CO-TRUST

E10 Series AC Servo Driver
User Manual

V2.30

SHENZHEN CO-TRUST TECHNOLOGY CO.,LTD

Contents

1 Safety Announcement

Please be sure to observe

To avoid personal injury and possession damage, the matters which need attention will be explored in more detail below.

Please read the following instructions or precautions carefully before using the servo driver, and must be complied with the installation and debugging preventive measures and operating procedures.

Disclaimer: Because the user not strictly in accordance with the operating requirements, causing serious consequences, and CO-TRUST is not responsible for.

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

DANGER	**Danger indicates an imminently hazardous situation which, if not Operate according to the requirement, will result in personal injury"**
CAUTION	**Caution indicates a potentially hazardous situation which, if not operate according to the requirement, may result in mild or moderate injury and equipment damage.**

DANGER	
Only professional electrical engineer should be allowed to handle wiring.	May cause an electric shock and fire danger.
Please confirm the input main power is on shut-off status before wiring.	May cause an electric shock and fire danger.
Please tightly connect power terminal with motor connectors.	May cause an electric shock and fire danger.
Please do not touch the output terminals directly; The Output line of Servo driver must avoid shorting with shell, and never short the output line.	May cause an electric shock and fire danger.
Please set up safety device such as breaker etc, so as to cut off power supply in time while external circuit short circuit and equipment failure occur.	May cause an electric shock and fire danger.

DANGER	
Please do not dismantle after servo driver power-ON.	May cause an electric shock.
For a while after power off, the internal circuits of driver is kept at higher voltage, please perform the transportation and wiring at least 15 minutes after the power off.	May cause an electric shock.
Do not use it in vibration 、fierce shock place.	May cause an electric shock, personal injury and fire danger.
Don't submerge the cable to oil and water.	May cause an electric shock, equipment malfunction or damage.
Do not use wet hands for wiring and operation.	May cause an electric shock and personal injury.
Do not insert your hands into the driver.	May cause an electric shock and burns.
Avoid the place where the driver is subjected to dust, corrosive gases, conductive objects (such as copper cuttings), liquids and inflammables.	May cause an electric shock and fire danger.
Avoid to place flammable objects near motors, drivers and regenerative resistors.	May cause an electric shock and fire danger.
Don't touch the motor, driver radiator or its regenerative resistor, since they become hot.	May cause an electric shock and burns、equipment malfunction or damage.
Make sure to ground the earth terminal of the driver and motor.	If not connect to ground, may cause an electric shock.

CAUTION	
Don't seize the cable、encoder line or motor shaft while transporting.	May cause personal injury and equipment malfunction or damage.
Avoid to use the servo driver in cases of damage, short of materials.	May cause personal injury.
Avoid to use it under direct sun beams.	May cause fire danger.

⚠ CAUTION	
Avoid to block the ventilation holes of driver, and do not let foreign matter fall into the servo driver.	May cause fire danger.
Please comply with the requirements of installation method and direction.	May cause personal injury and equipment malfunction or damage.
Don’t connect the input power wire to the output terminal U, V, and W.	May cause equipment malfunction or damage.
When two or more servo drivers place in the same cabinet , please ensure servo interval and effective heat transfer.	May cause personal injury and equipment malfunction or damage.
If an error occurs, remove the causes for the error and secure the safety before rebooting the operation.	If do not eliminate alarm error, may cause personal injury.
When driver failure occurs , please cut off the power supply of the driver.	If large current continued to flow through, may cause fire danger.
If necessary to use external braking resistor, please further preparation, and don't touch braking resistor while working.	May cause an electric shock and personal injury.
Please input specified voltage, do not connect 220V AC power to the 24V DC control power of the servo driver.	May cause equipment malfunction or damage.
Please process trial operation phase of servo motor while servo motor and mechanical transmission axis is under unconnected status.	May cause personal injury.
The nominal torque of servo motor should be greater than the actual load torque.	The long-term use may cause equipment malfunction or damage.
Non-professionals are not allowed to perform repair and maintenance for servo driver.	May cause personal injury and equipment malfunction or damage.
Please cut off the power supply in case of long time no use.	May cause personal injury.

2 Specifications

Technical Specifications for Driver

	E10 Servo driver		Order No.
Type Specification	200W (Low inertia)		CTSD E10-B2012-M000
	400W (Low inertia)		CTSD E10-B4012-M000
	750W (Low inertia)		CTSD E10-B7512-M000
	1KW (Low inertia)		CTSD E10-B1022-M000
	1KW (Middle inertia)		CTSD E10-B1022-M001
	200W (Low inertia + CANopen)		CTSD E10-B2012-M100
	400W (Low inertia + CANopen)		CTSD E10-B4012-M100
	750W (Low inertia + CANopen)		CTSD E10-B7512-M100
	1KW (Low inertia + CANopen)		CTSD E10-B1022-M100
	1KW (Middle+CANopen)		CTSD E10-B1022-M101
Basic Specifications	Input Power	Main Power	Single phase, 220VAC±15%, 50/60Hz
		Control Power	24VDC±15%
	Encoder Feedback		Incremental Encoder, 2500 p/r (Resolution: 10000)
	Cooling Method		Natural cooling (200W、400W), Fan-cooling (750W、1KW)
	Control Method		Use FOC(Magnetic positioning control)and SVPWM(Space Vector Modulation)
	Communication Functions		Modbus protocol, Based on RS-485, support radio CANopen protocol
	Braking Resistance		Internal / External braking resistance(Mainly applied to emergency start-stop situation)
	Protective Function		Over-voltage、under-voltage、over-current、over-load、over-heat、over-speed、excess position deviation、encoder feedback error、over-braking ratio、overtravel inhibit、EEPROM error etc.
	Display and Operation		5 LED Digital lights, can connect external servo debugger
	Parameter Setup		MagicWorks Tuner software or connect external servo debugger

Properties	Speed rate of change	Load rate of change	0～100%: 0.1% or less(Under rated revolution)
		Voltage rate of change	Rated voltage:±15%: 0%(Under rated revolution)
		Temperaturer ate of change	25±25℃: ±0.1% or lower(Under rated revolution)
	Frequency Response		100Hz(when JL=JM)
	Integrated PLC Control Function		NO
Input And Output Signal	Position Output	Output Type	Open-collector output
	Digital Input (7DI)		Servo-ON、Alarm clear、CW/CCW overtravel inhibit、Internal speed selection、torque limitation selection、Gear ratio switching、Control Mode switching、Gain switching、pulse input inhibit、zero-Speed clamp、positional deviation clear, IO multiplexing function registers selection.
	Digital Output (4DO)		Servo-Ready、Alarm output、Torque limit output、Positioning complete、Speed Arrival、Zero -Speed detection output、Brake clear output, IO multiplexing function registers selection.
	Analog Input		12bit A/D: 1 input
Position Control Mode	Max. Input Pulse Frequency		Differential method: 500KHz, open-collector method: 200KHz
	Pulse Command Mode		Pulse+Direction, A+B, CW+CCW
	Command Control Mode		External pulse control /16 communication register command
	Feedforward Compensation		0～1000‰(Setup resolution 1‰)
	Positioning Complete		0～32767 command unit(Resolution set to 1 command unit)
	Electronic Gear Ratio		Electronic Gear Ratio :N/M times, N:1～10000, M:1～10000(1/200<N/M<200)

Speed Control Mode	Analog Input	Voltage Range	-10V～+10V(Resolution:12 bit)
		Input Resistance	19K
		Sampling Frequency	1KHz
	Command Control Method		External analog Command/8 internal speed command/32 communication register command
	Command Smoothing Mode		Lowpass filtering, Smoothing time constant: 0~2500(x10us)
	Torque Limitation		Internal parameters/External analog
Torque Control Mode	Analog Input	Voltage Range	-10V～+10V(Resolution:12 bit)
		Input Resistance	19K
		Sampling Frequency	1KHz
	Command Control Mode		External analog Command /32 communication register command
	Command Smoothing Mode		Lowpass filtering, Smoothing time constant :0~2500(x10us)
	Speed Limitation		Internal parameters/External analog
Application Environment	Operating Temperature		0℃～55℃
	Storage Temperature		-20℃～70℃
	Humidity		Lower than 90% RH (No condensation)
	IP Level		IP20
	Installation Place		No corrosive gas, inflammable gas, oil mist or dust etc.
	Installation Method		Install in vertical position
	Altitude		Lower than 1000m
	Atmospheric Pressure		86Kpa～106Kpa
Cable Type	Motor cable		Order No.
	200W, 400W, 750W, 1KW (Low inertia)		CTSD MOL-M3110
	1KW (Middle inertia)		CTSD MOL-M3120
	Encoder cable		Order No.
	200W, 400W, 750W, 1KW (Low inertia)		CTSD ENL-M3110
	1KW (Middle inertia)		CTSD ENL-M3120

Model Description of Servo Driver

CTSD E10-B4012-M000

CTSD	CO-TRUST Driver products
E10	Economical servo driver
H1A	Standard Low-Voltage Servo Driver
H2A	Standard High-Voltage Servo Driver
A	Voltage Identification: 380VAC
B	220VAC
C	80VDC
401	Rated Power：40X10¹（W）
00	Supplement flag bit
0	Support Modbus Protocol
1	Support Modbus and CAN Protocols
2	Support Modbus and Industry Ethernet Protocols
A	Adapt to A series motor
M	Adapt to M series motor
H	Adapt to H series motor
0	9pin General Encoder interface
1	9pin Wiring-saving Encoder interface
2	15pin None-sparing Encoder interface
3	20pin None-sparing Encoder interface

Model Description of Servo Motor

CTSD M16-B4011-M000

CTSD	CO-TRUST Driver products
M	Motor
1	Motor Specification ：Low inertia
2	Middle inertia
3	High inertia
6	Flange Dimensions ：60*60mm
8	80*80mm
B	110*110mm
D	130*130mm
I	180*180mm
A	Voltage Identification ：380VAC
B	220VAC
C	80VDC
401	Rated power：40X10¹（W）
0	Reserved
0	Without Band-type brake
1	With Band-type brake
0	Optical axis、with Flat
1	Solid 、With Keys
2	Solid、With Keys and Screw holes
3	Solid、With Screw holes
A	A series motor
M	M series motor
H	H series motor
0	9pin General Encoder
1	9pin Wiring-saving Encoder
2	15pin None-sparing Encoder
3	20pin None-sparing Encoder

The cable Model Description of Motor and Encoder

CTSD MOL-M3110

CTSD	CO-TRUST Driver products
MOL	Motor power cable
ENL	Encoder cable
A	A series motor
M	M series motor
H	H series motor
0	None
1	Power cable with Band-type brake wires
1	Directly outgoing line
2	Air Sockets outgoing line
1	Adaptive series：E10 series
A	H1A series
2	H2A series
3	Cable length ：3m
5	5m
7	7m

3 Installing

Installing Driver and Motor

Please properly install the servo driver and servo motor to avoid malfunctions or accidents.

3.1 Driver Installing Environment

- The storage and installation of products must satisfy the environmental requirements.
- Servo driver must install according to the direction and the interval of the specifications, and shall be in good heat dissipation condition.
- Installation must use fireproofing material, and shall not be installed on top or near the inflammables in order to prevent fire.
- Electric cabinet that used to install servo driver should prevent dust, corrosive gas, conductive objects (such as copper chips), liquid and inflammables etc.
- Servo driver and servo motor should avoid shock and vibration.

3.2 Driver Environmental Condition

Item	Conditions
Operating temperature	0 ℃ to 55 ℃
Storage temperature	-20 ℃ to +70 ℃
Ambient Humidity	Lower than 90% RH (No condensation)
Altitude	Lower than 1000 meters
Vibration	10~57Hz 3.5mm, 57~150Hz 1g
Atmospheric Environment	No Corrosive gas, inflammable gas, oil mist or dust etc.

3.3 How to Install Driver

The servo driver use base plate installation method, install in vertical direction, the schematic diagram of base plate installation see as figure 3.1:

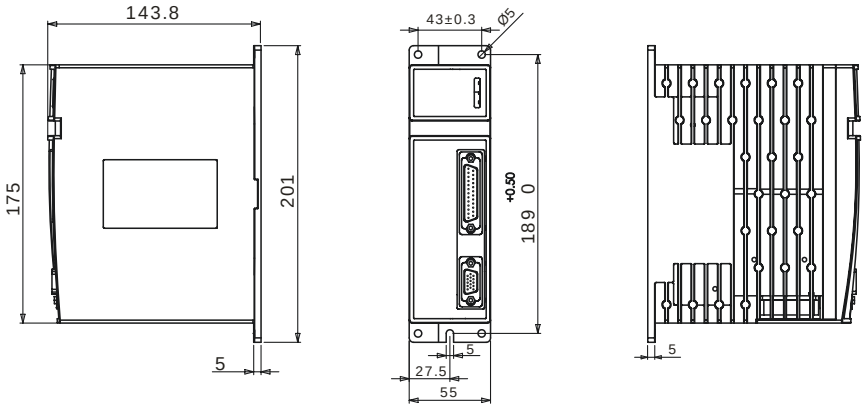


Figure 3.1 Base plate installation method of Servo driver

3.4 Installation Direction and Intervals

- In order to allow enough space surrounding for ventilation, please leave larger interval when in actual installation.
- So as to prevent the ambient temperature of the driver continuing to rise, best to contain a radiator in electricity cabinet to blow reciprocal winds to the driver.

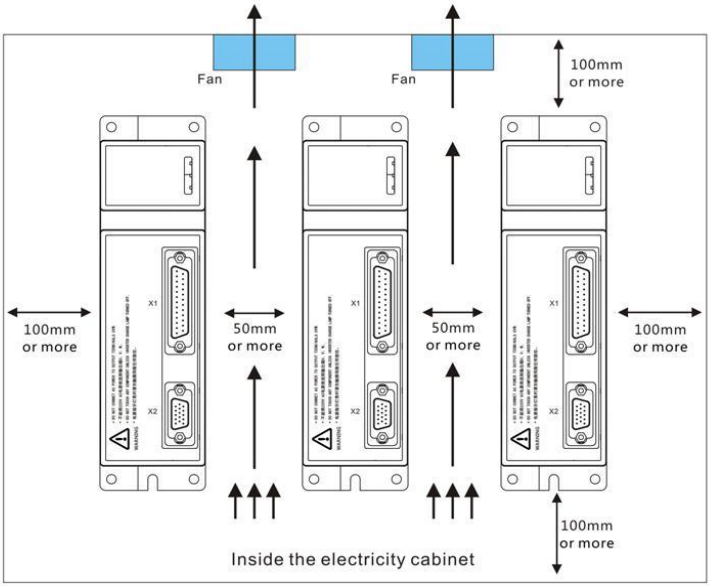


Figure 3.2 Installation intervals for one or more servo drivers

3.5 Motor Installation Environment

- Avoid installing the motor in rain water and direct sunshine rooms.
- Avoid the place where the motor is subjected to dust, corrosive gases, conductive objects, liquids and flammable gases.
- Keep motor in well-ventilated, no humidity, no oil and no water places.
- Ambient temperature should be held in -20～50℃(No freezing), in case of motor operates for a long-term under small space or near heating equipment, should consider to use forced cooling.
- Humidity should not higher than 90%RH(No condensation).
- Servo motor should avoid vibration and impact.

3.6 How to Install Motor

1. Maters needing attention in installation

- Encoders are high precision components, please remember to protect when handling or installation, also should avoid to knock or collide.
- Please do not use a hammer knocking directly on axial end when install or remove the coupling in the motor shaft.
- Try perfect alignment between shafts, otherwise may cause vibration, and damages of the bearings.
- Avoid dragging motor shaft, outgoing line or encoder when handling the motor.
- This motor isn't subjected to water and/or oil drops, please put the cable outlet downward when installing the motor.
- Don't use the motor with the cables being immersed in oil or water.
- Avoid long time in the overloading operations, otherwise the motor will be damaged.
- Be sure to firmly install the motor, and should prepare some measures to against loosening.

2. Installing method

The Servo motor can be installed either vertically or horizontally. Installation dimension refer to following figures.

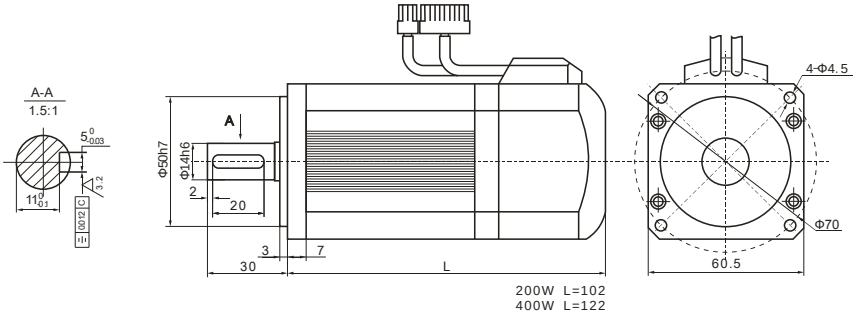


Figure 3.3 200W/400W (Low inertia) type Motor installation dimension (Unit: mm)

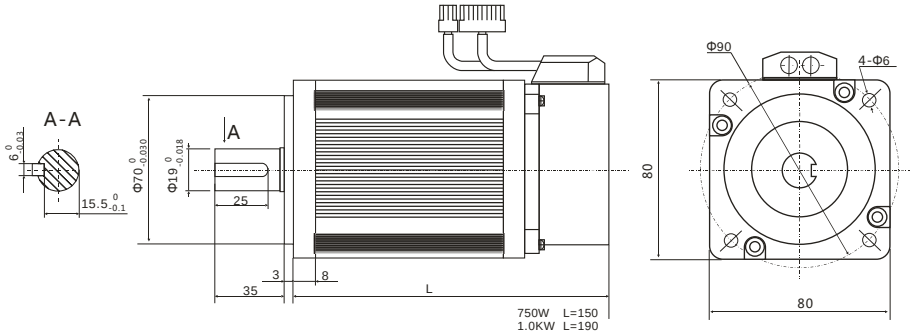


Figure 3.4 750W/1KW(Low inertia) type Motor installation dimension (Unit: mm)

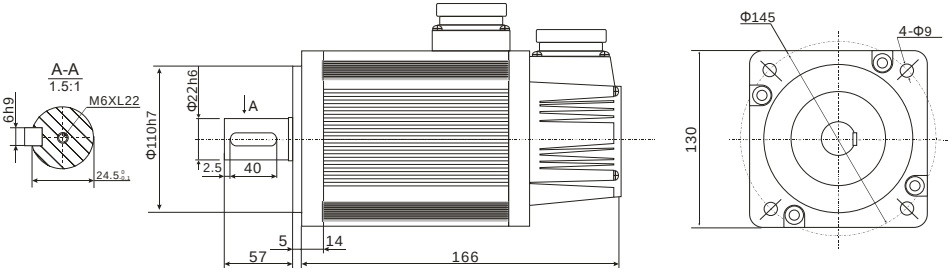


Figure 3.5 1KW(Middle inertia) type Motor installation dimension (Unit: mm)

3. Technology parameter of Motor

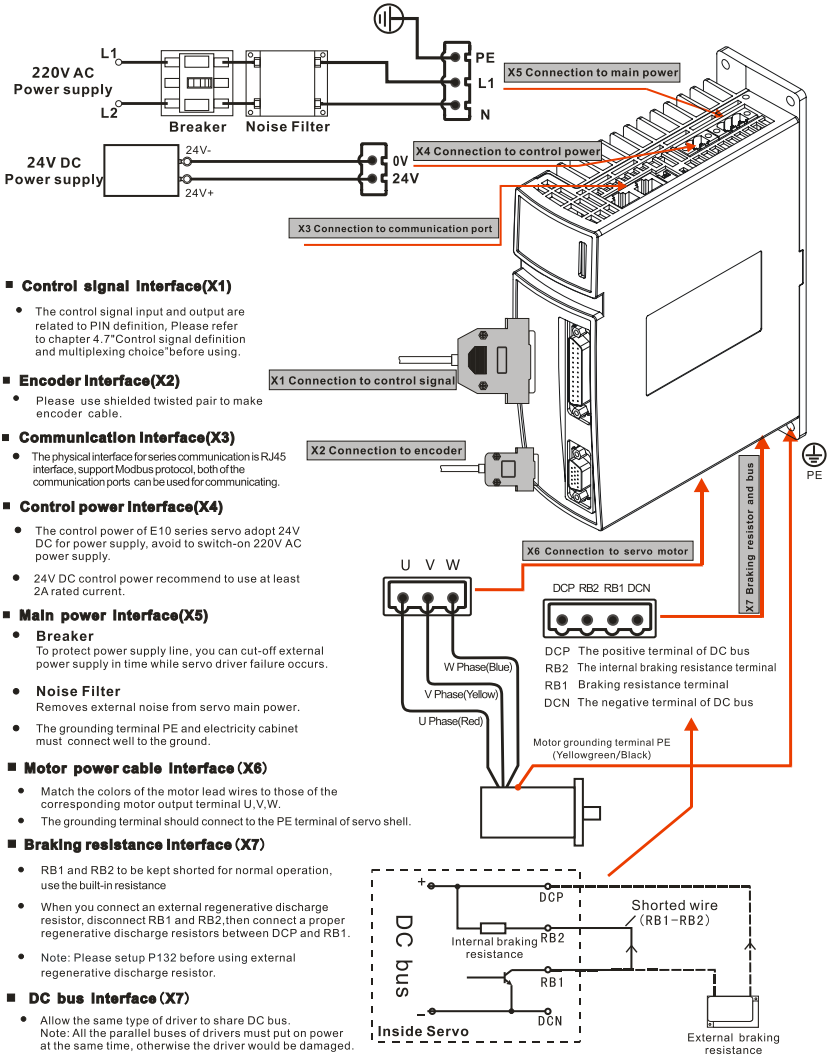
Motor Type	Rated Power	Rated Voltage	Rated revolution	Rated Torque	Rated Current	Peak Torque	Back-Emf Constant (Ke)	Poles	Rotor Inertia	Feedback Encoder
CTSD M16-B2011-M000	200W	220VAC	3000rpm	0.637N·m	1.5A	1.911N·m	28V/Krpm	4	0.17 $Kg{\cdot}cm^2$	2500ppr Incremental Encoder
CTSD M16-B4011-M000	400W	220VAC	3000rpm	1.27N·m	2.8A	3.8 N·m	28V/Krpm	4	0.302 $Kg{\cdot}cm^2$	2500ppr Incremental Encoder
CTSD M16-B7511-M000	750W	220VAC	3000rpm	2.39N·m	3A	7.1N·m	48V/Krpm	4	1.82 $Kg{\cdot}cm^2$	2500ppr Incremental Encoder
CTSD M16-B1021-M000	1.0KW	220VAC	2500rpm	4N·m	4.4A	12N·m	56V/Krpm	4	2.97 $Kg{\cdot}cm^2$	2500ppr Incremental Encoder
CTSD M2D-B1022-M200	1.0KW	220VAC	2500rpm	4N·m	4.0A	8N·m	72V/Krpm	4	8.5 $Kg{\cdot}cm^2$	2500ppr Incremental Encoder

4 Wring

General wiring diagram

⚠ Those who are authorized for wiring or inspection must qualify to the job.

⚠ To avoid electrical shock hazards, please perform the wiring and inspection at least 15 minutes after the power off.



■ **Control signal interface(X1)**

- The control signal input and output are related to PIN definition, Please refer to chapter 4.7"Control signal definition and multiplexing choice"before using.

■ **Encoder interface(X2)**

- Please use shielded twisted pair to make encoder cable.

■ **Communication interface(X3)**

- The physical interface for series communication is RJ45 interface, support Modbus protocol, both of the communication ports can be used for communicating.

■ **Control power interface(X4)**

- The control power of E10 series servo adopt 24V DC for power supply, avoid to switch-on 220V AC power supply.
- 24V DC control power recommend to use at least 2A rated current.

■ **Main power interface(X5)**

- **Breaker**
  To protect power supply line, you can cut-off external power supply in time while servo driver failure occurs.
- **Noise Filter**
  Removes external noise from servo main power.
- The grounding terminal PE and electricity cabinet must connect well to the ground.

■ **Motor power cable interface (X6)**

- Match the colors of the motor lead wires to those of the corresponding motor output terminal U,V,W.
- The grounding terminal should connect to the PE terminal of servo shell.

■ **Braking resistance interface (X7)**

- RB1 and RB2 to be kept shorted for normal operation, use the built-in resistance
- When you connect an external regenerative discharge resistor, disconnect RB1 and RB2,then connect a proper regenerative discharge resistors between DCP and RB1.
- Note: Please setup P132 before using external regenerative discharge resistor.

■ **DC bus interface (X7)**

- Allow the same type of driver to share DC bus.
  Note: All the parallel buses of drivers must put on power at the same time, otherwise the driver would be damaged.

Figure 4.1 External port schematic diagram

4.1 The Main Power Input Terminal

Terminal No.	Symbol	Name	Description
X5	L1	Main Power Input Terminal	Single phase input 220VAC±15%, 50/60Hz
	N		
	PE		
Caution	● In order to improve anti-jamming ability, advise to provide the power supply through noise filter. ● Advise to install the none-fusing type of circuit breaker so as to cut off the external power supply in time while driver failure occurs. ● To avoid electric shocks, you can choose isolation transformer to provide electrical power. ● Be sure to connect the grounding terminal PE with the electricity cabinet to the ground, multiple servos to avoid connecting with ground in series.		
Proposal specification list of driver peripheral equipment: Wire thickness of the main power: 750W/1.0KW 0.75mm2/AWG15 Rated current of breaker: 10A/Per one breaker Noise filter: Single phase power filter(First-order common mode +First-order differential mode) Rated voltage: AC 0-300V、40-440Hz Rated Current: 10A			

4.2 Control Power Input Terminal

Terminal No.	Symbol	Name	Description
750W/1.0KW X4	0V	Control Power 24VDC Input Terminal	Control Power Input Range: 24VDC±15%
	24V		
Caution	● The control power of E10 series servo adopt to 24VDC for power supply,avoid to switch-on 220V AC power supply. ● The rated current consumption of control power for a single servo is 450mA; 24V DC control power recommends 2A as the rated current.		

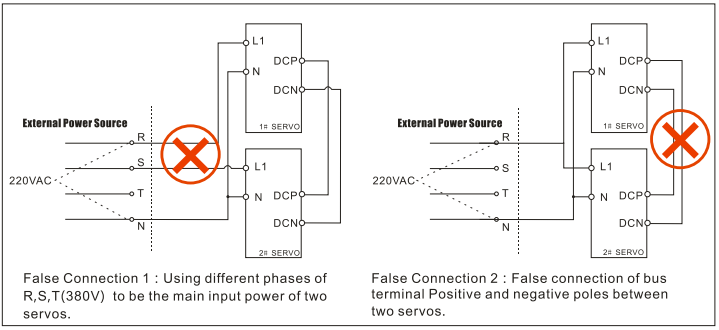
4.3 Braking Resistance and Bus Output Terminals

Terminal No.	Symbol	Name	Description
X7	DCN	The negative of direct current bus	The negative bus inside the driver.
	RB1	Brake resistor terminal	The brake output terminal inside the driver.
	RB2	Internal Brake resistor terminal	The brake resistor inside the driver.

	DCP	The positive of direct current bus	The positive bus inside the driver.

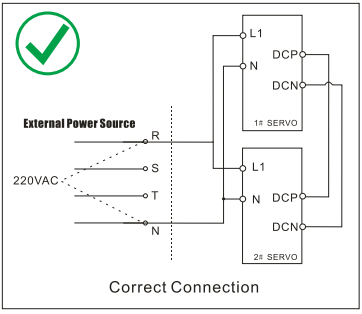
Caution

- Avoid to set P132 to 2 while using internal brake resistor.
- Please install the external braking resistance on incombustible matters such as metal etc, advise to set external protection like temperature insurance etc.
- Usually shorted RB1 and RB2, if "Excessive brake ratio" alarm occurs, please disconnect RB1 with RB2, and insert a proper external braking resistor between DCP and RB1, the specification recommend to use 100Ω 200W~300W, and set P132 as 1 or 2.
- DCP and DCN are the DC bus terminals of driver, applied to DC common bus of multiple servos system.
- Please don't touch driver braking resistance and bus terminal within 15 minutes after the power off.
- Advised not to use common DC bus, if really have to use common DC bus, the phase of the input power source must be the same. Such as if one servo connect R to N, other servos cannot connect T to N,or S to N.The diagram of wiring see as follows:



False Connection 1 : Using different phases of R,S,T(380V) to be the main input power of two servos.

False Connection 2 : False connection of bus terminal Positive and negative poles between two servos.



Correct Connection

4.4 Motor power cable interface

Terminal No.	Symbol	Name	Description
X6	U	U phase of Motor	Corresponds to the motor
	V	V phase of Motor	Corresponds to the motor
	W	W phase of Motor	Corresponds to the motor
	PE	Ground terminal	Corresponds to the motor
Caution	● Match the colors of the motor lead wires to those of the corresponding motor output terminal U、V、W. ● Please make sure to connect the grounding terminals of the motor to avoid electric shock. ● Don't touch the motor terminals, as the U、V and W phases of the motor will remain high pressure after power off. ● The plug serial number of U、V、W、PE (200W、400W、750W、1000W Low inertia motor) is: 3、2、1、4; The plug serial number of U、V、W、PE (1000W middle inertia motor) is: 2、3、4、1;		

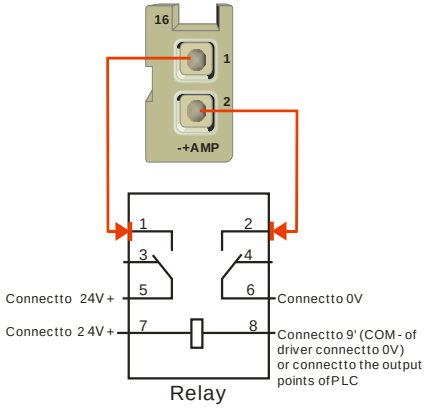
4.5 Permanent magnet safe brake of Motor

The wiring diagram of motor permanent magnet safe brake see as follows:

200W/400W Permanent magnet safe brake of Motor

Voltage：24V

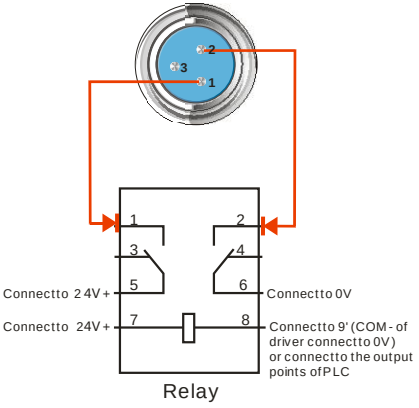
Wiring：1→24V、2→0V



750W/1000WPermanent magnet safe brake of Motor

Voltage：24V

Wiring：1→24V、2→0V、3→Null

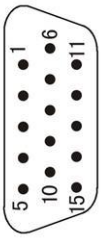


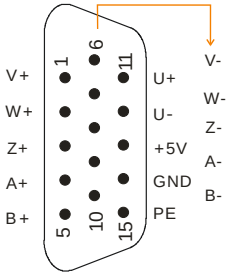
<Note> Connect the control terminal of brake resistance via relay (Control terminal: DC24V, load capacity is greater than or equal to 1A), and connect a Schottky diode in parallel at the control terminal of relay (Diode type is recommended as 1N4148, Package: DO-35 glass package, instrumented).

