COTRUST

A4N Series AC Servo Driver

User Manual

◎V1.23

SHENZHEN CO-TRUST TECHNOLOGY CO.,LTD.

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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 A4N 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 or 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 put your hands into the servo driver.	Failing to observe these instructions could result in electrical shocks and fire.
Do not use the product in the environment of corrosivity, inflammable gas, humidity or explosive.	

Danger	
Do not place combustible objects near motor, driver or regenerative resistor.	Failing to observe these instructions could result in electrical shocks and fire.
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.	Cause product failure or malfunction.
Please execute the switch and parameter setting consistent with the machine before starting operation.	Cause mechanical accident, failure or personal injury.
Do not make extreme changes to parameter settings.	May cause work instability, mechanical damage or injury risk.
To avoid accidents, please install limit switch or baffle in the movable terminal of the machine.	Failing to observe these instructions could result in machine damage and personal injuries.
Do not enter the operating range of the machine.	Failing to observe these instructions could result in injuries.

Danger	
Do not touch the servo motor and the movable part of the machine during operation.	Failing to observe these instructions could result in injuries.
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.	Failing to observe these instructions could result in 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 use servo driver that damaged or missing parts.	Failing to observe these instructions could result in personal injuries.
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.	Failing to observe these instructions could result in fire.
Please follow the specified installation method.	Failing to observe these instructions could result in machine damage and personal injuries.
Do not connect input power line to the U, V, W terminal.	Failing to observe the instruction could result in machine damage.
When two or more servo drivers are placed in the same cabinet, please notice the interval and heat dissipation.	Failing to observe these instructions could result in machine damage and personal injuries.
Restart machine after debugging and fully confirming the safety When equipment failure occurs.	If the cause of alarm error is not ruled out, there is a risk of injury.
Please cut off the driver power when failures occur.	Continuous large current may cause fire.

⚠ Caution	
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 electric shock and personal injuries.
The trial operation of the servo motor should be carried out when the motor is not connected with the mechanical drive shaft	Failing to observe these instructions could result in personal 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 repair or maintain the product by non-professionals.	Failing to observe these instructions could result in machine damage and personal injuries.
Please cut the power off for long time nonuse.	Failing to observe these instructions could result in personal injuries.
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.	Failing to observe these instructions could result in personal injuries.

2

Specifications

*Specifications of servo system

2 Specifications

2.1 Nameplate Explanation of Servo Driver and Motor

Designation Rule of Servo

CTSD A4N-B4015-M200

CTSD	COTRUST Drives
A3S	Standard servo driver
A3N	Bus servo driver
A4S	Standard servo driver
A4N	Bus servo driver
A	Voltage:380VAC
B	220VAC
401	Rated power:40X10^{1}(W)
00	Supplemental identification
0	Support Modbus
1	Support Modbus and CAN
2	Support Modbus and EtherCAT
M	Adapt to M-type motor
2	2500 PPR encoder
4	Rotary encoder (reserved)
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
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
2	2500 PPR encoder
4	Rotary encoder (reserved)
5	military spec plug 17-bit absolute encoder
7	AMP 17-bit absolute encoder
9	2500 PPR magnetic encoder
A	17 bit magnetic encoder

2.2 Combination of the Driver and Motor

Configuration table of servo driver and motor combination

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	A4N-B1012-M200	A	M14-B1012-M106 M14-B1012-M116	40	3000
		A4N-B1015-M200	A	M14-B1017-M106 M14-B1017-M116	40	3000
0.2		A4N-B2012-M200	A	M16-B2012-M100 M16-B2012-M110	60	3000
		A4N-B2015-M200	A	M16-B2017-M100 M16-B2017-M110	60	3000
0.4		A4N-B4012-M200	A	M16-B4012-M100 M16-B4012-M110	60	3000
		A4N-B4015-M200	A	M16-B4017-M100 M16-B4017-M110	60	3000
0.75		A4N-B7512-M200	A	M18-B7512-M100 M18-B7512-M110	80	3000
		A4N-B7515-M200	A	M18-B7517-M100 M18-B7517-M110	80	3000
1.0		A4N-B1022-M200	A	M18-B1022-M100 M18-B1022-M110	80	2500
		A4N-B1025-M200	A	M18-B1027-M100 M18-B1027-M110	80	2500
		A4N-B1022-M201	A	M2D-B1022-M200 M2D-B1022-M210	130	2500
		A4N-B1025-M201	A	M2D-B1025-M200 M2D-B1025-M210	130	2500
1.5		A4N-B1522-M200	C	M2D-B1522-M200 M2D-B1522-M210	130 (6N.M)	2500
		A4N-B1525-M200	C	M2D-B1525-M200 M2D-B1525-M210	130 (6N.M)	2500
		A4N-B1522-M201	C	M2D-B1522-M201 M2D-B1522-M211	130 (10N.M)	1500
		A4N-B1525-M201	C	M2D-B1525-M201 M2D-B1525-M211	130 (10N.M)	1500

Power consumption (kW)	Power	Order No. of driver CTSD ***-*****-****	Driver SIZE	Order No. of motor CTSD ***-*****-****	Flange	Rated speed (rpm)
2.0	Single-phase /three-phase AC 220V	A4N-B2022-M200	C	M2D-B2022-M200 M2D-B2022-M210	130	2500
		A4N-B2025-M200	C	M2D-B2025-M200 M2D-B2025-M210	130	2500
2.3		A4N-B2322-M200	C	M2D-B2322-M200 M2D-B2322-M210	130	1500
		A4N-B2325-M200	C	M2D-B2325-M200 M2D-B2325-M210	130	1500
3.0		A4N-B3022-M200	C	M2D-B3022-M200 M2D-B3022-M210	130	2500
		A4N-B3025-M200	C	M2D-B3025-M200 M2D-B3025-M210	130	2500
1.5	Three-phase AC 380V	A4N-A1525-M201	C	M2D-A1525-M201	130	1500
2.3		A4N-A2325-M200	C	M2D-A2325-M200	130	1500
3.0		A4N-A3022-M200	C	M3I-A3023-M200 M3I-A3023-M210	180	1500
		A4N-A3025-M200	C	M3I-A3025-M200 M3I-A3025-M210	180	1500
4.5		A4N-A4522-M200	E	M3I-A4523-M200 M3I-A4523-M210	180	1500
		A4N-A4525-M200	E	M3I-A4525-M200 M3I-A4525-M210	180	1500
5.5		A4N-A5522-M200	E	M3I-A5523-M200 M3I-A5523-M210	180	1500
		A4N-A5525-M200	E	M3I-A5525-M200 M3I-A5525-M210	180	1500
7.5		A4N-A7525-M200	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	2500 PPR 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 (30 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 specifications	**Note：Size-A 0.1kW~1.0kW；Size-C 1.5kW~3.0kW；Size-E 4.5kW~7.5kW**			
	Dimension（W×H×D）		Size-A	50x160x173 mm
			Size-C	90x160x183 mm
			Size-E	100x250x230 mm
	Input power	Control power	Size-A	Single-phase AC220V±10%, 50/60Hz
			Size-C	Single-phase AC220V±10%, 50/60Hz Single-phase AC380V±10%, 50/60Hz
			Size-E	Single-phase AC380V±10%, 50/60Hz
		Main power	Size-A	Single-phase / Three-phase AC220V±10%, 50/60Hz
			Size-C	Single-phase / Three-phase AC220V±10%, 50/60Hz Three-phase AC380V±10%, 50/60Hz
			Size-E	Three-phase AC380V±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 EtherCAT protocol.
	Isolation			Power/communication, encoder input and digital input/output isolated.
	Built-in brake resistance		Size-A	No built-in brake resistor（100W~400W）；50Ω，50W（750W~1.0kW）
			Size-C	100Ω，80W
			Size-E	40Ω，100W
	Common DC bus			Support the function of common DC bus driver output interface.
	Protection			Overvoltage, undervoltage, overcurrent, overload, overheating, overspeed, communication abnormity, register abnormity, encoder error, 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 parameters
	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±10%：0%
		Temperature variation	25±25℃: below ±0.1%
	Digital input (6)		Positive/negative direction limit, latch and origin signal etc. The pin function can be configured by software to input effective logic level.
	Digital output (3)		Servo ready, alarm output, brake release, command completion output, positioning completion output, speed arrival, torque limit arrival, etc.
	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
	EtherCAT communication	Support services	CoE(PDO、SDO)
		Synchronization mode	DC distributed clock
		Baud rate	100Mbit/s（100base-TX）
	Soft start/stop		Able to set 0~10s/1000rpm ACC and DEC
	The acceleration and subtraction of the S-curve		The acceleration and deceleration time of S curve can be set in PP and PV mode.
	Homing function		Speed, acceleration and origin reset method can be specified, supporting 21 kinds of Homing. Mode.
	Probe		With the latch signal of high-speed digital input position as the event trigger signal, the current axis position can

			be stored for the parameterized event along the valid axis, and the position data will be stored by the control system immediately, and there will be no missed trigger due to delay.
	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.
	Absolute value multi turn data reset		Reset by PC software or buttons on panel
	Whether the optional parameters are stored in 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		Internal oscilloscope, PC in Windows application software, can monitor operating parameters, such as speed, position, current, etc.
Position control mode	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‰)
	Positioning error setting		0~32767 instruction units(set resolution as 1 unit)
	Electronic gear ratio	N	1~10000(2500-PPR photoelectric encoder); 1~65535(17-bit bus encoder) 1/200<N/M<200
		M	
Torque / Speed control mode	Command control method		Speed control mode: 8 segment internal speed instruction / 32 segment communication register instruction. Torque control mode: 32communication register instructions.
	Instruction smoothing method		Speed control mode: Low-pass filtering, smoothing time constant 0~2500(x10us).
	Torque limit (Speed control mode)		Internal parameter

	Speed limit (Torque control mode)	
Working environment	Operating temperature	0°C～45°C
	Reservation temperature	-20°C～70°C
	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

2.5 Brake Resistance Specification

Servo driver	Built in resistance	Minimum value of external braking resistance (Unit: Ω)
Size-A 0.75kW~1.0kW	50Ω、Ω50W	50
Size-C（220V）1.5kW~3.0kW	100Ω、80W	25
Size-C（380V）1.5kW~3.0kW	100Ω、80W	30
Size-E 4.5kW~7.5kW	40Ω、100W	15

3

Installation

*Installation of drive 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.
- The servo drive must be installed in the specified direction and interval, and maintain good heat dissipation 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 Drive

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
Atmospheric Environment	No corrosive gas, flammable gas, oil mist or dust, etc.

3.3 Mounting Dimensions of Driver

A4N servo driver enjoys backplane installation, which means the installation direction is perpendicular.

The dimensions(unit: mm) of A4N servo drivers show as figure 3-1, 3-2 and 3-3:

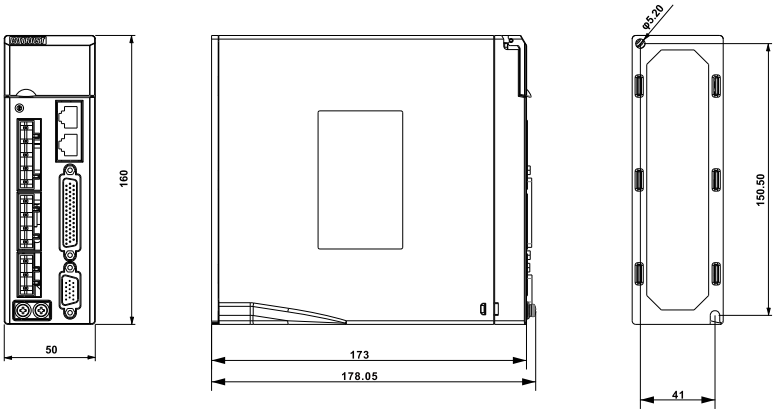


Fig 3-1 Size-A（100W~1.0kW）Installation of Servo Drive Backplane

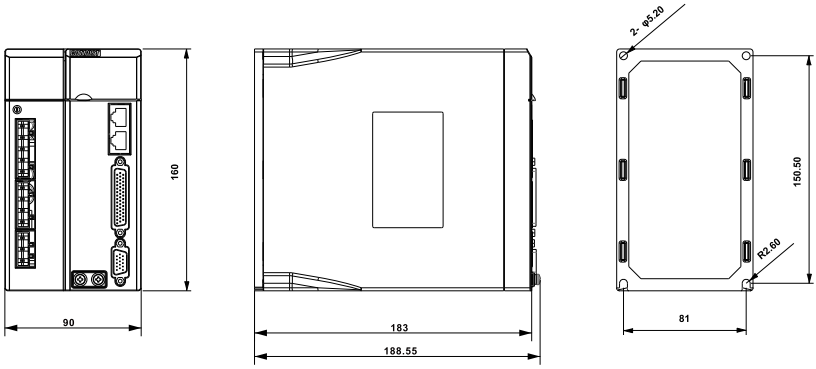


Fig 3-2 Size-C（1.5kW~3.0kW）Installation of Servo Drive Backplane

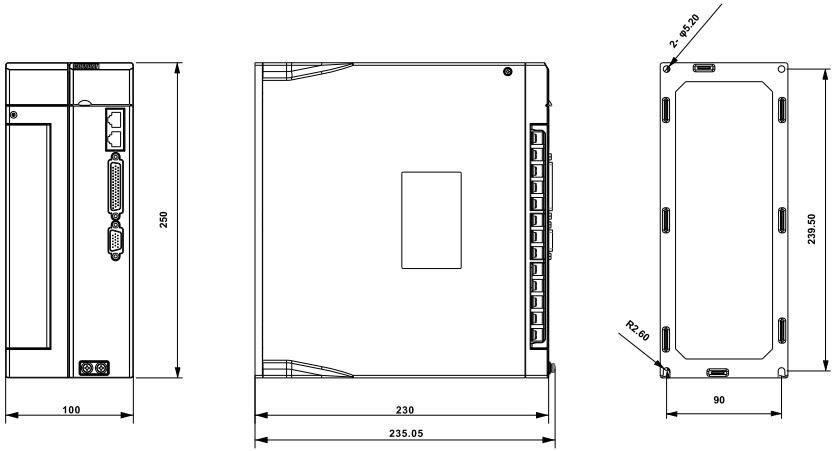


Fig 3-3 Size-E（4.5kW~7.5kW）Installation of Servo Drive Backplane

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.

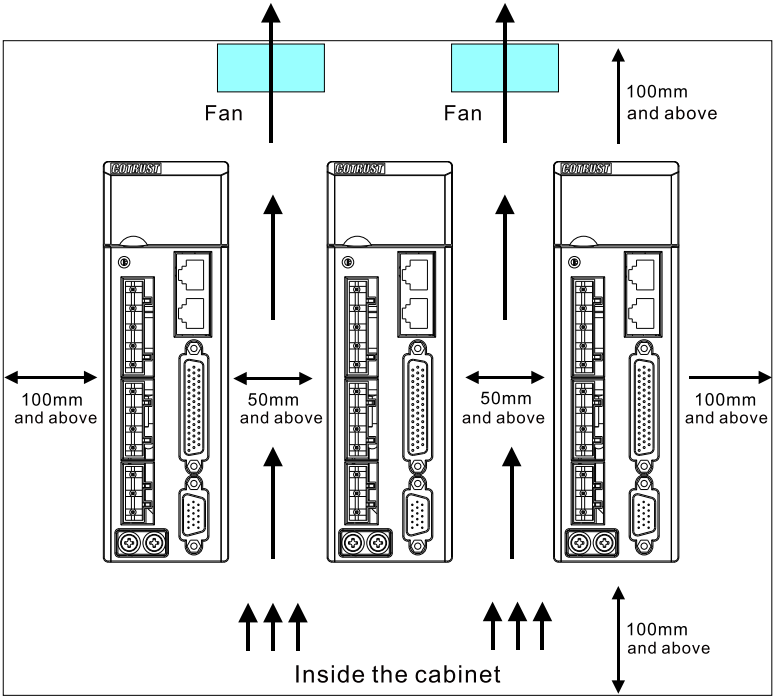


Fig 3-4 Interval between multiple servo drivers installed

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.

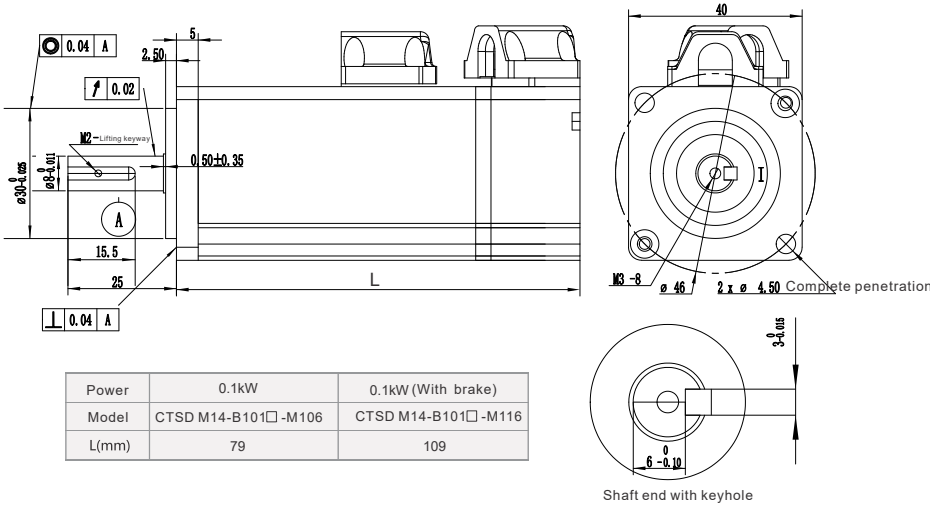
3.6 Installation of Motor

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.

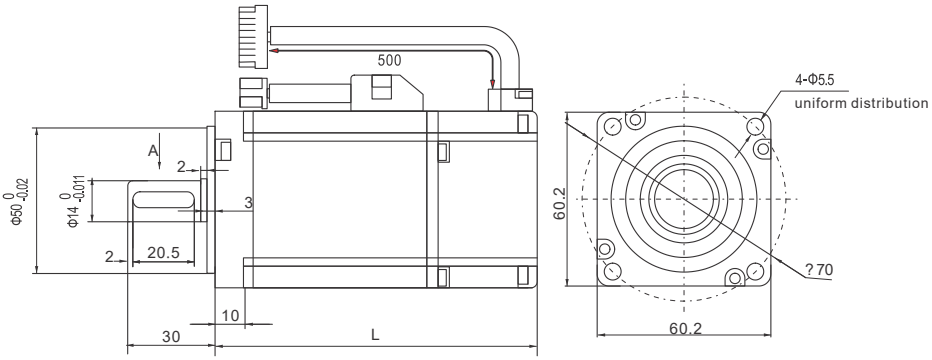
2 Dimensions

A4N servo motors can be mounted vertically or horizontally, the dimension of motors shows as figure 3-5 to figure 3-11.



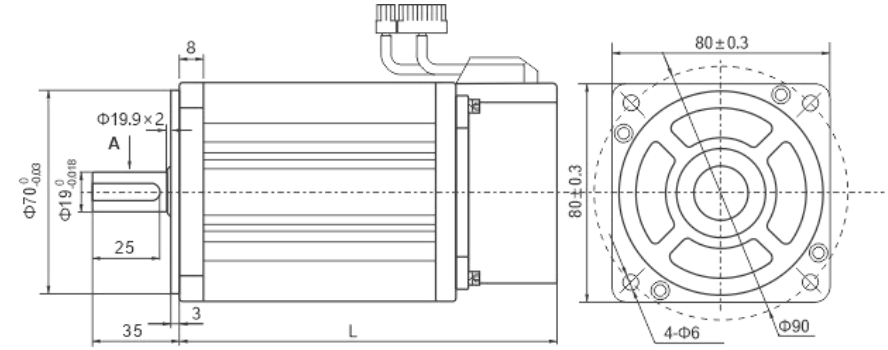
Power	0.1kW	0.1kW (With brake)
Model	CTSD M14-B101□ -M106	CTSD M14-B101□ -M116
L(mm)	79	109

Fig 3-5 Motor dimension of 0.1kW



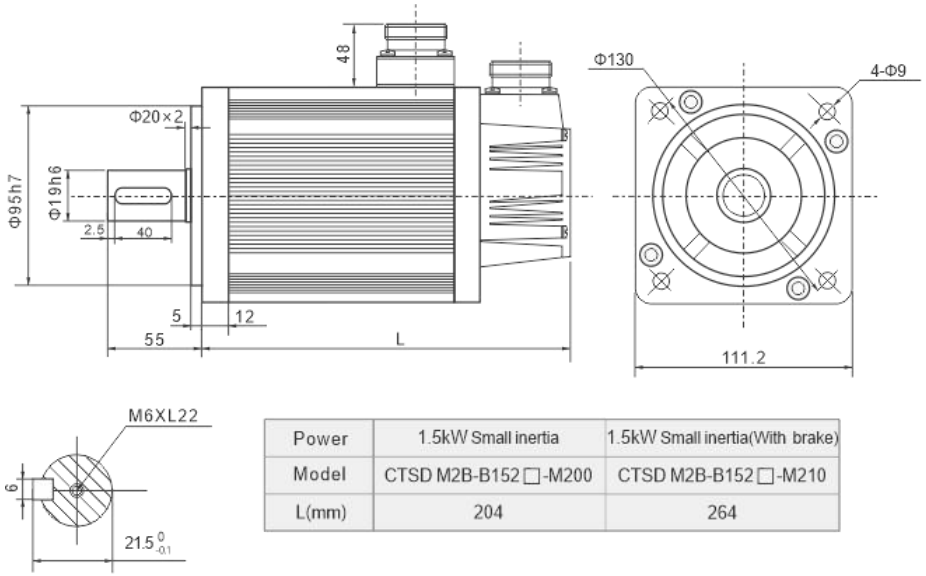
Power	0.2kW	0.4kW
Model	CTSD M16-B201□-M100	CTSD M16-B401□-M100
L(mm)	116	141
Power	0.2kW(With brake)	0.4kW(With brake)
Model	CTSD M16-B201□-M110	CTSD M16-B401□-M110
L(mm)	160	185

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



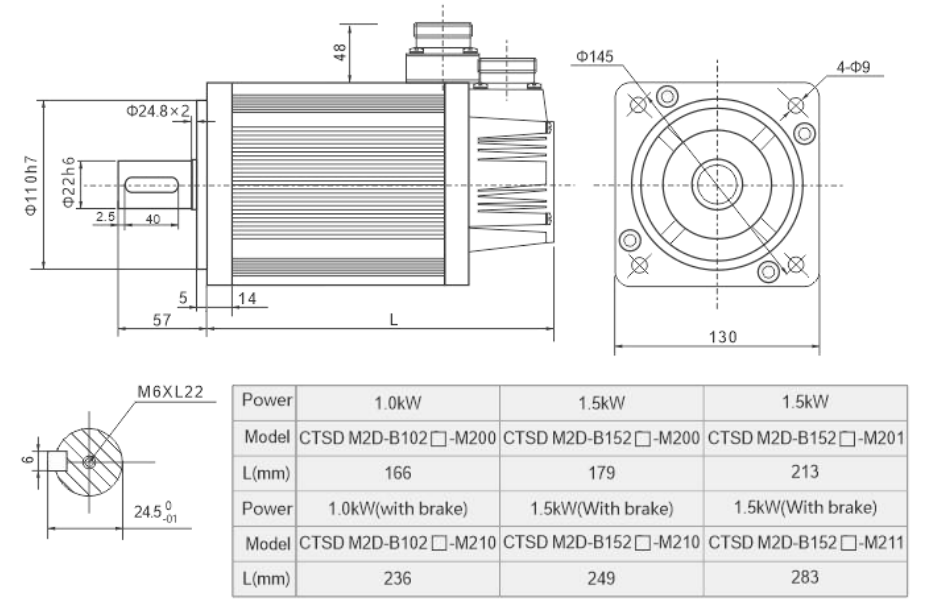
Power	0.75kW	1.0kW Small inertia
Model	CTSD M18-B751□-M100	CTSD M18-B102□-M100
L(mm)	151	191
Power	0.75kW(With brake)	1.0kW Small inertia(With brake)
Model	CTSD M18-B751□-M110	CTSD M18-B102□-M110
L(mm)	205	245

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



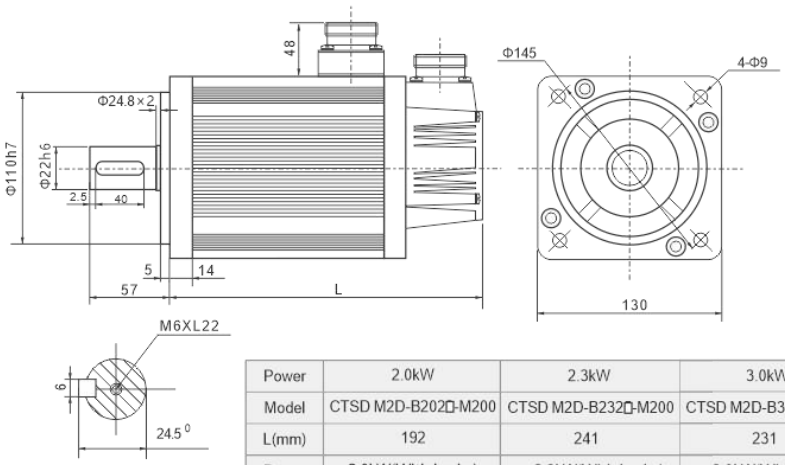
Power	1.5kW Small inertia	1.5kW Small inertia(With brake)
Model	CTSD M2B-B152□-M200	CTSD M2B-B152□-M210
L(mm)	204	264

Fig 3-8 Motor dimension of 1.5kW



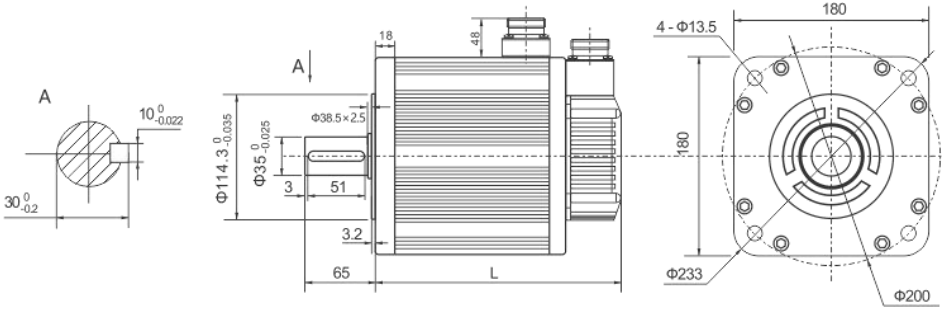
Power	1.0kW	1.5kW	1.5kW
Model	CTSD M2D-B102□-M200	CTSD M2D-B152□-M200	CTSD M2D-B152□-M201
L(mm)	166	179	213
Power	1.0kW(with brake)	1.5kW(With brake)	1.5kW(With brake)
Model	CTSD M2D-B102□-M210	CTSD M2D-B152□-M210	CTSD M2D-B152□-M211
L(mm)	236	249	283

Fig 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

Fig 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)	5.5kW(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

Fig 3-11 Motor dimension of 3.0kW/4.5kW/5.5kW/7.5kW

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·m2
M14-B1012-M106	0.1	220	3000	40	0.318	1.1	0.954	20.5	4	0.046×10^{-4}
※M14-B1012-M116										
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-A3023-M200	3.0	380	1500	180	19	7.5	38	97	4	3.8×10^{-3}
※M3I-A3023-M210										
M3I-A4523-M200	4.5	380	1500	180	27	10	67	103	4	6.1×10^{-3}
※M3I-A4523-M210										
M3I-A5523-M200	5.5	380	1500	180	35	12	70	90	4	8.6×10^{-3}
※M3I-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-M106	0.1	220	3000	40	0.318	1.1	0.954	20.5	4	0.046×10^{-4}
※M14-B1017-M116										
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	7.7	7.5	15.4	68	4	1.53×10^{-3}
※M2D-B2025-M210										
M2D-B2325-M200	2.3	220	1500	130	15	9.5	30	114	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	97	4	3.8×10^{-3}
※M3I-A3025-M210										
M3I-A4525-M200	4.5	380	1500	180	27	10	67	103	4	6.1×10^{-3}
※M3I-A4525-M210										
M3I-A5525-M200	5.5	380	1500	180	35	12	70	90	4	8.6×10^{-3}
※M3I-A5525-M210										
M3I-A7525-M200	7.5	380	1500	180	48	20	96	94	4	9.5×10^{-3}
※M3I-A7525-M210										

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

4

Wiring

*Servo wiring

4 Wiring

⚠ Only professional personnel can conduct wiring or inspection, and must be conducted within 15 minutes after power failure to avoid electric shock.

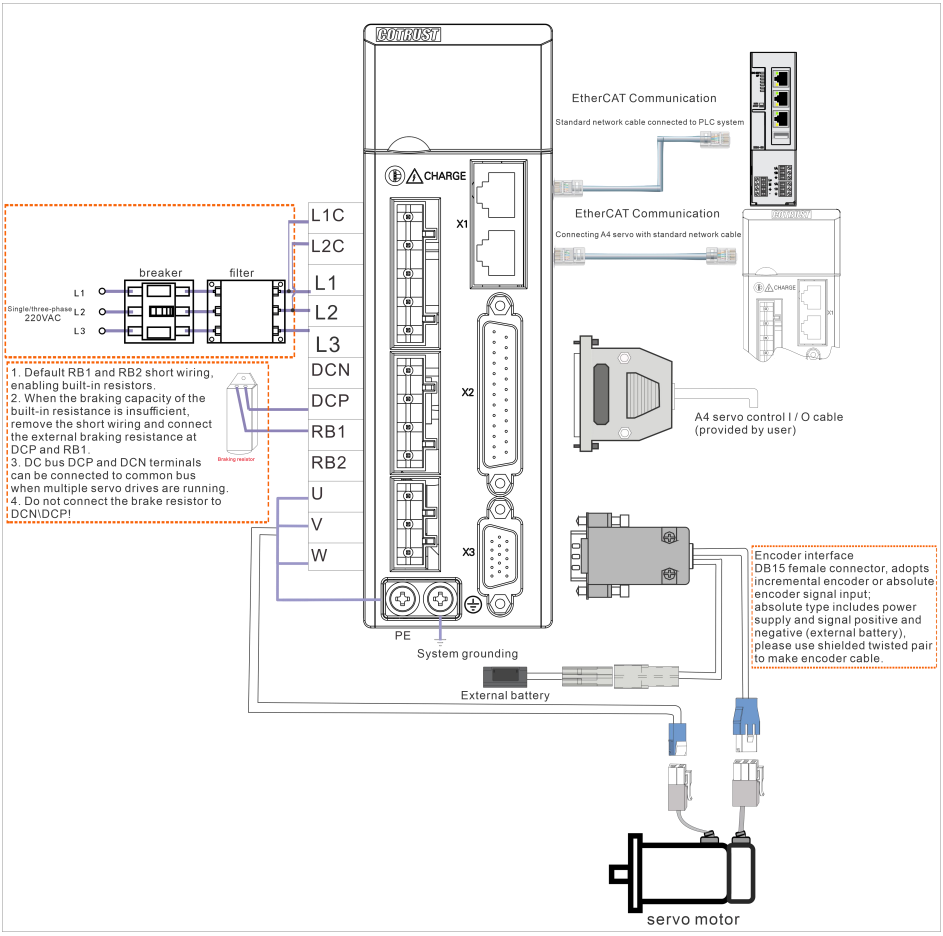


Fig 4-1 Schematic diagram of external port of size-A servo driver

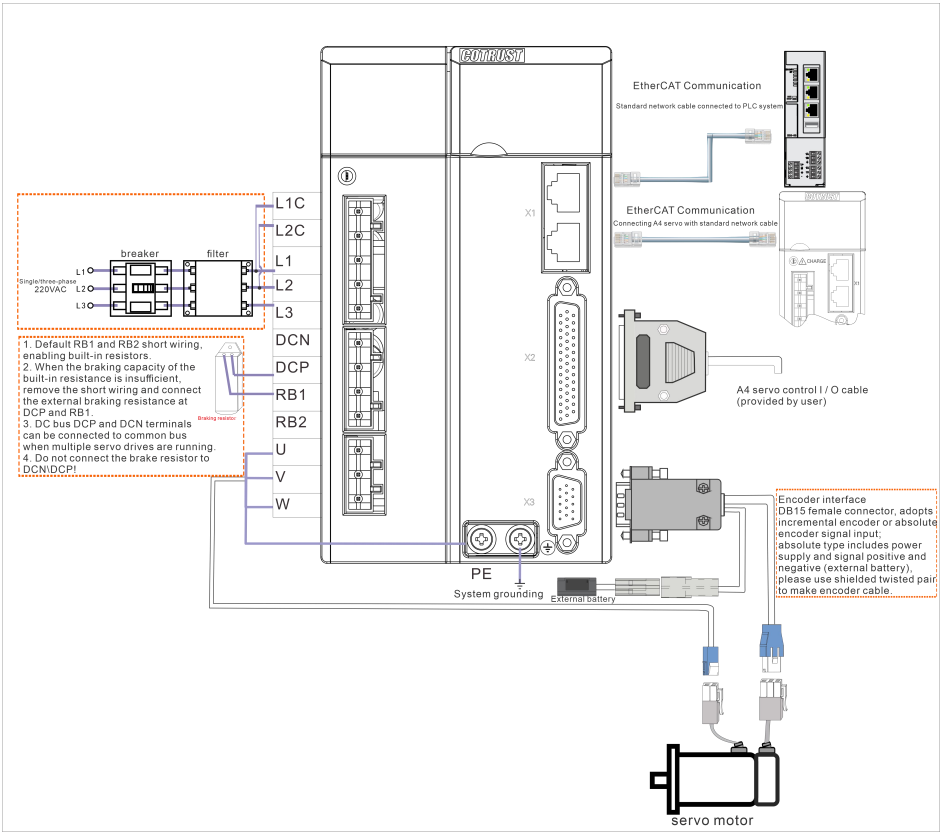


Fig 4-2 Schematic diagram of external port of size-C (220V) servo driver

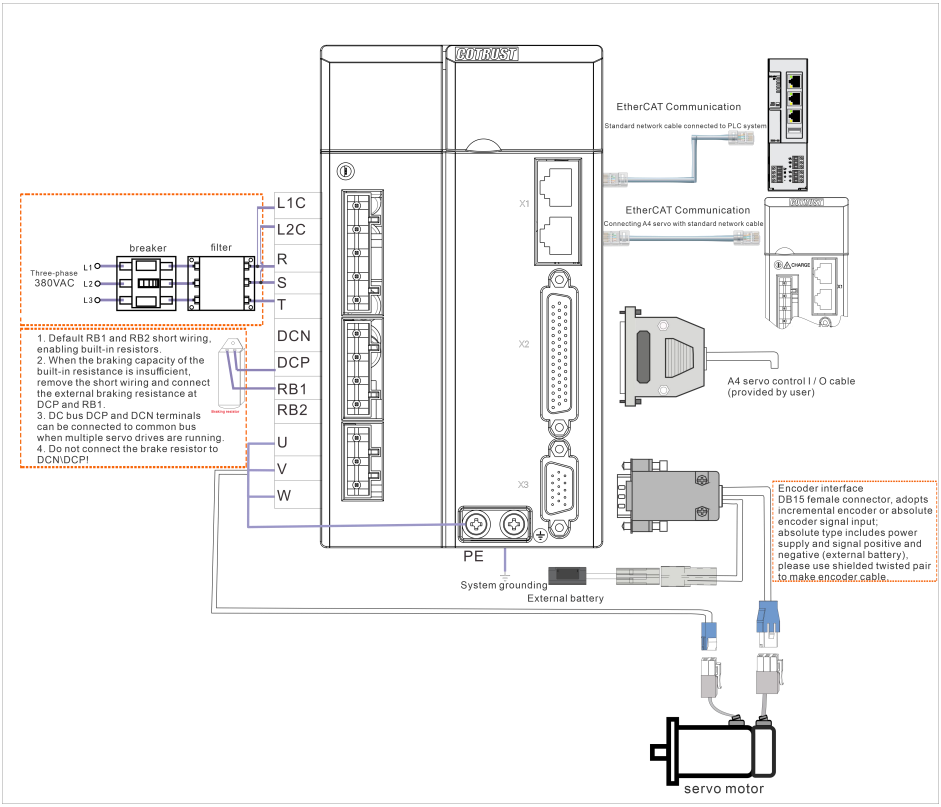


Fig 4-3 Schematic diagram of external port of size-C (380V) servo driver

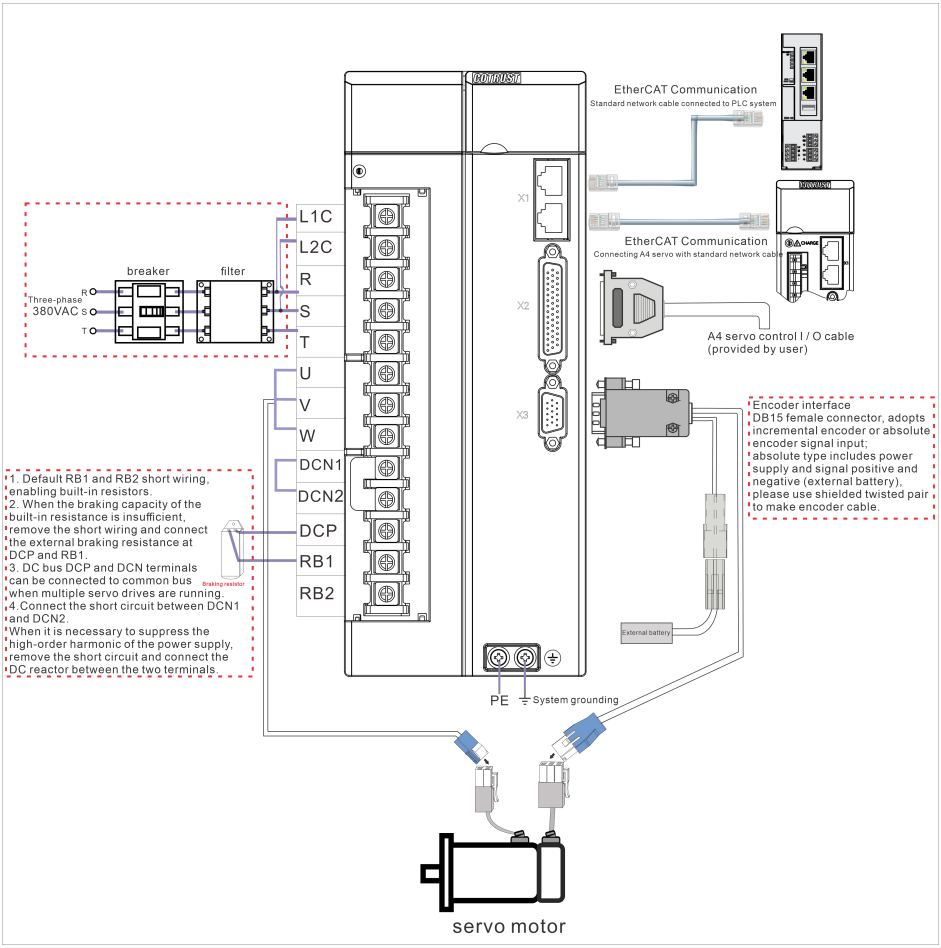
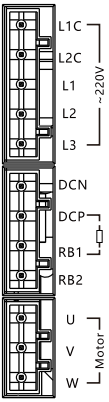


Fig 4-4 Schematic diagram of external port of size-E servo driver

4.1 Control Power Terminals

Size-A/C (220V) servo driver control power input interface

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. 4 Size-A 100W~400W specification servo without built-in braking resistor.
	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 connect short wires to DCP and RB1/RB2 when the built-in resistor is enabled, otherwise it will damage the drive.
- Do not short connect DCN and DCP, or the driver would be damaged.

