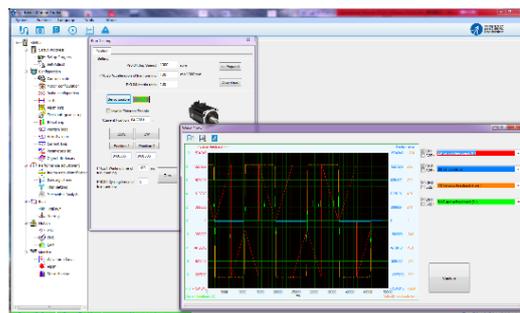




ELP Series AC Servo

Quick Start Guide

Only for ELP-D*** and ELP-RS*** V1.0.0





This guide is only for ELP-D*** and ELP-RS*** version, ELP-EC*** with EtherCAT communication isn't included in this guide, refer to [User Manual of ELP-EC***](#) for more details .

Main steps to tune ELP servo :

- [Step 1 : Unpacking check](#)
- [Step 2 : Wiring](#)
- [Step 3 : Run test](#)
- [Step 4 : Basic setting](#)
 - 1) [Select the right control working mode](#)
 - 2) [Select the right running mode](#)
 - 3) [Tune inertia ratio with load.](#)
 - 4) [Make servo on signal ready](#)
 - 5) [Tune the stiffness.](#)
 - 6) [Set the polarity and electronic ratio](#)
 - 7) [Tune command filter if needed.](#)
- [Step 5 : Save the value of parameters by panel](#)
- [Step 6 : Trouble shooting](#)

Step 1 : Unpacking check

A complete and workable AC servo system should include the following parts:

- 1) Matched Servo drive and Servo motor
- 2) A power cable, connect servo drive to servo motor
- 3) A feedback encoder cable , connect servo drive to servo motor
- 4) A power cable for brake **if needed**, connect the 24Vdc power to motor with brake
- 5) A tuning USB cable : Cable-USB1M5 , connect the Port CN3 to PC for communication.
- 6) 44-PIN connector (For I/O connections, Port CN2)

