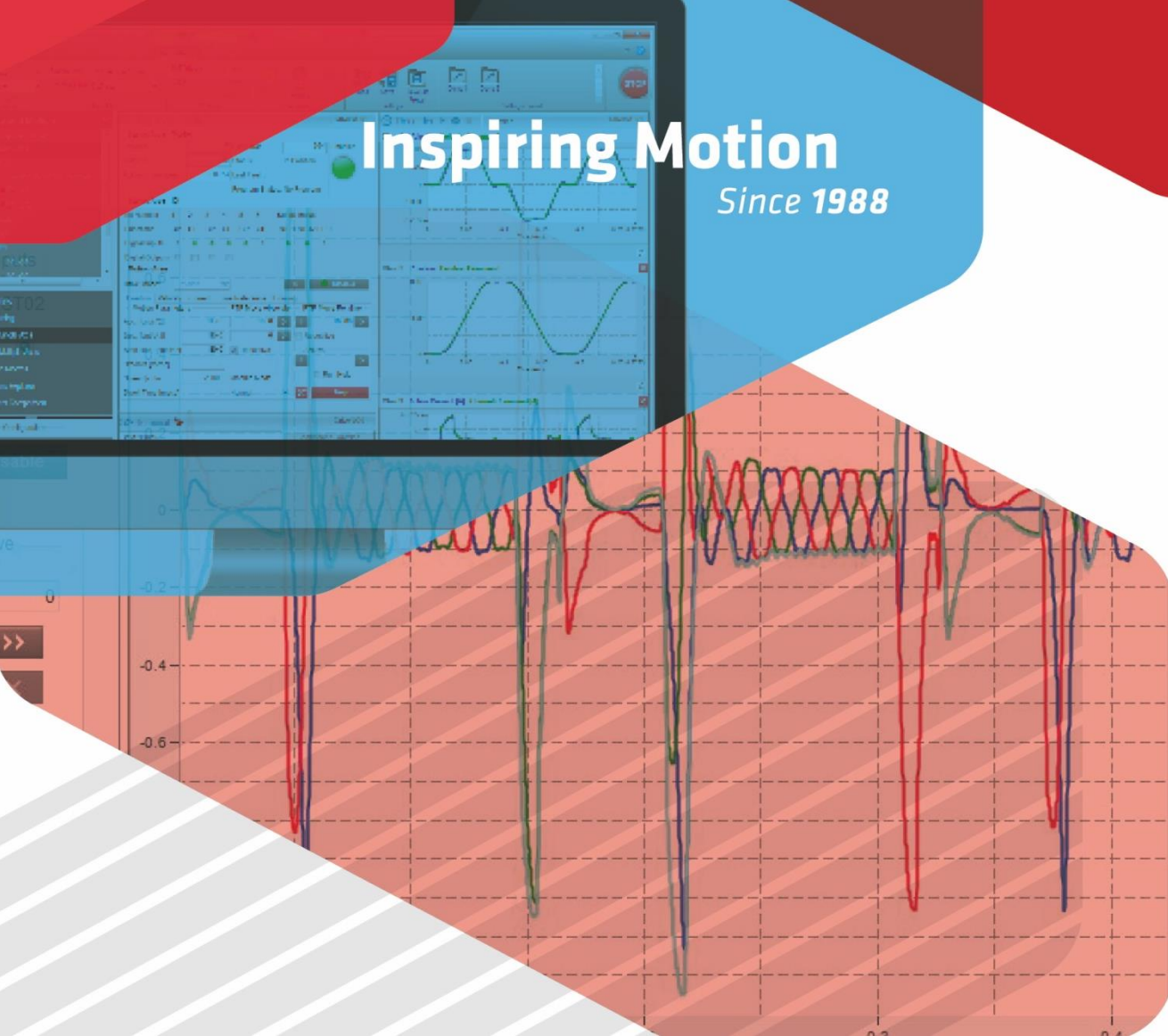


Inspiring Motion
Since 1988



Exercise #10

Configuring a Gantry Layout System

The key points of this demo show that:

- The Gantry system demonstrates control of two axes, of which the Master performs two separate synchronized control operations.
- Configuring and Tuning a Gantry assembly takes only minutes.
- The tuning process is backed by powerful algorithms for optimization.
- It is simple to simulate a gantry assembly using two axes in the RPS.

List of parameters for this demo:				
Parameter	Value		Parameter	Value
Motor type	Rotary Brushless		Feedback, Socket 1	Encoder Quad, Port A
Continuous stall current	1		Feedback Resolution	2048
Peak current	2			
Maximal speed	3000		G-MAS IP	192.168.1.3
# Pole Pairs	4		Computer IP	192.168.1.XXX

Exercise #10: Configuring a Gantry Layout

1. Start by connecting to the relevant drive that will serve as the Slave in the gantry system.

2. G-MAS connection

1. System Configuration

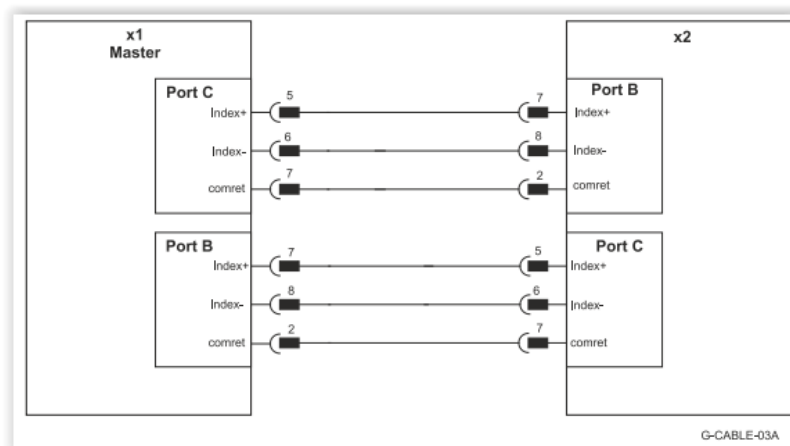
4. Gateways connection

3. Pre Op Mode

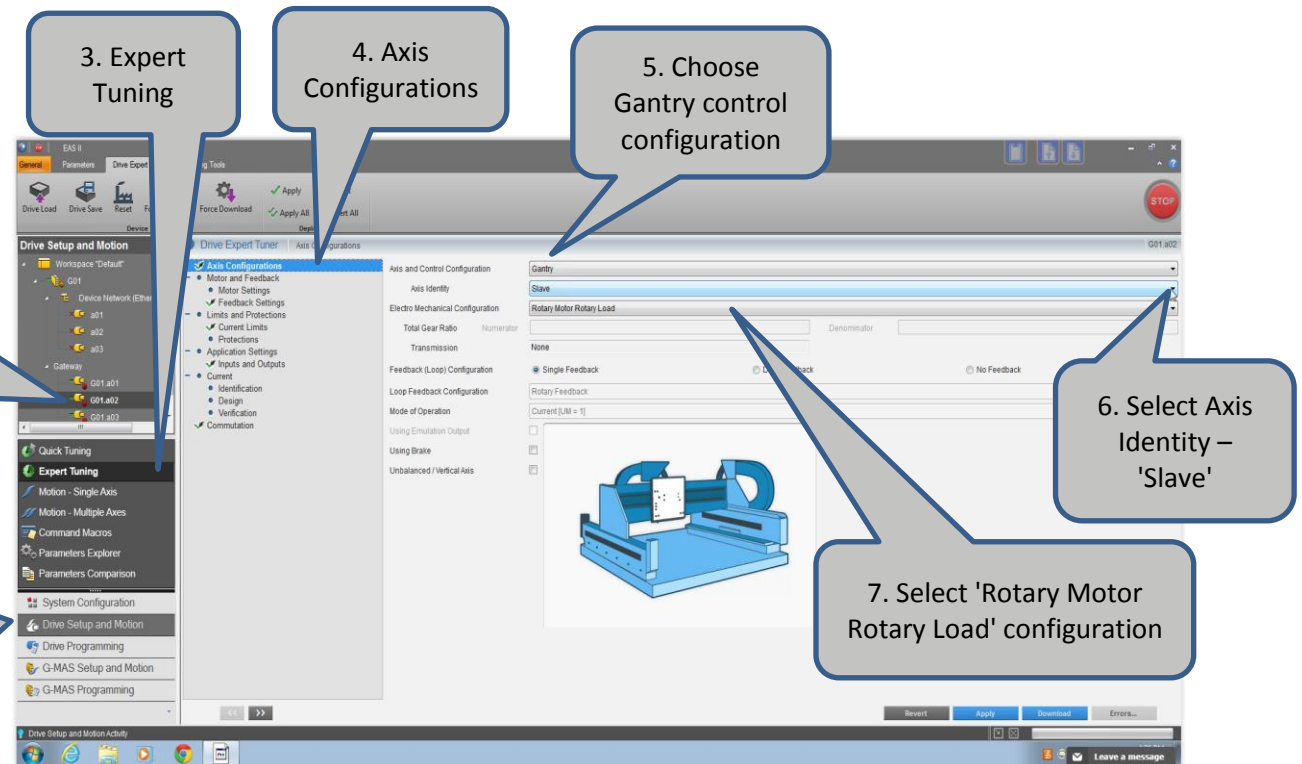
Note: Whenever tuning a gantry, you should always start with the drive that serves as the slave.

