

Working with Motion Studio

AC Servo Drive



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Before we start

Please prepare the following items before we start to work with Motion Studio.

1. Leadshine AC Servo Drive (EL6/ELP/EL7 Series)
2. Leadshine AC Servo Motor (Recommended by Leadshine to be matched with driver)
3. Data cable
 - a. Ethernet-to-DB9 female– For EL6 series AC servo drives
 - b. Mini-USB – For ELP/EL7 series AC servo drives
(Please mind that a charging cable might not be able to transfer data.)
4. Motor power cables (**Direct** or **Aviation** connector depending on motor models)
5. Encoder cables(**Direct** or **Aviation** connector depending on motor models)
6. Motion Studio. Can be downloaded on our website www.leadshine.com

System requirement to run Motion Studio

Operating system: Windows XP or above

CPU: 1.5GHz or above

RAM: 256MB or above

Hard disk capacity: 10GB or above

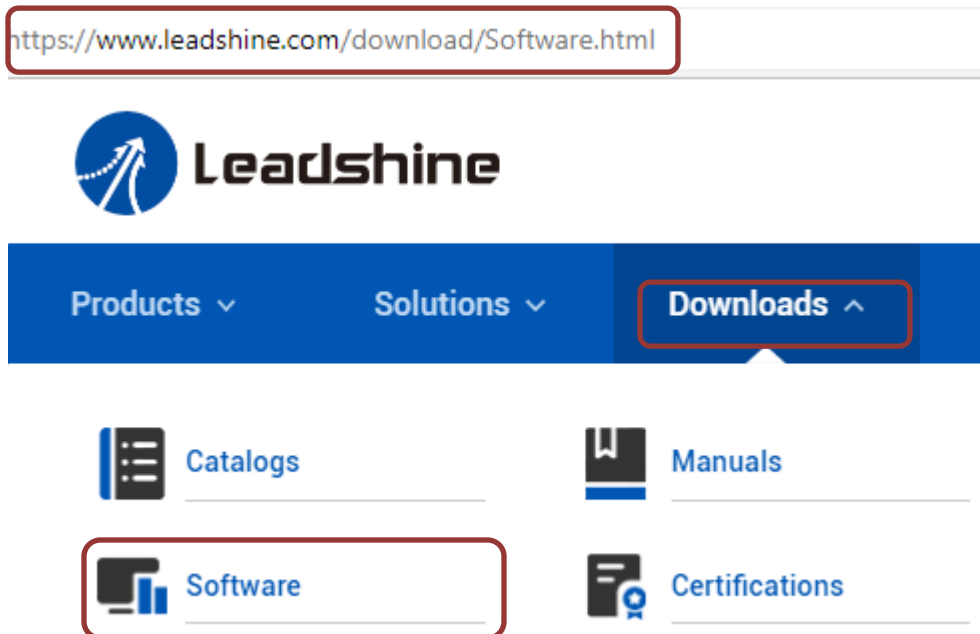
Display: Resolution 1024*768, color 24 bit

Communication interface: USB Type-A series adapter


Introduction

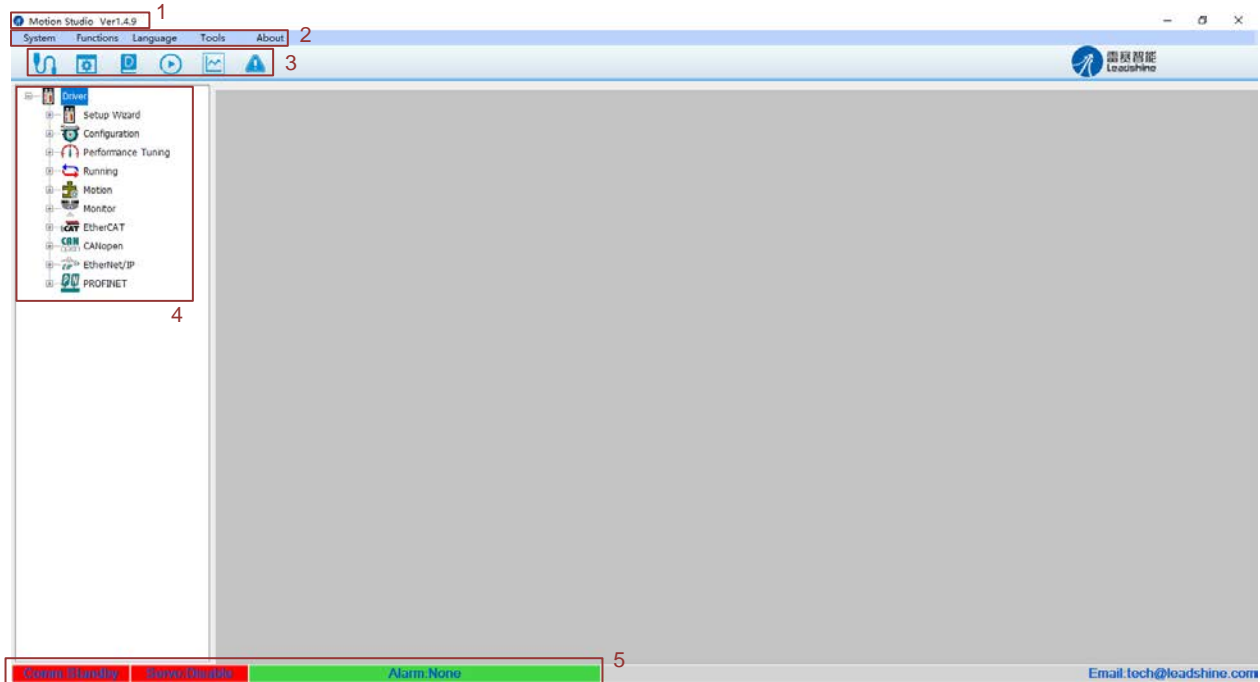
Motion Studio is a free-to-use software developed by Leadshine Technology Co., Ltd. for simple commissioning of Leadshine AC servo products. Through Motion Studio, users can connect the drivers to PC for parameters reading & writing, system performance tuning, trial run, driver status & data monitoring and much more. Most of the functions can be realized without connecting the driver to a main power supply.

There is no need to install Motion Studio. Download “MotionStudio_ACServo” for designated Leadshine products on our website and unzip the file. Click on MotionStudio.exe to start the software. User manual for Motion Studio can be found in Help folder. It is recommended to save Motion Studio in other disks than C: drive.



Getting started with Motion Studio

After unzipping “MotionStudio_ACServo”, click on  **MotionStudio.exe** to start Motion Studio.









Motion Studio Workspace

① Motion Studio software version

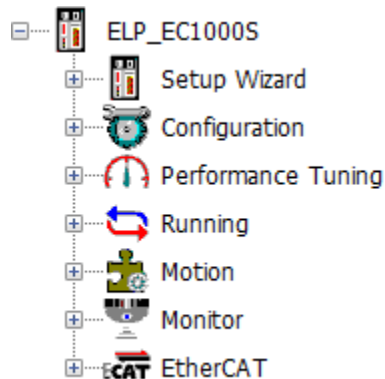
② Pull-down menu

System	<ul style="list-style-type: none"> ▪ To connect to servo drives ▪ To exit software
Functions	<ul style="list-style-type: none"> ▪ To save modified parameters ▪ To reset software ▪ To login to admin's rights
Languages	<ul style="list-style-type: none"> ▪ To switch between Chinese and English display languages
Tools	<ul style="list-style-type: none"> ▪ Serial Port Tool ▪ USB Tool ▪ Object Dict Tool ▪ Register Tool
About	<ul style="list-style-type: none"> ▪ Platform info ▪ User manual

③ Quick Access buttons

	Connect	<ul style="list-style-type: none"> To connect or disconnect servo drives in online or offline mode To check information of connected servo products
	Parameters List	<ul style="list-style-type: none"> To read/write, modify, compare servo drive parameters To save parameters files as backup. To restore parameters back to factory default
	Object Dictionary	<ul style="list-style-type: none"> To read/write, modify, compare servo drive objects. To save object dictionary as backup To configure PDO To restore objects back to factory default.
	Trial Run	<ul style="list-style-type: none"> To test run servo products after connected to driver and motor (Need to connect to main power supply) To run inertia identification
	Scope	<ul style="list-style-type: none"> To capture driver data waveforms To read captured driver's data
	Alarm Info	<ul style="list-style-type: none"> To check current occurrence of error or alarm historical records To check the cause(s) of motor stops running

④ Navigation tree




Driver model no. will appear on top of the navigation tree. Branches of the navigation tree will adapt according to the communication protocol of the connected servo drive. For example, servo drives with EtherCAT communication protocol will only have EtherCAT appearing on the navigation tree.

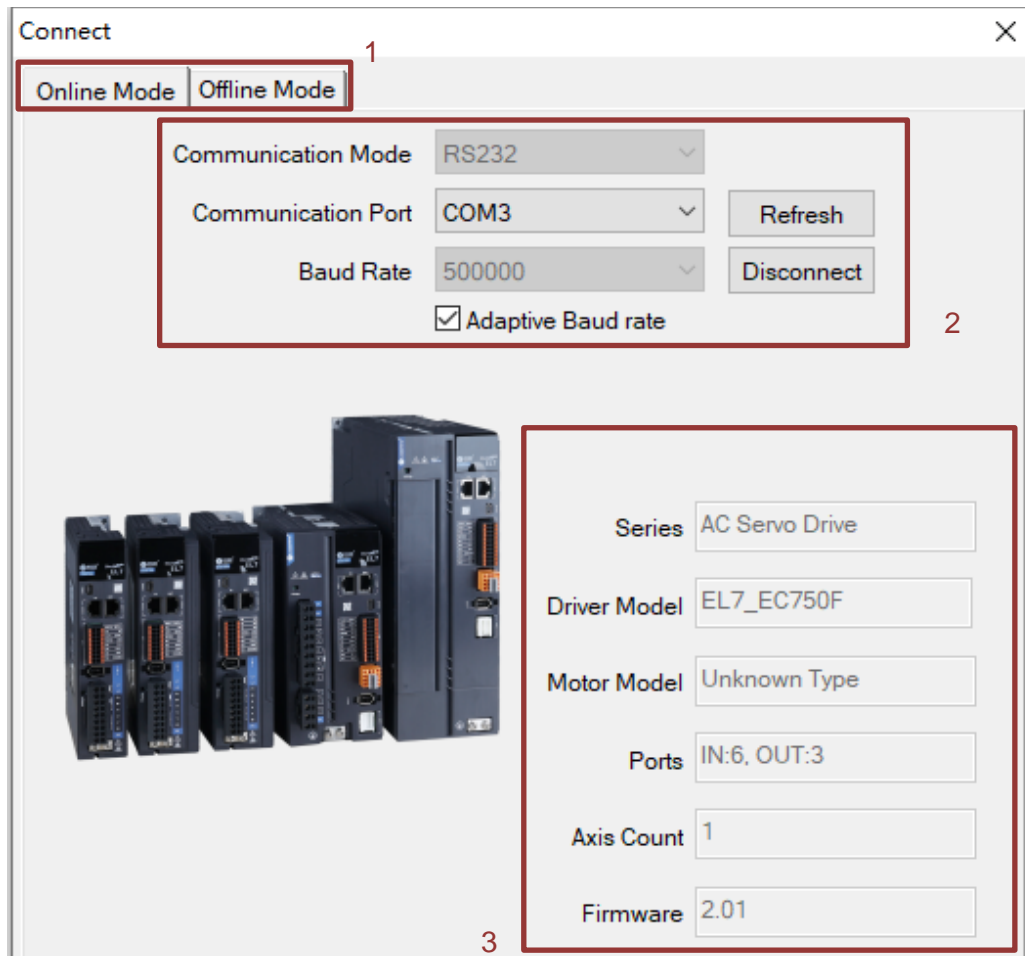
Branches and their extension functions will be explained in following chapters of the manual.

⑤ Status bar


Comm	To show connection status of the servo drive <ul style="list-style-type: none"> Standby (Red) – No driver connected yet Online (Green) – Driver successfully connected.
Servo	To show the status of the servo drive <ul style="list-style-type: none"> Disable (Red) – Servo drive is powered-off. Enable (Green) - Servo drive is powered-on.
Alarm	To show alarm status <ul style="list-style-type: none"> None (Green) – No alarm Other (Red) – Servo error occurs.

Connect to Servo Drive

1. Click on .
2. “**Connect**” pop-up window will appear.

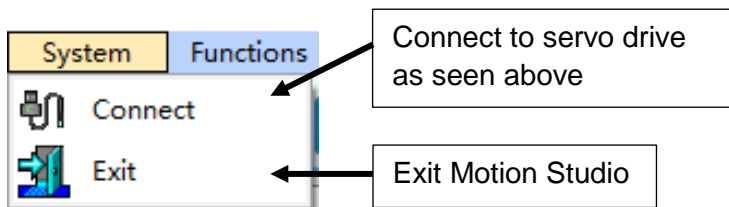


①	<ul style="list-style-type: none"> ▪ Online mode: Driver and motor connecting to USB port automatically identified ▪ Offline mode: Use offline mode to read parameters saved in PC.
②	<ul style="list-style-type: none"> ▪ Only RS232 communication mode is supported for the moment being. ▪ Communication Port can be automatically identified by clicking on “Refresh”. If driver failed to connect, please verify data cable or change to another USB port. ▪ Check “Adaptive Baud rate” and click on “Connect” to connect to servo products. <p><i>Driver can be connected to PC without main power supply.</i></p>
③	<ul style="list-style-type: none"> ▪ Servo products info such as series, model no., ports, axis count and firmware version can be found here.

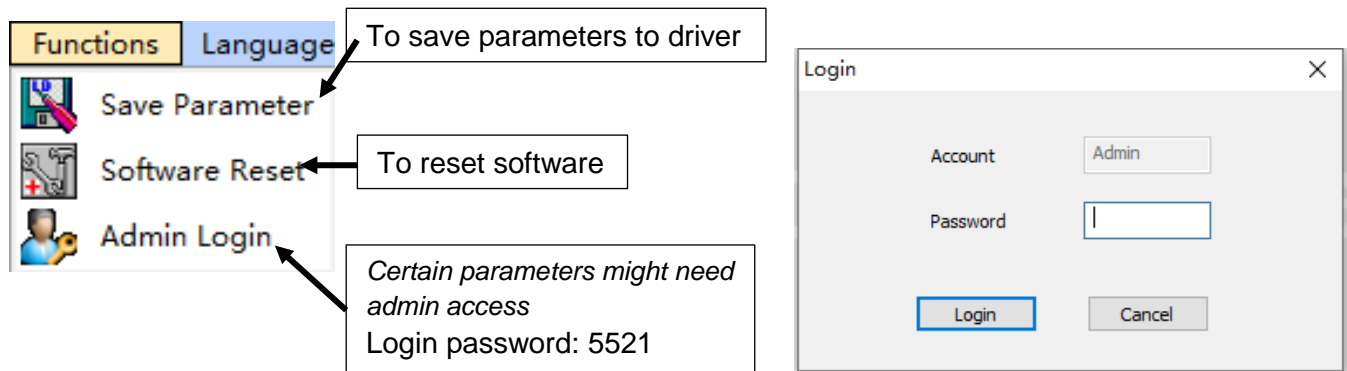
3. When servo drive is connected to PC through data cable, **USb** will appear on the front panel of the servo drive. Err0D2 will appear due to no main power supply connected, it doesn't affect most tuning works of the servo drive.
4. Once successfully connected, Comm on status bar will turn green with "Comm: Online".