Please refer to Figure 4.4 or 4.5 for the wiring diagram.

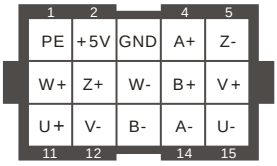
4.6 Encoder Input Interface Terminal

E10 series servo motor adopt to connect incremental encoder signal, which including encoder power, A、B、Z signal and shield layer(Contains Hall signal U、V、W), the specific wiring see below table:

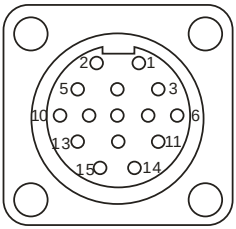
Terminal No.	Connector	Pin of servo	Pin of motor (Low inertia)	Pin of motor (Middle inertia)	Name
X2		1	10	11	Hall signal V+
		2	6	12	Hall signal W+
		3	7	6	Encoder signal Z+
		4	4	4	Encoder signal A+
		5	9	5	Encoder signal B+
		6	12	14	Hall signal V-
		7	8	15	Hall signal W-
		8	5	9	Encoder signal Z-
		9	14	7	Encoder signal A-
		10	13	8	Encoder signal B-
		11	11	10	Hall signal U+
		12	15	13	Hall signal U-
		13	2	2	Encoder signal +5V power supply
		14	3	3	Encoder grounding
		15	1	1	PE grounding
Caution	Short-circuiting between Encoder PE grounding wire and Encoder signal lines might result in damage of servo and motor.				



Viewing from Servo



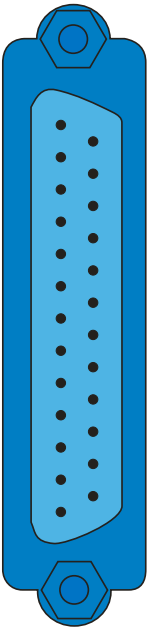
Viewing from Motor(Low inertia)



Viewing from Motor(1KW Middle inertia)

Figure 4.2 Encoder interface

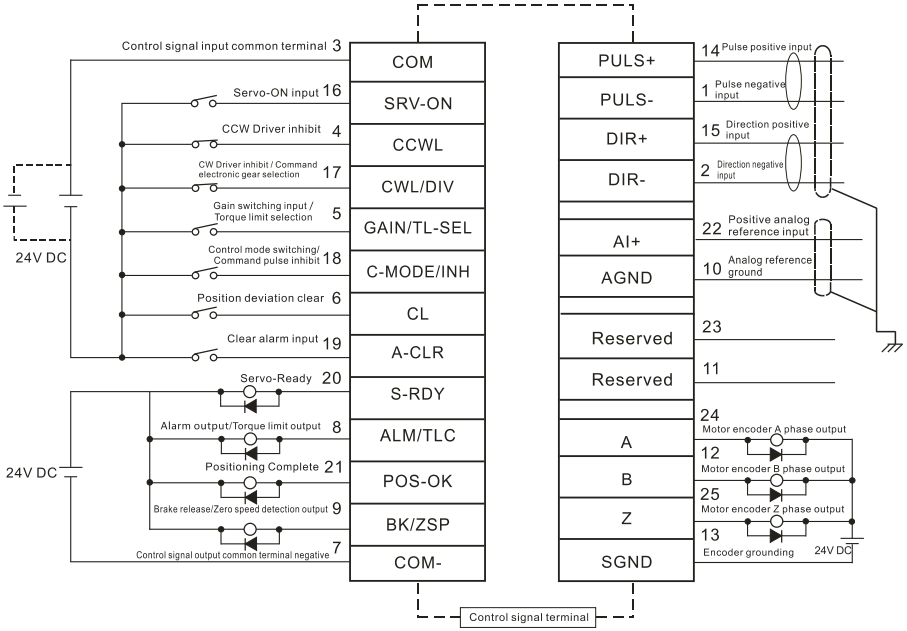
4.7 Control Interface Terminal



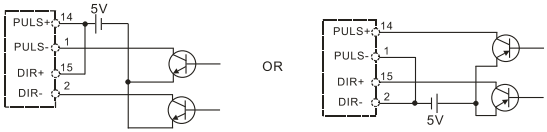
Pulse negative input	PULS-	1	14	PULS+	Pulse positive input
Direction negative input	DIR-	2	15	DIR+	Direction positive input
The control signal input common terminal	COM	3	16	SRV-ON	Servo-ON
Digital input 1	DIN1	4	17	DIN2	Digital input 2
Digital input 3	DIN3	5	18	DIN4	Digital input 4
Digital input 5	DIN5	6	19	DIN6	Digital input 6
The control signal output common negative terminal	COM-	7	20	DOUT1	Digital output 1
Digital output 2	DOUT2	8	21	DOUT3	Digital output 3
Digital output 4	DOUT4	9	22	AI+	Positive analog reference input
Analog reference ground	AGND	10	23	Reserved	Reserved
Reserved	Reserved	11	24	A	Motor encoder A phase positive output
Motor encoder B phase positive output	B	12	25	Z	Motor encoder Z phase positive output
Encoder grounding	SGND	13			

* This PIN figure is the X1 bus terminal of servo driver

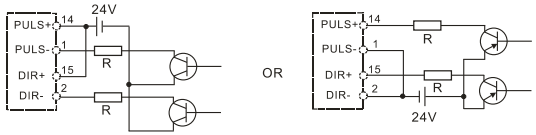
Figure 4.3 Pins sequence schematic diagram of Control signal terminal X1



1、Single-ended drive mode, please do not connect external resistance while using 5V power supply.



If use 24V power supply, make sure to connect resistances(2K~3.3K).



Calculation formula of R (Specification: ½ W)

$$\frac{V_{DC}-1V}{R+250} \approx 10mA$$

2、Differential drive mode

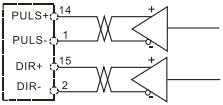
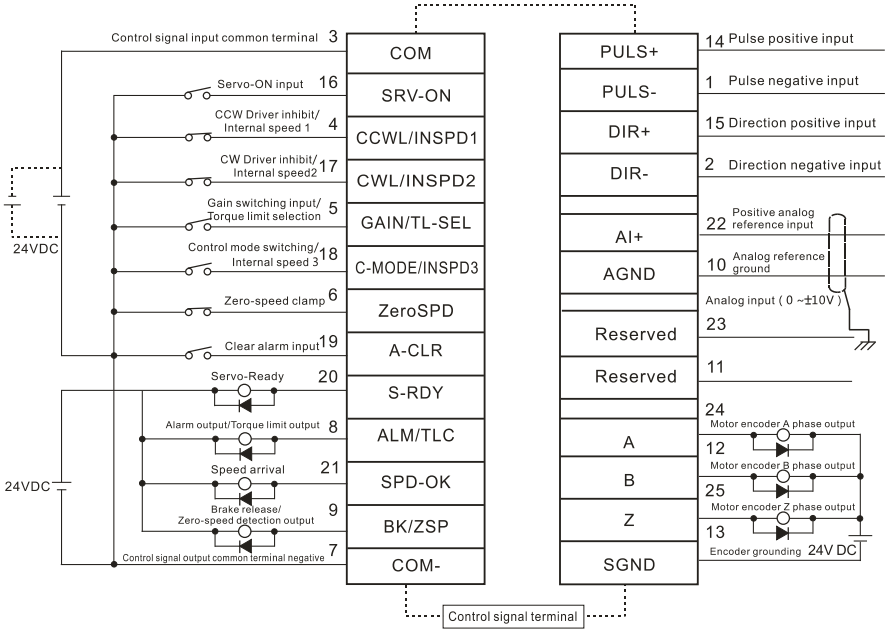


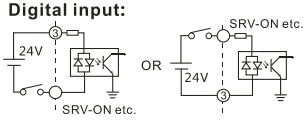
Figure 4.4 Wiring schematic diagram of External Position control mode



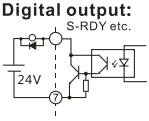
1、The voltage of control signal power between COM+ and COM- is 12 to 24V;Make the lower limit voltage of power supply between COM+ and this signal as 12V or more in order to ensure the control signal input is valid. (When you use contact inputs, use the dedicated switches and relays for micro current to avoid contact failure)

Max. output transistor: 30V,100mA Rated current output: 10mA.

Digital input:

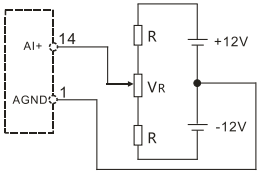


Digital output:



2、Analog input range : -10V~+10V

When you compose a simple command circuit using variableresistor(VR) and register R,see as below:



VR 2kΩ 1/2W or more is recommended,R 200Ω 1/2W or more is recommended.

Analog command input resolution: ADC 12Bit

3、The encoder output can only single-ended negative output.

Figure 4.5 Wiring schematic diagram of External Speed/Torque control mode

4.8 Communication Interface Terminal、Terminal Resistance and Restore Factory Default

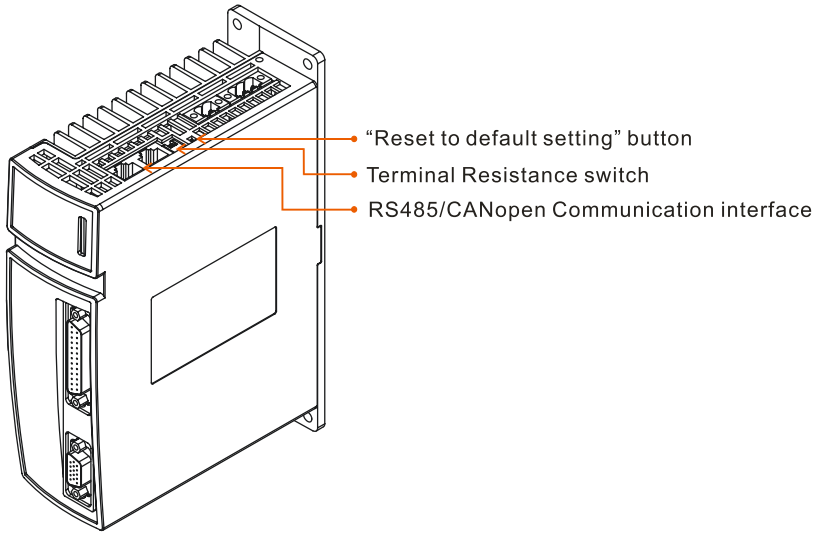


Figure 4.6 The schematic diagram of servo top terminal

The serial port Communication physical interface of E10 series servo are RJ45, which support Modbus protocol and CANopen protocol, both of the communication interfaces can be communicated, the specific wiring see below table:

RJ45 PIN	Signal	Description
1	CAN_H	CAN sending signal+
2	CAN_L	CAN sending signal-
4	RS485+	RS485 sending signal+
5	RS485-	RS485 sending signal-
Connector shell	PE	Chassis Ground

<Note> To avoid communication failure, please set the Parity of Communication Config to Even Parity or Odd Parity, rather than None Parity.

Make communication cables

If make reticle plug according to 568A or 568B standard, only need to draw out the blue and white-blue lines from the cable and then use them as RS485 communication

wires.(The communication distance could reach to 500m while using twisted pair network cable, recommend 300m or shorter for general use.)

Likewise, draw out orange and white-orange from the cable to make CANopen communication wires, you can set the communication rate by P11, below table describes the correspondence of communication rate and distance:

P11 Value	Communication Rate(kbit/s)	Max. Communication Distance(m)
1	1000	25
2	800	50
3	500	100
4	250	250
5	125	500
6	50	1000
7	20	2500

<Note> The max. Communication distance of above table would be shorted under the influence of various external factors.

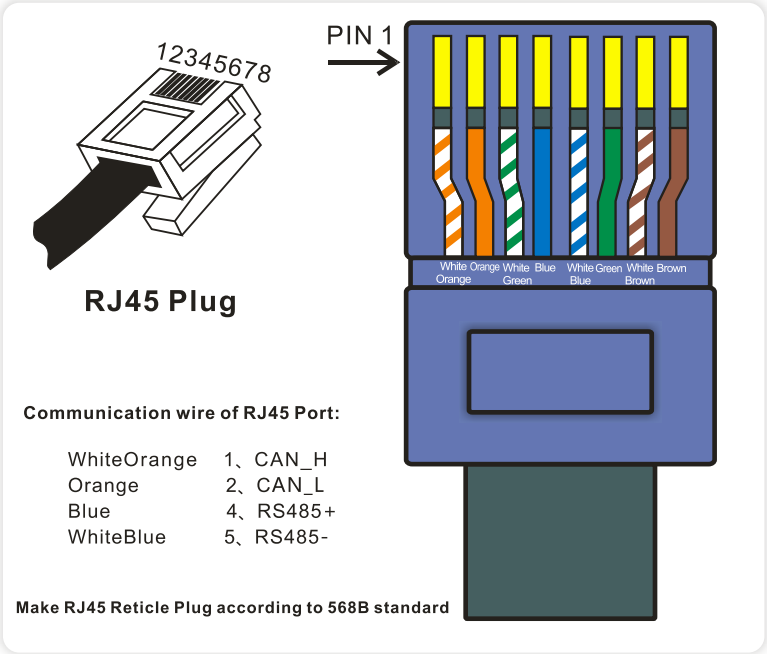
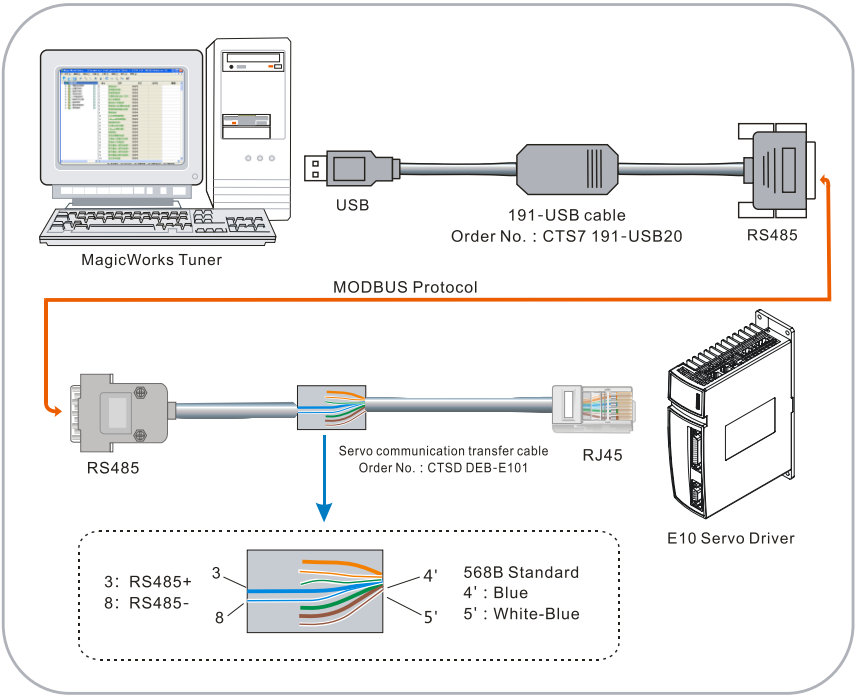


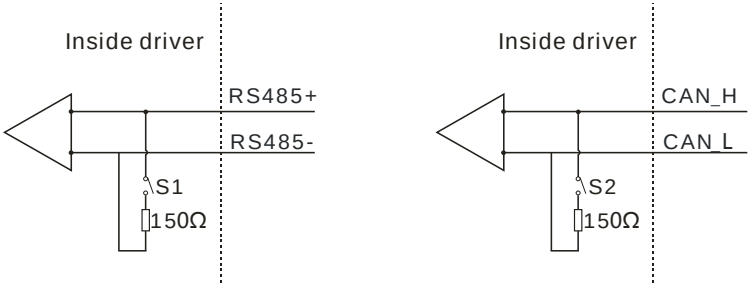
Figure 4.7 Reticle plug schematic diagram

Connection between E10 Servo driver and PC

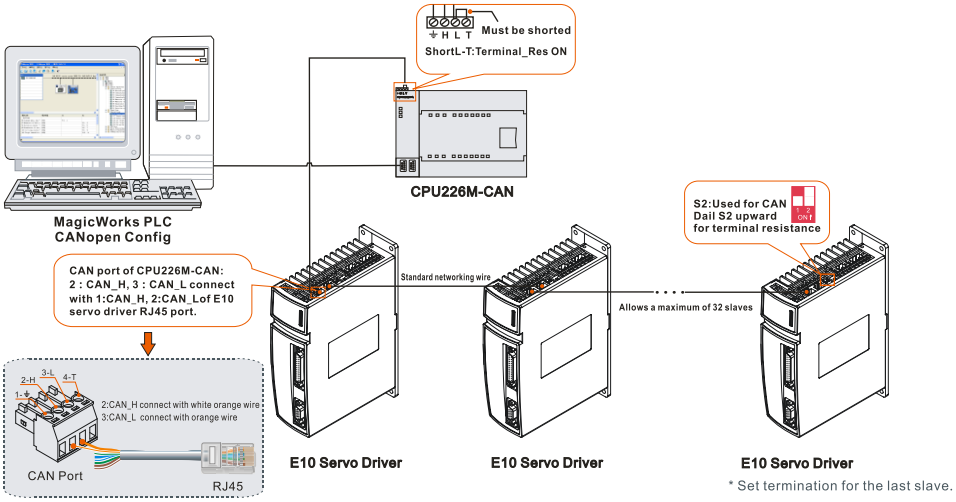


Set terminal resistance

Matching terminal resistance switch is used to eliminate the signal reflection in communication cable, to shield the signal reflection which caused by impedance discontinuity or mismatching. In practical application, if you use a long distance communication cable, and the network contains many branches, or the occasions with too much interference and frequently communication interrupt, recommend to turn on the terminal resistance of the servo so as to improve the reliability of communication.



In order to improve reliability of the communication data, both ends of the communication cable should be limited when building CANopen network, that is connecting a termination between CAN_L and CAN_H of the servo. The following figure indicates the termination method among E10 Servo Driver and CPU226M-CAN.



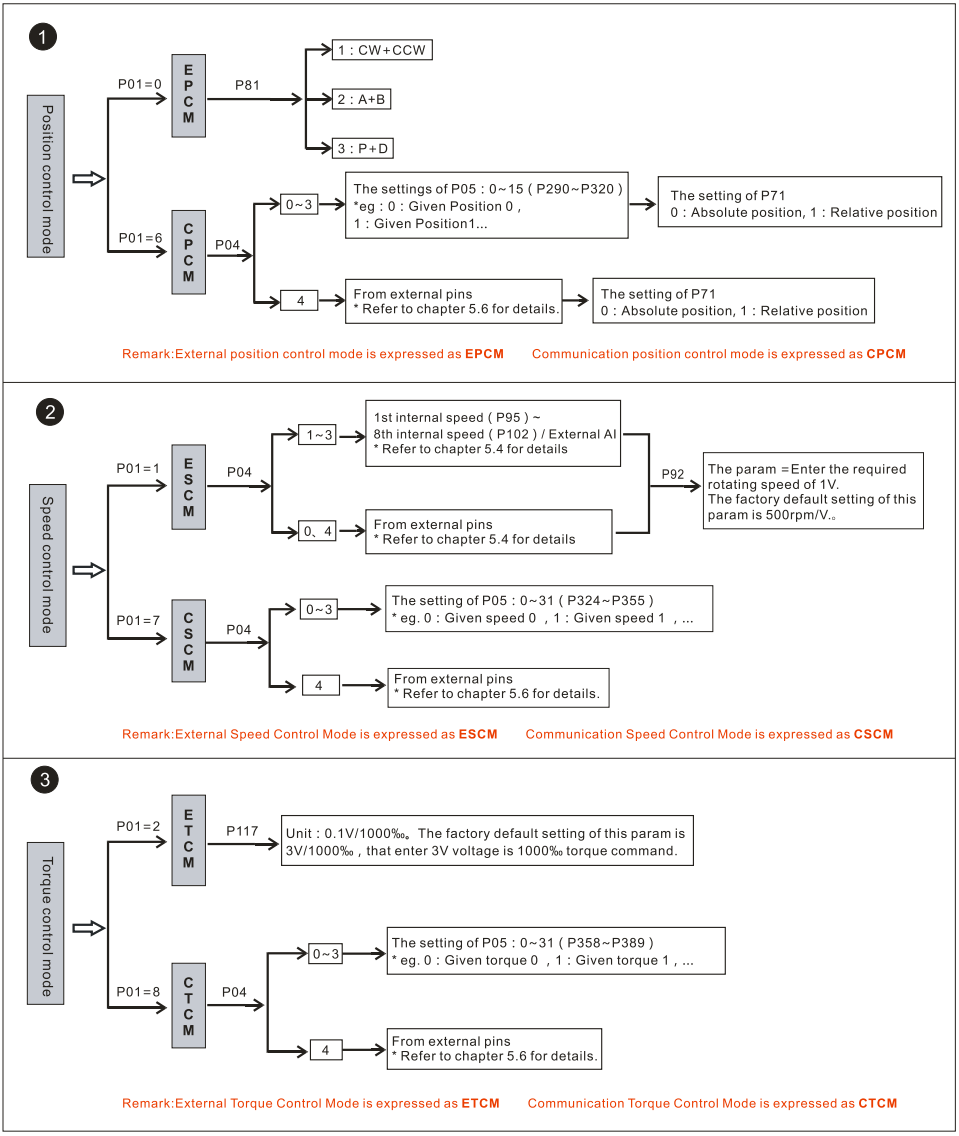
"Restore Factory" button is used to reset the servo parameters as the factory defaults, advise to restart the servo driver after restored factory defaults.

<Note> "Restore Factory" button is invalid while in servo-ON status.

5 Details of Control and given Signal

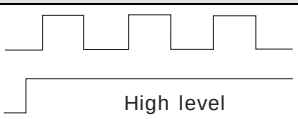
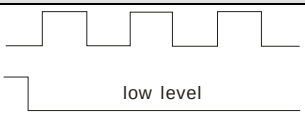
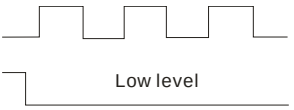
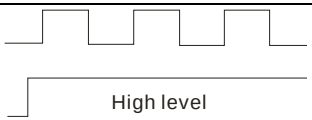
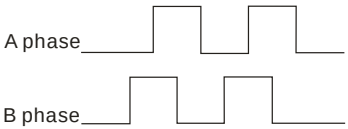
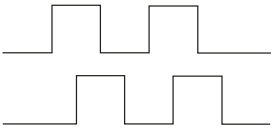
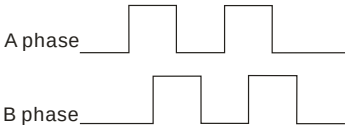
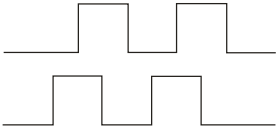
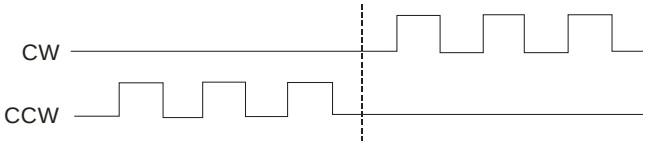
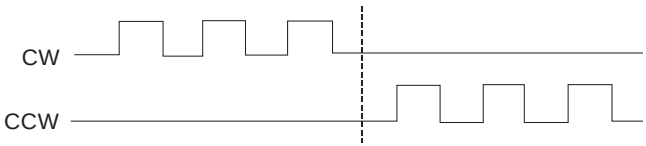
General input/output signal, communication external command and its functions

5.1 Given Command Source



While under position control mode, there are two tips described as follows to be noted:

◆ Set pulse direction and form according to the type of input command pulse:

Type	Direction	CCW(counterclockwise)	CW(clockwise)
3	0		
	1		
2	0		
	1		
1	0		
	1		

◆ Only Start signal is triggered that the given position command could take effect at relative position control.

5.2 Control Signal Definition and Multiplexing Choice

The command source of external / communication control mode and the related configurations of DI/DO signal are detailed below:

5.2.1 Selection of Digital input multiplexing functions

P73 decides the control command source and distribution mode of pins:

	Name	Value	Definition of Param value		Remark
			Communication control mode	External control mode	
P73	Selection of Control command source	0	From P281 Communication extended control word (Default allocation)	From external DI signal (Default allocation)	It's related to control mode.
		1	From external DI signal (Default allocation)	From external DI signal (Default allocation)	It's unrelated to control mode.
		2	From external DI signal (Decided by P75/76/77/78)	From external DI signal (Decided by P75/76/77/78)	
		3	From P281 Communication extended control word (Default allocation)	From P281 Communication extended control word (Default allocation)	
		4	From external DI or P281 Communication extended control word (Decided by P75/76/77/78)	From external DI or P281 Communication extended control word (Decided by P75/76/77/78)	

The function of P73 is to select control command source under External Position / Speed / Torque control mode and Communication position/Speed/Torque control mode, control commands include: Alarm clear input, Control mode switching, Zero-speed clamp/Position lock, Command Electronic Gear Selection, Homing command, Command pulse input inhibit / Command selection 4, Gain selection, Deviation counter clear, Command selection1, Command selection2, Command selection3, Torque limit switching input.

Sensor signal must come from external DI, which cannot be given by communication method. Sensor signal include: CCW Overtravel Inhibit, CW Overtravel Inhibit, Original switch.

<Note> P73 does not work for the three sensor signals and Servo-on signal.

P01=0~5 (External control mode), P01=6~11 (communication control mode).

- When P73 is set to 0, the control commands of external control mode are from external DI signal, and allocates the pin functions in accordance with defaults. And control commands of communication control mode are from P281 Communication extended control word.

- When P73 is set to 1 or 2, the control commands of External control mode and communication control mode are from external DI signals, P281 Communication extended control word is invalid. If P73 sets to 1, the pin functions comply with default allocation method. If P73 sets to 2, the pin functions are decided by P75/76/77/78.
- When P73 is set to 3, the control commands of External control mode and communication control mode are from P281 Communication extended control word, but sensor input signal: "CCW Overtravel Inhibit", "CW Overtravel Inhibit", "Original switch input" also need input by externals, and according to default allocation method.
- When P73 is set to 4, the control commands of External control mode and communication control mode can from P281 Communication extended control word or External DI signals, this function is valid as any of the option becomes effective. eg. When P73 is set to 4, Bit0~7 of P78 is set to 16#07 in accordance with P75/76/77/78 pin allocation method, that means pin DIN1 set as Homing command signal input, DIN1 input is valid, the servo would enter in Homing mode; bit7 of P281 write 1 via communication function can also turn into Homing mode, the Homing command input is valid as any of the control command input is effective.

1) Default allocation method

Digital input default functions				
PIN	Symbol	Position Mode	Speed Mode	Torque Mode
4	DIN1	CCW Overtravel Inhibit	CCW Overtravel Inhibit	CCW Overtravel Inhibit
17	DIN2	CW Overtravel Inhibit	CW Overtravel Inhibit	CW Overtravel Inhibit
5	DIN3	Gain Switching Input	Gain Switching Input	Gain Switching Input
18	DIN4	Control Mode Switching	Control Mode Switching	Control Mode Switching
6	DIN5	Original switch input	Original switch input	Original switch input
19	DIN6	Alarm clear input	Alarm clear input	Alarm clear input

2) Pin allocation method decided by P75/76/77/78

When P73 = 2 or 4, the 8 high-bit and 8 low-bit of P75, P76, P77, P78 determine the 7 pin functions separately, the correspondence of the high-low bits and function codes

refer to following table. Example: Configure DIN1 pin to Homing command, you should write 16#07 to P78 bit 0~7; If DIN2 pin is configured to Original switch input, you need write 16#0B to P78 Bit8~15.

So as to allow it function properly, be sure to set correct high-low bit.

<table>
<tr><th colspan="5">Digital input multiplexing functions</th></tr>
<tr><th>Param</th><th>Bit</th><th>Pin</th><th>Symbol</th><th>Function code</th></tr>
<tr><td>P75</td><td>B0~B7</td><td>16</td><td>SRV_ON</td><td rowspan="8">16#00: No functions were 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(Communication 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)
Command selection 4(Communication mode)
16#09: Gain selection
16#0A: Deviation counter clear(Position mode)
Speed direction selection(External speed mode)
16#0B: Original switch input
16#0C: Command selection 1
16#0D: Command selection 2
16#0E: Command selection 3
16#0F: Torque limit switching input
<Note> P75 is valid only when P16=1;
When P16=0, SRV_ON pin is used for enabling only.</td></tr>
<tr><td rowspan="2">P76</td><td>B8~B15</td><td>19</td><td>DIN6</td></tr>
<tr><td>B0~B7</td><td>6</td><td>DIN5</td></tr>
<tr><td rowspan="2">P77</td><td>B8~B15</td><td>18</td><td>DIN4</td></tr>
<tr><td>B0~B7</td><td>5</td><td>DIN3</td></tr>
<tr><td rowspan="2">P78</td><td>B8~B15</td><td>17</td><td>DIN2</td></tr>
<tr><td>B0~B7</td><td>4</td><td>DIN1</td></tr>
</table>

※Example

If under external position control mode, you are required to set those signals to CCW Overtravel Inhibit(DIN1), CW Overtravel Inhibit(DIN2), Original switch input(DIN3), Homing command(DIN4), Null(DIN5), Null(DIN6) in turns. Find the corresponding function code for each pin in accordance with above table, and enter 16#0000 for P76, 16#070B for P77, 16#0302 for P78.

<Note>

1) If multi-pins are allocated to the same function, the servo would report an alarm(P202 Alarm code: 16).

2) Set high bit or low bit of P75, 76, P77, P78 to 0 means assign no function for the relevant pin.

5.2.2 Selection of External input logic level

1) The default enabling method for external control mode is to validate the SRV_ON pin of external DI; Enable the servo in communication control mode: P16 is set to 1 or P282_Bit0 is set to 1. So as to force a shutdown of servo in case of the abnormalities, we offer enabling shutdown method whenever an interrupt occurs during communication, the specific settings see as below:

<table>
<tr><th colspan="2">Param</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>Enable Input (Pin16)</th><th>Communication Enable (P282_bit0)</th><th>Enable</th></tr>
<tr><td>0</td><td>0</td><td>No</td></tr>
<tr><td>0</td><td>1</td><td>Yes</td></tr>
<tr><td>1</td><td>0</td><td>No</td></tr>
<tr><td>1</td><td>1</td><td>No</td></tr>
</table>
</td><td>
<table>
<tr><th>Enable Input (Pin16)</th><th>Communication Enable (P282_bit0)</th><th>Enable</th></tr>
<tr><td>0</td><td>0</td><td>No</td></tr>
<tr><td>0</td><td>1</td><td>No</td></tr>
<tr><td>1</td><td>0</td><td>Yes</td></tr>
<tr><td>1</td><td>1</td><td>No</td></tr>
</table>
</td></tr>
<tr><td>1</td><td>
<table>
<tr><th>Enable Input (Pin16)</th><th>Communication Enable (P282_bit0)</th><th>Enable</th></tr>
<tr><td>0</td><td>0</td><td>No</td></tr>
<tr><td>0</td><td>1</td><td>No</td></tr>
<tr><td>1</td><td>0</td><td>No</td></tr>
<tr><td>1</td><td>1</td><td>Yes</td></tr>
</table>
</td><td>
<table>
<tr><th>Enable Input (Pin16)</th><th>Communication Enable (P282_bit0)</th><th>Enable</th></tr>
<tr><td>0</td><td>0</td><td>No</td></tr>
<tr><td>0</td><td>1</td><td>No</td></tr>
<tr><td>1</td><td>0</td><td>Yes</td></tr>
<tr><td>1</td><td>1</td><td>Yes</td></tr>
</table>
</td></tr>
<tr><td>P16=1</td><td>/</td><td>/</td><td colspan="2">Servo-on once power on. Users could shut off enable function by writing 1 to P281_Bit0. Which means enable function shut off when P281_Bit0=1, enable turn on when P281_Bit0=0.
0: Enable always on
1: Enable shut off</td></tr>
</table>

For example, if under communication position control mode, P72_bit0 = 0 & P282_bit0 = 1, the servo is in enabling state, when SRV_ON pin (Pin 16) is valid, the servo would shut down “Enable” signal in this case; P72_bit 0 = 1 and P282_bit 0 = 1, servo could not

turn into Enable status, SRV_ON pin (Pin 16) must be valid simultaneously that the servo could be enabled.

