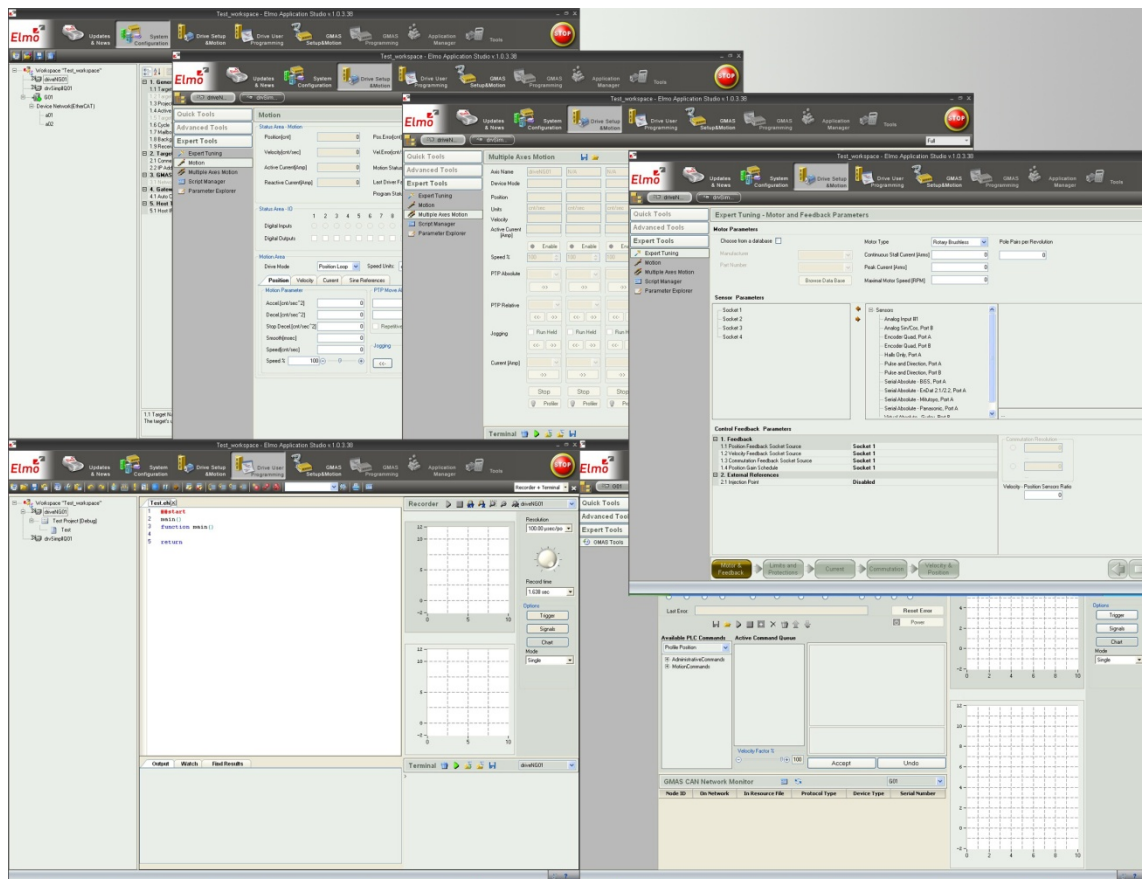


Elmo Application Studio (EAS) User Guide



December 2012 (Ver. 1.002)



www.elmomc.com

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1 Introduction

1.1 How to use this manual

This manual is part of the Elmo documentation set. It should be used in conjunction with the other manuals that describe any Elmo products that are going to be used with Elmo Application Studio.

Elmo Application Studio provides a user interface that makes the use of Elmo products more accessible for users. Some of fields in EAS are equivalent to drive commands. In other fields, the user enters information that is processed in EAS to generate a drive command or a set of commands.

To avoid too much overlapping between manuals, this manual provides only a functional explanation for every field. Where necessary, the equivalent drive command or parameter is mentioned. If you feel that you need more information about the command or parameter, please refer to the product's command reference guide. For a better understanding of drive algorithms and the relations between parameters, refer to the product's software manual.

1.2 What is the Elmo Application Studio (EAS)?

Elmo Application Studio (EAS) is a suite of Windows based software tools designed to ease the process of setting up a motion control system. Within Elmo Application Studio, you can set up a single drive or a sophisticated system including Elmo's multi axis controller with multiple controlled elements.

You can use Elmo Application Studio to:

- Define the system structure, its components and how they communicate
- Set up communication to Elmo Gold or SimpliIQ drives
- Automatically identify motion system characteristics
- Automatically or manually tune the control loops
- Enjoy easy access to drive parameters
- Start motion and record results
- Create user programs and much more.

Elmo Application Studio's user interface, groups the available tools in task-oriented groups. This allows you to focus on the task, working only on the settings necessary to accomplish it.

Common processes such as setting up and tuning a system are made easy using Wizards that walk you through the process systematically.

1.3 Installing EAS

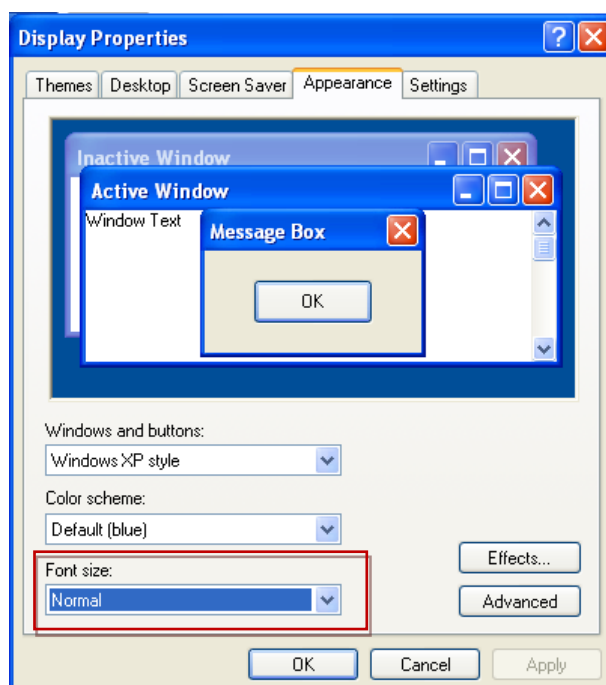
1.3.1 System Requirements

To install Elmo Application Studio you will need a PC with:

- Windows XP or Windows 7 (32Bit only)
- At least 1 GB RAM
- Windows installer 4.5 and .NET framework 3.5 versions

Note: Your Windows display font size must be set to Normal (Small) fonts. Otherwise, the EAS display will not be correct.

1. To change font size go to **Settings > Control Panel > Display > Appearance** tab.



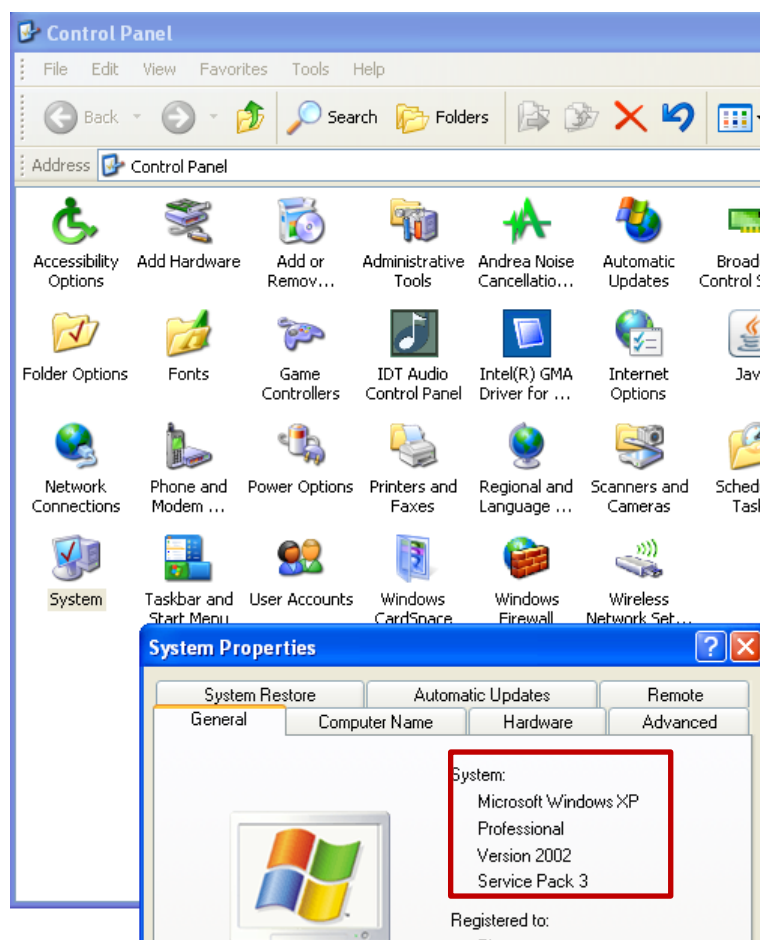
2. Verify that the screen resolution is according to the minimal and recommended screen resolutions.

Minimal screen resolution	1024X768
Recommended screen resolution	1280x1024 or higher

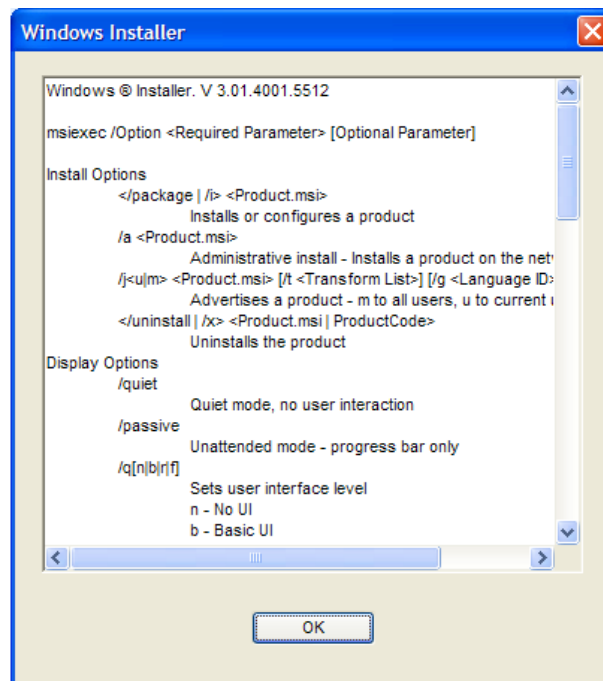
1.3.1.1 EAS Operation

To operate correctly EAS requires the following

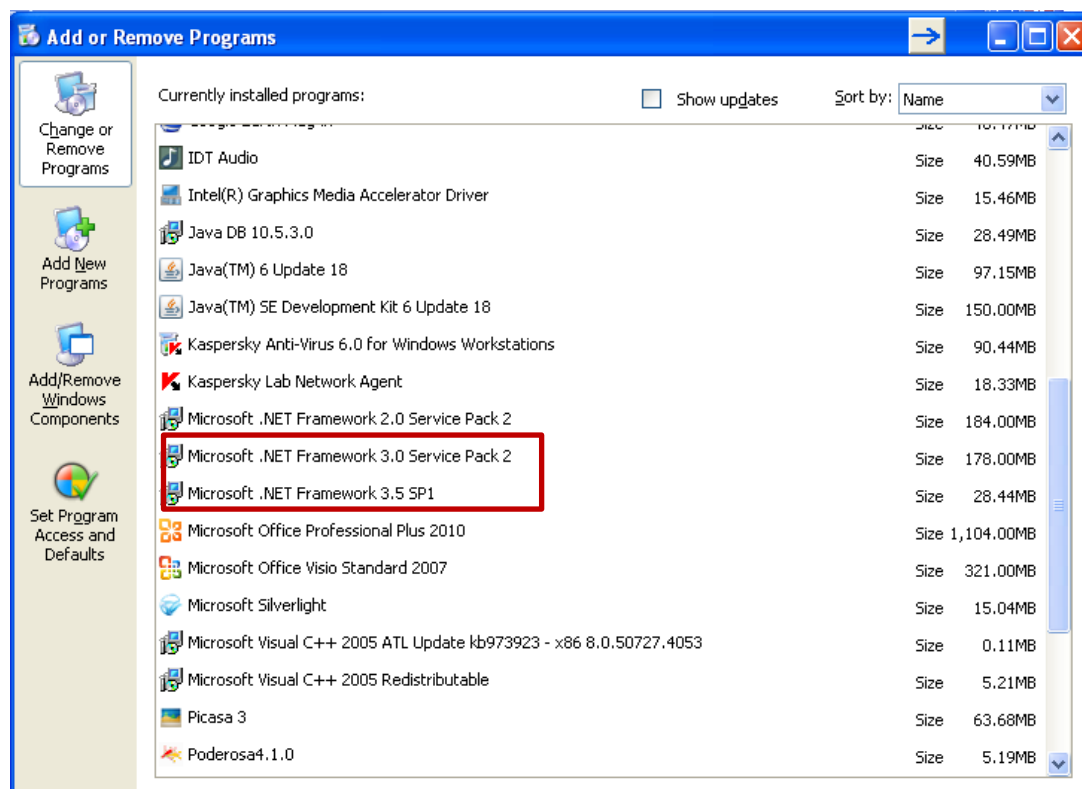
1. Verify that you are using a Windows XP version with service pack 3.5 and above. To find out which service pack you have installed go to **Control Panel > System**:



2. Verify that you are using Windows installer version 4.5.x.x. and above.
3. To find out which version of Windows installer you are using type “cmd” in the Windows command line.
4. At the prompt type “msiexec” and enter. A window similar to the following will open



5. Verify that you have .NET framework version 3.5 and above

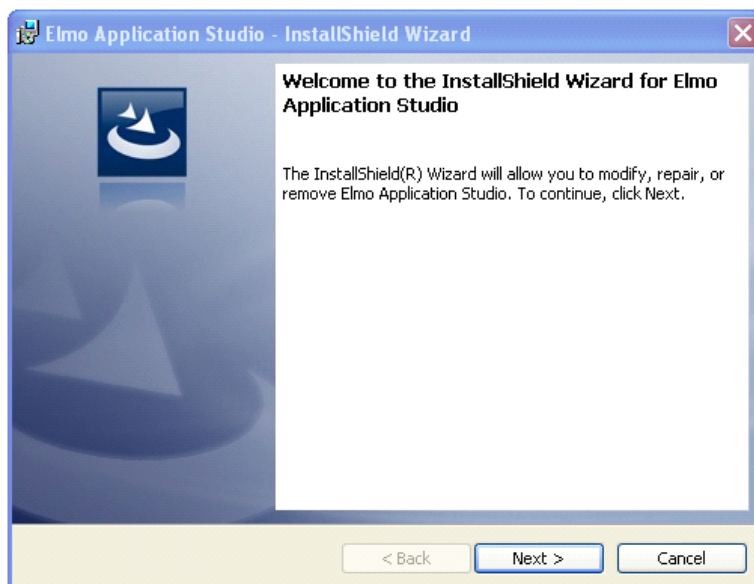


1.3.2 Installation

To install EAS

1. Double click on the installation file icon  to start the installation. The InstallShield window opens.

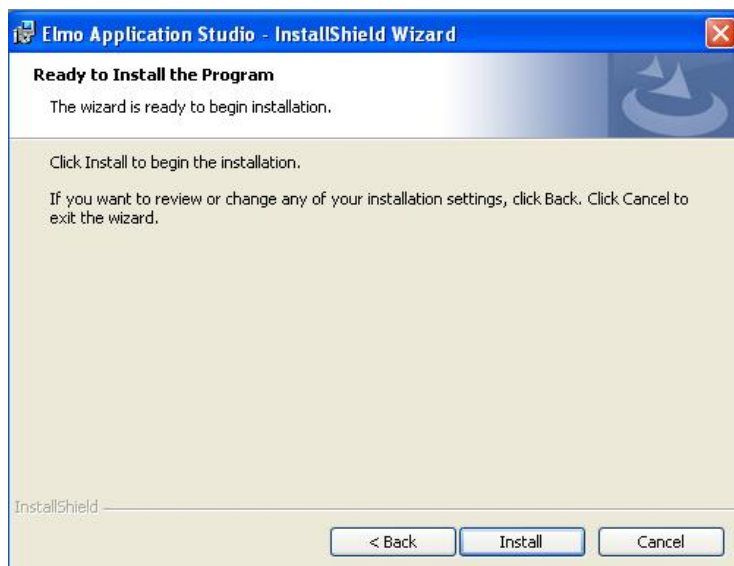
Note: When installing in a system with Windows 7 O/S, make sure to highlight the install file icon, and right-click to select Install as Administrator.



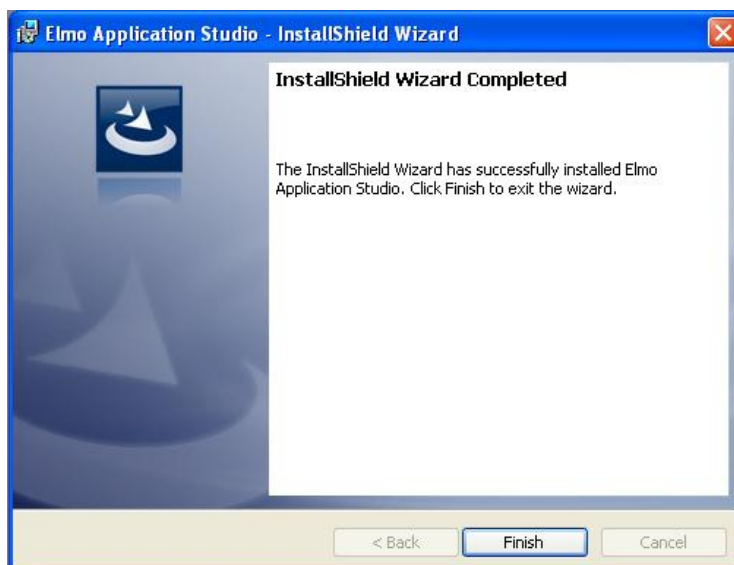
2. Click **Next**.



3. Click **Next** to install EAS in the default location or **Change** to select a different location.



4. Click **Install** to start installation. A progress bar is displayed showing the progress of the installation. When completed, the InstallShield Wizard Completed window appears.



5. Click **Finish** to exit the installation.

The EAS icon now appears on your desktop. A new group called “Elmo Motion Control” is added to the Programs in your Windows Start menu.

1.3.3 Upgrading the EAS

To upgrade to a new version of EAS, see section 8.1

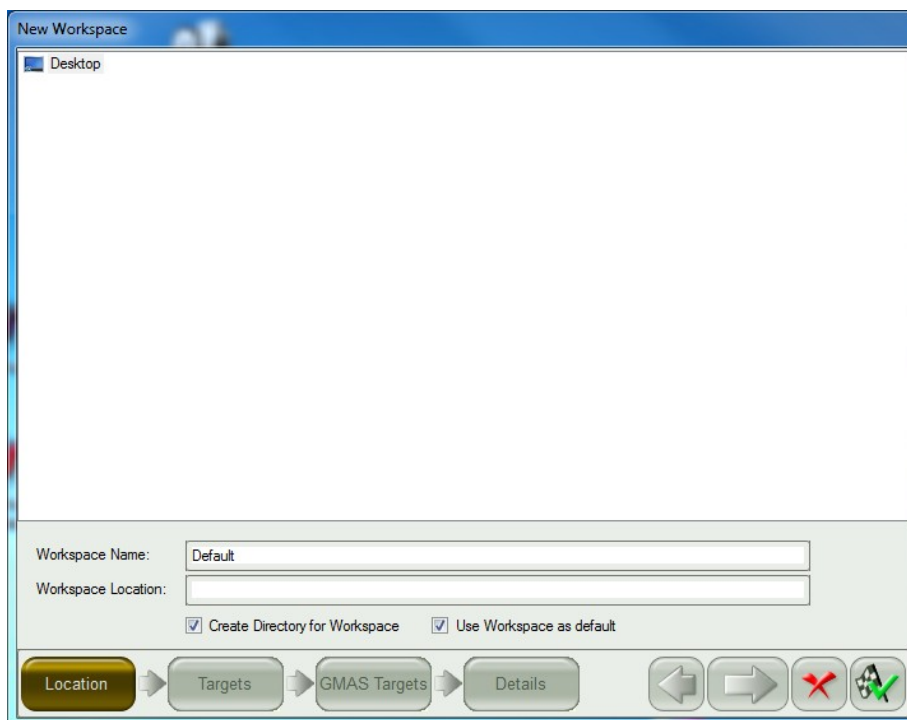
1.3.4 Uninstalling the EAS

If you wish to uninstall EAS, see section 8.2.

1.4 Getting Started with EAS – New Workspace Wizard

1.4.1 Workspace

Workspace defines the setup and configuration of your system drives, motion controllers etc. that are constructed in the form your application.



When working with the Elmo Application Studio, you can view the tree of the workspace displaying information related to your application.



Some examples of this information are:

- The number and types of devices in your system
- The communication parameters for each device
- I/O definitions
- User program projects
- Device parameters
- Multi-Axis controller (Gold Maestro) resource files.

During operation of the Workspace wizard it is necessary to manually save your workspace before exiting. When you open EAS, your default Workspace is opened, and the program will start showing the last screen, when closed.

1.4.1.1 System and Workspace

Notice that the **New Workspace Wizard** ends after the basic system information is entered. Workspace and the system structure are linked, but defined separately:

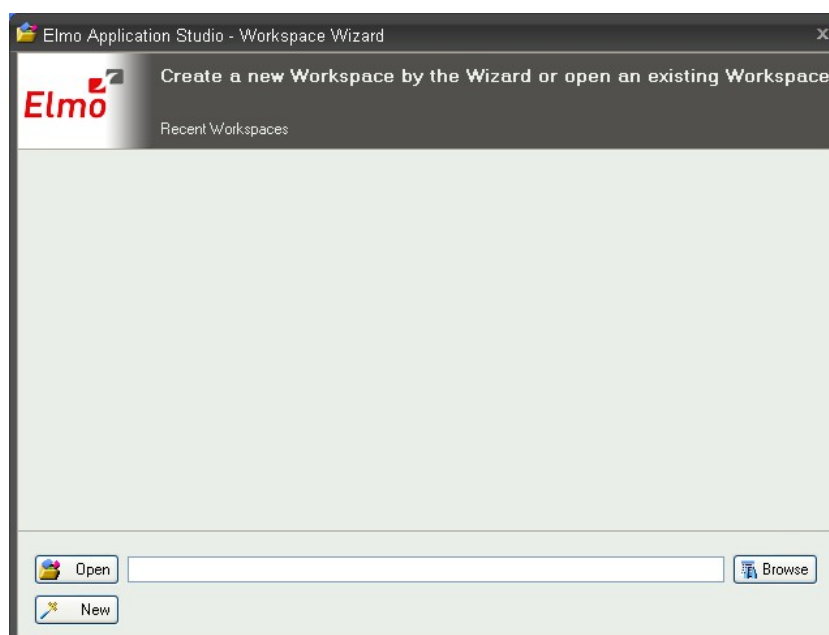
- **System** will usually relate to the physical components connected to the PC; drives, controllers, and the communication network they form.
- **Workspace** refers to the drives, motion controllers, and folders that include, but are not limited to, the description of the application.

The terms will sometimes be used as synonyms, since each Workspace includes one System. If a user wishes to save his work within several systems, several workspaces are required.

To Start the EAS

1. Double click on the Elmo Application Studio icon on your desktop or select **Elmo Motion Control-> Elmo Application Studio** in Windows Start menu.

You are prompted to create a new workspace.



1.4.2 New Workspace Wizard - Location

To create a new workspace

1. Click **New**.



The following are shown:

Browser Window	Expand or collapse folders to select a location for your Workspace folder.
Workspace Name	Type in a name for your Workspace
Workspace Location	Displays the location selected in the Browser window. Type in a folder location to change the selection or use the browser window.
Create Directory for Workspace	Creates a separate new directory for the new Workspace. If unchecked, the files related to this workspace will be located in the selected folder.
Use Workspace as Default	If checked, the new Workspace will be the workspace that opens as default every time EAS is opened. This selection overrides any previous selection for default workspace. If this box is left unchecked, then when EAS is opened in the future, the Workspace selection dialog box opens. This window opens by default on the first time EAS is opened. At the next activation, EAS will open to show the Studio window of the default workspace. If no default workspace is defined, this window will appear in the next start-up of EAS.

1.4.3 The New Workspace Wizard Toolbar



1. Use the **Next** and **Previous** buttons to navigate between the different steps of the wizard.
2. When you have completed defining your system, click **Finish** to save it and open the studio window. If you wish to cancel the definitions you created, and exit the wizard, click **Cancel**.

1.4.4 Targets

A target can be a servo drive, motion controller, or any other device connected within the configuration of the application and displayed within the EAS workspace.

To enter Targets

1. Enter the number of hardware targets of every type connected to the PC.

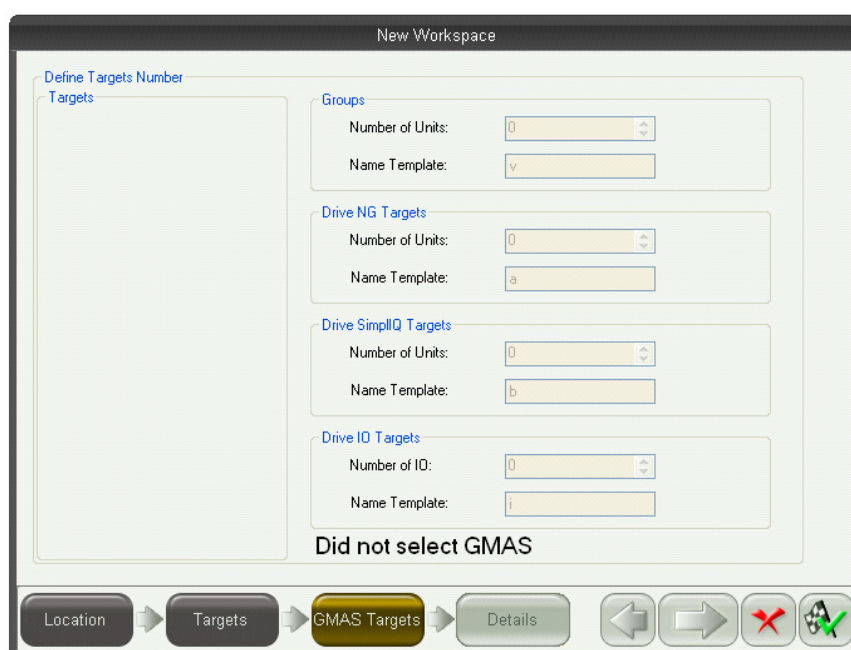
To connect only Gold Line drives:

Leave all entries “0” except for **Add Drive NG** where you enter the number of Gold Line (NG – New Generation) drives connected to the PC.



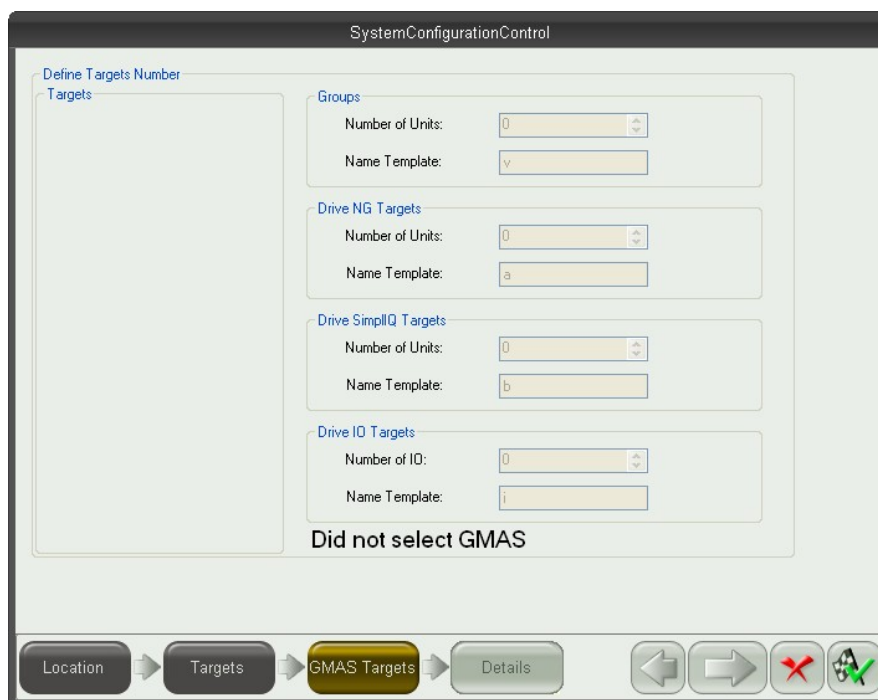
2. To continue, click the **Next** button .

The next step is relevant only for systems with Gold Maestro. If only drives are connected, the following screen appears.



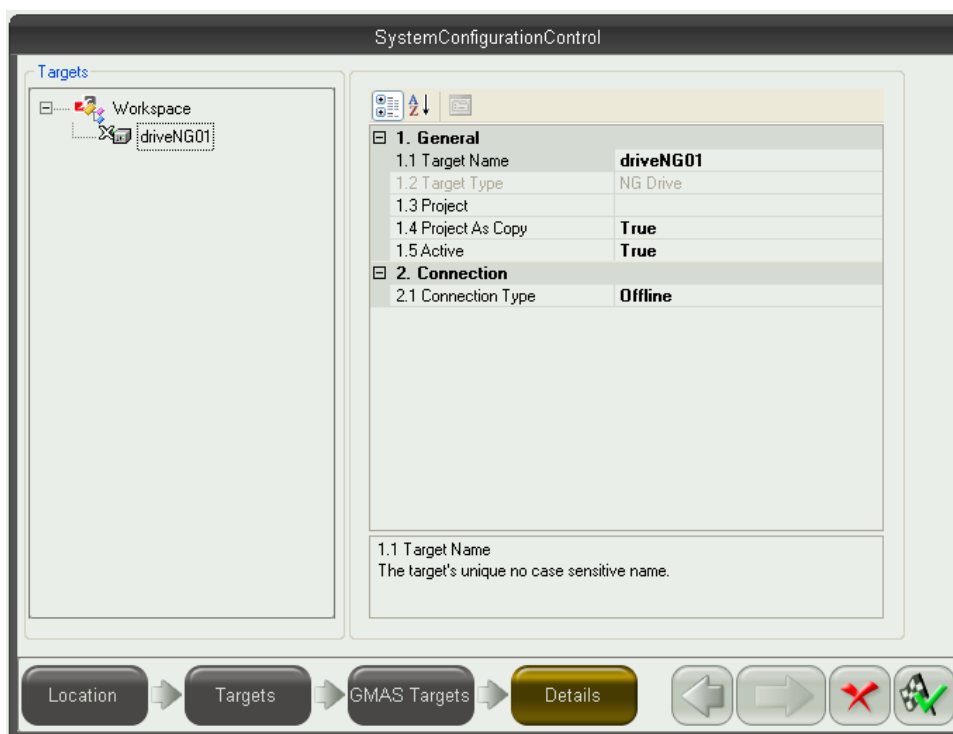
This screen shows only information related to systems that include Gold Maestro multi-axis controllers. If drives are connected via GMAS, their information will be shown in this

screen. Since we have selected only Gold Line drives, all fields in this screen are inactive and the text message “Did not select GMAS” is displayed.



3. Click **Next** to continue.

1.4.5 Target Details

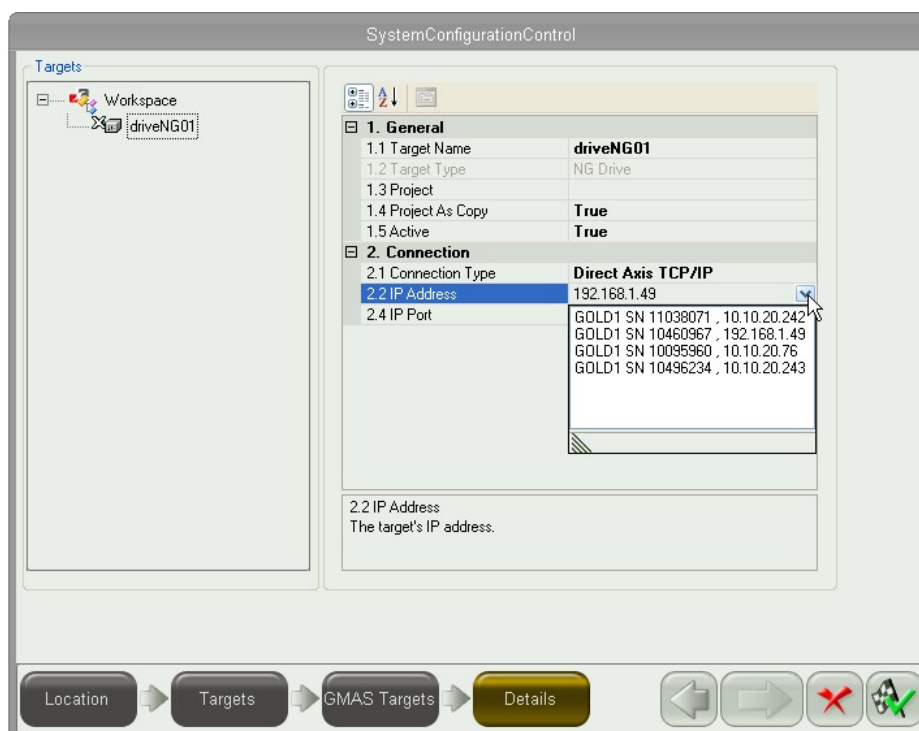


1. Define basic details for each target drive. The following Target Details can be defined:

Target Name Double click the name to change it

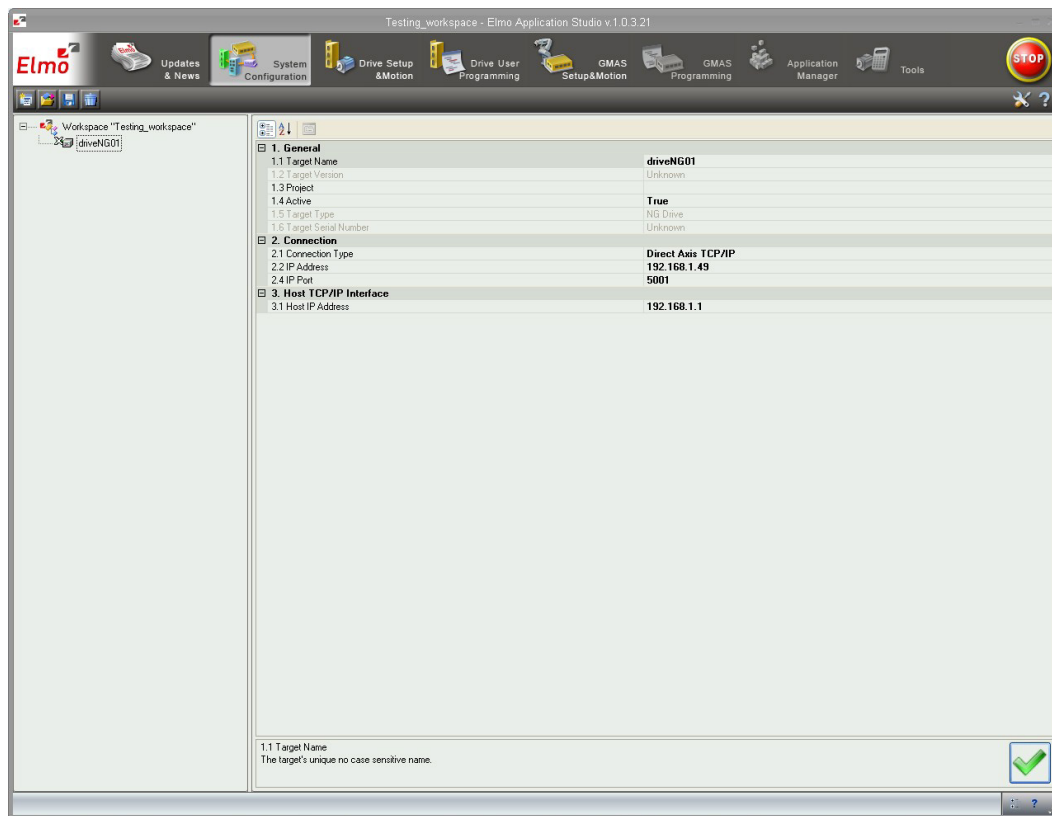
Target Type	Displays the type of the drive
Project	Browse to select a project including a user program to be assigned to the drive
Project As Copy	Your project can be opened as a copy. See explanation in section 6.4.2
Active	Select true or false. An active drive is displayed in other EAS windows as part of the current system
Connection	Select how the drive is connected to the PC. Use the Offline option to explore EAS or edit offline files without connecting a drive.

2. Select each drive in turn to set its details.



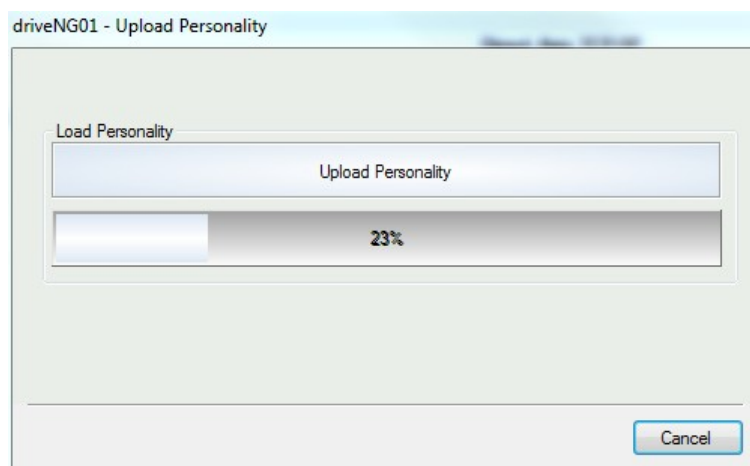
3. After entering the details for all the devices, click **Finish**  to open the main Elmo Application Studio (EAS) window.

The EAS opens for the first time in the **System Configuration** activity.

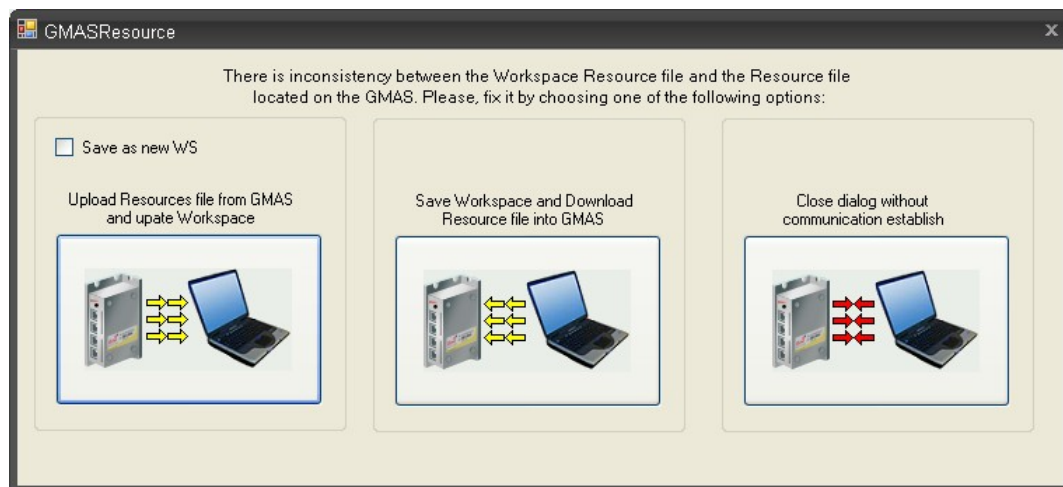


When EAS is reopened, the EAS window displays the same screen that was active when you last closed the program. In addition, EAS remembers the size and location of the window.

4. When the new Personality (database parameters) of a device is downloaded (not previously downloaded), it is synchronized with the present devices and the following window opens.



5. EAS then opens the following window to synchronize the Workspace Resource file and the Resource file located in the G-MAS:



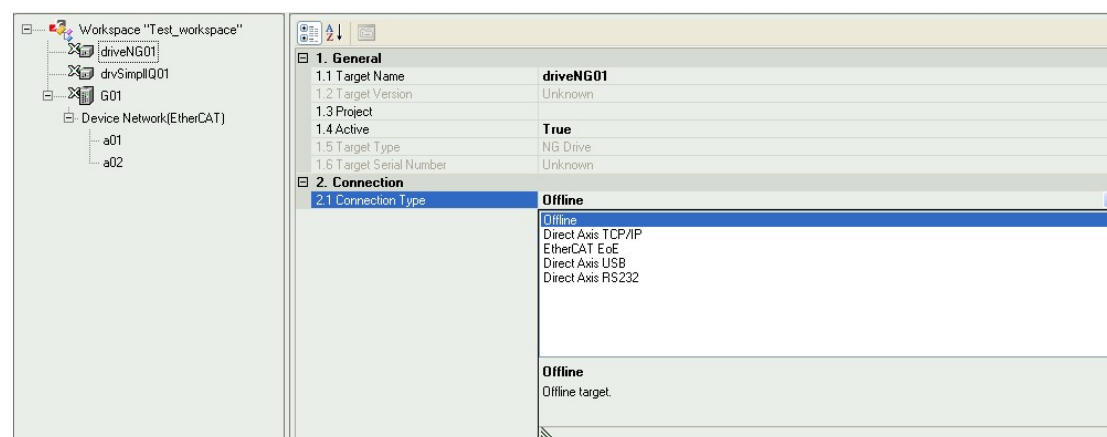
Select from the following options:

- Click the checkbox next to Save as new WS (Workspace).
- Upload Resource file from the G-MAS and update the Workspace.
- Save Workspace and download Resource file from the G-MAS.
- Close the dialog without establishing communication.

1.4.6 Connecting a Drive to PC

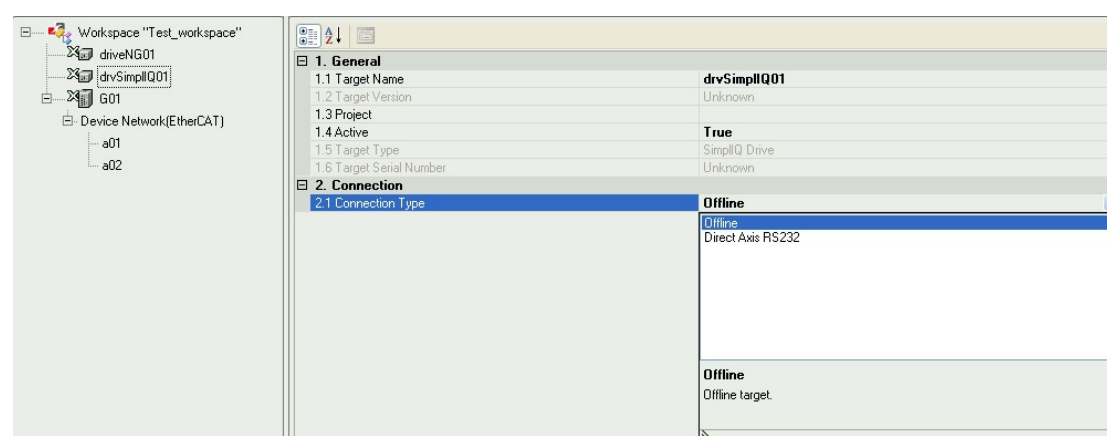
A drive can communicate with a PC in the following ways, depending on the type and specific model:

For Gold Drives



Connection Type	Explanation
Offline	All drives, and motion controllers are offline, but the EAS windows are operational.
Direct Axis TCP/IP	Direct Access TCP/IP. Main connection for most drives
EtherCAT EoE	Direct Access USB – USB 2.0 communication is not operational at this moment
Direct Axis RS232	Direct Access RS232. Communication using RS-232 port

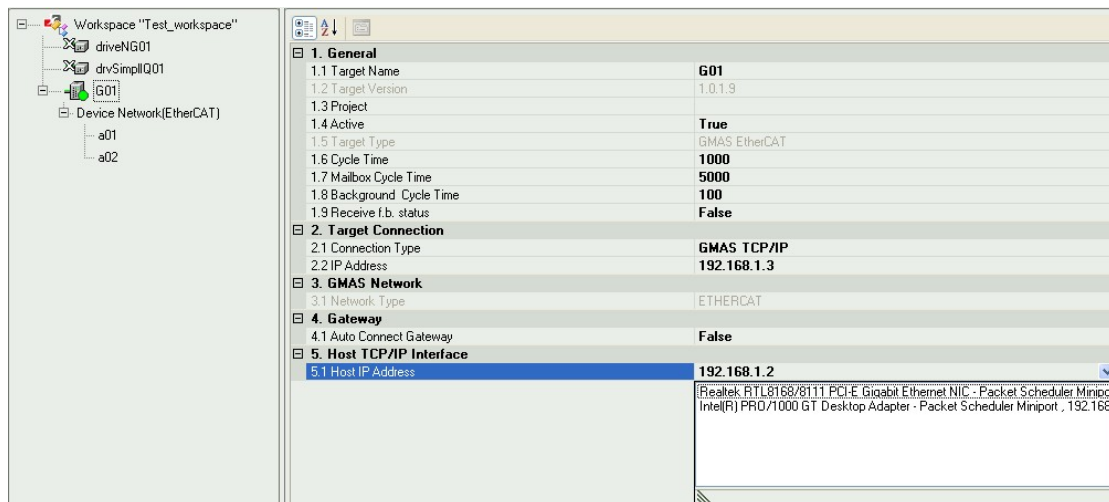
For SimplIQ Drives



Connection Type	Explanation
Offline	All drives, and motion controllers are offline, but the EAS windows are operational.

Connection Type	Explanation
Direct Axis RS232	Direct Access RS232. Communication using RS-232 port

For G-MAS Motion Controllers



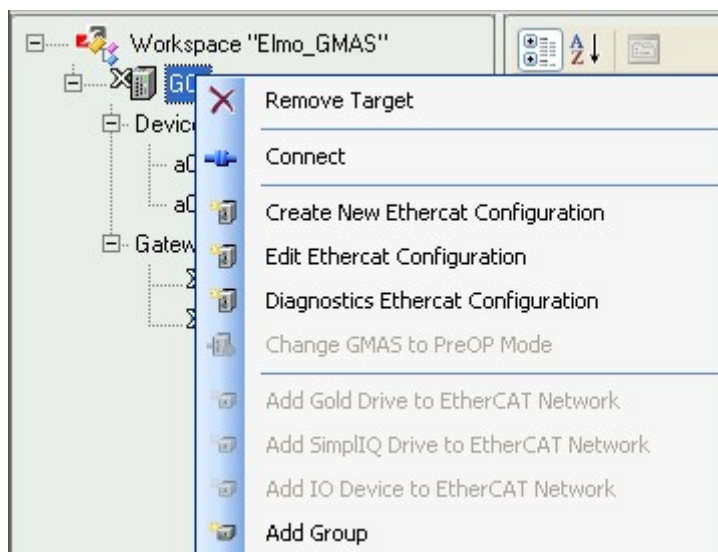
Connection Type	Explanation
Direct Axis TCP/IP	Direct Access TCP/IP. Main connection for the G-MAS motion controllers

Note: USB and Ethernet connections require some PC setup as well as EAS configuration. For a detailed explanation about connecting a servo drive, refer to 9 Drive Communication Setup.