5. Connect window will close automatically in 3s after successfully connected.
6. If connection failed, please verify:
 - a. Data cable. Charging cable might not be able to transfer data.
 - b. Change another USB port.
 - c. Any alarm error which needs to be reset.

Pull-down Menu

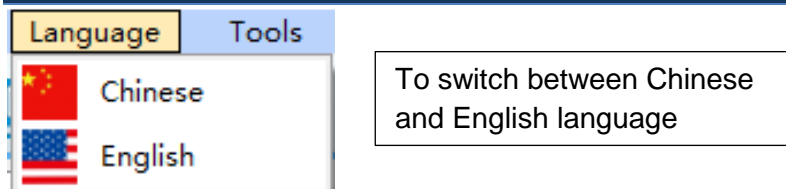
System



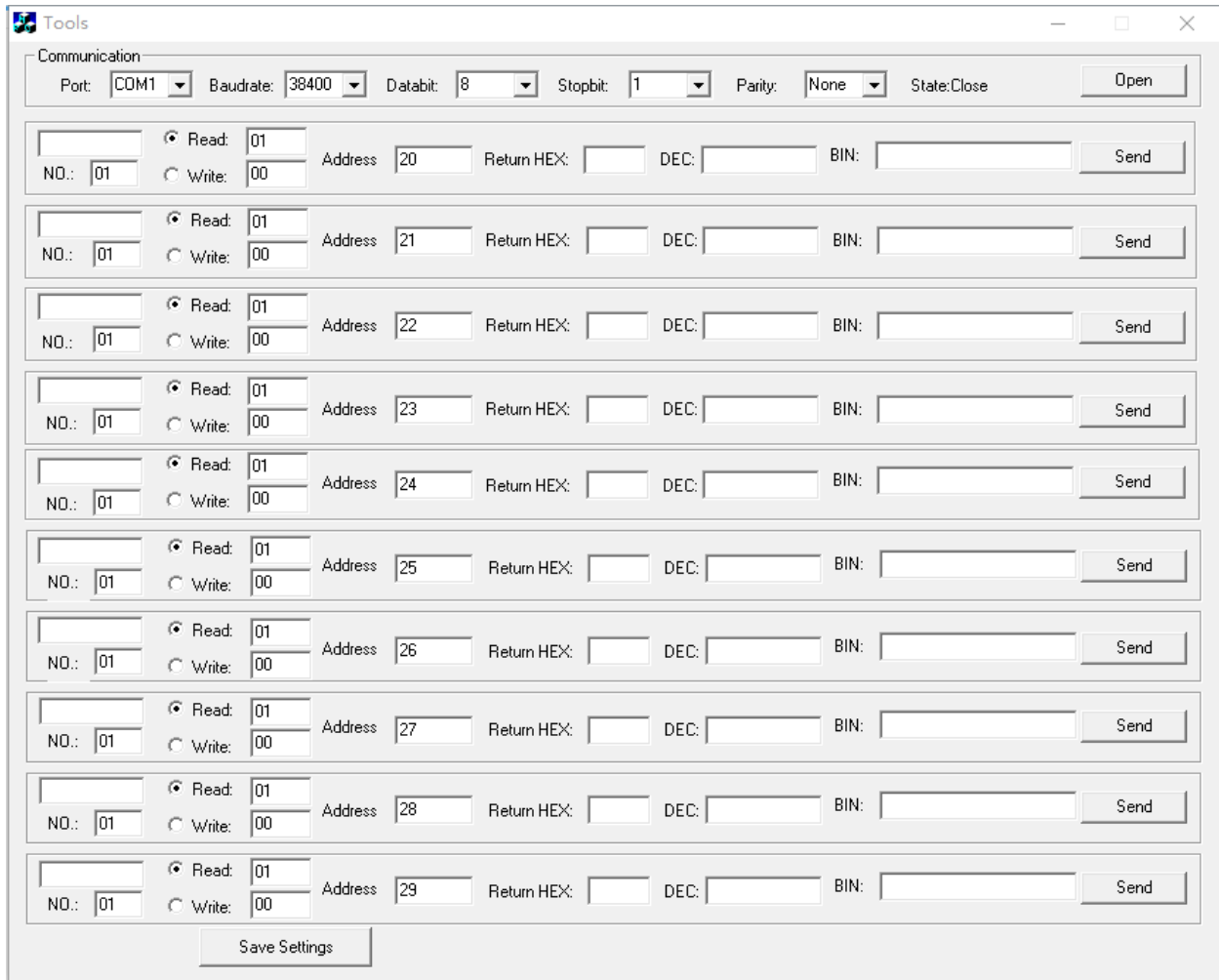
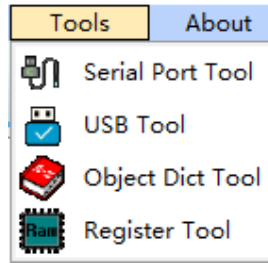
Functions



Language



Tools



USB Debug Tool

Init

Driver No.:

Address(Dec):

Simple R/W

Return:

Write: Return:

Batch Size R/W

len = 0

(Hex) len = 0

Object Dictionary Tool

Object Dictionary Region

Index(HEX) SubIndex(HEX)

Value(HEX) Value(DEC) Error Code(HEX)

Object Dictionary Region 1

Index(HEX) SubIndex(HEX)

Value(HEX) Value(DEC) Error Code(HEX) Continuous read

Object Dictionary Region 2

Index(HEX) SubIndex(HEX)

Value(HEX) Value(DEC) Error Code(HEX) Continuous read

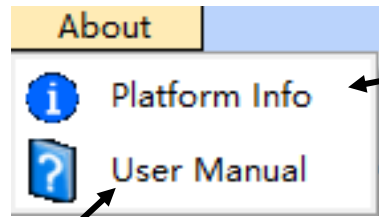
Register Tool

Register Region

Address(HEX) Value(HEX) Value(DEC)

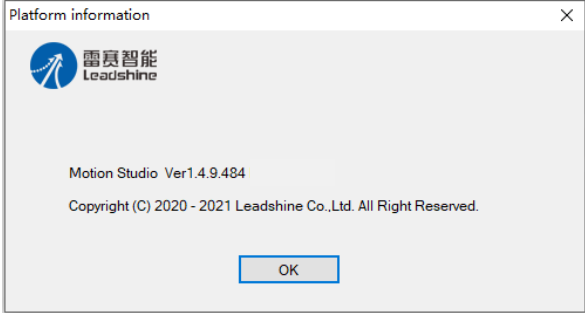
Continuous read

About



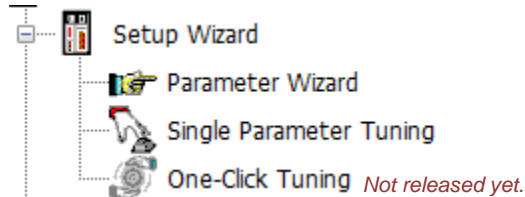
Access to Parameter descriptions and Motion Studio User Manual

Access to Parameter descriptions and Motion Studio User Manual



Navigation tree

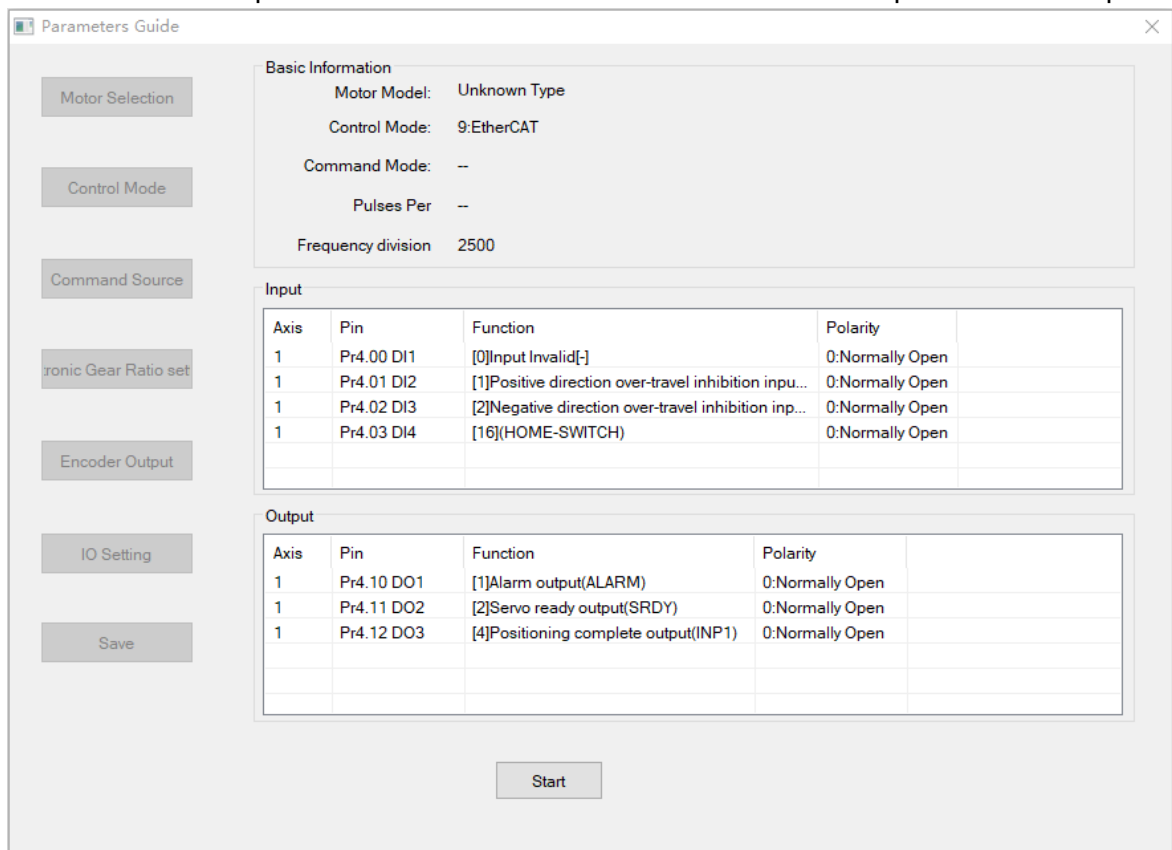
Setup Wizard



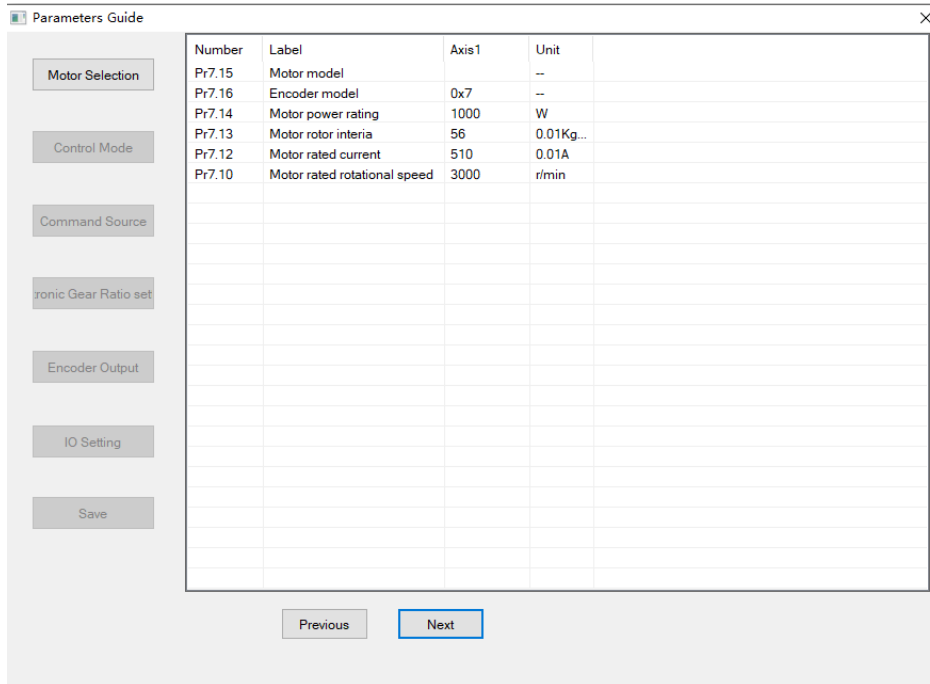
Parameter Wizard

Step-by-step guide to set up servo drives. Most of the parameters are automatically identified and set to default value once servo drive + motor is connected but users may need some customizations to servo parameters and settings.

1. Start screen of Parameter wizard consists of basic information of the servo products, I/O interfaces and setup menu on the left. Click on “Start” to start servo parameters setup.



- On motor selection page, user can find out more about motor and encoder specifications. Users are not recommended to modify any parameters on this page as it might cause abnormal behavior of the driver or motor. Click on “Next” to go to the next page or “Previous” to go back to previous page.

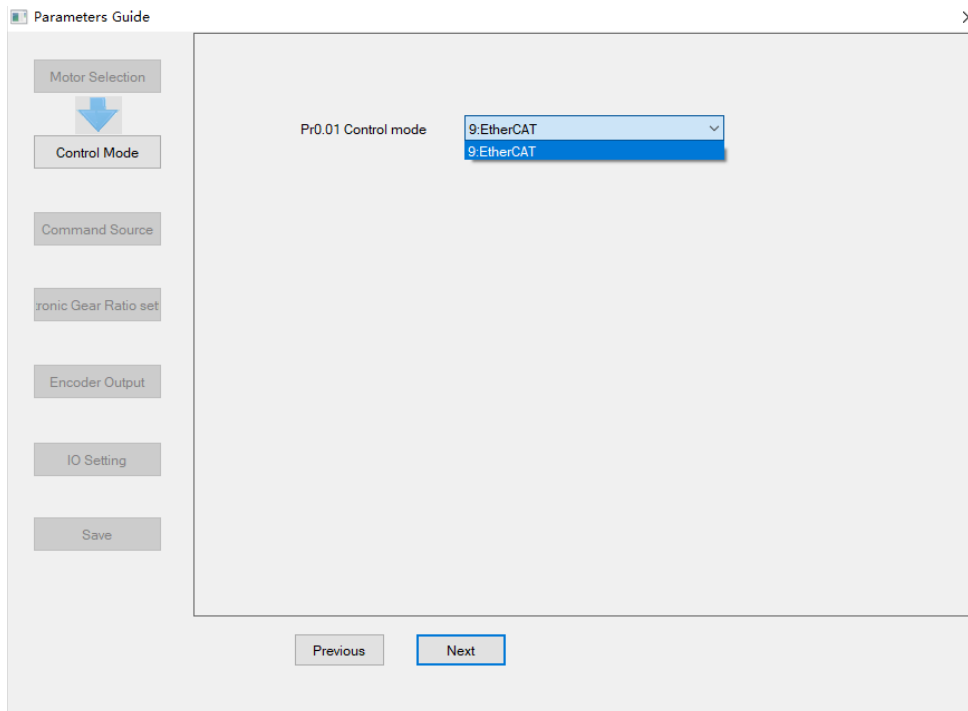


The screenshot shows a window titled "Parameters Guide" with a sidebar on the left containing buttons for "Motor Selection", "Control Mode", "Command Source", "Tonic Gear Ratio set", "Encoder Output", "IO Setting", and "Save". The main area contains a table with the following data:

Number	Label	Axis1	Unit
Pr7.15	Motor model	--	--
Pr7.16	Encoder model	0x7	--
Pr7.14	Motor power rating	1000	W
Pr7.13	Motor rotor inertia	56	0.01Kg...
Pr7.12	Motor rated current	510	0.01A
Pr7.10	Motor rated rotational speed	3000	r/min

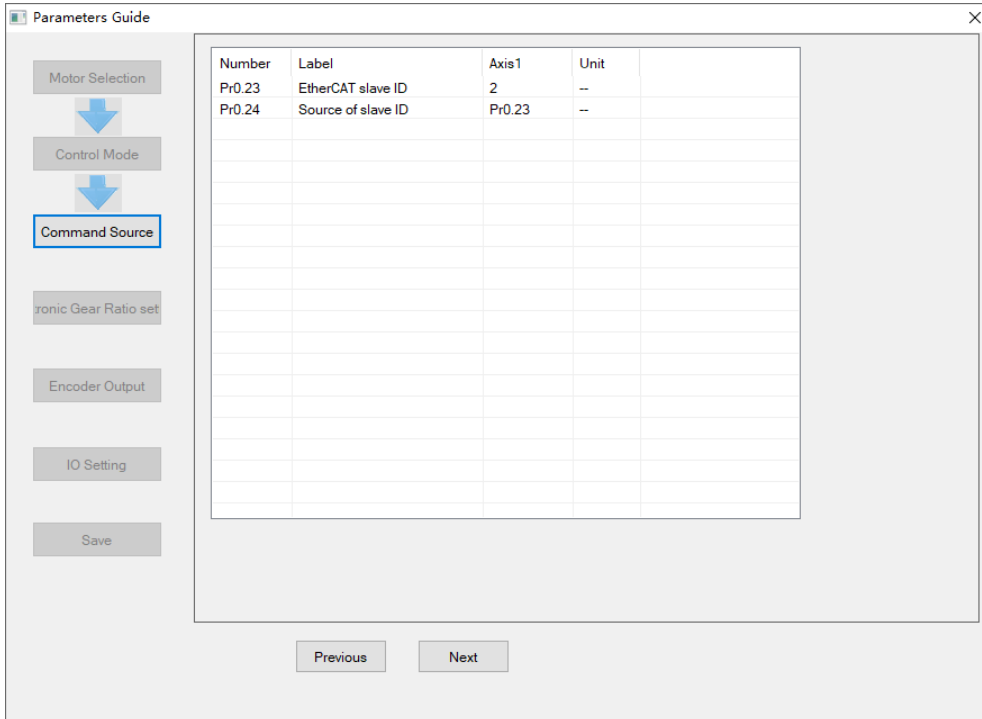
At the bottom of the window are "Previous" and "Next" buttons.

- On control mode page, control mode of the driver is automatically identified. Click on “Next” to go to the next page or “Previous” to go back to previous page.

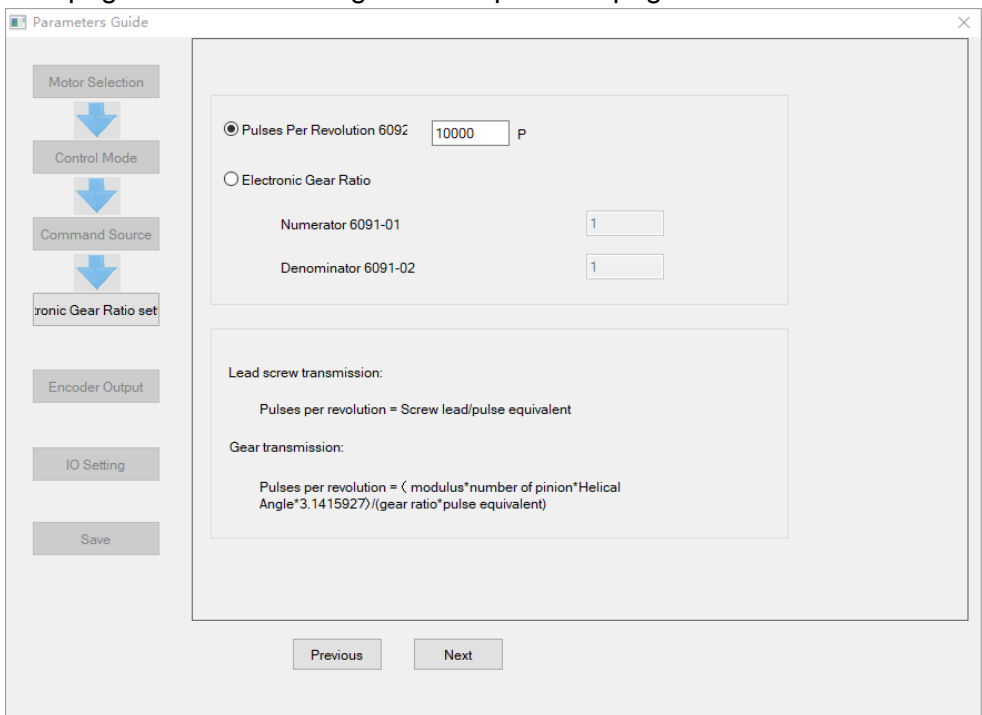


The screenshot shows the "Parameters Guide" window with the "Control Mode" button selected in the sidebar. A blue arrow points to this button. The main area displays "Pr0.01 Control mode" with a dropdown menu showing "9.EtherCAT" selected. The "Next" button at the bottom is highlighted.

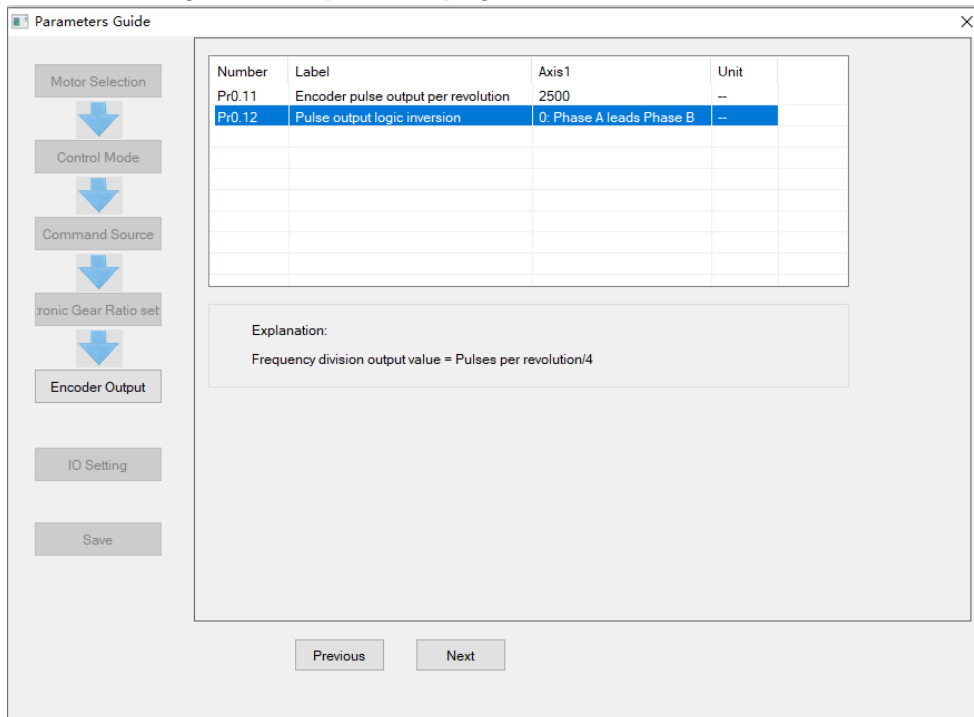
- On command source page, set up slave ID source. Click on “Next” to go to the next page or “Previous” to go back to previous page.



- On Electronic Gear Ratio page, users can choose between setting pulses per revolution or electronic gear ratio. Calculation formulas are provided. Click on “Next” to go to the next page or “Previous” to go back to previous page.



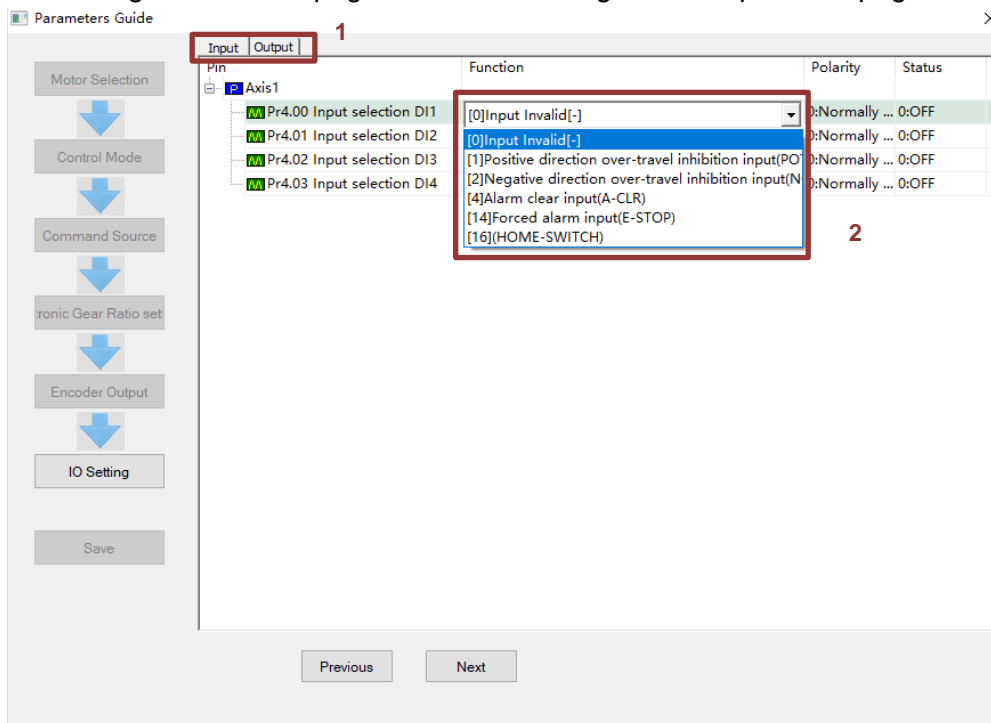
- On Encoder Output page, users can set up encoder pulse output per revolution (= Pulses per revolution/4) and pulse logic. Click on “Next” to go to the next page or “Previous” to go back to previous page.



Number	Label	Axis1	Unit
Pr0.11	Encoder pulse output per revolution	2500	--
Pr0.12	Pulse output logic inversion	0: Phase A leads Phase B	--

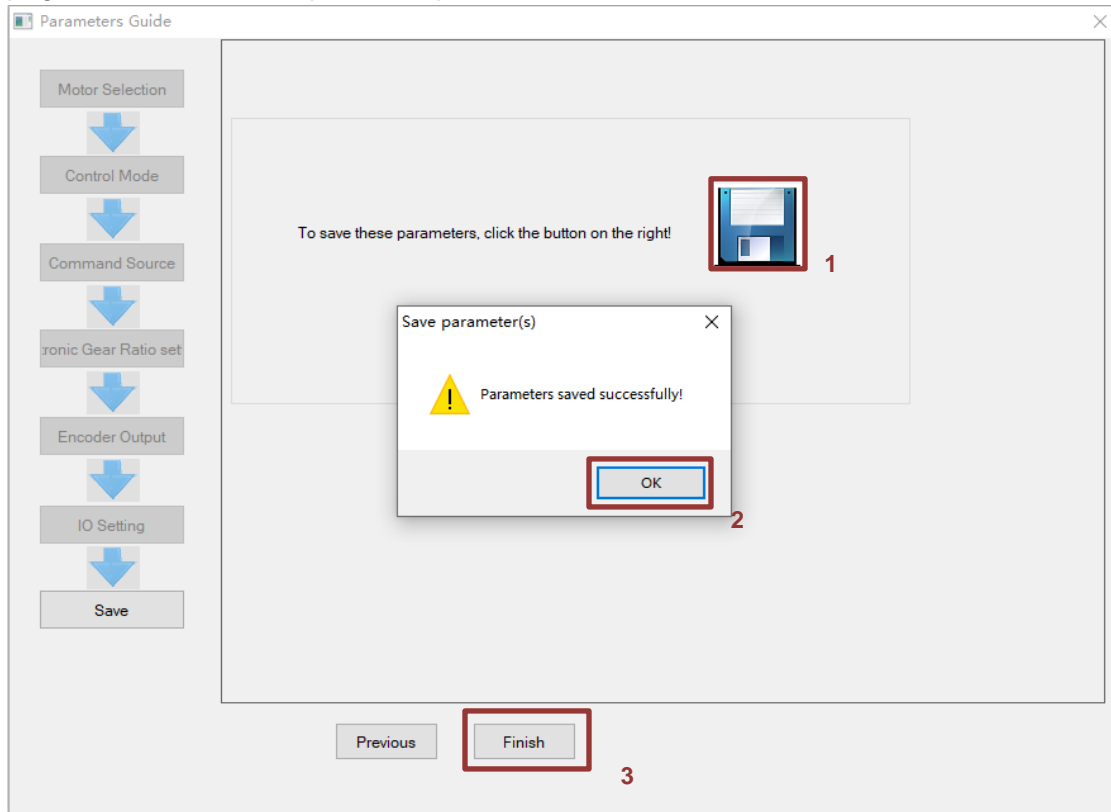
Explanation:
Frequency division output value = Pulses per revolution/4

- On IO settings page, users can allocate DI/DO signals to selected channels. Click on “Next” to go to the next page or “Previous” to go back to previous page.



Pin	Function	Polarity	Status
Axis1			
Pr4.00 Input selection DI1	[0]Input Invalid[-]	Normally ... 0:OFF	
Pr4.01 Input selection DI2	[0]Input Invalid[-]	Normally ... 0:OFF	
Pr4.02 Input selection DI3	[1]Positive direction over-travel inhibition input(PO)	Normally ... 0:OFF	
Pr4.03 Input selection DI4	[2]Negative direction over-travel inhibition input(N)	Normally ... 0:OFF	

8. On Save page, users can save modified parameters. Click on “Next” to go to the next page or “Finish” to complete setup.



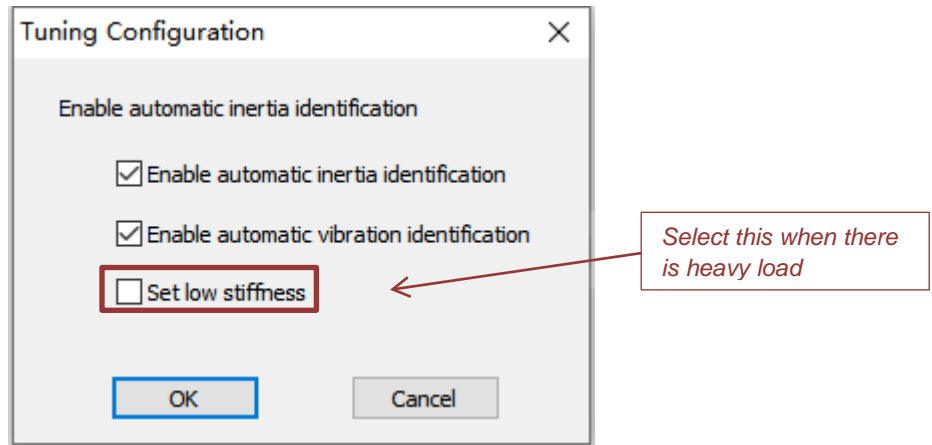
Single Parameter Tuning

Set a mechanical stiffness level and the driver will automatically tune the parameters accordingly, including inertia measuring and vibration suppression to fulfill responsiveness and stability needs. At same time, more advanced functions can be applied, for example: Command pulse filter, low frequency vibration suppression, etc.