Recommended drive peripherals list specifications:

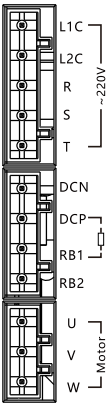
Diameter of main power cable: 1.5kW and below: ≥1mm^2/AWG17, recommend 1.6mm^2/AWG15

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

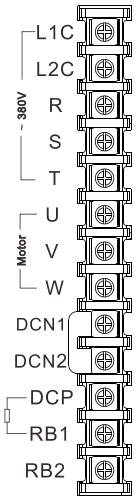
Noise filter: single/three phase power filter

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

Size-C (380V) servo driver control power input interface

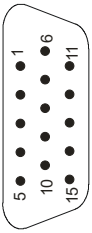
<table>
<tr><th>Terminal</th><th>Sign</th><th>Name</th><th>Description</th></tr>
<tr><td rowspan="10"> 
</td><td>L1C</td><td rowspan="2">Single-phase power input of control circuit</td><td rowspan="3">Size-C(380V): Mark ~380V</td></tr>
<tr><td>L2C</td></tr>
<tr><td>R</td><td rowspan="3">Three-phase power 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 drive peripherals list specifications:
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 power filter
Rated voltage: AC 380V, 50/60Hz</td></tr>
</table>

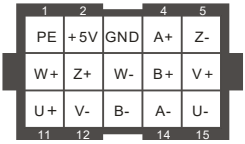
Size-E (380V) servo driver control power input interface

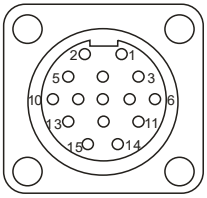
<table>
<tr><th>Terminal</th><th>Sign</th><th>Name</th><th>Description</th></tr>
<tr><td rowspan="11"> 
</td><td>L1C</td><td rowspan="2">Single-phase power input of control circuit</td><td rowspan="4">Size-E: mark ~380V</td></tr>
<tr><td>L2C</td></tr>
<tr><td>R</td><td rowspan="3">Three-phase power input of main circuit</td></tr>
<tr><td>S</td></tr>
<tr><td>T</td></tr>
<tr><td>U</td><td>U phase of motor</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.
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.</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>DCN1</td><td>DC bus negative 1</td></tr>
<tr><td>DCN2</td><td>DC bus negative 2</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>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 Driver Peripheral List Specifications:
Main power wire thickness: ≥2mm2/AWG14, Recommend 2.6mm2/AWG13.
Noise filter: three-phase filter
Rated voltage: AC 380V, 50/60Hz</td></tr>
</table>

4.2 Encoder Signal Terminal X3

A4N series servo motor 2500-PPR incremental photoelectric encoder signal access, the specific wiring is shown in the following table:

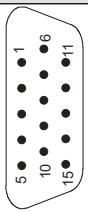
<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Connector Terminal</th><th rowspan="2">Servo</th><th colspan="2">Motor</th><th rowspan="2">Name</th></tr>
<tr><th>Small inertia</th><th>Medium and large inertia</th></tr>
<tr><td rowspan="16">X3</td><td rowspan="16"> 

Servo
 

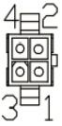
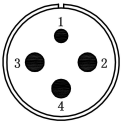
Motor(small inertia)
 

Motor(middle inertia)）</td><td>1</td><td>10</td><td>11</td><td>Hall signal V+</td></tr>
<tr><td>2</td><td>6</td><td>12</td><td>Hall signal W+</td></tr>
<tr><td>3</td><td>7</td><td>6</td><td>Encoder signal Z+</td></tr>
<tr><td>4</td><td>4</td><td>4</td><td>Encoder signal A+</td></tr>
<tr><td>5</td><td>9</td><td>5</td><td>Encoder signal B+</td></tr>
<tr><td>6</td><td>12</td><td>14</td><td>Hall signal V-</td></tr>
<tr><td>7</td><td>8</td><td>15</td><td>Hall signal W-</td></tr>
<tr><td>8</td><td>5</td><td>9</td><td>Encoder signal Z-</td></tr>
<tr><td>9</td><td>14</td><td>7</td><td>Encoder signal A-</td></tr>
<tr><td>10</td><td>13</td><td>8</td><td>Encoder signal B-</td></tr>
<tr><td>11</td><td>11</td><td>10</td><td>Hall signal U+</td></tr>
<tr><td>12</td><td>15</td><td>13</td><td>Hall signal U-</td></tr>
<tr><td>13</td><td colspan="2">2</td><td>+5V power supply</td></tr>
<tr><td>14</td><td colspan="2">3</td><td>Power ground</td></tr>
<tr><td>15</td><td colspan="2">-</td><td>-</td></tr>
<tr><td>Shell</td><td colspan="2">1</td><td>PE ground(Shielding layer)</td></tr>
<tr><td>⚠
Caution</td><td colspan="5">• Do not short connect encoder PE ground wire with its signal wire, otherwise it may cause interference to servo and motor.</td></tr>
</table>

The definition of encoder signal access of A4N series servo motor bus incremental / absolute encoder motor:

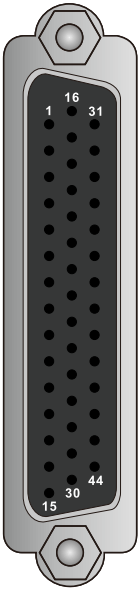
No.	Connector Terminal	Servo	Motor		Name
			Incremental	Absolute	
X3	 Servo  Motor(small inertia)  Motor(middle inertia)	1	6		SD signal+
		2	-		-
		3	-		-
		4	-		-
		5	-	3	Battery BAT+
		6	4		SD signal--
		7	-		-
		8	-		-
		9	-		-
		10	-	2	Battery BAT-
		11	-		-
		12	-		-
		13	7		+5V power supply
		14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

Definition of motor power wiring:

Type of motor	Pin number	Pin signal definition
 40/60/80 Flange Motor	1	W
	2	V
	3	U
	4	PE
 110/130/180 Flange Motor	1	PE
	2	U
	3	V
	4	W

4.3 Control Signal Terminal X2

PIN definition of A4N series servo control signal terminal

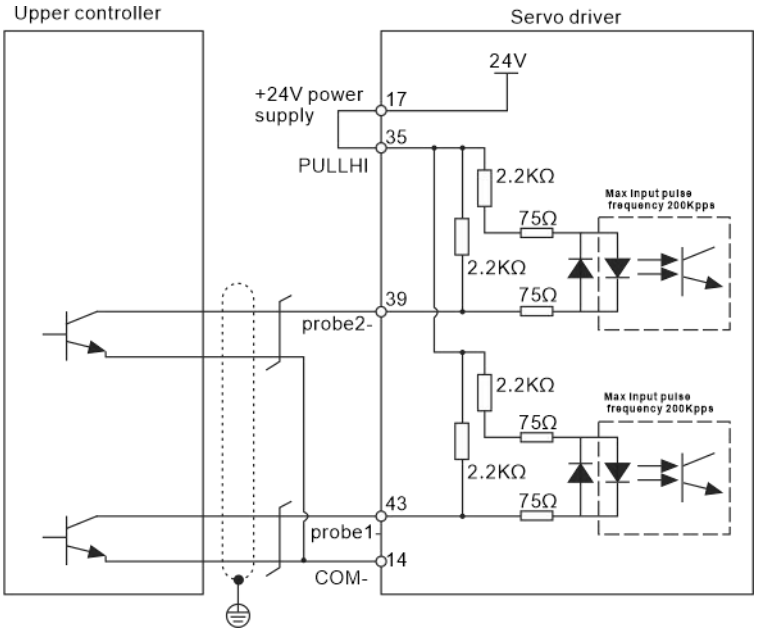
Terminal	PIN	Name	Definition	PIN	Name	Definition
	1	-	-	23	PBO-	Encoder B pulse frequency division output -
	2	DO3-	Digital output 3-	24	PZO-	Encoder Z pulse frequency division output -
	3	DO3+	Digital output 3+	25	PBO+	Encoder B pulse frequency division output +
	4	DO2-	Digital output 2-	26	-	-
	5	DO2+	Digital output 2+	27	-	-
	6	DO1-	Digital output 1-	28	-	-
	7	DO1+	Digital output 1+	29	GND	Encoder Z pulse open collector output signal ground
	8	DI3	Digital input 3	30	-	-
	9	SRV-ON	Servo enable	31	-	-
	10	DI1	Digital input 1	32	DI5	Digital input 5
	11	COM	Digital input common terminal	33	DI4	Digital input 4
	12	-	-	34	DI2	Digital input 2
	13	PZO+	Encoder Z pulse frequency division output +	35	PULLHI	Command pulse power input
	14	COM-	Internal 24 V power supply 0 V	36	-	-
	15	-	-	37	Probe2+	Probe 2 +
	16	-	-	38	-	-

	17	+24V	Internal 24 V power supply 24 V	39	Probe2-	Probe 2 -
	18	-	-	40	-	-
	19	-	-	41	Probe1+	Probe 1 +
	20	-	-	42	-	-
	21	PAO+	Encoder A pulse frequency division output +	43	Probe1-	Probe 1 -
	22	PAO-	Encoder A pulse frequency division output -	44	PZ_OUT	Encoder Z-pulse open collector output

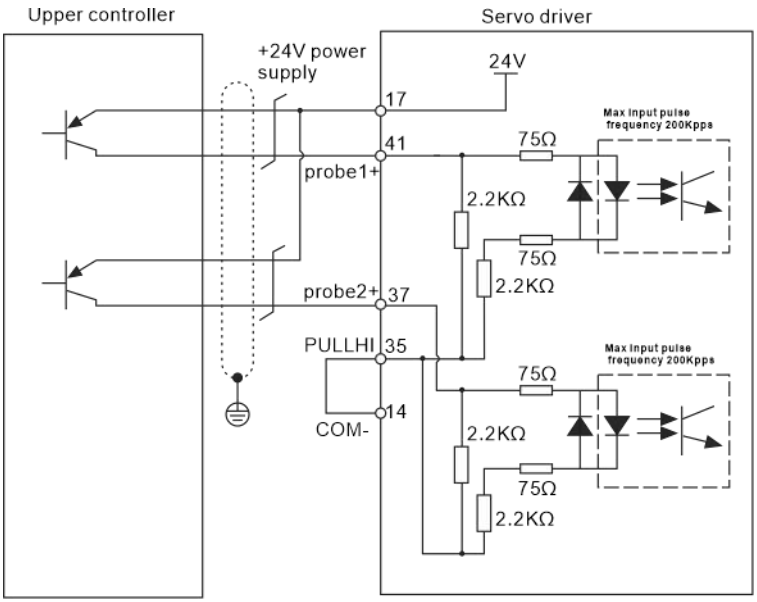
4.3.1 Probe input

1 Probe input method

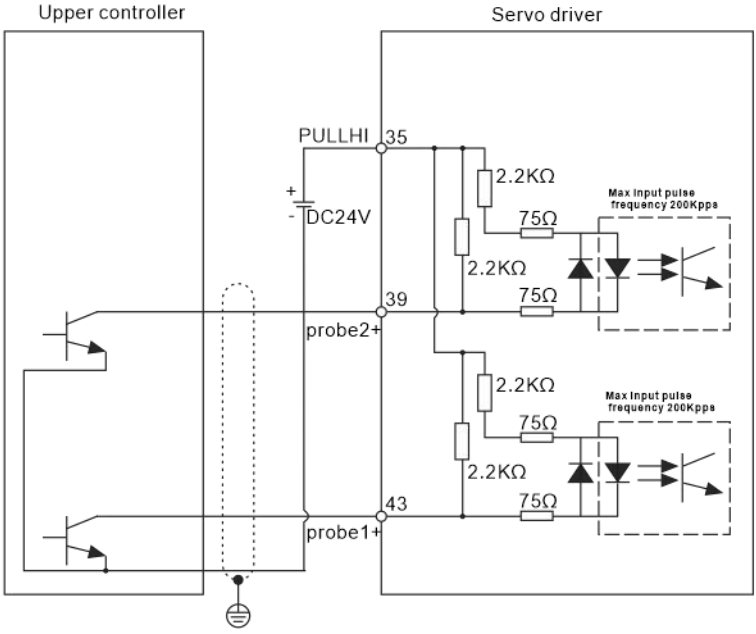
The upper device is an NPN open collector and uses an internal 24V power supply:



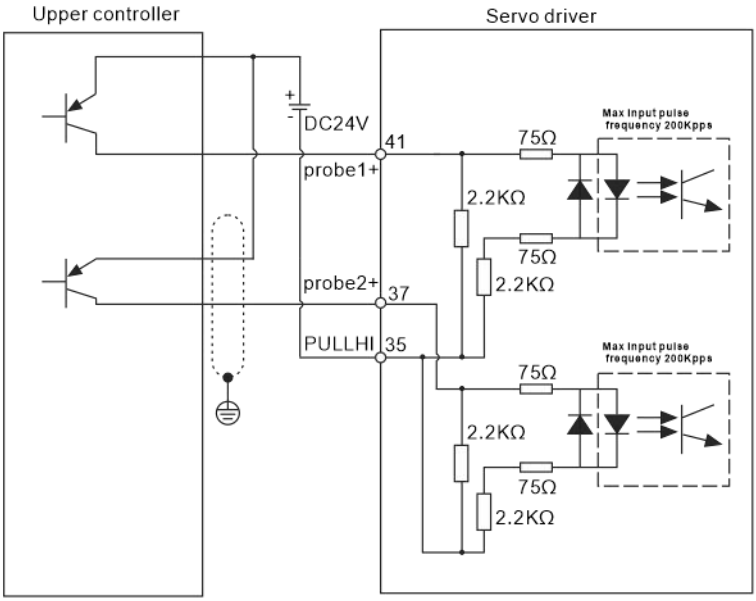
The upper device is PNP type open collector, using internal 24V power supply:



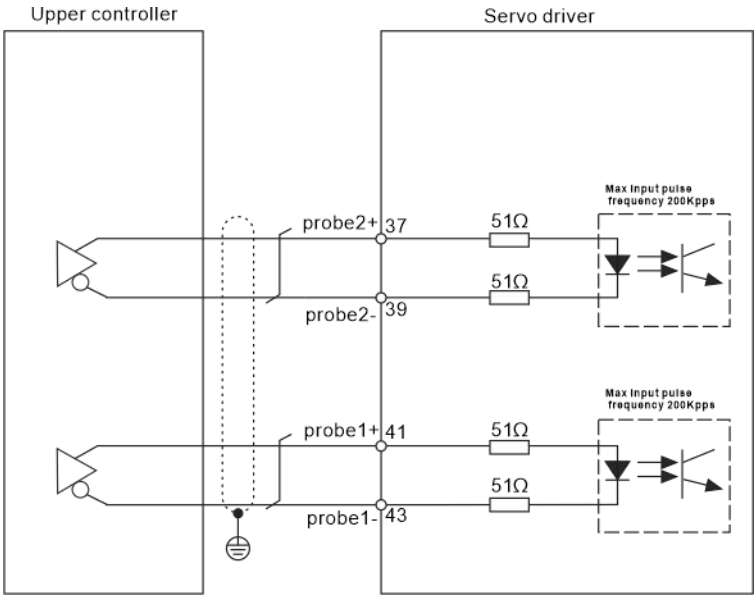
The upper device is NPN type open collector, using external 24V power supply:



The upper device is PNP type open collector, using an external 24V power supply:



2 Differential drive mode

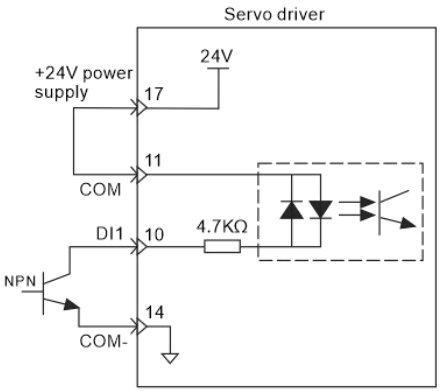


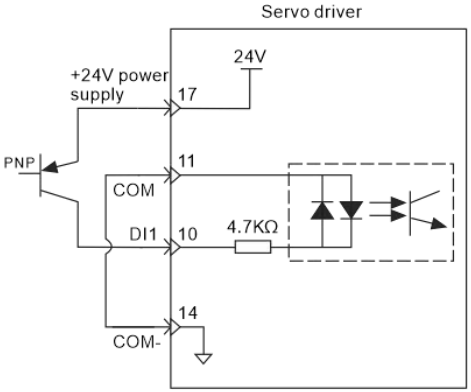
4.3.2 Digital Input and Output

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.

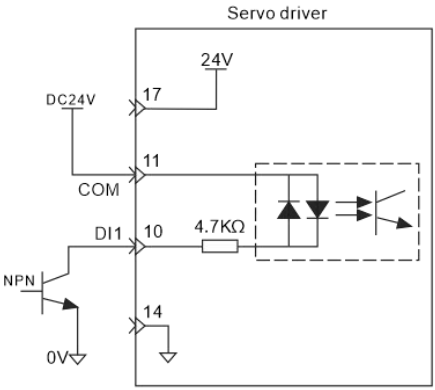
1. DI circuit

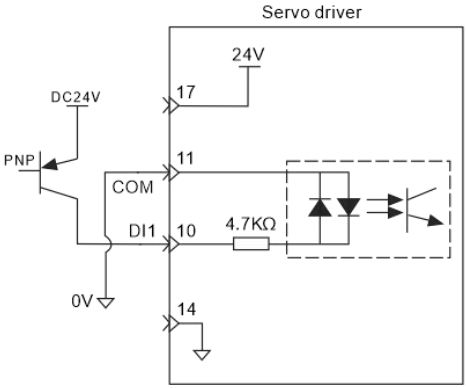
With internal 24V power:



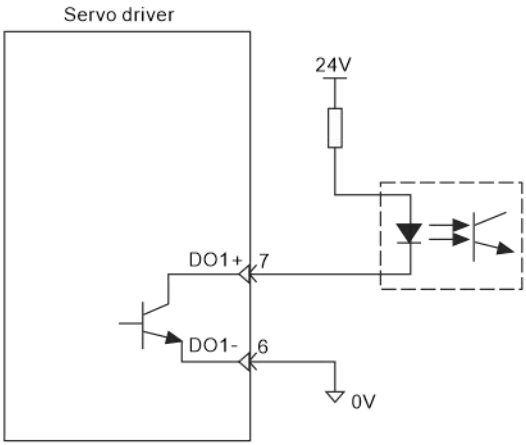


With external 24V power:





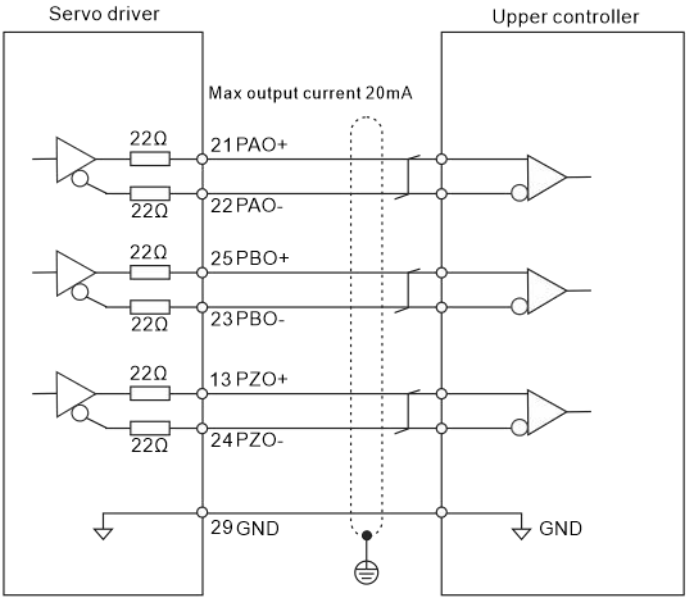
2. DO circuit(take DO1 as an example)



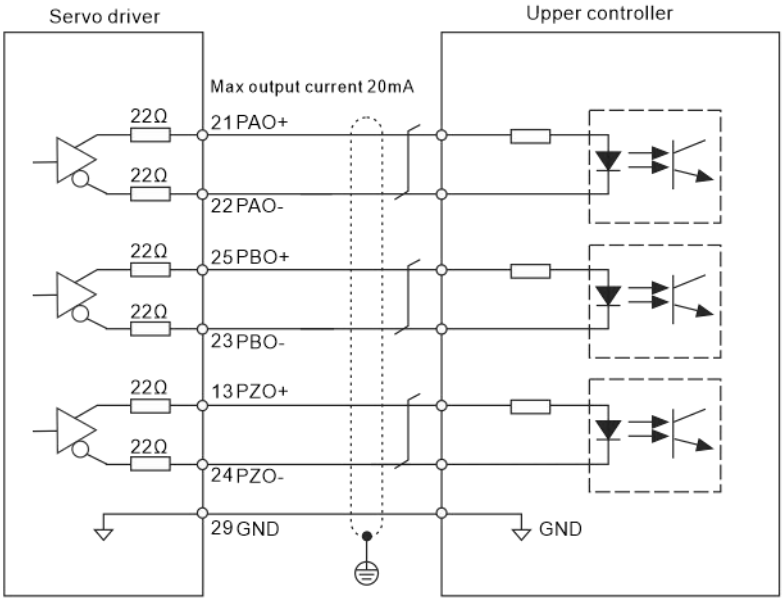
4.3.3 Encoder Frequency-division Output

The frequency division output circuit of the encoder outputs the differential signal through the differential driver, which provides the feedback signal for the position control system of the upper device. In the upper device, the differential or optocoupler receiving circuit is used to receive the signal, and the maximum output current is 20mA.

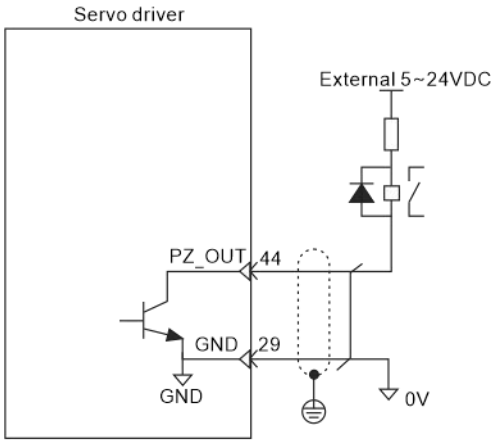
Signal received by differential circuit:



Signal received by optocoupler circuit:



The Z-phase pulse frequency division output circuit of encoder can output signal through open collector. The feedback signal is provided for the position control system of the upper device. Please use optical coupling circuit, relay circuit or bus receiving circuit to receive signal in upper device.



4.4 Communication Ports and Switch of Terminal Resistor

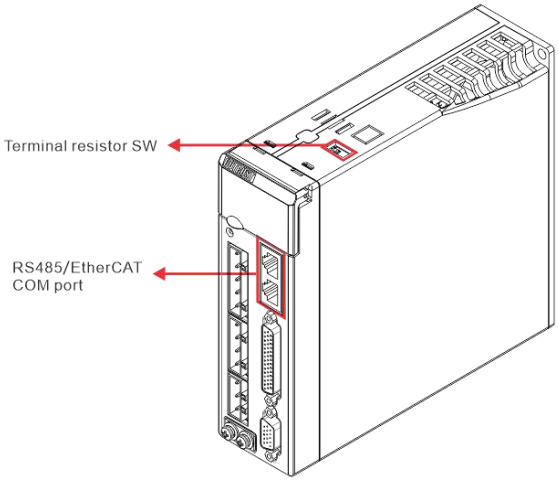
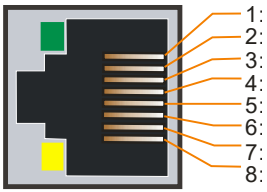


Fig 4-5 Communication interface and dial switch

A4N series servo uses RJ45 network port as communication interface, two Ethernet ports, top in and bottom out. Support EtherCAT and Modbus protocol, the pin definition is shown in the following table:

RJ45 Pin		name	description
	1	DP_PHY0_TX+	EtherCAT send signal +
	2	DP_PHY0_TX-	EtherCAT send signal -
	3	DP_PHY0_RX+	EtherCAT receive signal +
	4	RS485+	485 send signal +
	5	RS485-	485 send signal -
	6	DP_PHY0_RX-	EtherCAT receive signal -
	7	GND	485 ground wire
	8	NC	keep
Shielding layer		Shielding ground (EARTH)	Shielding ground (EARTH)

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.

Making network cable crystal head

Make the crystal head of the network cable according to the 568B standard, and lead out the green and white and green wires at the other end, which can be used as the EtherCAT communication input line (using twisted pair network cable for communication distance up to 100m); lead out the orange and white orange wires, which can be used as EtherCAT communication output line, as shown in the figure below:

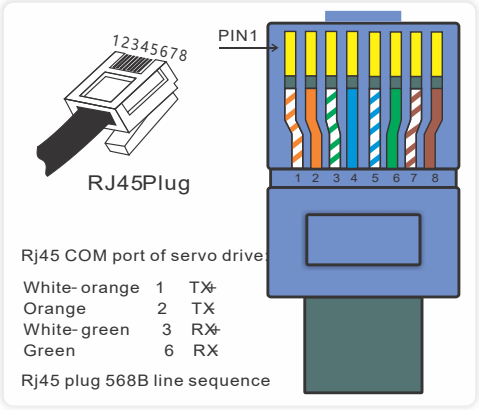
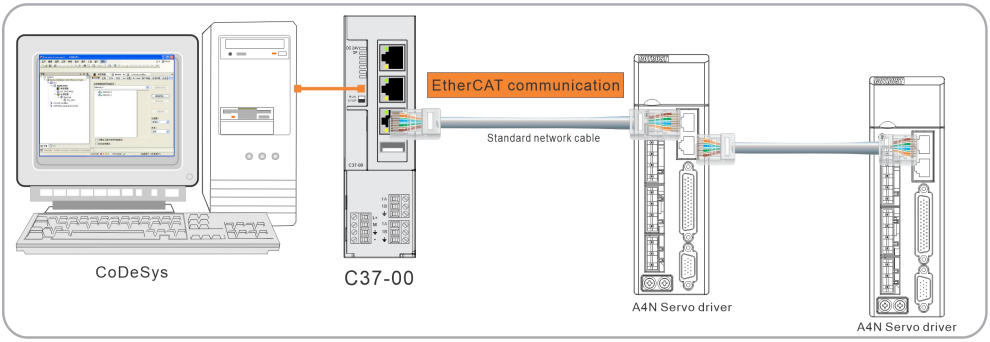


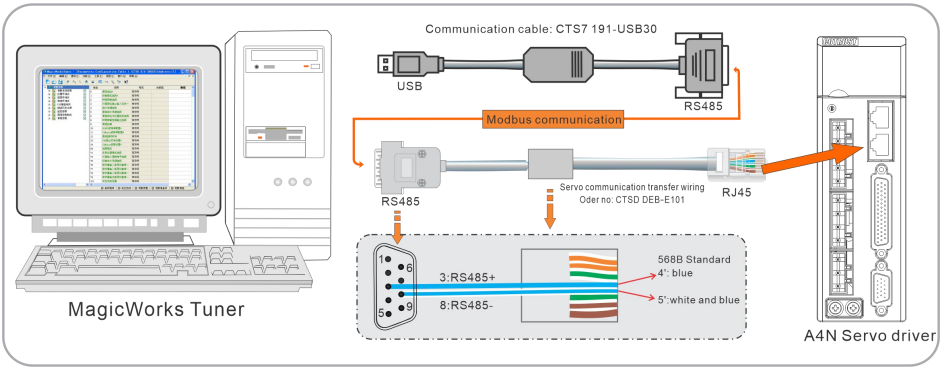
Fig 4-6 Making the communication line

PC connected to A4N servo

◆ Wiring of EtherCAT communication



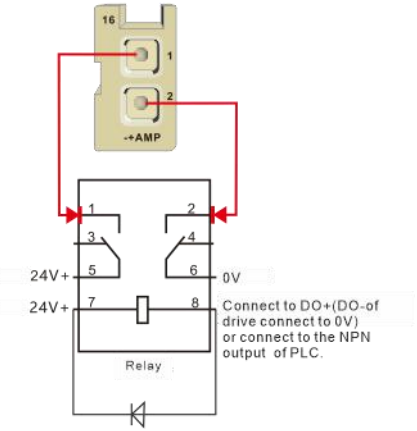
◆ Wiring of Modbus communication

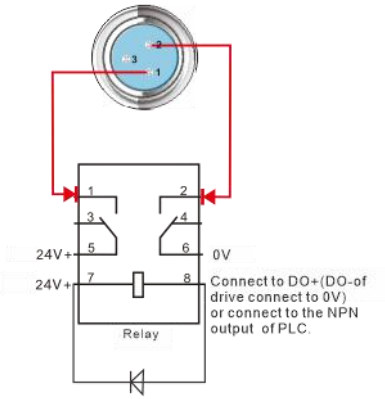


4.5 Wiring of Motor Brake

The default digital output of A4N servo drive does not have a brake output signal. If it is used with a brake motor, the user needs to configure the DOUT output as a brake output function.

Brake connection method of brake motor:

Motor specifications	Wiring
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 terminal of the brake through a relay (control terminal: DC24V, load capacity greater than or equal to 1A), and connect a Schottky diode in parallel to the control terminal of the relay (the recommended diode model is 1N4148, package: DO-35 glass package, plug-in), refer to 4 Wiring

5

Control Signal And Given Signal

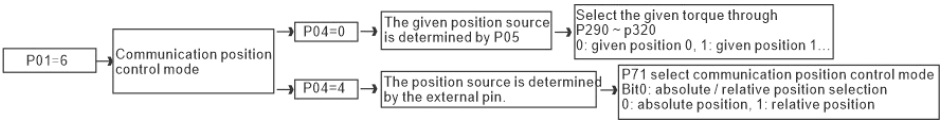
*I/O signal, communication and external command

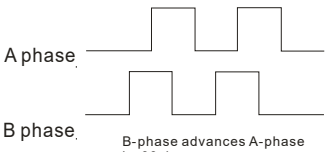
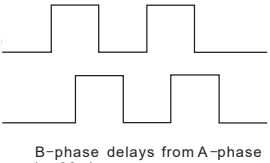
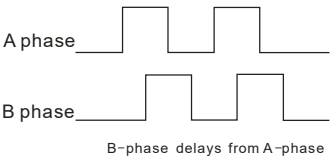
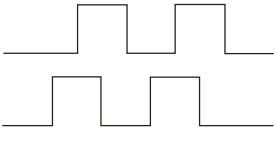
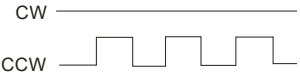
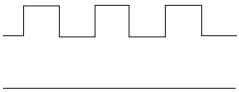
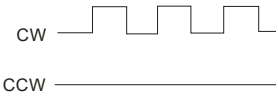
5 Control Signal And Given Signal

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

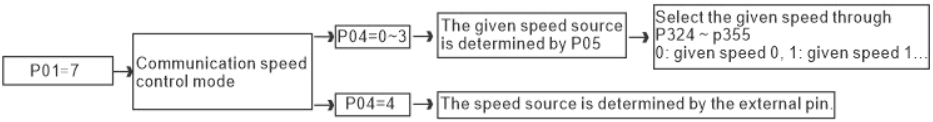
5.1 Given Instruction Source

◆ Communication position control mode:

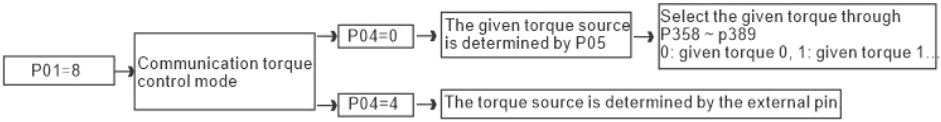


P81	P80	CCW	CW
2	0		
2	1		
1	0		
	1		

◆Communication speed control mode:



◆Communication torque control mode:



5.2 Control signal definition and multiplexing selection

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

5.2.1 Selection of DI multiplexing function

The selection of pin function allocation mode and control command source is determined by p73 parameter.

No.	Definition	Value	Definition of parameter		Remark
			Communication control	External control	
P73	Control command source selection	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 (Decide by P75/76/77/78)	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

DI default function				
PIN	**Name**	**Position mode**	**Speed mode**	**Torque mode**
9	SRV-ON	SRV-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		

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.

<table>
<tr><th colspan="5">Definition of digital input multiplexing function</th></tr>
<tr><th>Parameter</th><th>Bit No.</th><th>PIN</th><th>Name</th><th>Function code</th></tr>
<tr><td>P75</td><td>B0~B7</td><td>9</td><td>SRV_ON</td><td rowspan="3">16#00: No distribution
16#01: Alarm-clear
16#02: CCW overtravel inhibit signal
16#03: CW overtravel inhibit signal
16#04: Control mode switching
16#05: ZSPD(ST)/Pos LCK(P)
16#06: DIV(DiP)/M-CMD Startup(Cm)
(external position mode).
Multi-stage position/speed/torque command start signal (communication mode)
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.</td></tr>
<tr><td>P76</td><td>B0~B7</td><td>32</td><td>DIN5</td></tr>
<tr><td rowspan="2">P77</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">P78</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>

※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) An alarm will be generated by servo while multiple pins are assigned the 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	0

			communication on communication mode.	
	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 Selection of DO multiplexing function

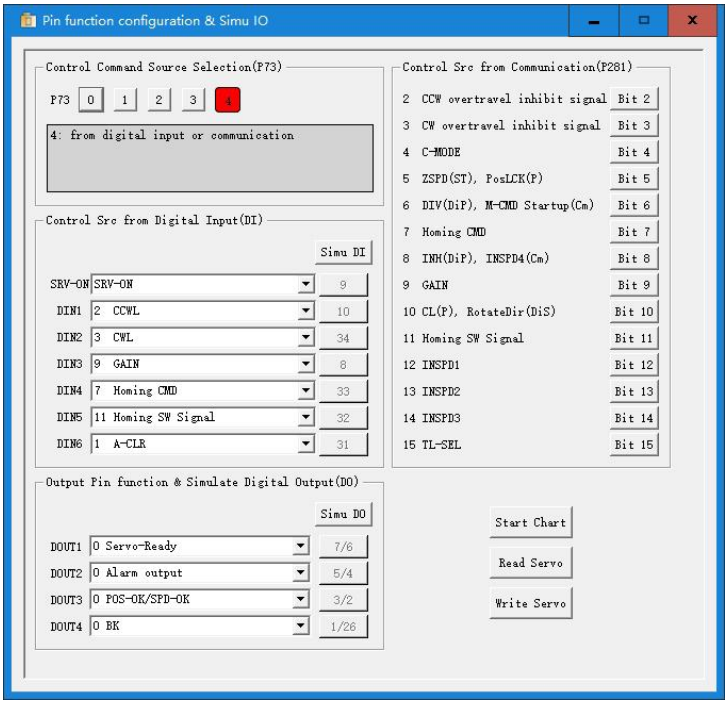
The DO PIN configurations in chapter above are factory default, you can also configure function of DOUT1~DOUT4 by software on PC or servo. Different from DI, the function of DO can just be set by P79, table below shows the function code of its Bit:

Parameter	PIN	Name	Default	Function
P7	6/7	DOUT1	12	0: Torque limit control 1: Zero speed detection 2: Any alarm (no alarm output conduction) 3: Discharge resistor overload alarm 4: Overload alarm 5: Speed consistent output 6: Back to the original completion outpu 7: reserved 8: reserved 9: Torque reach output 10: Brake output 11: Alarm output (with alarm output on) 12: Servo is ready to output 13: Positioning completed/speed reached output
P8	5/4	DOUT2	2	
P15	3/2	DOUT3	13	

5.2.4 Configuration of PIN and Analog IO

Steps to configure PIN and analog 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:

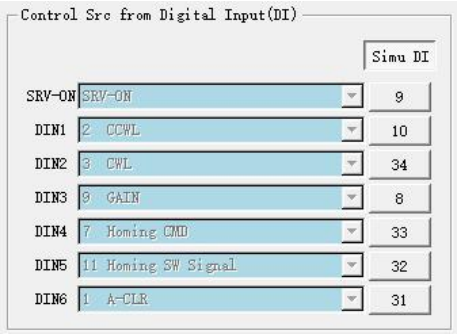
Parameter	Definition	Value	Definition of parameter		Definition of parameter
			Communication control	External control	
P73	Control command source selection	0	From P281 communication expansion control word (default allocation)	From external DI signal (Default allocation)	Related to control mode
		1	From external DI signal (Default allocation)	From external DI signal (Default allocation)	Unrelated to control mode
		2	From external DI signal (Distribution method determined by P75/76/77/78)	From external DI signal (Distribution method determined by P75/76/77/78)	
		3	From P281 communication expansion control word (default allocation)	From P281 communication expansion control word (Default allocation)	
		4	From external DI signal or P281 communication extension control word (Distribution method determined by P75/76/77/78)	From external DI signal or P281 communication extension control word (Distribution method determined by P75/76/77/78)	

Step 3: DIN1~DIN5 signal input and DOUT1~DOUT3 signal output pin functions are optional, please refer to 5.2.1 Selection of DI multiplexing function configure DIN1~DIN5 pin function, refer to 5.2.3 Selection of DO multiplexing function configure DOUT1~DOUT3 pin functions.