Step 2 : Wiring

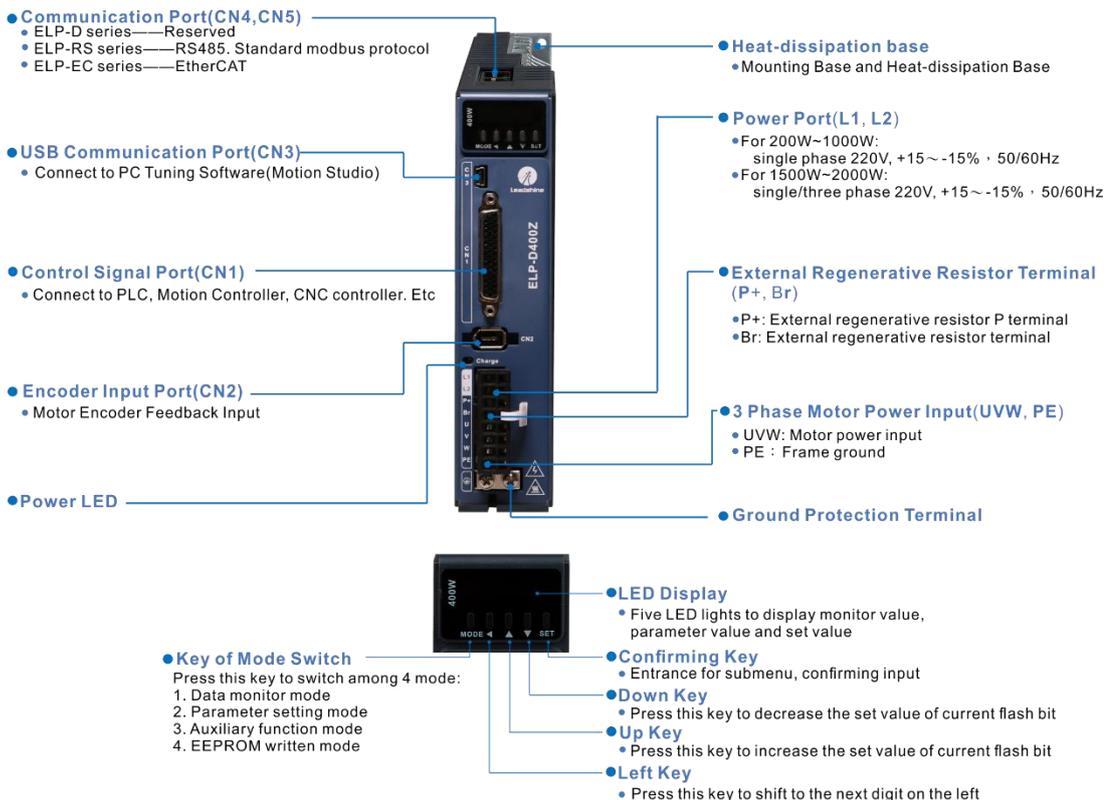


All ELP servo drives all only available with 220VAC , 380VAC is forbidden

220vac 1 phase : only for ELP-*400Z/-*750Z/-*1000Z

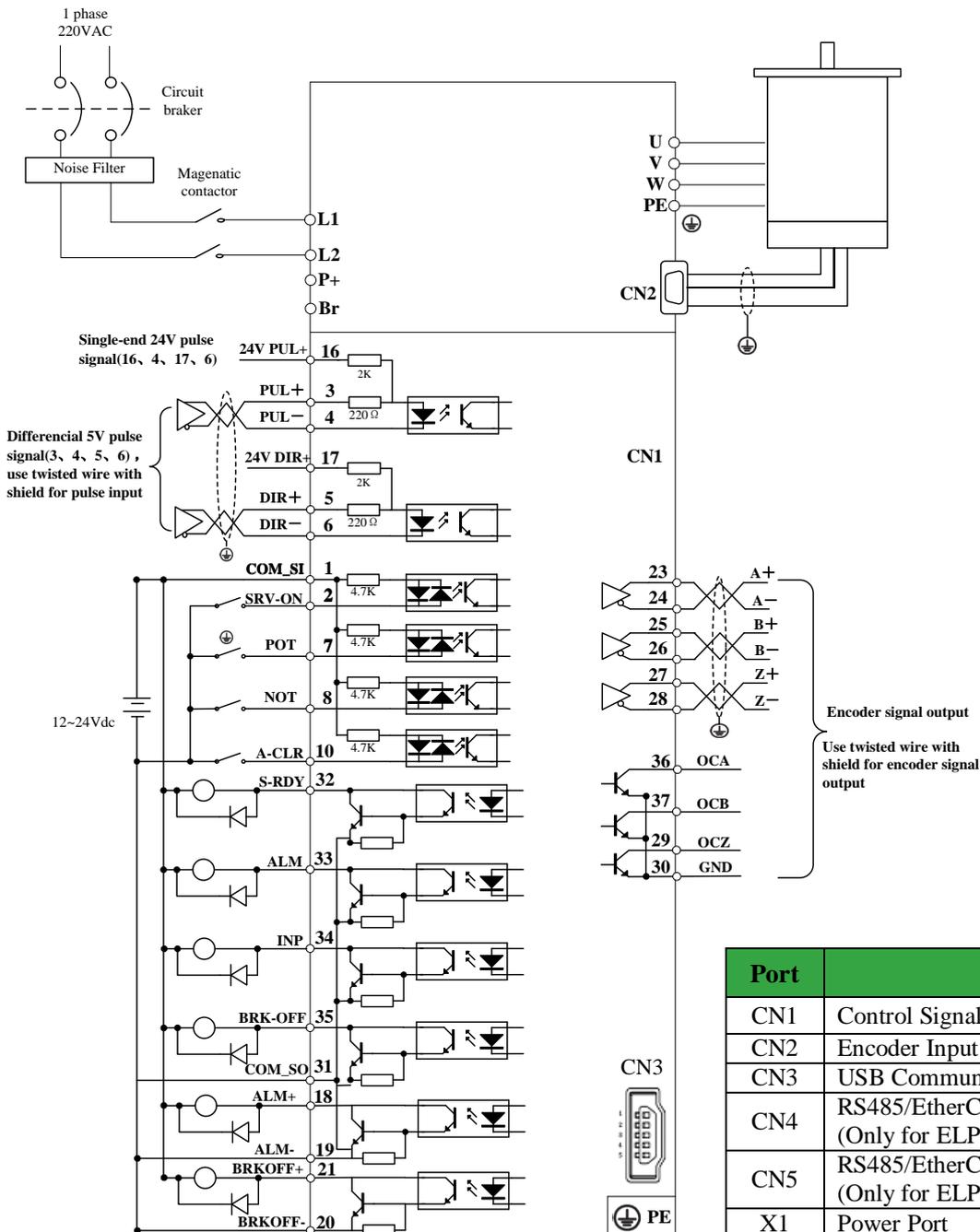
220vac 3 phases : only for ELP-*1500Z/-*2000Z

ELP-D Series ELP-RS Series ELP-EC Series



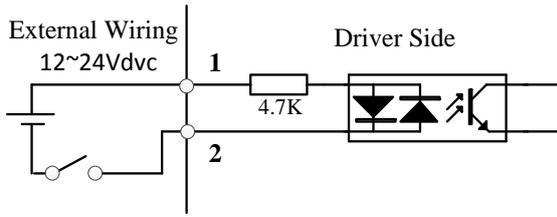
Port	Pin	Signal	Detail
X1	L1	For 1 phase 220V	For 1 phase 220V , +15 ~ -15% , 50/60Hz
	L2	For 1 phase 220V	
Notes	✧ Isolation transformer can be used for power supply; ✧ Do not connect 380VAC power supply to ELP drive , otherwise drive will be damaged seriously; ✧ In case of serious interference, it is recommended to use noise filter for power supply;		
Port	Pin	Signal	Detail
X1	P +	DC bus + terminal	✧ Driver DC bus + terminal ✧ External regenerative resistor P terminal
	Br	External regenerative resistor terminal	External regenerative resistor terminal
Port	Pin	Signal	Detail
X1	U	U	3 phases motor power input
	V	V	
	W	W	
	PE	PE	Frame ground
Notes	Connect the drive to the ground end (PE) of the motor and connect it to the earth		

Typical wiring of ELP-D***Z



Port	Function
CN1	Control Signal Port
CN2	Encoder Input Port
CN3	USB Communication Port
CN4	RS485/EtherCAT Communication Port (Only for ELP-RS /ELP-EC series)
CN5	RS485/EtherCAT Communication Port (Only for ELP-RS /ELP-EC series)
X1	Power Port

1) Switch Input Interface



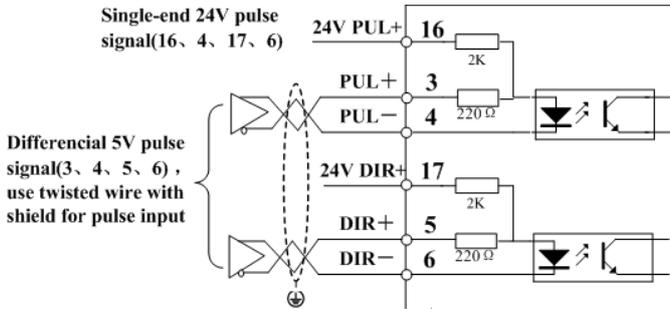
Notice: COM_SI is used for input signal, while COM_SO is used for output signal .

If the driver is enabled with internal signal, no need to connect Pin1 & Pin2 .

Pr4.00=83 for internal enable.