In the RPS, drives 2 and 3 are wired with the appropriate cables and can be used to simulate a gantry system.

The diagram below illustrates the connections used:



2. Start by configuring axis 2 to use as the gantry Slave.



Note: As the Slave receives only a current command from the Master drive, the mode of operation is changed to Current [UM=1] and only the Current loop tuning option remains.

3. Fill in motor settings as listed in the motor data sheet.

1. Motor Settings

2. Choose the motor type and fill in the electrical and mechanical limitations of the motor according to its data sheet

The screenshot displays the EAS II Drive Expert Tuner software interface. The left sidebar contains a tree view with categories like 'Workspace "Default"', 'Device Network (EtherCAT)', 'Gateway', 'Quick Tuning', 'Expert Tuning', 'Motion - Single Axis', 'Motion - Multiple Axes', 'Command Macros', 'Parameters Explorer', 'Parameters Comparison', 'System Configuration', 'Drive Setup and Motion', 'Drive Programming', 'G-MAS Setup and Motion', and 'G-MAS Programming'. The 'Drive Setup and Motion' category is expanded, showing sub-items: 'Axis Configurations', 'Motor and Feedback', 'Motor Settings' (highlighted), 'Limits and Protections', 'Current Limits', 'Protections', 'Application Settings', 'Inputs and Outputs', 'Current', 'Identification', 'Design', 'Verification', and 'Commutation'. The 'Motor Settings' panel is active, showing a 'From Data Base' dropdown set to 'Rotary Brushless (3 Phase)'. Below this, several parameters are listed with input fields: 'Peak Current (Arms)' set to 2, 'Continuous Stall Current (Arms)' set to 1, 'Maximal Motor Speed (RPM)' set to 3000, and 'Pole Pairs per Revolution Ck(19)' set to 4. At the bottom of the interface, there are buttons for 'Revert', 'Apply', 'Download', and 'Errors...'. A status bar at the very bottom indicates 'One or more invalid parameters on page' and includes a 'Leave a message' link.

4. Fill in feedback settings as listed in the data sheet.

The screenshot shows the EAS II Drive Expert Tuner software interface. The left sidebar contains a tree view with 'Feedback Settings' selected. The main window displays the 'Feedback Settings' configuration page. Four callouts are present:

- 1. Feedback Settings**: Points to the 'Feedback Settings' option in the left sidebar.
- 2. Choose the encoder type and the port to which it is connected**: Points to the 'Encoder Quad, PortA' dropdown menu.
- 3. Choose whether the feedback is using digital halls or not**: Points to the 'Use Digital Halls' checkbox, which is currently checked.
- 4. Fill in the feedback's resolution**: Points to the 'Resolution' field, which is set to 2500 counts/revolution.

The configuration page includes sections for 'Feedback on Motor' and 'Feedback on Load'. The 'Feedback on Motor' section contains a table with the following data:

Encoder Quad, PortA	
1. General	
Sensor Name	Encoder Quad, PortA
Sensor Type	Rotary
Feedback control function	Position + Velocity + Commutation
Use Digital Halls	Yes
2. Sensor Parameters	
Direction	Non Invert
Glitch Filter (cnt/sec)	500000
Velocity FIR Filter Window	Disabled
3. Resolution	
Resolution	2500
counts/revolution	10000

The 'Advanced' section is also visible at the bottom of the configuration page.

5. Fill in the current limits based on the application's requirements

1. Current Limits

2. Enter the current limitations as per the specific application's requirements

Parameter	Value			
Max Current MC [Amp]	5			
Max Voltage BV	100			
Peak Current	Drive PL1 [I] [Amp]	2.83	Motor [Amp]	2.83
Continuous Current	Drive CL1 [I] [Amp]	1.41	Motor [Amp]	1.41
Peak Current Duration PL2 [sec]	3			
PWM Output Duty Cycle Limit US [1] [%]	99			

Exercise #10: Configuring a Gantry Layout

3. Protections

The screenshot shows the Elmo Drive Expert Tuner software interface. The left sidebar contains a tree view with categories like 'Workspace', 'Device', 'Quick Tuning', 'Expert Tuning', 'Motion', 'Command Macros', 'Parameters Explorer', 'Parameters Comparison', 'System Configuration', 'Drive Setup and Motion', 'Drive Programming', 'G-MAS Setup and Motion', and 'G-MAS Programming'. The 'Drive Setup and Motion' category is expanded, showing sub-items like 'G01', 'a01', 'a02', 'a03', 'Gateway', 'G01.a01', 'G01.a02', and 'G01.a03'. The 'Protections' sub-item is selected. The main panel displays the 'Protections' configuration page. It includes a 'Maximum Tracking Errors' section with fields for 'Position Error Window ER[3] [cot]', 'Velocity Error Window ER[2] [cot/sec]', and 'Yaw Position Error ER[5] [cot]'. Below this is the 'Motor Stuck' section with fields for 'Current Limit CL[2] [% of CL]' (set to 0), 'Velocity Limit CL[3] [cot/sec]' (set to 0), and 'Time Duration CL[4] [msec]' (set to 3000). A text box explains the conditions for the motor being disabled: 'The motor will be disabled (with Motor Stuck fault: MF=0x200000) when the following conditions apply: • The actual motor Current is above CL[2] current limit (given in % of CL[1], max continuous current limit), and • The actual motor velocity is below CL[3] velocity limit (given in counts/sec) • For at least CL[4] consecutive time duration (given in milliseconds)'. The 'Advanced' section is also visible. At the bottom, there are buttons for 'Revert', 'Apply', 'Download', and 'Errors...'. A 'Leave a message' button is in the bottom right corner.

4. If required, enter required 'Motor Stuck' conditions.

6. Application Settings.

1. Inputs and
Outputs

The screenshot shows the EAS II Drive Expert Tuner software interface. The left sidebar contains a tree view of the device configuration, with 'Inputs and Outputs' selected under 'Application Settings'. The main area displays a table for configuring inputs and outputs. The table has columns for Number, Polarity, Function, Filter (msec), and Status. The inputs are configured as follows:

Number	Polarity	Function	Filter (msec)	Status
Input 1	High	General Purpose	0	
Input 2	High	General Purpose	0	
Input 3	High	General Purpose	0	
Input 4	High	General Purpose	0	
Input 5	High	General Purpose	0	
Input 6	High	General Purpose	0	
Port A.A	High	Ignore	0	
Port A.B	High	Ignore	0	
Port A.Index	High	Ignore	0	
Port B.A	High	Ignore	0	
Port B.B	High	Ignore	0	
Port B.Index	High	Ignore	0	

The outputs are configured as follows:

Number	Polarity	Function	Status
Output 1	High	General Purpose	
Output 2	High	General Purpose	
Output 3	High	General Purpose	
Output 4	High	General Purpose	
Port C.A	Low	General Purpose	
Port C.B	Low	General Purpose	
Port C.Index	High	General Purpose	