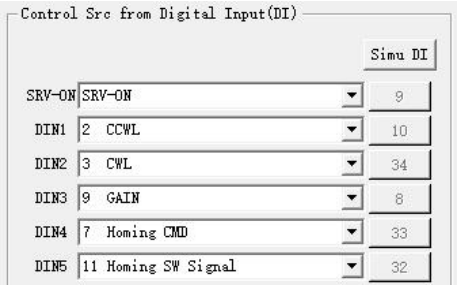
Step 4: After setting the pin function, you can write value to the corresponding parameter through the "Write Configuration" button, so that the pin function would be effective.

Step 5: Click the "simulate DI" or "simulate do" button to open the corresponding simulation function, and the corresponding configuration options will not be changed.

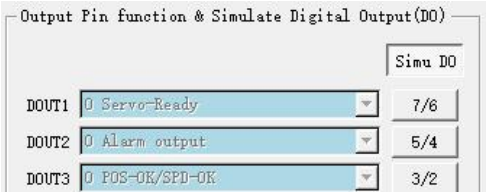
Start "analog DI", and the fixed pin number (9, 10, 34, 8, 33, 32) will be changed into optional key, and the change of key will directly cause the change of corresponding signal input of DIN1~DIN5.



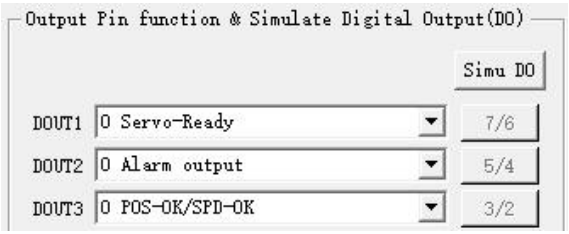
Stop "analog DI", DIN1~DIN5 corresponding signal input is input by external pin.



After starting "Analog DO", DO output signal is controlled, the fixed pin numbers (7/6, 5/4, 3/2) become optional keys. The change of keys directly causes the change of corresponding signal output from DOUT1 to DOUT3.



Stop “Simu DO”, and the corresponding signals of DOUT1~DOUT are output according to the current output state of servo.



<Note>

- Click the "Monitor" button to monitor the status of DIN or DOUT pins in real time when simulation DI or DO is not turned on.
- Click the "Read Configuration" button to read the configuration of the control mode and pin function from the target device.
- Click the "Write Configuration" button to write the currently selected pin function configuration to the target device.

5.3 Control Signal

A4N series servo has two methods: external control and communication control. Different control methods use different control signals. The specific control signal functions are as follows:

Signal	Name	Status Bit	Function
Power of control signal	COM	/	● Common port of control signal Input voltage range: 12~24VDC
	COM-	/	● Common port of positive of control signal

Signal	Name	Status Bit	Function
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.
CCW overtravel inhibit signal	CCWL	P281_Bit2	● 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
CW overtravel inhibit signal	CWL	P281_Bit3	● 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
DIV(DiP)	DIV	P281_Bit6	● 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.

<table>
<tr><th>Signal</th><th>Name</th><th>Status Bit</th><th>Function</th></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 Switchingfor 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>
<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>
</table>

<table>
<tr><th>Signal</th><th>Name</th><th>Status Bit</th><th>Function</th></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 (default p73 = 0):
<table>
<tr><td>P01</td><td>DI ineffective
Select the first mode</td><td>DI effective
Select the second mode</td></tr>
<tr><td>3</td><td>External position control</td><td>External SPD control</td></tr>
<tr><td>4</td><td>External position control</td><td>External Torque control</td></tr>
<tr><td>5</td><td>External SPD control</td><td>External Torque 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>Communication position control</td><td>Communication SPD contro</td></tr>
<tr><td>10</td><td>Communication position control</td><td>Communication Torque control</td></tr>
<tr><td>11</td><td>Communication SPD control</td><td>Communication Torque control</td></tr>
</table>
</td></tr>
<tr><td>Position error clear</td><td>CL</td><td>P281_Bit10</td><td>
● Clear the contents of the deviation counter to zero.
● 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 when short connect CL with COM- or P281_Bit10=1</td></tr>
<tr><td>2</td><td>Reset when short connect CL with COM- or P281_Bit10=1</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 Servo instruction 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>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>

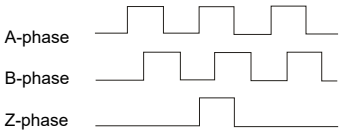
Valid only in communication position control mode
To input position-lock, the servo rotate speed is 0

<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>

In communication mode, when P4=4, the source of position/speed/torque instruction comes from external DI, and the rising edge of this signal is needed to trigger the update instruction.
Relative position control, must trigger this signal for the given position instruction to take effect.
Refer to 10.2 Internal Multi-Position/Speed/Torque Control
Position/Speed/Torque Control for detailed description of multi-stage 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。
<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>
Effective only when the external AI as speed/torque commands
</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 Protection function
</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
</td></tr>
<tr><td>Torque limit outpu</td><td>TLC</td><td>P204 multiple-bit</td><td>
When the actual torque output reaches the torque limit value.
Select the output of the DOUT output terminal with the parameters P07, P08, P09, and P15.
</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>

<table>
<tr><th>Signal</th><th>Name</th><th>Status Bit</th><th>Function</th></tr>
<tr><td>Brake release</td><td>0BK</td><td>P204_Bit3</td><td>● Please first set motor timing of mechanical brake action P130 and P131 before using
● Valid when hold-brake release
Note:
Please connect the control terminal of the brake through the relay (control terminal: DC24V, load capacity greater than or equal to 1A), and connect a Schottky diode (diode recommended model 1N4148, package: DO-35 glass package, insert) in parallel at the control terminal of the relay.</td></tr>
<tr><td>Output of zero speed detection</td><td>ZSP</td><td>P204 multiple-bit</td><td>● The actual speed of the motor is close to 0 when the signal output.
● Select the output of the DOUT output terminal with the parameters P07, P08, P09, and P15.</td></tr>
<tr><td>Internal command switch 1~4</td><td>INTSPD 1~4</td><td>P203 multiple-bit</td><td>● Select internal speed of 1~8 by INTSPD1~3.
● instruction selection of communication control mode (when P4=4), select the given instruction source through INTSPD1-4, see chapter 10.2 Internal Multi-Position/Speed/Torque Control see chapter.</td></tr>
<tr><td>Reserved</td><td>AI+</td><td>22</td><td rowspan="2">Reserved</td></tr>
<tr><td>Reserved</td><td>AGND</td><td>10</td></tr>
<tr><td>Encoder A-phase negative output</td><td>PAO-</td><td>22</td><td rowspan="7">● 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.
 
</td></tr>
<tr><td>Encoder B-phase negative output</td><td>PBO-</td><td>23</td></tr>
<tr><td>Encoder Z-phase negative output</td><td>PZO-</td><td>24</td></tr>
<tr><td>Encoder A-phase positive output</td><td>PAO+</td><td>21</td></tr>
<tr><td>Encoder -B positive output</td><td>PBO+</td><td>25</td></tr>
<tr><td>Encoder Z-phase positive output</td><td>PZO+</td><td>13</td></tr>
</table>

5.4 Bus-absolute encoder system

1) Overview

Bus - based 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

Absolute value system parameter setting:

Addr	Name	Description
41	Bus-absolute encoder setting	0: Use as multi-turn bus-absolute encoder 1: Use as bus incremental encoder 2: Use as single- turn bus-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

Addr	Name	Description
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.

Servo battery error, the user can troubleshoot the hardware problem or check the servo internal P244 coded alarm type to troubleshoot the fault.

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). After resetting multiple turns and clearing errors, the device is reset to

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.

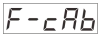
The encoder battery alarms (P244_Bit7=1) when detection voltage is lower than 3.0V. Please replace battery as steps below:

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  on display for help. Please refer to Clear the feedback position of bus encoder.

● 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

Addr	Name		Addr	Name
00	Communication Address※		24	The first torque filter time constant
01	Control mode setup※		25	Velocity feed forward
02	Torque limitation selection		26	Velocity feedforward filter time constant
03	Overtravel Inhibit input invalid setting※		27	The 2nd position loop gain
04	Command source selection		28	The 2nd velocity loop gain
05	Communication command source selection		29	The 2nd velocity loop integration time constant
06	Zero-speed clamp selection		30	The 2nd speed detection filter
07	DOUT1 output function selection		31	The 2nd torque filter time constant
08	DOUT2 output function selection		32	Inertia ratio
10	RS485 Baud rate configuration※		33	PDO inhibit time※
12	Communication timeout		34	EtherCAT Alarm setup※
13	Lock setup on operational panel※		41	Bus absolute encoder setup
14	LED initial status※		42	Origin offset of bus absolute encoder
15	DOUT3 output function selection		44	Encoder overheat alarm threshold
16	Configuration of servo power-on※		46	Enable capturing of interrupted POS※
18	Current loop gain		47	Pulse input filter time selection for the encoder A/B-phase
19	Current loop integration time constant		48	Pulse input filter time selection for the encoder Z-phase
20	The first position-loop gain		49	Time of External DI filter time※
21	The first velocity-loop gain		50	Interpolation selection in communication position mode
22	The first velocity loop integration time constant		51	Selection of phase missing detection
23	The first velocity detection filter		54	Coordinate clear of origin signal

Addr	Name		Addr	Name
55	External feedback pulse logic inversion ※		81	Command pulse input method※
56	Numerator of command pulse ratio of External feedback pulse※		82	Command pulse inhibit input invalidation setting
57	Denominator of command pulse ratio of External feedback pulse※		86	Numerator of 1st command pulse ratio
58	External pulse input filter time select※		87	Numerator of 2nd command pulse ratio
59	Homing mode		88	Denominator of command pulse ratio
60	Gain switching action setup		89	Smoothing filter
61	Gain switching action mode		90	Selection of motor Positive rotating direction in communication mode※
62	Control switching delay time		91	Deviation Counter clear input method
65	Position loop gain switching time		95	The 1st internal speed
66	Input filter selection parameters for Probe1 and Probe2 signals※		96	The 2nd internal speed
69	Torque slope parameter		97	The 3rd internal speed
70	JOG speed setup		98	The 4th internal speed
71	Communication position control mode		99	The 5th internal speed
72	External input logic level selection		100	The 6th internal speed
73	Control command source selection		101	The 7th internal speed
75	Digital input multiplexing function register 4		102	The 8th internal speed
76	Digital input multiplexing function register 3		112	Speed command filter
77	Digital input multiplexing function register 2		113	Acceleration time setup
78	Digital input multiplexing function register 1		114	Deceleration time setup
79	Digital output multiplexing function register		115	External pulse speed limit enable
80	Command pulse direction- select setup ※		119	The 1st torque limitation

Addr	Name		Addre	Name
120	The 2th torque limitation		203	Command status
121	Positioning complete range		204	Output state
122	Zero-speed detection range		205	Input IO signal state
123	Arrival speed		206	Output IO signal state
124	Positioning complete signal output setup		212	Sum of command pulses
126	Sequence at over-travel inhibition※		214	Sum of Feedback pulses
128	Position increment during homing		216	User position coordinates
130	Mechanical brake delay time at motor standstill		218	Command pulse deviation
131	Mechanical brake delay time at motor in motion		220	Command speed
132	External brake resistance setting※		221	Feedback speed
134	Torque setup at motor emergency stop		222	Velocity deviation
135	Switch of motor runaway estimation		223	Torque command
136	Excessive level of position deviation		224	Actual torque
138	Over-load level		225	Torque deviation
139	Over-speed level		226	Busbar voltage
140~149	Historical record1~10		228	Alarm status
174	Turn setting		229	Torque output loading rate
177	Output threshold of torque reached		230	Discharge resistor load factor
178	Output offset threshold of reached torque		231	Overload rate
180	Software version		234	Motor automatic identification function
181~194	Parameter of manufacturer		235	Factor of "No-Motor Running"
197	Logic version number		236	EtherCAT state
198	Logical sub-version number		237	DSP402 Control status word
200	System status		238	Input of second encoder
201	Current Control mode		240	Bus-type absolute encoder single-turn position
202	Type of error		242	The circle number of encoder

Addr	Name		Addr	Name
244	Absolute encoder alarm type		288	Pulse Alarm
248	Fault 1 given position		290~320	Given position 0~31
250	Fault 1 feedback position		324~355	Given speed 0~31
252	Fault 1 given speed		358~389	Given torque 0~31
253	Feedback speed of error 1		432	Probe 1 feedback on the rising edge position
254	Given torque of error 1		434	Probe 1 falling edge position feedback
255	Feedback torque of error 1		436	Probe 2 feedback on the rising edge position
256	Bus voltage of error 1		438	Probe 2 falling edge position feedback
257	Bus voltage of error 2		502	S-curve mode of given speed※
258	Given position of error 2		503	Load torque compensation output gain
260	Feedback position of error 2		504	Load torque output filter
262	Given speed of error 2		505	The torque observer compensation dead zone
263	Feedback speed of error 2		506	Switch of rigidity level
264	Given torque of error 2		507	Rigidity level
265	Feedback torque of error 2		508	Velocity differential antecedent gain
274	Increment of given position		509	Torque feedforward gain
279	EtherCAT communication control Word		510	Time constant of torque feedforward filter
280	Communication function code		514	Speed-loop nonlinear PI switch
281	Communication extended control word		515	Switch and speed selection of on-line inertia identification
282	Communication control word		516	Second proportional degree of freedom of speed-loop PI
284	Pulse filter 1		517	Second integral degree of freedom of speed-loop PI
286	Pulse filter 2		526	Operation days

Addr	Name		Addr	Name
527	Operation time		535	Notch depth of low-frequency vibration suppression
532	Speed level of low-frequency vibration detection		536	Automatically updated threshold of Low-frequency vibration suppression frequency
533	Selection of low-frequency vibration suppression mode		567	Rated torque of motor
534	Frequency value of low-frequency vibration suppression		568	Inertia of the motor itself

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	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>01</td><td>Control mode setup※</td><td>ALL</td><td>0~15</td><td>15: CiA DSP_402 control mode
<Note>
1）Speed is limited by the 3rd internal speed (P97) in Communication position control mode.
2）Speed is limited by the 4th internal speed (P98) in Communication / External torque control mode.
3）Please enable the servo first before sending pulse in mode 0.</td><td>R/W</td><td>0</td></tr>
<tr><td>02</td><td>Torque limitation selection</td><td>P/S</td><td>0~5</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>
</table>

Addr	Name	Control mode	Range	Function	Read-write	Default
04	Command source selection	ALL	0~4	Select the source of instruction for external speed control mode and communication position/speed/torque control mode. Communication control mode: 0~3: instruction source is determined by P05 communication instruction source parameter value 4: The instruction source is determined by INTSPD1~INTSPD4	R/W	0
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

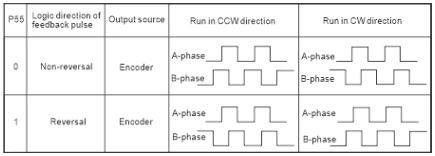
Addr	Name	Control mode	Range	Function	Read-write	Default
07	DOUT1 output function selection	ALL	0~15	Output content used to select torque limit control signal: 0: torque limit control 1: Zero speed detection 2: Any alarm (no alarm output on) 3: Discharge resistance overload alarm 4: Overload alarm 5: Speed consistency output 6: Return to original output 7. Reservation 8. Reservation 9: Torque to output 10: Holding brake output 11: Alarm output (with alarm output on) 12: Servo ready for output 13: Positioning complete / speed reaching output **<Notes>** Please refer to the chapter for details 5.2.3 Selection of DO multiplexing function	R/W	12
08	DOUT2 output function selection	ALL	0~15		R/W	2
15	DOUT3 output function selection	ALL	0~13		R/W	13
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
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 setup on operational 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: Analog command input value 17: Factor of “No-Motor Running” 18: Servo status	R/W	1
16	Configuration of servo 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	300
19	Current loop integration time constant	ALL	0~5000	Define the response characteristics of integration action. Time unit: ×100us	R/W	900
20	The first 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	400

Addr	Name	Control mode	Range	Function	Read-write	Default
21	The first 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	250
22	The first velocity loop integration time constant	ALL	10~ 60000	Set the parameters of integral action speed. Unit: ms Reducing this parameter value can speed up the integral action.	R/W	3183
23	The first 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 first 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	80
25	Velocity feed forward	P	-2000~2 000	Set the velocity feed forward value. The smaller position deviation will reach faster response, especially in situation that needs high response.	R/W	0
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 gain of position loop. Unit: 1/s Increasing this gain can improve the servo rigidity of position loop control, but excessive gain will lead to oscillation.	R/W	560
28	The 2nd velocity loop gain	ALL	1~3500	Define the gain of speed loop. Unit: Hz Increasing this gain can improve the speed response.	R/W	250
29	The 2nd velocity loop integration time constant	ALL	0~ 60000	This parameter is used to set the speed of integral action. Reducing this parameter value can speed up the integral action, unit: ms	R/W	51200
30	The 2nd speed detection filter	ALL	0~5	Used to select the type of speed detection filter. The larger the value is set, the smaller the noise but the slower the response.	R/W	3

Addr	Name	Control mode	Range	Function	Read-write	Default
31	The 2nd torque filter time constant	ALL	0~2500	Define the time constant of the primary delay filter inserted after the torque command. Unit: 10us	R/W	80
32	Inertia ratio	ALL	0~ 10000	Set the ratio of the total moment of inertia of the mechanical load of the load to the moment of inertia of the motor itself: (Total moment of inertia of mechanical load/Moment of inertia of motor itself) ×100%	R/W	100
33	PDO inhibit time※	ALL	0~ 32767	PDO prohibit time setting. Limitation of communication abnormalities caused by too frequent EtherCAT communication. Unit: 0.1ms. **<Note>** This parameter is mainly used to limit the transmission frequency of EtherCAT communication parameters, so as to avoid communication congestion caused by excessive communication frequency, which may cause abnormalities in communication.	R/W	100
34	EtherCAT Alarm setup※	ALL	0~1	Settings when an abnormality occurs in EtherCAT communication: 0: When the communication is abnormal, the servo does not prompt an alarm and keeps the original running state 1: When the communication is abnormal, the servo will give an alarm and stop running	R/W	1
40	Bus absolute encoder setup	ALL	0~1	0: Unshielded encoder no response error 1: Shielding encoder no response error **<Note>** Only valid for bus encoder.	R/W	0
41	Origin offset of bus absolute encoder	ALL	0~2	0: Used as a multi-turn bus type absolute encoder 1: Use as a bus-type incremental encoder 2: Used as a single-turn bus-type absolute encoder	R/W	1
42	Encoder overheat alarm threshold	ALL	-231-1~ +231	Set the offset between the origin of the bus-type absolute encoder and the position of the mechanical coordinate system.	R/W	0

Addr	Name	Control mode	Range	Function	Read-write	Default
44	The 2nd speed detection filter	ALL	0~127	Indicates the encoder overheating alarm threshold, and it only takes effect when the encoder type is an absolute encoder. When it is 0, it means that the encoder overheating alarm is shielded.	R/W	120
46	Enable capturing of interrupted POS※	ALL	0~3	0: Disable the interrupt position capture function 1: Enable probe 1 signal interrupt position capture function. 2: Enable probe 2 signal interrupt position capture function. 3: Enable probe 1 signal and probe 2 signal interrupt position capture function at the same time.	R/W	0
47	Pulse input filter time selection for the encoder A/B-phase	ALL	0~13	2500-line incremental photoelectric encoder motor only has this parameter: 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 for the encoder Z-phase	ALL	0~7	2500-line incremental photoelectric encoder motor only has this parameter: 0：0.55us 1：1.05us 2：1.56us 3：2.06us 4：2.56us 5：3.08us 6：3.56us 7：4.08us		

Addr	Name	Control mode	Range	Function	Read-write	Default
49	Time of External DI filter time※		0~6	Select the external DI filter time through this parameter: 0：0.5ms 1：1ms 2：2ms 3：4ms 4：8ms 5：16ms 6：32ms 33~8000: The value set in 33~8000ms is the filter time The filter time set by this parameter has an error of 100us	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 peed is determined by controller, P97 takes no effect	R/W	0
51	Selection of phase missing detection	ALL	0~1	0: enable phase missing alarm 1: shield phase missing alarm **<Note>** 220V series servo the default value of this parameter is 1. 380V series servo the default value of this parameter is 0.	R/W	
54	Coordinate clear of origin signal	ALL	0~1	0: Invalid 1: Valid	R/W	0
55	External feedback pulse logic inversion※	ALL	0~1	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. 	R/W	0

Addr	Name	Control mode	Range	Function	Read-write	Default
56	Numerator of command pulse ratio of External feedback pulse※	ALL	1~ 32767	Set the number of pulses output from the feedback signal interface per motor revolution. ① P57=0: Number of feedback pulses per revolution=P56×4 ② P57≠0: Number of feedback pulses per revolution = (P56/P57) × encoder resolution × 4 **<Note>** 1) Encoder resolution: 2500p/r 2) The number of feedback pulses per revolution does not exceed the resolution of the encoder. If it exceeds 1, it will still be calculated as 1. 3) The motor outputs a Z-phase pulse signal every revolution. 4) The Z-phase pulse width changes with the frequency division ratio setting.	R/W	1
57	Denominator of command pulse ratio of External feedback pulse※	ALL	0~ 32767		R/W	1

Addr	Name	Control mode	Range	Function	Read-write	Default
58	External pulse input filter time select※	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 **<Note>** 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

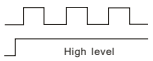
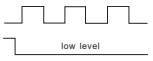
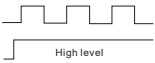
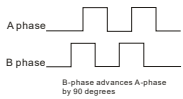
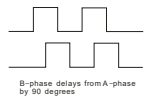
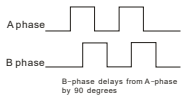
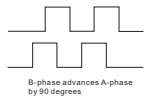
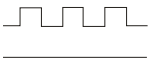
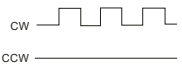
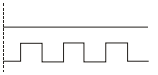
Addr	Name	Control mode	Range	Function	Read-write	Default
59	Homing mode	ALL	1~20、35	Select the homing mode: **1:** Refer to both the negative original switch and Z-phase signal mode. **2:** Refer to both the positive original switch and Z-phase signal mode. **3:** Refer to the negative original switch 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 chapter10.1 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>0~2</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 parameters for Probe1 and Probe2 signals※</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>
</table>

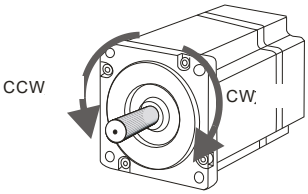
Addr	Name	Control mode	Range	Function	Read-write	Default
69	Torque slope parameter	ALL	0~1000	Max adjustment range each turn. Unit: ‰	R/W	100
70	JOG speed setup	ALL	0~5000	Set the JOG (Test run) speed. Unit: rpm	R/W	200
71	Communication position control mode	P	0~1	**Bit0:** Absolute/relative position 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

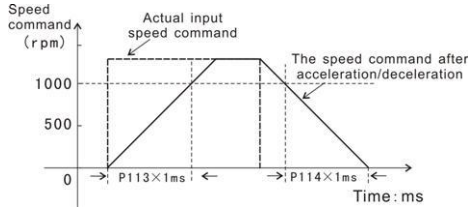
<table>
<tr><th>Addr</th><th>Name</th><th>Control mode</th><th>Range</th><th>Function</th><th>Read-write</th><th>Default</th></tr>
<tr><td>72</td><td>External input logic level selection</td><td>ALL</td><td>Any</td><td>Logic level selection of external DI
Bit0: the way servo on
0: You can not enable 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 chapter5.2.2 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 rowspan="2">Value</th><th colspan="2">Parameter value definition</th></tr>
<tr><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 Selection of DI multiplexing function 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>0~65535</td><td rowspan="4">There are two DI PIN distributions, refer to chapter 5.2.1 Selection of DI multiplexing function or 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>76</td><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></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>0~65535</td><td>16#010B</td></tr>
<tr><td>77</td><td>Digital input multiplexing function register 2</td><td>ALL</td><td>0~65535</td><td>16#0709</td></tr>
<tr><td>78</td><td>Digital input multiplexing function register 1</td><td>ALL</td><td>0~65535</td><td>16#0302</td></tr>
<tr><td colspan="5">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></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>0: Servo ready</td><td>0: Servo ready</td></tr>
<tr><td>2~3</td><td>4/5</td><td>DOUT2</td><td>0: Alarm output
1: Setting of P8</td><td>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>
</table></td><td>R/W</td><td>0</td></tr>
<tr><td>80</td><td>Command pulse direction-select 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> 
</td><td> 
</td></tr>
<tr><td>1</td><td> 
</td><td> 
</td></tr>
<tr><td rowspan="2">2</td><td>0</td><td> 
</td><td> 
</td></tr>
<tr><td>1</td><td> 
</td><td> 
</td></tr>
<tr><td rowspan="2">1</td><td>0</td><td> 
</td><td>  </td></tr>
<tr><td>1</td><td> 
</td><td>  </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: Command pulse prohibition function will be shielded. 0: Valid means that input is prohibited, and invalid means that input is allowed.
<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 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.
) the revolution of 2500-PPR incremental encoder is 10000 and that of the bus absolute encoder is 131072
5) Please refer to chapter 6.3 Setup of Electronic Gear Ratio for setting.</td><td>R/W</td><td>1</td></tr>
<tr><td>87</td><td>Numerator of 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
95	The 1st internal speed	S	-10000 ~ 10000	Set the 1st speed of internal speed command. Unit: rpm	R/W	0
96	The 2nd internal speed	S	-10000 ~ 10000	Set the 2nd speed of internal speed command. Unit: rpm	R/W	0
97	The 3rd internal speed	P,S	-10000 ~ 10000	Set the 3rd speed of internal speed command. Unit: rpm **<Notes>** This parameter is used as the execution speed in the communication position control mode, that is, the maximum speed command in the communication position control mode does not exceed the setting value of this parameter.	R/W	500
98	The 4th internal speed	S,T	-10000 ~ 10000	Set the 4th speed of internal speed command. Unit: rpm	R/W	500
99	The 5th internal speed	S	-10000 ~ 10000	Set the 5th speed of internal speed command. Unit: rpm	R/W	0

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	R/W	0
101	The 7th internal speed	S	-1000 0~ 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	0~640 0	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

Addr	Name	Control mode	Range	Function	Read-write	Default
115	External pulse speed limit enable		0~1	0: Speed is decided by pulse frequency 1: Speed is limited by P9	R/W	0
119	The 1st torque limitation	ALL	0~3000	Set the restriction value of 1st torque. Unit:‰	R/W	2000
120	The 2th torque limitation	ALL	0~3000	Set the restriction value of 2nd torque. Unit:‰	R/W	2000
121	Positioning complete range	P	0~32767	The range of positioning completion can be set. When the difference between the actual feedback position of the servo motor and the command pulse position is less than the setting value of this parameter, the positioning completion signal is output. Unit: Number of pulses.	R/W	100
122	Zero-speed detection range	ALL	10~20000	Set the threshold value of zero speed detection. When the actual speed of the motor is lower than the setting value of this parameter, the zero speed detection signal will be output. This parameter value is also used as the speed consistency output threshold. When the difference between the actual motor speed and the command speed is within the setting range of this parameter, the speed consistency signal is output. This parameter value has a hysteresis of 10 rpm. Unit: rpm	R/W	10
123	Arrival speed	S,T	10~20000	Set the speed reaching threshold, and output the speed reaching signal when the actual speed of the motor exceeds the setting value of this parameter. This parameter value has a hysteresis of 10 rpm. Unit: rpm	R/W	1000

<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>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>If the number of position deviation pulses is within the range of positioning completion, the output is turned on.</td></tr>
<tr><td>1</td><td>If there is no position command, and if the number of position deviation pulses is within the range of positioning completion, the output is turned on.</td></tr>
<tr><td>2</td><td>If there is no position command, the zero-speed detection signal is output, and if the number of position deviation pulses is within the range of positioning completion, the output is turned on.</td></tr>
<tr><td>3</td><td>If the position deviation of P218 is less than P121 and the command completion is 1, P204 will output the positioning completion signal.</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 colspan="2">Value</th><th>During deceleration</th><th>After stalling</th><th>Deviation counter content</th></tr>
<tr><td colspan="2">0</td><td colspan="2">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>
<tr><td>127</td><td>Brake delay release time</td><td>ALL</td><td>0~ 32767</td><td>The delay time released by servo from UVW output to brake release, Unit : ms</td><td>R/W</td><td>0</td></tr>
<tr><td>128</td><td>Position increment when homing</td><td></td><td>-2^{31}~ $+2^{31}$</td><td>Homing mode (P59) is set to 15 or 16, when the origin switch is reached, it will run according to the given position set by this parameter.</td><td>R/W</td><td>0</td></tr>
</table>

Addr	Name	Control mode	Range	Function	Read-write	Default
130	Mechanical brake delay time at motor standstill	ALL	0~500	Set the delay time from the disconnection of the mechanical brake release signal (BRK-OFF) to the power-off of the motor when the servo enable signal (SRV-ON) is turned off in the motor stop state. Unit: ms	R/W	50
131	Mechanical brake delay time at motor in motion	ALL	0~500	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	Torque setup 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
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

Addr	Name	Control mode	Range	Function	Read-write	Default
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	0~2000	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.	R/W	0
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	0

Addr	Name	Control mode	Range	Function	Read-write	Default
174	Turn setting	ALL		Set the number of turns, and modify the value of the number of turns in P242 through the rising edge of P282 bit3 **<Note>** This function is limited to use when equipped with a 2500-line encoder motor.	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 reached torque	ALL	0~3000	Output signal off when actual torque lower than P177-P178, unit: ‰	R/W	100
180	Software version			Version of current driver software.	R	
181~194	Parameter of manufacturer				R	
197	Logic version number	ALL		Internal logic version	R	
198	Logical sub-version number	ALL		Logical sub-version number	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	

Addr	Name	Control mode	Range	Function	Read-write	Default
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	
202	Type of error	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 26: EtherCAT communication configuration error 27: Encoder communication error 28: UVW output phase loss 30: Software overcurrent	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	Output state	ALL		Set the system status output to 1 on true condition: **Bit0:** Servo-Ready. **Bit1:** Alarm output, 1: Turn ON **Bit2:** Positioning complete. **Bit3:** Brake release. **Bit4:** Zero -Speed detection. **Bit5:** Torque in-limit. **Bit6:** Speed consistency output. **Bit7:** Resistance braking. **Bit8:** Speed Arrival. **Bit9:** Over-load alarm. **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 **Bit14:** Direction PIN input **Bit15:** Pulse PIN input	R	0
206	Output IO signal state	ALL		Control signal terminal interface signal output, when the corresponding bit bit is 1, the pin number transistor is turned on. **Bit0:** The 7/6th PIN DOUT1 **Bit1**: The 5/4th PIN DOUT2 **Bit2:** The 3/2th PIN DOUT3	R	

Addr	Name	Control mode	Range	Function	Read-write	Default
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	
230	Discharge resistor load factor	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	

Addr	Name	Control mode	Range	Function	Read-write	Default
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	EtherCAT state		0~65535	Check the EtherCAT communication status: 0: Initialization 4: Stop 5: Run 127: Pre-run	R	
237	DSP402 Control status word	ALL	-	Check the control status of DSP402: Bit 0: Servo has no fault Bit 1: Waiting to turn on the servo enable Bit 2: Servo operation Bit 3: Fault Bit 4: Connect the main circuit power Bit 5: Fast shutdown Bit 6: Servo ready Bit 10: position reached Bit 12~Bit 13: related to the current control mode of the servo Bit 15: Return to zero completed	R	

Addr	Name	Control mode	Range	Function	Read-write	Default
238	Input of second encoder	ALL		The input of external 2nd encoder	R	
240	Bus-type absolute encoder single-turn position		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	Fault 1 given position	ALL	-2^{31}~ $+2^{31}$	Record the given position when fault 1 occurs	R	
250	Fault 1 feedback position	ALL	-2^{31}~ $+2^{31}$	Record the feedback position when fault 1 occurs	R	
252	Fault 1 given speed	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 pulse increment value setting register of the special speed position mode. When the external trigger signal input is valid, the number of pulses of the servo given position increment. (32-bit double int)	R/W	0
279	EtherCAT 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#0110: Absolute value motor clears multiple turns 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 photoelectric 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)	R/W	0
284	Pulse filter 1		-2^{31}~+ 2^{31}	As a special speed position mode pulse filter value setting register. After switching from position mode to speed mode, the system starts to execute p284 (pulse filter value 1). When the output pulse value of the system reaches p284 (pulse filter value 1), it starts to detect the external switch signal.	R/W	0
286	Pulse filter 2		-2^{31}~ $+2^{31}$	As a special speed position mode pulse filter value setting register. In speed mode, after the external switch signal is detected for the first time, P286 (pulse filter value 2) is executed. When the output pulse value of the system reaches P286 (pulse filter value 2), the external switch signal is detected again, and the system switches from speed mode to position mode.	R/W	0
288	Pulse Alarm		-2^{31}~ $+2^{31}$	As a special speed position mode pulse alarm value setting register. In speed mode, if the external switch signal cannot be detected all the time and the pulse increment output by the system reaches the pulse alarm value, an error shutdown will be reported. If the value is 0, the alarm function will be turned off。	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
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

Addr	Name	Control mode	Range	Function	Read-write	Default
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
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

Addr	Name	Control mode	Range	Function	Read-write	Default
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
337	Given speed 13	S	-6000~ 6000	The command of given speed 13 in communication speed control mode. Unit: rpm	R/W	0

Addr	Name	Control mode	Range	Function	Read-write	Default
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 20	S	-6000~6000	The command of given speed 29 in communication speed control mode. Unit: rpm	R/W	0
354	Given speed 21	S	-6000~6000	The command of given speed 30 in communication speed control mode. Unit: rpm	R/W	0
355	Given speed 22	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 torque control mode. Unit:‰	R/W	0
359	Given torque 1	T	-3000~3000	The command of given torque 1 in communication torque control mode. Unit:‰	R/W	0
360	Given torque 2	T	-3000~3000	The command of given torque 2 in communication torque control mode. Unit:‰	R/W	0
361	Given torque 3	T	-3000~3000	The command of given torque 3 in communication torque control mode. Unit:‰	R/W	0
362	Given torque 4	T	-2500~3000	The command of given torque 4 in communication torque control mode. Unit:‰	R/W	0
363	Given torque 5	T	-3000~3000	The command of given torque 5 in communication torque control mode. Unit:‰	R/W	0
364	Given torque 6	T	-3000~3000	The command of given torque 6 in communication torque control mode. Unit:‰	R/W	0
365	Given torque 7	T	-3000~3000	The command of given torque 7 in communication torque control mode. Unit:‰	R/W	0
366	Given torque 8	T	-3000~3000	The command of given torque 8 in communication torque control mode. Unit:‰	R/W	0
367	Given torque 9	T	-3000~3000	The command of given torque 9 in communication torque control mode. Unit:‰	R/W	0
368	Given torque 10	T	-3000~3000	The command of given torque 10 in communication torque control mode. Unit:‰	R/W	0
369	Given torque 11	T	-3000~3000	The command of given torque 11 in communication torque control mode. Unit:‰	R/W	0

Addr	Name	Control mode	Range	Function	Read-write	Default
370	Given torque 12	T	-3000~3000	The command of given torque 12 in communication torque control mode. Unit:‰	R/W	0
371	Given torque 13	T	-3000~3000	The command of given torque 13 in communication torque control mode. Unit:‰	R/W	0
372	Given torque 14	T	-3000~3000	The command of given torque 14 in communication torque control mode. Unit:‰	R/W	0
373	Given torque 15	T	-3000~3000	The command of given torque 15 in communication torque control mode. Unit:‰	R/W	0
374	Given torque 16	T	-3000~3000	The command of given torque 16 in communication torque control mode. Unit:‰	R/W	0
375	Given torque 17	T	-3000~3000	The command of given torque 17 in communication torque control mode. Unit:‰	R/W	0
376	Given torque 18	T	-3000~3000	The command of given torque 18 in communication torque control mode. Unit:‰	R/W	0
377	Given torque 19	T	-3000~3000	The command of given torque 19 in communication torque control mode. Unit:‰	R/W	0
378	Given torque 20	T	-3000~3000	The command of given torque 20 in communication torque control mode. Unit:‰	R/W	0
379	Given torque 21	T	-3000~3000	The command of given torque 20 in communication torque control mode. Unit:‰	R/W	0
380	Given torque 22	T	-3000~3000	The command of given torque 22 in communication torque control mode. Unit:‰	R/W	0
381	Given torque 23	T	-3000~3000	The command of given torque 23 in communication torque control mode. Unit:‰	R/W	0
382	Given torque 24	T	-3000~3000	The command of given torque 24 in communication torque control mode. Unit:‰	R/W	0
383	Given torque 25	T	-3000~3000	The command of given torque 25 in communication torque control mode. Unit:‰	R/W	0
384	Given torque 26	T	-3000~3000	The command of given torque 26 in communication torque control mode. Unit:‰	R/W	0

Addr	Name	Control mode	Range	Function	Read-write	Default
385	Given torque 27	T	-3000~3000	The command of given torque 27 in communication torque control mode. Unit:‰	R/W	0
386	Given torque 28	T	-3000~3000	The command of given torque 28 in communication torque control mode. Unit:‰	R/W	0
387	Given torque 29	T	-3000~3000	The command of given torque 29 in communication torque control mode. Unit:‰	R/W	0
388	Given torque 30	T	-3000~3000	The command of given torque 30 in communication torque control mode. Unit:‰	R/W	0
389	Given torque 31	T	-3000~3000	The command of given torque 31 in communication torque 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 Probe 2	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

Addr	Name	Control mode	Range	Function	Read-write	Default
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
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	P/S	0~3	0: Off; 1: Inertia changes slowly; 2: Inertia changes normally; 3: Inertia changes rapidly	R/W	0
516	Second proportional degree of freedom of speed-loop PI	P/S	0~1000	It can be adjusted to weaken the gain effect during speed following, without changing the anti-disturbance. 0--1000: No effect-the gain effect is weakened, the larger the coefficient, the weaker the gain effect.	R/W	0
517	Second integral degree of freedom of speed-loop PI	P/S	0~1000	It can be adjusted to weaken the integral effect during speed following, without changing the anti-disturbance. 0-1000: No effect-the integral action is weakened, the larger the coefficient, the weaker the integral action.	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	In manual mode, this parameter sets the frequency to be suppressed; In automatic mode, this parameter monitors the vibration frequency value automatically identified and used Unit: 0.1Hz	R/W	0
535	Notch depth of low-frequency vibration	P	0~10	Set the depth of notch filter	R/W	10
536	Automatically 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 the motor itself	ALL	0~10^8	The inertia of the motor itself, unit: kg*m2*e-7.	R/W	400

<Note>

- The parameters marked with ※ need to be restarted to take effect after being written into the 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 Setup of Electronic Gear Ratio

Adjust electronic gear ratio to set the motor speed and displacement of each inputted 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 needs 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) $2500 = 10000 \times \frac{\text{P88}}{\text{P86 or P87}}$ → (P86 or P87): P88=4:1, which means you can set P86 or P87 to 400, set P88 to 100.
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 the electronic gear ratio is 10000: 2500.