To use RS-232 proceed to activate EAS and simply select the COM port and baud rate in the communication options.

1.4.7 G-MAS options

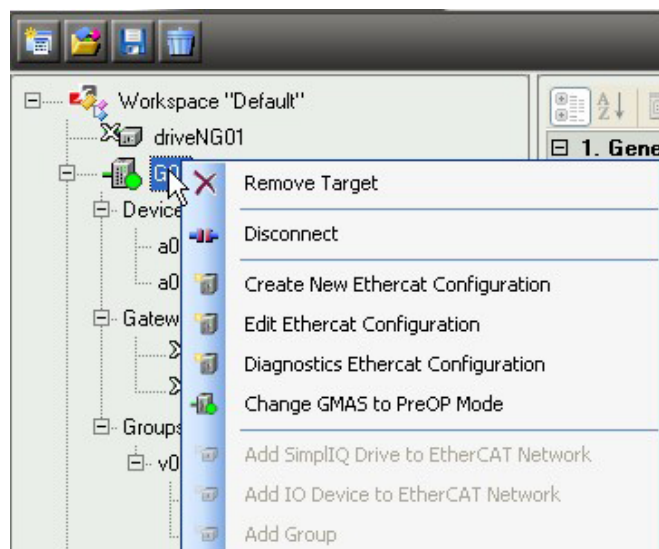
The following G-Mas options are available when the G-MAS is inactive.



1. Right-click on the G-MAS within the Workspace window pane.
2. Select from the options displayed:

Remove Target	Remove the G-MAS from the workspace entirely
Connect	Connect the G-MAS to its devices and activate the G-MAS configuration
Create New EtherCAT Configuration	Refer to the section 1.5 Setting the EtherCAT Configuration on page 30.
Edit EtherCAT Configuration	Edits the EtherCAT configuration and allows quick editing of the Master configuration
Diagnose EtherCAT Configuration	Allows diagnostics of the EtherCAT network for troubleshooting and information
Change GMAS to PreOP Mode	Change the G-MAS to pre-operational mode and allow download of parameters to the G-MAS. Only available when the G-MAS is active.
Add Gold Drive to EtherCAT Network	Add an Gold EtherCAT drive to the present EtherCAT network.
Add SimplIQ Drive to EtherCAT Network	Add a SimplIQ drive to the present EtherCAT network. Only available when the G-MAS is active.
Add I/O device to EtherCAT Network	Adds an I/O device to the EtherCAT network
Add Group	Add a group of EtherCAT or non-EtherCAT drives to the present configuration.

When the G-MAS is active the options available change accordingly.



3. Right-click on the G-MAS within the Workspace window pane.
4. Select from the options displayed:

Remove Target

Disconnect

Create New EtherCAT Configuration

Edit EtherCAT Configuration

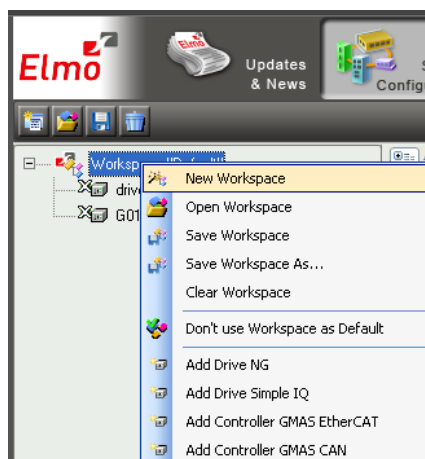
Diagnostics EtherCAT Configuration

Change GMAS to PreOP mode

1.4.8 Returning to New Workspace Wizard window

To return to the New Workspace Wizard window after EAS was opened

1. Select **System Configuration**. Right click at the name of the current workspace and select **New Workspace**.



1.5 Setting the EtherCAT Configuration

This section describes how to set up the G-MAS and drives using EtherCAT communication. The setup applies to a configuration where the G-MAS is not connected, but can equally apply to a G-MAS which is connected. The following diagram describes the Master/Slave communication and their relevant layers.

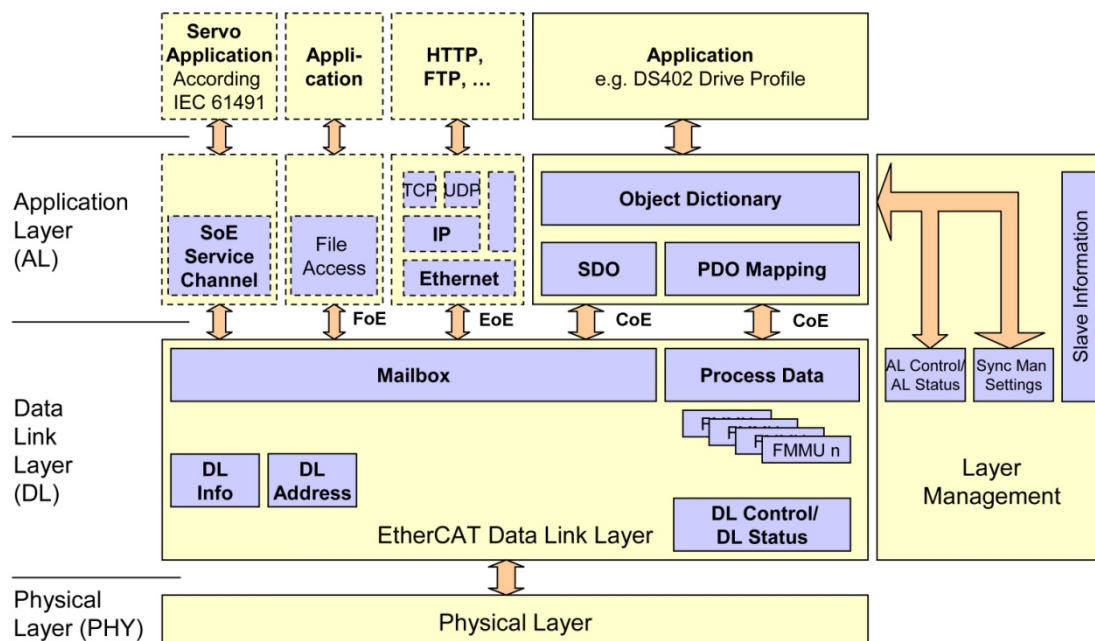
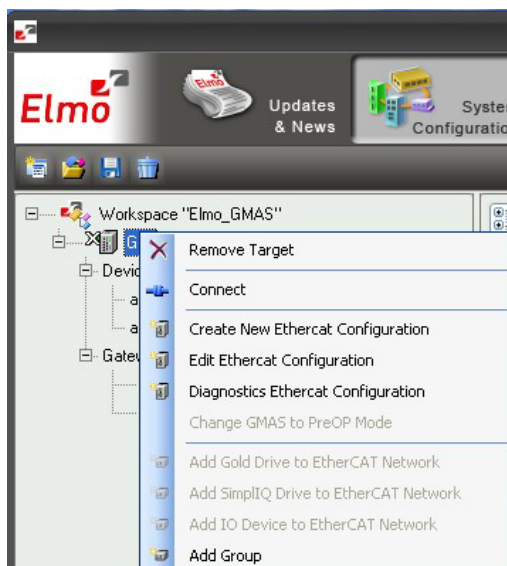


Figure 1.1 EtherCAT Communication

To Setup EtherCAT configuration

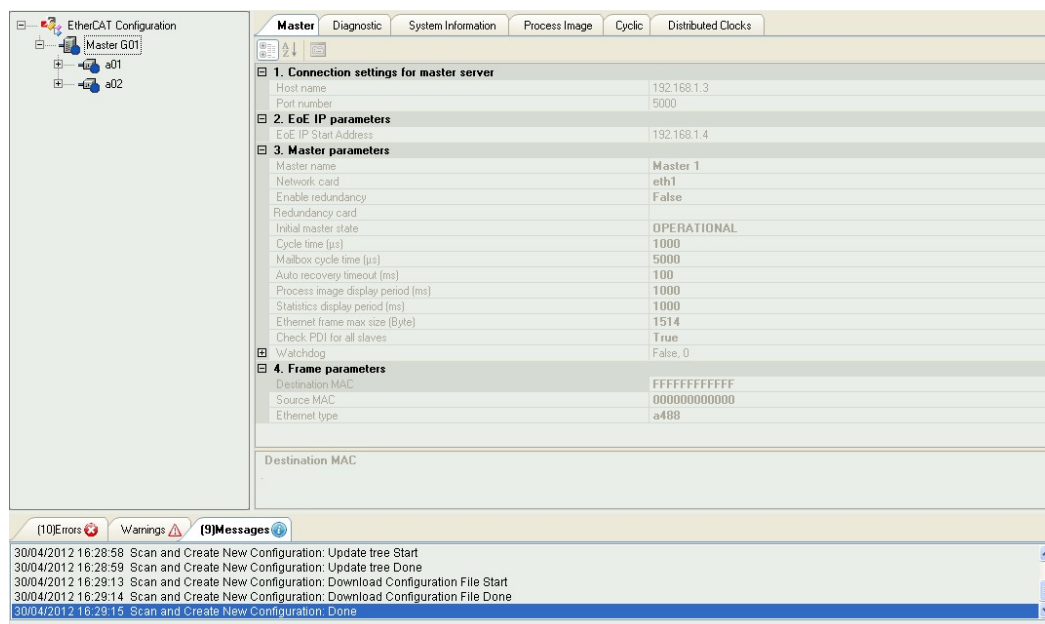


1. Right-click on the G-MAS icon in the Workspace window tab. A menu opens displaying options, which includes the following:

Create New EtherCAT configuration

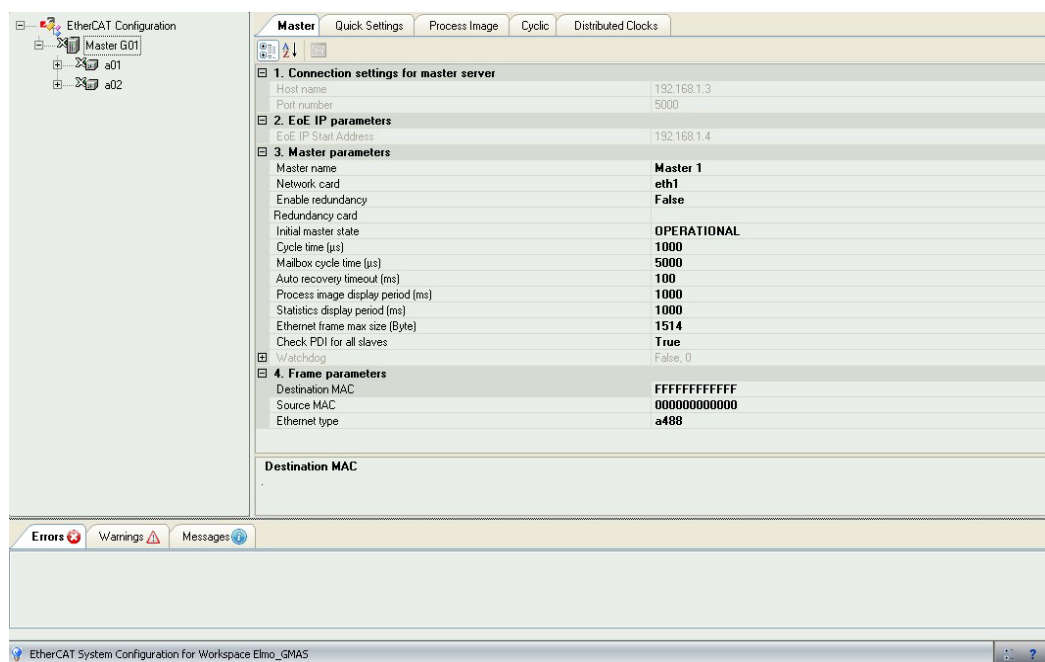
Creates a new EtherCAT configuration by locating all connections, which are either

connected or potentially connected via
EtherCAT



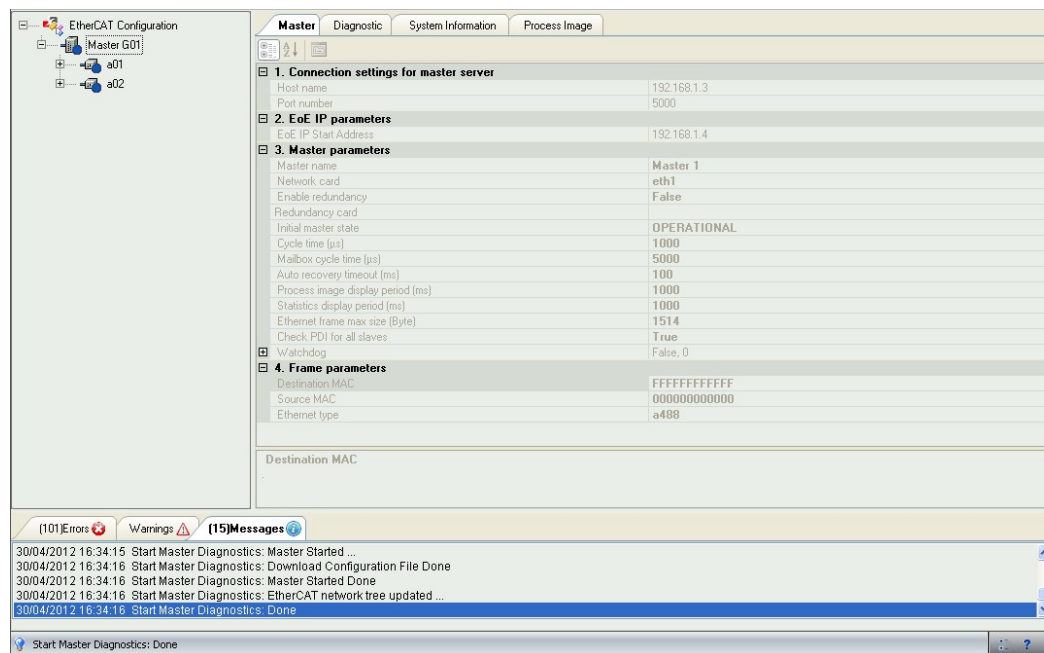
Edit EtherCAT Configuration

Edits the present configuration and allows
editing of the configuration

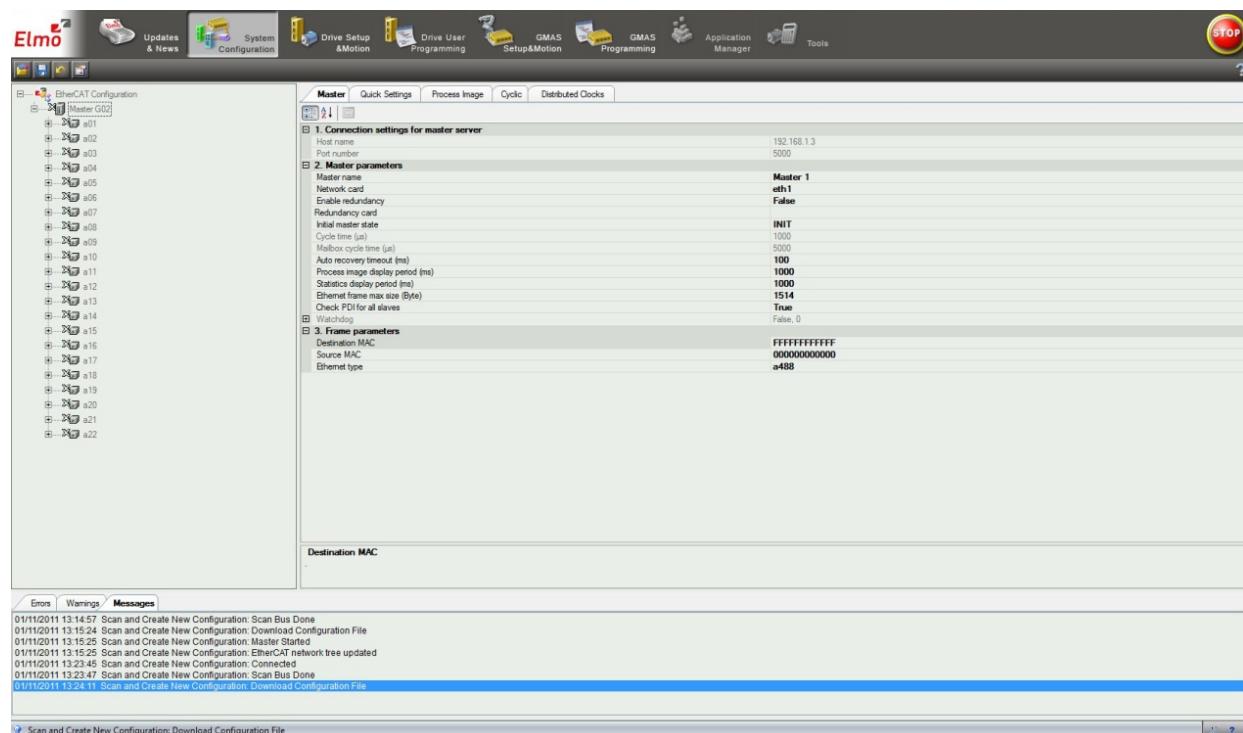


Diagnostics EtherCAT Configuration

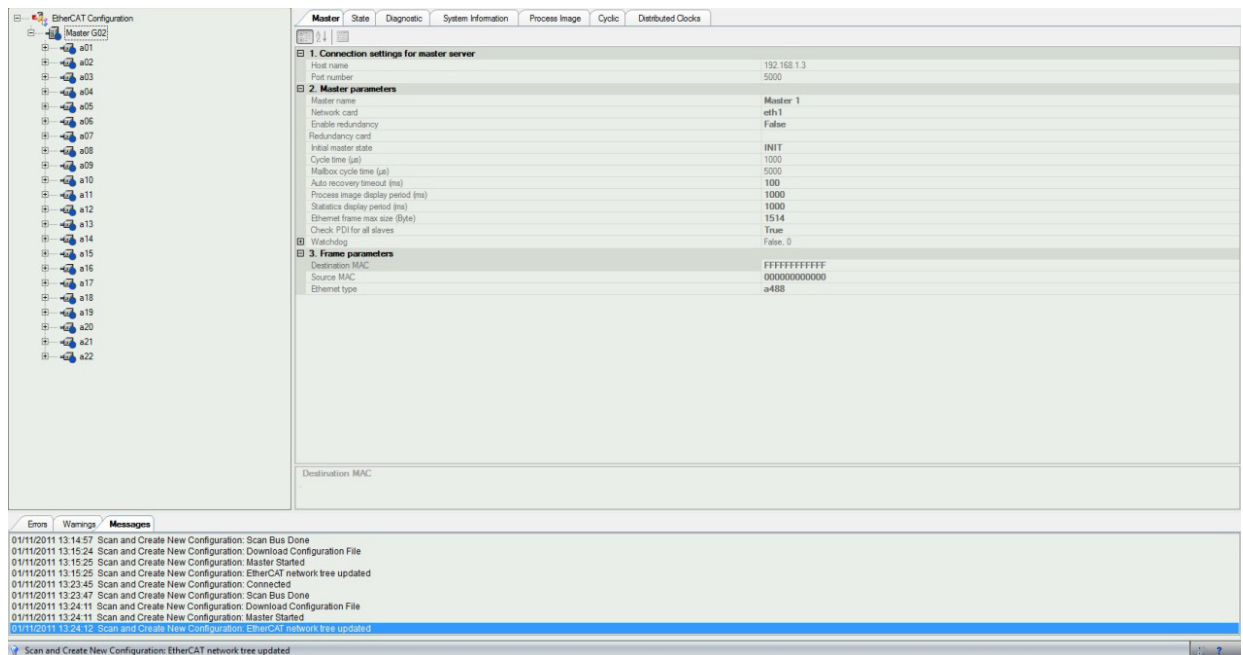
Adds a present or new drive to the EtherCAT Network



- To create a new EtherCAT configuration, select **Create New EtherCAT configuration**.
The system automatically detects and enters EtherCAT configuration mode.



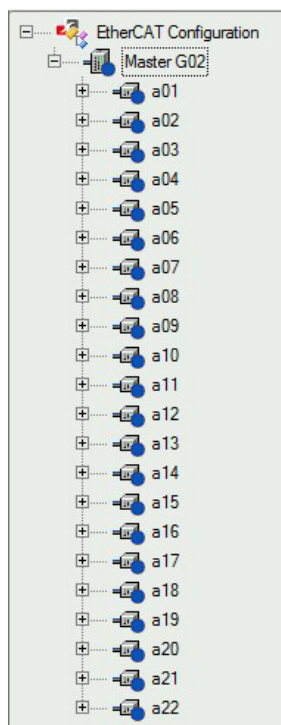
Finally appearing as:



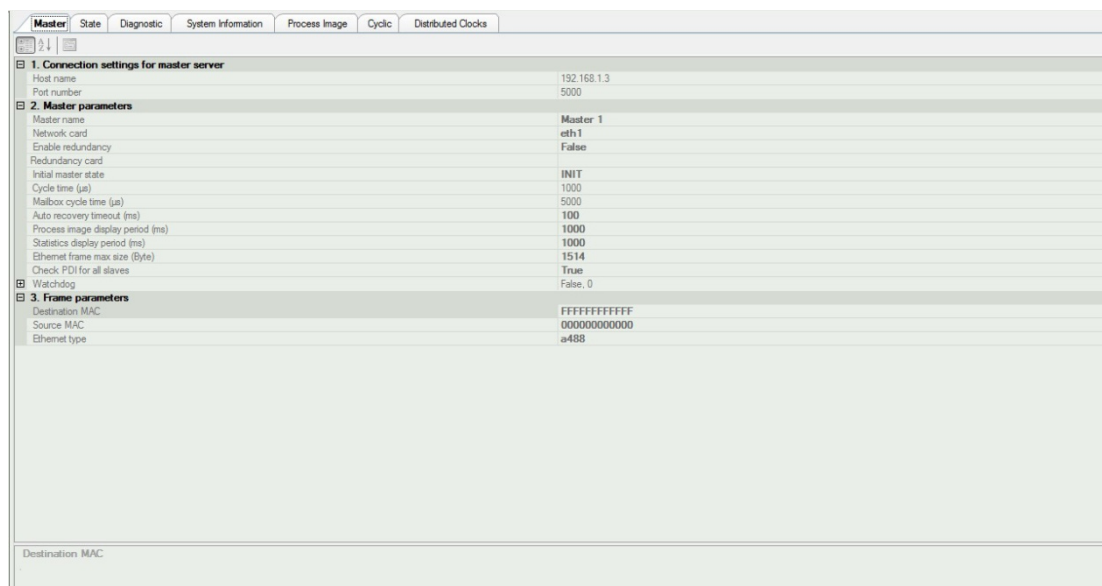
Notice that the Messages tab window displays the operations that the EtherCAT configuration has applied:

```
01/11/2011 13:14:57 Scan and Create New Configuration: Scan Bus Done
01/11/2011 13:15:24 Scan and Create New Configuration: Download Configuration File
01/11/2011 13:15:25 Scan and Create New Configuration: Master Started
01/11/2011 13:15:25 Scan and Create New Configuration: EtherCAT network tree updated
01/11/2011 13:23:45 Scan and Create New Configuration: Connected
01/11/2011 13:23:47 Scan and Create New Configuration: Scan Bus Done
01/11/2011 13:24:11 Scan and Create New Configuration: Download Configuration File
01/11/2011 13:24:11 Scan and Create New Configuration: Master Started
01/11/2011 13:24:12 Scan and Create New Configuration: EtherCAT network tree updated
```

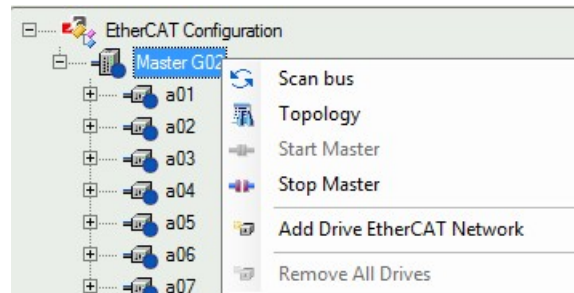
In addition, the Workspace window pane, displays the EtherCAT configuration model of the Master G-MAS and its slave drives.



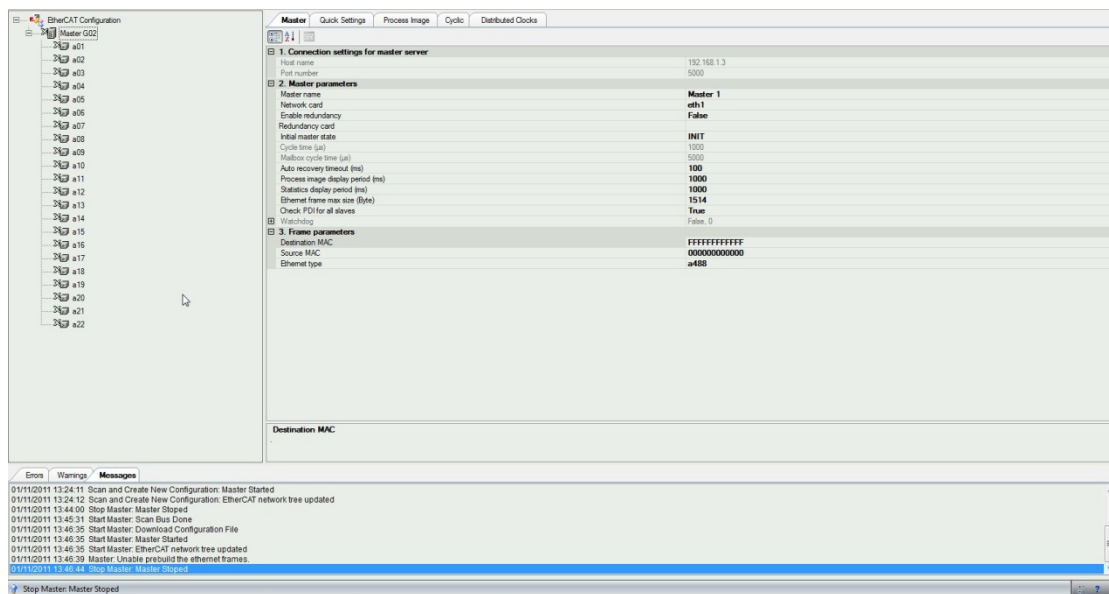
3. Click the Master XXX icon in the workspace, to gain information about the Master.



4. Similarly, click a Slave XXX icon in the workspace, to gain information about the Slave.
5. To view or change parameters in any of the main Master or Slave tab setting windows, **deactivate** the Master:
 - a. At the EtherCAT Configuration tab, highlight the Master XXXX



- b. Right-click on the Master to open the Master menu.
- c. Select **Stop Master**. The Master is stopped and the parameters tabs become active to edit.



6. To view or change parameters in any of the other Master or Slave tab setting windows, **activate** the Master:

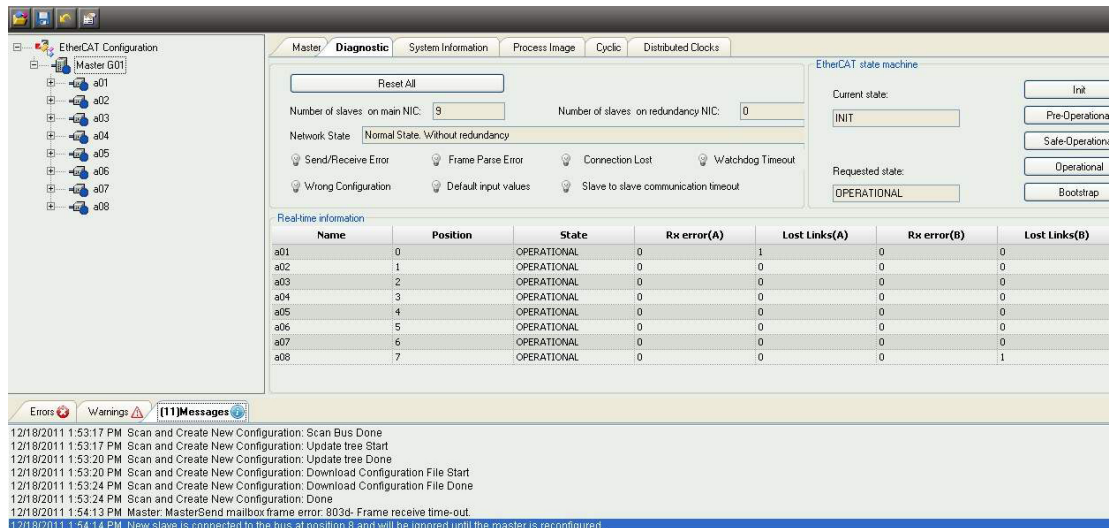
- a. At the EtherCAT Configuration tab, highlight the Master XXXX
- b. Right-click on the Master to open the Master menu.



- c. Select **Start Master**. The Master is activated and the parameters tabs become inactive to edit. However, further tabs become available for viewing.

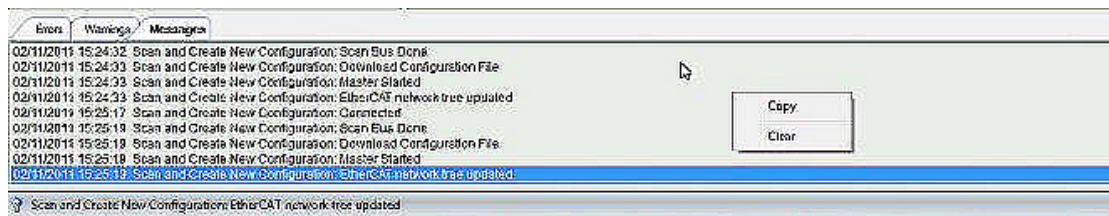
Master		State	Diagnostic	System Information	Process Image	Cyclic	Distributed Clocks
1. Connection settings for master server Host name 192.168.1.3 Port number 5000							
2. Master parameters Master name Master 1 Network card eth1 Enable redundancy False Redundancy card Initial master state INIT Cycle time (µs) 1000 Mailbox cycle time (µs) 5000 Auto recovery timeout (ms) 100 Process image display period (ms) 1000 Statistics display period (ms) 1000 Ethernet frame max size (Byte) 1514 Check PDI for all slaves True							
Watchdog Enable False, 0 Check time (ms) False 0							
3. Frame parameters Destination MAC FFFFFFFFFFFF Source MAC 000000000000 Ethernet type a488							
Watchdog							

7. To add a Slave drive to the EtherCAT Master G-MAS:
 - a. Deactivate the Master is in step 5 above.
 - b. Switch off any power supply to the Master and Slave drives.
 - c. Physically connect the Slave drive to the Master G-MAS.
 - d. Switch on the power supply to the Master and Slave drives.
 - e. At the EtherCAT Configuration tab, highlight the Master XXXX, and right-click on the Master to open the Master menu.
 - f. From the Master menu, select **Scan and Create New Configuration**.
 - g. Again, open and select from the Master menu, **Start Master**. The Master and Slaves are activated, and the new message appears that a new Slave has been added.

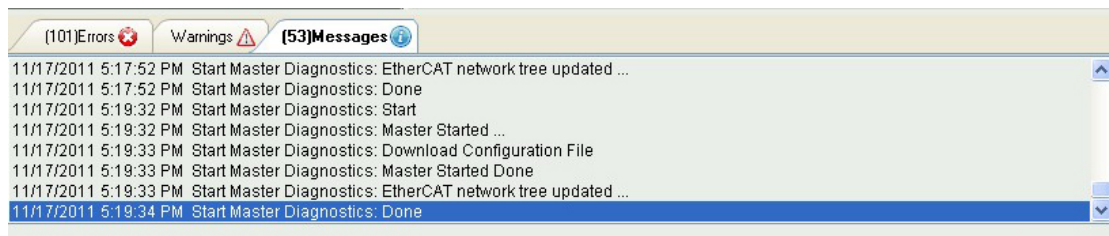


Name	Position	State	Rx error(A)	Lost Links(A)	Rx error(B)	Lost Links(B)
a01	0	OPERATIONAL	0	1	0	0
a02	1	OPERATIONAL	0	0	0	0
a03	2	OPERATIONAL	0	0	0	0
a04	3	OPERATIONAL	0	0	0	0
a05	4	OPERATIONAL	0	0	0	0
a06	5	OPERATIONAL	0	0	0	0
a07	6	OPERATIONAL	0	0	0	0
a08	7	OPERATIONAL	0	0	0	1

8. At any time, the Messages can be individually copied, or cleared by right-clicking on the message or selecting Copy or Clear from the popup menu.



In addition, the lower tabs record the number of Errors, Warnings, and Messages in brackets. This is useful for diagnostics, and as a warning if the number of errors becomes very large.



1.5.1 EtherCAT Configuration Options

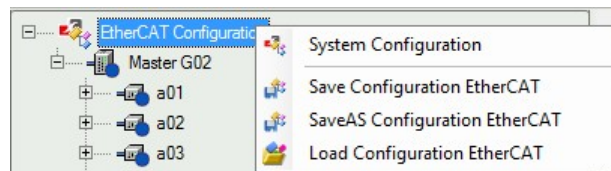
When online, the EtherCAT configuration offers a number of options:

- System Configuration
- Save Configuration EtherCAT
- Save As Configuration EtherCAT
- Load Configuration EtherCAT

Similarly, the Master and Slaves each have separate option menus, as described in the procedures below. The options available when the Master/Slaves are **offline** are also explained.

To use an EtherCAT Configuration option

1. When online, right-click on the EtherCAT Configuration icon. A menu opens.

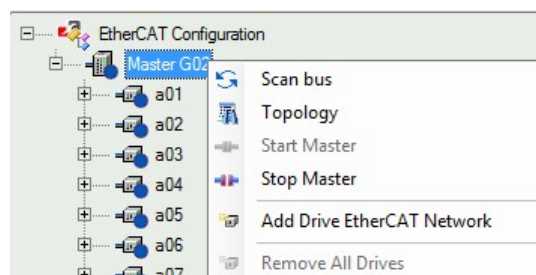


2. Select from the menu to perform the following:

System Configuration	Reconfigure the EtherCAT system
Save Configuration EtherCAT	Save the EtherCAT configuration to a file
Save As Configuration EtherCAT	Save The EtherCAT configuration under a different file name type
Load Configuration EtherCAT	Load an EtherCAT configuration file

To select from the Master options

1. When online/offline, right-click on the Master icon. A menu opens.

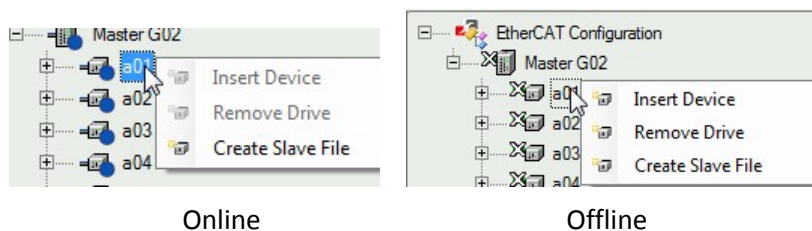


2. Select from the menu to perform the following:

Scan Bus	Scans the EtherCAT bus for any changes in the network configuration
Topology	Creates a topological map of the EtherCAT network
Start Master	Only available when the Master is offline. Starts the Master/Slave system and changes the status to online.
Stop Master	Stops the Master and its Slaves. The system is then offline.
Add Drive EtherCAT Network	Adds a new EtherCAT network to the present Master/Slave network
Remove All Drives	Only available when the Master is offline. Removes the drives from the network and disconnects the drives from the Master.

To select from the Slave options

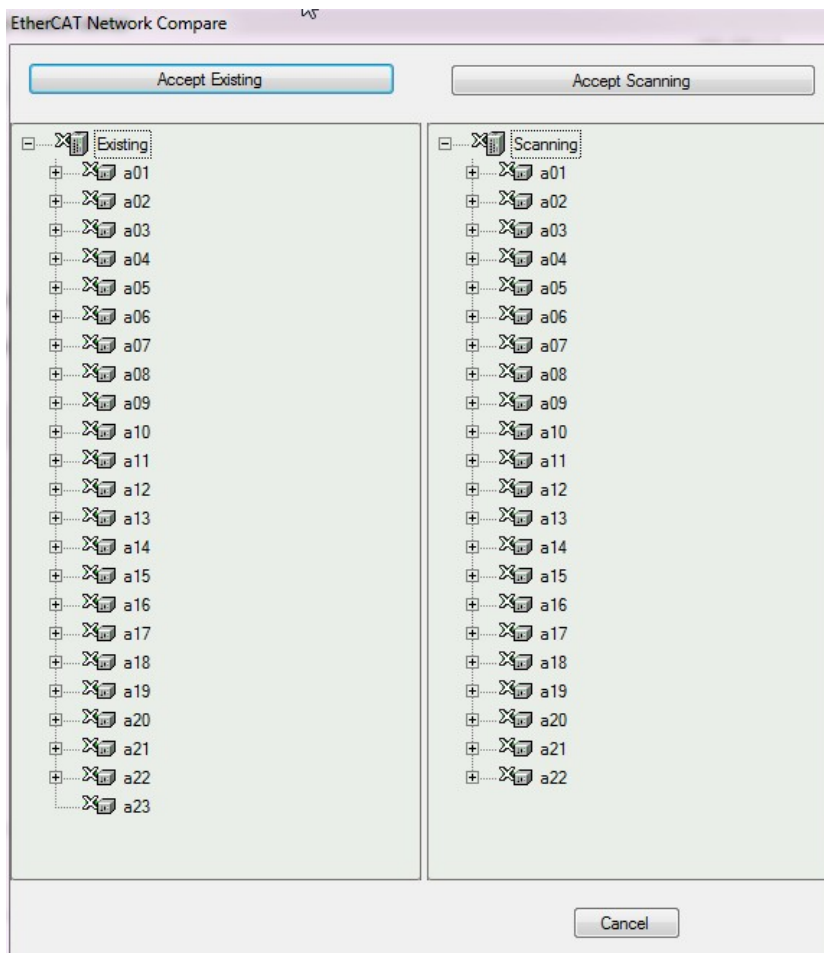
1. When online/offline, right-click on the Slave icon. A menu opens.



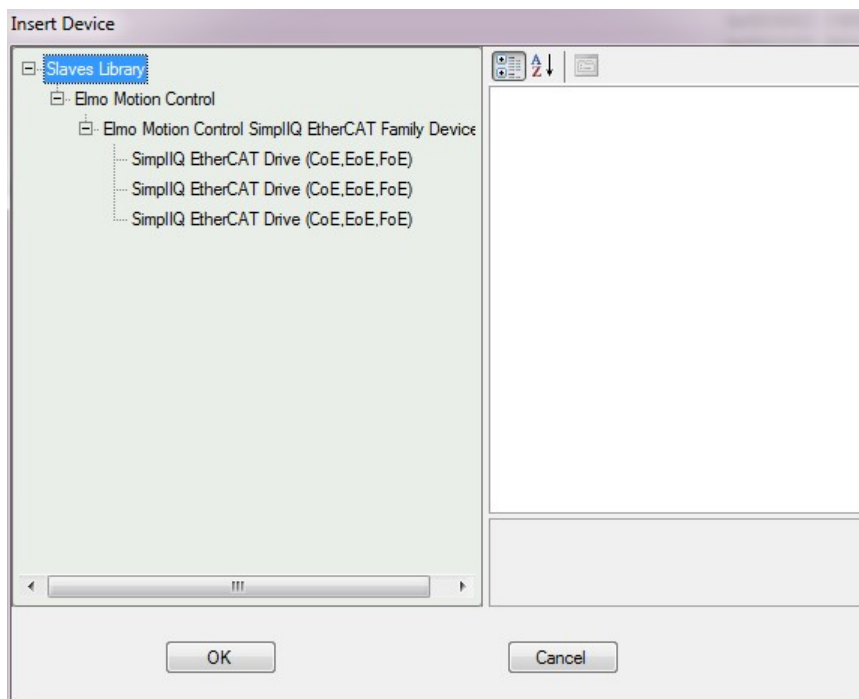
2. Select from the menu to perform the following:

Insert Device	Only available when the Master is offline. Insert a new device to the Master/Slave network
Remove Drive	Only available when the Master is offline. Remove a drive from the Master/Slave network
Create Slave File	Create a Slave File with the specific parameters and data details of the selected slave

- a. If **Remove Drive** is selected, the application rescans the network, comparing the present with the saved configurations and the following window opens.



- b. Either, accept the saved configuration and click **Accept Existing**, or accept the updated scan configuration and click **Accept Scanning**.
- c. If **Insert Device** is selected, the application opens the Slaves Library to import the new device, and its parameters.



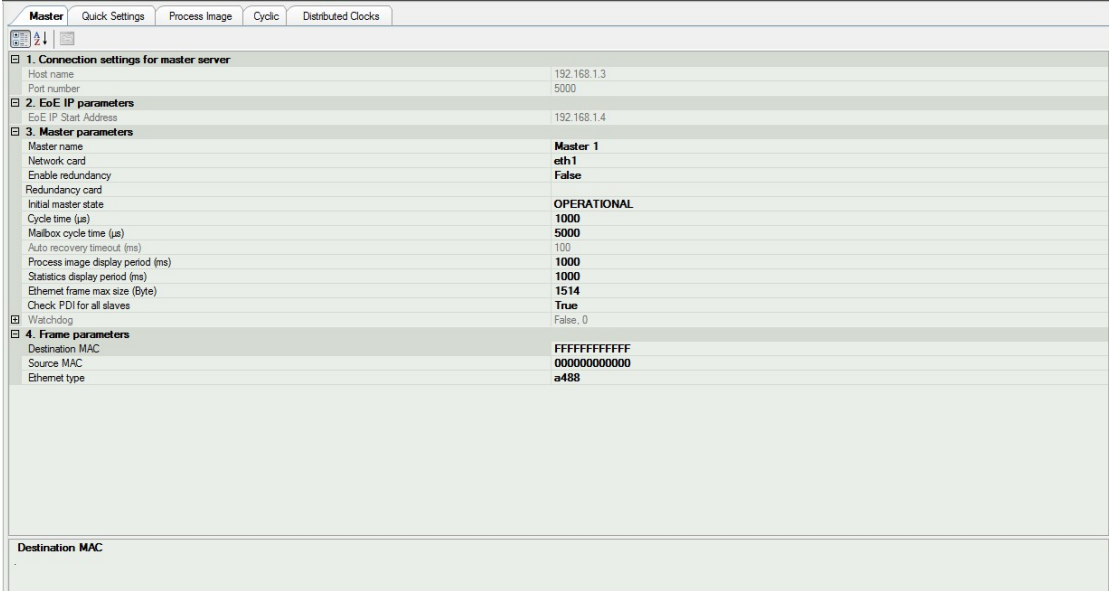
- d. Select the slave device to add from the library, with its input and output parameters.
- e. Then click **OK**. The device is imported.

1.5.2 EtherCAT Master Settings Tabs

The following sub-sections describe the Master tabs available **when the Master is inactive**. These tabs are editable:

- Master
- Quick Settings
- Process Image
- Cyclic
- Distributed Clocks

1.5.2.1 EtherCAT Master Settings Tab



Section	Parameter	Value
1. Connection settings for master server	Host name	192.168.1.3
	Port number	5000
2. EoE IP parameters	EoE IP Start Address	192.168.1.4
	EoE IP End Address	
3. Master parameters	Master name	Master 1
	Network card	eth1
	Enable redundancy	False
	Redundancy card	
	Initial master state	OPERATIONAL
	Cycle time (µs)	1000
	Mailbox cycle time (µs)	5000
	Auto recovery timeout (ms)	100
	Process image display period (ms)	1000
	Statistics display period (ms)	1000
	Ethernet frame max size (Byte)	1514
	Check FDI for all slaves	True
	Watchdog	False, 0
	4. Frame parameters	Destination MAC
Source MAC		000000000000
Ethernet type		a488

Destination MAC: -

The EtherCAT Master settings consist of the following:

Connection settings for master server

Host name

Port number

The Connection settings enable set up of the communication to a PC where the Master is running.

It is possible to attach to a remote or a local Master.

When trying to attach to localhost, if the Master is not running, it is started automatically with default settings (host name:localhost; port number: 5000).

In case of connecting to a remote Master, specify a host name and a port number. On further changing the host name or the port number, the connection is automatically performed.

EoE IP Parameters

EoE IP Start Address The EtherCAT over Ethernet IP start address between the Master and the Slaves.

Master parameters

Master Name Name of a selected Master

Network card Name of the network card, which provides an interface to connect slaves

Enable redundancy Enable/disable redundancy mode

Redundancy card Name of the network card, which is additionally used in redundancy mode

Initial master state State to be used when starting up the Master:

2. Master parameters	
Master name	Master 1
Network card	eth1
Enable redundancy	False
Redundancy card	
Initial master state	INIT
Cycle time (µs)	INIT
Mailbox cycle time (µs)	PRE_OPERATIONAL
Auto recovery timeout (ms)	BOOTSTRAP
Process image display period (ms)	SAFE_OPERATIONAL
Statistics display period (ms)	OPERATIONAL

Init	Defines the root of the communication relationship between the Master and the slave in an application layer. No direct communication between the Master and the slave on the application layer is possible. The Master has access to the Data Link (DL) Information registers.
Pre-Operational	The EtherCAT mailbox is active if the slave supports the optional mailbox. Both the Master and the slave can use the mailbox and the appropriate protocols to exchange application specific initializations and parameters. No process data communication is possible in this state.
Safe Operational	The application of the slave delivers actual input data without manipulating the output data. The outputs should be set to their "safe" state.

	Operational	The application of the slave delivers actual input data and application of the Master should deliver actual output data.
	Bootstrap	The application of the slave can accept a new firmware downloaded with the FoE protocol.
Cycle time	Cycle time setting in microseconds	
Mailbox cycle time	Time to poll slaves mailboxes in microseconds	
Auto recovery timeout	Time for Master device to recover slave device in milliseconds	
Process image display period	Process Image refresh time in milliseconds	
Statistics display period	Statistics information refresh time in milliseconds	
Ethernet frame max size (Byte)	Maximum size of Ethernet frame in bytes	
Check PDI for all slaves	Enables/disables the Check Process Data Information (PDI) init command for all slaves.	
Watchdog	If there is a PLC program crash or it is hanging and no output value has been set within this timeout, a default value will be assigned to all outputs.	