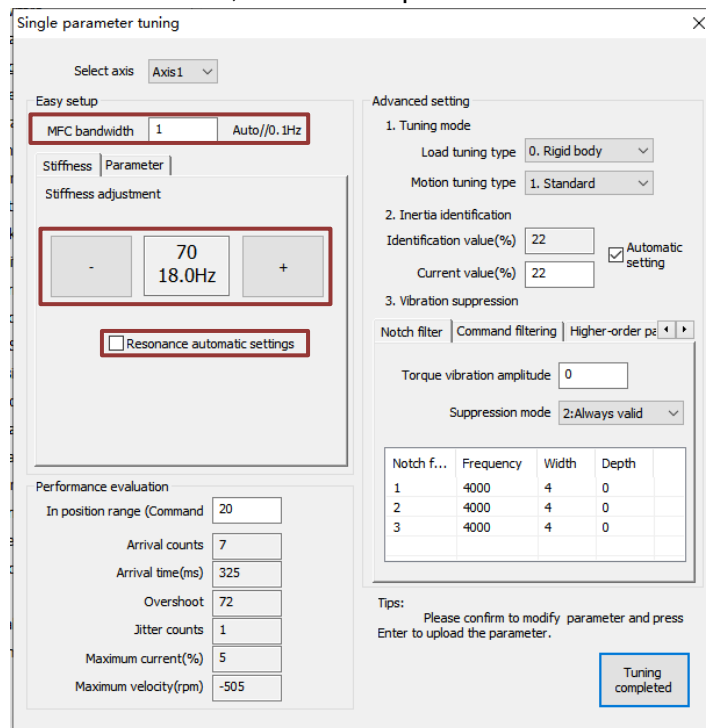
Recommended for applications where inertia changes is minute. Single parameter tuning is more complicated to set up compared to one-click tuning. Use single parameter tuning when one-click tuning doesn't fulfill the needs.

Easy Mode

1. Click on “Single Parameter Tuning” under Setup Wizard. Choose “Enable automatic inertia identification” and “Enable automation vibration identification”. If the system is heavily loaded with Pr0.03 mechanical stiffness value lower than 70, by selecting “Set low stiffness”, initial Pr0.03 value in Single Parameter Tuning will start at 70.



2. Set the value of MFC bandwidth, stiffness as per the table below under Easy Setup.



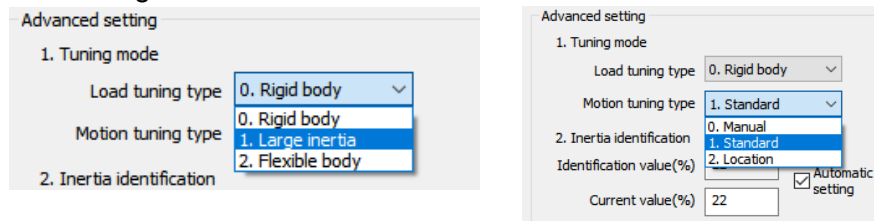
MFC bandwidth set value	Description
0	Deactivate model-following control function
【1】	Automatically adjust MFC bandwidth
2~9	Invalid
10~2000	Manually adjust MFC bandwidth; Recommended 30-100 for transportation belt applications

Stiffness level goes from 81-50 with 50 being highest stiffness level. Velocity response improves with higher stiffness level but vibration might occur. For flexible structures, decrease stiffness level and setup vibration suppression.

3. Resonance automatic settings: Automatically identified vibration under actual stiffness level settings. Default value is restored when no vibration is detected. If not selected, value will not be restored to default.

Advanced mode

4. Set Tuning mode.



Load tuning type

Rigid body: Structure with low flexibility (i.e. screw leads)

High Inertia: 30-40 times higher than load inertia.

Flexible body: Low stiffness (i.e. belt)

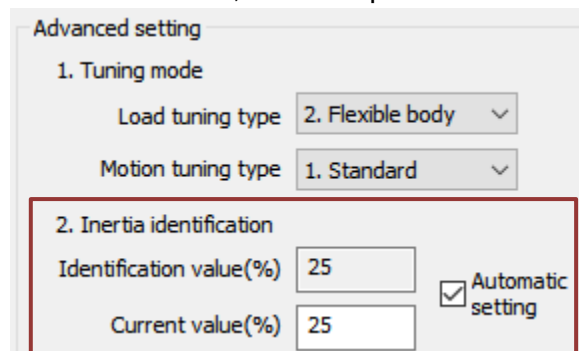
Motion tuning type

Manual: Auto adjustment off. Parameters under Easy Setup available to be modified.

Standard: Prioritize stability. No switch gaining.

Location: Recommended for horizontal axis with variable load or ball screw structures.

5. Inertia identification is automatically enabled at the start.
 Identification value (%): Inertia ratio will be automatically identified with yellow box blinking on every successful identification
 Current value (%): If "Automatic setting" is selected, inertia ratio will be automatically synchronize to Pr0.04. If not selected, user can press Enter to set the value to Pr0.04.



6. Vibration suppression: Notch filter

Torque vibration amplitude: 0% - Max. sensitivity, 100% - Deactivated (*Adjust accordingly*)

Suppression mode: 0 – Adaptive notch filter **deactivated**

1 – Adaptive notch filter **valid for once**

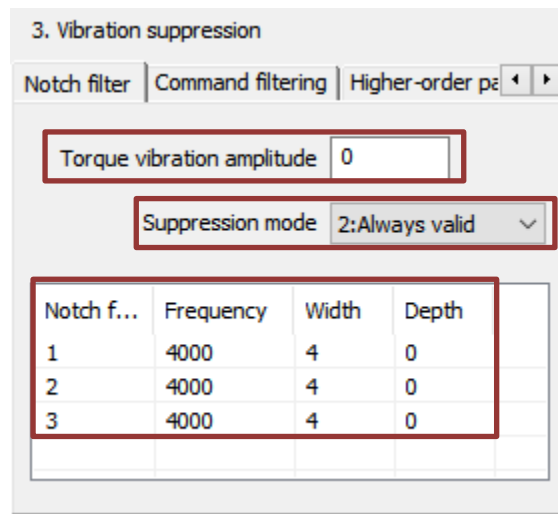
2 – Adaptive notch filter **always valid**

Notch filter: 1st, 2nd and 3rd notch filter

Frequency(Hz): 50~2000

Width: 0~20

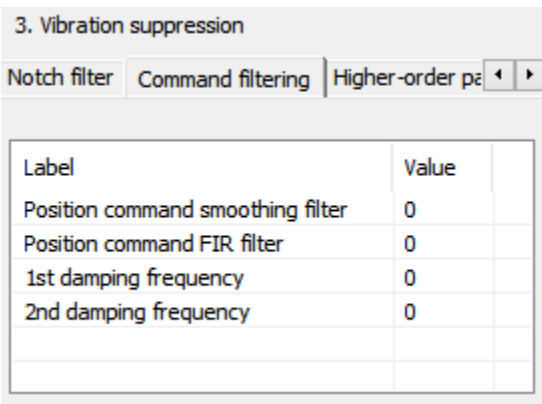
Depth: 0~99



*Right click on notch filter parameters to **cut, paste** or **reset** the parameters*

Vibration suppression: Command filtering

(These parameters are manually set, cannot be automatically identified.)



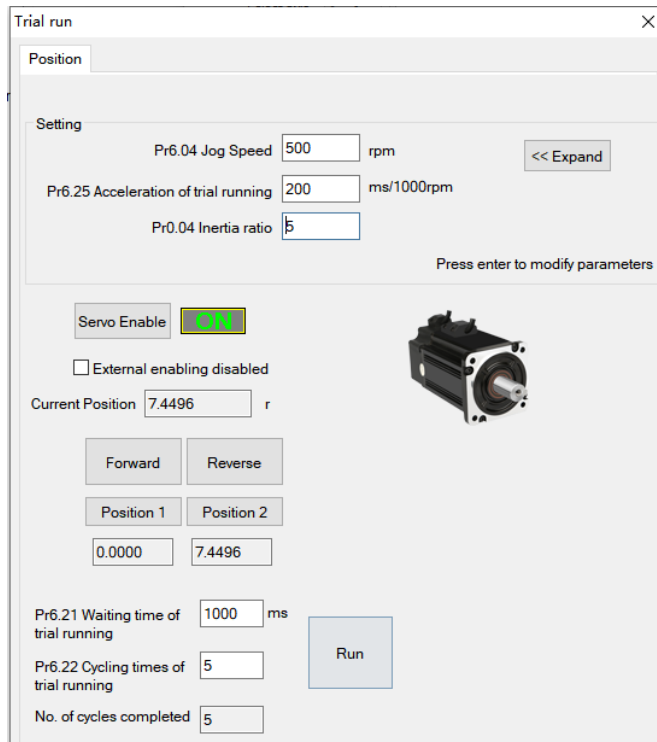
Parameter	Range(Unit)	Description
Position command smoothing filter	0~32767(0.1ms)	Large set value might elongate tuning time
Position command FIR filter	0~10000(0.1ms)	
1 st damping frequency	10~2000(0.1Hz)	To suppress mechanical end vibration
2 nd damping frequency	10~2000(0.1Hz)	

Vibration suppression: Higher-order Parameters



Parameter	Range(Unit)	Description
Velocity observer gain	0~32767	Defaulted to stable gain and bandwidth. Set = 1 to deactivate.
Velocity observer bandwidth	0~32767(ms)	
Current response settings	50~100(%)	Current loop related effective value ratio

7. After the settings are done, use trial run to run the motor for at least 5 cycles.



Jog speed > 300rpm

Acceleration < 600ms

Position 1 and Position 2 should be around 5r

Interval waiting time between cycles should be < 500ms with at least 5 cycles

8. Performance evaluation

Single parameter tuning

Select axis: Axis 1

Easy setup
MFC bandwidth: 1 Auto//0.1Hz
Stiffness: Parameter
Stiffness adjustment: 70 18.0Hz

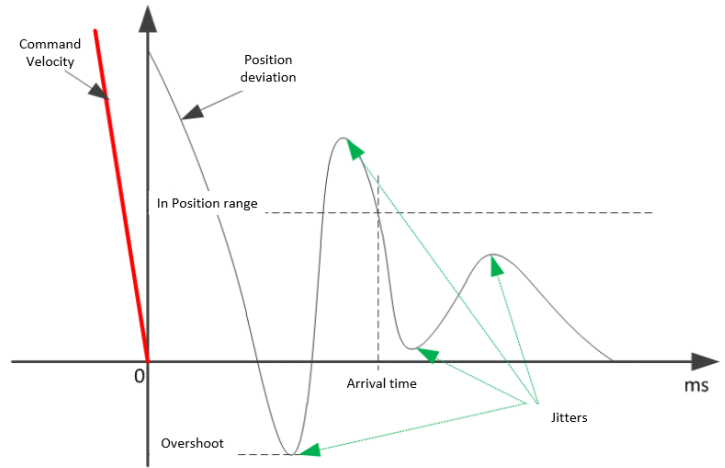
Advanced setting
1. Tuning mode: Load tuning type: 2. Flexible body; Motion tuning type: 1. Standard
2. Inertia identification: Identification value(%): 13; Current value(%): 13; Automatic setting:
3. Vibration suppression: Notch filter: Command filtering; Higher-order pe: Torque vibration amplitude: 0; Suppression mode: 2: Always valid

Notch f...	Frequency	Width	Depth
1	4000	4	0
2	4000	4	0
3	4000	4	0

Performance evaluation
In position range(0.0001r): 20
Arrival counts: 11
Arrival time(ms): 18
Overshoot: 15
Jitter counts: 1
Maximum current(%): 5
Maximum velocity(rpm): -501

Tips: Please confirm to modify parameter and press Enter to upload the parameter.

Tuning completed



In position range	To set the velocity deviation between target velocity and actual velocity
Arrival counts	Number of times target value is arrived
Overshoot	The difference between target value and actual value. 10%(White) < Overshoot(Yellow) < 100% (Red)
Jitter counts	Detected jitters. Jitter count = 1(Yellow), more than 1(Red). Default(White)
Max. current	Percentage of max. current

Use Scope to get desired waveform by decreasing stiffness value manually.

Scope

CH1: Axis 1 - 49: Position command velocity
CH2: Axis 1 - 48: Velocity feedback before filter
CH3: Axis 1 - 3: Position deviation
CH4: Axis 1 - 80: Current setting(%)

CH1: Axis 1 - 49: Position command velocity

CH2: Axis 1 - 48: Velocity feedback before filter

CH3: Axis 1 - 3: Position deviation

CH4: Axis 1 - 80: Current setting(%)

CH5: Axis 1 - 4A: Internal position command velocity

CH6: Axis 1 - 40: Velocity setting

Trigger: Trigger Source: Axis 1 - 1: Velocity feedback; Trigger Mode: 0: Rising edge trigger; Trigger Threshold: 30

Sampling Frame and Precision: Single Frame and High Precision; Sampling Interval: 5.000

Multi Frame and Low Precision; Sampling Interval: 100

X = 500.000, CH1 = 499, CH2 = 500, CH3 = 1517, CH4 = 47.

Capture

9. Disable automatic inertia and vibration identification. Confirm to save parameters or restore to previous settings if the tuning setup is not wanted.

