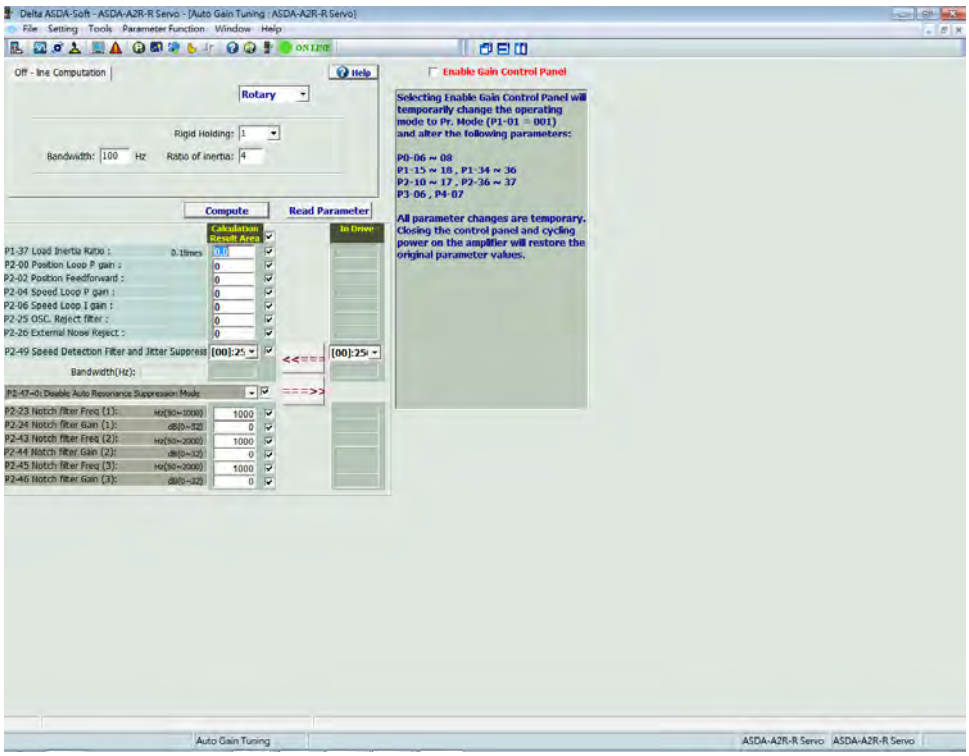
3.2 Auto Gain Tuning

Users can auto adjust the gain value of control loop via [Auto Gain Tuning] provided by ASDA-Soft. Followings are its main features:

- Fill in the data of bandwidth, inertia ratio and rigid holding to compute the gain value. Then, the value will be downloaded into the servo drive for testing.
- Through the motor speed and travelling distance (distance between two points), users can estimate the inertia during operation. Use the average inertia value to compute the relative gain value of control loop.
- Manually enter all related gain value. This is for a higher level of engineer for advanced setting.
- For the adjustment of resonance suppression, users can setup parameters after acquiring the resonance position and value from the scope.

Figure below is the main screen after enabling scope function:



