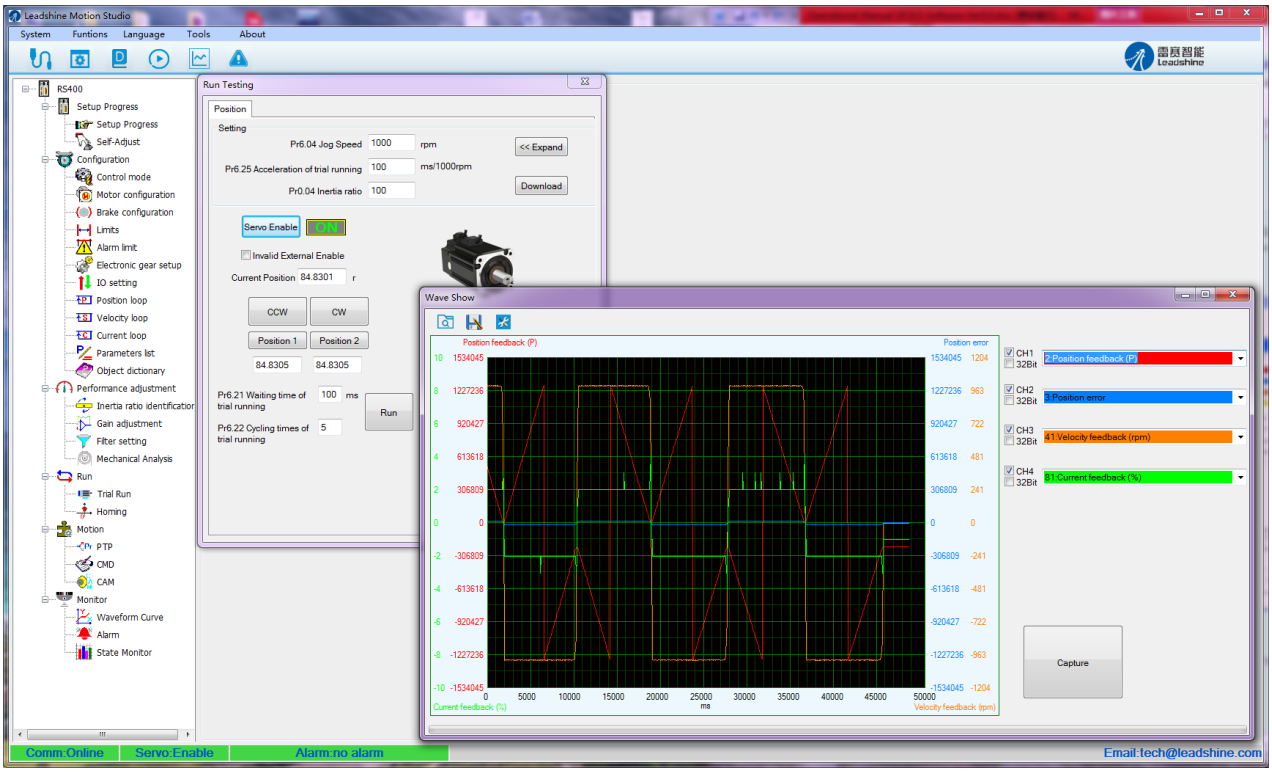
Operational Manual Of ELP Software



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Chapter 1 Introduction

This software can run in Windows XP, Windows Vista, Win7. The computer make data exchanged and debug ELP series driver by series port communication. Please read the operation specification of driver when using.

1. System composition

This software is matched with ELP series driver, can't be used for other driver.

2. Running condition

CPU: above 1.5GHz

RAM: above 256M

Hard disk capacity: above 10G

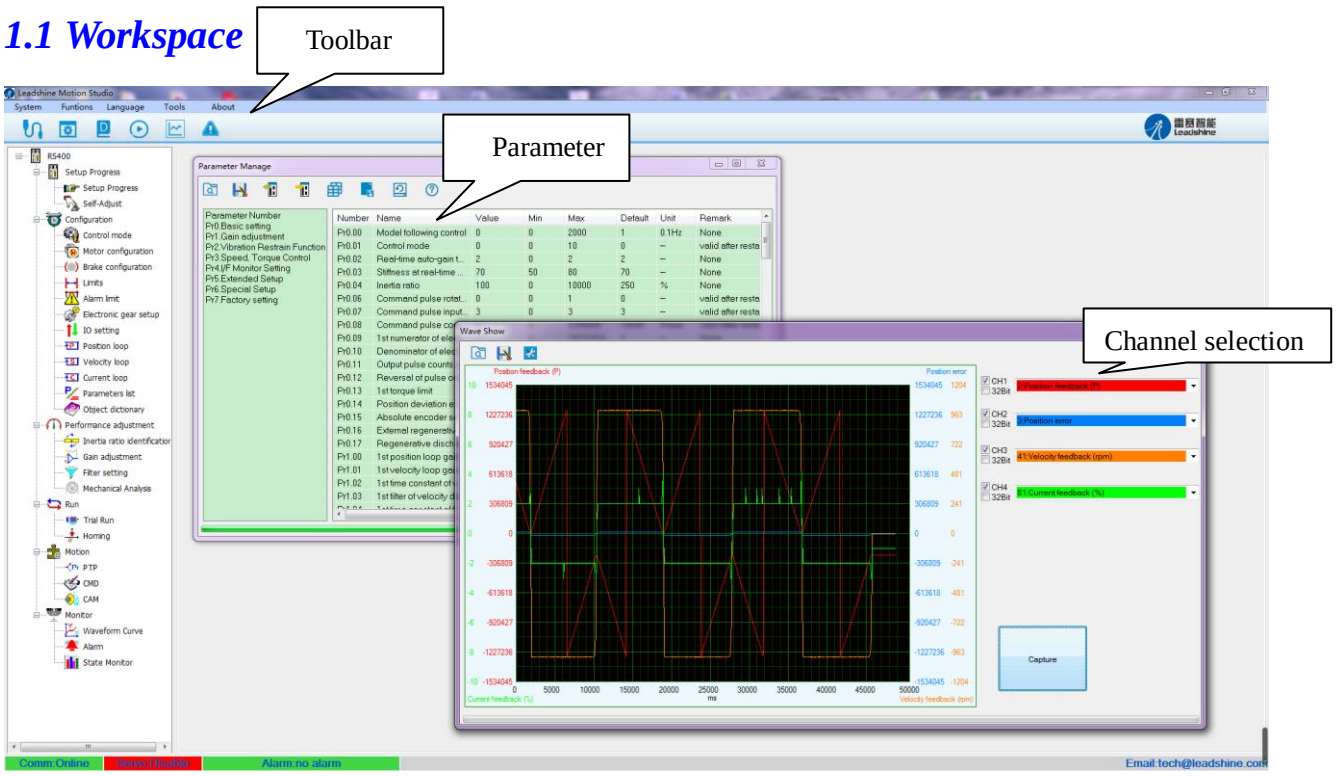
Displayer: resolution 1024*768, color 24 bit

Communication interface: normal series or USB series adapter

Note: because of the update of software version, the chart maybe different and actual.

Protuner for ELP series is a software tool designed to configure and tune the Leadshine ELP series digital servo driver. The user can tune the velocity/current loop and adjust the position loop parameters in this software.

1.1 Workspace



1.2 Menus and Toolbar

Menus and toolbars are at the top of the workspace. Users can click menu bar to view the pull-down menu. The toolbar below the menu offers the common commands.

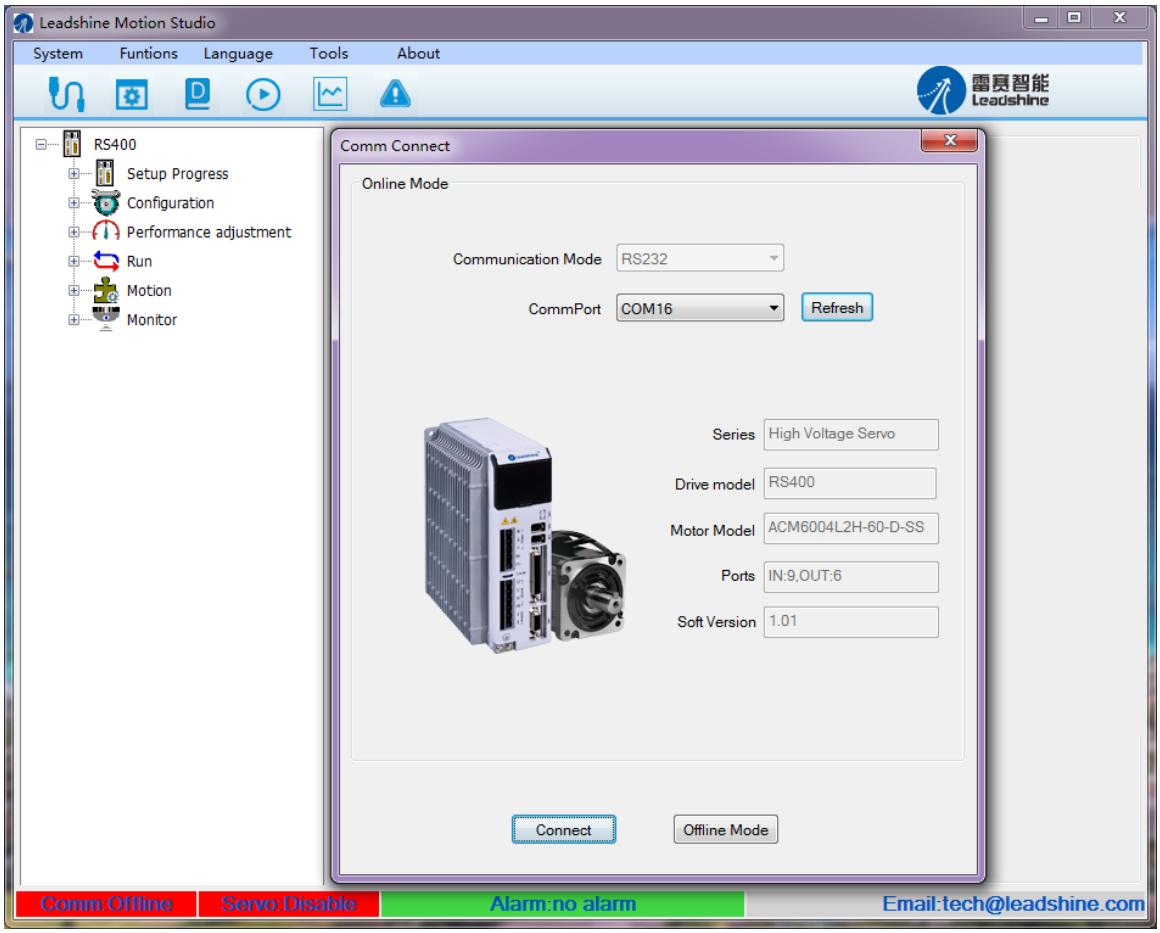
Menu	Pull Down	Toolbar	Function

System ->	Connect		Communication setup dialog box, users can select the parameter of communication and connect computer to driver
	Exit		Read, display, modify the parameter of driver, save the value of parameter to project file or local disk
Functions ->	Save Parameter		Save parameter into Non-Volatile Memory
	Software Reset		Software reset to make the parameters setting valid instead of restart power-supply
Language->	Chinese		Switch the software to Chinese version
	English		Switch the software to English version
Tools->	Debug Tool		Fast set specify address parameter. convenience to professional fast setup
Parameter Manage	Read parameter file		Reading parameter setup from the folder (the project file from PC computer)
	Save parameter		Make the current values of parameter saved as project file; while users can write note before
	Upload		Upload the parameters values of driver to the computer.
	Download		Make the modified values of parameter downloaded to the driver.
	Parameter compare		Compare the difference of parameter value of two projects and display it out.
	Save to Driver		Save parameter into Non-Volatile Memory
	Factory Reset		Reset all values of parameter to defaults
	Help		Check the explanation of parameters
Run Testing	Run Test		Run the driver, debug the parameters to performance better.
Wave Show	Wave Show		Monitor current running state, debugging
Alarm Info	Alarm Info		Check the alarm history of driver

Chapter 2 Using the software

2.1 Connecting driver

Click “  ” to connect driver and PC computer.



If the driver is power off, click “Offline Mode”.
In general, if the driver is power on, set Comm Port , like the picture above, then click “Connect” to enter the interface.

Note:

Notice

Before clicking the Connect button, please make sure:
1) The RS232 cable has been connected between the drive and the PC’s USB port.
2) The drive has been powered on and the green LED is on.
The motor is unnecessary connecting to the drive if users just want to change the parameters but not tuning.

2.2 Off-line using

Users can operate software as no connection between driver and PC computer, users can see the parameter value of projects which is saved in PC.

2.3 Parameter Management

Read parameters file:

Reading parameter setup from the folder (the project file from PC computer)

Save parameters:

Make the current values of parameter saved as project file; while users can write note before save it so that other users can clearly know some effect of this project.

Unload:

Upload the parameters values of driver to the computer.

Download:

Make the modified values of parameter downloaded to the driver.

Parameter Compare:

Compare the difference of parameter value of two projects and display it out.

Save To Driver:

Save parameter into Non-Volatile Memory

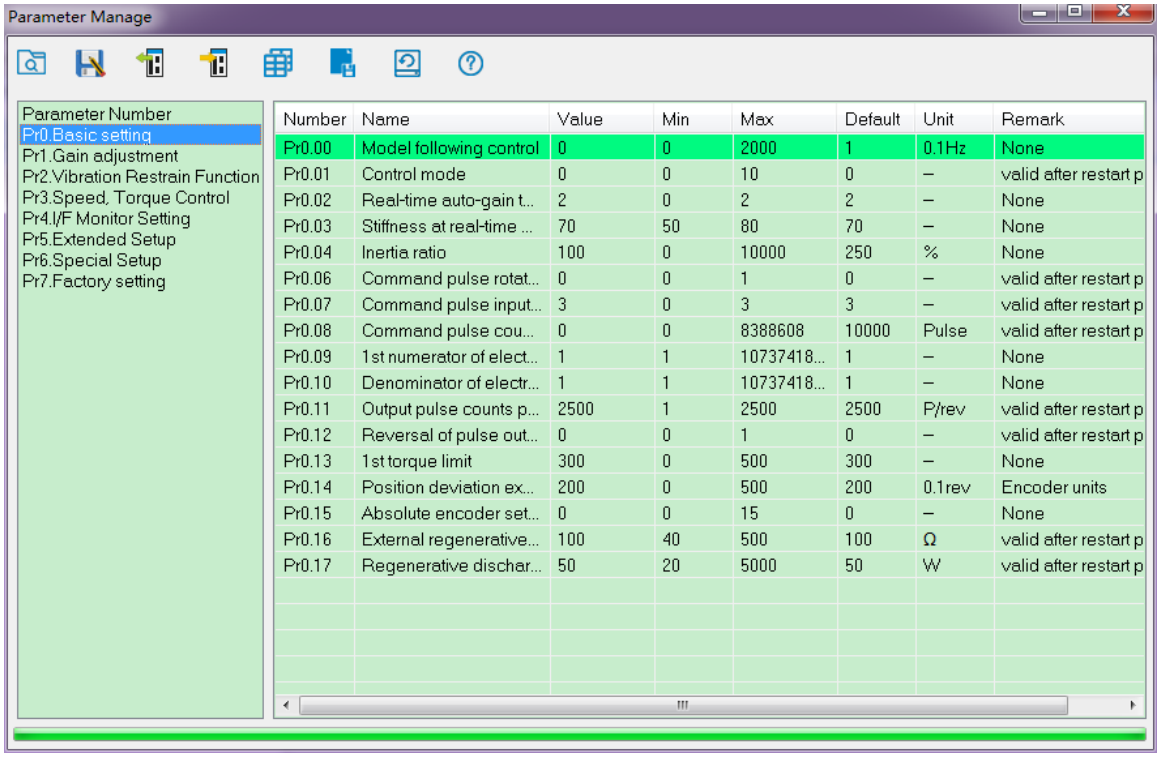
Factory Reset:

Reset all values of parameter to defaults

Help

Check the explanation of parameters.

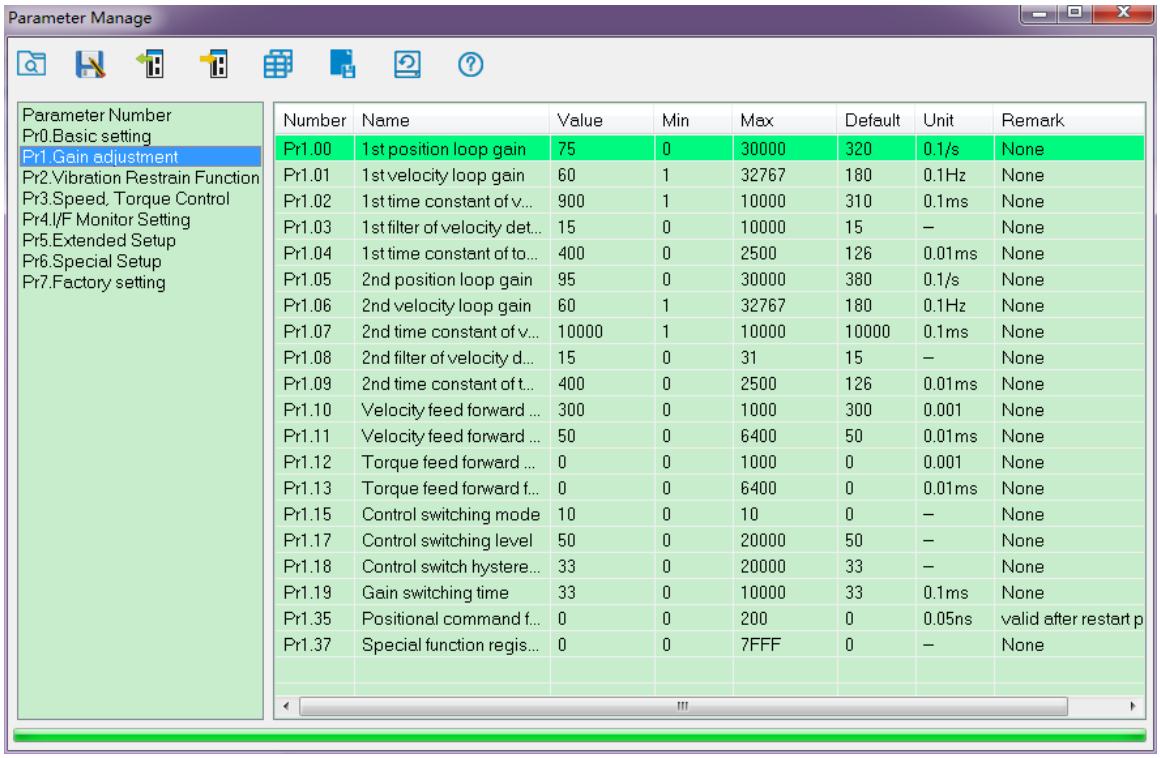
Basic setting



Number	Name	Value	Min	Max	Default	Unit	Remark
Pr0.00	Model following control	0	0	2000	1	0.1Hz	None
Pr0.01	Control mode	0	0	10	0	–	valid after restart p
Pr0.02	Real-time auto-gain t...	2	0	2	2	–	None
Pr0.03	Stiffness at real-time ...	70	50	80	70	–	None
Pr0.04	Inertia ratio	100	0	10000	250	%	None
Pr0.06	Command pulse rotat...	0	0	1	0	–	valid after restart p
Pr0.07	Command pulse input...	3	0	3	3	–	valid after restart p
Pr0.08	Command pulse cou...	0	0	8388608	10000	Pulse	valid after restart p
Pr0.09	1st numerator of elect...	1	1	10737418...	1	–	None
Pr0.10	Denominator of electr...	1	1	10737418...	1	–	None
Pr0.11	Output pulse counts p...	2500	1	2500	2500	P/rev	valid after restart p
Pr0.12	Reversal of pulse out...	0	0	1	0	–	valid after restart p
Pr0.13	1st torque limit	300	0	500	300	–	None
Pr0.14	Position deviation ex...	200	0	500	200	0.1rev	Encoder units
Pr0.15	Absolute encoder set...	0	0	15	0	–	None
Pr0.16	External regenerative...	100	40	500	100	Ω	valid after restart p
Pr0.17	Regenerative dischar...	50	20	5000	50	W	valid after restart p

In this window, users can set the values of this kind of parameter. Users can set the control mode, etc.