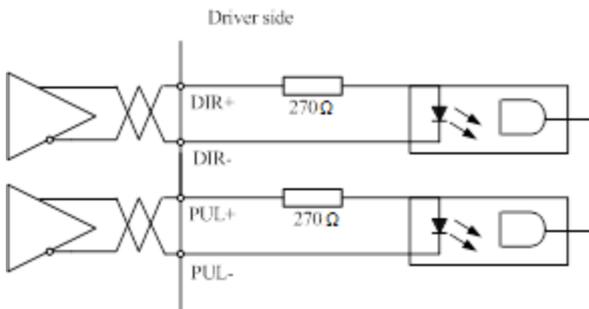
Pr4.00=3 for external enable.

2) Pulse Input Interface

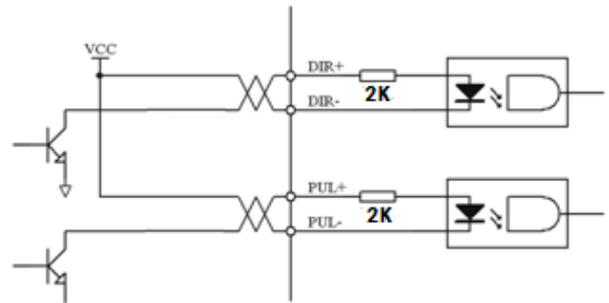


If the voltage of pulse signal is 5V, please connect Pin3. Pin4. Pin5. Pin6.

If the voltage of signal is 24V, please connect Pin16. Pin4. Pin17. Pin6.



Differential 5V Pulse Signal
(Pin3、 Pin4、 Pin5、 Pin6 of CN1 Port)

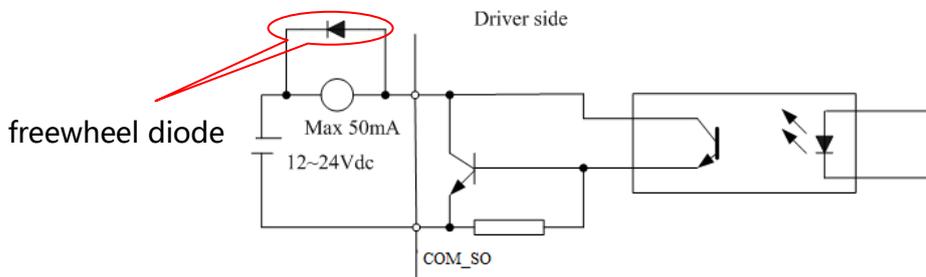


Single-end 24V Pulse Signal
(Pin16、 Pin4、 Pin117、 Pin6 of CN1 Port)

3) Switch Output Interface

Using reversed freewheel diode for digital output port **(only for motor with brake)**

The relay is widely used for logic control. Usually it is connected directly to IO port of driver if the motor is with brake. Connect a freewheel diode in anti-parallel to avoid interference of high voltage which comes from the moment of power on or power off.



Notice: Don't connect the diode in wrong polarity, otherwise driver will be damaged.

Step 3 : Run Test

Use “run testing” function to run the motor for basic setting . Make sure the shaft of motor is free before running , and also release the brake firstly if motor is with brake.

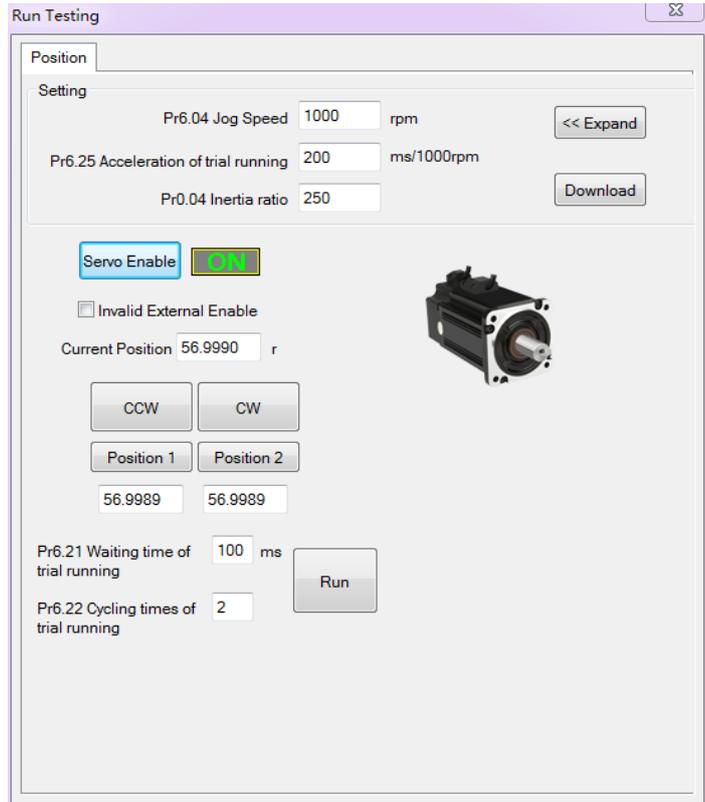
1 . Set parameters for run testing:

Pay attention to Pr0.03 (Stiffness) and Pr0.04 (Inertia ratio) which are strongly for better performance

2 . Run testing guidance

- Click “Servo enable”.
- Click “CCW” to make motor run
- Click ”Position 1” to save the testing position limit 1.
- Click “CW” to make motor run in CW direction, click ”Position 2” to save the testing position limit 2.
- Click ”Run” to start Testing progress.

3 . During the Run Testing progress , the interface of “wave show” can be used to check the real-time performance.