Watchdog	False, 0
Enable	False
Check time (ms)	0

Enable	To enable/disable the Watchdog function, select either Yes or No from the Enable combo-box
Check time	Set a required timeout by choosing an appropriate value in the Timeout (ms) edit-box

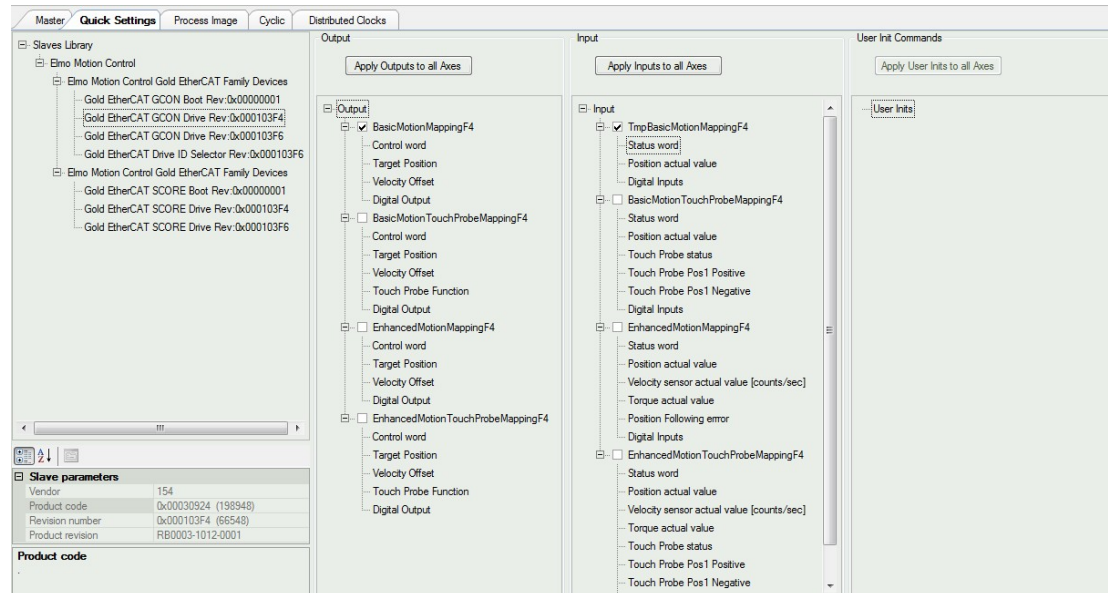
Frame parameters

It is possible to set the following Frame parameters:

Destination MAC	Network card to accept frames
Source MAC	Network card to send frames
Ethernet type	Type of Ethernet communication

1.5.2.2 EtherCAT Quick Settings Tab

The following tab parameters are available when the Master is inactive. This tab describes the hardware configuration parameters of the drive, and consists of an *.XML file which the EAS application uses to update this interface.



The EtherCAT quick settings consist of the following:

Drive's Vendor

The name of the vendor supplying the drive

Drive's devices

The EtherCAT devices associated with the drive and their protocols

Output

Click a checkbox next to a protocol and select **Apply Outputs to all Axes** to apply protocol to all axes.

BasicMotionMappingF4

Control Word

Target Position

Velocity Offset

Digital Output

BasicMotionTouchProbeMappingF4

Control Word

Target Position

Touch Probe Function
 Digital Output
 EnhancedMotionMappingF4
 Control Word
 Target Position
 Velocity Offset
 Digital Output
 EnhancedMotionTouchProbeMappingF4
 Control Word
 Target Position
 Touch Probe Function
 Digital Output

Input

Click a checkbox next to a protocol and select **Apply Inputs to all Axes** to apply protocol to all axes.

TmpBasicMotionMappingF4
 Status word
 Position actual value
 Digital Inputs
 BasicMotionTouchProbeMappingF4
 Status word
 Position actual value
 Touch Probe status
 Touch Probe Pos 1 Positive
 Touch Probe Pos 1 Negative
 Digital Inputs
 EnhancedMotionMappingF4
 Status word
 Position actual value
 Velocity sensor actual value (counts/sec)
 Torque actual value
 Position Follower error

Digital Inputs
 EnhancedMotionTouchProbeMappingF4
 Status word
 Position actual value
 Velocity sensor actual value (counts/sec)
 Torque actual value
 Touch Probe status
 Touch Probe Pos 1 Positive
 Touch Probe Pos 1 Negative

User Init Commands

Click a checkbox next to a User Init protocol and select
Apply Inits to all Axes to apply initiator to all axes.

User Inits – user initiation commands

1.5.2.3 EtherCAT Process Image Settings Tab

The Process Image tab displays Output and Input variables of Process Image. Each variable includes Name, Data type, Bit size, PI offset (in online mode the Value column is added). All output and input variables of connected slaves are displayed.

Master Quick Settings Process Image Cyclic Distributed Clocks					
Variables					
	Name	Type	Bit Size	PI offset	Value
1	[-] Input variables (size 20bytes, length 20bytes)				
2	--- a01.Inputs.Position actual value	DINT	32	0	
3	--- a01.Inputs.Digital Inputs	DINT	32	32	
4	--- a01.Inputs.Status word	UINT	16	64	
5	--- a02.Inputs.Position actual value	DINT	32	80	
6	--- a02.Inputs.Digital Inputs	DINT	32	112	
7	--- a02.Inputs.Status word	UINT	16	144	
8	[+] Output variables (size 20bytes, length 20bytes)				
9	--- a01.Outputs.Target Position	DINT	32	0	
10	--- a01.Outputs.Digital Outputs	DINT	32	32	
11	--- a01.Outputs.Control word	UINT	16	64	
12	--- a02.Outputs.Target Position	DINT	32	80	
13	--- a02.Outputs.Digital Outputs	DINT	32	112	
14	--- a02.Outputs.Control word	UINT	16	144	

The EtherCAT process image settings consist of the following tabs, with the Slaves sorted by names in ascending order:

Input variables table

Name	Names of output variables in attached slaves devices
Data type	Data types of input variable in attached slaves devices

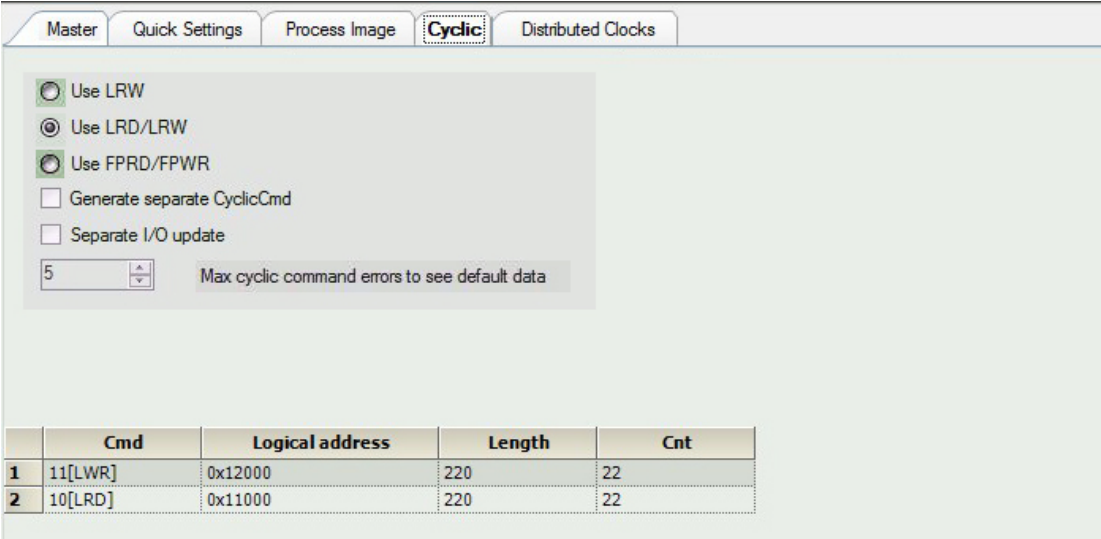
Bit size	Bits occupied by input variable in attached slaves devices
PI offset	Location of slave's input variable in memory
Value	Show physical property values The values are displayed in the Process Image tab in online mode.

Output variables table

Name	Names of output variables in attached slaves devices
Data type	Data types of output variable in attached slaves devices
Bit size	Bits occupied by output variable in attached slaves devices
PI offset	Location of slave's output variable in memory
Value	Show physical property values The values are displayed in the Process Image tab in online mode.

1.5.2.4 EtherCAT Cyclic Settings Tab

The Cyclic tab shows types of cyclic commands for reading, writing and read-writing data from physical memory within the slaves.



	Cmd	Logical address	Length	Cnt
1	11[LWR]	0x12000	220	22
2	10[LRD]	0x11000	220	22

The EtherCAT cyclic settings consist of the following:

Three types of cyclic commands:

LRW Master writes memory to and reads from one or many slaves selected by a logical address. A slave device can retrieve data from the EtherCAT frame (write operation) and put data in the same EtherCAT frame (read operation). Due to use of the same frame for read and write operations, LRW reduces the cycle, thus if slaves support this type of command, it should be used.

LRD/LWR Logical read/logical write (Master reads memory from and writes memory to one or many slaves selected by a logical address). A slave device retrieves data from the EtherCAT frame (write operation) and puts data in another EtherCAT frame (read operation). If a slave does not support LRW commands, LRD/LWR should be used.

FPRD/FPWR Physical read/physical write (Master reads memory from one slave selected by a physical address). This type is used when a slave does not support logical commands.

Generate separate cycle Cmd It is possible to change the type of cyclic commands. If the Generate separate Cyclic Cmd checkbox is not selected, the chosen type commands will be generated for all slaves. Otherwise, the chosen type commands are generated for each slave separately.

Separate I/O update To generate separate I/O updating, select the Separate I/O update checkbox. The Master will send frames to read inputs first.

Afterwards frames for reading outputs will be sent.

Max. cycle command errors to see default data:

The Max cyclic command errors to set default data parameter is a value that sets the maximum number of errors for a cyclic command due to invalid working counter or impossibility to send a cyclic command. If the number of errors reaches the set value, the Master sets a default number of signals for the given command.

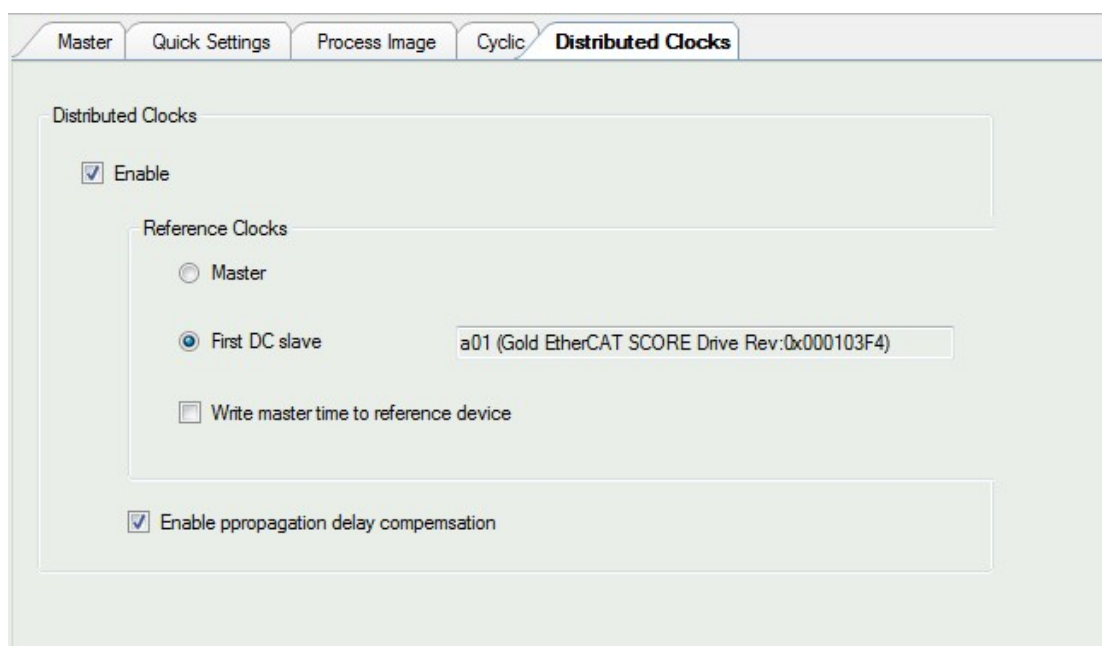
Commands	Command Type:
LRD	logical read
LWR	logical write
LRW	logical read/logical write
FPRD	physical read
FPWR	physical write
Logical address	location of slave's input/output variable in memory
Length (bytes)	command length
Cnt	working counter

1.5.2.5 EtherCAT Distributed Clocks Settings Tab

The Distributed Clocks (DC) EtherCAT feature performs synchronization of the master and all slave devices in the bus.

NOTE: This is set by default, and changing this could result in the system malfunctioning.

In general, when the feature is enabled, the master or a first DC-capable slave in the network is configured to become a reference clock. Then the time of the reference clock is propagated along the network to all slaves connected to the EtherCAT master.



The EtherCAT distributed clocks settings consist of the following:

DC slave as a reference clock

When the first DC slave is used as a reference clock, the EtherCAT Master sends Auto Increment Read , Multiple Write (ARMW) commands in cycles to read the bus time from the appropriate register of the clock master and write this value in the corresponding registers of the rest Distributed Clocks (DC) slaves.

EtherCAT master as a reference clock

In this case, the master sends the Broadcast Write (BRW) command in order to propagate its local time among the corresponding DC slaves. Update of local times in the DC-capable slaves is performed by a controller integrated in their EtherCAT Slave Controller (ESC).

In both cases, it is necessary to compensate delays in transporting the EtherCAT frames emerging between particular slaves, to maintain the

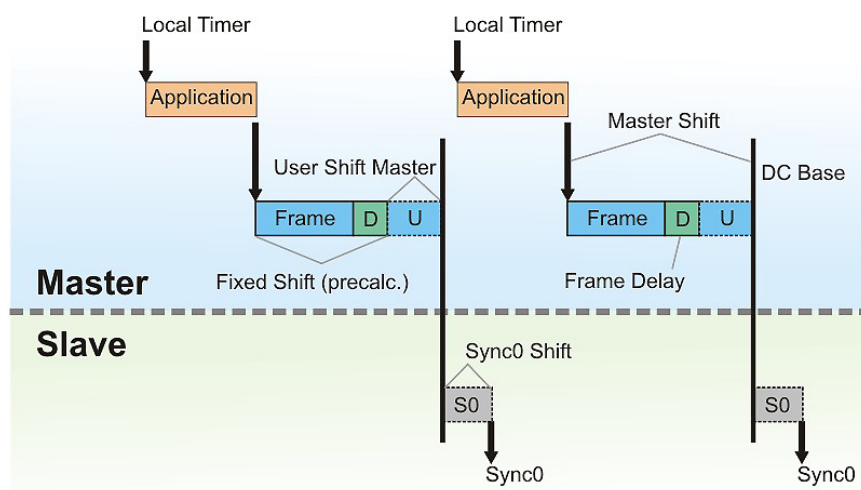
requested accuracy that may range even below 1us for the slaves clocks.

This is provided in the following way: for each slave the time between the frame departure and frame arrival is measured at each connected port. Then the master computes the delays between the slaves and writes the corresponding compensation values into the appropriated register of the ESC.

The ESC controller's DC unit provides two digital output signals, SYNC0 and SYNC1.

Based on the bus time, these SYNC pulses, whose frequency generally corresponds to the EtherCAT bus clock, are generated. For example, if the EtherCAT master sends the cyclical I/O data at a 500 us rate, as a rule the SYNC pulse frequency will be set to 2 kHz. On the one hand, these SYNC signals are available as a digital output signal (e.g. to activate the slave hardware components) on the slave side and, on the other hand, as an interrupt source for the slave software.

As previously explained, it is obvious that all slaves have to be provided with the new data before the SYNC pulse is released, see picture below.



Therefore a minimum time lag between the arrival of new cyclical I/O data and the SYNC pulse must be guaranteed to ensure this data update.

The local application is started with a local timer. The local timer is shifted to the DC base Time by the sum of the following times:

Duration of the application execution time (Application)

Frame transmission time (Frame)

Frame transmission delay (Delay)

User Shift (U) which should include the maximum of the minimum delay times of the slaves and the maximum jitter of the execution of the application:

U+ positive User Shift as shown in Figure User Shift

U- negative User Shift as shown in Figure User Shift

Master Synchronization

The EtherCAT master stack sends its cyclic I/O data in accordance with a local timer in the controller hardware (e.g. Programmable Interval Timer (PIT) or Advanced Programmable Interrupt Controller (APIC) timer). Should the system run in a 2kHz cycle, the local timer and the slave timer responsible to generate the SYNC pulses are set to 2kHz. In fact, the local timer and the slave timers will not run at an exact cycle rate producing a drift among these timers. Consequently, a constant interval between sending the cyclic I/O data in the master and generation of the SYNC pulses in the slaves is impossible. In this case to enable control over the interval with a constant value the EtherCAT master either has to synchronize its local timer with the clock in the first DC-capable slave which is set as a reference clock or synchronize the clocks in all DC-capable slaves with its local timer.

The Master Synchronization is supported by the KPA Master EtherCAT and can be employed in two ways:

1. The local timer (e.g. the PIT or APIC-timer) is re-adjusted from the Master side (The first DC slave is a reference clock)
2. The bus time is re-adjusted in accordance with the Master's local timer (Master is a reference clock).

When the first option is used, the EtherCAT master cyclically calculates the difference between the EtherCAT master time and the DC clock master time. The re-adjustment value is rated with a PI controller algorithm in accordance with the set value (the distance from the SYNC pulse to the timer-interrupt in the master).

For the second option, the Master cyclically propagates the local time by mean of BWR command.

To enable the Master Distributed Clocks, select the Enable check-box.

Reference Clock

The reference clock is the time keeping standard to regulate the accuracy of other clocks.

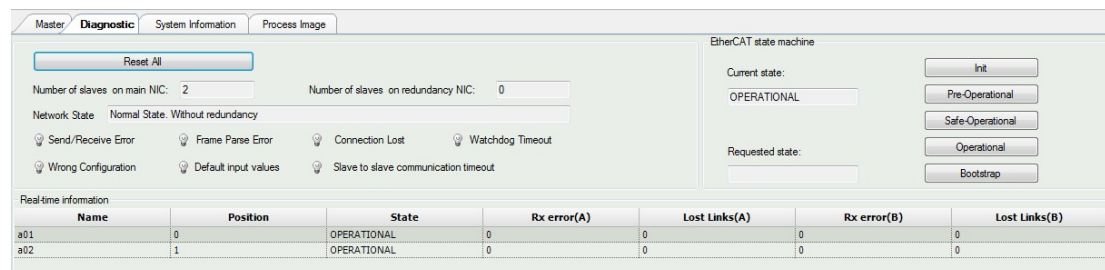
If the Master option is selected, the Master sends its local time to slaves cyclically;

If the First DC slave option is selected, the first DC slave sends its time to other slaves cyclically;

If the Write master time to reference device check-box is ticked, the Master writes its local time to the First DC slave (which is the Reference clock) only during DC initialization.

Tick the Enable propagation delay compensation check-box to compensate delays in frames sending.

1.5.2.6 EtherCAT Diagnostic Settings Tab



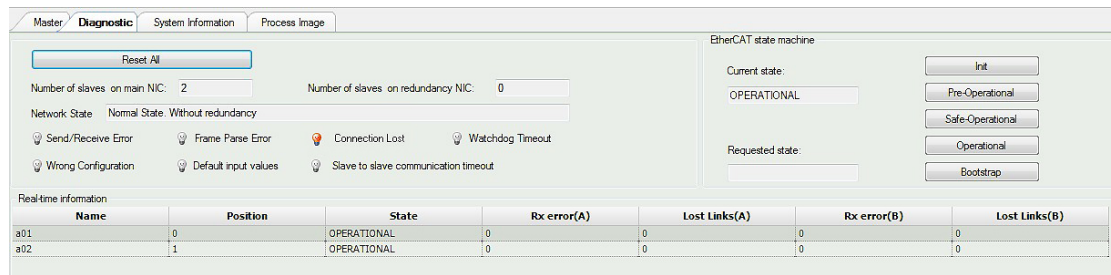
Name	Position	State	Rx error(A)	Lost Links(A)	Rx error(B)	Lost Links(B)
a01	0	OPERATIONAL	0	0	0	0
a02	1	OPERATIONAL	0	0	0	0

The EtherCAT Diagnostic settings consist of the following:

Number of slaves on main NIC	No. of slaves connected to the master via the Network Interface Card (NIC)
Number of slaves on redundancy NIC	Number of slaves, if the Master operates with the redundancy NIC
Network State	Network State, and communication between master and slaves. Default is Normal State. Without redundancy

State	Conditions and explanation
Network state	current network state (with or without redundancy)
Normal state without redundancy	frames are sent from the main NIC. The redundancy NIC is not used
Normal state with redundancy	frames are sent from the main NIC and received by the redundancy NIC
Normal state with redundancy	Frames can't reach the opposite card The cable connecting the redundancy NIC is damaged or unplugged
Safe redundancy state	Broken connection or mixed In-Out ports between slaves. The cable connecting the slaves is damaged, unplugged or the connection ports are mixed: In-In or Out-Out instead of In-Out
Inverse redundancy state	frames are sent from the redundancy NIC and received by the main NIC
Inverse redundancy state	Frames can't reach the opposite card The cable connecting the main NIC is damaged or unplugged

Errors



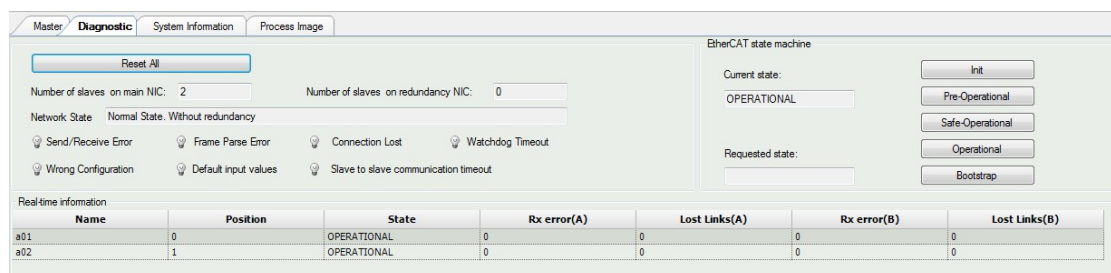
The screenshot shows the 'Diagnostic' tab of the Elmo Application Studio. It includes a 'Reset All' button, fields for 'Number of slaves on main NIC' (2) and 'Number of slaves on redundancy NIC' (0), and a 'Network State' dropdown set to 'Normal State Without redundancy'. Below these are seven error indicators with light bulb icons: 'Send/Receive Error', 'Frame Parse Error', 'Connection Lost', 'Watchdog Timeout', 'Wrong Configuration', 'Default input values', and 'Slave to slave communication timeout'. To the right is the 'EtherCAT state machine' section with 'Current state' (OPERATIONAL) and 'Requested state' (empty), each with a dropdown menu and a set of buttons: 'Init', 'Pre-Operational', 'Safe-Operational', 'Operational', and 'Bootstrap'. At the bottom is a 'Real-time information' table.

Name	Position	State	Rx error(A)	Lost Links(A)	Rx error(B)	Lost Links(B)
a01	0	OPERATIONAL	0	0	0	0
a02	1	OPERATIONAL	0	0	0	0

The following errors are only active when the Master is online. When an error is detected, the relevant error light bulb changes color to orange.

In addition, the Message tab displays the exact error with an Error No. For more details refer to chapter 12 EtherCAT Error Messages on page 423.

Send/receive error	The Master can neither send nor receive a frame to/from a slave
Frame parse error	Error while frame parsing
Connection lost	The connection is lost to the Master/Slave
Wrong configuration	Current network configuration differs from the one downloaded to the Master
Slave to slave communication timeout	For slaves only: The Slave to slave communication has exceeded its time to maintain communication
Default input values	Incorrect Working Counter(WKC), value exceeded limit. Default values were set for inputs
Watchdog timeout	Outputs of the Master Process Image were not set during timeout by the external communication



This is a duplicate of the screenshot above, showing the 'Diagnostic' tab with error indicators, the EtherCAT state machine, and the real-time information table.

Name	Position	State	Rx error(A)	Lost Links(A)	Rx error(B)	Lost Links(B)
a01	0	OPERATIONAL	0	0	0	0
a02	1	OPERATIONAL	0	0	0	0

Real-time information

Name	Name of the slave
Position	Position order relative to the master
State	Present state of the slave
Rx error (A)	Read errors at the Port A

Lost Links (A) Lost links at Port A

Rx error (B) Read errors at the Port B

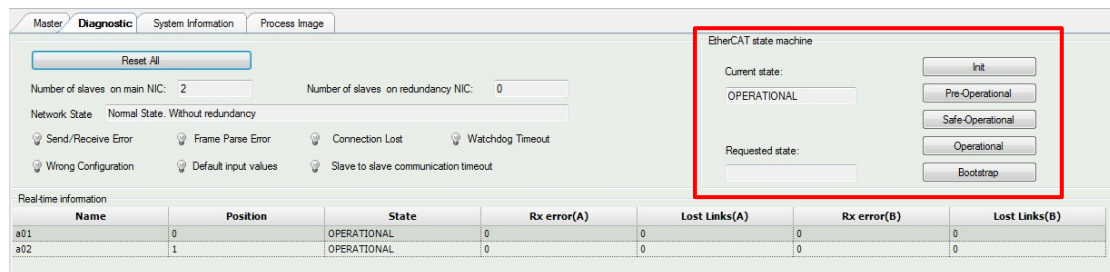
Lost Links (B) Lost links at Port B

Reset All button

All information within the Diagnostic window tab can be updated by pressing the Reset All button.

1.5.2.6.1 EtherCAT State Settings

The following tab parameters are available when the Master is online. This tab allows the user to view and change The Current State (the state of the EtherCAT State Machine (ESM)) to a required state, the Requested State. This in turn, describes the states and state changes of the slave application.



The EtherCAT State settings consist of the following:

Current State The present state of the system.

The state may be changed to only if the system allows the change. The default is INIT.

Requested State The ideal state required by the user.

Click any of the five options at the right hand side:

Init

Defines the root of the communication relationship between the Master and the slave in an application layer. No direct communication between the Master and the slave on the application layer is possible. The Master has access to the DL Information registers.

Pre_Operational

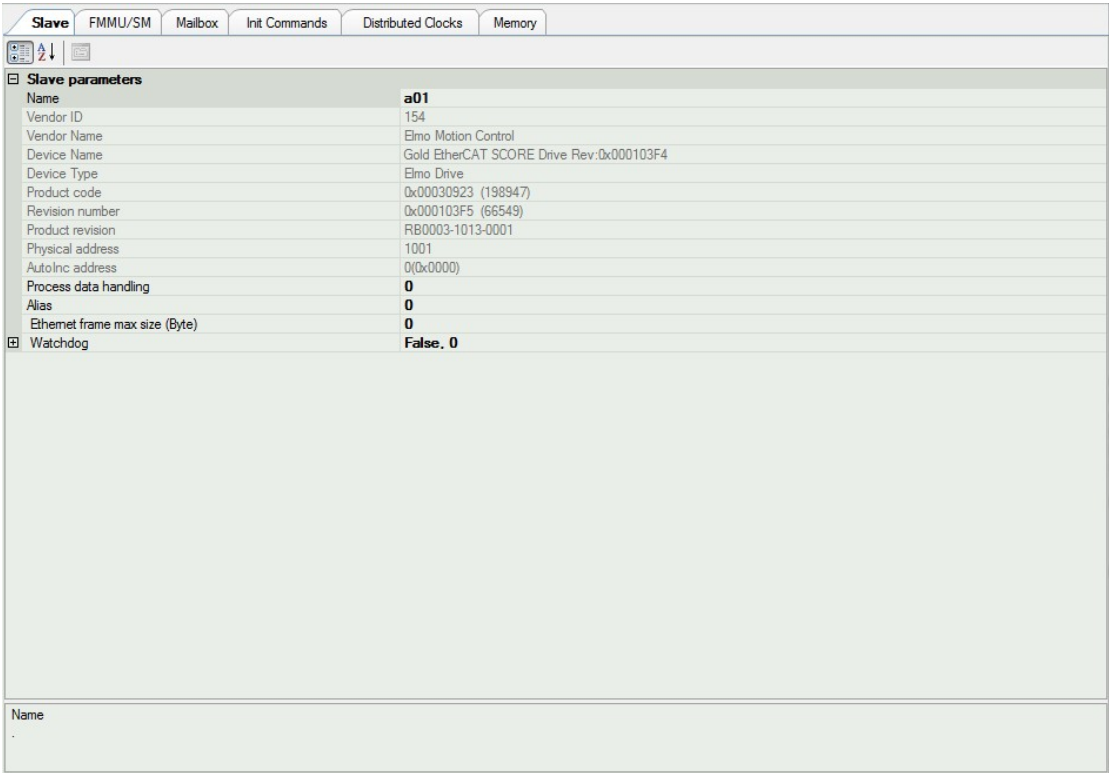
The EtherCAT mailbox is active if the slave supports the optional mailbox. Both the Master and the slave can use the mailbox and the appropriate protocols to exchange application specific initializations and parameters. No process data communication is possible in this state.

Safe-Operational	The application of the slave delivers actual input data without manipulating the output data. The outputs should be set to their "safe" state.
Operational	The application of the slave delivers actual input data and application of the Master should deliver actual output data.
Bootstrap	The application of the slave can accept a new firmware downloaded with the FoE protocol.

1.5.3 EtherCAT Slave Settings Tabs

The following sub-sections describe the Slave tabs per drive available.

1.5.3.1 EtherCAT Slave Settings Tab



Slave parameters	
Name	a01
Vendor ID	154
Vendor Name	Elmo Motion Control
Device Name	Gold EtherCAT SCORE Drive Rev:0x000103F4
Device Type	Elmo Drive
Product code	0x00030923 (198947)
Revision number	0x000103F5 (66549)
Product revision	RB0003-1013-0001
Physical address	1001
AutoInc address	0(0x0000)
Process data handling	0
Alias	0
Ethernet frame max size (Byte)	0
Watchdog	False, 0

The EtherCAT Slave settings consist of the following:

General settings

Name	Displays current slave name. Slave name can be changed
Vendor ID	Slave device vendor ID
Vendor Name	Slave device vendor
Device Name	Name of the device and whether CoE, EoE, or FoE

Device Type	Slave device type
Product code	Slave device product code (example: 72100946)
Revision number	Slave revision number (example: 65536)
Product revision	Slave product revision number (example: EK1100-0000-0001)
Physical address	Slave physical address (example: 1001). Physical address can be changed
AutoInc address	Set auto increment value to slave.

Process data handling

LRW support, slave supports the LRW command (some slaves support only separate LRD and LWR commands)

Generate separate cyclic command

Alias

Alias is a unique slave's identifier, which is written to the slave's memory and used for the Hot Connect function. The setting enables/disables this function for a slave.

Watchdog

The watchdogs are used to observe communication and returns to a safe state in case of an error.

Tick the Enable checkbox in the Slave Settings tab to enable the Watchdog function.

Adjust Watchdogs using the Multiplier, PDI and Synchronization Mode (SM) Watchdog parameters.

The resulting values are displayed in milliseconds.

The ESCs support up to two internal watchdogs:

SYNC Manager watchdog, which is used for monitoring process data accesses

Process Data Interface watchdog, which monitors PDI activity

The timeout for both watchdogs can be configured individually, but they share a single Multiplier. The watchdog timeout is calculated by multiplying the Multiplier setting by the Watchdog Time settings for PDI or SYNC Managers. Basic time unit is 40 ns.

SYNC Manager Watchdog

The SYNC Manager watchdog is triggered by a write access to a SyncManager buffer area if the SyncManager is configured to generate a watchdog trigger signal. The watchdog trigger signal is generated after the buffer has been completely and successfully written (similar to the Interrupt Write of a SyncManager).

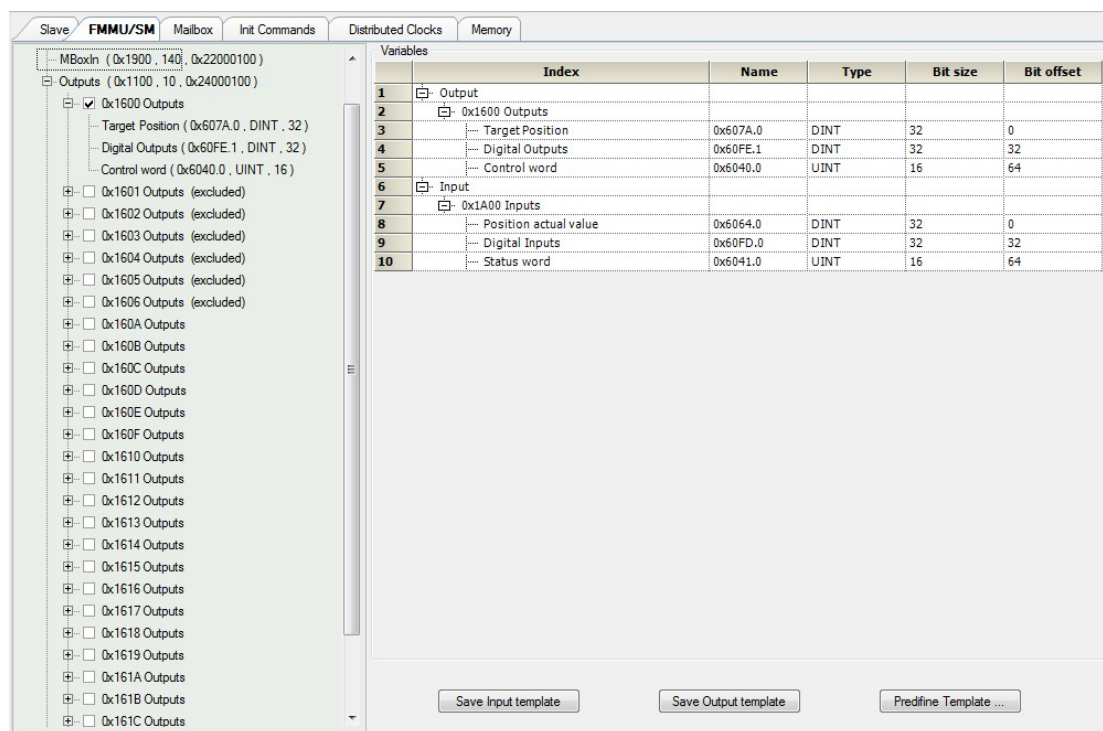
The SYNC Manager watchdog can be disabled by setting the SYNC Manager Watchdog Time to 0.

PDI Watchdog

The PDI watchdog is triggered by any correct read or write access by the PDI. It can be disabled by setting the PDI Watchdog Time to 0.

1.5.3.2 EtherCAT FMMU/SM Settings Tab

The FMMU/SM tab shows the FMMU (Fieldbus Memory Management Unit) and SYNC Manager configurations. It allows the user to configure the slave's process data to be updated through the Master's Process Image, using the PDO assignment/configuration.



Index	Name	Type	Bit size	Bit offset
1	Output			
2	0x1600 Outputs			
3	Target Position	DINT	32	0
4	Digital Outputs	DINT	32	32
5	Control word	UINT	16	64
6	0x1A00 Inputs			
7	Position actual value	DINT	32	0
8	Digital Inputs	DINT	32	32
9	Status word	UINT	16	64
10				

The EtherCAT FMMU/SM settings consist of the following:

FMMU

Fieldbus Memory Management Units (FMMU) handle the local assignment of physical slave memory addresses to logical segment wide addresses. The configuration of the FMMU entities is made available by the Master device and transferred to the slave devices during the start-up phase. For each FMMU entity, the following items are configured: a logical, bit-oriented

start address, a physical memory start address, a bit length, and a type, which specifies the direction of the mapping (input or output).

Any data within the memory of a slave device can thus be mapped bit-wise to any logical address.

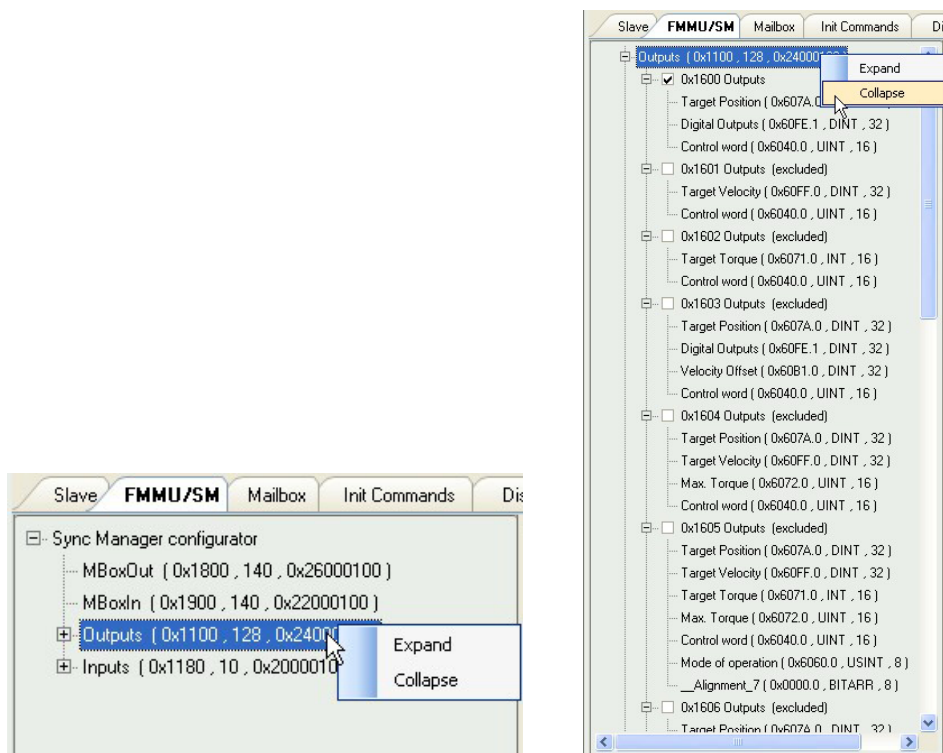
When a telegram with logical addressing is received, the slave device checks whether one of its FMMU entities shows an address match. If appropriate, it inserts data at the associated position of the data field into the telegram (input type) or extracts data from the associated position of the telegram (output type). Telegrams can therefore be assembled flexibly and optimized to the requirements of the control application.

SM

The Sync Manager controls the access to the application memory. Each channel defines a consistent area of the application memory. If a specific Input address is selected by selecting the relevant checkbox, then Input addresses linked to that address are excluded, and cannot be used, as shown in the example above.

The Sync Manager configuration tree consists of:

- | | |
|---------|--|
| MBoxOut | Mailbox output with the start address, length and data |
| MBoxIn | Mailbox input with the start address, length and data |



Outputs

Outputs with the start address, length and data

Inputs

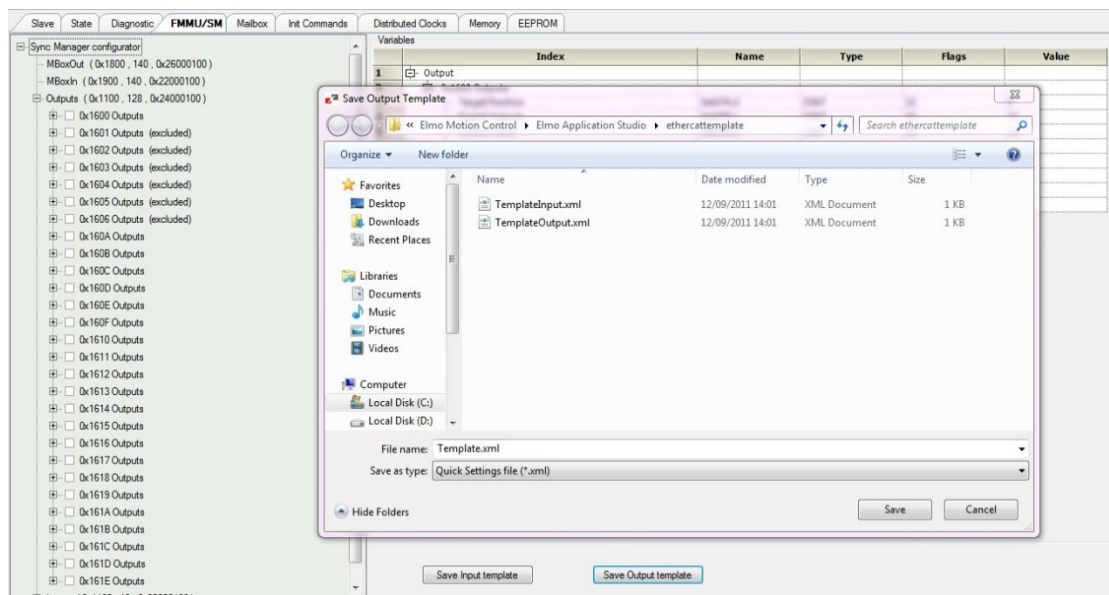
Inputs with the start address, length and data

The variables section defines the detailed objects that can be saved to a template, and downloaded in the Quick Settings tab for each slave.

To Expand the Input/Output details, right-click on the highlighted parameters and select **Expand**.

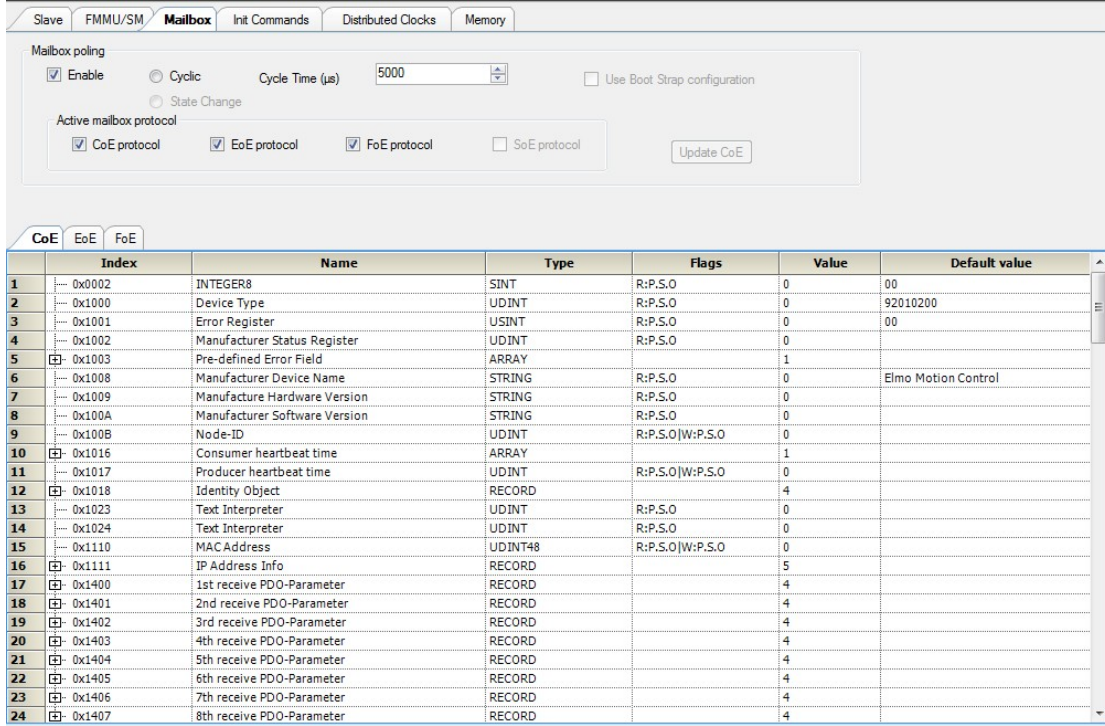
To Collapse the parameters, highlight and select **Collapse**.

To save either an Input or Output template click the appropriate button. The Save Output/Input Template window is displayed. Select a specific name for the slave input/output data and click **Save**. The template is saved in the correct directory to be accessed when using the Master Quick Settings tab



1.5.3.3 EtherCAT Mailbox Settings Tab

The Settings tab (mailbox is not available in all slaves but mandatory for each complex slave device) serves to edit Mailbox settings.



	Index	Name	Type	Flags	Value	Default value
1	0x0002	INTEGER8	SINT	R:P.S.O	0	00
2	0x1000	Device Type	UDINT	R:P.S.O	0	92010200
3	0x1001	Error Register	USINT	R:P.S.O	0	00
4	0x1002	Manufacturer Status Register	UDINT	R:P.S.O	0	
5	0x1003	Pre-defined Error Field	ARRAY		1	
6	0x1008	Manufacturer Device Name	STRING	R:P.S.O	0	Elmo Motion Control
7	0x1009	Manufacture Hardware Version	STRING	R:P.S.O	0	
8	0x100A	Manufacturer Software Version	STRING	R:P.S.O	0	
9	0x100B	Node-ID	UDINT	R:P.S.O W:P.S.O	0	
10	0x1016	Consumer heartbeat time	ARRAY		1	
11	0x1017	Producer heartbeat time	UDINT	R:P.S.O W:P.S.O	0	
12	0x1018	Identity Object	RECORD		4	
13	0x1023	Text Interpreter	UDINT	R:P.S.O	0	
14	0x1024	Text Interpreter	UDINT	R:P.S.O	0	
15	0x1110	MAC Address	UDINT48	R:P.S.O W:P.S.O	0	
16	0x1111	IP Address Info	RECORD		5	
17	0x1400	1st receive PDO-Parameter	RECORD		4	
18	0x1401	2nd receive PDO-Parameter	RECORD		4	
19	0x1402	3rd receive PDO-Parameter	RECORD		4	
20	0x1403	4th receive PDO-Parameter	RECORD		4	
21	0x1404	5th receive PDO-Parameter	RECORD		4	
22	0x1405	6th receive PDO-Parameter	RECORD		4	
23	0x1406	7th receive PDO-Parameter	RECORD		4	
24	0x1407	8th receive PDO-Parameter	RECORD		4	

Active mailbox protocols group-box displays all protocols supported by the slave.

The mailbox works in both directions – from the Master to a slave and vice versa. It supports full duplex, independent communication in both directions and multiple protocols. Slave-to-slave communication is managed by the Master, operating as a router. The mailbox header contains an address field, allows the Master to redirect appropriate messages.

