

TB267 (Rev4) - CNC11 Yaskawa Sigma5 Precision Mode Setup

Overview:

This document will walk you through the process of configuring and tuning a Yaskawa Sigma V Servo Drive Pack and motor with a centroid CNC11 based control, running in Precision Mode.

Centroids Precision Mode can provide very good resolution and high feedrates, but the following maximums should not be exceeded:

MPU11 max Counts/min = 72,000,000

This maximum is derived from the maximum counts per interrupt 300 counts/int * 4000 int/sec * 60 seconds

Drive max command counts per second that the drive can accept (1,200,000/s)

The following table shows examples of resolutions resulting from selected encoder counts per rev and ballscrew pitch.

Encoder Counts/Rev Yielding Resolution and Speeds.

12mm Pitch	Counts/Rev	Resolution	MaxRPM	Max Speed	Max Speed
		("/Count)		("/Min)	(mm/Min)
	8192	0.000058	8789	4152	49828
	16384	0.000029	4395	2076	24914
See Notes*	24000	0.000020	3000	1417	17008
	32768	0.000014	2197	1038	12457

16mm Pitch	Counts/Rev	Resolution	MaxRPM	Max Speed	Max Speed
		("/Count)		("/Min)	(mm/Min)
	8192	0.000077	8789	5536	88583
	16384	0.000038	4395	2768	44291
See Notes*	24000	0.000026	3000	1890	30236
	32768	0.000019	2197	1384	22146

*Yaskawa Sigma Series 5 Motors (SG-MGV) Maximum RPM = 3000

The 8192 default value referred to in the Tech Bulletin and manual refers to 8192 lines= 32768counts per rev.

Prerequisites:

The following items are needed:

- Computer with the Yaskawa SigmaWin+ software installed.
- A to Mini-B type USB cable (Yaskawa part number JZSP-CVS06-02-E) – connected between the laptop and the Yaskawa drive you wish to setup.

ServoPack Configuration Process:

- Launch the Yaskawa SigmaWin+ software.
- You will see the following screen (Illustration 1):

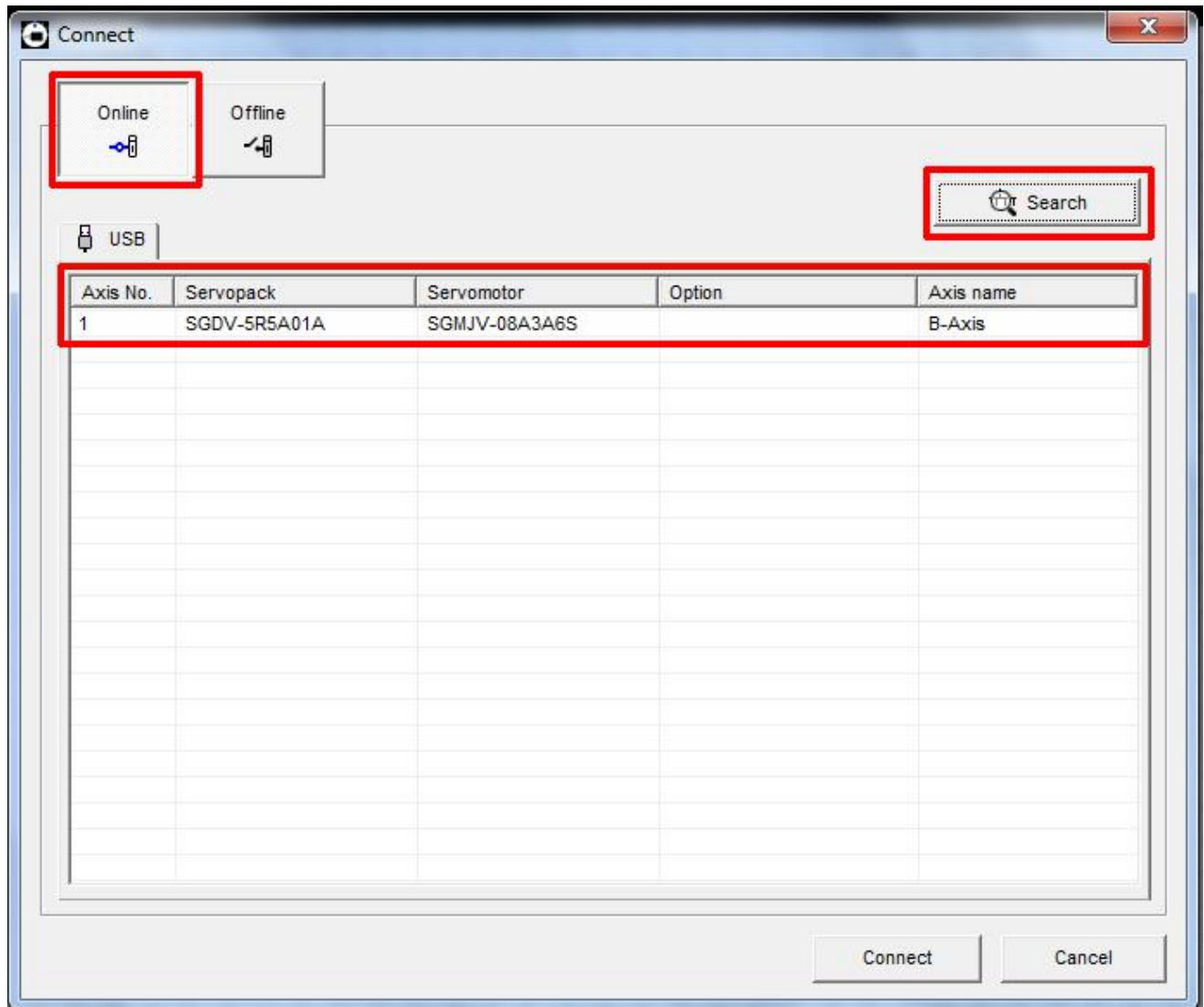


Illustration 1: Yaskawa SigmaWin+ Launch Screen

- Ensure "Online" is selected as shown above
- Select "**Search**" and make sure "Σ5 drives" are selected. This search must be done every time you power up the software or connect to a different ServoPack because the SigmaWin+ software remembers the last drive that was connected to it and displays that rather than what is currently connected.
- Select the drive that appears and click "**Connect**".
- SigmaWin+ will then open to the main screen as shown below (Illustration 2):