7

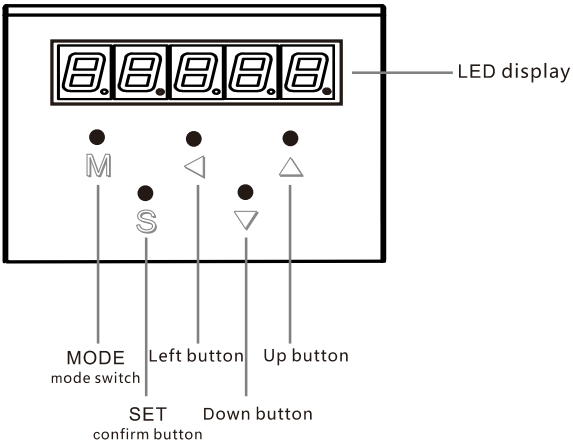
How to Use the Front Panel

*Introduction of front panel and buttons

7 How to use the front panel

Introduction of the front panel and buttons

The front panel of A4N series servo owns 5-digit LED and five keys:



7.1 Buttons Function

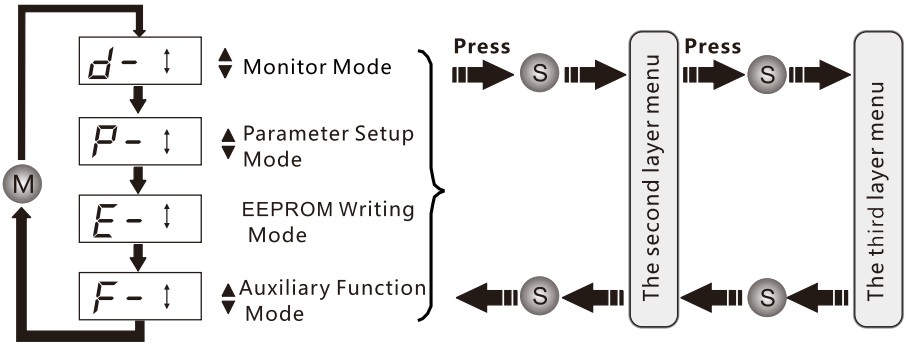
Buttons	Name	Function	
M	Mode switch	Switch between the following four modes:: • Monitor Mode • Parameter Setup Mode • EEPROM Writing Mode • Auxiliary Function Mode	
S	SET button	• Enter menu; • Confirm operation;	
▲	Up	Increase numerical value, long press to repeat	**<Note>** When changing a value,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

7.2 Menu Function

There are 4 operation modes, which can be changed with the MODE key.

The first layer is the main menu, press SET to enter the second menu. After the specific operation is completed, press SET to confirm the operation, then return to the main menu. When the menu is deeply embedded, the operation is similar as the front.

Structure of modes:

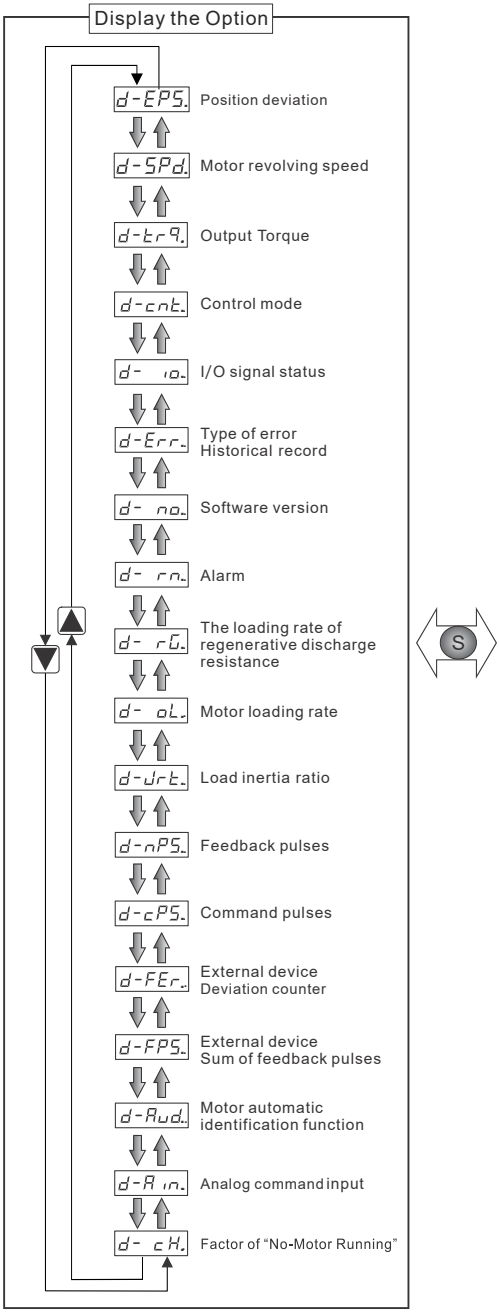


7.3 Operation Modes

The LED shows  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.


Display the Option
d-EPS. Position deviation
d-SPd. Motor revolving speed
d-trq. Output Torque
d-cnt. Control mode
d- io. I/O signal status
d-Err. Type of error Historical record
d- no. Software version
d- rn. Alarm
d- rG. The loading rate of regenerative discharge resistance
d- oL. Motor loading rate
d-Jrt. Load inertia ratio
d-nPS. Feedback pulses
d-cPS. Command pulses
d-FEr. External device Deviation counter
d-FPS. External device Sum of feedback pulses
d-Aud. Motor automatic identification function
d-A in. Analog command input
d- cH. Factor of "No-Motor Running"
S
Excute the option
Display
Description
Remark
P 2
2 Deviation pulses
[Note1]
r2000
2000r/min
[Note1]
t 80.0
Output Torque 80%
[Note1]
PoSEc
External Position Control mode
[Note2]
in 0.A
Input signal No.0:Valid
[Note3]
Err.00
No error currently
[Note4]
A-0.00.
Software version 0.00
[Note5]

No alarm currently
[Note6]
rG 30
30% of allowable load
[Note7]
oL 30
30% of loading rate
[Note8]
J 100
Load inertia ratio 100%
[Note9]
50.
Feedback pulse sum is 50 pulses
[Note10] [Note15]
10.
Command pulse sum is 10 pulses
[Note10] [Note15]
FE 5
Deviation counter is 5 pulses
[Note11] [Note15]
500.
External feedback pulse sum is 500 pulses
[Note10] [Note15]
Audon
Automatic identify function is valid
[Note12]
A10.00
Speed command is + 10.0V
[Note13]
cP. 0.
No Servo-on signal input
[Note14]

Note 1

[Position deviation, displays the motor speed and torque]

Data

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

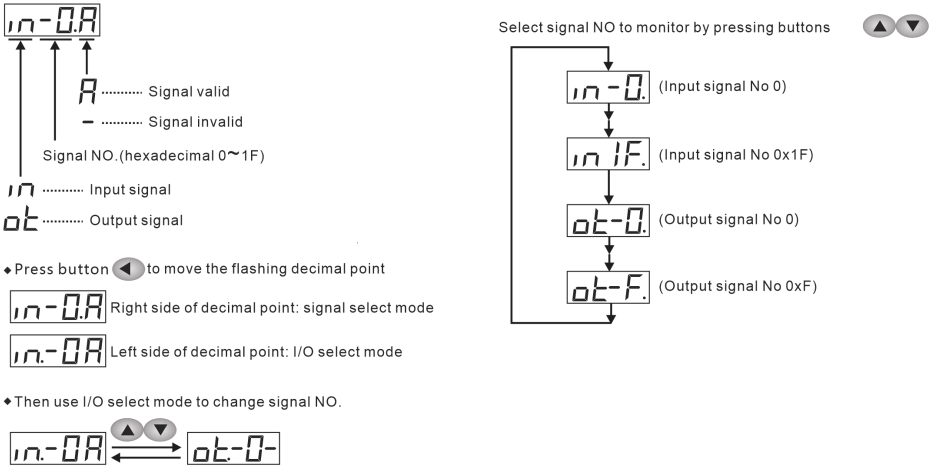
Note 2

[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

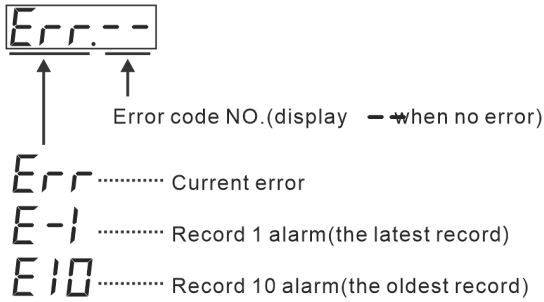
Note 3

[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 alarm code

alarm code	Function	alarm code	Function
1	Under-voltage	14	RS485 communication error
2	Over-voltage	15	EtherCAT communication abnormal
3	Over-current	16	External input PIN configuration error
4	Over-heat	17	Internal error 1
6	Encoder feedback error	18	Absolute encoder motor unmatched
7	Over braking rate	19	Special speed-position mode pulse error
8	Over-load	22	Main power lack-phase
9	Position deviation excess	23	Under-voltage of control power
10	Range limit alarm	24	Under-voltage of internal drive power
11	Over-speed	25	Motor runway alarm
12	Analog input excess	26	EtherCAT communication configuration error
13	EEPROM R/W error	30	Software over current

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(%)

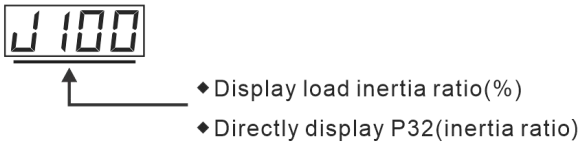
Valid when P132(can be selected as external regenerative discharge resistance) is 0 or 1

Note 8

[Display load-rate]

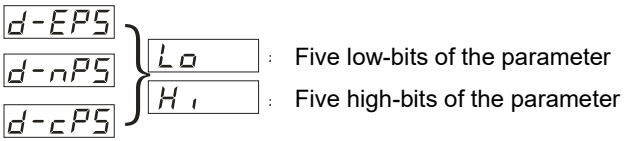
Note 9

[Display inertia ratio]

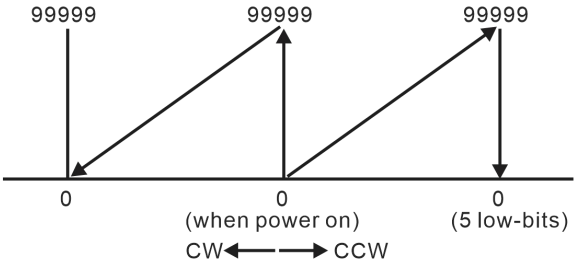


Note 10

[Display sum of feedback pulses, sum of command pulses and position deviations]



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



Note 11

[Deviation counter of external device]

Function reserved

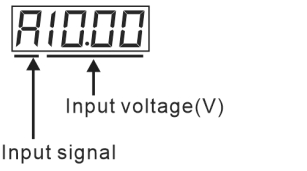
Note 12

[Automatic motor recognizing function]

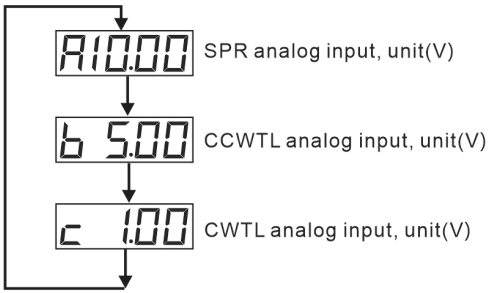
Function reserved

Note 13

[[Display the analog input]

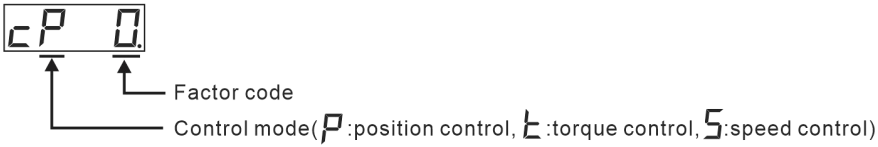


◆Select signal that needs to be checked by pressing ▲▼



Note 14

[Factor of no-motor running]



Error code

Error code	Control mode	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 (analog 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)

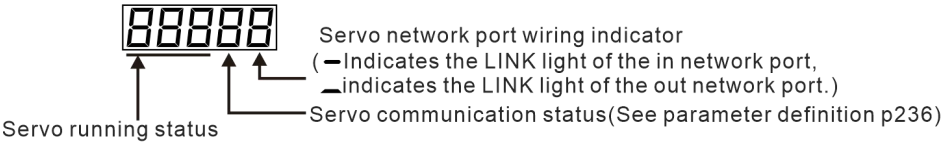
Error code	Control mode	Control mode	Factor
8	Valid of input deviation counter clear signal	P	● P91＝0 (input way of deviation counter) and CL signal is short connected with COM-
9	Zero-speed clamp input signal is valid	S、T	● P06＝1 (valid zero-speed clamp input), and the connect between ZEROSPD and COM- is open
10	Too small of speed command	S	● Too small of command voltage(lower than 0.06V) when input analog 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 analog 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(may be overloaded)	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

Note 15

[EtherCAT status display]

When parameter P14 is set to 18, the display panel will display the EtherCAT communication status.



rdy ····· Servo ready

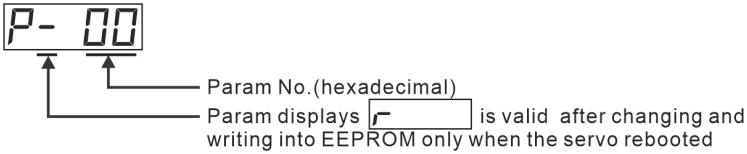
run ····· Servo is running

ndy ····· Servo is not ready

2. Parameter Setup Mode

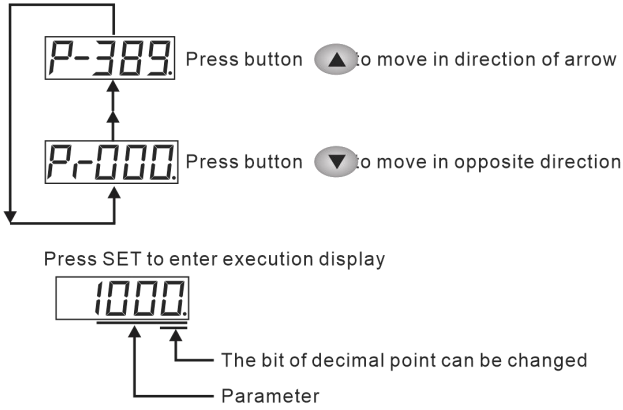
Selection display

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 ◄ 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.

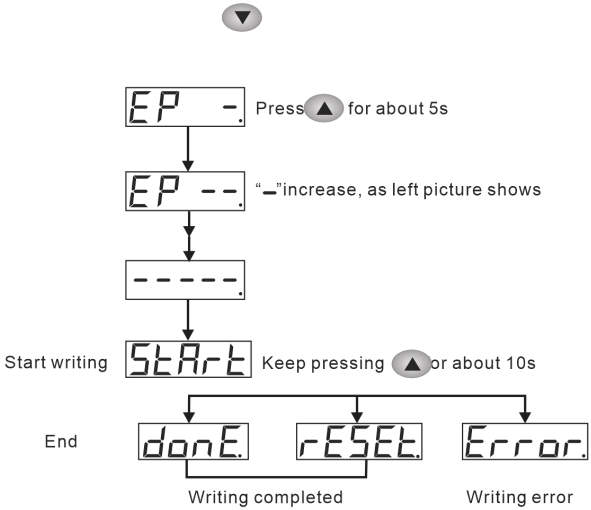
3. EEPROM Writing Mode

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

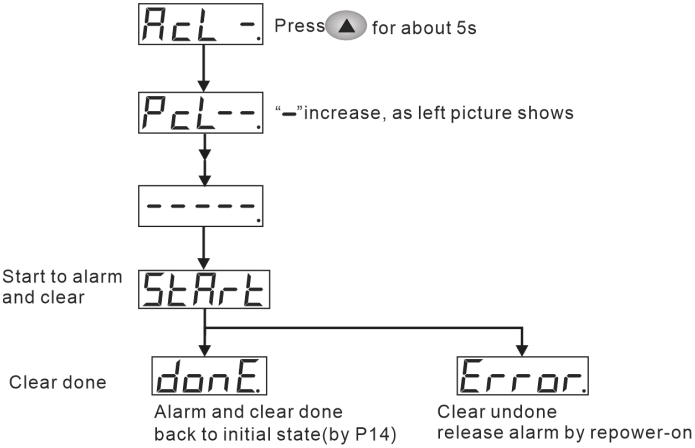
※ The alarm function is released, the motor stops (alarm occurs).

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)

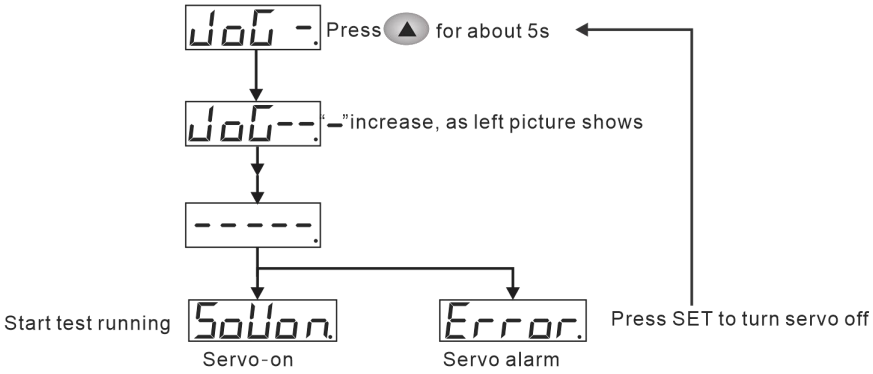
※Motor can rotate as JOG speed setting without external enable signal for servo in test run mode.

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

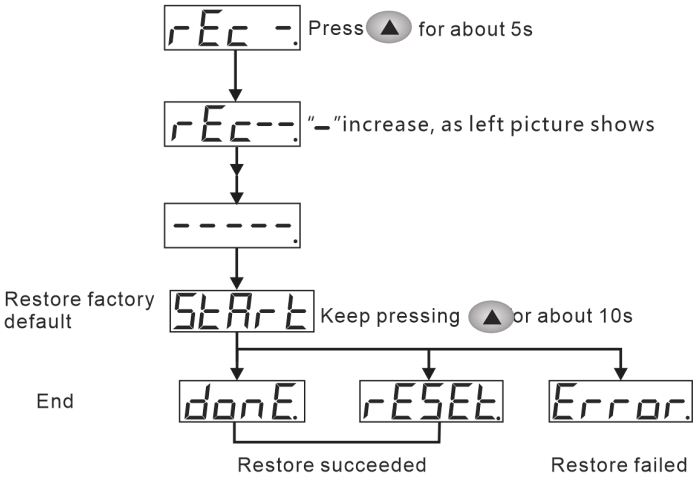
※※Reset servo parameter to factory default, it is recommended to reboot servo driver after reset.

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

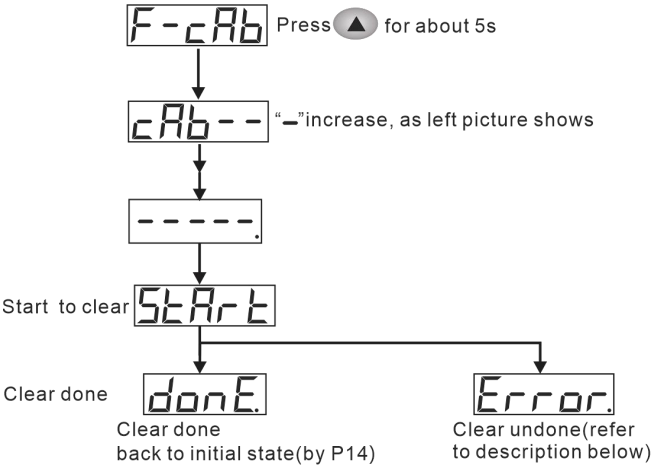
※ When P41=0 (used as the multi-turn bus absolute encoder), the motor encoder may lose multi-turn pulse due to the lack of battery power supply or other reasons, the servo driver will prompt Err.06 alarm, which can be used to clear this kind of alarm.

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.

Communication

*EtherCAT/Modbus communication protocols

8 Communication

Introduction of EtherCAT /Modbus communication protocol

8.1 EtherCAT Communication Protocol

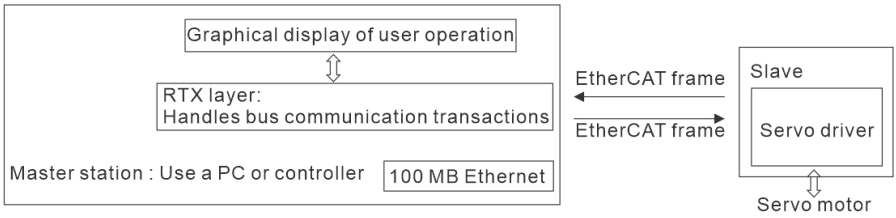
EtherCAT is an open real-time Ethernet communication protocol that sets new standards for real-time system performance and topology flexibility, while at the same time meeting or even reducing the cost of using fieldbus.

A4N servo supports EtherCAT communication. It is used as a slave station in EtherCAT Ethernet system, allowing A4N servo driver to set parameters, read state, write register and other operations directly through EtherCAT controller. In addition, A4N servo and Cotrust CTH3-C series motion controller control system, through the 100Mbps high-speed motion bus EtherCAT, can achieve 5 axis arbitrary interpolation Softmotion function, as well as electronic CAM, synchronization, single axis/multi-axis positioning control and other functions; At the same time, it has CNC function and supports writing motion control trajectory in GCODE mode.

1. EtherCAT communication parameters

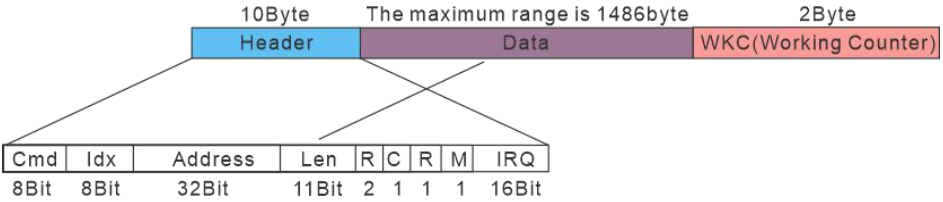
project	specifications
Communication Standard	IEC61158、IEC61800、IEC61784
Physical layer	100BASE-TX(IEEE802.3)
Connector	2 RJ45 communication ports
Transmission Medium	Recommend to use Category 5 Ethernet (100BASE-TX) twisted pair cable or higher
Communication Distance	The longest distance is 100M
Process data	Configure the PDO mapping
Mailbox (CoE)	SDO requests, SDO responses, SDO messages
Distribution clock (DC)	Synchronize in DC mode

The servo controller system based on EtherCAT adopts a master-slave structure, and its overall structure is shown in the figure below:



The master station initiates the communication to realize the monitoring of the slave device (servo driver) and the driven device (servo motor); The slave station (servo driver) receives the control command from the master station and sends the status of the driven device (servo motor) to the master station.

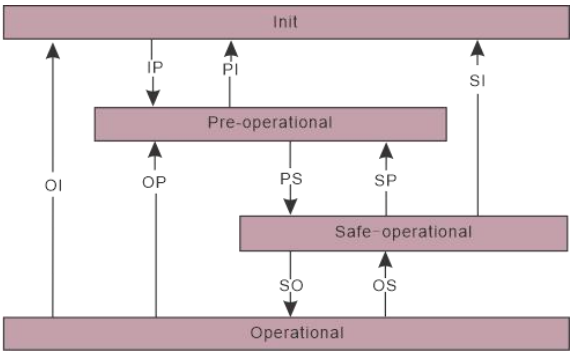
2. Definition of EtherCAT transport packet



3. EtherCAT State Machine (ESM)

The EtherCAT state mechanism is built in the data link layer, which defines the general information state of the EtherCAT slave device, and specifies the initialization and error handling when the EtherCAT slave device is enabled.

Four states are defined: Init, Pre-Operational, Safe-Operational, （Operational. The description of state management refers to the following:



state	description
Init	◆ Application layer has no data interaction ◆ The master station has access to data transmission information registration
Pre-Operational	◆ Mailbox communication on application layer ◆ No process data interaction
Safe-Operational	◆ Mailbox communication on application layer ◆ Process data communication, but only the input is evaluated and the output is in safe state.
Operational	◆ Both input and output are valid

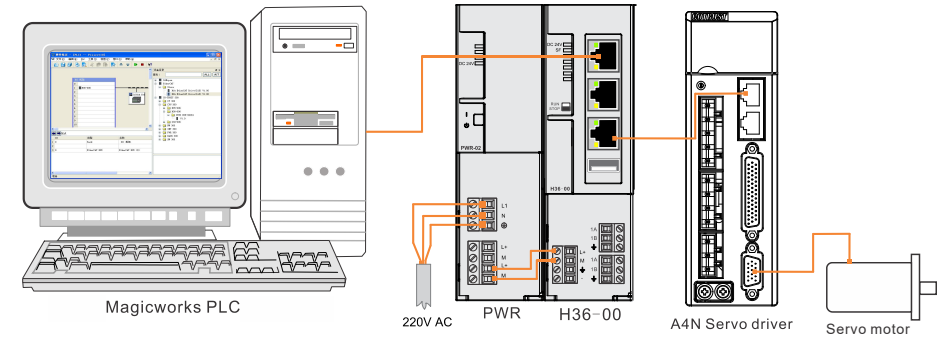
state transition

state transition	Local management services	Value
IP	Start mailbox communication	0x02
PI	Stop mailbox communication	0x01
PS	Start input update	0x04
SP	Stop input update	0x02
SO	Start output update	0x08
OS	Stop output update	0x04
OP	Stop output update and input update	0x02
SI	Stop input update and mailbox communication	0x01
OI	Stop input update, stop input update and mailbox communication	0x01

8.1.1 Example of A4N communication controlled by COTRUST CPU

Example 1: EtherCAT communication through magicworks PLC

This example introduces the process of EtherCAT communication between A4N servo and COTRUST H36-00 CPU. The connection diagram of the communication system is as follows:

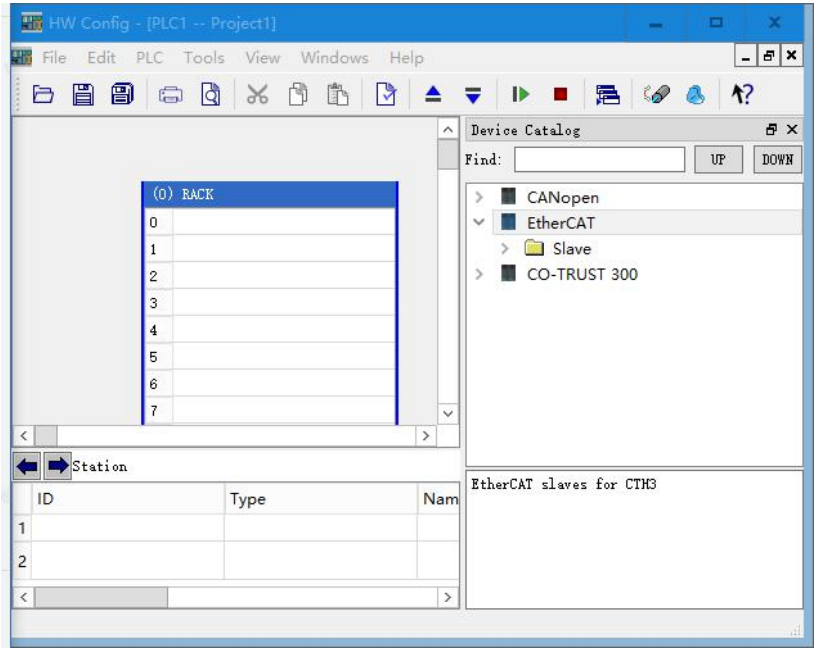


Please follow the steps for EtherCAT configuration in MagicWorks PLC software:

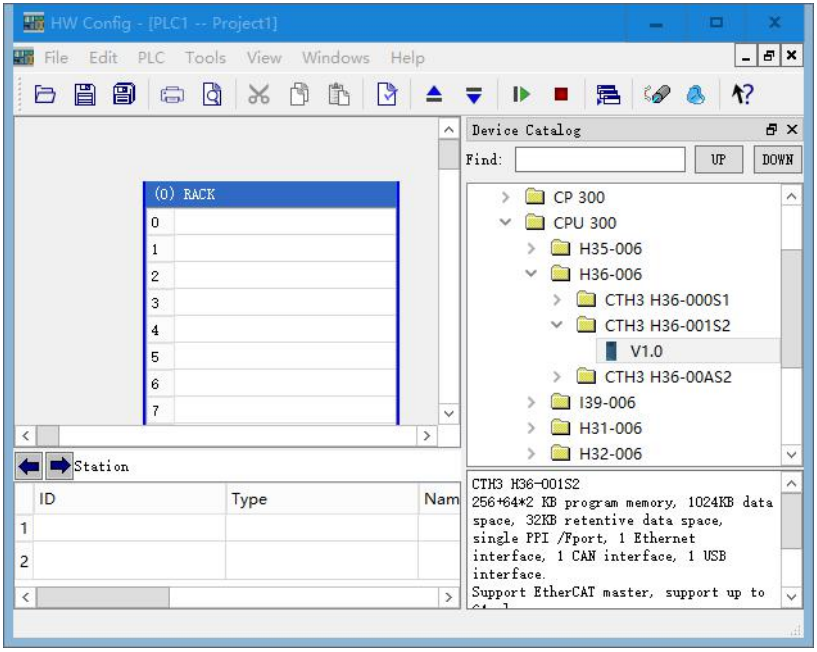
For more detaileds about MagicWorks PLC programming software, please refer to the *MagicWorks PLC user manual*, download address:

http://www.co-trust.com/Download/index.html

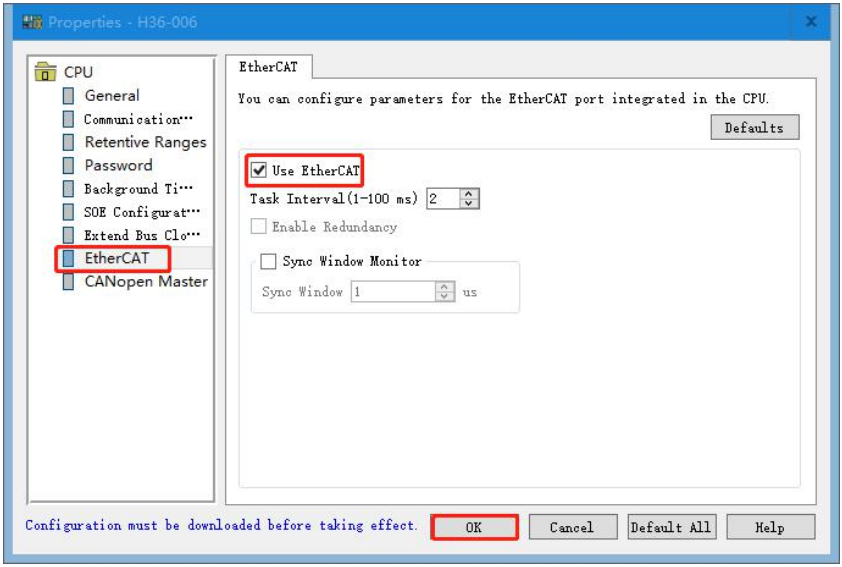
1) Open MagicWorks PLC software and enter the EtherCAT configuration interface under hardware configuration.



2) Expand CPU 300 node under Co-trust 300 node in device directory, select H36-006 and drag it into slot 1. As shown in the figure below:

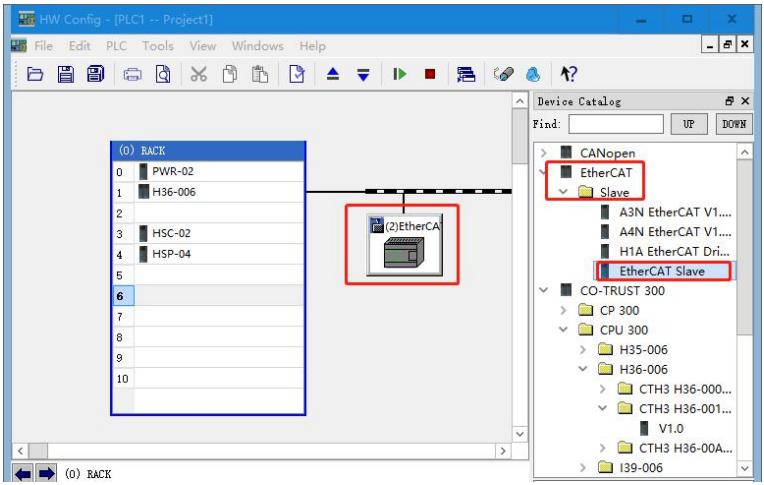


3) Double-click H36-006 in slot 1 to configure the communication parameters, select EtherCAT in the left directory bar, and tick "Enable EtherCAT master site function" in the right function item and click OK:

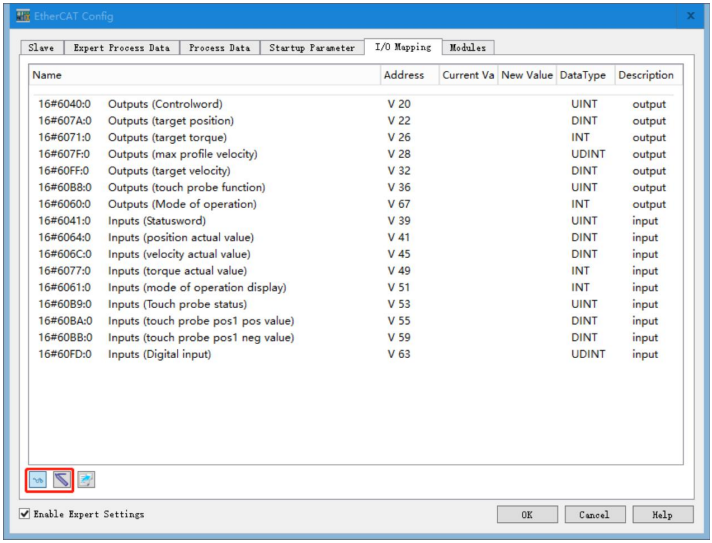


4) Expand the slave node in the device directory, select A4N as the slave and drag it onto

the EtherCAT bus:



5) Double-click the A4N slave station icon on the bus, and then configure parameters for it as needed:



The corresponding mapping address of the parameter can be written to the value of the relevant operation. For example, by setting the V memory address VW0 mapped by P279 to 15, the server can be enabled through EtherCAT communication.