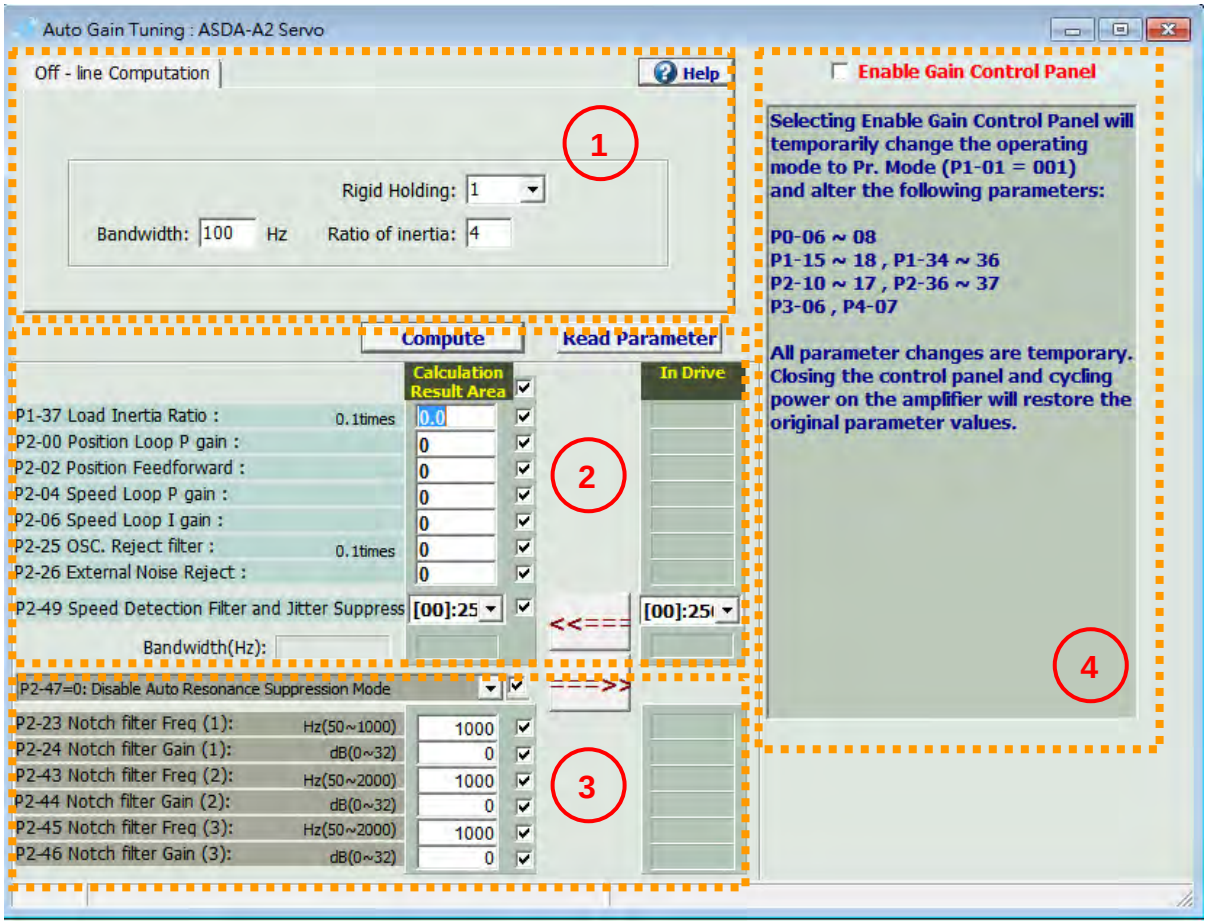
This section will be divided into two parts:

【**Interface Introduction**】: It detailed describes the function of auto gain tuning.

【**Description of Tuning**】: It describes the setup tuning procedures, including the setting of motor speed, operation distance and inertia estimation.

Interface Introduction

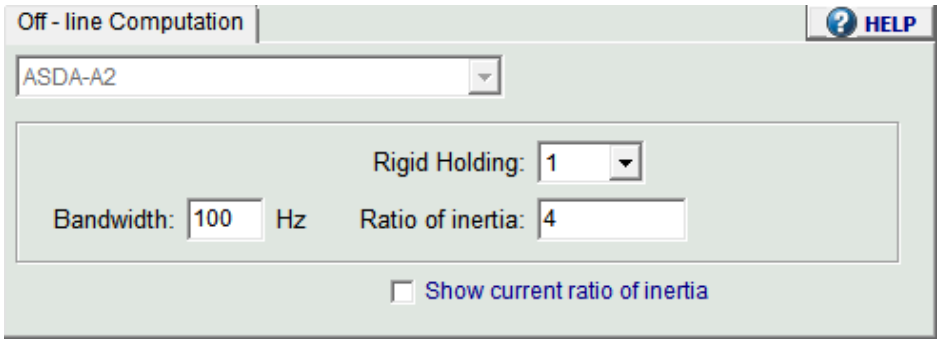
【Screen Analysis】:

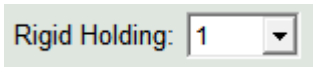
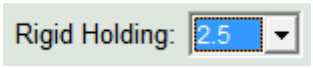
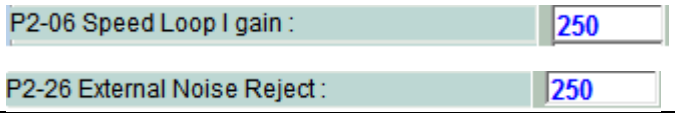


1). Setup low-frequency stiffness, response bandwidth and inertia ratio.
2). Setup each gain value and upload/download the gain value.
3). Setup three parameters of resonance suppression.
4). “Enable Gain Control Panel”

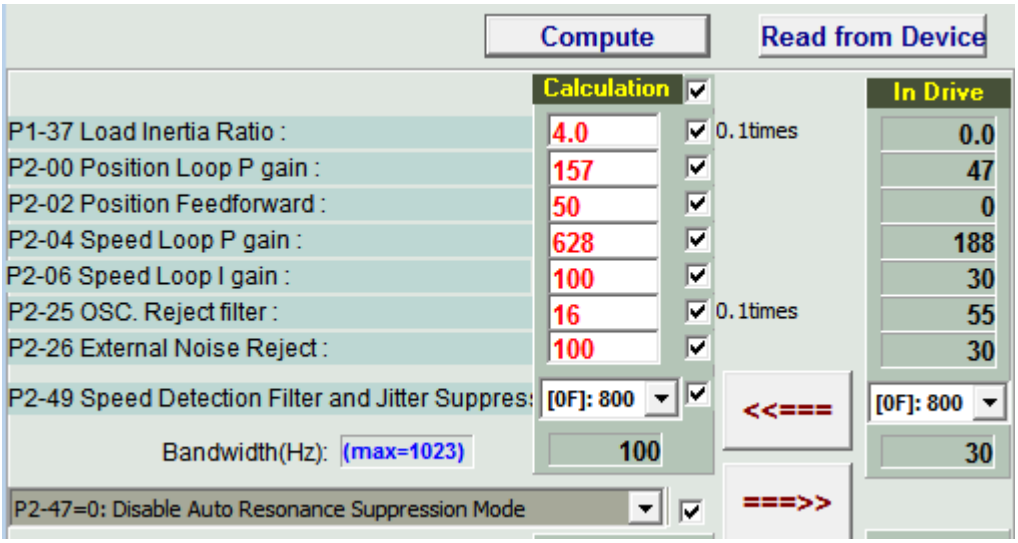
Followings are the description of each item:

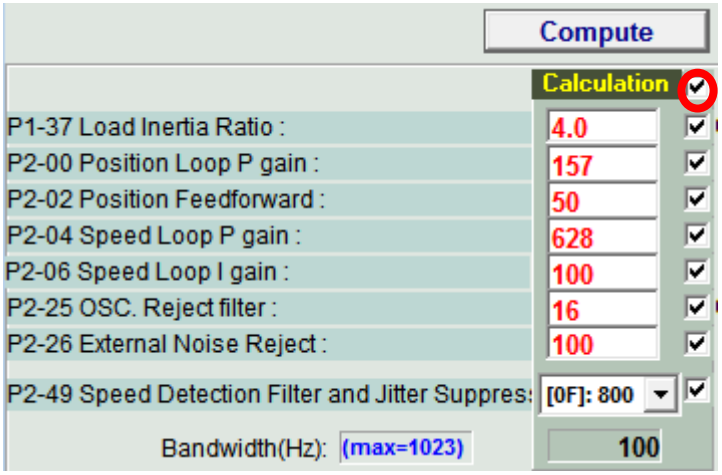
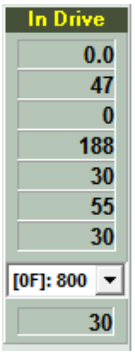
[Window for setting motor type, low-frequency stiffness, response bandwidth and inertia ratio]

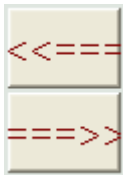


Icon	Function Description
	Setup response bandwidth of the servo drive. Users can also manually modify the value. After tuning, value will be displayed in this column.
	If the stiffness is not enough, when the position command is complete, the drive end still vibrates even when the motor almost stops. The adjustment will influence the value of P2-06 (Speed Integral Compensation) and P2-26 (Anti-interference Gain): Adjust the value of [low-frequency stiffness]. Use the value x 100 to setup P2-06 and P2-26. For example, Setup  . Click  , then the following two parameters will be: 
	Setup the inertia ratio of the servo drive. After tuning, value will be displayed in this column.