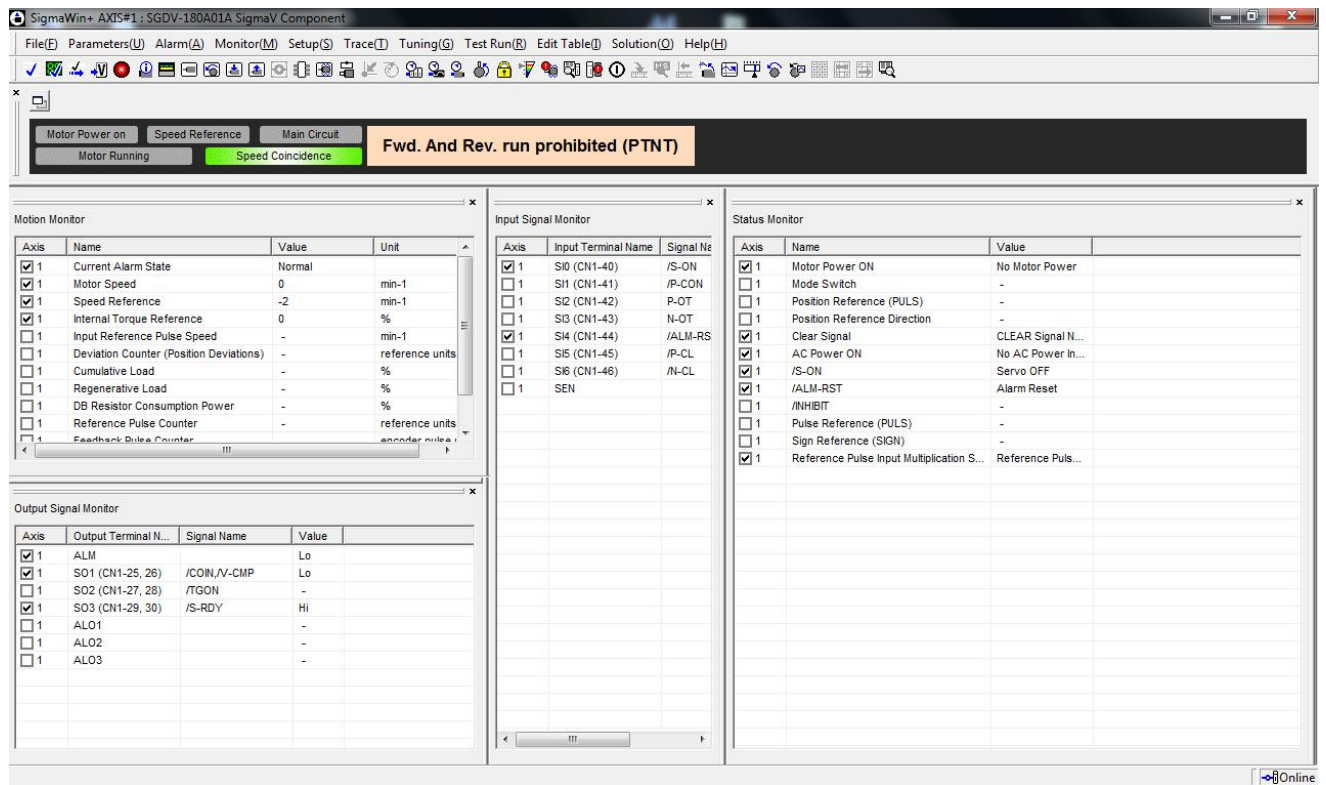


Illustration 2: Yaskawa SigmaWin+ Main Screen

- The best way to configure the ServoPack is by using the Setup Wizard, it is located under the Parameters menu option as shown below (Illustration 3):

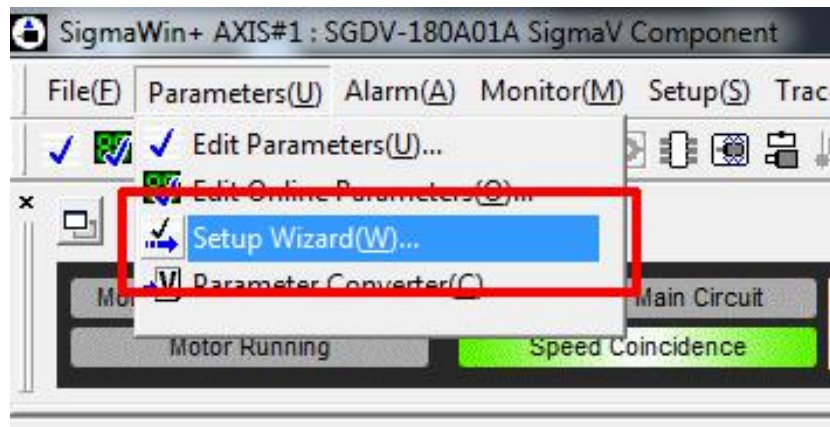


Illustration 3: Setup Wizard Menu

- Select the “**Parameters(U)**” menu then click on “**Setup Wizard(W)**” to start the wizard. The “**Setup Wizard(W)**” window is shown in illustration 4.

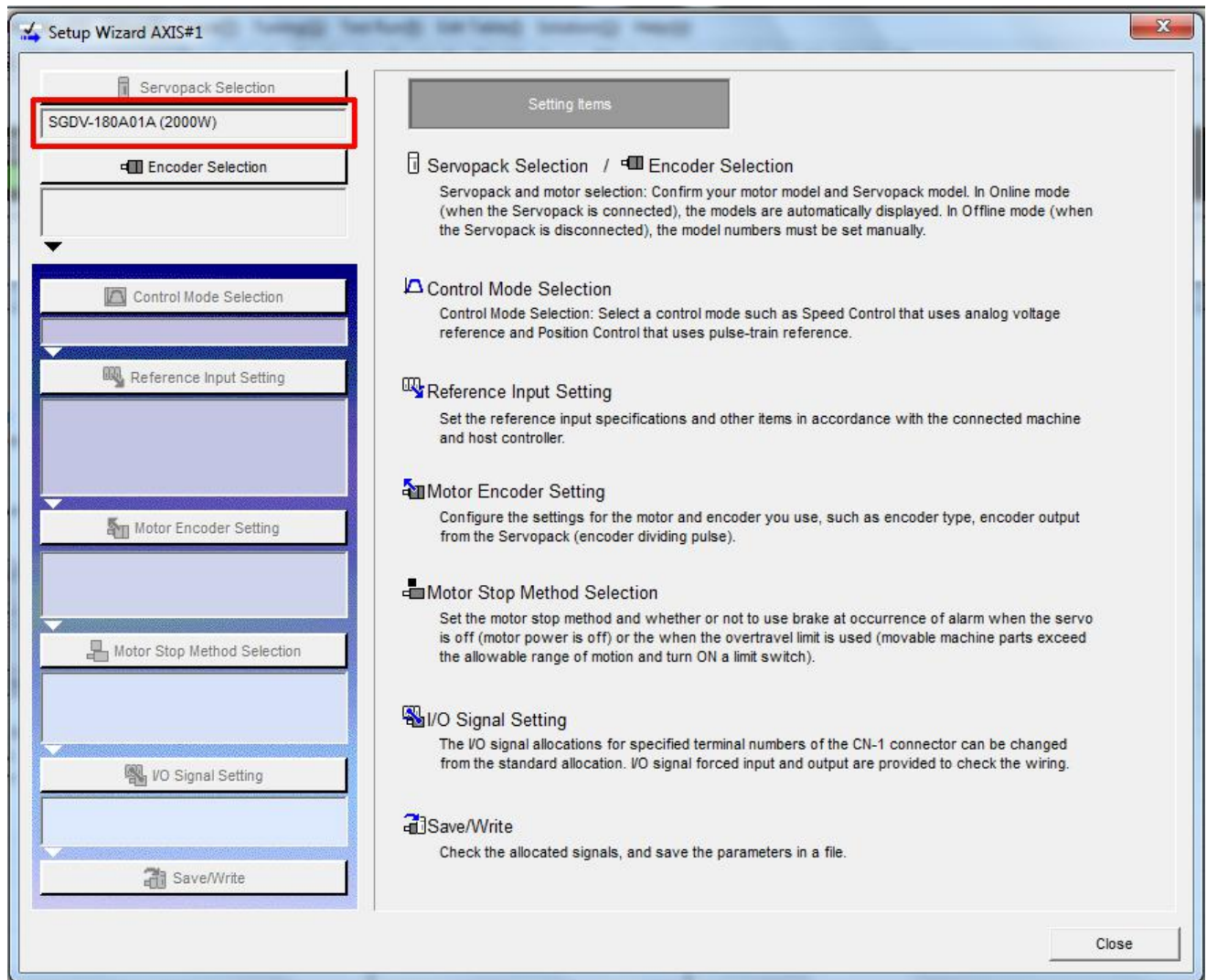
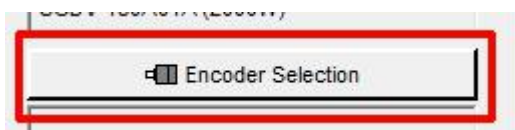
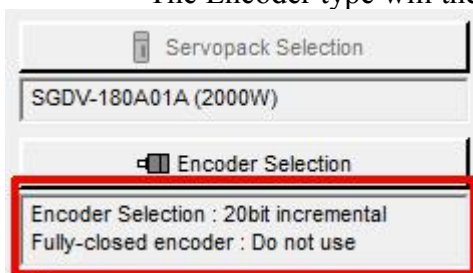


