refer to chapter 5.2.1 Function Selection of DI
For more details.</td><td>R/W</td><td>4</td></tr>
</table>

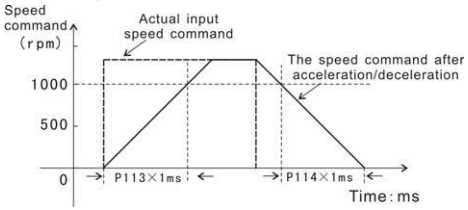
<table>
<tr><th>Addr</th><th>Name</th><th>Control mode</th><th>Range</th><th>Function</th><th>Read-write</th><th>Default</th></tr>
<tr><td>75</td><td>Digital input multiplexing function register 4</td><td>ALL</td><td>Any</td><td rowspan="4">There are two DI PIN distributions, refer to chapter 5.2.1 Function Selection of DI for more details
<table><tr><th>Parameter</th><th>Bit no.</th><th>PIN</th><th>Name</th></tr><tr><td>75</td><td>B0~B7</td><td>9</td><td>SRV_ON</td></tr><tr><td rowspan="2">76</td><td>B8~B15</td><td>31</td><td>DIN6</td></tr><tr><td>B0~B7</td><td>32</td><td>DIN5</td></tr><tr><td rowspan="2">77</td><td>B8~B15</td><td>33</td><td>DIN4</td></tr><tr><td>B0~B7</td><td>8</td><td>DIN3</td></tr><tr><td rowspan="2">78</td><td>B8~B15</td><td>34</td><td>DIN2</td></tr><tr><td>B0~B7</td><td>10</td><td>DIN1</td></tr></table>16#00: No functions allocated.
16#01: Alarm clear input
16#02: CCW Overtravel Inhibit,
16#03: CW Overtravel Inhibit
16#04: Control Mode Switching
16#05: Zero-speed clamp(Speed/Torque mode) Position lock(Position mode)
16#06: Command Electronic Gear Selection (External position mode)
“Pos-Start” signal of Multi-Position/ Speed/ Torque command (Communication mode)
16#07: Homing commands
16#08: Command pulse input inhibit (External position mode)
Internal speed selection 4 (Communication mode)
16#09: Gain selection, 0: the 1st gain, 1: the 2nd gain
16#0A: Deviation counter clear (Position mode)
Motor rotation direction (External speed mode)
16#0B: Origin switch signal
16#0C: Internal speed command selection 1
16#0D: Internal speed command selection 2
16#0E: Internal speed command selection 3
16#0F: Torque limit switching input
16#10: Cancel relative position command in Communication mode, 1: Cancel, 0: Do not cancel
16#12: JOG run test positive
16#13: JOG run test negative
<Note> P75 is valid when P16=1; When P16=0, SRV_ON pin is used only for enabling.
※Example: To set the signal terminals to CCW Overtravel Inhibit(DIN1), CW Overtravel Inhibit(DIN2), Original switch input(DIN3), Homing command(DIN4) respectively in external position control mode, just find the corresponding function code for each pin in table above, and enter 16#070B for P77, 16#0302 for P78.</td><td rowspan="4">R/W</td><td>0</td></tr>
<tr><td>76</td><td>Digital input multiplexing function register 3</td><td>ALL</td><td>Any</td><td>16#010B</td></tr>
<tr><td>77</td><td>Digital input multiplexing function register 2</td><td>ALL</td><td>Any</td><td>16#0709</td></tr>
<tr><td>78</td><td>Digital input Multiplexing function register 1</td><td>ALL</td><td>Any</td><td>16#0302</td></tr>
</table>

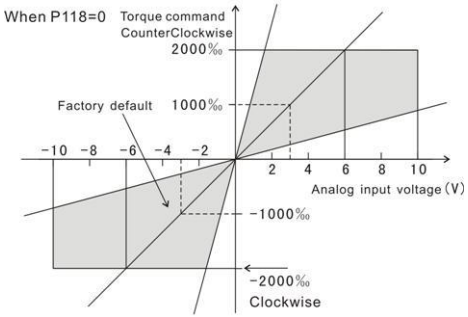
<table>
<tr><th>Addr</th><th>Name</th><th>Control mode</th><th>Range</th><th>Function</th><th>Read-write</th><th>Default</th></tr>
<tr><td>79</td><td>Digital output Multiplexing function register</td><td>ALL</td><td>Any</td><td>Select the DO function as table below:
<table>
<tr><th>Bit</th><th>Pin</th><th>Name</th><th>Position mode</th><th>Speed/torque mode</th></tr>
<tr><td>0~1</td><td>7/6</td><td>DOUT1</td><td colspan="2">0: Servo ready</td></tr>
<tr><td>2~3</td><td>4/5</td><td>DOUT2</td><td colspan="2">0: Alarm output
1: Setting of P8</td></tr>
<tr><td>4~5</td><td>2/3</td><td>DOUT3</td><td>0: Position finished</td><td>0: Speed finished</td></tr>
<tr><td>6~7</td><td>1/26</td><td>DOUT4</td><td colspan="2">0: Brake release
1: Setting of P9</td></tr>
</table></td><td>R/W</td><td>0</td></tr>
<tr><td>80</td><td>Command pulse select direction setup※</td><td>P</td><td>0~1</td><td rowspan="2">Set the direction and form of pulse according to the command pulse type
<table>
<tr><th>P81</th><th>P80</th><th>CCW(counterclockwise)</th><th>CW(clockwise)</th></tr>
<tr><td rowspan="2">3</td><td>0</td><td colspan="2"> 
</td></tr>
<tr><td>1</td><td colspan="2"> 
</td></tr>
<tr><td rowspan="2">2</td><td>0</td><td colspan="2"> 
</td></tr>
<tr><td>1</td><td colspan="2"> 
</td></tr>
<tr><td rowspan="2">1</td><td>0</td><td colspan="2"> 
</td></tr>
<tr><td>1</td><td colspan="2"> 
</td></tr>
</table>
<Note> You cannot modify the value on line, it will take effect after re-up the power.</td><td>R/W</td><td>0</td></tr>
<tr><td>81</td><td>Command pulse input method※</td><td>P</td><td>1~3</td><td>R/W</td><td>3</td></tr>
</table>

<table>
<tr><th>Addr</th><th>Name</th><th>Control mode</th><th>Range</th><th>Function</th><th>Read-write</th><th>Default</th></tr>
<tr><td>82</td><td>Command pulse inhibit input invalidation setting</td><td>P</td><td>0~1</td><td>1: function invalid, 0: “valid” means allow to input while “invalid” means inhibit.
<table><tr><th>Register value</th><th>INH input-</th><th>External command pulse</th></tr><tr><td rowspan="2">0</td><td>Valid</td><td>Allowed</td></tr><tr><td>Invalid</td><td>Inhibit</td></tr><tr><td rowspan="2">1</td><td>Valid</td><td>Allowed</td></tr><tr><td>Invalid</td><td>Allowed</td></tr></table></td><td>R/W</td><td>1</td></tr>
<tr><td>86</td><td>Numerator of the 1st command pulse ratio</td><td>P</td><td>0~32767</td><td rowspan="3">Set the resolution of command pulse according to frequency division.
$\text{Pulses each turn needs} \times \frac{\text{P86 or P87 numerator}}{\text{P88 denominator}} = \text{Encoder resolution}$
<Notes>
1) If the numerator of frequency multiplication = 0, the actual denominator parameters will be the current pulses each turn.
2) If the numerator of frequency multiplication ≠ 0, calculate pulses for each turn according to formula above.
3) In communication position control mode, if change the parameter and rewrite to EEPROM, it becomes effective once re-up the power. While in external position control mode, the parameter takes effect once the parameter changed.
4) Please refer to chapter 6.3 Electronic Gear Ratio for setting.
5) the revolution of 2500-PPR incremental encoder is 10000 and that of the bus absolute encoder is 131072</td><td>R/W</td><td>1</td></tr>
<tr><td>87</td><td>Numerator of the 2nd command pulse ratio</td><td>P</td><td>0~32767</td><td>R/W</td><td>1</td></tr>
<tr><td>88</td><td>Denominator of command pulse ratio</td><td>P</td><td>1~32767</td><td>R/W</td><td>1</td></tr>
<tr><td>89</td><td>Smoothing filter</td><td>P</td><td>0~7</td><td>Set the parameter of the primary delay filter that inserted to the pulse command.
This parameter is applied to lower input pulse frequency or excess electronic gear ratio.
The higher value you set, the servo driver would filter according to input position command, and the smoother command pulse you can obtain, but the response for command pulse will delay.</td><td>R/W</td><td>3</td></tr>
</table>

Addr	Name	Control mode	Range	Function	Read-write	Default
90	Selection of Motor Positive rotating direction in communication mode※		0~1	Select the positive rotating direction of motor in communication mode: **0:** Toward the motor shaft, the CCW rotating direction of motor is the positive. **1:** Toward the motor shaft, the CW rotating direction of motor is the positive.	R/W	0
91	Deviation Counter clear input method	P	0~2	Set the way of clearing deviation counter. 0: High Level valid 1: Rising edge is valid. 2: Shielding reset function It is related to CL PIN (External Control) or P281 Bit10 (Communication Control).	R/W	1
92	Analog Speed command scale factor	S, T	10~2000	Set the relationship between motor speed and voltage that applied to the analog velocity command input terminal, which equals to motor rotation speed of 1V inputted. The default setting is 500 rpm, and 3000rpm when 6V inputted.  **<Note>** Input voltage range: -10V~+10V.	R/W	500

<table>
<tr><th>Addr</th><th>Name</th><th>Control mode</th><th>Range</th><th>Function</th><th>Read-write</th><th>Default</th></tr>
<tr><td>93</td><td>Speed command logic inversion</td><td>S</td><td>0~1</td><td>Set the logic level of analogy speed command.
<table>
<tr><th>Register value</th><th colspan="3">Direction of Speed command</th></tr>
<tr><td>0</td><td>Non-reversal</td><td colspan="2">Positive voltage→CCW rotation,
Negative voltage→CW rotation</td></tr>
<tr><td>1</td><td>Reversal</td><td colspan="2">Positive voltage→CW rotation,
Negative voltage→CCW rotation</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Speed direction Selection control</td><td>DI input / P281 Bit10</td><td>Direction</td></tr>
<tr><td>Valid/1</td><td>Positive/Negative voltage→CW rotation</td></tr>
<tr><td>Invalid/0</td><td>Positive/Negative voltage→CCW rotation</td></tr>
</table></td><td>R/W</td><td>0</td></tr>
<tr><td>94</td><td>Analog input command zero-drift adjustment</td><td>S/T</td><td>-2047~ 2047</td><td>To adjust the analog speed/torque command zero-drift.</td><td>R/W</td><td>0</td></tr>
<tr><td>95</td><td>The 1st internal speed</td><td>S</td><td>-10000 ~ 10000</td><td>Set the 1st speed of internal speed command. Unit: rpm
<Note> Please refer to chapter 5.4 Internal Speed Switchover in External Speed Control Mode for more</td><td>R/W</td><td>0</td></tr>
<tr><td>96</td><td>The 2nd internal speed</td><td>S</td><td>-10000 ~ 10000</td><td>Set the 2nd speed of internal speed command. Unit: rpm
<Note> Please refer to chapter 5.4 Internal Speed Switchover in External Speed Control Mode for more</td><td>R/W</td><td>0</td></tr>
<tr><td>97</td><td>The 3rd internal speed</td><td>P/S</td><td>-10000 ~ 10000</td><td>Set the 3rd speed of internal speed command.
Unit: rpm
<Note> As the operation speed in communication position control mode which can not be exceeded by the max. Speed command.</td><td>R/W</td><td>500</td></tr>
<tr><td>98</td><td>The 4th internal speed</td><td>S/T</td><td>-10000 ~ 10000</td><td>Set the 4th speed of internal speed command. Unit: rpm
<Note> As the max speed limitation in external/ communication torque control mode which can not be exceeded by the max. Speed command.</td><td>R/W</td><td>500</td></tr>
<tr><td>99</td><td>The 5th internal speed</td><td>S</td><td>-10000 ~ 10000</td><td>Set the 5th speed of internal speed command. Unit: rpm
<Note> Please refer to chapter 5.4 Internal Speed Switchover in External Speed Control Mode for more</td><td>R/W</td><td>0</td></tr>
</table>

Addr	Name	Control mode	Range	Function	Read-write	Default
100	The 6th internal speed	S	-10000 ~ 10000	Set the 6th speed of internal speed command. Unit: rpm **<Note>** Please refer to chapter 5.4 Internal Speed Switchover in External Speed Control Mode for more details	R/W	0
101	The 7th internal speed	S	-10000 ~ 10000	Set the 7th speed of internal speed command which is the return speed in homing process. Unit: rpm	R/W	0
102	The 8th internal speed	S	-10000 ~ 10000	Set the 8th speed of internal speed command which is the creep speed in homing process. Unit: rpm	R/W	0
112	Speed command filter	S/T	0~ 6400	Set the parameters of the primary delay filter that inserted to the Analog speed/torque command, higher value with more stable rotation, but accordingly the response of the system will reduce. Unit ×10us	R/W	1000
113	Acceleration time setup	S	0~ 10000	Set the acceleration/deceleration time of external/communication speed control mode. If the input speed command changes so much, switch to smoother one. Unit:ms The time ×1ms P113 speed command accelerates from 0 to 1000rpm The time ×1ms P114 speed command decelerates from 1000rpm to 0  **<Note>** 1) For V rpm target speed, calculate the acceleration/ deceleration time by conversion: Acceleration time= V / 1000 × P113× 1ms Deceleration time= V / 1000 × P114× 1ms 2) Acceleration/Deceleration time set parameters valid in communication position control mode, where the servo driver would accelerate from 0 to speed limitation value (3rd internal speed) or decelerates from speed limitation value to 0, so as to control the acceleration and deceleration according to the communication given position command.	R/W	100
114	Deceleration time setup	S	0~ 10000		R/W	100

<table>
<tr><th>Addr</th><th>Name</th><th>Control mode</th><th>Range</th><th>Function</th><th>Read-write</th><th>Default</th></tr>
<tr><td>115</td><td>Speed limitation of external pulse</td><td></td><td>0~1</td><td>0: Speed is decided by pulse frequency
1: Speed is limited by P98(Vmax=1.2*P98)</td><td>R/W</td><td>0</td></tr>
<tr><td>117</td><td>Analog Torque command scale factor</td><td>T</td><td>10~100</td><td>Set the relationship between the motor torque and the voltage applied to the analog torque command input.
Unit: 0.1V/ 1000‰
As the default value of this parameter is 3V/1000‰, input 3V voltage is 1000‰ torque command.
 

<Note> Input voltage range: -10V~+10V.</td><td>R/W</td><td>30</td></tr>
<tr><td>118</td><td>Torque command logic inversion</td><td>T</td><td>0~1</td><td>Set the logic level of analogy torque command
<table>
<tr><th>Register value</th><th colspan="3">Direction of torque command</th></tr>
<tr><td>0</td><td>Non-reversal</td><td colspan="2">Positive voltage→CCW rotation,
Negative voltage→CW rotation</td></tr>
<tr><td>1</td><td>Reversal</td><td colspan="2">Positive voltage→CW rotation,
Negative voltage→CCW rotation</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Torque direction Selection control</td><td>DI input / P281 Bit10</td><td>Direction</td></tr>
<tr><td>Valid/1</td><td>Positive/Negative voltage→CW rotation</td></tr>
<tr><td>Invalid/0</td><td>Positive/Negative voltage→CCW rotation</td></tr>
</table></td><td>R/W</td><td>0</td></tr>
<tr><td>119</td><td>The 1st torque limitation</td><td>ALL</td><td>0~3000</td><td>Set the restriction value of 1st torque. Unit:‰</td><td>R/W</td><td>2000</td></tr>
<tr><td>120</td><td>The 2nd torque limitation</td><td>ALL</td><td>0~3000</td><td>Set the restriction value of 2nd torque. Unit:‰</td><td>R/W</td><td>2000</td></tr>
</table>

<table>
<tr><th>Addr</th><th>Name</th><th>Control mode</th><th>Range</th><th>Function</th><th>Read-write</th><th>Default</th></tr>
<tr><td>121</td><td>Positioning complete range</td><td>P</td><td>0~ 32767</td><td>Set the range of position-complete signal, which means the allowable pulse number. Unit: pulse number.</td><td>R/W</td><td>100</td></tr>
<tr><td>122</td><td>Zero-speed detection range</td><td>ALL</td><td>10~ 20000</td><td>Set the threshold value of Zero-speed detection, there is 10rpm hysteresis. Output signal when the actual rotate speed is lower setting value. Unit: rpm
This parameter is also taken as the output threshold of speed consistency. When the difference between the actual motor speed and the command speed is within the setting range, output the speed consistency signal.</td><td>R/W</td><td>10</td></tr>
<tr><td>123</td><td>Arrival speed</td><td>S,T</td><td>10~ 20000</td><td>Set the threshold of Arrival speed, output signal when the actual rotating speed of the motor exceeds this parameter value. There is 10rpm hysteresis. Unit: rpm</td><td>R/W</td><td>1000</td></tr>
<tr><td>124</td><td>Positioning complete signal output setup</td><td>P</td><td>0~3</td><td>Set the output condition
<table><tr><th>Value</th><th>POS_OK output condition</th></tr><tr><td>0</td><td>Output signal when the pulses number of positional deviation within the range of positioning complete.</td></tr><tr><td>1</td><td>Output signal when there is no position command and the positional deviation pulses within the range of positioning complete.</td></tr><tr><td>2</td><td>Output signal when there is no position command, output the zero-speed detection signal and the pulses of positional deviation within the range of positioning complete.</td></tr><tr><td>3</td><td>P204 outputs the position-complete signal if the position deviation of P218 is lower than P121 and the command completion is 1</td></tr></table></td><td>R/W</td><td>0</td></tr>
<tr><td>126</td><td>Sequence at over-travel inhibition※</td><td>ALL</td><td>0~1</td><td>Set the drive condition during motor deceleration and after stalling while over-travel inhibit input is valid.
<table><tr><th>Value</th><th colspan="2">During deceleration</th><th>After stalling</th><th>Deviation counter content</th></tr><tr><td>0</td><td colspan="3">Torque command=0 towards over-travel inhibited direction</td><td>Hold</td></tr><tr><td rowspan="3">1</td><td colspan="3">Control mode</td><td></td></tr><tr><td>P</td><td colspan="2">Position command=0 towards over-travel inhibited direction</td><td>Clear before or after deceleration</td></tr><tr><td>S/T</td><td>Zero-speed clamp Position command = 0</td><td>Speed command=0 towards inhibited direction</td><td>——</td></tr></table>Reboot motor to make parameter modified valid.</td><td>R/W</td><td>1</td></tr>
</table>

Addr	Name	Control mode	Range	Function	Read-write	Default
127	Brake delay release time	ALL	0~32767	The delay time released by servo from UVW output to brake release, Unit : ms	R/W	0
128	Position increment when homing		-2^{31}~ $+2^{31}$	When set P59 to 15 or 16, the system would finish the given position set by this parameter if the original switch signal has reached.	R/W	0
130	Mechanical brake delay time at motor standstill	ALL	0~100	Set the delay time of the mechanical braking release signal (BRKOFF) to the motor shutdown while SRV-ON signal is cut-off in motor stalling status. Unit: ms	R/W	50
131	Mechanical brake delay time at motor in motion	ALL	0~100	Set the delay time from now to the shutdown of mechanical brake release signal (BRK-OFF) while SRV-ON signal is cut-off in motor in motion status. Unit:ms BRK-OFF signal will shut-off if the motor speed falls to 30rpm before time setup.	R/W	50
132	External brake resistance setting※	ALL	0~3	Set the brake resistance and its overload protection. **0:** Enable Internal brake resistor only, and start protection for it. There will be alarm of excessive braking rate if the brake resistance operating limitation exceeds 10%. **1:** Enable External brake resistor, and start protection for it. There will be alarm of excessive braking rate if the brake resistance operating limitation over 10%. **2:** Enable External brake resistor, but no protection. **3:** Without braking resistance circuit, only depend on the internal capacitance discharging.	R/W	0
134	Setup the torque at motor emergency stop	ALL	0~3000	Set the torque limitation value in following conditions: **1:** The deceleration process at overtravel inhibit. **2:** Some deceleration process. Unit: ‰	R/W	2000
135	Switch of motor runaway estimation	ALL	0~1	0: Estimation off 1: Estimation on	R/W	1

Addr	Name	Control mode	Range	Function	Read-write	Default
136	Excessive level of position deviation	P	0~32767	Set the detection range of the excessive position deviation pulse number. Unit: ×256 Servo alarms when the actual deviation counter value exceeds this parameter×256. If set parameter to 0, the excessive position deviation function will be canceled.	R/W	25000
137	Excessive level of Analog command	S, T	0~100	Set the detection for excess voltage level of analog velocity command or torque command after the zero-drift adjustment. Unit: ×0.1V Servo alarms when the voltage of external analogy after zero-drift actual exceeds this parameter value. The function will be cancelled if set parameter to 0.	R/W	0
138	Over-load level	ALL	0~1200	Set the overload level of motor. Unit: ‰ This max parameter value can be set to 1050‰ of the motor rated torque, if no need for high overload, please set lower value. The 1~8 are special settings. **0:** 1.05 times over load, overload time *1 **1:** 1.05 times over load, overload time *1.25 **2:** 1.05 times over load, overload time *1.5 **3:** 1.05 times over load, overload time *1.75 **4:** 1.30 times over load, overload time *1 **5:** 1.50 times over load, overload time *1 **6:** 1.05 times over load, overload time *0.25 **7:** 1.05 times over load, overload time *0.5 **8:** 1.05 times over load, overload time *0.75	R/W	0
139	Over-speed level	ALL	0~20000	Set the overspeed level of motor. Unit: rpm The overspeed level becomes 1.2 times of the motor max speed by setting this parameter to 0(generally).	R/W	0

Addr	Name	Control mode	Range	Function	Read-write	Default
140 ～ 149	History record			10 alarm records servo occurred recently: 0: No alarm 1: Under-voltage 2: Over-voltage 3: Over-current 4: Over-heat 6: Encoder feedback error 7: Over-braking ratio 8: Over-load 9: Excess position deviation 10: Overtravel inhibit alarm 11: Over-speed 12: Excess analog input deviation 13: EEPROM read-write error 14: Abnormal RS485 Communication 15: Abnormal CANopen Communication 16: Configuration error of external input pin 17: Internal error 1 18: Absolute encoder motor unmatched 19: Pulse error 22: Main power lack-phase 23: Control power input under voltage 24: Internal drive power under voltage 25: Alarm of motor runaway **<Note>** P140 is the latest alarm record	R	
174	Turn setting	ALL		32bits, setting the turns by P282 bit3 rising edge trigger to modify the turns of P242 counted internal.	W	
177	Output threshold of torque reached	ALL	0~3000	The detection condition of torque completion which will be outputted when actual torque larger than setting value. Unit: ‰	R/W	500
178	Output offset threshold of torque reached	ALL	0~3000	Output signal off when actual torque lower than P177-P178, unit: ‰	R/W	100

Addr	Name	Control mode	Range	Function	Read-write	Default
180	Software version			Version of current driver software.	R	
181 ~ 194	Manufacturer parameter				R	
197	Logic version	ALL		Internal logic version	R	
200	System status	ALL		Current system status of servo: 0: Initial value after power on. 1: Initialization state. 2: Startup status, the adjust procedure towards motor position. 3: Motor running state. 4: Ready state. 5: Error state. 8: Wait main power on	R	
201	Current Control mode	ALL		Current control mode of servo: 16#0000: No control mode, motor is not running. 16#0001: External position control mode. 16#0002: External speed control mode. 16#0004: External torque control mode. 16#0101: Communication position control mode. 16#0102: Communication speed control mode. 16#0104: Communication torque control mode. **<Note>** This parameter concerns the running state of internal control, it has nothing to do with the control mode selection setting.	R	

Addr	Name	Control mode	Range	Function	Read-write	Default
202	Error type	ALL		The current alarm state of servo: 0: No alarm 1: Under-voltage 2: Over-voltage 3: Over-current 4: Over-heat 6: Encoder feedback error 7: Over-braking ratio 8: Over-load 9: Excess position deviation 10: Overtravel inhibit alarm 11: Over-speed 12: Excess analog input deviation 13: EEPROM read-write error 14: Abnormal RS485 Communication 15: Abnormal CANopen communication 16: Configuration error of external input pins 17: Internal error 1 18: Absolute encoder motor unmatched 19: Alarm of position mode pulse 22: Main power lack-phase 23: Control power input under voltage 24: Internal drive power under voltage 25: Alarm of motor runaway	R	

Addr	Name	Control mode	Range	Function	Read-write	Default
203	Command Status	ALL		External command of the current servo control signal: **Bit0:** Servo-ON, 1: Enable, 0: Disable **Bit1:** Alarm clear, 1: Valid, 0: Invalid **Bit2:** CCW overtravel inhibit, 1: Valid, 0: Invalid **Bit3:** CW overtravel inhibit, 1: Valid, 0: Invalid **Bit4:** Control Mode switch, 0: The 1st control mode, 1: The 2nd control mode **Bit5:** Zero-speed clamp, 1: Valid, 0: Invalid Position lock, 1: Valid, 0: Invalid **Bit6:** External position mode, Command electronic gear selection, 0: The 1st Multiplication, 1: 2nd Multiplication Start signal of multi-position/speed/torque command (Communication mode) **<Note>** Trigger Start-signal to make the given position command take effect at relative position control mode. **Bit7:** Homing command, 1: enable **Bit8:** Command pulse input inhibit, 1: Valid Command switch 4 (Communication mode) **Bit9:** Gain selection, 0: The 1st gain, 1: The 2nd gain **Bit10:** Deviation counter clear in position mode, 1: Valid Speed direction selection(external speed mode) 0: CCW direction, 1: CW direction **Bit11:** Original switch input, 1: Valid **Bit12:** Internal Command switch 1 **Bit13:** Internal Command switch 2 **Bit14:** Internal Command switch 3 **Bit15:** Torque limitation switching input 0: The 1st Torque limitation, 1: The 2nd Torque limitation	R	

Addr	Name	Control mode	Range	Function	Read-write	Default
204	State of Output	ALL		Set the system status output to 1 on true condition: **Bit0:** Servo-Ready, 1: Turn ON **Bit1:** Alarm output, 1: Turn ON **Bit2:** Positioning complete, 1: Turn ON **Bit3:** Brake release, 1: Turn ON **Bit4:** Zero -Speed detection, 1: Turn ON **Bit5:** Torque in-limit, 1: Turn ON **Bit6:** Speed consistency output, 1: Turn ON **Bit7:** Resistance braking, 1: Turn ON **Bit8:** Speed Arrival, 1: Turn ON **Bit9:** Over-load alarm, 1: Turn ON **Bit10**: Homing status **Bit11:** Data overrange **Bit13**: Torque arrival **Bit14**: Symbol of command complete	R	
205	Input IO signal state	ALL		External X2 control interface signal input, the bit turns 1 when connecting its PIN with COM-. **Bit0:** The 9th PIN SRV-ON **Bit1:** The 10th PIN DIN1 **Bit2:** The 34th PIN DIN2 **Bit3:** The 8th PIN DIN3 **Bit4:** The 33th PIN DIN4 **Bit5:** The 32th PIN DIN5 **Bit6:** The 31th PIN DIN6	R	0
206	Output IO signal state	ALL		External X2 control interface signal output, the bit turns 1 when its PIN is connected with COM-. **Bit0:** The 7/6th PIN DOUT1 **Bit1**: The 5/4th PIN DOUT2 **Bit2:** The 3/2th PIN DOUT3 **Bit3:** The 1/26th PIN DOUT4	R	
207	Analog input command value	ALL	-32760~ +32760	Input external analogy Value of 32000 corresponds to 10V Analog input. It's normal for the parameter to exist zero-drift which can be adjusted by P94.	R	

Addr	Name	Control mode	Range	Function	Read-write	Default
208	CCWTL analogy input command	ALL	-32760~+32760	Input of CCWTL signal analogy Value of 32000 corresponds to 10V Analog input. Parameter will bounce when CCWTL signal hang.	R	
212	Sum of command pulses	ALL	-2^{31}~$+2^{31}$	The sum of command pulse. Unit: pulse	R	
214	Sum of Feedback pulses	ALL	-2^{31}~$+2^{31}$	The sum of feedback pulse. Unit: pulse	R	
216	User position coordinates	ALL	-2^{31}~$+2^{31}$	The absolute coordinates of communication control. Unit: pulse	R	
218	Command pulse deviation	ALL	-2^{31}~$+2^{31}$	Command pulse deviation. Unit: pulse	R	
220	Command speed	ALL		The current command speed. Unit: rpm	R	
221	Feedback speed	ALL		The current actual speed. Unit: rpm	R	
222	Velocity deviation	ALL		The current speed deviation. Unit: rpm	R	
223	Torque command	ALL		The current command torque. Unit: ‰	R	
224	Actual torque	ALL		The current actual torque. Unit: ‰	R	
225	Torque deviation	ALL		The current torque deviation. Unit: ‰	R	
226	Busbar voltage	ALL		The current bus voltage of servo driver. Unit: V	R	
228	Alarm status	ALL	0~1	The current alarm state which is 1 while alarm occurs.	R	
229	Torque output loading rate	ALL	-2000~2000	Feedback torque *feedback rotate speed /rated rotate speed. Unit: ‰	R	