Step 4 : Basic setting

1) Control mode setting (Pr0.01)

Pr0.01*	Control Mode Setup	Range	unit	default	Related control mode		
		0 -10	-	0	P	S	T
Set using control mode							
Setup value	Content		When you set up the combination mode of 3.4.5, you can select either the 1st or the 2nd with control mode switching input(C-MODE). When C-MODE is open, the 1st mode will be selected. When C-MODE is shorted, the 2nd mode will be selected.				
	1st mode	2nd mode					
0	Position	-					
1	Velocity	-					
2	Torque	-					
6	Pr-Mode						

2) Mode of real-time auto-gain tuning setting (Pr0.02)

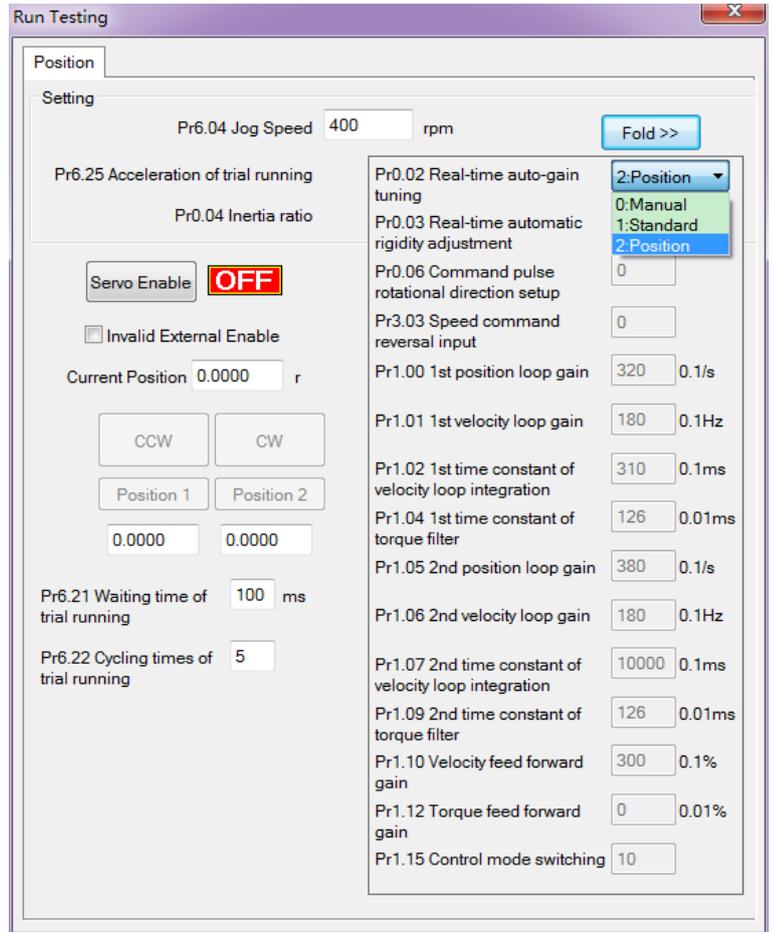
This helps to set the servo working in right running mode .

For **Manual** mode(Pr0.02=0), Kp, Ki and other parameters can be set manually. Pr003 is unavailable now .

About how to tune position loop, Ki can be adjusted to a very small value in advance and hold it constantly, then enlarge the value of Kp parameter slowly until system oscillation occurs, then enlarge the value of Vi parameter slowly until system oscillation occurs.

For **Standard** mode(Pr0.02=1), it is usually for interpolation movement. It is unavailable to modify the value of Pr1.00-1.14, just need to change the value of Pr0.03, then all values of Pr1.00-1.14 will be changed accordingly.

For **Positioning** mode(Pr0.02=2), it is usually for point to point movement. It is unavailable to modify the value of Pr1.00-1.14, just change the value of Pr0.03, then all values of Pr1.00-1.14 will be changed



3) Performance adjustment—Tuning the inertia ratio(Pr0.04)

- It is important to find the ratio of inertia for one axis, in order to get best performance before setting other parameters (for example, setting PID of position loop or velocity loop).
- Connect motor with load before testing one axis.
- Make sure the axis can be moved in safe distance, any interference should be avoided to ensure safety

Inertia ratio identification

Pre-conditions:

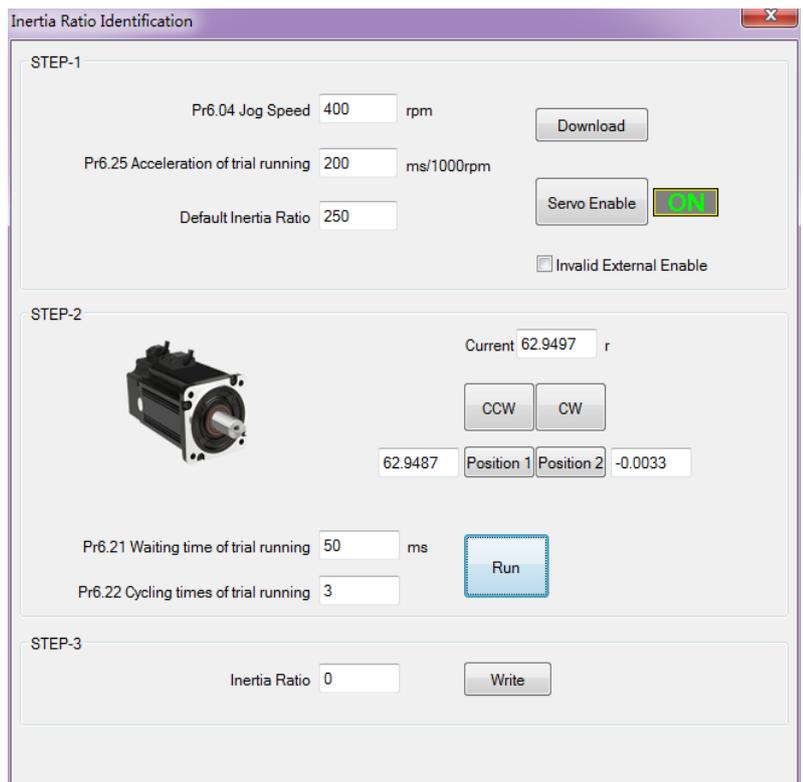
1. Servo disable.
2. Positive limit and negative limit invalid

Steps:

- 1) Set the Jog speed Pr6.04 at 300~1000rpm is recommend, Acc Pr6.25 at 50~100 ms/1000rpm is recommend.
Set the Default Inertia Ratio.