Illustration 4: Setup Wizard

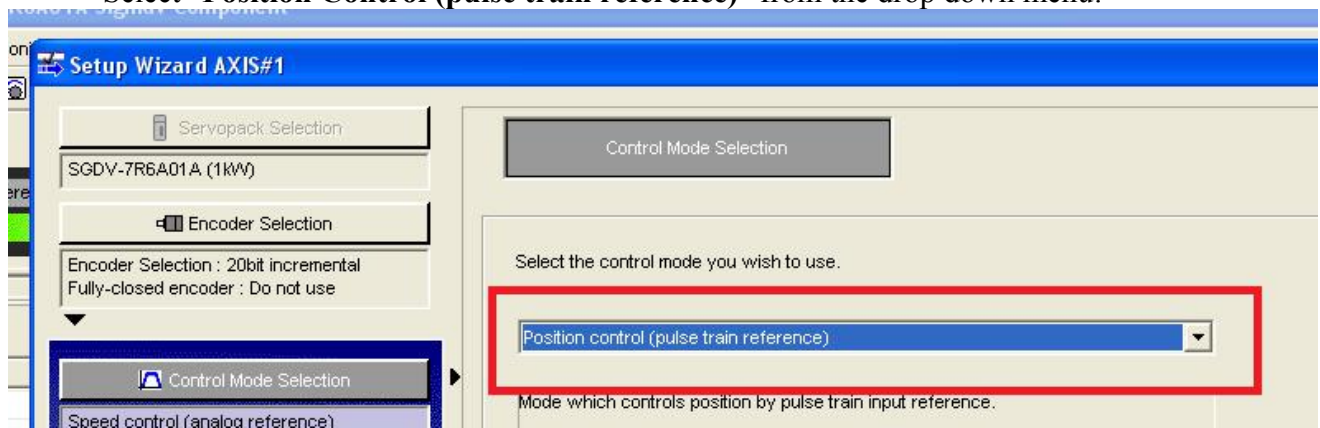
- To run the setup wizard you will click on the buttons at the left of the window. Starting at the top and working down the list.
- Start by clicking on the "**Encoder Selection**" button.



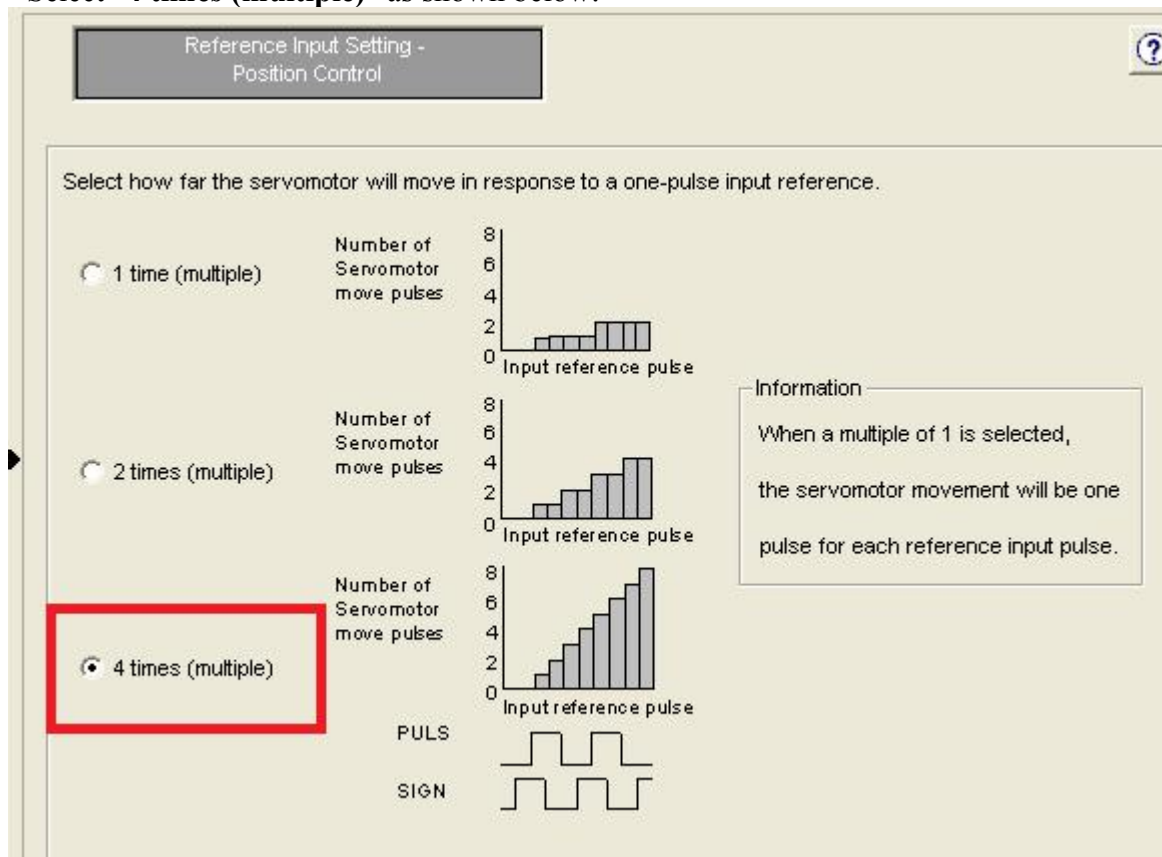
- Nothing is displayed in the window under "**Encoder Selection**" until you click on "**Apply**" at the lower right corner.
- The Encoder type will then be shown under the Encoder Selection button.