Addr	Name	Control mode	Range	Function	Read-write	Default
230	Discharge resistance loading rate	ALL	1000	The current load rate of servo brake resistor,× 0.1%	R	
231	Overload rate	ALL	-2000~2000	The current overload rate of motor	R	
234	Motor automatic identification function	ALL		Reserved	R	
235	Factor of "No-Motor Running"	ALL		Factors of "No-motor Running": 0: No particular reason 1: Main power off 2: SRV-ON signal invalid 3: Over-travel inhibition is valid 4: Torque limitation setup is too small 7: Too small of position command or the 3rd internal speed 8: Deviation Counter clear input 9: Zero-speed clamp 10: Speed command is too small 12: Torque command is too small 13: Speed limitation is too small 14: Over-load of motor or UVW cable wring wrong 15: Servo Alarm 17: The UVW wires are unconnected or the too weak gain	R	
236	CANopen state		0~65535	Check the CANopen communication status: 0: Initialization 4: Stop 5: Run 127: Pre-run	R	
237	EtherCAT state word		0~32767	To check the EtherCAT communication status: Bit 3: fault, 1: valid Bit 10: position arrival, 1: valid	R	
238	Input of the 2nd encoder	ALL		The input of external 2nd encoder	R	

Addr	Name	Control mode	Range	Function	Read-write	Default
240	Single-turn position for absolute encoder		0~ 131071	The value encoder in single-turn	R	
242	The circle number of absolute encoder	ALL	-2^{31}~ $+2^{31}$	The multi-turn value is showed when matching with bus absolute encoder motor. The number of encoder circles is showed when matching with 2500-PPR incremental encoder, modify the number as the setting in P174 by rising edge of P282 bit3		
244	Alarm status Word of bus absolute encoder			Encoder alarm status: Bit0: Overspeed Bit1: Absolute full-state error Bit2: Counting error Bit3: Counter overflow Bit4: Overheating Bit5: Multi-turn error Bit6: Battery error Bit7: Battery warning Bit11 and Bit8: Reserved Bit12: Counting error Bit13: Bit4~Bit7 Or Bit14: Communication parity error Bit15: Communication delimiter error	R	
248	Given position of error 1	ALL	-2^{31}~ $+2^{31}$	Record the given position when fault 1 occurs	R	
250	Feedback position of error 1	ALL	-2^{31}~ $+2^{31}$	Record the feedback position when fault 1 occurs	R	
252	Given speed of error 1	ALL	-2^{15}~ $+2^{15}$	Record the given speed when fault 1 occurs	R	
253	Feedback speed of error 1	ALL	-215~ +215	Record the feedback speed when fault 1 occurs	R	

Addr	Name	Control mode	Range	Function	Read-write	Default
254	Given torque of error 1	ALL	-2^{15}~ $+2^{15}$	Record the given torque when fault 1 occurs	R	
255	Feedback torque of error 1	ALL	-2^{15}~ $+2^{15}$	Record the feedback torque when fault 1 occurs	R	
256	Bus voltage of error 1	ALL	-2^{15}~ $+2^{15}$	Record the bus voltage when fault 1 occurs	R	
257	Bus voltage of error 2	ALL	-2^{15}~ $+2^{15}$	Record the bus voltage when fault 2 occurs	R	
258	Given position of error 2	ALL	-2^{31}~ $+2^{31}$	Record the given position when fault 2 occurs	R	
260	Feedback position of error 2	ALL	-2^{31}~ $+2^{31}$	Record the feedback position when fault 2 occurs	R	
262	Given speed of error 2	ALL	-2^{15}~ $+2^{15}$	Record the given speed when fault 2 occurs	R	
263	Feedback speed of error 2	ALL	-2^{15}~ $+2^{15}$	Record the feedback speed when fault 2 occurs	R	
264	Given torque of error 2	ALL	-2^{15}~ $+2^{15}$	Record the given torque when fault 2 occurs	R	
265	Feedback torque of error 2	ALL	-2^{15}~ $+2^{15}$	Record the feedback torque when fault 2 occurs	R	
274	Increment of given position			As the register of pulse incremental setting in speed-position mode, which is the number of pulses of given position increment. (32-bit double int)	R/W	0
279	CANopen communication control word		0~ 32767	15: Enable 128: Alarm clear **<Note>** Set P279 to 15 or set P282_bit0 to 1 to enable servo in communication control mode	R/W	

Addr	Name	Control mode	Range	Function	Read-write	Default
280	Communication function code	ALL	See right	The related communication control function codes: 16#0000: No command. 16#0102: Write all parameters into EEPROM. 16#0104: Write the memory updated parameters down to EEPROM. 16#0108: Clear history record. 16#1001: Position sine response command. 16#1002: Speed sine response command. 16#1004: Torque sine response command. 16#2001: Position step response command. 16#2002: Speed step response command. 16#2004: Torque step response command.	R/W	
281	Communication extended control word	ALL	See right	The given external command signal of communication control mode: **Bit0:** Turn servo off in the situation of "servo-on" 0: servo-on, 1: servo-off **Bit2:** CCW overtravel inhibition **Bit3:** CW overtravel inhibition **Bit4:** Control mode switching, 0: The 1st control mode, 1: The 2nd control mode. **Bit5:** Zero-speed clamp (Speed/Torque mode) 1: Zero-speed clamp is valid. **Bit6:** Selection of command pulse ratio (External Position mode) 0: The 1st Multiplication, 1: The 2nd Multiplication Start signal of Multi-Position/Speed/Torque Command (Communication mode) **<Note>** Trigger start signal to make the given position command effective at relative position control mode. **Bit7:** Homing command,1: Enabled **Bit8:** Command pulse input inhibit (External position mode) 1: Valid, 0: Invalid Command selection 4 (Communication mode) **Bit9:** Gain selection, 0: The 1st gain, 1: The 2nd gain **Bit10:** Deviation counter clear, 1: valid Selection of Speed direction (External speed mode), 1: Valid **Bit11:** Original switch input, 1: Valid **Bit12:** Command selection 1 **Bit13:** Command selection2 **Bit14:** Command selection3 **Bit15:** Torque limitation switching input, 0-the 1st torque limitation, 1-the 2nd torque limitation.	R/W	

Addr	Name	Control mode	Range	Function	Read-write	Default
282	Communication control word	ALL	See right	**Enable bit:** **Bit0:** Servo-on, 1: Servo on; 0: Servo off **Bit1:** 1: Alarm clear, 0: Invalid, 1: Valid **Bit2:** Cancel relative position command, 1: Cancel, 0: Reserved **Enable bit of 2500-PPR incremental encoder:** **Bit3:** Modify turn, 1: modify 0: Not modify **Enable bit of bus absolute encoder:** **Bit3**: Reset multi-turn and clear error **Bit4:** Clear error(encoder error P244 indicated) **Remark:** For communication control, you should set P282_bit0 to 1, and set P279 to 15, so that the servo could be enabled.	R/W	0
284	Pulse filter 1		-2^{31}~ $+2^{31}$	This parameter is a register to set the pulse filter of speed position mode. When the system is switching from position mode to speed mode, the servo starts output pulses, by the time the output pulses reach P284, the system starts to detect external signal.	R/W	0
286	Pulse filter2		-2^{31}~ $+2^{31}$	This parameter is a register to set the pulse filter of speed position mode. When external signal is firstly detected in speed mode, the servo outputs pulses, by the time the output pulses reach P286, the system search the external signal for second time and turn to position mode from speed mode while receiving the external signal.	R/W	0
288	Pulse Alarm		-2^{31}~ $+2^{31}$	This parameter is a register to set the pulse filter of speed position mode. If external switch signal cannot be detected all the time in speed mode, and the output pulses alarms, the servo will stop to alarm. Alarm off when P288 =0.	R/W	0
290	Given position 0	P	-2^{31}~+ 2^{31}	The command of given position 0 in communication position control mode. Unit: pulse number (32-bit double int)	R/W	0
292	Given position 1	P	-2^{31}~+ 2^{31}	The command of given position 1 in communication position control mode. Unit: pulse number (32-bit double int)	R/W	0

Addr	Name	Control mode	Range	Function	Read-write	Default
294	Given position 2	P	-2^{31}~+ 2^{31}	The command of given position 2 in communication position control mode. Unit: pulse number (32-bit double int)	R/W	0
296	Given position 3	P	-2^{31}~+ 2^{31}	The command of given position 3 in communication position control mode. Unit: pulse number (32-bit double int)	R/W	0
298	Given position 4	P	-2^{31}~+ 2^{31}	The command of given position 4 in communication position control mode. Unit: pulse number (32-bit double int)	R/W	0
300	Given position 5	P	-2^{31}~+ 2^{31}	The command of given position 5 in communication position control mode. Unit: pulse number (32-bit double int)	R/W	0
302	Given position 6	P	-2^{31}~+ 2^{31}	The command of given position 6 in communication position control mode. Unit: pulse number (32-bit double int)	R/W	0
304	Given position 7	P	-2^{31}~+ 2^{31}	The command of given position 7 in communication position control mode. Unit: pulse number (32-bit double int)	R/W	0
306	Given position 8	P	-2^{31}~+ 2^{31}	The command of given position 8 in communication position control mode. Unit: pulse number (32-bit double int)	R/W	0
308	Given position 9	P	-2^{31}~+ 2^{31}	The command of given position 9 in communication position control mode. Unit: pulse number (32-bit double int)	R/W	0
310	Given position 10	P	-2^{31}~+ 2^{31}	The command of given position 10 in communication position control mode. Unit: pulse number (32-bit double int)	R/W	0
312	Given position 11	P	-2^{31}~+ 2^{31}	The command of given position 11 in communication position control mode. Unit: pulse number (32-bit double int)	R/W	0
314	Given position 12	P	-2^{31}~+ 2^{31}	The command of given position 12 in communication position control mode. Unit: pulse number (32-bit double int)	R/W	0
316	Given position 13	P	-2^{31}~+ 2^{31}	The command of given position 13 in communication position control mode. Unit: pulse number (32-bit double int)	R/W	0

Addr	Name	Control mode	Range	Function	Read-write	Default
318	Given position 14	P	-2^{31}~+ 2^{31}	The command of given position 14 in communication position control mode. Unit: pulse number (32-bit double int)	R/W	0
320	Given position 15	P	-2^{31}~+ 2^{31}	The command of given position 15 in communication position control mode. Unit: pulse number (32-bit double int)	R/W	0
324	Given speed 0	S	-6000~ 6000	The command of given speed 0 in communication speed control mode. Unit: rpm	R/W	0
325	Given speed 1	S	-6000~ 6000	The command of given speed 1 in communication speed control mode. Unit: rpm	R/W	0
326	Given speed 2	S	-6000~ 6000	The command of given speed 2 in communication speed control mode. Unit: rpm	R/W	0
327	Given speed 3	S	-6000~ 6000	The command of given speed 3 in communication speed control mode. Unit: rpm	R/W	0
328	Given speed 4	S	-6000~ 6000	The command of given speed 4 in communication speed control mode. Unit: rpm	R/W	0
329	Given speed 5	S	-6000~ 6000	The command of given speed 5 in communication speed control mode. Unit: rpm	R/W	0
330	Given speed 6	S	-6000~ 6000	The command of given speed 6 in communication speed control mode. Unit: rpm	R/W	0
331	Given speed 7	S	-6000~ 6000	The command of given speed 7 in communication speed control mode. Unit: rpm	R/W	0
332	Given speed 8	S	-6000~ 6000	The command of given speed 8 in communication speed control mode. Unit: rpm	R/W	0
333	Given speed 9	S	-6000~ 6000	The command of given speed 9 in communication speed control mode. Unit: rpm	R/W	0
334	Given speed 10	S	-6000~ 6000	The command of given speed 10 in communication speed control mode. Unit: rpm	R/W	0
335	Given speed 11	S	-6000~ 6000	The command of given speed 11 in communication speed control mode. Unit: rpm	R/W	0
336	Given speed 12	S	-6000~ 6000	The command of given speed 12 in communication speed control mode. Unit: rpm	R/W	0

Addr	Name	Control mode	Range	Function	Read-write	Default
337	Given speed 13	S	-6000~6000	The command of given speed 13 in communication speed control mode. Unit: rpm	R/W	0
338	Given speed 14	S	-6000~6000	The command of given speed 14 in communication speed control mode. Unit: rpm	R/W	0
339	Given speed 15	S	-6000~6000	The command of given speed 15 in communication speed control mode. Unit: rpm	R/W	0
340	Given speed 16	S	-6000~6000	The command of given speed 16 in communication speed control mode. Unit: rpm	R/W	0
341	Given speed 17	S	-6000~6000	The command of given speed 17 in communication speed control mode. Unit: rpm	R/W	0
342	Given speed 18	S	-6000~6000	The command of given speed 18 in communication speed control mode. Unit: rpm	R/W	0
343	Given speed 19	S	-6000~6000	The command of given speed 19 in communication speed control mode. Unit: rpm	R/W	0
344	Given speed 20	S	-6000~6000	The command of given speed 20 in communication speed control mode. Unit: rpm	R/W	0
345	Given speed 21	S	-6000~6000	The command of given speed 21 in communication speed control mode. Unit: rpm	R/W	0
346	Given speed 22	S	-6000~6000	The command of given speed 22 in communication speed control mode. Unit: rpm	R/W	0
347	Given speed 23	S	-6000~6000	The command of given speed 23 in communication speed control mode. Unit: rpm	R/W	0
348	Given speed 24	S	-6000~6000	The command of given speed 24 in communication speed control mode. Unit: rpm	R/W	0
349	Given speed 25	S	-6000~6000	The command of given speed 25 in communication speed control mode. Unit: rpm	R/W	0
350	Given speed 26	S	-6000~6000	The command of given speed 26 in communication speed control mode. Unit: rpm	R/W	0
351	Given speed 27	S	-6000~6000	The command of given speed 27 in communication speed control mode. Unit: rpm	R/W	0
352	Given speed 28	S	-6000~6000	The command of given speed 28 in communication speed control mode. Unit: rpm	R/W	0

Addr	Name	Control mode	Range	Function	Read-write	Default
353	Given speed 29	S	-6000~6000	The command of given speed 29 in communication speed control mode. Unit: rpm	R/W	0
354	Given speed 30	S	-6000~6000	The command of given speed 30 in communication speed control mode. Unit: rpm	R/W	0
355	Given speed 31	S	-6000~6000	The command of given speed 31 in communication speed control mode. Unit: rpm	R/W	0
358	Given torque 0	T	-3000~3000	The command of given torque 0 in communication speed control mode. Unit:‰	R/W	0
359	Given torque 1	T	-3000~3000	The command of given torque 1 in communication speed control mode. Unit:‰	R/W	0
360	Given torque 2	T	-3000~3000	The command of given torque 2 in communication speed control mode. Unit:‰	R/W	0
361	Given torque 3	T	-3000~3000	The command of given torque 3 in communication speed control mode. Unit:‰	R/W	0
362	Given torque 4	T	-3000~3000	The command of given torque 4 in communication speed control mode. Unit:‰	R/W	0
363	Given torque 5	T	-3000~3000	The command of given torque 5 in communication speed control mode. Unit:‰	R/W	0
364	Given torque 6	T	-3000~3000	The command of given torque 6 in communication speed control mode. Unit:‰	R/W	0
365	Given torque 7	T	-3000~3000	The command of given torque 7 in communication speed control mode. Unit:‰	R/W	0
366	Given torque 8	T	-3000~3000	The command of given torque 8 in communication speed control mode. Unit:‰	R/W	0
367	Given torque 9	T	-3000~3000	The command of given torque 9 in communication speed control mode. Unit:‰	R/W	0
368	Given torque 10	T	-3000~3000	The command of given torque 10 in communication speed control mode. Unit:‰	R/W	0
369	Given torque 11	T	-3000~3000	The command of given torque 11 in communication speed control mode. Unit:‰	R/W	0
370	Given torque 12	T	-3000~3000	The command of given torque 12 in communication speed control mode. Unit:‰	R/W	0

Addr	Name	Control mode	Range	Function	Read-write	Default
371	Given torque 13	T	-3000~3000	The command of given torque 13 in communication speed control mode. Unit:‰	R/W	0
372	Given torque 14	T	-3000~3000	The command of given torque 14 in communication speed control mode. Unit:‰	R/W	0
373	Given torque 15	T	-3000~3000	The command of given torque 15 in communication speed control mode. Unit:‰	R/W	0
374	Given torque 16	T	-3000~3000	The command of given torque 16 in communication speed control mode. Unit:‰	R/W	0
375	Given torque 17	T	-3000~3000	The command of given torque 17 in communication speed control mode. Unit:‰	R/W	0
376	Given torque 18	T	-3000~3000	The command of given torque 18 in communication speed control mode. Unit:‰	R/W	0
377	Given torque 19	T	-3000~3000	The command of given torque 19 in communication speed control mode. Unit:‰	R/W	0
378	Given torque 20	T	-3000~3000	The command of given torque 20 in communication speed control mode. Unit:‰	R/W	0
379	Given torque 21	T	-3000~3000	The command of given torque 21 in communication speed control mode. Unit:‰	R/W	0
380	Given torque 22	T	-3000~3000	The command of given torque 22 in communication speed control mode. Unit:‰	R/W	0
381	Given torque 23	T	-3000~3000	The command of given torque 23 in communication speed control mode. Unit:‰	R/W	0
382	Given torque 24	T	-3000~3000	The command of given torque 24 in communication speed control mode. Unit:‰	R/W	0
383	Given torque 25	T	-3000~3000	The command of given torque 25 in communication speed control mode. Unit:‰	R/W	0
384	Given torque 26	T	-3000~3000	The command of given torque 26 in communication speed control mode. Unit:‰	R/W	0
385	Given torque 27	T	-3000~3000	The command of given torque 27 in communication speed control mode. Unit:‰	R/W	0
386	Given torque 28	T	-3000~3000	The command of given torque 28 in communication speed control mode. Unit:‰	R/W	0

Addr	Name	Control mode	Range	Function	Read-write	Default
387	Given torque 29	T	-3000~3000	The command of given torque 29 in communication speed control mode. Unit:‰	R/W	0
388	Given torque 30	T	-3000~3000	The command of given torque 30 in communication speed control mode. Unit:‰	R/W	0
389	Given torque 31	T	-3000~3000	The command of given torque 31 in communication speed control mode. Unit:‰	R/W	0
432	Feedback the Rising edge for Probe1	ALL	-	The rising edge coordinate (32-bit) of probe 1 after starting interruption position capture function.	R	
434	Feedback the Falling edge for Probe1	ALL	-	The falling edge coordinate (32-bit) after probe 1 starting interruption position capture function.	R	
436	Feedback the Rising edge for Probe2	ALL	-	The rising edge coordinate (32-bit) of probe 2 after starting interruption position capture function.	R	
438	Feedback the Falling edge for Probe2	ALL	-	The falling edge coordinate (32-bit) after probe 2 starting interruption position capture function.	R	
502	S-curve mode of given speed※	S	0~2	0: off; 1: mode1(three speed curve); 2: mode2 (two speed curve)	R/W	1
503	Load torque compensation output gain	P/S	0~120	0: off; 100: 100% output Unit: %	R/W	0
504	Load torque output filter	P/S	0~10000	Larger filter value, smoother output compensation	R/W	9000
505	The torque observer compensation dead zone	P/S	200~1000	The output of torque compensation is zero when speed error is lower than value of this parameter. Unit: 0.1RPM	R/W	200

Addr	Name	Control mode	Range	Function	Read-write	Default
506	Switch of rigidity level	ALL	0~1	Setting of speed-circle gain, speed-circle integration constant, torque command filter constant and position gain. 0: manual setting; 1: Rigidity level	R/W	0
507	Rigidity level	ALL	0~31	Rigidity level	R/W	12
508	Velocity differential antecedent gain	P/S	0~3000	Too large gain will cause speed vibration	R/W	0
509	Torque feedforward gain	P/S	0~100	Larger gain, stronger torque feedforward, no feedforward in zero. Unit: 0.01	R/W	10
510	Time constant of torque feedforward filter	P/S	0~6400	First-order low-pass filter time constant. Unit: 0.01ms	R/W	0
514	Speed-loop nonlinear PI switch	P/S	0~1	0: Off ; 1: Continuous nonlinear PI	R/W	1
515	Switch and speed selection of on-line inertia identification	P/S	0~3	0: Off; 1: Inertia changes slowly; 2: Inertia changes normally; 3: Inertia changes rapidly	R/W	0
516	The second proportional degree of freedom of speed-loop PI	P/S	0~1000	Turn the gain in speed follow down without changing disturbance rejection 0 to 1000: Gain becomes weaker as the coefficient grow larger.	R/W	0
517	The second integral degree of freedom of speed-loop PI	P/S	0~1000	Turn the integration in speed follow down without changing disturbance rejection 0 to 1000: Integration becomes weaker as the coefficient grow larger.	R/W	0

Addr	Name	Control mode	Range	Function	Read-write	Default
526	Operation days	ALL		Sum of operation days. Unit: day	R	0
527	Operation time	ALL		Sum of operation time(less than a day). Unit: h/min/s Format: hx10000+minx100+s	R	0
532	Speed level of low-frequency vibration detection	P	1~6	Set the speed of detection of low-frequency vibration frequency. Larger value, faster speed and grater error	R/W	3
533	Selection of low-frequency vibration suppression mode	P	0~2	Configure the work mode of low-frequency restrain 0: off; 1: automatic mode; 2: manual mode	R/W	0
534	Frequency value of low-frequency vibration suppression	P	0~1500	Set the frequency that need to be restrained in manual mode while in automatic mode monitor and recognize the vibration frequency. Unit: 0.1Hz	R/W	0
535	Notch depth of low-frequency vibration suppression	P	0~10	Set the depth of notch filter	R/W	10
536	Automatic updated threshold of Low-frequency vibration suppression frequency	P	1~300	Update the frequency of notch filter when deviation of latest detected vibrational frequency and notch frequency which is being using is larger than this parameter value. Unit : 0.1Hz	R/W	30
567	Rated torque of motor	ALL	0~65535	Rated torque of motor, unit: 0.01Nm	R/W	1270
568	Inertia of motor body	ALL	$0\sim10^8$	Inertia of motor body, unit: kg*m2*e-7	R/W	400

<Note>

- Parameter with means it need reboot to takes effect after writing into EEPROM.
- System will reserve P0~P199, P274, P284, P286, P288, P290~P389, P400~P413 and P502~P536 to EEPROM when parameters being saved to EEPROM.

6.3 Electronic Gear Ratio

Adjust electronic gear ratio to set the motor speed and displacement of each input command pulse unit in position control mode. (For example: resolution of 2500-PPR incremental encoder is 10000 and that of 17-bit bus absolute encoder is 131072)

Calculation of pulses number each circle needed shows as follows:

$$\text{Pulses each turn needs} \times \frac{\text{P86 or P87 numerator}}{\text{P88 denominator}} = \text{Encoder resolution}$$

If numerator P86 or P87 of command pulse frequency multiplication is 0, the value of P88 (Command pulse frequency multiplication denominator) is the pulse number each circle needed.

For example: Setting of 2500 pulses each circle needed.

1) $2500 = 10000 \times \frac{P88}{P86 \text{ or } P87}$ → (P86 or P87): P88=4:1, which means you can set P86 or P87 to 400.
2) Set P86 or P87 to 0 and set P88 to 2500, which means the value of P86 or P87 is equivalent to encoder resolution 10000, so electronic gear ratio is 10000: 2500.

7

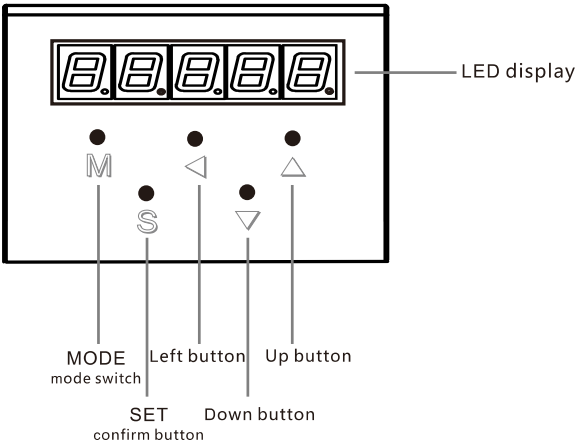
How to Use the Front Panel

*Introduction of front panel and buttons

7 How to Use the Front Panel

Introduction of the front panel and buttons

The front panel of A4S series servo owns 5-digit LED and five keys:



7.1 Buttons Function

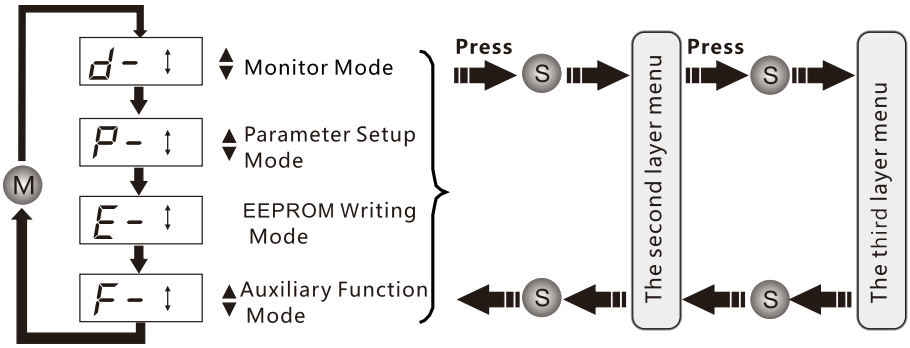
Buttons	Name	Function	
M	Mode switch	Press to switch in the following four modes: • Monitor Mode • Parameter Setup Mode • EEPROM Writing Mode • Auxiliary Function Mode	
S	SET button	• Enter menu; • Confirm operation;	
▲	Up	Increase numerical value, long press to repeat	**<Note>** When changing a value, it is only valid for the one digit with the flashing decimal point.
▼	Down	Decrease numerical value, long press to repeat	
◀	Left	Shifting to higher digit	

7.2 Menu Function

Press MODE to switch in 4 operation modes.

The first layer is the main menu, press SET to enter the second, then press SET to confirm after operation, and exit from the second layer menu to return to the first. When the menu is deeply embedded, the operation is similar.

Structure of modes:

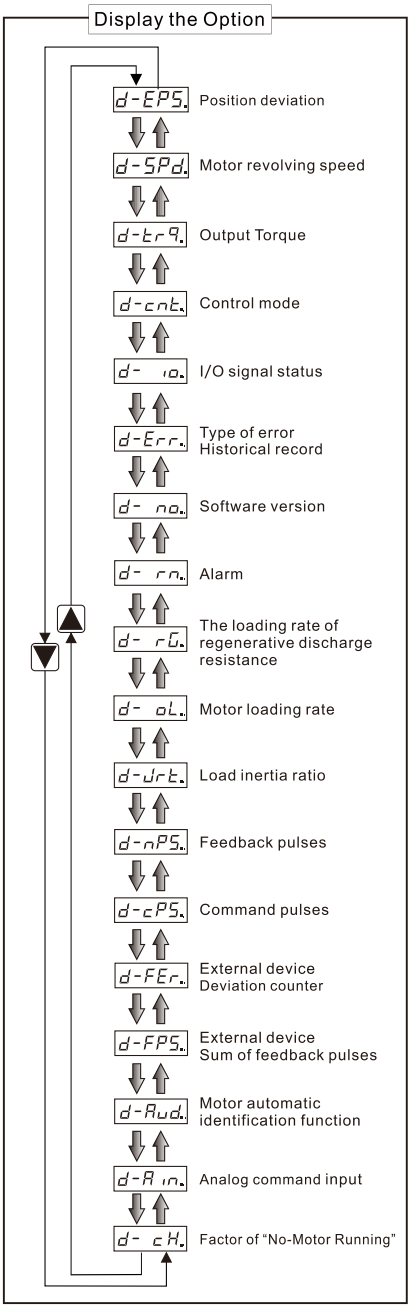


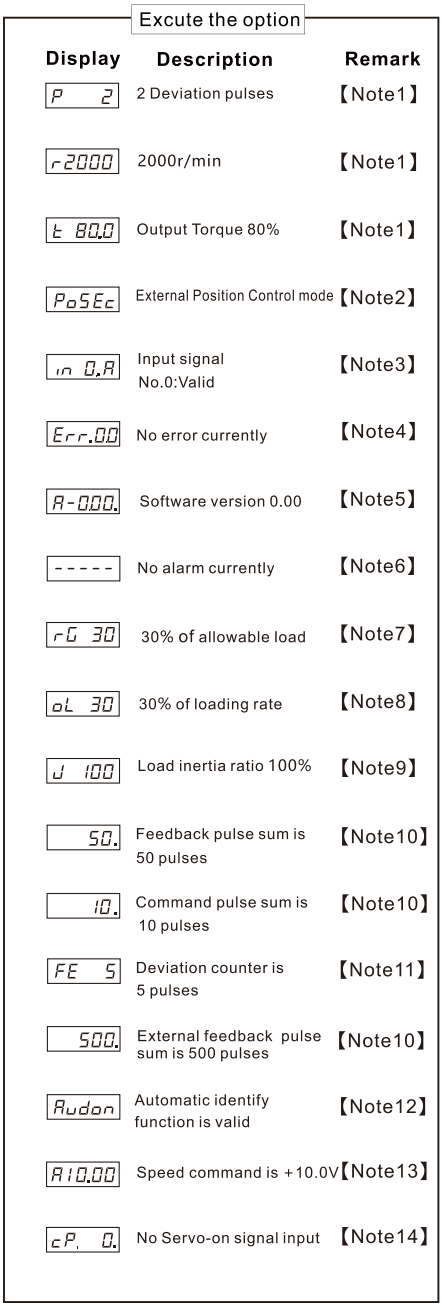
7.3 Operation Modes

The LED shows r 0. for first power-on, which also can be changed by setting P14. The details of each control mode shows as following:

1. Monitor Mode

Press MODE to select the monitor mode "d-" in main menu, and press ▲▼ to select the item you want to display then press SET to confirm.