2) External DI signal CCW Overtravel Inhibit, CW Overtravel Inhibit, zero-speed clamp are valid at low level, original switch signal is effective at high level. In order to compatible with different sensors, we offers external sensor DI input logic level to select the param, the specific setting see as follows:

Param	Bit	Control signal	Effective way	Default
P72	0	Servo enabling method	0: The communication enable and pin enable cannot take effect at the same time.	0
			1: All modes need enable pin, the communication should be enabled under communication mode as well.	
	2	CCW Overtravel Inhibit	0: Low Level On	0
			1: High Level On	
	3	CW Overtravel Inhibit	0: Low Level On	0
			1: High Level On	
	5	Zero-speed clamp	0: Low Level On	0
			1: High Level On	
	11	Original switch input	1: Low Level On	0
			0: High Level On	

For example, Sensor signals: CCW Overtravel Inhibit, CW Overtravel Inhibit, Original switch input, zero-speed clamp signals are activated at high level, then you should set P72 bit2 to 2#1, set P72 bit3 to 2#1、set P72 bit5 to 2#1、set P72 bit11 to 2#0 so that the signals would be effective at high level.

5.2.3 Selection of Digital output multiplexing functions

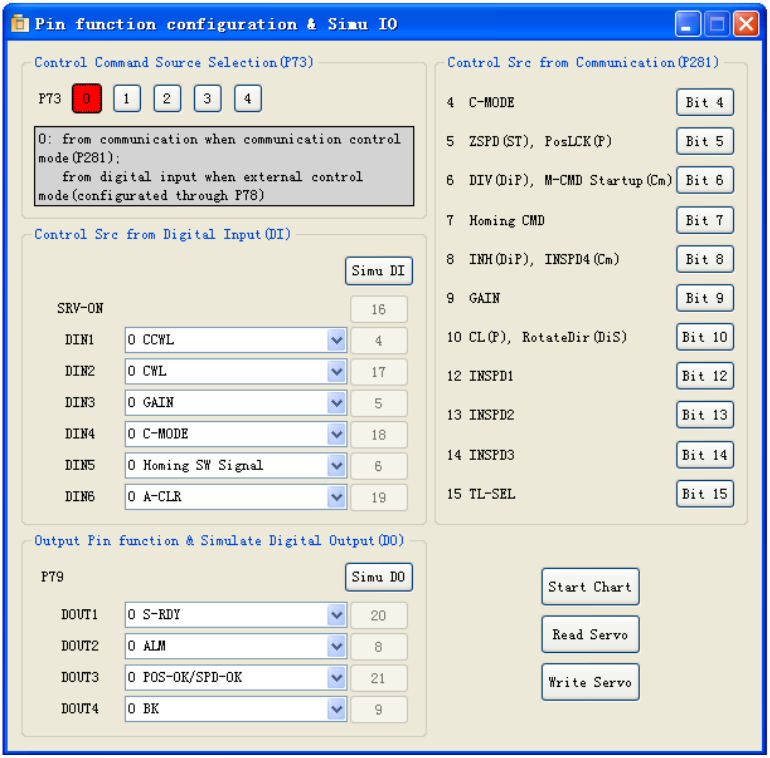
The pin functions marked in figure 4.4 and figure 4.5 are the default functions, you can configure other functions for DOUT1~DOUT4 by MagicWorks Tuner or CO-TRUST debugger. The DO has only one pin-allocation way which is different from DI, and the DO multiplexing functions is determined by P79, the function code for each bit is described in following table:

Digital output multiplexing functions						
Param	Bit	Pin	Symbol	Position mode	Speed mode	Torque mode
P79	Bit0~1	20	DOUT1	0: Servo-Ready	0: Servo-Ready	0: Servo-Ready
	Bit2~3	8	DOUT2	0: Servo Alarm output 1: Torque limit output	0: Servo Alarm output 1: Torque limit output	0: Servo Alarm output 1: Torque limit output
	Bit4~5	21	DOUT3	0: Positioning complete output	0: Speed Arrival output	0: Speed Arrival output
	Bit6~7	9	DOUT4	0: Brake release 1: Zero-speed detection output	0: Brake release 1: Zero-speed detection output	0: Brake release 1: Zero-speed detection output

5.2.4 Pin function configuration & simu IO

You can allocate functions for pins via MagicWorks Tuner, the steps see as follows:

Step 1: Choose menu command “Option” → “Pin function configuration & simu IO” :

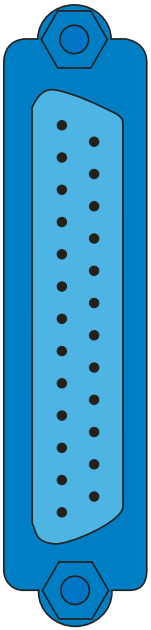


Step 2: Select pin function allocation method and control command source according to

P73:

	Name	Value	Definition of Param value		Remark
			Communication control mode	External control mode	
P73	Selection of Control command source	0	From P281 Communication extended control word (Default allocation)	From external DI signal (Default allocation)	It's related to control mode.
		1	From external DI signal (Default allocation)	From external DI signal (Default allocation)	It's unrelated to control mode.
		2	From external DI signal (Decided by P75/76/77/78)	From external DI signal (Decided by P75/76/77/78)	
		3	From P281 Communication extended control word (Default allocation)	From P281 Communication extended control word (Default allocation)	
		4	From external DI or P281 Communication extended control word (Decided by P75/76/77/78)	From external DI or P281 Communication extended control word (Decided by P75/76/77/78)	

Step 3: Functions for DIN1~DIN6 and DOUT1~DOUT4 can be selectable, the relationship between DIN1~DIN6, DOUT1~DOUT4 and fixed pins refer to follows:



Pulse negative input	PULS-	1	14	PULS+	Pulse positive input
Direction negative input	DIR-	2	15	DIR+	Direction positive input
The control signal input common terminal	COM	3	16	SRV-ON	Servo-ON
Digital input 1	DIN1	4	17	DIN2	Digital input 2
Digital input 3	DIN3	5	18	DIN4	Digital input 4
Digital input 5	DIN5	6	19	DIN6	Digital input 6
The control signal output common negative terminal	COM-	7	20	DOUT1	Digital output 1
Digital output 2	DOUT2	8	21	DOUT3	Digital output 3
Digital output 4	DOUT4	9	22	AI+	Positive analog reference input
Analog reference ground	AGND	10	23	Reserved	Reserved
Reserved	Reserved	11	24	A	Motor encoder A phase positive output
Motor encoder B phase positive output	B	12	25	Z	Motor encoder Z phase positive output
Encoder grounding	SGND	13			

* This PIN figure is the X1 bus terminal of servo driver

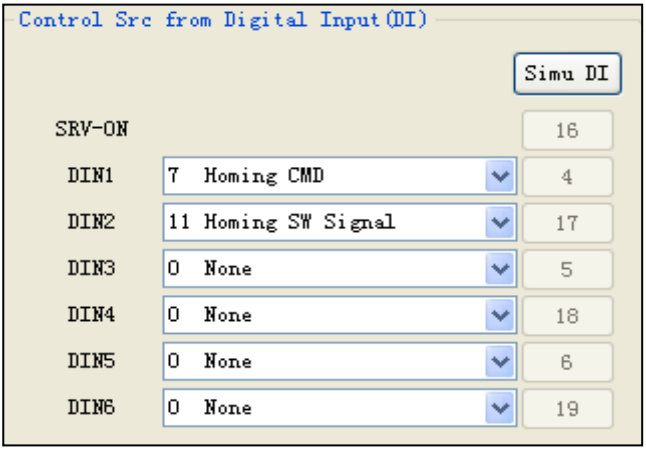
Tips

- Refer to “5.2.1 Selection of Digital input multiplexing functions“ for more info on configuring functions for DIN1~DIN6 pins.
- Refer to “ 5.2.3 Selection of Digital output multiplexing functions“ for more info on configuring functions for DOUT1~DOUT4 pins.

Step 4: After functions for pin has been allocated, you can press “Write servo” button to write the configurations, so that the pin function would be effective.

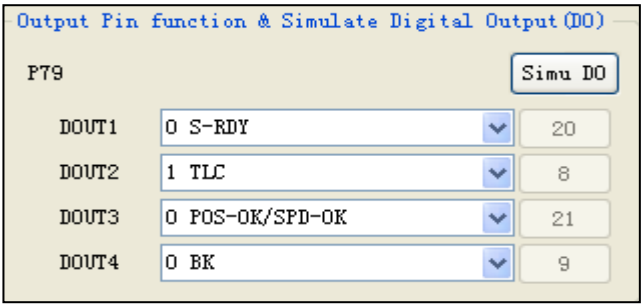
Step 5: Press “Simu DI” or “Simu DO” button to start simu function, the corresponding options would not be modified.

Start “Simu DI”, the fixed pins (4~5、16~19) would turn to selectable buttons, the change of the buttons would make the change of DIN1~DIN6 input.



Stop “Simu DI”, the signal of DIN1~DIN6 would be inputted by external pins.

Start “Simu DO”, the fixed pins (8、9、20、21) would turn to selectable buttons, the change of the buttons would make the change of DOUT1~DOUT4 output.



Stop “Simu DO”, the signal of DOUT1~DOUT4 would be outputted in accordance with servo present status.

<Notes>

- Press “Start Chart” button, you can monitor DIN or DOUT pin status in real-time when simu DI or DO has not been started.
- Press “Read Servo” button, you can read the control mode and pin configuration from target device.
- Press “Write Servo” button, you can write the pin configuration to target device.

5.3 Details of Control Signal

E10 series servo have two methods: External control and communication control, different control modes using different control signals, the specific control signal functions see as follows:

Signal	Symbol	Status bit	Function
Control Signal Power	COM	/	· Control signal input common terminal. Input voltage range:: 12～24VDC
	COM-	/	· Control signal output common terminal negative.
Servo-ON	SRV-ON	P282 Bit0	· The signal is used to activate servo-on status. · As in communication control mode, P282 bit0 is used as enabling control bit. · Avoid to start or stop the motor by this signal. · To obtain better performance of servo, servo-on bit added protection setting, please refers to “Selection of external input logic level” of chapter 5.2.

Signal	Symbol	Status bit	Function
CCW Overtravel Inhibit	CCWL	/	· The overtravel inhibit of both External control mode and Communication control mode are controlled by external IO. · This signal is used to input Overtravel inhibit signal in counterclockwise direction. · When P03(Overtravel Inhibit input invalid setting) is set to 1, Overtravel inhibit function is invalid. · P126 (Sequence at over-travel inhibition) is used to select the action while CCWL input is effective. · Overtravel inhibit alarm becomes effective once servo power-on. · Effective high / low level can be set by this signal, for details please observe the selection of external input logic level of chapter 5.2.
CW Overtravel Inhibit	CWL	/	· The overtravel inhibit of both External control mode and Communication control mode are controlled by external IO, please set P78 Bit2 ~ 3 to 0 before use. · This signal is used to input the Overtravel inhibit signal in clockwise direction. · When P03(Overtravel Inhibit input invalid setting) is set to 1, Overtravel inhibit function is invalid. · P126 (Sequence at over-travel inhibition) is used to select the action while CWL input is effective. · Overtravel inhibit alarm becomes effective once servo power-on. · Effective high / low level can be set by this signal, for details please observe the selection of external input logic level of chapter 5.2.
Command Electronic Gear Selection	DIV	/	· You can select the first or second numerator set up by Command Electronic Gear under position control mode. If the signal is effective, the numerator value of command pulse frequency multiplication changes from P86 (1th numerator) to P87 (2th numerator). · This function is invalid in communication control mode.

<table>
<tr><th>Signal</th><th>Symbol</th><th>Status bit</th><th>Function</th></tr>
<tr><td>Gain Switching Input</td><td>GAIN</td><td>P281 Bit9</td><td>
・ You can set the function of this signal by P60 (Gain switching action setup).
・ Please refer to chapter “11.5 Gain Switching” for details.
<table>
<tr><th>P60</th><th>DI input / Bit9</th><th>Function</th></tr>
<tr><td rowspan="2">0</td><td>Invalid / 0</td><td>Velocity loop: PI (percentage\integration) operation</td></tr>
<tr><td>Valid / 1</td><td>Velocity loop: P(percentage) operation</td></tr>
<tr><td rowspan="3">1</td><td colspan="2">When P61 = 2:</td></tr>
<tr><td>Invalid / 0</td><td>1st gain selected</td></tr>
<tr><td>Valid / 1</td><td>2nd gain selected</td></tr>
</table>
</td></tr>
<tr><td>Torque Limitation Selection</td><td>TL-SEL</td><td>P281 Bit15</td><td>
・ The signal is used to input the torque limitation switching signal(TL-SEL).
・ When P02(Torque limitation selection) is set to 3, and this signal is invalid, P119 1st torque limitation is effective; Likewise, if this signal is valid, P120 2nd torque limitation is effective.
</td></tr>
<tr><td>Command Pulse Inhibit</td><td>INH</td><td>/</td><td>
・ You can use this signal to inhibit the input(INH signal) of command pulse.
・ As the signal is invalid, the position command pulse input is shielded.
・ When P82(Command pulse inhibit input) is set to 1, Command pulse inhibit is invalid.
・ The function is invalid in communication control mode.
</td></tr>
<tr><td>Original switch input</td><td>ORG_SW</td><td>/</td><td>
・ Effective high / low level can be set by this signal, for details please observe the selection of external input logic level of chapter 5.2.
・ P212 (Sum of command pulses) and P216 (User position coordinates) would fall to zero.
・ As the Homing command input is valid under the signal enabling status, the servo would enter Homing mode, please refer to chapter "9.1 Homing Function” for details.
</td></tr>
</table>

<table>
<tr><th>Signal</th><th>Symbol</th><th>Status bit</th><th>Function</th></tr>
<tr><td>Control Mode Switching</td><td>C-MODE</td><td>P281 Bit4</td><td>· If P01(control mode selection) is set to 3~5 or 9~11,you can switch between the two control modes by below table's description(when P73 defaults to 0):
<table>
<tr><th>P01</th><th>DI input is invalid
Select 1st control mode</th><th>DI input is valid
Select 2nd control mode</th></tr>
<tr><td>3</td><td>External Position Control</td><td>External Velocity Control</td></tr>
<tr><td>4</td><td>External Position Control</td><td>External Torque Control</td></tr>
<tr><td>5</td><td>External Velocity Control</td><td>External Torque Control</td></tr>
<tr><td></td><td>P281 Bit4=0
Select 1st control mode</td><td>P281 Bit4=1
Select 2nd control mode</td></tr>
<tr><td>9</td><td>Communication position control</td><td>Communication speed control</td></tr>
<tr><td>10</td><td>Communication position control</td><td>Communication torque control</td></tr>
<tr><td>11</td><td>Communication speed control</td><td>Communication torque control</td></tr>
</table>
· It is controlled by P281 Bit4 while in communication control mode; Please set P78 Bit6~7 to 0 if under external control.</td></tr>
<tr><td>Positional Deviation Clear</td><td>CL</td><td>P281 Bit10</td><td>· It can be used to clear deviation counter.
· You can clear position deviation counter while this signal. is shorted with COM-.
· P91(Deviation Counter clear input method) is used to select the clear method:
<table>
<tr><th>P91</th><th>Function</th></tr>
<tr><td>0</td><td>CL terminal short with COM- or P281 Bit10 = 1, the position deviation counter would be cleared.</td></tr>
<tr><td>1</td><td>You can clear the positional deviation counter only once by connecting CL with COM– from opening to shorted status or the value of P281 Bit10 changes from 0 to 1.</td></tr>
<tr><td>2</td><td>Shielding position deviation clear function, position deviation clear function is invalid.</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Signal</th><th>Symbol</th><th>Status bit</th><th>Function</th></tr>
<tr><td>Homing Command</td><td>Homing</td><td>P281 Bit7</td><td>· This signal is used to enter Homing mode.
· This signal is effective at rising edge, and the input is invalid before enabling.
· After the homing status is completed, the homing status bit will be outputted, that bit10 of P204 would set to 1.
· Whenever the homing status is finished, the controller must clear the homing command manually, that the servo allows input operation.
· P59 can be used to select the Homing mode, for details please refer 6.4 Homing function.</td></tr>
<tr><td>Zero-Speed Clamp</td><td>ZeroSPD</td><td>P281 Bit5</td><td>· This signal is invalid at external position control.
· It can be used to input Zero-Speed Clamp, the revolving speed of servo command is 0.
<table>
<tr><th>P06</th><th>DI input</th><th>Function</th></tr>
<tr><td>0</td><td>/</td><td>Zero-Speed clamp function is invalid and shielded.</td></tr>
<tr><td rowspan="2">1</td><td>Invalid</td><td>Speed command is 0, zero-Speed clamp.</td></tr>
<tr><td>Valid</td><td>Normal operation</td></tr>
</table></td></tr>
<tr><td>Position Lock</td><td>PosLock</td><td>P281_Bit5</td><td>· This function is only valid in communication position control mode.
· It can be used to input position lock, the revolving speed of servo command is 0.
<table>
<tr><th>P06</th><th>DI input</th><th>Function</th></tr>
<tr><td>0</td><td>/</td><td>Zero-Speed clamp function is invalid.</td></tr>
<tr><td rowspan="2">1</td><td>Invalid</td><td>Position lock</td></tr>
<tr><td>Valid</td><td>Normal operation</td></tr>
</table></td></tr>
<tr><td>Start signal</td><td>Pos_Start</td><td>P281 Bit6</td><td>· This signal is only effective for communication multi-control.
· The new command can be triggered by the rising edge of this signal after the command selection (Logic relationship) of external DI selected certain position/speed/torque.
· Only activate Start signal that can validate the given position command at relative position control.
· Details of mulit-position control refer to Chapter “9.2 Communication Multi-Position\Speed\Torque control”.</td></tr>
</table>

<table>
<tr><th>Signal</th><th>Symbol</th><th>Status bit</th><th>Function</th></tr>
<tr><td>Selection of Speed direction</td><td>SPD_dir</td><td>P281
Bit10</td><td>· This signal is to select the input command direction of Speed mode.
<table>
<tr><th>P93</th><th>DI input / P281_Bit10</th><th>Function</th></tr>
<tr><td>0~1</td><td>/</td><td>Selection of Speed direction is invalid.</td></tr>
<tr><td rowspan="2">2</td><td>Invalid / 0</td><td>Non-reverse the speed command direction</td></tr>
<tr><td>Valid / 1</td><td>Reverse Speed command direction</td></tr>
</table>
· This function is effective only if external analog input act as speed command.</td></tr>
<tr><td>Alarm Clear</td><td>A-CLR</td><td>P282</td><td>· when in External control mode, the alarm status will be cleared if this terminal kept closed with COM- for more than 120 ms.
· Some alarm status cannot be removed through this method, it must re-up power, please refer to “10 Protective Function” for details.</td></tr>
<tr><td>Servo-Ready</td><td>S-RDY</td><td>P204
Bit0</td><td>· When the control power is connected, and no alarm occurs, the output turns on.</td></tr>
<tr><td>Servo Alarm Output</td><td>ALM</td><td>P204
Bit1</td><td>· The output would shut off if Alarm status happened, If no alarm, the output turns on.</td></tr>
<tr><td>Torque limitation output</td><td>TLC</td><td>P204
Multi-bit</td><td>· Use P08 to select the output content of this terminal.
· The Factory Default value of P08 is 0, which means the signal output Torque limitation control signal.
· You can choose to output different contents, please refer to chapter “5.6 Selection of Torque Limitation Output(TLC) and Zero-speed Detection Output(ZSP) Signal”.</td></tr>
<tr><td>Positioning Complete</td><td>POS-OK</td><td>P204
Bit2</td><td>· Output positioning complete signal, which only becomes effective at position control.
· When the position deviation is less than P121(Positioning complete range) value, the output turns on.
· P124(Positioning complete signal output setting) can be used to select the output conditions of positioning complete signal.</td></tr>
<tr><td>Speed Arrival</td><td>SPD-OK</td><td>P204
Bit8</td><td>· Output speed arrival signal ,only becomes effective under speed and torque control mode.
· If the actual rotating speed of motor reaches or exceeds P123(Arrival speed) setting value, this output turns on.</td></tr>
</table>

Signal	Symbol	Status bit	Function
Brake Release	BK	P204 Bit3	· Please set the motor mechanical brake action timing P130 and P131 before using this function. · This output turns on when brake keeps releasing. **<Note>** Connect the control terminal of brake resistance via relay (Control terminal: DC24V, load capacity is greater than or equal to 1A), and connect a Schottky diode in parallel at the control terminal of relay(Diode type is recommended as 1N4148, Package: DO-35 glass package, instrumented). The wiring diagram refers to Figure 4.4 or 4.5.
Zero-Speed Detection Output	ZSP	P204 Multi-bit	· You can use P09 to choose the output content of this signal. · The Factory Default value of P09 is 1, it means this signal output Zero-Speed detection signal. · You can select to output different contents (Torque limitation, Zero-speed detection, Alarm status, Over-load alarm of brake resistance, Over-load alarm, speed consistency, homing complete).
Command selection 1~4	INTSPD 1~4	R203 Multi-bit	· Select 1st~8th internal speed via INTSPD1~3, details refer to “5.4 Selection of Internal Speed Switching Under External Speed Control Mode”. · Command selection in communication control mode, details refer to “5.5 Communication command selection under communication control mode (P4=4)”.

<table>
<tr><th>Signal</th><th>Symbol</th><th>PIN</th><th>Function</th></tr>
<tr><td>Command Pulse+ Input</td><td>PULS+</td><td>14</td><td rowspan="4">· Servo receives single-ended or differential pulses, input under external speed or external torque mode is invalid.
⚠ Caution
· Servo only receives 5V pulse, if need to use other pulses which voltage is higher than 5V, please be sure to connect proper resistances respectively with control signal pulse input and pulse direction Pins, which could avoid over-voltage damage to the servo. Resistors selection please refers to "R value calculation formula".
· Please refer to P80 & P81 of Chapter 6 for details.
<Note> The DIR signal in special speed position mode is different from the DIR signal here.</td></tr>
<tr><td>Command Pulse- Input</td><td>PULS-</td><td>1</td></tr>
<tr><td>Command Direction+ Input</td><td>DIR+</td><td>15</td></tr>
<tr><td>Command Direction- Input</td><td>DIR-</td><td>2</td></tr>
<tr><td>Positive Analog Reference Input</td><td>AI+</td><td>22</td><td rowspan="2">· You can use it as external speed or torque analog command.
· The input can be used as torque limitation while P02=0.
· P92 is external speed control gain command, P93 is speed command logic inverse command.
· P117 is torque gain command, P118 is torque inverse command.
· P112 is speed command filter.
· It's normal for Analog input existing zero-drift, we can learn the size of zero-drift from observing P210(Analog input command), adjusting P94(Analog input command zero-drift adjustment) can compensate for zero-drift.
<Note> The input resistance is 10.6KΩ, the input voltage cannot exceed the range of -10V~+10V, otherwise the driver might be damaged.</td></tr>
<tr><td>Reference Ground</td><td>AGND</td><td>10</td></tr>
<tr><td colspan="2">Reserved</td><td>23</td><td rowspan="2"></td></tr>
<tr><td colspan="2">Reserved</td><td>11</td></tr>
<tr><td>Motor Encoder A Phase Positive Output</td><td>A+</td><td>24</td><td rowspan="4">· The output common terminal of encoder can connect with 5V~24V power.
· Output encoder signal (A, B, Z phase) which is being processed via frequency division.
· You can set command pulse ratio of output pulses by P56 and P57.
· You can invert the phase relation between A and B phases by inverting the logic of the B-phase pulse with P55.
· The max. frequency of output pulses is 500K (4 multiplication later).</td></tr>
<tr><td>Motor Encoder B Phase Positive Output</td><td>B+</td><td>12</td></tr>
<tr><td>Motor Encoder Z Phase Positive Output</td><td>Z+</td><td>25</td></tr>
<tr><td>Encoder Grounding</td><td>GND</td><td>13</td></tr>
</table>

5.4 Selection of Internal Speed Switching Under External Speed Control Mode

PIN X1 Internal command pin input			P04 (Internal/External speed selection)			
Command selection1	Command selection2	Command selection3	0 / 4	1	2	3
0	0	0	Analog Input Command	1st Internal Speed P95	1st Internal Speed P95	1st Internal Speed P95
1	0	0	Analog Input Command	2nd internal speed P96	2nd Internal Speed P96	2nd Internal Speed P96
0	1	0	Analog Input Command	3rd internal speed P97	3rd Internal Speed P97	3rd Internal Speed P97
1	1	0	Analog Input Command	4th internal speed P98	Analog Input Command	4th Internal Speed P98
0	0	1	Analog Input Command	1st internal speed P95	1st Internal Speed P95	5th Internal Speed P99
1	0	1	Analog Input Command	2nd internal speed P96	2nd internal speed P96	6th Internal Speed P100
0	1	1	Analog Input Command	3rd internal speed P97	3rd Internal Speed P97	7th Internal Speed P101
1	1	1	Analog Input Command	4th Internal Speed P98	Analog Input Command	8th Internal Speed P102

Remark:
1)This table becomes effective at external speed control mode, as well as P04=0/1/2/3/4.
2)“0” indicates invalid, “1” indicates valid.

5.5 Communication command selection under communication control mode (P4=4)

PIN X1 Internal command pin input				Given Command Source		
Command selection 4	Command selection 3	Command selection 2	Command selection 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)

“0” indicates invalid, “1” indicates valid.