The state of the parameter can be read by reading the corresponding mapping address of the parameter. For example, the mapping address VW16 of parameter R202 can check the type of servo alarm error

6) Diagnosing the EtherCAT master and master station network through the front panel of A4N and the SMB status word of MagicWorks PLC.

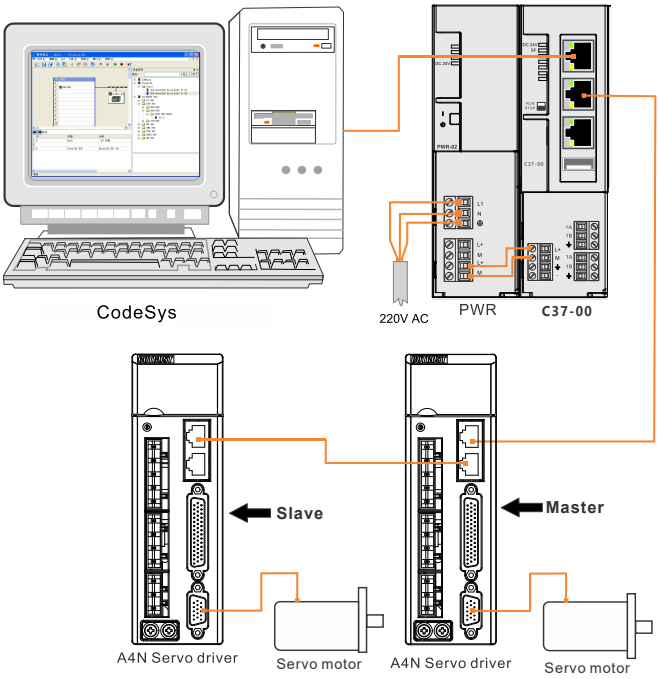
H36-00 special memory SMB400~SMB499 diagnostic function

SMB	description
SMB400	Number of EtherCAT slave stations found
SMB401	EtherCAT error: 0: No errors 1: Configuration parameter error 2: No slave station found 3: State switching error 4: Error writing configuration 5: Wrong number of slave stations
SMB402~SMB499	Status of the first slave station: 0: No connection 1: Initialize the state 2: Pre-operation state 4: Safe operation 8: Operation state

Example 2 uses Codesys software to realize electronic CAM based on EtherCAT communication

In this case, CTH3-C series motion controller C37-00 is used as EtherCAT master station and A4N servo driver is used as EtherCAT slave station. EtherCAT communication is carried out through Codesys software to achieve electronic CAM control function.

Schematic diagram of EtherCAT communication connection between A4N servo driver and C37-00 is as follows:



Remarks:

The station number is automatically assigned by the master station, and the physical connection determines the servo position.

Please refer to the following steps to configure EtherCAT in CoDeSys software:

1) Add EtherCAT master

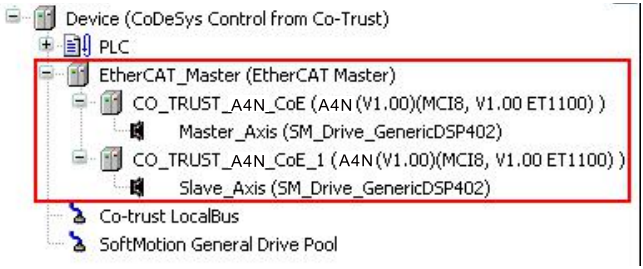
In the device view, select "device (CoDeSys control from CO trust)" and right-click to select "add device", then select Add EtherCAT master in the pop-up dialog box.

2) Add EtherCAT slave

In the device view, select the EtherCAT master station that has been successfully added and right-click to select "add device", then the slave station (A4N) connected to the EtherCAT master station can be added below the EtherCAT master station.

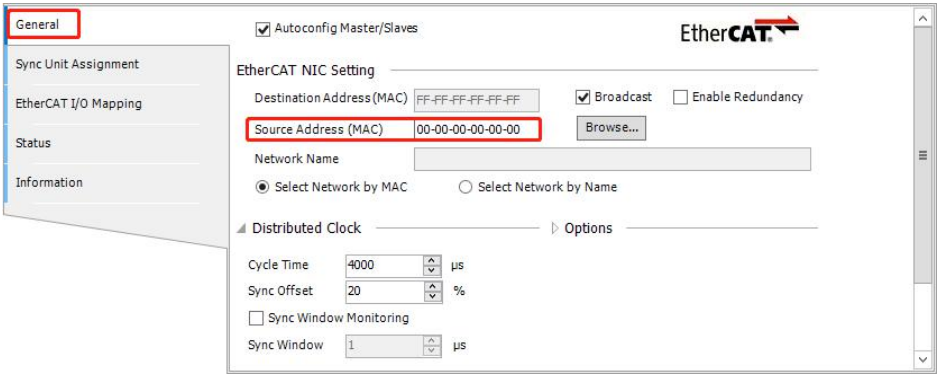
3) Add EtherCAT slave driver

In the device view, select the EtherCAT slave (A4N) and right-click, and select "add softmotion-DSP402-axis" in the pop-up menu, that is, the driver is added successfully.



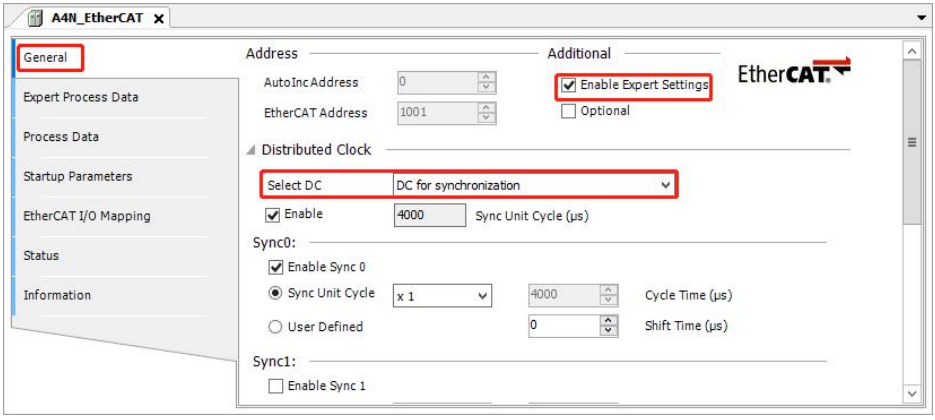
4) Configure EtherCAT master

Set the source address (MAC) in the " General" TAB: Click the "Browse" button to the right of "Source Address" and select the appropriate MAC address in the pop-up dialog box. Or select "select network by name" and enter the corresponding network name.



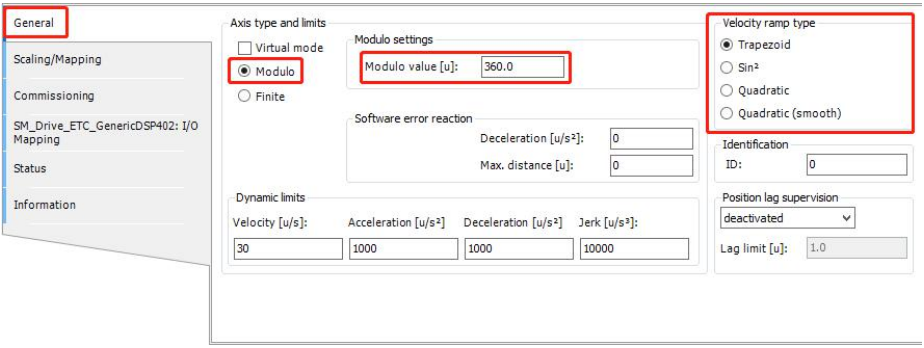
5) Configure EtherCAT slave (A4N)

On the “General” TAB, check "Enable Expert Settings," then select "DC for Synchronization" in the Select DC drop-down box.



6) Configure A4N driver（SM_Driver_GenericDSP402）

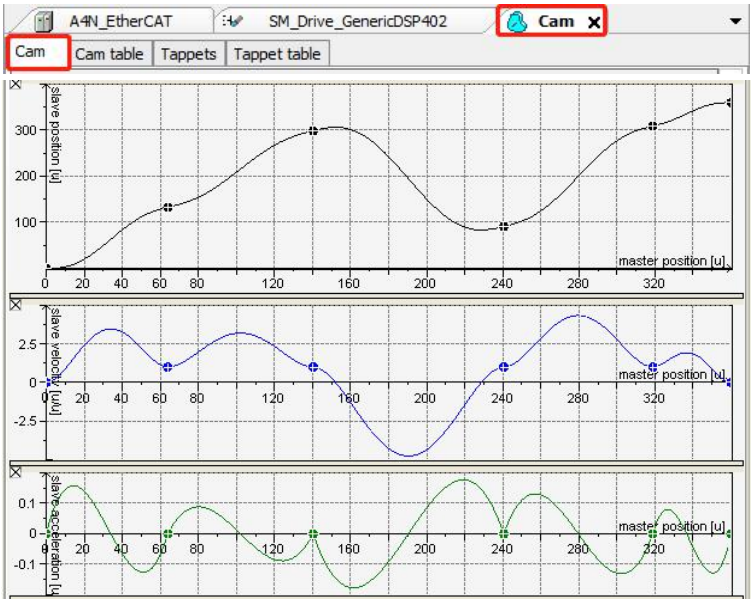
The "Softmotion Driver: Basic" TAB of SM_DRIVER_GENERICDSP402 is set as follows:



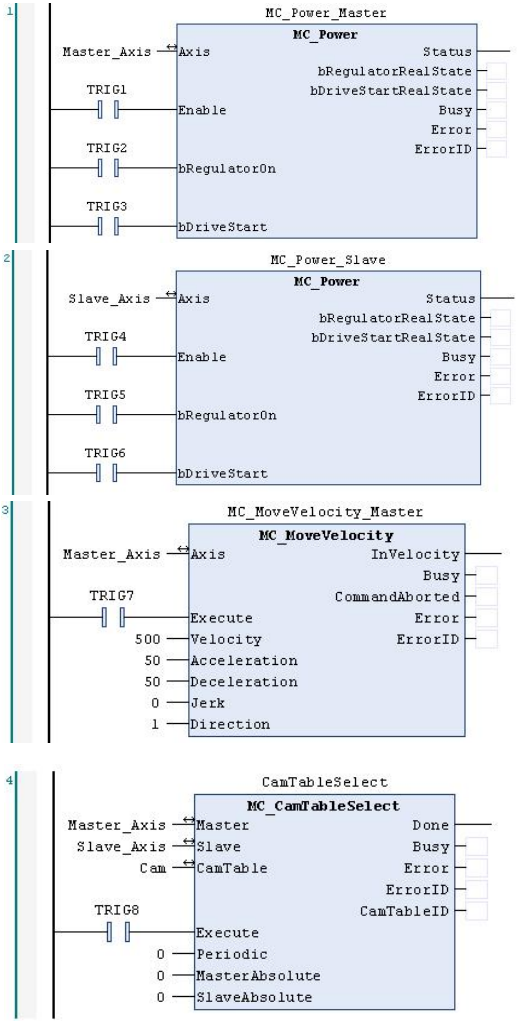
The running track is "Modulo", the Modulo value is set to 360.0, and the Velocity ramp type is Trapezoid.

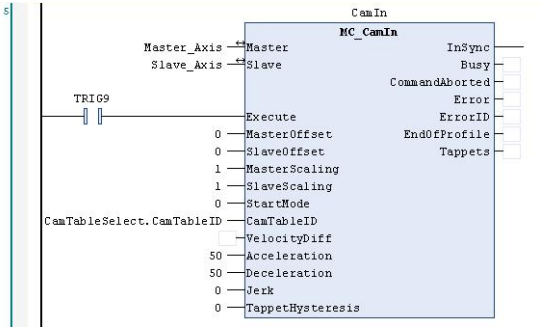
7) New Cam form

Expand "Device "→" PLC" in the Device view, and then right-click "Application" and select "Add Object "→" Cam table". Enter the name of the table in the pop-up dialog box, and click "Open". The CAM table will be created successfully. Double-click to open the Cam table you just created and adjust the electronic Cam table to the ideal condition, as shown below:



8) Expand "PLC" → "Application" in the device view, and then double-click to open "PLC_PRG" for programming:





9) Double-click "Device" in the Device view to open the Device dialog box, and then set up the communication in the TAB "Communication Settings" to communicate and connect C37-00 with the upper computer.

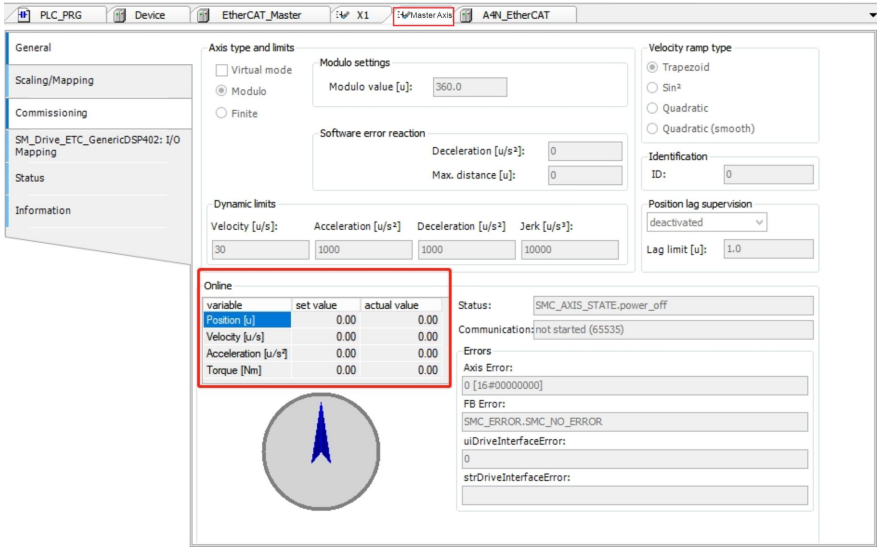
10) Operation and debugging

Double click on the device view to open the spindle Master_Axis. The effect of Master_Axis is as follows:

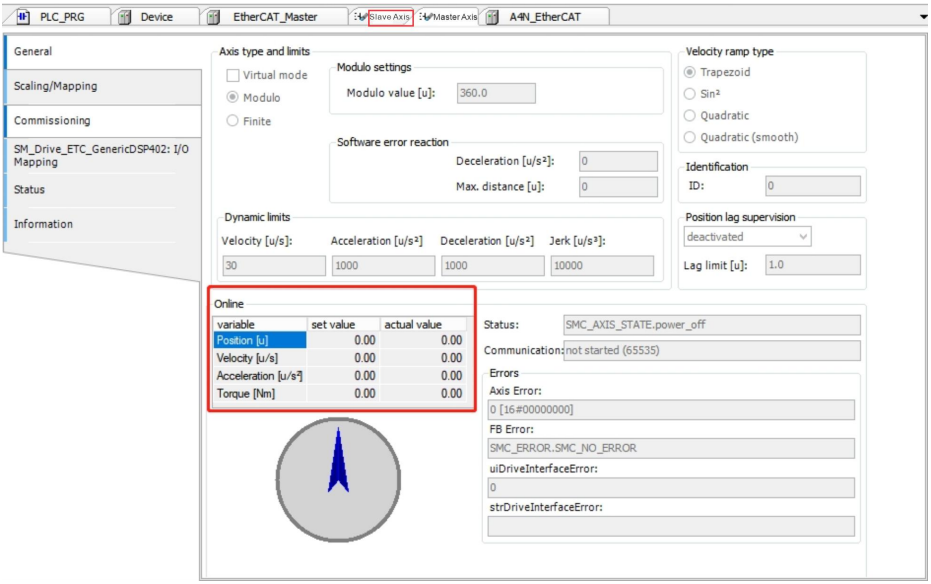
Select the menu item "Online" → "Login..." Make the application connect with C37-00 and enter the online state; Then select the menu item "Debug" → "Start" to start the application in C37-00.

Double-click "PLC_PRG(PRG)" in the device view to open the program table, trigger and download each instruction in turn.

Double click on the device view to open the spindle MASTER_AXIS. The effect of MASTER_AXIS is as follows:



Double-click in the device view to open Slave_Axis. The effect of Slave_Axis is as follows:



<note> For detailed the use of CTH300-C series motion control, please refer to *CTH300-C series motion controller manual*

Download website: http://www.co-trust.com/Download/index.html

5. Diagnosis

If the EtherCAT communication process is abnormal, please check the parameter P237 through the front panel of A4N servo driver to diagnose the current EtherCAT network. The function description of P237 is shown in the following table:

NO.	Name	Description
237	EtherCAT communication status word	EtherCAT communication status: Bit 3:fault，1: on Bit 10: position arrival ,1: on

Causes of EtherCAT communication failure:

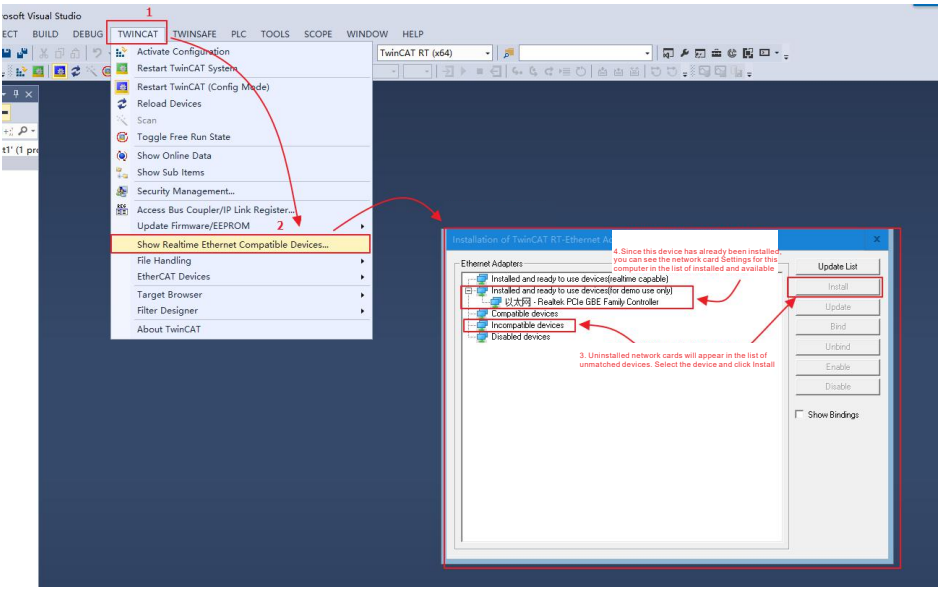
Alarm code	Alarm type	Cause of failure
15	EtherCAT abnormal communication	When EtherCAT communication is abnormal, there is a fault: ● The communication environment is greatly disturbed; ● The communication is blocked for a long time; ● The communication line is broken; ● The master station is abnormal.

8.1.2 Example of A4N communication controlled by Beckhoff CPU

TwinCAT3.0 is used as the programming environment, and the EtherCAT communication is realized by using Beckhoff PLC and A4N servo driver.

Install TWINCAT software

After installing TwinCAT, add a network card driver (the operating system environment for this example is Win10). The operation is as follows:



Preparation steps

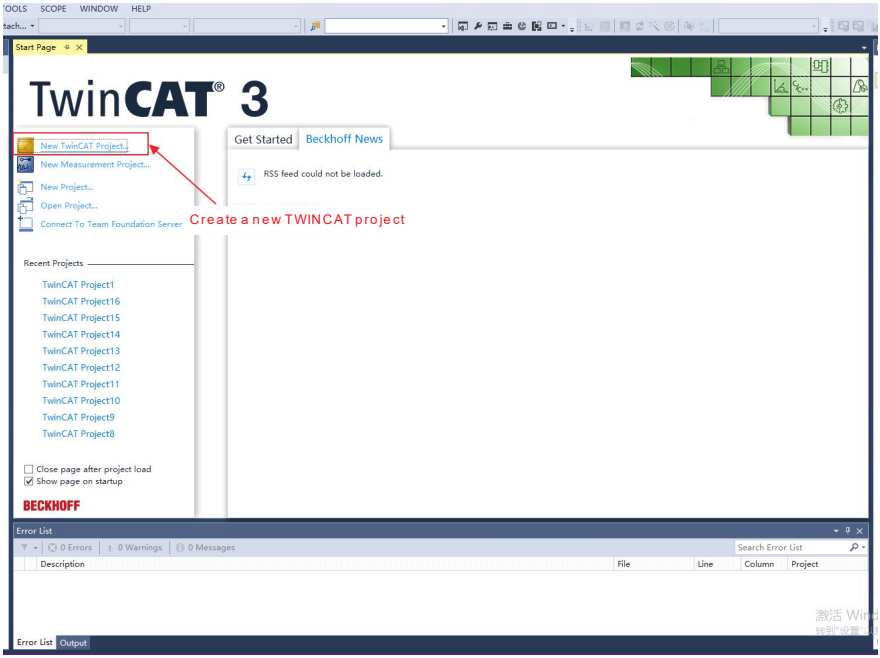
1. Put the device description file to be used in the corresponding path of the installation directory of TWINCAT 3, and set the control mode of A4N servo to EtherCAT communication control mode (P1= 15).

<Note>: The required equipment description files can be downloaded from COTRUST's official website . Download address: http://www.co-trust.com/

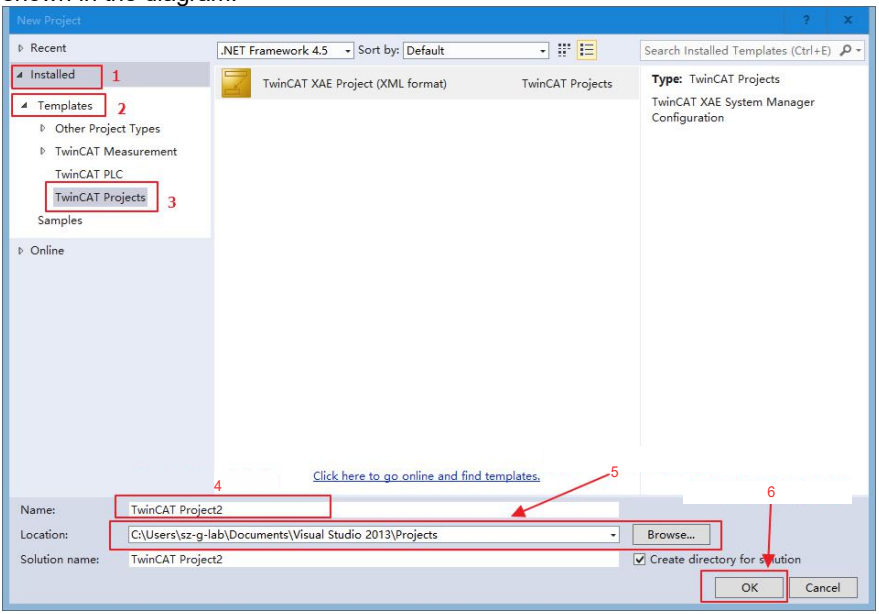
2. Restart TWinCAT3 or perform the next step for the first time.

3. Find the TWINCAT3 on your computer. Usually you can see this icon in the system tray after the installation. Start TWinCAT3.

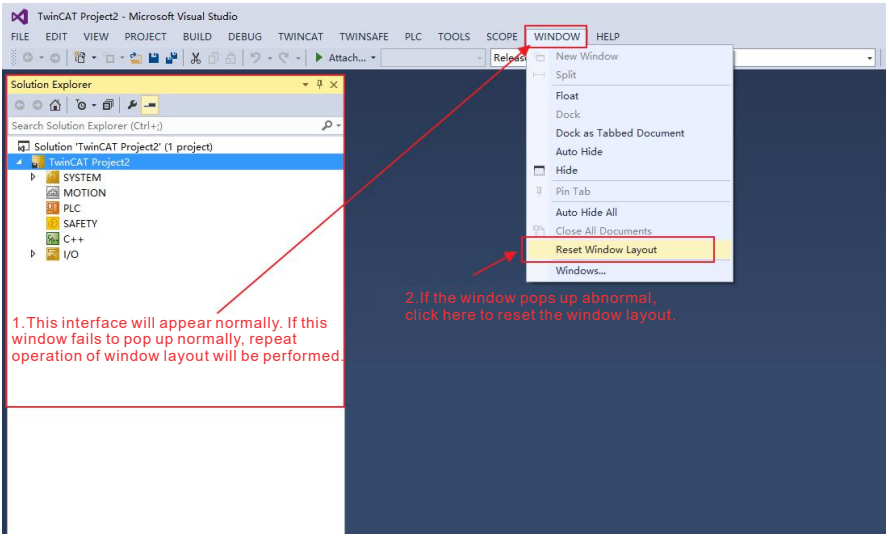
4. After Twincat3 is started, the following interface will appear. Select a new project in the interface, and users can customize the specific storage path and project name according to their needs.



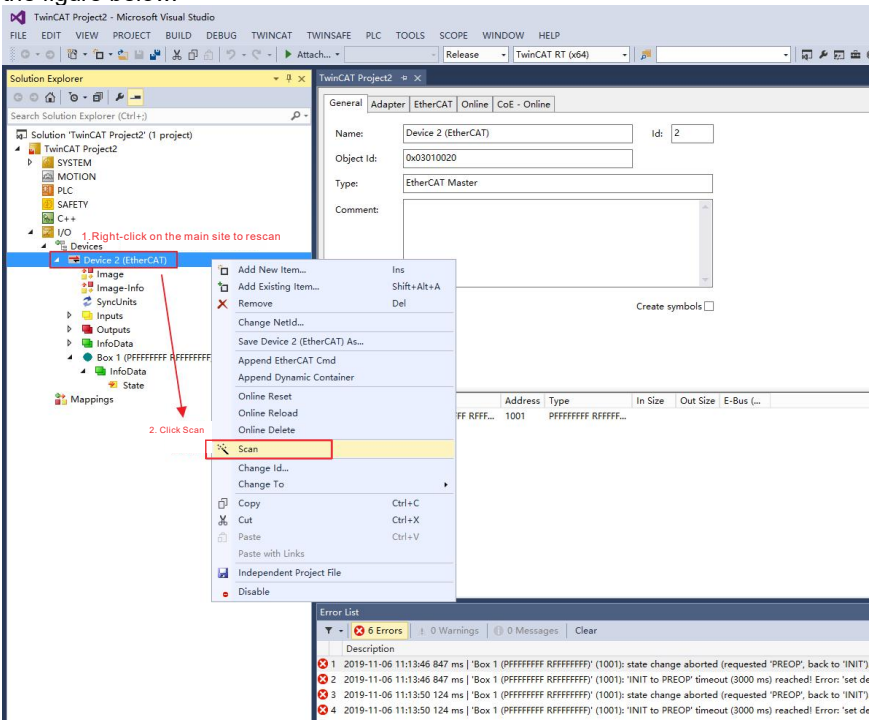
5. After building a new project, the following dialog box will appear. Follow the steps shown in the diagram.



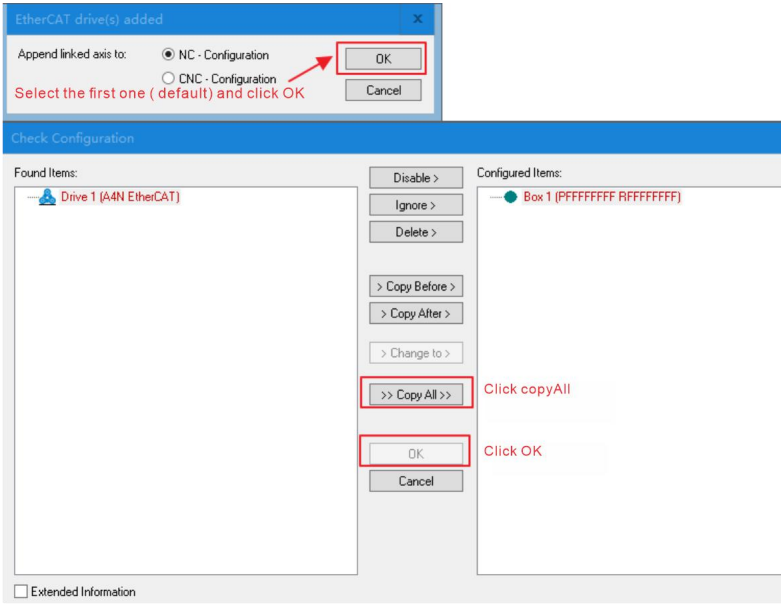
6. After the new project is created, it will enter the following project interface.



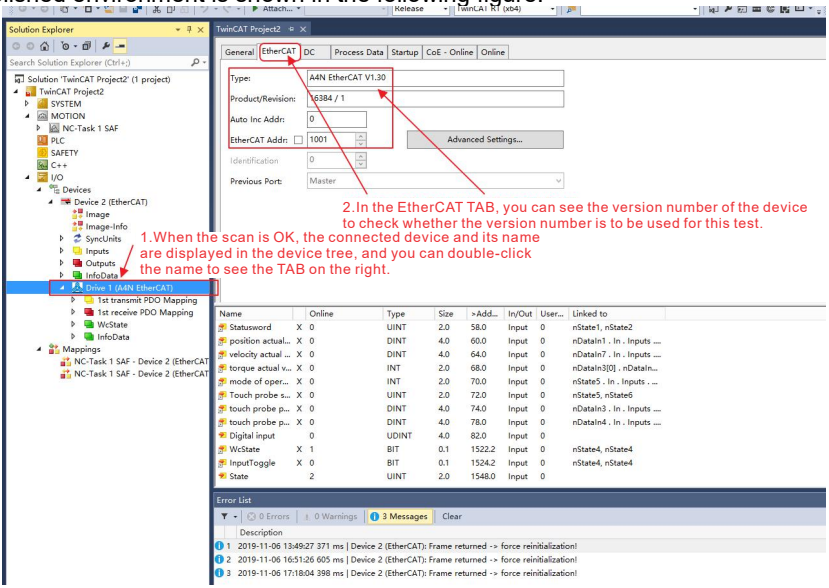
7. Expand I/O→ Devices in the directory tree and perform device scanning as shown in the figure below.

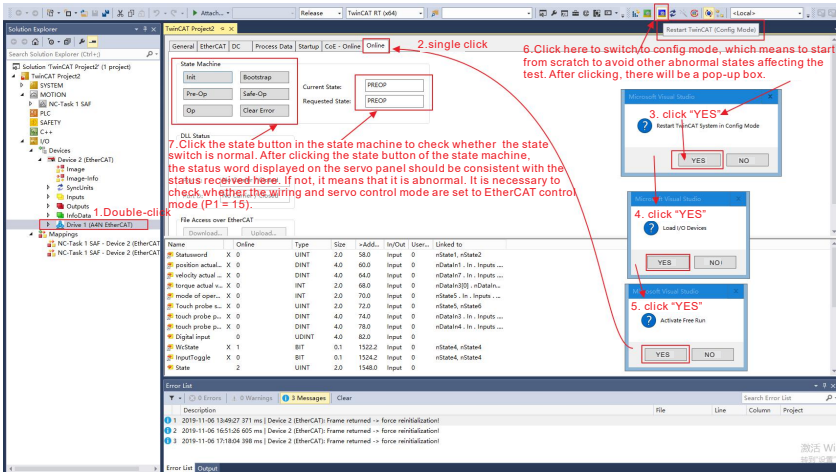


8. After clicking Scan, the following situations may occur. Just execute according to the figure below



9. After operations, the test environment has been set up, and the test can start. The established environment is shown in the following figure.

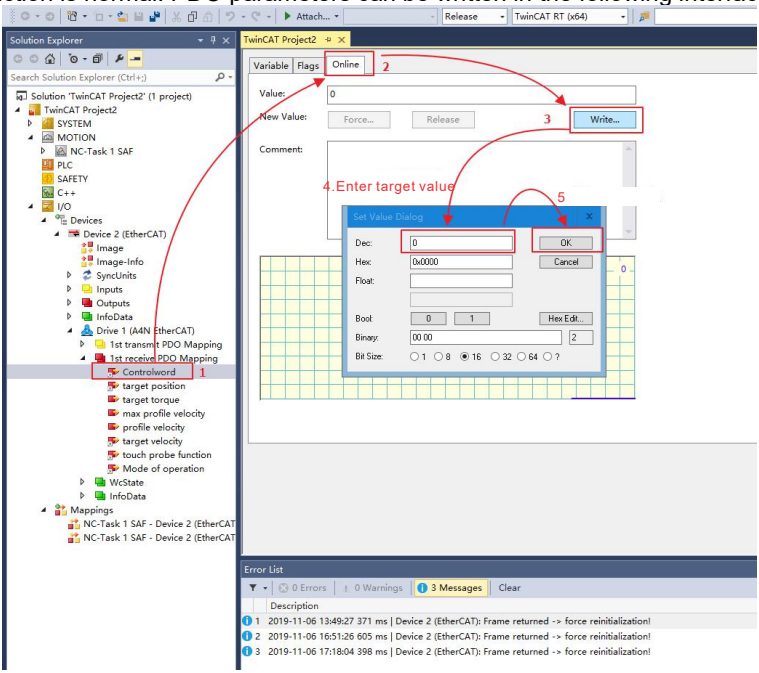




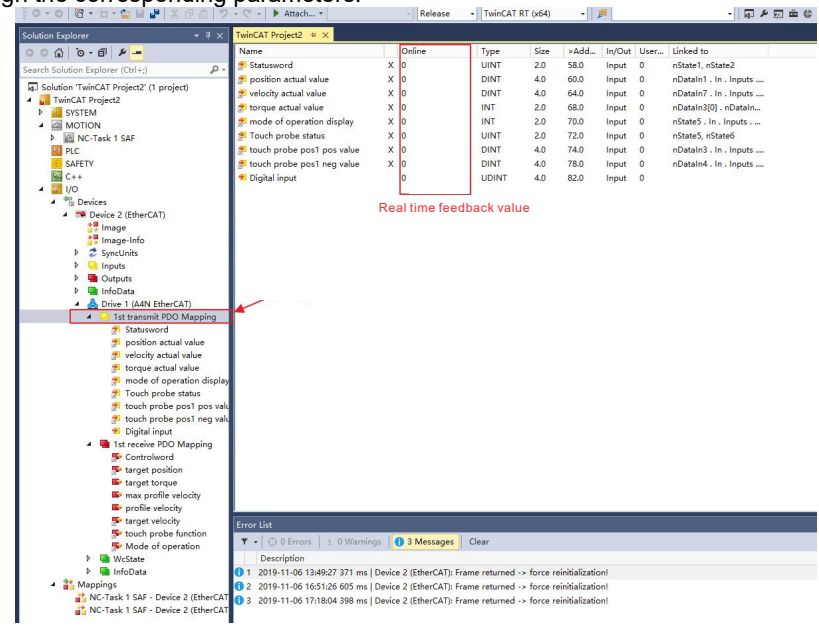
Application demonstration

1. This demonstration is mainly to verify whether the TPDO object is normal and the mode switch is normal after adding and deleting the RPDO object in the device description file. The above steps are mainly to burn the device description file to the servo and connect the servo on TWinCAT. After the preparation, it is better to restart the servo and search the connected servo again with TWinCAT.

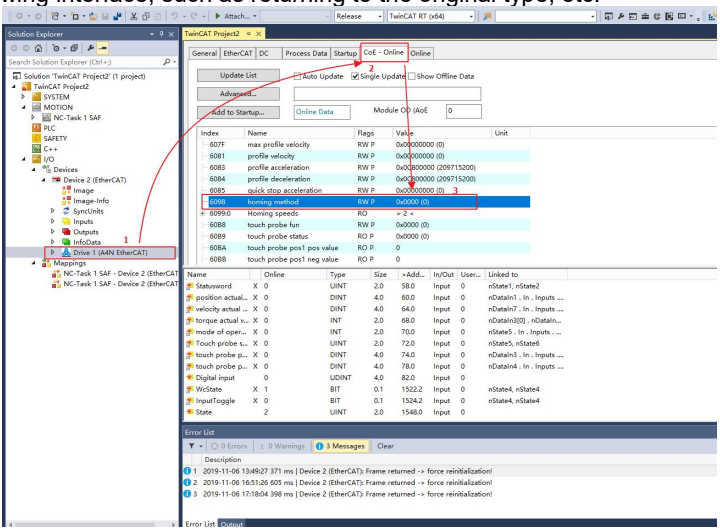
2. Before adding or deleting RPDO objects, first test the original environment to see if each function is normal. PDO parameters can be written in the following interface.