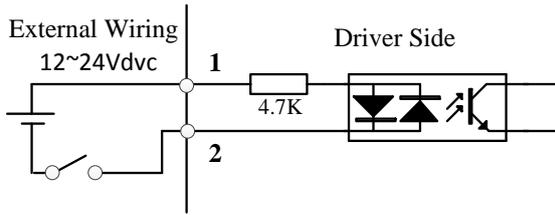
Download these settings, then make **Servo Enable**.

- 2) Click “CCW” to make motor run, click “Position 1” to save the position limit 1
Click “CW” to make motor run to CW direction,
Click “Position 2” to save the position limit 2
Click “Run” to start Inertia ratio identification.
- 3) Click “Write” to save the Inertia ratio identification result into NVM after finishing all steps above.



4) Make servo on of drive ready (Pr400)

This helps to set the servo drive with servo_on ready .



Notice: COM_SI is used for input signal, while COM_SO is used for output signal .

If the driver is enabled with internal signal, no need to connect Pin1 & Pin2 .

Pr4.00=83 for internal enable.

Pr4.00=3 for external enable.

5) Performance adjustment—Stiffness adjustment(Pr0.03)

The definition of Pr0.03

Pr0.03	Selection of machine stiffness at real-time auto-gain tuning	Range	unit	default	Related control mode		
		50 -81	-	70	P	S	T

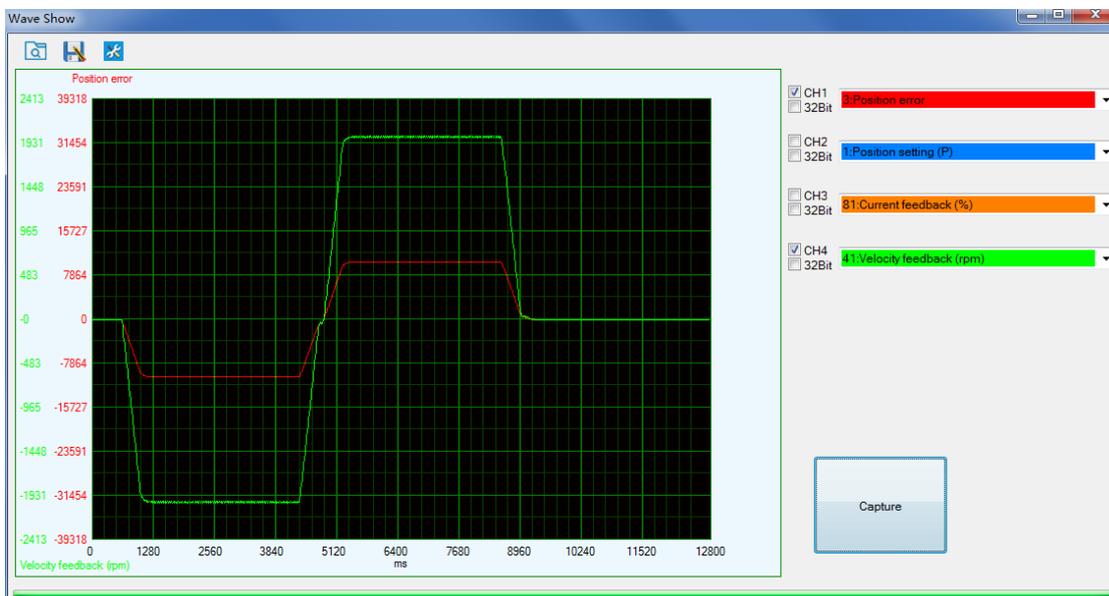
You can set up response while the real-time auto-gain tuning is valid.

Low → Machine stiffness → High
 Low → Servo gain → High
 81.80.....70.69.68.....51.50
 Low → Response → High

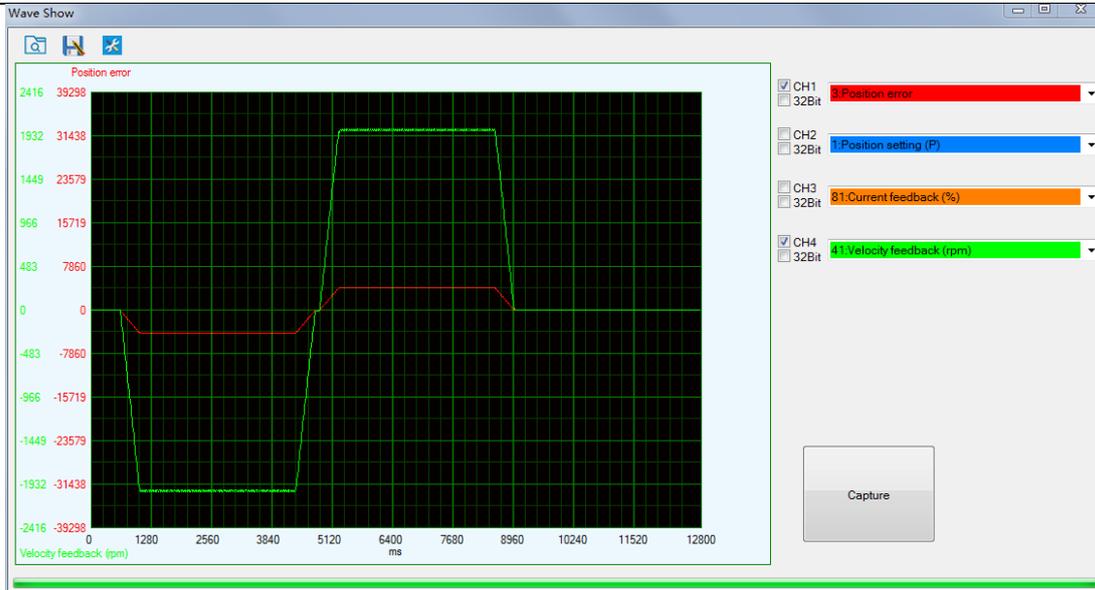
Notice: Lower the setup value, higher the velocity response and servo stiffness will be obtained. However, when decreasing the value, check the resulting operation to avoid oscillation or vibration. Control gain is updated while the motor is stopped. If the motor can't be stopped due to excessively low gain or continuous application of one-way direction command ,any change made to Pr0.03 is not used for update. If the changed stiffness setting is made valid after the motor stopped, abnormal sound or oscillation will be generated. To prevent this problem, stop the motor after changing the stiffness setting and check that the changed setting is enabled.