5.6 Selection of Torque Limitation Output (TLC) and Zero-speed Detection Output (ZSP) Signal

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

6 Parameter List

Descriptions of Parameters

6.1 Parameter Checklist

Adrs	Parameter Name		Adrs	Parameter Name
00	Communication Address※		26	Velocity feedforward filter time constant
01	Control mode setup※		27	2nd position loop gain
02	Torque limitation selection		28	2nd velocity loop gain
03	Overtravel Inhibit input invalid setting※		29	2nd velocity loop integration time constant
04	Command source selection		30	2nd speed detection filter
05	Communication command source selection		31	2nd torque filter time constant
06	Zero-speed clamp selection		32	Inertia ratio
08	Torque limitation control output selection		33	PDO inhibit time※
09	Zero-speed detection		34	CANopen Alarm setup※
10	RS485 Baud rate configuration※		49	Selection of External DI filter time
11	CANopen baud rate configuration※		50	Interpolation selection in communication position mode
12	Communication timeout		55	External feedback pulse logic inversion※
16	Selection of servo-on once power on ※		56	Numerator of command pulse ratio of External feedback pulse※
18	Current loop gain		57	Denominator of command pulse ratio of External feedback pulse※
19	Current loop integration time constant		58	External pulse input filter time selection※
20	1st position loop gain		59	Homing mode
21	1st velocity loop gain		60	Gain switching action setup
22	1st velocity loop integration time constant		61	Gain switching action mode
23	1st velocity detection filter		62	Control switching delay time
24	1st torque filter time constant		65	Position loop gain switching time
25	Velocity feed forward		70	JOG speed setup

Adrs	Parameter Name	Adrs	Parameter Name
71	Communication position control method	98	4th internal speed
72	External input logic level selection	99	5th internal speed
73	Control command source selection	100	6th internal speed
75	Digital input multiplexing function register 4	101	7th internal speed
76	Digital input multiplexing function register 3	102	8th internal speed
77	Digital input multiplexing function register 2	112	Speed command filter
78	Digital input multiplexing function register 1	113	Acceleration time setup
79	Digital output Multiplexing function register	114	Deceleration time setup
80	Command pulse select direction setup※	115	Speed limitation of external pulse
81	Command pulse input method※	117	Analog Torque command scale factor
82	Command pulse inhibit input invalidation setting	118	Torque command logic inversion
86	Numerator of 1st command pulse ratio	119	1st torque limitation
87	Numerator of 2nd command pulse ratio	120	2th torque limitation
88	Denominator of command pulse ratio	121	Positioning complete range
89	Smoothing filter	122	Zero-speed detection range
90	Selection of motor Positive rotating direction in communication mode※	123	Arrival speed
91	Deviation Counter clear input method	124	Positioning complete signal output setup
92	Analog Speed command scale factor	126	Sequence at over-travel inhibition※
93	Speed command logic inversion	128	Position increment during homing
94	Analog input command zero-drift adjustment	130	Mechanical brake delay time at motor standstill
95	1st internal speed	131	Mechanical brake delay time at motor in motion
96	2nd internal speed	132	External brake resistance setting※
97	3rd internal speed	134	setup the torque at motor emergency stop

Adrs	Parameter Name		Adrs	Parameter Name
136	Excessive level of position deviation		221	Feedback speed
137	Excessive level of Analog command		222	Velocity deviation
138	Over-load level		223	Torque command
139	Over-speed level		224	Actual torque
140 ~ 149	Historical record 1~10		225	Torque deviation
180	Software version		226	Busbar voltage
181	Type of servo and motor		228	Alarm status
182	Manufacturer parameter 2		229	Torque output loading rate
183	Manufacturer parameter 3		230	Discharge resistance loading rate
184	Manufacturer parameter 4		231	Overload rate
200	System status		234	Motor automatic identification function
201	Current Control mode		235	Factor of "No-Motor Running"
202	Type of error		237	EtherCAT Communication status word
203	Command status		274~275	Increment of Given Position
204	Output state		279	EtherCAT Communication control word
205	Input IO signal state		280	Communication function code
206	Output IO signal state		281	Communication extended control word
207	Analog input command value		282	Communication control word
210	Analog output value		284	Pulse filter 1
212	Sum of command pulses		286	Pulse filter 2
214	Sum of Feedback pulses		288	Pulse Alarm
216	User position coordinates		290~320	Given position 0~15
218	Command pulse deviation		324~355	Given speed 0-31
220	Command speed		358~389	Given torque 0-31

6.2 Details of Parameters

⚠ **Make sure to understand the Parameters' meaning before adjustment, incorrect settings may result in equipment malfunction.**

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

⚠ **Advise to adjust the servo motor parameters under no-load situation.**

Adrs	Name	Control mode	Range	Function	Read-Write	Default value
00	Communication Address※	ALL	1~32	It's used for serials port communication, you can 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	0~13	Select 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 **<Note>** Speed is limited by the 3rd internal speed while in Communication position control mode. Speed is limited by the 4th internal speed while in Communication / External torque control mode.	R/W	0

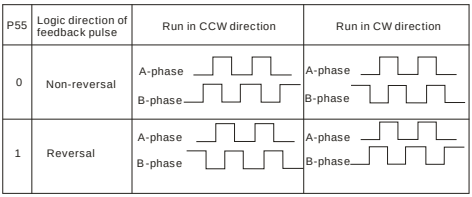
<table>
<tr><th>Adrs</th><th>Name</th><th>Control mode</th><th>Range</th><th>Function</th><th>Read-Write</th><th>Default value</th></tr>
<tr><td>02</td><td>Torque limitation selection</td><td>P/S</td><td>0 ~ 3</td><td>You can set the torque limitation signal in both clockwise and counterclockwise directions.
<table>
<tr><th>Value</th><th>CCW (Counterclockwise)</th><th>CW (Clockwise)</th></tr>
<tr><td>0</td><td>External Analog Absolute Value</td><td>External Analog Absolute Value</td></tr>
<tr><td>1</td><td>1st torque limitation P119</td><td>1st torque limitation P119</td></tr>
<tr><td>2</td><td>1st torque limitation P119</td><td>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>
<Notes>
1) If the value = 3, it is associated with TL-SEL PIN(External control) or P281 bit15 (Communication control).
2) Torque limitation value is controlled by P119 while in torque control mode.
Take no account of the parameter value.
3) If under external analog mode, the register cannot be configured to 0.In case is 0,the torque limitation value will be set by external analog either. Advise not to do so.
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>You can set up whether the overtravel Inhibit signal for CCW/CW direction is valid or not.
0: Overtravel Inhibit is valid, it moves in accord with the preset sequence with P126.
1: Overtravel Inhibit is invalid.
2: The servo alarm is triggered while either one of the direction happens overtravel Inhibit.</td><td>R/W</td><td>1</td></tr>
</table>

Adrs	Name	Control mode	Range	Function	Read-Write	Default value
04	Command source selection	S	0 ~ 4	You can select the command source of external speed control mode and communication control mode. 0: Analog input command 1: Internal Command (1st~4th internal command) 2: Internal Command (1st~3rd internal command; Analog input command) 3: Internal Command (1st~8th internal command) 4: The command source of communication control mode is selected by INTSPD1~INTSPD4. **<Notes>** 1) Please refer to chapter 5.4 for internal speed selection when this param value is 0 ~ 3. 2) The Command source of communication control mode is determined by INTSPD1~INTSPD4 while the param value is set to 4. If the param value is not 4, the command source of communication control is up toP05(Communication command source selection). 3) The command source of external speed is up to analog input command.	R/W	0
05	Communication command source selection	ALL	0 ~ 31	The command source under communication position / speed / torque control mode: 0~15: Select communication given position command. 0~31: Select Communication given speed/torque command. **<Notes>** 1) For this setting of the parameter to take effect, please keep P04 ≠ 4. 2) You can switch to the command source of the corresponding control mode by setting this parameter. eg, if this param is set to 1 under communication speed control mode, P325(Given speed 1) is the command speed of the motor; If this param is set to 31, P355(Given speed 31) is treated as the command speed of the motor.	R/W	0

Adrs	Name	Control mode	Range	Function	Read-Write	Default value
06	Zero-speed clamp selection	S/T	0~1	You can select the function of external zero-speed clamp signal: 0: zero-speed clamp is disabled. 1: zero-speed clamp is enabled. While the parameter is configured to 2, it operates in external speed mode, so the given input is positive voltage and also can achieve to rotate both directions. 1: CW direction, 0: CCW direction. Only External Speed control is effective, the rest of the control modes are invalid. Please refer to P93 for details. **<Note>** It is associated with external IO input.	R/W	0
08	Torque limitation control output selection	ALL	0 ~ 5	You can select the output of Torque limitation control signal. 0: Torque limitation control 1: Zero-speed detection 2: Alarm status 3: Overload alarm of discharge resistance 4: Overload alarm 5: Speed consistency output 6: Homing complete **<Note>** Please refer to chapter “5.6 Selection of Torque Limitation Output(TLC) and Zero-speed Detection Output(ZSP) Signal”.	R/W	0
09	Zero-speed detection	ALL	0 ~ 5	You can select the output of zero Speed limit control signal. 0: Torque limitation control 1: Zero-speed detection 2: Alarm status 3: Discharge resistance overload alarm 4: Overload alarm 5: Speed consistency output 6: Homing complete **<Note>** Please refer to chapter “5.6 Selection of Torque Limitation Output(TLC) and Zero-speed Detection Output(ZSP) Signal”.	R/W	1
10	RS485 Baud rate configuration ※	ALL	0 ~ 5	You can set the communication speed of RS485. 0: 4800Bps 1: 9600Bps 2: 19200Bps 3: 38400Bps 4: 57600Bps 5: 115200Bps	R/W	2

Adrs	Name	Control mode	Range	Function	Read-Write	Default value
11	CANopen baud rate configuration ※	ALL	0~7	You can set the communication rate of CANopen communication. 0: CANopen bus not used 1: 1000Kbps 2: 800Kbps 3: 500Kbps 4: 250Kbps 5: 125Kbps 6: 50Kbps 7: 20Kbps **<Note>** Different settings of this param would affect the max. Communication distance, please refer to chapter 4.7 for details.	R/W	1
12	Communication timeout		0 ~ 2000	Unit: ×100ms, 0 means cancel the function. When firstly communicated after power-on, if no correct messages were received during the preset time, the communication would be abnormal.	R/W	0
16	Selection of servo-on once power on ※		0~1	0: Servo-on once power on is invalid 1: Servo-on once power on is valid (Pin16 can be configured as other signal) Remark: Please save and reboot that the modifications of the parameter could be effective.	R/W	0
18	Current loop gain	ALL	0 ~ 3000	You can define the size of current loop gain.	R/W	160
19	Current loop integration time constant	ALL	0 ~ 5000	You can define the response characteristics of integration action. Time unit:×100us	R/W	20
20	1st position loop gain	P	0 ~ 3000	You can define the size of position loop gain. Unit:1/s Higher the gain you set, better the servo rigidity of position loop control you can obtain, but over-high gain will result in vibration.	R/W	80
21	1st velocity loop gain	ALL	1~ 3500	You can define the size of speed loop gain. Unit: Hz Higher the gain you set, quicker the response speed you can obtain.	R/W	20

Adrs	Name	Control mode	Range	Function	Read-Write	Default value
22	1st velocity loop integration time constant	ALL	1 ~ 1000	You can define the response characteristics of integration action. Reducing the setting, you can accelerate the integration action. Unit: ms	R/W	50
23	1st velocity Detection filter	ALL	0 ~ 5	You can set the type of velocity Detection filter. The higher value you set, the smaller noise you can obtain, however, the response will be slower.	R/W	3
24	1st torque filter time constant	ALL	0 ~ 2500	You can set the time constant of the primary delay filter that is inserted to the torque command portion. Unit: 10us	R/W	3
25	Velocity feed forward	P	-2000 ~ 2000	You can set the velocity feed forward value. The smaller position deviation will reaches to fast response, especially apply to the situation where need high response.	R/W	500
26	Velocity feedforward filter time constant	P	0 ~ 6400	You can set the time constant of the velocity feed forward primary delay filter. Unit :ms	R/W	3
27	2nd position loop gain	P	0 ~ 3000	You can define the size of position loop gain. Unit: 1/s Higher the gain you set, better the servo rigidity of position loop control you can obtain, but over-high gain will result in vibration.	R/W	100
28	2nd velocity loop gain	ALL	1 ~ 3500	You can define the size of speed loop gain. Unit: Hz Higher the gain you set, quicker the response speed you can obtain.	R/W	20
29	2nd velocity loop integration time constant	ALL	1 ~ 1000	You can define the response characteristics of integration action. Reducing the parameter value so as to accelerate the integration action. Unit: ms	R/W	500
30	2nd speed detection filter	ALL	0 ~ 5	You can set the type of velocity Detection filter. The higher the value you set, the smaller the noise you can obtain, however, the response will be slower.	R/W	3

Adrs	Name	Control mode	Range	Function	Read-Write	Default value
31	2nd torque filter time constant	ALL	0 ~ 2500	You can set the time constant of the primary delay filter that is inserted to the torque command portion. Unit:10us	R/W	3
32	Inertia ratio	ALL	0 ~ 10000	You can set the ratio of load inertia against the rotor (of the motor) inertia. (Load inertia/Rotor inertia) ×100%	R/W	100
33	PDO inhibit time*	ALL	0~32767	You can set the PDO inhibit time, so as to restrict the abnormalities caused by frequently CANopen communication. Unit: 0.1ms **<Note>** This param is used to restrict frequently CANopen communication, as abnormalities would occur due to jamming communication.	R/W	100
34	CANopen alarm setup*	ALL	0~1	You can set the operations while abnormal CANopen communication occurs. 0: Servo would not raise alarm and keep on running status when abnormal communication occurs. 1: Servo reports an alarm and stop running when abnormal communication occurs.	R/W	1
49	Selection of External DI filter time		0~6	Select external DI filter time: 0 : 0.5ms 1 : 1ms 2 : 2ms 3 : 4ms 4 : 8ms 5 : 16ms 6 : 32ms	R/W	3
50	Interpolation selection in communication position mode	P		Enable or disable the Interpolation command in communication control mode: **0:** Normal communication position mode, motor rotating speed is determined by P97. **512:** Enable Interpolation mode, the motor rotating speed is determined by controller, P97 takes no effect.	R/W	0
55	External feedback pulse logic inversion※	ALL	0~1	You can set the B-phase of pulse output. You can invert the phase relation between A and B phases by inverting the logic of the B-phase pulse with this parameter. 	R/W	0

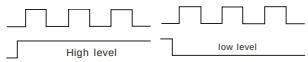
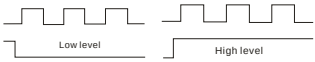
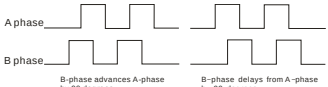
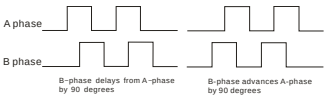
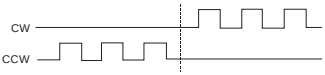
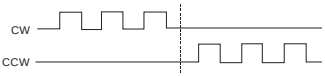
Adrs	Name	Control mode	Range	Function	Read-Write	Default value
56	Numerator of command pulse ratio of External feedback pulse※	ALL	1~ 32767	Set the output pulses number from feedback interface per one motor single turn. ① P57 = 0: Feedback pulses per single turn = P56×4 ② P57≠0: Feedback pulses per single turn = (P56 / P57) × Encoder resolution **<Notes>** · Encoder resolution: 2500p/r · The pulses number per one turn could not excess the encoder resolution, it would account as 1 once excess 1. · Motor output one Z-phase signal per one single turn. Z-phase pulse width changes with the setting of frequency dividing ratio.	R/W	1
57	Denominator of command pulse ratio of External feedback pulse※	ALL	0~ 32767		R/W	1
58	External pulse input filter time selection*	P	0~13	It is used to set the software filter time of command pulse, you can choose proper filter time according to the input pulse frequency. 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>** The higher value you set, the more favorable effect you can obtain, but the max input pulse frequency would fall subsequently. Please set the parameter with care, advise to use default value.	R/W	2

Adrs	Name	Control mode	Range	Function	Read-Write	Default value
59	Homing mode	ALL	0~14	You can select the homing mode: **0:** Reset the P216 (User position coordinates) by triggering the DI signal **1:** Refer to both the negative original switch and Z-phase signal mode. **2:** Refer to both the positive original switch and Z-phase signal mode. **3:** Refer to the negative original switch only **4:** Refer to the positive original switch only **5:** Refer to Z-phase signal (Homing towards negative direction)only **6:** Refer to Z-phase signal (Homing towards positive direction) only **7:** Refer to original switch/positive limit switch/Z-phase signal (on the left of the left edge of the original switch) **8:** Refer to original switch/positive limit switch/Z-phase signal (on the right of the left edge of the original switch) **9:** Refer to original switch/positive limit switch/Z-phase signal (on the left of the right edge of the original switch) **10:** Refer to original switch/positive limit switch/Z-phase signal (on the right of the right edge of the original 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 and position increment **16:** Refer to the positive original switch and position increment **<Note>** For the details of Homing, please observe chapter “9.1 Homing Function”.	R/W	0

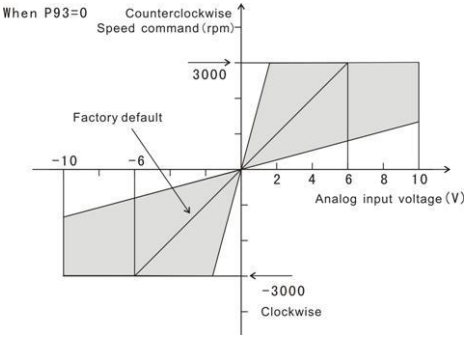
<table>
<tr><th>Adrs</th><th>Name</th><th>Control mode</th><th>Range</th><th>Function</th><th>Read-Write</th><th>Default value</th></tr>
<tr><td>60</td><td>Gain switching action setup</td><td>ALL</td><td>0 ~ 1</td><td>You can select the conditions for switching between the 1st and 2nd gain.
0: PI/P can be switched by selecting the 1st gain.
1: You can select to switch between the 1st and 2nd gain settings.
<Note> It is related to GAIN PIN(External control)or P281 bit9(Communication control).</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>You can select the conditions for switching between the 1st and 2nd gains at the Gain switching mode.
<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>
</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>You can set the delay time for switching from the 1st to 2nd gains(or switching from the 2nd to 1st gains).
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>While 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, so as to restrain the rapid shock during switching procedure.
Unit:250us</td><td>R/W</td><td>100</td></tr>
<tr><td>70</td><td>JOG speed setup</td><td>ALL</td><td>0 ~ 5000</td><td>Setup JOG(Test run)speed.
Unit: rpm</td><td>R/W</td><td>200</td></tr>
<tr><td>71</td><td>Communication position control method</td><td>P</td><td>0~1</td><td>Absolute/Relative position selection of Multi-Position:
0: Absolute position, 1: Relative position
<Notes>
1) This param is effective at communication position mode, which is unrelated to P4 value. That means both absolute position and relative position control can be used no matter the command source is 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).</td><td>R/W</td><td>0</td></tr>
</table>

<table>
<tr><th>Adrs</th><th>Name</th><th>Control mode</th><th>Range</th><th>Function</th><th>Read-Write</th><th>Default value</th></tr>
<tr><td>72</td><td>External input logic level selection</td><td>ALL</td><td>0~65535</td><td>You can select the External DI logic level.
Bit0: Servo-on method
0: The communication enable and pin enable cannot take effect at the same time.
1: All modes need enable pin, 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
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 "5.2.2 Selection of External input logic level".</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>You can select the pin allocation method and control command source:
<table>
<tr><th>value</th><th>Communication control mode</th><th>External control mode</th></tr>
<tr><td>0</td><td>From P281 Communication extended control word (Default allocation)</td><td>From external DI signal (Default allocation)</td></tr>
<tr><td>1</td><td>From external DI signal (Default allocation)</td><td>From external DI signal(Default allocation)</td></tr>
<tr><td>2</td><td>From external DI signal (Decided by P75/76/77/78)</td><td>From external DI signal (Decided by P75/76/77/78)</td></tr>
<tr><td>3</td><td>From P281 Communication extended control word (Default allocation)</td><td>From P281 Communication extended control word (Default allocation)</td></tr>
<tr><td>4</td><td>From external DI or P281 Communication extended control word (Decided by P75/76/77/78)</td><td>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 for details.</td><td>R/W</td><td>0</td></tr>
</table>

<table>
<tr><th>Adrs</th><th>Name</th><th>Control mode</th><th>Range</th><th>Function</th><th>Read-Write</th><th>Default value</th></tr>
<tr><td>75</td><td>Digital input multiplexing function register4</td><td>ALL</td><td>Any</td><td rowspan="4">
<table>
<tr><th>Parameter</th><th>Bit</th><th>Pin</th><th>Symbol</th></tr>
<tr><td>75</td><td>B0~B7</td><td>16</td><td>SRV_ON</td></tr>
<tr><td rowspan="2">76</td><td>B8~B15</td><td>19</td><td>DIN6</td></tr>
<tr><td>B0~B7</td><td>6</td><td>DIN5</td></tr>
<tr><td rowspan="2">77</td><td>B8~B15</td><td>18</td><td>DIN4</td></tr>
<tr><td>B0~B7</td><td>5</td><td>DIN3</td></tr>
<tr><td rowspan="2">78</td><td>B8~B15</td><td>17</td><td>DIN2</td></tr>
<tr><td>B0~B7</td><td>4</td><td>DIN1</td></tr>
</table>
16#00: No functions were 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: 1st gain, 1: 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
<Note> P75 is valid when P16=1; When P16=0, SRV_ON pin is used for enabling only.
※Example: If under external position control mode, you are required to set those signals to CCW Overtravel Inhibit(DIN1), CW Overtravel Inhibit(DIN2), Original switch input(DIN3), Homing command(DIN4), Null(DIN5), Null(DIN6).</td><td>R/W</td><td>0</td></tr>
<tr><td>76</td><td>Digital input multiplexing function register3</td><td>ALL</td><td>Any</td><td>R/W</td><td>0</td></tr>
<tr><td>77</td><td>Digital input multiplexing function register2</td><td>ALL</td><td>Any</td><td>R/W</td><td>0</td></tr>
<tr><td>78</td><td>Digital input Multiplexing function register1</td><td>ALL</td><td>Any</td><td>R/W</td><td>0</td></tr>
</table>

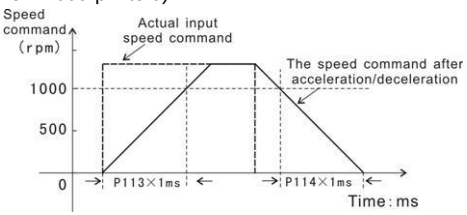
<table>
<tr><td></td><td></td><td></td><td></td><td>Find the corresponding function code for each pin in above table, and enter 16#0000 for P76, 16#070B for P77、16#0302 for P78.</td><td></td><td></td></tr>
<tr><td>79</td><td>Digital output Multiplexing function register</td><td>ALL</td><td>Any</td><td>Please refer to Chapter 5.2 "Control signal definition and Multiplexing choice".</td><td>R/W</td><td>0</td></tr>
<tr><td>80</td><td>Command pulse select direction setup※</td><td>P</td><td>0 ~ 1</td><td>You can set the type of command pulse to be given to the driver from the controller. There are three types of command pulse as shown in below table. Select an appropriate type according to the controller.
<table>
<tr><th>Type</th><th>Dir</th><th>CCW(counterclockwise)</th><th>CW(clockwise)</th></tr>
<tr><td rowspan="2">3</td><td>0</td><td colspan="2"> 
</td></tr>
<tr><td>1</td><td colspan="2"> 
</td></tr>
<tr><td rowspan="2">2</td><td>0</td><td colspan="2"> 
</td></tr>
<tr><td>1</td><td colspan="2"> 
</td></tr>
<tr><td rowspan="2">1</td><td>0</td><td colspan="2"> 
</td></tr>
<tr><td>1</td><td colspan="2"> 
</td></tr>
</table>
<Note> You cannot modify the value on line, it will take effect after re-up the power.</td><td>R/W</td><td>0</td></tr>
<tr><td>81</td><td>Command pulse input method※</td><td>P</td><td>1~3</td><td></td><td>R/W</td><td>2、3</td></tr>
<tr><td>82</td><td>Command pulse inhibit input invalidation setting</td><td>P</td><td>0~1</td><td>If the parameter is set to 1, the command pulse inhibit function will be disabled, if the parameter is set to 0, it is related to INH PIN(External control).
<table>
<tr><th>Register value</th><th>INH with COM-</th><th>External command pulse</th></tr>
<tr><td rowspan="2">0</td><td>Short</td><td>Allow to input</td></tr>
<tr><td>Open</td><td>Inhibit input</td></tr>
<tr><td rowspan="2">1</td><td>Short</td><td>Allow to input</td></tr>
<tr><td>Open</td><td>Allow to input</td></tr>
</table></td><td>R/W</td><td>1</td></tr>
</table>

Adrs	Name	Control mode	Range	Function	Read-Write	Default value
86	Numerator of 1st command pulse ratio	P	0 ~ 32767	You can set the resolution of command pulse according to frequency division. $\text{Pulse Number Per One Revolution} \times \frac{\text{P86 or P87 Numerator}}{\text{P88 Denominator}} = \text{Encoder Resolution (10000)}$ **<Notes>** 1) If the numerator of frequency multiplication = 0, the actual denominator parameters will be the pulses per one revolution. 2) If the numerator of frequency multiplication ≠ 0, setup the pulses per one revolution according to above formula. 3) In communication position control mode, if change the parameter and rewrite to EEPROM, it becomes effective once re-up the power. While in external position control mode, the parameter takes effect once the parameter changed. 4) Please refer to chapter 6.3 "Electronic gear ratio Setup".	R/W	1
87	Numerator of 2nd command pulse ratio	P	0 ~ 32767		R/W	1
88	Denominator of command pulse ratio	P	0 ~ 32767		R/W	1
89	Smoothing filter	P	0~7	You can set the parameter of the primary delay filter that is inserted to the pulse command portion. 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, however, it will delay the response for command pulse.	R/W	1
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 counterclockwise rotating direction of motor is the positive direction. **1:** Toward the motor shaft , the clockwise rotating direction of motor is the positive direction.	R/W	0
91	Deviation Counter clear input method	P	0~2	You can set the function for clearing deviation counter. 0: Low Level On 1: Falling edge is valid. 2: Shielding reset function It is related to CL PIN (External Control) or P281 Bit10 (Communication Control).	R/W	1

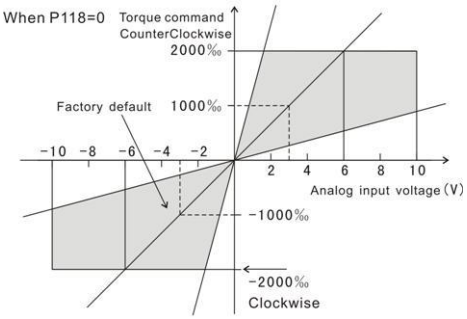
<table>
<tr><th>Adrs</th><th>Name</th><th>Control mode</th><th>Range</th><th>Function</th><th>Read-Write</th><th>Default value</th></tr>
<tr><td>92</td><td>Analog Speed command scale factor</td><td>S、T</td><td>10~2000</td><td>You can set the relationship between the motor speed and the voltage applied to the analog velocity command input terminal.
This parameter defines the gradient "rpm/command voltage".
The default of this parameter is 500[(r/min)/V], e.g. 6V with 3000 r/min.
 

<Note> Input voltage cannot exceed the range: -10V~+10V.</td><td>R/W</td><td>500</td></tr>
<tr><td>93</td><td>Speed command logic inversion</td><td>S</td><td>0 ~ 1</td><td>You can set the logic level of analog speed command:
<table>
<tr><th>Register value</th><th colspan="3">Direction of Speed command</th></tr>
<tr><td>0</td><td>Non-reversal</td><td colspan="2">Positive voltage→CCW rotation,
Negative voltage→CW rotation</td></tr>
<tr><td>1</td><td>Reversal</td><td colspan="2">Positive voltage→CW rotation,
Negative voltage→CCW rotation</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Speed direction Selection control</td><td>DI input / P281 Bit10</td><td>Direction</td></tr>
<tr><td>Valid/1</td><td>Positive/Negative voltage→CW rotation</td></tr>
<tr><td>Invalid/0</td><td>Positive/Negative voltage→CCW rotation</td></tr>
</table></td><td>R/W</td><td>0</td></tr>
<tr><td>94</td><td>Analog input command zero-drift adjustment</td><td>S、T</td><td>-2047 ~ 2047</td><td>You can adjust the analog speed command/analog torque command zero-drift.</td><td>R/W</td><td>0</td></tr>
</table>

Adrs	Name	Control mode	Range	Function	Read-Write	Default value
95	1st internal speed	S	-20000~20000	You can set the 1st speed of internal speed command. Unit:rpm	R/W	0
96	2nd internal speed	S	-20000~20000	You can set the 2nd speed of internal speed command. Unit:rpm	R/W	0
97	3rd internal speed	S	-20000~20000	You can set the 3rd speed of internal speed command. Unit:rpm **<Note>** The parameter is used to set the max. speed limitation under communication position control mode, so the max. Speed command under communication position control mode cannot exceed the value of this parameter.	R/W	500
98	4th internal speed	S、T	-20000~20000	You can set the 4th speed of internal speed command. Unit:rpm **<Note>** The parameter is used to set the max. speed limitation under external torque mode and communication torque control mode, so the max. Speed command under external torque mode and communication torque control mode cannot exceed the value of this parameter.	R/W	500
99	5th internal speed	S	-20000~20000	You can set the 5th speed of internal speed command. Unit:rpm	R/W	0
100	6th internal speed	S	-20000~20000	You can set the 6th speed of internal speed command. Unit:rpm	R/W	0
101	7th internal speed	S	-20000~20000	You can set the 7th speed of internal speed command. Unit:rpm	R/W	0
102	8th internal speed	S	-20000~20000	You can set the 8th speed of internal speed command. Unit:rpm	R/W	0
112	Speed command filter	S、T	0~6400	You can set the parameters of the primary delay filter that is inserted to the Analog speed command/Analog torque command, increase the value could make the servo rotates much more stable, but accordingly the responsiveness of the system is reduced. Unit ×10us	R/W	1000

<table>
<tr><th>Adrs</th><th>Name</th><th>Control mode</th><th>Range</th><th>Function</th><th>Read-Write</th><th>Default value</th></tr>
<tr><td>113</td><td>Acceleration time setup</td><td>S</td><td>0~1000</td><td rowspan="2">You can set the acceleration/deceleration time of external/communication speed control mode. If the input speed command changes so much, it would switch to rather smoothing acceleration/Deceleration speed command. 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>
If the target speed is V rpm, you can get the acceleration/deceleration time by the calculation:
Acceleration time= V / 1000 × P113× 1ms
Deceleration time= V / 1000 × P114× 1ms
Acceleration/Deceleration time setup parameters are valid under communication position control mode. According to the communication given position command, 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.</td><td>R/W</td><td>100</td></tr>
<tr><td>114</td><td>Deceleration time setup</td><td>S</td><td>0~1000</td><td>R/W</td><td>100</td></tr>
<tr><td>115</td><td>Speed limitation of external pulse</td><td></td><td>0~1</td><td>0: The speed is decided by external pulse frequency.
1: The speed is limited by P98 (Vmax=1.2*P98)</td><td>R/W</td><td>0</td></tr>
</table>

<table>
<tr><th>Adrs</th><th>Name</th><th>Control mode</th><th>Range</th><th>Function</th><th>Read-Write</th><th>Default value</th></tr>
<tr><td>117</td><td>Analog Torque command scale factor</td><td>T</td><td>10~100</td><td>You can set the relationship between the motor torque and the voltage applied to the analog torque command input terminal.
Unit: 0.1V/1000‰
As the default value of this parameter is 3V/1000 ‰ ,input 3V voltage is 1000 ‰ torque command.
 