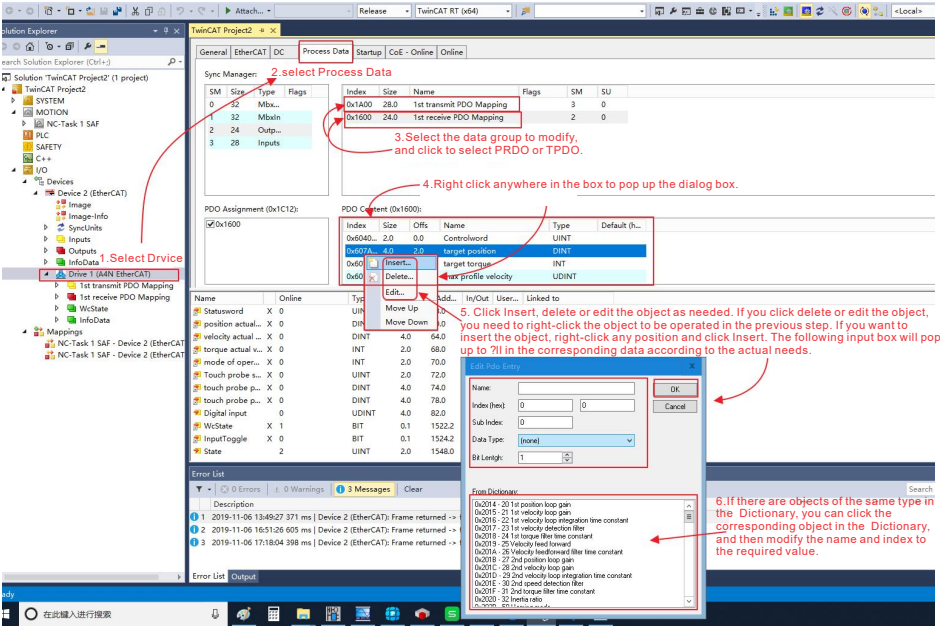
3. After the parameter is written, some parameters will have feedback values. You can check whether the writing is successful and whether the corresponding state is correct through the corresponding parameters.



4. If some parameters need to be modified in the COE-Online TAB, you can modify them in the following interface, such as returning to the original type, etc.



5. After the test of the original file is completed, you can test whether the relevant PDO data is added or deleted, and then test whether the relevant feedback value is still normal. Add or delete data can be performed according to the steps below.

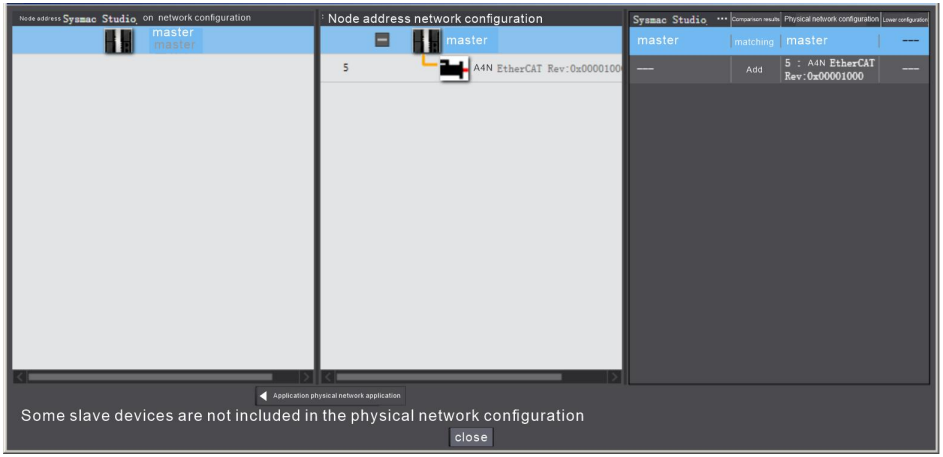


8.1.3 Example of A4N communication controlled by OMRON CPU

Step 1: set up EtherCAT slave station as follows:

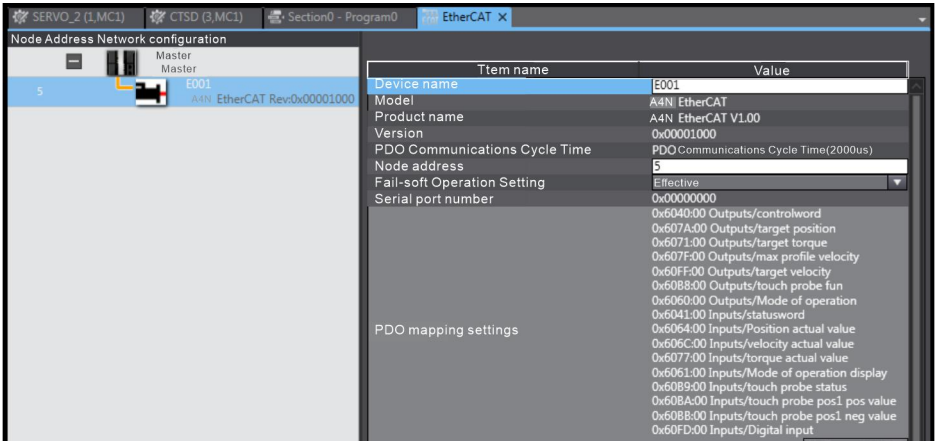
1. Import servo ESI file into sysmac studio

2. After restarting sysmac studio, connect PLC online, select "compare and merge with physical network configuration" in "EtherCAT" to synchronize device configuration.

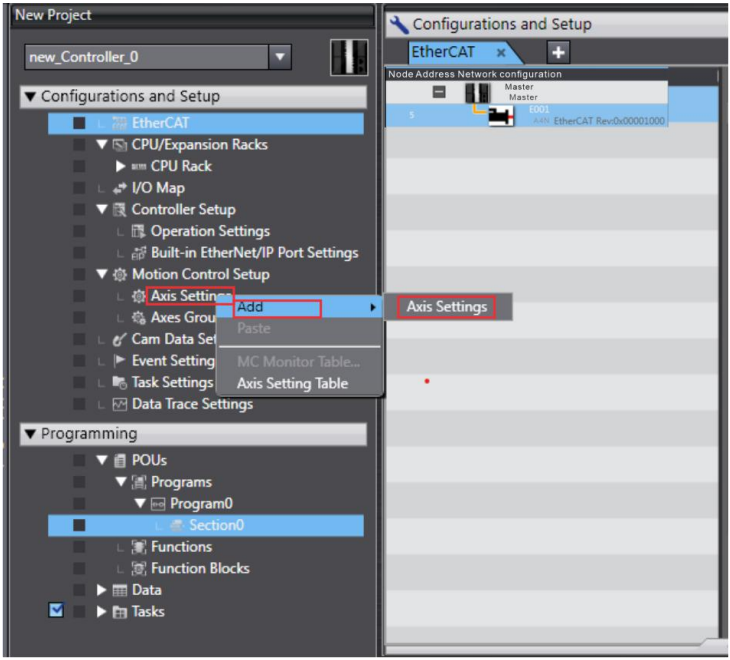


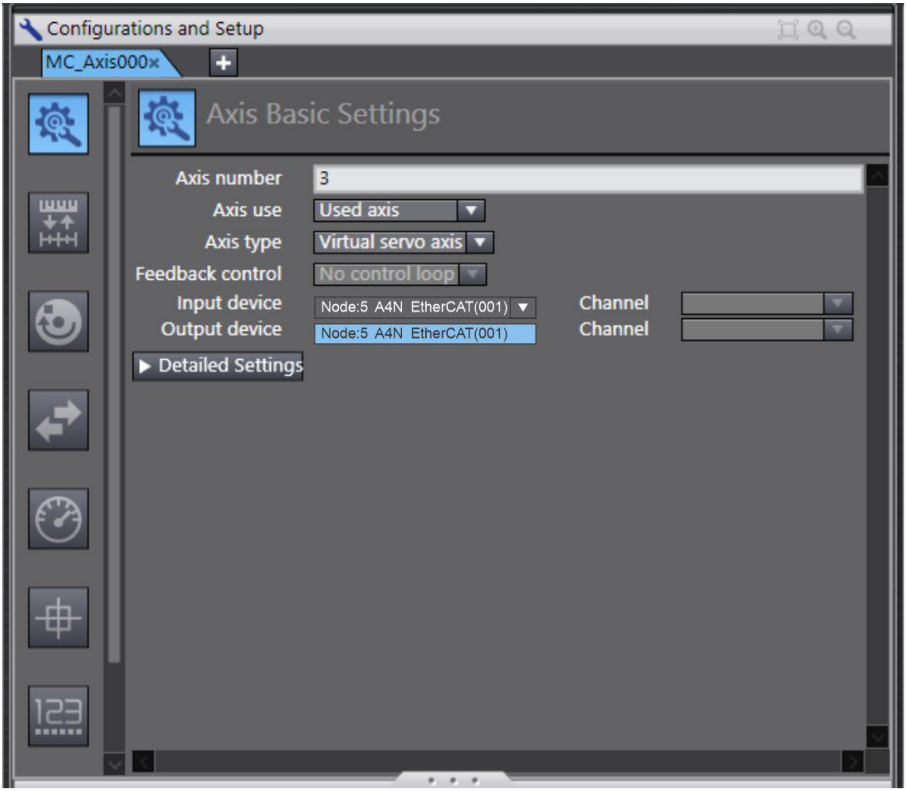
3. Set the address of the servo node, which should be consistent with the address set in

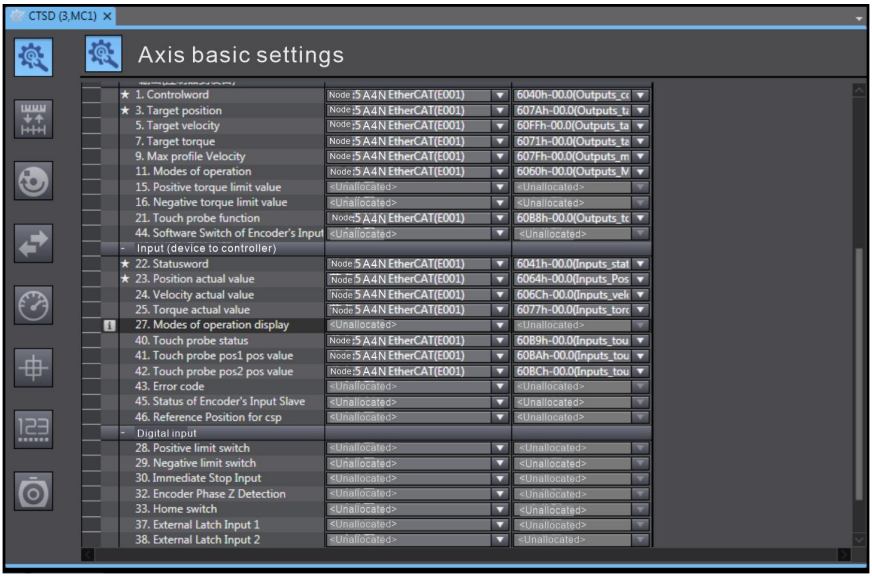
the controller.



4. Add the motion control axis "CTSD", select "Output Device 1" as A4N servo controller in "Basic Settings of Axis", and configure the corresponding process data in "Detailed Settings", as shown in the figure below.

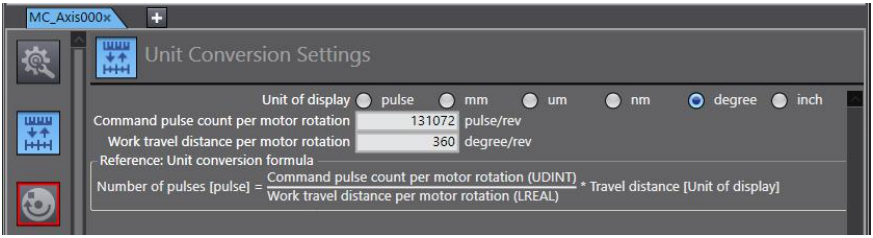




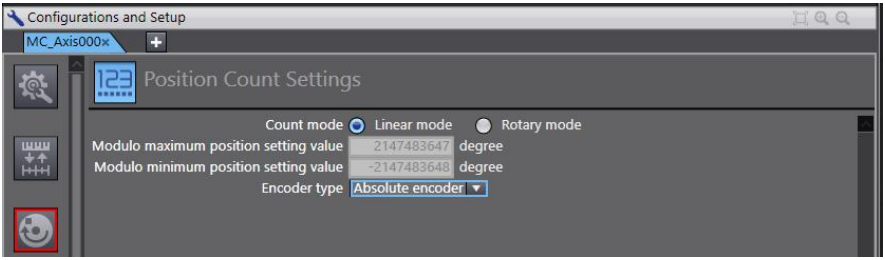


5. In the "Unit Conversion Settings" interface, change the parameters according to the

actual demand, and change the "Command pulse Count per motor rotation" to "131072".

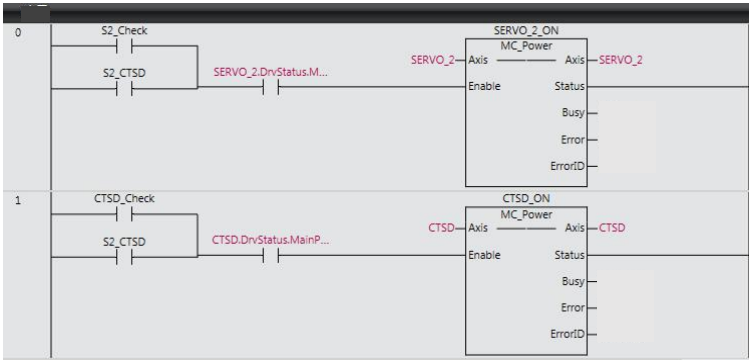


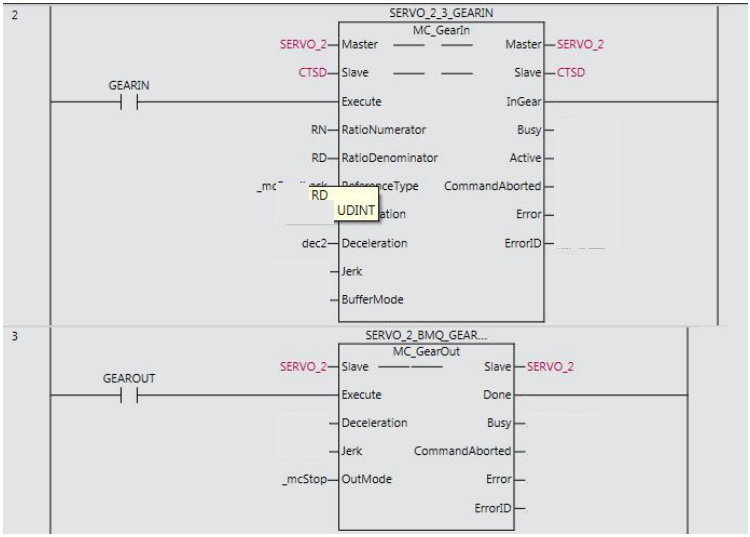
6. In the "Position Count Settings" interface, set "Encoder type" to "Absolute Encoder".

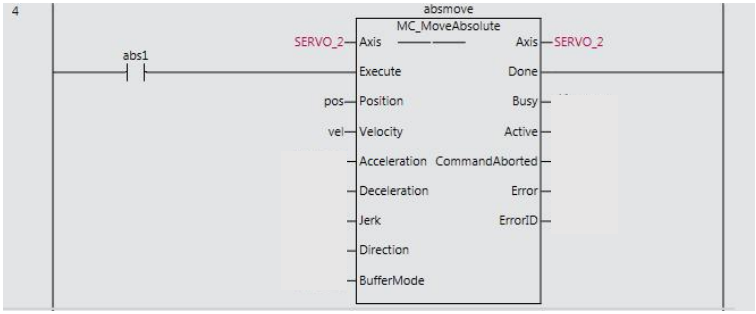


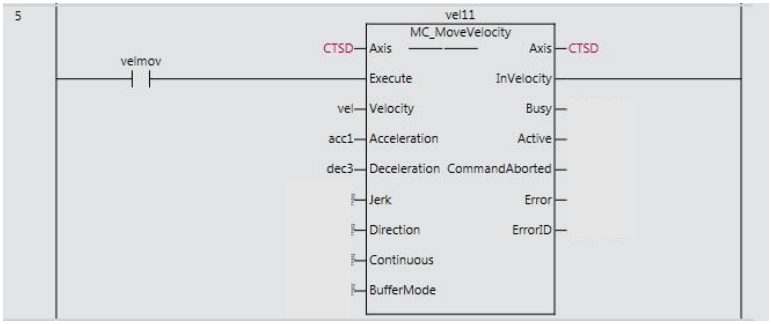
7. Add servo controller, configure and add motion control axis "SERVO_2"

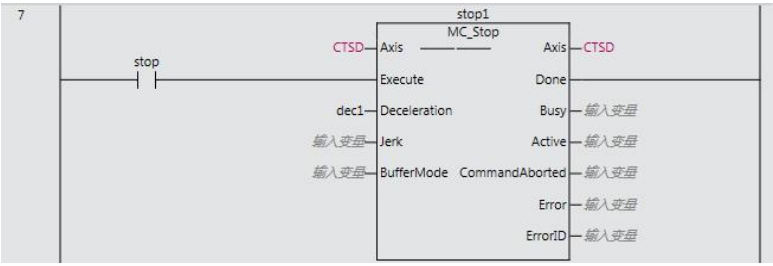
Step 2: Write PLC program to control the movement of A4N servo driver




2
SERVO_2_3_GEARIN
MC_GearIn
SERVO_2
Master
Master
SERVO_2
CTSD
Slave
Slave
CTSD
GEARIN
Execute
InGear
RN
RatioNumerator
Busy
RD
RatioDenominator
Active
RD
UDINT
CommandAborted
Error
dec2
Deceleration
ErrorID
Jerk
BufferMode
3
SERVO_2_BMQ_GEAR...
MC_GearOut
SERVO_2
Slave
Slave
SERVO_2
GEAROUT
Execute
Done
Deceleration
Busy
Jerk
CommandAborted
_mcStop
OutMode
Error
ErrorID


4
absmove
MC_MoveAbsolute
SERVO_2
Axis
Axis
SERVO_2
abs1
Execute
Done
pos
Position
Busy
vel
Velocity
Active
Acceleration
CommandAborted
Deceleration
Error
Jerk
ErrorID
Direction
BufferMode


5
vel11
MC_MoveVelocity
CTSD
Axis
Axis
CTSD
velmov
Execute
InVelocity
vel
Velocity
Busy
acc1
Acceleration
Active
dec3
Deceleration
CommandAborted
Jerk
Error
Direction
ErrorID
Continuous
BufferMode



8.2 Modbus RTU Communication Protocol

A4N 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, A4N 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, A4N 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 9.2.2 Example Of Communication Speed Control Mode for the example of Modbus communication

9

Applications of Basic Control Modes

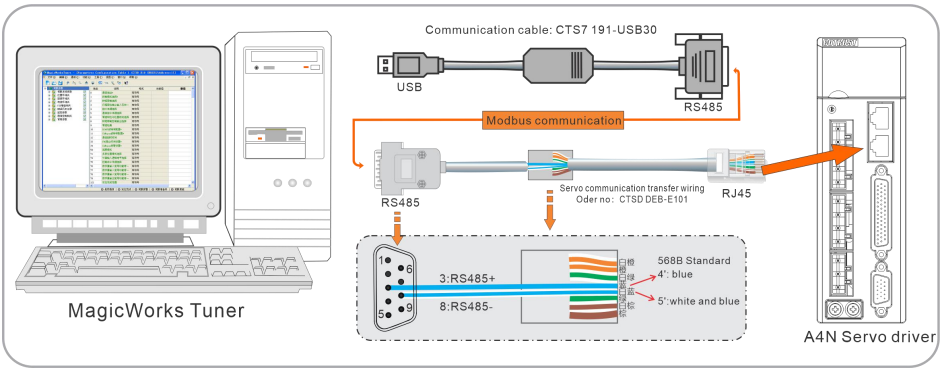
pplications of communication/external control modes

9 Applications of Basic Control Modes

Applications of communication control and external control mode

You can set the parameters of A4N 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.

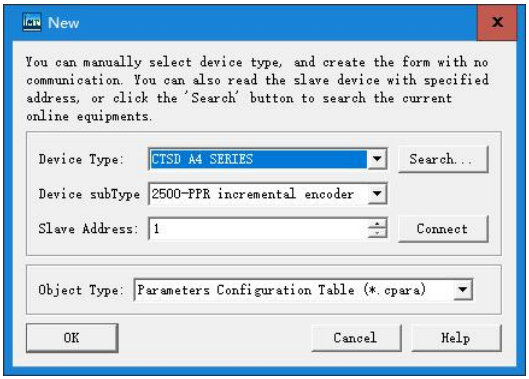
Connect upper computer with A4N servo driver as below, an isolated serial port converter is recommended.



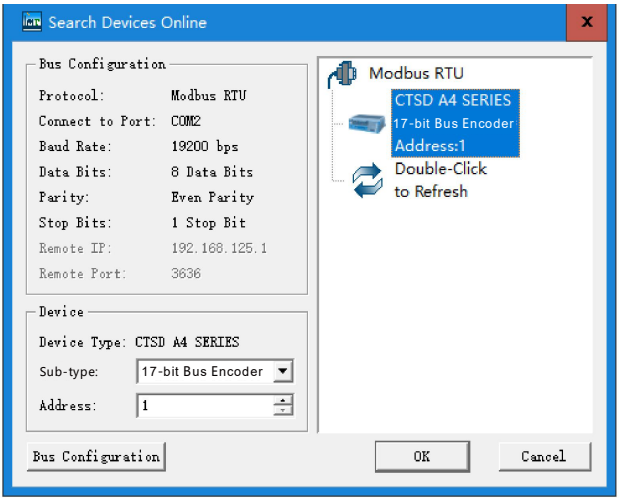
Here are steps to use MagicWorks Tuner:

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 the menu item "connect "→" search", or directly click the search button on the toolbar to open the search dialog box (factory default baud rate is 19200bps, even parity). Double click refresh to start the search.



4) In the parameter table, select the parameter to operate, and then click the write button on the toolbar to write the setting value of the current parameter to the servo in the status table. Finally, click the save to EEPROM button on the toolbar to save the setting; Parameters with ※ need to power off and restart the servo to take effect.

9.1 Test Run

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

Step 1: Wiring

Please refer to 4 Wiring connect the main power supply, control power supply, encoder, motor drive cable, etc., and then power up the servo drive. If the servo drive LED has a red light on, please refer to Section 11 Protection function deal with the fault.

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 （communication command source selection） 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 X communication given speed command (P324 ~ 355 are 32 given speed parameters) through P05 (communication command source selection). In this example, if P05 is set to 0, the motor will rotate with the parameter 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 (p358-389 is 32 given torque parameters) via P05 （communication command source selection） , 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 Communication control mode

Communication control mode includes three control modes: communication position, speed and torque.

Communication position control mode: change the position command through communication mode to control the position.

Communication speed control mode: change the speed command through communication mode to control the speed.

Communication torque control mode: change the torque command through communication mode to control the torque.

9.2.1 Application example of communication position control mode

[Relevant Parameters]

No.	Name	Description
P01	Control mode selection	6: Communication position control -P
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 resolut
P87	Numerator of 2nd command pulse ratio	
P88	Command pulse division/multiplication denominator	
P97	3rd internal speed	Execution speed of communication position control mode
P121	Positioning completion scope	Set the location to complete the range.

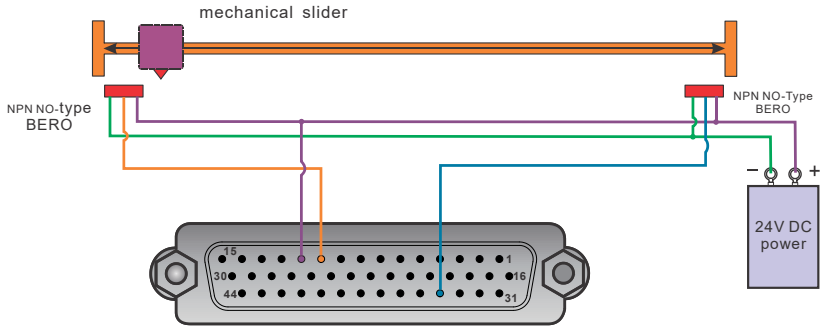
No.	Name	Description
P04	Command source selection	Select the command source of the control mode
P05	Communication command source selection	0 ～ 15： Select communication given position command
P281	Communication extension control word	Communication given control commands, such as zero-speed clamp, return to original command, etc.
P282	Communication control word	Communication given control commands, such as servo enable, alarm clear, etc.
P71	Communication position control mode	Bit0: 0: Absolute position, 1: Relative position
P290~320	Given position	P290: Given position0 P292: Given position 1 ..... P320: Given position15
P204	Output status	Servo system status output, such as return to original completion, positioning completion, etc.

[example]

The example introduces the A4N servo and COTRUST's motion control CPU for EtherCAT communication position control, please follow the steps below:

Step 1: Wiring the servo

Connect the limit switch signals in both directions to the servo control signal terminal: the left sensor is used as the origin switch signal, and the right sensor is used as the counterclockwise travel limit.



Step 2: Configure parameters

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

② Set communication address: P0=2

③ 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)

No.	Bit	PIN	symbol	value
P78	B8~B15	34	DIN2	16#02：CCW overtravel inhibit
	B0~B7	10	DIN1	16#0B： Original switch input

⑥ 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:

No.	Bit	Function	Value of Bit	Effective way
P72	2	CCW overtravel inhibit	0	External input disconnect is valid
			1	External input conduction is valid
	11	Original switch input	0	External input conduction is valid
			1	External input disconnected and effective

⑦ Select homing mode: P59=1 (Refer to Negative original switch and Z-phase signal)

Step 3: Configure EtherCAT communication via MagicWorks PLC

For specific examples, please refer to Example 1 in 8.1 EtherCAT Communication Protocol through MagicWorks PLC. For EtherCAT communication, only when P279 is set to 15, or P282_bit0 is set to 1, can the servo be enabled.

9.2.2 Example Of Communication Speed Control Mode

[Relevant Parameters]

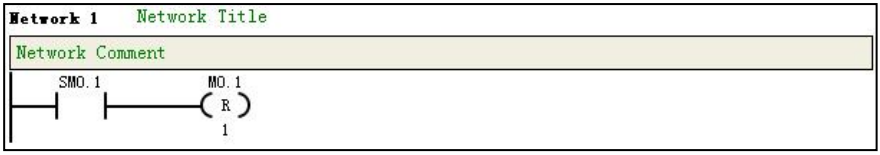
No.	Name	Description
P01	Control mode setup	7: Communication Speed control -S
P113	Acceleration time setup	Set the acceleration/deceleration time, convert to smoother ACC/DCC speed command
P114	Deceleration time setup	

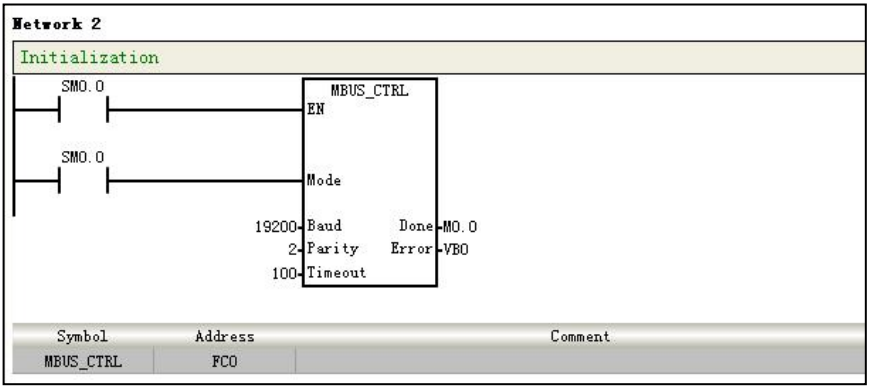
P04	Command source selection	Select the command source of external speed control mode and communication control mode.
P05	Communication command source selection	0~31: select communication given speed command
P281	Communication extended control word	Communication given control command, such as Zero-speed 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]

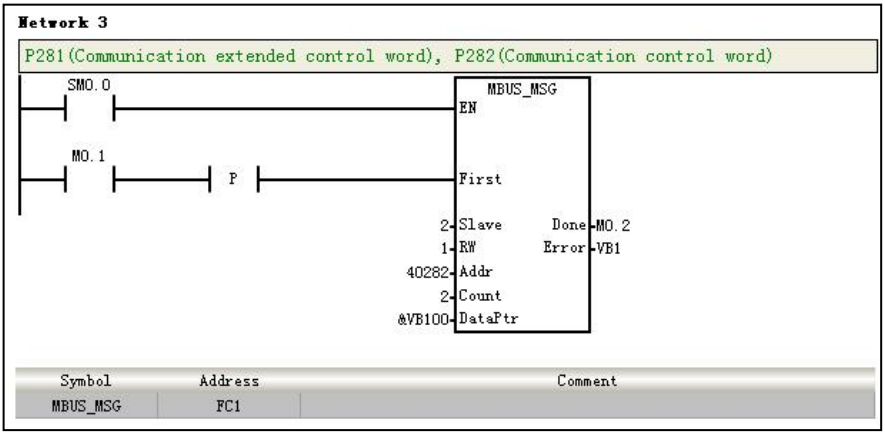
Here introduces the Modbus communication between A4N servo and CPU 226M in communication speed control mode, please refer to following steps:

网络 1 and 2：Master initialization





Network 3: Sequentially write two words to P281(Communication extended control word) and P282(Communication control word) of the driver, whose communication address is 02.



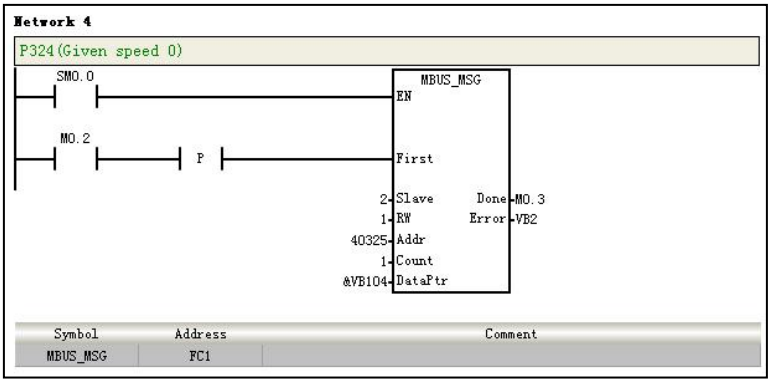
Servo-on request frame (P282_Bit0 =1):

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 a new value of 100 to the single parameter P324 (given speed 0) of the drive with communication address 02.



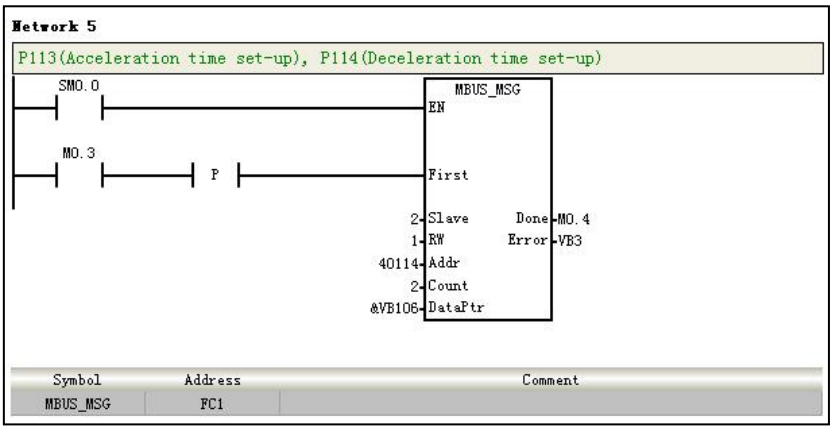
Request frame:

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

Write a single parameter successfully, response 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

Network 5: continuously write new values 100 and 200 to the two parameters p113 / 114 (acceleration and deceleration time) of the driver with communication address 02.



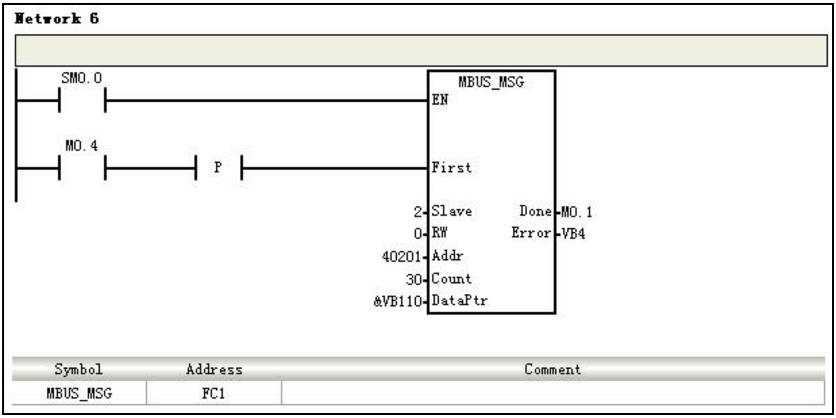
Request frame:

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

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#00	16#71	16#00	16#02	16#XX	16#XX

Network 6: The master station reads the drive parameters P200 ~ p229 with address 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 68 70 00 01 00

9.2.3 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 Application 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 A4N 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 Parameterfor details of parameter.

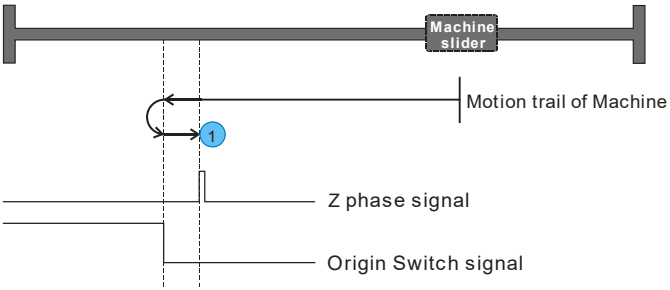
[Mode specification]

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

Homing Mode	descripton
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

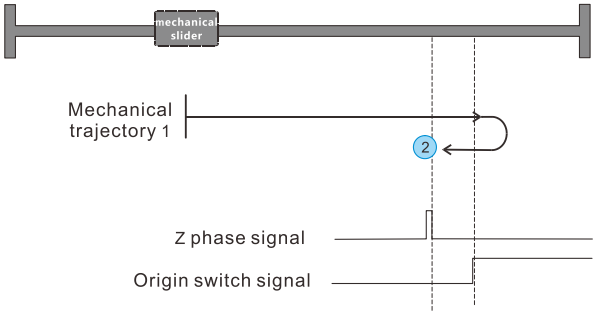
No matter where the machine located, the original point servo searched is always unique after the desired device (original switch and positive/negative overtravel inhibit switch) were well installed. Symbol "|" in following diagram indicates the mechanical initial position, "X" represents the original position.

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



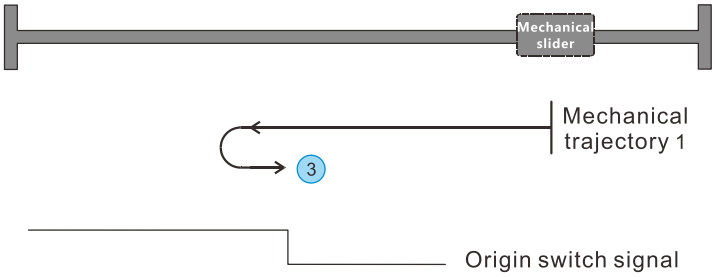
The origin switch located in the negative mechanical direction. The machine moves towards the origin switch, decelerates to stop after detecting the origin switch, then reverses to exit the origin switch, finds the next Z phase signal of the motor and records it as the origin, the motor stops immediately.

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



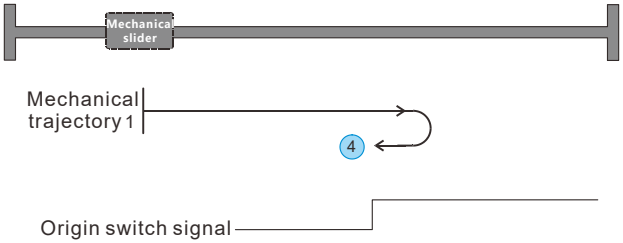
The Homing switch located in the positive mechanical direction. The machine moves towards the Homing switch, decelerates to stop after detecting the Homing switch, then reverses to exit the Homing switch, finds the next Z phase signal of the motor and records it as the Homing, the motor stops immediately.

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



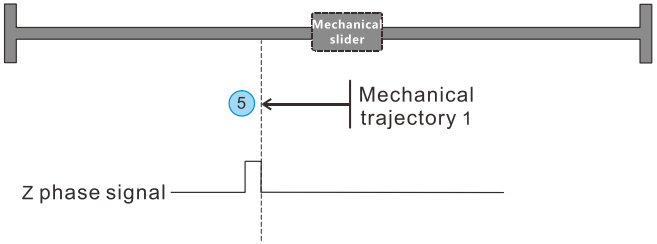
The Homing switch located in the negative mechanical direction. The machine moves towards the Homing switch, decelerates to stop after detecting the Homing switch, and then reverses to exit the Homing switch. Find and record Homing switch signal falling edge as the Homing, and the motor stops immediately.

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



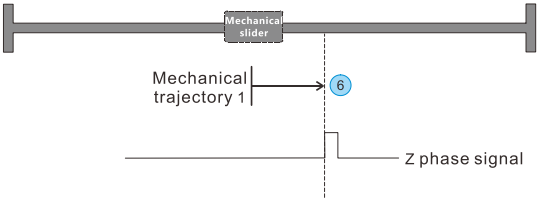
The Homing switch located in the positive mechanical direction. The machine moves towards the Homing switch, decelerates to stop after detecting the Homing switch, and then reverses to exit the Homing switch. Find and record Homing switch signal falling edge as the Homing, and the motor stops immediately.