- Next click on "**Control Mode Selection**".
- Select "**Position Control (pulse train reference)**" from the drop down menu:

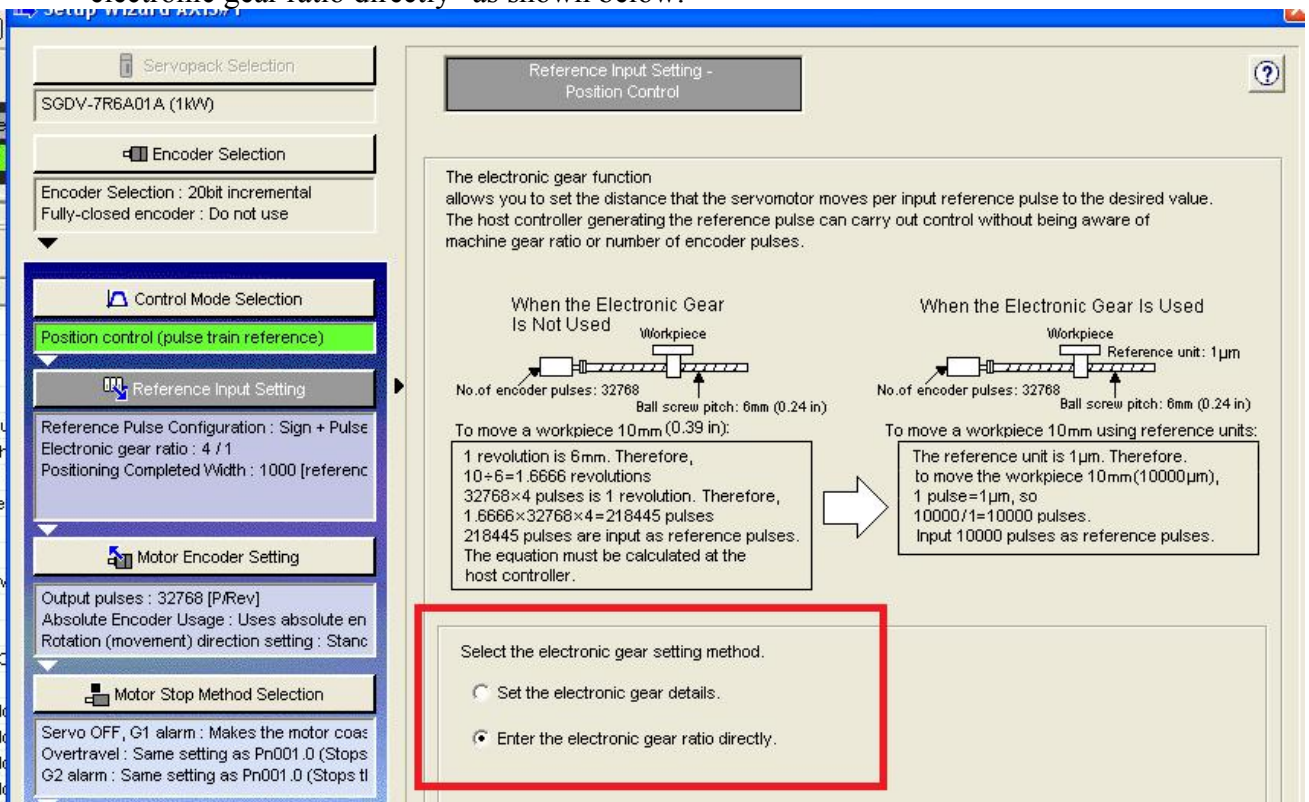


- Click "**Apply**".
- Click "**Reference Input Setting**".
Note: the "**Control Mode Selection**" setting is now highlighted in green, signifying that it has been completed.
- Select "**phase A + phase B**" and click "**Next**".
- You will then need to select how far the servomotor will move in response to a one-pulse input.
- Select "**4 times (multiple)**" as shown below:

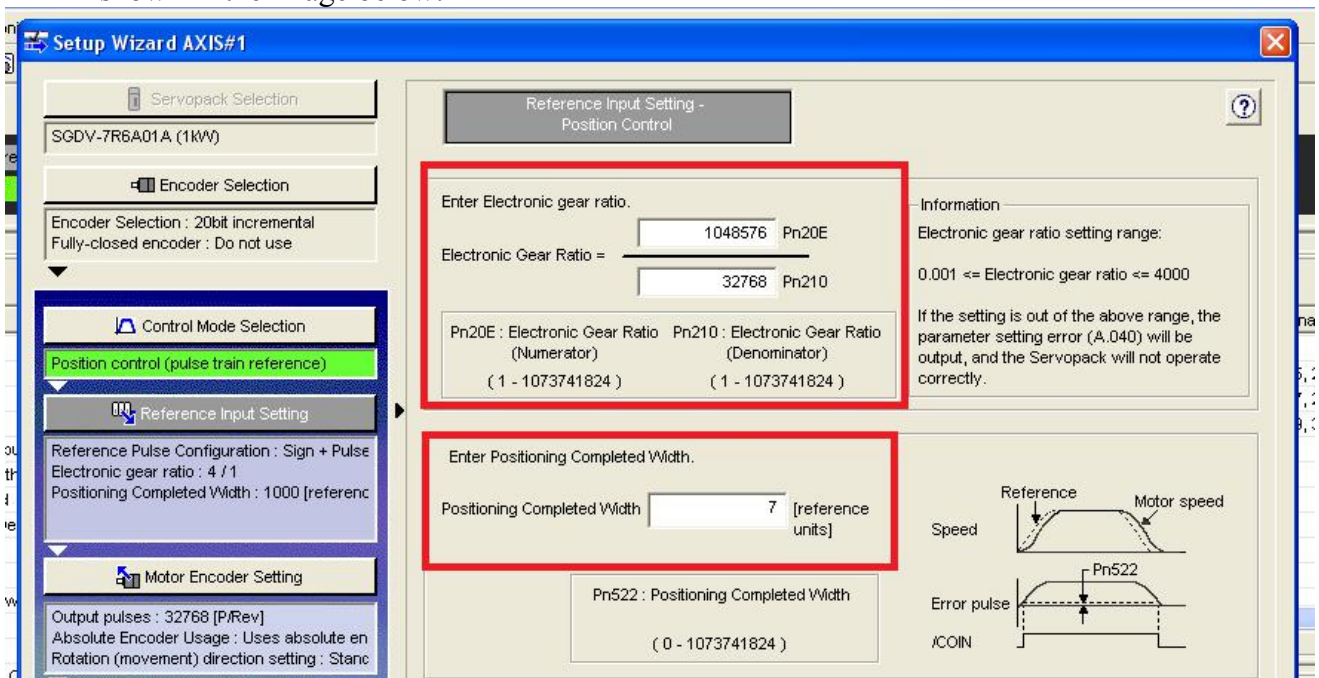


- Click "**Next**".