<Note> Input voltage cannot exceed the range: -10V~+10V.</td><td>R/W</td><td>30</td></tr>
<tr><td>118</td><td>Torque command logic inversion</td><td>T</td><td>0~1</td><td>You can set the logic level of analog torque command.
<table>
<tr><th>Register value</th><th colspan="2">Speed command direction</th></tr>
<tr><td>0</td><td>Non-reversal</td><td>Positive voltage→CCW rotation,
Negative voltage →CW rotation</td></tr>
<tr><td>1</td><td>Reversal</td><td>Positive voltage→CW rotation,
Negative voltage →CCW rotation</td></tr>
</table>
CW: Clockwise, CCW: Counterclockwise</td><td>R/W</td><td>0</td></tr>
<tr><td>119</td><td>1st torque limitation</td><td>ALL</td><td>0~2000</td><td>You can set the restriction value of 1st torque.
Unit:‰</td><td>R/W</td><td>1000</td></tr>
<tr><td>120</td><td>2nd torque limitation</td><td>ALL</td><td>0~2000</td><td>You can set the restriction value of 2nd torque.
Unit:‰</td><td>R/W</td><td>1000</td></tr>
<tr><td>121</td><td>Positioning complete range</td><td>P</td><td>0 ~ 32767</td><td>You can set the range of Positioning complete signal, which means the allowable pulse number.
Unit: pulse number.</td><td>R/W</td><td>5</td></tr>
<tr><td>122</td><td>Zero-speed detection range</td><td>ALL</td><td>10 ~ 20000</td><td>You can set the threshold value of Zero-speed detection, there is 10rpm hysteresis.
Unit: rpm</td><td>R/W</td><td>30</td></tr>
</table>

<table>
<tr><th>Adrs</th><th>Name</th><th>Control mode</th><th>Range</th><th>Function</th><th>Read-Write</th><th>Default value</th></tr>
<tr><td>123</td><td>Arrival speed</td><td>S,T</td><td>10 ~ 20000</td><td>You can set the threshold value of Arrival speed, when the actual rotating speed of the motor exceeds this parameter value, the arrival speed signal outputs. There is 10rpm hysteresis of the parameter. Unit: rpm</td><td>R/W</td><td>1000</td></tr>
<tr><td>124</td><td>Positioning complete signal output setup</td><td>P</td><td>0 ~ 2</td><td>You can set the output conditions of Positioning complete signal.<table><tr><th></th><th>POS_OK output condition</th></tr><tr><td>0</td><td>The signal turns on when the pulses number of positional deviation within the range of positioning complete.</td></tr><tr><td>1</td><td>The signal turns on when there is no position command and the positional deviation pulses within the range of positioning complete.</td></tr><tr><td>2</td><td>The signal turns on when there is no position command, the zero-speed detection signal has output and the pulses of positional deviation within the range of positioning complete.</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>You can set the driving conditions during motor decelerating and after stalling while over-travel inhibit input is valid.<table><tr><th>Value</th><th colspan="2">During deceleration</th><th>After stalling</th><th>Deviation counter content</th></tr><tr><td>0</td><td colspan="3">Torque command=0 towards over-travel inhibited direction</td><td>Hold</td></tr><tr><td rowspan="3">1</td><td colspan="4">Control mode</td></tr><tr><td>P</td><td colspan="2">Position command=0 towards over-travel inhibited direction</td><td>Clears before/ 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>This parameter can be successful written or modified after the motor rebooted.</td><td>R/W</td><td>1</td></tr>
<tr><td>128</td><td>Position increment during homing</td><td></td><td></td><td>When P59 is set to 15 or 16, and the original switch signal has reached, the system would finish the given position set by this parameter. (32-bit signed number)</td><td>R/W</td><td>0</td></tr>
</table>

Adrs	Name	Control mode	Range	Function	Read-Write	Default value
130	Mechanical Brake delay time at motor standstill	ALL	0 ~ 100	Defines the delay time from OFF of the mechanical braking release signal (BRKOFF) to the shutdown of motor while SRV-ON signal is cut-off in motor stalling status. Unit:ms	R/W	50
131	Mechanical brake delay time at motor in motion	ALL	0 ~ 100	Defines 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 below 30rpm before setup the time.	R/W	50
132	External brake resistance setting※	ALL	0 ~ 3	Defines the setting of brake resistance as well as over-load protection function. **0:** Enabling Internal brake resistor only, and enable protective function for it. In case of the brake resistance operating limitation exceeds 10%,the alarm for excessive braking rate occurred. **1:** Enabling External brake resistor function, and enable protective function for it. In case the brake resistance operating limitation exceeds 10%, the alarm for excessive braking rate occurred. **2:** Using External brake resistor function, but no protective function is enabled. **3:** Without braking resistance circuit, depend entirely on the internal capacitance discharging.	R/W	0
134	Setup the torque at motor emergency stop	ALL	0 ~ 3000	Set the torque limitation value in following conditions: **1:** The deceleration process at overtravel inhibit. **2:** Some deceleration process. Unit: ‰	R/W	2000
136	Excessive level of position deviation	P	0 ~ 32767	You can set the detection range for the excessive position deviation pulse number. Unit: ×256 When actual deviation counter value exceeds this parameter×256, servo occurs excessive position deviation alarm. If this parameter is set to 0, the function of excessive position deviation function will be canceled.	R/W	25000

Adrs	Name	Control mode	Range	Function	Read-Write	Default value
137	Excessive level of Analog command	S、T	0～100	You can set the excess voltage level of analog velocity command or torque command after the zero-drift adjustment. Unit: ×0.1V The excessive analog command function will be can celled when you set up this parameter to 0.	R/W	0
138	Over-load level	ALL	0～2000	You can set the over-load level of motor. Unit: ‰ This max. parameter value can be set to 1050‰ of the motor rated torque, if no need high over-loading, please set lower value. **0:** 1.05 times over load, overload level *1 **1:** 1.05 times over load, overload level *1.25 **2:** 1.05 times over load, overload level *1.5 **3:** 1.05 times over load, overload level *1.75 **4:** 1.30 times over load, overload level *1 **5:** 1.50 times over load, overload level *1 **6:** 1.05 times over load, overload level *0.25 **7:** 1.05 times over load, overload level *0.5 **8:** 1.05 times over load, overload level *0.75	R/W	1050
139	Over-speed level	ALL	0～20000	You can set the over-speed level of motor. Unit: rpm The over-speed level becomes 1.2 times of the motor max. speed by setting this parameter to 0. The parameter is generally set to 0.	R/W	0
140～149	Historical record			You can select to display ten alarm records the servo happened recently. All alarms are detailed as below: 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 Communication 15: Abnormal CANopen Communication 16: Configuration error of external input pin	R	

Adrs	Name	Control mode	Range	Function	Read-Write	Default value
180	Software version			Software version of current driver.	R	
181	Type of servo and motor	ALL		16#0101: E10 series + 400W motor + 2500 p/r Encoder 16#0202: E10 series + 200W motor + 2500 p/r Encoder 16#0303: E10 series + 750W motor + 2500 p/r Encoder 16#0404: E10 series + 1.0KW motor + 2500 p/r Encoder	R	
182 ~ 184	Manufacturer parameter 2~4				R	
200	System status	ALL	0~5	Display present system state of servo: 0: Initial value after power on. 1: Initialization state. 2: Started state, the adjust procedure towards motor position. 3: Motor running state. 4: Ready state. 5: Error state.	R	
201	Current Control mode	ALL		Display present control mode of servo: 16#0000: No control mode, means 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	

Adrs	Name	Control mode	Range	Function	Read-Write	Default value
202	Type of error	ALL		The current alarm state of the 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 Communication 15: Abnormal communication of CANopen 16: Configuration error of external input pins	R	
203	Command Status	ALL		You can display the control signal command of current servo: **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 switching, 0: 1st control mode, 1: 2nd control mode **bit5:** Zero-speed clamp, 1: Valid, 0: Invalid **bit6:** External position mode, Command electronic gear selection, 0: 1st Multiplication, 1: 2nd Multiplication Start signal of multi-position/speed/torque command (Communication mode) **<Note>** Only Start signal is triggered that the given position command could take effect at relative position control. **bit7:** Homing command, 1: enable **bit8:** Command pulse inhibit input, 1: Valid Command selection 4 (Communication mode) **bit9:** Gain selection, 0: 1st gain, 1: 2nd gain **bit10:** Deviation counter clear in position mode, 1: Valid External speed mode, motor rotate direction,	R	

				0: CCW direction, 1: CW direction **bit11:** Original switch input, 1: Valid **bit12:** Command selection 1 **bit13:** Command selection 2 **bit14:** Command selection 3 **bit15:** Torque limitation switching input 0: 1st Torque limitation, 1: 2nd Torque limitation		
204	Output State	ALL		The system status output set to 1 while the condition is true: **bit0:** Servo-Ready, 1: Turn ON **bit1:** Alarm output, 1: Turn ON **bit2:** Positioning complete, 1: Turn ON **bit3:** Brake release, 1: Turn ON **bit4:** Zero -Speed detection, 1: Turn ON **bit5:** Torque in-limit, 1: Turn ON **bit6:** Speed consistency output, 1: Turn ON **bit7:** Resistance braking, 1: Turn ON **bit8:** Speed Arrival, 1: Turn ON **bit9:** Over-load alarm, 1: Turn ON	R	
205	Input IO signal state	ALL		External X1 or X4 control interface signal input, while the following PIN is connected with COM-,the corresponding bit is 1. **Bit0:** The 16th PIN **Bit1:** The 4th PIN **Bit2:** The 17th PIN **Bit3:** The 5th PIN **Bit4:** The 18th PIN **Bit5:** The 6th PIN **Bit6:** The 19th PIN	R	
206	Output IO signal state	ALL		External X1 or X4 control interface signal output, while the corresponding bit is 1,the transistor of the PIN turns on. **Bit0:** 20th PIN **Bit1:** 8th PIN **Bit2:** 21th PIN **Bit3:** 9th PIN	R	
207	Analog input command value	ALL	-32760 ~ +32760	You can set the input value of External Analog. This parameter value 32000 corresponds to 10V Analog input. It's normal for the parameter to exist zero-drift, and it can be adjusted by P94.	R	
210	Analog output value	ALL	-32760 ~ +32760	You can set the output value of External Analog. This parameter is related to P07 (Speed/Torque monitor selection)	R	

Adrs	Name	Control mode	Range	Function	Read-Write	Default value
212	Sum of command pulses	ALL	-2^{31}~$+2^{31}$	The total number of command pulse. Unit:pulse	R	
214	Sum of Feedback pulses	ALL	-2^{31}~$+2^{31}$	The total number 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	-20000 ~+2000	The present command speed. Unit: rpm	R	
221	Feedback speed	ALL	-20000 ~+2000	The present actual speed. Unit: rpm	R	
222	Velocity deviation	ALL	-20000 ~+2000	The present speed offset. Unit: rpm	R	
223	Torque command	ALL	-2000~2000	Present command Torque. Unit: ‰	R	
224	Actual torque	ALL	-2000~2000	Present actual torque. Unit: ‰	R	
225	Torque deviation	ALL	-2000~2000	Present torque deviation. Unit: ‰	R	
226	Busbar voltage	ALL		The Busbar voltage of current servo driver. Unit: V	R	
228	Alarm status	ALL	0~1	The present alarm state, this parameter =1 while alarm occurs.	R	
229	Torque output loading rate	ALL	-2000~2000	The output torque loading rate of present servo driver.	R	
230	Discharge resistance loading rate	ALL	1000	The brake resistance loading rate of present servo, × 0.1%	R	
231	Overload rate	ALL	-2000~2000	The Overload rate of present servo motor.	R	
234	Motor automatic identification function	ALL		Reserved	R	

Adrs	Name	Control mode	Range	Function	Read-Write	Default value
235	Factor of "No-Motor Running"	ALL		Please see below for the explanation of "No-motor Running": 0: No particular reason 1: Main power shutoff 2: SRV-ON signal is not enabled 3: Over-travel inhibition is valid 4: Torque limitation setup is too small 7: Position command or 3rd internal speed is too small 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: The load of the motor is more than it can bear 15: Servo Alarm 17: The U,V,W wires of motor are not connected	R	0
237	EtherCAT Communication status word		0~32767	Display EtherCAT communication status: **Bit 3:** Fault, 1: Turn on **Bit 10:** Position arrival, 1: Turn on	R	
274 ~ 275	Increment of Given Position	13	-2^{31} ~ $+2^{31}$	This parameter is a register which is used to set the pulse number under special speed-position mode. When the external signal is inputted valid, the pulse number of position increment given by servo(32 bit Double Integer).	R/W	0
279	EtherCAT Communication control word		0~32767	**15:** Enable **128:** Clear Alarm **Remark:** For communication control, you should set P279 to 15, and set P282_bit0 to 1, so that the servo could be enabled.	R/W	

Adrs	Name	Control mode	Range	Function	Read-Write	Default value
280	Communication function code	ALL	See right	The related communication control function codes: 16#0000: No command. 16#0102: Write all parameters down to EEPROM. 16#0104: Write the memory updated parameters down to EEPROM. 16#0108: Clear historical record. 16#1001: The position sine response. 16#1002: The speed sine response. 16#1004: The torque sine response. 16#2001: Position step response. 16#2002: Speed step response. 16#2004: Torque step response.	R/W	
281	Communication extended control word	ALL	See right	The given external command signal of communication control: **bit4:** Control mode switching, 0: 1st control mode, 1: 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: 1st Multiplication, 1: 2nd Multiplication Start signal of Multi-Position/Speed/Torque Command (Communication mode) **<Note>** Only Start signal is triggered that the given position command could take effect at relative position control. **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: 1st gain, 1: 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: 1st torque limitation,1: 2nd torque limitation.	R/W	

Adrs	Name	Control mode	Range	Function	Read-Write	Default value
282	Communication control word	ALL	See right	**Bit0:** 1: Servo is enabled, 0: Servo is disabled. **Bit1:** 1: Alarm clear is valid, 0: Alarm clear is invalid. **Bit2:** Cancel relative position command, 1: Cancel, 0: Do not cancel **Remark:** For communication control, you should set P282_bit0 to 1, and set P279 to 15, so that the servo could be enabled.	R/W	0
284	Pulse filter 1		-2^{31}~ $+2^{31}$	This parameter is a register which is used to set the pulse number as filter 1. When the system is switching from position mode to speed mode, the servo starts output pulses, by the time the output pulses reach P284, the system starts to detect external signal.	R/W	0
286	Pulse filter2		-2^{31}~ $+2^{31}$	This parameter is a register which is used to set the pulse number as filter 2. When external signal is firstly detected in speed mode, the servo starts output pulses, by the time the output pulses reach P286, that the system starts to search the external signal for second time; While the external signal is received again, the system switches from speed mode to position mode.	R/W	0
288	Pulse Alarm		-2^{31}~ $+2^{31}$	This parameter is a register which is used to set the alarm number of pulse. If external switch signal cannot be detected all the time under speed mode, and the output pulses reach the pulse number of alarm, the servo would be stopped and an alarm would be reported. If the value of this parameter=0, the alarm function would be shut off.	R/W	0
290 ~ 320	Given position 0~15	P	-2^{31}~ $+2^{31}$	Position command parameter will be given in communication position control mode. The communication given source is up to P05. Unit: pulse number.(32 bit double integral type)	R/W	0
324 ~ 355	Given speed 0-31	S	-3000~ 3000	Speed command parameter will be given under Communication speed control mode. The communication given source is up to P05. Unit: rpm	R/W	0
358 ~ 389	Given torque 0-31	T	-2000~ 2000	The torque command parameter will be given under communication torque control mode. The communication given source is up to P05. Unit:‰	R/W	0

<Notes>

1) The parameter marked with ※ need write in EEPROM, it will take effect once the servo rebooted (The parameters modified by PC software cannot write in EEPROM under servo-ON mode).

2) When saving parameters to EEPROM, the system would not save Read-only parameters and communication control parameters (P280~P389) to EEPROM.

3) Can read and write show as P, read only show as R.

4) The values in above table are the default parameters of E10 Series 400W Servo driver.

6.3 Electronic gear ratio setup

While in position control mode, adjusting electronic gear ratio can set the motor speed and displacement per input command pulse unit. (For example: Encoder resolution is 10000)

The pulses number per one revolution is calculated as follows:

$$\text{Pulse Number Per One Revolution} \times \frac{\text{P86 or P87 Numerator}}{\text{P88 Denominator}} = \text{Encoder Resolution(10000)}$$

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 per one revolution.

For example: The setting method of 2500 pulses per one revolution.

1) $2500 = 10000 \times \frac{\text{P88}}{\text{P86 or P87}}$ → P86(P87): P88=4:1, Command pulse frequency multiplication denominator P88 can set to 100, numerator P86(P87) set to 400.
2) Command pulse frequency multiplication numerator P86(P87) set to 0, P88 set to 2500, the value of P86(P87) is equivalent to encoder resolution 10000, and so electronic gear ratio is 10000: 2500.

7 Communication Functions

Introduction of Modbus / CANopen communication protocols

7.1 Introduction of CANopen protocol

E10 servo driver supports CANopen communication, which allows the operations of writing/reading params via CANopen controller. The controller can modify param commands in real time so as to change the running position or speed etc while E10 servo driver under communication control mode.

E10 servo can be used as a slave in CANopen bus network (refer to “CIA Draft Standard 301”), other functions are achieved via “Manufacturer Assigned Data Area”; The operations for device are based on Object Dictionary, you can access all the params’ value and function via the address which constituted by index and sub-index.

CANopen Communication has defined following kinds of messages:

Abbreviation	Full name	Description
SDO	Service Data Object	Service Data Object for transmitting system data
PDO	Process Data Object	Process Data Object for fast transmission of data in the CAN network (eg. Actual position)
EMCY	Emergency Message	Emergency object, object for fast transmission of error messages in the network
SYNC	Synchronization Message	Synchronization object, object for synchronizing devices on the network
NMT	Network Management	Network Management, services provided by the CAN Application Layer
NODE Guarding	Node Guarding	Monitoring function at the serial interface.

1. CANopen Protocol

Standard properties of E10 are described in following table:

NMT	Slave device
Conformed Protocol	Conform to CANopen standard protocol DS301_V402, and not fit DSP402 standard
Server SDO	1
Tx PDO	4

Rx PDO	4
PDO transmit type	Event-trigger, Time-trigger, Synchronizing cycle and Asynchronizing cycle are supported.
Emergency Object	NO
Sync Object	YES
Time Object	NO
Error Control Protocols	Heartbeat Protocol

2. Object Dictionary (OD)

The central point of connection for all objects is the object dictionary of every CANopen network device. Other devices can find here a list of all the objects through which they can make contact with that device.

The objects are addressed in the object dictionary via a 16 bit long index. One or more 8 bit long sub-index entries for each object specify individual data fields in the object. Index and sub-index are shown in hexadecimal notation.

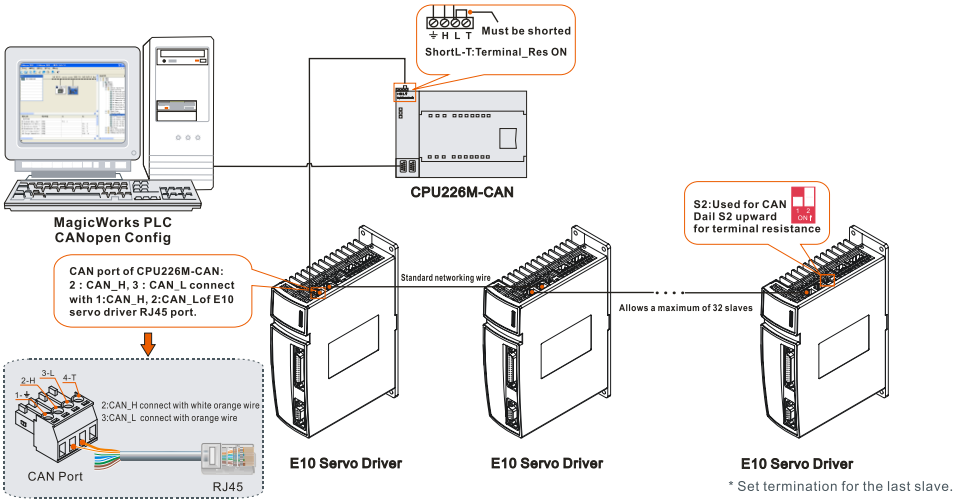
Index form of param: index.sub-index

Param	index	sub-index
P0~99	16#2000	Add 1 to the last two bit of the param, and convert it to hexadecimal.
P100~199	16#2001	Add 1 to the last two bit of the param, and convert it to hexadecimal.
P200~299	16#2002	Add 1 to the last two bit of the param, and convert it to hexadecimal.
P300~399	16#2003	Add 1 to the last two bit of the param, and convert it to hexadecimal.

Such as P282, add 1 to the last two bit 82, that is 83, then convert 83 to hexadecimal, so the sub-index is 53, other examples see following table:

Param	index	sub-index	Description
282	16#2002	16#53	Communication control word
290	16#2002	16#5B	Given position 0
97	16#2000	16#62	3rd internal speed

3. The connection between E10 servo driver and CPU226M-CAN



<Note> Be sure to set terminal resistance for CPU226M-CAN and the last slave device.

4. Applications

Application example of CANopen config refer to “8.3.1 Application Example of Communication position control mode”.

5. Diagnostic

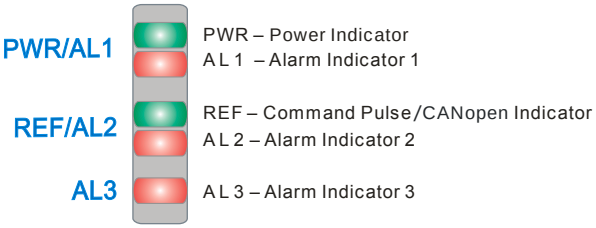
You can diagnose CANopen network by E10 CANopen indicator or SMB status byte of MagicWorks PLC.

➢ Diagnose via CANopen indicator

CANopen indicator stays out before communication is connected, if communication is successful, the indicator would light on, which means the CANopen communication function properly.

If abnormity occurs during CANopen communication, the CANopen indicator would turn out, please observe No.15 param of “10 Protective Function” for abnormal reasons.

E10 CANopen indicator show as follows:



➢ Diagnose via MagicWorks PLC

CPU226M-CAN has assigned 100 bytes to dedicated memory(SM), users can get the error info via status byte, the status bytes for CAN station are described as below:

	Number of Bits	Address Allocation	Description of status bit
SMB Status Bit	100	SMB550: The CAN communication status of master (CPU)	0x00: Initialing 0x01: Disconnected 0x04: Stopped 0x05: Operational 0x7f: Pre-operational 0xff: Configuration data error
		SMB551-SMB582: The CAN communication status of 1st ~ 32th slaves (Arrange slaves from small to large order according to Node ID)	0x00: Initialing 0x01: Disconnected 0x05: Operational 0x7f: Pre-operational 0x7: Configuration data error

7.2 Introduction of Modbus RTU Protocol

E10 series servo driver built-in standard Modbus RTU protocol, which supports Modbus RTU master reading/writing single or multiple params. As the controller that with Modbus protocol was connected with Servo driver, the controller would execute the operation of setting params, reading status etc. Controller could modify the commands in real time so as to change the motor running speed, position etc., while E10 servo driver under communication control mode.

Modbus RTU protocol contains various bus commands, E10 series servo driver support 3 kinds of the commonest commands. The 3 kinds of commands could 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 params of the driver
16#06	Write single param of the driver
16#10	Write multiple params of the driver

The params of E10 series servo driver corresponds to the Modbus address, eg. The Pr0.00 of driver corresponds to Modbus address 0, P324 corresponds to Modbus address 324.

E10 servo driver could invoke Modbus library as CO-TRUST PLCs read/write Modbus params with E10.The library address should add 40001 on the basis of Modbus address, which means Pr0.00 of driver corresponds to 0x40001 of Modbus library, others are shifted accordingly. For example, P324 corresponds to 40325 of the Modbus library.

1、Read Params (16#03)

The following request frame indicates: Read the two data with the start of P221 (Feedback speed) which communication address is 01.

Request frame:

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

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

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

3) Start Adr H/L: High/Low bit of param initial address, the starting address should convert to hexadecimal value, eg. Pr221 of this example convert to hexadecimal value:16#00DD, that the high bit is 16#00、low bit is 16#DD.

4) No.of Regs H/L: High/Low bit of reading params quantity, the starting address should convert to hexadecimal value, the params of this example (16#0002), high bit is 16#00、low bit is 16#02.

5) CRC: CRC Check word.

If the read operation is successful, response frame see 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	
Example	16#01	16#03	16#04	16#00	16#00	/	16#00	16#00	XXXX	XXXX

1) Slave Adr: Communication address of the driver.

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

3) Data Length: Length of data byte, it's equal to the quantity of reading params (No.of Regs)×2;

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

5) CRC: CRC check word.

2、Write single param (16#06)

The following request frame indicates: write 500 to P324(Given speed 0) which communication address is 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	
Example	16#01	16#06	16#01	16#44	16#01	16#F4	XXXX	XXXX

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

2) CMD: Function code, 16#06 is the operation of writing single param.

3) Reg Adr H/L: Initial address High/Low bit of the param that was written. the starting address should convert to hexadecimal value, eg.P324 of this example convert to hexadecimal value:16#0144, that the high bit is 16#01、low bit is 16#44.

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

5) CRC: CRC check word.

If single param is successfully written, the response 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	
Example	16#01	16#06	16#01	16#44	16#01	16#F4	XXXX	XXXX

1) Slave Adr: Communication address of the driver.

2) CMD: Function code, 16#06 is the operation of writing single param.

3) Reg Adr H/L: Initial address High/Low bit of the param that was written.

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

5) CRC: CRC check word.

3、Write Multi-params((16#10)

The following request frame indicates: Consecutively write 200 and 300 to P113/P114 (Acceleration/Deceleration) which communication address is 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

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

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

3) Start Adr H/L: Initial address High/Low bit of the param that was written. The starting address should convert to hexadecimal value, eg.P113 of this example convert to hexadecimal value:16#0071, that the high bit is 16#00、low bit is 16#71.

4) No. of Regs H/L: Quantity High/Low bit of the param that was written, the quantity of the param need convert to hexadecimal value. eg. the two params of this example(16#0002), that the high bit is 16#00、the low bit is 16#02.

5)Data Length: Length of data byte, it's equal to the quantity of writing params(No. of Points)× 2, the starting address should convert to hexadecimal value.

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

7) CRC: CRC Check word.

If multi-params are successfully written, the response 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#10	16#01	16#38	16#00	16#02	XXXX	XXXX

1) Slave Adr: Communication address of the driver.

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

3) Start Adr H/L: Initial address High/Low bit of the param that was written.

4) No. of Regs H/L: Quantity High/Low bit of the param that was written.

5) CRC: CRC check word.

4、Error Code

The slave (servo driver) receives the MODBUS message from master without transmission errors, but it could not execute master commands properly or response correctly, the slave would response abnormal message as answers.

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

Format of abnormal response frame:

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

1) Slave Adr: Communication address of the driver.

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

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

Error Code	Name	Description
16#02	Illegal data address	Incorrect writing range of param, Param is read only、 Incorrect manufacturer password etc.
16#03	Illegal data	Address for param group is greater than 11st group etc.
16#06	Busy、Refuse to execute	Slave might be saving to EEPROM now、Servo is currently enabling etc.

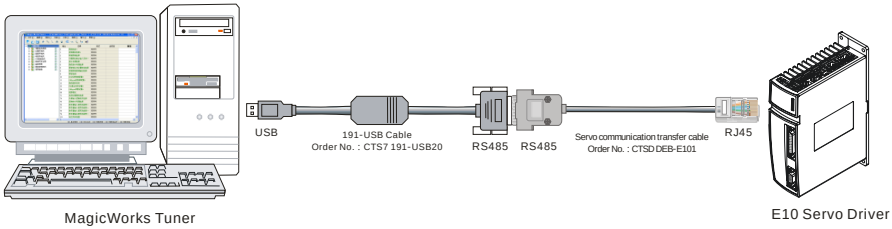
4) CRC: CRC check word.

8 Applications of Basic control modes

Applications of Communication control or External control modes

You can set the parameters of E10 series servo by MagicWorks Tuner software from the upper computer. Please download the MagicWorks Tuner software from our company's website: www.co-trust.com. You can define a set of parameters, and generate a parameter configuration table for the control mode according to the field requirements via using the "Config wizard" function after MagicWorks Tuner software has been installed.

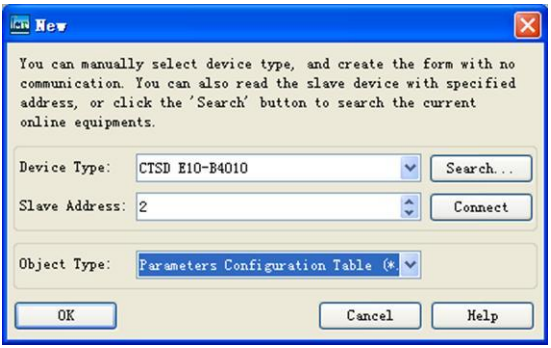
The connection between upper computer and E10 servo driver are shown as below, advise to use isolated serial port converter.



The following steps are simply introduced how to start the use of MagicWorks Tuner:

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

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



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

4、Click button from the toolbar, and write the new parameter value in servo from the Parameter status table, then click button to save the settings into EEPROM, store setting has always been operating effectively. The parameters marked with ※ become effective after rebooted the servo.

8.1 Test Run

This section introduces the test run for servo in communication position / speed / torque

mode, the specific steps see as follows:

Step 1: Wiring

Be sure to connect well with main power, control power, encoder, and motor driver cables etc. according to “chapter 4 Wiring”, and turn on the power of servo driver. If red light turns on, please refer to “10 Protective Function” for the solutions.

Step 2: Mode selection

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

备注➠ Save the settings to EEPROM and power-off to reboot, so that the changes would be effective.

Step 3: Enable the servo

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 Xth given position(P290~P320), for this example, P05 is set to 0, so that 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 Xth given speed(P324~P355) via P05, for this example, P05 is set to 0, so that the motor rotates as the value of P324(Given speed 0).

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

③ Test run in communication torque mode

Select Xth given torque(P358~P389) via P05, for this example, P05 is set to 0, so that the motor rotates as the value of 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 the driver has not reported alarm, please refer to P235 for the stall reason.

Tip
X1 can be disconnected in communication control mode, all control functions except Overtravel inhibit can be given by external commands.

8.2 External Control Mode

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

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

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

External Torque control mode: Control the output torque of motor via external analog voltage, so as to achieve torque. Speed limitation must set for the mode.

8.2.1 Application Example of External position control mode

【Relevant Parameters】

No.	Name	Description
P01	Control mode setup※	0: External Position control-P
P80	Command pulse select direction setup※	Select pulse direction: CW, CCW
P81	Command pulse input method※	Select pulse input method: P+D、A+B、CW+CCW

P86	Numerator of 1st command pulse ratio	Setup the resolution of command pulse according to frequency division. $\text{Pulse Number Per One Revolution} \times \frac{\text{P86 or P87 Numerator}}{\text{P88 Denominator}} = \text{Encoder Resolution (10000)}$
P87	Numerator of 2nd command pulse ratio	
P88	Denominator of command pulse ratio	
P136	Excessive level of position deviation	setup the detection range for the excessive position deviation pulse number.
P121	Positioning complete range	Setup the range of Positioning complete. The signal is being output when the deviation between motor actual feedback position and command pulse position is less than the value of P121.
P124	Positioning complete signal output setup	Setup the output conditions of Positioning complete signal.

【Example】

This section simply introduced the basic operations in external control mode, please setup the servo driver according to below steps:

Step 1: If need set electronic gear ratio parameters, please refer to chapter "6.3 Electronic gear ratio setup" for the specific setting method.

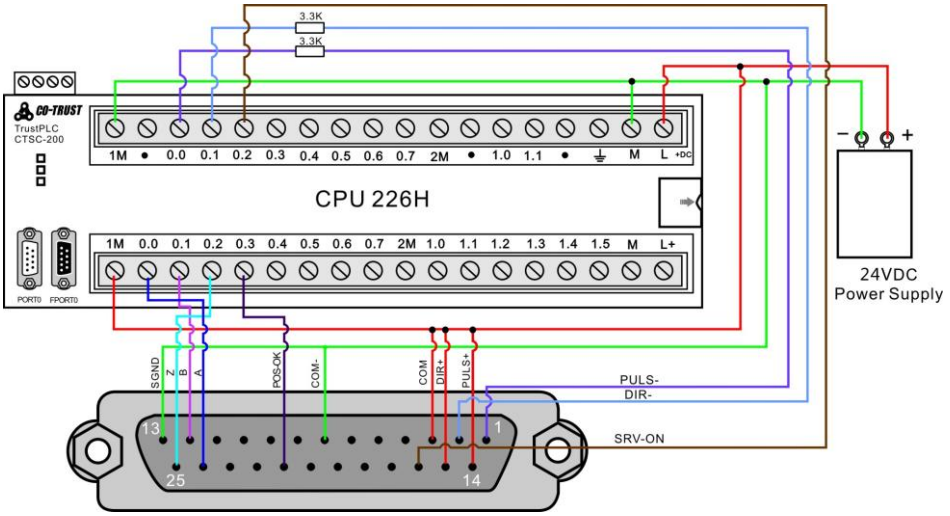
Step 2: When the input pulse frequency is lower or the electronic gear ratio is excessive, you should increase the value of P89(Smoothing filter), the servo driver would perform filtering in accordance with the input position so as to make servo motor rotates much more smooth.

Step 3: Please confirm whether need to set the related parameters of command pulse inhibit input, deviation counter clear, positioning complete output, each kinds of alarms and the torque limitation etc. Please use defaults in case of no special requirements.

Step 4: Be sure to connect well with main power, control power, encoder, motor driver cables etc., according to “chapter 4 Wiring”, and connect to external upper controller by the wiring method of "chapter 4.7 Control interface terminal".