Here below is a simple example showing how to tune Pr003 :

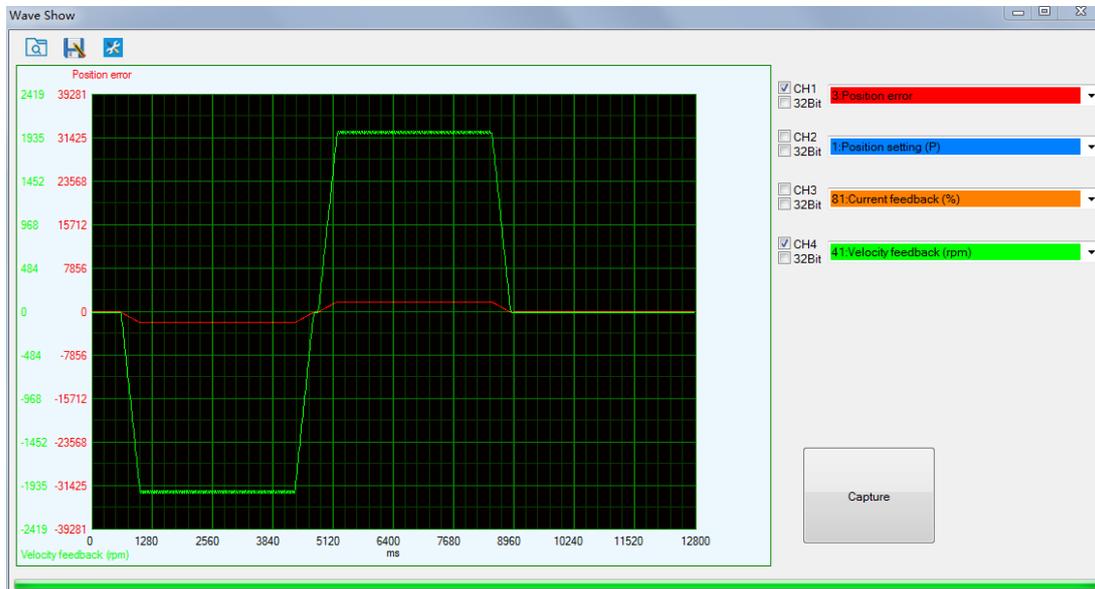
The following figure showing Pr0.02=2, Pr0.03=70, the position error (curve in red) is unacceptable! Keep decreasing value of Pr0.03, then the position error become smaller and smaller.



Pr0.03=66

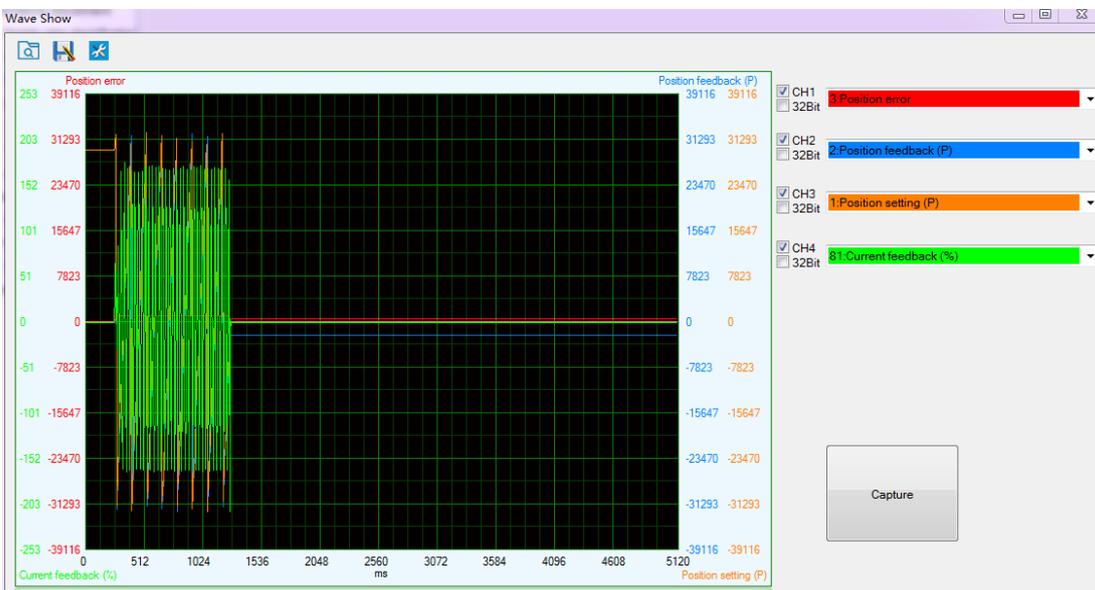


Pr0.03=62



Keep decreasing the value of Pr0.03, the position loop gain K_p become bigger and bigger, the integration time constant V_i become smaller and smaller, the position error become smaller, close to zero.