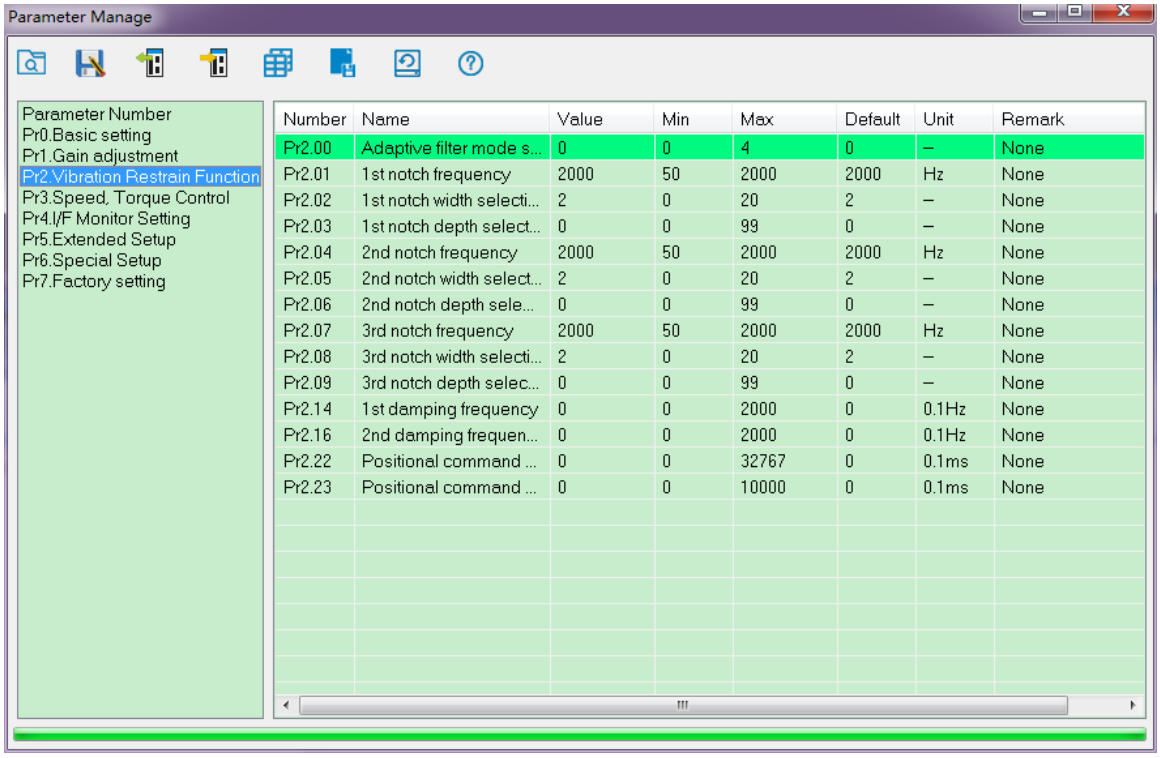
Gain adjustment



Number	Name	Value	Min	Max	Default	Unit	Remark
Pr1.00	1st position loop gain	75	0	30000	320	0.1/s	None
Pr1.01	1st velocity loop gain	60	1	32767	180	0.1Hz	None
Pr1.02	1st time constant of v...	900	1	10000	310	0.1ms	None
Pr1.03	1st filter of velocity det...	15	0	10000	15	–	None
Pr1.04	1st time constant of to...	400	0	2500	126	0.01ms	None
Pr1.05	2nd position loop gain	95	0	30000	380	0.1/s	None
Pr1.06	2nd velocity loop gain	60	1	32767	180	0.1Hz	None
Pr1.07	2nd time constant of v...	10000	1	10000	10000	0.1ms	None
Pr1.08	2nd filter of velocity d...	15	0	31	15	–	None
Pr1.09	2nd time constant of t...	400	0	2500	126	0.01ms	None
Pr1.10	Velocity feed forward ...	300	0	1000	300	0.001	None
Pr1.11	Velocity feed forward ...	50	0	6400	50	0.01ms	None
Pr1.12	Torque feed forward ...	0	0	1000	0	0.001	None
Pr1.13	Torque feed forward f...	0	0	6400	0	0.01ms	None
Pr1.15	Control switching mode	10	0	10	0	–	None
Pr1.17	Control switching level	50	0	20000	50	–	None
Pr1.18	Control switch hystere...	33	0	20000	33	–	None
Pr1.19	Gain switching time	33	0	10000	33	0.1ms	None
Pr1.35	Positional command f...	0	0	200	0	0.05ns	valid after restart p
Pr1.37	Special function regis...	0	0	7FFF	0	–	None

In this window, users can set the values of parameter about gain adjustment.

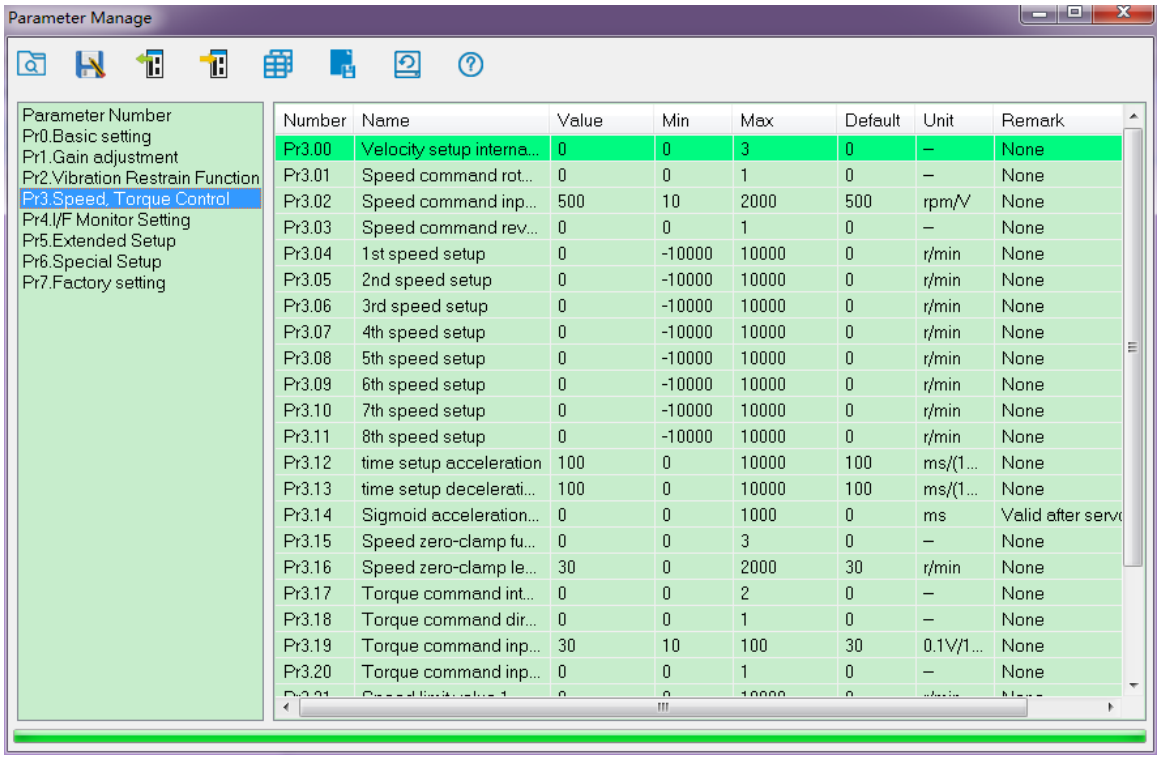
Vibration suppression



Number	Name	Value	Min	Max	Default	Unit	Remark
Pr2.00	Adaptive filter mode s...	0	0	4	0	–	None
Pr2.01	1st notch frequency	2000	50	2000	2000	Hz	None
Pr2.02	1st notch width selecti...	2	0	20	2	–	None
Pr2.03	1st notch depth select...	0	0	99	0	–	None
Pr2.04	2nd notch frequency	2000	50	2000	2000	Hz	None
Pr2.05	2nd notch width select...	2	0	20	2	–	None
Pr2.06	2nd notch depth sele...	0	0	99	0	–	None
Pr2.07	3rd notch frequency	2000	50	2000	2000	Hz	None
Pr2.08	3rd notch width selecti...	2	0	20	2	–	None
Pr2.09	3rd notch depth selec...	0	0	99	0	–	None
Pr2.14	1st damping frequency	0	0	2000	0	0.1Hz	None
Pr2.16	2nd damping frequen...	0	0	2000	0	0.1Hz	None
Pr2.22	Positional command ...	0	0	32767	0	0.1ms	None
Pr2.23	Positional command ...	0	0	10000	0	0.1ms	None

In this window, users can set the values of parameter about vibration and disturbance suppression.

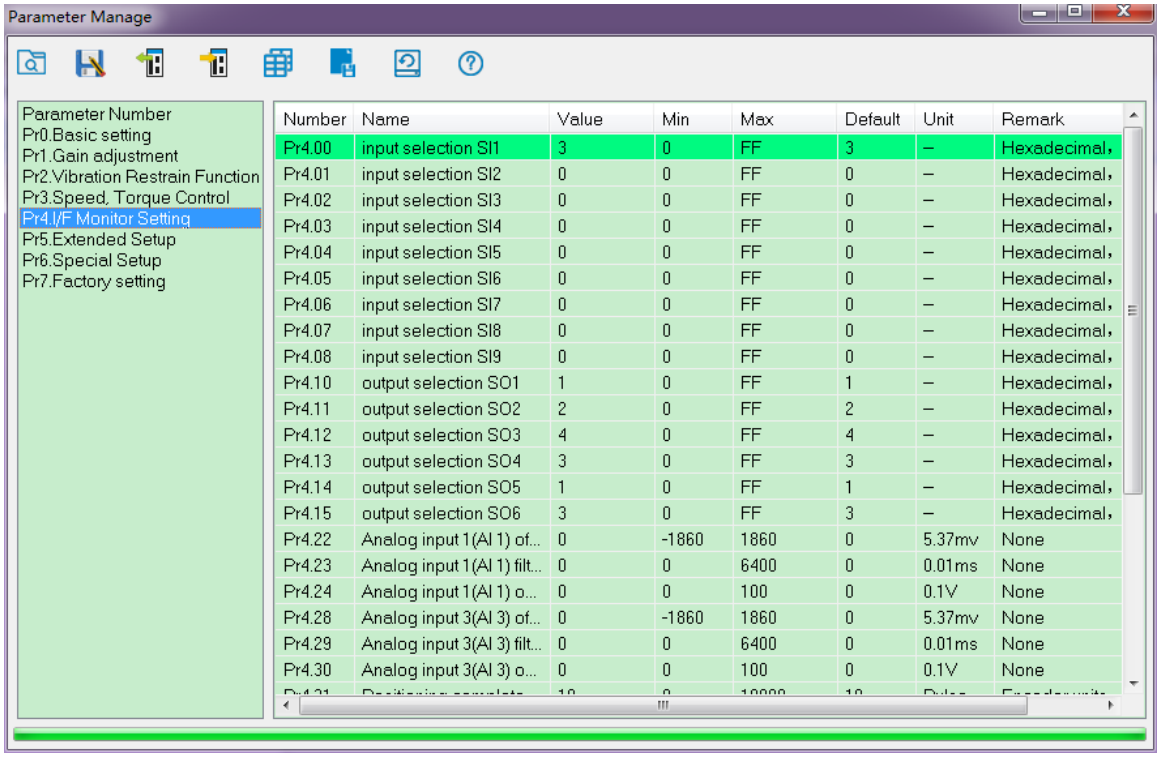
Velocity torque control



Number	Name	Value	Min	Max	Default	Unit	Remark
Pr3.00	Velocity setup interna...	0	0	3	0	–	None
Pr3.01	Speed command rot...	0	0	1	0	–	None
Pr3.02	Speed command inp...	500	10	2000	500	rpm/V	None
Pr3.03	Speed command rev...	0	0	1	0	–	None
Pr3.04	1st speed setup	0	-10000	10000	0	r/min	None
Pr3.05	2nd speed setup	0	-10000	10000	0	r/min	None
Pr3.06	3rd speed setup	0	-10000	10000	0	r/min	None
Pr3.07	4th speed setup	0	-10000	10000	0	r/min	None
Pr3.08	5th speed setup	0	-10000	10000	0	r/min	None
Pr3.09	6th speed setup	0	-10000	10000	0	r/min	None
Pr3.10	7th speed setup	0	-10000	10000	0	r/min	None
Pr3.11	8th speed setup	0	-10000	10000	0	r/min	None
Pr3.12	time setup acceleration	100	0	10000	100	ms/(1...	None
Pr3.13	time setup decelerati...	100	0	10000	100	ms/(1...	None
Pr3.14	Sigmoid acceleration...	0	0	1000	0	ms	Valid after serv
Pr3.15	Speed zero-clamp fu...	0	0	3	0	–	None
Pr3.16	Speed zero-clamp le...	30	0	2000	30	r/min	None
Pr3.17	Torque command int...	0	0	2	0	–	None
Pr3.18	Torque command dir...	0	0	1	0	–	None
Pr3.19	Torque command inp...	30	10	100	30	0.1V/1...	None
Pr3.20	Torque command inp...	0	0	1	0	–	None

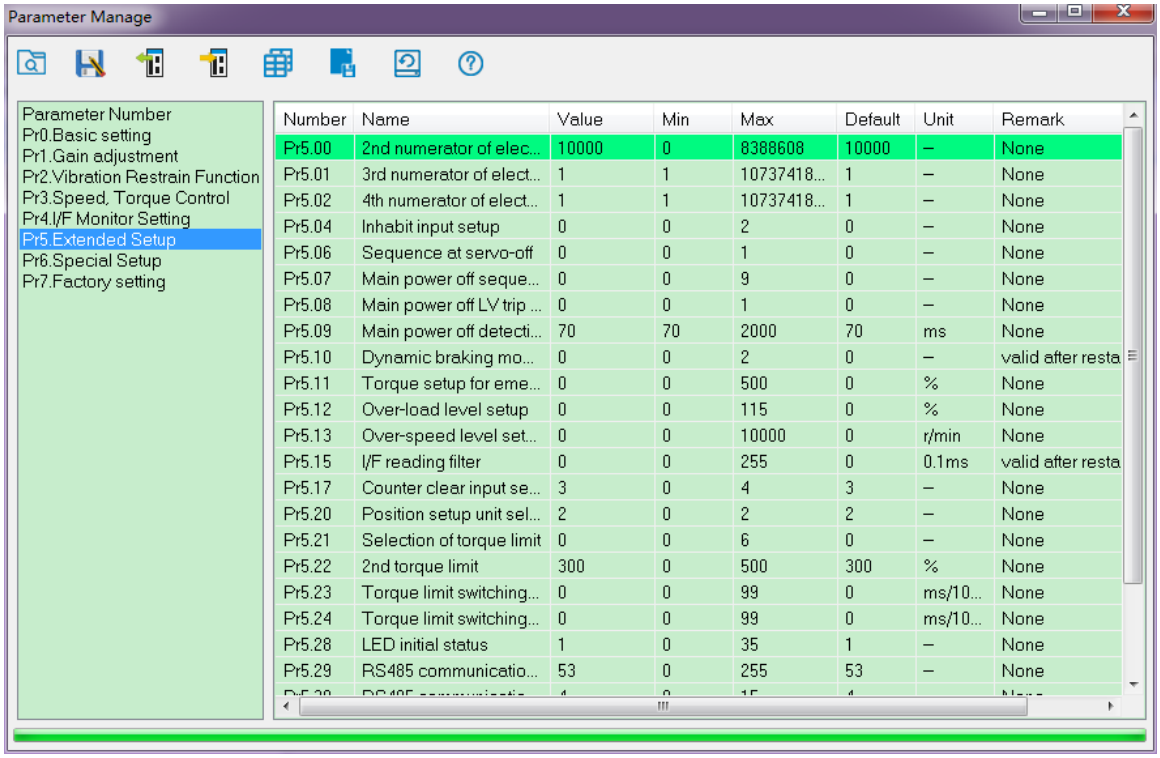
In this parameter window, users can set the values of parameter about velocity / torque control.

Monitor setup



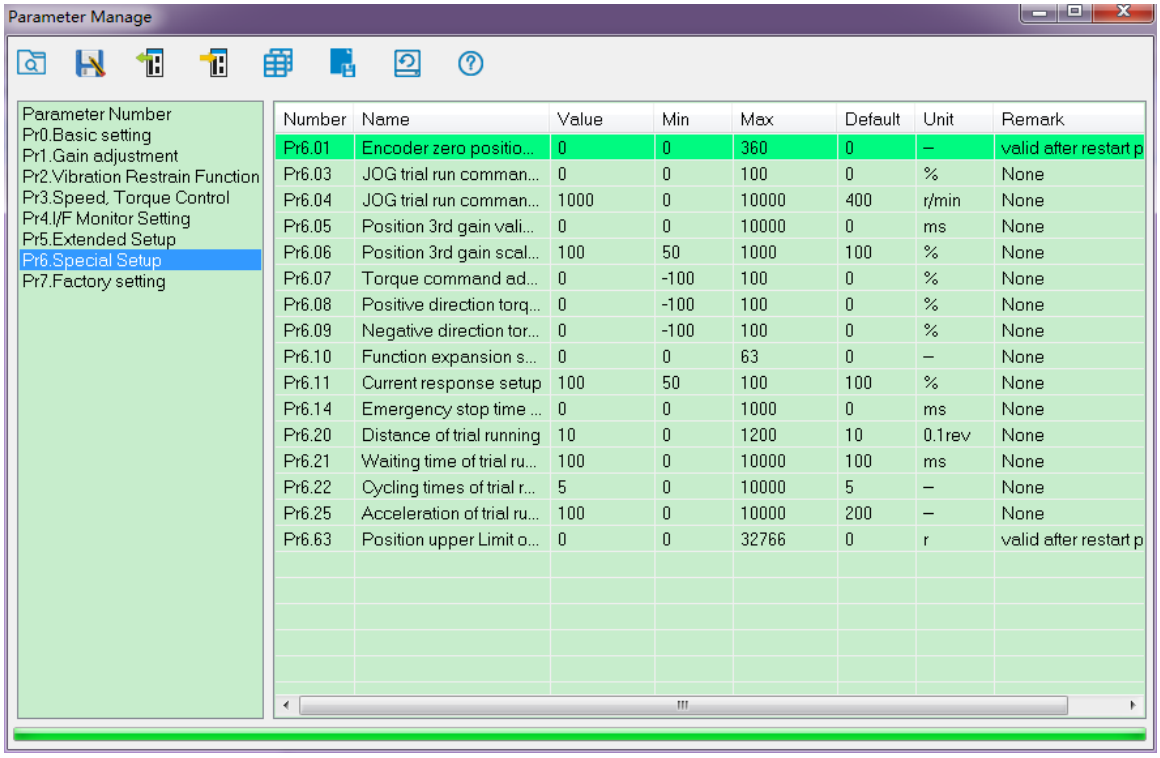
In this window, users can set the values of parameter about input/output setting, speed zero clamping, etc.

Extension setting



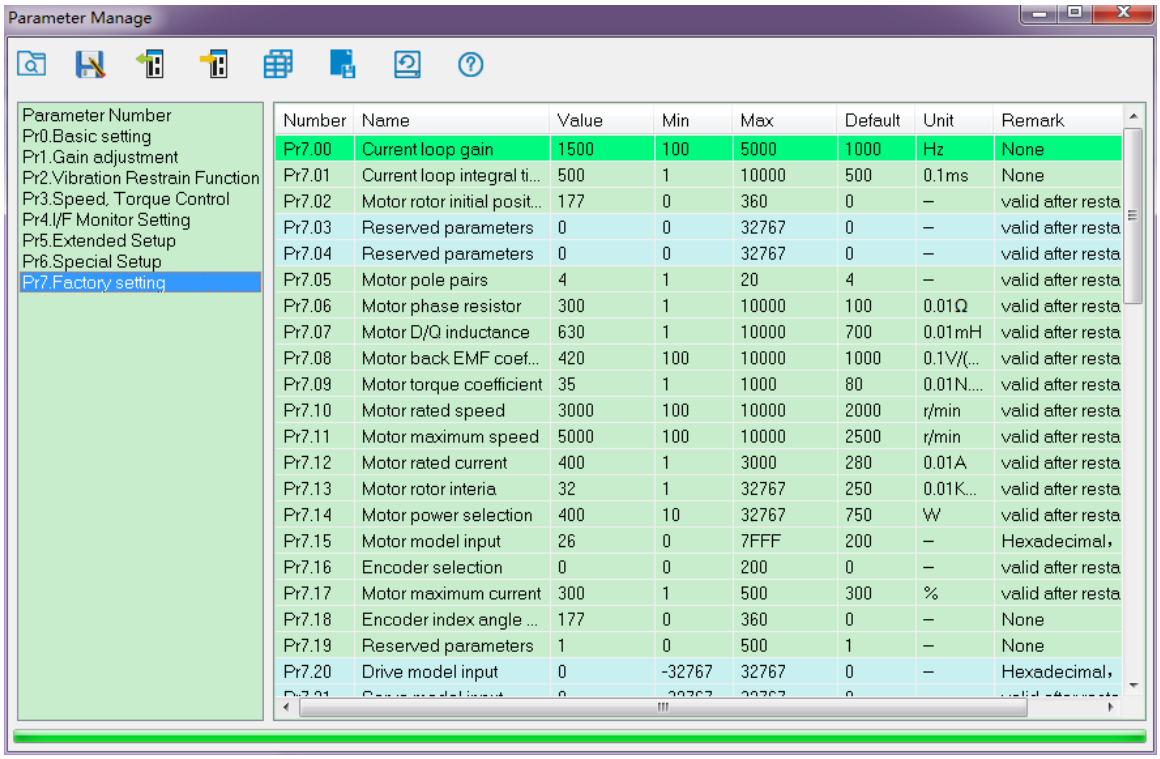
In this window, users can set the values of parameter about extended function.