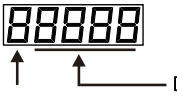




Remark: Display shifts toward the arrowed direction by pressing ▲ and reversed direction by pressing ▼

Note 1

[Position deviation, displays the motor speed and torque]



P ..... Position deviation
All decimal points of data bits are lighted: torque in CW direction
No decimal point of data bits are lighted: torque in CCW direction

r ..... Motor rpm Unit【r/min】
All decimal points of data bits are lighted: CW
No decimal point of data bits are lighted: CCW

t ..... Torque command Unit【%】(Rated torque 100.0)
All decimal points of data bits are lighted: CW
No decimal point of data bits are lighted: CCW

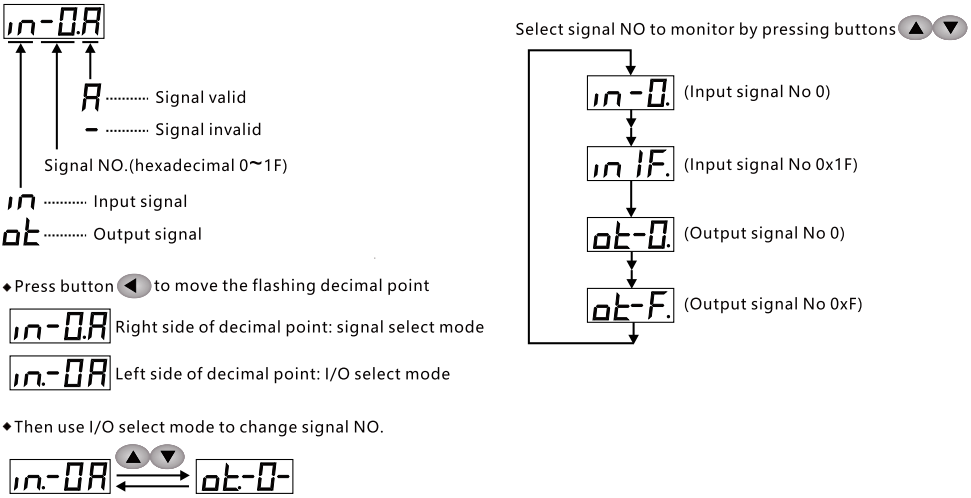
Note 2

[Display control mode]

Panel display	Definition
PoSEc	External position control mode
SPdEc	External speed control mode
trqEc	External torque control mode
PoScc	Communication position control mode
SPdcc	Communication speed control mode
trqcc	Communication torque control mode
0	Off

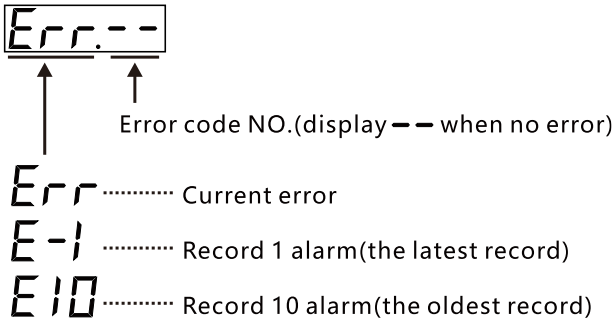
Note 3

[Display the status of I/O signal]



Note 4

[Factor of error and history record]



- Able to check the factor of the last 10 (including the current record) errors. Press to choose record you want to check.
- When historical error occurs, the current error and record 1 display same error code.
- The screen flashes when error occurs.

List of error code

Error code	Function	Error code	Function
1	Under-voltage	13	EEPROM R/W error
2	Over-voltage	14	RS485 communication error
3	Over-current	15	CANopen communication error
4	Over-heat	16	External input PIN configuration error
6	Encoder feedback error	17	Internal error 1
7	Over braking rate	18	Absolute encoder motor unmatched
8	Over-load	19	Special speed-position mode pulse error
9	Position deviation excess	22	Main power lack-phase
10	Range limit alarm	23	Under-voltage of control power
11	Over-speed	24	Under-voltage of internal drive power
12	Analogy input excess	25	Motor runway alarm

Note 5

[Software version]

..... Display the software version of driver

Note 6

[Display warning]

Function reserved

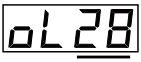
Note 7

[Display load-rate of regeneration and release resistor]

Display the alarm level and ratio(%)
Valid when P132(can be selected as external regenerative discharge resistance) is 0 or 1

Note 8

[Display load-rate]



◆Dispaly relevant rated load ratio(%)

Note 9

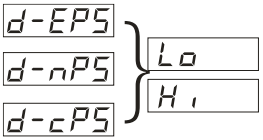
[Display inertia ratio]

◆Display load inertia ratio(%)

◆Directly display P32(inertia ratio)

Note 10

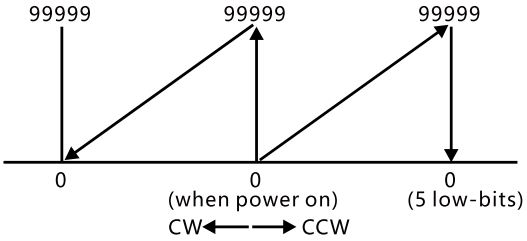
[Display sum of feedback pulse, sum of command pulse and position deviation]



Five low-bits of the parameter

Five high-bits of the parameter

Sum of pulses after control power off, picture below shows the situation of overflow:



Note 11

[Deviation counter of external device]

Function reserved

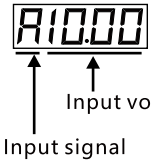
Note 12

[Automatic motor recognizing function]

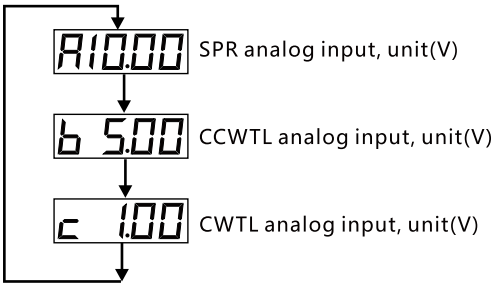
Function reserved

Note 13

[Display the analogy input]



◆Select signal that needs to be checked by pressing ▲ ▼



Note 14

[Factor of no-motor running]

Error code

Error code	Description	Control mode	Factor
Flash	Error/alarm	ALL	Error is occurring or alarm is triggered
0	No special factor	ALL	No factor detected, motor run in normal
2	No servo-on signal	ALL	The SRV-ON signal didn't connect to COM-
3	Over-travel inhibition is valid	ALL	● P03＝0 (Over-travel inhibition is valid) ● CCWL is not connected to COM－, and the speed command of CCW was inputted ● CWL is not connected to COM－, and the speed command of CW was inputted
4	Too small of torque limit	ALL	● P02＝0 (analogy torque input is valid) ● Too small CCWTL or CWTL input command, so the output torque is unable to have motor run ● P02＝1~3, check P119 or P120 for torque limit, no motor running if the value is lower than 0.2% (no-load)
7	Too small of position command or 3rd internal speed	P	● Incorrect input of command pulse ● The setting of P80(pulse direction setting) or P81 (pulse input way) is unmatched with actual input ● Short of one pulse in a control period ● Setting of 3rd internal speed is lower than 1rpm (no-load)

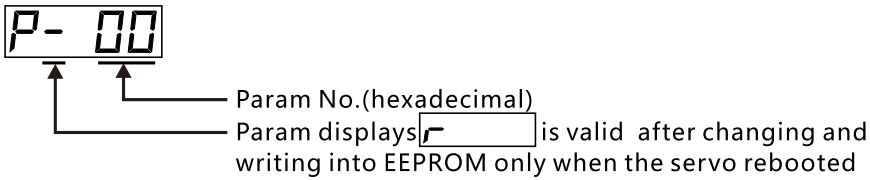
Error code	Description	Control mode	Factor
8	Valid of input deviation counter clear signal	P	P91＝0 (input way of deviation counter) and CL signal is short connected with COM-
9	Zero-speed clamp input signal is valid	S/T	P06＝1 (valid zero-speed clamp input), and the connect between ZEROSPD and COM- is open
10	Too small of speed command	S	● Too small of command voltage(lower than 0.06V) when input analogy speed command signal ● It should be lower than 30rpm when input internal speed command (no-load) ● It should be lower than 30rpm when input communication speed command (no-load)
12	Too small of torque command	T	● Too small of analogy torque command(TQRQ or CCWTL) which is lower than 5% of rated torque ● Too small of given torque setting which is lower than 5% of rated torque when choosing communication torque command
13	Too small of speed limit	T	When P98＝0(use 4th internal speed as limit), set it lower than 30rpm
14	Other factor	ALL	● Even excluding the above 0 ~ 13 reasons, the motor is still rotating at a speed of 20rpm or lower, which may due to too small of command speed, too heavy load, locked motor, the load is hit or the drive or motor is out of control, etc.. ● Wrongly connect UVW cables
15	Any alarm occurs		See “error code and function” of Note 4
17	Motor UVW cables unconnected		UVW cables of motor didn’t connect
22	Main power phase loss		● Poor-wiring of three-phase input ● Three-phase servo run in single-phase power ● Unbalanced power or too low of voltage of three-phase ● Servo breakdown
23	Control power under-voltage		Unstable control power or power loss; poor-contact of control power cable
24	Internal drive power under-voltage		Activation when internal drive power is under-voltage
25	Runaway alarm		● Wrongly connect of UVW cables ● Motor rotor initial phase detection error by disturbance signal when power-on ● Wrong encoder type or wire failure ● Aging corrosion or loose plug of encoder cable ● Too heavy load in vertical shaft working condition

<Note> Code of motor is 0 when normally rotate

2. Parameter Setup Mode

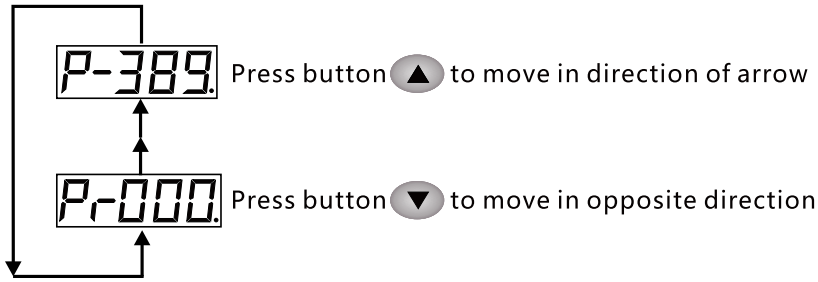
Selection display

Start from the LED initial status, press SET then MODE till the parameter setup mode shows:

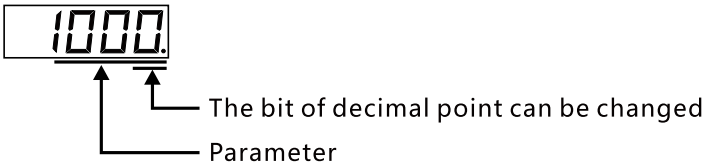


Execution display

Press ▲▼ to select the parameter you want to check or edit



Press SET to enter execution display



Press ◄ to change the digit as you want, press ▲▼ to set parameter (▲ to increase, ▼ to decrease)

Note

The changes by pressing SET will be reflected in control. When changing the parameters that have a great influence on the motor (especially the parameters such as speed loop gain and position loop gain), please do not change the values that are too big one time but in several times.

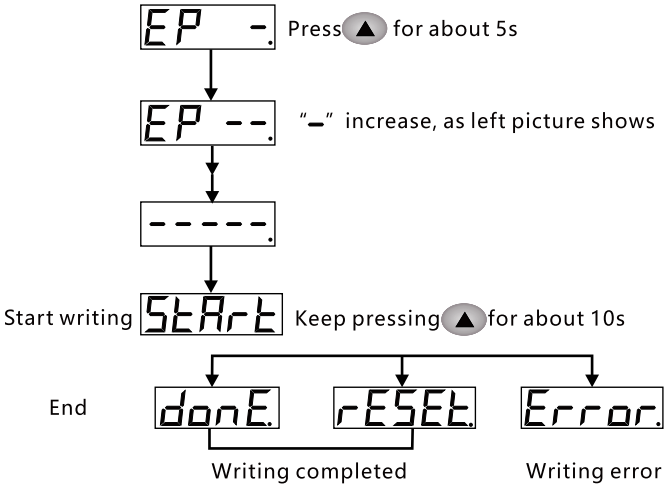
3. EEPROM Writing Mode

Selection display

Start from the LED initial status, press SET then press MODE twice till the parameter setup mode E-SEt shows:

Execution display

Press SET to display execution EP -, then continue to press ▲ till StArt shows:



To make the contents modified effective, please turn the control power off to reset after writing the ending-display rESEt.

Notice

1) Rewrite when writing errors occur, if there are still errors after several times repeating, the servo may fail.

2) Do not turn power off in EEPROM write operation which may result in incorrect data written. If this happens, reset all parameters and rewrite after confirmation.

4. Auxiliary Function Mode

1) Alarm clear

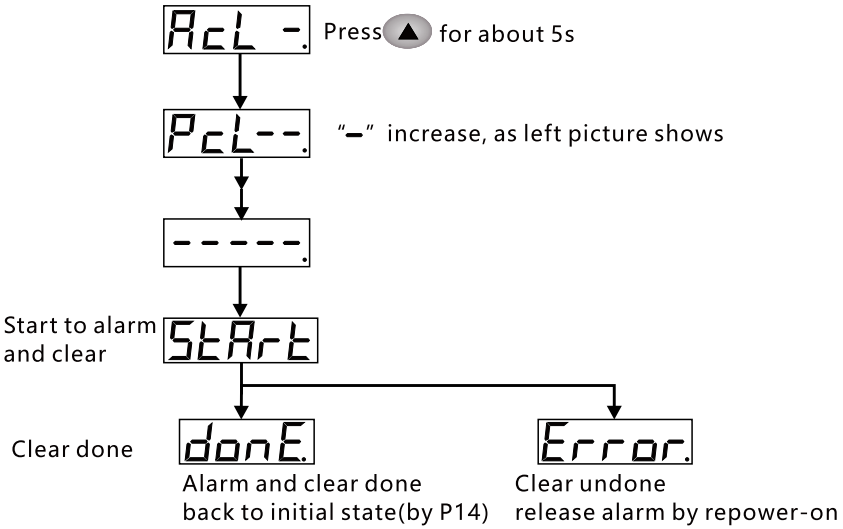
※Clear alarm in servo-off.

Selection display

Start from the LED initial status, press SET then press MODE till F-AcL. shows

Execution display

Press SET showing execution display AcL -., continue to press ▲ till StArt shows.



Back to selection display after changing parameter.

Notice

Do not cut off the contact between controller and servo in StArt and donE. mode. If the connector disconnected, please operate after insert it again.

2) Test run (JOG-run)

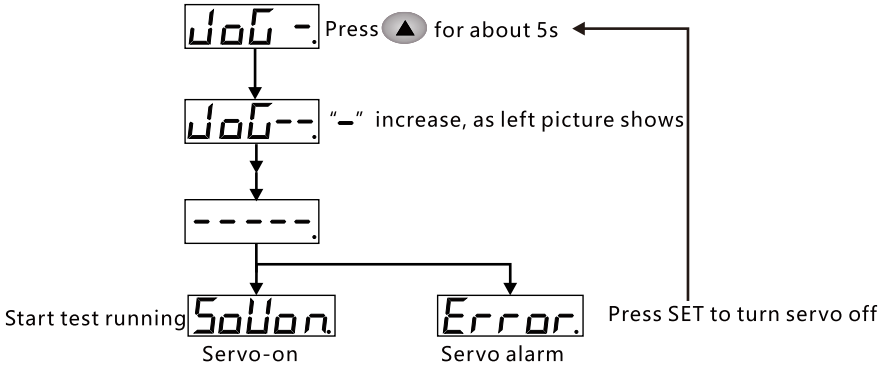
※Motor can rotate as JOG speed setting without external enable signal for servo in test run mode

Selection display

Start from the LED initial status, press SET then press MODE till F-AcL. shows, then press ▲▼ F-JoG.

Execution display

Press SET to display execution JoG -., then continue to press ▲ till SoUon. shows.



Servo starts test run mode

The command speed of servo is P70 (JOG speed setting), press ▲ to rotate in CCW direction and ▼ in CW direction. Motor stop running when not press ▲▼.

Notice

- It is recommended to use factory default parameters, especially servo gain parameters, before test run.
- Please disassemble the motor load to cut the X2 off before test run.
- Please check P02-torque limit selection, P03-limit inhibition input invalid and P06-zero-speed selection valid when no-motor running in SoUon..

3) Restore factory default

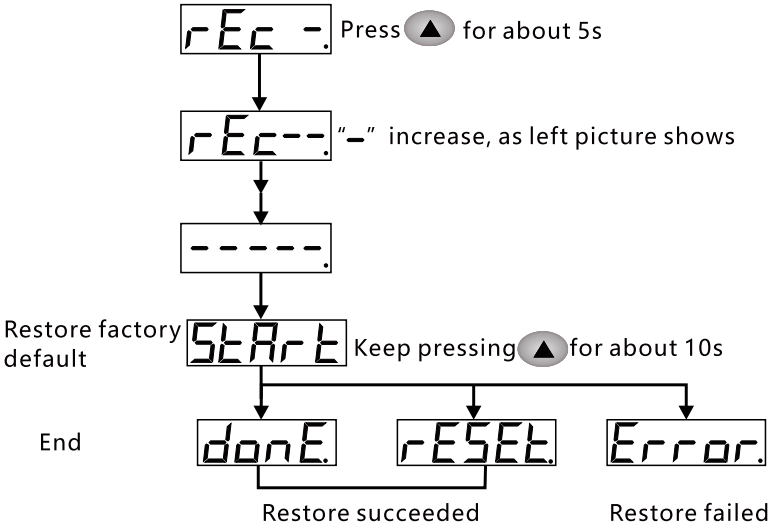
※Reset servo parameter to factory default, it is recommended to reboot servo driver after reset.

Selection display

Start from the LED initial status, press SET following press MODE three times, then press ▲▼ showing F-rEc.

Execution display

Press SET showing execution display rEc -., continue to press ▲ till StArt shows.



To make the contents modified effective, please turn the control power off and reset after writing the ending-display rESEt..

Notice

1) Rewrite when writing errors occur, if there are still errors after several times repeating, the servo may fail.

2) Do not turn power off in EEPROM write operation which may result in incorrect data written. If this happens, reset all parameters and rewrite after confirmation.

4) Clear the feedback position of bus encoder

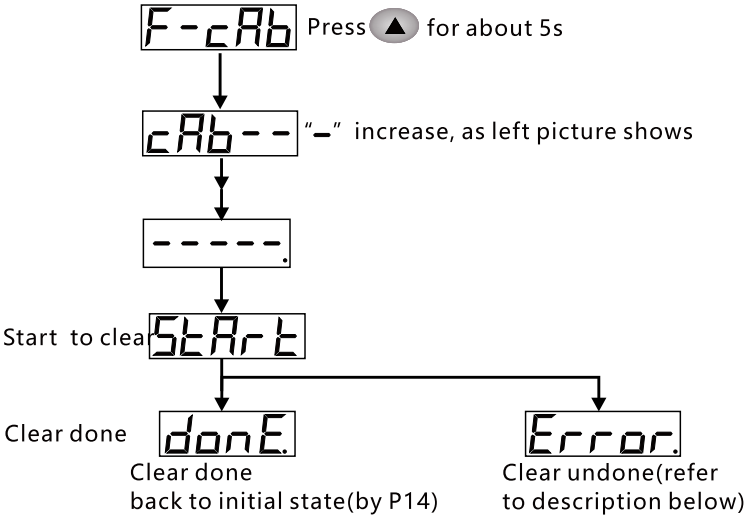
※ When P41=0 (used as the multi-turn bus absolute encoder), the motor encoder may lose multi-turn pulse due to the lack of battery power supply or other reasons, the servo driver will prompt Err.06 alarm, which can be used to clear this kind of alarm.

Selection display

Start from the LED initial status, press MODE three times after pressing SET showing F-AcL, then press, then press ▲ three times showing F-cAb

Execution display

Press SET showing execution display cAb--, continue to press ▲ for 5s till StArt shows.



Back to selection display after changing parameter.

The screen shows Error for unfinished clearing where you need to operate again. If there are still error, reboot the driver.

Notice

1) Do not cut off the contact between controller and servo in StArt and donE. mode. If the connector disconnected, please operate after insert it again.

2) The user coordinate will be reset after alarms cleared.

8

Communication

*CANopen/Modbus communication protocols

8 Communication

Introduction of CANopen/Modbus communication protocol

8.1 CANopen Communication Protocol

A4S servo driver supports CANopen communication, which allows the operations of writing/reading parameters via CANopen controller. The controller can modify parameter commands in real time so as to change the running position or speed etc. in communication control mode.

A4S servo can be used as a slave in CANopen bus network (refer to “CIA Draft Standard 301”), other functions are achieved via “Manufacturer Assigned Data Area”. The operations for device are based on Object Dictionary, you can access all the parameters’ value and function via the address that is constituted by index and sub-index.

CANopen Communication has defined following kinds of messages:

Abbreviation	Full name	Description
SDO	Service Data Object	Normal parameter setting of servo
PDO	Process Data Object	Process Data Object for fast transmission of data in the CAN network (eg. Actual position)
EMCY	Emergency Message	Emergency error messages in network
SYNC	Synchronization Message	Synchronization of multi-node on network
NMT	Network Management	Network Management, services provided by the CAN Application Layer
Node Guarding	Node Guarding	Monitoring function at the serial interface.

1. CANopen protocol

Standard properties of A4S:

NMT	Slave device
Conformed Protocol	Conform to CANopen standard protocol DS301_V402 and DSP402
Server SDO	1
Tx PDO	4
Rx PDO	4
PDO transmit type	Support event-trigger, time-trigger, synchronizing and synchronous aperiodic.
Emergency Object	NO
Sync Object	YES
Time Object	NO
Error Control Protocols	Heartbeat Protocol

2. Object Dictionary OD

The core concept of CANopen is device OD (Object Dictionary), which allows to access all the parameters of servo driver. Each object is addressed with a 16-bit index value, while an 8-bit sub-index is defined to allow access to individual elements in the data structure.

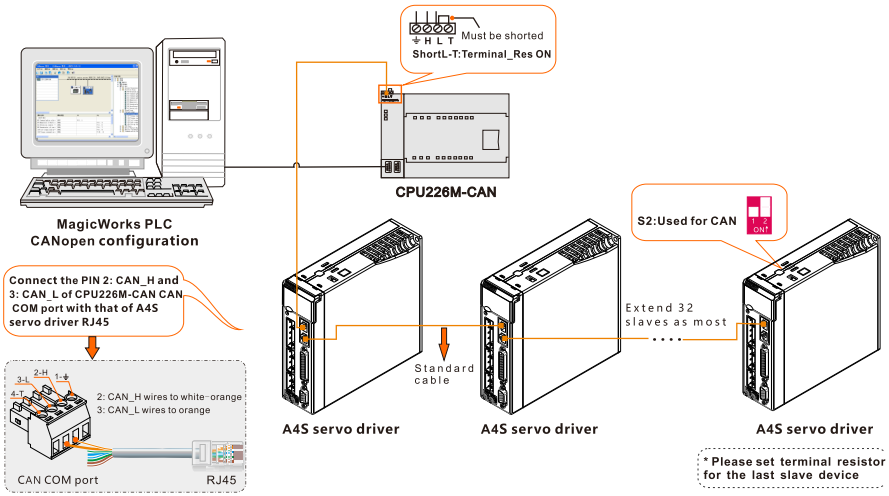
Index form of parameter: index, sub-index

Parameter No	Index	Sub-index
P0~99	16#2000	Add 1 to the last two bits of the parameter, and convert it to hexadecimal.
P100~199	16#2001	
P200~299	16#2002	
P300~399	16#2003	
P400~499	16#2004	

For example: The last two bits of P282 is 82, which becomes 83 adding 1, then convert it to hexadecimal 53, so the sub-index of P282 is 16#53. Others see following table:

Parameter No	Index	sub-index	Description
282	16#2002	16#53	Communication control Word
290	16#2002	16#5B	Given position 0
97	16#2000	16#62	The 3rd internal speed

3. Connection



<Note> Please do set terminal resistor for CPU226M-CAN and the last slave device

4. Example

Please refer to chapter 9.3.1 Example of Communication Position Control Mode for CANopen communication example in communication position control mode

5. Diagnosis

You can diagnosis CANopen network by front panel of A4S or the SMB status byte of MagicWorks PLC.

- Diagnose via front panel

If any abnormality happened in the process of CANopen communication, diagnose by checking P236 on front panel.

- Diagnose via MagicWorks PLC

CPU226M-CAN has assigned 100 bytes to dedicated memory(SM), users can get the error info via status byte, see following:

	Byte	Address allocation	Description of status value
SMB Status Word	100	SMB550: CAN communication status of master(CPU)	0x00: Initialization 0x01: Contact broken 0x04: Stop 0x05: Run 0x7f: Pre-operation 0xff: Configuration data error
		SMB551-SMB582: CAN communication status of No.1 to No.32 slave(In order from smallest to largest of Node ID)	0x00: Initialization 0x01: Contact broken 0x05: Run 0x7f: Pre-operation 0x7: Configuration data error

8.2 Modbus RTU Communication Protocol

A4S series servo driver built-in standard Modbus RTU protocol, which supports Modbus RTU master reading/writing single or multiple parameters. As the controller with Modbus protocol was connected with Servo driver, it can set parameters and read status etc. Controller can modify the commands in real time so as to change the motor running speed and position etc. in communication control mode.

Modbus RTU protocol contains various bus commands, A4S series servo driver supports the three most commonly used commands, which meet the demand of controller from

controlling the servo driver in all aspects. The specific functions see as follows:

Function code(CMD)	Signification
16#03	Read single or multiple parameters of the driver
16#06	Write single parameter of the driver
16#10	Write multiple parameters of the driver

In order to facilitate the Modbus controller to read and write the driver parameters, A4S series driver corresponds the parameter number to the Modbus address of device, drive 0 corresponds to the device Modbus address 40001, and the rest are postponed accordingly. For example, P324, the given speed instruction in communication speed control mode, with Modbus address 40325 to corresponding device, that is, the operation result of the Modbus address 40325 corresponds to the P324 parameter value.

1. Read parameter (16#03)

The following request frame indicates: Read the two data from driver of communication address 01 that start from P221 (Feedback speed).

Request frame format:

Format	Slave Adr	CMD	Start Adr H	Start Adr L	No. of Regs H	No. of Regs L	CRC	
	1Byte	1Byte	2Bytes		2Bytes		2Bytes	
Eg.	16#01	16#03	16#00	16#DD	16#00	16#02	XXXX	XXXX

Slave Adr: Communication address of the driver, the setting value of P0. Slave address need convert to hexadecimal value.

CMD: Function code, 16#03 is the operation of reading function code.

Start Adr H/L: High/Low bit of parameter initial address, which need to be converted to hexadecimal. Eg. Convert Pr221 of this example to hexadecimal value: 16#00DD, so the high-bit is 16#00 and low-bit is 16#DD.

No. of Regs H/L: High/Low bit of reading parameter quantity, which need to be converted to hexadecimal, for example, there are two parameter (16#0002) whose high-bit is 16#00 and low-bit is 16#02.

CRC: CRC Check word.

If the read operation succeed, see response frame as follows:

Format	Slave Adr	CMD	Data Length	Data 0	Data1	…	Data n×2-2	Data n×2-1	CRC	
	1Byte	1Byte	1Byte	2Bytes		…	2Bytes		2Bytes	
Eg.	16#01	16#03	16#04	16#00	16#00	/	16#00	16#00	XXXX	XXXX

Slave Adr: Communication address of the driver.