Tuning parameter confirmation ✕

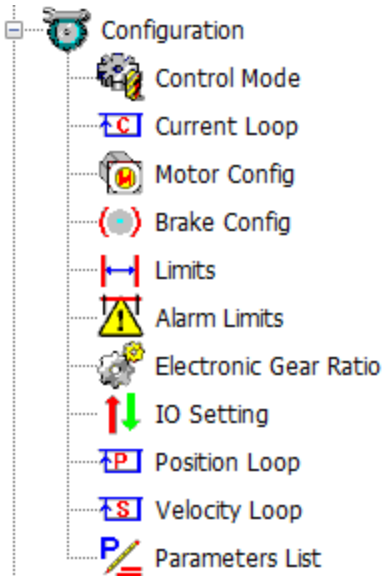
To maintain stability, it is recommended

Disable automatic inertia identification

Disable automatic vibration identification

Device	Modified Para...	Label	Before tuning	After tuning
Axis1	Pr0.02	Real time Auto Gain Adjusting	0x121	0x111
Axis1	Pr0.04	Inertia ratio	25	22
Axis1	Pr2.01	1st notch frequency	4000	400
Axis1	Pr2.03	1st notch depth selection	0	72

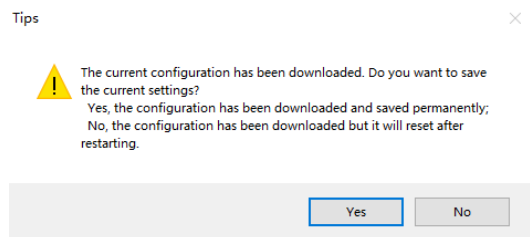
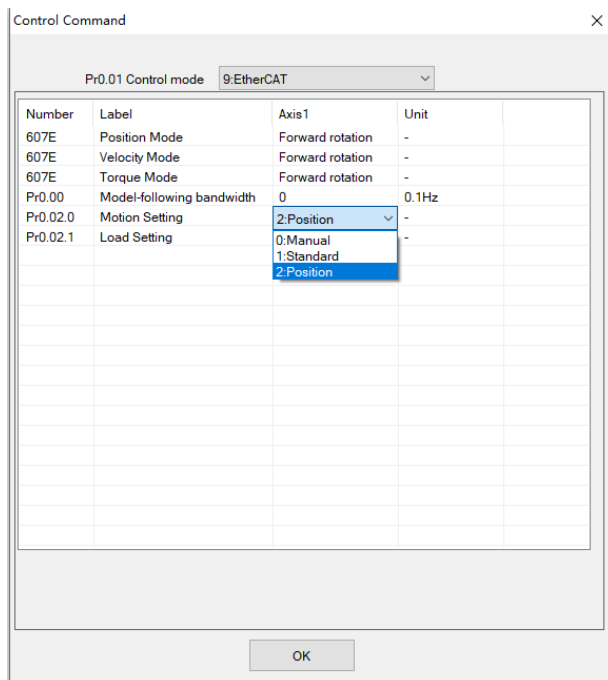
Configuration



Most of the parameters settings can be set up in *Configuration*. Please refer to the parameters description chapter in the manual for explanation and further details on each parameter and their functions.

Control Mode

To set up control mode and Model Following Control (MFC) related parameters. Click on drop-down menu of each parameter for functions/selection assignments. Click “OK” after modification

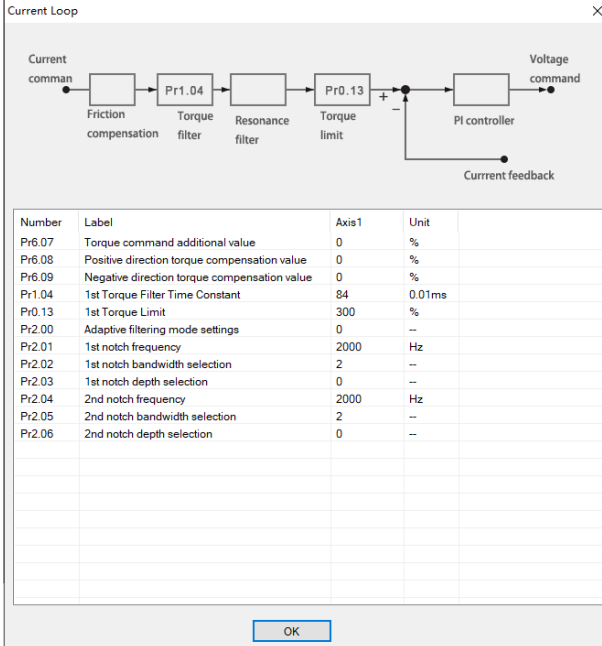


Click on “Yes” to save modification permanently. It is recommended to back up parameters before modifying crucial parameters.

Click on “No” and parameters will be restored after servo drive is restarted.

Current loop (Torque loop)

To set up current loop (Torque loop) related parameters. Notch filters can be activated if vibration suppression is required. Pr2.01 - Pr2.06 are valid if Pr2.00 adaptive filtering mode is disabled.

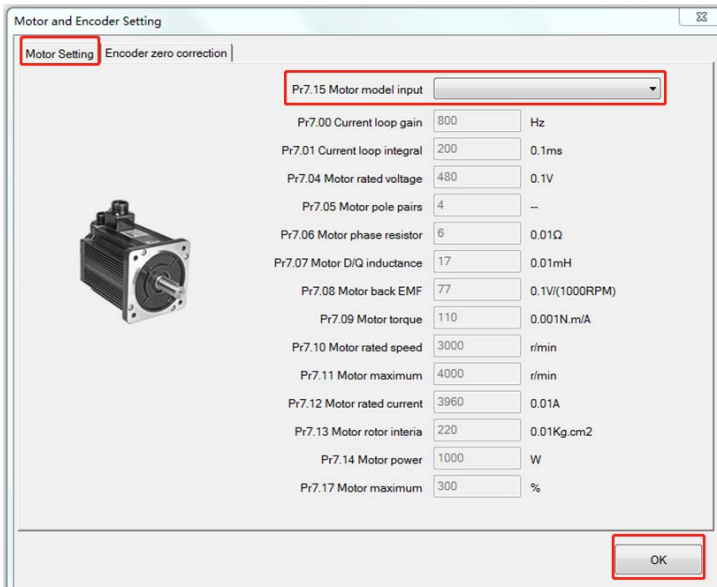


The diagram shows a control loop starting with 'Current command' entering a 'Friction compensation' block, followed by a 'Torque filter' block (Pr1.04), a 'Resonance filter' block, and a 'Torque limit' block (Pr0.13). The output of the torque limit block is summed with 'Current feedback' (indicated by a minus sign) and fed into a 'PI controller' block, which outputs the 'Voltage command'.

Number	Label	Axis1	Unit
Pr6.07	Torque command additional value	0	%
Pr6.08	Positive direction torque compensation value	0	%
Pr6.09	Negative direction torque compensation value	0	%
Pr1.04	1st Torque Filter Time Constant	84	0.01ms
Pr0.13	1st Torque Limit	300	%
Pr2.00	Adaptive filtering mode settings	0	--
Pr2.01	1st notch frequency	2000	Hz
Pr2.02	1st notch bandwidth selection	2	--
Pr2.03	1st notch depth selection	0	--
Pr2.04	2nd notch frequency	2000	Hz
Pr2.05	2nd notch bandwidth selection	2	--
Pr2.06	2nd notch depth selection	0	--

Motor Config.

Only for motor with incremental ABZ+Hall UVW encoder. Select motor model on Motor model input and click on “OK” to save motor parameter settings.



The 'Motor and Encoder Setting' dialog box has a 'Motor Setting' tab selected. A red box highlights the 'Pr7.15 Motor model input' dropdown menu. Below it, various motor parameters are listed with input fields and units:

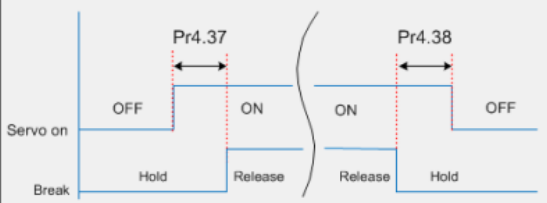
- Pr7.00 Current loop gain: 800 Hz
- Pr7.01 Current loop integral: 200 0.1ms
- Pr7.04 Motor rated voltage: 480 0.1V
- Pr7.05 Motor pole pairs: 4 --
- Pr7.06 Motor phase resistor: 6 0.01Ω
- Pr7.07 Motor D/Q inductance: 17 0.01mH
- Pr7.08 Motor back EMF: 77 0.1V/(1000RPM)
- Pr7.09 Motor torque: 110 0.001N.m/A
- Pr7.10 Motor rated speed: 3000 r/min
- Pr7.11 Motor maximum: 4000 r/min
- Pr7.12 Motor rated current: 3960 0.01A
- Pr7.13 Motor rotor inertia: 220 0.01Kg.cm2
- Pr7.14 Motor power: 1000 W
- Pr7.17 Motor maximum: 300 %

An image of a motor is shown on the left side of the dialog. A red box highlights the 'OK' button at the bottom right.

Brake Config.

To set up holding brake output signal, activation and delay time.

Brake Setting ✕



Number	Label	Axis1	Unit
Pr4.37	Motor power-off delay time	0	ms
Pr4.38	Delay time for holding brake release	0	ms
Pr4.39	Holding brake activation speed	30	r/min
-	Holding brakeOutput	<--None-->	-
-	Polarity	Normally ...	-

OK

Limits

To set up positional, torque and velocity limits. Max. motor speed is the min. value of limit set in Pr7.11 and 6080h.

Limit settings ✕

Number	Label	Axis1	Unit
607D-01	607D-01 Positive Limit	0	P
607D-02	607D-02 Negative Limit	0	P
Pr5.21	Torque limit selection	0	--
Pr0.13	1st Torque Limit	300	%
Pr5.22	2nd torque limit	300	%
60E0	60E0 Positive Torque Limit	3000	0.1%
60E1	60E1 Negative Torque Limit	3000	0.1%
6072	6072 Max. motor torque	3000	0.1%
6080	6080 Max. motor velocity	6000	rpm
Pr7.11	Motor maximum speed	7000	r/min

Note: Max. motor speed is the min value of the 2.

OK

Alarm limits

To set alarm threshold value (value which alarm occurs once exceeded).

Alarm threshold settings ×

Number	Label	Axis1	Unit
Pr7.25	Temperature setting for fan on	50	°C
Pr7.27	Driver over-temperature alarm threshold setting	105	°C
Pr7.30	Undervoltage threshold value	140	V
Pr7.34	Overvoltage threshold value	400	V
Pr7.32	Vent on threshold value settings	380	V
Pr0.16	Regenerative resistance	50	Ω
Pr0.17	Regenerative resistor power rating	75	W
Pr7.35	Relay control mode setting	0	--
Pr7.36	Relay close threshold value	200	V
Pr0.14	Excessive Position Deviation Settings	200	0.1rev

Warning: Set these parameters under professional guidance!

OK
Cancel

Electronic Gear Ratio

To set up Pulses per revolution or electronic gear ratio. Calculation formulas are provided.

Electronic Gear Ratio ×

Pulses Per Revolution 6092 P

Electronic Gear Ratio

Numerator 6091-01

Denominator 6091-02

Lead screw transmission:

Pulses per revolution = Screw lead/pulse equivalent

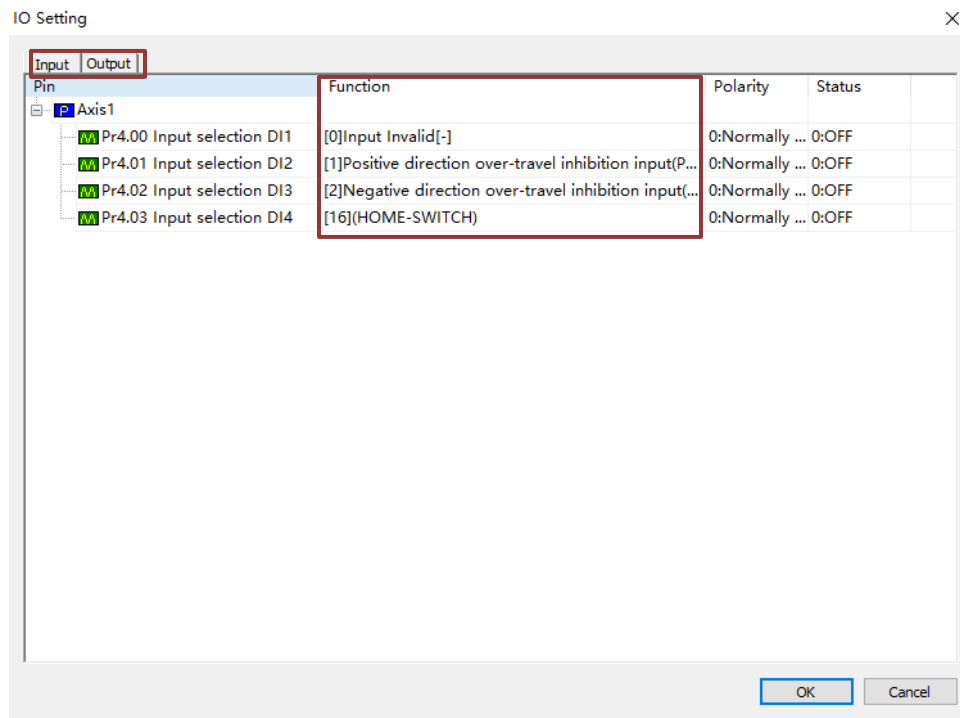
Gear transmission:

Pulses per revolution = (modulus*number of pinion*Helical Angle*3.1415927)/(gear ratio*pulse equivalent)

OK

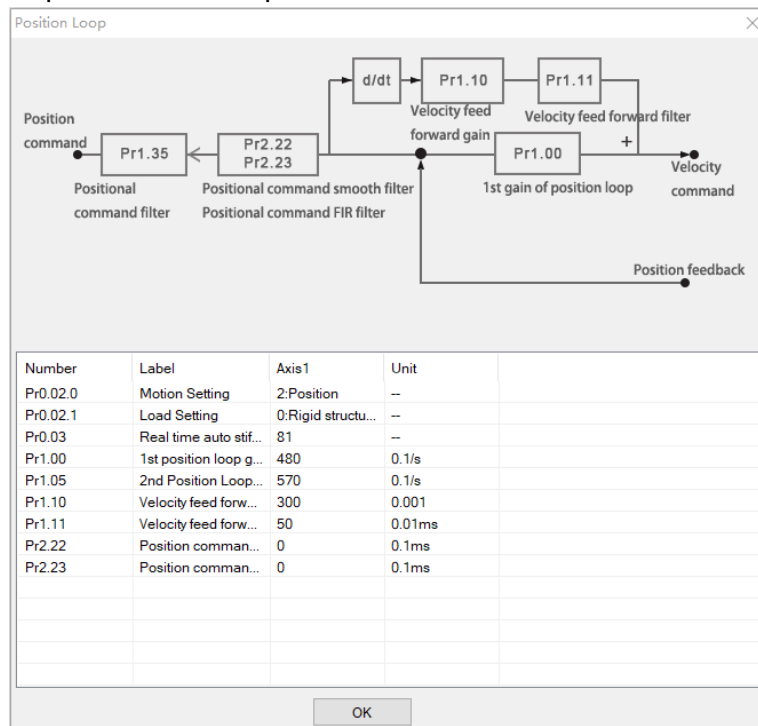
IO Settings

DI/DO signals can be switched on the tab above. DI/DO signals for each channel can be assigned using the drop-down menu on each channel.



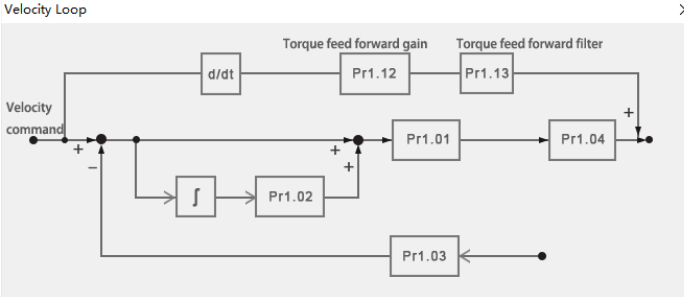
Position loop

To set up position loop control related parameters.



Velocity loop

To set up velocity loop control related parameters.