The mailbox uses the two first sync manager channels, one per each direction (sync manager channel 0 from the Master to the slave and sync manager channel 1 from the slave to the Master). The sync manager channels are configured to queued mode to prevent the other side from an overrun. Normally the mailbox communication is non-cyclic and addresses a single slave. Therefore, the physical addressing without the need of an FMMU is used instead of the logical addressing.

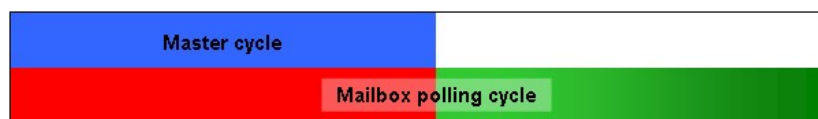
The Mailbox poling window describes the following:

- Enable** Enables/disables mailbox
- Cyclic** Information from mailbox is read cyclically.
- State Change** Information from mailbox is read when it changes.
- Cycle Time (µs)** Allows setting cycle time in µs

The EtherCAT mailbox settings consist of the following tabs:

Mailbox polling cycle

In order to provide optimum CPU load the Mailbox polling cycle should not be shorter than the Master cycle.



Use BootStrap configuration

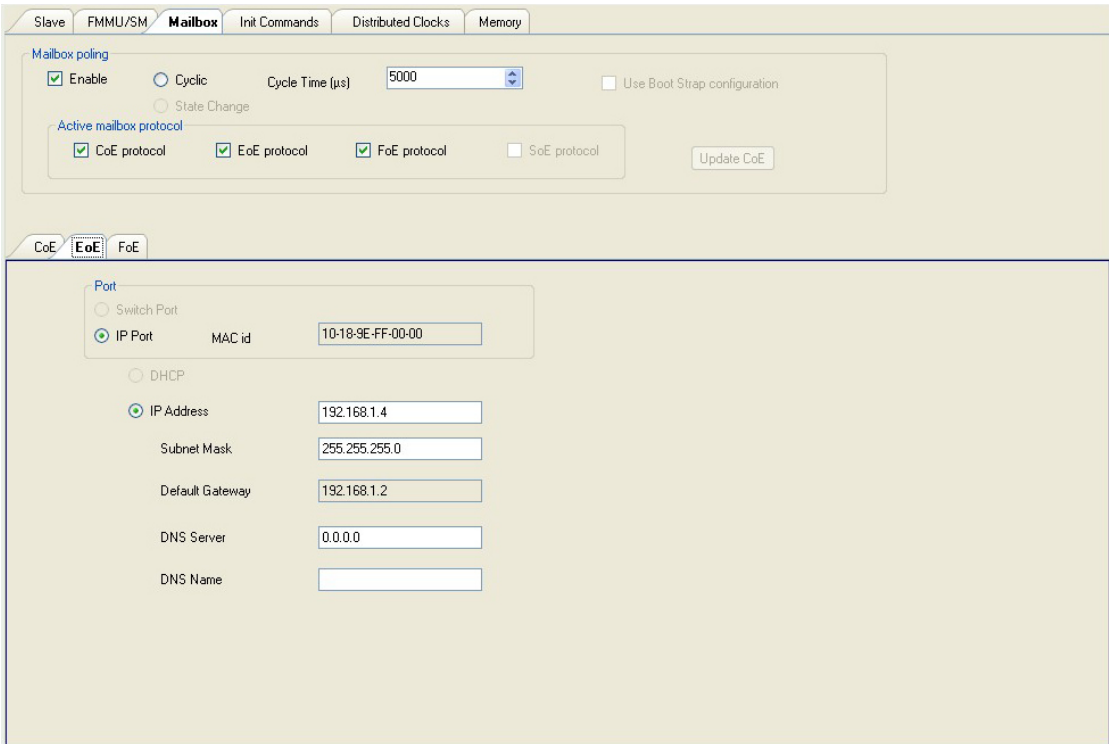
If the Use BootStrap configuration checkbox is selected, the mailbox is configured according to BootStrap settings.

CoE

CoE Tab is used to work with a slave's Object Dictionary (OD). It allows to access the following data-table:

Data table

Index	Number of OD object
Name	Object's name
Type	Object's data type
Flags	Object's access type (e.g., RO, read only, WO, write only)
Value	Actual value of OD object
Default value	Default value of OD object



EoE

The EoE tab is displayed for slaves which support the EoE mailbox protocol.

Switch port Allows connecting a networked PC to a non-networked one. In this case two slaves EL6601 are used

IP Port Allows connecting to a non-networked PC by using the IP configuration:

MAC Id MAC card identification number

DHCP network application protocol used by devices (DCHP clients) to obtain configuration information for operation in an IP network

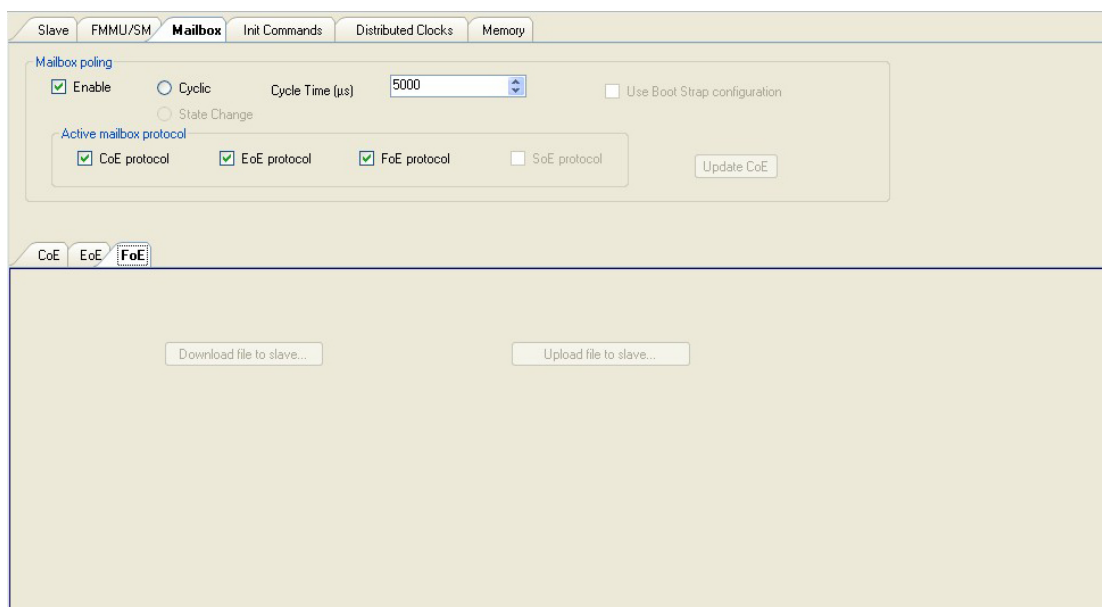
IP Address IP address according to RFC 791 to identify an IP node in the network

Subnet Mask specifies a group of addresses belonging to an IP subnet

Default Gateway consists of an IPD address identifying the next router in the network

DNS Server computer server that implements a name-service protocol

DNS Name domain name of the node



FoE

The FoE tab is used to upload/download files (e.g., firmware) from/to the slave.

This table is only available when the Master/Slaves are online.

1.5.3.4 EtherCAT Init Commands Settings Tab

Init commands initialize and control processes of communication with a slave (according to a specification). Init commands configuration is available in offline mode only. In online mode this tab displays the states for failed commands.

Slave	FMMU/SM	Mailbox	Init Commands	Distributed Clocks	Memory
	Source	Transitions	Destinations	Data	Comments
1	Init Commands				
2	Studio generation	PI,BI,SI,OI,IP,IB	Adp (auto incr.): 0 Ado : 0x120	1100	set device state to INIT
3	Studio generation	SI,OI	Adp (auto incr.): 0 Ado : 0x980	0000	clear dc activation
4	Studio generation	IP,IB	Adp (auto incr.): 0 Ado : 0x130	0000	check device state for INIT
5	Studio generation	IP	Adp (auto incr.): 0 Ado : 0x500	00	assign EEPROM to ECAT
6	Studio generation	IP,IB	Adp (auto incr.): 0 Ado : 0x140	0000	check PDI
7	Studio generation	IP	Adp (auto incr.): 0 Ado : 0x502	000108000000	check vendor id request
8	Studio generation	IP	Adp (auto incr.): 0 Ado : 0x508	00000000	check vendor id
9	Studio generation	IP	Adp (auto incr.): 0 Ado : 0x502	00010A000000	check product code request
10	Studio generation	IP	Adp (auto incr.): 0 Ado : 0x508	00000000	check product code
11	Studio generation	IP,IB	Adp (auto incr.): 0 Ado : 0x010	E903	set physical address
12	Studio generation	SP,OP	Adp : 0x03E9 Ado : 0x120	1200	set device state to PREOP
13	Studio generation	IP	Adp : 0x03E9 Ado : 0x400	C409	set watchdog divider
14	Studio generation	IP	Adp : 0x03E9 Ado : 0x410	0000	set PDI watchdog
15	Studio generation	IP	Adp : 0x03E9 Ado : 0x420	0000	set SM watchdog
16	Studio generation	PS	Adp : 0x03E9 Ado : 0x9A0	40420F0000000000	set dc cycle time
17	Studio generation	PS	Adp : 0x03E9 Ado : 0x990	40420F0000000000	set dc start time
18	Studio generation	PS	Adp : 0x03E9 Ado : 0x980	0003	set dc activation
19	Studio generation	PS	Adp : 0x03E9 Ado : 0x9A9	00	set dc latch1 cfg
20	Studio generation	IP,IB,PI,SI,OI	Adp : 0x03E9 Ado : 0x800	0000000000000000	clear sm 0 (mailbox out)
21	Studio generation	IP	Adp : 0x03E9 Ado : 0x800	00188C0026000100	set sm 0 (mailbox out)
22	Studio generation	IP,IB,PI,SI,OI	Adp : 0x03E9 Ado : 0x808	0000000000000000	clear sm 1 (mailbox in)
23	Studio generation	IP	Adp : 0x03E9 Ado : 0x808	00198C0022000100	set sm 1 (mailbox in)
24	Studio generation	IB	Adp : 0x03E9 Ado : 0x800	00188C0026000100	set sm 0 (bootstrap out)
25	Studio generation	IB	Adp : 0x03E9 Ado : 0x808	00198C0022000100	set sm 1 (bootstrap in)
26	Studio generation	IP,SP,SI,OP,OI	Adp : 0x03E9 Ado : 0x810	0000000000000000	clear sm 2 (output)
27	Studio generation	PS	Adp : 0x03E9 Ado : 0x810	00110A0024000100	set sm 2 (output)
28	Studio generation	IP,SP,SI,OP,OI	Adp : 0x03E9 Ado : 0x818	0000000000000000	clear sm 3 (input)
29	Studio generation	PS	Adp : 0x03E9 Ado : 0x818	80110A0020000100	set sm 3 (input)
30	Studio generation	SI,OI,SP,OP	Adp : 0x03E9 Ado : 0x600	00000000000000000000000000000000	clear fmmu 0 (output)
31	Studio generation	PS	Adp : 0x03E9 Ado : 0x600	002001000A0000070011000020100000	set fmmu 0 (output)
32	Studio generation	SI,OI,SP,OP	Adp : 0x03E9 Ado : 0x610	00000000000000000000000000000000	clear fmmu 1 (input)
33	Studio generation	PS	Adp : 0x03E9 Ado : 0x610	001001000A0000078011000010100000	set fmmu 1 (input)
34	Studio generation	SP,OP	Adp : 0x03E9 Ado : 0x130	0000	check device state for PREOP
35	Studio generation	IP,IB	Adp : 0x03E9 Ado : 0x500	01	assign EEPROM to PDI
36	Studio generation	IP	Adp (auto incr.): 0 Ado : 0x500	00	assign EEPROM back to ECAT

The EtherCAT Init Commands table consist of the following columns:

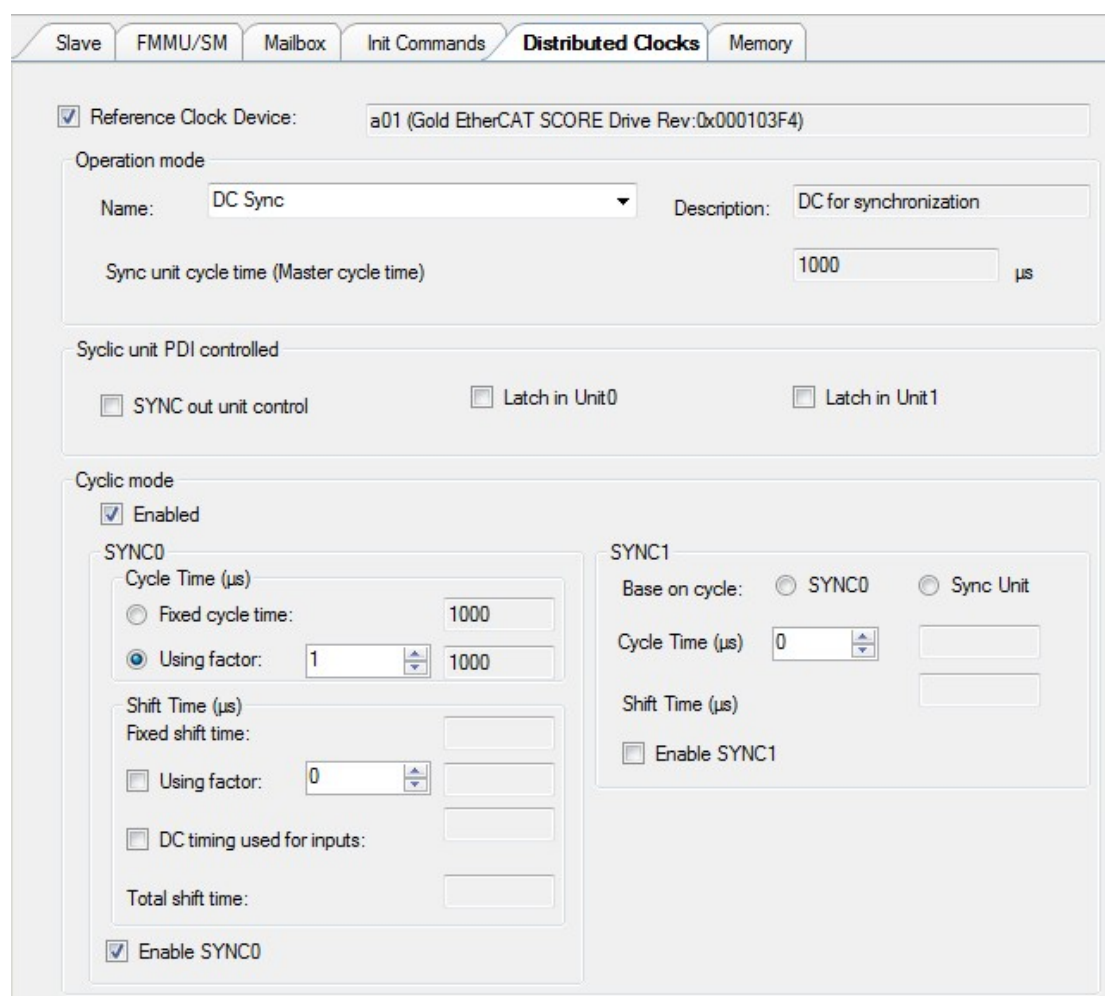
Source	Origin of a command
Transitions	Slave state transitions at which a command is sent
Destination	Item(-s) to be written with a command
Data	A command data
Comments	The purpose of sending a command

1.5.3.5 EtherCAT Distributed Clocks Settings Tab

The Distributed Clocks (DC) EtherCAT feature performs synchronization of the master and all slave devices in the bus.

NOTE: This is set by default, and changing this could result in the system malfunctioning.

The Slave Distributed clocks function can be used only if the Master Distributed clock is enabled. Switching to the slave's Distributed Clock tab displays the following:



The screenshot shows the 'Distributed Clocks' tab in the Elmo Application Studio interface. At the top, there are tabs for 'Slave', 'FMMU/SM', 'Mailbox', 'Init Commands', 'Distributed Clocks', and 'Memory'. The 'Distributed Clocks' tab is active.

Under the 'Distributed Clocks' tab, the 'Reference Clock Device' is checked and set to 'a01 (Gold EtherCAT SCORE Drive Rev:0x000103F4)'. Below this, the 'Operation mode' section shows 'Name' set to 'DC Sync' and 'Description' set to 'DC for synchronization'. The 'Sync unit cycle time (Master cycle time)' is set to '1000' μ s.

The 'Cyclic unit PDI controlled' section has three checkboxes: 'SYNC out unit control' (unchecked), 'Latch in Unit0' (unchecked), and 'Latch in Unit1' (unchecked).

The 'Cyclic mode' section has an 'Enabled' checkbox checked. Below it, the 'SYNC0' section has 'Cycle Time (μ s)' set to '1000' (Fixed cycle time) and 'Using factor' set to '1' (Using factor). The 'Shift Time (μ s)' section has 'Fixed shift time' set to '0' (Using factor) and 'DC timing used for inputs' (unchecked). The 'Total shift time' is set to '0'. The 'Enable SYNC0' checkbox is checked.

The 'SYNC1' section has 'Base on cycle' set to 'SYNC0' (radio button selected) and 'Sync Unit' (radio button unselected). The 'Cycle Time (μ s)' is set to '0' and 'Shift Time (μ s)' is set to '0'. The 'Enable SYNC1' checkbox is unchecked.

Distributed Clock settings are initially read from an ESI file, which once defined, can be later edited. A slave can have a considerable number of Operation modes, and therefore a complete list of these modes is read from the file and the first Operation mode of the list is loaded. All data presented in Cyclic unit PDI controlled and Cyclic mode group-boxes is relevant to the chosen Operation mode.

At the top of the panel, there is a **Reference Clock Device** check-box which allows setting of the main clock device to synchronize all other slave clocks. The reference clock device is always the first one in the range of devices that support the reference clock device function. It works cyclically and therefore **Cyclic Mode** is used for its adjustment.

The slave's Distributed Clock tab consists of three main group-boxes:

Operation mode

Allows to select an Operational mode from the list of modes supported by the slave.

Name	Vendor specific name of selected Operation mode
SYNC unit cycle time	Vendor specific description of Operation mode
Description	Cycle time during which the process data of the device is updated (equals EtherCAT cycle time).

Cyclic Unit PDI controlled

Allows to determine (set) whether Cyclic Units are PDI- or EtherCAT-controlled.

The DC Latch Unit enables time stamping of LatchSignal events for two external signals, Latch0 and Latch1. Both rising edge and falling edge time stamps are recorded.

The two LatchSignal units of the Distributed Clocks entity are controlled by a local μ Controller (PDI). With PDI control, a μ Controller can set up cyclic interrupts for itself.

The preferences can be set by ticking the corresponding check-boxes:

SYNC out unit control	If checked, the SYNC out unit control is PDI-controlled
Latch In Unit0	If checked, Latch In Unit0 is PDI-controlled
Latch In Unit1	If checked, Latch In Unit1 is PDI-controlled

Cyclic mode

Allows to determine (set) Sync Unit settings. The slave's application is synchronized to the SYNC0 or SYNC1 Event. It is also possible to enable these synchronizing signals by ticking the corresponding check-boxes. The SYNC0 signal is always the first one. The value of the SYNC1 signal is always greater than the SYNC0 value.

SYNC0	This group-box allows to determine (set) SYNC0 signal settings
Cycle time (μs)	Allows to determine (set) cycle time of SYNC0 signal. It can be set either by input of a fixed cycle time or by using a factor, based on sync unit cycle time

Shift time (μs) Shift (offset) of start time of SYNC0 relating to global DC reference. This is determined by adding the following values, if available:
Fixed shift time – a fixed value of the shift time
Using factor – a value that depends on the SYNC0 cycle time
DC timing used for Inputs – shift specified for inputs. It is used when input latch event shall be shortly before the frame collects input data
Total shift time – an accumulative value of shift time

SYNC1 This group-box allows to determine the cycle time of SYNC1 signal. Cycle time of SYNC1 signal shall be an integer multiple of Cycle time of SYNC0 signal.

Based on cycle Cycle time of SYNC1 can be set based on either cycle time of SYNC0 signal or sync unit cycle time.

Cycle time (μs) Cycle time of SYNC1 signal.

Shift time (μs) Shift (offset) of start time of SYNC1 signal relating to the start time of SYNC0 signal.

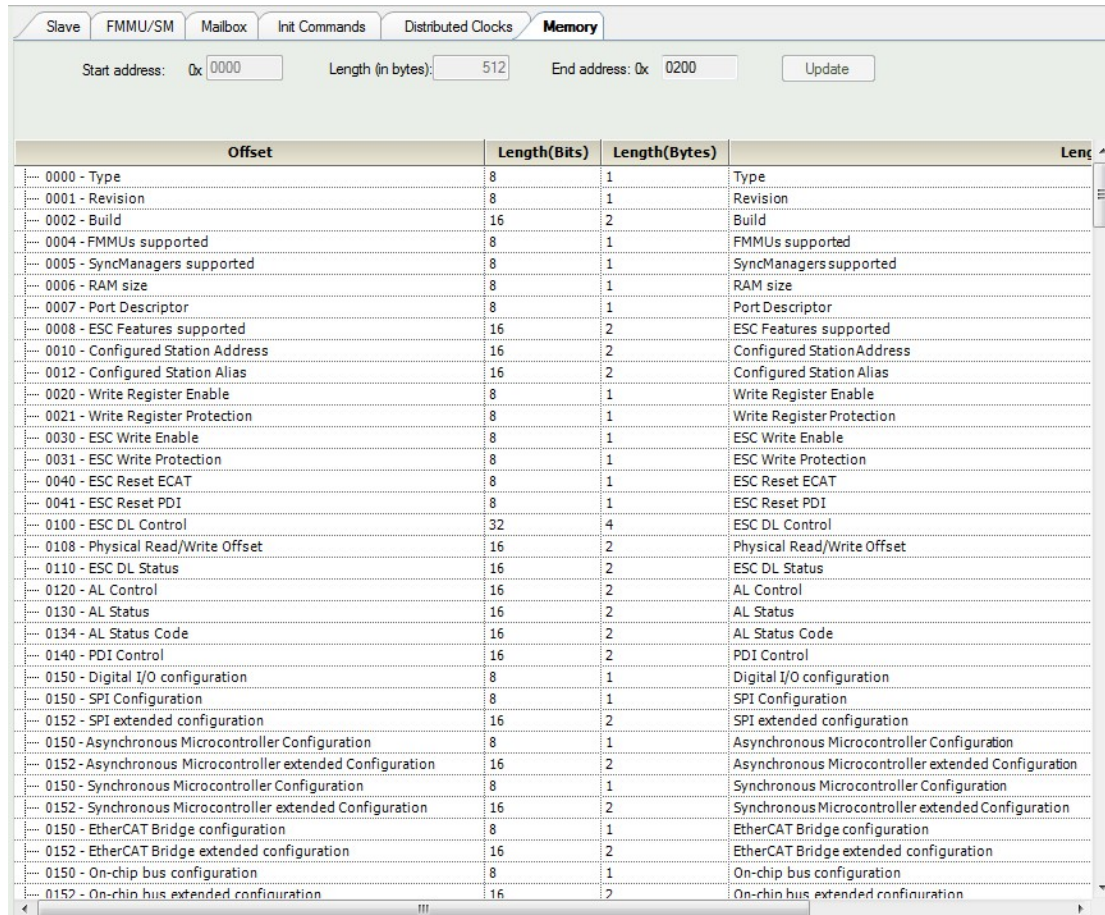
Note: If the checkbox Enable (Cyclic mode) is ticked, Sync Out Unit is activated.

If the checkbox Enable SYNC0 is ticked, SYNC0 pulse is generated.

If the checkbox Enable SYNC1 is ticked, SYNC1 pulse is generated.

1.5.3.6 EtherCAT Memory Settings Tab

In offline mode this tab serves to map the memory registers to the Process Image. In online mode, it reads the slave's memory registers.



Offset	Length(Bits)	Length(Bytes)	Description
0000 - Type	8	1	Type
0001 - Revision	8	1	Revision
0002 - Build	16	2	Build
0004 - FMMUs supported	8	1	FMMUs supported
0005 - SyncManagers supported	8	1	SyncManagers supported
0006 - RAM size	8	1	RAM size
0007 - Port Descriptor	8	1	Port Descriptor
0008 - ESC Features supported	16	2	ESC Features supported
0010 - Configured Station Address	16	2	Configured Station Address
0012 - Configured Station Alias	16	2	Configured Station Alias
0020 - Write Register Enable	8	1	Write Register Enable
0021 - Write Register Protection	8	1	Write Register Protection
0030 - ESC Write Enable	8	1	ESC Write Enable
0031 - ESC Write Protection	8	1	ESC Write Protection
0040 - ESC Reset ECAT	8	1	ESC Reset ECAT
0041 - ESC Reset PDI	8	1	ESC Reset PDI
0100 - ESC DL Control	32	4	ESC DL Control
0108 - Physical Read/Write Offset	16	2	Physical Read/Write Offset
0110 - ESC DL Status	16	2	ESC DL Status
0120 - AL Control	16	2	AL Control
0130 - AL Status	16	2	AL Status
0134 - AL Status Code	16	2	AL Status Code
0140 - PDI Control	16	2	PDI Control
0150 - Digital I/O configuration	8	1	Digital I/O configuration
0150 - SPI Configuration	8	1	SPI Configuration
0152 - SPI extended configuration	16	2	SPI extended configuration
0150 - Asynchronous Microcontroller Configuration	8	1	Asynchronous Microcontroller Configuration
0152 - Asynchronous Microcontroller extended Configuration	16	2	Asynchronous Microcontroller extended Configuration
0150 - Synchronous Microcontroller Configuration	8	1	Synchronous Microcontroller Configuration
0152 - Synchronous Microcontroller extended Configuration	16	2	Synchronous Microcontroller extended Configuration
0150 - EtherCAT Bridge configuration	8	1	EtherCAT Bridge configuration
0152 - EtherCAT Bridge extended configuration	16	2	EtherCAT Bridge extended configuration
0150 - On-chip bus configuration	8	1	On-chip bus configuration
0152 - On-chip bus extended configuration	16	2	On-chip bus extended configuration

The EtherCAT memory settings consist of the following:

Start address

Beginning of the memory address, an offset of a register where the reading of the slave's memory begins

Length (in bytes)

Memory allocated. The size of a memory block read from the slave.

End address

End of the memory address

Update

Button to update the Start, End address and Length of the memory

Registers table data fields

Offset Register's offset in slave's memory



Value	Register's memory value in Decimal
	Register's memory value in Hexadecimal
Length	Register's length in slave's memory
Description	Description of the register.

Example:

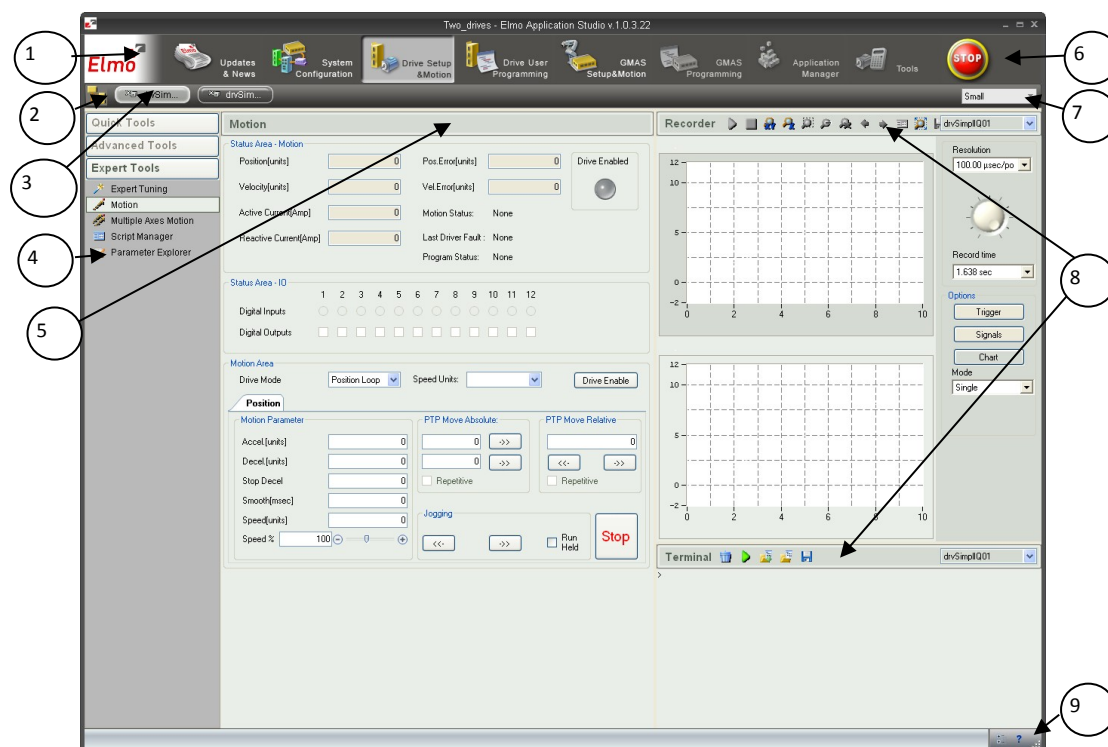
If Start offset is set at 10 and Length is set at 20, it means that the size of register block to be read from the slave's memory is 20 bytes and the reading begins from the register with an offset of 0x0010.

2 EAS Basics

This chapter describes the options available in the EAS Window.

2.1 The EAS Window Display

An EAS window displays the following (Drive Setup & Motion shown):



The main parts of the display are:

1 Activity Selector Bar

From the activity selector you can access any activity tool suite:

- Updates and News
- System Configuration
- Drive Setup and Motion
- Drive User Programming
- GMAS Setup and Motion
- GMAS Programming
- Application Manager
- Tools

2 System Tree Button

Click this button to view the system tree and perform basic operations such as connecting and disconnecting drives.

- 3 System Drives**

All the drives that are designated as active in the system configuration appear on this bar. Click a drive button to cause the main tool to refer to this drive. The main tool drive button changes color to light grey. It is possible to select more than one drive at a time using the Ctrl button. This is useful for some main tools that interact with multiple drives. If more than one drive is selected and a single axis tool is used the leftmost drive is the main tool drive.

When a drive is connected, a red dot appears in its button


- 4 Tool Selector**

Displays the various tools available within the selected activity. Click on the name of a main tool to use it.
- 5 Main Tool**

The main tool is displayed in the upper left corner of the tools area. Note that the main tool has no target selector in the tool bar since it operates on the selected drive.

EAS Toolbar - The EAS toolbar in this display has two buttons on the left:



The buttons are:

 - Save Workspace
 - Open Workspace
- 6 Emergency Stop Button**

Click this button to kill motion on all drives
- 7 Layout Selector**

Each main tool is accompanied by supporting tools. Several layout options are available for each main tool. Use the layout selector to use the layout you prefer.
- 8 Supporting Tools**

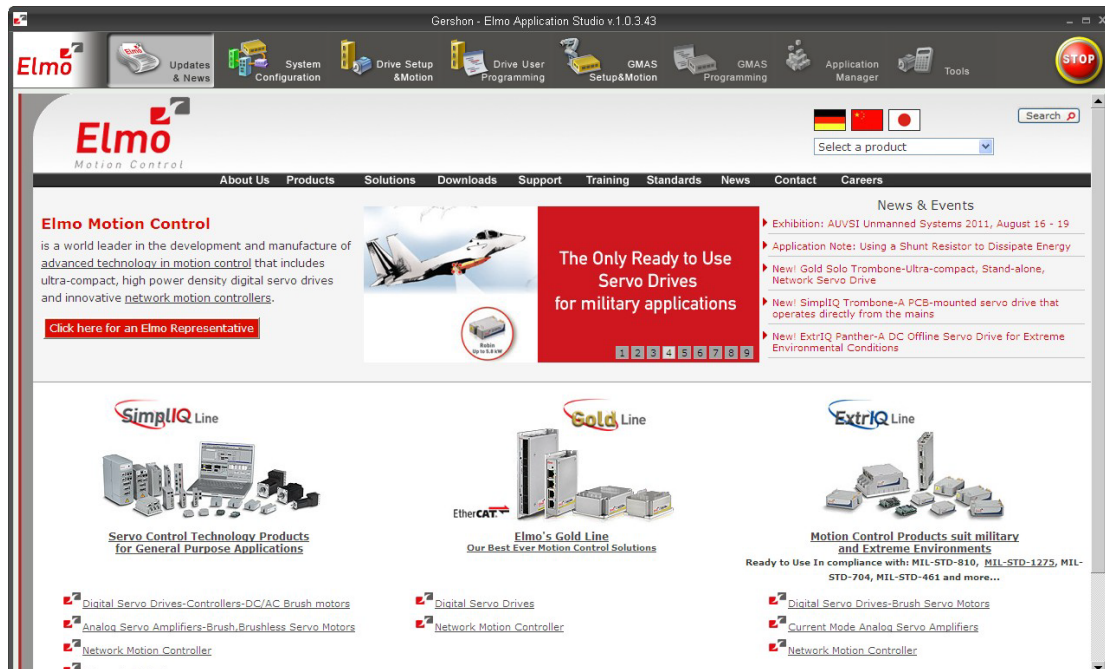
The supporting tools appear next to the main tool to help the user with the task. Each supporting tool has a target selector so you can monitor the effect of the activity performed by the main tool on other drives in the system.
- 9 Settings and About Buttons**

To change the EAS properties. Refer to the section

2.2 Updates & News Activity

To access the Elmo's Updates and News window:

1. From the main window, click the  icon. The Elmo Motion Control main webpage opens.



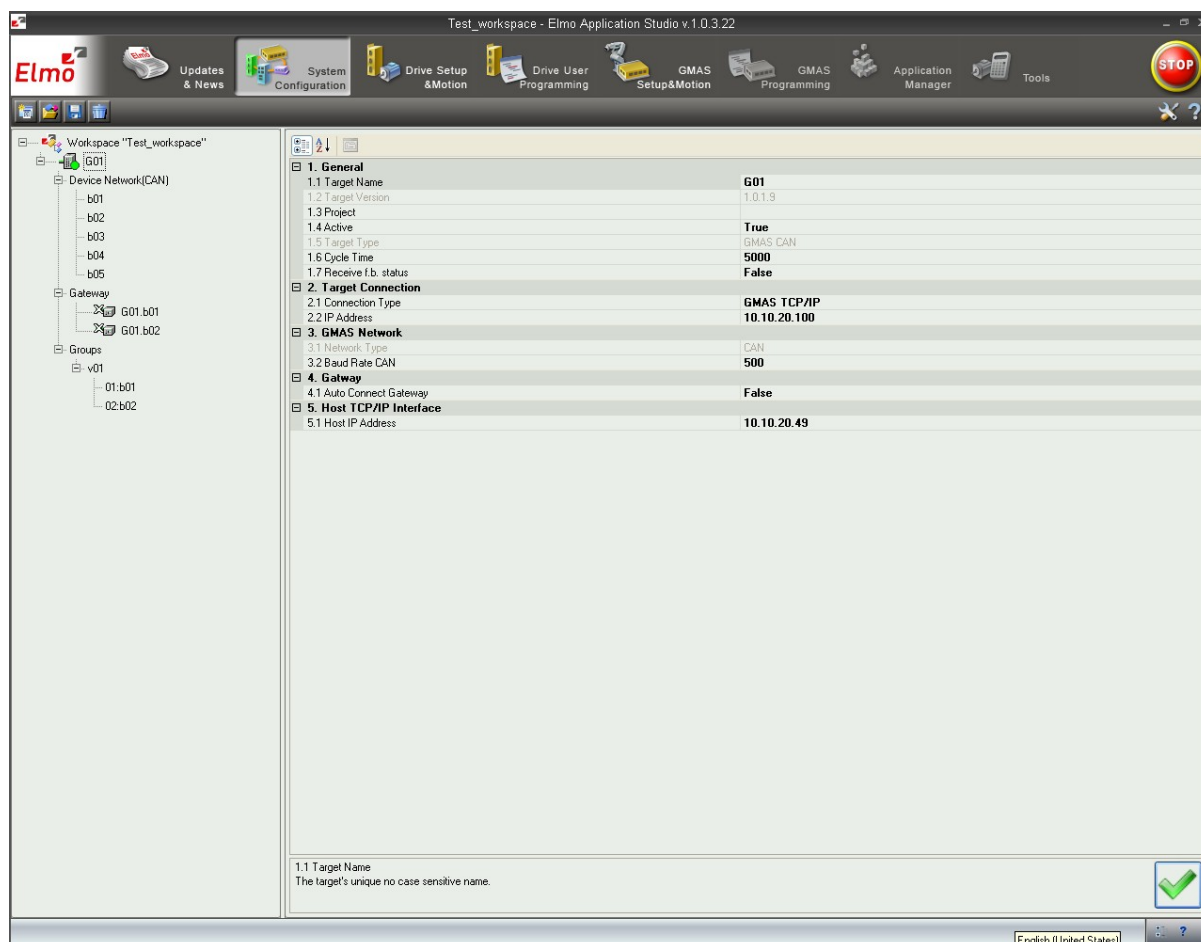
Note: While surfing the Elmo web site, you are still within the EAS application.

Access any section of the web site.

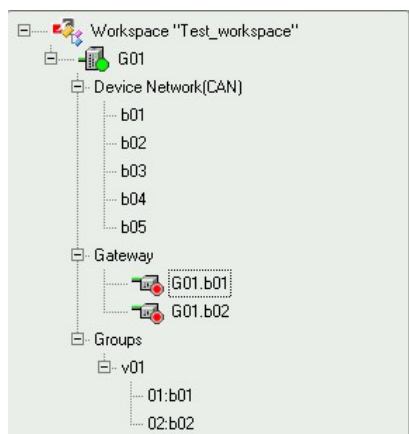
2. To exit the web site and return to the operation of the application, click any other main icon at the top of the EAS main window.

3 System Configuration

The System Configuration window is the initial window displayed when the EAS is first opened. To open the System Configuration window any other time, click the **System Configuration** icon in the Activities Selector.



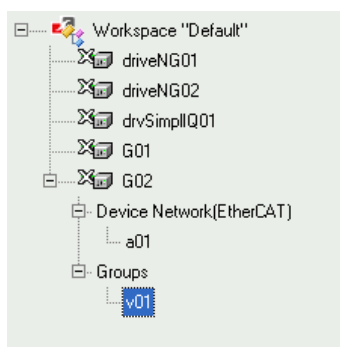
3.1 The Workspace Explorer



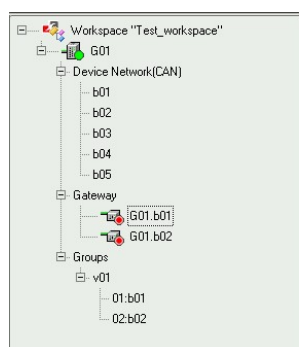
The Workspace Explorer displays the system components as a tree.

When only drives are connected to the PC directly, this tree has only one level of branches under the Workspace name.

If a multi-axis controller – Gold Maestro – is added, the tree has further levels:



The Gold Maestro is displayed as a hierarchy, depicting the network connected to it.

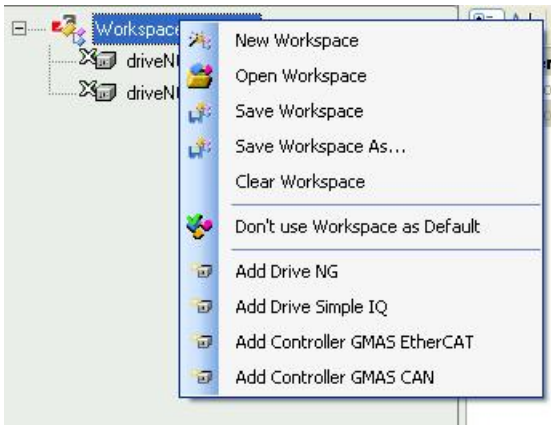


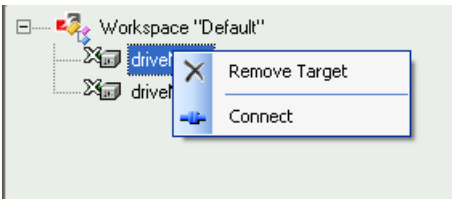
1. General	
1.1 Target Name	G01.b01
1.2 Target Version	Bassoon 2.02.07.00 10May2006
1.3 Project	
1.4 Active	True
1.5 Target Type	SimplIQ Drive GMAS Gateway
1.6 Target Serial Number	150115
2. Connection	
2.1 Connection Type	GMAS TCP/CAN Gateway

The devices connected to the Gold Maestro's device network (either Can or EtherCAT) are grouped together. Each defined device group is also displayed.

3.1.1 Workspace Explorer Actions

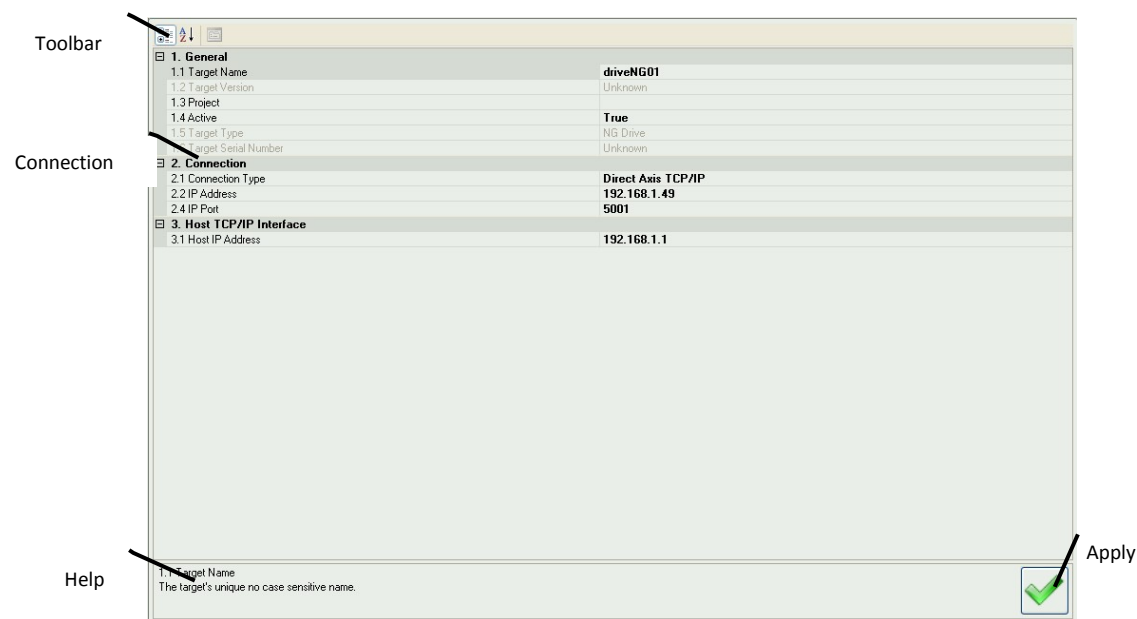
The following operations can be performed from the Workspace Explorer:

Action	Result
Clicking the mouse on the Workspace name	Displays the name and path of the workspace. These attributes are fixed and cannot be edited.
Clicking mouse on a drive name	Opens that drive's details for viewing or editing.
Right clicking on the workspace name	Opens a menu: 
Selecting menu items in the top group – Workspace Management	New Workspace – Create a new Workspace Open Workspace – Browse to close the current Workspace and open another saved workspace Save Workspace – Save all changes to the current Workspace Save Workspace As - Save another copy of the current Workspace with a different name, closes the current Workspace and opens the newly saved Workspace Clear Workspace – All the information related to the current Workspace is cleared, except for its name and location. Don't use Workspace as Default – If this Workspace was the Default Workspace (opens automatically each time EAS is opened), clicking this option will cause EAS not to use it as default any longer.
Selecting the menu items in the lower group – Add Components to System	Select any of the options to add the component described to the system tree.

Action	Result
Right click on any target name	Opens a menu:  Remove Target – Removes the selected target from the system. Connect – Establish communication with the selected drive using the set communication parameters (not available Offline). The other menu items are the same as above.

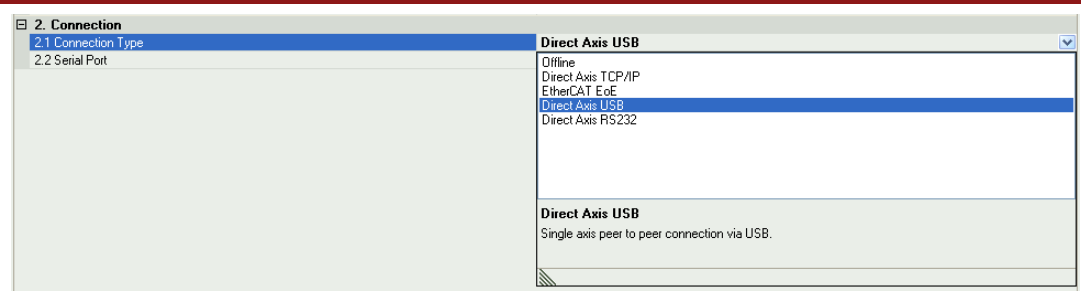
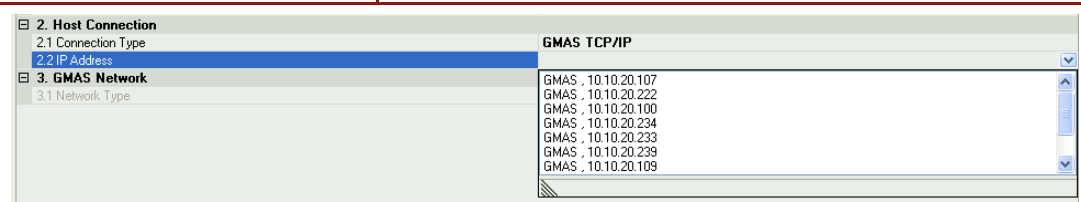
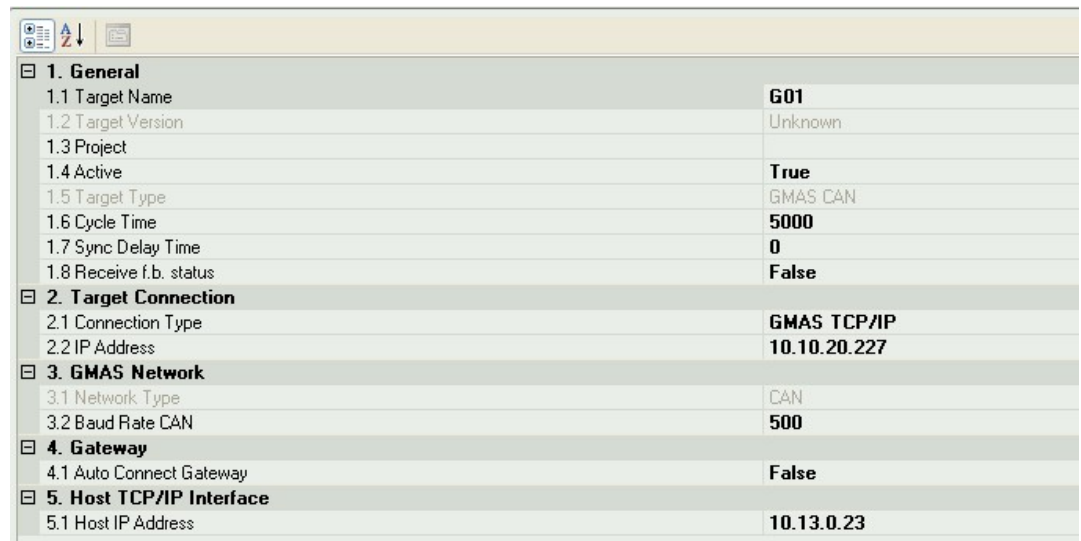
3.2 Target Details Window

The main window in the System Configuration is the Target Details window.