[Window for setting each gain value]

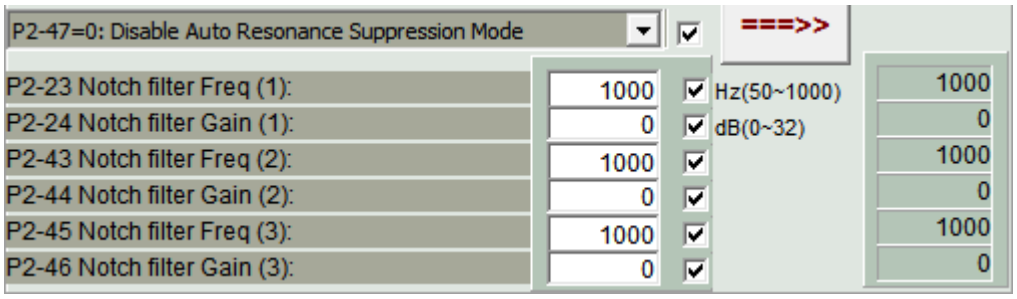


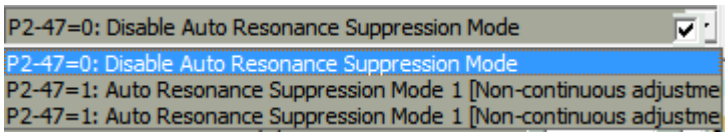
Icon	Function Description
Compute	When all parameter setting is complete, click this to compute the gain value.
Read from Device	This button can be used to read parameters from the servo drive.
	Click Compute, the computing result will show in this area. In addition, users can determine if the modified parameters will be downloaded into the servo drive. The check box highlighted in red means users can select or cancel all parameter.
	Click Read from Device, the gain value of the servo drive will be uploaded to this window.

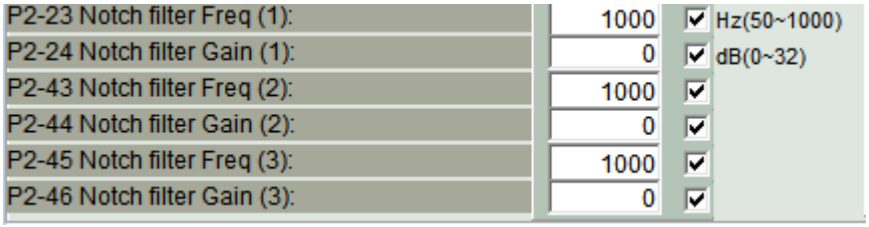
	Users can use these two buttons to upload and download the parameter:  : Upload the parameter from servo drive to Calculation.  : After computing, download the parameter to In Drive.

[Setup three parameters of resonance suppression]

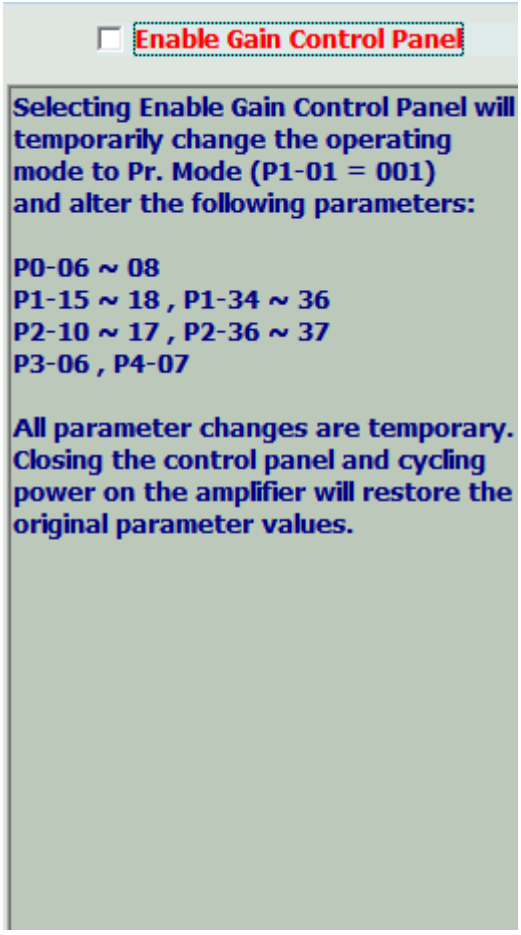
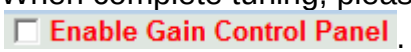
Use FFT to analysis the resonance position and value, users can setup three parameters of resonance suppression here.