CMD: Function code, 16#03 is the read operation.

Data Length: Length of data byte, which equals to the quantity of reading parameter (No.of Regs)×2;

Data0/Data1/…/Data n×2-1: Read the 8 high-bit of the initial parameter/8 low-bit of the initial parameter/.../Read the 8 low-bit of the last parameter.

CRC: CRC check word.

2. Write single parameter (16#06)

The following request frame indicates: write 500 to P324 (Given speed 0) of driver of communication address 01.

Request frame format see as follows:

Format	Slave Adr	CMD	Reg Adr H	Reg Adr L	Preset Data H	Preset Data L	CRC	
	1Byte	1Byte	2Bytes		2Bytes		2Bytes	
Eg.	16#01	16#06	16#01	16#44	16#01	16#F4	XXXX	XXXX

Reg Adr H/L: Write the initial address High/Low bit of the parameter. Convert starting address to hexadecimal value, eg. convert P324 to hexadecimal value: 16#0144, so the high-bit is 16#01 and low-bit is 16#44.

Preset Data H/L: High/Low byte of preset data, convert writing data to hexadecimal value.

Slave Adr: Communication address of the driver. The setting value of P0. Slave address needs to be converted to hexadecimal.

CMD: Function code, 16#03 is the read operation.

CRC: CRC check word.

If the successfully write single, see response frame as follows:

Format	Slave Adr	CMD	Reg Adr H	Reg Adr L	Preset Data H	Preset Data L	CRC	
	1Byte	1Byte	2Bytes		2Bytes		2Bytes	
Eg.	16#01	16#06	16#01	16#44	16#01	16#F4	XXXX	XXXX

Slave Adr: Communication address of the driver.

CMD: Function code, 16#06 is the operation of writing single parameter.

Reg Adr H/L: Initial address High/Low bit of the parameter to be written.

Preset Data H/L: High/Low byte of preset data.

CRC: CRC check word.

3. Write Multi-parameters (16#10)

The following request frame indicates: Consecutively write 200 and 300 to P113/P114 (Acceleration/Deceleration) of diver of communication address 01.

Request frame format:

Format	Slave Adr	CMD	Start Adr H	Start Adr L	No. of Regs H	No. of Regs L	Data Length	Data 0	Data 1	…	Data n×2-2	Data n×2-1	CRC	
	1Byte	1Byte	2Bytes		2Bytes		1Byte	2Bytes		…	2Bytes		2Bytes	
Eg.	16#01	16#10	16#00	16#71	16#00	16#02	16#04	16#00	16#C8	/	16#01	16#2C	XXXX	XXXX

Slave Adr: Communication address of the driver, the setting value of P0. Slave address need to be converted to hexadecimal value.

CMD: Function code, 16#10 is the operation of writing multi-parameters.

Start Adr H/L: Initial address High/Low bit of the parameter need to be written. Convert starting address to hexadecimal value, eg. Convert P113 to hexadecimal value: 16#0071, so the high-bit is 16#00 and the low-bit is 16#71.

No. of Regs H/L: Quantity High/Low bit of the parameter to be written, the quantity of the parameter needs to be converted to hexadecimal value. eg. there are two parameters (16#0002), so the high bit is 16#00 and the low bit is 16#02.

Data Length: Length of data byte which equals to the quantity of writing params (No. of Points)×2, the starting address need to be converted to hexadecimal value.

Data0/Data1/…/Data n×2-1: Write the 8 high-bit of the initial parameter/8 low-bit of the initial parameter /.../Write the 8 low-bit of the last parameter.

CRC: CRC Check word.

If multiple- write succeed, see response frame as follows:

Format	Slave Adr	CMD	Start Adr H	Start Adr L	No. of Regs H	No. of Regs L	CRC	
	1Byte	1Byte	2Bytes		2Bytes		2Bytes	
Eg.	16#01	16#10	16#01	16#38	16#00	16#02	XXXX	XXXX

Slave Adr: Communication address of the driver.

CMD: Function code, 16#10 is the operation of writing multi-params.

Start Adr H/L: Initial address High/Low bit of the written parameter.

No. of Regs H/L: Quantity High/Low bit of the written parameter.

CRC: CRC check word.

4. Error code

The slave (servo driver) received MODBUS message from master without transmission errors, but it could not execute master commands properly or response correctly, or response abnormal messages.

The following request frame indicates: Slave responses abnormality when master read P280 of slave whose address is 01.

Abnormal response frame Format:

Format	Slave Adr	CMD	Error	CRC	
	1Byte	1Byte	1Byte	2Bytes	
Eg.	16#01	16#86	16#02	XXXX	XXXX

Slave Adr: Communication address of the driver.

CMD: Function code, set the highest Bit (7th) of master function code in abnormal response frame to 1, eg. Write 16#06 to the function code of master request frame, the abnormal response frame sets the highest Bit of master function code to 1, the final data is 16#86.

Error: Error code, the description of error code see as below:

Error Code	Name	Description
16#02	Illegal data address	Incorrect parameter writing range and manufacturer password, read-only parameters etc.
16#03	Illegal data	Address of parameter group is greater than 11th group etc.
16#06	Busy, refuse to execute	Slave might be saving to EEPROM now or servo is on etc.

CRC: CRC check word.

Note: Please refer to chapter 9.3.2 Example of Communication Speed Control mode for the example of Modbus communication

9

Applications of Basic Control Modes

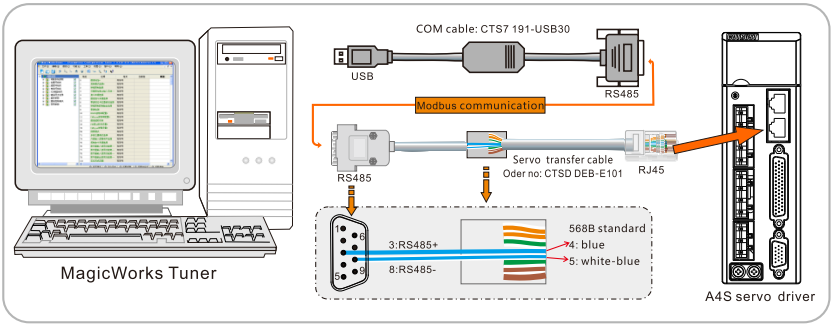
*Applications of communication/external control modes

9 Applications of Basic Control Modes

Applications of communication control and external control mode

You can set the parameters of A4S series servo by MagicWorks Tuner, which can be used to define and generate a set of parameters and download the configuration table to servo according to the field requirements via using the "Config wizard", on the upper computer. You can download it from our company's website: [www.co-trust.com.](http://www.co-trust.com)

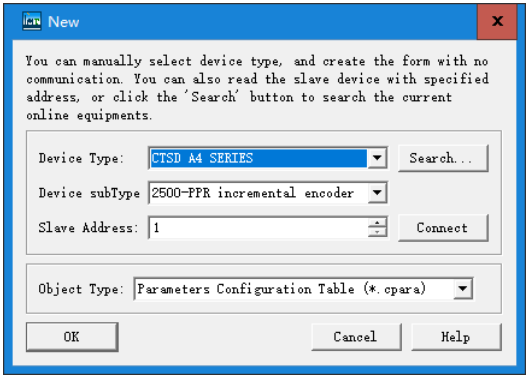
Connect upper computer with A4S servo driver as below, an isolated serial port converter is recommended.



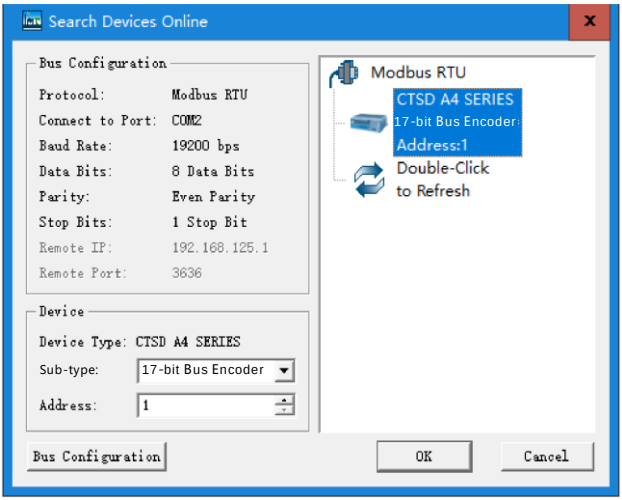
Here are steps to use MagicWorks Tuner:

1) Download the latest version of MagicWorks Tuner software, and install it.

2) Double-click the icon from the desktop to open the software after installation completed. The "New" window will pop-up by selecting "File" -> "New" from the main interface. Then choose the corresponding "Device Type" and "Slave Address" for current device. And click the drop-down list of "Object Type" to create a "Parameters configuration Table".



3) Select "Connection" -> "Search" in the main interface, or click the search button from the toolbar to open the search dialog box (default baud rate is 19200bps, Even parity). Then double-click the Refresh button to search, the interface see as follows:



4) Click button on the toolbar to write new parameter value into servo from the Parameter status table, then click button to save the settings into EEPROM, store setting is always effective. The parameters marked with ※ become effective only after rebooted the servo.

9.1 Test Run

P01=6(communication position control mode), P01=7(communication speed control mode), P01=8(communication torque control mode)

<Note> Save the selected mode into EEPROM and restart to take effect

This section introduces the test run of servo in communication position / speed / torque mode, see specific steps as follows:

Step 1: Wiring

Be sure to well connect main power, control power, encoder, and motor driver cables etc. according to chapter 4 Wiring, and turn power of servo driver on. If the red light turns on, please refer to chapter 11 Alarms and Protections for solutions.

Step 2: Mode selection

P01=6 (Communication position control mode), P01=7 (Communication speed control mode), P01=8 (Communication torque control mode).

<Note> Reboot to make the changes effective after saving the settings to EEPROM.

Step 3: Enable servo

Set P16=1 (Selection of servo-on once power on) or P282_Bit0=1 to enable the servo.

Step 4: Select given position/speed command

① Test run in communication position mode

First set P97 (3rd internal speed), and select the Xth given position command (P290~P320), for this example by setting P05. For example, set P05 to 0, so the motor rotates as the value of P290 (Given position 0).

Address	Comment	Format	Current Value	New Value
1	Control Mode Set-up*	Signed		+6
282	Communication control word	Binarry		2#0000_0000_0000_0001
97	3rd internal speed	Signed		+10000
5	Communication command source selection	Signed		+0
290	Given position 0	Signed		+8000

② Test run in communication speed mode

Select the Xth given speed command (P324~P355) via P05. For example, set P05 to 0, so the motor rotates as the value of P324 (Given speed 0).

Address	Comment	Format	Current Value	New Value
1	Control Mode Set-up*	Signed		+7
282	Communication control word	Binarry		2#0000_0000_0000_0001
5	Communication command source selection	Signed		+0
324	Given speed 0	Signed		+1000

③ Test run in communication torque mode

Select the Xth given torque (P358~P389) via P05, for example, set P05 to 0, so the motor rotates as the value of P98 (the 4th internal speed) and P358 (Given torque 0).

Address	Comment	Format	Current Value	New Value
1	Control Mode Set-up*	Signed		+8
282	Communication control word	Binarry		2#0000_0000_0000_0001
5	Communication command source selection	Signed		+0
358	Given torque 0	Signed		+1000

Step 5: If servo motor stalls and no alarm, please check P235 for causes.

Note

Communication control may not connect to the control signal terminal, except the stroke limit function, each control mode is given by the communication external command.

9.2 External Control Modes

External control modes include: External Position, speed, torque control modes, the definition of each mode describe as follows:

External Position control mode: Control the revolving speed and position of motor via the number and frequency of external pulses, so as to control position.

External Speed control mode: Select the corresponding internal speed via external analog voltage or the combination of external DI to control motor revolving speed, so as to control speed

External Torque control mode: Control the output torque of motor via external analog voltage, so as to control torque. You should also set speed limitation for the mode.

9.2.1 Example of External Control Modes

【Relevant Parameters】

No.	Name	Description
P01	Control mode setup	0: External position control -P
P50	Communication location instruction interpolation mode	2: Use pulse adjustment which equals to value of P290
P80	Command pulse direction setting *	Select the pulse direction: CW or CCW
P81	Command pulse input method *	Select the pulse input way: P+D, A+B, CW+CCW
P86	Numerator of 1st command pulse ratio	Set the resolution of command pulse according to frequency division. Pulses each turn needs X $\frac{\text{P86 or P87 numerator}}{\text{P88 denominator}}$ = Encoder resolution ● Resolution of 2500-PPR incremental encoder: 10000 ● Resolution of bus absolute encoder: 131072
P87	Numerator of 2nd command pulse ratio	
P88	Denominator of command pulse ratio	
P136	Excessive level of position deviation	Set the detection range for the excessive position deviation pulse number.
P121	Position complete range	Set the Position complete range. Output signal when the deviation between motor actual feedback position and command pulse position is lower than the value of P121.
P124	Position complete signal output setup	Set the output condition of position complete
P290	Given position 0	Pulse adjustment

【Example】

Here introduces the basic operation in external control mode, please set the servo driver according to steps below:

Step 1: Make sure if the electronic gear ratio need to be set, please refer to chapter "6.3 Electronic gear ratio setup" for the specific setting method.

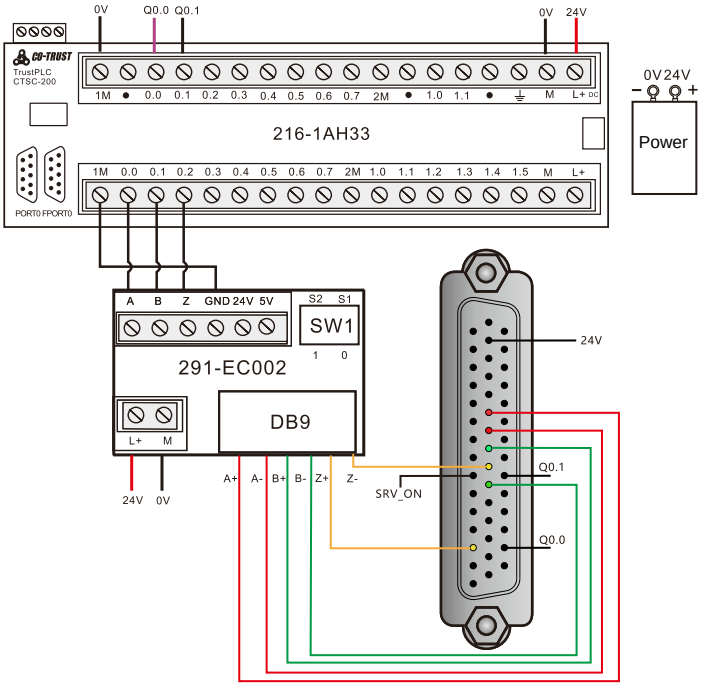
Step 2: When the input pulse frequency is low or the electronic gear ratio is excessive, increase the value of P89(Smoothing filter), the servo driver will filter in accordance with the input position so as to make servo motor rotates smoother.

Step 3: Make sure if the related parameters of command pulse inhibit input, deviation counter clear, positioning complete output, each kinds of alarms and the torque limitation etc. need to be set. Please use defaults when no special requirements.

Step 4: Be sure to connect well with the main power, control power, encoder, motor cables etc., and connect to external upper controller.

If PLC (such as Mitsubishi or Omron PLC) or upper computer are NPN output, the connection as following:

◆ Connection example of CPU 226H and A4S servo driver:



Step 5: After wiring, the controller enables servo and sends out pulse command to have motor rotate. Please check the monitor parameters (P235/ P202) while motor stalls or alarms occur.

9.2.2 External Speed Control Mode

【Relevant Parameters】

No.	Name	Description
P01	Control mode setup	1: External Speed control -S
P04	Select command source	Select the command source of external speed control mode and communication control mode.
P92	Analog Speed command scale factor	Set the relationship between the motor speed and the voltage applied to the analog velocity command input terminal, which equals to motor rotate speed that input 1V needed.
P93	Speed command logic inversion	Set the logic level of analog speed command
P94	Analog input command zero-drift adjustment	Adjust the zero-drift of analog speed/ torque command
P112	Speed command filter	Set the parameters of the primary delay filter that inserted to the Analog speed/ torque command.
P113	Acceleration time setup	Set the acceleration/deceleration time, convert to smoother ACC/DCC speed command
P114	Deceleration time setup	
P122	Zero-speed detection range	Set the threshold value of Zero-speed detection

9.2.3 External Torque Control Mode

【Relevant Parameters】

No.	Name	Description
P01	Control mode setup	2: External Torque control-T
P117	Analog torque command scale factor	Set the relationship between the motor torque and the voltage applied to the analog torque command input terminal, which equals to motor rotate speed that input 1V needed.
P118	Torque command logic inversion	Set the logic level of analog torque command.
P94	Analog input command zero-drift adjustment	Adjust the analog speed /torque command zero-drift
P112	Speed command filter	Set the parameters of the primary delay filter that inserted to the Analog speed / torque command.
P98	The 4th internal speed	Set the 4th speed of internal speed command

9.3 Communication Control Mode

Communication control modes include: Communication position/speed/torque control mode, the definition of each mode describe as follows:

Communication position control mode: Control position via modifying position command in communication mode.

Communication speed control mode: Control speed via modifying speed command in communication mode.

Communication torque control mode: Control torque via modifying torque command in communication mode.

9.3.1 Example of Communication Position Control Mode

【Relevant Parameters】

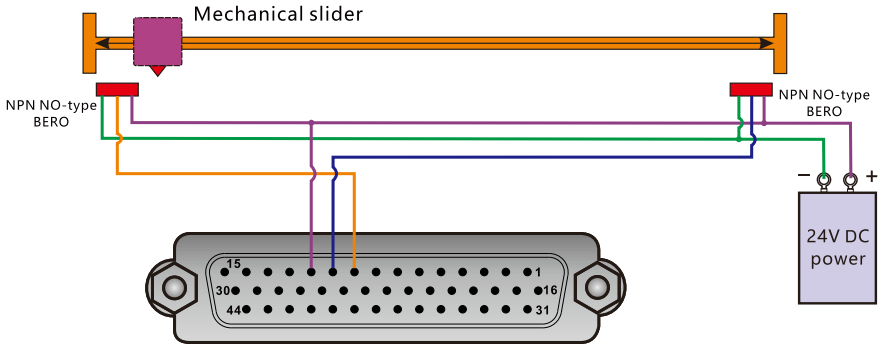
No.	Name	Description
P01	Control mode setup	6: Communication Position control -P
P86	Numerator of 1st command pulse ratio	Set the resolution of command pulse according to frequency division. $\text{Pulses each turn needs} \times \frac{\text{P86 or P87 numerator}}{\text{P88 denominator}} = \text{Encoder resolution}$
P87	Numerator of 2nd command pulse ratio	
P88	Denominator of command pulse ratio	
P97	3rd internal speed	Execution speed in communication position control mode
P121	Positioning complete range	Set the range of Positioning complete
P04	Command source selection	Select the command source of control modes.
P05	Communication command source selection	0~15: Select communication given position command.
P281	Communication extended control word	Communication given control command, such as Zero-speed clamp, Homing command etc.
P282	Communication control word	Communication given control command, such as Servo-on, Alarm clear etc.
P71	Communication position control method	Bit0: 0: Absolute position, 1: Relative position
P290~320	Given Position	P290: Given position 0 P292: Given position 1 ..... P320: Given position 15
P204	Output state	Output status of servo system, such as homing complete, positioning complete etc.

【Example】

Here introduces the CANopen communication between A4S servo and CPU 226M-CAN in communication position mode, please refer to following steps:

Step 1: Wiring

Connect CW & CCW inhibit signal to the control signal terminal of servo. The Left sensor uses as original switch signal while the right one uses as CCW overtravel inhibit signal.



Step 2: Configure parameters

① Select the control mode: P01=6 (Communication position control mode)

② Set the communication baud rate: P11=1 (1000Kbps)

③ Set communication address: P0=2

④ Select the command source: P04=4 (The command source of communication control mode is selected by INTSPD1~INTSPD4)

⑤ Select PIN function allocation method and control command source: P73=4 (Pin functions are allocated by P75/76/77/78)

⑥ Select digital input multiplexing function: P78 (digital input multiplexing function register1) =16#020B

Parameter	Bit	PIN	Name	Value
P78	B8~B15	34	DIN2	16#02: CCW overtravel inhibit
	B0~B7	10	DIN1	16#0B: Original switch input

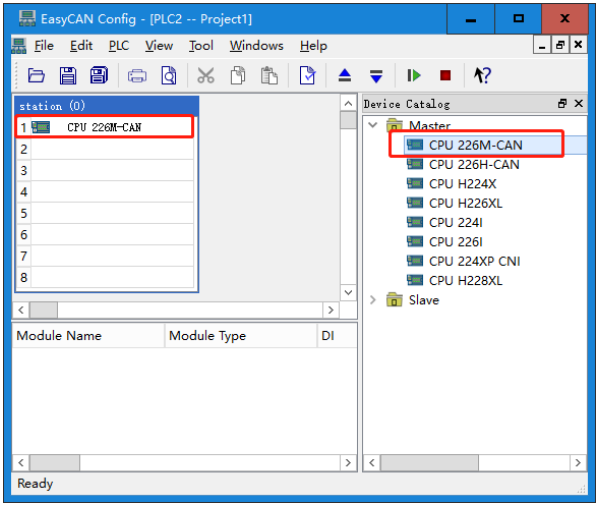
⑦ Effective level of sensor signal is high-level, so we need to choose external input logic level: set P72_Bit2 to 1, set P72_Bit11 to 0 as the following table shows:

Parameter	Bit	Function	Value of Bit	Effective way
P72	2	CCW overtravel inhibit	0	Low Level On
			1	High Level On
	11	Original switch input	0	Low Level On
			1	High Level On

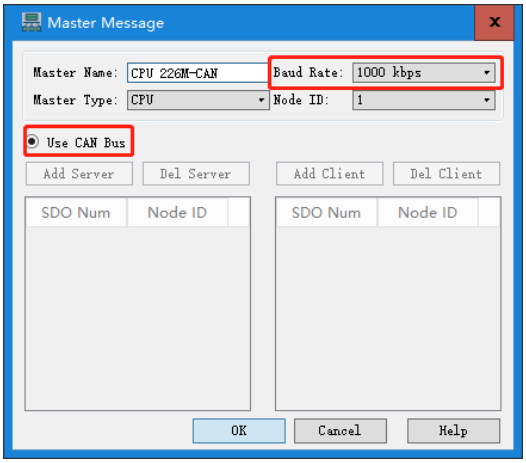
⑧ Select homing mode: P59=1 (Refer to Negative original switch and Z-phase signal)

Step 3: Configure CANopen communication via MagicWorks PLC

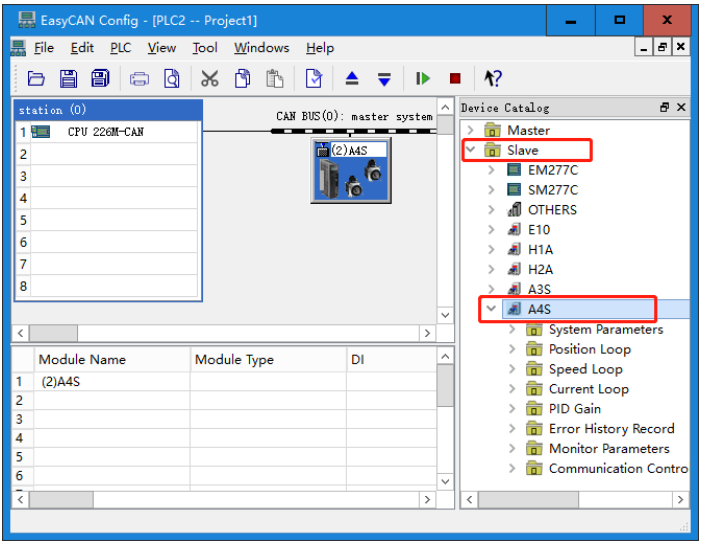
① Open MagicWorks PLC and enter in CANopen config interface, see picture below:



② Add master CPU226M-CAN to slot 1 of station rack, then double click master to configure. Choose 1000kbps (Baud Rate) and “Use CAN Bus”:



③ Double click A4S or drag it from “Slave” to CAN Bus to add as master:



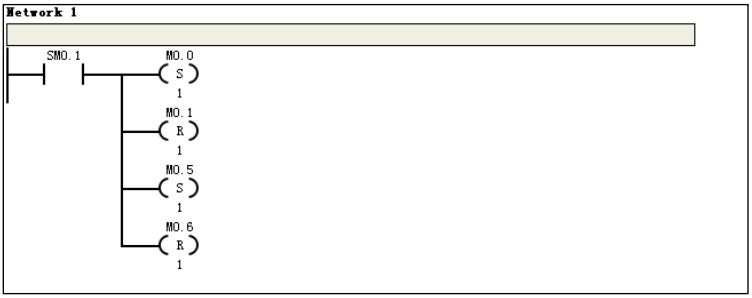
④ Expand A4S node from Device Catalog, and select the desired parameters to start communication position control for E10 Servo. The parameters selected for A4S described as follows:

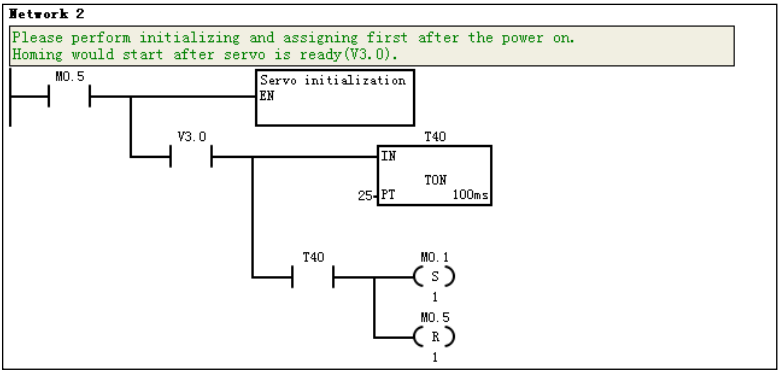
	Module Name	Module Type	DI	DQ
1	(2)A4S			
2	202 Type of error	16DI	V:0...1	
3	204 Output state	16DI	V:2...3	
4	216 User position coo...	32DI	V:4...7	
5	221 Feedback speed	16DI	V:8...9	
6	282 Communication c...	16DQ		V:10...11
7	281 Communication ex...	16DQ		V:12...13
8	290 Given position 0	32DQ		V:14...17
9	97 3rd internal speed	16DQ		V:18...19
10	113 Acceleration/Dece...	32DQ		V:20...23
11	101 7th internal speed	16DQ		V:24...25
12	102 8th internal speed	16DQ		V:26...27

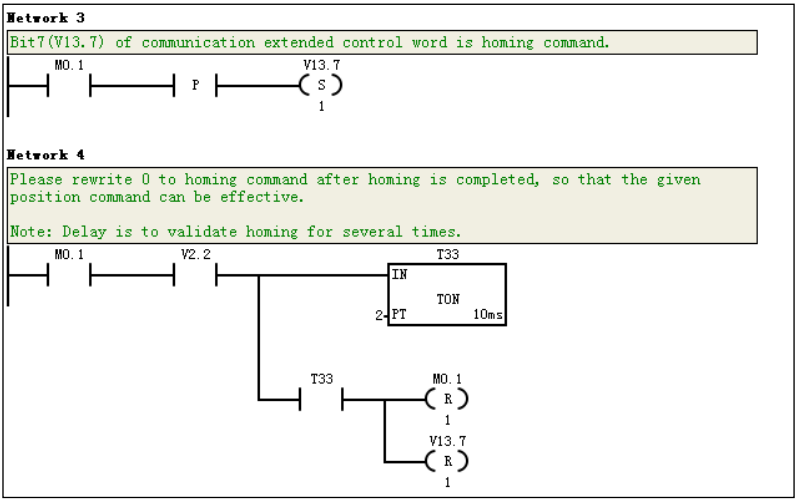
Write new value to the mapping address of parameter for related operation, eg, Write 1 to P282_Bit0, with mapping address V10.....11 to enable the servo in communication mode.