The following options are available:

Toolbar Buttons	Option Details
Show Categorized	Displays the details list by categories
Show Alphabetically	Arranges the details Alphabetically
Property Pages	Allows viewing and editing the target's parameters
NG Target Parameters	Option Details
Target Name	Double click the name to change it
Target Type	Displays the type of the drive
Project	Enter the path for a user program project
Active	Select true or false. True will display the drive on the toolbar as one of the connected drives
Connection	Select how the drive is connected to the PC. Use the Offline option to explore EAS or edit offline files without connecting a drive.

Toolbar Buttons	Option Details
	
	If Direct Axis USB is selected, a Serial Port line appears. If Direct Axis RS232 is selected, both Serial Port and Baud Rate need to be determined. If you select TCP/IP, you receive a list of all the GMAS or Gold line units that are currently available to you on your network. Select the one you are working with:
	
SimplIQ Target Parameters	Option Details
Target Name	Double click the name to change it
Target Version	Displays the target's firmware version
Project	Enter the path for a user program project
Active	Select true or false. True will display the drive on the toolbar as one of the connected drives
Connection	Either Offline or RS232
GMAS Target Parameters	Option Details
	

Toolbar Buttons	Option Details
General	
Target Name	Double click the name to change it
Target Version	Displays the target's firmware version
Project	Enter the path for a user program project
Active	Select true or false. True will display the drive on the toolbar as one of the connected drives
Target Type	Version of the target
Cycle Time	In EtherCAT communication, the cycle time defines the Minimal Distributed Clock Cycle Time of the system. Its value is currently defined as 1 msec (1000 μs). The master EtherCAT in the GMAS is responsible for updating the SYNC cycle time in the servo drives, and therefore knows when the SYNC is generated. In CAN Bus communication, it defines the Sync Time of the CAN network. Its value is currently defined as 3 msec.
Receive f.b. status	Receive the status of an individual function block for C, and C++ programs only. This definition can be changed via the function MMC_SetEnquireFBStatus.
Target Connection	
Connection Type	Either Offline , TCP/IP or USB
IP Address	If TCP/IP then then details of the IP address are listed
GMAS Network	
Network Type	The type of network connection, either CAN or EtherCAT
Baud Rate CAN	If CAN Network then the Baud Rate is listed
Gateway	
Auto Connect Gateway	Whether a connection via a gateway should be initiated at startup of EAS. The default is False.
Host TCP/IP Interface	
Host IP Address	The host IP address of the system connected to the G-MAS and/or servo drive(s). This will depend on the connection and network hardware within the host system.

To apply any of the options

1. Click the Apply button to save the target properties. The properties are saved in the Workspace file: workspace_name.ElmoWS.

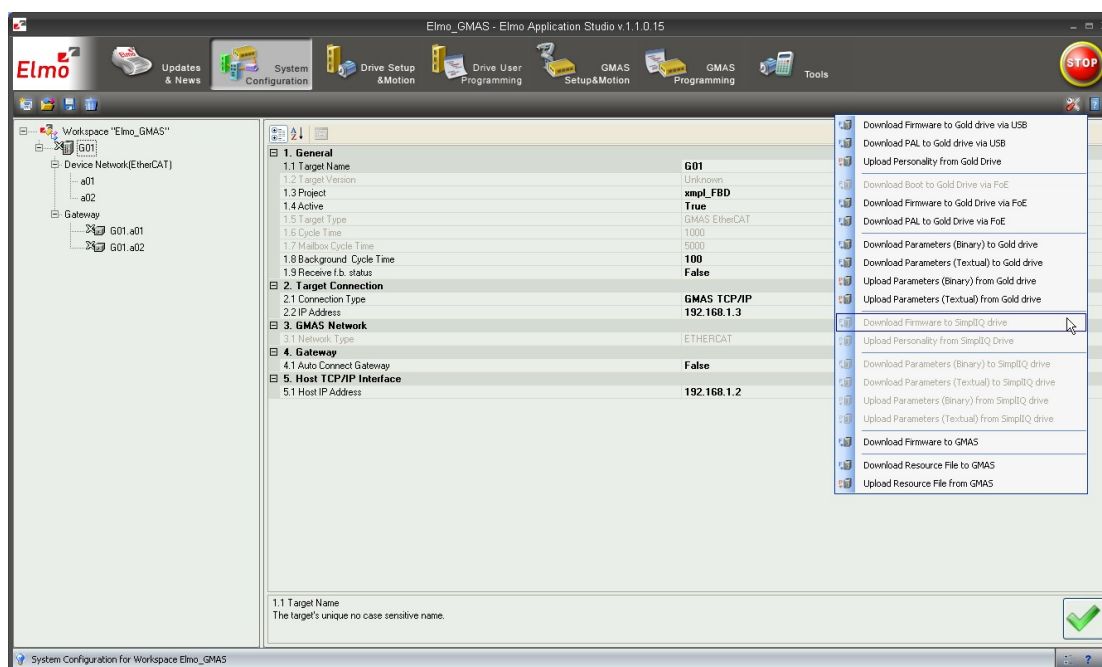
3.3 G-MAS and Drive Administration

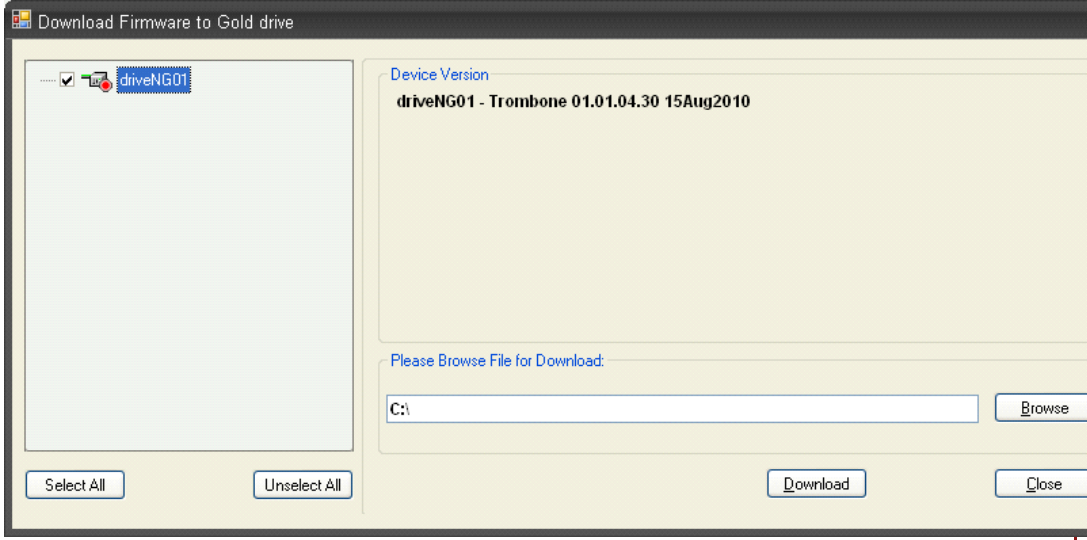
This section describes the administration of the Motion Controllers and Drives, and includes the following:

- Download and Upload of parameters to the drives
- Download of firmware to the drives
- Upload Personality from the Drives
- Download firmware to the G-MAS
- Upload Resources from the G-MAS

3.3.1 The System Tools Button

The **System Tools Button**  is part of the system configuration activity. It allows you to upload or download drive, controller and system files. Click the **System Tools** button to invoke the following menu:



System Tool	Details
Download Firmware to Gold Drive	Download new firmware to an Elmo Gold Line drive. Click to open the following dialog:
	
	Browse to the location of the new drive version and click Download to start downloading firmware. If you have more than one drive connected, you can download firmware to all or some of the drives by selecting them from the list in the left window.



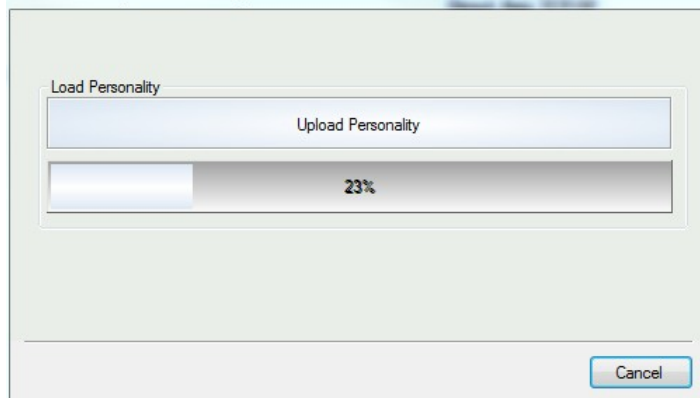
System Tool

Details

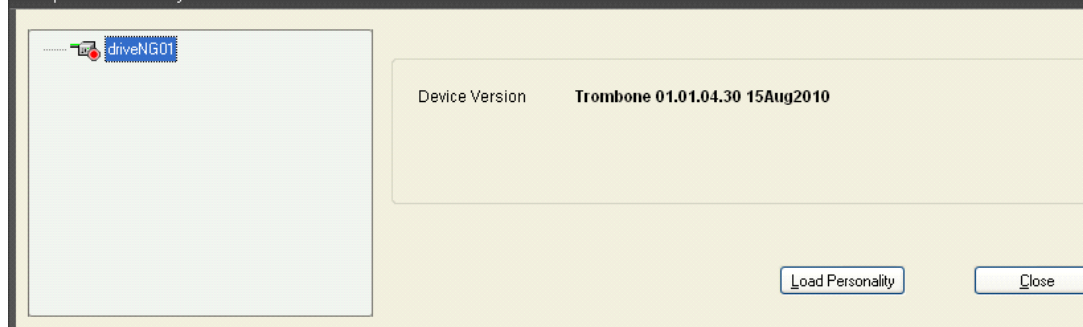
Upload Personality from Gold Drive

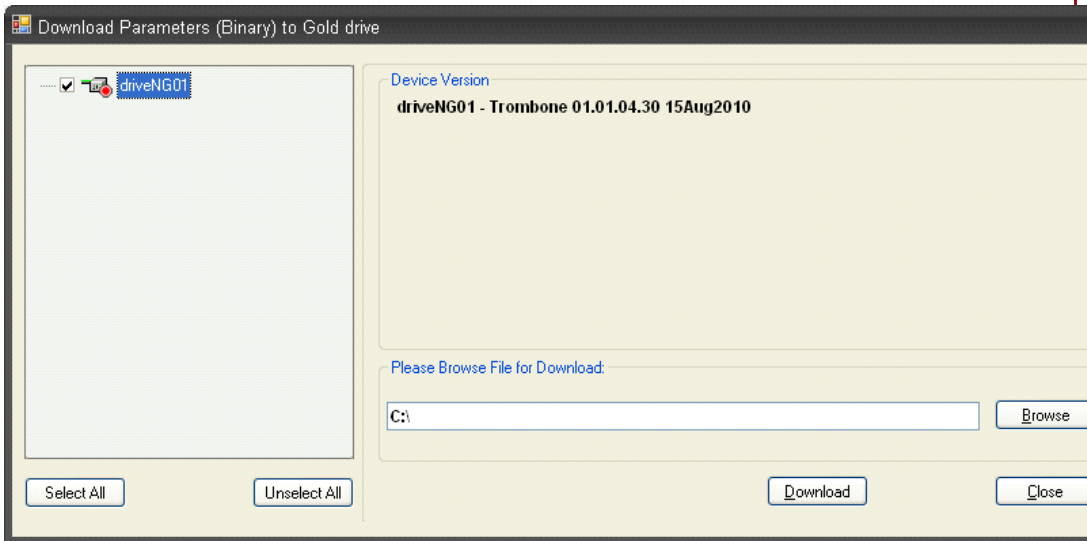
The drive's personality (characteristics) includes information about the drive model. It includes a list of all the commands and parameters supported by this specific drive, arranged in groups and including a brief description of each. This file is used by EAS to determine various behaviors and to display parameters. When you click this button, the upload process begins. To see the result, go to the **Parameter Explorer**. During normal operation, EAS will upload the drive's personality automatically when necessary. Use this button only if you have reason to believe that something went wrong with the usual process.

driveNG01 - Upload Personality



Upload Personality from Gold Drive



System Tool	Details
Download Parameters (Binary) to Gold Drive	Download a parameter file to an Elmo Gold Line (NG) drive. A binary parameter file contains an image of the flash memory area containing the parameters. Such a file may be obtained by uploading a parameter file from the drive. A binary parameters file has the extension “.gimg”. Do not use this option if you updated the drive firmware version after uploading a binary file. It may have unexpected results. To save the downloaded file to the flash memory, use the terminal to send an “SV” command to the drive
	
Download Parameters Gold Drive	Download a parameter file to an Elmo Gold Line (NG) drive. A parameter file is a readable file containing all the drive’s parameters in the drive’s language. Such a file may be obtained by uploading a parameter file from the drive. A parameters file has the extension “.txt”. To save the downloaded file to the flash memory, use the terminal to send an SV command to the drive
Download FlashImage Gold Drive	A Flash Image is a binary file that holds an image of the contents of the flash that is in the drive. It is not a readable file and may be obtained by uploading a flash image from the drive. A flash image file has the extension “.img” Downloading a file that is not compatible (absolutely) with the drive may result in unexpected behavior. A file may not be compatible with a different drive version. Using Flash Image files is faster than using parameter files. It is recommended only for copying drive setup from one drive to a large number of drives.



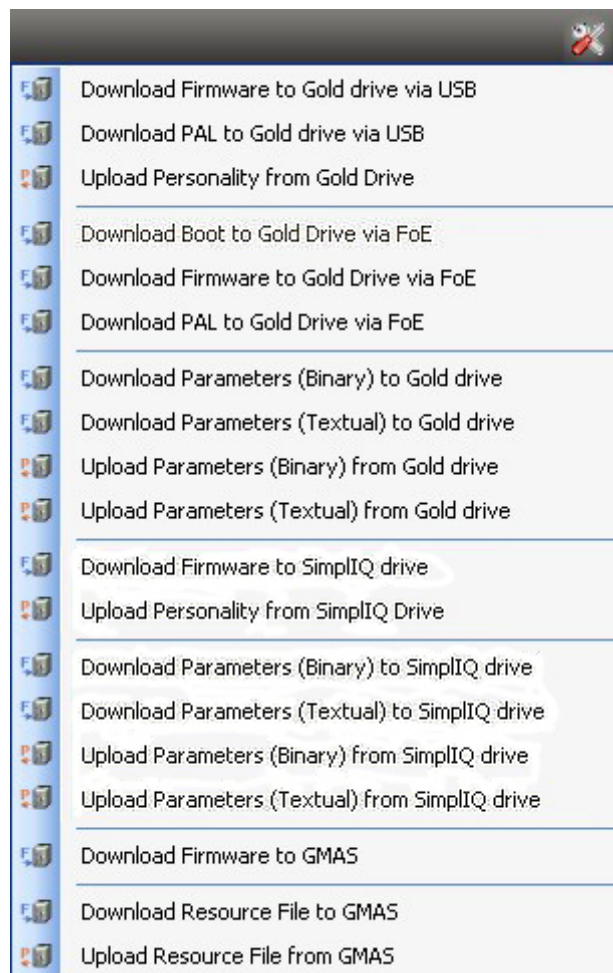
System Tool	Details
	Since the image is downloaded directly to the flash memory, it is also saved in it. The RAM memory is updated to hold the same information as the flash memory.
Download Parameters Gold Drive	Download a parameter file to an Elmo Gold Line (NG) drive. A parameter file is a readable file containing all the drive's parameters in the drive's language. Such a file may be obtained by uploading a parameter file from the drive. A parameters file has the extension ".txt". To save the downloaded file to the flash memory, use the terminal to send an SV command to the drive.
Upload Flash Image Gold Drive	Click to upload a Flash Image file from the drive (See explanation above).
Upload Parameters Gold Drive	Click to upload a parameters file from the drive (See explanation above).
Upload personality	The drive's personality (characteristics) includes information about the drive model. It includes a list of all the commands and parameters that are supported by this specific drive, arranged in groups and including a brief description of each. This file is used by EAS to determine various behaviors and to display parameters. When you click this button, the upload process begins. To see the result go to the Parameter Explorer. During normal operation, EAS will upload the drive's personality automatically when necessary. Use this button only if you have reason to believe that something went wrong with the usual process.

Important:

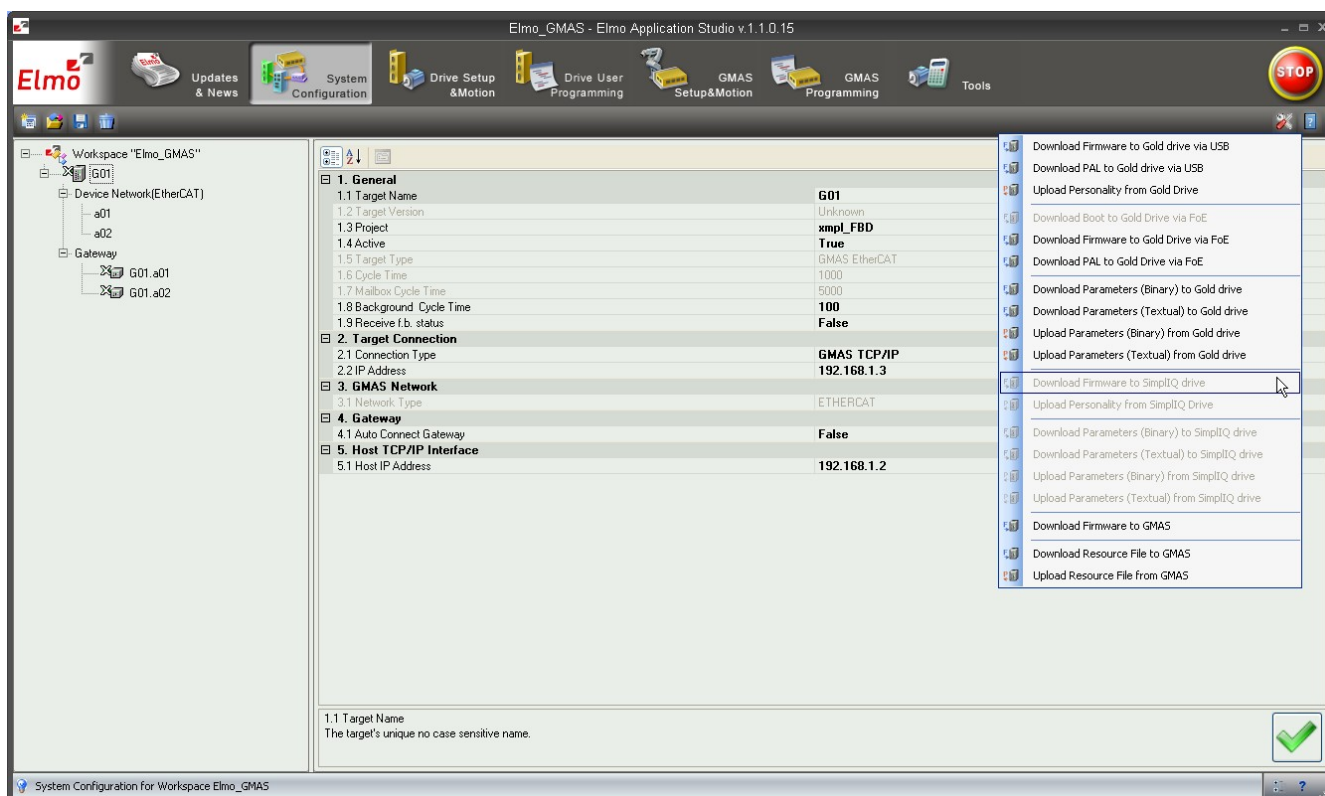
When selecting to download via USB or FoE, only one type of connection is allowed for Downloading at any one time. Select whether to hardware connect via USB or TCP/IP before Downloading, and then choose the appropriate download option.

3.3.2 Recommended Download Sequence for Gold Drives

The following is the recommended download sequence for Gold Drives based on the EAS download menu of options.



3.3.3 Downloading Firmware



When system has been correctly set up, it is then possible to click , at the top right corner and download or upload firmware or parameters to both Gold and SimplIQ drives.

When Gold drives are connected within the G-MAS system, the SimplIQ options are grayed, and unavailable. Similarly, vice-versa.

Important: All G-MAS and drives must be at Standby and disabled before performing any downloads or uploads.

For the **G-MAS**, the following options are available when clicking :

Download Firmware to GMAS

Update the firmware of the G-MAS is recommended regularly to maintain the software and hardware compatibility.

Download Resource File to GMAS

Option to download the saved Resource File to the G-MAS from the EAS application.

Upload Resource File from GMAS

Option to upload the saved Resource File from the G-MAS to the EAS application.

For **Gold drives**, the following options are available when clicking :

Download Firmware to Gold drive via USB

When connected via USB, use this method to download firmware.

Download PAL to Gold Drive (via USB)

After downloading the firmware, the relevant PAL

	firmware should be downloaded.
Upload Personality from Gold Drive	It is recommended to upload the Personality from the Gold Drive (especially for new drives) to prevent re-Tuning of the drive. The drive Personality can then be downloaded after upgrading the firmware and PAL.
Download Boot to Gold Drive via FoE	In situations where the Boot is either missing, defective, or overwritten, the Boot may be downloaded. To perform this procedure, refer to Elmo for help.
Download Firmware to Gold Drive via FoE	When connected via TCP/IP network (and optionally configured as an EtherCAT system), the firmware download can be performed by FoE(File over EtherCAT).
Download PAL to Gold Drive via FoE	When connected via TCP/IP network (and optionally configured as an EtherCAT system), the PAL download can be performed by FoE.
Download Parameters (Binary) to Gold drive	Download the Gold drive parameters in binary format to the drive. This option does not allow easy editing of the parameters file.
Download Parameters (Textual) to Gold drive	Download the Gold drive parameters in textual format to the drive. This option allows easy editing of the parameters file.
Upload Parameters (Binary) from Gold drive	Upload the Gold drive parameters in binary format from the drive to the EAS. This option does not allow easy editing of the parameters file.
Upload Parameters (Textual) from Gold drive	Upload the Gold drive parameters in textual format from the drive to the EAS. This option allows easy editing of the parameters file.

For **SimplIQ drives**, the following options are available when clicking :

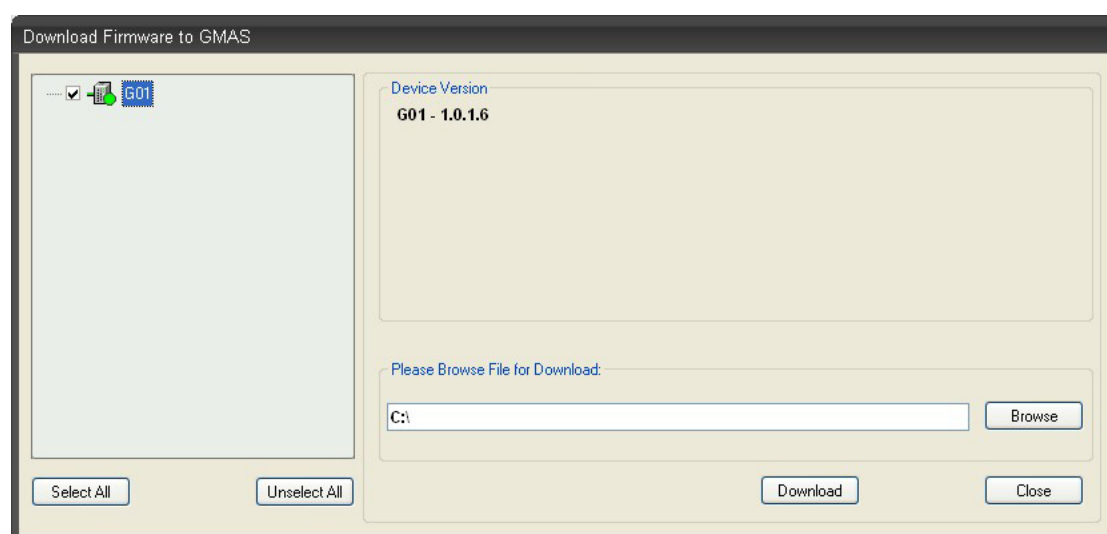
Download Firmware to SimplIQ drive	When connected to the drive, use this method to download firmware.
Upload Personality from SimplIQ Drive	It is recommended to upload the Personality from the drive (especially for new drives) to prevent re-Tuning of the drive. The drive Personality can then be downloaded after upgrading the firmware.
Download Parameters (Binary) to SimplIQ drive	Download the drive parameters in binary format to the drive. This option does not allow easy editing of the parameters file.
Download Parameters (Textual) to SimplIQ drive	Download the drive parameters in textual format to the drive. This option allows easy editing of the parameters file.

Upload Parameters (Binary) from SimplIQ drive	Upload the drive parameters in binary format from the drive to the EAS. This option does not allow easy editing of the parameters file.
Upload Parameters (Textual) from SimplIQ drive	Upload the drive parameters in textual format from the drive to the EAS. This option allows easy editing of the parameters file.

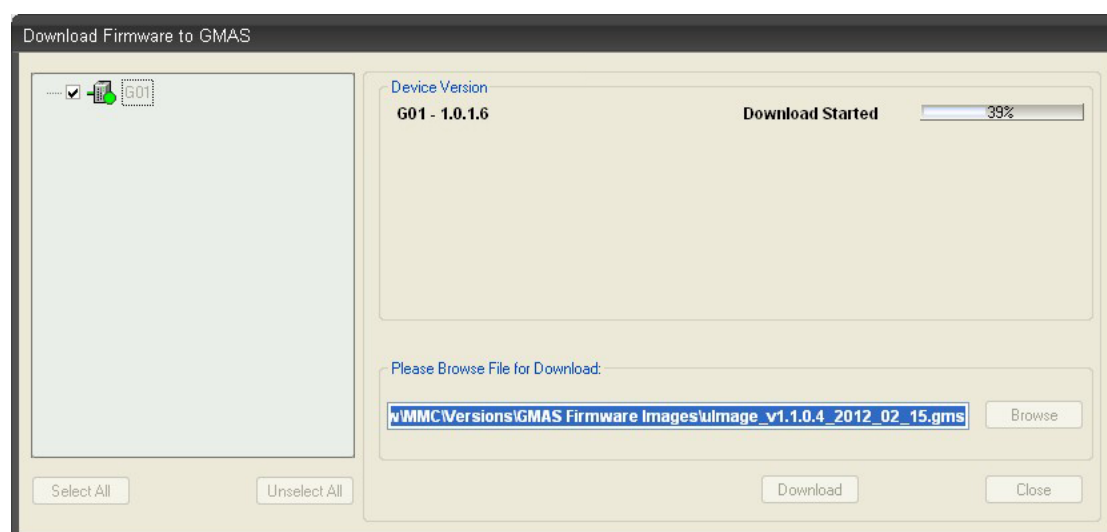
3.3.3.1 Download Firmware to G-MAS

To download firmware to the G-MAS:

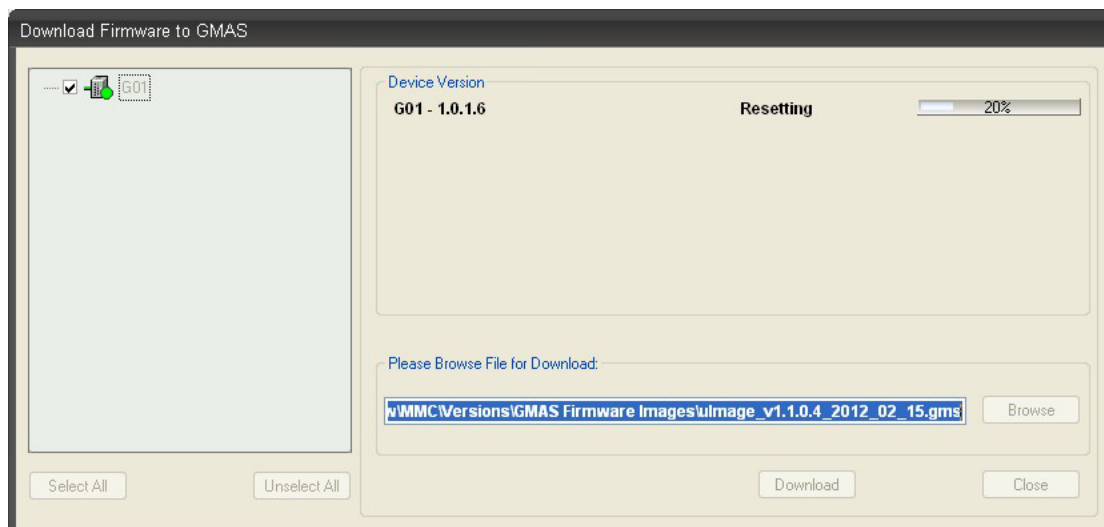
- From the main window top right, click the icon .
- From the menu that appears, select **Download Firmware to GMAS**.



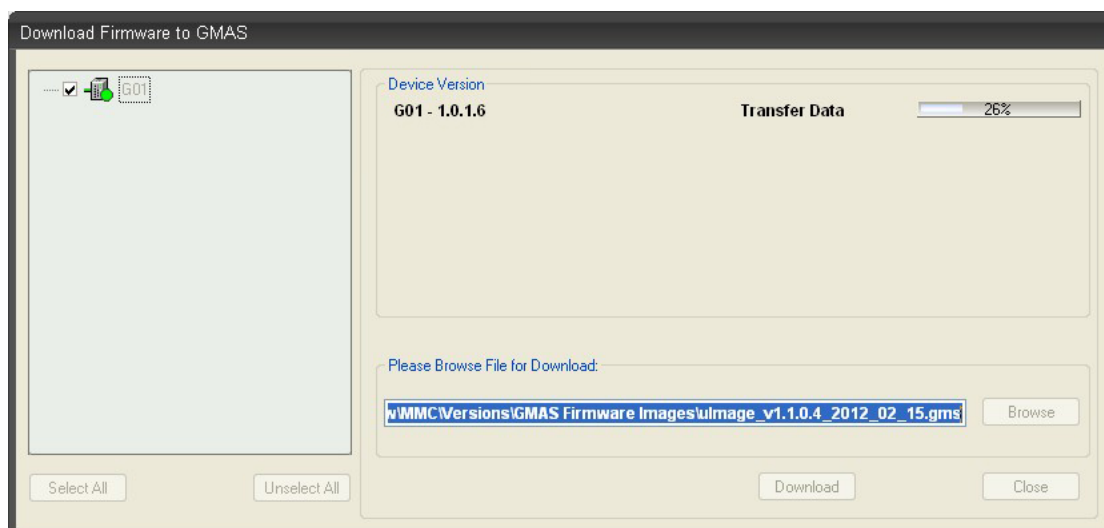
- Click **Browse**, and locate the updated version of the G-MAS firmware image. The file is highlighted when located and selected.



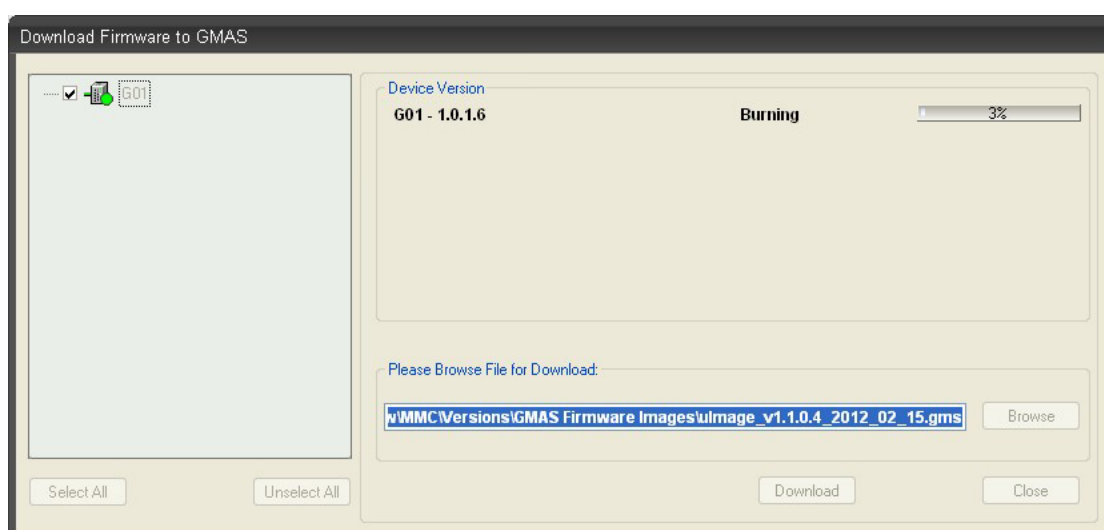
4. Click Download to start the download process.



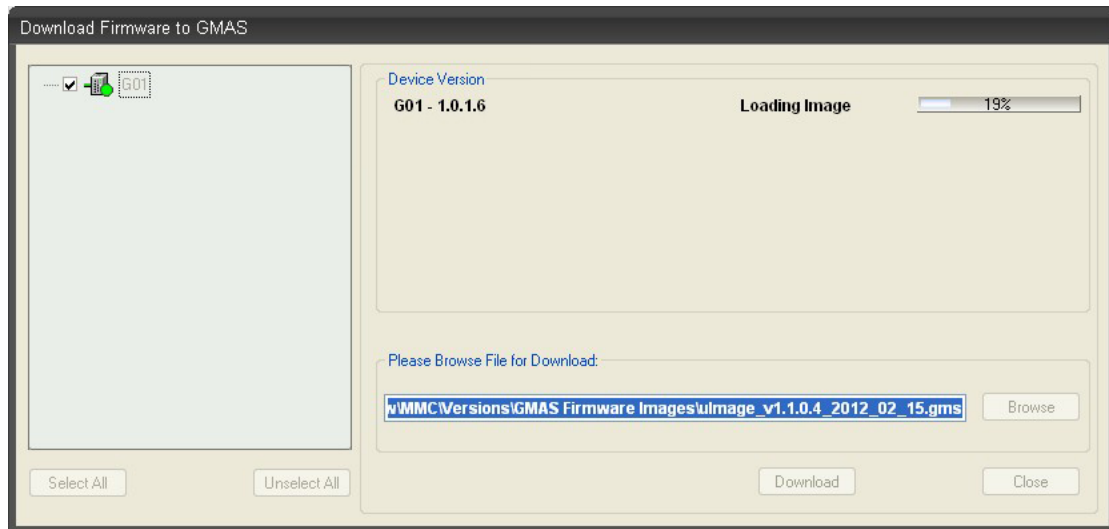
The process continues with Resetting and Transfer Data.



Burning data



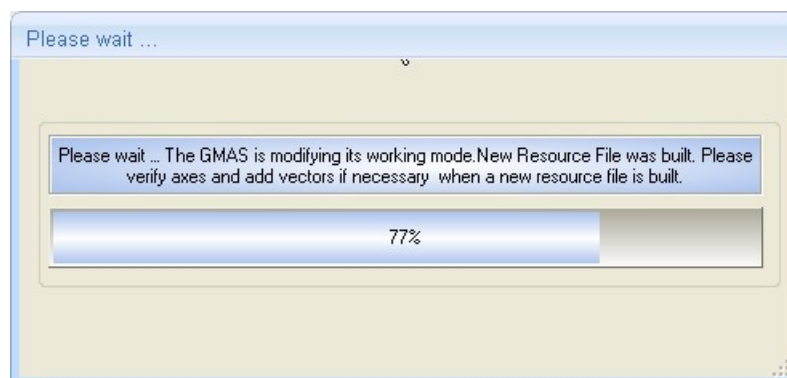
Loading image



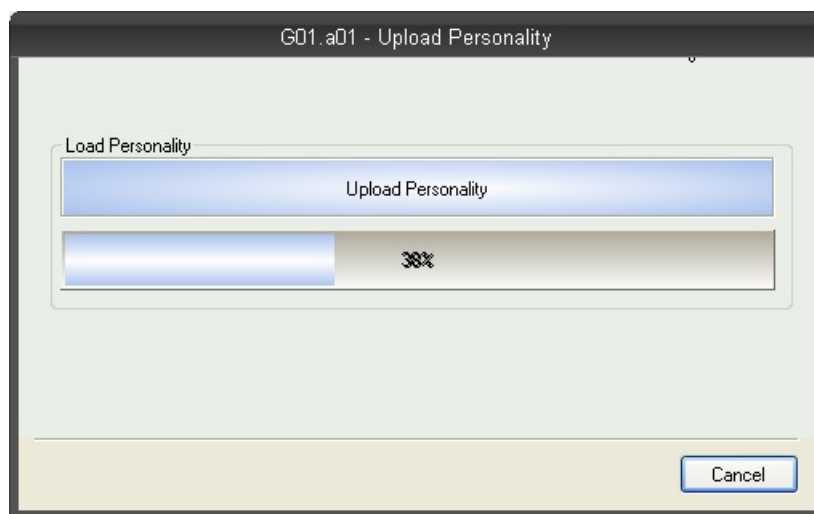
Finally the download completion window appears.



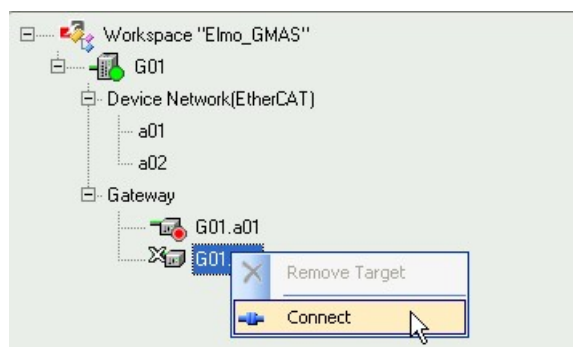
5. Reboot the device(servo drive) system.
6. When initially connected via TCP/IP, the following may appear for the G-MAS:



7. When initially connected via TCP/IP, the following may appear for the drives:



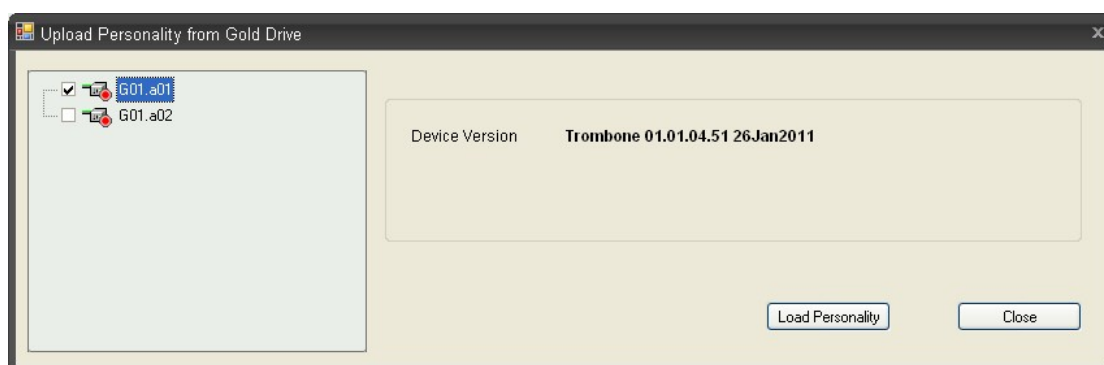
8. Then it is possible to connect all the drives.



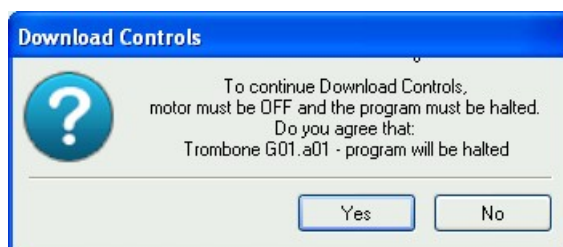
3.3.3.2 Download Firmware to a Gold Drive via USB

To download firmware to a Gold drive via USB:

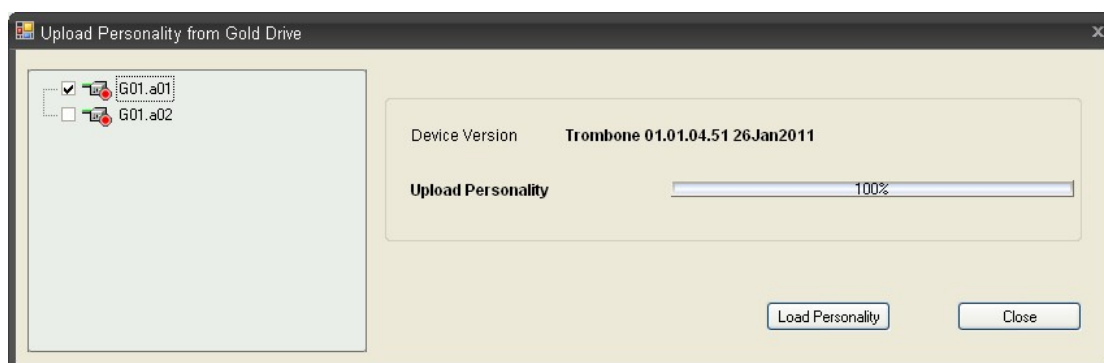
1. Connect the drive to the EAS system via a USB – USB cable.
2. Within EAS, connect the drive or drives.
3. From the main window top right, click the icon .
4. From the menu that appears, select **Upload Personality from Gold Drive**.



5. Click **Load Personality** to upload the personality from the Drive to the EAS.
When the Download Controls window pops-up, click **Yes**.



When completed the following window appears:

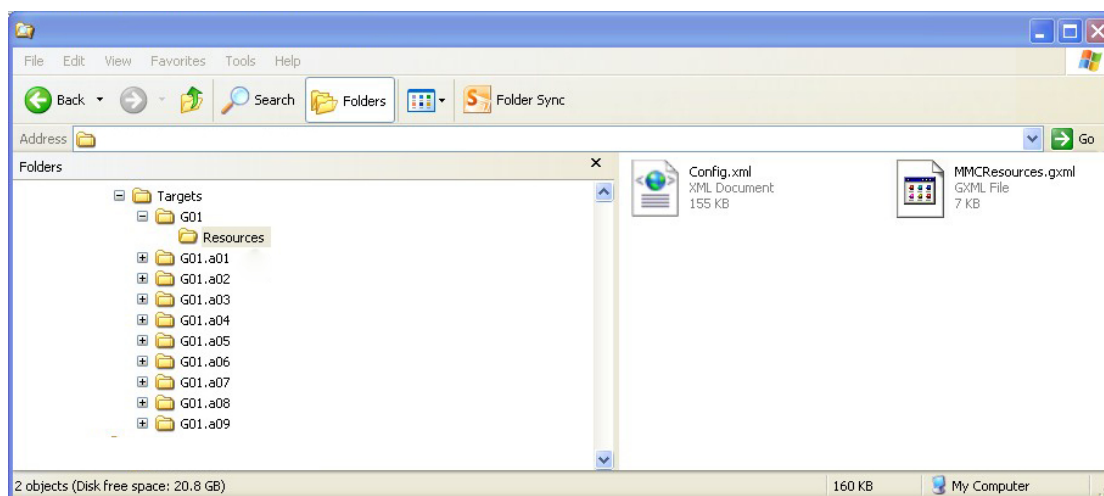


6. From the Firmware download icon options, select **Download Firmware to Gold Drive via FoE**.

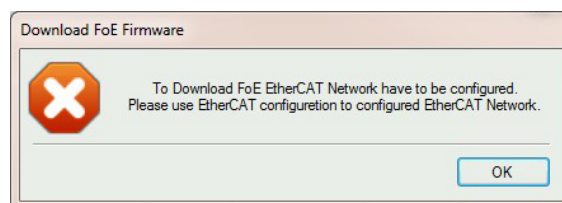
3.3.3.3 Download Firmware to a Gold Drive via FoE

To download firmware to a Gold drive via FoE:

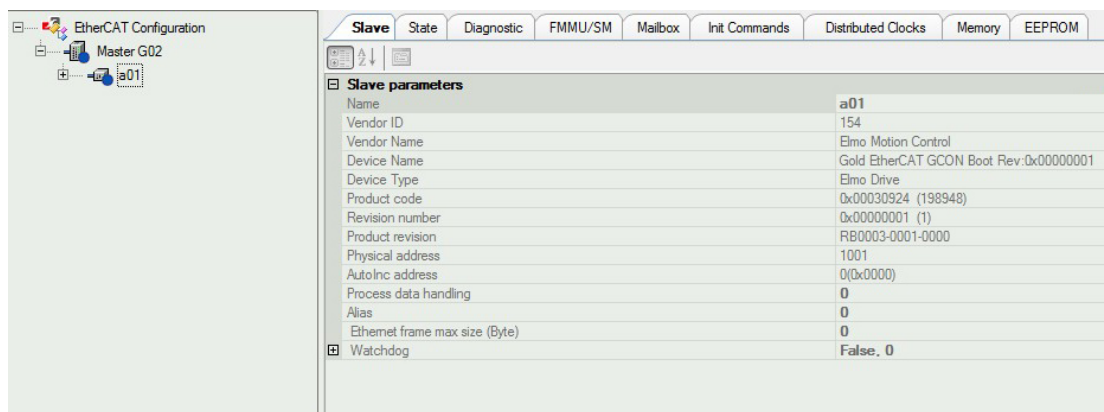
1. Make sure that the Gold drive is configured via EtherCAT.
2. From the main window top right, click the icon .
3. From the menu that appears, select **Download Firmware to Gold Drive via FoE**.
4. Make sure that two files are present in the directory:
../Targets/"Name of G-MAS"/Resources
As shown in the screen capture below.