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



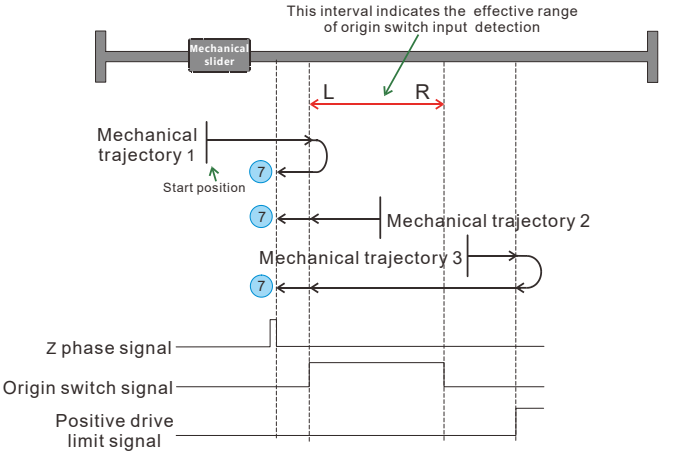
The motor moves along the negative direction from the current position and records it as the Homing when the next Z phase signal is found.

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.

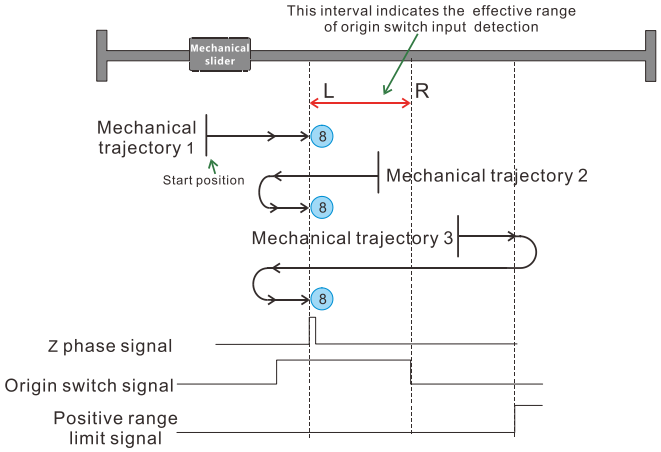
Homing mode 7: Refer to Homing mode of Homing switch, Z phase signal and positive limit (adopt Z phase signal of positive Homing switch left of left edge)



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.

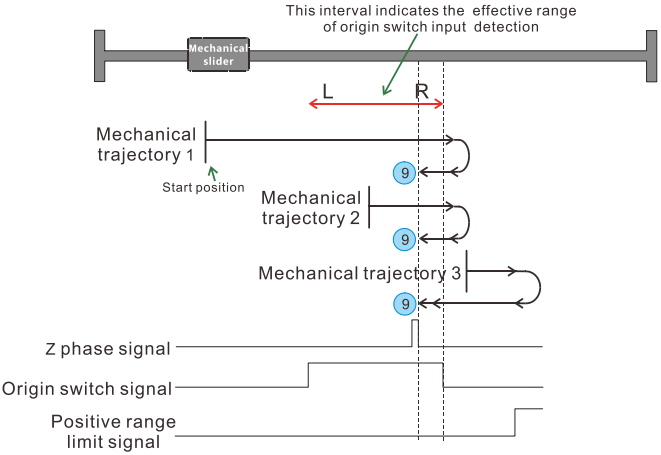
Homing mode 8: Refer to Homing mode of Homing switch, Z phase signal and positive limit (adopt Z phase signal of positive Homing switch right of left edge)



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.

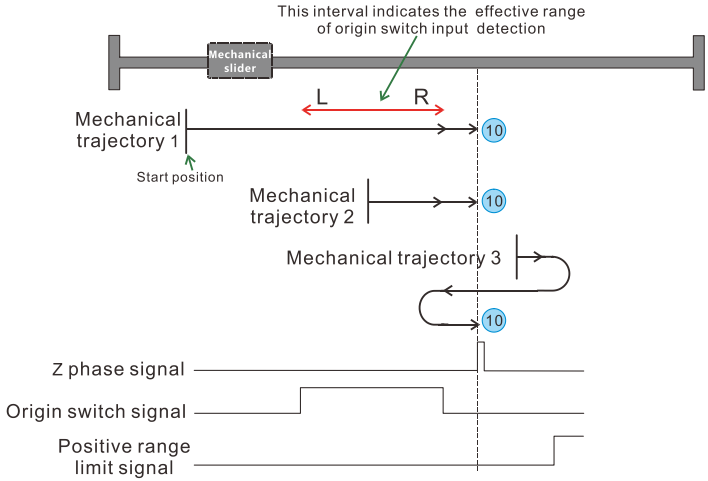
Homing mode 9: Refer to Homing mode of Homing switch, Z phase signal and positive limit (adopt Z phase signal of positive Homing switch left of right edge)



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.

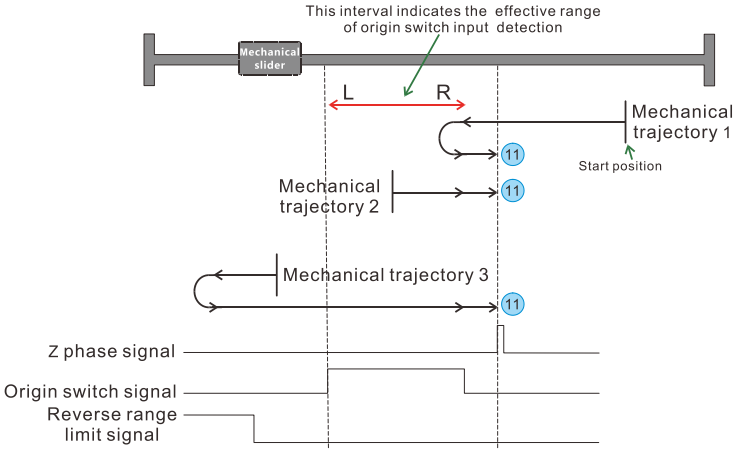
Homing mode 10: Refer to Homing mode of Homing switch, Z phase signal and positive limit (adopt Z phase signal of positive Homing switch right of right edge)



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.

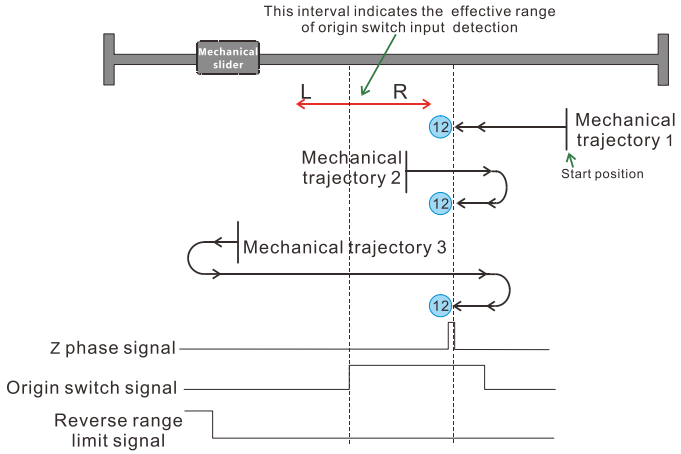
Homing mode 11: Refer to Homing mode of Homing switch, Z phase signal and negative limit (adopt Z phase signal of positive Homing switch right of right edge)



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.

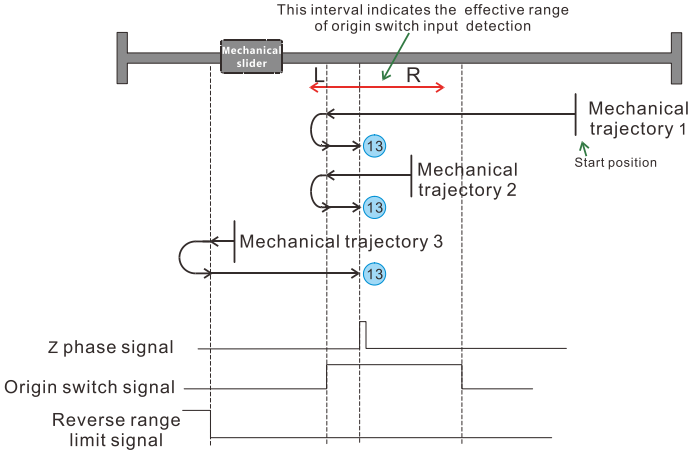
Homing mode 12: Refer to Homing mode of Homing switch, Z phase signal and negative limit (adopt Z phase signal of positive Homing switch left of right edge).



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.

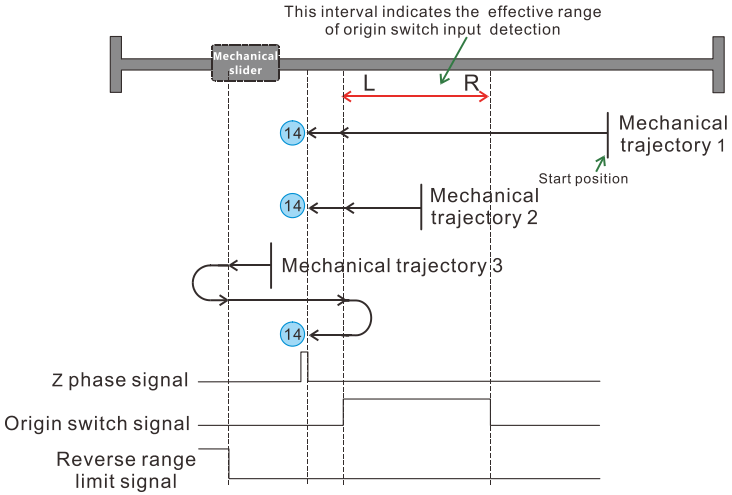
Homing mode 13: Refer to Homing mode of Homing switch, Z phase signal and negative limit (adopt Z phase signal of positive Homing switch right of left edge).



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.

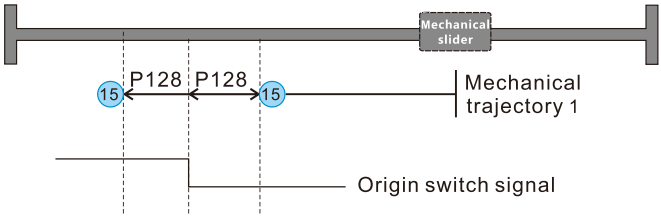
Homing mode 14: Refer to Homing mode of Homing switch, Z phase signal and negative limit (adopt Z phase signal of positive Homing switch left of left edge).



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.

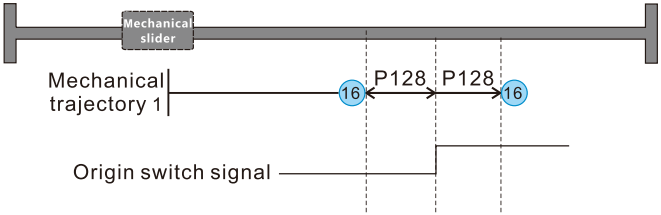
Homing mode15: Refer to the negative original switch plus position increment.



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.

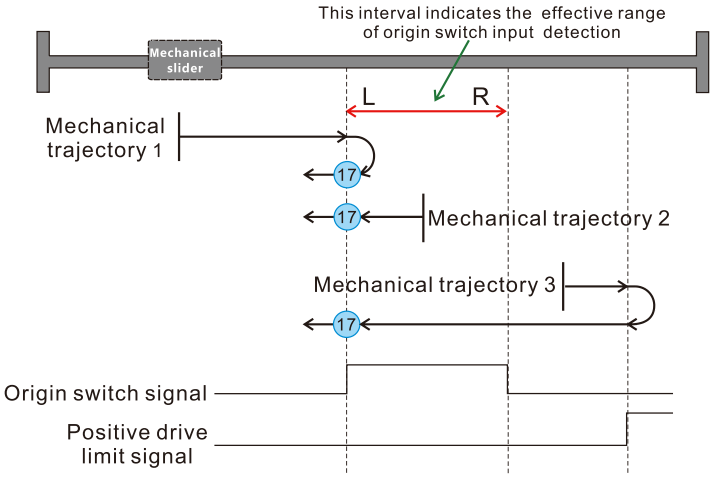
Homing mode 16: Refer to the positive original switch plus position increment



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

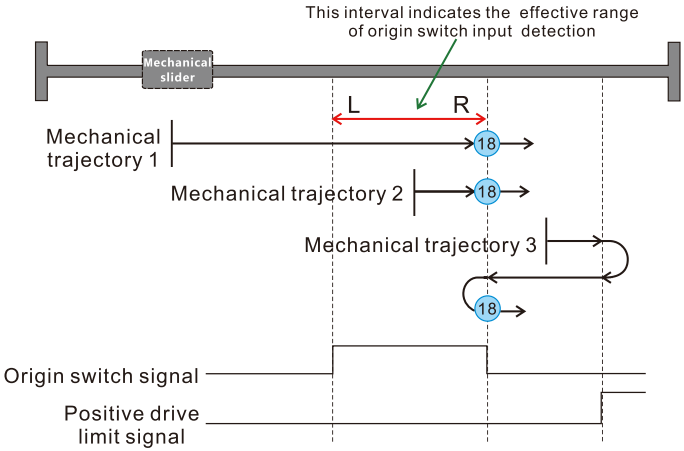
Original switch is located in the positive direction of the machine. The machine is moving in the direction of original switch, as the original switch is detected, it continues to finish the position increment of P128 (Running speed set by P97), the homing complete signal would be outputted after P128 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.

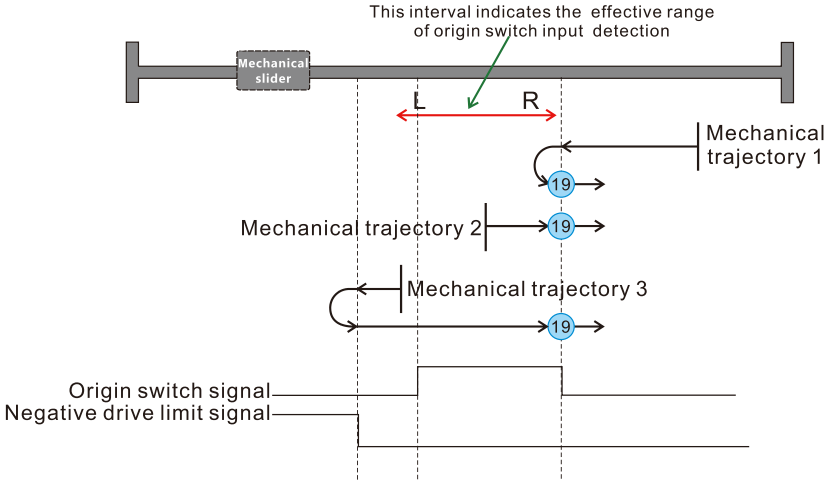
Homing mode 18: Refer to the homing switch/positive limit switch (on the right edge of homing switch)



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.

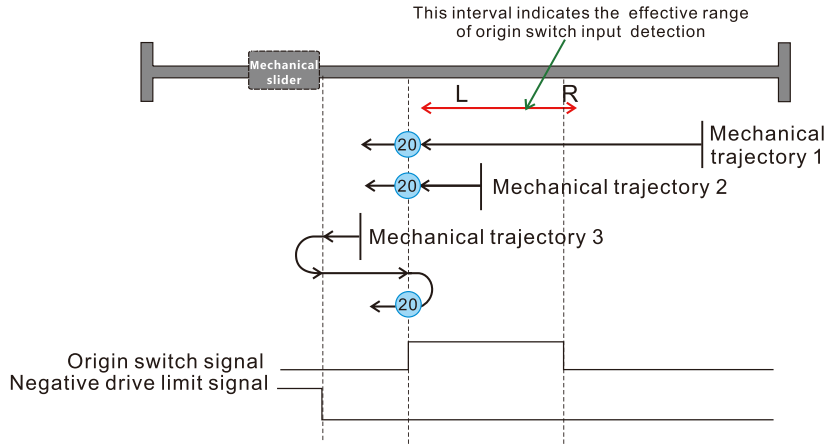
Homing mode 19: Refer to the homing switch/negative limit switch (on the right edge of

homing switch).



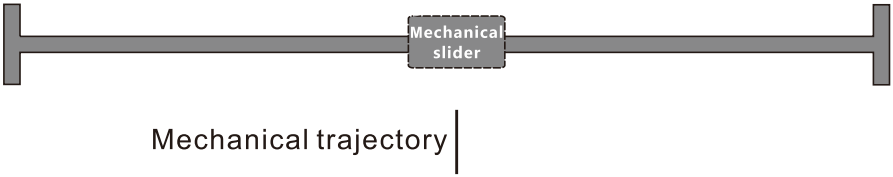
If the starting position of mechanical slider is out of the origin switch range, the initial motion is negative. If the initial position is within the range, it is considered to find the origin when it encounters the descending edge of the origin switch.

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	External input disconnect is valid
			1	External input conduction is valid
	3	CW Overtravel Inhibit	0	External input disconnect is valid
			1	External input conduction is valid
	11	Original switch input	0	External input conduction is valid
			1	External input disconnect is valid

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

No.	Name	Description
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: command source selection from DI

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

Control the internal instruction pin input of the signal terminal				Given instruction source		
Internal instruction switch 4	Internal instruction switch 3	Internal instruction switch 2	Internal instruction switch 1	Communication position mode	Communication speed mode	Communication 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 （P312）	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）

<remark> A"0" means invalid and "1" means valid.

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 Analog 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).

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

- If you do not have many options and do not occupy all pins, please select the lower pin. For example, you only need to select 2 pins. Please select Internal Command Switching 1 and Internal Command Switching 2.
- communication multi-segment position control, acceleration time (P113), deceleration time (P114) and the third internal speed (P97) for the selection of each segment of the position are effective, if you need to change the value of these parameters in a segment of the position value, must be set before triggering the segment of the position through communication.
- The difference between absolute position and relative position: the absolute position is the distance calculated from the origin (if there is no back-to-original operation, the default power-on position is the origin), and the relative position is the distance from the current position. For

example, if the current position is 10000 and the target position is 25000, if absolute position control is used, the given position is 25000. If relative position control is used, given a position of 15000, the actual running position will be 15000+10000=25000.

- In the multi-stage position control, if the next position instruction is triggered before the completion of positioning, the servo will directly run according to the new given position; If the position of the upper segment is required to be completed before the position of the lower segment can be run, the user can pick up the P204 signal to complete the position, and then trigger the instruction of the position of the lower segment through the start signal after the position is completed.
- Multi-segment communication location, speed and torque instruction parameters can be saved to EEPROM, if necessary, write EEPROM operation should be performed.
- When P4 is 4, the communication speed mode and the communication torque mode are also selected by the pins (communication speed mode: P324~P339, communication torque mode: P358-P373), and the starting signal rising edge must be generated to trigger the update instruction.

10.3 Special position control mode

[Function Overview]

Special 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 selection	13: Special speed position mode
P204	Output status	Check the positioning completion signal through bit2 to detect whether the positioning of p284 or P286 is completed. If bit2 = 1, the positioning is completed.
P205	Input IO signal state	Input effective DIR signal when Bit14=1.
P274	Increment of Given Position	When switching to position mode, the number of pulses of servo given position increment.
P284	Pulse filter 1	Pulse filter value setting register for special speed position mode. After the system switches from position mode to speed mode, P284 (pulse filter value 1) is executed. When the output pulse value of the system reaches P284 (pulse filter value 1), the external switching signal is detected.
P286	Pulse filter 2	Pulse filter value setting register for special speed position mode. In speed mode, after the external switch signal is detected for the

		first time, P286 (pulse filter value 2) is executed. When the output pulse value of the system reaches P286 (pulse filter value 2), the external switch signal is detected again, and the system switches from speed mode to position mode.
P288	Pulse Alarm	Pulse filter value setting register for 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 pulse alarm value, an error will be reported to stop the machine.

[Value description]

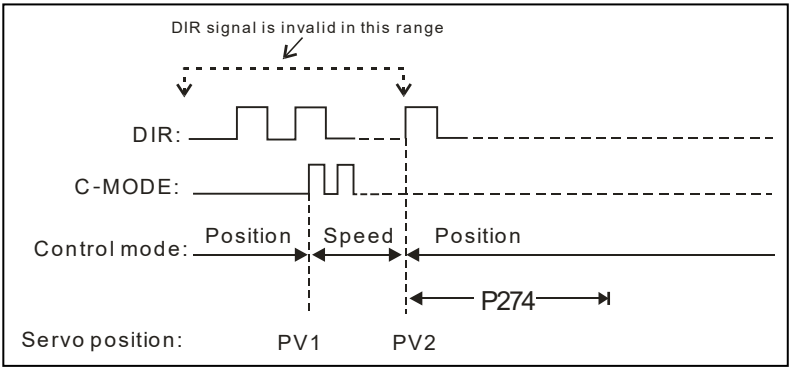
No.	Value of P284/286/288	Description
1	P284=0 & P286=0	In speed mode, the first rising edge of the DIR signal detected switches directly to position mode, and then the servo moves forward the set distance according to P274 (given position increment).
2	P284=0 & P286≠0	In speed mode, when the first rising edge of the DIR signal is detected, P286 (pulse filter value 2) is executed. After the pulse value reaches P286 (pulse filter value 2), the DIR signal is detected again. When the first falling edge of the DIR signal is detected, the servo switches to position mode and moves forward according to p274 (given position increment).。
3	P284≠0 & P286=0	In the speed mode, when the pulse value reaches p284 (pulse filter value 1), the DIR signal is detected. When the first rising edge of the DIR signal is detected, the servo switches to the position mode and moves forward according to the set distance of p274 (given position increment).

No.	Value of P284/286/288	Description
4	P284≠0 & P286≠0	In the speed mode, the DIR signal is detected after the pulse value reaches P284 (pulse filtering value 1). When the first rising edge of the DIR signal is detected, the servo executes P286 (pulse filtering value 2). After the pulse value reaches P286 (pulse filtering value 2), the DIR signal is detected again. The servo switches to the communication position mode and moves forward the set distance according to P274 (given position increment).
5	P288≠0	In speed mode, the DIR signal will be detected after the pulse value reaches P284 (pulse filtering value 1). If the DIR signal cannot be detected all the time, and the pulse increment output by the system reaches P288 (pulse alarm value), an error will be reported and the machine will stop.
6	P288=0	When the alarm function is turned off, the DIR signal cannot be detected and the system will not alarm.

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

Explication 1（P284=0 & P286=0）

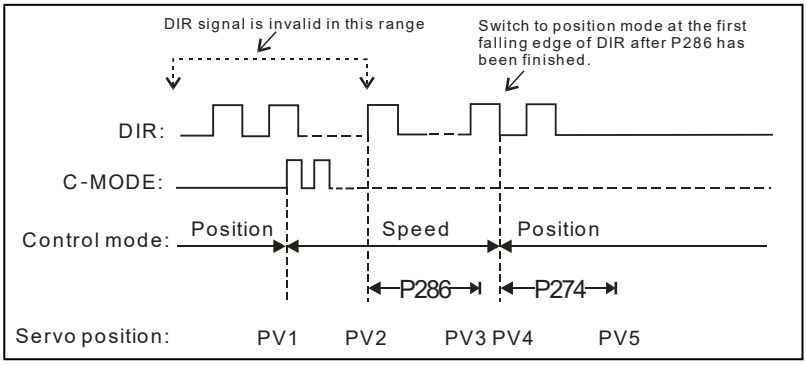
When the C-mode signal is detected, the servo immediately switches from the communication position mode to the speed mode. When the first rising edge of the dir signal is detected, it directly switches to the position mode, and then the servo moves forward according to the set distance of p274 (given position increment).



Explication 2（P284=0 & P286≠0）

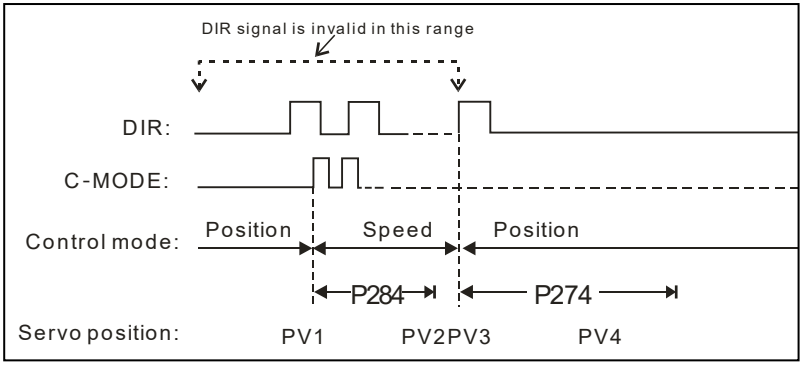
When the C-MODE signal is detected, the servo will immediately switch from the

communication position MODE to the speed MODE. At this time, P286 (pulse filtering value 2) will be executed when the first rising edge of the DIR signal is detected. When the pulse value reaches P286 (pulse filtering value 2), the DIR signal will be detected again. The servo switches to position mode and moves forward the set distance according to P274 (given position increment).



Explication 3（P284≠0 & P286=0）

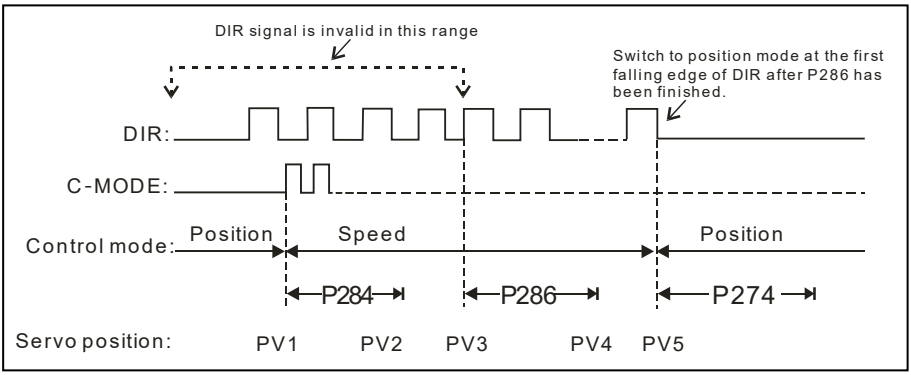
When C - MODE signal is detected, the servo immediately from the communication position MODE switch to speed MODE, the MODE of the pulse value reached P284 began after testing DIR (pulse filtering value 1) signals, when the first rising edge DIR signals, and servo position switch to the MODE in accordance with P274 (a given position increment) forward setting distance.



Explication 4（P284≠0 & P286≠0）

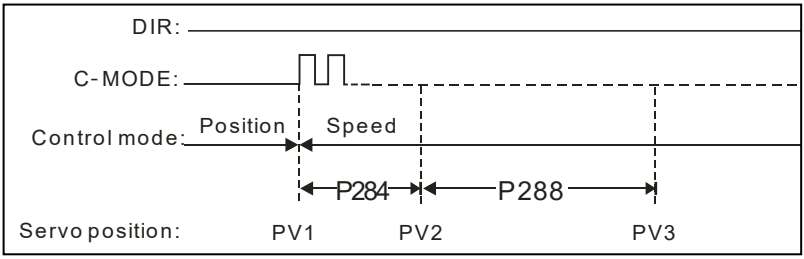
When the C-MODE signal is detected, the servo immediately switches from the communication position MODE to the speed MODE, in which the pulse value reaches P284 (pulse filtering value 1) and begins to detect the DIR signal. When the first rising

edge of the DIR signal is detected, the servo executes P286 (pulse filtering value 2). When the pulse value reaches P286 (pulse filtering value 2), the DIR signal is detected again. When the first falling edge of the DIR signal is detected, the servo switches to the communication position mode and moves forward the set distance according to P274 (given position increment).



Explication 5（P284≠0 & P288≠0）

When the C-MODE signal is detected, the servo will immediately switch from the communication position MODE to the speed MODE, and the DIR signal will be detected after the pulse value in this MODE reaches P284 (pulse filtering value 1). If the DIR signal cannot be detected all the time and the pulse increment output by the system reaches P288 (pulse alarm value), an error will be reported and the machine will stop.



[Terminal setting]

The trigger signal of the special speed position mode must come from the external sensor input and needs a fast response, so the signal input of the special speed position mode contact switch sensor is not the ordinary digital input, but the direction input pin of the multiplexed pulse. That is, DIR+ → No. 37 pin and DIR- → No. 39 pin of the control signal terminal (when P01 is set to 13, the pin function is automatically switched to trigger

signal input without configuring other reuse parameters). When the DIR+/- input is valid through P205_BIT14, the servo will generate an interrupt signal and act according to the set trajectory.

[Example]

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

Step 1: Select control mode

P01 =13(special speed position mode), 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

Electric start fault handling:

Startup process	Fault phenomenon	cause	Confirmation method
Turn on control power	Servo display panel does not light up	1.Control power supply voltage failure	1. After unplugging x1, X2 and X3, the fault still exists. 2. Measure the AC voltage of control power interface.
		2.Servo driver failure	——
Servo enable	The servo motor shaft is in free running state	1.Servo enable signal invalid	P001 is to configure servo control mode parameters, P201 is to display the current control mode of the servo; 1. Check P203_BIT0. If it is 0, then the servo is not in the enabled state. 2. Check P203_BIT0. If 0, then the servo is not in enabled state. In communication control mode, please check whether the parameter of P282 is 1. 3. When the servo parameter P16 is 1, it is the power on and enable function of the servo, and the field application can depend on whether it is used or not. 4. When CIA402 axis is controlled, please check whether the enabling instruction is normal.
		2.Parameter setting error	1. When the servo parameter P72_BIT0 is set to 0, the external control mode needs to be enabled by external DI, and the communication control mode needs to be enabled by the communication control word P282; 2. When the servo parameter P72_BIT0 is set to 1, any control mode needs to be enabled by external DI, and the communication control mode also needs to be enabled by the communication control word P282.

Startup process	Fault phenomenon	cause	Confirmation method
Input command	Servo motor does not operate	1.Servo command is 0	When in the external position control mode, check the value of the servo command position P212. If 0, no pulse signal is received. Please check: 1. Input mode of instruction pulse, P81, to check whether the set pulse mode is the same as the actual one; 2. Command status P203_BIT8, check whether the command pulse input ban function is valid.
			External speed/torque analog control mode: 1. Check the input values of servo analog quantity P207 and P208 to see whether the received analog quantity signal is normal; 2. Check whether there is any problem in setting the proportion coefficient of P92 and P117 analog quantity instructions; 3. Check P203_BIT5 to see whether the zero-speed clamp function is effective;
			When in communication control mode, check whether the given communication command is correct, given position P290~P320/ given speed P324~P355/ given torque P358-P389.
			Check the instruction source parameters P4 and P5 to see if the command selected at run time is correct.
	Servo motor reversal	1.Reverse instruction	1. Check the instruction source parameters P4 and P5 to see if the command selected at run time is correct.
			2. External speed control mode, check the P93 speed instruction logic inverse.
			3. External torque control mode, check P118 torque instruction logic inversion.
			4. Communication position control mode, check the positive direction selection of motor operation under P90 communication mode.

The A4N driver has the following protection functions. When an exception occurs, the display panel will display the current alarm code of different types.

The current alarm code can be viewed through the P202 parameter (error type). Combined with the alarm type described in the following table, you can quickly identify

the cause of the fault and deal with the fault in time.

Fault handling at runtime:

Fault code	cause	Confirmation method	measures
001 Under voltage	1.The main circuit power supply is unstable or power down	Measure whether the main power circuit cable meets the following specifications: 220V driver—220VAC±10% 380V driver—380V～440V±10%	Improve power supply capacity to ensure stable power supply
	2.instantaneous power loss		
	3.Power supply voltage drops during operation	Bus voltage value can monitor P226 parameters, undervoltage threshold:<200V	Increase the power supply capacity and increase the power supply cable
	4.Servo drive failure	Ensure that the power supply voltage and circuit are normal. Observe that the parameter value of P226 of the servo driver is close to 0, and the driver fails	Replace servo driver
002 overpressure	1.the main circuit power supply voltage is too high	Measure the main power loop cables to meet the following specifications: 220V driver -- 220VAC±10% 380V driver -- 380V ~ 440V±10%	Adjust the power supply to the specification range
	2.The energy can not be released during the deceleration process	Check whether the brake resistance wiring is well connected	Connected cables
		Measure the brake resistance value to see if it is too high to cause slow energy release	Replace the resistor with a smaller value
	3.Servo drive failure	Check the brake circuit, use the multimeter's diode tap, the red meter pen point RB1, the black meter pen point bus output "DCN", measure whether the continuing diode of the brake pipe is good, the multimeter display at about 0.4V is normal, short circuit or open circuit means damage. (Dangerous Note: Please do this after half an hour of power off or when the bus capacitor has no voltage	Replace servo driver

Fault code	cause	Confirmation method	measures
003 ※Over current	1.Motor UVW cable short circuit	Unplug the motor cable, use a multimeter to measure whether UVW two short circuit, wiring whether there is a burr	Connect the motor wire correctly
	2.Short circuit between motor UVW cable and ground	Unplug the motor cable and use a multimeter to measure whether there is a short circuit between UVW and the earth (PE) and whether there is a burr in the wiring	Connect the motor wire properly. If there is a short circuit between UVW and PE, the drive may have been damaged
	3.Motor is burnt out	Unplug the motor cable and measure whether the resistance value between two resistance values of UVW of the motor cable is balanced	Unbalance is replaced by the motor
	4.The gain setting is unreasonable and the motor oscillates	Check the driver model and motor model to check whether the motor vibration is serious and the noise is large during the starting and running process; You can also view the actual torque or current loop curve through MagicWorks Tuner, COTRUST's upper computer software	Adjust gain parameters
	5.The servo driver does not match the motor	check the driver model and motor model	If it does not match, replace it with a matching one
	6.Servo drive failure	Unplug the motor UVW cable and repower the drive to report failure	Replace drive
004 ※overheating	1.Ambient temperature is too high	Measure ambient temperature, air circulation	Improve the cooling condition of the drive and reduce the ambient temperature
	2.The fan is broken	Fans are only available for drives above 750W, and whether the fans operate when powered on	Replace drive
	3. The installation direction and servo interval are unreasonable	Confirm whether the installation is reasonable	Install according to installation standards
	4, servo modified overload level, long time overload operation	1. Check whether the parameter P138 has been modified; 2. Check the actual torque parameters of P224 in operation to confirm whether the operation has been overloaded	If it must be overloaded for a long time, please replace the servo driver with more power
	5. After overload alarm, it will be removed and continue to run	Check the fault history: parameters P140~P149, whether overload alarm	Change method of use
	6.Servo drive failure	Power off 10 minutes after the power again still report the fault	Replace drive

Fault code	cause	Confirmation method	measures
006 ※2500 - PPR incremental encoder feedback error	1.Encoder wiring error	Check the encoder cable wiring	Rewire as per the correct definition
	2,The encoder cable is loose.	Check whether the connection terminal between the servo end and the encoder at the motor end is firm, and whether it will be loosened due to vibration.	Reconnect properly and make sure it is tight
	3.Encoder Z is believed to be disturbed	Check the servo parameters P398 and P399. If the difference between these two parameters exceeds 30 for 4 consecutive times, the Z-phase of the encoder will be interfered.	1. If you replace the cable, you can choose our standard cable first. 2. Add magnetic ring on the motor line and encoder line for anti-interference.
	4.Motor encoder failure	Replace another motor to check if the fault is reported.	If no failure is reported after the replacement of the motor, the motor will be replaced.
	5.Drive failure	Replace another drive to see if the failure has been reported.	Replace the driver if no failure is reported after replacement.
006 ※17 bit absolute encoder feedback error	1.When the power is off, the battery is not connected	When the cable encoder fails, check whether P244_bit6 is 1. If it is 1, it is a battery error.	Please connect the battery and clear the encoder battery error, refer to Section 5.4.
	2.The encoder battery voltage is too low	Check whether P244_BIT7 is 1, and then use a multimeter to measure whether the voltage at both ends of the battery is lower than 3.2V.	Lower than 3.2V, please replace the battery and remove the encoder battery warning.
	3.the encoder wiring error or disconnection	Check the number of continuous communication errors of the servo parameter P390 encoder.	If the parameter has been increased or is 32767, please check or replace the cable.
	4.The encoder is disturbed	Check the number of communication errors of single turn value of servo parameter P392. If the value is not 0, there will be interference.	1. Check the grounding of the encoder cable shielding layer. 2. Comb the wiring environment or replace the cable. 3. Add magnetic ring on the motor line and encoder line for anti-interference.