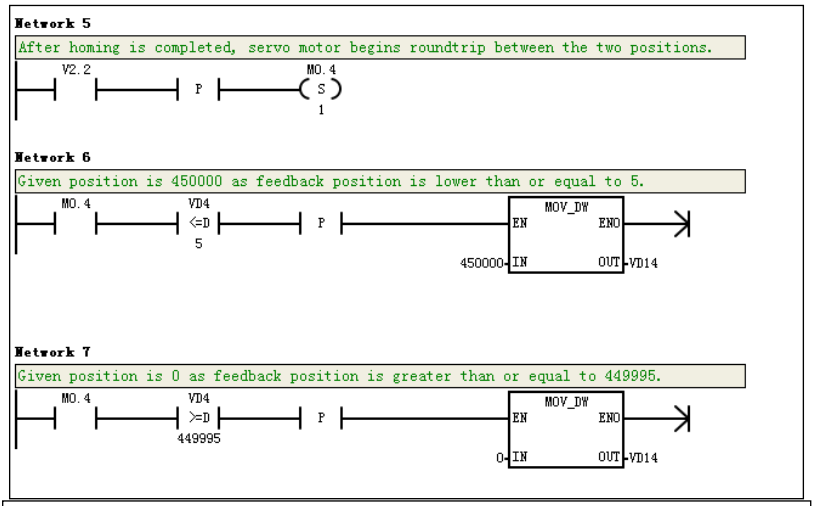
The parameter status can be read by the corresponding mapping address of the reading parameter. For example: read if the bit 0 of P204 mapping address V2...3 is 1, for 1 indicates that the servo is ready.

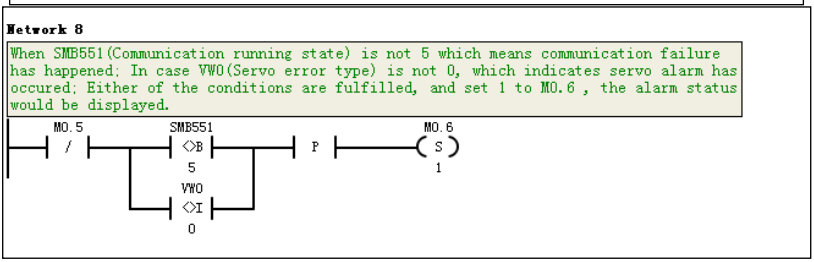
⑤ The program diagrams shows as below:


Network 1
SM0.1
M0.0
S
1
M0.1
R
1
M0.5
S
1
M0.6
R
1

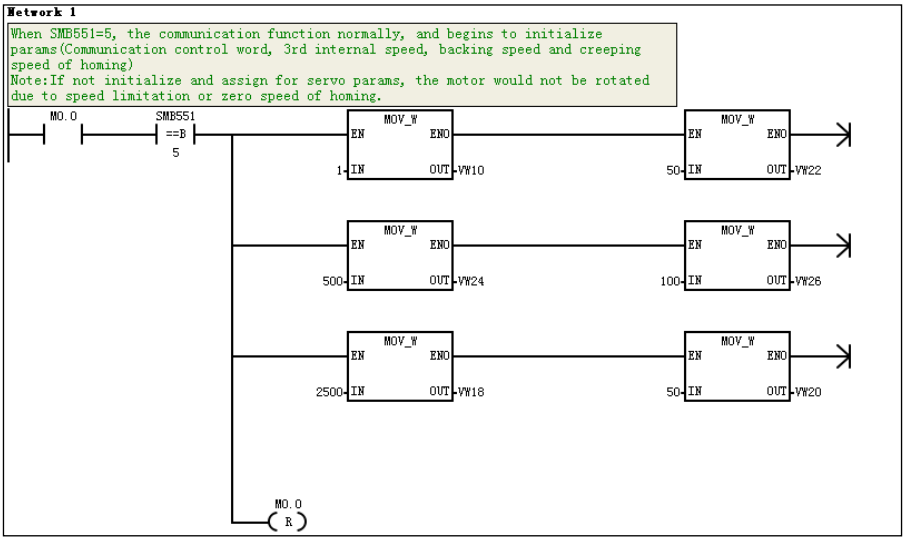

Network 2
Please perform initializing and assigning first after the power on.
Homing would start after servo is ready(V3.0).
M0.5
Servo initialization
EN
V3.0
T40
IN
TON
25 PT 100ms
T40
M0.1
S
1
M0.5
R
1


Network 3
Bit7(V13.7) of communication extended control word is homing command.
M0.1
P
V13.7
S
1
Network 4
Please rewrite 0 to homing command after homing is completed, so that the given position command can be effective.
Note: Delay is to validate homing for several times.
M0.1
V2.2
T33
IN
TON
2 PT 10ms
T33
M0.1
R
1
V13.7
R
1





Subprogram of servo initialization:



9.3.2 Example of Communication Speed Control mode

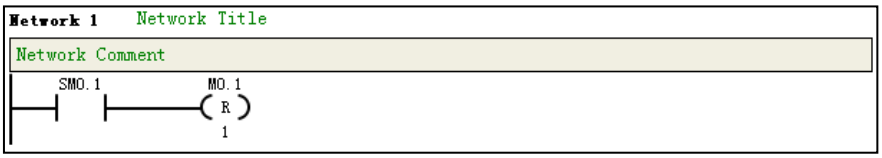
【Relevant Parameters】

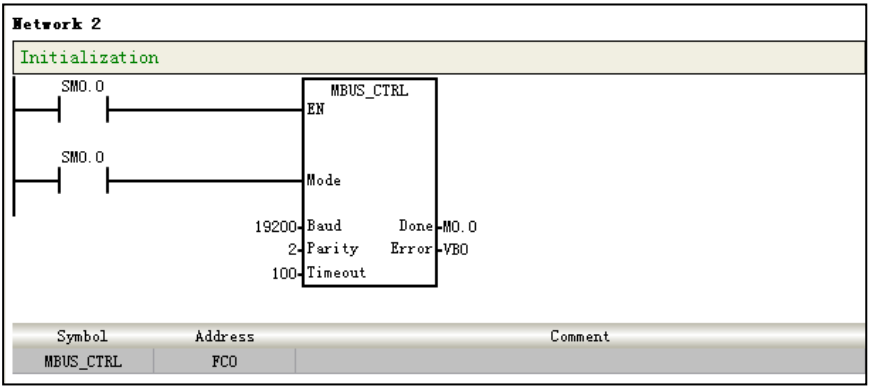
No.	Name	Description
P01	Control mode setup	7: Communication Speed control -S
P113	Acceleration time setup	Set the acceleration/deceleration time, convert to smoother ACC/DCC speed command
P114	Deceleration time setup	
P04	Command source selection	Select the command source of external speed control mode and communication control mode.
P05	Communication command source selection	0~31: select communication given speed command
P281	Communication extended control word	Communication given control command, such as Zero-speed clamp, Homing command etc.
P282	Communication control word	Communication given control command, such as Servo-on, Alarm clear etc.
P324~355	Given speed	P324: Given speed 0 P325: Given speed 1 ..... P355: Given speed 31
P204	Output state	Output status of servo system, such as homing complete, positioning complete etc.
P221	Feedback speed	Actual motor feedback speed

【Example】

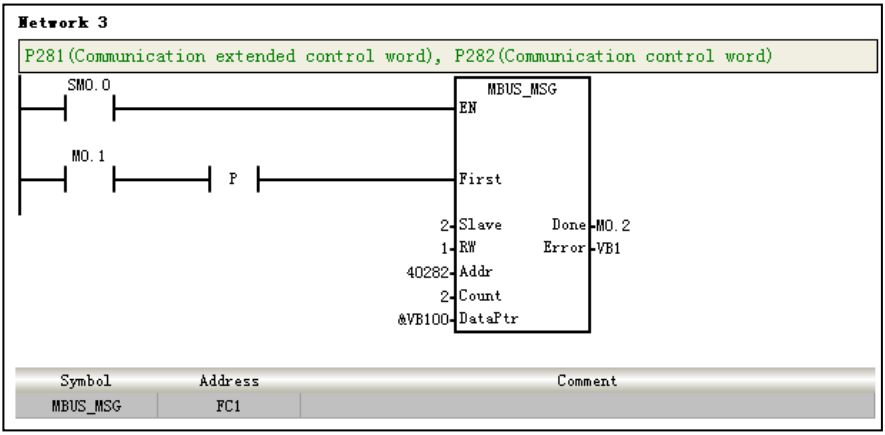
Here introduces the Modbus communication between A4S servo and CPU 226M in communication speed control mode, please refer to following steps:

Network 1 and 2: Master initialization





Network 3: Sequentially write two words to P281 and P282 of the driver, whose communication address is 02.



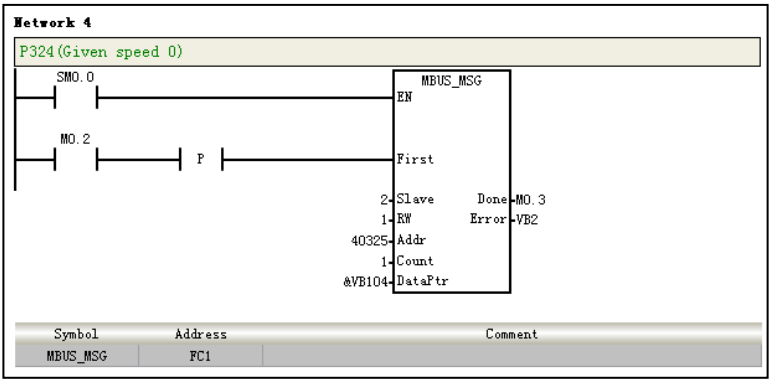
Servo-on request frame (P282_Bit0 =1):

Slave Adr	CMD	Start Adr H	Start Adr L	No. of Regs H	No. of Regs L	Data Length	Data 0	Data 1	Data 2	Data 3	CRC	
16#02	16#10	16#01	16#19	16#00	16#02	16#04	16#00	16#00	16#00	16#01	16#XX	16#XX

Multiple parameters are successfully written, the response frame:

Slave Adr	CMD	Start Adr H	Start Adr L	No. of Regs H	No. of Regs L	CRC	
16#02	16#10	16#01	16#19	16#00	16#02	16#XX	16#XX

Network 4: Write 100 to P324 of the driver, whose communication address is 02.



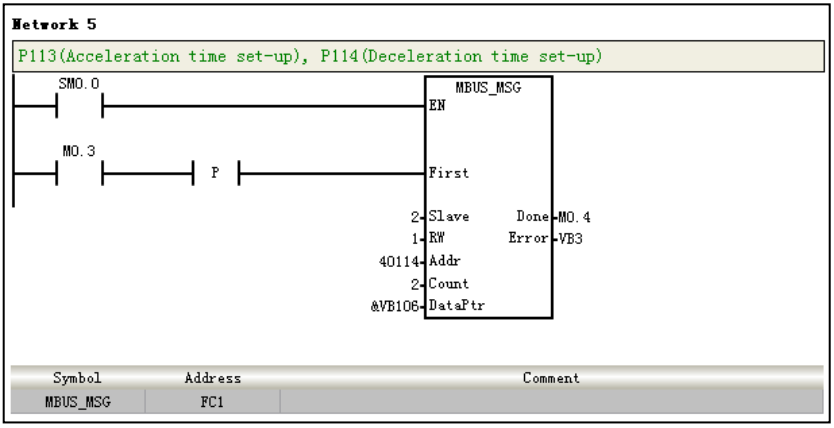
Request frame:

Slave Adr	CMD	Reg Adr H	Reg Adr L	Preset Data H	Preset Data L	CRC	
16#02	16#06	16#01	16#44	16#00	16#64	16#XX	16#XX

Response frame after successfully writing single param:

Slave Adr	CMD	Reg Adr H	Reg Adr L	Preset Data H	Preset Data L	CRC	
16#02	16#06	16#01	16#44	16#00	16#64	16#XX	16#XX

Network 5: Sequentially write 1000 and 200 to P113/ P114 of the driver whose communication address is 02.



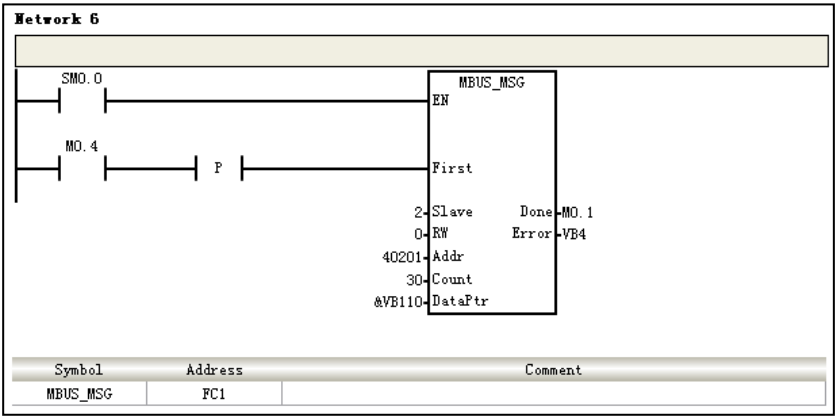
Request frame:

Slave Adr	CMD	Start Adr H	Start Adr L	No. of Regs H	No. of Regs L	Data Length	Data 0	Data 1	Data 2	Data 3	CRC	
16#02	16#10	16#00	16#71	16#00	16#04	16#00	16#00	16#64	16#00	16#C8	16#XX	16#XX

Response frame after successfully writing multiple parameters:

Slave Adr	CMD	Start Adr H	Start Adr L	No. of Regs H	No. of Regs L	CRC	
16#02	16#10	16#00	16#71	16#00	16#02	16#XX	16#XX

Network 6: Master read parameters P200~P229 of the driver whose address is 02.



Request frame:

Slave Adr	CMD	Start Adr H	Start Adr L	No. of Regs H	No. of Regs L	CRC	
16#02	16#03	16#00	16#C8	16#00	16#1E	16#44	16#0F

Response frame after successfully reading parameters:

Slave Adr	CMD	Data Length	Data 0	...	Data58	CRC	
16#02	16#03	16#3C	16#00	...	16#00	16#01	16#00

Data0~Data58: 00 05 00 00 00 06 00 00 00 12 00 00 00 00 00 18 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 68 70 00 01 00

9.3.3 Communication Torque Control Mode

【Relevant Parameters】

No.	Name	Description
P01	Control mode setup	8: Communication Torque control -T
P119	The 1st torque limitation	Set the restriction value of the 1st torque.
P134	Set the torque when motor stops in emergency	Set the torque limitation in emergency conditions
P98	The 4th internal speed	Set the 4th speed of internal speed command.
P04	Command source selection	Select the command source of external speed control mode and communication control mode.
P05	Communication command source selection	0~31: select communication given torque command
P281	Communication extended control word	Communication given control command, such as Zero-speed clamp, Homing command etc.
P282	Communication control word	Communication given control command, such as Servo-on, Alarm clear etc.
P358-389	Given Torque	P358: Given Torque 0 P359: Given Torque 1 ..... P389: Given Torque 31
P204	Output state	Output status of servo system, such as homing complete, positioning complete etc.

10

Applied Functions

*Introduction and example of applied functions

10 Applied Functions

Introduction and example of applied functions

10.1 Homing Function

【Function Overview】

The homing function in communication/external position control mode is a positioning function that the servo searches the origin point of device.

During homing, the motor would not decelerate enough to stop when approaching original switch, if Z-phase encoder signal is received, the stop position would be more precise. Advise to use A4S homing function when absolute positioning control are required.

【Relevant Parameters】

No.	Name	Description
P59	Homing mode	Homing modes (0~20 and 35)
P281	Communication extended control word	Enable Homing command by setting bit7 to 1
P73	Control command source selection	2: From external DI signal (decided by P75/76/77/78)
P75~78	DI function register 4~1	Selection of DI function
P03	Overtravel Inhibit input invalid setting	Select whether to validate the overtravel Inhibit signal for CCW/CW direction or not. 0: Valid 1: Invalid 2: The servo alarms any one of the direction happens overtravel Inhibit.
P72	External input logic level selection	Select the External DI logic level.
P101	The 7th internal speed	Set coming back speed during homing process
P102	The 8th internal speed	Set creeping speed during homing process
P203	Command status	Check homing executing status
P204	Output status	Check homing complete status
P8 / P9	Torque limitation control output selection / Zero-speed detection	Output homing complete signal

<Note> Please refer to chapter 6.2 Details of Parameter for details of parameter

【Mode specification】

There are 21 homing modes for servo, where you can select according to requirements of accuracy and the practical applications.

Homing modes	Description
0	Reset the P216 (User position coordinates) by triggering the DI signal
1	Refer to both the negative original switch and Z-phase signal mode.
2	Refer to both the positive original switch and Z-phase signal mode.
3	Refer to the negative original switch only
4	Refer to the positive original switch only
5	Refer to Z-phase signal (Homing towards negative direction) only
6	Refer to Z-phase signal (Homing towards positive direction) only
7	Refer to original switch/positive limit switch/Z-phase signal (on the left of the left edge of the original switch)
8	Refer to original switch/positive limit switch/Z-phase signal (on the right of the left edge of the original switch)
9	Refer to original switch/positive limit switch/Z-phase signal (on the left of the right edge of the original switch)
10	Refer to original switch/positive limit switch/Z-phase signal (on the right of the right edge of the original switch)
11	Refer to original switch/negative limit switch/Z-phase signal (on the right of the right edge of the original switch)
12	Refer to original switch/negative limit switch/Z-phase signal (on the left of the right edge of the original switch)
13	Refer to original switch/negative limit switch/Z-phase signal (on the right of the left edge of the original switch)
14	Refer to original switch/negative limit switch/Z-phase signal (on the left of the left edge of the original switch)
15	Refer to the negative original switch plus position increment
16	Refer to the positive original switch plus position increment
17	Refer to the homing switch/positive limit switch (on the left edge of homing switch)
18	Refer to the homing switch/positive limit switch (on the right edge of homing switch)
19	Refer to the homing switch/negative limit switch (on the right edge of homing switch)
20	Refer to the homing switch/negative limit switch (on the left edge of homing switch)
35	Set current position as origin

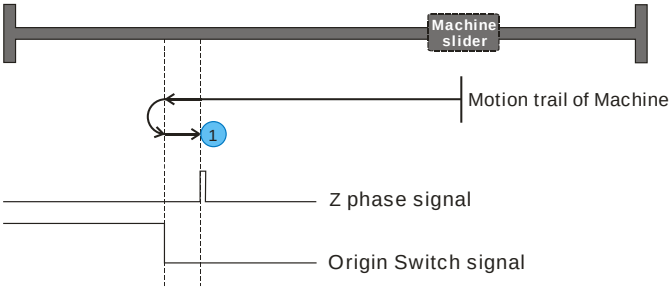
No matter where the machine located, the original point servo searched is always unique after the desired device (original switch and positive/negative overtravel inhibit switch)

were well installed. Symbol "|" in following diagram indicates the mechanical initial position, "X" represents the original position.

Homing mode 0: Reset P216 (User position coordinates) by triggering the DI signal

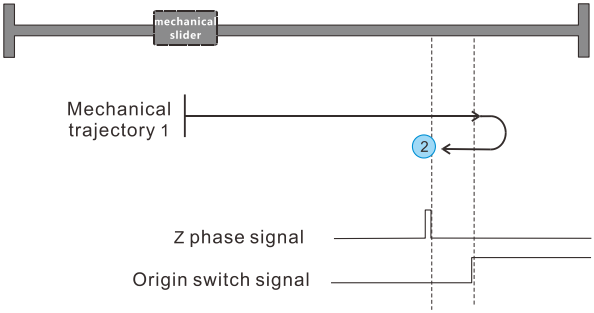
Configure the DI PIN to "homing switch signal", when the rising edge of the DI PIN is detected, the P216 (User Position Coordinates) will be reset. (This homing mode is a special one without "homing complete signal")

Homing mode 1: Refer to Negative original switch and Z-phase signal



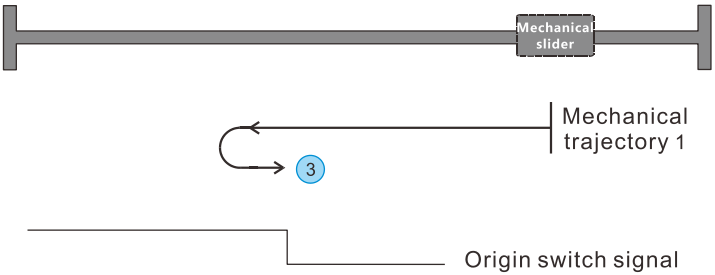
The origin switch located in the negative mechanical direction. The machine moves towards the origin switch, decelerates to stop after detecting the origin switch, then reverses to exit the origin switch, finds the next Z phase signal of the motor and records it as the origin, the motor stops immediately.

Homing mode 2: Refer to positive Homing switch and Z phase signal Homing mode



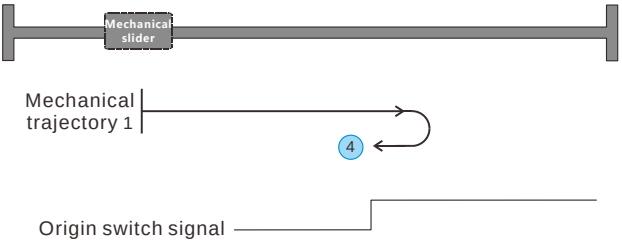
The Homing switch located in the positive mechanical direction. The machine moves towards the Homing switch, decelerates to stop after detecting the Homing switch, then reverses to exit the Homing switch, finds the next Z phase signal of the motor and records it as the Homing, the motor stops immediately.

Homing mode 3: Only refer to Homing mode of negative Homing switch



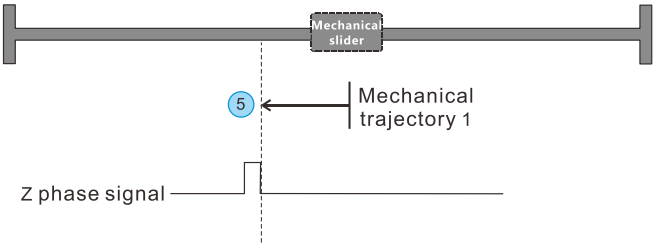
The Homing switch located in the negative mechanical direction. The machine moves towards the Homing switch, decelerates to stop after detecting the Homing switch, and then reverses to exit the Homing switch. Find and record Homing switch signal falling edge as the Homing, and the motor stops immediately.

Homing mode 4: Only refer to Homing mode of positive Homing switch



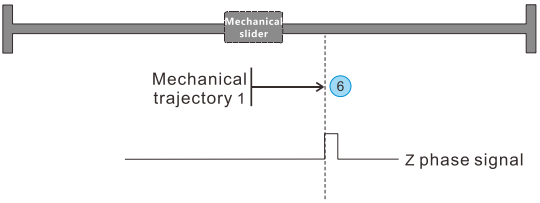
The Homing switch located in the positive mechanical direction. The machine moves towards the Homing switch, decelerates to stop after detecting the Homing switch, and then reverses to exit the Homing switch. Find and record Homing switch signal falling edge as the Homing, and the motor stops immediately.

Homing mode 5: Only refer to Homing mode of Z phase signal (negative back to zero)



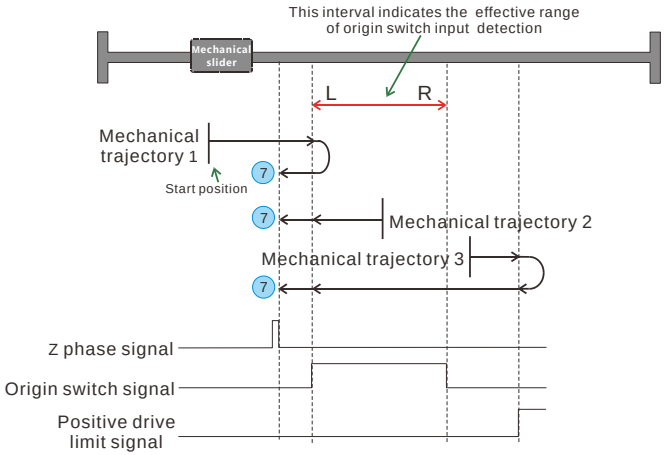
The motor moves along the negative direction from the current position and records it as the Homing when the next Z phase signal is found.

Homing mode 6: Only refer to Homing mode of Z phase signal (positive back to zero)



The motor moves along the positive direction from the current position and records it as the Homing when the next Z phase signal is found.

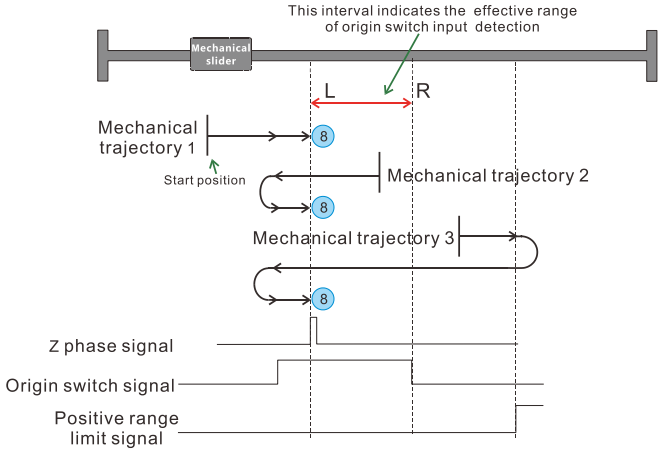
Homing mode 7: Refer to Homing mode of Homing switch, Z phase signal and positive limit (adopt Z phase signal of positive Homing switch left of left edge)



As shown in the figure above, the mechanical slider slides in the positive limit direction (positive direction), and Z in the left position along the left side of the Homing switch signal, that is, outside the effective range of the Homing switch signal.

When the machine is within the Homing switch range (mechanical motion trajectory 2), the Homing can be found by directly running in the negative direction. When the machine is outside the Homing switch (mechanical motion track 1 and 3), the machine runs in a constant direction (positive direction) toward the limit switch. According to the detected sequence of the Homing switch and limit switch, find the movement track and the Homing.

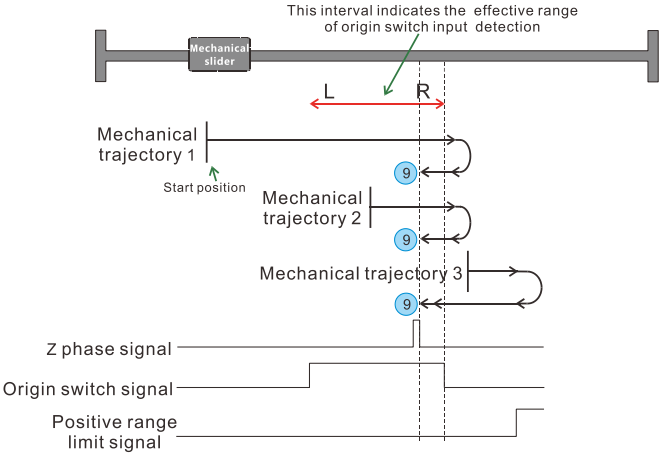
Homing mode 8: Refer to Homing mode of Homing switch, Z phase signal and positive limit (adopt Z phase signal of positive Homing switch right of left edge)



As shown in the figure above, the mechanical slider slides in the positive limit direction (positive direction), and Z in the left position along the right side of the Homing switch signal, the effective range of the Homing switch signal.

When the machine is within the Homing switch range (mechanical motion trajectory 2), the Homing can be found by directly running in the negative direction. When the machine is outside of the Homing switch (mechanical motion track 1 and 3), the machine runs in a constant direction (positive direction) toward the limit switch. According to the detected sequence of the Homing switch and limit switch, find the movement track and the Homing.

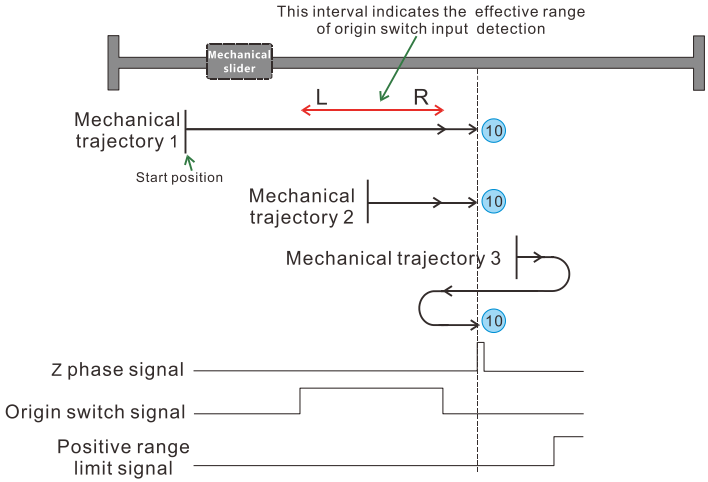
Homing mode 9: Refer to Homing mode of Homing switch, Z phase signal and positive limit (adopt Z phase signal of positive Homing switch left of right edge)



As shown in the figure above, the mechanical slider slides in the positive limit direction (positive direction), and Z in the right position along the left side of the Homing switch signal, the effective range of the Homing switch signal.

When the machine is within the Homing switch range (mechanical motion trajectory 2), the Homing can be found by directly running in the negative direction. When the machine is outside of the Homing switch (mechanical motion track 1 and 3), the machine runs in a constant direction (positive direction) toward the limit switch. According to the detected sequence of the Homing switch and limit switch, find the movement track and the Homing.