Icon	Function Description
	Setup resonance suppression mode from drop-down menu; P2-47 provides three methods: **When the value of P2-47 is set to 0:** Users can manually setup three parameters of resonance suppression. **When the value of P2-47 is set to 1:** Auto resonance suppression. When the system is stable, the value will return to 0 automatically and the system will store the resonance suppression point; if not, it will re-estimate when re-power on or when the value is 1. **When the value of P2-47 is set to 2:** Continuous

	adjustment. When the system is stable, it will store the resonance suppression point, if not, it will re-estimate when re-power on.
	Users can setup three parameters via P2-47 that mentioned above. When P2-47 is set to 1 and 2, the 2nd and 3rd parameter of resonance suppression will be unable to setup. These two parameters will be set as auto estimation.

[Open the window of "Enable Gain Control Panel"]

Icon	Function Description
	Check  , the system will switch to the setting page of tuning. Please pay attention that when enabling this function, the operation mode is temporarily changed to PR mode. Some parameters will be changed temporarily. When complete tuning, please uncheck  .

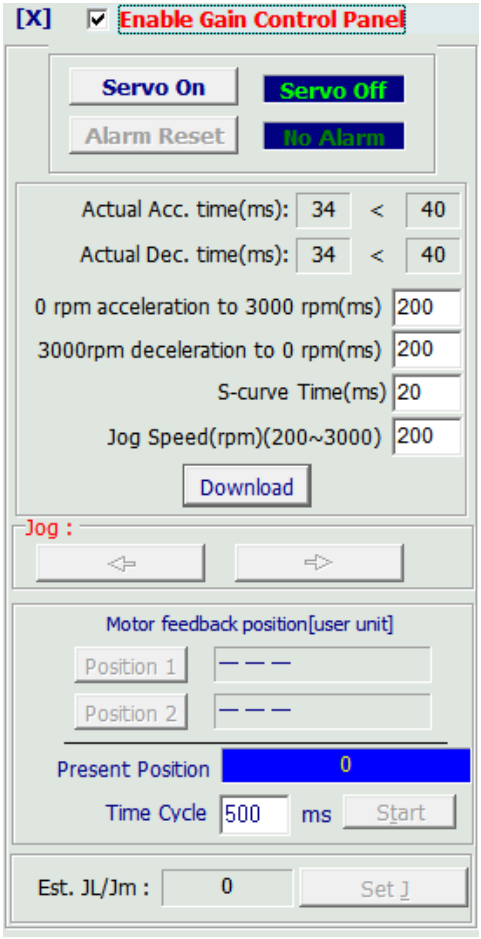
Description of Tuning

It is recommended to use tuning to setup control loop parameters. Through the actual operation, users can directly estimate the change of inertia.

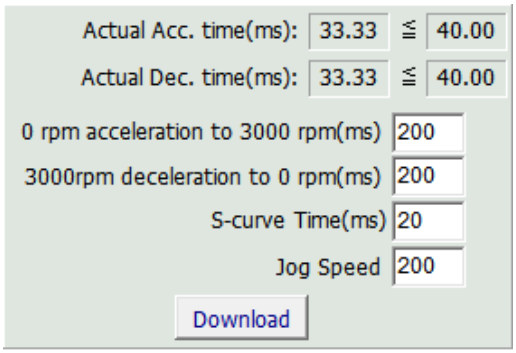
NOTE In order to acquire the accurate result of estimation, the servo motor must operate a distance at forward / reverse direction. Also, the motor speed should be set up to 200rpm.