Special setting



In this window, users can set the values of parameter about special setting, trial run parameter, etc.

Factory setup



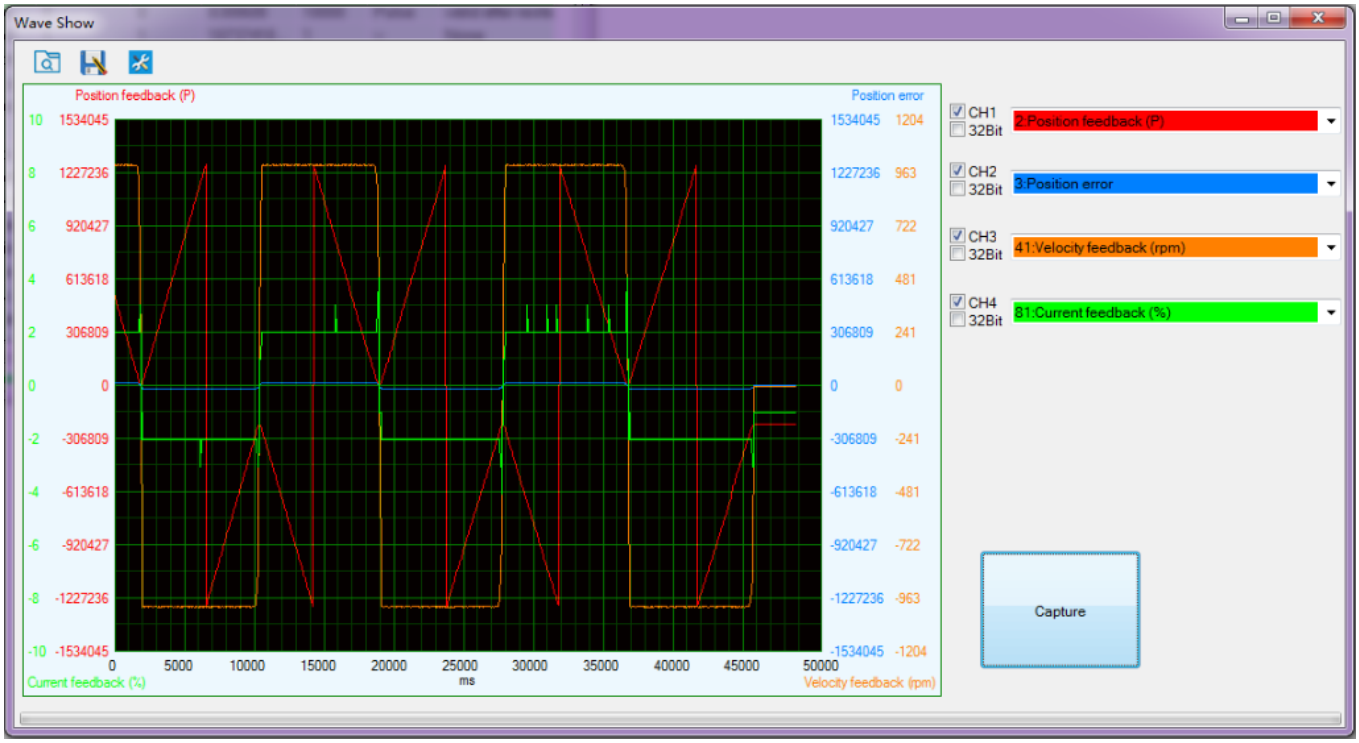
In this window, users can set the values of parameter about motor setting.
If the motor isn't included in motor library, then users can match this motor through modifying the parameter of Pr7.00 – Pr7.16. First, set Pr7.15=0, then set other parameters according to the specification of motor.
In general, we can't see all the parameters like the picture above, we can make some operation to see all of them, just refer to the appendix about how to find the hidden parameter.

Notice:

Restart the driver to make some modified values of parameter valid.

2.4 Wave Show

If users want to see monitor the status of performance when the motor is running, for example, the driver and motor are running position feedback、position error、 velocity feedback and current feedback, users can click to analysis these data.



:

Load wave file from the computer.

:

Save current wave record as wave file.

:

Wave capture setting.

Sampling interval:

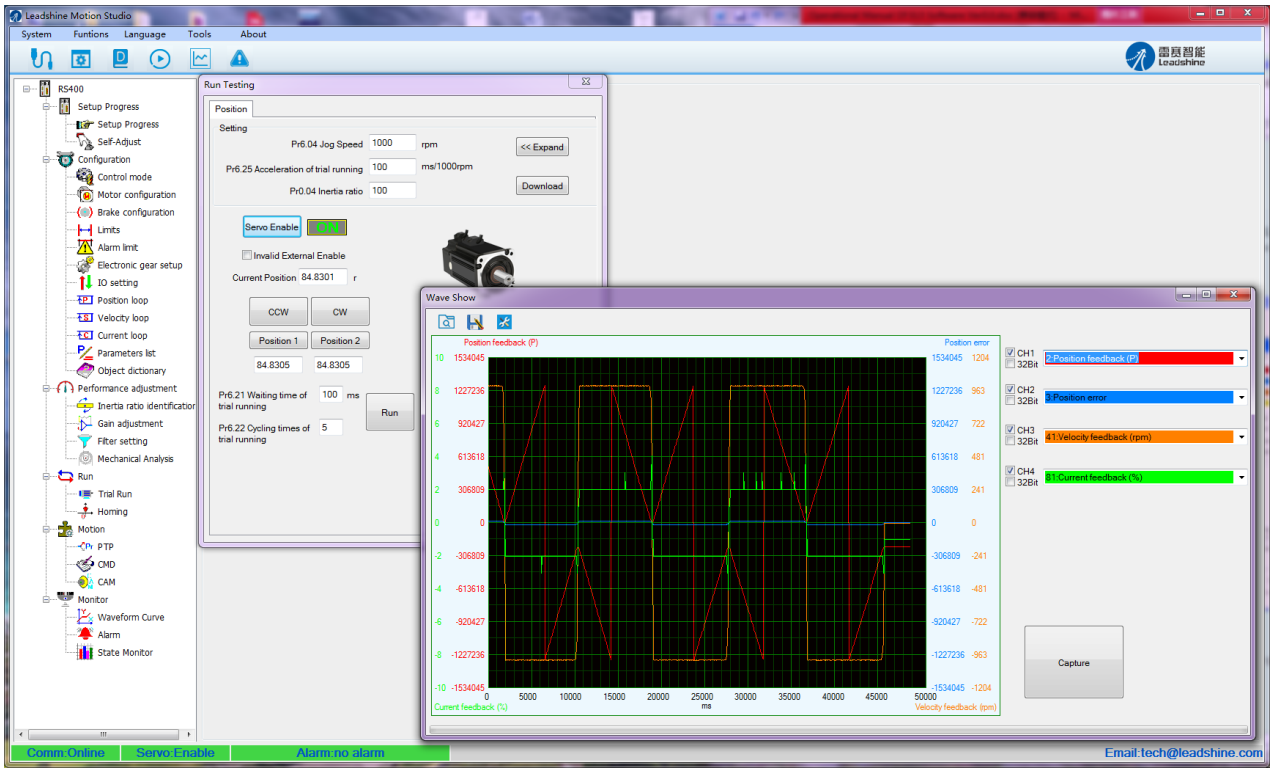
The time value of sampling interval.

Chapter 3 Run Test

There is position mode in run testing.

Position Mode Tuning Window

In position mode, the parameter what users need to adjust is Jog Speed, ACC time, Inertia ratio, etc. users can setup real-time auto adjust mode, then adjust real-time auto adjust rigidity. Users need to decrease the rigidity for better performance. If the noise exists while it means the rigidity is too big.



1、Set parameters for run testing:

Specially pay attention to Pr0.03 Stiffness and Pr0.04 Inertia ratio which strongly corresponding to better performance

2、Run testing guidance

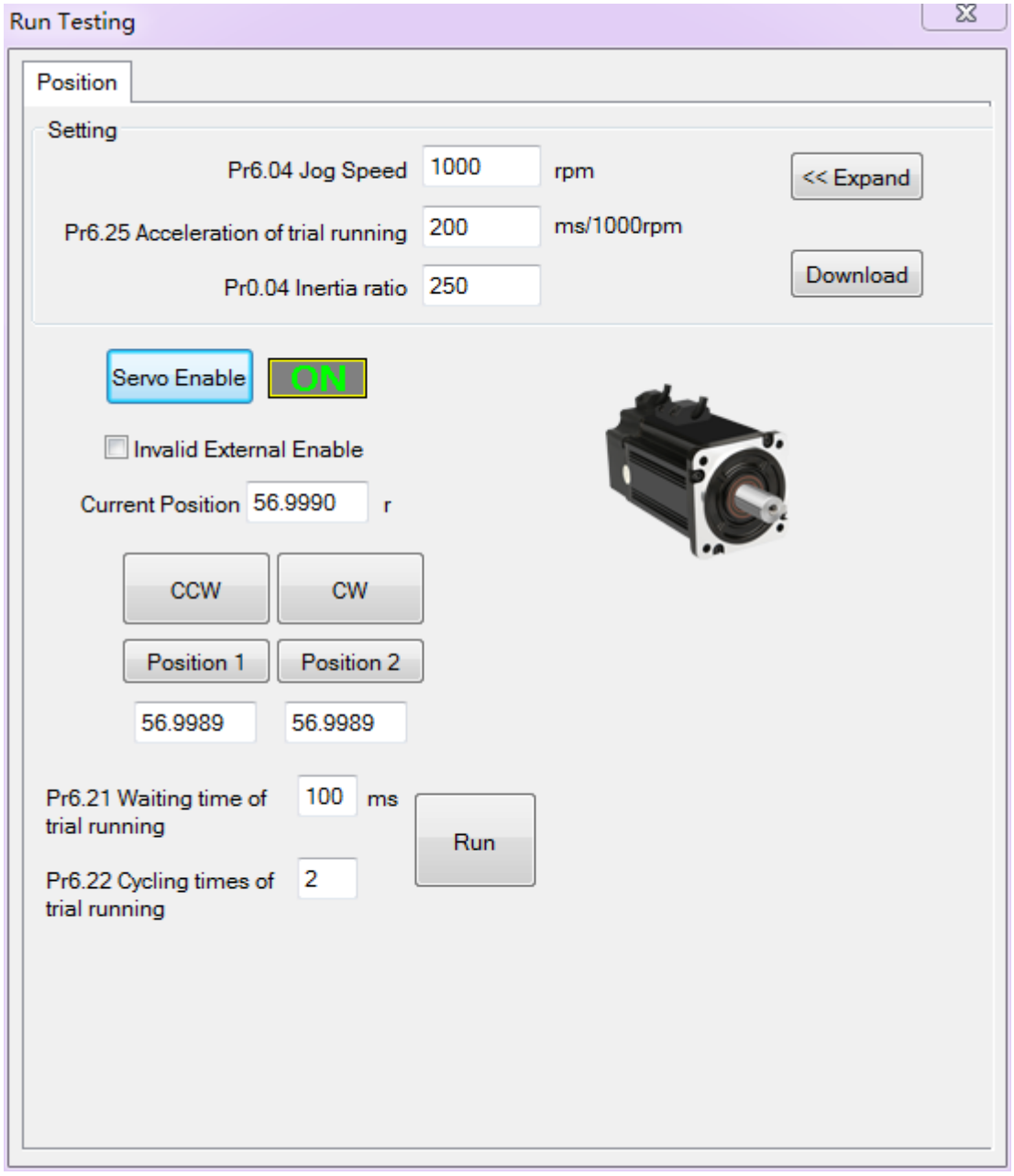
Click button “Servo enable”

Click “CCW” to make motor run to CCW direction，click ”Position 1” to save the testing position limit 1

Click “CW” to make motor run to CW direction，click ”Position 2” to save the testing position limit 2

Click ”Run” to start Testing progress

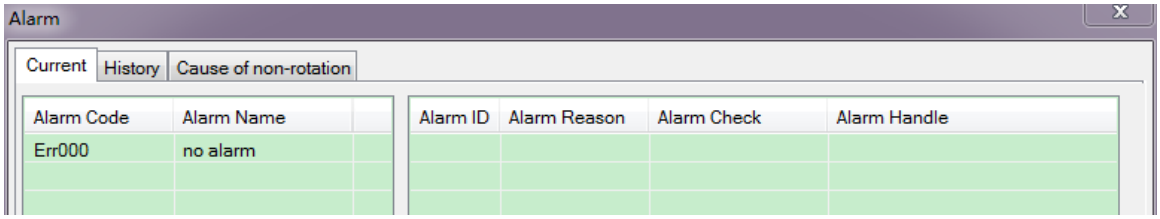
3、During the Run Testing progress，the wave show monitor the performance of the current parameters setting.


Run Testing
Position
Setting
Pr6.04 Jog Speed
1000
rpm
<< Expand
Pr6.25 Acceleration of trial running
200
ms/1000rpm
Pr0.04 Inertia ratio
250
Download
Servo Enable
ON
Invalid External Enable
Current Position
56.9990
r
CCW
CW
Position 1
Position 2
56.9989
56.9989
Pr6.21 Waiting time of trial running
100
ms
Pr6.22 Cycling times of trial running
2
Run

Chapter 4 Alarm and Tool

4.1 Current alarm

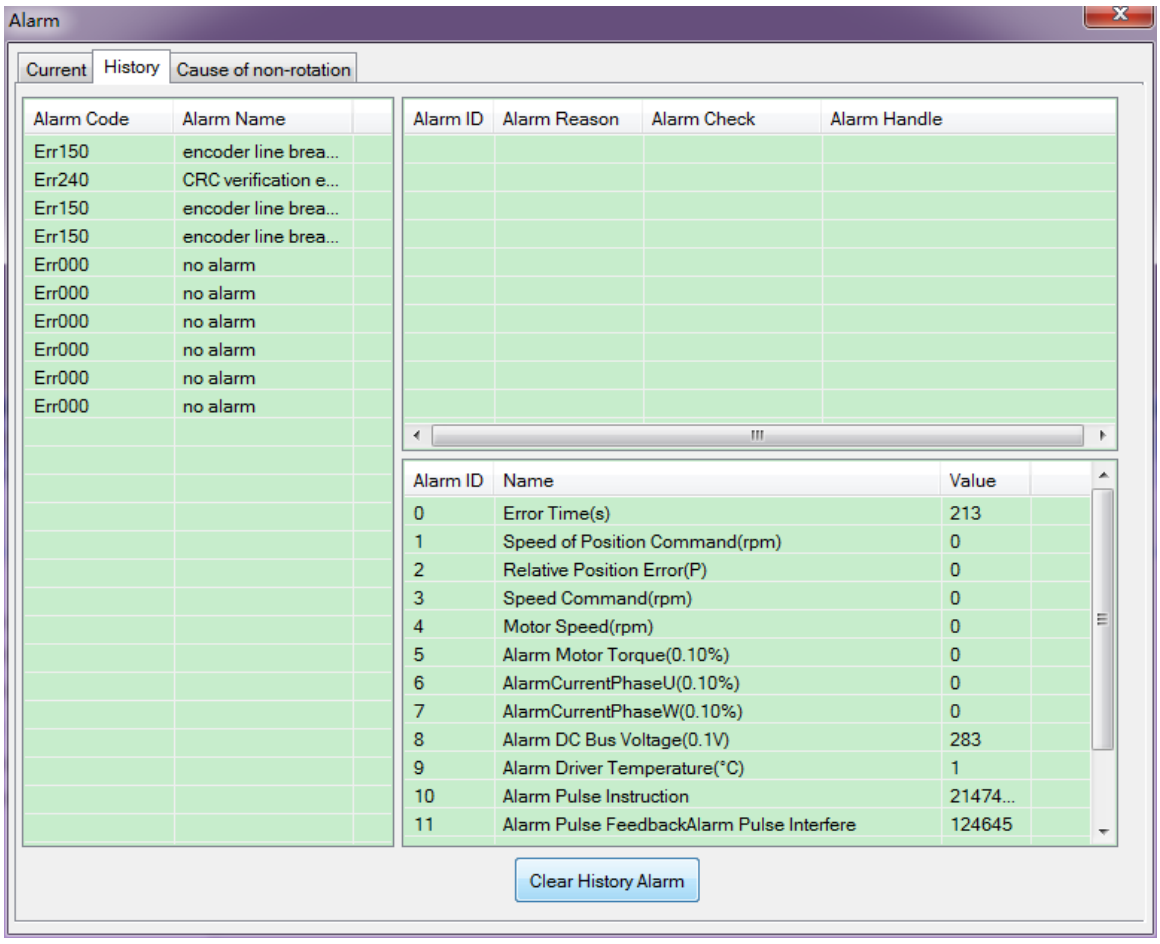
Click the “  ” :
Then the window showing like this：



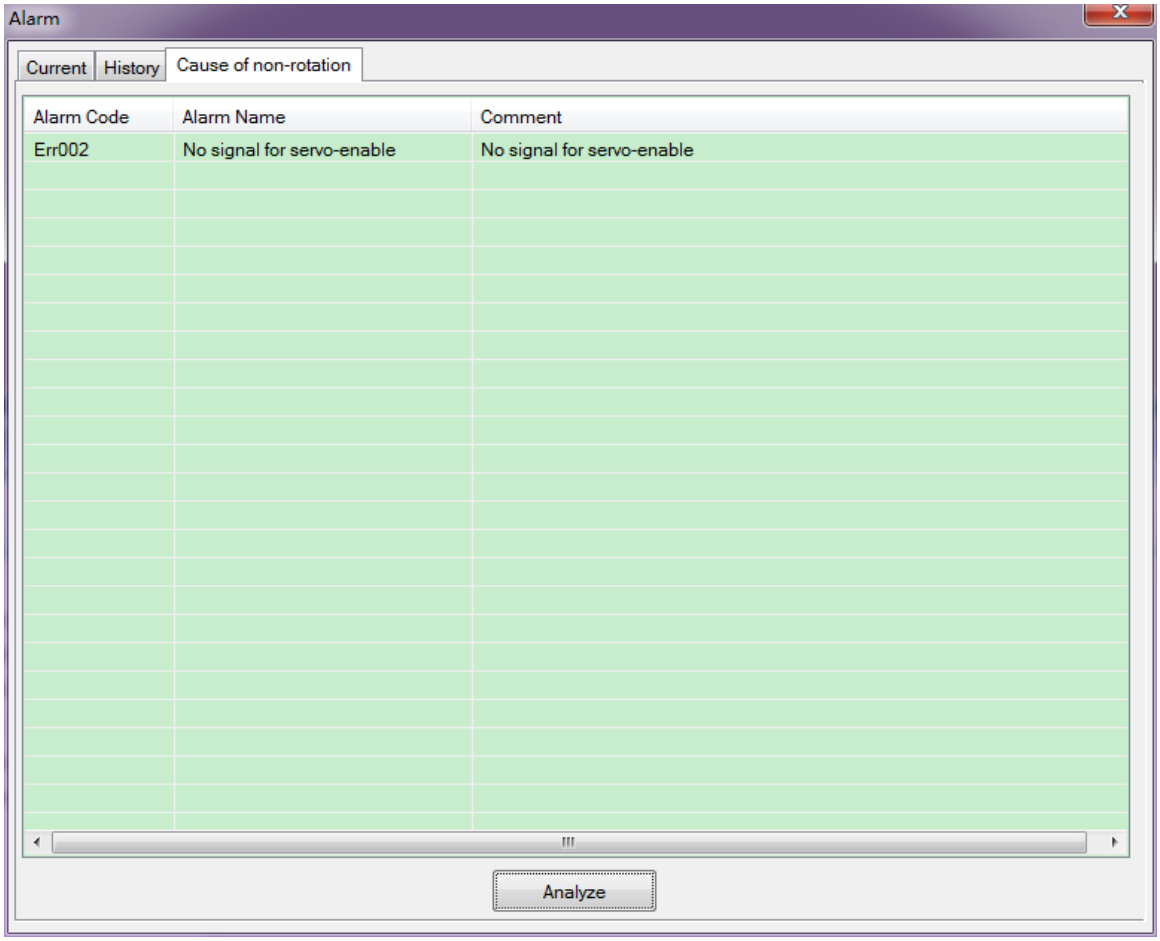
Users can see the alarms after power on, the alarm will be eliminated after power off .