Pr0.03=61



The noise of motor occurs and alarm occurs if the position loop gain becomes bigger, noise need to be avoided.

Finally, set Pr0.03=62, the basic setting for position loop is finished in Position mode.

6) Set the polarity and electronic ratio

- 1) Confirm pulse polarity Pr0.06, command input mode Pr0.07
- 2) Modify Pr0.08 and set a suitable electronic gear ratio, Pr0.09 and Pr0.10 are needed to be tuned if needed

Parameters	Range	Details
Pr0.06(Pulse polarity setting)	0/1	Set Pr0.06 to change the rotation direction.
Pr0.07(Pulse input model)	0/1/2/3	Command Pulse Input Mode, set Pr0.07 according to controller signal
Pr0.08 (command pulse per motor rotation)	0-8388608	1) If Pr008≠0 , the motor actual turns = pulse number / Pr008 2) If Pr008=0 , Pr0.09 1st numerator of electronic gear and Pr0.10 Denominator of electronic gear become valid.
Pr0.09 (numerator of electronic gear)	0-8388608	If Pr008=0 , Pr0.09 1st numerator of electronic gear and Pr0.10 Denominator of electronic gear become valid.
Pr0.10 (denominator of electronic gear)	0-8388608	

Remark:

1. Default for Pr0.08 pulse per rev is 10000 .
2. Electronic gear ratio can be also set by Pr0.09(numerator) and Pr0.10(denominator), Pr0.08 must be set as 0 before that.
3. Input pulse frequency which is higher than 500K can not be identified by driver. Assuming that 10000 ppr, that means corresponding command bandwidth of 3000rpm can reach to 500k. If motor run above 3000 rpm, the pulse per rev must be lower than 10000.

7) Position command filter

To make the positional command divided or multiplied by the electronic gear smooth, set the command filter.

Pr2.22	Positional command smoothing filter	Range	unit	default	Related control mode	
		0 -32767	0.1ms	0	P	

- Set up time constant of the 1st delay filter in response to the positional command.
- When a square wave command for the target speed V_c is applied ,set up time constant of the 1st delay filter as shown in the figure below.

Pr2.23	Positional command FIR filter	Range	unit	default	Related control mode	
		0 -10000	0.1ms	0	P	

- Set up time constant of the 1st delay filter in response to the positional command.
- When a square wave command for the target speed V_c is applied , set up the V_c arrival time as shown in the figure below.

8) Tuning the dynamic tracking performance (Pr000) (optional)

Notes: Pr000 is only available in position mode .

Model Following Control (MFC)

- MFC is used to enhance the performance of dynamic tracking for input command, make positioning faster, cut down the tracking error, run more smoothly .
- There are two different way to use it, one is set Pr0.00 =1, the other is set Pr0.00 as another integer which is more than 10 .
- It is very useful for multi-axis synchronous movement and interpolation, the performance will be better if the value of Pr000 for each axis is the same.

Pr0.00	Mode loop gain	Range	unit	default	Related control mode	
		0 -32767	0.1Hz	0	P	

Set up the bandwidth of MFC , it is similar to the response bandwidth

Setup value	Meaning
0	Disable the function.
1	Enable the function , set the bandwidth automatically , recommended for most application .
2-10	Forbidden and reserved .
11-20000	Set the bandwidth manually , 1.1Hz – 2000Hz

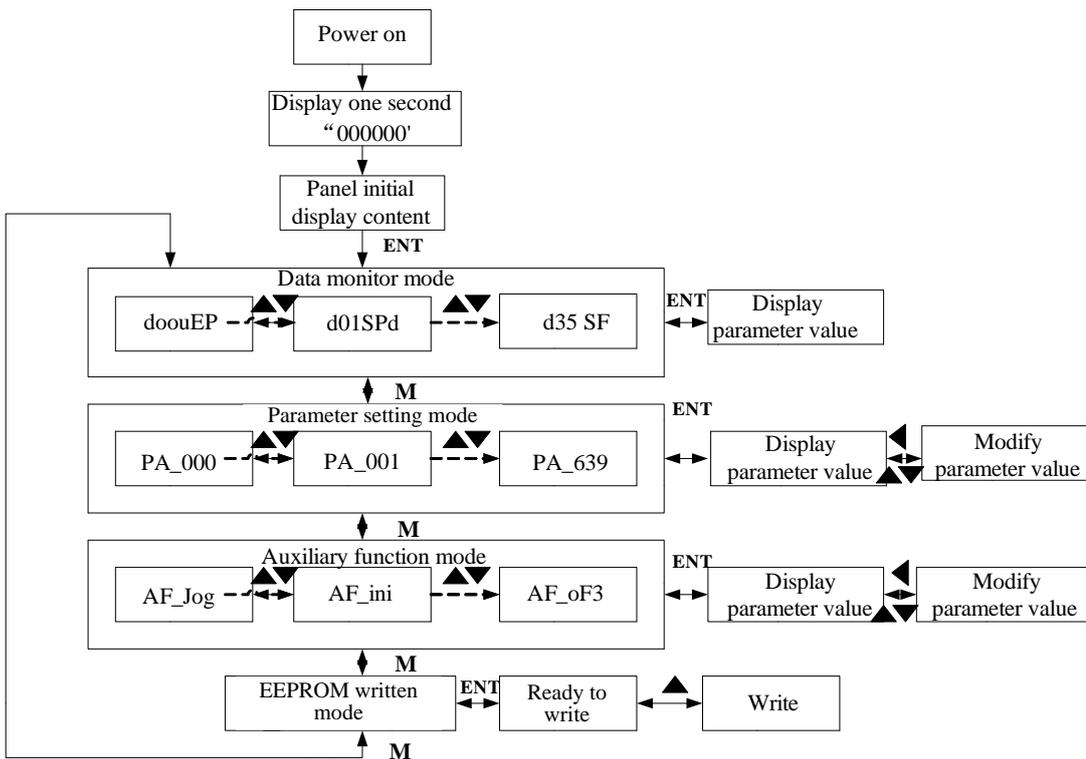
The steps to use this function :