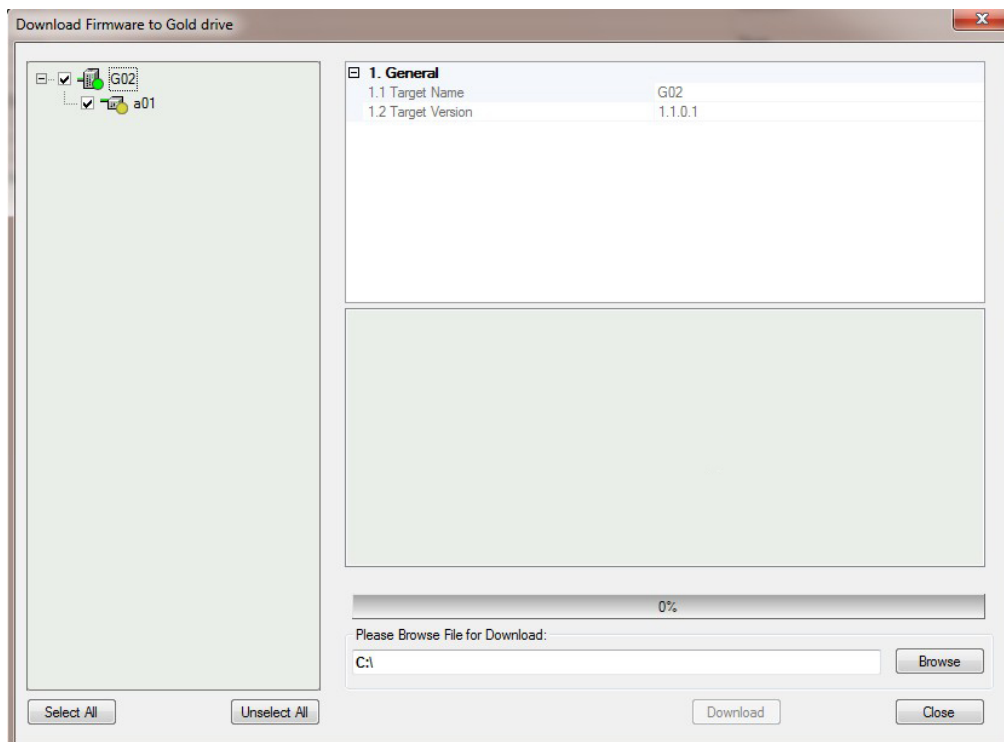
If not, the following error will appear.



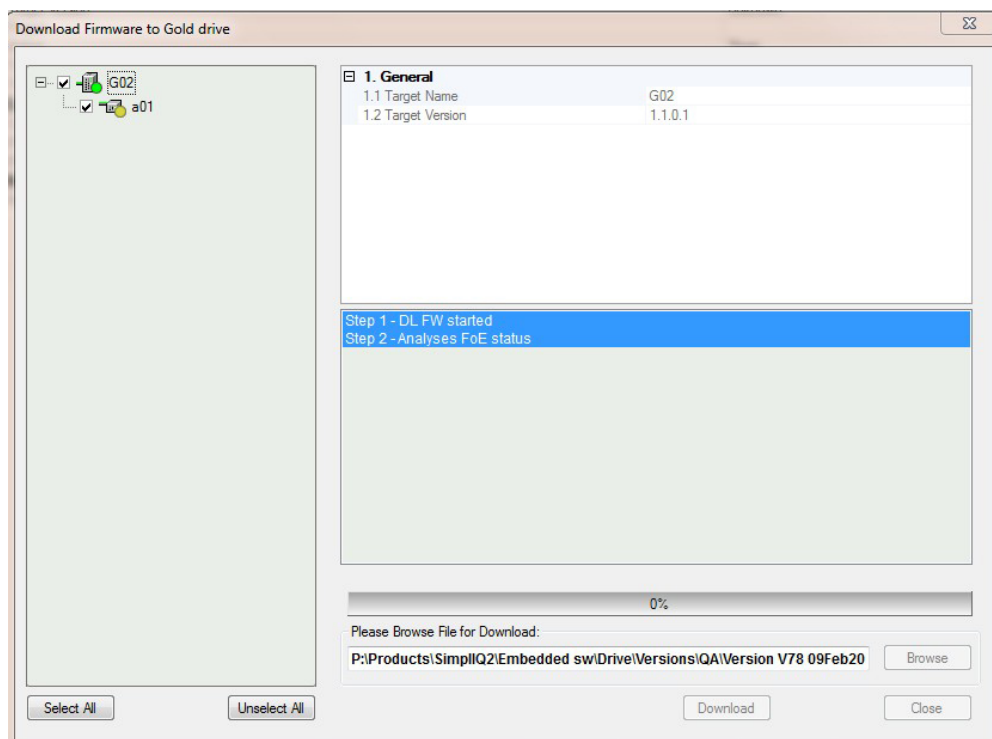
If the error appears, rescan the system to reset the Targets configuration to the EtherCAT Master/Slave configuration. Then return the system to the original system configuration mode.



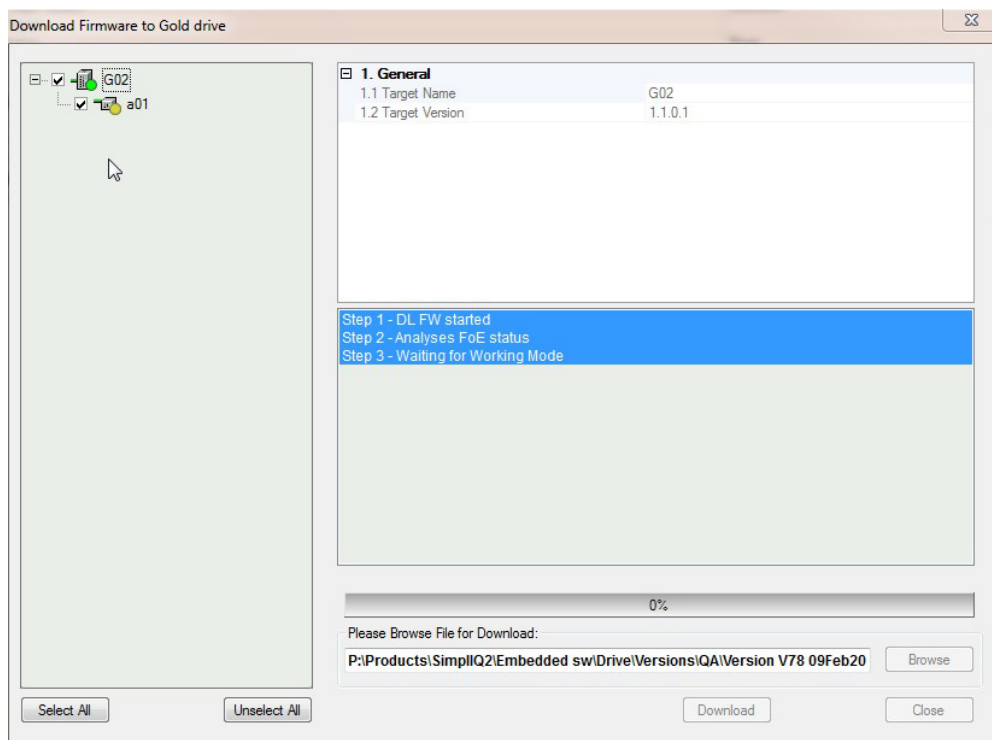
5. Then reselect **Download Firmware to Gold Drive via FoE** from the download options menu. The Download Firmware to Gold drive window appears.
6. Select the Drive to which the firmware will be downloaded, and click the checkbox next to the drive(s). Then click **Browse** to locate the file to download.



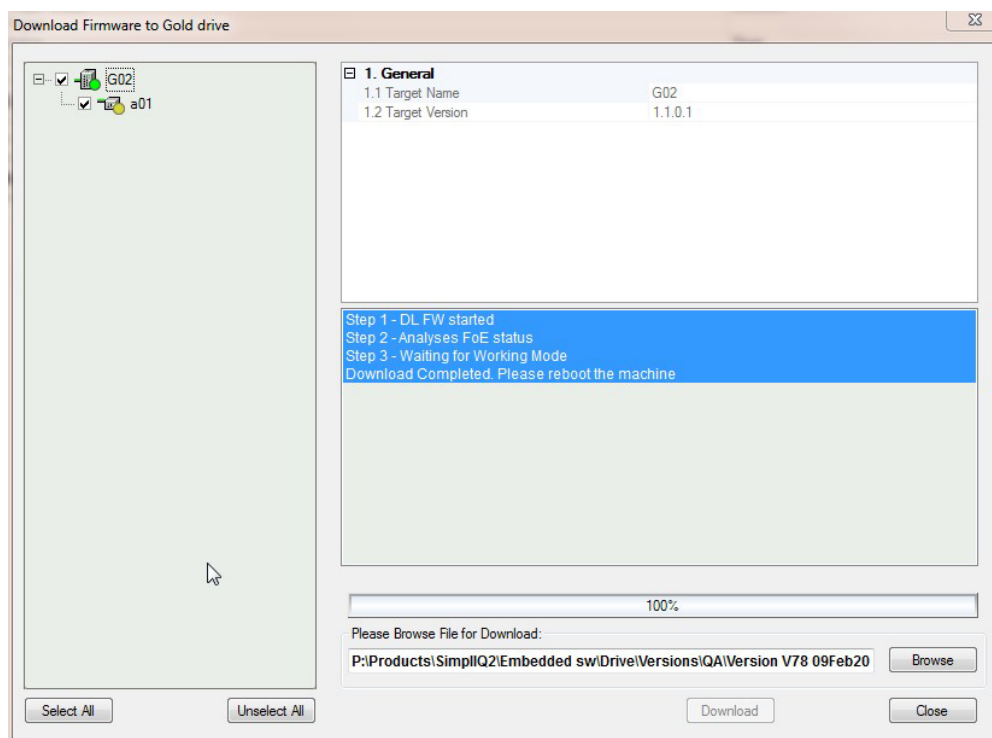
7. Click **Download**. The download steps progress is displayed.



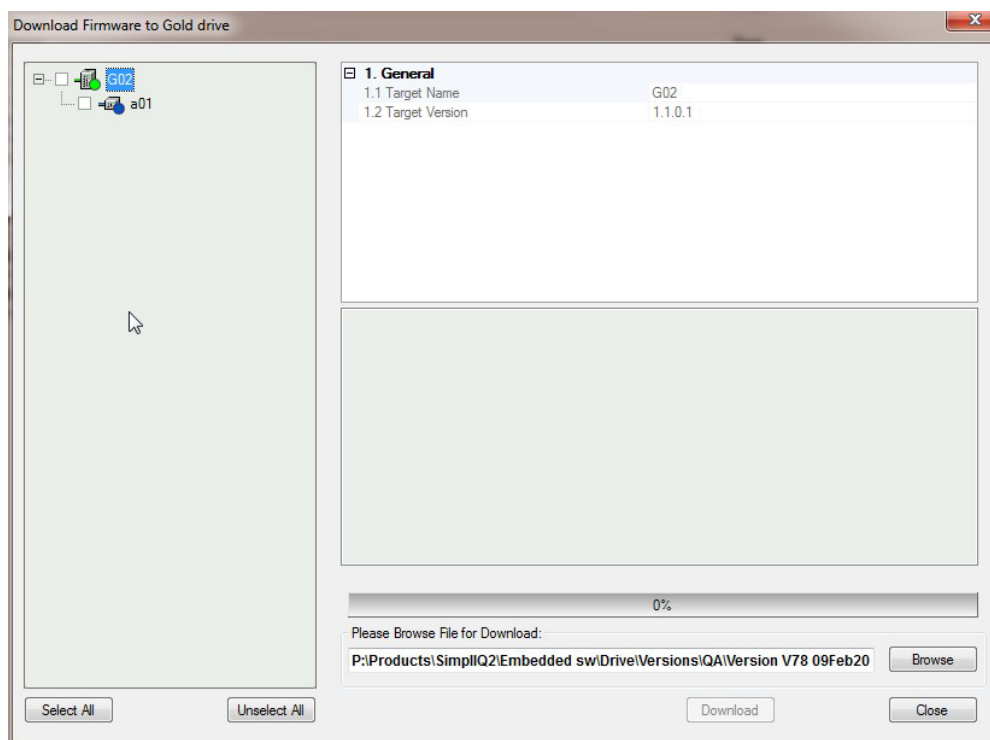
8. The operation progresses to Step 3 as displayed below.



9. When complete, the display requests a machine reboot. Do not reboot the system or machine. **Simply reset the Slaves only.**



Until the Slaves are reset, the Target Version remains unchanged.



10. Click **Close** to close the Download window.

Download Firmware to a SimplIQ Drive

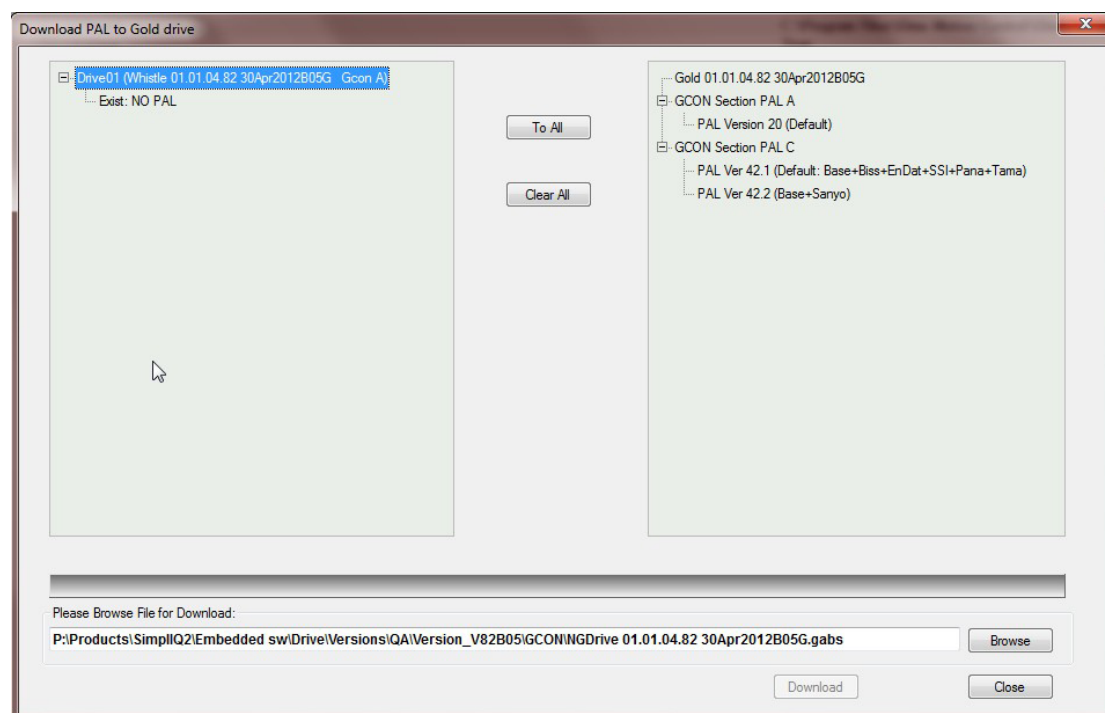
3.3.4 Downloading PAL

The Programmable Array Logic (PAL) is a user programmable chip programmed according to specific application requirements. The PAL contains the available feedback signature which is integrated in the drive. The PAL code is sufficiently large in the GCON Rev C and is no longer part of the firmware download, but a separate download. This download can be performed when the drive is connected and configured using either USB or FoE.

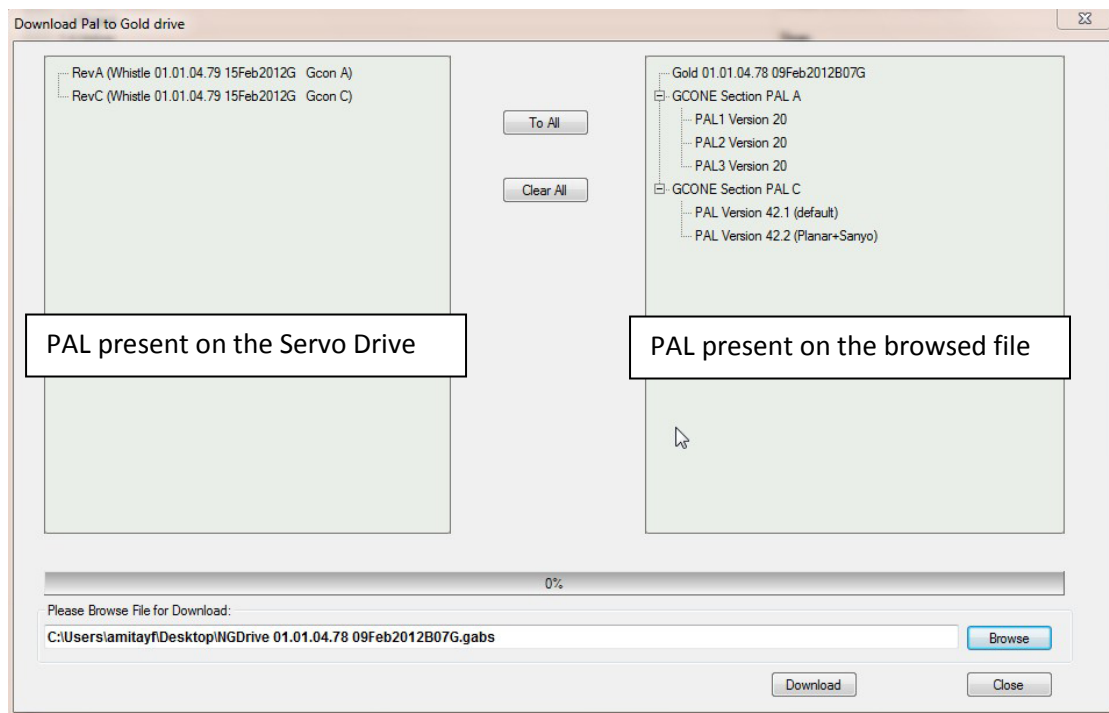
3.3.4.1 Download PAL to a Gold Drive via USB

To download PAL to a Gold drive via USB:

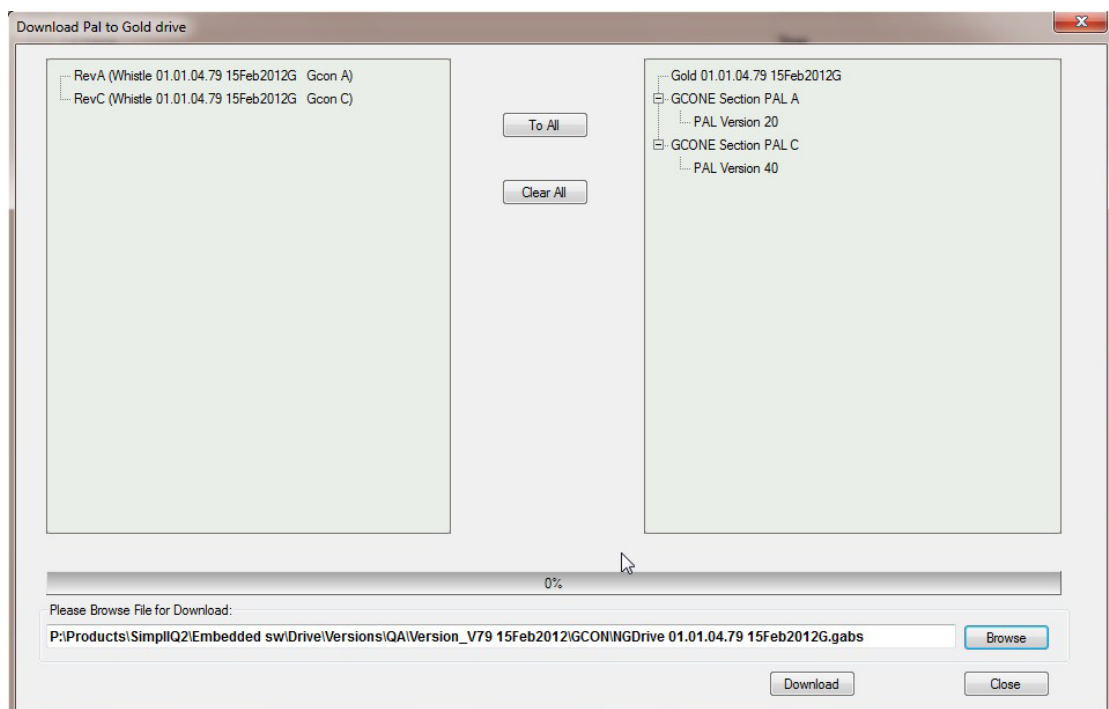
1. Connect the drive to the EAS system via a USB – USB cable.
2. Within EAS, connect the drive or drives.
3. From the main window top right, click the icon .
4. From the menu that appears, select **Download PAL to Gold Drive via USB**.
5. Select the drive to update or install the PAL.



6. Click **Browse** to select the latest PAL update options. A PAL download file may have a number of associated PAL configurations available, as shown below.

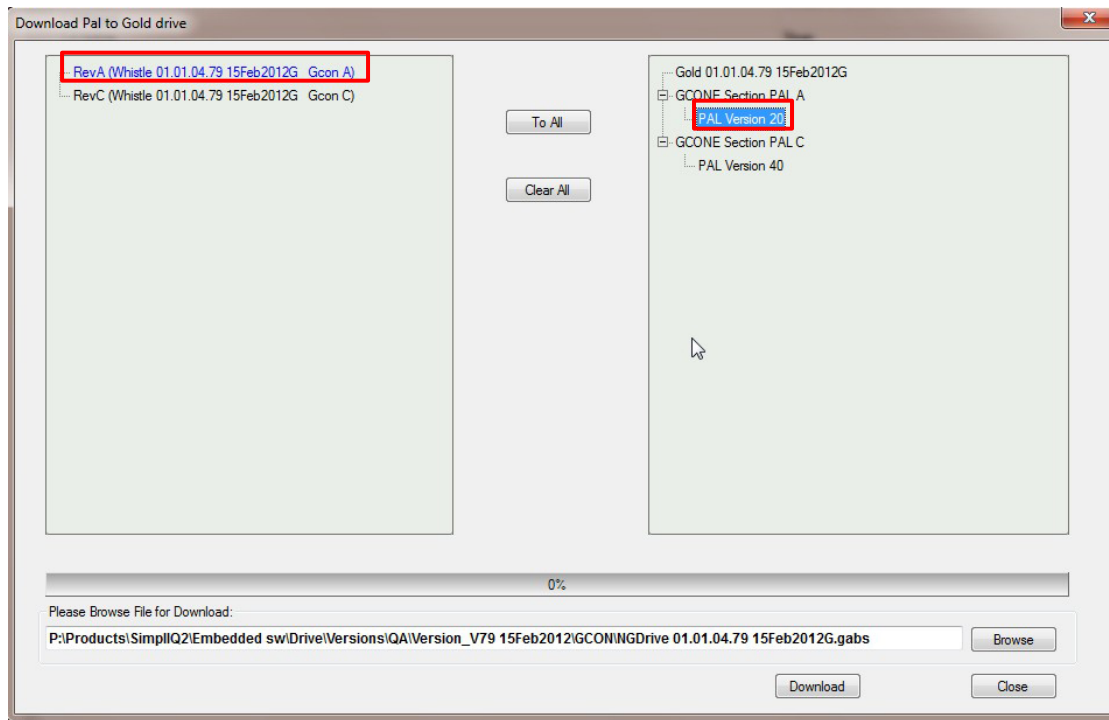


Another PAL with a different of PAL configurations.

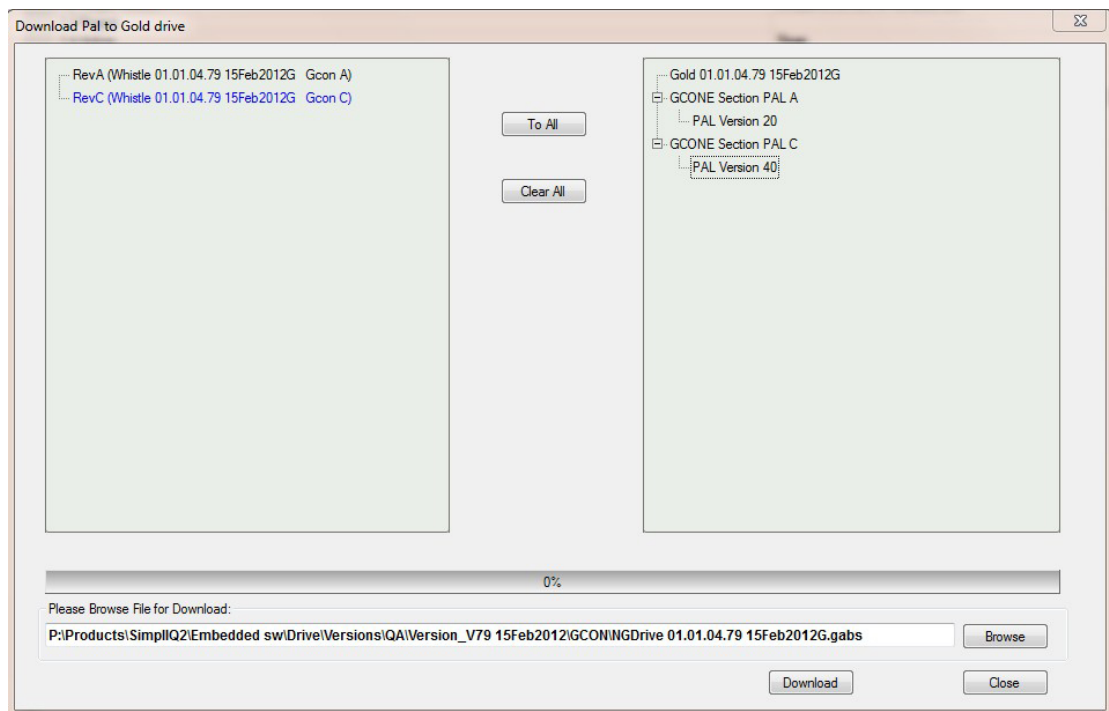


7. When the PAL file configuration type is selected and matches itself to the servo drive configuration type the hardware configuration is displayed in blue, as shown in the examples below.

PAL A configuration type matched from the loaded file to the hardware.

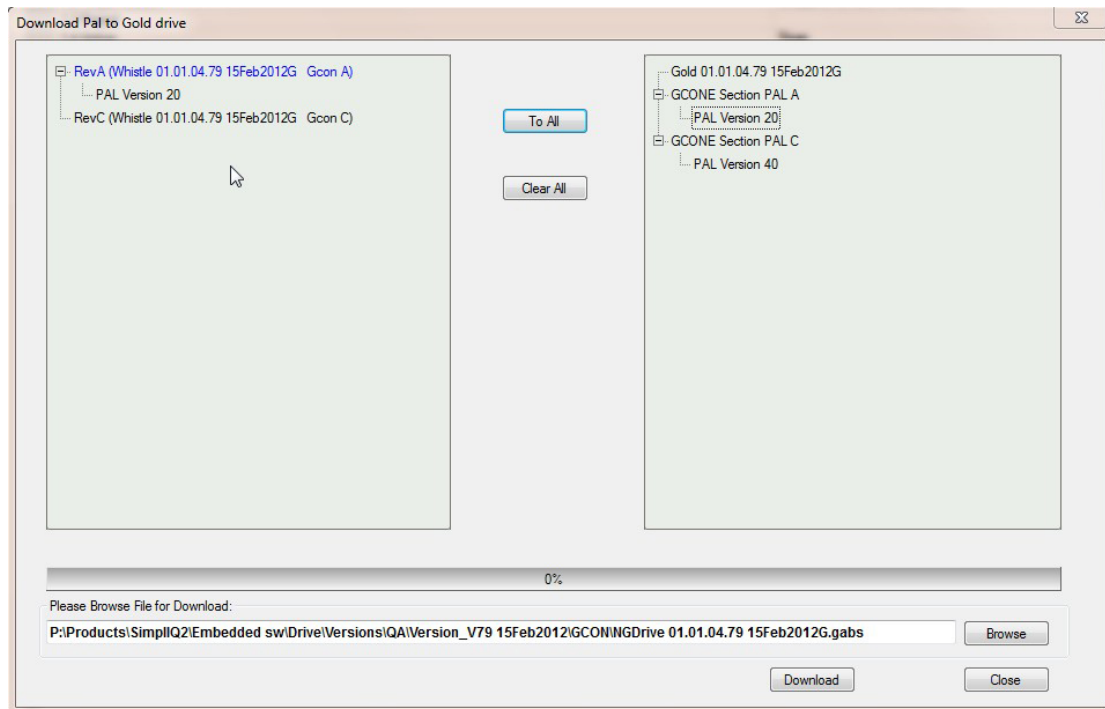


PAL C configuration type matched from the loaded file to the hardware.

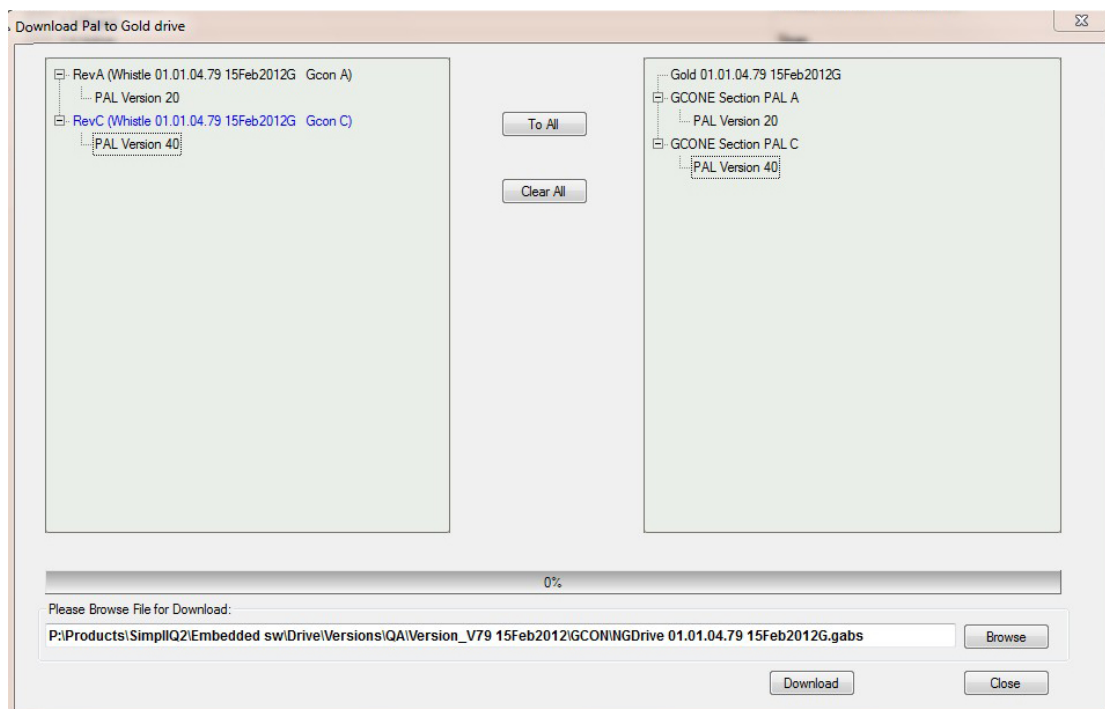


8. Select the appropriate PAL configuration to download from the options.
9. Then select whether the configuration should be administered to all the same servo drive types, by selecting **To All**.

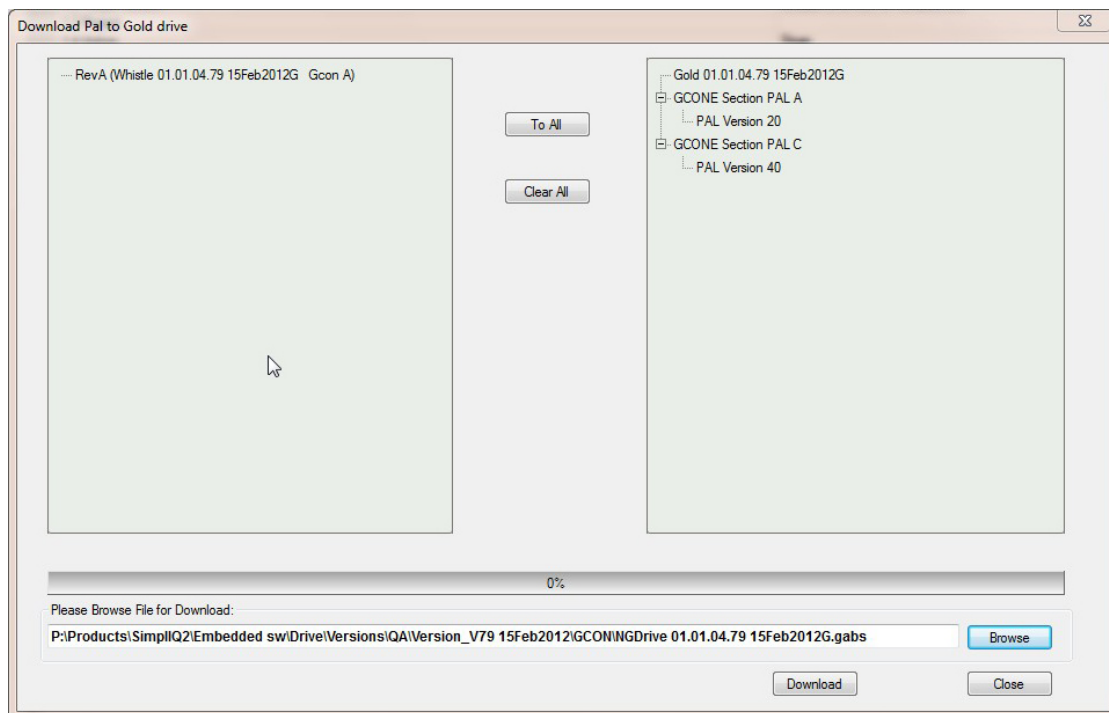
For the PAL A Configuration as shown below.



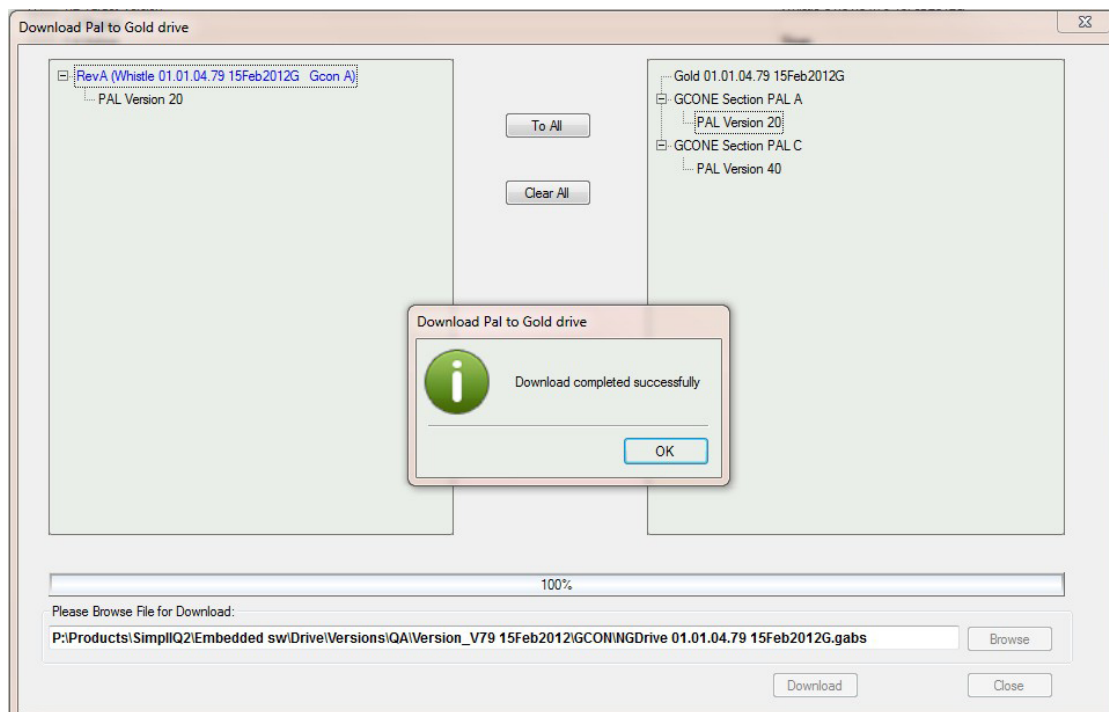
For the PAL C Configuration as shown below.



10. Make sure to locate and match the correct PAL configuration type before selecting **Download**.



11. When the PAL configuration type is matched the hardware will reflect the match, and changing to blue. Then click **Download**.

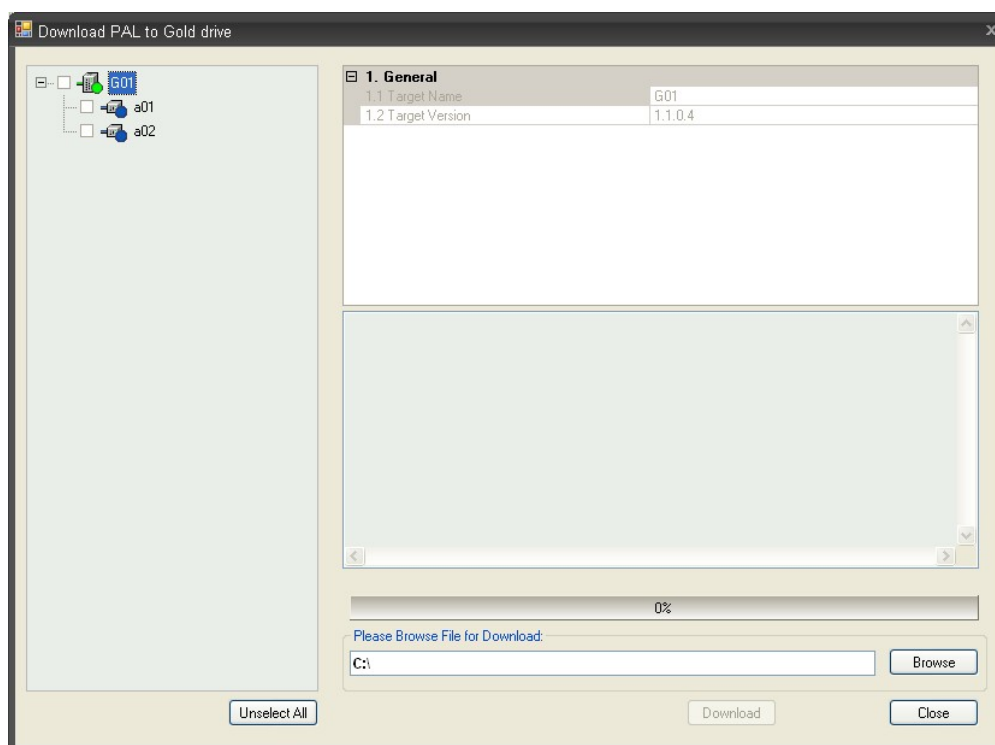


12. Click **OK**, and then **Close** to close both open window boxes.

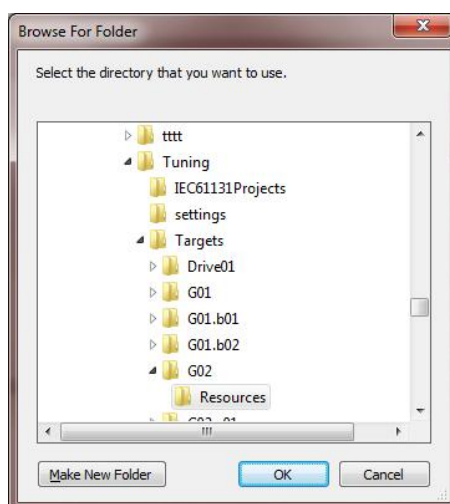
3.3.4.2 Download PAL to a Gold Drive via FoE

To download PAL to a Gold drive via FoE:

1. Make sure that the Gold drive is configured via EtherCAT.
2. From the main window top right, click the icon .
3. From the menu that appears, select **Download PAL to Gold Drive via FoE**.



4. Select eth Gold drive(s) to which the PAL should be updated.
5. Click **Browse** to browse for the latest PAL file relevant to the Gold drive and click **OK**.



6. Click **Download** to download the PAL file to the drive(s).
7. When completed, the Completed Successfully window appears.

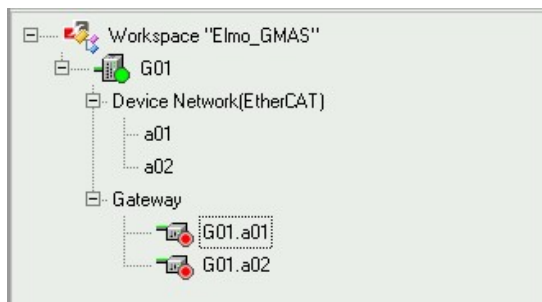
3.3.5 Upload Personality

This section describes how to upload the Personality from a Gold or SimplIQ drive to the EAS application.

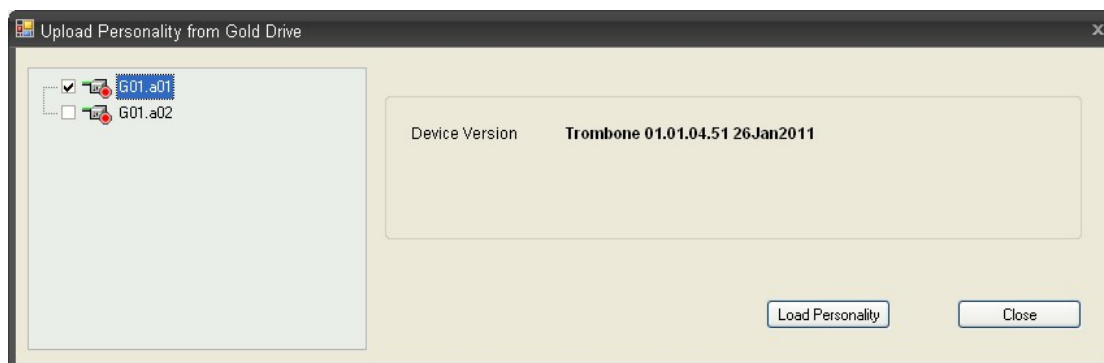
3.3.5.1 Upload Personality from a Gold Drive

To upload the Personality from a Gold Drive:

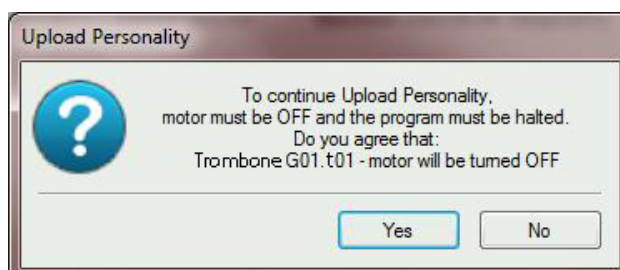
1. Make sure that the Gold drive is active.



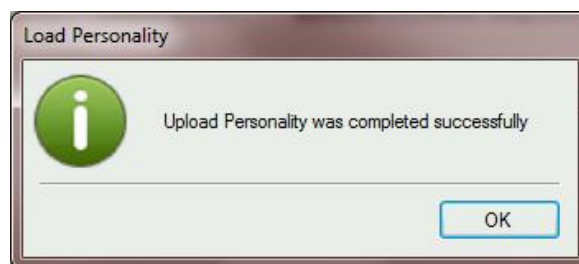
2. From the main window top right, click the icon .
3. From the menu that appears, select **Upload Personality from a Gold Drive**.



4. Select the relevant drive whose Personality is to be uploaded and click the checkbox next to it.
5. Click **Load Personality** to upload the personality.
6. When completed, a dialog box appears. Click **Yes** when the motor is switched OFF, to close the dialog box.



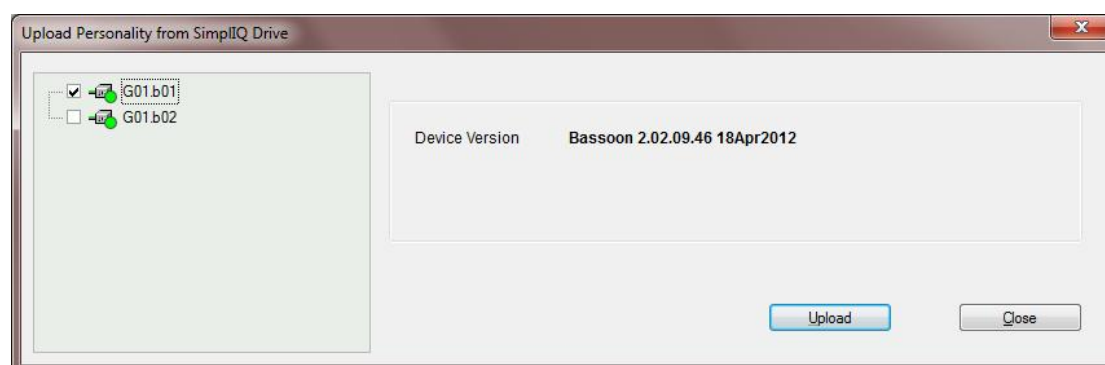
7. The uploading then finalizes and the Completed Successfully dialog box appears. Click **OK** to close the box.



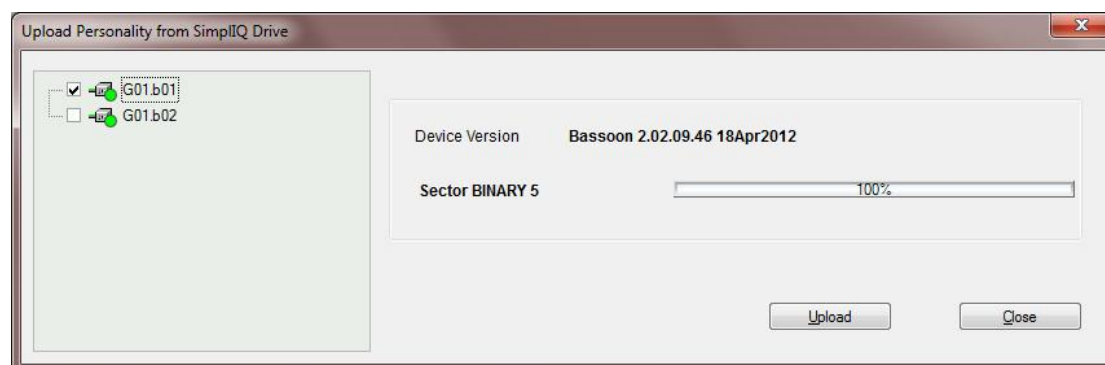
3.3.5.2 Upload Personality from a SimplIQ Drive

To upload the Personality from a SimplIQ Drive:

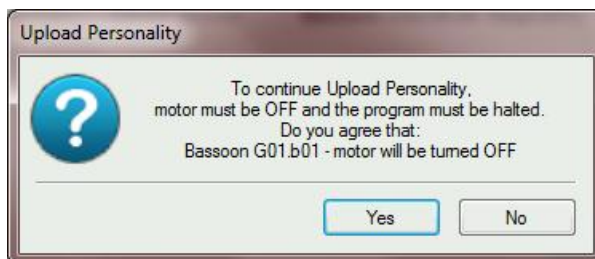
1. Make sure that the SimplIQ drive is active.
2. From the main window top right, click the icon .
3. From the menu that appears, select **Upload Personality from a SimplIQ Drive**.