Fault code	cause	Confirmation method	measures
007 ※Excessive braking rate	1.Poor wiring, falling off or broken wire of external brake resistance.	When connecting external braking resistance, measure the resistance between "DCP" and "RB1".	Check the cable first, and replace the brake resistor if the cable is OK.
	2.The short circuit of RB1 and Rb2 with internal brake resistance is in poor contact or the brake resistance is damaged.	Measure the resistance between "DCP" and "RB2".	Check the short circuit first. If there is no problem with the short circuit, use the external brake resistor or replace the driver.
	3.Main circuit power supply voltage too high.	Measure the main power loop cables to meet the following specifications: 220V driver -- 220VAC±10% 380V driver -- 380V ~ 440V±10%	Adjust the power supply to the specification.
	4.Unreasonable selection of external braking resistance.	Aluminum shell resistance is recommended, 50 ~ 100 ohm resistance is recommended for 100W ~ 1kW, 30 ~ 50 ohm resistance is recommended for 1.5KW ~ 3KW, and 25 ~ 50 ohm resistance is recommended for 4.5kw ~ 7.5kW; P132 value can choose 1 or 2 according to the actual situation.	
	5.Too much inertia, frequent deceleration required.	You can use the MagicWorks Tuner upper computer to monitor the speed curve for confirmation.	Select the external brake resistor with large capacity and small resistance value, P132 value can choose 1 or 2 according to the actual situation.
	6.Servo drive failure		Replace the drive.
008 overload	1.Wrong sequence or poor contact of UVW wire of motor wire	Compare the correct wiring diagram to see if the wiring at both ends is in good condition.	Connect with connection method.
	2.Too heavy load, motor output torque for a long time over rated torque use.	Check the actual torque of the servo parameter P224 to see if it will exceed 1000 for a long time.	Replacement of higher power drives and motors; Reduce the load and increase the acceleration and deceleration time.
	3.Improper gain adjustment or too rigid.	Obtain whether the motor vibrates and the noise is abnormal.	Readjust gain
	4.Driver and motor mismatch.	Check the driver and motor model to see if they match.	Replace it with a matching one
	5.Motor stalling due to mechanical factor.	Check the P224 parameters, such as the actual torque value is large but the actual position is not moving.	Eliminate mechanical factors
	6.Servo drive failure.		Replace the drive

Fault code	cause	Confirmation method	measures
009 Too much position deviation	1.Low servo gain, unable to follow	By MagicWorks Tuner upper computer to monitor the position curve to see if the actual position lags too far behind the instruction position.	Readjust the gain
	2.The pulse input frequency exceeds the maximum speed of the motor	Check whether P86/P87/P88 are reasonable.	Decrease pulse frequency;Change P86 / P87 / P88
	3.Whether the alarm level (P136) is set too small	Check P136.	Set reasonable P136 parameters.
	4.Motor line and motor failure	Test operation can be used to see whether the motor rotates normally.	Correctly connect the motor wire; replace the motor.
	5.Drive failure	Test operation can be used to see whether the motor rotates normally.	Replace drive
010 Trip limit alarm	1.The parameter setting is unreasonable	1. Check the parameter settings of P03 and P72. 2. Check whether the normally open / normally closed output signal of limit sensor corresponds to P72 parameter setting.	Change to a reasonable parameter.
	2.DI wiring error	Check the output signal source / drain type of the limit sensor, and check whether the corresponding input pin connection method is correct.	Please connect with the correct method
011 Over-speed	1.The parameter setting is unreasonable	Check whether parameter P139 is set reasonably	Change to a reasonable parameter.
	2. Actual motor speed exceeds the maximum speed	Monitor the actual motor speed P221 to see if it exceeds the maximum motor speed.	Reduce the speed.
	3.Motor line UVW phase sequence connection is wrong	Check UVW phase sequence of motor line.	Please connect with the correct method.
012 Analog input deviation is too large	1.The parameter setting is unreasonable	Check whether parameter P137 is set reasonably.	Change to a reasonable parameter.
	2.The actual analog input voltage is too large	The reasonable range of analog input voltage is -10V ~ +10V.	Reduce the analog input voltage.

Fault code	cause	Confirmation method	measures
013 ※EEPROM read/write error		Generally, this fault occurs when the parameters are modified after updating the firmware or during the operation of saving EEPROM.	factory data reset.
014 RS485 communication abnormal		RS485 communication interruption time exceeds P12 parameter setting value, alarm.	Reasonable setting of P12 parameters.
015 Canopen/EtherCAT communication error	1.Interference or poor contact of network cable connection	Check whether the servo communication status p236 is normal	1.Replace the anti-jamming cable with better quality, and recommend to use our company's supporting cable. 2.CANopen communication can dial the terminal resistor.
	2.external cause communication disconnect	Abnormal alarm of communication No.15 is an alarm when communication is disconnected after communication is normal. Check whether it is caused by unplugging network cable or executing PLC download program.	This situation is normal. After communication is restored, remove the servo alarm.
016 Configuration error of external input pins	1.The parameter setting is unreasonable	Check the P74/P75/P76/78 configuration DI input function parameters for duplication of functions.	Change the parameter
017 Internal error	1.Internal communication error of servo.	Power off and restart the servo. If this alarm occurs again, please replace the servo driver.	Replace servo driver
018 Absolute encoder motor unmatched	1.Motor type mismatch	Check whether the motor model is the bus absolute value encoder motor.	Replace with bus absolute value encoder motor

Fault code	cause	Confirmation method	measures
019 Pulse error	1. Control mode 13, P288 pulse alarm value setting is unreasonable.	Check whether the servo driver parameter P288 is set too small.	Change the parameter
	2. DIR signal is abnormal.	Check whether the signal input from the sensor to DIR is norma.	Normal access to DIR signal
020 Homing error	1. Z-phase pulse is missed when returning to the original.	This function is to return to the original protection function, if the problem appears in the original, please clear the alarm and re-execute a return to the original.	
022 Main power phase loss	1. Bad contact of three-phase input main power supply.	Check power cable contact.	Reconnect properly and make sure it is tight
	3. three-phase power supply imbalance or three-phase voltage is too low.	Use a multimeter to measure the main supply voltage.	Please adjust according to the input power specification of the drive
	3. Servo drive failure	Make sure the main power input is correct and the drive still alarms.	Replace servo driver
023 Control power input undervoltage	1. Bad contact of the control power cable.	Check power cable contact.	Reconnect properly and make sure it is tight
	2. The control power supply is unstable or the voltage is low.	Use a multimeter to measure the control power supply.	Please adjust according to the input power specification of the drive
024 Internal drive power undervoltage	1. Internal servo drive failure.	Ensure that the power input of servo drive is normal. If it is still unable to contact the alarm after the factory is restored.	Replace servo driver
025 Motor runaway alarm	1. UVW phase sequence wiring er.	Check whether the phase sequence of the driver UVW output connects to the motor power connector.	Rewire with the correct UVW phase sequence
	2. Wrong type of motor encoder or wrong wiring.	Check whether the driver model matches the motor model.	Replace with a matching one
	3, the encoder cable wiring error.	Check whether the encoder cable wiring definition is wrong.	Resolder or replace cables
	4. The initial phase detection error of motor rotor is caused by interference during power on.		Power off and restart the servo drive

Fault code	cause	Confirmation method	measures
026 PDO configuration error	The EtherCAT communication configuration PDO data is incorrect	Check the PDO configuration of EtherCAT communication to see if there is an object dictionary or data length error.	Change the PDO configuration
027 Encoder communication error	1.The encoder wiring error or disconnection	Check the number of continuous communication errors of the servo P390.	If the parameter has been increased or is 32767, please check or replace the cable
	2.The encoder is disturbed.	Check the number of communication errors of single turn value of servo parameter P392. If the value is not 0, there will be interference.	1. Check the grounding of the encoder cable shielding layer. 2. Comb the wiring environment or replace the cable. 3. Add magnetic ring on the motor line and encoder line for anti-interference.
	3.Motor encoder failure	Replace another motor to check if the fault is reported.	If no failure is reported after the replacement of the motor, the motor will be replaced.
	4.Servo drive failure	Replace another drive to see if the failure has been reported.	Replace the driver if no failure is reported after replacement.
028 UVW output phase missing	1.motor line UVW contact is poor.	Check the UVW wiring.	Reconnect properly and make sure it is tight
	2.UVW output of the driver is damaged.	Replace drive.	Replace drive
	3.Motor UVW connector or internal damage.	Check the UVW connector at the motor end, or change the motor to test.	Replace the motor
030 Software over current	1.The actual current output by the driver to the motor exceeds the over-current point specified by the driver.		1.Reduce the torque limit 2.Reduce the rigidity 3.Check the UVW phase sequence

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

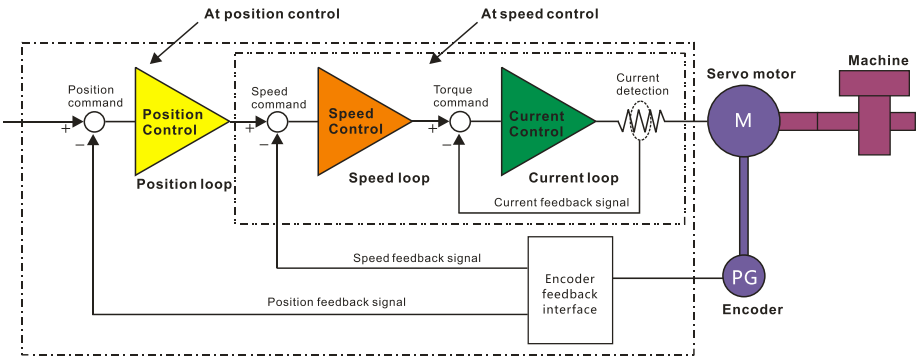
12 Gain Adjustment

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 Control block diagram of A4N series servo driver system



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.

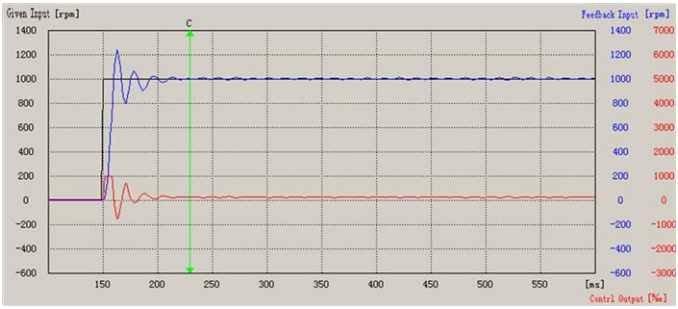


Fig 12-1 speed loop curve at high gain of speed loop

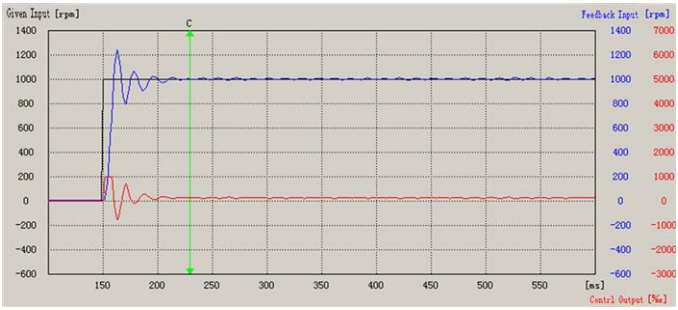


Fig 12-2 peed loop curve at low gain of speed loop

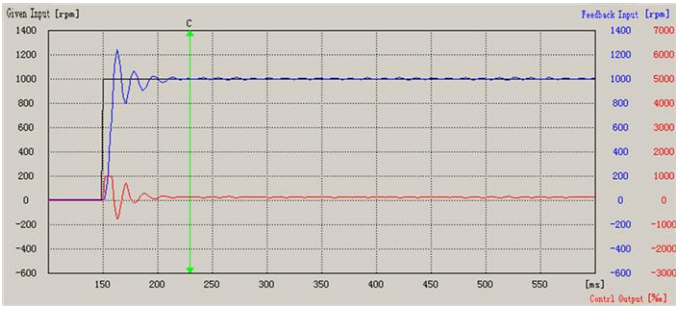


Fig 12-3 speed loop curve of proper speed loop gain

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.

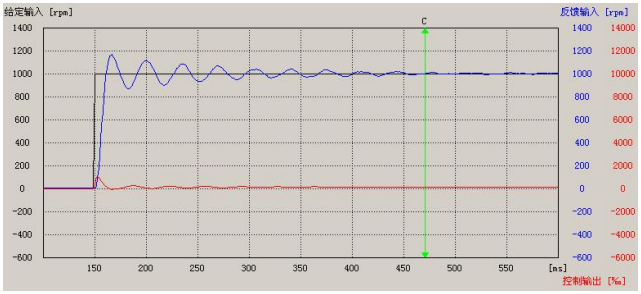


Fig 12-4 speed loop curve at low speed loop integration

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.

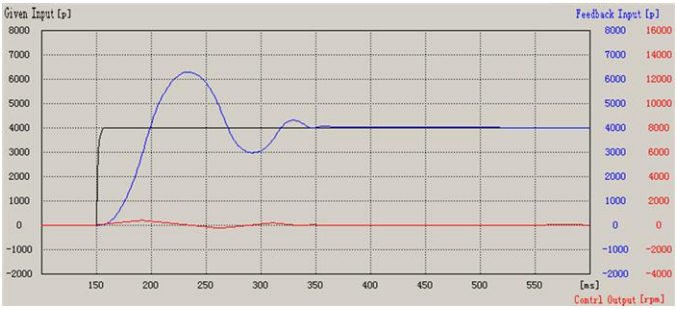


Fig 12-5 position loop curve at high gain of position loop

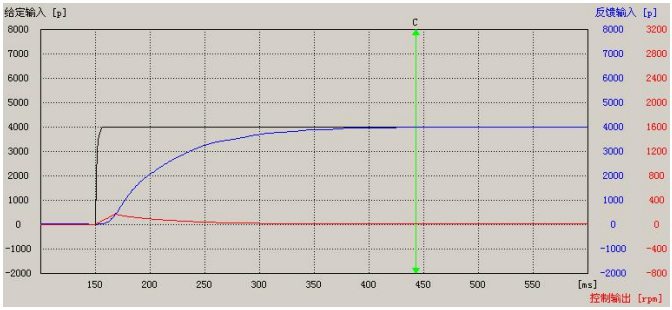


Fig 12-6 position loop curve at low gain of position loop

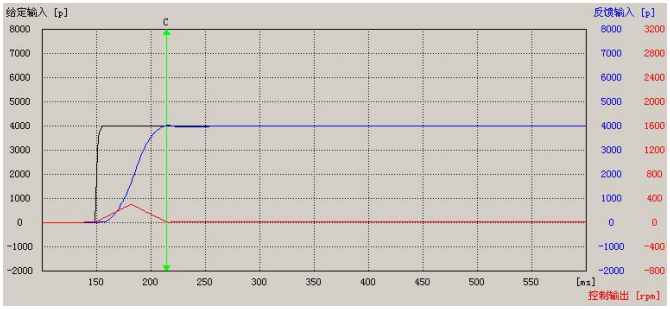


Fig 12-7 position loop curve of proper position loop gain

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.

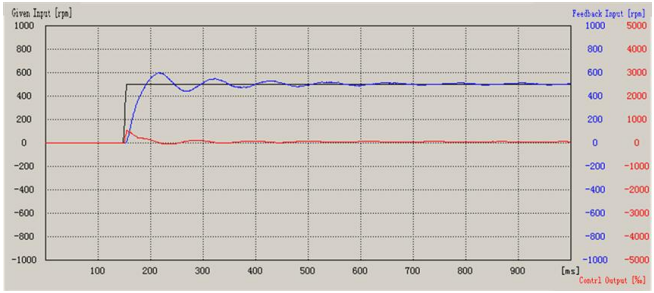


Fig 12-8 speed loop curve of insufficient integration time of increasing the inertia ratio

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.

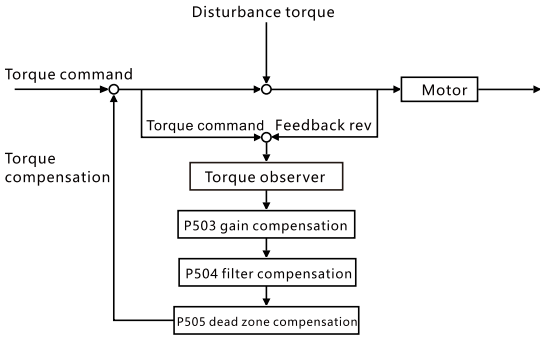


Fig 12-9 torque compensation control

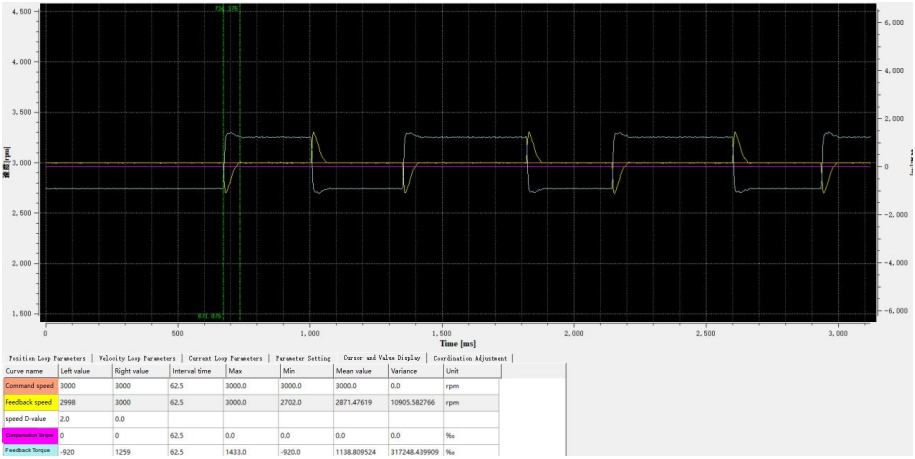


Fig 12-10 before continuous load torque compensation in speed mode

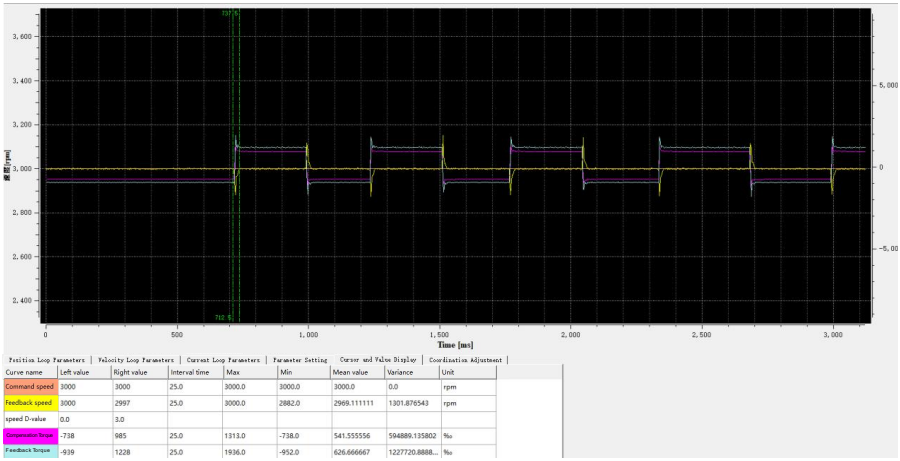


Fig 12-11 after continuous load torque compensation in speed mode

- 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.

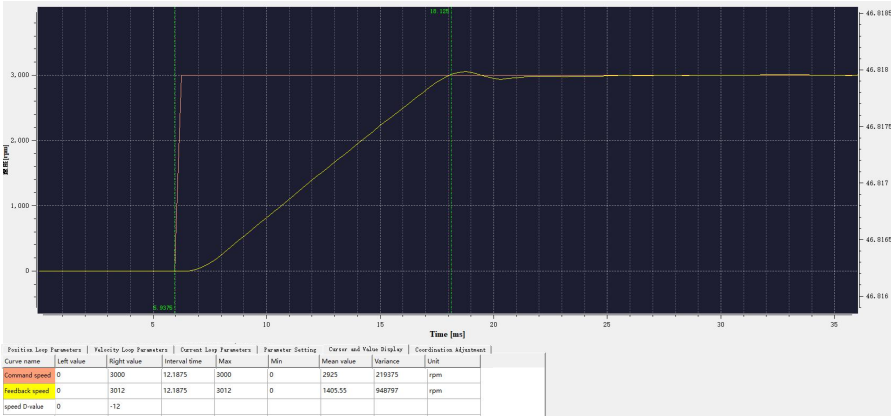


Fig 12-12 differential gain in closed speed step

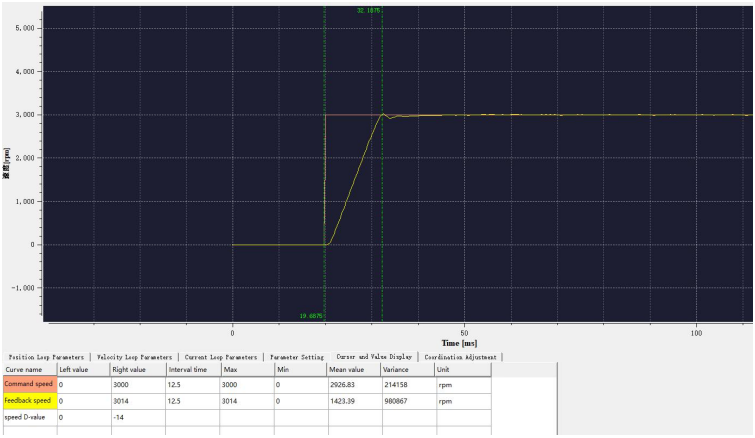


Fig 12-13 differential gain in opening speed step

- Applicable range

Control modes which except torque mode.

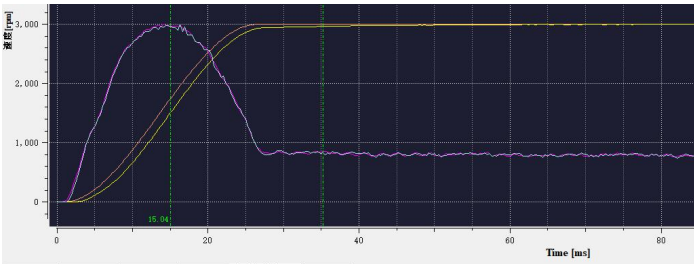
- How to use

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

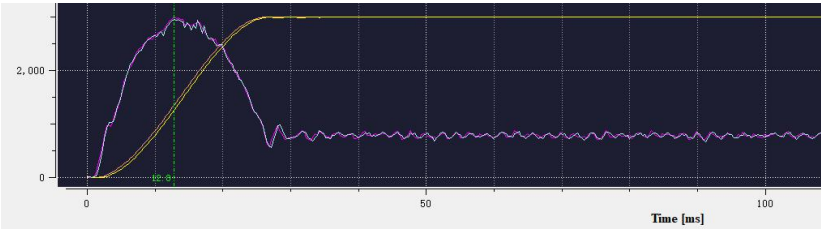
Torque feedforward can improve the following characteristics in stage of ACC/DCC.



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	1746	3000	20.16	3000	1746	2732.92	142270	rpm
Feedback speed	1508	2964	20.16	2965	1508	2612.25	200102	rpm
speed D-value	238	36						
Compensation Torque	20433	5837	20.16	20483	5551	11232.7	3.36889e+07	‰
Feedback Torque	20366	5724	20.16	20672	5471	11188.3	3.32927e+07	‰
Torque D-value	67	113						

Fig 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						

Fig 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	The time constant of first order low pass filter is used to filter the torque	The noise caused by increase of P509 can be

	feedforward filter	feedforward output, whose increase helps to reduce the noise.	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.

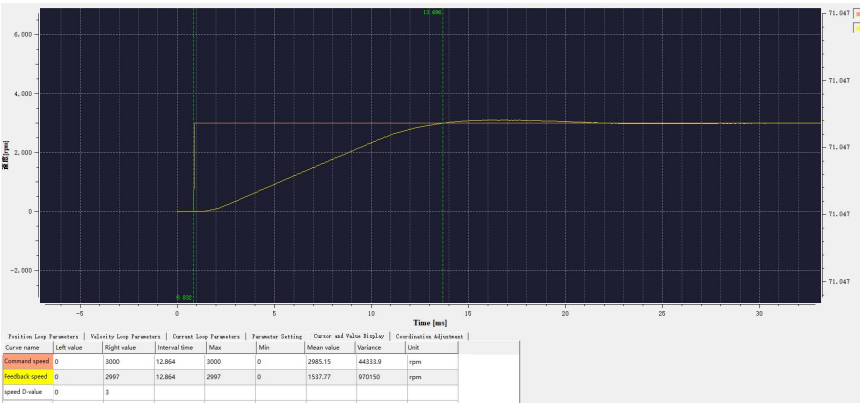


Fig 12-16 without the 2nd degree of freedom of velocity loop PI

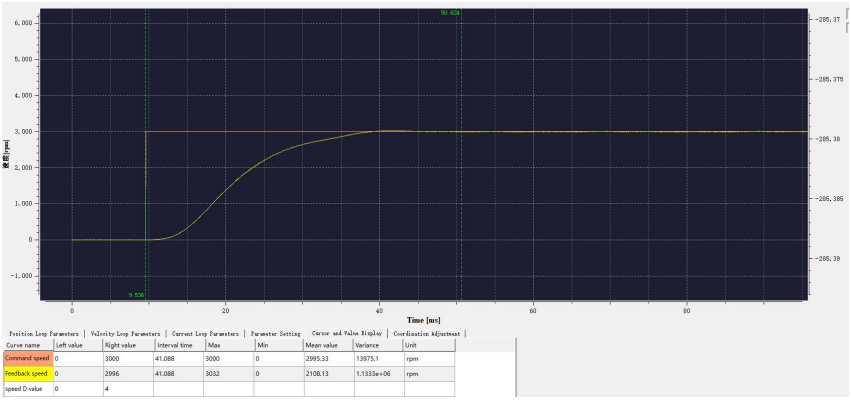


Fig 12-17 with the 2nd degree of freedom of velocity loop PI

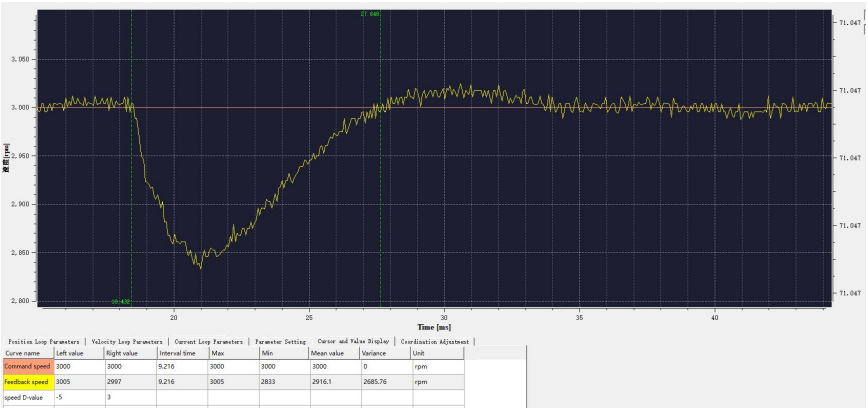


Fig 12-18 without the 2nd degree of freedom of velocity loop PI

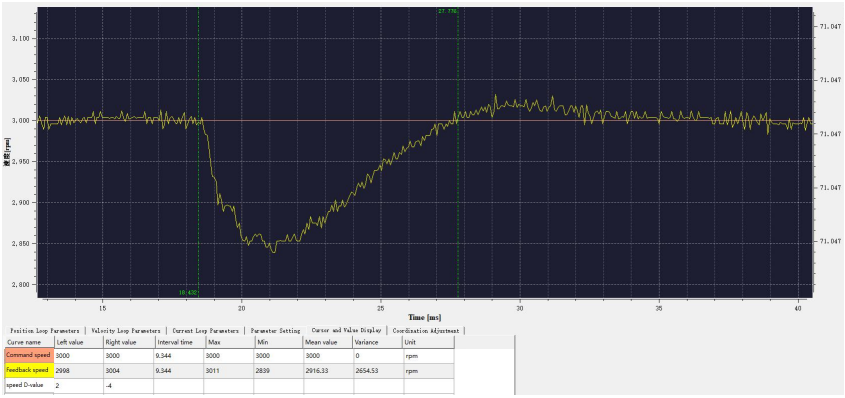


Fig 12-19 with the 2nd degree of freedom of velocity loop PI

- 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

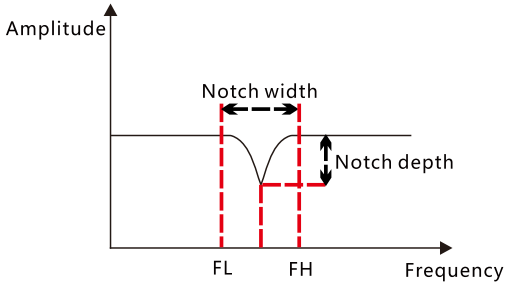


Fig12-20 Amplitude frequency characteristic of notch filter

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

- How to use

(1) Choose inertia identification

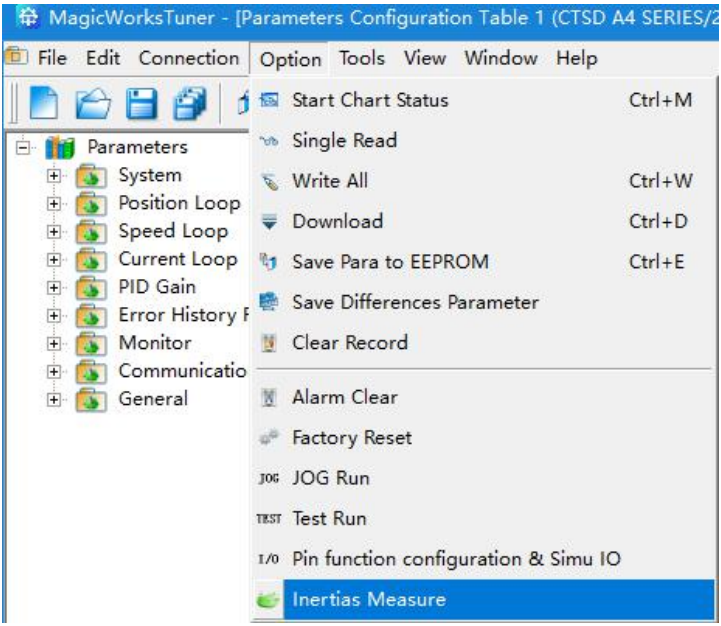


Fig 12-21 off-line inertia identification menu

(2) Inertia identification of function menu

- It is suggested that the speed and stroke should be set within the allowable range of the equipment. The larger the two parameters are set, the more accurate the inertia identification result is;
- Speed gain and speed integral constant are recommended by default;

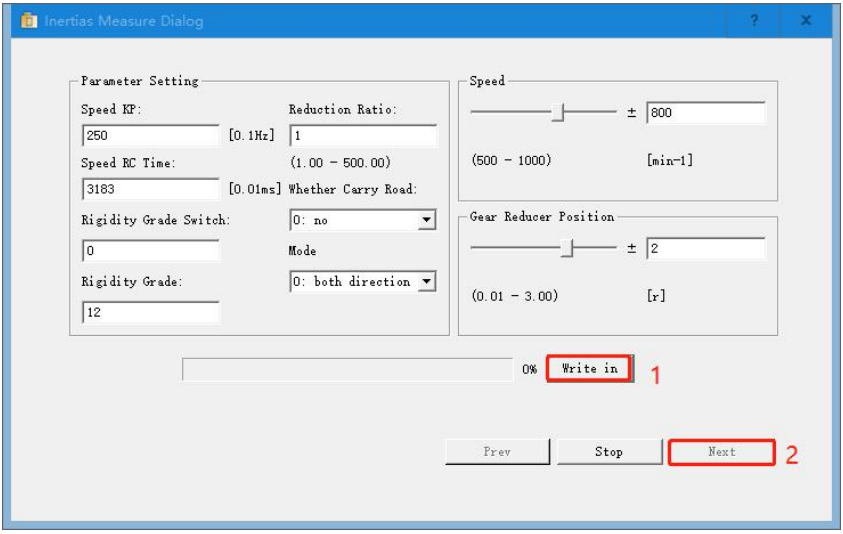


Fig 12-22 setting of off-line inertia identification

(3) Start identification

The inertia ratio will update after identification

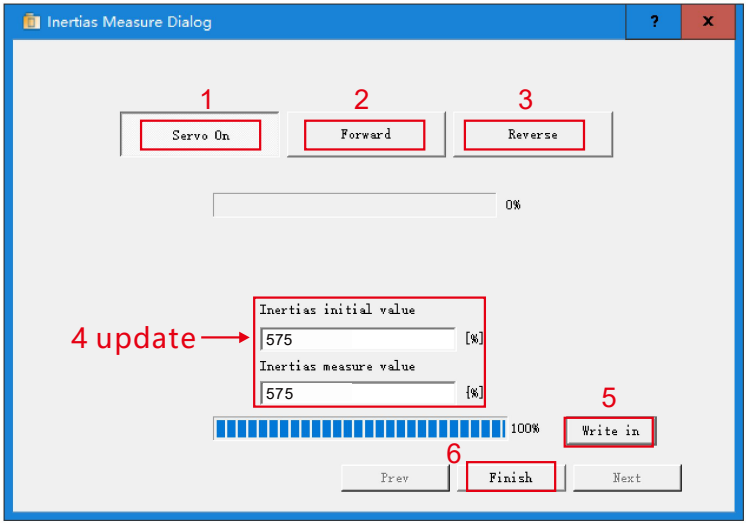


Fig 12-23 steps of off-line inertia identification

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

The control parameters of the position loop and speed loop can be quickly adjusted by setting the rigidity level parameters. The rigidity level table is shown in Table 12-1, and the corresponding parameter descriptions are shown in Table 12-2.

Table 12-1 Rigidity grade table

parameter		P21	P22	P20	P24	P28	P29	P27	P31
Rigid hierarchy	0	15	50000	24	1326	15	51200	40	1326
	1	20	39789	32	995	20	51200	48	995
	2	25	31831	40	796	25	51200	56	796
	3	30	26526	48	663	30	51200	72	663
	4	35	22736	56	568	35	51200	96	568
	5	45	17684	72	442	45	51200	120	442
	6	60	13263	96	332	60	51200	144	332
	7	75	10610	120	265	75	51200	176	265
	8	90	8842	144	221	90	51200	224	221
	9	110	7234	176	181	110	51200	288	181
	10	140	5684	224	142	140	51200	400	142
	11	180	4421	288	111	180	51200	480	111
	12	250	3183	400	80	250	51200	560	80
	13	300	2653	480	66	300	51200	640	66
	14	350	2274	560	57	350	51200	800	57
	15	400	1989	640	50	400	51200	960	50
	16	500	1592	800	40	500	51200	1200	40
	17	600	1326	960	33	600	51200	1440	33
	18	750	1061	1200	27	750	51200	1840	27
	19	900	884	1440	22	900	51200	2240	22

parameter		P21	P22	P20	P24	P28	P29	P27	P31
Rigid hierarchy	20	1150	692	1840	17	1150	51200	2720	17
	21	1400	568	2240	14	1400	51200	3360	14
	22	1700	468	2720	12	1700	51200	4000	12
	23	2100	379	3360	9	2100	52100	4480	9
	24	2500	318	4000	8	2500	51200	4960	8
	25	2800	284	4480	7	2800	51200	5440	7
	26	3100	257	4960	6	3100	51200	5920	6
	27	3400	234	5440	6	3400	51200	6400	6
	28	3700	215	5920	5	3700	51200	7200	5
	29	4000	199	6400	5	4000	51200	8000	5
	30	4500	177	7200	5	4500	51200	8000	5
	31	5000	159	8000	5	5000	51200	8000	5

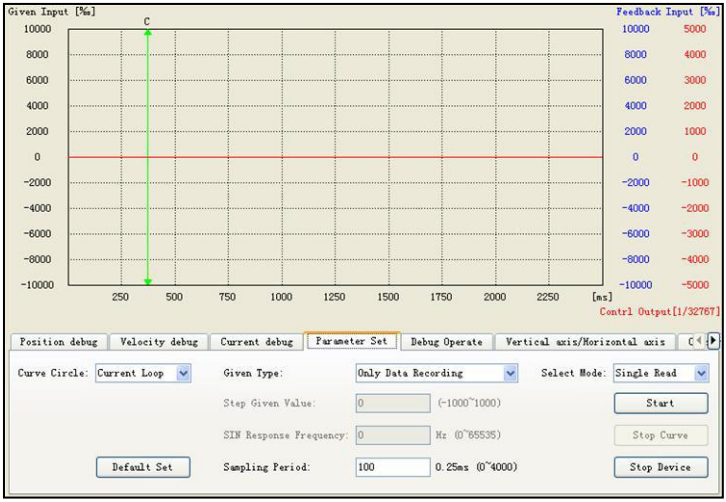
parameter	P21	P22	P20	P24	P28	P29	P27	P31
Factory Settings	250	3183	400	79	400	2000	640	79
Unit	0.1Hz	0.01ms	0.1Hz	0.01ms	0.1Hz	0.01ms	0.1Hz	0.01ms
Predetermined area	1~ 20000	15~ 51200	1~ 20000	0~ 3000	1~ 20000	15~ 51200	1~ 20000	0~ 3000
access	RW							
type of data	Uint16							

Table 12-2 Parameter description

No	Name
P20	First position loop gain
P21	First speed loop gain
P22	First velocity loop integral time constant
P24	First torque instruction filtering time constant
P27	Second position loop gain
P28	Second speed loop gain
P29	Second velocity-loop integral time constant
P31	Second torque instruction filtering time constant

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 unit of the position loop step reference value is the number of pulses, and the output is the speed command (unit: rpm). The given value is the number of pulses before the

gear ratio. If the gear ratio is 1:1 and the step given value is 10000, the motor will position for one revolution after starting. Since the given value is not controlled by the acceleration/deceleration time, if the gear ratio is too large or the given pulse number is too large, the servo instantaneous position deviation will be very large, which may cause the servo to generate an overspeed alarm.

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). Default is the first gain.

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: 9/F, block a, building 6, international innovation Valley, Nanshan District, Shenzhen
Tel: 0755-86226822
Fax:0755-86226922
E-mail: sales@co-trust.com
Website: http://www.co-trust.com

Version: V1.23
Release date: 6/2021
Order number: CTM1-A4N2021