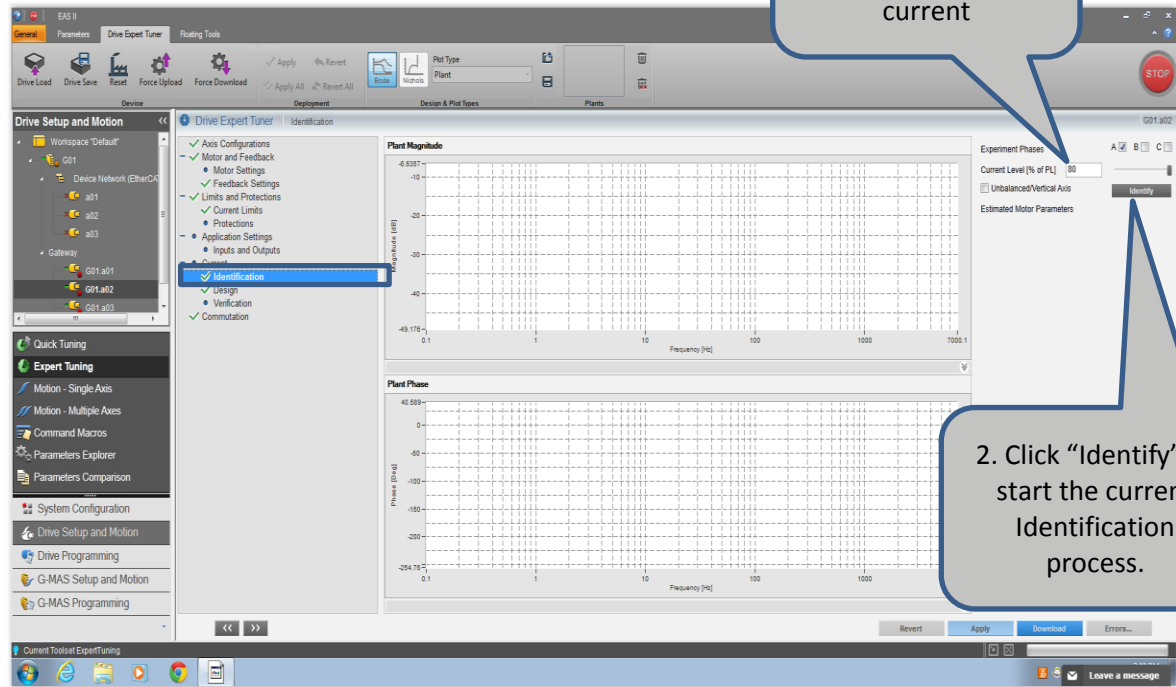
At the bottom of the table, there are buttons for 'Low', 'General Purpose', and 'Set all Digital Inputs'. The right sidebar contains a 'STOP' button and a 'Leave a message' button.

2. Adjust I/O functions as required for the application

7. Perform the Identification process for the current loop.

1. Choose the current level as the percentage of peak current

2. Click "Identify" to start the current Identification process.



8. Current design.

1. Current Loop Design

2. Choose the required bandwidth and phase margin

3. Click to start the Design process

4. Note that EASII automatically calculates the required proportional and integral gain and allows you to fine tune it

5. The system's achieved performance can be reviewed here

Required Performance Limits

Parameter	Value
Bandwidth [Hz]	1800
Phase Margin [Deg]	52

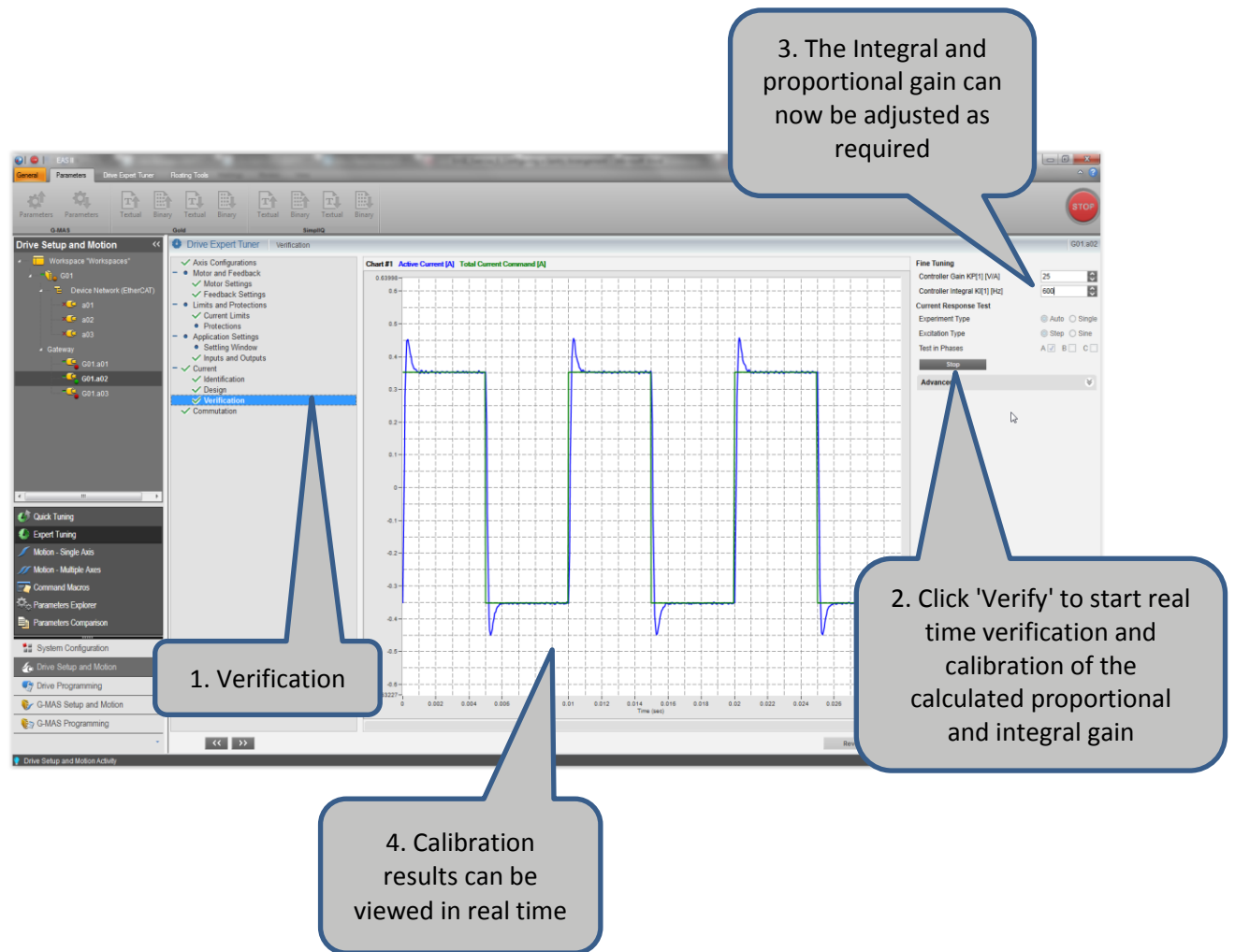
Fine Tuning

Parameter	Value
Controller Gain $K_P(1)$ [V/A]	15.049
Controller Integral $K_I(1)$ [Hz]	655.49

Achieved Performance

Parameter	Value
Bandwidth [Hz]	3091.3591
Phase Margin [Deg]	55.5164

9. Test the Current loop performance in real time.



Exercise #10: Configuring a Gantry Layout

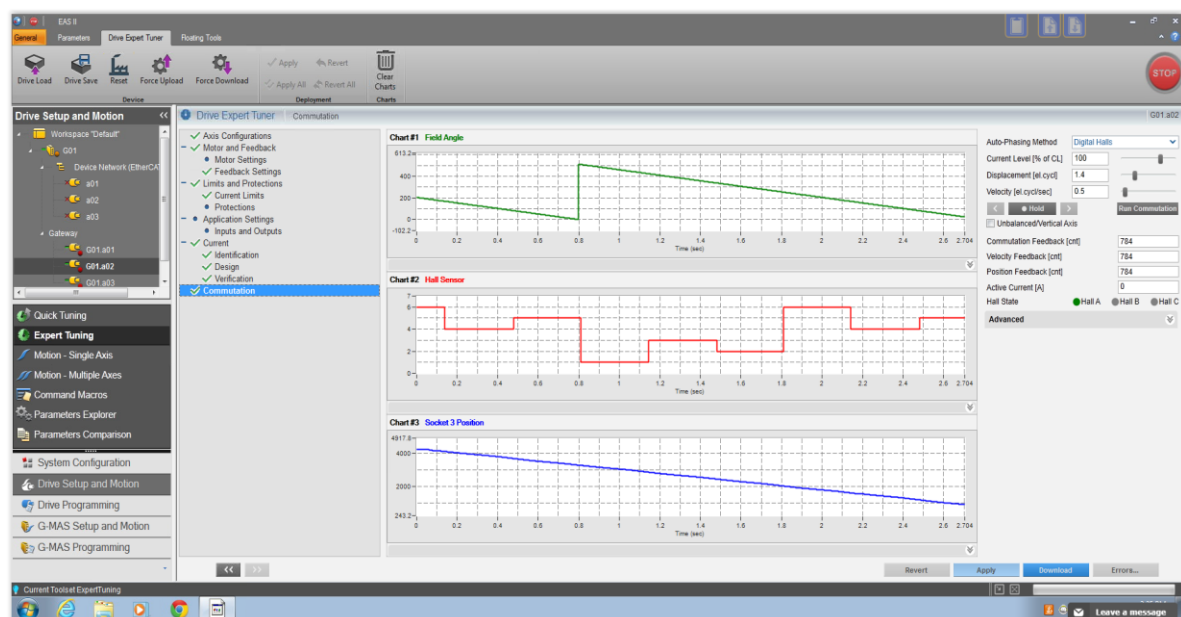
10. Run Commutation.