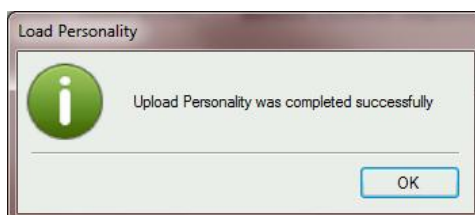
4. Select the relevant drive whose Personality is to be uploaded and click the checkbox next to it.
5. Click **Upload** to upload the personality. The application begins to upload the personality, sector by sector, announcing each section uploaded according to the percentage progress bar.



6. When completed, a dialog box appears. Click **Yes** when the motor is switched OFF, to close the dialog box.



7. The uploading then finalizes and the Completed Successfully dialog box appears. Click **OK** to close the box.

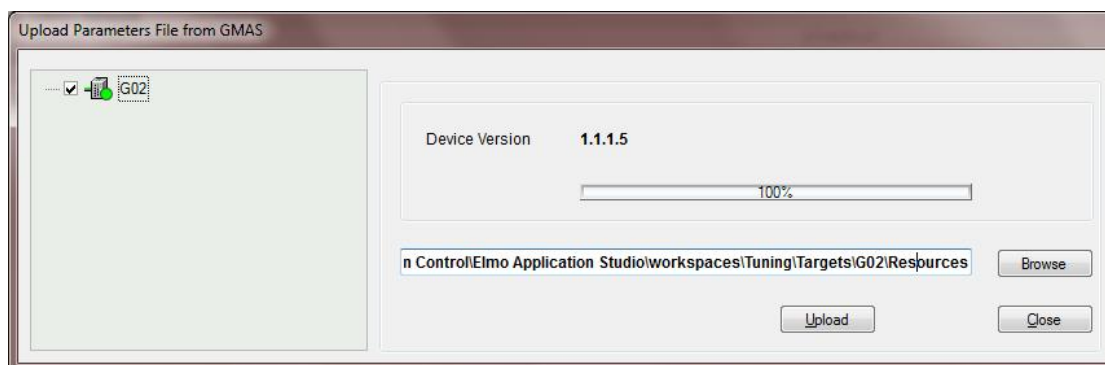


3.3.6 G-MAS Parameters Download and Upload

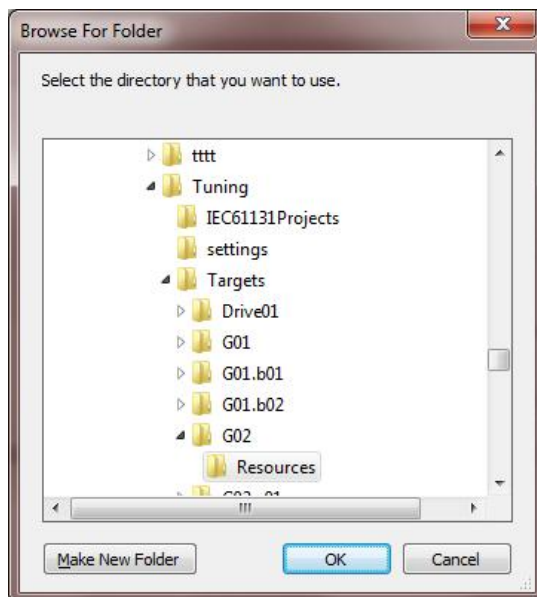
3.3.6.1 G-MAS Parameters Upload

To upload the Parameters file from the G-MAS:

1. Make sure that the G-MAS is active.
2. From the main window top right, click the icon .
3. From the menu that appears, select **Upload Parameters File from the G-MAS**.



4. At the *Upload Parameters File from GMAS* window, click **Browse**. Locate the G-MAS Parameters file from the saved resources and click **OK**.



5. Click **Upload** to upload the file. The progress bar displays the percentage uploaded. When it reaches 100%, the Completed Successfully window appears.

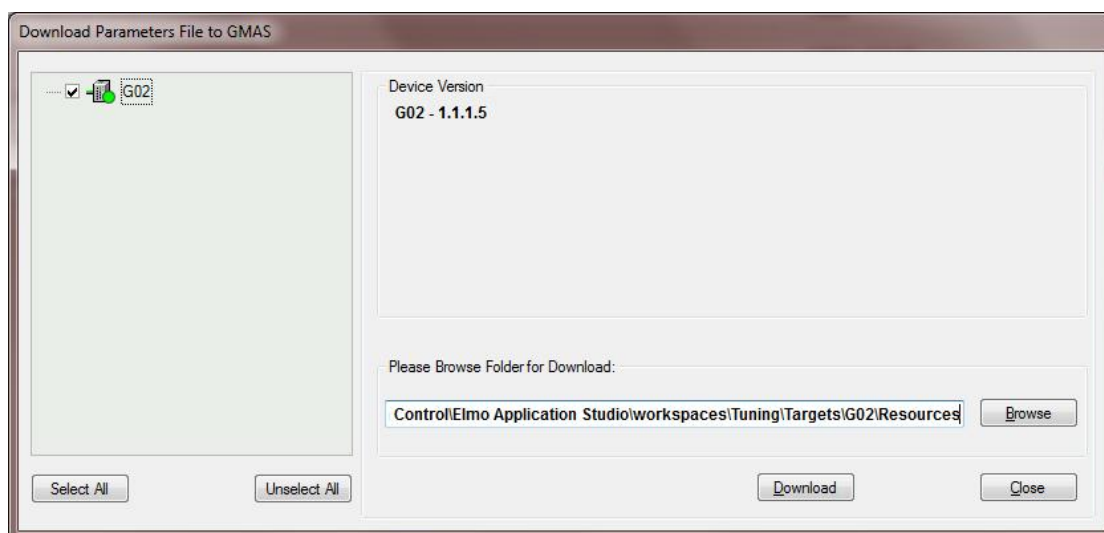


6. Click **OK** to close the window.

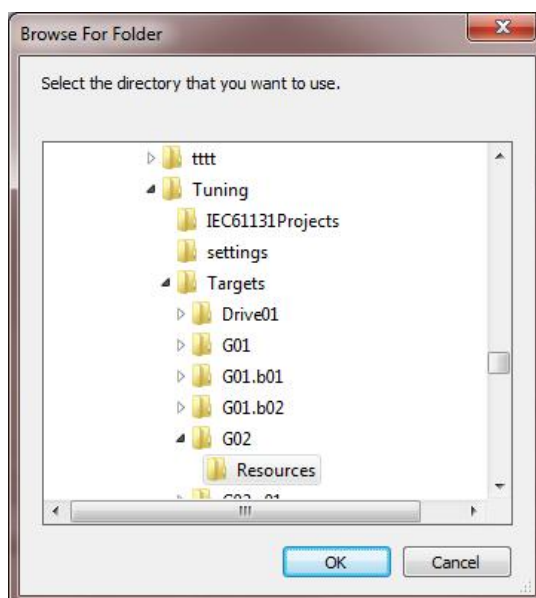
3.3.6.2 G-MAS Parameters Download

To download the Parameters file to the G-MAS:

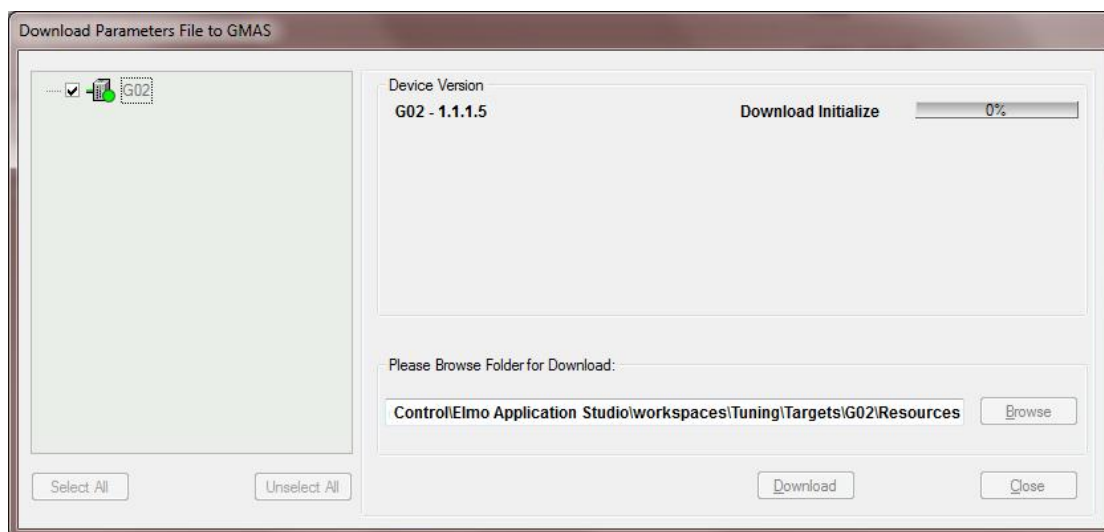
1. Make sure that the G-MAS is active.
2. From the main window top right, click the icon .
3. From the menu that appears, select **Download Parameters File to the GMAS**.



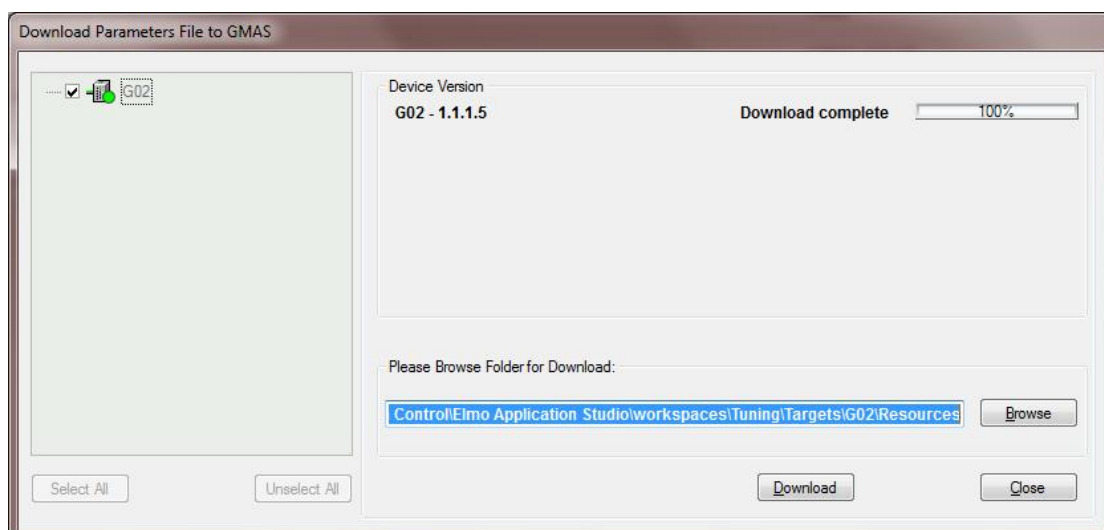
4. At the *Download Parameters File to GMAS* window, click **Browse**. Locate the relevant G-MAS Parameters file and click **OK**.



5. Click **Download** to download the file. The progress bar displays the percentage downloaded.



6. When the download progress bar reaches 100%, Download Complete is displayed.



7. Click **Close** to close the *Download Parameters File to GMAS* window. The Completed Successfully window opens.



8. Click **OK** to close the window box.

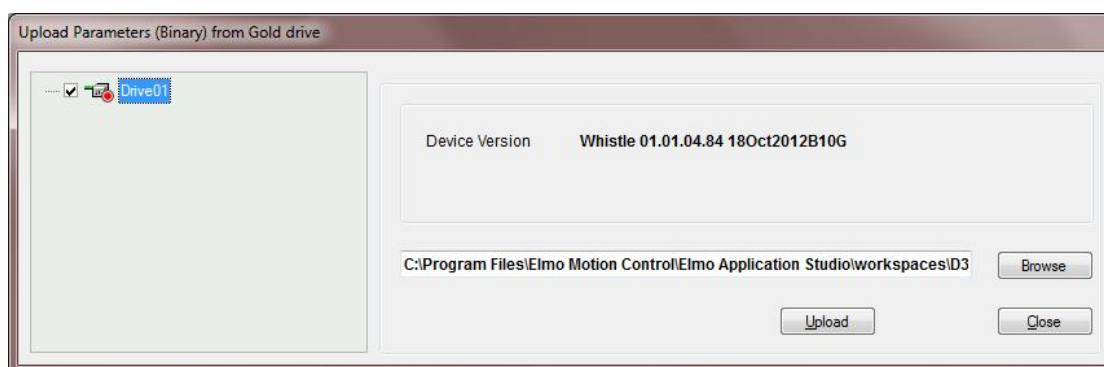
3.3.7 Drive Parameters Download and Upload

This section describes the procedures to upload and download Binary or Textual formatted parameters from and to the Gold drive.

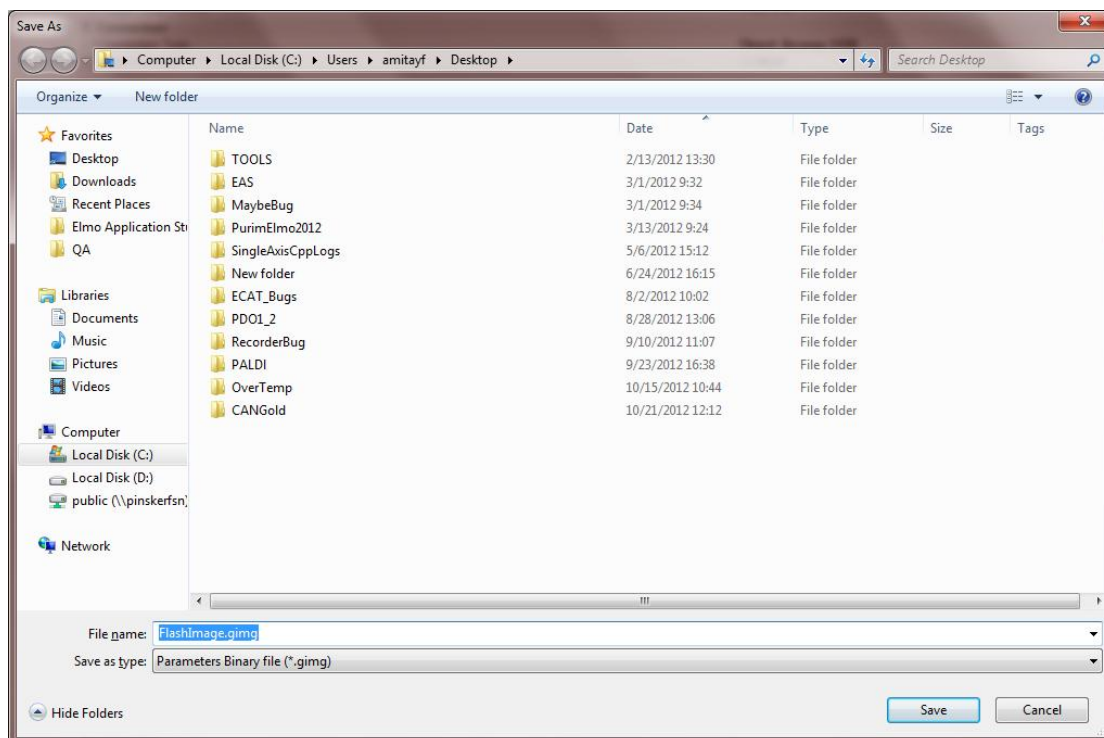
3.3.7.1 Upload Parameters (Binary) from Gold Drive

To upload the Parameters (Binary) from the Gold drive:

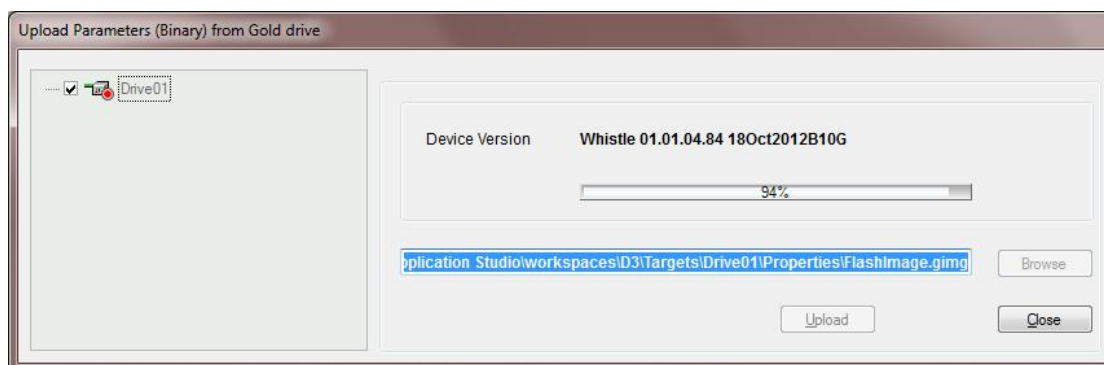
1. Make sure that the Gold drive is active.
2. From the main window top right, click the icon .
3. From the menu that appears, select **Upload Parameters (Binary) from the Gold Drive**.



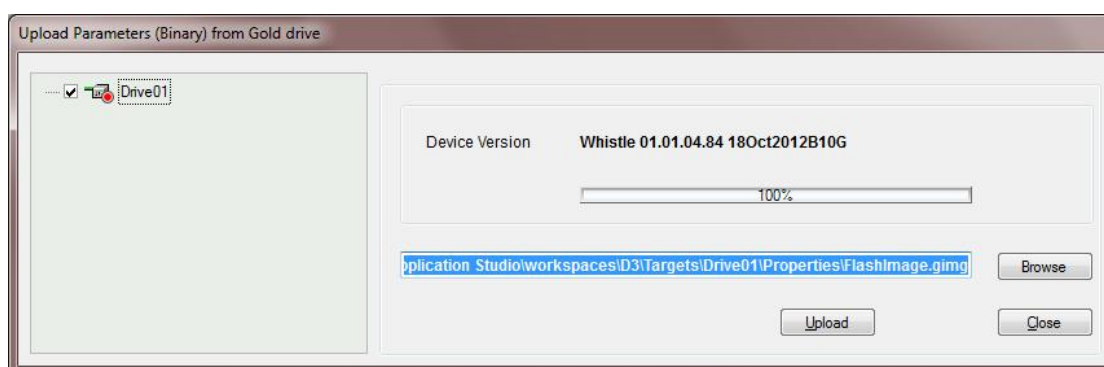
4. Click **Browse**.
5. Locate the Parameters Binary File. Click **Save As** to select a location for the FlashImage file.



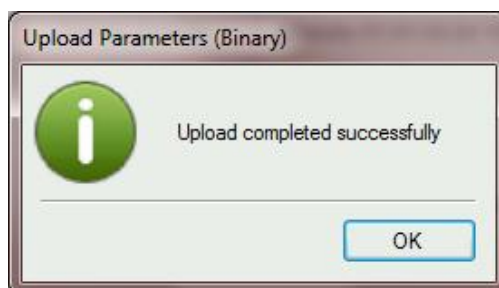
6. Click **Upload**. The progress bar shows the progress of the upload.



7. When the upload is complete (100%) click **Close** to close the window.



8. When the Completed Successfully window opens click **OK**.



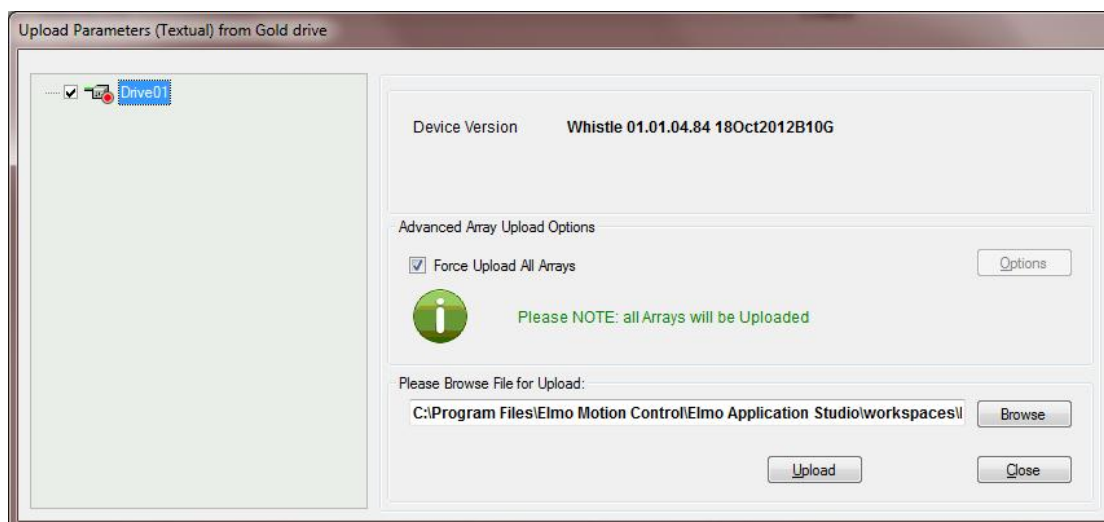
If you repeat the upload for any reason, a new window will open asking whether you wish to overwrite the present FlashImage file present in the EAS directory. Select **Yes** or **No** for whatever circumstances is relevant.



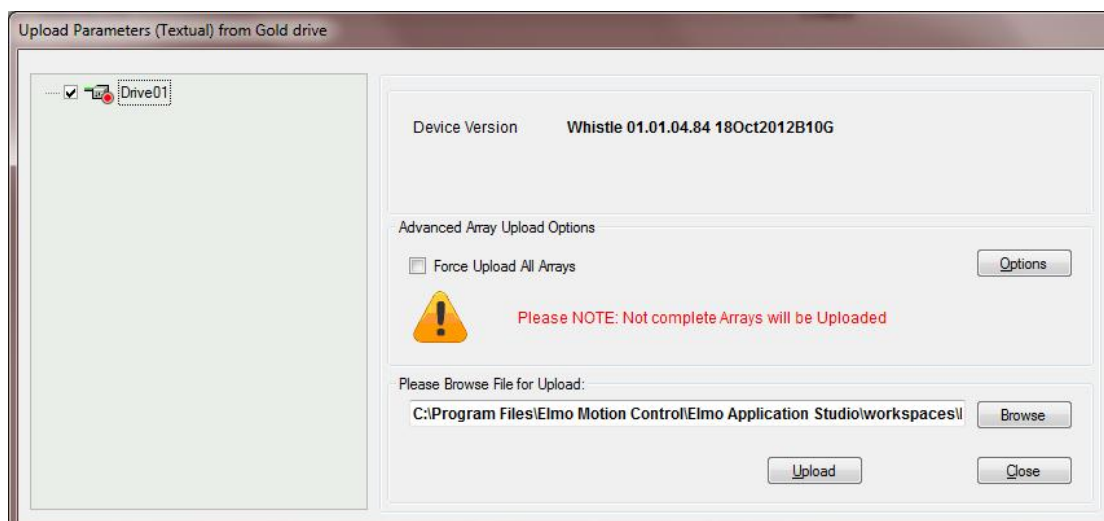
3.3.7.2 Upload Parameters (Textual) from Gold Drive

To upload the Parameters (Textual) from the Gold drive:

1. Make sure that the Gold drive is active.
2. From the main window top right, click the icon .
3. From the menu that appears, select **Upload Parameters (Textual) from the Gold Drive**.
4. Select whether to Force Upload of all Array parameters or individual drives.



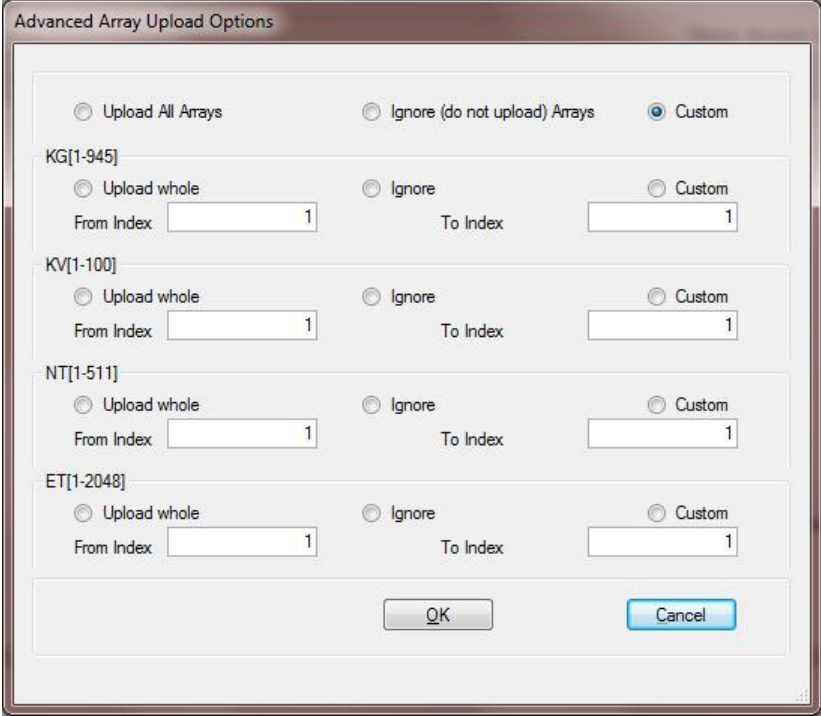
If the checkbox next to Forced Upload All Arrays is not selected, click **Options** at the right side.



The Advanced Array Upload Options window opens. This window box allows you to manually select whether to **Upload All Arrays**, **Ignore the Arrays**, or **Custom** - meaning manually enter values for each of the Command parameters which will be uploaded.

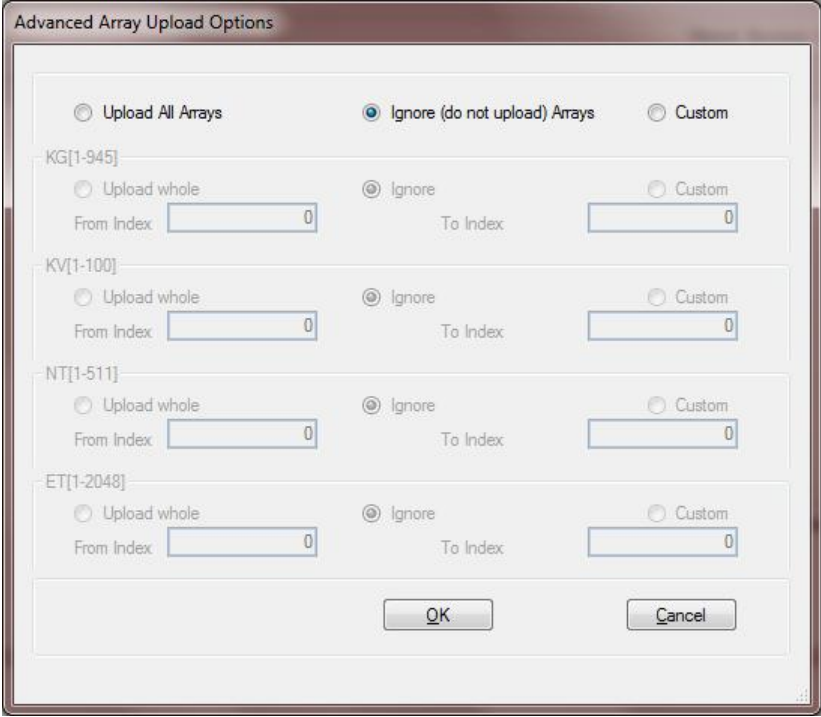
Select one of the following:

- a. **Custom**, to manually enter values for each of the Command parameters shown in the window below.



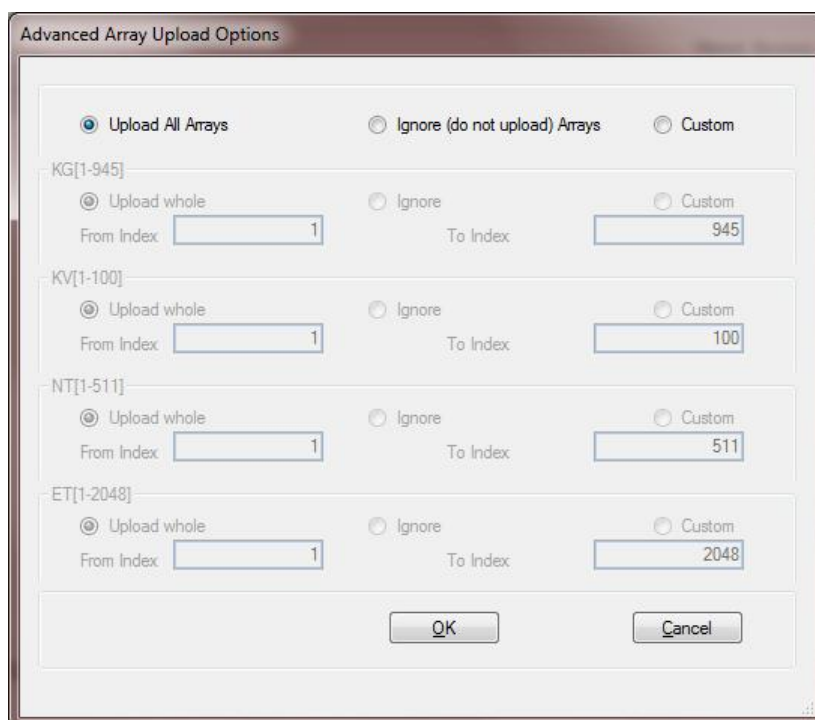
The dialog box is titled "Advanced Array Upload Options". It contains three radio buttons at the top: "Upload All Arrays", "Ignore (do not upload) Arrays", and "Custom". The "Custom" option is selected. Below this, there are four sections, each for a different array: KG[1-945], KV[1-100], NT[1-511], and ET[1-2048]. Each section has three radio buttons: "Upload whole", "Ignore", and "Custom". The "Custom" option is selected for all four arrays. Each section also has two text input fields: "From Index" and "To Index", both containing the value "1". At the bottom, there are "OK" and "Cancel" buttons.

- b. **Ignore Arrays**, to only upload individual parameters of the relevant drive.

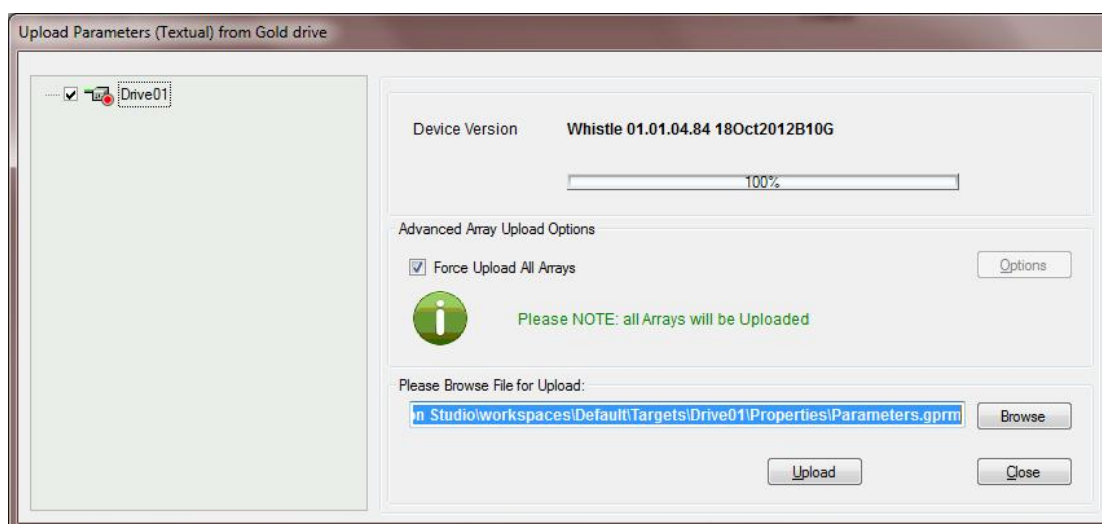


The dialog box is titled "Advanced Array Upload Options". It contains three radio buttons at the top: "Upload All Arrays", "Ignore (do not upload) Arrays", and "Custom". The "Ignore (do not upload) Arrays" option is selected. Below this, there are four sections, each for a different array: KG[1-945], KV[1-100], NT[1-511], and ET[1-2048]. Each section has three radio buttons: "Upload whole", "Ignore", and "Custom". The "Ignore" option is selected for all four arrays. Each section also has two text input fields: "From Index" and "To Index", both containing the value "0". At the bottom, there are "OK" and "Cancel" buttons.

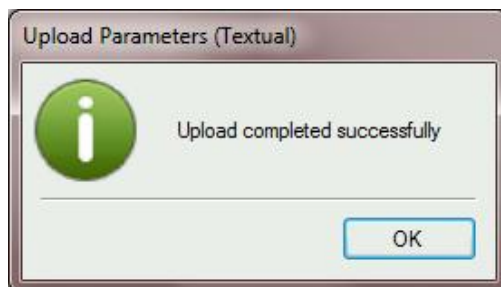
- c. **Upload All Arrays**, to upload all array parameters.



5. After performing the relevant selection in the Advanced Array Upload Options window, click **OK**.
6. In the main upload window, click **Browse**.
7. Locate the Parameters Binary File. Click **Open** to open the FlashImage file.
8. Click **Upload** to start the upload process. A progress bar displays the progress of the upload.



9. When completed the Completed Successfully window appears.



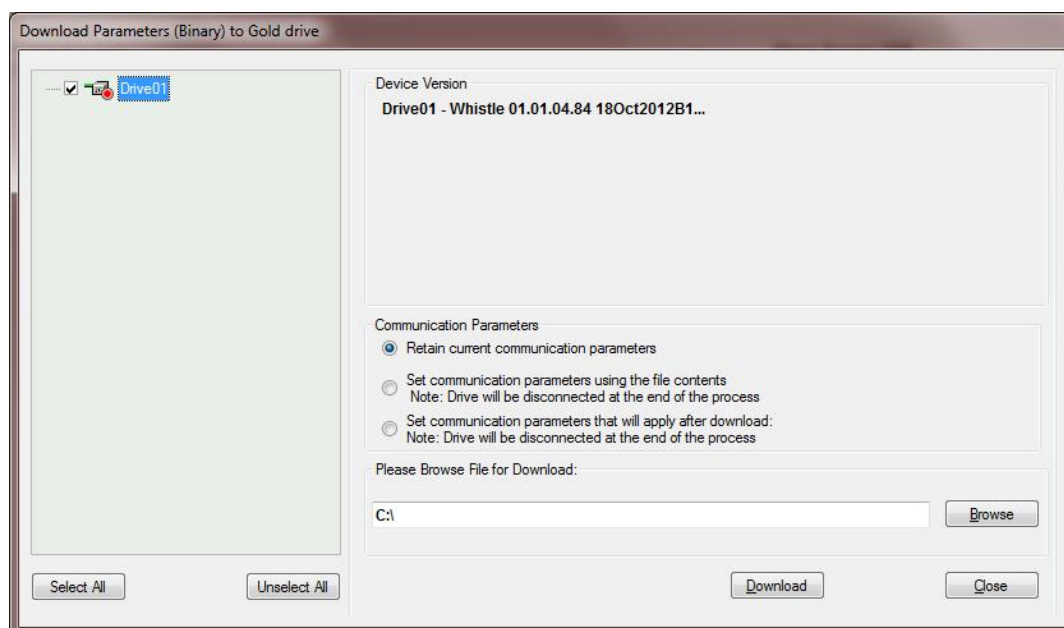
If you repeat the upload for any reason, a new window will open asking whether you wish to overwrite the present FlashImage file present in the EAS directory. Select **Yes** or **No** for whatever circumstances is relevant.



3.3.7.3 Download Parameters (Binary) to Gold Drive

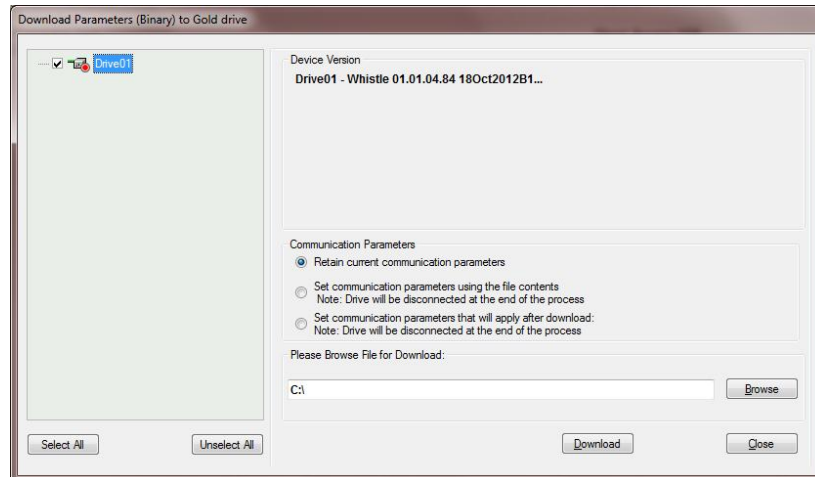
To download the Parameters (Binary) to the Gold drive:

1. Make sure that the Gold drive is active.
2. From the main window top right, click the icon .
3. From the menu that appears, select **Download Parameters (Binary) to the Gold Drive**.

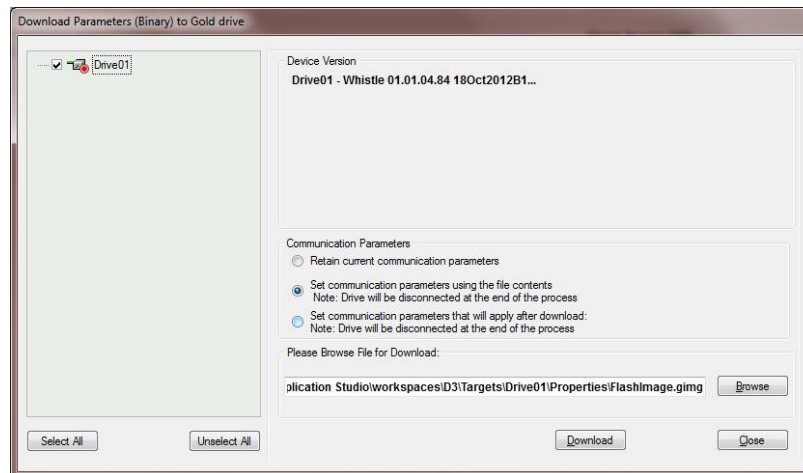


There are three options available for the Communication Parameters in this window box:

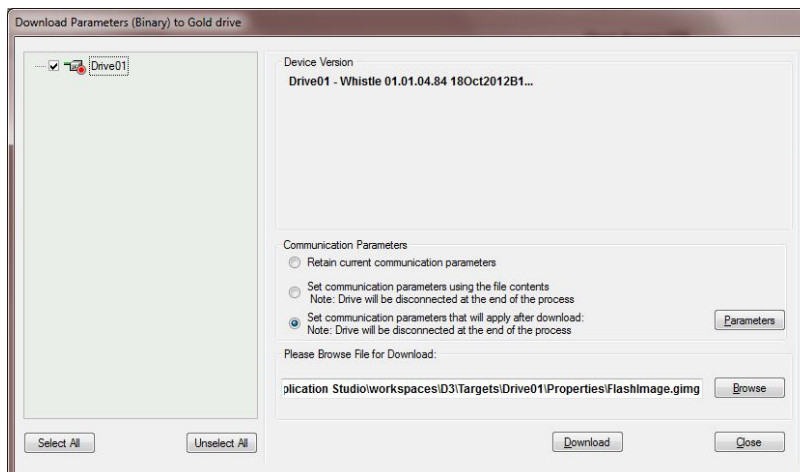
- a. Retain current communication parameters configured at the drive setup and ignore the communication parameters within the binary file to be downloaded in this procedure.



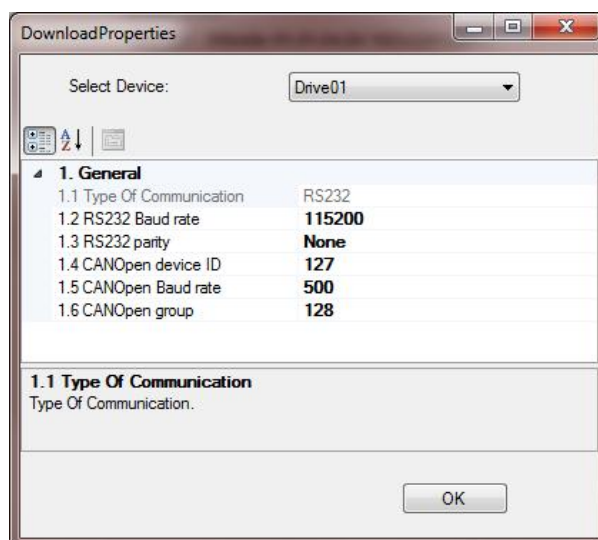
- b. When the binary parameters are downloaded to the drive, they will override the present parameters configured at the drive setup.



- c. Manually reconfigure the communication parameters at this point, to be applied after the download of the parameters binary file, and ignoring the communication settings within the file.

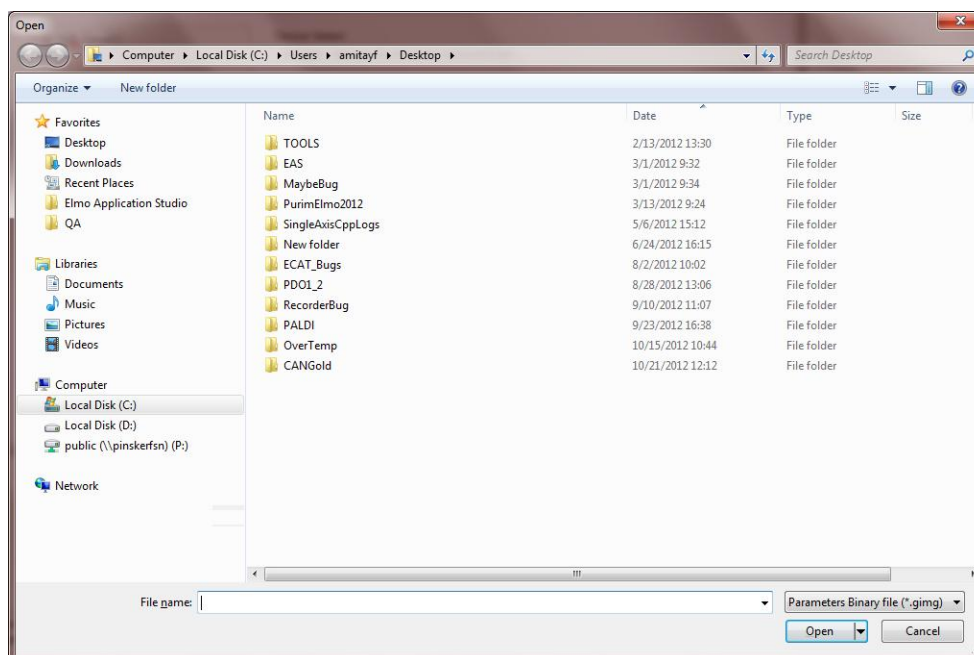


Click **Parameters**. The *Download Properties* window box opens.

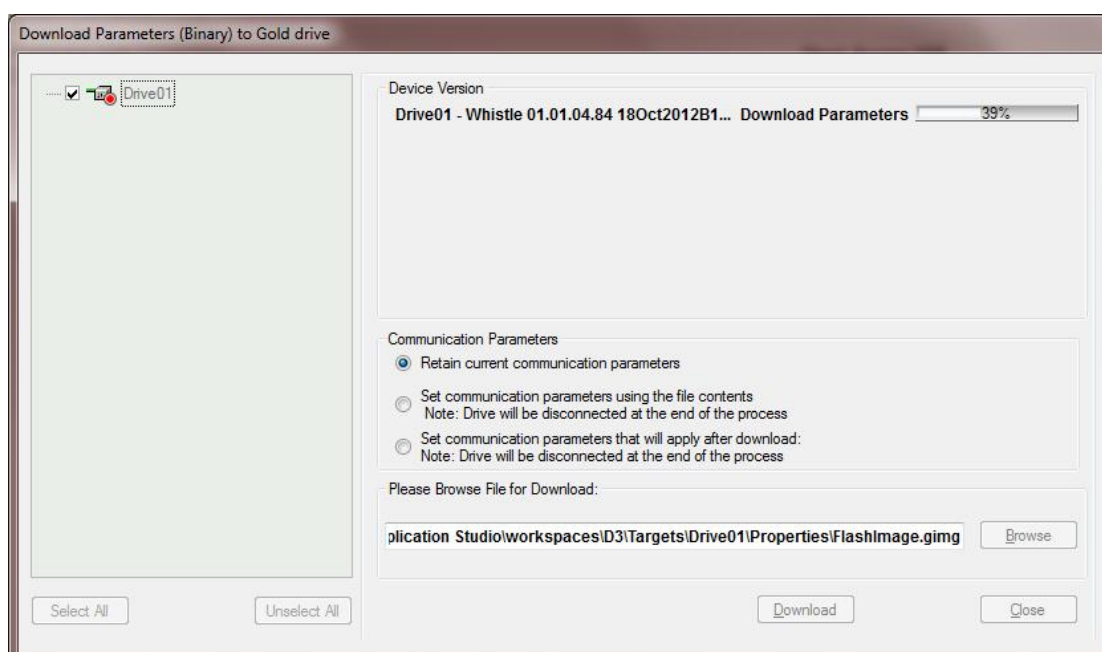


Manually change the parameters as necessary. Then click **OK**.