Following is the operation procedure:

Step 1: Check “Enable Gain Control Panel”, screen on the right will switch to the one of tuning.



Step 2: Setup the parameter of motor speed. It is suggested to set from low speed to the actual operation one:

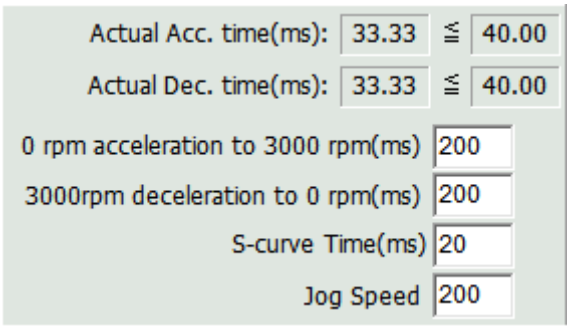


- Setup JOG speed first; The JOG speed is used when applying hand wheel or manually adjusting the positioning point. The system will regard this speed as the motor speed (at forward / reverse direction) when estimating inertia.
  Note: JOG speed must faster than 200rpm so as to achieve the desired result of inertia estimation.
  JOG speed will be used to estimate the max. allowable time. See the following example:

  Max. allowable time (ms) = Current JOG speed (rpm) ÷ (5000(rpm)÷1(s))

  So, max. allowable time (ms): 200rpm÷(5000rpm÷1000ms) = 40ms
  It means when JOG speed is 200rpm, the max. allowable time is 40ms.

- Users can setup acceleration constant, deceleration constant and S-curve smooth constant according to the actual machinery situation.
  Note: The acceleration/deceleration time cannot exceed the max. allowable time.
  Formula of auto computing the actual acceleration/deceleration time is shown as below:
  Actual acceleration/deceleration time = setting value + S-curve smooth constant
  Setting value = The acceleration time from 0 to 3000 rpm x JOG speed (rpm) ÷ 3000(rpm)



  Take the above figure as the example. When the acceleration time and deceleration time is 200ms; the setting value should be:

  200(ms) × 200(rpm) ÷ 3000(rpm) = 13.33(ms)

  The actual acceleration or deceleration time = 13.33(ms) + 20(ms) = 33.33(ms)

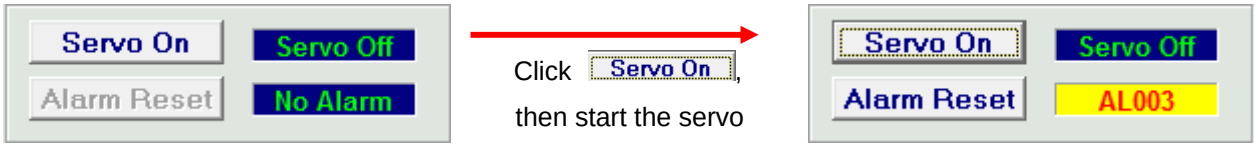
  Thus, the actual acceleration and deceleration time is shorter than the max.

allowable time which eligible for inertia estimation.

- When the setting is complete, click Download to download the motor speed to the servo drive temporarily.

  Note: Click Download, if the input value is not an integer or the actual acceleration/deceleration time exceeds the max. allowable time, the following window will pop up and the data will not be downloaded into the servo.

Step 3: After the setting of motor speed is complete, please start the servo.



If an alarm occurs, please turn off the servo and troubleshoot the problem. And use Alarm Reset to resume the servo drive.

NOTE Some alarms cannot be cleared via reset button. Users have to re-power on the servo drive. Please refer to the user manual for detailed description about alarms.

Step 4: Setup motor operation distance. It is suggested to start from left limit to right limit. Users also can setup the specified section. The setting of positioning point is similar to the setting of hand wheel or JOG position. Users could use the direction key of JOG to adjust motor's moving direction.

Direction key could move the motor to the positioning point. Then, use "Position 1" and Position 2" to setup. Value in blue mark represents "Current Position". Users can access the actual feedback position of the motor.

"Time Interval" can be used to operate the motor after some delayed time when each section is complete.