- You will then be asked to Select the electronic gear setting method, select "Enter the electronic gear ratio directly" as shown below:



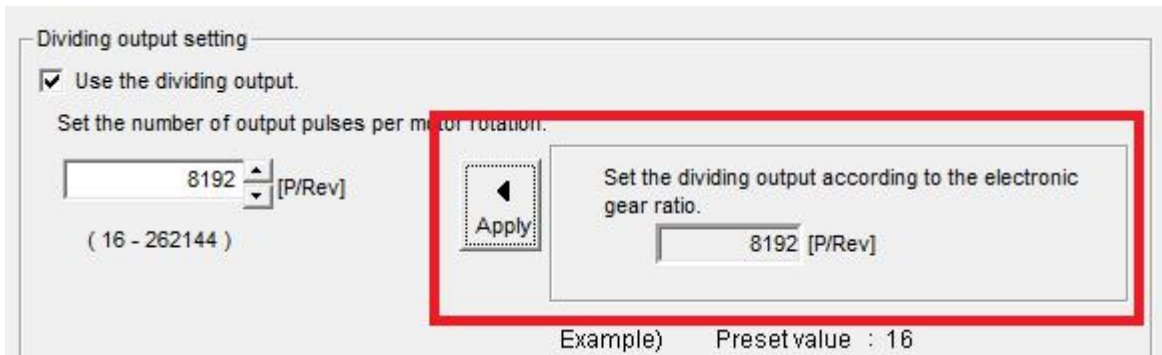
- Click "Next"
- You will then need to enter the gear ratio. Enter **1048576** on top and **32768** on the bottom as shown in the image below:



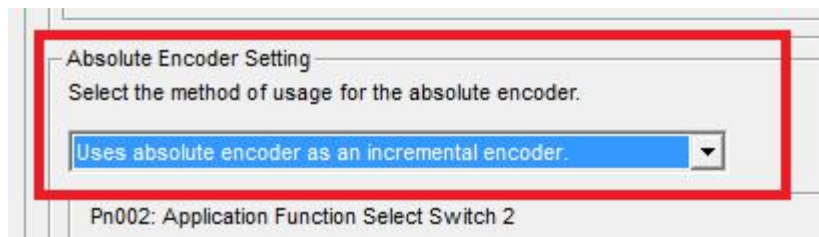
- Verify the Positioning Completed Width is set to 7 and click "Apply".
- Reference Input settings will now be green.

Click "**Motor Encoder Settings**".

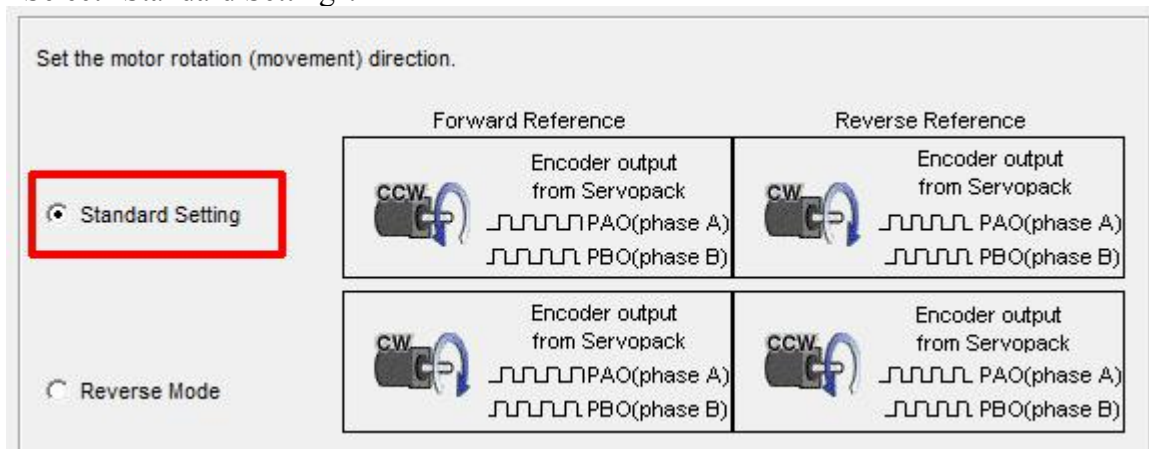
- On the right side of the screen you will see the option to Set the dividing output according to the electronic gear ratio, as shown below. Click on the "**Apply**" arrow button to set the number of output pulses per motor rotation to **8192**.



- Some times due to availability you may receive a motor with an absolute encoder instead of an incremental encoder. The wizard will detect this and allow you to set the following option (shown below). The "**Absolute Encoder Setting**" must be changed to use the absolute encoder as an incremental encoder.:



- Note: The "**Absolute Encoder Setting**" option is grayed out if you have an incremental encoder.
- Click "**Next**".
- Select "**Standard Setting**":



- Click "**Apply**".

The "**Motor Encoder Settings**" section will now also be green.

- Click "**Motor Stop Method**" Selection.
- Pn001.0 should be set by default to the settings in the picture below. If not, make sure they are set accordingly.
- Set "Servo Off" to "0 - Stops motor by applying Dynamic Brake".
- Set "Overtravel" to "0 - Stops motor by applying Dynamic Brake".
- Set "G2 Alarm" to "0 – Stops the motor by setting the speed reference to 0".

Motor Stop Method Selection

Select a motor stop method.

Servo OFF, G1 alarm(Pn001.0)

0 : Stops the motor by applying DB (dynamic brake).

Overtravel(Pn001.1)

0 : Same setting as Pn001.0 (Stops the motor by applying DB or by coasting).

G2 alarm(Pn00B.1)

0 : Stops the motor by setting the speed reference to "0".

- If the Servo Motor you are setting up has a brake you will need to check the "Use the Holding brake" option as shown below:

Brake setting

Use the holding brake (servomotor with the holding brake).

- Click "**Apply**".
- Click "**IO Signal Settings**", then click "**Input Signal Settings**".
- Disable "N-OT" by clicking in the "**Always OFF**" column as shown below.
- Disable "P-OT" by clicking in the "**Always OFF**" column as show below.

Select the input signal allocation mode.

Standard allocation | Customize allocation

Click any cell to allocate an input signal.

	Allocation	SI0 (CN1-40)	SI1 (CN1-41)	SI2 (CN1-42)	SI3 (CN1-43)	SI4 (CN1-44)	SI5 (CN1-45)	SI6 (CN1-46)	Always ON	Always OFF
/S-ON	Required	/S-ON(L)								
/P-CON	Possible		/P-CON(L)							
P-OT	Possible									P-OT
N-OT	Possible									N-OT
/ALM-RST	Possible					/ALM-RST(L)				
/P-CL	Possible						/P-CL(L)			
/N-CL	Possible							/N-CL(L)		
/SPD-D	Not required									/SPD-D
/SPD-A	Not required									/SPD-A
/SPD-B	Not required									/SPD-B
/C-SEL	Not required									/C-SEL
/ZCLAMP	Not required									/ZCLAMP
/INHIBIT	Not required									/INHIBIT
/G-SEL	Possible									/G-SEL
/P-DET	Possible									/P-DET

VO name (L) Normal allocation
VO name (H) Reversed allocation

Pn50A: Input Signal Selection 1 Pn50C: Input Signal Selection 3
Pn50B: Input Signal Selection 2 Pn50D: Input Signal Selection 4

- Click **"OK"**.
- Click **"Output Signal Settings"**.
- You must set **"/COIN"** and **"/V-CMP"** to **"Always OFF"**.
- For motors with a Holding Brake you must also set **"/BK"** to **"SO1 – Output 1"** as shown: below:

Click any cell to allocate an output signal.