4.2 History alarm

The history alarm can mostly record 13 alarms, Click read history alarm will appear all of history alarm numbers and alarm name. Click alarm name to display alarm reason and process method. When the number of alarm exceed 13 alarms, users need to click clear history alarm, it will clear all of history alarms.



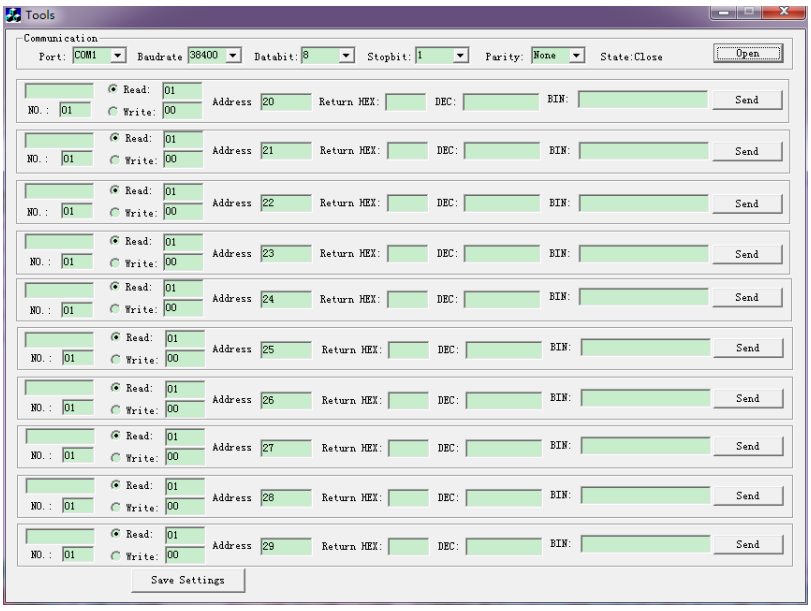
4.3 The reasons of servo stop running



Click analysis, the window will appear about the reason of no running.

4.4 Tool

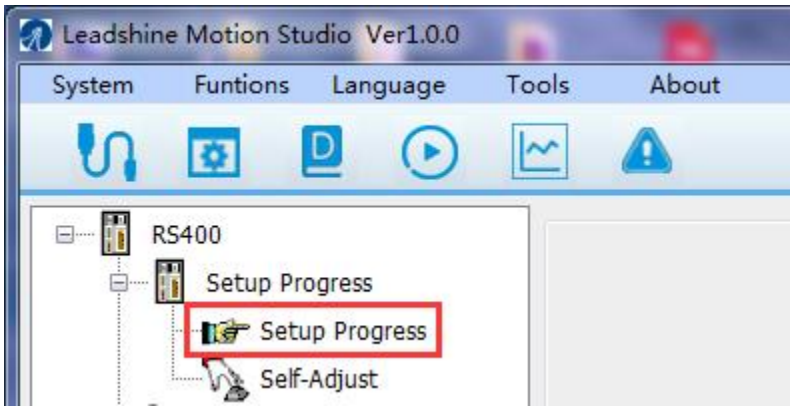
Serial port tool

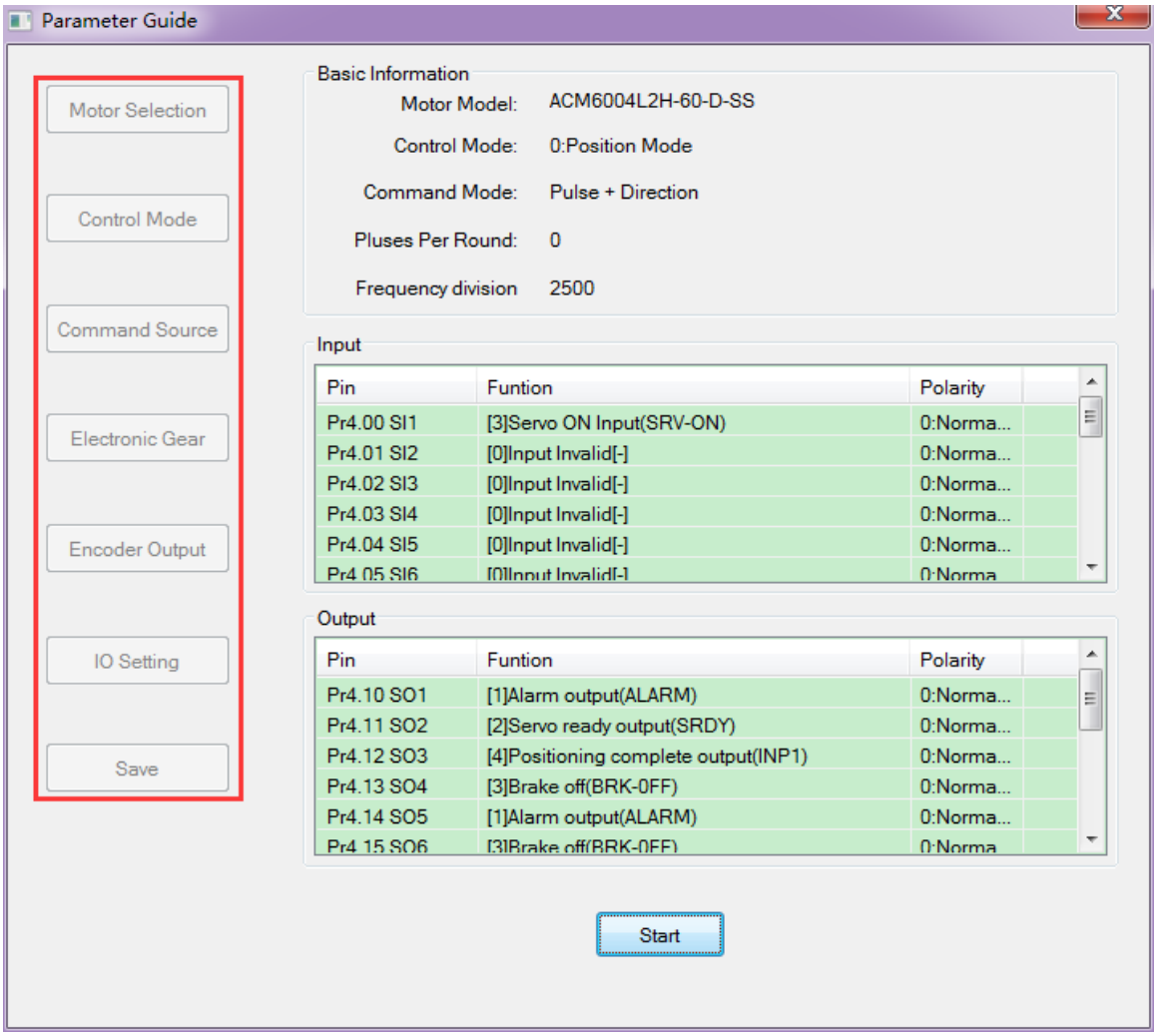


Chapter 5 Configuring the Driver

5.1 Setup progress

The debug software for ELP series is newly designed. To configure a new drive, users can follow the ***Setup Progress*** to set the parameters for special application.



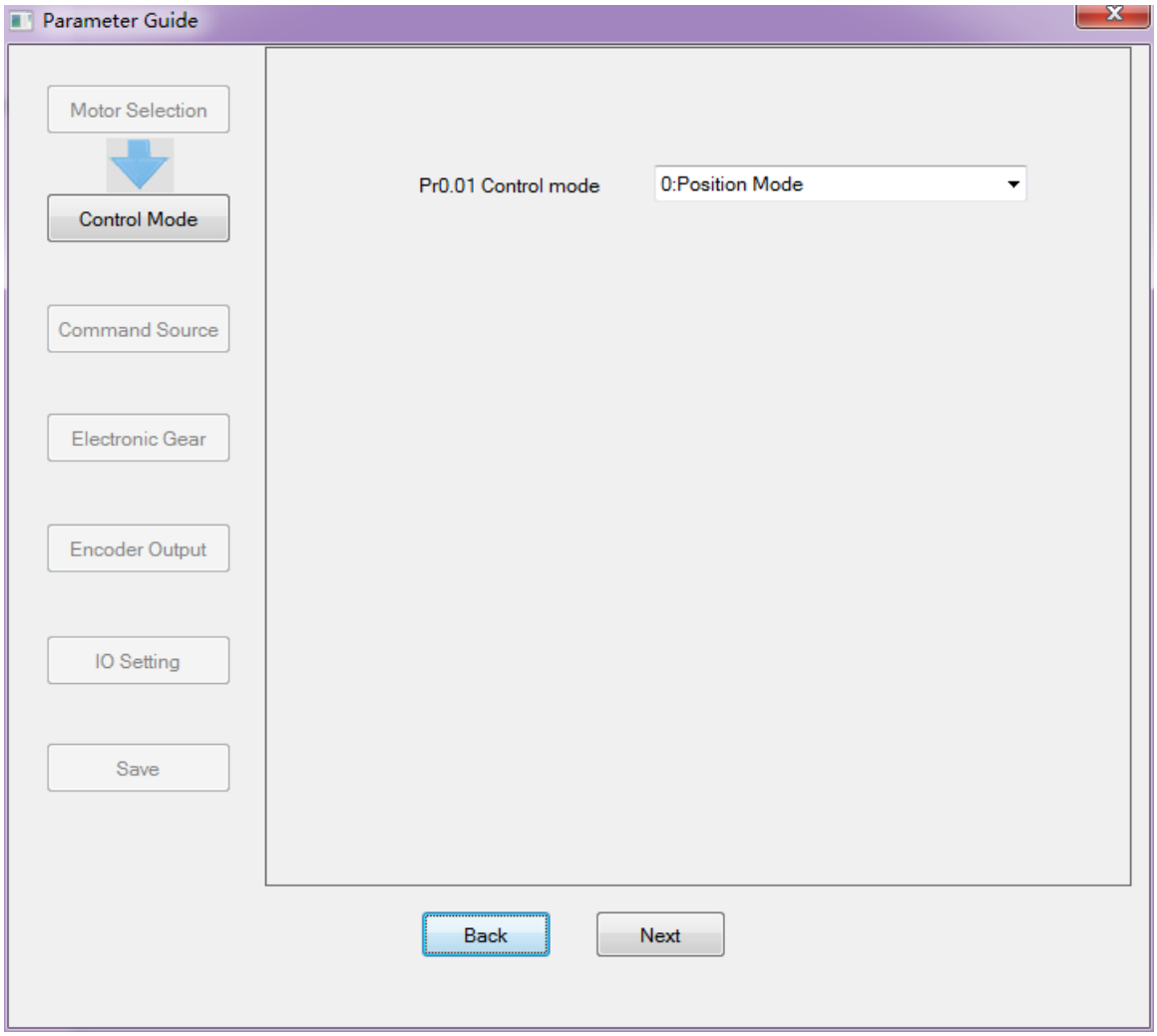


To follow the setup progress, there are 6 steps :

1. Motor Selection

The motor model is automatically detect by serial communication of encoder， so users could go to the 2nd Step—> Control Mode

2. Control Mode
There are 3 modes for selection， select the control mode according to mechanical system and the application.
   - Position Mode:
     Mainly for positioning application. (Pulse+Direction / CW+CCW/A+B phase)
   - Velocity Mode:
     Mainly for velocity application. (Analog / Internal Speed / Analog and Internal Speed)
   - Torque Mode:
     Mainly for torque application. (Analog)



3. Command Source
Select the command source according to the control mode and controller command source.
The command source for each control mode is showing as follows:
   - Position Mode:
     (Pulse+Direction / CW+CCW/A+B phase)
   - Velocity Mode:
     (Analog / Internal Speed / Analog and Internal Speed)
   - Torque Mode:
     (Analog)

4. Electronic Gear
When the transmission structure is screw:
Pulses per round = Screw lead / Pulse equivalent

When the transmission structure is rack and pinion:
Pulses per round = (Modulus*Number of pinion*Helical angle*3.1415627) / (Gear ratio*Pulse equivalent)

5. Encoder Output
The output pulses counts per motor revolution = Pulses Per Round / 4

6. IO Setting
There are 9 inputs，the function of general-purpose input is selected by parameters.
Inputs functions:
Servo-ON、Alarm clear、Positive/Negative Limit、Control mode switching、Gain switching、Deviation counter clear、Command pulse inhibition、Electronic gear switching、Torque limit switching、Speed zero clamp、Speed command sign input、Torque command sign input、E-STOP、Inertia ratio switching、Internal speed selection.

There are 6 outputs，the function of general-purpose input is selected by parameters.
Outputs functions:
Alarm output、Servo-Ready、Positioning complete、At-speed、Zero-speed、Velocity consistent、Positional command ON/OFF、Servo-ON、Home-OK.

The polarity of inputs and outputs can be configured as normally open or normally closed.
If users select normally open，the external connection is needed. If users select normally closed，the external connection is no need.

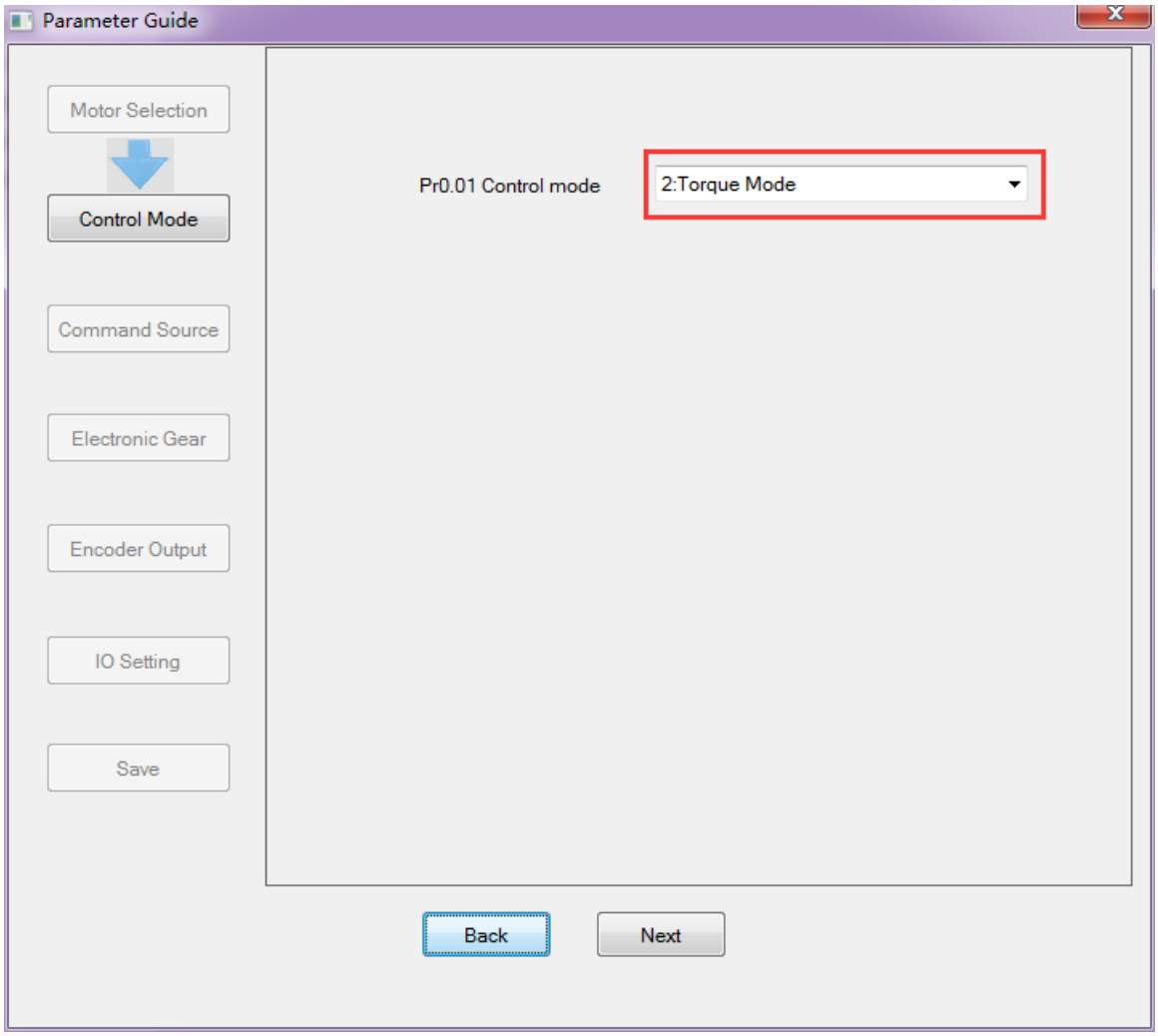
7. Save
After the all the configuration，users should save the parameters into NVM.（Non-Volatile Memory）

Before running ELP series driver, users need to select different work mode according to mechanical system and the application, while different work mode need to wire in different way, please refer to user manual. when driver wiring connecting was finished, users can tune the parameter with ProTuner software.

5.2 Torque mode

The command resource of torque mode is ***Analog Input***, via AI3 send ±10V analog input signal, in torque mode, users can't see waveform curve, but users can setup related parameters with torque mode.

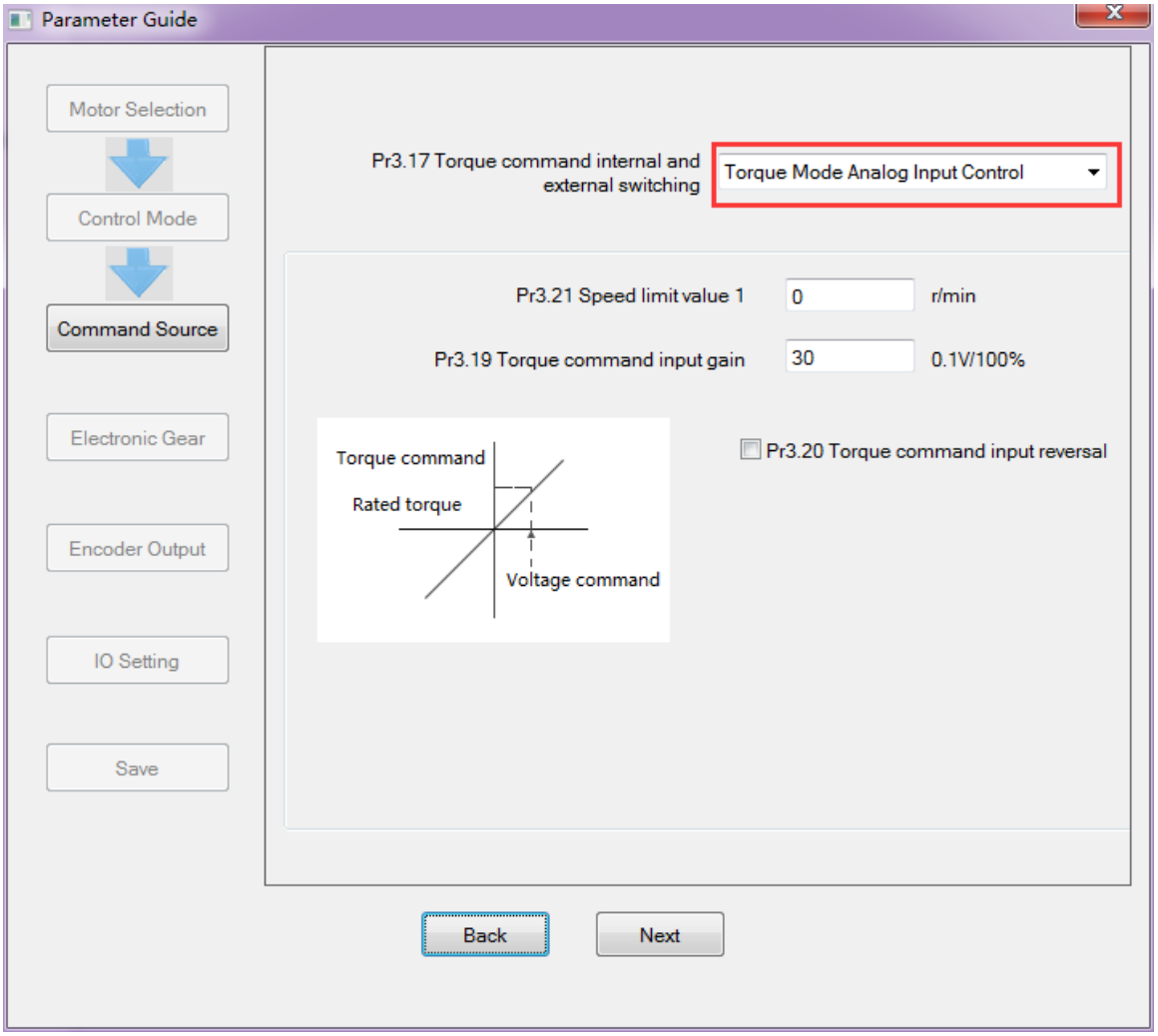
5.2.1 Setup progress—Control Mode window



In setup progress—Control Mode window， users need to set Pr0.01=2 to select Torque Mode.