2. Choose method and adjust test parameters if required

1. Commutation

3. Run Commutation to determine the relationship between the commutation sensor reading and motor phases

Commutation results

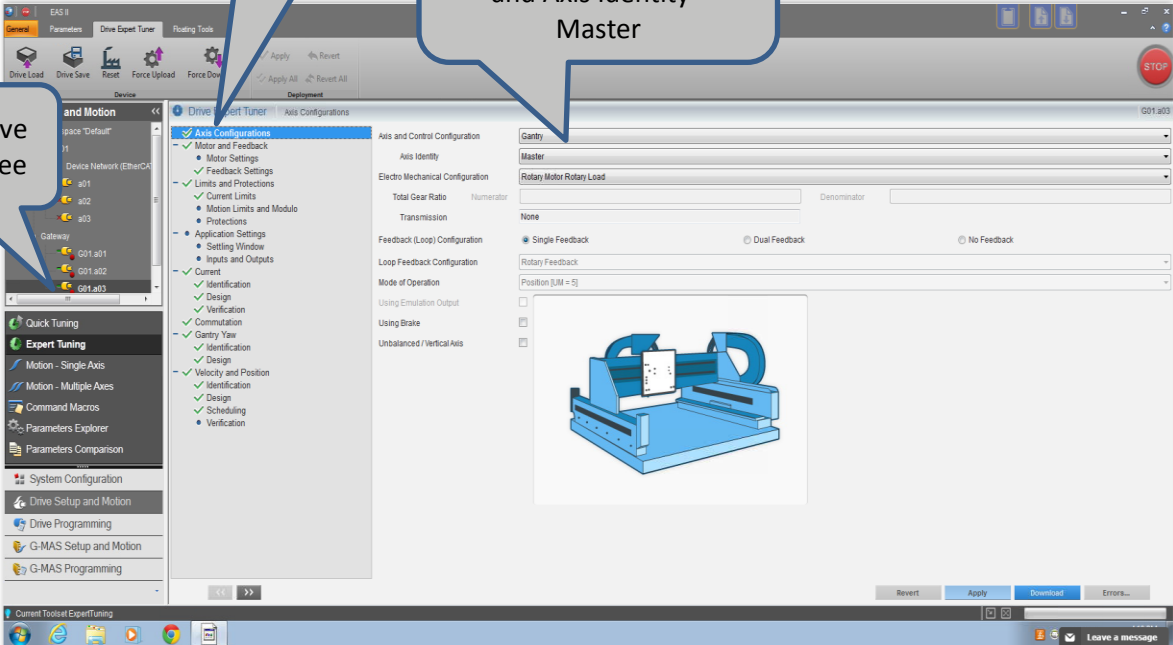


11. Now, switch to the drive that will be used as the Master:

1. Select drive number three

2. Axis Configuration

3. Select Axis Configurations – Gantry and Axis Identity - Master



13. Master Motor and Feedback.

The screenshot displays the EAS II software interface for configuring a motor. The interface is divided into several sections: a left sidebar with navigation options, a central parameter list, and a right-hand configuration area. The 'Motor Settings' tab is selected in the central list. The right-hand area shows the 'Motor Settings' configuration for a 'Rotary Brushless (3 Phase)' motor. The 'Pole Pairs per Revolution CA(18)' is set to 3. The 'Feedback Settings' tab is also visible, showing the 'Encoder Quad, Port A' configuration. The 'General' section of the feedback settings shows 'Encoder Quad, Port A' as the sensor name and 'Rotary' as the sensor type. The 'Sensor Parameters' section shows 'Non Invert' for direction and '4096000' for the filter. The 'Resolution' section shows 'lines/revolution' as 2500. The 'Advanced' section is also visible. The interface includes buttons for 'Revert', 'Apply', 'Download', and 'Errors...'. A status bar at the bottom indicates 'One or more invalid parameters on page'.

1. Motor Settings

2. Ensure the data is correct

3. Change number of pole pairs to 3

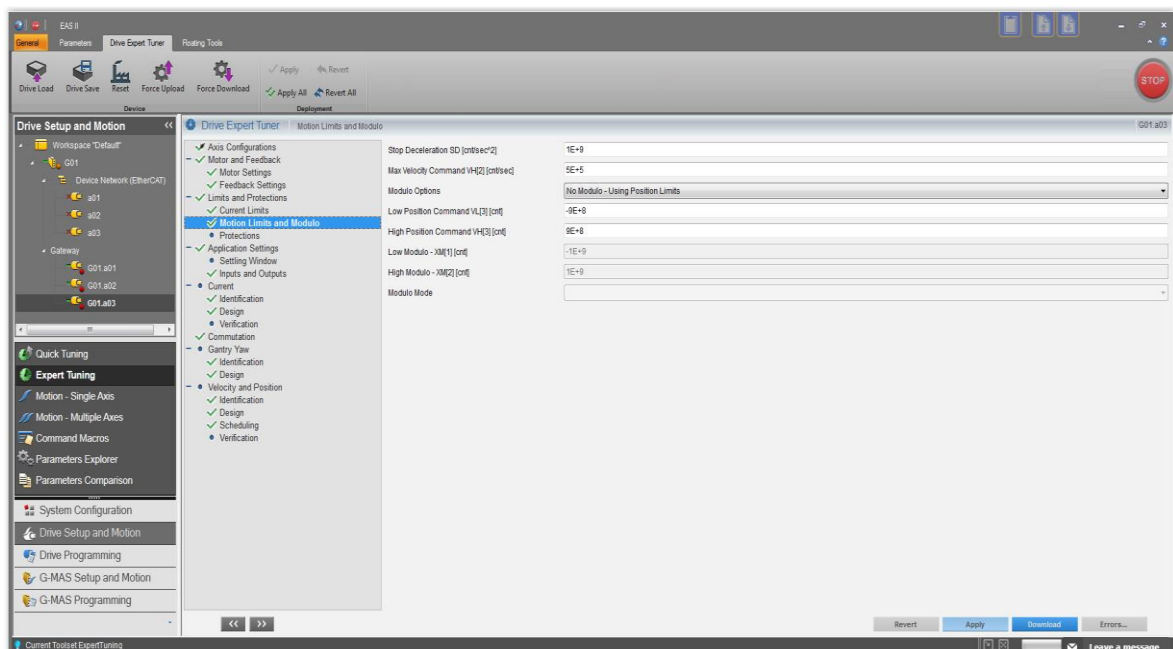
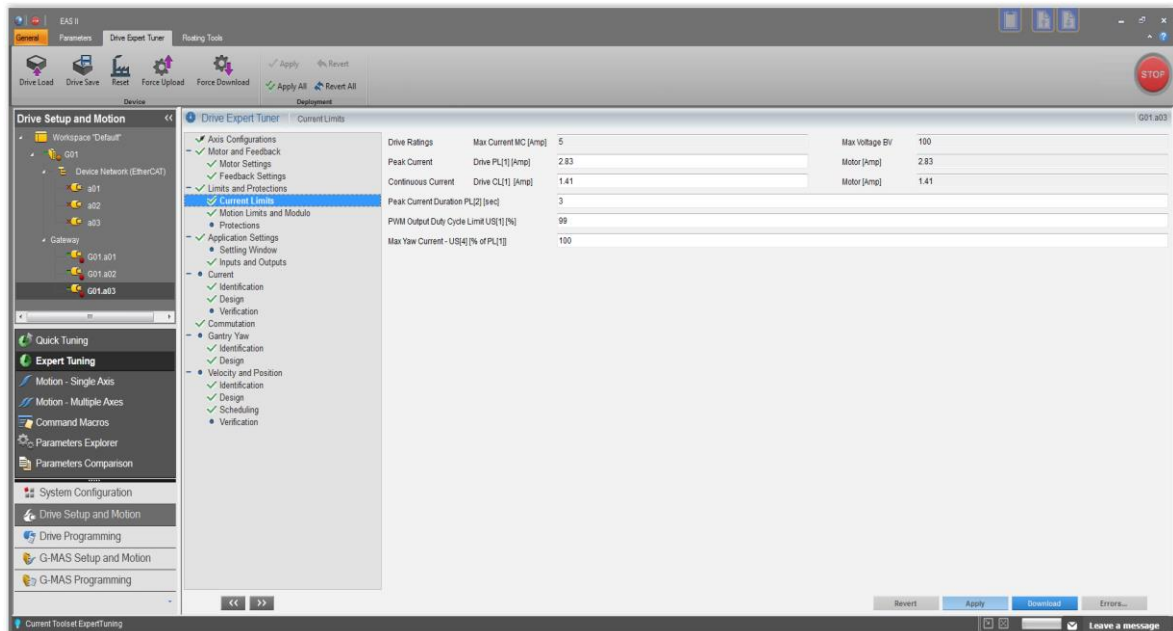
4. Feedback Settings