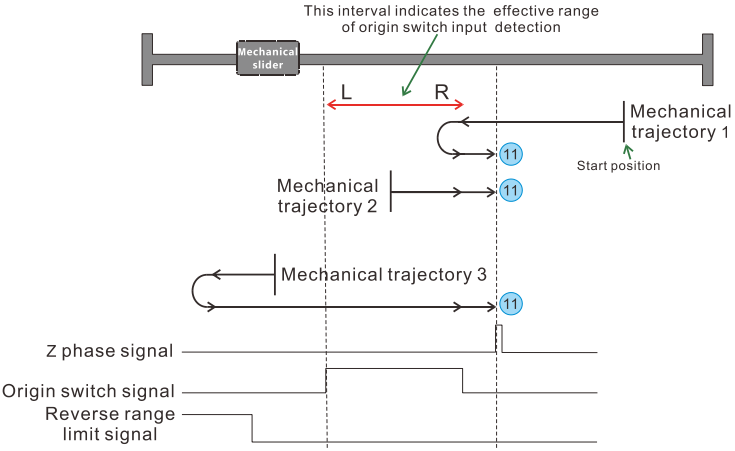
Homing mode 10: Refer to Homing mode of Homing switch, Z phase signal and positive limit (adopt Z phase signal of positive Homing switch right of right edge)



As shown in the figure above, the mechanical slider slides in the positive limit direction (positive direction), and Z in the right position along the right side of the Homing switch signal, the effective range of the Homing switch signal.

When the machine is within the Homing switch range (mechanical motion trajectory 2), the Homing can be found by directly running in the negative direction. When the machine is outside of the Homing switch (mechanical motion track 1 and 3), the machine runs in a constant direction (positive direction) toward the limit switch. According to the detected sequence of the Homing switch and limit switch, find the movement track and the Homing.

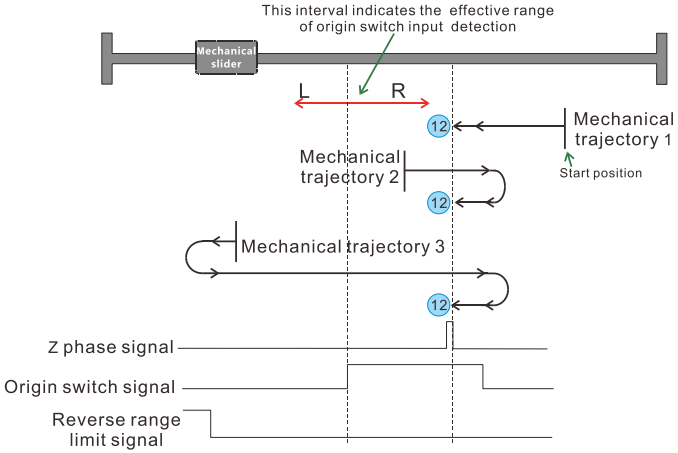
Homing mode 11: Refer to Homing mode of Homing switch, Z phase signal and negative limit (adopt Z phase signal of positive Homing switch right of right edge)



As shown in the figure above, the mechanical slider slides in the negative limit direction (negative direction), and Z in the right position along the right side of the Homing switch signal, outside of the effective range of the Homing switch signal.

When the machine is within the Homing switch range (mechanical motion trajectory 2), the Homing can be found by directly running in the negative direction. When the machine is outside of the Homing switch (mechanical motion track 1 and 3), the machine runs in a constant direction (positive direction) toward the limit switch. According to the detected sequence of the Homing switch and limit switch, find the movement track and the Homing.

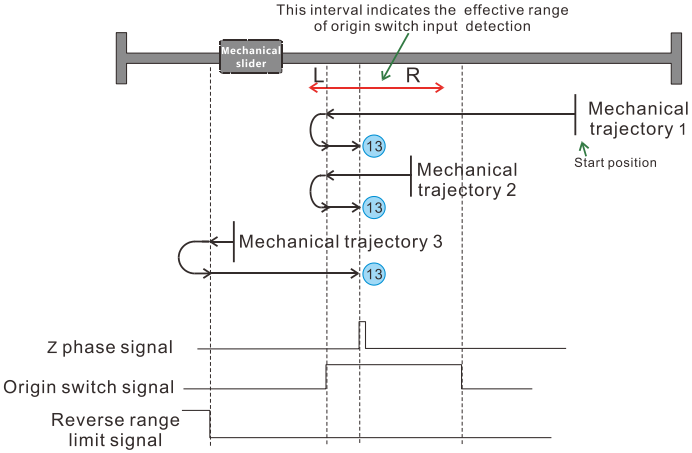
Homing mode 12: Refer to Homing mode of Homing switch, Z phase signal and negative limit (adopt Z phase signal of positive Homing switch left of right edge)



As shown in the figure above, the mechanical slider slides in the negative limit direction (negative direction), and Z in the right position along the right side of the Homing switch signal, inside of the effective range of the Homing switch signal.

When the machine is within the Homing switch range (mechanical motion trajectory 2), the Homing can be found by directly running in the positive direction. When the machine is outside of the Homing switch (mechanical motion track 1 and 3), the machine runs in a constant direction (negative direction) toward the limit switch. According to the detected sequence of the Homing switch and limit switch, find the movement track and the Homing.

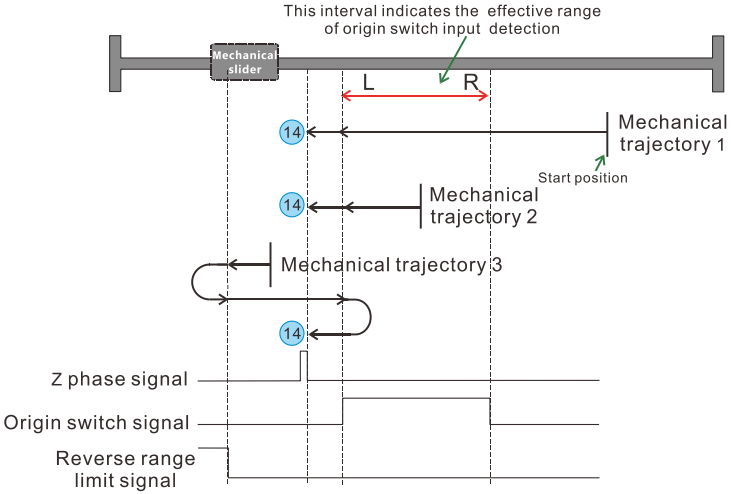
Homing mode 13: Refer to Homing mode of Homing switch, Z phase signal and negative limit (adopt Z phase signal of positive Homing switch right of left edge)



As shown in the figure above, the mechanical slider slides in the negative limit direction (negative direction), and Z in the left position along the right side of the Homing switch signal, inside of the effective range of the Homing switch signal.

When the machine is within the Homing switch range (mechanical motion trajectory 2), the Homing can be found by directly running in the negative direction. When the machine is outside of the Homing switch (mechanical motion track 1 and 3), the machine runs in a constant direction (negative direction) toward the limit switch. According to the detected sequence of the Homing switch and limit switch, find the movement track and the Homing.

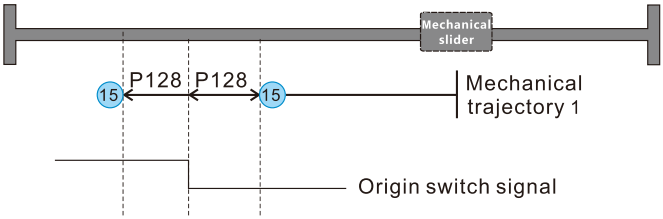
Homing mode 14: Refer to Homing mode of Homing switch, Z phase signal and negative limit (adopt Z phase signal of positive Homing switch left of left edge)



As shown in the figure above, the mechanical slider slides in the negative limit direction (negative direction), and Z in the left position along the left side of the Homing switch signal, inside of the effective range of the Homing switch signal.

When the machine is within the Homing switch range (mechanical motion trajectory 2), the Homing can be found by directly running in the negative direction. When the machine is outside of the Homing switch (mechanical motion track 1 and 3), the machine runs in a constant direction (negative direction) toward the limit switch. According to the detected sequence of the Homing switch and limit switch, find the movement track and the origin.

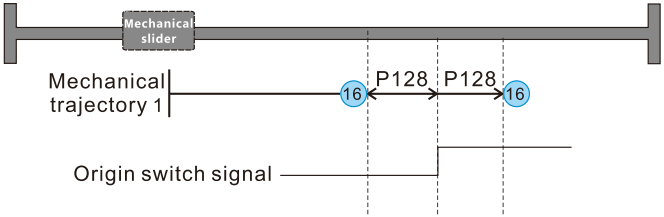
Homing mode15: Refer to the negative original switch plus position increment



For positive P128, the mechanical slider moves as thegiven position of P128 in positive direction, while in negative direction for negative P128

Original switch is located in the negative direction of the machine. The machine is moving in the direction of original switch, as the original switch is detected, it continues to finish the position increment of P128 (Running speed set by P97), the homing complete signal would be outputted after P128 has been finished. If disable the “homing command”, the P216 (User Position Coordinates) will be reset.

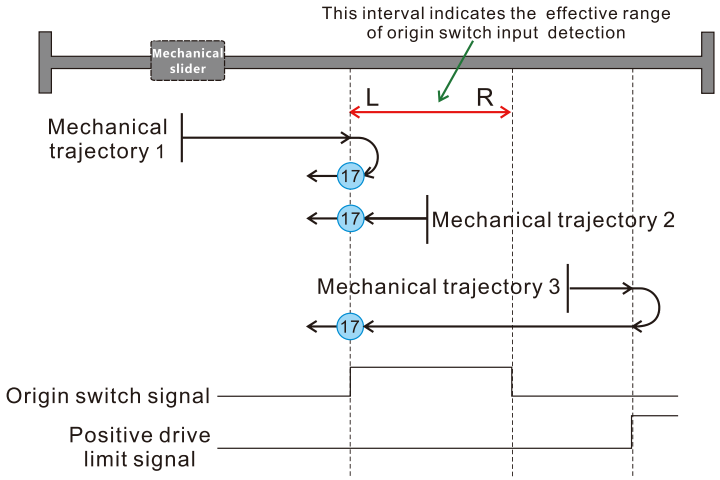
Homing mode 16: Refer to the positive original switch plus position increment



For positive P128, the mechanical slider moves as thegiven position of P128 in positive direction, while in negative direction for negative P128

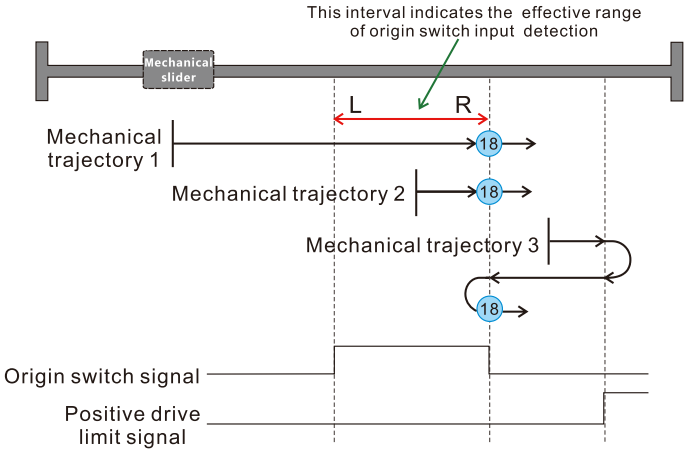
Original switch is located in the positive direction of the machine. The machine is moving in the direction of original switch, as the original switch is detected, it continues to finish the position increment of P128 (Running speed set by P97), the homing complete signal would be outputted after P128 has been finished. If disable the “homing command”, the P216 (User Position Coordinates) will be reset.

Homing mode 17: Refer to the homing switch/positive limit switch (on the left edge of homing switch)



If the starting position of mechanical slider is out of the origin switch range, the initial motion mode is forward. If the initial position is within the range, the origin is considered to be found when it encounters the descending edge of the origin switch.

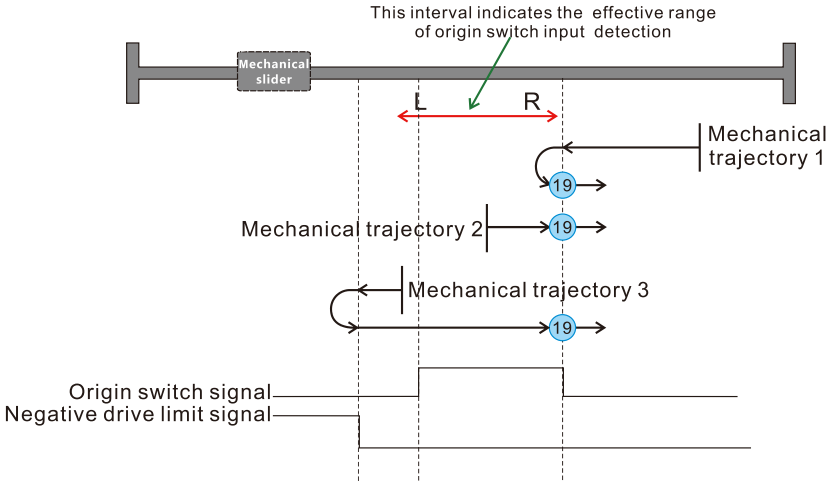
Homing mode 18: Refer to the homing switch/positive limit switch (on the right edge of homing switch)



If the starting position of mechanical slider is out of the origin switch range, the initial motion mode is forward. If the initial position is within the range, it is considered to find the origin when it encounters the descending edge of the origin switch.

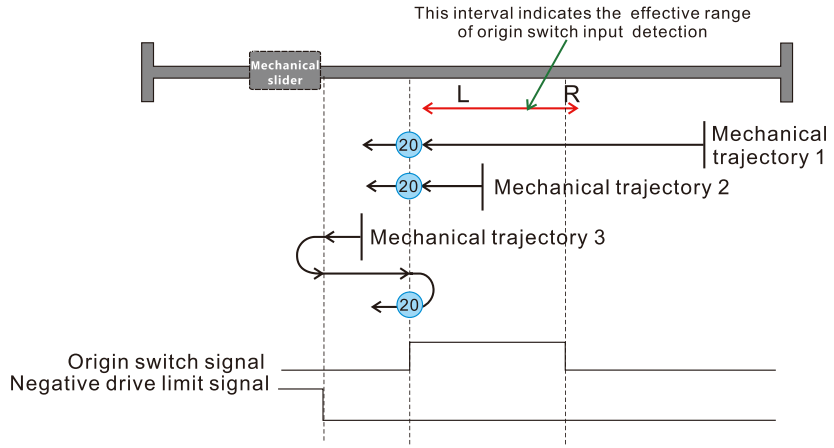
Homing mode 19: Refer to the homing switch/negative limit switch (on the right edge of

homing switch)



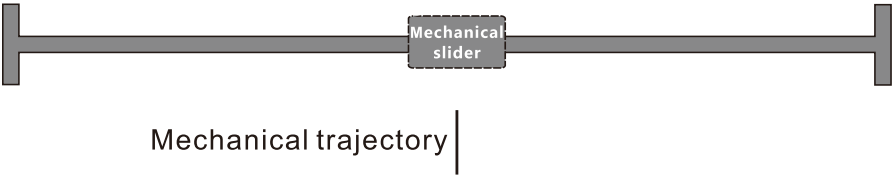
If the starting position of mechanical slider is out of the origin switch range, the initial motion is negative. If the initial position is within the range, it is considered to find the origin when it encounters the descending edge of the origin switch.

Homing mode 20: Refer to the homing switch/negative limit switch (on the left edge of homing switch)



If the starting position of mechanical slider is out of the origin switch range, the initial motion is negative. If the initial position is within the range, it moves in the negative direction. The origin is considered to be found when the descent edge of the origin switch is encountered.

Homing mode 35: Set current position as origin



Motor remains stop in current position where homing complete when signal is given.

【Examples】

There are two examples below to introduce homing function in communication and external control mode.

Example 1 Applying Homing function in communication position control mode, please follow these steps:

Step 1: Select homing mode

Select homing mode by setting P59, for this example, use mode 7~14.

Step 2: Set overtravel inhibit function

As we Chosen mode 7~14 via P59, the overtravel inhibit function must be effective, that P03 (Overtravel Inhibit input invalid setting) is set to 0.

Step 3: Selection of PIN configuration

Set P73 to 0 which means the control command selection comes from P281

Step 4: Selection of external input logic level

Select the effective level for input signal by P72 (External input logic level):

Param	Bit	Function	Value of Bit	Effective way
P72	2	CCW Overtravel Inhibit	0	Low level On
			1	High level On
	3	CW Overtravel Inhibit	0	Low level On
			1	High level On
	11	Original switch input	0	Low level On
			1	High level On

Step 5: Set homing speed

During homing process, the coming-back speed for searching origin switch is decided by P101 (the 7th internal speed), and the creep speed for searching Z-phase signal is

decided by P102 (the 8th internal speed).

Remark: Please set coming back speed and creep speed lower so as to ensure successful homing operation.

Step 6: Enable servo

P16 = 1 or P282_Bit0 = 1 to enable servo.

Remark: Please enable servo before homing.

Step 7: Enable homing command

Set P281_bit7 to 1 to enable homing function.

Step 8: Check whether the homing function is effective

R203_Bit7 would be set to 1 when it is valid.

Step 9: Check whether homing function is completed

R204_Bit10 would be set to 1 when homing is completed.

Step 10: Output homing complete signal

Set P08 or P09 to 6 to output the homing complete signal.

<Remark> Please set homing command to 0 after homing complete, so that the servo works properly.

Example 2 Applying Homing function in external position control mode, please follow these steps:

Step 1: Select homing mode

Select homing mode by setting P59, for this example, use mode 1.

Step 2: Select control command source

Select MagicWorks Tuner menu bar “Option” -> “Pin function configuration & simu IO”, then set P73 to 2 so that the PIN allocation method decided by P75\76\77\78.

Step 3: Configure homing command and homing switch signal

Configure DIN1 to “7 Homing CMD” and DIN2 to “11 Homing SW signal” in “Pin function configuration & simu IO” interface.

Step 4: Configure homing complete signal

Configure DOUT2 to “1 TLC” in “Pin function configuration & simu IO” interface.

Step 5: Enable servo

Enable servo by PIN 9 of the communication port X2.

Remark: Please enable servo before homing.

Step 6: Write servo

Press “Write Servo” button in “Pin function configuration & simu IO” interface when DIN1 and DIN2 were configured. The servo would slow to back and stall at the first rising edge of Z-phase signal.

Step 7: Read servo

Press “Read Servo” button in “Pin function configuration & simu IO” interface when DOUT2 was configured to output the homing complete signal.

<Remark> After the homing function complete, reset the homing command so the servo would run normally

10.2 Internal Multi-Position/Speed/Torque Control

【Function Overview】

Multi control under communication control mode means: Set multi given position / speed / torque control parameters (16 given position / speed / torque params at most) via upper controller, and switch between different sections (Position/speed/torque) by several external DI, then the driver run according to the settings.

Since servo is controlled by its internal params, there is no need to install upper controller that with external pulse or analog output but need to cooperate external DI signal with communication functions to achieve flexible multi-control.

【Relevant Parameters】

No.	Name	Description
P01	Control mode setup	6~11: Communication control mode
P04	Command source selection	4: The command source of communication control mode is selected by INTSPD1~INTSPD4.
P71	Communication position control method	Bit0: 0: Absolute position, 1: Relative position
P73	Control command source selection	Select pin allocation method and control command source.
P75~78	Digital input multiplexing function register 4~1	16#08: Command selection 4 16#0E: Command selection 3 16#0D: Command selection 2

		16#0C: Command selection 1 16#06: Start signal of Multi-position/speed/torque command
P97	The 3rd internal speed	Executing speed in communication position mode
P282	Communication control word	Bit0: 1: Servo is enabled, 0: Servo is disabled.
P290-320	Given Position	P290: Given Position 0 P292: Given Position 1 ..... P320: Given Position 15
P324-355	Given Speed	P324: Given Speed 0 P325: Given Speed 1 ..... P355: Given Speed 31
P358-389	Given Torque	P358: Given Torque 0 P359: Given Torque 1 ..... P389: Given Torque 31
P203	Command Status	Check the executing status of multiple commands

【Example】

Here is the example of operation of internal absolute multi-position control mode.

Step 1: Select control mode

Set P01 to 6 (communication position control), save the setting to EEPROM and restart the servo to validate the setting.

Step 2: Select Command source

P04 = 4, given command source is determined by INTSPD1~INTSPD4.

Step 3: Multi-position (Absolute position control mode)

Absolute position control: Set P71_Bit0 to 0.

Step 4: Set DI allocation method

P73= 2, external DI PIN allocation method is up to P75/76/77/78.

Step 5: Allocate external PIN functions

Configure DIN1~DIN5 to 16#0C (Command selection 1), 16#0D (Command selection 2), 16#0E (Command selection 3), 16#08 (Command selection 4) and 16#06 (Start signal of multi-position/ speed/ torque command). Refer to chapter 5.2.4 Configuration of PIN and Analogy IO for details.

Step 6: Enable the servo

P16=1 or P282_Bit0=1 to enable servo would be enabled.

Step 7: Set absolute multi-position

P290 (Given position 0)~P320 (Given position 15)

Step 8: Select position command source by setting PIN value

Set DIN4~DIN1 (Command selection 4~1) to 0101 where the given position is P300 (Given position 5). Please refer to chapter for details.

Step 9: Trigger the rising edge of DIN5 (start signal)

DIN5 changes from 0 to 1 (Monitor the value of P203_Bit6: from 0 to 1) to trigger operation, so servo would run to P300 with the speed of P97.

Step 10: Repeat step 8 & 9

First modify command source, and then generate rising edge of start signal to activate multi-position command.

Notice

- This function is disabled in External Position/Speed/Torque control mode.
- Please use low-bit pins if there are not so much options to occupy the pins. For example, if you need use two pins, please choose command selection 1 and command selection 2.
- P113 (Acceleration time setup), P114 (Deceleration time setup) and P97 (the 3rd internal speed) are effective under communication multi-position control for each selected position. If need to modify these parameters in a certain position, you'd better set by communication before the position is triggered.
- The difference between absolute position and relative position is: Absolute position is counting distance from original point (If homing function is not executed, the power-on position defaults to original point), relative position is counting distance from present position. For example, if current position is 10000, the destination position is 25000, the given position is 25000 as used absolute position control; for given position 15000 the actual running position would be 15000+10000=25000 as relative position is selected.
- When in multi-position control, the servo would running according to the given position as the next position command is triggered before positioning is completed; If willing to execute the next position after the former is completed, users can use P204(Positioning complete), which would trigger the next position by start signal after the positioning is finished.
- Multi-position/speed/torque command cannot be saved to EEPROM, you have to write before

executing multi control for each time.

- Commands are selected by pins under communication speed/torque mode (Communication speed mode: P324~P339, Communication torque mode: P358~P373) while P4=4, only the rising edge of start signal is triggered that the command can be updated.
- The relationship between external DI command selection and the actual given position please refer to chapter 5.5 Commands Switchover (P4=4) in Communication Control Mode

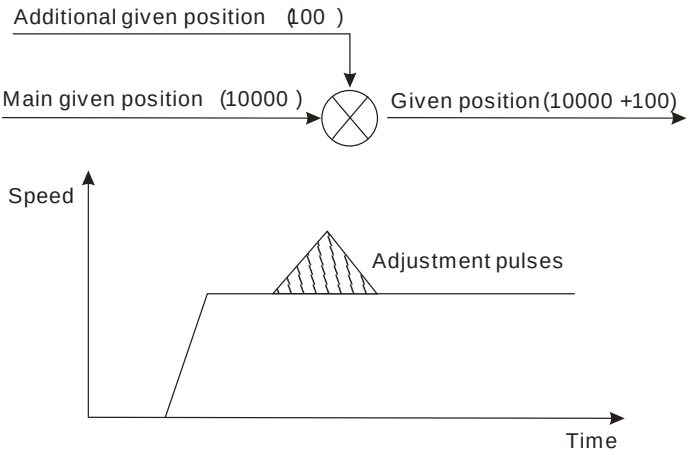
10.3 Pulse Adjustment

【Function Overview】

Adjust pulse by adding correction on the basis of external pulse in external position mode.

Servo operates in external position mode, controller or upper software set given pulses to servo parameters P290~P320 via Modbus/CANopen protocol, the settings take effect immediately. When P04=4, given position 0~15 can be selected via the high-low level of external I/O pins. The adjustments are added on basis of present pulses to achieve the adjustment function during the running process of motor.

Control error caused by pulse loss for some reasons can be adjust by communication command. PC software or controller set given pulse adjustment to P290 ~ P320 internal parameters of servo drive by the Modbus/CANopen communication when servo works in the external position mode, which can take effect immediately. Select given position 0~15 by external I/O high/low-level when P04=4, the servo will overlay the pulse adjustment amount on the basis of the original given pulse number to realize pulse compensation during the motor operation.



【Relevant Parameters】

No.	Name	Description
P01	Control mode setup	0: External position control mode
P04	Command source selection	4: The command source of communication control mode is selected by INTSPD1~INTSPD4.
P50	Communication location instruction interpolation mode	2: Use pulse adjustment which equals to value of P290
P73	Control command source selection	2: From external DI signal(Decided by P75/7/77/78)
P75~78	Digital input multiplexing function register 4~1	16#0C: Command selection 1; 16#0D: Command selection 2; 16#0E: Command selection 3; 16#08: Command selection 4;
P290~320	Given Position	P290: Given Position 0 P292: Given Position 1 ..... P320: Given Position 15

【Example】

Step 1: Select control mode

P01 = 0 (External position mode), save the setting to EEPROM and restart the servo to validate the setting.

Step 2: Select command source

P04 = 4, the command source is selected by INTSPD1 ~ INTSPD4.

Step 3: Select DI allocation method

P73= 2, the control signal is from external DI (Decided by P75/76/77/78).

Step 4: Configure function for external PIN

Set DIN1 to 16#0C (Command selection 1).

Step 5: Set modifications for given position

● Set correction of P290 (Given position 0) to 0;

●Set correction of P292 (Given position 1) to 100;

Step 6: Enable servo

Enable servo by PIN 9 of the communication port X2.

Step 7: Add modification

● Set DIN1 to 1 (P292 being effect), add 100 pulses on basis of current given position;

● Set DIN1 to 0 (P290 being effect), no pulses overplay.

Notice

- No need to start trigger signal for this function;
- At most 4 PINs (INTSPD1~INTSPD4)
- The modification, which usually within thousands of pulses, can not be too large.

10.4 Special Speed-Position Control Mode

【Function Overview】

Special speed-position mode is a special mode servo uses to switch between position mode and speed mode by C-MODE (Mode switch signal) or DIR (External switch signal).

【Relevant Parameters】

No.	Name	Description
P01	Control mode setup	13: Special speed position mode
P204	Output State	Check if the positioning of P284 or P286 completed by Bit2, which is yes when Bit2=1.
P205	Input IO signal state	Input effective DIR signal when Bit14=1.
P274	Increment of Given Position	The pulse no. of servo given position increment when switch to position mode.
P284	Pulse filter 1	As the pulse filter setting register in special speed-position mode. When the system switches from position mode to speed mode, the servo starts output pulses, by the time the output pulses reach P284, the system starts to detect external signal.

P286	Pulse filter2	As the pulse filter setting register in special speed-position mode. Execute P286 (pulse filter 2) after first detected external switch signal, then detect it again when the pulse system output reaches P286, where the system switch from speed to position mode.
P288	Pulse Alarm	As the pulse filter setting register in special speed-position mode. In the speed mode, if the external switch signal cannot be detected all the time, and the pulse increment output by the system reaches the alarm value of the pulse, the machine will stop and alarm.

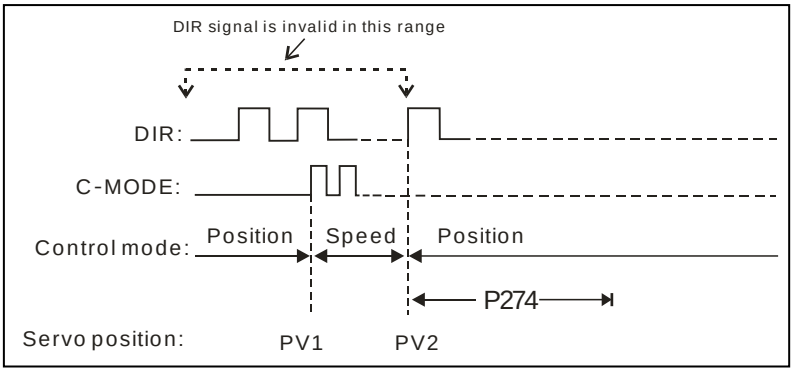
【Value description】

No.	Value of P284/286/288	Description
1	P284=0 & P286=0	Switch to position mode when the first rising edge of DIR signal is detected in speed control mode, then finish the designated position as P274 (given position increment).
2	P284=0 & P286≠0	Execute P286 (pulse filter 2) after first detected DIR signal in speed mode, then detect it again when the pulse system output reaches P286, where the system switch from speed to position mode and move as setting distance of P274 when the first falling edge was detected.
3	P284≠0 & P286=0	Detect DIR signal when the pulse reaches P284(pulse filter 1) in speed mode, servo switches to position mode and move as setting distance of P274 when the first rising edge was detected.
4	P284≠0 & P286≠0	Detect DIR signal when the pulse reaches P284(pulse filter 1) in speed mode. Execute P286 (pulse filter 2) after first detected DIR signal in speed mode, then detect it again when the pulse system output reaches P286, where the system switch from speed to position mode and move as setting distance of P274 when the first falling edge was detected.
5	P288≠0	Detect DIR signal when the pulse reaches P284(pulse filter 1) in speed mode. The system will stop and alarm when pulse increment outputted reaches P288 (pulse alarm value).
6	P288=0	Turn the alarm function off, which means the system will not alarm even though DIR cannot be detected.