	Allocation	SO1 (CN1-25,26)	SO2 (CN1-27,28)	SO3 (CN1-29,30)	Disable (Do not use)
/COIN	Not require				/COIN
/V-CMP	Possible				/V-CMP
/TGON	Possible		/TGON(L)		
/S-RDY	Possible			/S-RDY(L)	
/CLT	Possible				/CLT
/VLT	Not require				/VLT
/BK	Required	/BK(L)			
/WARN	Possible				/WARN
/NEAR	Not require				


- Click **"OK"**.
- You will then be returned to the IO Signal Settings screen, hit **"Apply"** to save the settings and then click **"Save/Write"**.
- Check **"Write with a backup file"** this will save the current configuration and then write the current configuration to the ServoPack:

Writes the set parameter into the Servopack.

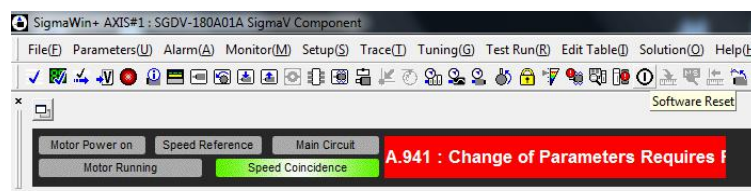
Select the writing method, and then click the Write button.

Write with a backup file
Saves the current Servopack settings in a backup file, and then writes the set parameters into the Servopack.

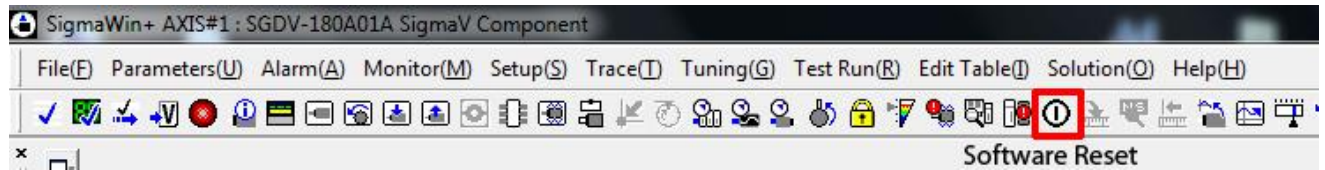
Write without backup file
Writes the set parameters into the Servopack without saving the current settings in a backup file.



- Click **"Finish"**.
- Click **"Yes"** when prompted to complete the Setup Wizard.
- The ServoPack will now have an A941 Error – This indicates that a reset is required to apply the configuration changes.



- To Reset the ServoPack you must click the "**Software Reset**" button in SigmaWin or remove power from the ServoPack. Before clicking the "**Software Reset**" button press the **Estop** button the control, this avoids putting the control into an error state when the drive and motor go offline. The Software Reset button is indicated below:



- After pressing the "**Software Reset**" button you will receive a warning, simply click "**Execute**" to continue:

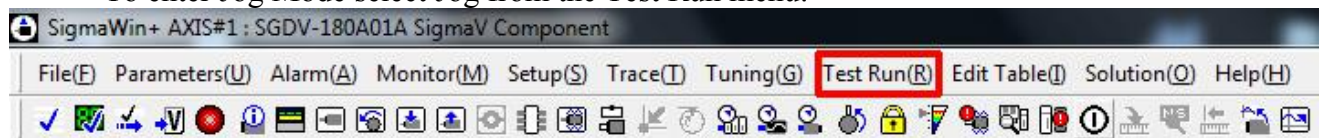


- Then click "**Execute**" at the next screen that pops up to confirm reset of the ServoPack.
- Every time the Drive is Reset you will normally get an error on the Centroid Control. Really having the control estopped will avoid the error message.
- Once the drive is reset you will have a "Motor Base Blocked - bb" message displayed on the ServoPack. This message means everything is OK.

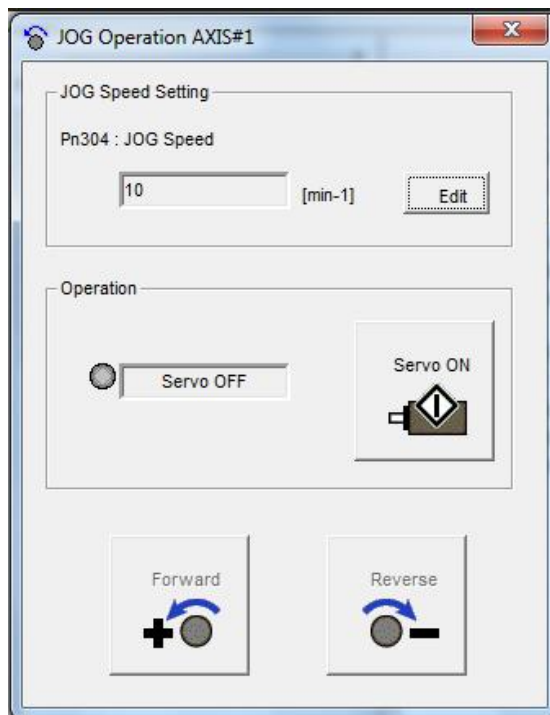
Test Run:

We are now ready to perform a test run of the ServoPack and motor. This test run will be performed from the SigmaWin software using the Jog system.

- To enter Jog Mode select Jog from the Test Run menu:

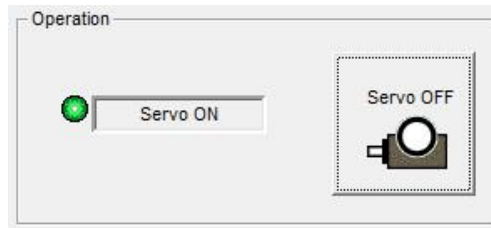


- You will then see the Jog Operation Pop-up shown below:



- Click "**Edit**" to change the JOG Speed. "50 RPM" is a good safe starting point.
- Release **ESTOP** on the Centroid Control.
- Click "**Servo ON**" to enable the ServoPack Motor Power.

The screen should then show "Servo ON" as shown below:



- You can now jog the motor by pressing and holding either the Forward or Reverse buttons
- If everything is working correctly you should have smooth motion of the Servo Motor. Simply close the Test Jog popup to exit Jog Mode, the cycle ESTOP on the Centroid Control

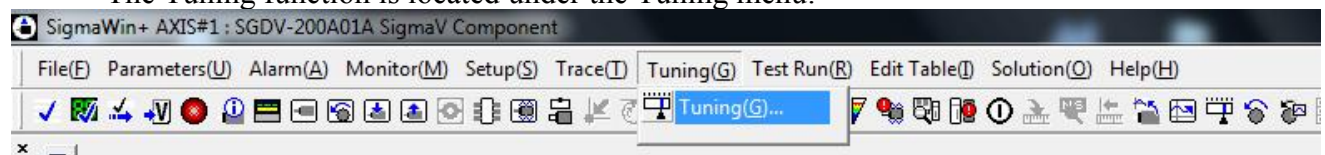
ServoPack Tuning:

We are now ready to tune the Yaskawa ServoPack. There are two main options for tuning of the drive:

1. "Tune Less Mode" – this is the default mode for the ServoPack, it obtains a stable response without adjustment.
2. "Autotuning" – In this mode the ServoPack will attempt to tune itself to the dynamics of the system, saving the parameters for use after that.