5. Select feedback type – Encoder Quad on port A

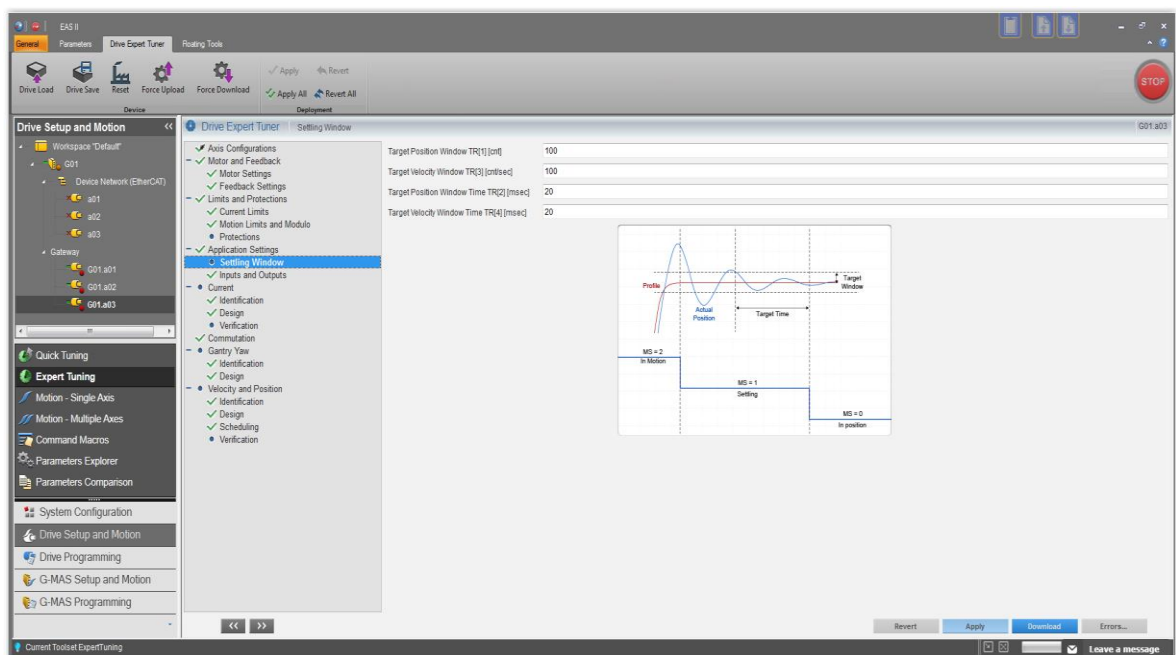
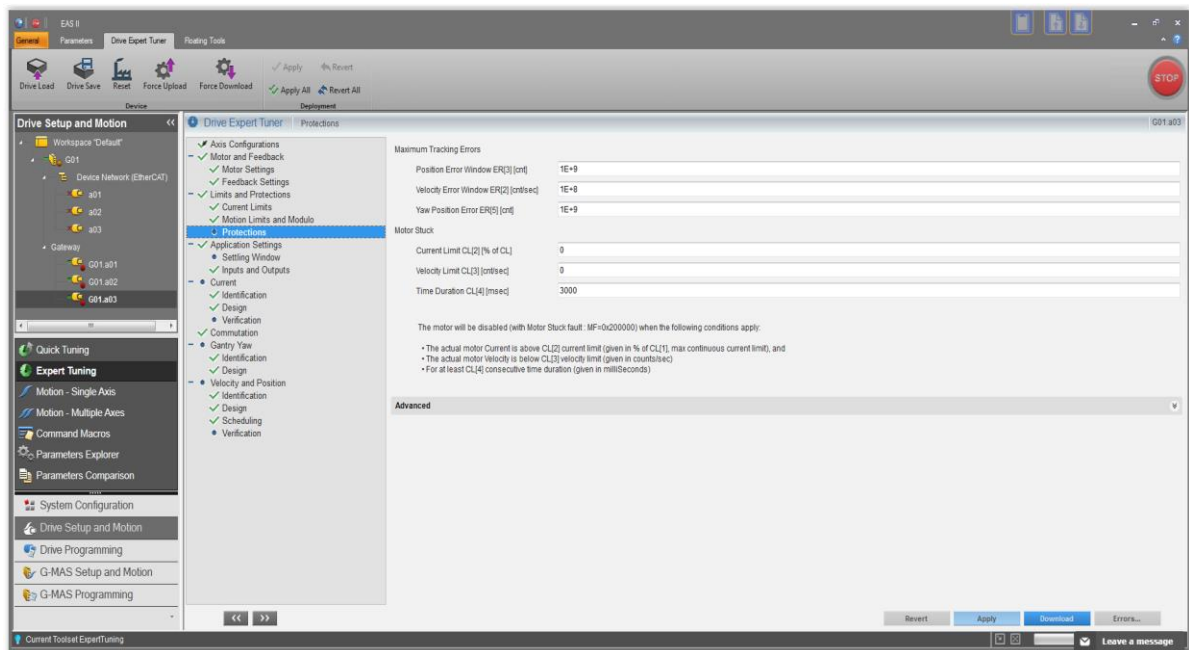
6. Change number of lines per revolution to 2500

7. Click Apply

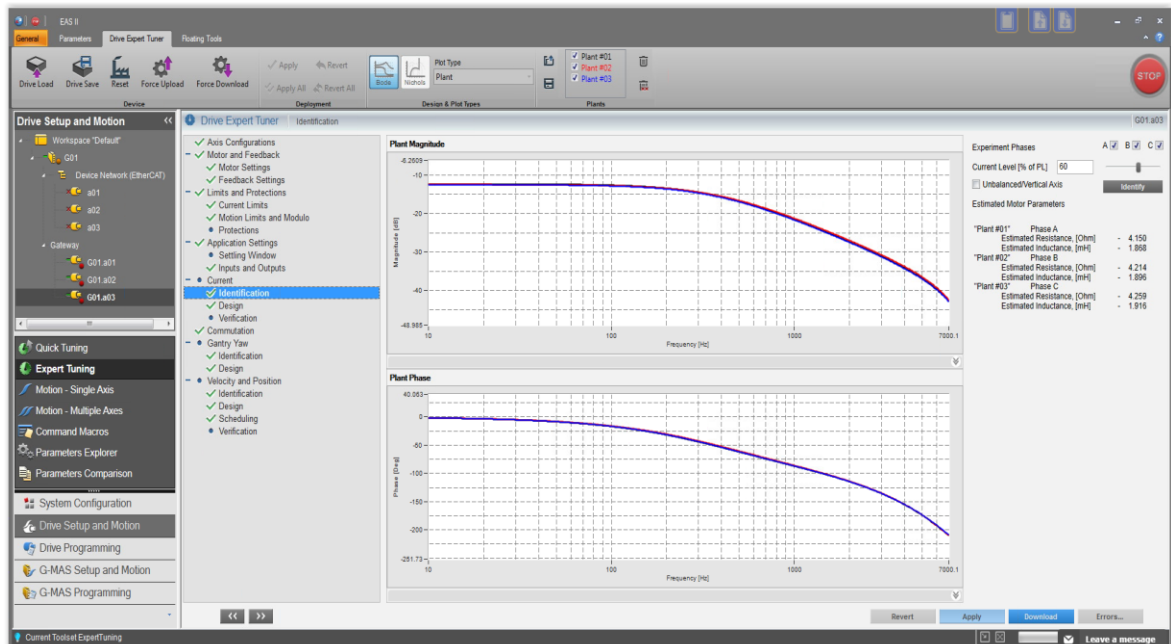
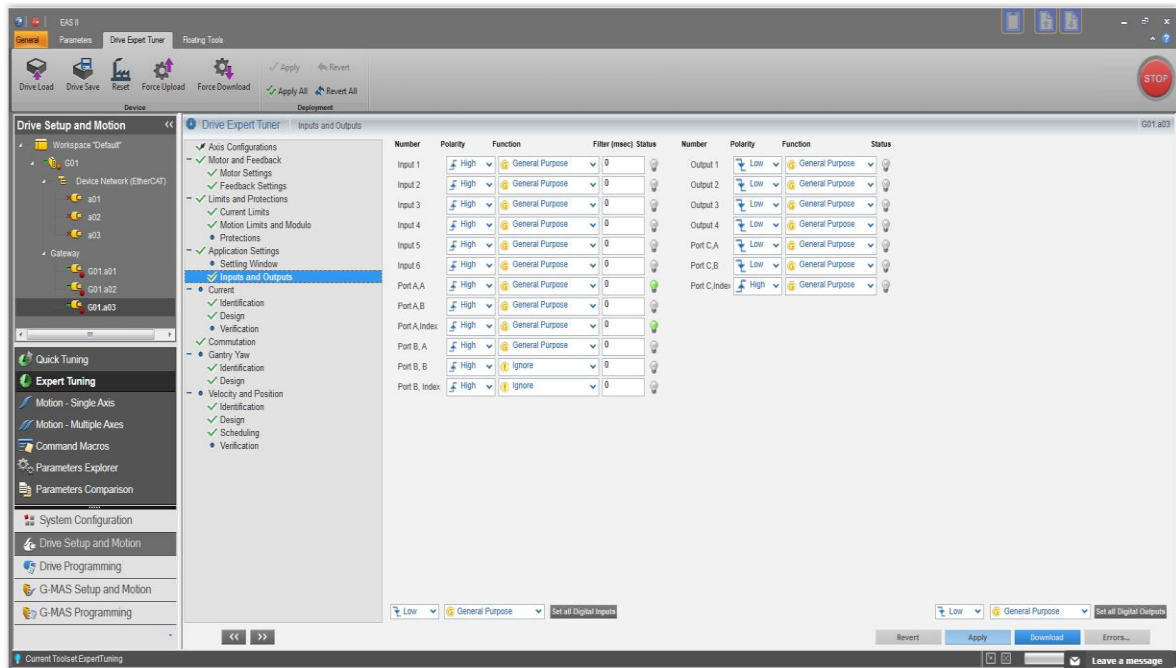
14. Continue with the Limits and Protections, Application Settings, Current and Commutation stages as performed with the slave.