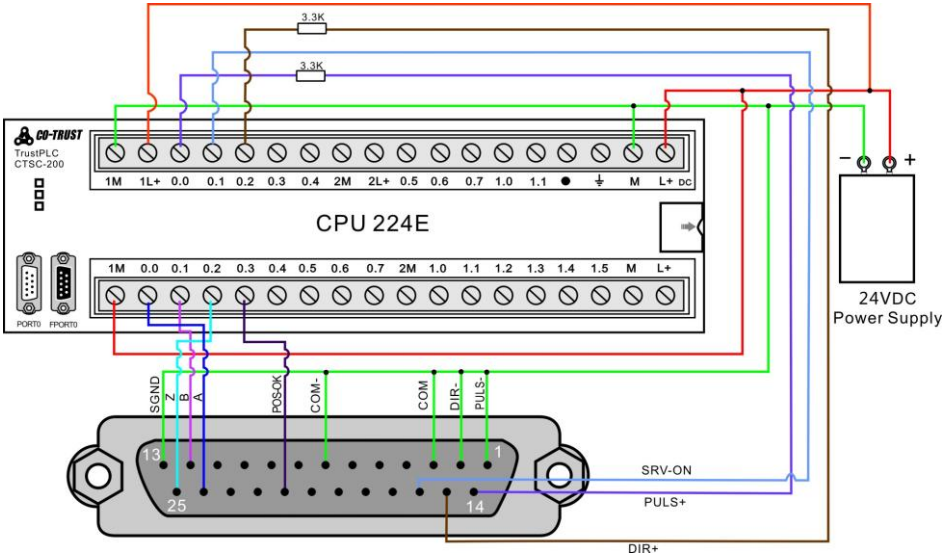
If PLC (such as Mitsubishi or Omron PLC) or upper computer uses NPN output, the connection refers to following diagram:

◆ Connection example of CTSC-200 CPU 226H and E10 servo driver:



If PLC (such as Siemens PLC) or upper computer uses PNP output, the connection refers to following diagram:

◆ Connection example of CTSC-200 CPU 224E and E10 servo driver:



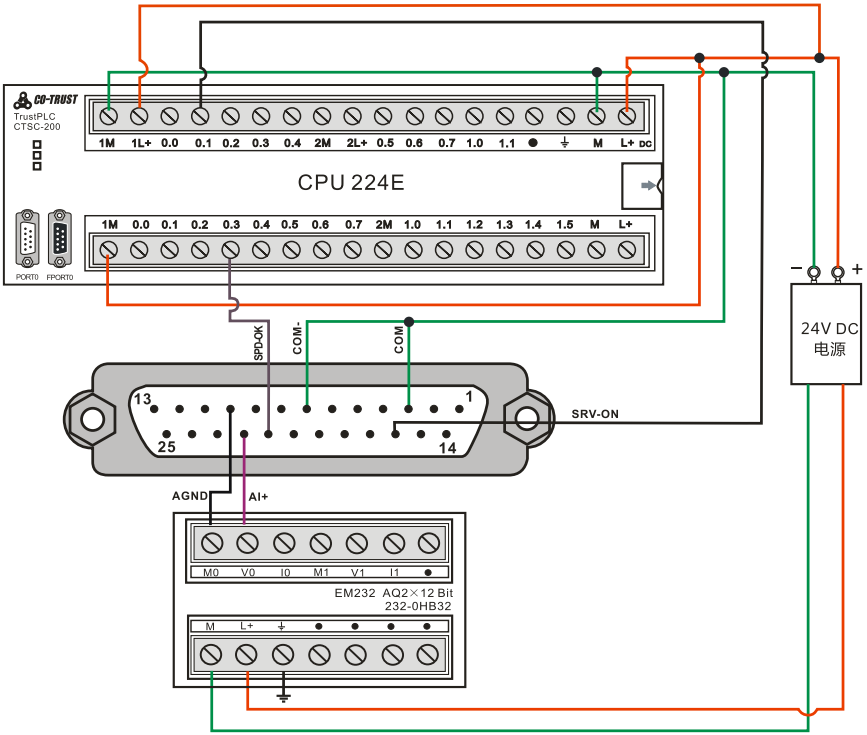
Step 5: After the wiring is completed, the controller enables the servo driver and sends out pulse command, the pulse indicator begins to twinkle, and the motor starts to rotate. Please check the monitor parameters (R235 \ R202) while motor stalls.

8.2.2 Application Example of External speed control mode

【Relevant Parameters】

No.	Name	Description
P01	Control mode setup※	1: External Speed control-S
P04	Command source selection	Select the command source of external speed control mode and communication control mode.
P92	Analog Speed command scale factor	Setup the relationship between the motor speed and the voltage applied to the analog velocity command input terminal. The default of this parameter is 500[(r/min)/V],
P93	Speed command logic inversion	setup the logic level of analog speed command:
P94	Analog input command zero-drift adjustment	You can adjust the zero-drift for analog speed command/analog torque command.
P112	Speed command filter	setup the parameters of the primary delay filter that is inserted to the Analog speed command/Analog torque command.
P113	Acceleration time setup	setup the acceleration/deceleration time of external speed control or communication speed control mode. If the input speed command changes so much, it would switch to rather smoothing Acceleration/Deceleration speed command.
P114	Deceleration time setup	
P122	Zero-speed detection range	setup the threshold value of Zero-speed detection.

◆ Connection example of CTSC-200 CPU 224E, EM232-0H32 and E10 servo driver:



8.2.3 Application Example of External torque control mode

【Relevant Parameters】

No.	Name	Description
P01	Control mode setup※	2: External Torque control-T
P117	Analog Torque command scale factor	Setup the relationship between the motor torque and the voltage applied to the analog torque command input terminal.
P118	Torque command logic inversion	Setup the logic level of analog torque command.
P94	Analog input command zero-drift adjustment	You can adjust the analog speed command/analog torque command zero-drift.
P112	Speed command filter	Setup the parameters of the primary delay filter that is inserted to the Analog speed command/Analog torque command.
P98	4th internal speed	Setup the 4th speed of internal speed command

8.3 Communication control mode

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

Communication Position control mode: Achieve position control via modifying position command in communication mode.

Communication Speed control mode: Achieve speed control via modifying speed command in communication mode.

Communication Torque control mode: Achieve torque control via modifying torque command in communication mode.

8.3.1 Application Example of Communication position control mode

【Relevant Parameters】

No.	Name	Description
P01	Control mode setup※	6: Communication Position control-P
P86	Numerator of 1st command pulse ratio	Setup the resolution of command pulse according to frequency division. $\text{Pulse Number Per One Revolution} \times \frac{\text{P86 or P87 Numerator}}{\text{P88 Denominator}} = \text{Encoder Resolution (10000)}$
P87	Numerator of 2nd command pulse ratio	
P88	Denominator of command pulse ratio	
P97	3rd internal speed	Speed limiting value of communication position control mode.
P121	Positioning complete range	Setup the range of Positioning complete, that means the allowable pulse number.
P04	Command source selection	Select the command source of external speed control mode and communication control mode.
P05	Communication command source selection	0~15: Select communication given position command.
P281	Communication extended control word	Communication given control command, such as Zero-speed clamp, Homing command etc.
P282	Communication control word	Communication given control command, such as Servo-on、Alarm clear etc.
P71	Communication position control method	Bit0: 0: Absolute position, 1: Relative position

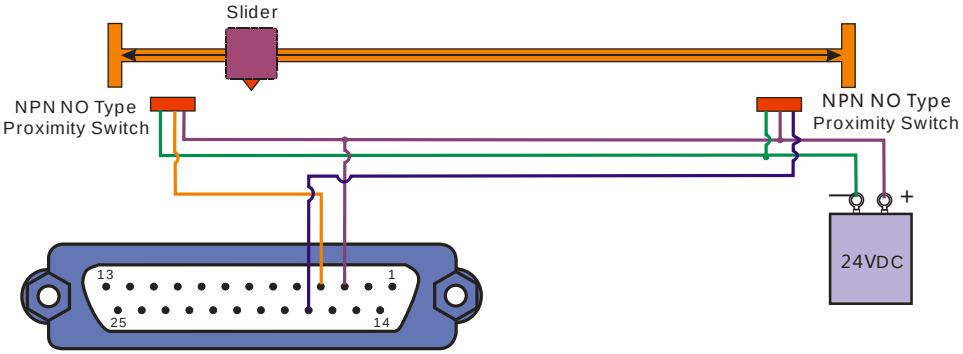
P290~320	Given Position	P290: Given Position 0 P292: Given Position 1 ..... P320: Given Position 15
R204	Output state	Output status of servo system, such as homing complete, positioning complete etc.

【Example】

The example introduces the CANopen communication between E10 servo and CTSC-200 CPU 226M-CAN in communication position mode, please refer to following steps:

Step 1: Wiring

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



Step 2: Configure parameters

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

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

③ Set communication address for servo: P0=2

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

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

⑥ Select Digital input Multiplexing function: P78 (Digital input Multiplexing function register1) =16#020B

Parameter	Bit	pin	symbol	Value
P78	B8~B15	17	DIN2	16#02: CCW overtavel inhibit
	B0~B7	4	DIN1	16#0B: Original switch input

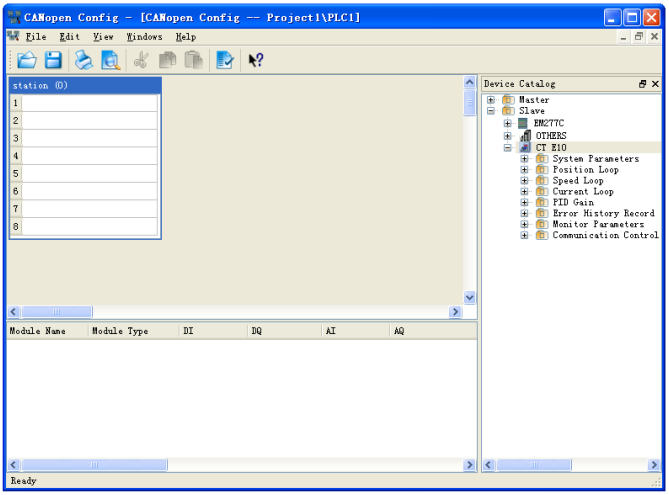
⑦ Effective level for Sensor signal is high level, so we need choose external input logic level: P72_Bit2 is set to 1, P72_Bit11 is set to 0, refer to following table:

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

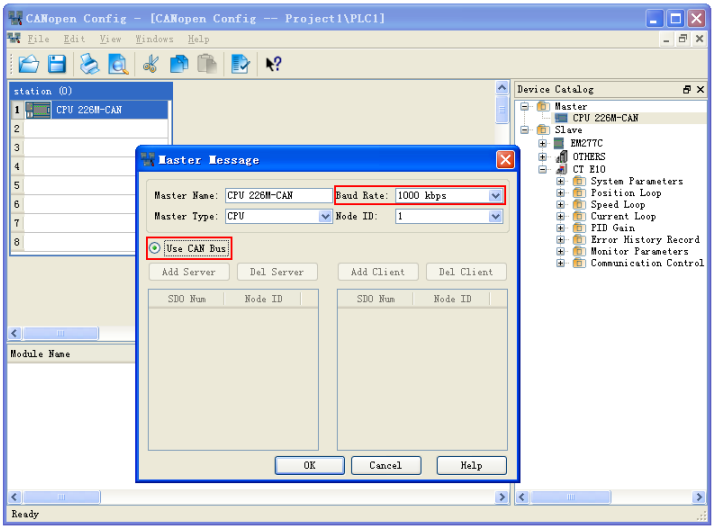
⑧ Select homing mode: P59=1 (Refer to Negative original switch and Z-phase signal)

Step 3：Configure CANopen communication via MagicWorks PLC

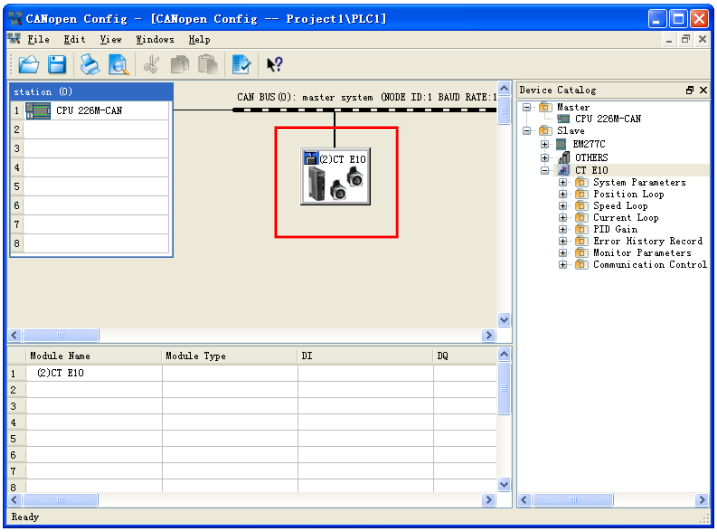
① Start MagicWorks PLC, and enter in CANopen config interface, see below:



② Add master CPU226M-CAN to station rack, which can only be placed in No. 1 slot, then you can configure params for master station by double-clicking No. 1 slot, here we set baud rate to 1000kbps, and select “Use CAN Bus”:



③ Double click CT E10 or drag CT E10 from Device Catalog to CAN Bus, that you can add E10 slave for master:



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

1	(2)CT E10			
2	202 Type of error	16DI	V:0...1	
3	204 Output State	16DI	V:2...3	
4	216 User position coordinates	32DI	V:4...7	
5	221 Feedback speed	16DI	V:8...9	
6	282 Communication control word	16DQ		V:10...11
7	281 Communication external command	16DQ		V:12...13
8	290 Given position 0	32DQ		V:14...17
9	97 3rd internal speed	16DQ		V:18...19
10	113 Acceleration/Deceleration time set-up	32DQ		V:20...23
11	101 7th internal speed	16DQ		V:24...25
12	102 8th internal speed	16DQ		V:26...27

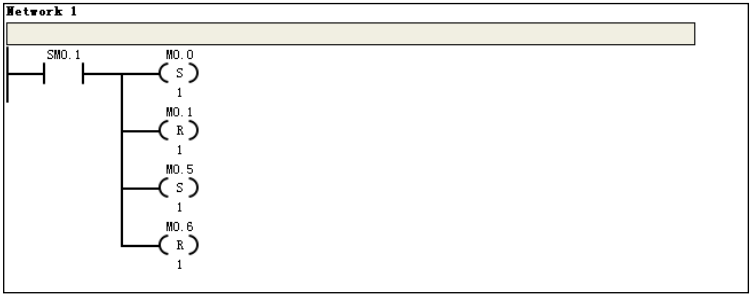
Write new value to the mapping address of param to execute related operation, eg, Write 1 to P282_Bit0, which mapping address is V10.....11, so that you can enable the servo in communication mode.

282	Communication control word	Bit0: 1: Servo is enabled, 0: Servo is disabled.

Read of 204_Bit 0 from mapping address V2.....3 to check its status, if the bit0 is 1 that you can confirm the servo is ready, otherwise it's not ready.

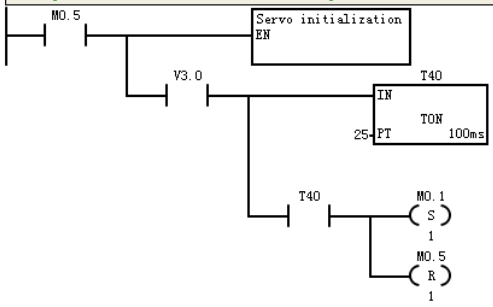
204	Output state	The output of system status is set to 1 while the condition is true: Bit0: Servo-Ready, 1: Turn ON

⑤ The network diagrams of the program show as below:



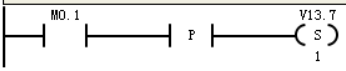
Network 2

Please perform initializing and assigning first after the power on.
Homing would start after servo is ready(V3.0).



Network 3

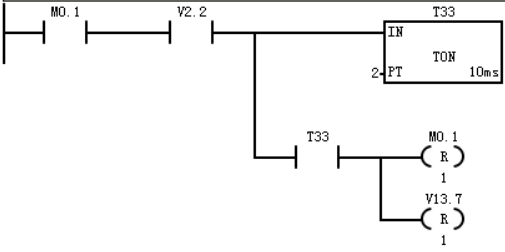
Bit7(V13.7) of communication extended control word is homing command.



Network 4

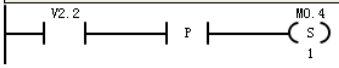
Please rewrite 0 to homing command after homing is completed, so that the given position command can be effective.

Note: Delay is to validate homing for several times.



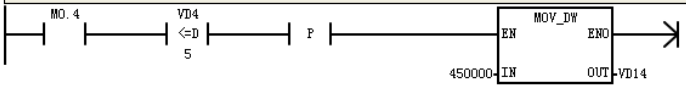
Network 5

After homing is completed, servo motor begins roundtrip between the two positions.



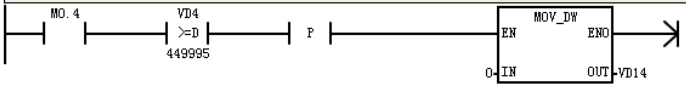
Network 6

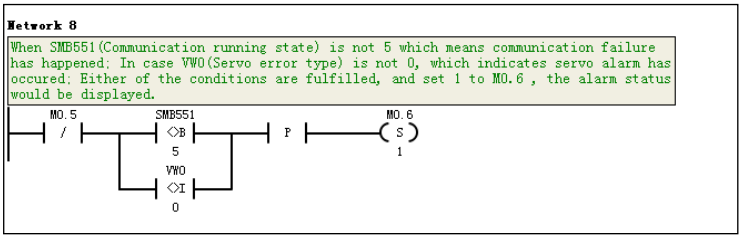
Given position is 450000 as feedback position is lower than or equal to 5.



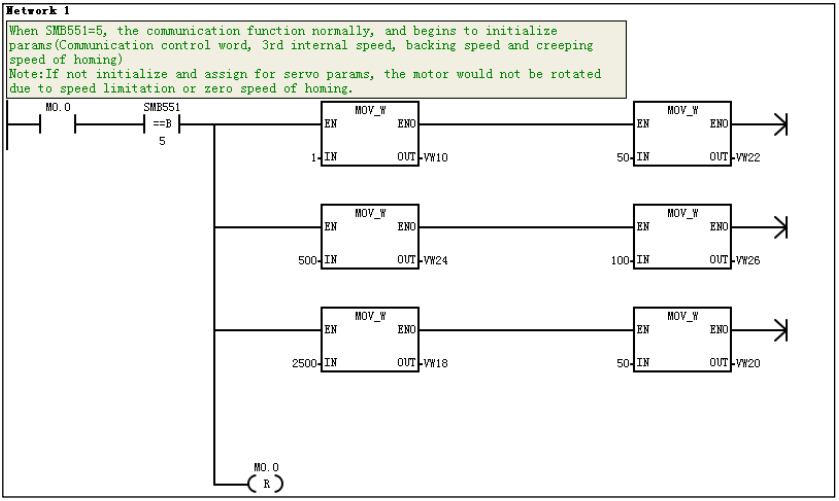
Network 7

Given position is 0 as feedback position is greater than or equal to 449995.





Subprogram for servo initialization see as follows:



8.3.2 Application Example of Communication speed control mode

【Relevant Parameters】

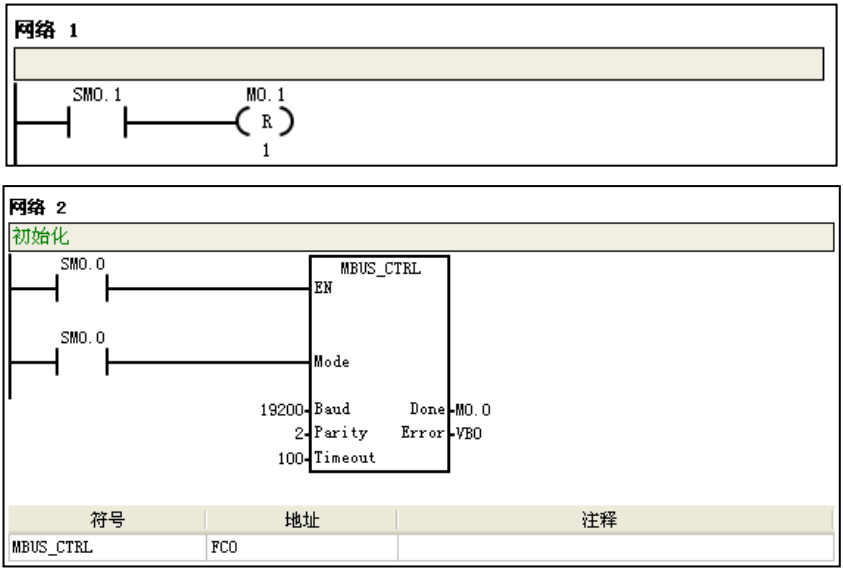
No.	Name	Description
P01	Control mode setup※	7: Communication Speed control-S
P113	Acceleration time setup	You can set the acceleration/deceleration time of external speed control or communication speed control mode. If the input speed command changes so much, it would switch to rather smoothing Acceleration/Deceleration 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
R204	Output state	Output status of servo system, such as homing complete, positioning complete etc.
R221	Feedback speed	Motor actual feedback speed.

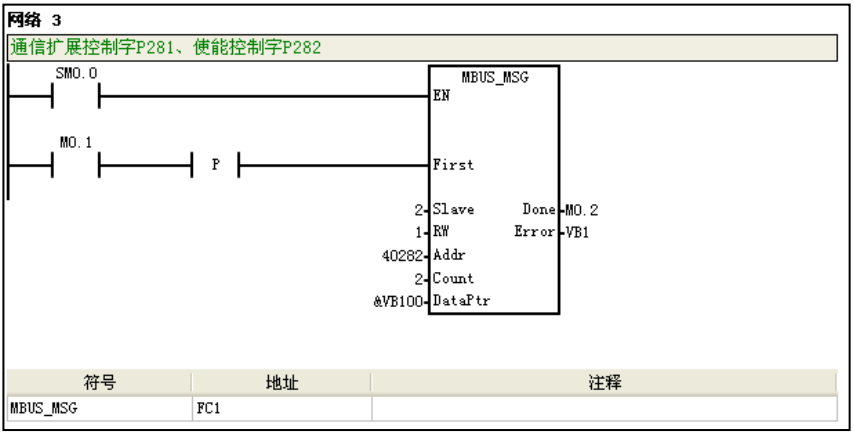
【Example】

The example introduces the modbus communication between E10 servo and CTSC-200 CPU 226M in communication speed mode, please refer to following steps:

Network 1、2: Master initialization



Network 3: Sequential write two words to P281, P282 of the driver which communication address is 02.



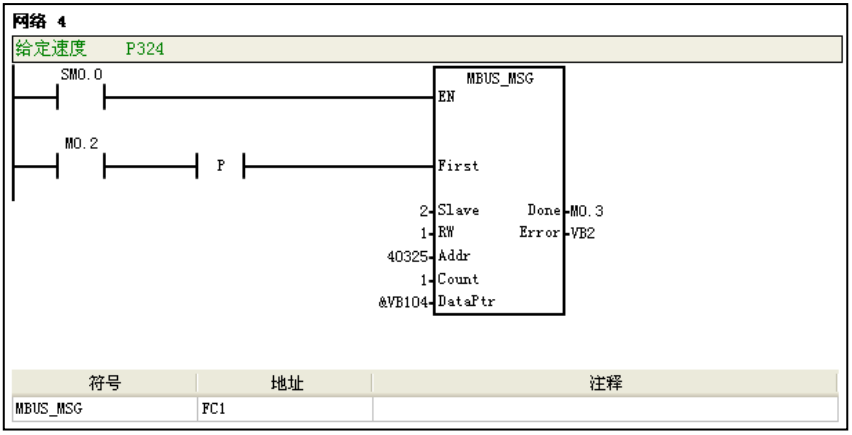
Request frame (P282_Bit0 =1):

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 see as follows:

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

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



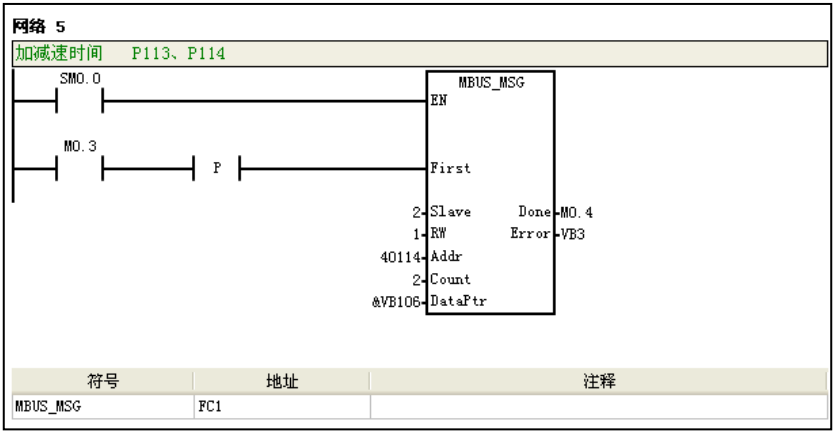
Request frame:

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

If the write operation is successful, response frame see as follows:

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: Sequential write 1000, 200 to P113, P114 of the driver which communication address is 02.



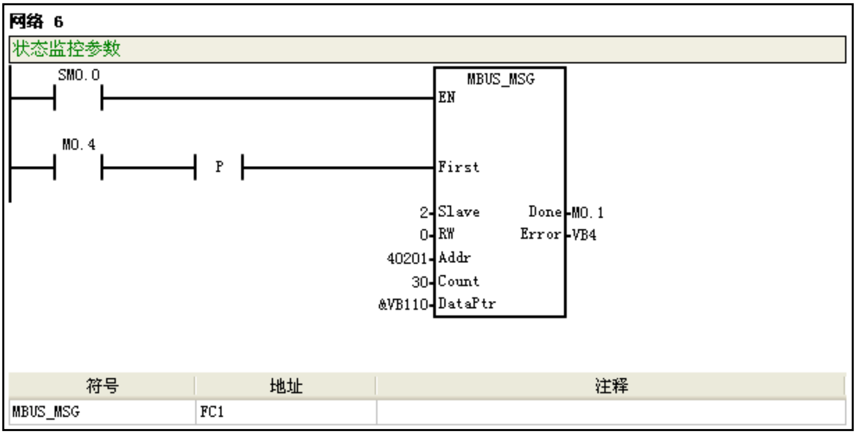
Request frame:

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

If the write operations are successful, response frame see as follows:

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

Network 6: Master read parameters R200~R229 of the driver which address is 02.



Request frame:

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

If the read operation is successful, response frame see as follows:

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 68 70 00 01 00

8.3.3 Application Example of Communication torque control mode

【Relevant Parameters】

No.	Name	Description
P01	Control mode setup※	8: Communication Torque control-T
P119	1st torque limitation	Setup the restriction value of 1st torque.
P134	Setup the torque at motor emergency stop	Setup the torque limitation value in following conditions
P98	4th internal speed	Setup 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
R204	Output state	Output status of servo system, such as homing complete, positioning complete etc.

9 Introduction and Example of Application functions

Introduction and example of Application functions

9.1 Homing Function

【Function Overview】

The homing function in communication/external position 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 much more precise. Advise to use E10 homing function when absolute positioning control are required.

【Relevant Parameters】

No.	Name	Description
P59	Homing mode	0~14 homing modes
P281	Communication extended control word	Enable homing command, bit7 is set to 1
P73	Control command source selection	2: From external DI signal(Decided by P75/76/77/78)
P75~78	Digital input multiplexing function register 4~1	Select digital input multiplexing function
P03	Overtravel Inhibit input invalid setting※	Select whether to validate the overtravel Inhibit signal for CCW/CW direction or not. 0: Overtravel Inhibit is valid, it moves in accord with the preset sequence with P126. 1: Overtravel Inhibit is invalid. 2: The servo alarm is triggered while either one of the direction happens overtravel Inhibit.
P72	External input logic level selection	Select the External DI logic level.
P101	7th internal speed	Set coming back speed during homing process
P102	8th internal speed	Set creeping speed during homing process
R203	Command Status	Check homing executing status
R204	Output State	Check homing complete status
P08 / P09	Torque limitation control output selection / Zero-speed detection	Output homing complete signal

<Note> Please refer to “6.2 Details of Parameters” for details of above parameters.

【Mode specification】

There are 14 kinds of homing modes for servo, you can select the modes according to your requirements of accuracy and the practical applications.

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

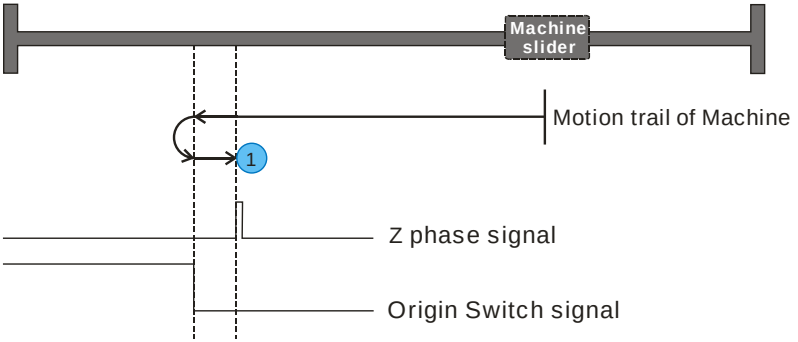
No matter where the machine is located, the original point the servo searched is always unique after the desired device(original switch and positive/negative overtravel inhibit switch) were well installed. “I” in following diagram indicates the Initial position of machine, “X” represents the original position.

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

Configure the DI PIN to “homing switch signal”, when the rising edge of the DI PIN is detected, the P216 (User Position Coordinates) will be reset. (This homing mode is a

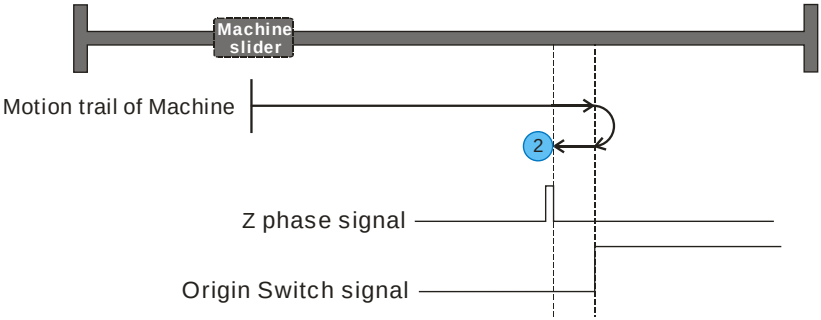
special one without “homing complete signal”)

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



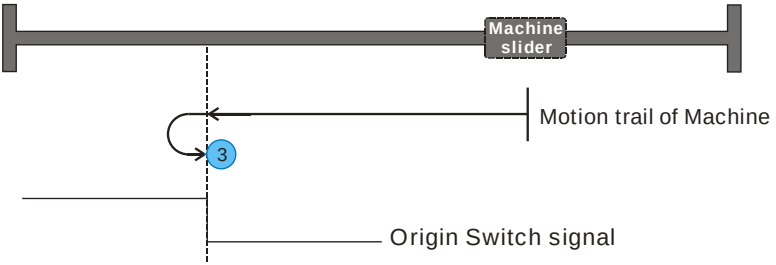
Original switch is located in the negative direction of the machine. The machine is moving in the direction of original switch, it would suspend while original switch is detected, then exist from the original switch and turn back to search the next Z-phase signal of motor, after that the servo would mark the first Z-phase signal as the original point, and the motor stop immediately.

Homing mode 2: Refer to Positive original switch and Z-phase signal



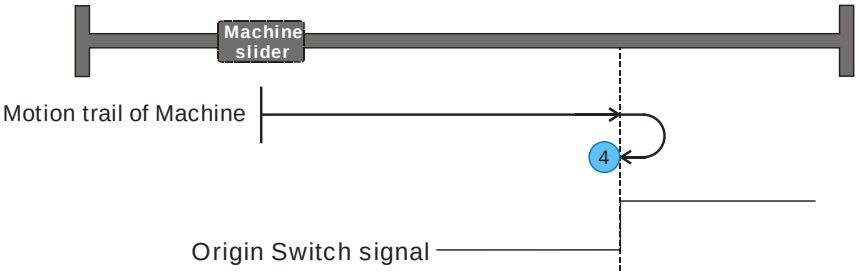
Original switch is located in the positive direction of the machine. The machine is moving in the direction of original switch, it would suspend while original switch is detected, then exist from the original switch and turn back to search the next Z-phase signal of motor, after that the servo would mark the first Z-phase signal as the original point, and the motor stop immediately.