5.2.2 Setup progress—Command Source window

Users need select the ***Torque Mode Analog Input Control*** as command resource for torque mode；**(待替换)**



5.2.3 Setup progress—IO Setting window

Then in setup progress—IO Setting(Input) window， users need select Pr4.00 SI1 as ***Servo ON Input*** to make motor enable.
Users can select SI2~SI9 input as other functions. Such as : ***Alarm clear***、***Positive limit***、***Negative limit*** . etc

Then in setup progress—IO Setting(Output) window，users can select SO1~SO6 output as other functions. Such as : ***Alarm output***、***Servo ready output*** . etc

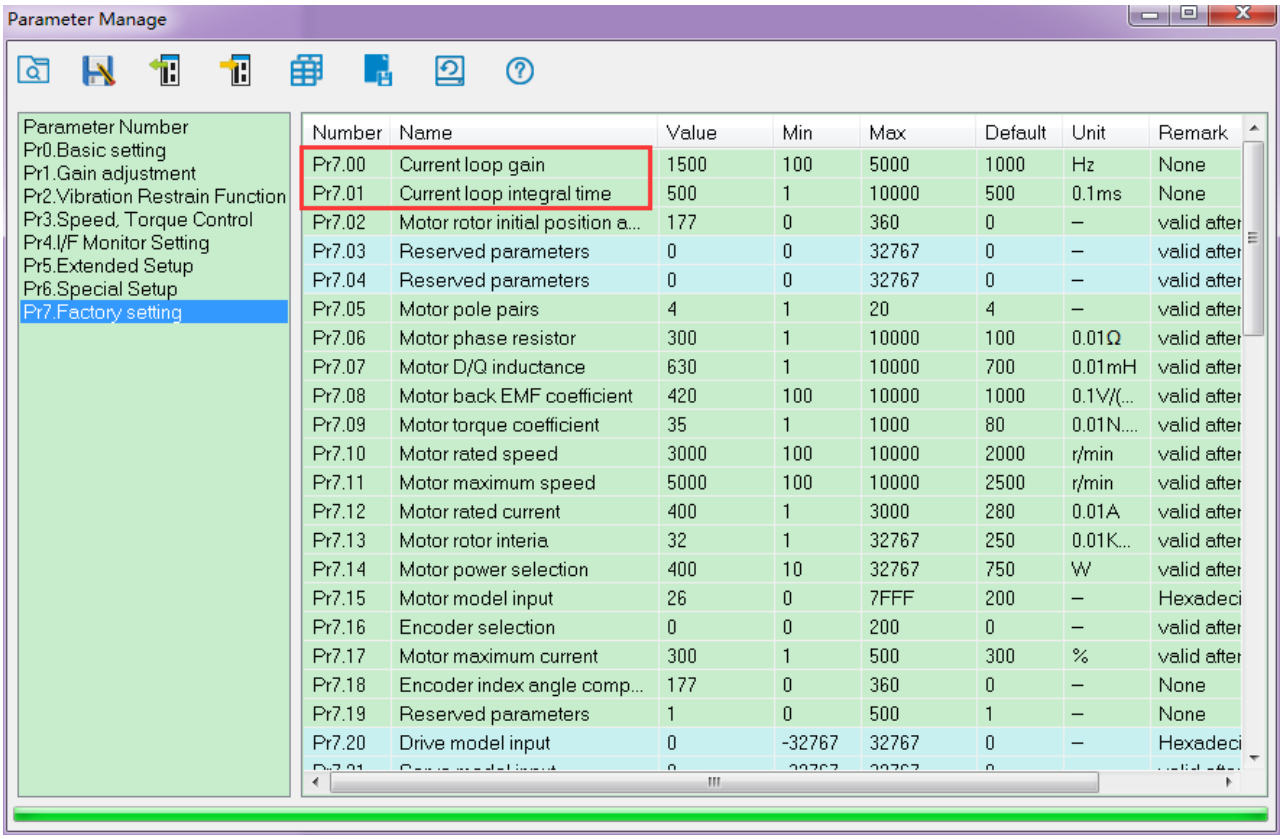
5.2.4 Save the setting

After the all the configuration， users should save the parameters into NVM.（Non-Volatile Memory）
Then users need to download and save the new settings to the driver, then restart the power supply or software reset to make new values of parameters valid .

5.2.5 Operation

When users have finished the above all of these parameters setting, users can give analog input AI3 signal to drive by CN1 port. The motor will work in torque mode, if users aren't satisfied with the performance of motor, users can continue adjusting related torque parameter.

About the tuning of current loop gain
Users can adjust the gain of current loop gain pr7.00 and current loop integral time pr7.01. in general , users can't see the parameter except pr7.15 and pr7.16, so refer to the appendix on how to find the hidden parameter.

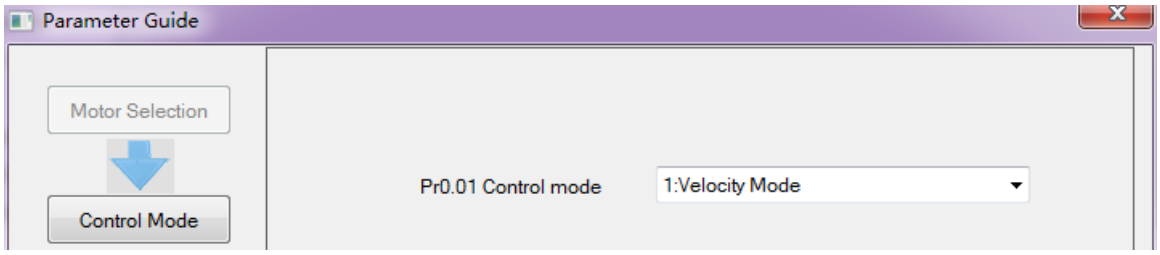


Number	Name	Value	Min	Max	Default	Unit	Remark
Pr7.00	Current loop gain	1500	100	5000	1000	Hz	None
Pr7.01	Current loop integral time	500	1	10000	500	0.1ms	None
Pr7.02	Motor rotor initial position a...	177	0	360	0	–	valid after
Pr7.03	Reserved parameters	0	0	32767	0	–	valid after
Pr7.04	Reserved parameters	0	0	32767	0	–	valid after
Pr7.05	Motor pole pairs	4	1	20	4	–	valid after
Pr7.06	Motor phase resistor	300	1	10000	100	0.01Ω	valid after
Pr7.07	Motor D/Q inductance	630	1	10000	700	0.01mH	valid after
Pr7.08	Motor back EMF coefficient	420	100	10000	1000	0.1V/(...	valid after
Pr7.09	Motor torque coefficient	35	1	1000	80	0.01N....	valid after
Pr7.10	Motor rated speed	3000	100	10000	2000	r/min	valid after
Pr7.11	Motor maximum speed	5000	100	10000	2500	r/min	valid after
Pr7.12	Motor rated current	400	1	3000	280	0.01A	valid after
Pr7.13	Motor rotor interia	32	1	32767	250	0.01K...	valid after
Pr7.14	Motor power selection	400	10	32767	750	W	valid after
Pr7.15	Motor model input	26	0	7FFF	200	–	Hexadeci
Pr7.16	Encoder selection	0	0	200	0	–	valid after
Pr7.17	Motor maximum current	300	1	500	300	%	valid after
Pr7.18	Encoder index angle comp...	177	0	360	0	–	None
Pr7.19	Reserved parameters	1	0	500	1	–	None
Pr7.20	Drive model input	0	-32767	32767	0	–	Hexadeci

5.3 Velocity mode

The command resource of velocity mode is ***Analog input / Internal Speed / Internal Speed and Analog***, via AI1 send ±10V analog input signal, in velocity mode, users can setup related parameters with velocity mode.

5.3.1 Setup progress—Control Mode window



In setup progress—Control Mode window， users need to set Pr0.01=1 to select Velocity Mode.

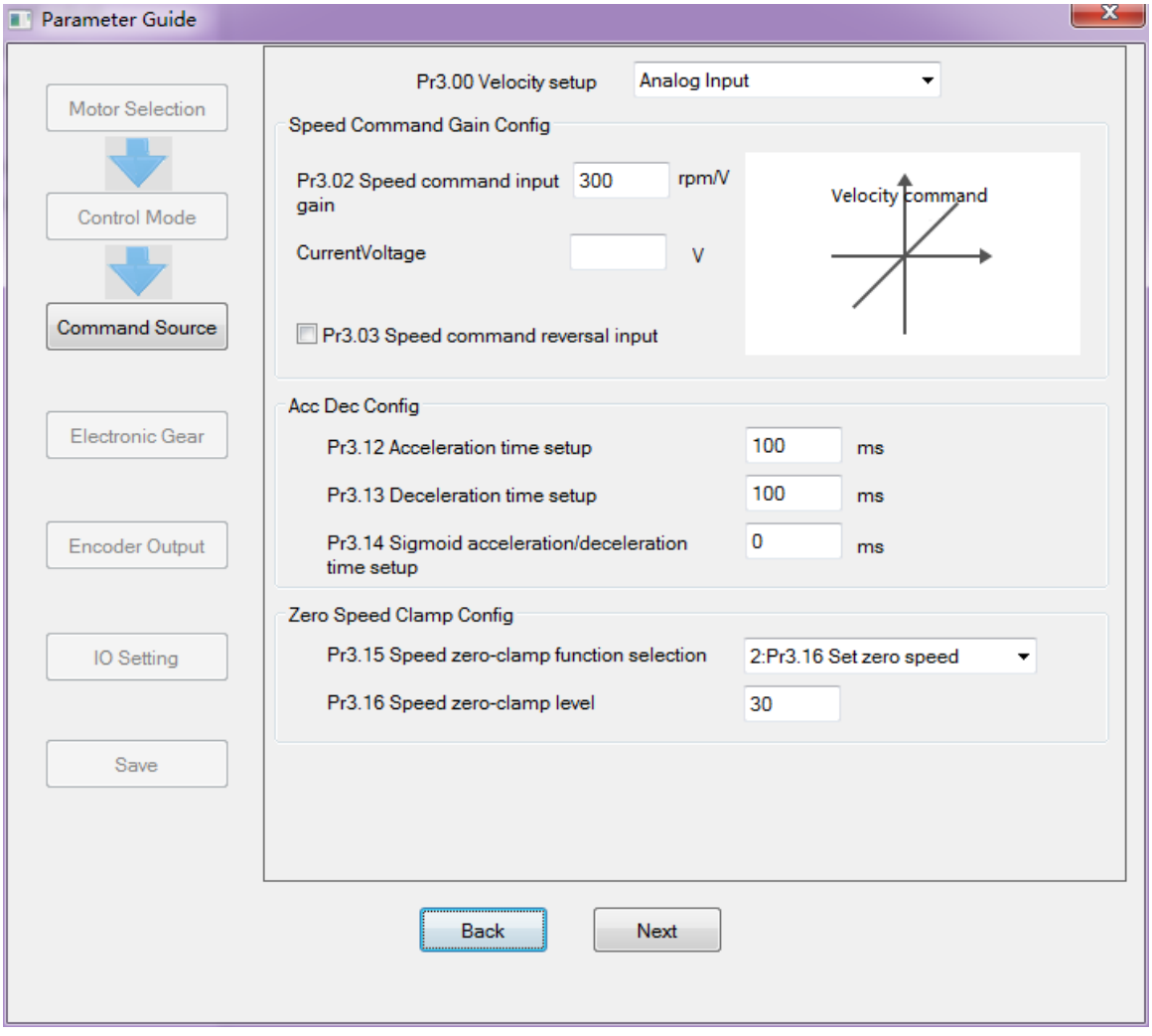
5.3.2 Setup progress—Command Source window

Users select the command resource for velocity mode

A : Select Pr3.00—Analog Input as velocity mode command resource

The command of speed mode is ***Analog Input***, via AI1 send ±10V analog input signal, in speed mode, we can setup related parameter with speed mode.

Then set other parameters related to Velocity Mode—Analog Input, such as Pr3.02 Speed command input gain、Pr3.12~Pr3.14(Acc and Dec)、Pr3.15 Speed zero-clamp function selection、Pr3.16 Speed zero-clamp level.



Pr3.00	Speed setup, Internal /External switching	Range	unit	default	Related control mode		
		0 -3	-	0		S	

This driver is equipped with internal speed setup function so that users can control the speed with contact inputs only.

Setup value	Speed setup method
0	Analog speed command(SPR)
1	Internal speed command 1st to 4th speed(PR3.04-PR3.07)
2	Internal speed command 1st to 3rd speed (PR3.04-PR3.06), Analog speed command(SPR)
3	Internal speed command 1st to 8th speed (PR3.04-PR3.11)

<relationship between Pr3.00 Internal/External switching speed setup and the internal command speed selection 1-3 and speed command to be selected>

Setup value	selection 1 of internal command speed(INTSPD1)	selection 2 of internal command speed (INTSPD2)	selection 3 of internal command speed (INTSPD3)	selection of Speed command
1	OFF	OFF	NO effect	1st speed
	ON	OFF		2nd speed
	OFF	ON		3rd speed
	ON	ON		4th speed
2	OFF	OFF	NO effect	1st speed
	ON	OFF		2nd speed
	OFF	ON		3rd speed
	ON	ON		Analog speed command
3	The same as [Pr3.00=1]		OFF	1st to 4th speed
	OFF	OFF	ON	5th speed
	ON	OFF	ON	6th speed
	OFF	ON	ON	7th speed

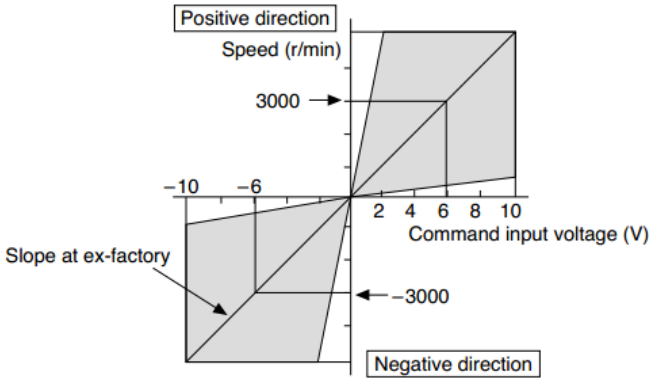
Pr3.02	Input gain of speed command	Range	unit	default	Related control mode		
		10 -2000	(r/min)/v	500		S	T

Based on the voltage applied to the analog speed command (SPR), set up the conversion gain to motor command speed.

Users can set up "slope" of relation between the command input voltage and motor speed, with Pr3.02. Default is set to Pr3.02=500(r/min)/V, hence input of 6V becomes 3000r/min.

Notice:

1. Do not apply more than ±10V to the speed command input(SPR).
2. When users compose a position loop outside of the driver while users use the driver in velocity control mode, the setup of Pr3.02 gives larger variance to the overall servo system.
3. Pay an extra attention to oscillation caused by larger setup of Pr3.02.



Pr3.03	Reversal of speed command input	Range	unit	default	Related control mode
		0 -1	-	0	S

Specify the polarity of the voltage applied to the analog speed command (SPR).

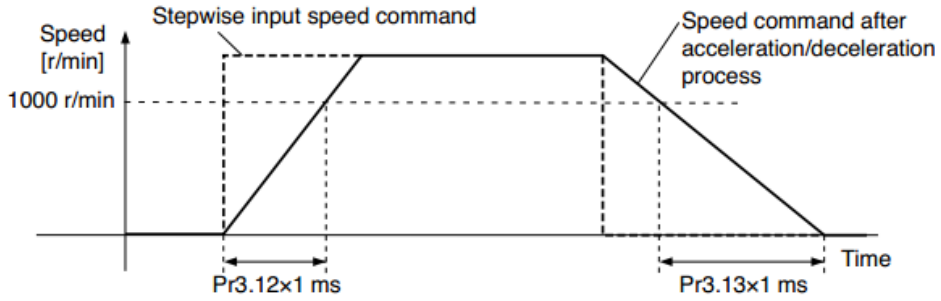
Setup value	Motor rotating direction	
0	Non-reversal	[+ voltage] →[+ direction] [- voltage] → [-direction]
1	reversal	[+ voltage] →[- direction] [- voltage] → [+direction]

Caution: When users compose the servo drive system with this driver set to velocity control mode and external positioning unit, the motor might perform an abnormal action if the polarity of the speed command signal from the unit and the polarity of this parameter setup does not match.

Pr3.12	time setup acceleration	Range	unit	default	Related control mode
		0 -10000	Ms(1000r/min)	100	S
Pr3.13	**time setup deceleration**	**Range**	**unit**	**default**	**Related control mode**
		0 -10000	Ms(1000r/min)	100	S

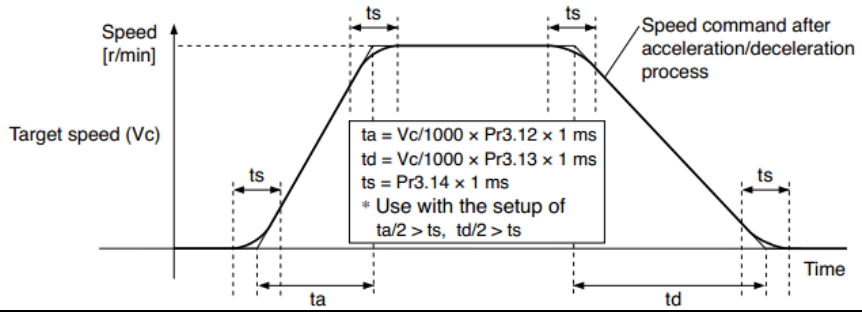
Set up acceleration/deceleration processing time in response to the speed command input.
Set the time required for the speed command(stepwise input)to reach 1000r/min to Pr3.12 Acceleration time setup. Also set the time required for the speed command to reach from 1000r/min to 0 r/min, to Pr3.13 Deceleration time setup.
Assuming that the target value of the speed command is Vc(r/min), the time required for acceleration/deceleration can be computed from the formula shown below.

Acceleration time (ms)=Vc/1000 *Pr3.12 *1ms
Deceleration time (ms)=Vc/1000 *Pr3.13 *1ms



Pr3.14	Sigmoid acceleration/deceleration time setup	Range	unit	default	Related control mode
		0 -1000	ms	0	S

Set S-curve time for acceleration/deceleration process when the speed command is applied.
According to Pr3.12 Acceleration time setup and Pr3.13 Deceleration time setup, set up sigmoid time with time width centering the inflection point of acceleration/deceleration.