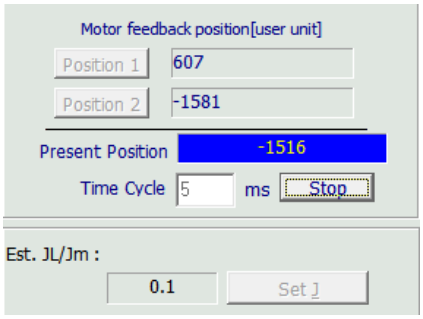
WARNING Please note that the position control is operated by JOG control of the servo drive. Followings are the situation users should bear in mind:

1. Pease make sure the hardware switch of emergency stop or the

controller's DO signal can work. Function of digital I/O can be used for testing.

2. Please make sure the software connection is successfully built. If the communication is breakdown, the motor might unable to run properly.
3. During the operation, if any alarm occurs, press the button of emergency stop immediately or issue the command to stop the motor.

Step 5: Click Start. The motor will operate automatically.



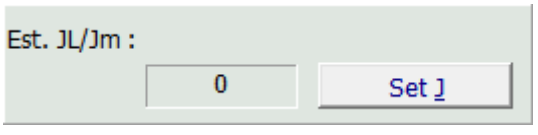
Please observe the variation of inertia ratio. The system will automatically adjust the gain value of control loop. Thus, the inertia ratio will gradually become stable.

It is suggested to use the proper speed to estimate the inertia. When the change of inertia ratio is smaller, click Stop to stop the motor.

WARNING

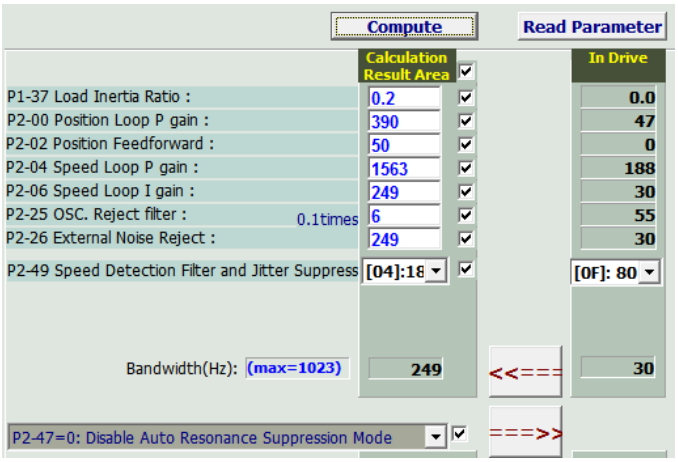
1. During the process of inertia estimation, press the button of emergency stop if any abnormality occurs and cut off the power supply of software and servo drive. Then, re-start the inertia estimation after troubleshooting the problem.
2. The value of estimated inertia ratio (value of P1-37) should bigger or smaller than 1, which means the system is actually tuning. Incorrect inertia value would result in wrong estimation of system bandwidth and gain value.

Step 6: When the estimation of inertia ratio is complete, the new value will show in the box below. Click Set J to the new value will display on the left.



Value of inertia ratio on the left will be replaced by the new value

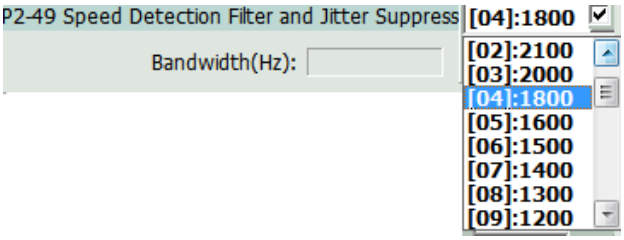
Step 7: When the above mentioned inertia ratio is altered, bandwidth and gain value will be adjusted, too.



Please pay special attention to the variation of bandwidth. From the above example, the value is adjusted without load, so the bandwidth estimated by the system is 249Hz. However, for general mechanism, high response setting is unnecessary. Users can adjust the bandwidth and gain value according to the real situation.

Step 8: Click ===>> to download the new value into the servo drive.

NOTE Value of P2-49 will not be adjusted by system. It should be set by users.



Following is the diagram of speed control: P2-49, low-pass filter, is used to process the feedback signal of encoder, which could reduce the interference and the error occurrence caused by speed control loop. Its setting value is from 100 to 2500 Hz.