Homing mode 3: Refer to Negative original switch only



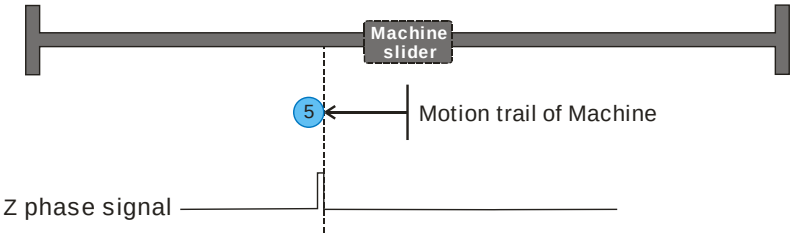
Original switch is located in the negative direction of the machine. The machine is moving in the direction of original switch, it would slow to a suspend while the original switch is detected, then exist from the original switch and turn back to search the falling edge of original switch, after that it would mark the falling edge as the original point, and the motor stop immediately.

Homing mode 4: Refer to Positive original switch only



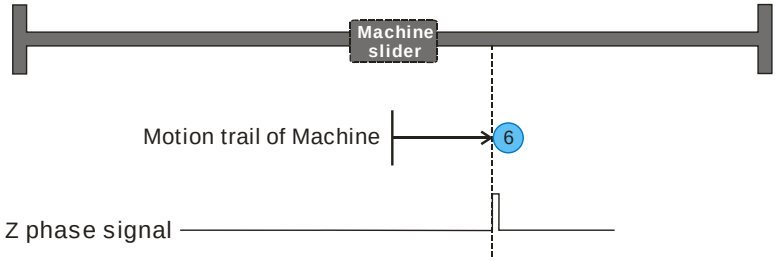
Original switch is located in the positive direction of the machine. The machine is moving in the direction of original switch, it would slow to a suspend while the original switch is detected, then exist from the original switch and turn back to search the falling edge of original switch, after that it would mark the falling edge as the original point, and the motor stop immediately.

Homing mode 5: Refer to Z-phase signal only (Homing towards negative direction)



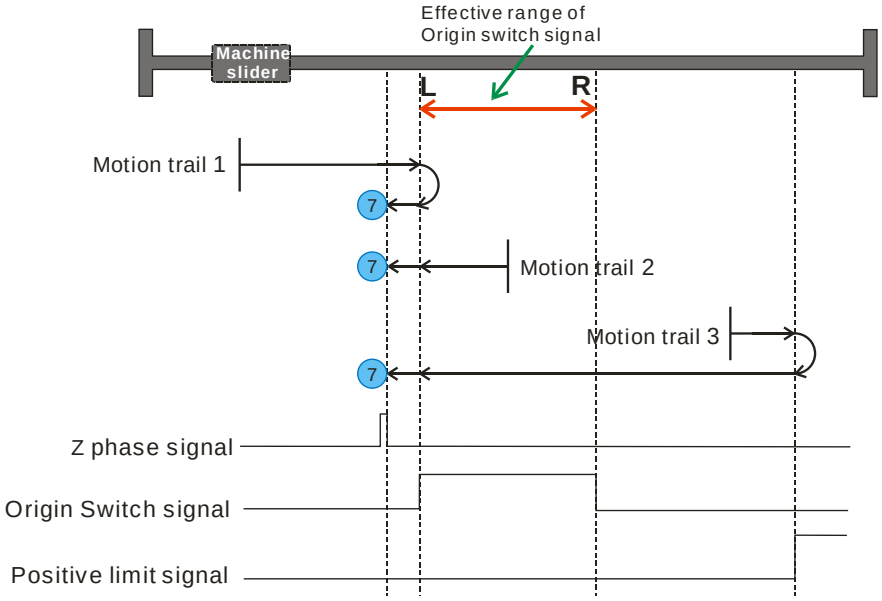
After received the homing command, the motor is moving in negative direction, and it would record the next Z-phase signal as the original point.

Homing mode 6: Refer to Z-phase signal only (Homing towards positive direction)



After received the homing command, the motor is moving in positive direction, and it would record the next Z-phase signal as the original point.

Homing mode 7: Refer to original switch/positive limit switch/Z-phase signal (on the left of the left edge of the original switch)

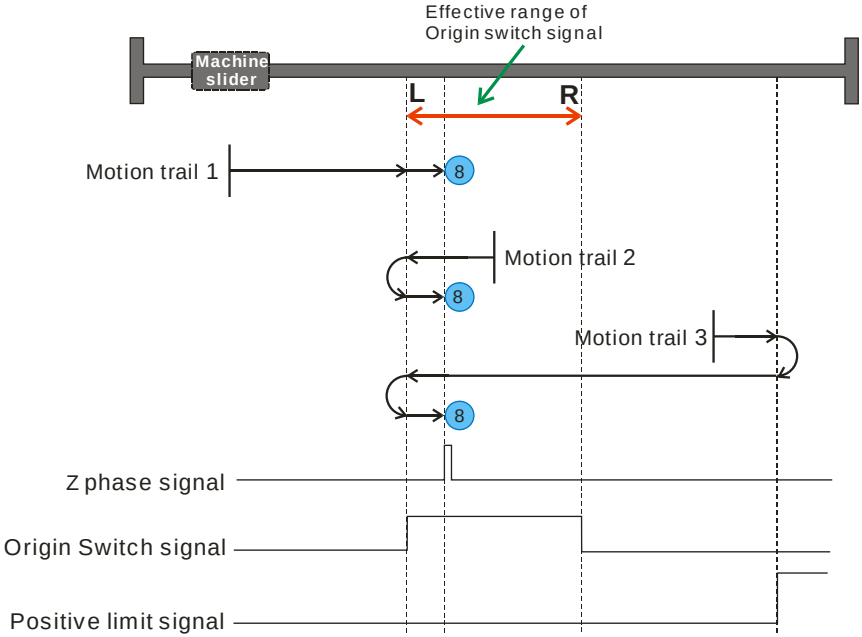


As seen above, machine is moving to the positive limit switch, Z-phase signal is located at left of left edge of the original point signal, which is out of the range of original switch.

When machine is within the range of original switch(Motion trail 2 of machine), it

searches the original point in negative direction; As the machine is out of the range (Motion trail 1 & 3 of the machine), it moves towards the direction of inhibit switch, which can search the original point according to the motion trail of the detected order for Original switch and inhibit switch.

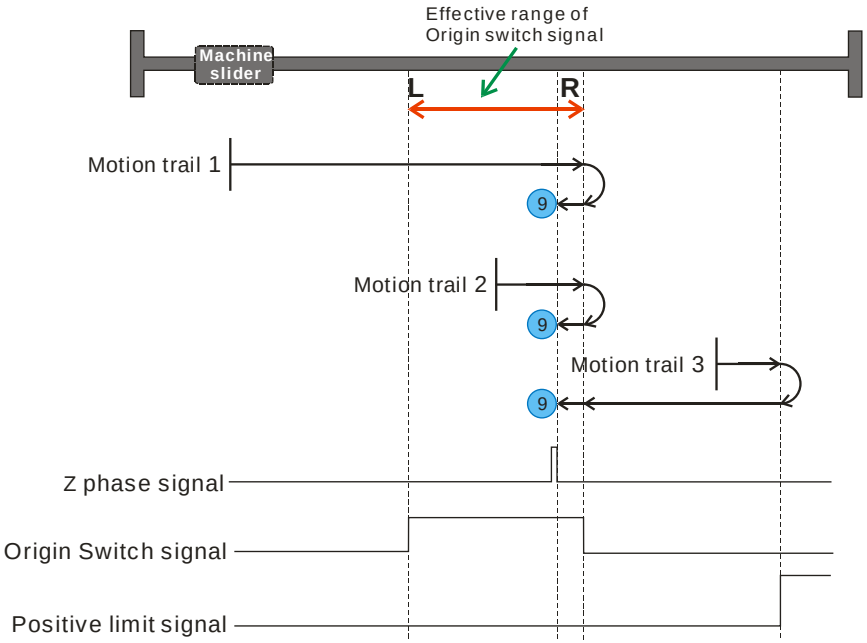
Homing mode 8: Refer to original switch/positive limit switch/Z-phase signal (on the right of the left edge of the original switch)



As seen above, machine is moving to the positive limit switch, Z-phase signal is located at right of left edge of the original point signal, which is within the range of original switch.

When machine is within the range of original switch(Motion trail 2 of machine), it searches the original point in negative direction; As the machine is out of the range (Motion trail 1 & 3 of the machine), it moves towards the direction of inhibit switch, which can search the original point according to the motion trail of the detected order for Original switch and inhibit switch.

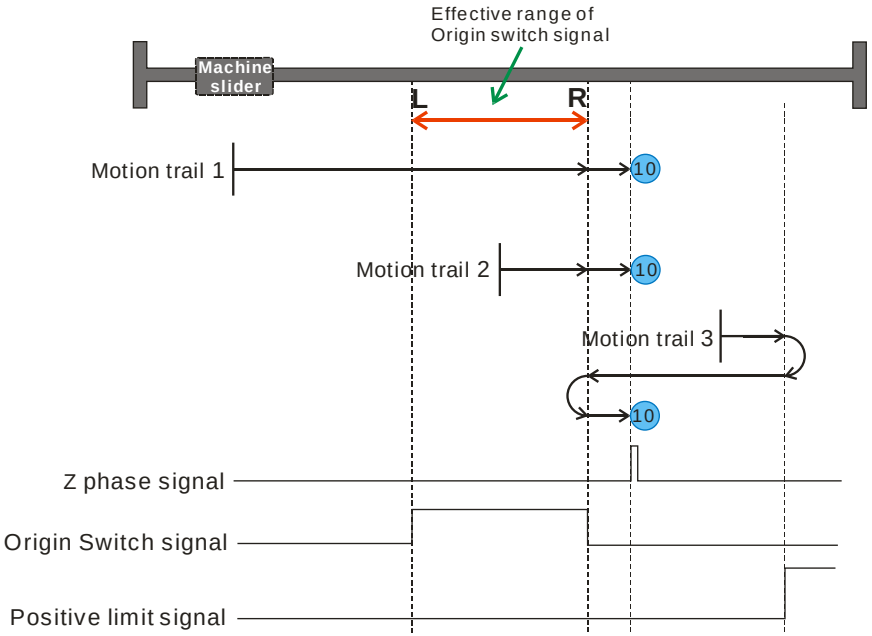
Homing mode 9: Refer to original switch/positive limit switch/Z-phase signal (on the left of the right edge of the original switch)



As seen above, machine is moving to the positive limit switch, Z-phase signal is located at left of right edge of the original point signal, which is within the range of original switch.

When machine is within the range of original switch(Motion trail 2 of machine), it searches the original point in positive direction; As the machine is out of the range (Motion trail 1 & 3 of the machine), it moves towards the direction of inhibit switch, which can search the original point according to the motion trail of the detected order for Original switch and inhibit switch.

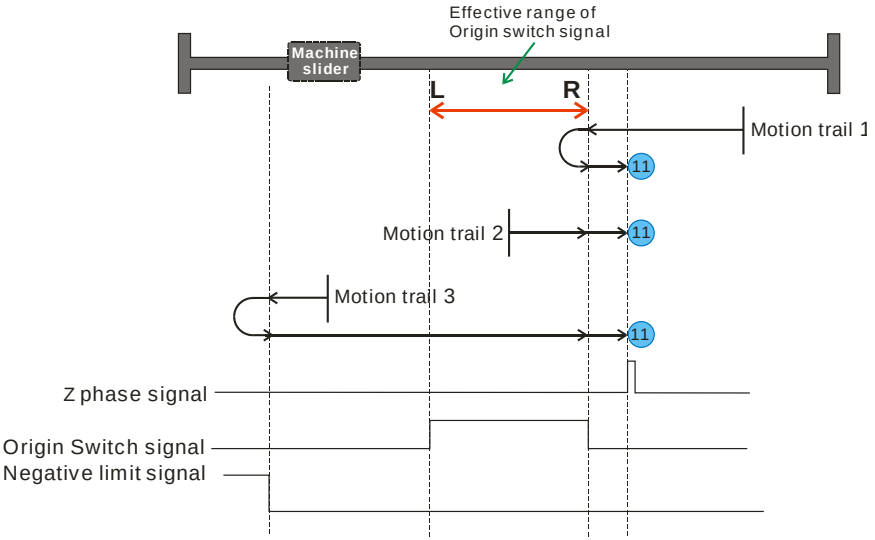
Homing mode 10: Refer to original switch/positive limit switch/Z-phase signal (on the right of the right edge of the original switch)



As seen above, machine is moving to the positive limit switch, Z-phase signal is located at right of right edge of the original point signal, which is out of the range of original switch.

When machine is within the range of original switch(Motion trail 2 of machine), it searches the original point in positive direction; As the machine is out of the range (Motion trail 1 & 3 of the machine), it moves towards the direction of inhibit switch, which can search the original point according to the motion trail of the detected order for Original switch and inhibit switch.

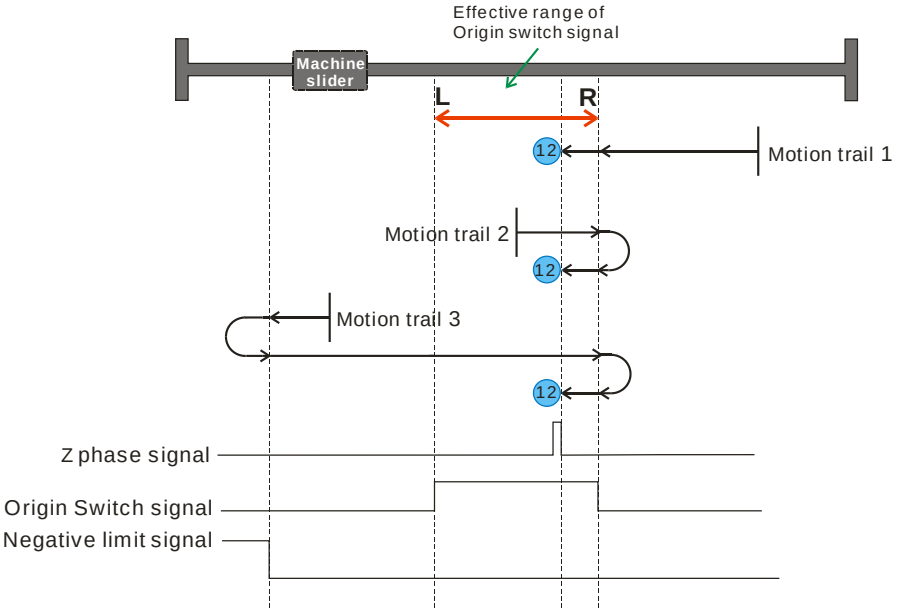
Homing mode 11: Refer to original switch/negative limit switch/Z-phase signal (on the right of the right edge of the original switch)



As seen above, machine is moving to the negative limit switch, Z-phase signal is located at right of right edge of the original point signal, which is out of the range of original switch.

When machine is within the range of original switch(Motion trail 2 of machine), it searches the original point in positive direction; As the machine is out of the range (Motion trail 1 & 3 of the machine), it moves towards the direction of inhibit switch, which can search the original point according to the motion trail of the detected order for Original switch and inhibit switch.

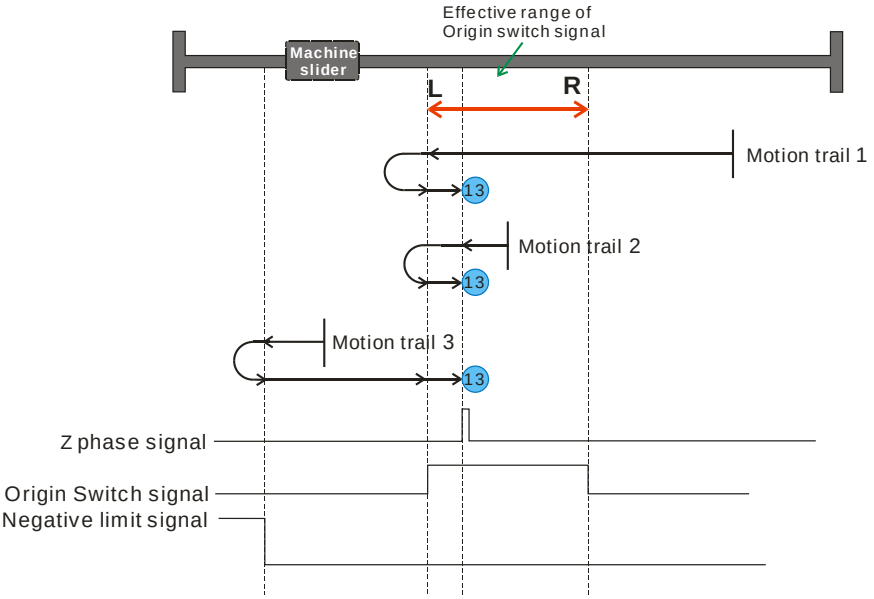
Homing mode 12: Refer to original switch/negative limit switch/Z-phase signal (on the left of the right edge of the original switch)



As seen above, machine is moving to the negative limit switch, Z-phase signal is located at left of right edge of the original point signal, which is within the range of original switch.

When machine is within the range of original switch(Motion trail 2 of machine), it searches the original point in positive direction; As the machine is out of the range (Motion trail 1 & 3 of the machine), it moves towards the direction of inhibit switch, which can search the original point according to the motion trail of the detected order for Original switch and inhibit switch.

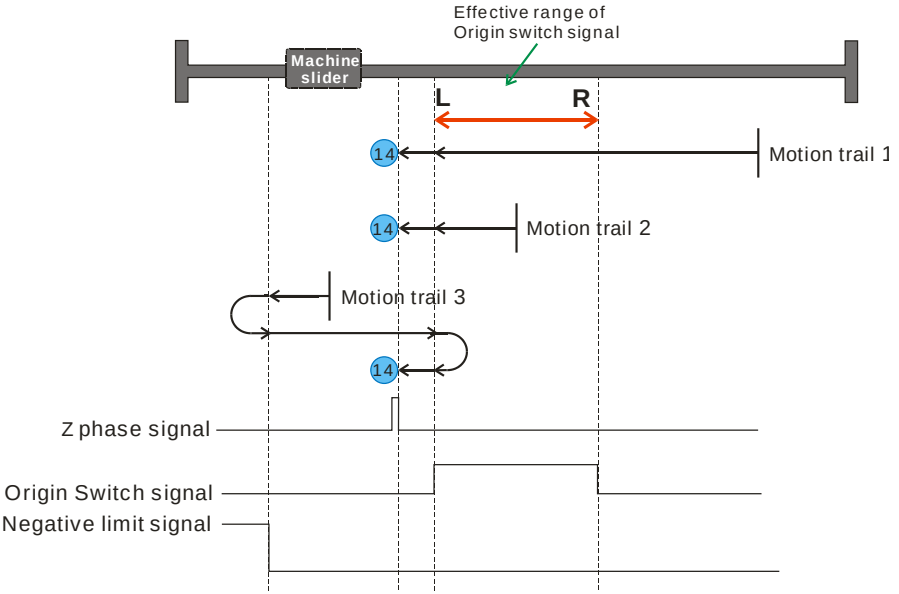
Homing mode 13: Refer to original switch/negative limit switch/Z-phase signal (on the right of the left edge of the original switch)



As seen above, machine is moving to the negative limit switch, Z-phase signal is located at right of left edge of the original point signal, which is within the range of original switch.

When machine is within the range of original switch(Motion trail 2 of machine), it searches the original point in negative direction; As the machine is out of the range (Motion trail 1 & 3 of the machine), it moves towards the direction of inhibit switch, which can search the original point according to the motion trail of the detected order for Original switch and inhibit switch.

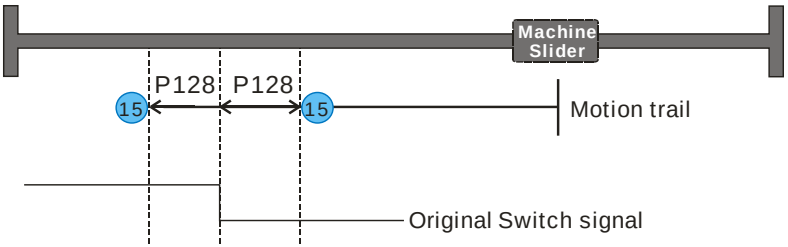
Homing mode 14: Refer to original switch/negative limit switch/Z-phase signal (on the left of the left edge of the original switch)



As seen above, machine is moving to the negative limit switch, Z-phase signal is located at left of left edge of the original point signal, which is out of the range of original switch.

When machine is within the range of original switch(Motion trail 2 of machine), it searches the original point in negative direction; As the machine is out of the range (Motion trail 1 & 3 of the machine), it moves towards the direction of inhibit switch, which can search the original point according to the motion trail of the detected order for Original switch and inhibit switch.

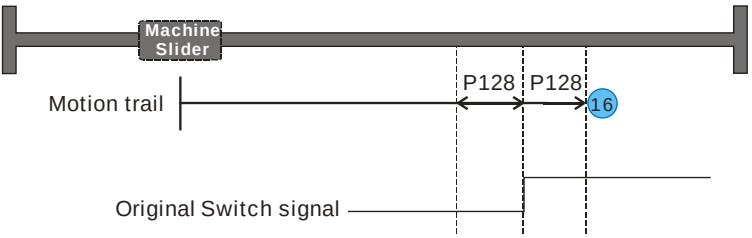
Homing mode 15: Refer to the negative original switch and position increment



When P128 is positive value, the machine slider would finish the given position of P128 in positive direction.
When P128 is negative value, the machine slider would finish the given position of P128 in negative direction.

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 and position increment



When P128 is positive value, the machine slider would finish the given position of P128 in positive direction.
When P128 is negative value, the machine slider would finish the given position of P128 in negative direction.

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.

【Examples】

Two examples below indicate homing function in communication control and external control mode, which led to a better understanding of homing function.

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, we 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 external input logic level

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

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

Step 4: Set homing speed

During homing process, the coming back speed for searching original switch is decided by P101 (7th internal speed), the creep speed for searching Z-phase signal is decided by P102 (8th internal speed).

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

Step 5: Enable servo

P16 = 1 or P282_Bit0 = 1, so that the servo can be enabled.

Remark: Please enable servo before performing homing function.

Step 6: Enable homing command

P281_bit7 is set to 1, so that the homing function can be enabled.

Step 7: Check whether homing function is effective

R203_Bit7 would be set to 1 when homing function is valid.

Step 8: Check whether homing function is completed

R204_Bit10 would be set to 1 when homing is completed.

Step 9: Output homing complete signal

Set P08 or P09 to 6, the homing complete signal would be outputted.

<Remark> Please set homing command to 0 after homing is completed, so that the servo would 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, we use mode 1.

Step 2: Select control command source

Select MagicWorks Tuner menu bar “Option” -> ”Pin function configuration & simu IO”, set P73 to 2 in ”Pin function configuration & simu IO” interface, pin allocation method decided by P75\76\77\78.

Step 3: Configure homing command and homing switch signal

Configure DIN1 to “7 Homing CMD”, configure 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 16 of the communication port X1.

Remark: Please enable servo before performing homing function.

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, so that the homing complete signal can be outputted.

<Remark> After the homing function has completed, you have to set the homing command to 0 that the servo would function properly.

9.2 Communication Multi-Position\Speed\Torque control

【Function Overview】

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

Since servo is controlled by its internal params, no need to install external impulsing or analog output type of upper controller, only cooperate external DI signal with communication functions to achieve flexible multi-control.

【Relevant Parameters】

No.	Name	Description
P01	Control mode setup※	6~11: Communication control mode
P04	Command source selection	4: The command source of communication control mode is selected by INTSPD1~INTSPD4.
P71	Communication position control method	Bit0: 0: Absolute position, 1: Relative position
P73	Control command source selection	Select pin allocation method and control command source.
P75~78	Digital input multiplexing function register 4~1	16#08: Command selection 4 16#0E: Command selection 3 16#0D: Command selection 2 16#0C: Command selection 1 16#06: Start signal of Multi-position/speed/torque command
P97	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
R203	Command Status	Check the executing status of multiple commands

【Example】

Following example illustrates the function of communication multi-position control.

Step 1: Select control mode

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

Step 2: Select Command source

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

Step 3: Multi-position (Absolute position control)

Absolute position control: P71_Bit0 is set 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 functions for external pins

DIN1~DIN5 are configured to 16#0C (Command selection 1), 16#0D (Command selection 2), 16#0E (Command selection 3), 16#08 (Command selection 4), 16#06 (Start signal of multi-position/ speed/ torque command). Refer to “5.2.4 Pin function configuration & simu IO” for details.

Step 6: Enable the servo

P16=1 or P282_Bit0=1, so that the servo would be enabled.

Step 7: Set absolute position for each position

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

Step 8: Select position command source by setting pin value

DIN4~DIN1 (Command selection 4~1) set to 0101, so the given position is P300 (Given

position 5). Please refer to “5.5 Communication command selection under communication control mode (P4=4)” for details.

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

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

Step 10: Repeat step 8 & 9

Repeat step 8& step 9, that is to modify command source, and generate rising edge of start signal to activate multi-position command.

Tips

- This function is disabled under External Position/Speed/Torque control mode.
- Advise to use low bit pins as there are not so much options to occupy the pins. For example, if you need use two pins, please choose command selection 1 and command selection 2.
- P113(Acceleration time setup), P114(Deceleration time setup) and P97(3rd internal speed) are effective under communication multi-position control for each selected position. If need to modify these params in a certain position, you’d better set by communication before the position is triggered.
- The difference between absolute position and relative position is: Absolute position is counting distance from original point(If homing function is not executed, the power-on position defaults to original point), relative position is counting distance from present position. For example, if current position is 10000, the destination position is 25000, the given position is 25000 as used absolute position control; The given position is 15000 and the actual running position would be 15000+10000=25000 as relative position is selected.
- When in multi-position control, the servo would running according to the given position as the next position command is triggered before positioning is completed; If willing to execute the next position after the former is completed, users can use P204(Positioning complete), which would trigger the next position by start signal after the positioning is finished.
- Multi-position/speed/torque command cannot be saved to EEPROM, you have to write before executing multi control for each time.
- Commands are selected by pins under communication speed/torque mode (Communication speed mode: P324~P339, Communication torque mode: P358~P373) while P4=4, only the rising edge of start signal is triggered that the command can be updated.
- The relationship between external DI command selection and the actual given position please

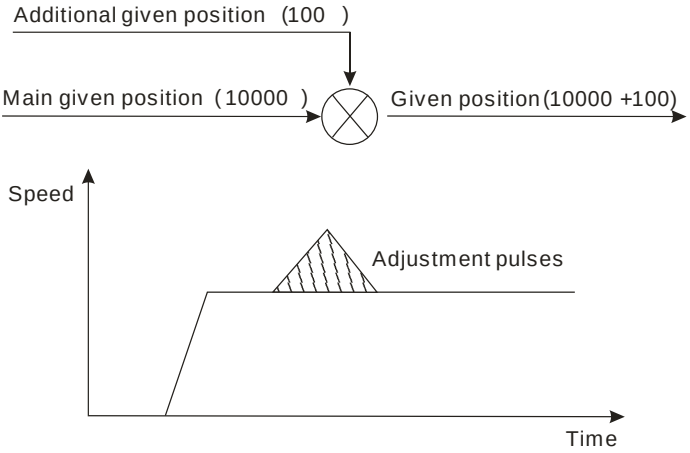
observe chapter “5.5 Communication command selection under communication control mode (P4=4)”.

9.3 Adjustment function of Pulse

【Function Overview】

In external position mode, pulse adjustment function can be achieved by adding pulses on basis of external pulses.

In case of some reasons, such as missing pulses due to interference etc., which would result in misalignment of control, you can adjust the pulses via communication command. Servo operates in external position mode, controller or upper software set given pulses to servo parameters P290~P320 via Modbus/CANopen protocol, the settings take effect immediately. When P04=4, given position 0~15 can be selected via the high-low level of external I/O pins. The adjustments are added on basis of present pulses to achieve the adjustment function during the running process of motor.



【Relevant Parameters】

No.	Name	Description
P01	Control mode setup※	0: External position mode
P04	Command source selection	4: The command source of communication control mode is selected by INTSPD1~INTSPD4.
P73	Control command	2: From external DI signal(Decided by P75/7/77/78)

	source selection	
P75~78	Digital input multiplexing function register 4~1	16#0C: Command selection 1; 16#0D: Command selection 2; 16#0E: Command selection 3; 16#08: Command selection 4;
P290~320	Given Position	P290: Given Position 0 P292: Given Position 1 ..... P320: Given Position 15

【Example】

Step 1: Select control mode

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

Step 2: Select command source

P04 = 4, The command source of communication control mode is selected by INTSPD1 ~ INTSPD4.

Step 3: Select DI allocation method

P73= 2, from external DI signal(Decided by P75/7/77/78).

Step 4: Configure function for external pin

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

Step 5: Set modifications for given position

● P290 (Given position 0) is set to 0;

● P292 (Given position 1) is set to 100;

Step 6: Enable servo

Enable servo by pin 16 of the communication port X1.

Step 7: Add modification

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

● DIN1 is set to 0 (P290 being effect) , no pulses were added.

Tips
• This function no need start signal to trigger; • Command pins have up to 4, that is INTSPD1~INTSPD4; • The modification could not be too large, usually within thousands of pulses.

9.4 Special Speed-Position Control Mode

【Function Overview】

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

【Relevant Parameters】

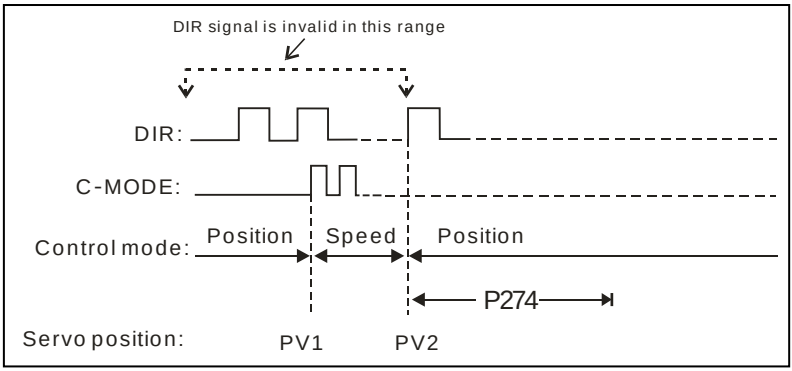
No.	Name	Description
P01	Control mode setup※	13: Special speed position mode
R204	Output State	Check the position complete signal to confirm whether P284 or P286 has been finished. If Bit2=1, positioning has been completed.
R205	Input IO signal state	When Bit14=1, input valid DIR signal
P274	Increment of Given Position	Increment of given position in position mode.
P284	Pulse filter 1	This parameter is a register which is used to set the pulse number as filter1. When the system is switching from position mode to speed mode, the servo starts output pulses, by the time the output pulses reach P284, that the system starts to detect external signal.
P286	Pulse filter2	This parameter is a register which is used to set the pulse number as filter 2. When external signal is firstly detected in speed mode, the servo starts output pulses, by the time the output pulses reach P286, that the system starts to search the external signal for second time; While the external signal is received again, the system switches from speed mode to position mode.
P288	Pulse Alarm	This parameter is a register which is used to set the alarm number of pulse. If external switch signal cannot be detected all the time under speed mode, and the output pulses reach the pulse number of alarm, the servo would be stopped and an alarm would be reported. If the value of this parameter=0, the alarm function would be shut off.