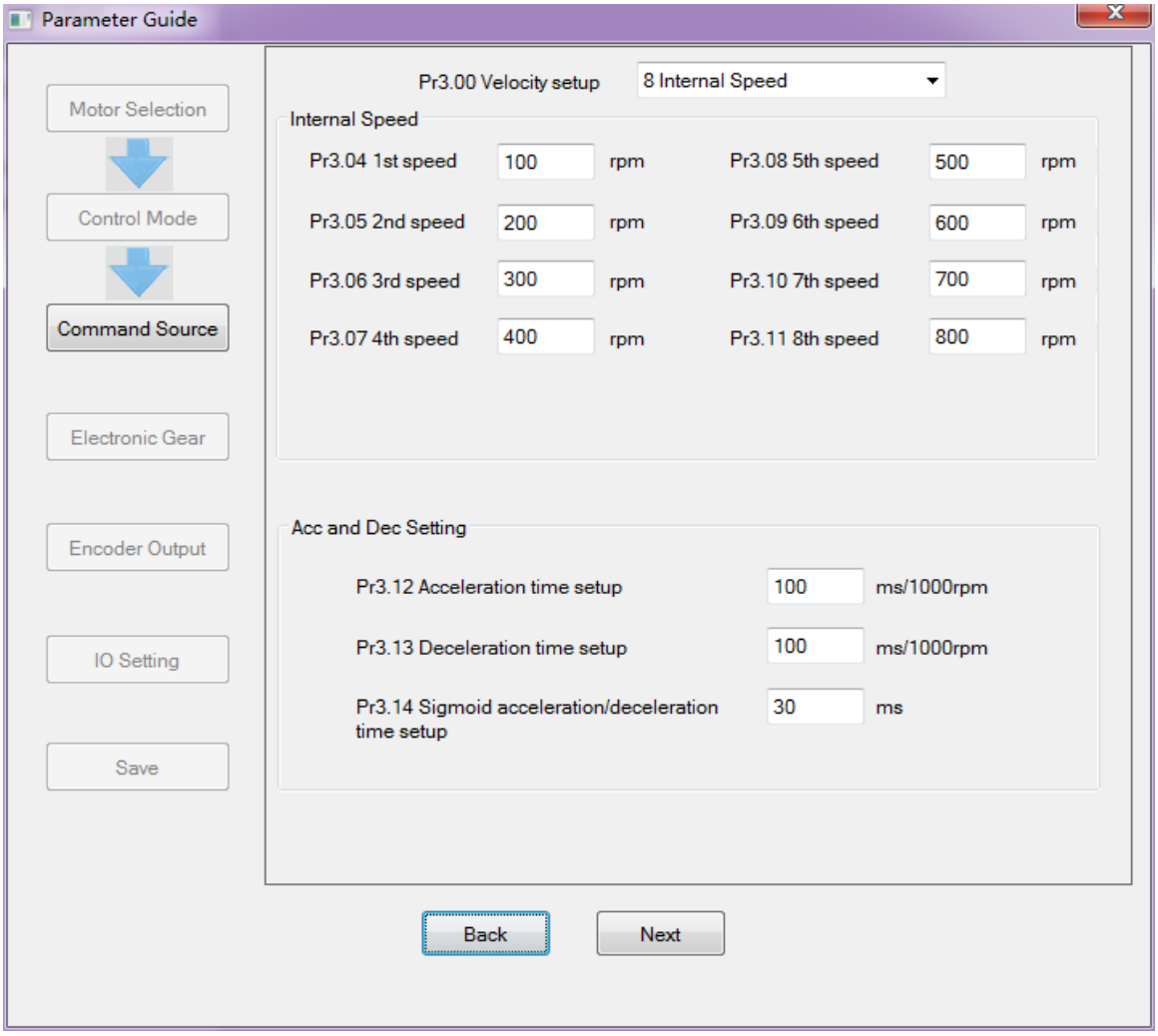
Pr3.15	Speed zero-clamp function selection	Range	unit	default	Related control mode
		0 -3	-	0	S

1. If Pr3.15=0, the function of zero clamp is forbidden. It means the motor rotates with actual velocity which is controlled by the analog voltage input 1 even if the velocity is less than 10 rpm. The motor runs no matter what the value of Pr3.16 is. The actual velocity is controlled by external the analog voltage input .
2. If Pr3.15=1 and the input signal of Zero Speed is available in the same time, the function of zero clamp works. It means motor will stop rotating in servo-on condition no matter what the velocity of motor is, and motor stop rotating no matter what the value of Pr3.16 is.
3. If Pr3.15=2 , the function of zero clamp belongs to the value of Pr3.16. If the actual velocity is less than the value of Pr3.16, the motor will stop rotating in servo-on condition.

Pr3.16	Speed zero-clamp level	Range	unit	default	Related control mode
		0 -20000	r/min	30	S

When analog speed given value under speed control mode less than zero speed clamp level setup, speed command will set to 0 strongly.

B : Select Pr3.00—8 Internal Speed as velocity mode command resource



Then set other parameters related to Velocity Mode—8 Internal Speed, such as Pr3.04~Pr3.11、Pr3.12~Pr3.14(Acc and Dec)

5.3.3 Setup progress—IO Setting window

A、For Analog Input as velocity mode command resource

In setup progress—IO Setting(Input) window ， users need select Pr4.00 SI1 as ***Servo ON Input*** to make motor enable.

Users can select SI2~SI9 input as other functions. Such as : ***Alarm clear***、***Positive limit***、***Negative limit*** . etc

In setup progress—IO Setting(Output) window， users can select SO1~SO6 output as other functions. Such as : ***Alarm output***、***Servo ready output*** . etc

B、For 8 Internal Speed as velocity mode command resource

In setup progress—IO Setting(Input) window ， users need select Pr4.00 SI1 as ***Servo ON Input*** to make motor enable.

Users need select SI2~SI4 inputs as ***Selection 1~3 input of internal command speed***

Selection 1 of internal command speed(INTSPD1)	Selection 2 of internal command speed (INTSPD2)	Selection 3 of internal command speed (INTSPD3)	Selection of Speed command
OFF	OFF	OFF	1st speed
ON	OFF	OFF	2nd speed
OFF	ON	OFF	3rd speed
ON	ON	OFF	4th speed
OFF	OFF	ON	5th speed
ON	OFF	ON	6th speed
OFF	ON	ON	7th speed
ON	ON	ON	8th speed

Users can select SI5~SI9 input as other functions. Such as : ***Alarm clear***、***Positive limit***、***Negative limit*** . etc

In setup progress—IO Setting(Output) window， users can select SO1~SO6 output as other functions. Such as : ***Alarm output***、***Servo ready output*** . etc

5.3.4 Save the setting

After the all the configuration， users should save the parameters into NVM.（Non-Volatile Memory）
Then users need to download and save the new settings to the driver, then restart the power supply or software reset to make new values of parameters valid .

5.3.5 Operation

When users have finished the above all of these parameters setting .

A、For Analog Input as velocity mode command resource

Users can give analog input AI1 signal to drive by CN1 port. The motor will work in speed mode, if users aren't satisfied with the performance of motor, users can continue adjusting related speed parameter.

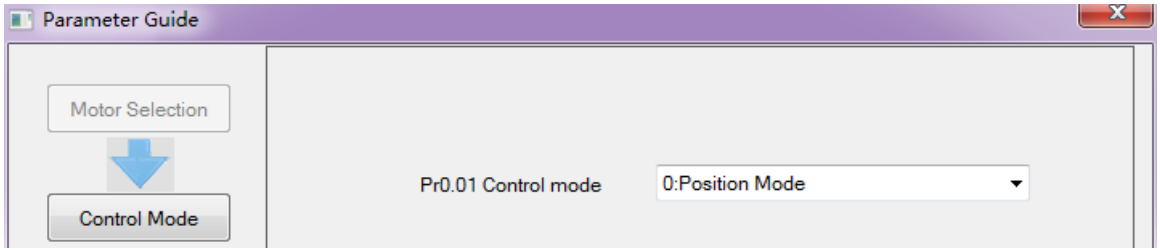
B、For 8 Internal Speed as velocity mode command resource

Users can select one of 8 internal speed by SI inputs signal of CN1 port. The motor will work in speed mode, if users aren't satisfied with the performance of motor, users can continue adjusting related speed parameter.

5.4 Position mode

The command resource of velocity mode is ***Pulse+Direction / CW + CCW / A + B phase*** , in position mode, users can setup related parameter with position mode.

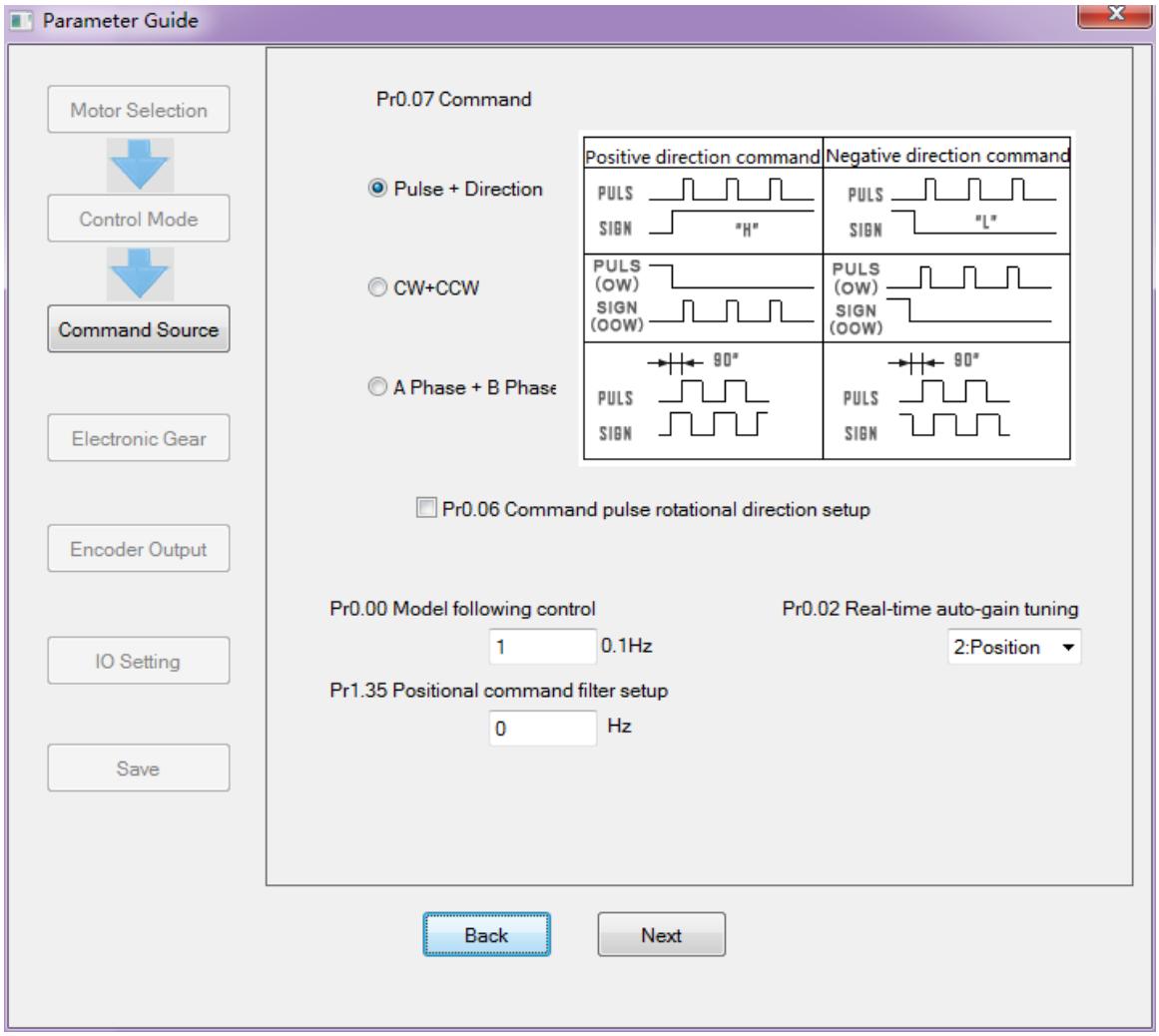
5.4.1 Setup progress—Control Mode window



In setup progress—Control Mode window， users need to set Pr0.01=0 to select Position Mode.

5.4.2 Setup progress—Command Source window

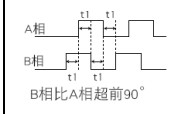
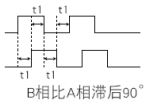
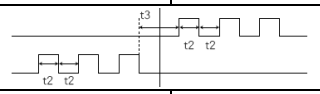
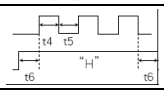
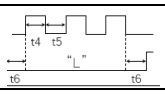
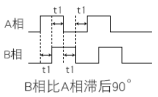
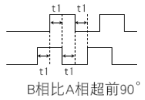
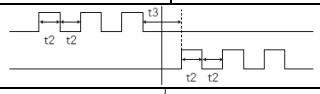
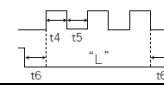
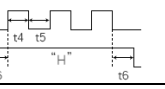
Users select the command resource for position mode



Then set other parameters related to Position Mode, such as Pr0.06 Command Pulse Rotational Direction Setup、Pr0.00 Mode loop gain、Pr0.02 Real-time Auto-gain Tuning、Pr1.35 Positional command filter setup.

Pr0.06*	Command Pulse Rotational Direction Setup	Range	unit	default	Related control mode		
		0 -1	-	0	P		
Set command pulse input rotate direction, command pulse input type							

Pr0.07*	Command Pulse Input Mode Setup	Range	unit	default	Related control mode		
		0 -3	-	3	P		

Pr0.06	Pr0.07	Command Pulse Format	Signal	Positive Direction Command	Negative Direction Command
0	0 or 2	90 phase difference 2-phase pulse(A phase +B phase)	Pulse sign		
	1	Positive direction pulse + negative direction pulse	Pulse sign		
	3	Pulse + sign	Pulse sign		
1	0 or 2	90 phase difference 2 phase pulse(A phase +B phase)	Pulse sign		
	1	Positive direction pulse + negative direction pulse	Pulse sign		
	3	Pulse + sign	Pulse sign		

Command pulse input signal allow largest frequency and smallest time width

PULS/SIGN Signal Input I/F		Permissible Max. Input Frequency	Smallest Time Width					
			t1	t2	t3	t4	t5	t6
Pulse series interface	Long distance interface	500kpps	2	1	1	1	1	1
	Open-collector output	200kpps	5	2.5	2.5	2.5	2.5	2.5

Pr0.00	Mode loop gain	Range	unit	default	Related control mode		
		0 -2000	0.1Hz	0	P	S	T

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

MFC is used to enhance the performance of dynamic tracing for input command , make positioning faster , cut down the tracking error , run more smooth and steady . It is very useful for multi-axis synchronous movement and interpolation, the performance will be better.

The main way to use this function :

a. Choose the right control mode : Pr001 = 0
b. Set up the inertia of ratio : Pr004
c. Set up the rigidity : Pr003
d. Set up the Pr000 :
   1) If no multi-axis synchronous movement , set Pr000 as 1 or more than 10 ;
   2) If multi-axis synchronous movement needed , set Pr000 as the same for all the axes .
   3) If Pr000 is more than 10 , start with 100 , or 150 , 200 , 250 , …. .

Caution:

1. Set up the right control mode , the right inertia of ratio and rigidity firstly .
2. Don't change the value of Pr000 when the motor is running , otherwise vibration occurs
3. 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

Pr0.02	Real-time Auto-gain Tuning	Range	unit	default	Related control mode		
		0 -2	-	0	P	S	T

Users can set up the action mode of the real-time auto-gain tuning.

Setup value	mode	Varying degree of load inertia in motion
0	Manual	Real-time auto-gain tuning function is disabled.
1	Standard	Basic mode. do not use unbalanced load, friction compensation or gain switching
2	Position	Main application is positioning. it is recommended to use this mode on equipment without unbalanced horizontal axis, ball screw driving equipment with low friction, etc.

Caution: If pr0.02=1 or 2 , users can't modify the values of pr1.01 – pr1.13, the values of them depend on the real-time auto-gain tuning ,all of them are set by the driver itself.

Users can select different operation mode in real-time automatic adjustment mode, generally select Locate mode. If users want to adjust gain parameter by yourself, users can select Manual mode, then users can adjust related parameter step by step until system requirement.

Users can adjust position loop gain, velocity integration time constant and ratio of inertia for tunning position loop tuning. If users need stronger rigid, users only need adjust ratio of inertia, then adjust gain and integration

In **Manual** mode, users can setup Kp, Ki and other related parameters. During tuning position loop, users can adjust KI to a very small value in advance and hold it constant, then users can enlarge the value of Kp parameter slowly until system oscillation occurs, at this moment users can enlarge the value of Vi parameter slowly until system oscillation occurs, at this moment the basic adjustment of system finished.

In **Position** mode. It is unavailable to modify the value of pr1.00- 1.14, we just change the value of real-time automatic adjustment rigid, firstly we select a smaller value.

Pr1.35*	positional command filter setup	Range	unit	default	Related control mode		
		0 -200	0.05us	0	P		

Do filtering for positional command pulse, eliminate the interference of the narrow pulse, over-large setup will influence the input of high frequency positional command pulse, and make more time-delayed.

5.4.3 Setup progress—Electronic Gear window

Pr0.08	Command pulse counts per one motor revolution	Range	unit	default	Related control mode		
		0-8388 608	pulse	0	P	S	T

Set the command pulse that causes single turn of the motor shaft.
1) If Pr008≠0 , the actual turns = pulse number / Pr008
2) If Pr008 = 0 , Pr009 1st numerator of electronic gear and Pr0.10 Denominator of electronic Gear become valid.

When the transmission structure is screw:

Pulses per round = Screw lead / Pulse equivalent

When the transmission structure is rack and pinion:

Pulses per round = (Modulus*Number of pinion*Helical angle*3.1415627) / (Gear ratio*Pulse equivalent)

Pr0.09	1st numerator of electronic gear	Range	unit	default	Related control mode		
		1-10737 41824	-	1	P		

Set the numerator of division/multiplication operation made according to the command pulse input.

Pr0.10	denominator of electronic gear	Range	unit	default	Related control mode		
		1-10737 41824	-	1	P		

Set the denominator of division/multiplication operation made according to the command pulse input.

Pr0.09	Pr0.10	Command division/multiplication operation
1-10737 41824	1-10737 41824	Command pulse input → 【Pr0.09 set value】 / 【Pr0.10 set value】 → position command

1、Settings：

(1)The driver input command pulse number is X

(2)The pulse number of encoder after frequency division and frequency doubling is Y

(3)The number of pulses per revolution of the motor encoder is Z

(4)Number of turns of motor is W

2、Calculations：

(1)Y=X* Pr0.09 / Pr0.10

(2)17Bit encoder: Z=2^17 = 131072

23Bit encoder: Z=2^23 = 8388608

5.4.4 Setup progress—Encoder Output window

The output pulses counts per motor revolution = Pulses Per Round / 4

5.4.5 Setup progress—IO Setting window

In setup progress—IO Setting(Input) window ， users need select Pr4.00 SI1 as ***Servo ON Input*** to make motor enable.

Users can select SI2~SI9 input as other functions. Such as : ***Alarm clear***、***Positive limit***、***Negative limit*** . etc

In setup progress—IO Setting(Output) window， users can select SO1~SO6 output as other functions. Such as : ***Alarm output***、***Servo ready output*** . etc

5.4.6 Save the setting

After the all the configuration， users should save the parameters into NVM.（Non-Volatile Memory） Then users need to download and save the new settings to the driver, then restart the power supply or software reset to make new values of parameters valid .

5.4.7 Operation

When users have finished the above all of these parameters setting .

Users can give signal to drive by CN1 port. The motor will work in position mode, if users aren't satisfied with the performance of motor, users can continue adjusting related speed parameter.