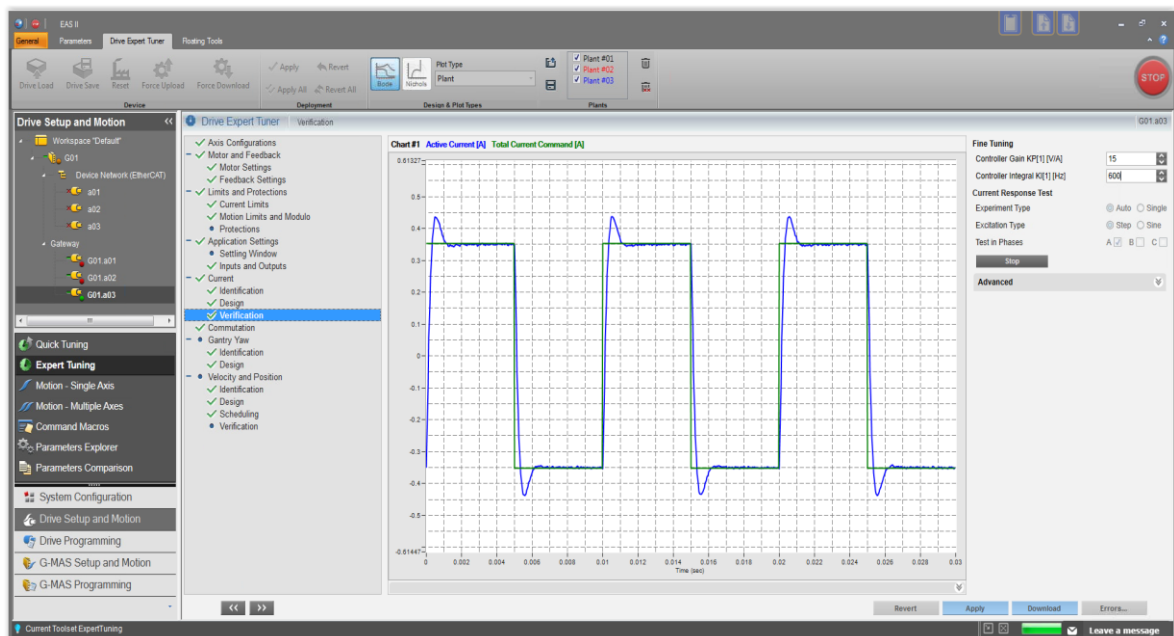
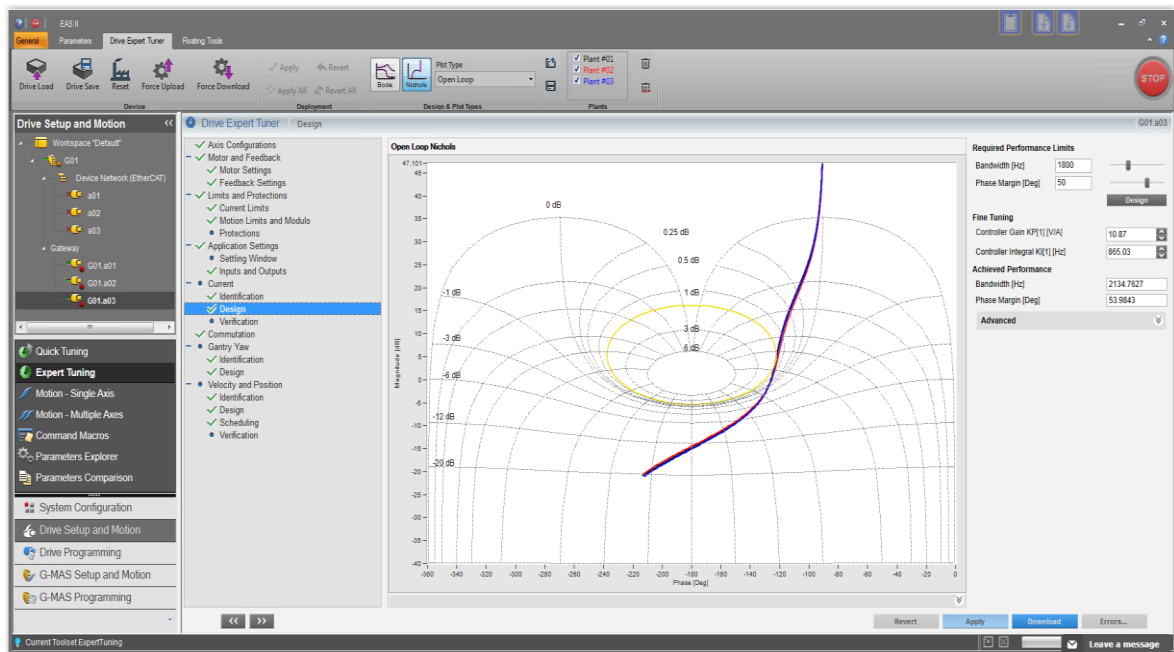
Exercise #10: Configuring a Gantry Layout



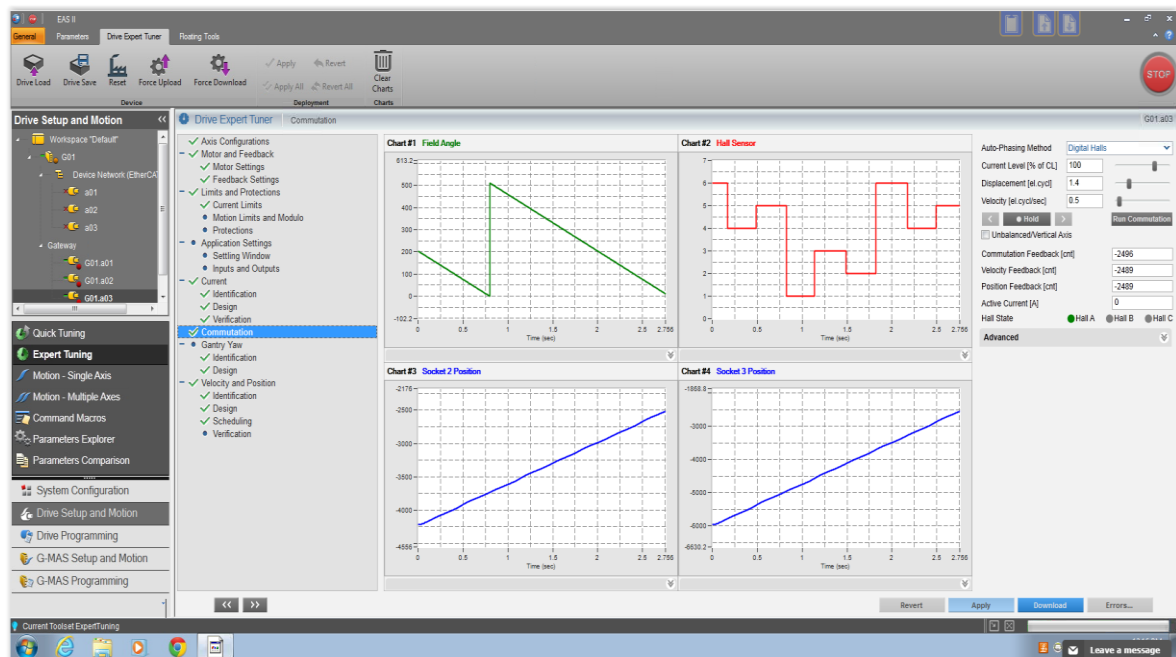
Exercise #10: Configuring a Gantry Layout