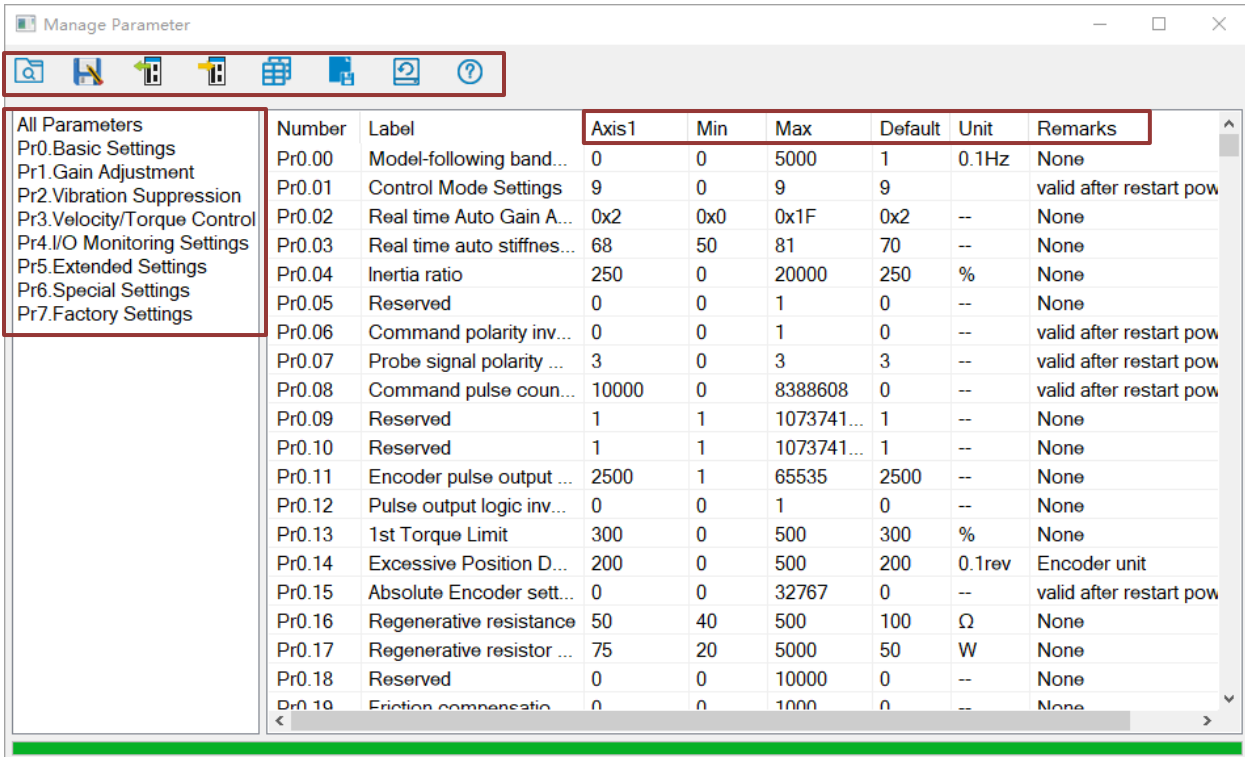
The diagram shows a control loop for velocity. The input is 'Velocity command'. It splits into two paths: one through a 'd/dt' block to a 'Torque feed forward gain' block (Pr1.12), followed by a 'Torque feed forward filter' block (Pr1.13). The other path goes through a summing junction, then an integrator block (∫), and a gain block (Pr1.02). The output of the integrator goes to another summing junction. The output of the Pr1.02 block also goes to this summing junction. The output of this summing junction goes to a gain block (Pr1.01), then to a summing junction where the feedforward path is added. The output of this second summing junction goes to a gain block (Pr1.04). The output of Pr1.04 is the system output. There is also a feedback path from the output through a filter block (Pr1.03) back to the first summing junction.

Number	Label	Axis1	Unit
Pr0.02.0	Motion Setting	2.Position	--
Pr0.02.1	Load Setting	0.Rigid str...	--
Pr0.03	Real time auto stiffness adj...	81	--
Pr0.04	Inertia ratio	250	%
Pr1.01	1st velocity loop gain	270	0.1Hz
Pr1.02	1st Integral Time Constant ...	210	0.1ms
Pr1.03	1st velocity detection filter	15	--
Pr1.12	Torque feed forward gain	0	0.001
Pr1.06	2nd velocity loop gain	270	0.1Hz
Pr1.07	2nd Integral Time Constant...	10000	0.1ms
Pr1.08	2nd velocity detection filter	15	--
Pr1.13	Torque feed forward filter ti...	0	0.01ms









OK

Parameters List

All servo drive parameters are listed in the parameters list. Parameters will be of default value at initial use. Parameters are classified into different categories on the left panel. Please be aware of **recommended range** when modifying the value on **Axis** column and **remarks** of the parameters as some parameter modifications may require servo drive restart to be valid. Admin right may be required for certain parameters.




Number	Label	Axis1	Min	Max	Default	Unit	Remarks
Pr0.00	Model-following band...	0	0	5000	1	0.1Hz	None
Pr0.01	Control Mode Settings	9	0	9	9		valid after restart pow
Pr0.02	Real time Auto Gain A...	0x2	0x0	0x1F	0x2	--	None
Pr0.03	Real time auto stiffnes...	68	50	81	70	--	None
Pr0.04	Inertia ratio	250	0	20000	250	%	None
Pr0.05	Reserved	0	0	1	0	--	None
Pr0.06	Command polarity inv...	0	0	1	0	--	valid after restart pow
Pr0.07	Probe signal polarity ...	3	0	3	3	--	valid after restart pow
Pr0.08	Command pulse coun...	10000	0	8388608	0	--	valid after restart pow
Pr0.09	Reserved	1	1	1073741...	1	--	None
Pr0.10	Reserved	1	1	1073741...	1	--	None
Pr0.11	Encoder pulse output ...	2500	1	65535	2500	--	None
Pr0.12	Pulse output logic inv...	0	0	1	0	--	None
Pr0.13	1st Torque Limit	300	0	500	300	%	None
Pr0.14	Excessive Position D...	200	0	500	200	0.1rev	Encoder unit
Pr0.15	Absolute Encoder sett...	0	0	32767	0	--	valid after restart pow
Pr0.16	Regenerative resistance	50	40	500	100	Ω	None
Pr0.17	Regenerative resistor ...	75	20	5000	50	W	None
Pr0.18	Reserved	0	0	10000	0	--	None
Pr0.19	Friction compensatio	0	0	1000	0	--	None

	Read parameter files	Read parameter settings save on PC (.Isr files)
	Save parameters	Save current parameter files as .Isr files. Recommended to back up parameter settings before any modification.
	Read from driver	Read parameter settings from driver
	Write to driver	Write parameters to drivers.
	Compare parameters*	Parameters comparison can be made between current parameter settings, saved parameter files and parameter default values.
	Save to driver	Save parameters into drivers.
	Factory reset	Restore all parameters back to factory default
	Help	Parameters description can be found in Motion Studio User Manual

Compare parameter



Parameter values can be compared by clicking on  in Parameters List. “Compare Parameters” window will appear with option to set up parameter 1 and 2 for comparison. Parameters between different axes can also be compared.

Compare parameters
✕

Parameter 1 Current Parameter ▾

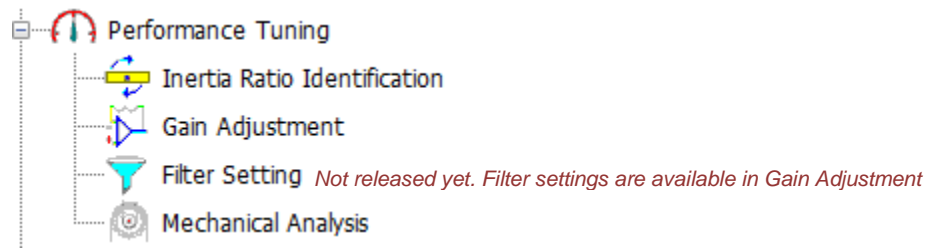
Parameter 2 Default ▾

Show Axis1 ▾ Compare axis parameters

Compare

Axis	Parameter Type	Label	Parameter Value 1	Parameter Value 2
1	Pr0.00	Model-following bandwidth	0	1
1	Pr0.03	Real time auto stiffness ad...	68	70
1	Pr0.08	Command pulse counts p...	10000	0
1	Pr0.16	Regenerative resistance	50	100
1	Pr0.17	Regenerative resistor pow...	75	50
1	Pr1.00	1st position loop gain	480	320
1	Pr1.01	1st velocity loop gain	270	180
1	Pr1.02	1st Integral Time Constant ...	210	310
1	Pr1.04	1st Torque Filter Time Con...	84	126
1	Pr1.05	2nd Position Loop Gain	570	380
1	Pr1.06	2nd velocity loop gain	270	180
1	Pr1.09	2nd Torque Filter Time Co...	84	126
1	Pr2.01	1st notch frequency	2000	4000
1	Pr2.04	2nd notch frequency	2000	4000
1	Pr2.07	3rd notch frequency	2000	4000
1	Pr3.12	Acceleration time settings	100	0
1	Pr3.13	Deceleration time settings	100	0
1	Pr4.11	Output selection DO2	0x2	0x3

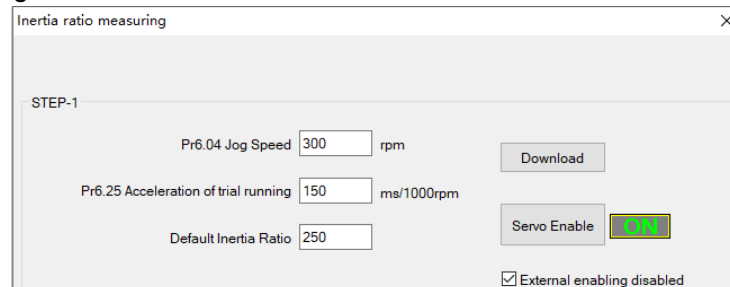
Performance Tuning



Inertia Ratio Identification

Inertia ratio of the servo product can be automatically identified using “Inertia Ratio Identification”. It is a step-by-step guided operation for performance tuning.

1. Set trial run velocity Pr6.04 and trial run acceleration Pr6.25, click on ‘Download’ to modify parameters. It is recommended to leave the parameters at default values. Then, Tick “External enabling disabled” and click on “Servo on” to enable the servo drive.



Inertia ratio measuring

STEP-1

Pr6.04 Jog Speed rpm

Pr6.25 Acceleration of trial running ms/1000rpm

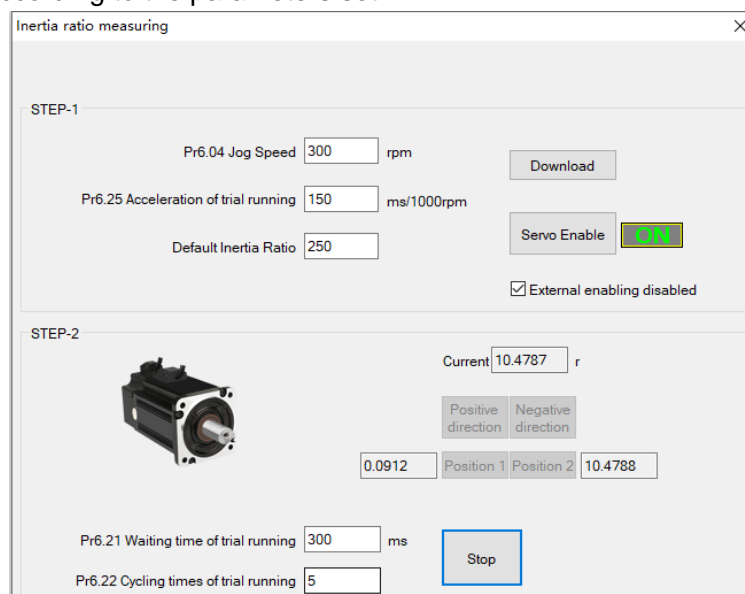
Default Inertia Ratio

Download

Servo Enable ON

External enabling disabled

2. Click and hold “Positive direction” to start the motor. Current position will show motor position. Click on POS 1 to save current position as starting point. Click and hold “Negative direction” to start the motor again. Click on POS 2 to save current position as ending point. Then, Set the waiting time between each cycle in Pr6.21 and no. of cycles in Pr6.22. Click on ‘Run’ and motor will run according to the parameters set.



Inertia ratio measuring

STEP-1

Pr6.04 Jog Speed rpm

Pr6.25 Acceleration of trial running ms/1000rpm


Default Inertia Ratio

Download

Servo Enable ON

External enabling disabled

STEP-2



Current r



Positive direction Negative direction

Position 1 Position 2

Pr6.21 Waiting time of trial running ms

Pr6.22 Cycling times of trial running

Stop

3. After the calculation is done, inertia ratio will be calculated automatically and click on 'Write' to enter the calculated value into Pr0.04. Click on “” to enter Parameters List to check or modify Pr0.04. Then, click on “” to save parameters to driver.

Inertia ratio measuring ✕


STEP-1

Pr6.04 Jog Speed rpm Download

Pr6.25 Acceleration of trial running ms/1000rpm Servo Enable

Default Inertia Ratio External enabling disabled

STEP-2



Current r

Positive direction Negative direction

Position 1 Position 2

Pr6.21 Waiting time of trial running ms

Pr6.22 Cycling times of trial running

STEP-3

Inertia Ratio

Please take note:

1. Trial run velocity and distance should be optimal to prevent any axis from bumping into objects.
2. It is recommended to move only in 1 direction for vertically mounted axis. Take precaution before moving the axis.
3. For applications with higher frictional drag, please set a minimal travel distance.

Gain Adjustment

Gain adjustment can be done automatically or manually. There are options for easy adjustments such as Single Parameter Tuning or One-click Tuning. Please refer to related AC servo drive series user manual for details on gain adjustment. Step-by-step guide to gain adjustment of different modes are available in product user manual. This section is only for introduction to gain and filter parameters tuning interface. Parameters descriptions are available in Help.