5.5 Performance adjustment

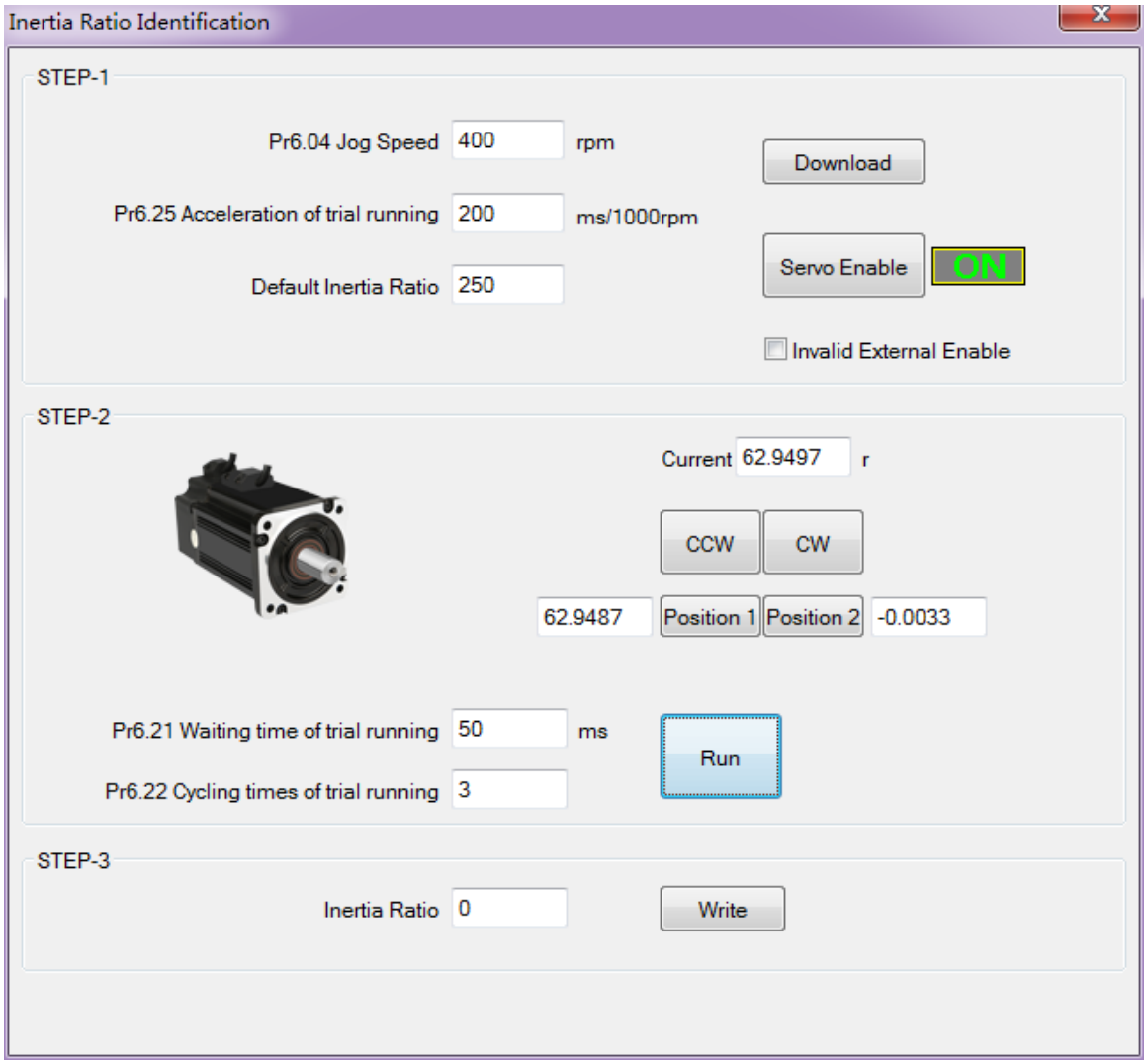
5.5.1 Inertia ratio identification

Pre-conditions：1、Servo disable.　2、Positive limit and negative limit invalid

Steps:

1、Set the Jog speed Pr6.04, and the setting should not be too large(600~1000rpm is recommend)
Set the Acc Pr6.25(50~100 ms/1000rpm is recommend)
Set the Default Inertia Ratio.
Download these settings, then ***Servo Enable***.

2、Click "CCW" to make motor run to CCW direction，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.



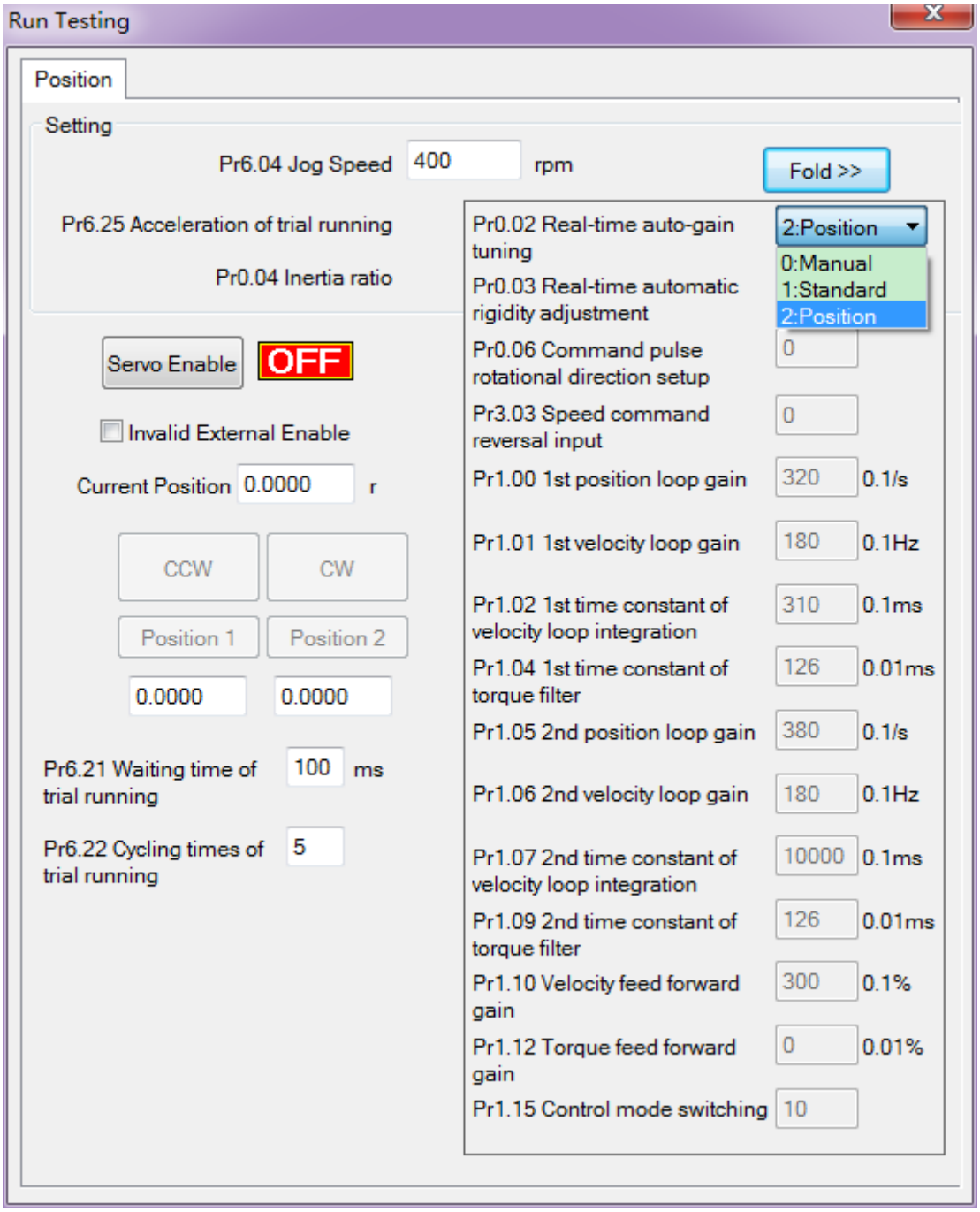
3、After finishing，Click "Write" to save the Inertia ratio identification result

5.5.2 Gain adjustment

To tuning for better performance, users need turning position loop parameters. Users need to open ***Run Testing*** window.

Users can select different operation mode in real-time automatic adjustment mode, generally select **Position** mode. If users want to adjust gain parameters by yourself, users can select **Manual** mode, then users can adjust related parameter step by step until meet system requirement.

Users can adjust position loop gain, velocity integration time constant and ratio of inertia for position loop tuning. If users need stronger rigid, users only need adjust ratio of inertia, then adjust gain and integration



In **Manual** mode(Pr0.02=0), users can setup Kp, Ki and other related parameters. During tuning position loop, users can adjust KI to a very small value in advance and hold it constant, then users can enlarge the value of Kp parameter slowly until system oscillation occurs, at this moment users can enlarge the value of Vi parameter slowly until system oscillation occurs, at this moment the basic adjustment of system finished.

In **Standard** mode(Pr0.02=1), it is usually for interpolation movement. It is unavailable to modify the value of Pr1.00- 1.14, we just change the value of Pr0.03 real-time automatic adjustment rigid.

In **Position** mode(Pr0.02=2), it is usually for point to point movement. It is unavailable to modify the value of Pr1.00- 1.14, we just change the value of Pr0.03 real-time automatic adjustment rigid.

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

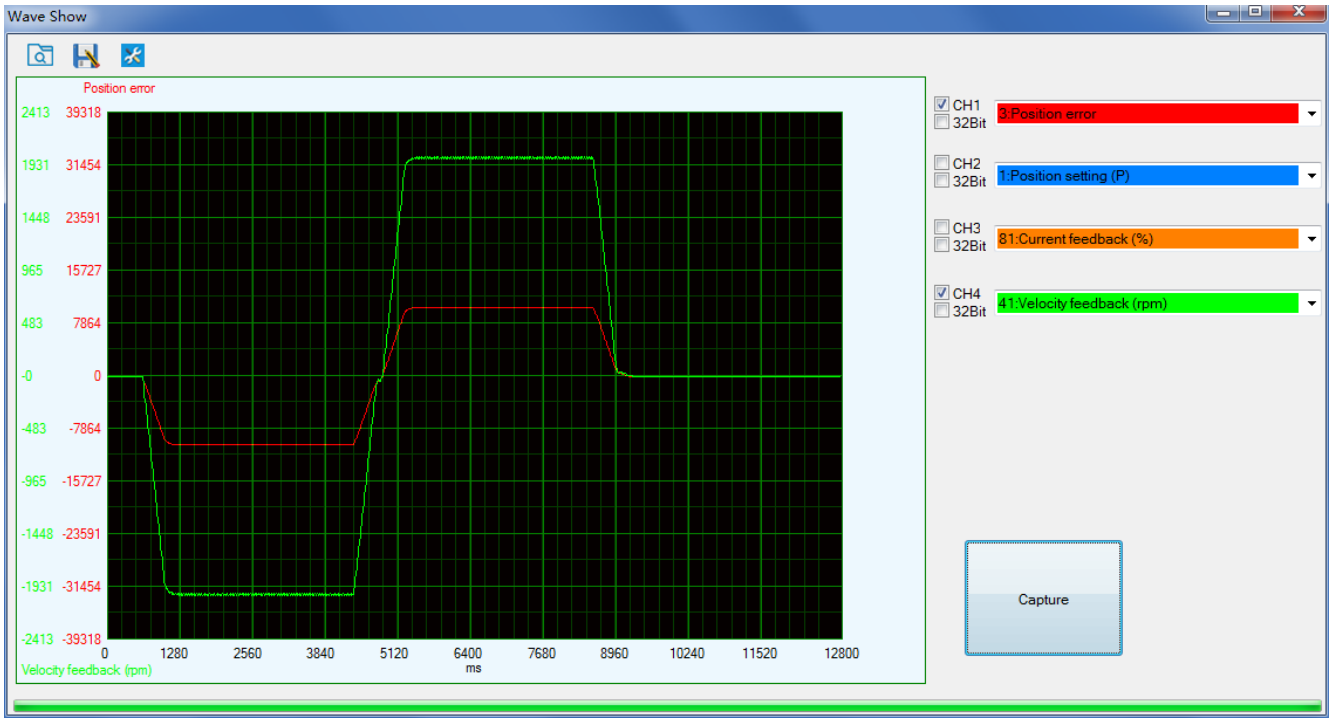
Low ⟶ Servo gain ⟶ High

81.80·····70.69.68·····51.50

Low ⟶ Response ⟶ High

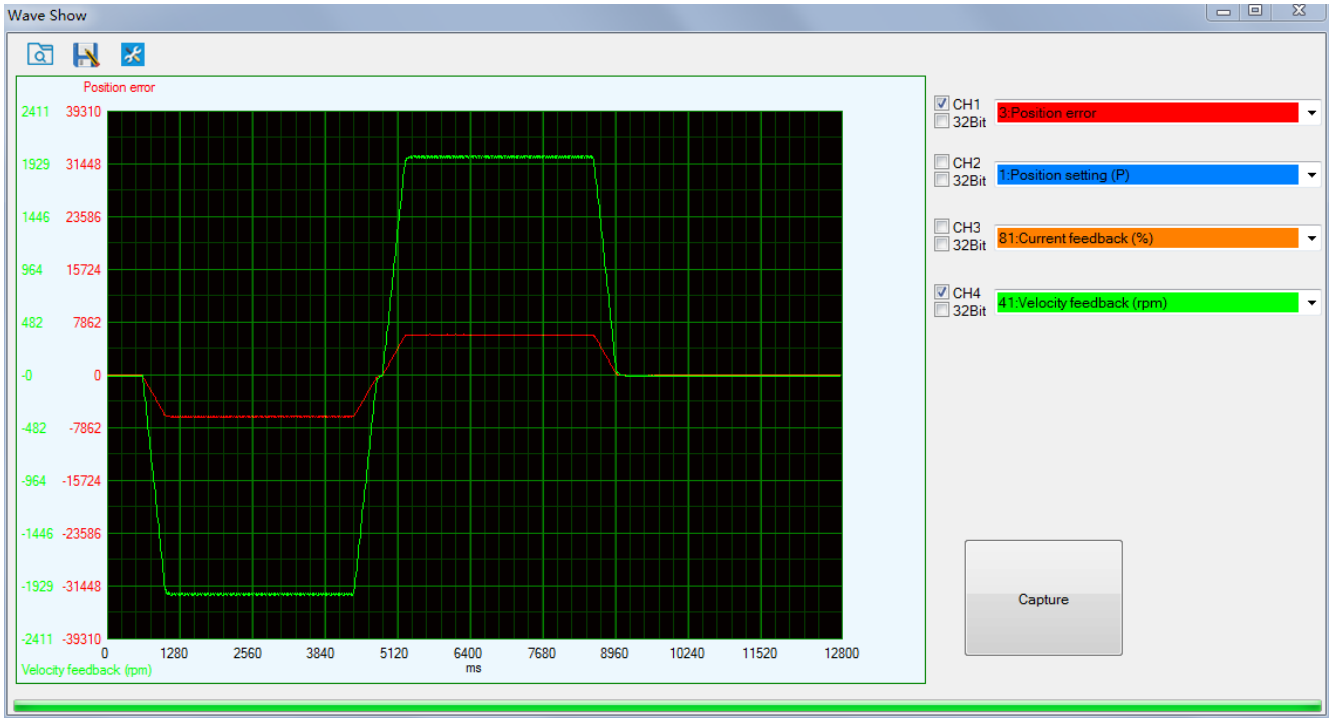
Notice: Lower the setup value, higher the velocity response and servo stiffness will be obtained. However, when decreasing the value, check the resulting operation to avoid oscillation or vibration. Control gain is updated while the motor is stopped. If the motor can't be stopped due to excessively low 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.

The following figure showing Pr0.02=2, Pr0.03=70, the position error (curve in red) is unacceptable!

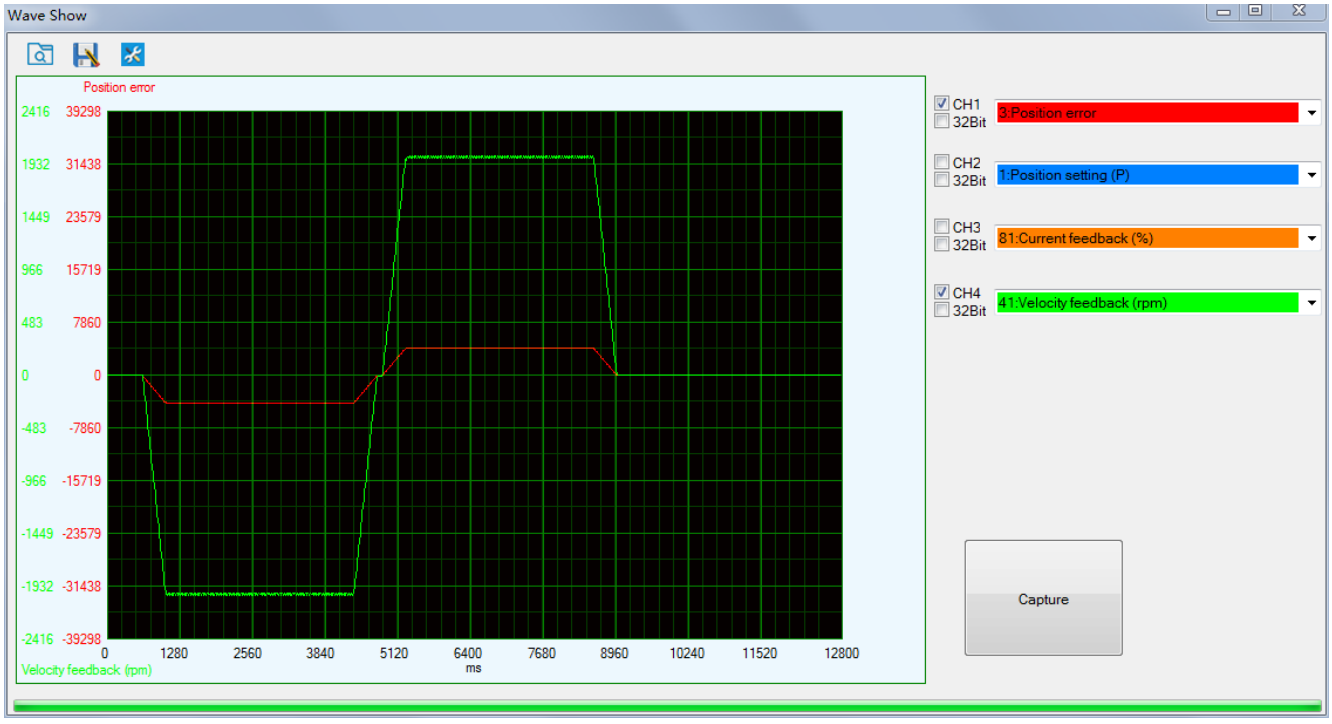


Then we continue decreasing value of Pr0.03, then the position error become smaller and smaller.