Exercise #10: Configuring a Gantry Layout



Exercise #10: Configuring a Gantry Layout



Exercise #10: Configuring a Gantry Layout

15. Turn the Slave motor on. This is necessary for the Master Gantry Yaw identification.

1. Floating Tools

2. Terminal

3. Change the target to the Slave – a02

4. Type in MO=1 and press enter. This turns the motor on.

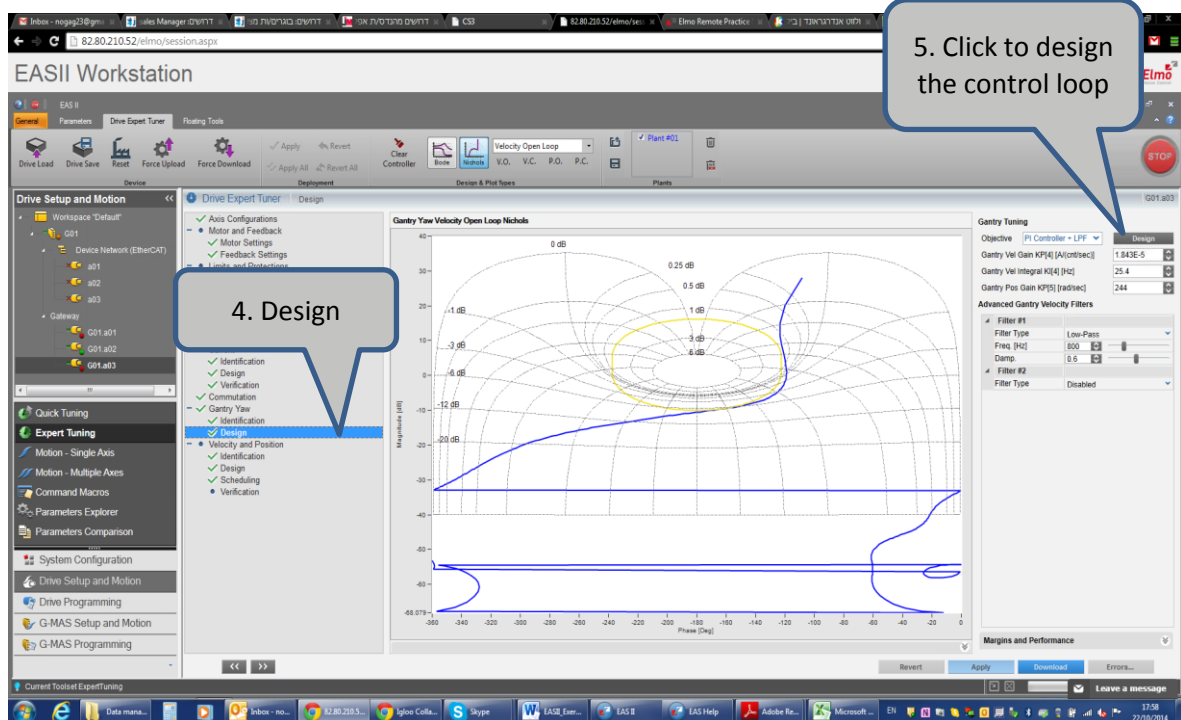
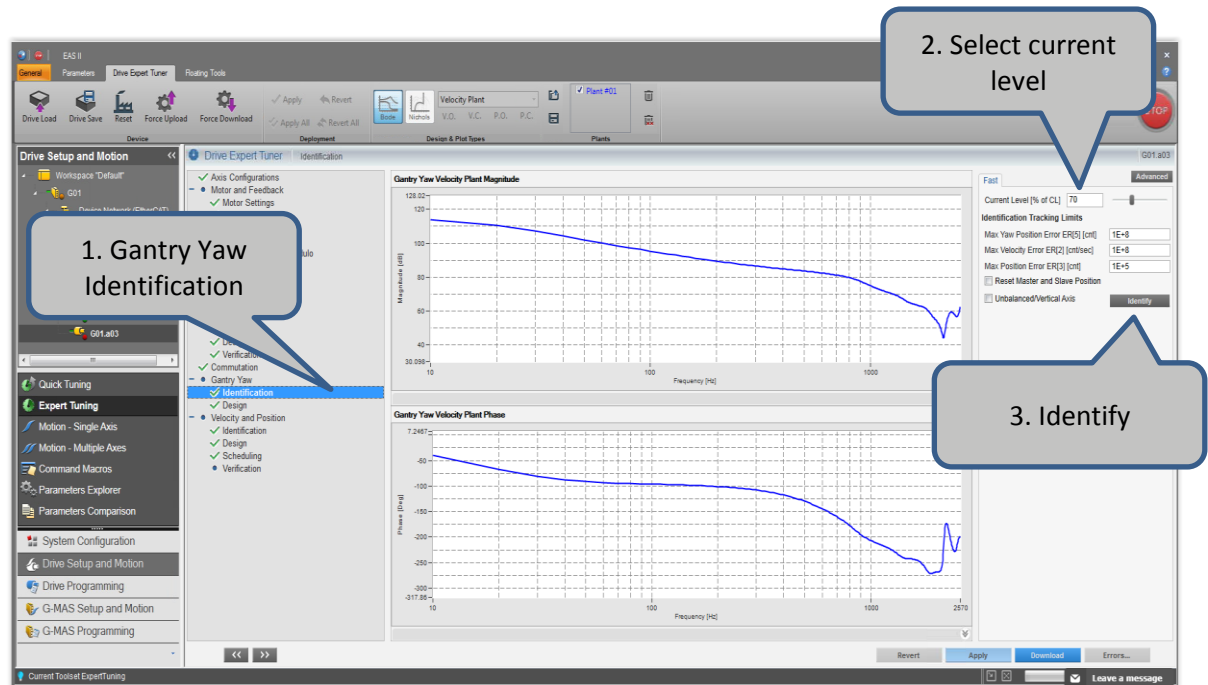
Another way of doing this is via the Motion – Single Axis activity:

1. Select axis two

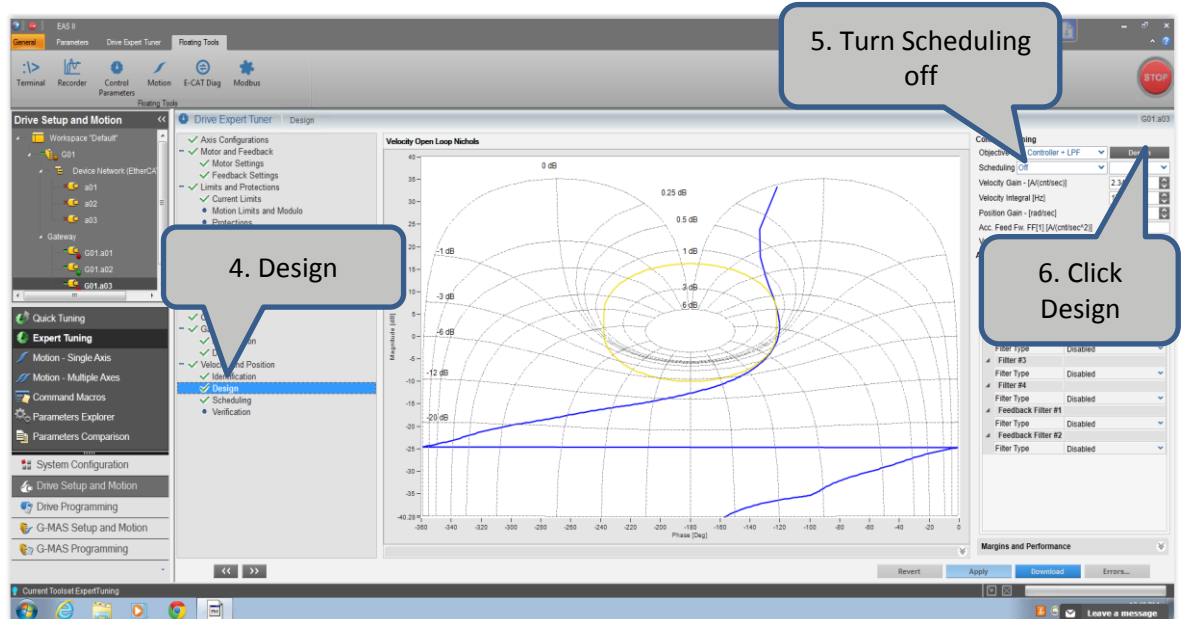
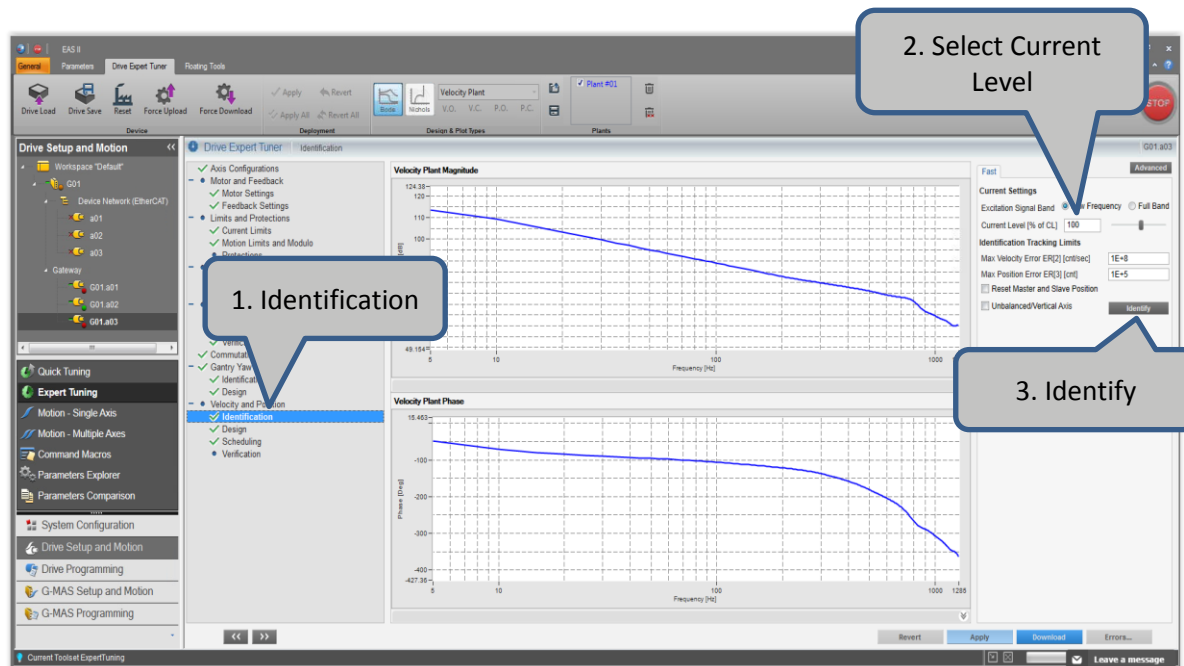
2. Motion – Single Axis

3. Click 'Enable'

16. Return to the Master's expert tuning and continue with the Gantry Yaw tuning.



17. Velocity and Position.



18. Verification.

5. If required, go to 'Recording' and choose which signals you would like to display

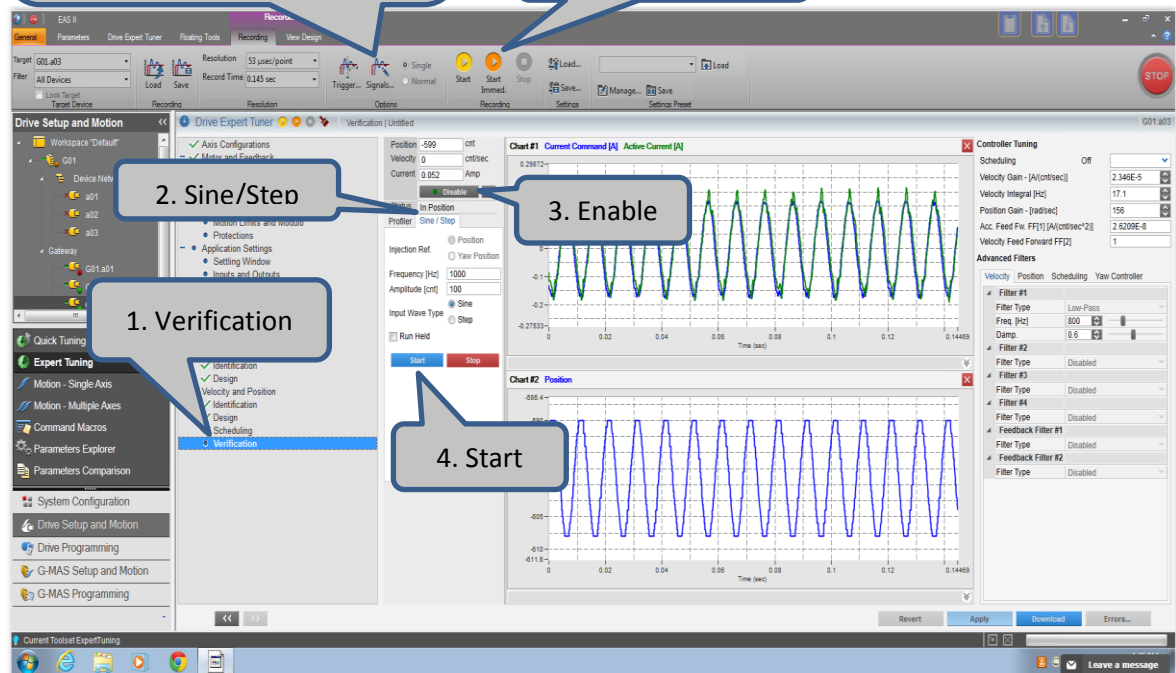
6. Start immediately

2. Sine/Step

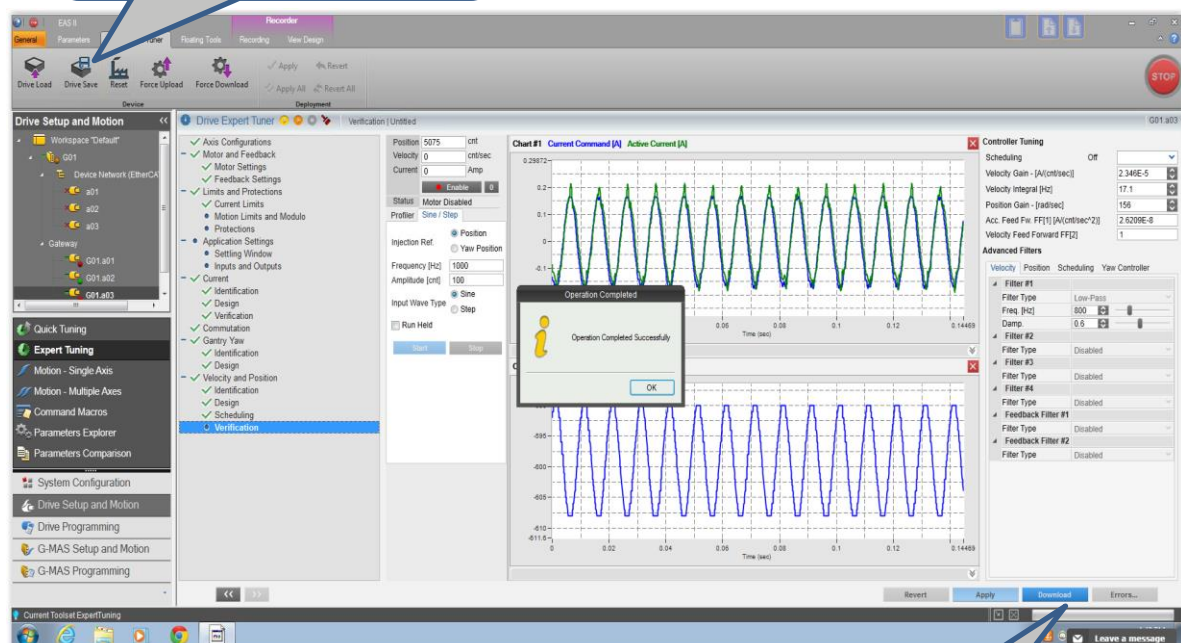
3. Enable

1. Verification

4. Start



8. Save data to drive and your gantry system is ready!



7. Download