Gain Adjustment
✕

Gain Config

Filter Config

Number	Label	Axis1	Unit	
Pr0.02.0	Motion Setting	2:Position	--	
Pr0.02.1	Load Setting	0:Rigid structu...	--	
Pr0.03	Real time auto stif...		--	
Pr1.00	1st position loop g...	480	0.1/s	
Pr1.01	1st velocity loop g...	270	0.1Hz	
Pr1.02	1st Integral Time ...	210	0.1ms	
Pr1.03	1st velocity detecti...	15	--	
Pr1.04	1st Torque Filter T...	84	0.01ms	
Pr1.05	2nd Position Loop...	570	0.1/s	
Pr1.06	2nd velocity loop ...	270	0.1Hz	
Pr1.07	2nd Integral Time ...	10000	0.1ms	

Notch Filter

Vibration Filter

Number	Label	Axis1	Unit	
Pr2.00	Adaptive filtering ...	0:Disable auto...	--	
Pr2.01	1st notch frequency	2000	Hz	
Pr2.02	1st notch bandwid...	2	--	
Pr2.03	1st notch depth se...	0	--	
Pr2.04	2nd notch frequen...	2000	Hz	
Pr2.05	2nd notch bandwi...	2	--	
Pr2.06	2nd notch depth s...	0	--	
Pr2.07	3rd notch frequency	2000	Hz	
Pr2.08	3rd notch bandwi...	2	--	

Pr0.01 Control mode
9:EtherCAT

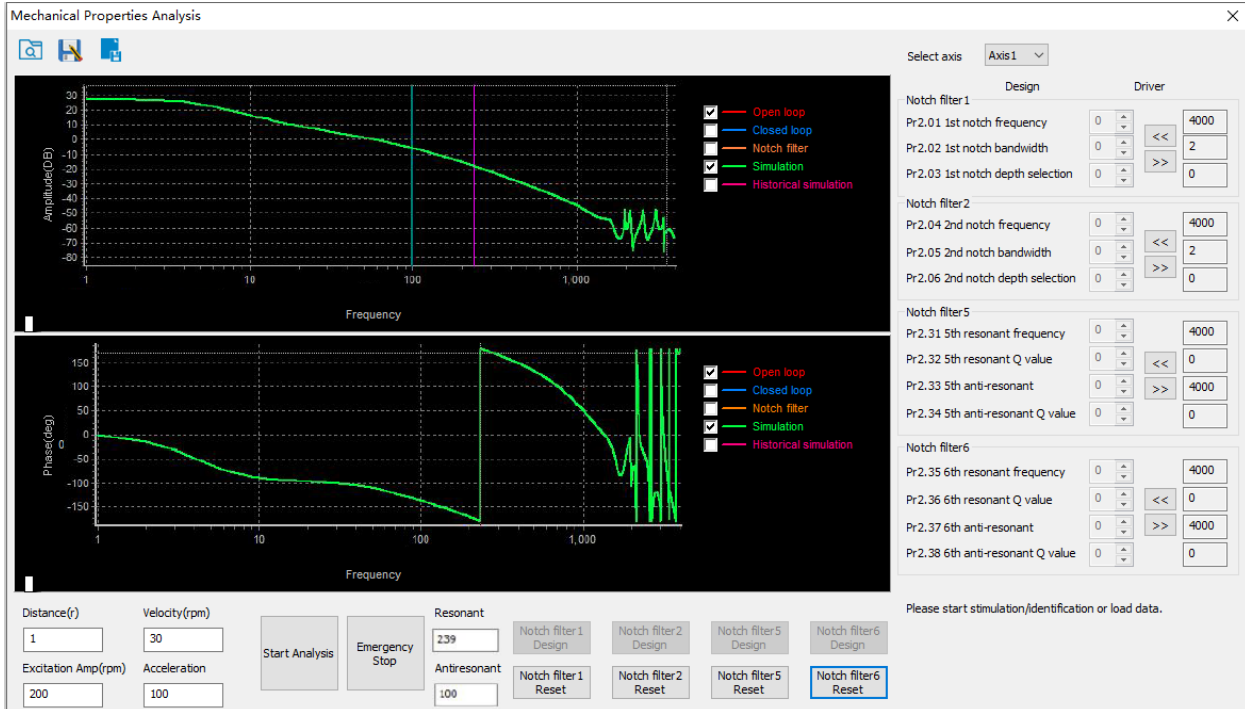
Pr0.04 Inertia ratio

OK

Click on "OK" to save modified parameters.

Mechanical Analysis

To determine mechanical and set up notch filter parameters to suppress vibration caused by resonance.



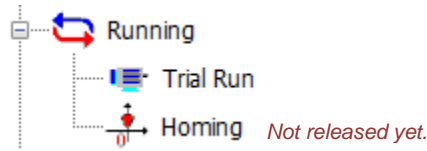
The screenshot displays the 'Mechanical Properties Analysis' window. It features two main plots: 'Amplitude (DB)' vs 'Frequency' and 'Phase (deg)' vs 'Frequency'. The Amplitude plot shows a resonance peak at approximately 239 Hz. The Phase plot shows a corresponding phase shift. To the right is a control panel for notch filters, with parameters for Notch filter 1, 2, 5, and 6. At the bottom are input fields for Distance (r), Velocity (rpm), Excitation Amp (rpm), and Acceleration, along with buttons for Start Analysis, Emergency Stop, and Notch Filter Design/Reset.

To avoid strong vibration, please first set lower excitation amplitude. However, if the set value is too low, data waveform will include some degree of distortion.

If vibration occurs during tests which can't be reduce through lowering electrical current excitation, it might be due to excessive gain. Please lower velocity gain and set notch filter as accordance from the mechanical properties analysis. Or might be due to inertia settings (Pr0.04) is too large, please use optimal inertia ratio value.

Click on "Start" to start mechanical properties analysis. Click on Notch Filter Design to get the identified notch filter settings. Use the arrow keys on the right panel to save the parameters to driver. Notch filter 1 and 2 is available on all servo drive models while notch filter 5 and 6 is model dependent. All analysis can be saved and read as .mch files.

Running



Trial Run

To test run servo products after successfully connected to Motion Studio and initial setup is done. Main power supply and motor/encoder cable need to be connected to use this function.

×

Position

Setting 1

Pr6.04 Jog Speed	300	rpm
Pr6.25 Acceleration of trial running	150	ms/1000rpm
Pr0.04 Inertia ratio	250	

<< Expand


Press enter to modify parameters

Servo Enable

ON

External enabling disabled

Current Position r



Positive direction

Negative direction

Position 1

Position 2

10.4785

10.4785

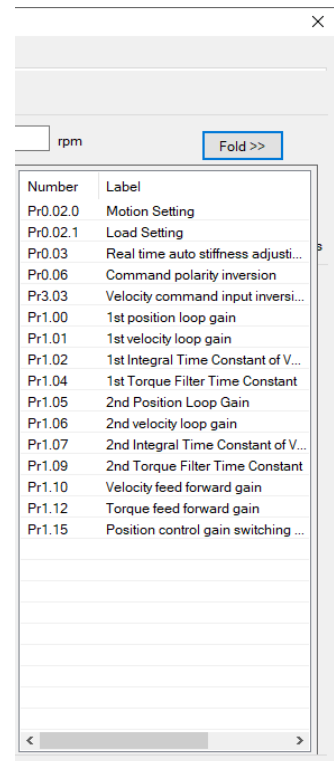
Pr6.21 Waiting time of trial running ms

Run

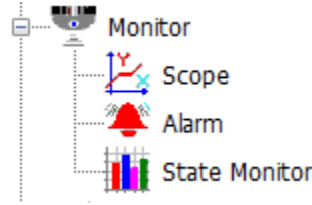
Pr6.22 Cycling times of trial running

1. Set jog velocity and acceleration. If unsure, leave both at default value. Press enter for modification of parameters to be valid.
2. Enable servo drive by clicking Servo Enable. **ON** indicates servo drive and motor are enabled.
3. Click and hold “Positive Direction” or “Negative Direction” for motor to rotate in desired direction. Click on Position 1 and Position 2 to set current point as starting and ending point of trial run. It is recommended to have at least 10r (10 revolutions) between Position 1 and 2
4. Set Pr6.21 for the time interval between each cycle and no. of cycles of the trial run.
5. Click on “Run” to start the motor. Click on “Stop” to stop the motor or motor will stop after completing the no. of cycles set.

Other related parameters can be found on the right after clicking on “Expand”. Servo drive needs to be enabled. Click on “Fold” to retract these parameters when not needed.

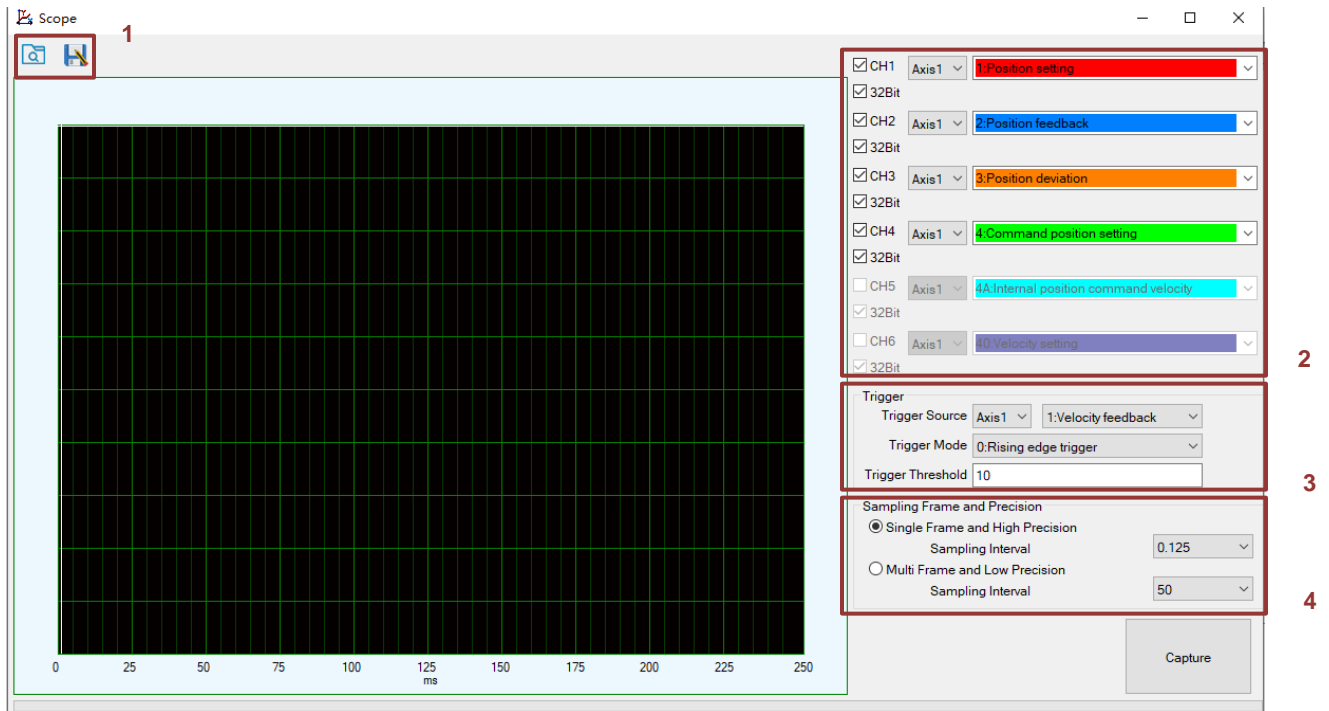


Monitor



Scope

To read or save captured data in waveform. Multiple different data of servo drives can be monitored using scope.



①	To read saved waveform files (.csv) To save captured waveform as .csv file.
②	Can monitor up to 6 variables at the same time (Servo drive model dependent)
③	Set trigger source, mode and conditions for waveform capturing to start
④	Set sampling size and its precision according to user's needs.

Alarm

To check error messages, causes and recommended solutions. Clear alarm after handling the error successfully. Historical records of alarms can also be found in this function. Alarms related to motor stops rotating is highlighted in different for users to easy detect the cause of error(s), solve the error and return axis to normal operational status.

Alarm

Current | History | Cause(s) of motor not rotating

Device	Alarm Code	Alarm label	Clearable	Error Level
Axis1	Err0D2	No main power supply detected	Yes	2

Click on the error in this list to get error analysis on the table below

Clear

Please make sure to handle alarm as recommended before clearing

Error Analysis

ID	Cause	Check	Handle
1	No main power supply	Verify L1.L2.L3 terminal voltage	1. Increase main power supply voltage ; 2. Secure conn...

Error Diagnostic

ID	Label	Value
----	-------	-------

Alarm

Current | History | Cause(s) of motor not rotating

Select axis: Axis1 | Clear | Generate Report

Alarm Code	Alarm label	ID	Label	Value
Err000	No alarm	0	Downtime(s)	NULL
Err000	No alarm	1	Position command velocity(rpm)	NULL
Err000	No alarm	2	Relative position deviation(P)	NULL
Err000	No alarm	3	Velocity setting(rpm)	NULL
Err000	No alarm	4	Motor velocity(rpm)	NULL
Err000	No alarm	5	Motor torque(0.1%)	NULL
Err000	No alarm	6	U/A phase current(0.1%)	NULL
Err000	No alarm	7	W/B phase current(0.1%)	NULL
Err000	No alarm	8	DC bus voltage(V)	NULL
Err000	No alarm	9	Driver/MCU temperature(°C)	NULL
Err000	No alarm	10	Command position(P)	NULL
Err000	No alarm	11	Feedback position(P)	NULL
Err000	No alarm	12	Encoder error count(Time)	NULL
Err000	No alarm	13	Max. motor current under 2s(0.1%)	NULL
Err000	No alarm	14	Motor overload ratio(%)	NULL
Err000	No alarm	15	Regenerative resistor overload ratio(%)	NULL
Err000	No alarm	16	Internal status	NULL
Err000	No alarm	17	Input status	NULL
Err000	No alarm	18	Output status	NULL
Err000	No alarm	19	Encoder status	NULL
Err000	No alarm	20	6040&6041(Control word& status word)	NULL
Err000	No alarm	21	6060&6061(Operation mode selection & display)	NULL
Err000	No alarm	22	607A (Target position)	NULL
Err000	No alarm		6064 (Actual position feedback)	NULL

Alarm historical record

Data record when alarm occurs

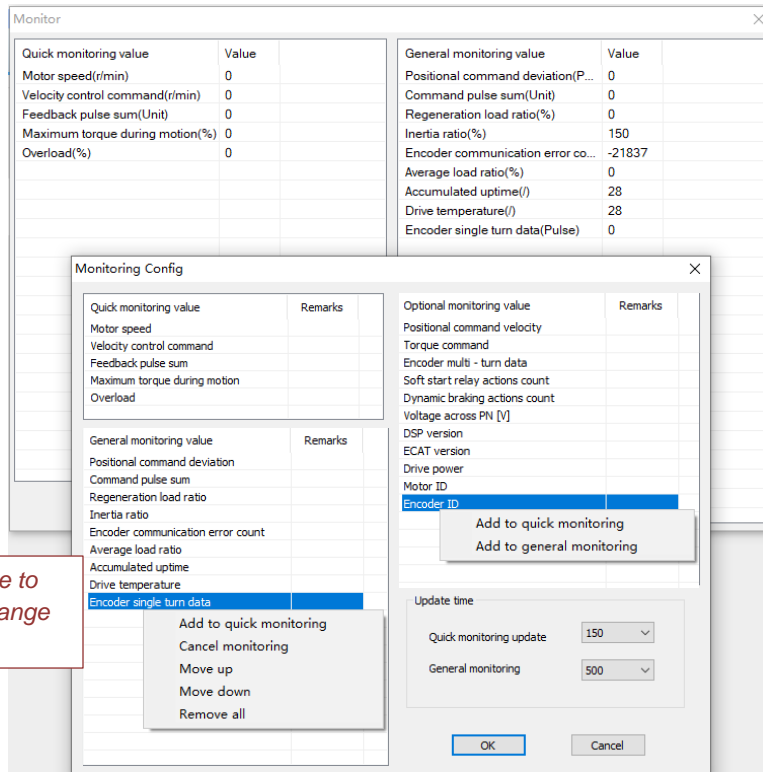
Error report can be generated and saved as .csv file.

State Monitor

The difference between short interval monitoring and general monitoring is the data sampling time interval. All data/variables can be added or removed from each monitoring list and the time intervals can be modified according to users' needs.

Short Interval monitoring: Sampling time interval of 50-200ms per cycle.

General monitoring: Sampling time interval 300ms up to 5000ms per cycle.