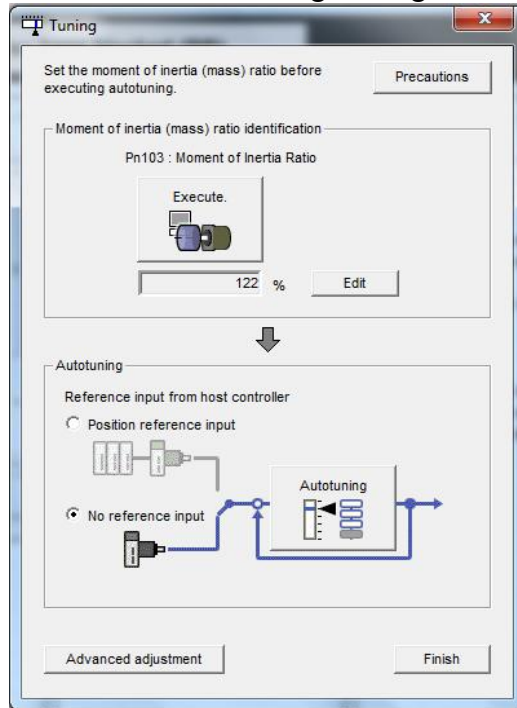
Note: Most ServoPack / Motor combinations seem to perform better once they have been Autotuned, so we will focus the rest of the time using that feature.

- The Tuning function is located under the Tuning menu:

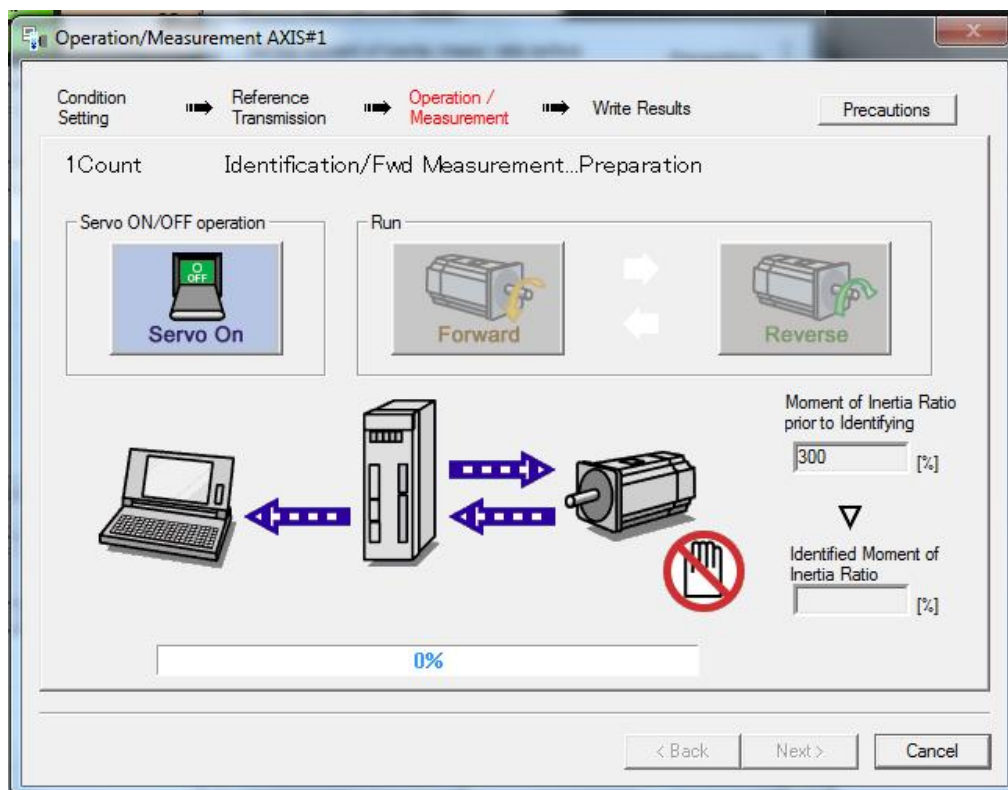


- You will then see a safety warning about the use of Tuning – simply press "Execute" to continue.

- You will then see the following Tuning Screen:

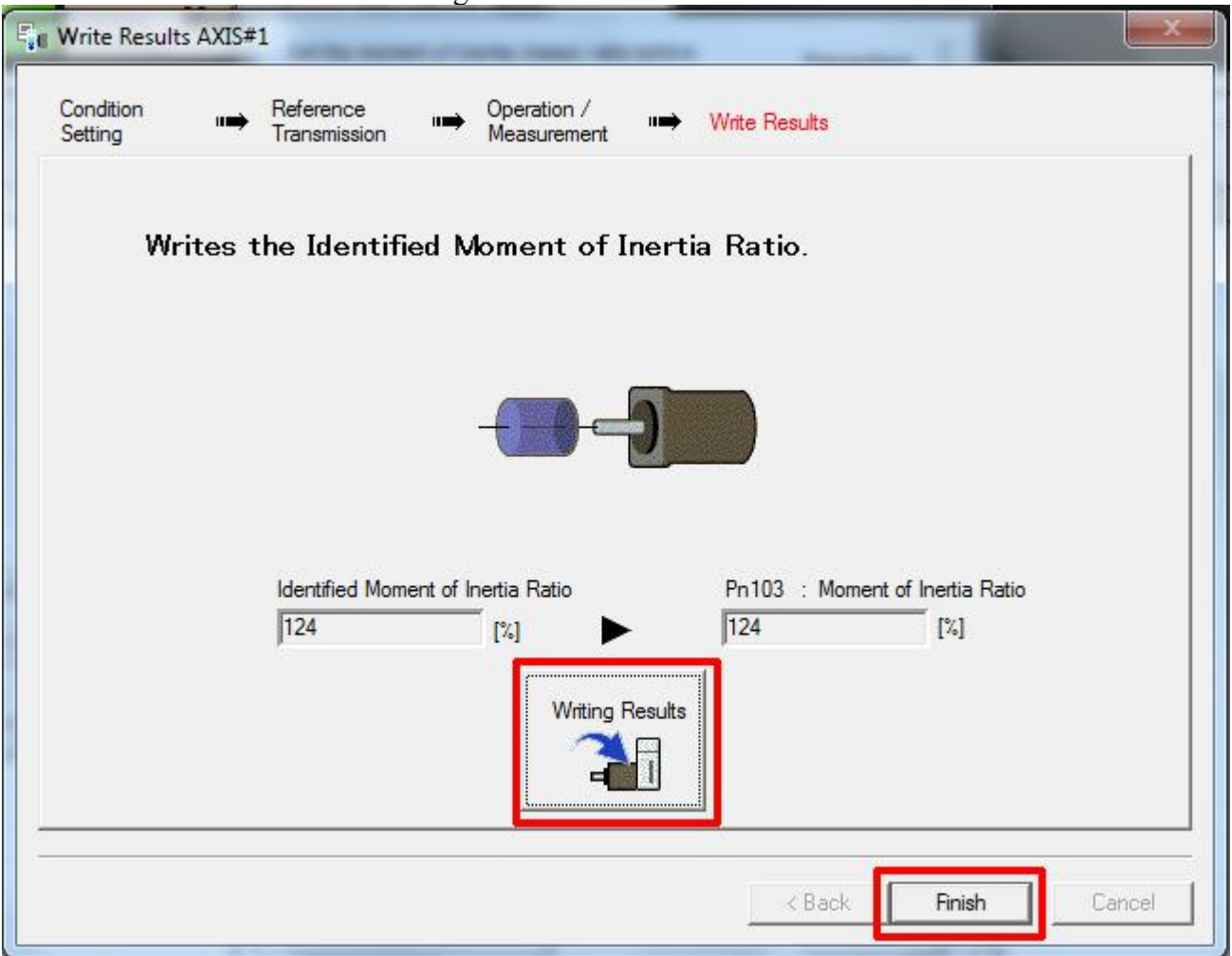


- Click "**Execute**" – this will begin the process to calculate the Moment of Inertia for the Motor system.
- You will then see the Condition Setting screen, click "**Next**".
- Click "**Start**" to transfer reference conditions to the ServoPack and click "**Next**".
- You will then see the Moment of Inertia calculation screen shown below:



- Release **ESTOP** on the Centroid Control.
- Click "**Servo ON**" to apply power to the ServoPack Motor.
- Alternatingly click "**Forward**", then "**Reverse**" until the SigmaWin software will no longer allow you to press either one, signifying the process is complete.
- Press **Estop** and click the "**Next**" button.

You will then see the following screen:



- Click the "**Writing Results**" button shown above to send the results to the ServoPack.
- Click "**Finish**".
- You will be prompted to Execute a ServoPack software Reset.
- You will then be returned to the Tuning screen.
- Under the Autotuning section click "**No Reference Input**" to ensure the correct mode during tuning, then click the "**Autotuning**" button.
- You will then see the following Autotuning Set Conditions screen:

Autotuning - Setting Conditions AXIS#1

Set conditions.

Switching the load moment of inertia (load mass) identification

1:A moment of inertia is not presumed.

Mode selection

2:For positioning

A gain adjustment specialized for positioning will be executed. In addition, the following automatic adjustments can be executed: Model following control, notch filter, anti-resonance control, and vibration suppression.

Mechanism selection

2:Ball screw mechanism or linear motor

Executes adjustment suitable for relatively high-rigidity mechanism, such as a ball screw or linear motor. Select this type if there is no applicable mechanism.

Distance

The moving range from the current value is specified.

786 X 1000 = 786000 [reference units]

(-99990 - 99990)

(Setting invalid range : -131 - 131)

3.0 [Rotation]

Tuning parameters

Start tuning using the default settings.

Next > Cancel

- The following settings should be set by default, verify they match these settings.
- Set "Switching the moment of inertia" to "1: A moment of inertia is not presumed".
- Set "Mode Selection" to "2: For Positioning".
- Set "Mechanism Selection" to "2: Ballscrew mechanism".
- Ensure the Moving Range is set to "3.0" rotations, click "Next".
- You will receive another warning – click "Yes" to send parameters to the drive.
- You will then see the following Tuning Screen:



- Release **Estop**.
- Click "**Servo ON**".
- Click "**Start Tuning**", the ServoPack will then tune itself.
Sometimes the autotune will fault. This can usually be fixed by performing a "**Software Reset**" and re-starting the Autotune.
- Click "**Finish**" when tuning is complete.
- At this point the ServoPack and motor are tuned. Execute a Software Reset to be sure everything is back in good operation

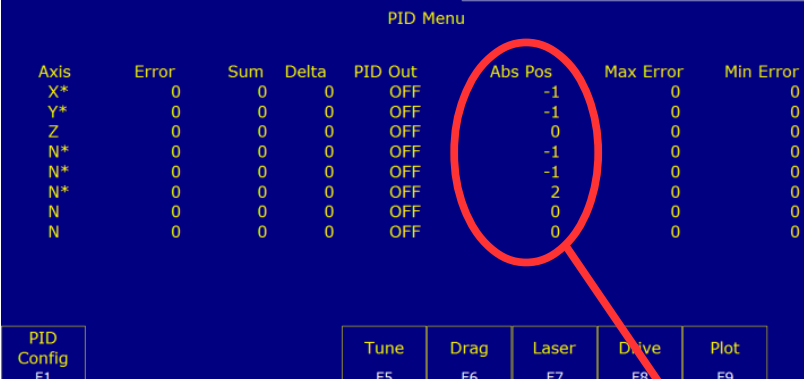
Centroid PID Configuration:

Centroid Control Parameter 256 must be set to 2 to let the control know we are in Position Mode. When using Position Mode the Centroid PID values should all be zeroed out as shown below:

Kp	Ki	Kd	Limit	Kg	Kv1	Ka	Accel.
0	0	0	2560000	0	0	0	0.500

The Axis Encoder Counts on the Centroid must be set to the value that we used on the Yaskawa – 32768 in this case.

Use the Yaskawa software to jog the motors (shown in the **Test Run** section above) In the PID menu, confirm that the Abs Pos field is increasing when the shaft is moving counter clockwise. If it is counting backwards or not counting, the encoders are wired incorrectly or drive mapping is not set.



Axis	Error	Sum	Delta	PID Out	Abs Pos	Max Error	Min Error
X*	0	0	0	OFF	-1	0	0
Y*	0	0	0	OFF	-1	0	0
Z	0	0	0	OFF	0	0	0
N*	0	0	0	OFF	-1	0	0
N*	0	0	0	OFF	-1	0	0
N*	0	0	0	OFF	2	0	0
N	0	0	0	OFF	0	0	0
N	0	0	0	OFF	0	0	0

PID Menu

PID Config F1

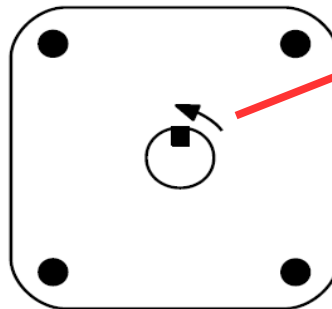
Tune F5

Drag F6

Laser F7

Drive F8

Plot F9



For a standard 3-axis system parameters 300 -302 should be set to 1, 2, 3, and parameters 308-310 should be set to 7, 8, 9. Also parameters 357 -359 should be set to 3000.

***After the Yaskawa drives have been configured and tuned or any time you have changed any settings on the drive(s) a Precision Mode Autotune must be performed on the control. This is done by selecting **F5-Tune** from the PID menu. Make sure all axes can move the specified amount without running into anything or running up against a limit.

Braking Resistors:

If the Yaskawa drive is wired to use an external braking resistor you must set Parameter 600 (Regenerative Resistor Capacity) on the Yaskawa to be equal to 20% of the wattage of the braking resistor.

Document History

Rev4 Created on 2015-05-03 by #240

Rev3 Created on 2015-16-02 by #397

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[Rev1](#) Created on 2012-07-18 by #358