- Choose the right control mode : Pr0.01 = 0
- Set up Pr0.02=1 for interpolation movement
- Set up the inertia ratio : Pr0.04
- Set up the rigidity : Pr0.03
- Set up the Pr0.00 :
 - If no multi-axis synchronous movement , set Pr0.00 as 1 or more than 10 ;
 - If multi-axis synchronous movement needed , set Pr0.00 as the same for all the axes .
 - If Pr0.00 is more than 10 , start with 100 , or 150 , 200 , 250 ,

Caution:

- Set up the right control mode , the correct inertia of ratio and rigidity firstly .
- Don't change the value of Pr0.00 when the motor is running , otherwise vibration occurs .
- Set up a small value from the beginning if using it in manual mode , smaller value means running more smooth and steady , while bigger one means faster positioning .

Step 5 : Save the value of parameters with panel



- 1) The panel will display **000000** for about one second at first , after power on. If no abnormal alarm occurs, the panel will display the value of initial parameter ; otherwise, abnormal alarm code will display.
- 2) Press **M** key to switch one mode to another mode :
data monitor mode → parameter setting mode → auxiliary function mode → EEPROM written mode.
- 3) If new abnormal alarm occurs, alarm code will display immediately , no matter what the current mode is, press **M** key to switch to the other mode.
- 4) In data monitor mode, press **▲** or **▼** to select the type of monitor parameter; Press **ENT** to enter the parameter type , then press **◀** to display the high 4 bits “H” or low 4 bits “L” of some parameter values.
- 5) In parameter setting mode, press **◀** to select current editing bit of parameter No, press **▲** or **▼** to change current editing bit of parameters No. Press **ENT** key to enter the parameter setting mode of corresponding parameters No. Press **◀** to select current bit of parameter value when editing it, press **▲** or **▼** to change the value of the bit. Press **ENT** to save it and switch to the interface of parameter No.

• Saving parameter

Operation procedure:

1. press **M** to select EEPROM written mode, display “**EE0000**”;
2. Press **ENT** to enter into written mode operation:
3. Press and hold **▲**, display LED from “**EE0000**” to “**EE0000**”, then it become “**EE0000**”, finally it become “**EE0000**”, indicate that EEPROM written operation have been began;
4. “**EE0000**” means that EEPROM written is unsuccessful while “**EE0000**” show that the written is successful; Follow steps 3 and 4 to repeat the operation again ; the drive may be damaged if repetition of several times still fail. (Contact the seller about repairing if drive is damaged)
5. The drive need to be power off and restart again to make sure written of EEPROM successfully .

NOTE: Don't turn off the power if EEPROM writing operation goes on, otherwise it may cause a writing wrong data; If this happens, please reset all the parameters, then do EEPROM writing operation again.

Step 6 : Trouble shooting

Protection function is activated when an error occurs, the driver will stop the rotation of servo motor, and the front panel will automatically display the corresponding fault error code. The history of the error can be viewed on data monitoring mode. error logging submenu displays like:“d12Er”.

For alarm can be cleared:

1. Use auxiliary function “AF_ACL”
 - a. Press M to select auxiliary function
 - b. Press SET to enter into “AF_ACL”
 - c. Press and hold ◀ to clear the alarm
2. Set IO input function as Alarm clear input “(A-CLR)”, refer to switch input interface connection to clear the alarm

For alarm can not be cleared:

Restart the power-supply to clear the alarm.

Event	Description	Likely Cause	Recommended Actions
Er0E0 Er0E1	Over current	<ul style="list-style-type: none"> • Short of driver output wire • Abnormal wiring of motor • Short circuit of IPM • Abnormal setting of parameter 	<ul style="list-style-type: none"> • Check wiring of motor/drive • Adjust motor wiring sequence • replace the driver with a new one • Adjust parameter to proper range
Er 100	motor over-load	<ul style="list-style-type: none"> • Load is too heavy; • wiring error of motor ; • Brake not released. 	<ul style="list-style-type: none"> • Decrease load, adjust limit parameter • Check wiring or replace a new encoder/motor • Release the brake
Er 101	Driver over-load	wiring error of motor power line ;	Check U.V.W wiring if error occurs or not, if line breaks or not
Er 150 Er 152	Encoder line breaked	<ul style="list-style-type: none"> • Encoder line disconnected ; • Encoder damaged. 	<ul style="list-style-type: none"> • Reconnect encoder wiring. • replace the motor with a new one
Er 180	position error over-large error	<ul style="list-style-type: none"> • Unreasonable set of position error parameter; • Gain set is too small ; • load is too large 	<ul style="list-style-type: none"> • Enlarge the value of Pr0.14 • Enlarge the value of Pr1.00, Pr1.05 • Increase acceleration/ deceleration time decrease speed, decrease load
Er 190	motor vibration	<ul style="list-style-type: none"> • Current vibration ; • Current loop is too strong 	<ul style="list-style-type: none"> • Cut down the value of Pr0.03. Pr0.04
Er 1A0	over-speed	Motor speed has exceeded the first speed limit (PA_321)	Adjust the value of input speed command, enlarge the value PA_321 value, modify command pulse input frequency and division frequency coefficient,
Er 1A1	speed out of control	<ul style="list-style-type: none"> • Control maladjustment • Encoder error • Special application 	<ul style="list-style-type: none"> • Anti-interference treatment or change motor • The special assessment of practical application, set 0 to 4 for PA137 to shield ERR1A1 alarm.
Note : For other alarms, Please refer to the User manual.			