The screenshot shows the 'Monitor' window with two columns of data: 'Quick monitoring value' and 'General monitoring value'. The 'Monitoring Config' dialog is open, showing lists for 'Quick monitoring value', 'General monitoring value', and 'Optional monitoring value'. A context menu is visible over the 'Encoder single turn data' variable in the 'Quick monitoring value' list. The 'Update time' section at the bottom of the dialog shows 'Quick monitoring update' set to 150 and 'General monitoring' set to 500.

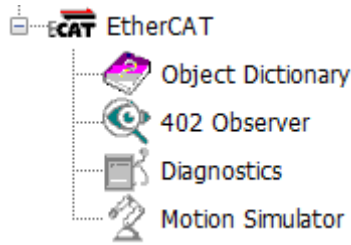
Quick monitoring value	Value	General monitoring value	Value
Motor speed(r/min)	0	Positional command deviation(P...	0
Velocity control command(r/min)	0	Command pulse sum(Unit)	0
Feedback pulse sum(Unit)	0	Regeneration load ratio(%)	0
Maximum torque during motion(%)	0	Inertia ratio(%)	150
Overload(%)	0	Encoder communication error co...	-21837
		Average load ratio(%)	0
		Accumulated uptime(I)	28
		Drive temperature(I)	28
		Encoder single turn data(Pulse)	0

Add variables to required monitoring mode

Right click on variable to add, remove or rearrange variables in the list

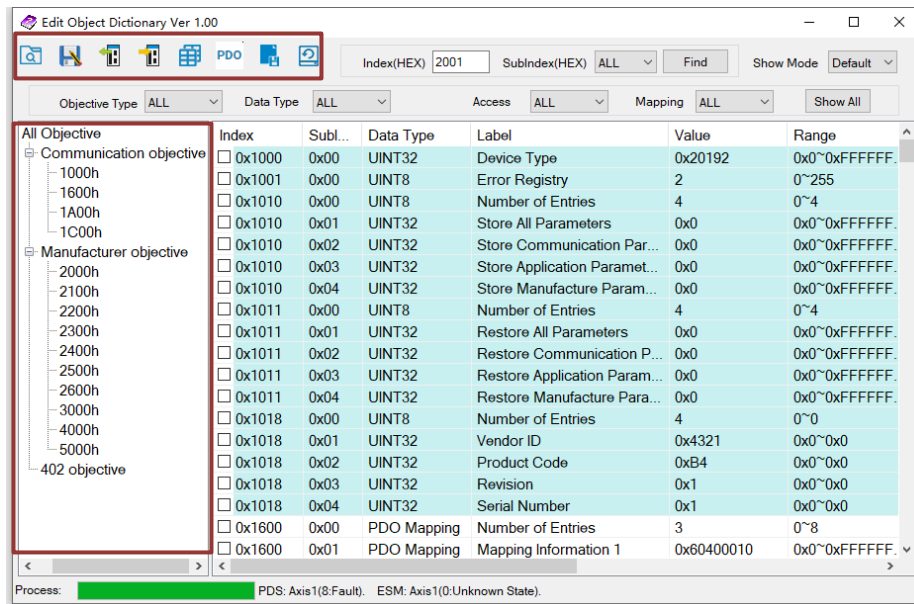
Set sampling time interval for 2 different modes

EtherCAT



Object Dictionary

To edit Object Dictionary. Descriptions can be found in Parameters Guide. Object categories can be found on the left panel. Objects can be filtered to make locating specific object easier.



	Read object files	Read object settings save on PC (.obd files)
	Save objects	Save current object files as .obd files. Recommended to back up object settings before any modification.
	Read from driver	Read object settings from driver
	Write to driver	Write objects to drivers.
	Compare objects	Objects comparison can be made between current object settings, saved object files and object default values.
	PDO configuration*	To modify Process Data Objects
	Save to driver	Save objects into drivers.
	Factory reset	Restore all objects back to factory default

PDO configuration

PDO Configuration

Receive PDO | Transmit PDO | SDO

Label	Index	SubIndex	Bit length
<input checked="" type="checkbox"/> Receive PDO 1	0x1600	0x00	
<input checked="" type="checkbox"/> Control Word	0x6040	0x00	16
<input checked="" type="checkbox"/> Target Position	0x607A	0x00	32
<input checked="" type="checkbox"/> Probe Function	0x60B8	0x00	16
<input type="checkbox"/> Receive PDO 2	0x1601	0x00	
<input type="checkbox"/> Control Word	0x6040	0x00	16
<input type="checkbox"/> Target Position	0x607A	0x00	32
<input type="checkbox"/> Profile Velocity	0x6081	0x00	32
<input type="checkbox"/> Profile Acceleration	0x6083	0x00	32
<input type="checkbox"/> Profile Deceleration	0x6084	0x00	32
<input type="checkbox"/> Operation Mode	0x6060	0x00	8
<input type="checkbox"/> Receive PDO 3	0x1602	0x00	
<input type="checkbox"/> Control Word	0x6040	0x00	16
<input type="checkbox"/> Target Velocity	0x60FF	0x00	32
<input type="checkbox"/> Profile Acceleration	0x6083	0x00	32
<input type="checkbox"/> Profile Deceleration	0x6084	0x00	32
<input type="checkbox"/> Operation Mode	0x6060	0x00	8
<input type="checkbox"/> Receive PDO 4	0x1603	0x00	
<input type="checkbox"/> Control Word	0x6040	0x00	16
<input type="checkbox"/> Homing Method	0x6098	0x00	8
<input type="checkbox"/> Limit Switch Velocity	0x6099	0x01	32
<input type="checkbox"/> Homing Velocity	0x6099	0x02	32
<input type="checkbox"/> Homing Acceleration	0x609A	0x00	32
<input type="checkbox"/> Home Offset	0x607C	0x00	32
<input type="checkbox"/> Operation Mode	0x6060	0x00	8

Add Delete Edit Up Down Save

Tip: Double click to edit PDO

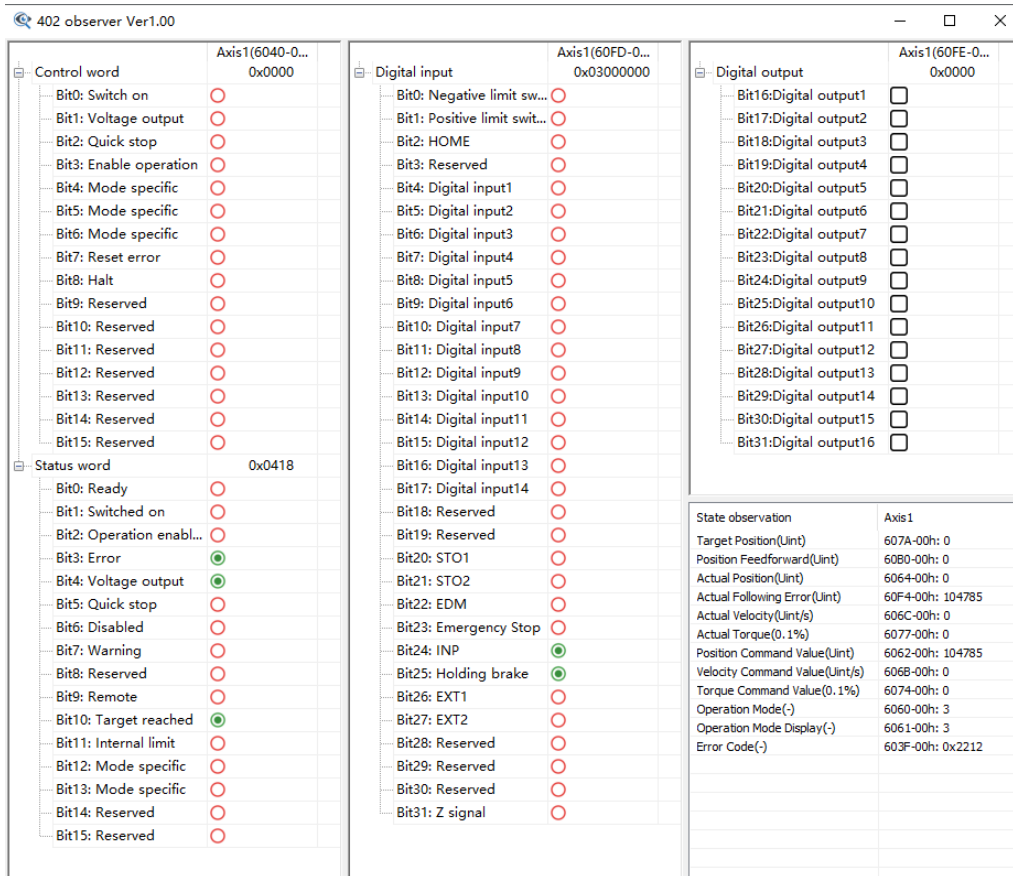
PDO Configuration

Receive PDO | Transmit PDO | SDO

ID	Index : SubIndex	Label	Value	Bit le...
1	0x1600 - 0x01	Mapping Information 1	0x60400010	32
2	0x1600 - 0x02	Mapping Information 2	0x607A0020	32
3	0x1600 - 0x03	Mapping Information 3	0x60B80010	32
4	0x1600 - 0x00	Number of Entries	3	32
5	0x1601 - 0x01	Mapping Information 1	0x60400010	32
6	0x1601 - 0x02	Mapping Information 2	0x607A0020	32
7	0x1601 - 0x03	Mapping Information 3	0x60810020	32
8	0x1601 - 0x04	Mapping Information 4	0x60830020	32
9	0x1601 - 0x05	Mapping Information 5	0x60840020	32
10	0x1601 - 0x06	Mapping Information 6	0x60600008	32
11	0x1601 - 0x00	Number of Entries	6	32
12	0x1602 - 0x01	Mapping Information 1	0x60400010	32
13	0x1602 - 0x02	Mapping Information 2	0x60FF0020	32
14	0x1602 - 0x03	Mapping Information 3	0x60830020	32
15	0x1602 - 0x04	Mapping Information 4	0x60840020	32
16	0x1602 - 0x05	Mapping Information 5	0x60600008	32
17	0x1602 - 0x00	Number of Entries	5	32
18	0x1603 - 0x01	Mapping Information 1	0x60400010	32
19	0x1603 - 0x02	Mapping Information 2	0x60980008	32
20	0x1603 - 0x03	Mapping Information 3	0x6099120	32
21	0x1603 - 0x04	Mapping Information 4	0x6099220	32
22	0x1603 - 0x05	Mapping Information 5	0x609A0020	32
23	0x1603 - 0x06	Mapping Information 6	0x607C0020	32
24	0x1603 - 0x07	Mapping Information 7	0x60600008	32
25	0x1603 - 0x00	Number of Entries	7	32
26	0x1A00 - 0x01	Mapping Information 1	0x603F0010	32
27	0x1A00 - 0x02	Mapping Information 2	0x60410010	32
28	0x1A00 - 0x03	Mapping Information 3	0x60610008	32
29	0x1A00 - 0x04	Mapping Information 4	0x60640020	32
30	0x1A00 - 0x05	Mapping Information 5	0x60B90010	32
31	0x1A00 - 0x06	Mapping Information 6	0x60BA0020	32
32	0x1A00 - 0x07	Mapping Information 7	0x60FD0020	32
33	0x1A00 - 0x00	Number of Entries	7	32
34	0x1A01 - 0x00	Number of Entries	0	32
35	0x1C12 - 0x01	SM2 PDO Mapping 0	0x1600	16
36	0x1C12 - 0x00	Number of Entries	1	8

402 observer

To monitor control/status word and DI/DO state



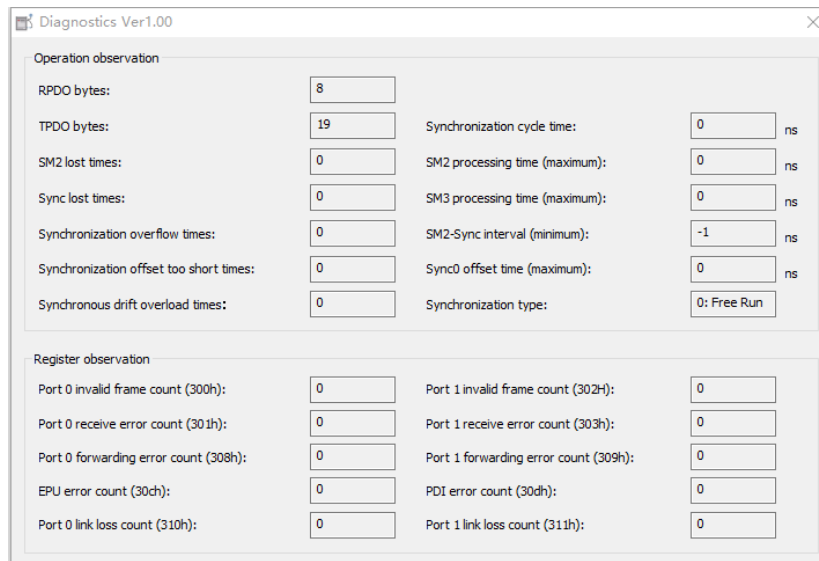
The screenshot displays the '402 observer Ver1.00' window, which is divided into several sections for monitoring Axis1 (6040-0...).

- Control word (0x0000):** A list of 16 bits. Bit 4 (Mode specific) and Bit 10 (Target reached) are currently active (green circles).
- Status word (0x0418):** A list of 16 bits. Bit 3 (Error), Bit 4 (Voltage output), and Bit 10 (Target reached) are active (green circles).
- Digital input (0x03000000):** A list of 32 bits. Bit 25 (Holding brake) and Bit 26 (EXT1) are active (green circles).
- Digital output (0x0000):** A list of 16 bits, all currently inactive (white circles).
- State observation (Axis1):** A table of real-time data:

Parameter	Value
Target Position(Uint)	607A-00h: 0
Position Feedforward(Uint)	6080-00h: 0
Actual Position(Uint)	6064-00h: 0
Actual Following Error(Uint)	60F4-00h: 104785
Actual Velocity(Uint/s)	606C-00h: 0
Actual Torque(0.1%)	6077-00h: 0
Position Command Value(Uint)	6062-00h: 104785
Velocity Command Value(Uint/s)	606B-00h: 0
Torque Command Value(0.1%)	6074-00h: 0
Operation Mode(-)	6060-00h: 3
Operation Mode Display(-)	6061-00h: 3
Error Code(-)	603F-00h: 0x2212

Diagnostics

Operation and Register Operation can be found here



The screenshot displays the 'Diagnostics Ver1.00' window, which is divided into two main sections:

- Operation observation:** A table of timing and synchronization parameters:

RPDO bytes:	8	Synchronization cycle time:	0 ns
TPDO bytes:	19	SM2 processing time (maximum):	0 ns
SM2 lost times:	0	SM3 processing time (maximum):	0 ns
Sync lost times:	0	SM2-Sync interval (minimum):	-1 ns
Synchronization overflow times:	0	Sync0 offset time (maximum):	0 ns
Synchronization offset too short times:	0	Synchronization type:	0: Free Run
Synchronous drift overload times:	0		
- Register observation:** A table of error and frame counts:

Port 0 invalid frame count (300h):	0	Port 1 invalid frame count (302h):	0
Port 0 receive error count (301h):	0	Port 1 receive error count (303h):	0
Port 0 forwarding error count (308h):	0	Port 1 forwarding error count (309h):	0
EPU error count (30ch):	0	PDI error count (30dh):	0
Port 0 link loss count (310h):	0	Port 1 link loss count (311h):	0

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