【Explication for parameters' value】

No.	Value of P284/286/288	Description
1	P284=0 & P286=0	In speed control mode, when DIR signal rising edge is detected, it would switch to position mode, and finish the designated position of P274.
2	P284=0 & P286≠0	In speed mode, when the rising edge of DIR signal is detected, P286 would be performed, after pulses number reached P286, servo starts to detect DIR signal, while the first falling edge of DIR signal is detected, servo would switch to position mode, and finish the designated position of P274.
3	P284≠0 & P286=0	In speed mode, P284 is being performed, after the pulses number reached P284, servo starts to detect DIR signal, when the first rising edge of DIR signal is detected, servo would switch to position mode, and finish the designated position of P274.
4	P284≠0 & P286≠0	In speed mode, P284 is being performed, after the pulses number reached P284, servo starts to detect DIR signal, when the first rising edge of DIR signal is detected, servo would execute P286, when the pulses number reached P286, servo starts to detect DIR signal, as the first falling edge of DIR signal is detected, servo switch to position mode, and finish the designated position of P274.
5	P284≠0 & P288≠0	In speed mode, P284 is being performed, after the pulses number reached P284, servo starts to detect DIR signal, if DIR signal cannot be detected all the time, and the output pulses reach P288, the servo would be stopped and an alarm would be reported.
6	P288=0	Alarm function has been shut, the system would not report alarm even though DIR cannot be detected.

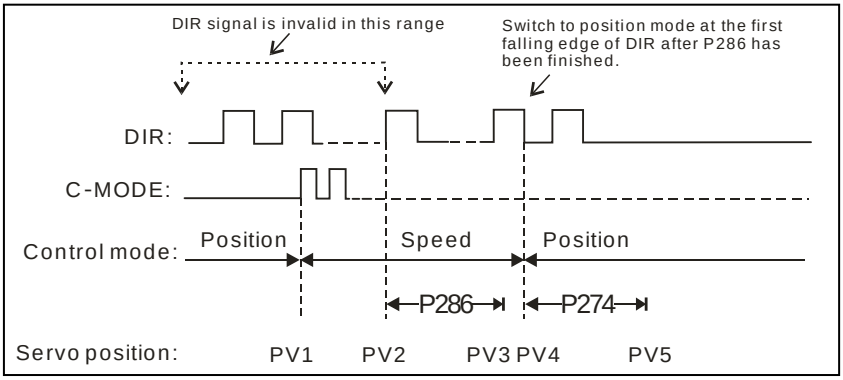
Explication 1 (P284=0 & P286=0)

When C-MODE signal has been detected, servo would switch from position mode to speed mode immediately, as the rising edge of DIR signal is detected in speed mode, servo would switch to position mode and finish the designated position of P274.



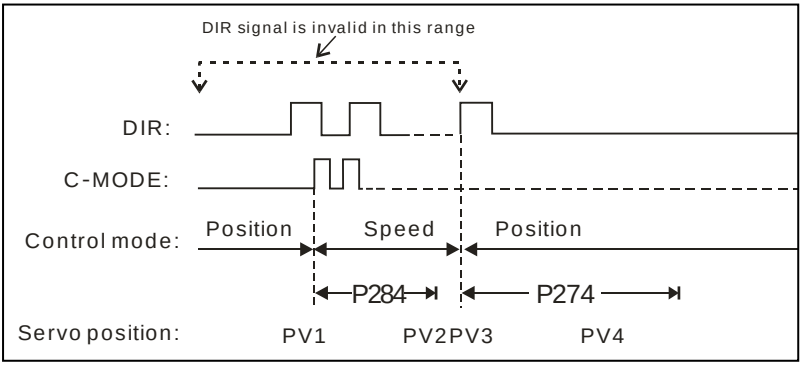
Explication 2 (P284=0 & P286≠0)

When C-MODE signal has been detected, servo would switch from position mode to speed mode immediately, when the rising edge of DIR signal is detected in speed mode, P286 would be performed, after pulses number reached P286, servo starts to detect DIR signal, while the first falling edge of DIR signal is detected, servo would switch to position mode, and finish the designated position of P274.



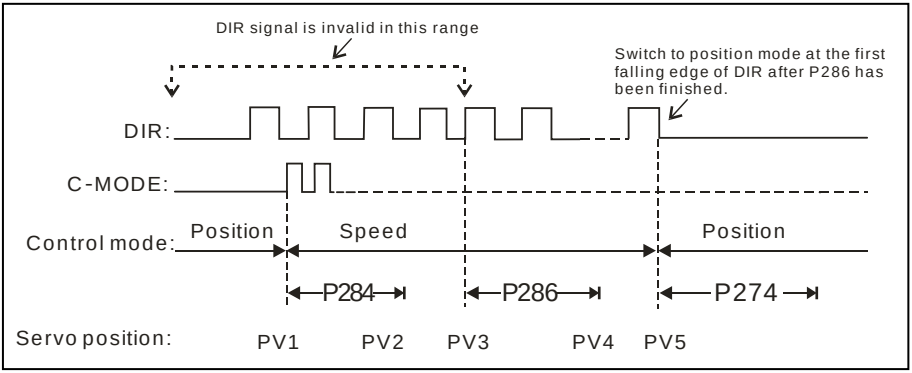
Explication 3 (P284≠0 & P286=0)

Servo switches from position mode to speed mode immediately as C-MODE signal has been detected, then P284 would be performed, after pulses number reached P284, servo starts to detect DIR signal, while the first rising edge of DIR signal is detected, servo would switch to position mode, and finish the designated position of P274.



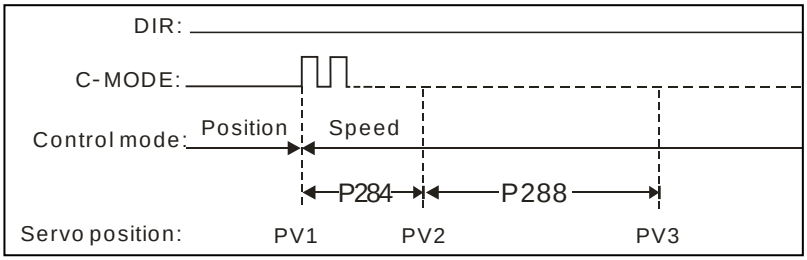
Explication 4 (P284≠0 & P286≠0)

Servo switches from position mode to speed mode immediately when C-MODE signal has been detected, then P284 is being performed, after pulses number reached P284, servo starts to detect DIR signal, while the first rising edge of DIR signal is detected, P286 would be executed, as the pulses number reach P286, servo starts to detect the DIR signal, servo switches to position mode when the first falling edge of DIR signal is being detected, and it would finish the designated position of P274.



Explication 5 (P284≠0 & P288≠0)

When C-MODE signal has been detected, servo would switch from position mode to speed mode immediately, then P284 is being performed, after the pulses number reached P284, servo starts to detect DIR signal, if DIR signal cannot be detected all the time, and the output pulses reach P288, the servo would be stopped and an alarm would be reported.



【Set Terminal】

The trigger signal for special control mode must come from external sensor input, and need faster response as well, so the contact switch sensor signal input is direction input pin of multiplexing pulses rather than normal DI, that is DIR+ (pin 15 of X1)and DIR- (pin 2 of X2), When P01 is set to 13, pin function switches to trigger signal input automatically, and no need configure other multiplexing params. While DIR+/- input is effective (Monitoring by R205_Bit14), servo would generate interrupt signal and action according to the setting trail.

【Example】

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

Step 1: Select control mode

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

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

Servo switch to speed mode while C-MODE is detected, and marked the present position as PV1, when the new position PV2 reach the pulses requirement (|PV2 - PV1| ≥ P284), it starts to detect external switch signal.

<Remark>

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

Step 3: Detect DIR signal (External switch signal)

The position would marked as PV3 when the rising edge of DIR signal has been detected, then servo continue to detect DIR signal, the position would marked as PV4 when the first falling edge of DIR signal has been detected. If |PV4 - PV3| ≥ P286, servo would

switch to position mode, and the position would marked as PV5, finally servo finish the designated position of P274.

<Note> Check DIR signal via R205_Bit14.

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

System would switch to speed mode when the rising edge of C-MODE signal has been detected.

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

1) If servo switches to fixed position control mode, P285 Bit0 is set to 1, the servo would reset this Bit automatically, and changes to communication speed control, keep on running according to the given speed command.

2) If servo switches to fixed position control mode, P285 Bit0 is not set to 1, there is an external trigger signal again after positioning is completed, the servo would keep on operating at fixed position control, and running in accordance with P274(Increment of Given Position).

3) The rising edge of external trigger signal is effective, in case there is a rising edge again before the positioning is completed under fixed position control mode, the servo would moves according to P274(Increment of Given Position) from the latest received position.

4) When P285 Bit1 is set to 0, it would not enter in fixed position control mode even if external trigger signal is valid.

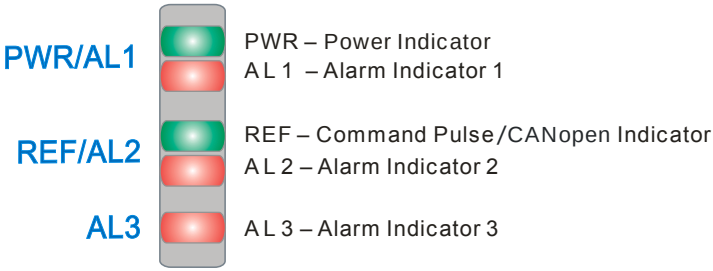
5) P274(Increment of Given Position) is out of the calculation of electronic ratio, the electronic ratio is 1:1 at special speed-position mode, that the pulses per single turn is fixed to 10000.

6) The acceleration/deceleration time and speed limit params would be effective after entered fixed position mode.

10 Protective Function

Description of Alarms and faults

Normally, alarm indicator stays off, power indicator and command pulse indicator are in the right status. If abnormal situation occurs, power indicator and command pulse indicator would turn off, the alarm indicator would lit according to the alarm type.



By viewing parameter R202 (Error type) and combine with the following table, you can quickly recognize alarm reason, so as to solve the faults in time.

Alarm No.	ALM1、2、3	Alarm Type	Failure Description	Solutions
0	000	Proper Functioning		
1	001	Under-voltage	It is activated while the major loop voltage is lower than the specified value (200V after rectification).	· Check the connections of power lines; · Measure the voltage between L1 and L2 is within the range; · Check the power supply is sufficient.
2	001	Over-voltage	It is activated while the major loop voltage is higher than the specified value(395V after rectification).	· Measure the voltage between L1 and L2 to eliminate capacitive load; · If this alarm occurs while using internal resistance, please select proper external resistance; · If this alarm occurs while using external resistance, please replace it with a larger one.

Alarm No.	ALM1、2、3	Alarm Type	Failure Description	Solutions
3	010	※Over-current	It is activated while the major loop current exceeds 1.5 times of instantaneous max. current of the motor.	· Poor connections between the motor cables; · The U. V and W terminals may short circuit with the ground; · The U、V、W terminals may short circuit with each other; · The motor is not applicable to the servo driver. · Motor may have burnt out, check the resistance value between U、V、W, if it's unequal that means the motor has burnt out.
4	010	※Over-heat	It is activated while the IPM module over-heat(80°C).	· Try to reduce the ambient temperature, and increase the cooling equipment; · lighten load; · Install the servo driver in ventilated place.
6	110	※Encoder feedback error	Failure of Encoder signal feedback.	· Check the disconnections between encoder feedback signal wires; · Check the possible misconnections with encoder extension lines.
7	111	※Excessive brake ratio	The regenerative energy is larger than the capacity of discharge resistance.	· Motor is at power generating situation and busbar voltage continues to rise, the brake ratio output exceeds 10%,please replace it with a larger capacity external resistance, or servo doesn't provide protection to external resistance while P132=2 (Be sure to keep sufficient external resistance capacity so as not to burn out).

Alarm No.	ALM1、2、3	Alarm Type	Failure Description	Solutions
8	010	Over-load	It is activated while the driver over-loading exceeds specified time.	· Actual torque has exceeded the P138(Overload level) value of driver and kept running for a long time. · Vibrations or abnormal noises due to incorrect gains. · Motor kept overloading for a long time; · The motor is locked or stuck; · Please replace a higher power of servo driver while overload occurs.
9	100	Excessive position deviation	It is activated while position control errors are higher than the specified value.	· Setup value of P136 (Excess position deviation) is too small. · Setup value of Torque limitation is too low. · The motor cannot rotate or reach the given position due to heavy load, in such case you should enlarge the torque limit values or increase gains.
10	111	Overtravel inhibit alarm	Connection of both CW and CCW over-travel inhibit switch to COM- have been opened, while P03 (Over-travel inhibit input invalid setup) set to 0. Or either one of the connection of CW or CCW overtravel inhibit switch to COM- has been opened, while P03 is set to 2.	· Overtravel inhibit alarm becomes effective once servo power-ON. · Check the switch of Overtravel inhibit ; · If the alarm occurs once power-ON, please check whether the servo has been disconnected with COM- before power-ON.

Alarm No.	ALM1、2、3	Alarm Type	Failure Description	Solutions
11	011	Over-speed	It is activated while the actual velocity of motor exceeds the specified limit.	· The given speed is too high; · Improper gains will result in instantly over-speed.
12	111	Excessive Analog input	The input analog is greater than excessive level of analog command.	· The setup value of P137 (Analog command excess) is too small; · Input analog oversize, adjusting speed or torque gain, inputting lower analog can also realize larger torque or speed; · The alarm can be canceled by setting P137 to 0.
13	110	※EEPROM Read-write error	Abnormal operation occurs while EEPROM perform accessing.	· Read EEPROM error data at the moment the control power-ON, please try to restore the factory default parameters, if the invalid operations happened for several times, advise to replace with another driver .
14	101	Abnormal communication	It is activated when abnormal communication of RS-485 occurs.	· Incorrect setting value of P12 (Communication time-out); · The communication condition suffers great interference; · Or communication converter goes wrong.
15	101	Abnormal communication of CANopen	It is activated when abnormal CANopen communication occurs.	· Communication environment is subjected to great interference. · Long jam of CANopen communication; · The communication cable for CANopen has been disconnected; · CANopen master exists abnormalities.

Alarm No.	ALM1、2、3	Alarm Type	Failure Description	Solutions
16	111	Configuration error of external input pins	Multi-pins were configured to the same signal	· Please check the settings of P75、P76、P77、P78 (Whether two or more pins were allocated to the same function).
17	111	Internal error 1	It is activated when internal communication error occurs.	· Try to clear the alarm reboot or restore the factory default setting if this error occurs. · Replace the servo with a new one if such alarm occurs for several times.

<Notes>

1) Alarm codes marked with ※ cannot be cleared with A-CLR (Alarm Clear Input) or communication control word. They should be cleared by turning the power off, removing the causes, and then turning on the power again.

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

3) After the alarm is triggered, the servo driver will record the recently ten alarm histories, and driver will automatically store the alarm records into EEPROM.

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

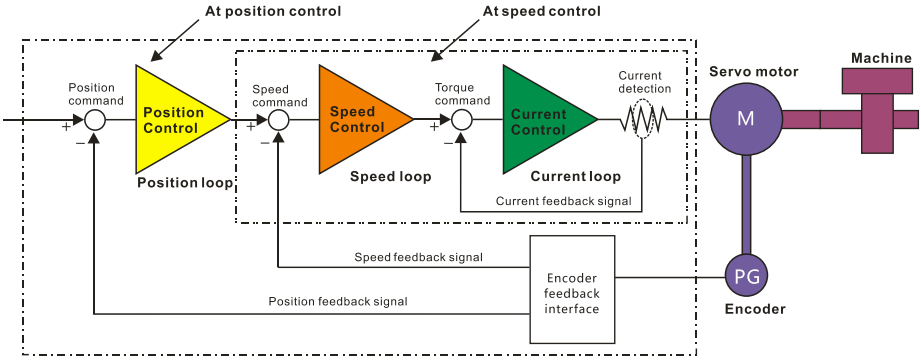
11 Gain Adjustment

Adjustment of performance gain parameters

You can conduct a gain adjustment for servo during system debugging procedure so that you can run the motor as closely as possible to the commands and obtain the optimum performance of the machine. When servo comes with the factory, the gain parameters have already set to stable values. In order to enhance the performance of the system, users can adjust the gain parameters according to the requirements of field system.

The servo gain parameters affect the value of each other, be sure to keep motor running at high-performance status, recommending professional engineers to adjust the gain parameters.

11.1 System Control Block Diagram of E10 Series Servo Driver



11.2 Setup the Related Gain Parameters of Servo

1、The gain of current loop (P18)

Higher the gain of current loop you set, higher gain and better response you can obtain. Note that as the inner current loop must ensure high response so that you can obtain better servo performance.

2、The integration time of current loop (P19)

Lower the integration time of current loop you set, faster integration speed you can obtain. Current loop requires high responsiveness, the current loop integration time should set as small value as possible under the conditions that without 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. The speed loop should set as higher value as possible under the conditions that without oscillation. In General, the greater load inertia you set, the higher speed gain you should set.

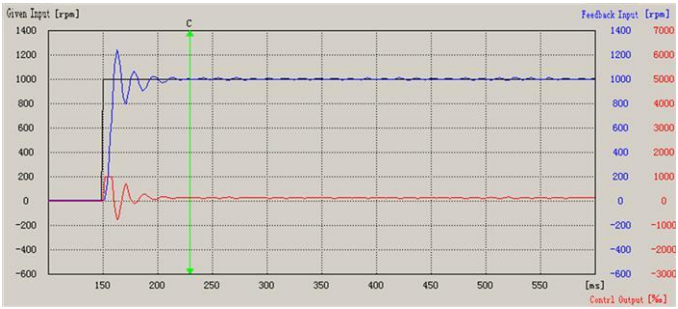


Figure 9.1 The speed loop curve at high gain of speed loop

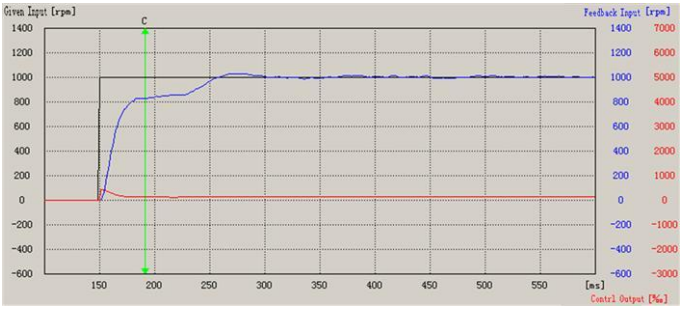


Figure 9.2 The speed loop curve at low gain of speed loop

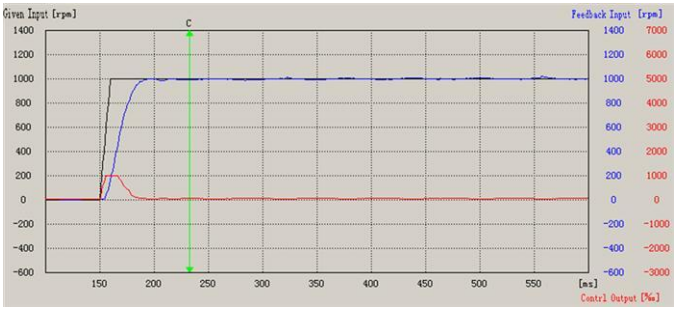


Figure 9.3 The speed loop curve of proper speed loop gain

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

4、Speed loop integration(P22、P29)

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

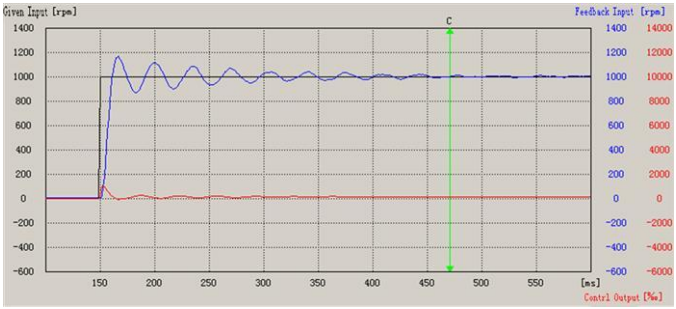


Figure 9.4 The speed loop curve at low speed loop integration

5、The gain of position loop(P20、P27)

Higher the gain of position loop you set, higher gain and better rigidity you can obtain. With the same frequency command pulse, the better trackability of position command, the higher response speed, the shorter positioning time, and the hysteresis error might be small, but while the positioning is completed, it's easy to cause oscillation.

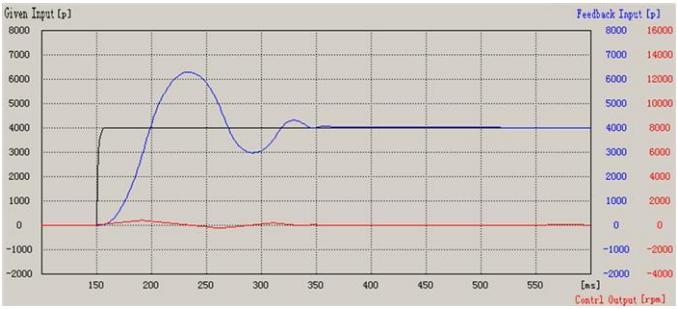


Figure 9.5 The position loop curve at high gain of position loop

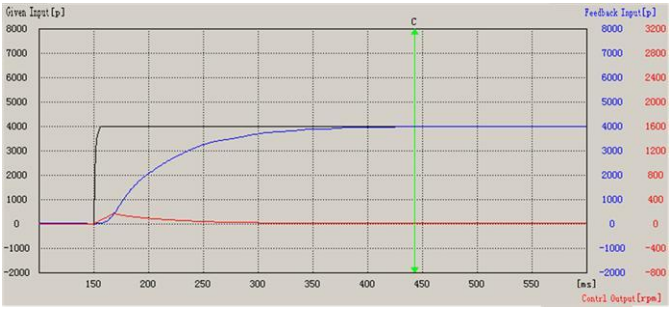


Figure 9.6 The position loop curve at low gain of position loop

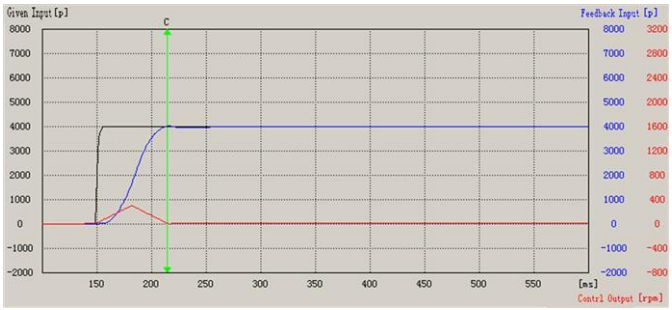


Figure 9.7 The position loop curve of proper position loop gain

The above three schematics reflect that higher position loop gain will result in vibration and overshoot, lower gains will 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、P30)

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

7、The time constant of torque filter(P24、P31)

Some conditions under the application occasion may appear torque covibration and meanwhile vibration noise might be produced. After increasing the torque command, the time constant of primary delay filter will restrain such vibration.

8、Speed feedforward(P25)

Speed feedforward is used for feedforward compensation which shorten the response time in position control mode. Higher the setup, smaller positional deviation and better response you can obtain, however this might cause an vibration and unstable system position, over-speed alarm of servo may also occur.

9、Speed feedforward filtering time constant(P26)

Setup higher speed feedforward value may result in big noise, you can restrain the noise by setting higher primary delay filter time constant of speed feedforward.

10、Inertia ratio(P32)

It is used to 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 over-size inertia ratio might cause oscillation. When growing the load inertia, if mechanical system contains the factors of oscillation, this might result in mechanical oscillation if speed integration time does not increase up to a certain extent.

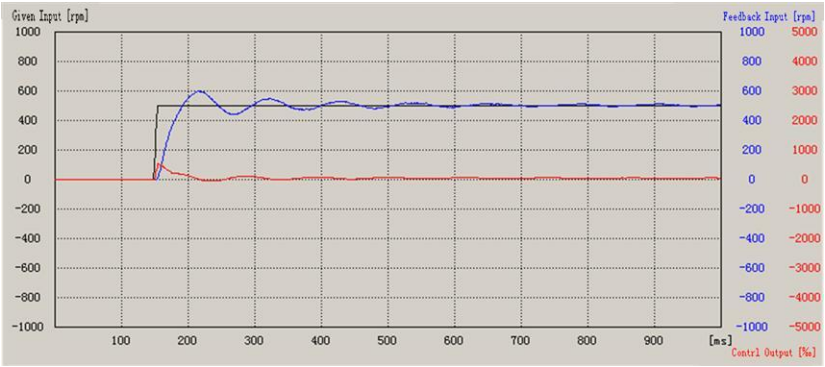
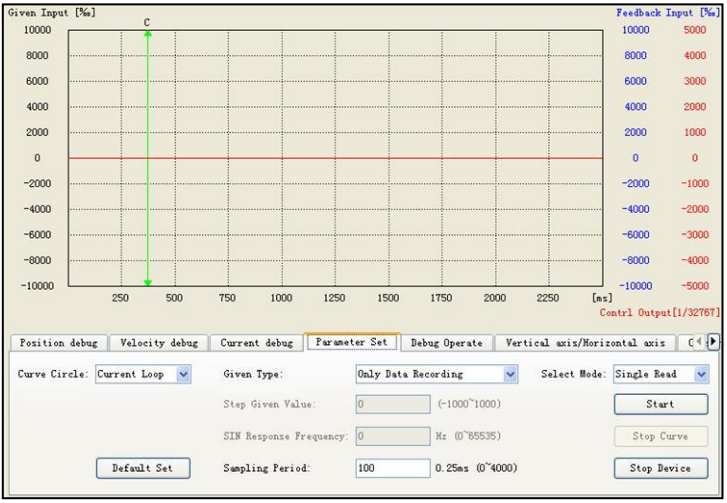


Figure 9.8 The speed loop curve of insufficient integration time of increasing the inertia ratio

11.3 The Curve Graphic of Servo Upper Computer MagicWorks Tuner

The curve graphic is used for users adjusting servo performance, which will be more intuitional to check the sampling curve of current loop, speed loop or position loop. The curve graphic includes the Given input, Feedback input, Control output three curves of current loop (or speed loop or position loop), every curve sample 1000 points according

to the Sampling Period, and then draw a curve in accordance with the 1000 sampling points. The interface show as following:



We can check the Current loop (or Speed Loop, or Position Loop) by clicking the pull-down box of "Curve Circle", and might also single Read or Cycle Monitor by selecting the pull-down box of "Select Mode". Clicking "Start" button to start the motor, then begin to sample data and draw the curve. Clicking "Stop Curve" button to stop the record of curve but not stall the motor, you might stop the motor by clicking "Stop Device" button.

The given command of the three loops:

The given unit of current loop step is ‰, the revolving speed is restricted by the 4th internal speed limitation, the output is position command (Unit: pulse).

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

The given unit of position loop step is the number of pulses, the output is speed command (Unit: rpm). The given value is the pulse number without gear ratio, if gear ratio is 1:1, the given value of step is 4000, and the motor will position a round after

launching the motor. Due to the given value is controlled without deceleration time, if gear ratio or given pulses becomes too much which might lead to large instant position deviation, this would also cause an over-speed alarm of servo.

11.4 The Principles and Methods of Parameter Adjustment

The adjustment of servo gain parameter should obey a control principle, the inner loop the more necessary to improve the responsiveness. If fails to conform to the principle, bad responsiveness or vibration will be generated. Current loop is the innermost loop, due to the factory defaults have ensured its sufficient responsiveness, please make a lock protection for servo current loop which only need you to adjust the parameters of position loop and speed loop.

The adjustment parameters of servo are restrained by each other.

For example, if you want to enhance the responsiveness for position loop, and you only increase the gain for position loop, the output speed command of position loop might be unstable, potentially leading to unstable performance of servo system.

As you only improved the response for position loop, this would cause the position loop response to be more than the speed loop response. The acceleration and deceleration control which are supposed to operate by the output speed command of position loop, but this would unable to keep pace with the action due to bad response of speed loop, and then positional deviation are accumulated to increase, servo might also add the speed command, the result is the revolving speed of servo motor will be too fast, the position loop would begin to decrease speed commands, repetitive execution of the process would appear vibration due to motor failure to adaptation. At last, in order to ensure the speed loop response to be more than the position loop response, increasing the gain of position loop, the speed loop gain would be improved accordingly.

<Notes>

① Before performing the gain adjustment, please be sure to know its application scope and matters needing attention, also need to ensure the change of load position would not appear dangers while adjusting the gain.

② Be sure to take safety precautions, such as setup P136(excess position deviation), P139(Over-speed level) etc.

Please refer to the following steps for adjusting the gain parameters of servo, you might also use the curve function of MagicWorks Tuner software to assist the adjustment:

1)Set the position loop gain to a lower value, and gradually increase the gain of speed loop to the max. value under the precondition which no abnormal noise and vibration generated.

2)Reducing the speed loop gain by gradually fine-tuning, and meanwhile increasing the position loop gain. Please set the position loop gain to the max. value under the preconditions that no overshoot and vibration caused by the whole operation.

3)The integration time constant of speed loop depends on the length of positioning time, please shorten the value under nonvibrating condition of mechanical system.

4)Find the optimal value by fine-tuning the position loop gain, speed loop gain and integration time constant.

11.5 Gain Switching

The servo contains two different sets of gain parameters. At gain switching, you can switch between the two sets of gain parameters by setting servo internal parameter or gain switching external signal (Communication Control P281_Bit9), this default to 1st gain.

You can switch to lower gain by gain switching operation so as to restrain vibration or noise while motor stalls;

Or you can switch to higher gain to increase the stiffness of servo at motor stops;

Or you can obtain better position tracking performance by switching to a higher gain at motor operates;

Or reach the best performance by switching different gains settings according to different loading mechanical devices under field situation.

The related delay time parameter of gain switching:

P62	Control switching delay time	Setup the delay time of switching from 1st to 2nd gain (or from 2nd to 1st). Unit:250us
P65	Position loop gain switching time	For gain switching, if the switching of two different position loop changes great, we might use the parameter to set switching

		delay time for position loop gain, so as to restrain the rapid shock during switching. Unit:250us

The related parameters of gain switching see as follows:

When P61=0, fixed to 1st Gain

P20 1st Position loop gain
P21 1st speed loop gain
P22 1st Speed loop integral time constant
P23 1st Speed detection filter
P24 1st torque filter time constant

P61=2
Select 1st gain while gain switching is invalid
Select 2nd gain while gain switching is valid

When P61=1, fixed to 2th Gain

P27 2nd position loop gain
P28 2nd speed loop gain
P29 2nd speed loop integration time constant
P30 2nd Speed detection filter
P31 2nd torque filter time constant

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