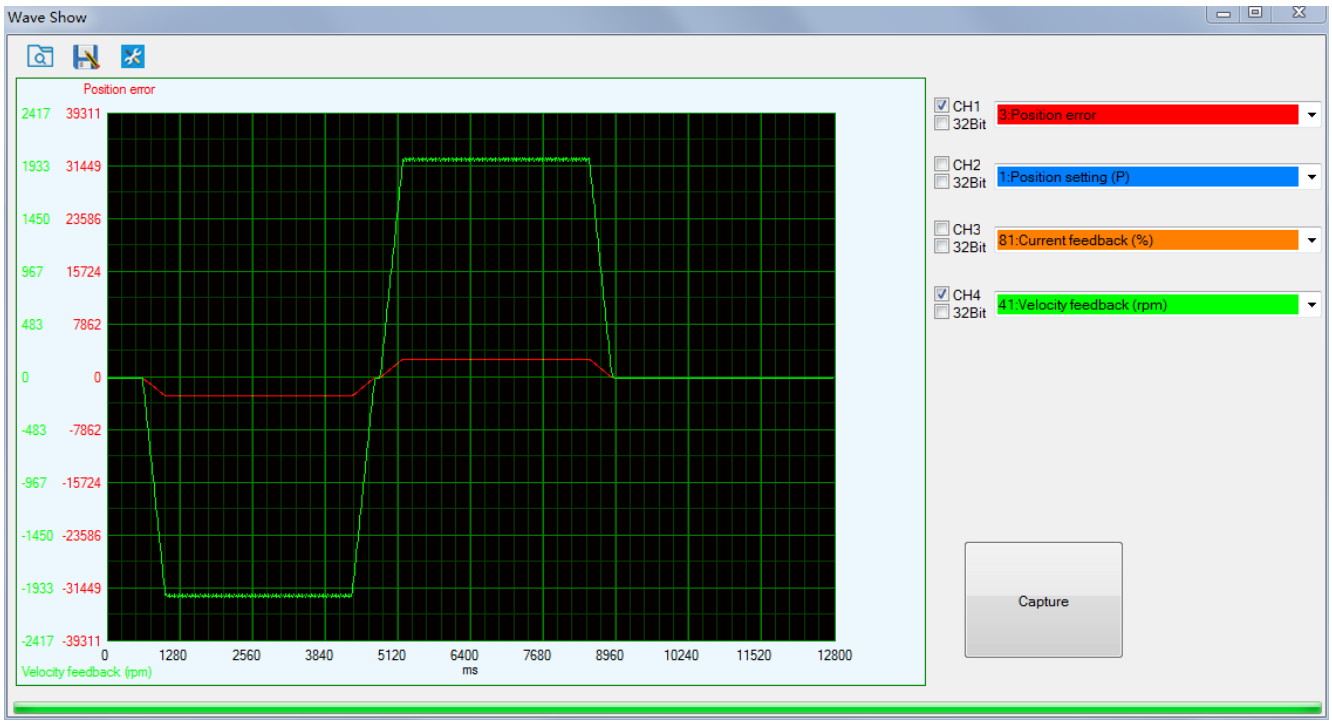
Pr0.03=68



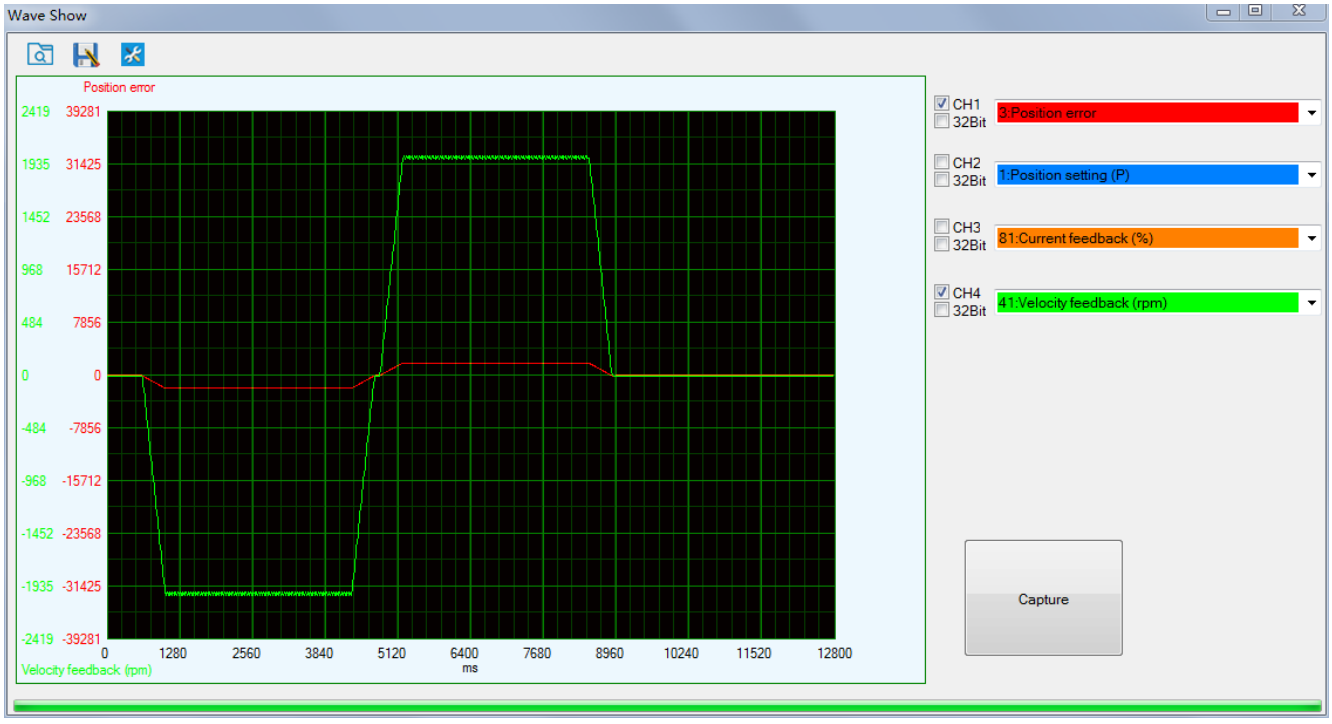
Pr0.03=66



Pr0.03=64

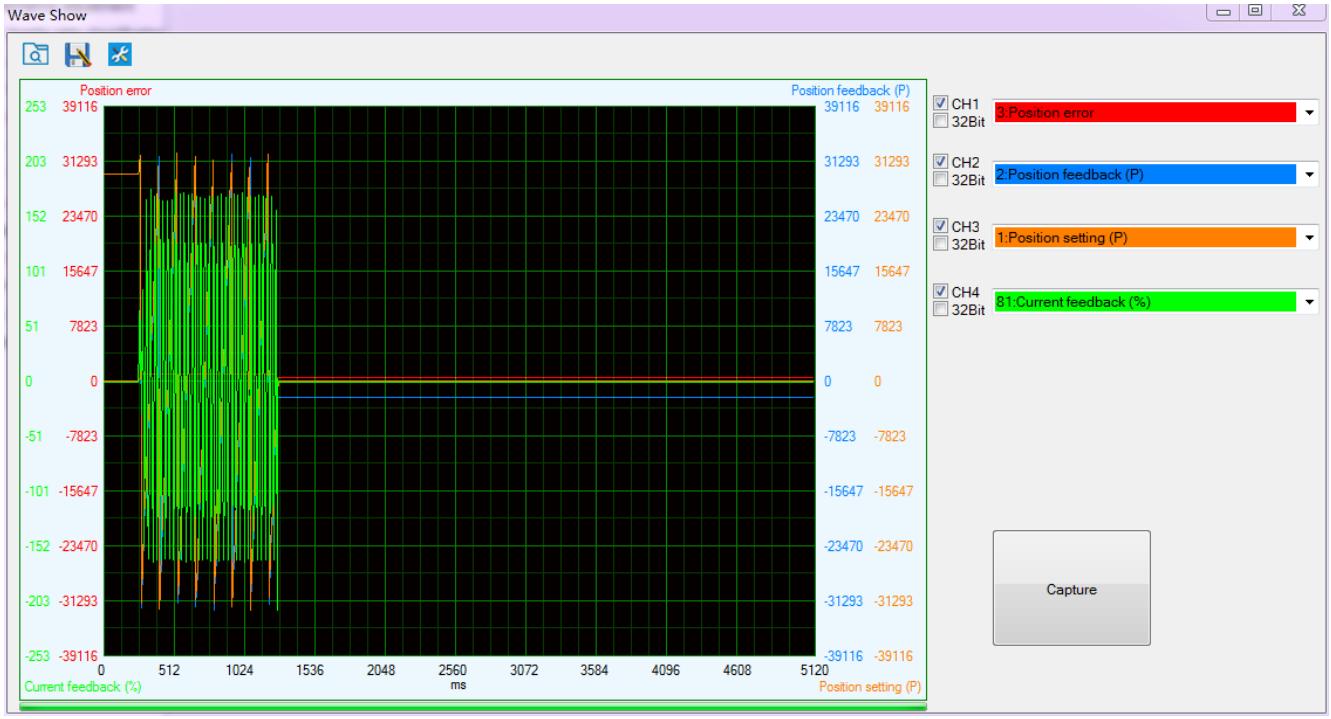


Pr0.03=62



As we continue decreasing the value pf Pr0.03, then the position loop gain Kp become bigger and bigger, the integration time constant Vi become smaller and smaller, the position error become close to zero.

Pr0.03=61



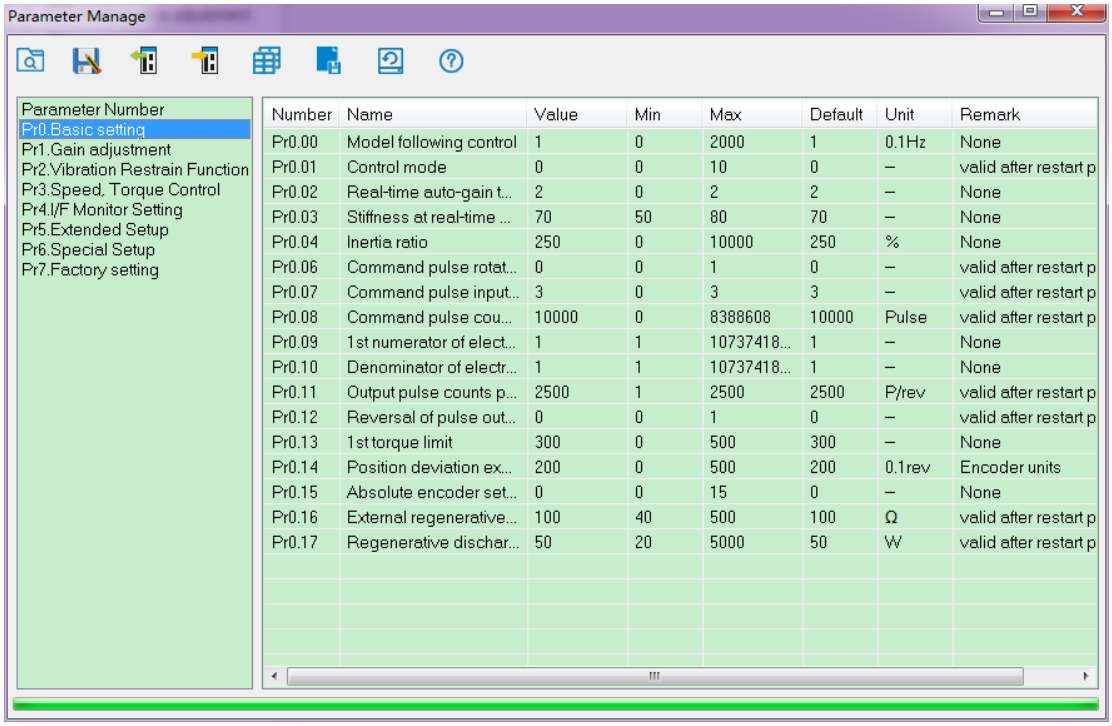
The noise of motor occurs and alarm occurs if the position loop gain becomes bigger, so just make sure there is no noise.

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

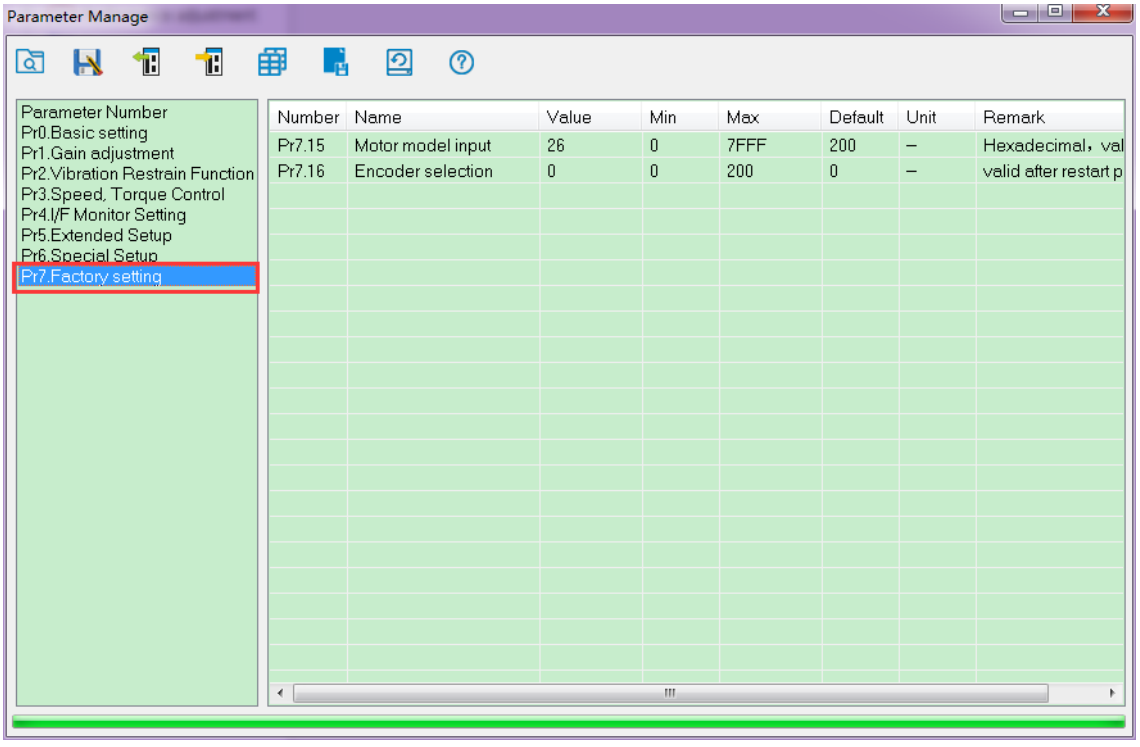
Appendix

How to find the hidden parameter of ProTuner

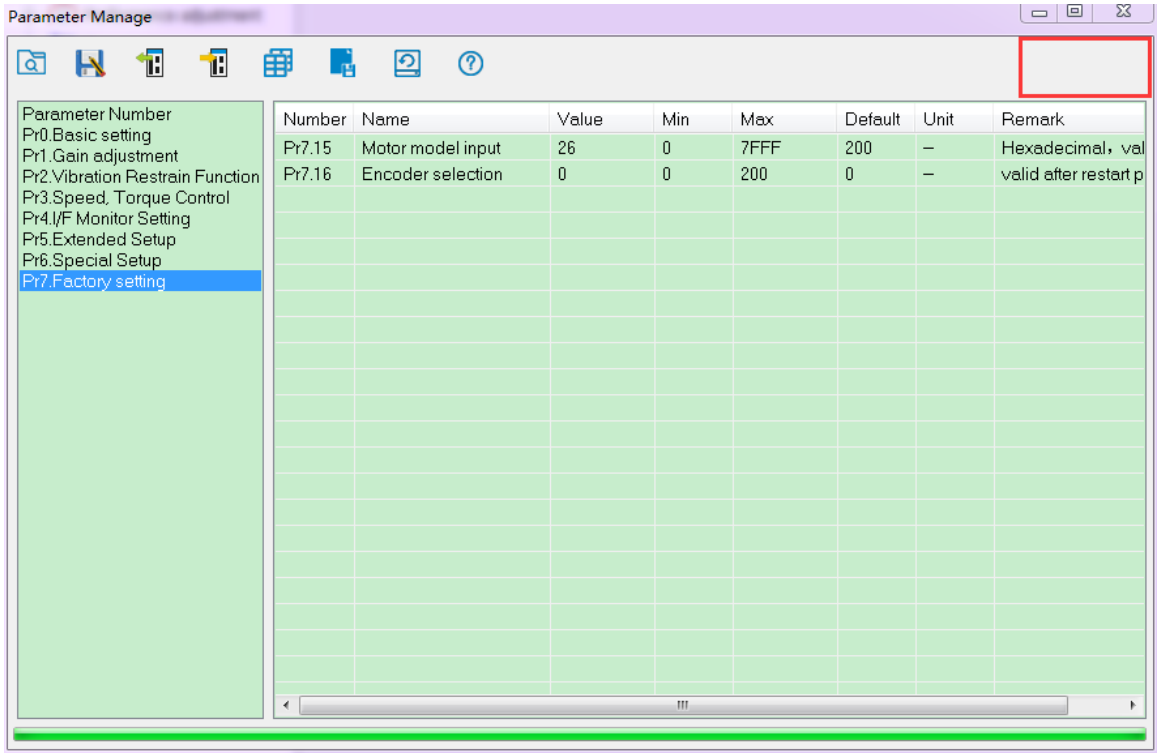
1. Run the software of ProTuner , we just find part of the parameter :



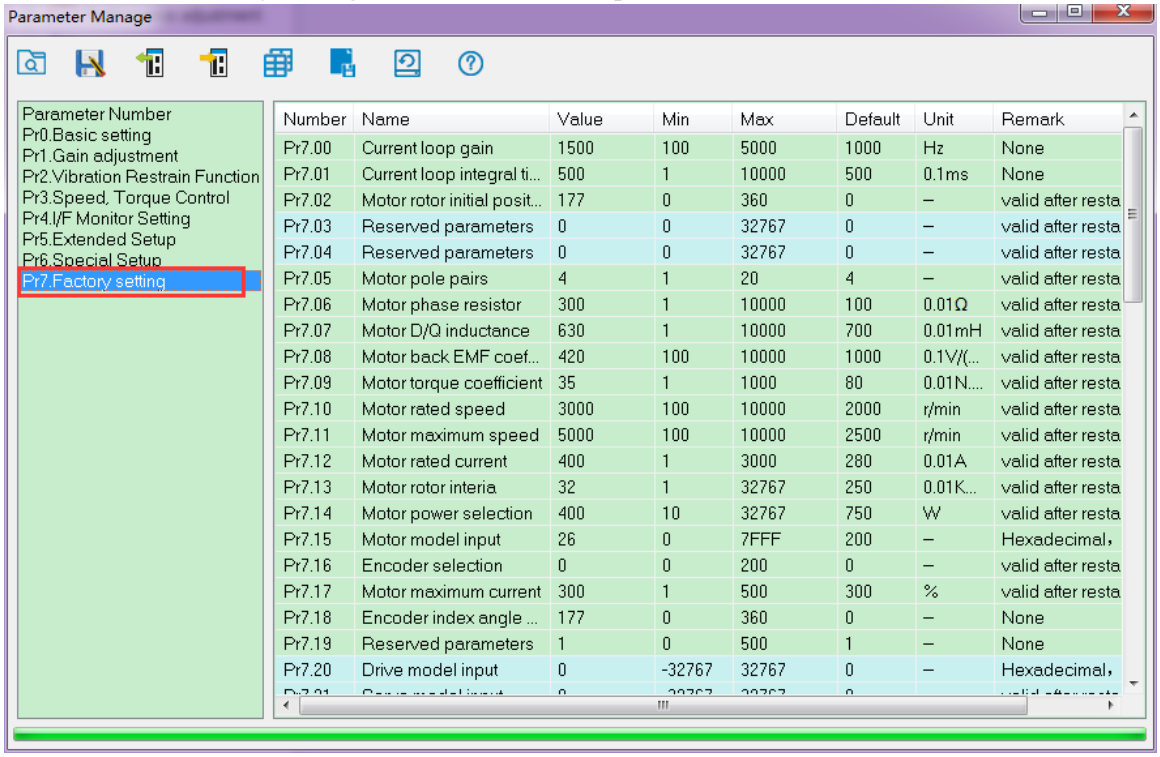
2. Now here is the way to find all of them :
   a. Click “Factory setting” :



b. Click “here” 5 times:



c. Then click “ Factory Setting” ,then we can find all parameters:



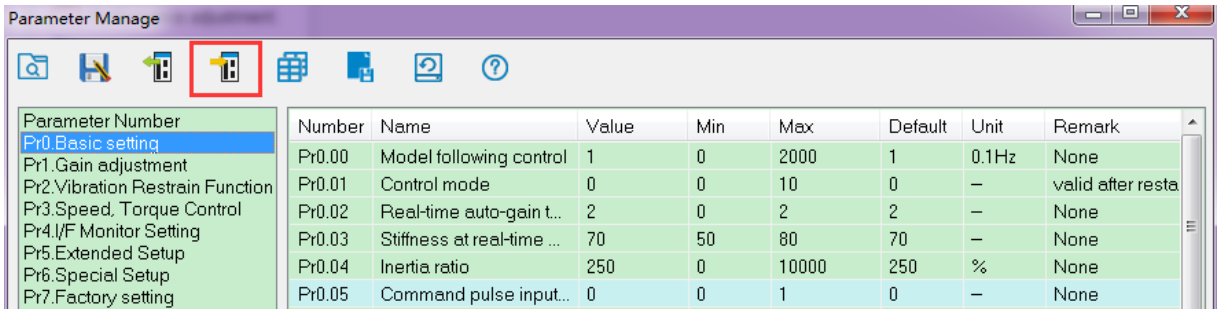
If users restart the software ProTuner , just make the same steps above.

How to modify the new values of parameter to the driver

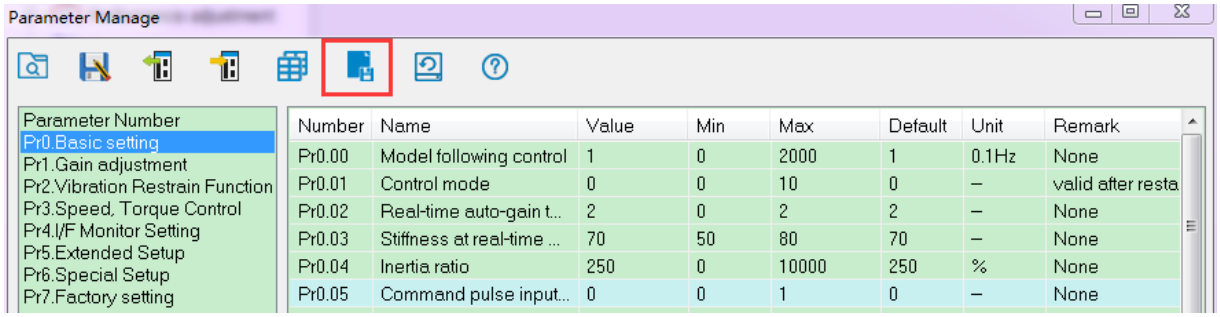
Sometimes, we need to restart the driver to make it available after modifying the values of parameter, so it is very important to follow the right step. Users need to do the operation with the steps below:

1. Modify the value of parameter.

2. Click "download ":



3. Click "save":



4. Then users can power off the driver and restart it again, or users can ***Software Reset*** to make the new parameters setting valid.

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