Please refer to diagram below for modes in special speed-position:

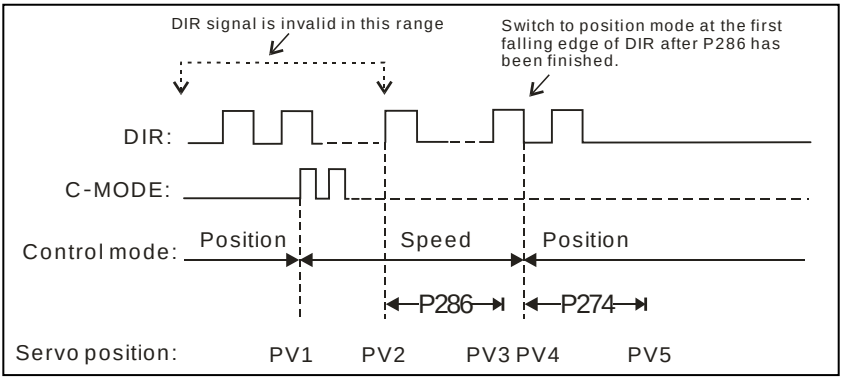
Explication 1（P284=0 & P286=0）

When C-MODE signal has been detected, servo switches from position to speed mode immediately and then switches to position mode as well as moves setting distance as P274 the moment rising edge of DIR signal is detected in speed mode.



Explication 2（P284=0 & P286≠0）

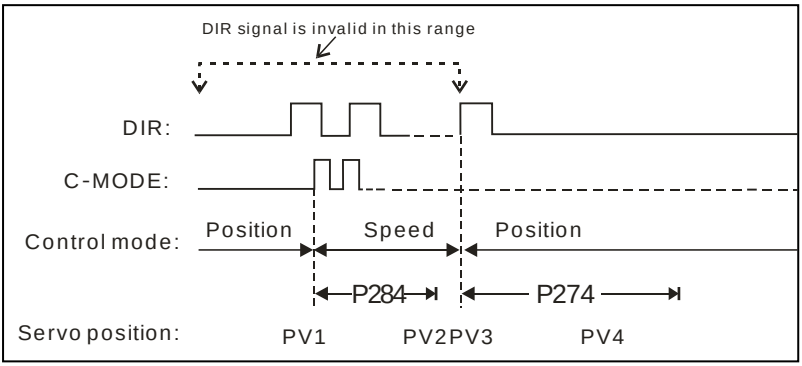
When C-MODE signal has been detected, servo switches from position to speed mode immediately, Execute P286 (pulse filter 2) after the first rising edge of DIR signal was detected, then detect it again when the pulse system output reaches P286, where the system switches to position mode and move as setting distance of P274 when the first falling edge was detected.



Explication 3（P284≠0 & P286=0）

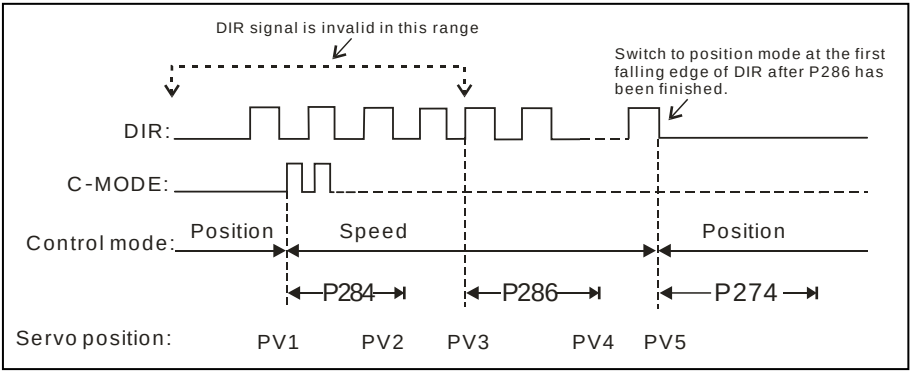
Servo switches from position mode to speed mode the moment C-MODE signal is detected, where to detect DIR signal when pulse reaches P284. Servo switches to position mode and moves as setting distance of P274 when the first rising edge was

detected.



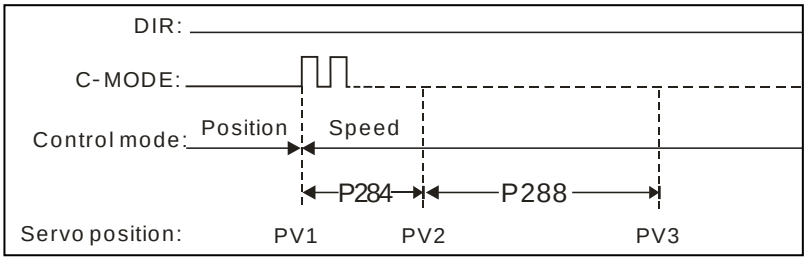
Explication 4（P284≠0 & P286≠0）

Servo switches from position mode to speed mode immediately when C-MODE signal is detected, where to detect DIR signal when pulse reaches P284, then Execute P286 (pulse filter 2) after the first rising edge of DIR signal was detected, then detect it again when the pulse system output reaches P286, where the system switches to position mode and move as setting distance of P274 when the first falling edge was detected.



Explication5（P284≠0 & P288≠0）

Servo switches from position mode to speed mode immediately when C-MODE signal is detected, where to detect DIR signal when pulse reaches P284. The system will stop and alarm if no DIR signal was detected and the pulse increment reaches P288 (pulse alarm value).



【Terminal setting】

The trigger signal for special control mode should come from external sensor input and also with fast response, so the contact switch sensor signal input is direction input pin of multiplexing pulses rather than normal DI, which is DIR+ of X2 terminal→ PIN 37 DIR- → PIN 39(When P01 is set to 13, pin function switches to trigger signal input automatically without configuration for other multiplexing parameters). Servo will generate interrupt signal and act as setting trail when DIR+/- input is effective (Monitoring by R205_Bit14).

【Example】

Here takes “Explication 4” as an example to illustrate the operations in special speed position mode.

Step 1: Select control mode

P01 =13, save the setting to EEPROM and restart the servo to validate the setting.

Step 2: Detect C-MODE signal (Mode switching signal)

Servo switch to speed mode while C-MODE is detected, and mark position as PV1, when the new position PV2 reaches the pulses requirement (|PV2 - PV1| ≥ P284), start to detect external switch signal.

<Remark>

- Check C-MODE signal status via R203_Bit4;
- Check whether P284 or P286 has completed the positioning via R204_Bit2.

Step 3: Detect DIR signal (External switch signal)

Mark the position as PV3 when the rising edge of DIR signal was detected, then servo continue to detect DIR signal, mark position as PV4 when the first falling edge of DIR signal was detected. If |PV4 - PV3| ≥ P286, servo would switch to position mode, where the position mark as PV5, then it will run in given distance of P274.

<Note> Check DIR signal via R205_Bit14.

Step 4: Detect C-MODE signal (Mode switching signal)

System switches to speed mode when the rising edge of C-MODE signal was detected.

<Note> If external switch signal cannot be detected all the time in speed mode, and the output pulses reach the number of alarm, the servo will stop and alarm, then you can clear the error by “Alarm clear” function to restore to position mode. If set the value of P288 to 0, the alarm function would be shut off.

11

Alarms and Protections

*Introduction of Alarm and Protection

11 Alarms and Protections

Introduction of alarm and protection

A4S driver enjoys protection functions as below, the front panel will display different alarm code when abnormality occurs.

Check the alarm code by P202 (error type). Combined with the alarm type described in the following table, you can quickly identify the cause of fault and deal with it in a time.

Code	Type	Error description	Solutions
0	No errors		
1	Undervoltage	Activated when the main circuit voltage is lower than specified one (200V after rectifying)	1) Check the wiring of power cables; 2) Measure if the voltage between L1 and L2 is within the range; 3) Check if the power supply is sufficient.
2	Overvoltage	Activated when the main circuit voltage is higher than specified one (395V after rectifying)	1) Measure the voltage between L1 and L2 to eliminate capacitive load; 2) If it alarms while using internal resistance, please use proper external resistance;
3	※Overcurrent	Activated while the major loop current exceeds 1.5 times of instantaneous max current of the motor.	1) Poor motor cables contact; 2) The UVW cables may short circuit with ground; 3) The UVW terminals may short circuit; 4) The motor is not applicable to the servo driver. 5) Motor may have burnt out, check the resistance value between UVW which should be the same.
4	※Overheat	Activated when IPM module overheated(80℃)	1) Try to lower the ambient temperature, and increase the cooling equipment; 2) Lighten load; Install servo in ventilated place.
6	※Encoder feedback error	Encoder feedback error	Check if there is open circuit of encoder feedback signal wires and misconnect of its extension lines
7	※Excessive brake ratio	The regenerative energy is larger than the capacity of discharge resistance.	Motor at power generating situation will rise busbar voltage continuously to have the brake ratio output over 10%, where you should replace with a larger capacity external resistance, or servo doesn't protect external resistance while P132=2 (Be sure to keep sufficient external resistance capacity so as not to be burn out).

Code	Type	Error description	Solutions
8	Overload	Activated when the driver overloads for some time.	1) Actual torque exceed the value of P138 (overload level). 2) Vibrations or abnormal noises due to incorrect gains. 3) Motor overloads for a long time or is stuck ; 4) Please replace servo with higher power when overloaded.
9	Excessive position deviation	Activated while position control errors are higher than the allowed value.	1) Too small setting value of P136 (excess position deviation). 2) Too small setting value of Torque limitation. 3) The motor cannot rotate or reach the given position due to heavy load where you should enlarge the torque limit or gains.
10	Overtravel inhibit alarm	Connection of both CW and CCW overtravel inhibit switch to COM- are broken when P03 is 0. Any PIN of CW or CCW overtravel inhibit switch to COM- are broken when P03 is 2.	1) Effective the moment servo power-ON. 2) Check the switch of Overtravel inhibit switch ; 3) If the alarm occurs once power-ON, please check whether the servo has been disconnected with COM- before power on.
11	Overspeed	Actual speed of motor exceeds the overspeed	Too high of given command speed or instant overspeed caused by inappropriate gain
12	Excessive Analog input	Input analogy exceeds the excessive analogy input	1) Too small setting value of P137 (analog command excess); 2) Too large input analog, adjusting speed or torque gain, input lower analog to realize larger torque or speed; 3) The alarm can be canceled by setting P137 0.
13	※EEPROM R/W error	Error when EEPROM R/W	Please try to restore the factory default parameters if errors occur the moment power on to read EEPROM data, if invalid for several times, please replace with another driver
14	RS485 Abnormal communication	Abnormal communication of RS485	1) Incorrect setting value of P12 (Communication time-out); 2) The communication condition suffers great interference or communication converter error.

Code	Type	Error description	Solutions
15	CANopen Abnormal communication	Abnormal communication of CANopen	1) Communication environment suffers great interference. 2) Long jam of CANopen communication; 3) The communication cable of CANopen break; 3) Abnormal CANopen master.
16	Configuration error of external input pins	Multi-pins were configured to the same signal	Check if two or more PINs (P75~P78) were allocated with same function
17	Internal error 1	Activated when internal communication error.	1) Try to clear alarm, reboot or restore the factory default setting if this error occurs. 2) Replace the servo with a new one if it alarm for several times.
18	Absolute encoder motor unmatched	Absolute encoder motor unmatched	Check if the motor is bus absolute encoder, if not, replace a matched one
19	Pulse error	As the pulse alarm setting register in special speed-position mode. In the speed mode, if the external switch signal cannot be detected all the time, and the pulse increment output by the system reaches the alarm value of the pulse, the machine will stop and alarm.	Reduce the frequency division pulse of encoder, so that the output pulse frequency is less than the upper limit allowed by hardware within the whole speed range required by machinery. Reduce the input pulse frequency to the maximum frequency allowed by the hardware.
22	Main power phase loss	1) Poor contact of three-phase wiring 2) Three-phase driver run in single-phase power 3) Unbalanced power or low voltage of three-phase 4) servo error	1) change cable and connect main circuit correctly 2) Forbid the warning of power phase loss 3) Please adjust power specification or replace it if the input voltage is not specified 4) Replace servo with a new one.
23	Control power input undervoltage	1) Control power is unstable or power-off 2) Poor contact of control power cable	1) Power-on again, for abnormal power-off, please ensure the switch power output stable 2) Wiring again or replace the cable

Code	Type	Error description	Solutions
24	Internal drive power undervoltage	Internal drive power undervoltage	Phase loss or undervoltage. Please disconnect the power and re-check the wiring or replace the cable to start the servo after ensure control power is normal. If the alarm cannot be removed after restart, please replace another servo driver.
25	Motor runaway alarm	1) Wrongly contact U V W 2) The initial phase detection error of the motor rotor caused by interference signal when power-on 3) Wrong encoder type or wiring 4) Cable aging or corrosion 5) Overload in vertical working condition	1) Wiring U V W cable correctly 2) Power-on again 3) Matching the servo driver with same type motor 4) Reweld, plug tightly or change encoder cable 5) Reduce vertical load or increase rigidity, shield the fault under the prerequisite of ensuring safety and use

Notice

1) Alarm codes marked with ※ cannot be cleared with A-CLR (Alarm Clear Input) or communication control word but can be cleared by restarting.

2) When overload alarm is triggered, clear it after 10 seconds or longer.

3) The servo driver will record the recently ten alarm histories after alarm, and store the records into EEPROM automatically.

4) After alarms occur, servo driver stop running, and the current is cut-off where motor enter free coasting status, meanwhile the ALM servo alarm output of control signal is shut-off.

12

Gain Adjustment

*Adjustment of performance gain parameters

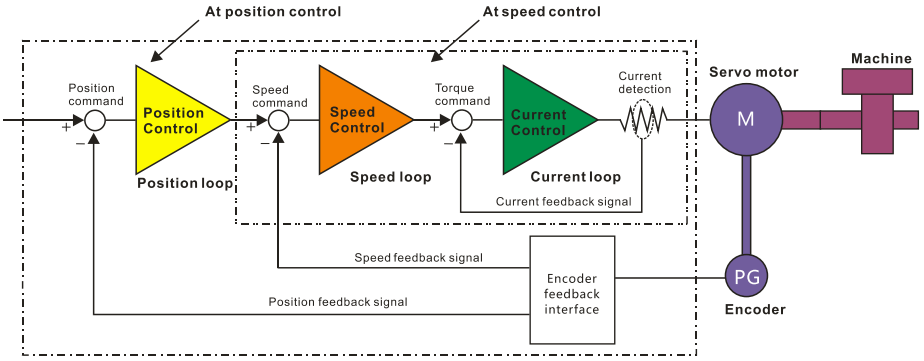
12 Gain Adjustment

Adjustment of performance gain parameters

The servo gain parameters, which need to be adjusted in the process of debugging, will directly affect the performance of the system. The user can also adjust the servo gain parameter, whose factory default is stable, according to the needs of the field mechanical system to further improve the system performance.

The gain parameters of the servo affect each other, so it is recommended that engineers with professional knowledge to adjust the gain parameters to ensure that the servo motor operation with high performance.

12.1 A4S Series Servo Diver System Control Diagram



12.2 Setting of Servo Related Gain Parameters

1. The gain of current loop (P18)

The larger gain of current loop you set, the higher gain and better response you can obtain. The inner current loop must equip with high response to obtain better servo performance.

2. The integration time of current loop (P19)

The lower the integration time of current loop you set, the faster integration speed you can obtain. Current loop requires high responsiveness, the current loop integration time should be set as small as possible under the condition of no oscillation and noise.

3. The gain of speed loop (P21, P28)

Higher the gain of speed loop you set, higher gain and better rigidity you can obtain. Set the speed loop as high as possible under the condition of no oscillation. In General, higher speed gain setting accompany with greater load inertia.

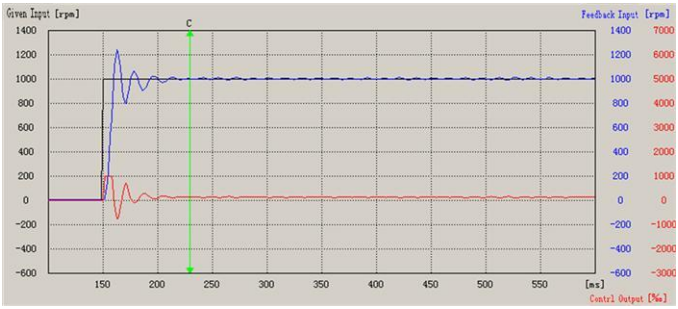


Figure 12-1 speed loop curve at high gain of speed loop

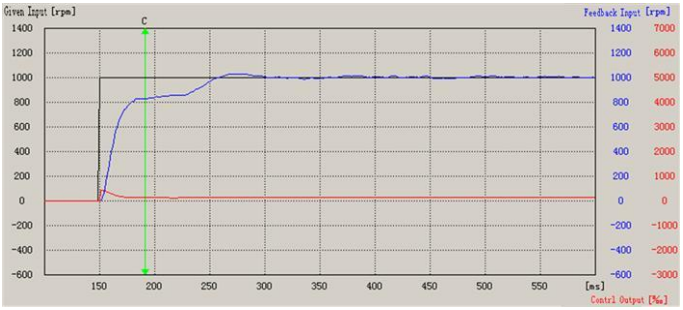


Figure 12-2 peed loop curve at low gain of speed loop

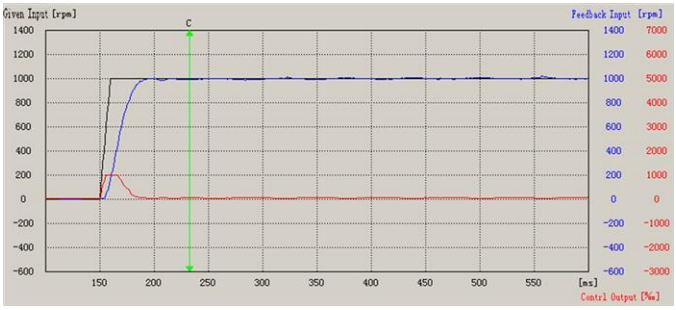


Figure 12-3 speed loop curve of proper speed loop gain

As can be seen from figure 12-1, 12-2 and 12-3, too much gain of the velocity loop will lead to overshoot and oscillation, while too little lead to long arrival time of the velocity

loop and poor system responsiveness. The appropriate speed loop gain can avoid overshoot and oscillation and with short positioning time.

4. Speed loop integration (P22 and P29)

Lower value you set, faster integration speed you can obtain. According to the given conditions, set as small as possible to improve the response speed but will also arise oscillation. So try to set smaller value under the condition without oscillating. In general, higher load inertia you get, higher speed integration you should set.

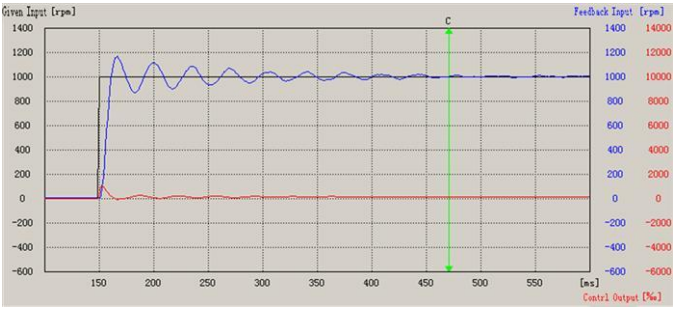


Figure 12-4 speed loop curve at low speed loop integration

5. The gain of position loop (P20 and P27)

Higher gain of position loop you set, higher gain and better rigidity you can obtain. With the same frequency command pulse, the better track ability of position command, the higher the response speed and the shorter positioning time are, and the hysteresis error might be small, but easier to cause oscillation after positioning.

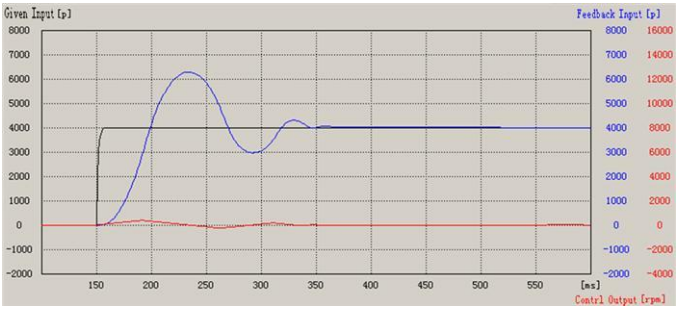


Figure 12-5 position loop curve at high gain of position loop

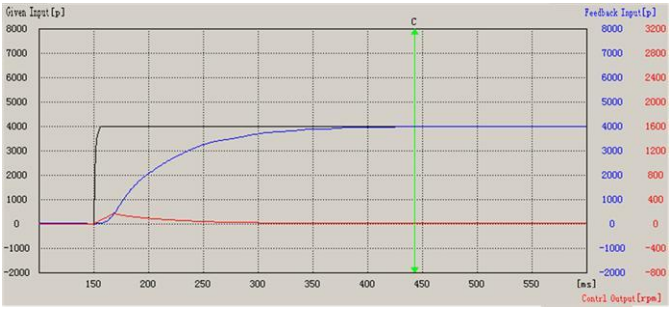


Figure 12-6 position loop curve at low gain of position loop

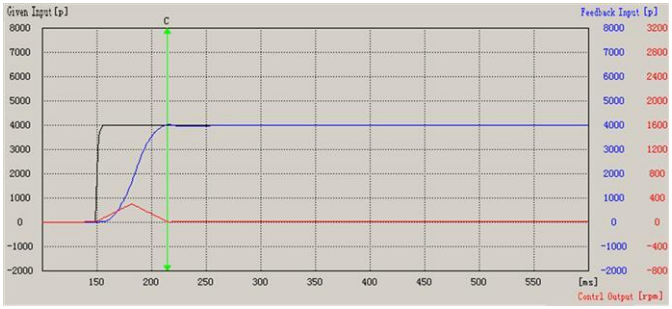


Figure 12-7 position loop curve of proper position loop gain

The three schematics above reflect that higher position loop gain will result in vibration and overshoot, while lower lead to overtime of speed arrival, only proper position loop gain can complete positioning in a short time and won't cause vibration and overshoot.

6. Speed detection filter (P23 and P30)

The parameter is used to select the type of speed detection filter. Higher value you set, better noise restraint ability you can get, but the response speed will be slower.

7. The time constant of torque filter (P24 and P31)

There may be torque covibration and noise in some occasions, where you should increase the time constant of primary delay filter behind torque command to restrain such vibration.

8. Speed feedforward (P25)

Speed feedforward a compensation to shorten the positioning response time in position control mode. Higher value with smaller positional deviation and better response, while too high may cause vibration and unstable system position, which will result in over-speed alarm

9. Speed feedforward filtering time constant (P26)

If the operation noise increased due to too large speed feedforward value, you can set the time constant of the primary delay filter with speed feedforward to increase this value to suppress the noise.

10. Inertia ratio (P32)

Set the ratio of load Inertia against rotor (of the motor) inertia. P32= (load inertia/rotor inertia) ×100 [%]. Increasing the value of inertia ratio is equivalent to improve the system gain, but too large might cause oscillation. When enlarge the load inertia, if mechanical system contains the factors of oscillation, it may result in mechanical oscillation while speed integration time does not increase up to a certain extent.

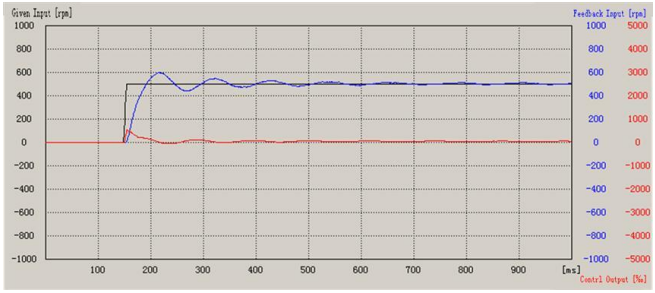


Figure 12-8 speed loop curve of insufficient integration time of increasing the inertia ratio

11. Torque estimator compensation (P503, P504 and P505)

- Function

As shown in figure 12-9, add to the torque instruction as a compensation by observing external disturbance torque to reduce the influence of torque disturbance on servo. The effect is shown in figure 12-11 below.

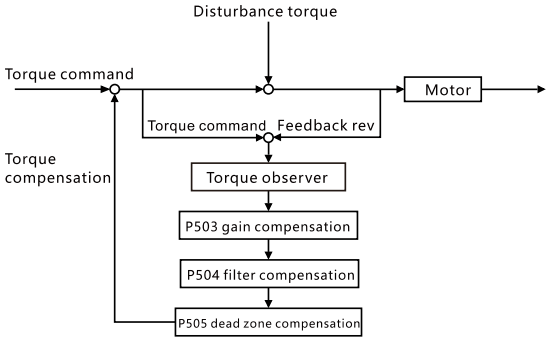


Figure 12-9 torque compensation control

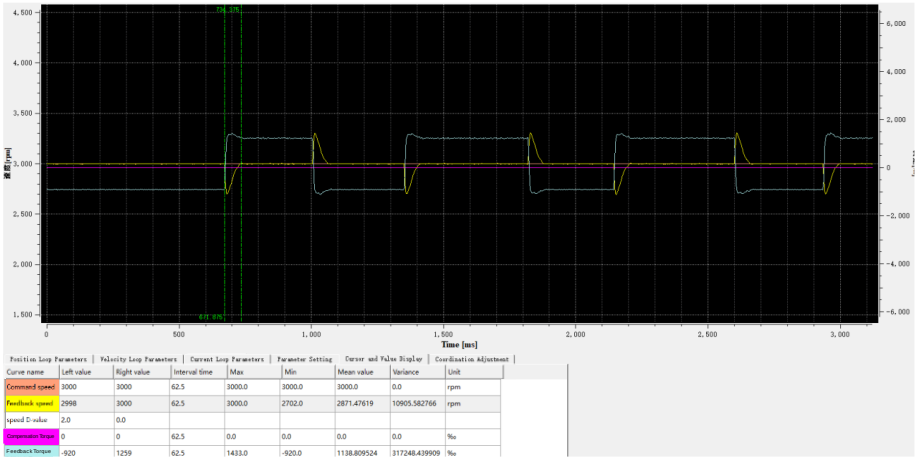


Figure 12-10 before continuous load torque compensation in speed mode

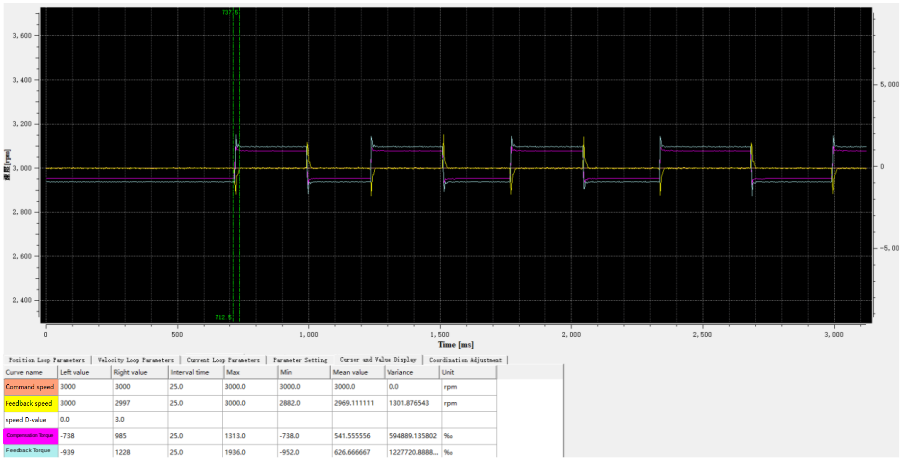


Figure 12-11 after continuous load torque compensation in speed mode

- Applicable range

Control modes which except torque mode.

Notice
When this function is used, the system inertia needs to be identified for using this.

- How to use

Addr	Name	How to use	
		Parameter function	Adjustment
P503	Torque compensation output gain	The larger the gain, the larger the compensation output, but the larger noise.	P504 remains default while P503 enlarges from 0 till better compensation reached
P504	Torque output filter	The larger the filter, the smaller noise and larger lag of the compensation will output. The smaller the filter, the larger the noise, and the smaller lag of compensation output.	After adjustment of P503, P504 can be reduced and P503 can be increased appropriately for better results.
P505	Torque estimator compensation dead zone	Torque compensation takes effect when velocity error is greater than this value	Increase P505 when P503 and P504 get bad effect.

12. Incomplete differential gain of velocity (P508 and P509)

- Function

In actual system, the pure differential is easy to cause system oscillation while incomplete differential can not only reduce the system deviation, but also ensure the stability of the system. As shown in the following figure, the incomplete differential can reduce overshoot of velocity feedback in transient state and improve speed stability in steady state.

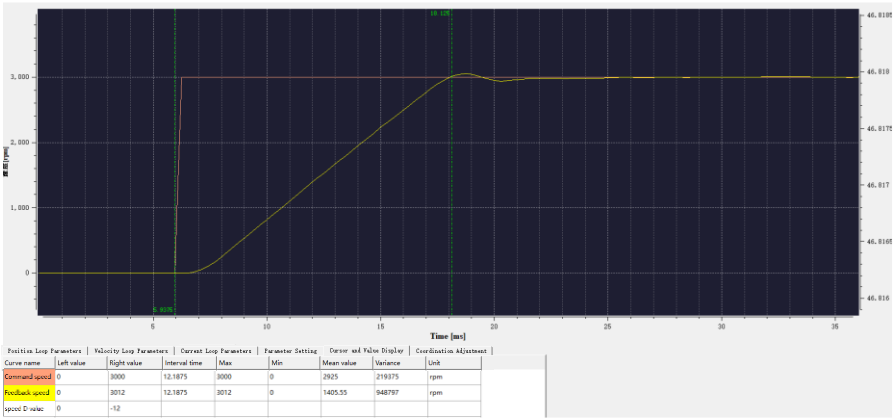


Figure 12-12 differential gain in closed speed step

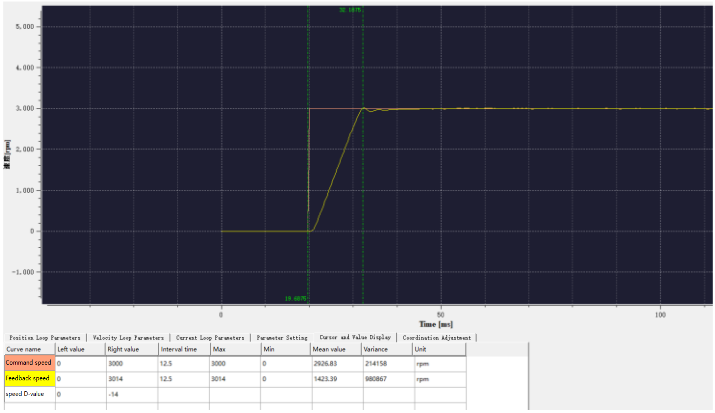


Figure 12-13 differential gain in opening speed step

- Applicable range

Control modes which except torque mode.

- How to use

Addr	Name	How to use	
		Parameter function	Adjustment
P508	Velocity differential antecedent gain	Increasing the parameter to reduce the velocity overshoot and improve its stability. But too large gain will cause speed vibration	Increases from 0 till get a better result

13. Torque feedforward (P509 and P510)

- Function

Torque feedforward can improve the following characteristics in stage of ACC/DCC.

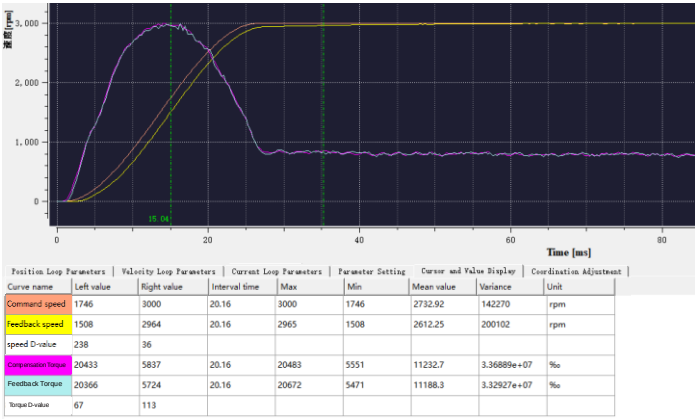
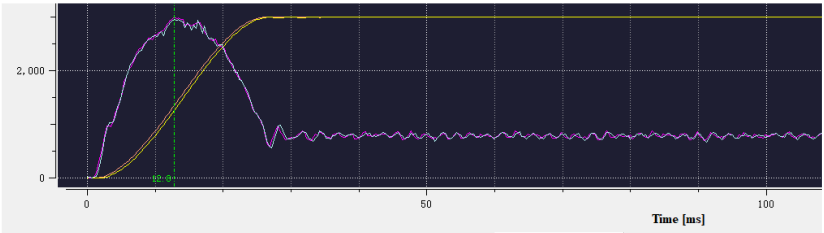


Figure 12-14 no feedforward



Position Loop Parameters | Velocity Loop Parameters | Current Loop Parameters | Parameter Setting | Cursor and Value Display | Coordination Adjustment

Curve name	Left value	Right value	Interval time	Max	Min	Mean value	Variance	Unit
Command speed	1353	3000	306.88	3000	1353	2971.42	29446.4	rpm
Feedback speed	1258	3000	306.88	3003	1258	2967.59	34290.7	rpm
speed D-value	95	0						
Compensation Torque	21249	5337	306.88	21249	4125	5900.43	5.72227e+06	‰
Feedback Torque	20863	5272	306.88	20895	3942	5896.03	5.63919e+06	‰
Torque D-value	386	65						

Figure 12-15 with feedforward

- Applicable range

Control modes which except torque mode.

- How to use

Addr	Name	How to use	
		Parameter function	Adjustment
P509	Torque feedforward gain	The larger the gain, the larger the feedforward, but the larger the noise and speed feedback.	Increases from 0 till get a better result.
P510	Time constant of torque feedforward filter	The time constant of first order low pass filter is used to filter the torque feedforward output, whose increase helps to reduce the noise.	The noise caused by increase of P509 can be reduced by enlarge P510

14. The second degree of freedom of velocity loop PI (P516 and P517)

- Function

increasing P516 and P517 can weaken the effect of the velocity loop PI in the acceleration and deceleration stage (as shown in figure 12-16 and 12-17), while not changing its effect in the uniform speed stage (as shown in figure 12-18 and 12-19). In order to separately adjust the speed following and disturbance resistance.

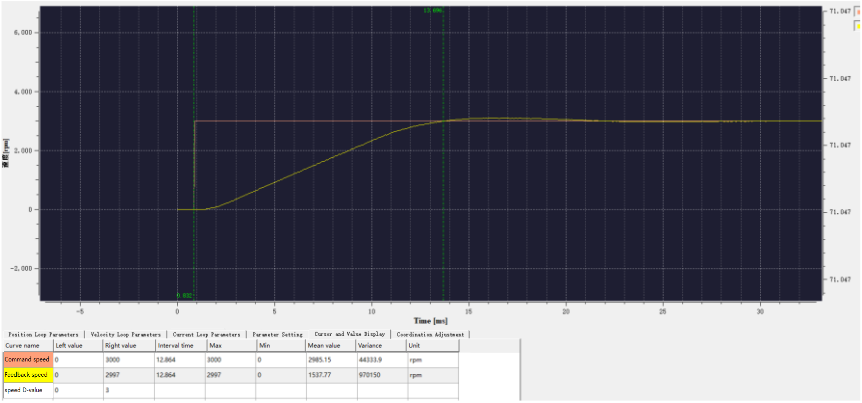


Figure 12-16 without the 2nd degree of freedom of velocity loop PI

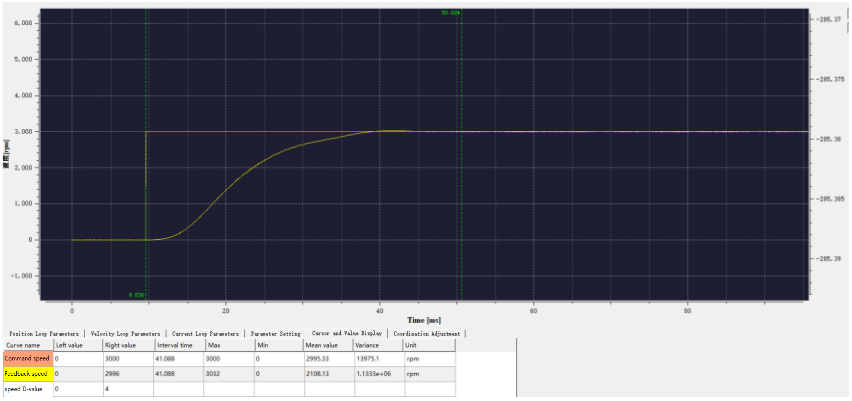


Figure 12-17 with the 2nd degree of freedom of velocity loop PI

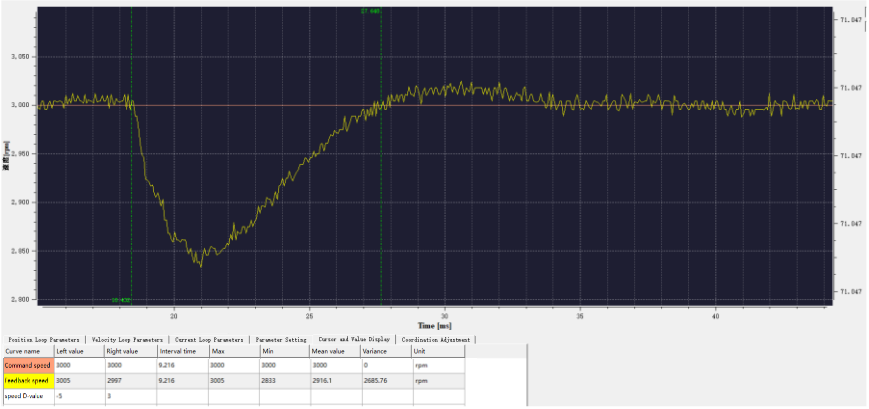


Figure 12-18 without the 2nd degree of freedom of velocity loop PI

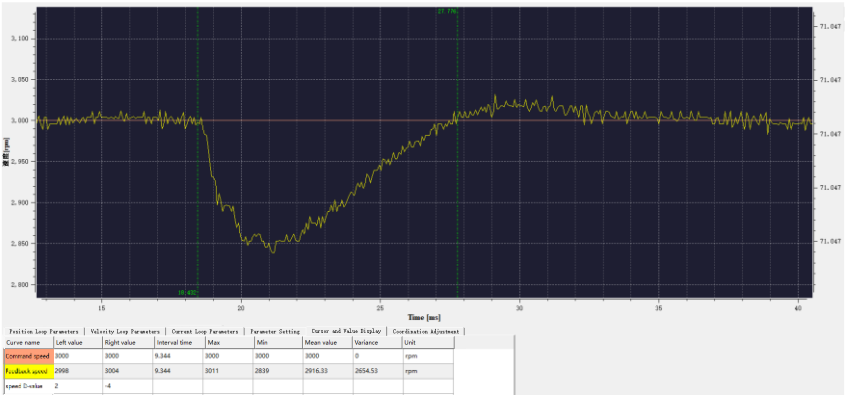


Figure 12-19 with the 2nd degree of freedom of velocity loop PI

- Applicable range

Non-torque mode in control mode.

- How to use

Addr	Name	How to use	
		Parameter function	Adjustment
P516	Second proportional degree of freedom of speed-loop PI	Reduce gain in speed follow 0 to 1000: Gain becomes weaker as the coefficient grow larger.	Enlarge parameter value when the speed overshoot is too large
P517	Second integral degree of freedom of speed-loop PI	Reduce integration in speed follow 0 to 1000: Integration becomes weaker as the coefficient grow larger.	

15. Vibration suppression (P532, P534, P535 and P536)

- Function

Suppress the vibration at the resonant frequency by notch filter when the system resonates there.

- Applicable range

Position control mode

- How to use

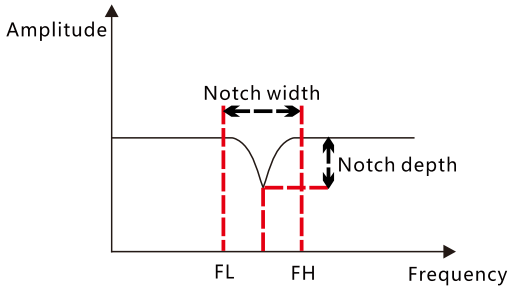


Figure 12-20 Amplitude frequency characteristic of notch filter

Addr	Name	Parameter function
P532	Speed level of low-frequency vibration detection	Set the speed of detecting low-frequency vibration frequency. The higher the value, the faster the detection speed and the larger the error
P533	Selection of low-frequency vibration suppression mode	Configure the working mode in low-frequency vibration suppression: 0-OFF, 1-automatic mode, 2-manual mode
P534	Frequency value of low-frequency vibration suppression	Set the frequency need to be suppressed in manual mode, monitor the vibration frequency that was identified automatically and used
P535	Notch depth of low-frequency vibration suppression	Set the notch depth
P536	Automatically updated threshold of Low-frequency vibration suppression frequency	Update the notch frequency when the deviation of newly detected frequency and the notch frequency in use is larger than this value

16. Off-line inertia identification

- Function

By setting the motor at a fixed speed, the positive and negative rotation is formed to identify the inertia of the system.

- Applicable range

Communication speed mode

Notice

1) In the identification of inertia, the velocity PI should be appropriate to ensure that the feedback speed can follow the given value
2) Before inertia identification, please fill the motor rated torque (P567, unit: mNm) and motor self inertia (P568, unit: kg*m2*e-7) correctly.

- How to use

1) Choose inertia identification

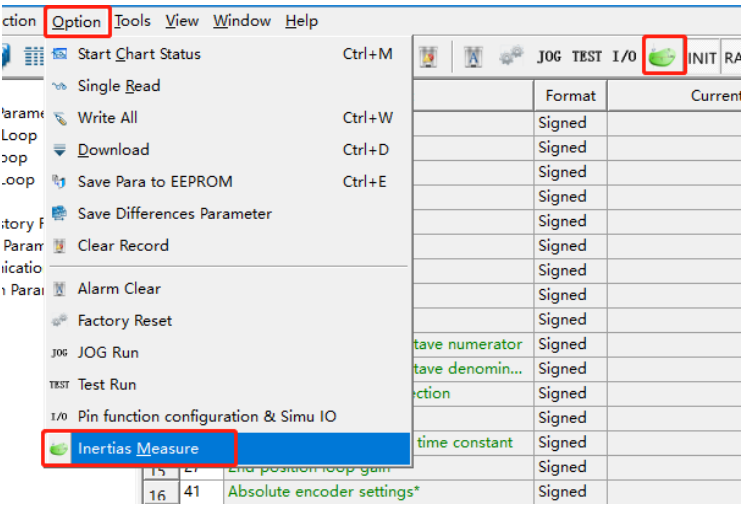


Figure 12-21 off-line inertia identification menu

2) Parameter setting

- Recommended speed: 500
- Recommended position 300
- Recommend setting the speed KP and speed RC time as default

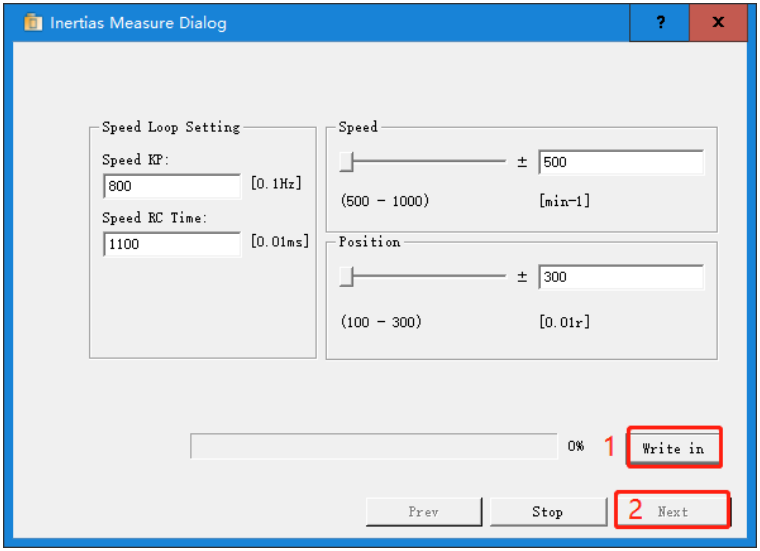


Figure 12-22 setting of off-line inertia identification

3) Start identification

The inertia ratio will update after identification

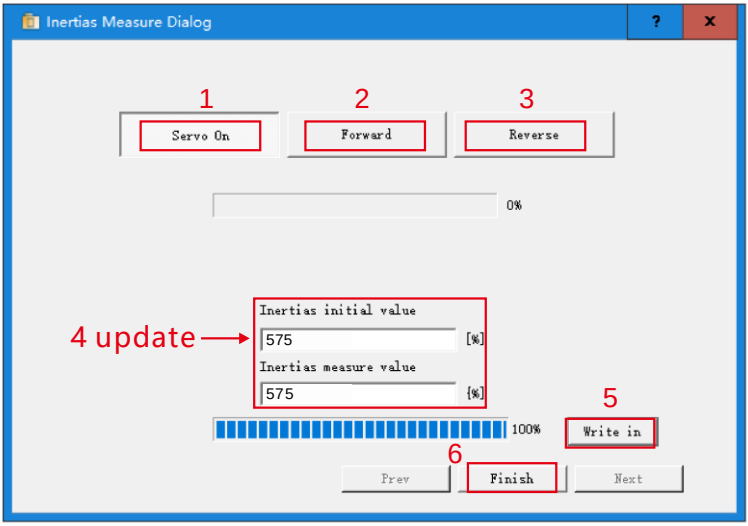


Figure 12-23 steps of off-line inertia identification

17. Online inertia identification (P515)

- Function

Identify inertia in real-time operation

- Applicable range

Control modes which except torque mode.

- How to use

Addr	Name	Parameter function
P515	Switch and speed selection of on-line inertia identification	1: The actual inertia ratio is almost constant; 2: The actual inertia changes slowly; 3: The actual inertia ratio changes quickly

18. Rigidity level (P506 and P507)

- Function

Setting parameter to quickly adjust the control parameter of position and velocity loop

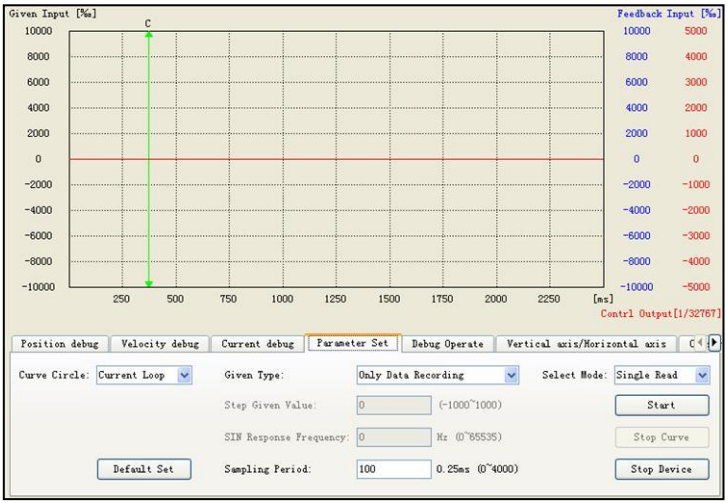
Table 12-1 rigidity level

Rigidity	The first gain				The second gain			
	Position loop gain [0.1/s]	Velocity loop gain [0.1Hz]	Velocity integral constant [0.01ms]	Torque filter time constant	Position loop gain [0.1/s]	Velocity loop gain [0.1Hz]	Velocity integral constant [0.01ms]	Torque filter time constant
0	20	50	28000	1300	80	50	30000	1300
1	40	60	25000	1050	120	60	30000	1050
2	80	80	20000	800	200	80	30000	800
3	120	100	15000	550	240	100	30000	550
4	200	130	10000	350	260	130	30000	350
5	240	180	5000	250	270	180	30000	250
6	260	240	3000	200	280	240	30000	200
7	270	310	2000	150	290	310	30000	150
8	280	400	1500	90	310	400	30000	90
9	290	500	1400	70	330	500	30000	70
10	310	600	1300	60	350	600	30000	60
11	330	700	1200	55	400	700	30000	55
12	350	800	1100	50	450	800	30000	50
13	400	900	1000	45	500	900	30000	45
14	450	1050	950	40	550	1050	30000	40
15	500	1200	900	35	600	1200	30000	35
16	550	1350	850	30	650	1350	30000	30
17	600	1500	800	27	700	1500	30000	27
18	650	1650	750	24	750	1650	30000	24
19	700	1800	700	21	800	1800	30000	21
20	750	2000	650	18	850	2000	30000	18
21	800	2200	600	15	900	2200	30000	15
22	850	2400	550	12	950	2400	30000	12
23	900	2600	500	10	1000	2600	30000	10
24	950	2800	450	8	1050	2800	30000	8
25	1000	3000	400	7	1100	3000	30000	7
26	1050	3200	350	7	1150	3200	30000	7

Rigidity	The first gain				The second gain			
	Position loop gain [0.1/s]	Velocity loop gain [0.1Hz]	Velocity integral constant [0.01ms]	Torque filter time constant	Position loop gain [0.1/s]	Velocity loop gain [0.1Hz]	Velocity integral constant [0.01ms]	Torque filter time constant
27	1100	3400	300	6	1250	3400	30000	6
28	1150	3600	250	5	1350	3600	30000	5
29	1250	3800	200	5	1450	3800	30000	5
30	1350	3900	150	4	1450	3900	30000	4
31	1450	4100	100	4	1450	4100	30000	4

12.3 The Curve Graphic of Software MagicWorks Tuner

The curve graphic, which includes three curves of given input, feedback input and control output of current/velocity/position loop, is used for adjusting servo performance to quickly view the sampling curve of this three loops. Each curve samples 1000 points according to period to map to a curve, which is shown as below:



Check the “Current loop” (or Speed Loop and Position Loop) by clicking the pull-down box of "Curve Circle", and check “Single Read” or “Cycle Monitor” by selecting the pull-down box of "Select Mode". Click button "Start" to start the motor where it begin to sample to draw the curve. Clicking "Stop Curve" to stop the record of curve but not the motor, you can stop the motor by clicking "Stop Device".

The given command of the three loops:

The given value of current loop step (unit: ‰,), limited by the 4th internal speed, outputs position command (Unit: pulse).

The given value of speed loop step (unit: rpm) and the frequency of speed loop sine response (unit: Hz) output torque command (unit: ‰). As the speed loop is related to deceleration time, please consider this while adjusting the performance of speed loop. Longer the acceleration or deceleration time, slower the response of speed loop you will obtain.

The given value of position loop step, whose is the number of pulses, outputs speed command (Unit: rpm). The given value, not controlled by ACC/DCC time, is the pulse number without gear ratio, which is 4000 if gear ratio is 1:1, and the motor will position a round after launching. Too large gear ratio or too much given pulses will lead to big instant position deviation which may cause overspeed alarm of servo.

12.4 The Principles and Methods of Parameter Adjustment

The adjustment of servo gain parameters should follow a control principle, that the more inboard the loop, the more responsive it needs to be. Failure to follow this principle may lead to vibration or poor responsiveness. The current loop is the innermost loop, which has been locked for ensuring the responsiveness of factory default. So you just need to adjust the parameters of position/ speed loop.

The servo gain parameters are mutually restricted, for example, to improve the responsiveness of the position loop, if only to increase its gain, the speed instructions outputted may become unstable, which may result in the performance of the entire servo system becoming unstable. Because only to increase the response of position loop, it will be greater than that of speed loop, so the speed instruction of former will accelerate or decelerate, which can not follow due to the poor responsiveness of speed loop. Then the position deviation increased and servo will add speed command, which will lead to overspeed of motor, there the speed loop will decrease command again. The looping execution will make motor unable to adapt to vibration. Therefore, to ensure the velocity loop response is greater than the position loop response, the velocity loop gain should also be increased with the position loop gain.

Notice

1) Please make the applicable range and precautions clear before adjusting gain, and also ensure that there is no danger of changing the load position during the adjustment process.
2) Please ensure that the safety measures are taken, such as setting P136 (too large position deviation) and P139 (overspeed).

Adjustment of servo gain parameters

Steps to adjust the servo gain parameter, use the curve function of MagicWorks Tuner for auxiliary adjustment when necessary:

1) Set the gain of the position loop to a lower value, and then gradually increase the gain of the velocity loop to the maximum value without any abnormal sound or vibration.

2) Gradually decrease the speed loop gain while increase the position loop gain without any abnormal sound or vibration.

3) The integral time constant of velocity loop, which depends on the length of the positioning time, should be minimized on the premise of no mechanical system vibration.

4) Then fine tuning the position loop gain, velocity loop gain and integral time constant to find the best value.

12.5 Gain Switching

Servo enjoys two different sets of gain parameters (The default is the first gain), which can be switched by setting the internal parameters of servo or switching the external signal terminals (P281_Bit9).

When the motor stops, switch to lower gain to suppress vibration or noise while higher gain to increase servo rigidity. When the motor runs, switch to a higher gain r to obtain better position tracking performance. It can also achieve the best performance by switching different gain settings according to different mechanical equipment loaded.

Related waiting time parameter of gain switching:

No.	Name	Function
P62	Control switching delay time	The delay time when switching from the first gain to the second gain (or on the contrary). Unit: 250us
P65	Position loop gain switching time	If there is a big change in the switching of two different position rings, this parameter can be used to set the switching delay for the position ring gain, so as to suppress the fast impact in the gain switching process. Unit: 250us

Related parameter of gain switching:

Fixed as the 1st gain when P61=0		Fixed as the 2nd gain when P61=1
P20(the 1st POS-loop gain)	1st gain at invalid gain switch ← P61=2 → 2nd gain at valid gain switch	P27(the 2nd POS-loop gain)
P21(the 1st speed-loop gain)		P28(the 2nd speed-loop gain)
P22(the 1st speed-loop integral time constant)	1st gain when position unfinished ← P61=3 → 2nd gain when position finished	P29(the 2nd speed-loop integral time constant)
P23(the 1st speed detect filter)		P30(the 2nd speed detect filter)
P24(time constant of the 1st torque filter)		P31(time constant of the 2nd torque filter)

13

Warranty

*Guarantee clauses and maintenance list

13 Warranty

Guarantee clauses and maintenance list

For consumers being assured and satisfied to use the products, we will strictly in accordance with the relevant laws and regulations issued by country to make reasonable after-sales service system.

13.1 Warranty Period

COTRUST provides warranty service in certain time (calculated from the date of first delivery) for products, please use as followed by regulations. Any non-human fault during the warranty period is free to be maintained.

Equipment damaged due to one of the following reasons during the warranty period, it will be charged for maintenance

1) Failure and damage caused by human factors and abnormal working environment, or not using according to the user manual provided by our company;

2) Users disassemble, repair or modify products without the consent of COTRUST.

3) Failure or damage due to falling or poor transportation after purchasing the product.

4) Failure or damage due to natural causes (such as flood, lightning, earthquake, abnormal voltage, other secondary disasters)

5) Failure or damage due to external device.

6) Abrasion or fracture by normally use.

7) No valid shopping credentials or the fuselage serial number was damaged

13.2 Warranty Information

◆ In case of product failure or damage, please fill in the " maintenance list" correctly and send it to us (see the mailing address on the next page).

◆ The charge of maintenance fee is subject to the price list of COTRUST.

◆ If your problem is not properly solved, please call or email our customer service department (see the contact information on the back cover), we will help you solve the problem in the shortest time.

◆ COTRUST reserves the right to interpret these clauses.

13.3 Maintenance List

Company that sends product to repair:

Company address:

Name: _____ Tel: _____ Fax: _____

No.	Type	Serial No.	Fault	note
1				Repair（√） Detect（ ） Upgrade（ ）
2				Repair（√） Detect（ ） Upgrade（ ）
3				Repair（√） Detect（ ） Upgrade（ ）
4				Repair（√） Detect（ ） Upgrade（ ）
5				Repair（√） Detect（ ） Upgrade（ ）
6				Repair（√） Detect（ ） Upgrade（ ）
7				Repair（√） Detect（ ） Upgrade（ ）
8				Repair（√） Detect（ ） Upgrade（ ）
9				Repair（√） Detect（ ） Upgrade（ ）
10				Repair（√） Detect（ ） Upgrade（ ）
11				Repair（√） Detect（ ） Upgrade（ ）
12				Repair（√） Detect（ ） Upgrade（ ）
13				Repair（√） Detect（ ） Upgrade（ ）
14				Repair（√） Detect（ ） Upgrade（ ）
15				Repair（√） Detect（ ） Upgrade（ ）

Agent seal:

(Seal to be valid)

Delivery info

Address: 268 New road, Yangyong village, Dalang town, Dongguan, CHINA
Addressee: Maintenance department
Tel: 0796-82220668
Postcode: 523770

Address: Room 209, 210 at IC Design Industrial Park of XiLi Chaguang Road, Nanshan District, Shenzhen
Tel: 0755-86226822
E-mail: sales@co-trust.com
Website: http：//www.co-trust.com
Version: V0.10
Release date: 11/2019
Order no: CTM1-G2019

Scan for more info