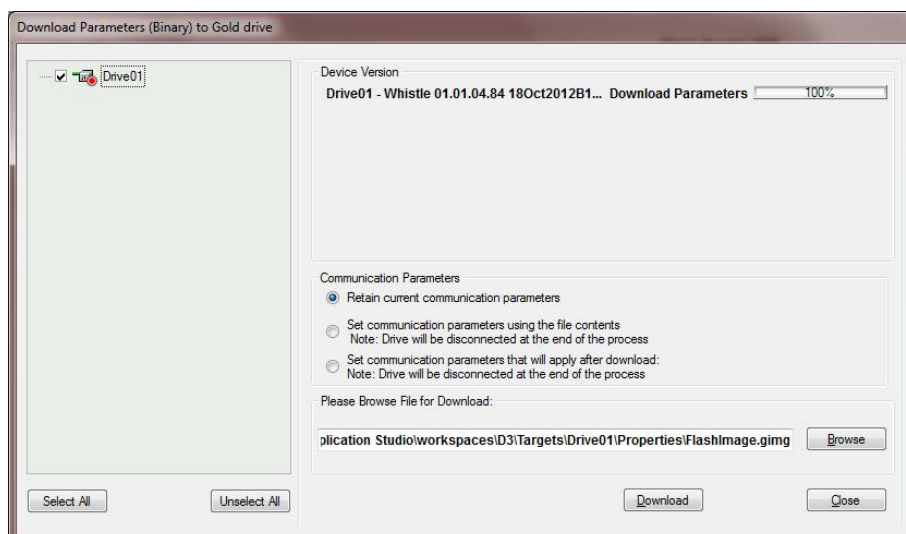
4. Click **Browse**.
5. Locate the Parameters Binary File. Click **Open** to open the FlashImage file.



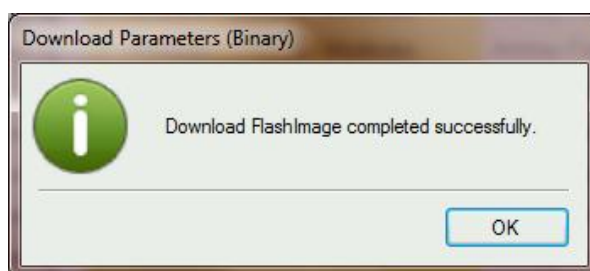
6. Click **Download** to download the Parameters binary file. The progress bar displays the progress of the download.



7. When the progress bar reach 100%, click **Close** to close the download window.



8. The Completed Successfully window box opens. Click **OK** to close it.



3.3.7.4 Download Parameters (Textual) to Gold Drive

3.3.7.5 Download Parameters (Binary) to SimplIQ Drive

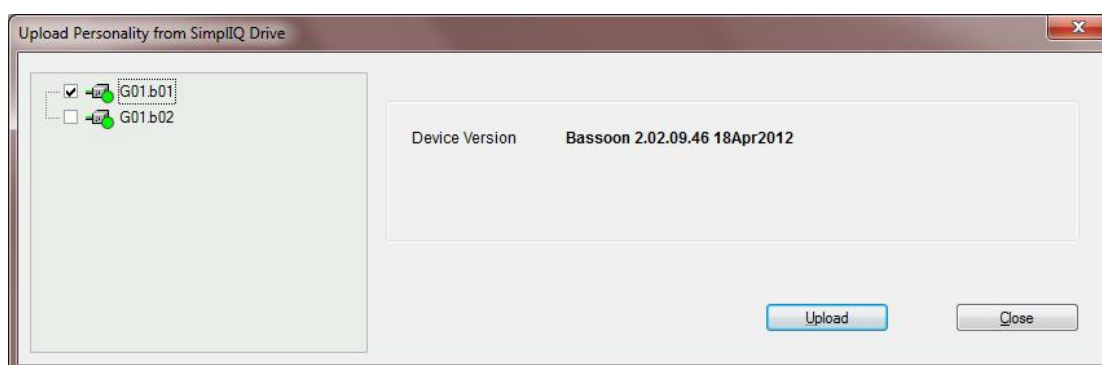
3.3.7.6 Download Parameters (Textual) to SimplIQ Drive

3.3.7.7 Upload Parameters (Binary) from SimplIQ Drive

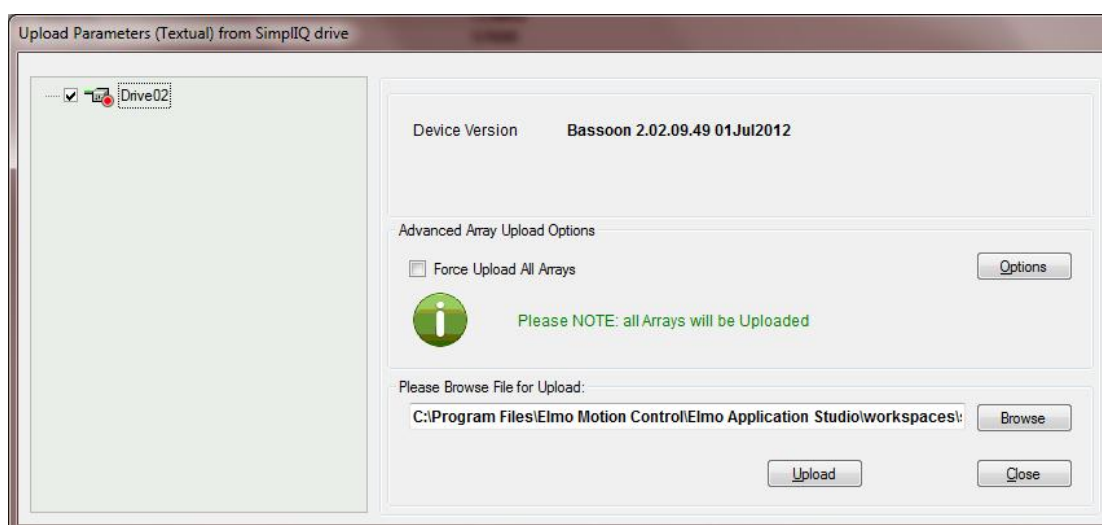
3.3.7.8 Upload Parameters (Textual) from SimplIQ Drive

To upload the Parameters (Textual) from the SimplIQ drive:

1. Make sure that the SimplIQ drive is active.
2. From the main window top right, click the icon .
3. From the menu that appears, select **Upload Parameters (Textual) from the SimplIQ Drive**.
4. Select whether to Force Upload of all Array parameters or individual drives.



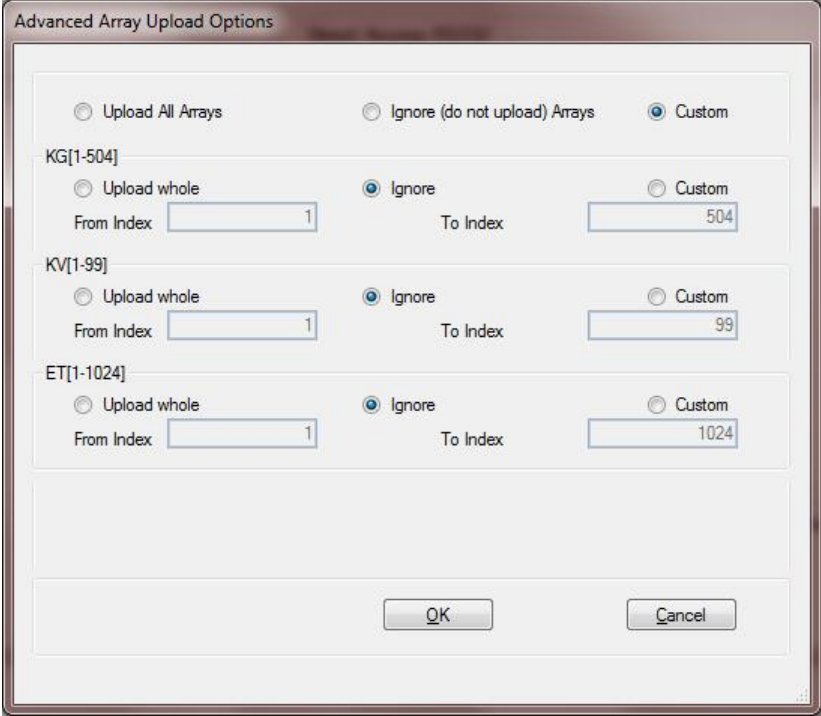
If the checkbox next to Forced Upload All Arrays is not selected, click **Options** at the right side.



The Advanced Array Upload Options window opens. This window box allows you to manually select whether to **Upload All Arrays**, **Ignore the Arrays**, or **Custom** - meaning manually enter values for each of the Command parameters which will be uploaded.

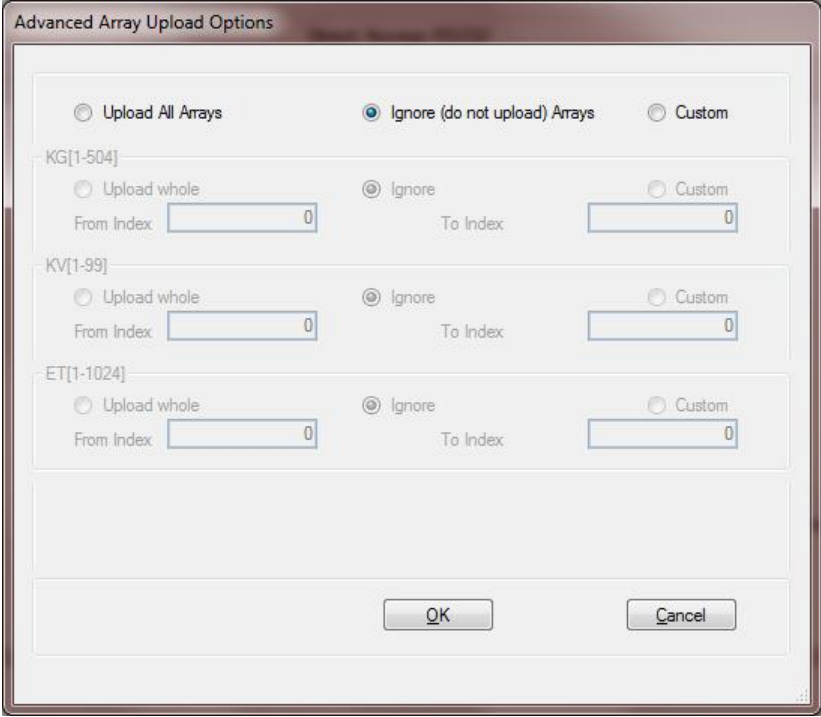
Select one of the following:

- a. **Custom**, to manually enter values for each of the Command parameters shown in the window below.



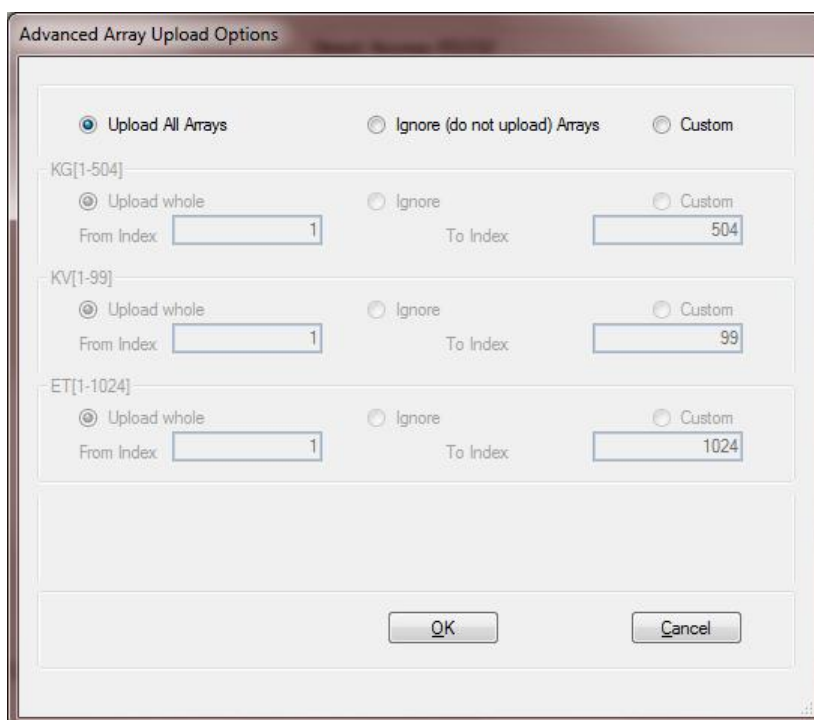
The dialog box titled "Advanced Array Upload Options" contains three radio buttons at the top: "Upload All Arrays", "Ignore (do not upload) Arrays", and "Custom". The "Custom" option is selected. Below this, there are three sections for different array types: KG[1-504], KV[1-99], and ET[1-1024]. Each section has three radio buttons: "Upload whole", "Ignore", and "Custom". The "Ignore" option is selected for all three sections. For each section, there are input fields for "From Index" and "To Index". For KG, the values are 1 and 504. For KV, the values are 1 and 99. For ET, the values are 1 and 1024. At the bottom, there are "OK" and "Cancel" buttons.

- b. **Ignore Arrays**, to only upload individual parameters of the relevant drive.

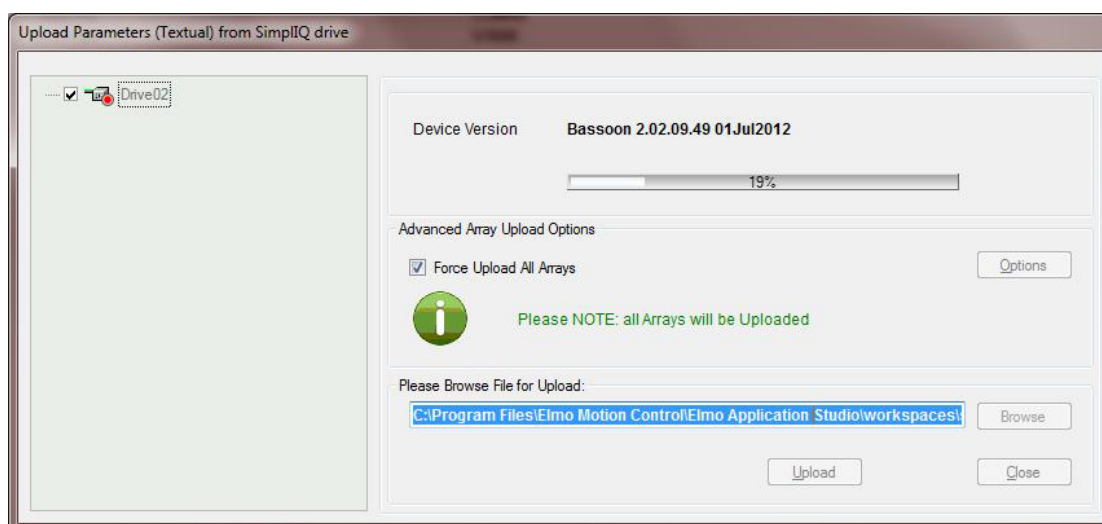


The dialog box titled "Advanced Array Upload Options" contains three radio buttons at the top: "Upload All Arrays", "Ignore (do not upload) Arrays", and "Custom". The "Ignore (do not upload) Arrays" option is selected. Below this, there are three sections for different array types: KG[1-504], KV[1-99], and ET[1-1024]. Each section has three radio buttons: "Upload whole", "Ignore", and "Custom". The "Ignore" option is selected for all three sections. For each section, there are input fields for "From Index" and "To Index". For KG, the values are 0 and 0. For KV, the values are 0 and 0. For ET, the values are 0 and 0. At the bottom, there are "OK" and "Cancel" buttons.

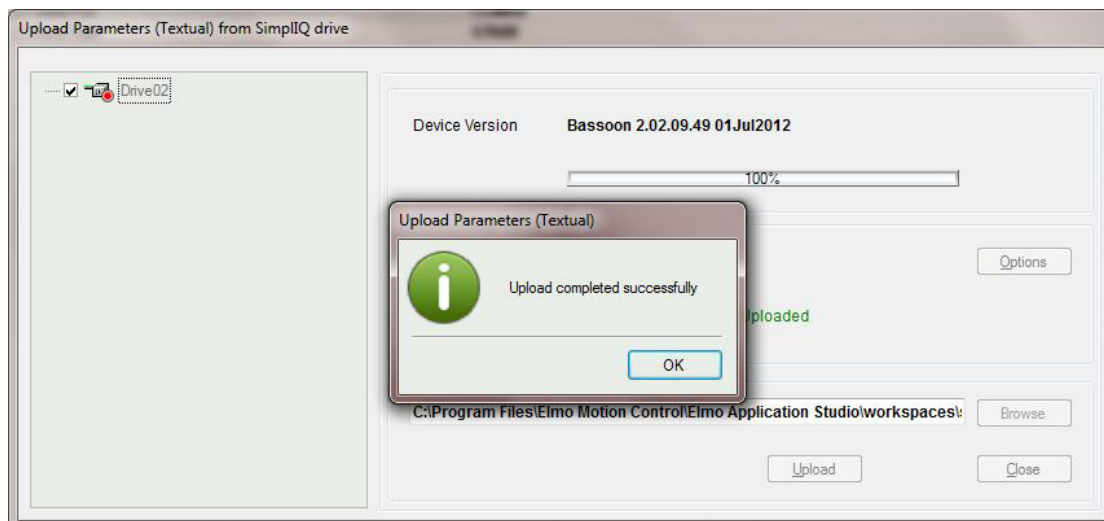
- c. **Upload All Arrays**, to upload all array parameters.



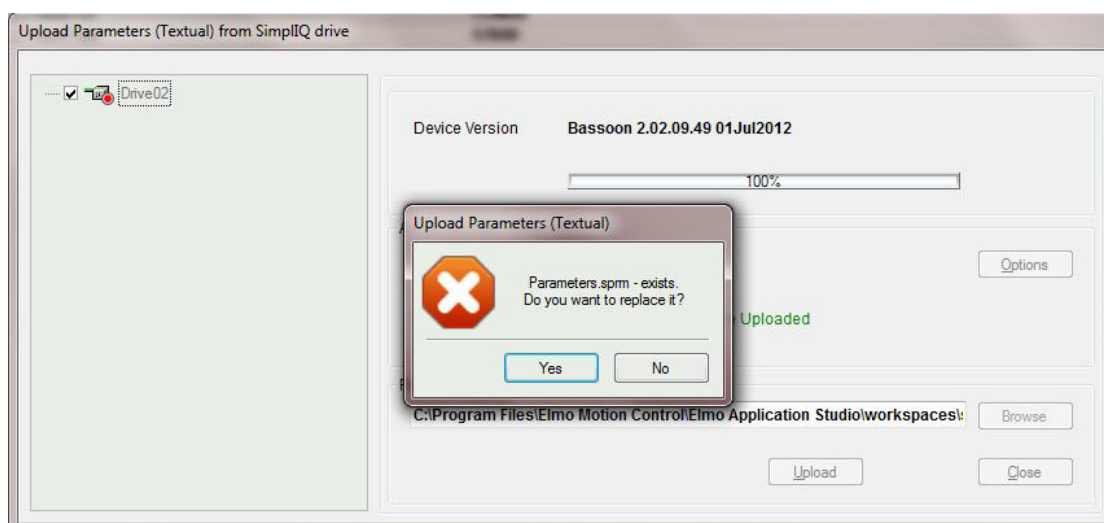
5. After performing the relevant selection in the Advanced Array Upload Options window, click **OK**.
6. In the main upload window, click **Browse**.
7. Locate the Parameters Binary File. Click **Open** to open the FlashImage file.
8. Click **Upload** to start the upload process. A progress bar displays the progress of the upload.



9. When completed the Completed Successfully window appears.



If you repeat the upload for any reason, a new window will open asking whether you wish to overwrite the present FlashImage file present in the EAS directory. Select **Yes** or **No** for whatever circumstances is relevant.



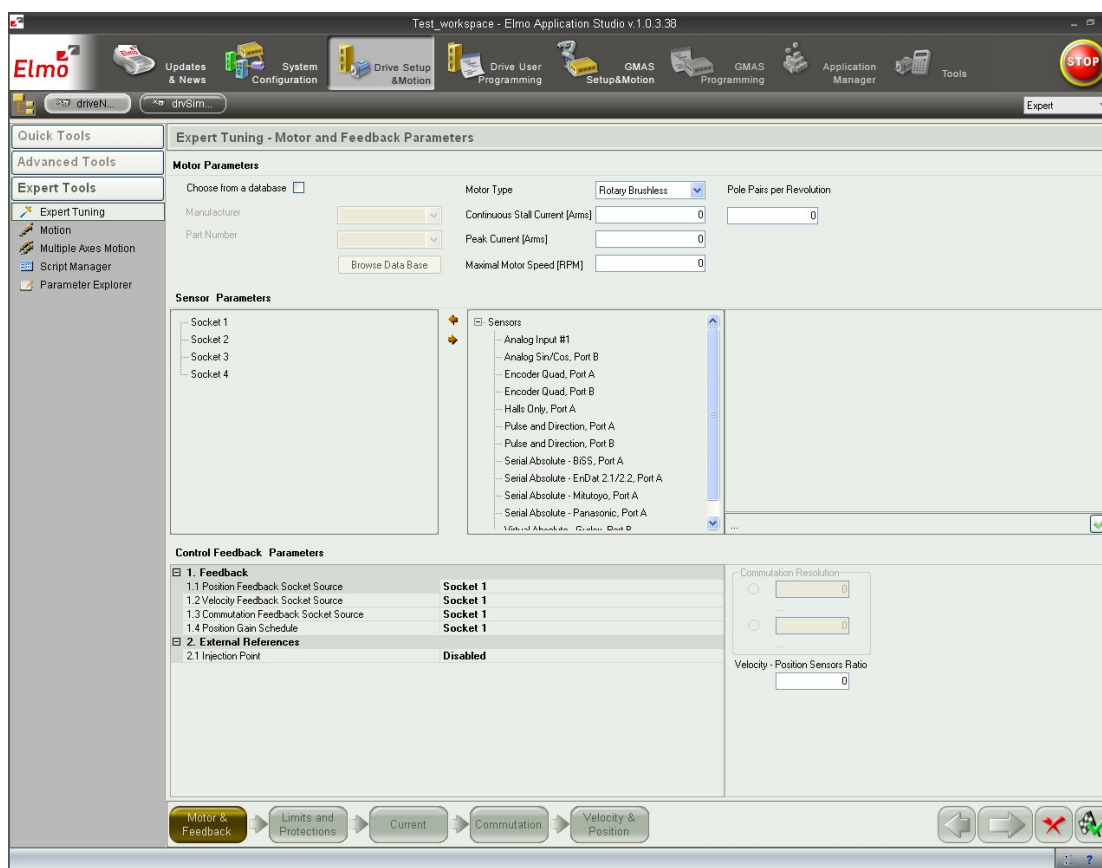
3.3.8 Download Boot to Gold Drive Via FoE

3.3.9 Download Resource File to G-MAS

3.3.10 Upload Resource File from G-MAS

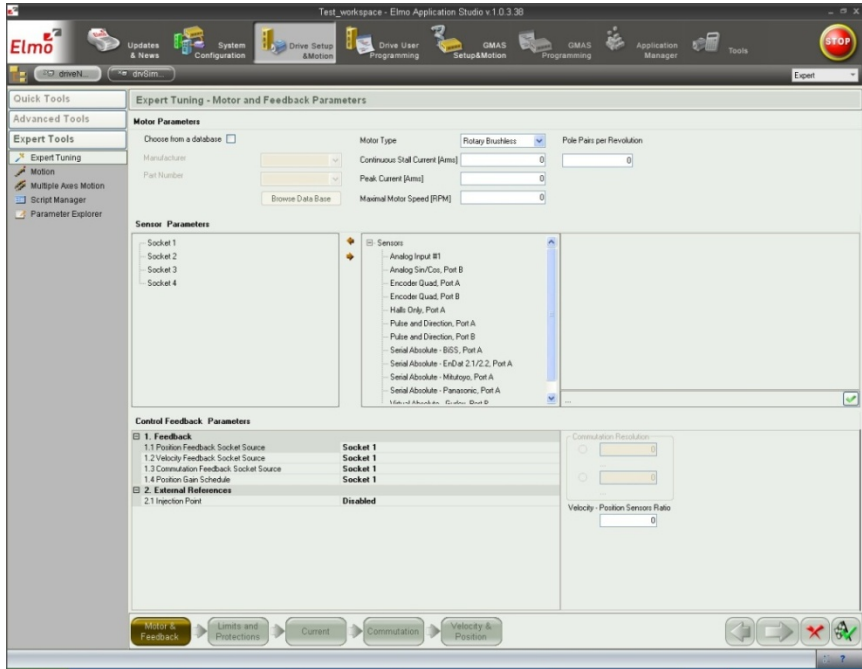
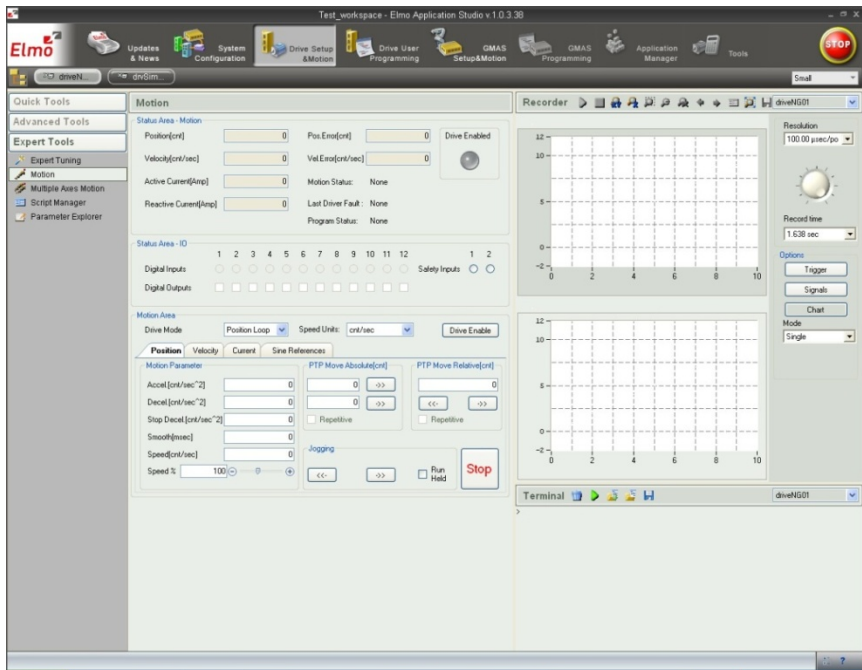
4 Drive Setup and Motion

The Drive Setup and Motion window is opened by click the icon . The window displays the following.



The Drive Setup and Motion window offers a number of selective activities to test and run your configuration of devices.

The following activities are available:

Activity	Explanation
Expert Tuning	Professional tuning of the servo drives.  For further details refer to the section 4.1 on page 130.
Motion	Detailed single axis motion using motion parameters built into the device.  For further details, refer to the section 4.2 on page 211.
Multiple Axes	Detailed multiple axis motion using motion parameters common to the multi-

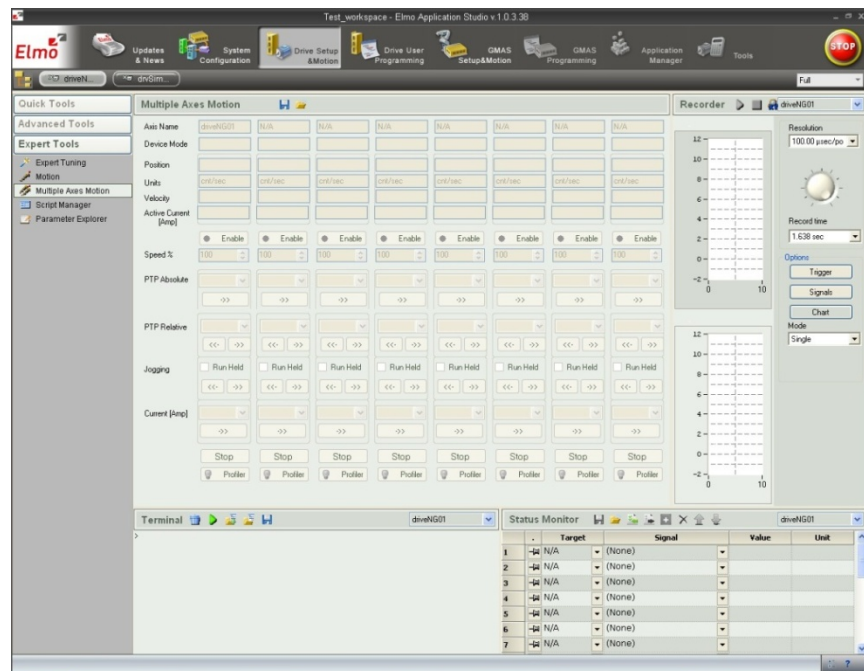


Activity

Explanation

Motion

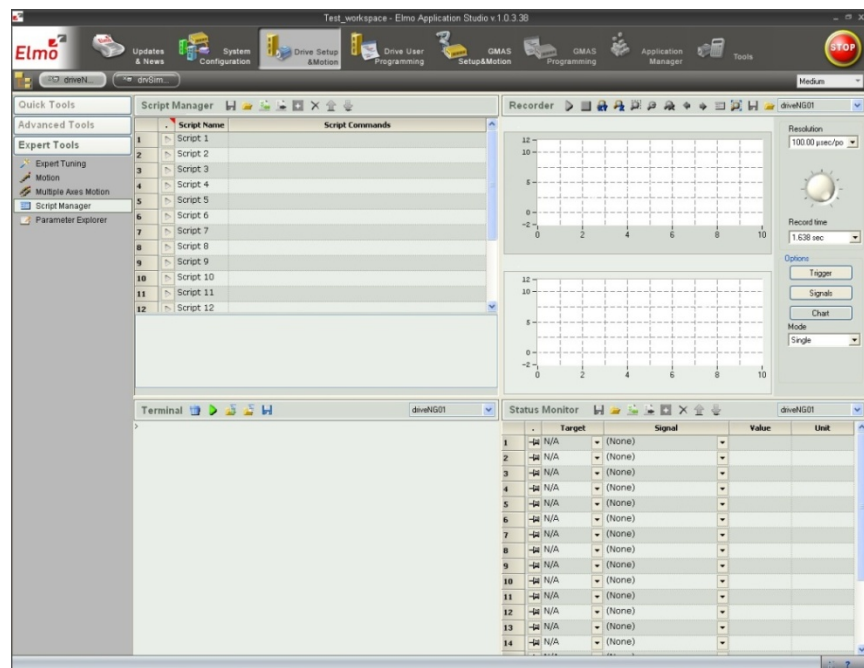
axes.



For further details, refer to the section 4.4 on page 255.

Script Manager

Create, save, load, organize and run a series of drive commands in the form of scripts.



For further details, refer to the section 4.5 on page 267.

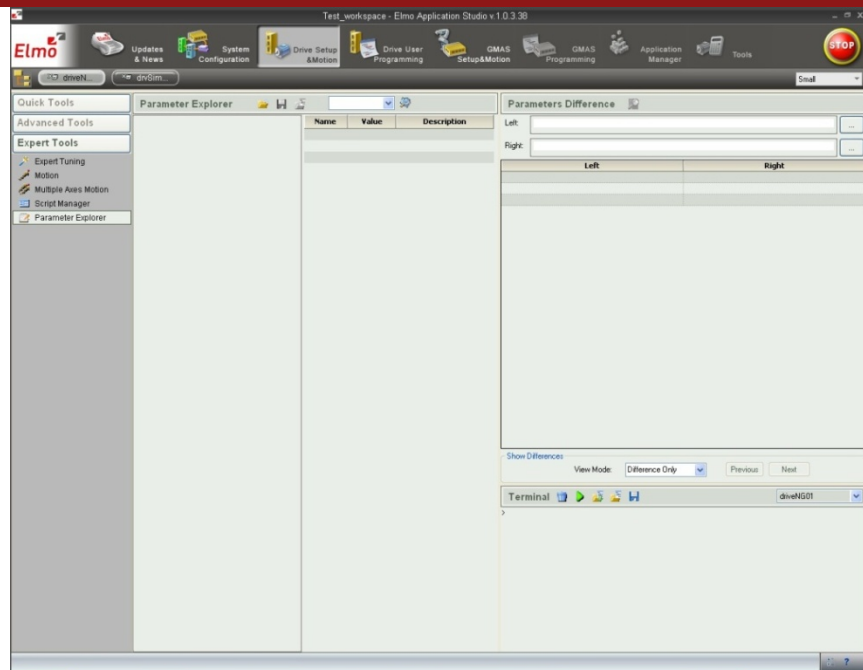
Parameter Explorer

View, Edit, Upload, and Save all drive parameters and Compare their files.



Activity

Explanation



For further details, refer to the section 4.6 on page 271.

4.1 Tuning a Gold Line Drive

4.1.1 Expert Tuning Wizard

The Expert Tuning wizard is a systematic process that helps the user set up all the parameters necessary for motion.

The EAS Wizard is similar to other popular software wizards used to install programs or assist the user in other streamlined processes. Like other wizards, the EAS wizard can be used as a systematic guide that progress you through all the necessary stages to produce a tuned, moving motor. Complete each stage fully and then move either to the next stage using the **Next** button or by clicking on the designated wizard button.

Unlike other wizards, you are allowed to move back and forth between the various screens. You can go to an advanced stage without completing previous stages, and you can go back and change setting in a previous screen. This flexibility provides the expert user with access to all the configuration and tuning tools at all times.

Obviously, sometimes skipping makes no sense. In some situations, this will result in system warnings, in other cases unexpected behavior or even damage can occur. The tuning wizard is a tool for experts, and should only be used if is fully understood.

For Experts only

Before performing the Tuning Wizard Tool, make sure that the defaults set in the EAS Settings window are appropriate for the system of drives, motion controllers, etc. you wish to Tune. To access these default settings refer to section 10.1 EAS Settings on page 413.

Warning: Change any settings with extreme caution. Incorrect settings could cause irreparable damage to your systems.

4.1.1.1 When is the information saved?

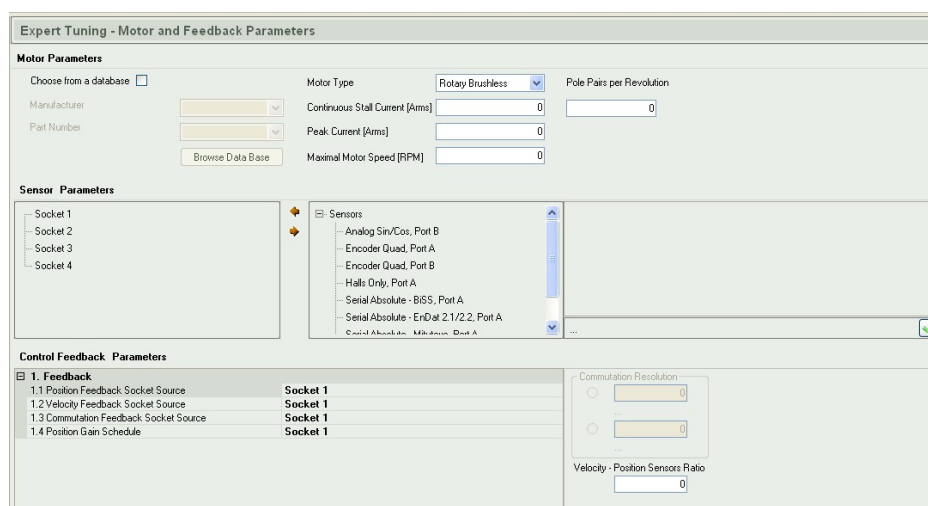
The information that is entered during the tuning process is not sent to the drive until each page is completed and the user moves to another page. When the user leaves a page, the information entered is sent to the drive and saved in the RAM.

When the **Finish** or **Apply** button is clicked, the information is saved to flash only.

4.1.1.2 Expert Tuning Procedure

To Tune a drive

1. Enter **Motor and Feedback** parameters – Enter the main motor parameters and feedback configuration.



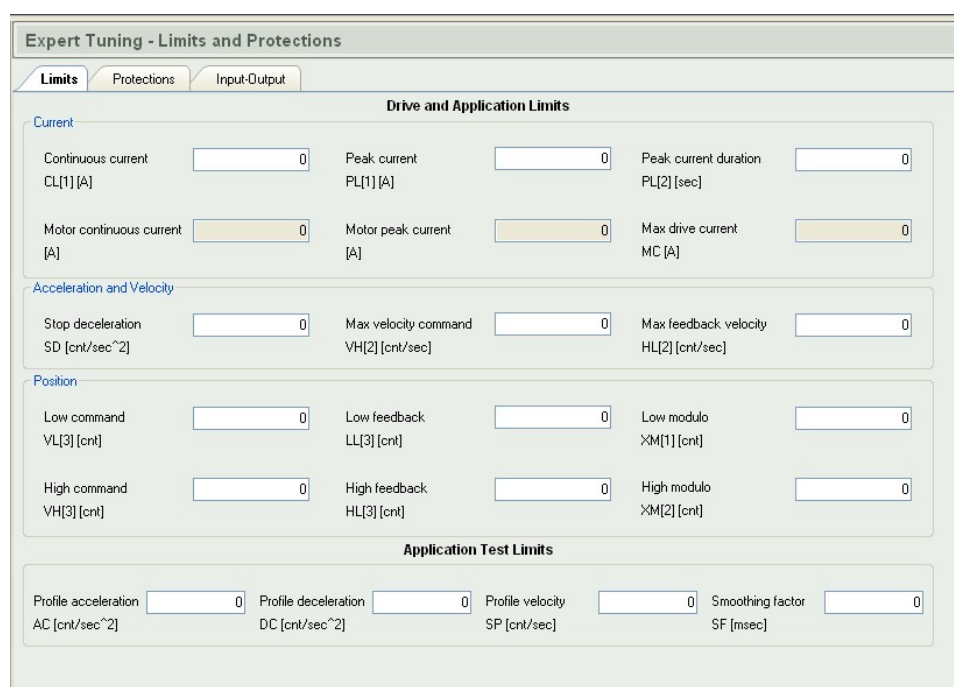
The dialog box is titled "Expert Tuning - Motor and Feedback Parameters". It is divided into three main sections:

- Motor Parameters:** Includes a "Choose from a database" checkbox, "Manufacturer" and "Part Number" dropdowns, a "Browse Data Base" button, "Motor Type" (Rotary Brushless), "Pole Pairs per Revolution" (0), "Continuous Stall Current [Amps]" (0), "Peak Current [Amps]" (0), and "Maximal Motor Speed [RPM]" (0).
- Sensor Parameters:** Includes a list of sockets (Socket 1, Socket 2, Socket 3, Socket 4) and a "Sensors" list with options like "Analog Sin/Cos, Port B", "Encoder Quad, Port A", "Encoder Quad, Port B", "Halls Only, Port A", "Serial Absolute - BiSS, Port A", "Serial Absolute - EnDat 2.1/2.2, Port A", and "Serial Absolute - Modbus, Port A".
- Control Feedback Parameters:** Includes a "1. Feedback" section with a table:

	Socket 1
1.1 Position Feedback Socket Source	Socket 1
1.2 Velocity Feedback Socket Source	Socket 1
1.3 Commutation Feedback Socket Source	Socket 1
1.4 Position Gain Schedule	Socket 1

Additional settings include "Commutation Resolution" (0) and "Velocity - Position Sensors Ratio" (0).

2. Set up **Limits and Protections** – Determine limits to the current and motion commands and values, define maximum errors, Bus Voltage, motor stuck, brake parameters and set up the I/O settings.



The dialog box is titled "Expert Tuning - Limits and Protections". It has three tabs: "Limits", "Protections", and "Input-Output". The "Limits" tab is active, showing "Drive and Application Limits".

Current:

- Continuous current CL[1] [A]: 0
- Motor continuous current [A]: 0
- Peak current PL[1] [A]: 0
- Motor peak current [A]: 0
- Peak current duration PL[2] [sec]: 0
- Max drive current MC [A]: 0

Acceleration and Velocity:

- Stop deceleration SD [cnt/sec^2]: 0
- Max velocity command VH[2] [cnt/sec]: 0
- Max feedback velocity HL[2] [cnt/sec]: 0

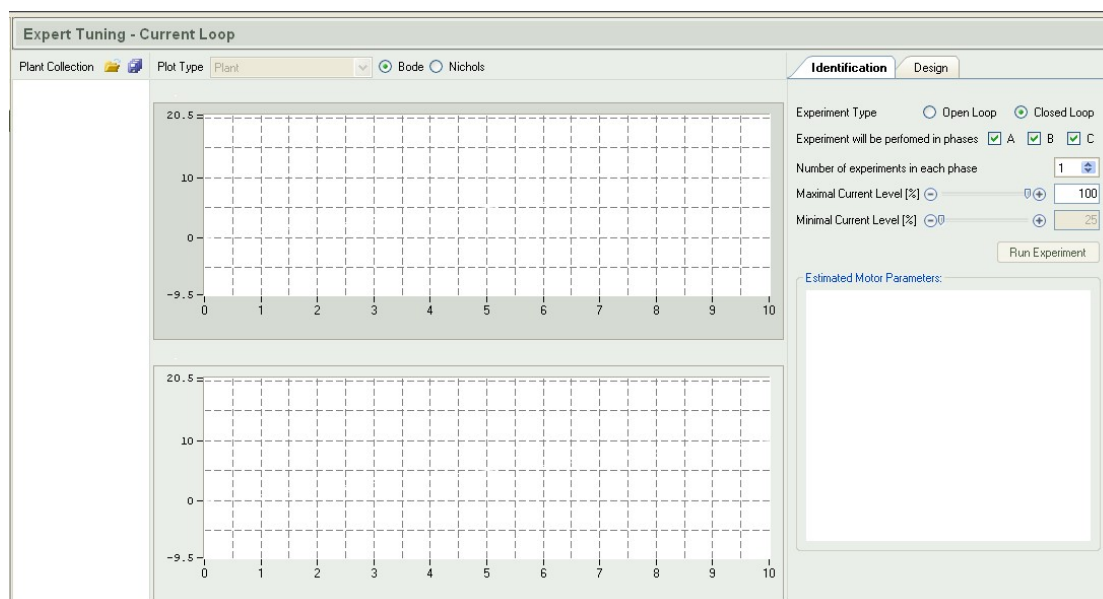
Position:

- Low command VL[3] [cnt]: 0
- Low feedback LL[3] [cnt]: 0
- Low modulo XM[1] [cnt]: 0
- High command VH[3] [cnt]: 0
- High feedback HL[3] [cnt]: 0
- High modulo XM[2] [cnt]: 0

Application Test Limits:

- Profile acceleration AC [cnt/sec^2]: 0
- Profile deceleration DC [cnt/sec^2]: 0
- Profile velocity SP [cnt/sec]: 0
- Smoother factor SF [msec]: 0

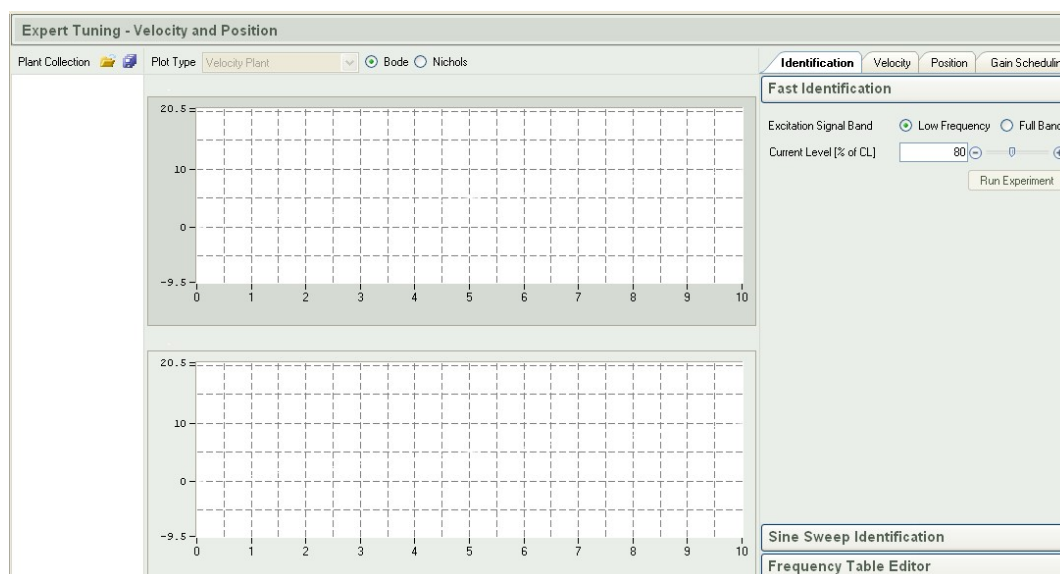
3. Identify the current response characteristics of your plant and design a **current controller** that meets your system requirements.



4. Automatically configure the **commutation order** to comply with the wiring of the phases. If analog feedback is used, it can be calibrated now.

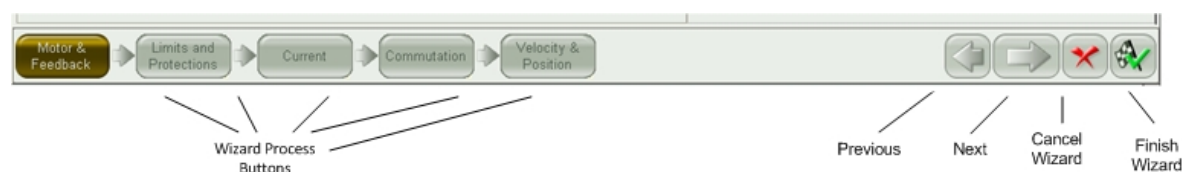


5. Identify the velocity and position response characteristics of your plant, and design a **velocity controller** and a **position controller** that meet your system requirements.



4.1.1.3 The Expert Tuning Wizard Toolbar

The Expert Tuning Wizard toolbar appears at the lower part of each Tuning Wizard screen.



The toolbar buttons control the flow of the Tuning Wizard process.

To use the Expert Tuning Wizard Toolbar

1. After entering all the required data in a wizard step, click **Next** to proceed to the next step.
2. When the **Next** button is clicked, all the information gathered in the current step is translated by EAS into drive parameters and sent via communication to the drive.

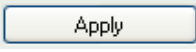
The information is kept in the RAM memory of the drive.

3. Click **Finish** to save all the parameters currently stored in the RAM to the drive's flash memory.

It is important to note that when opening the EAS application and performing the Expert Tuning wizard for the first time, it is recommended to following each procedural step systematically. When repeating the wizard for the same system, it is not necessary to follow the systematic steps, but you can click which step requires changing, in any order, and click the Finish button to complete the wizard and perform the analysis.



When you enter information in the wizard this information is not immediately sent via communication to the drive. Information is sent to the drive when you do one of the following:

- Click the **Next** button
- Click the **Apply** button ( or ) that appears in some of the windows

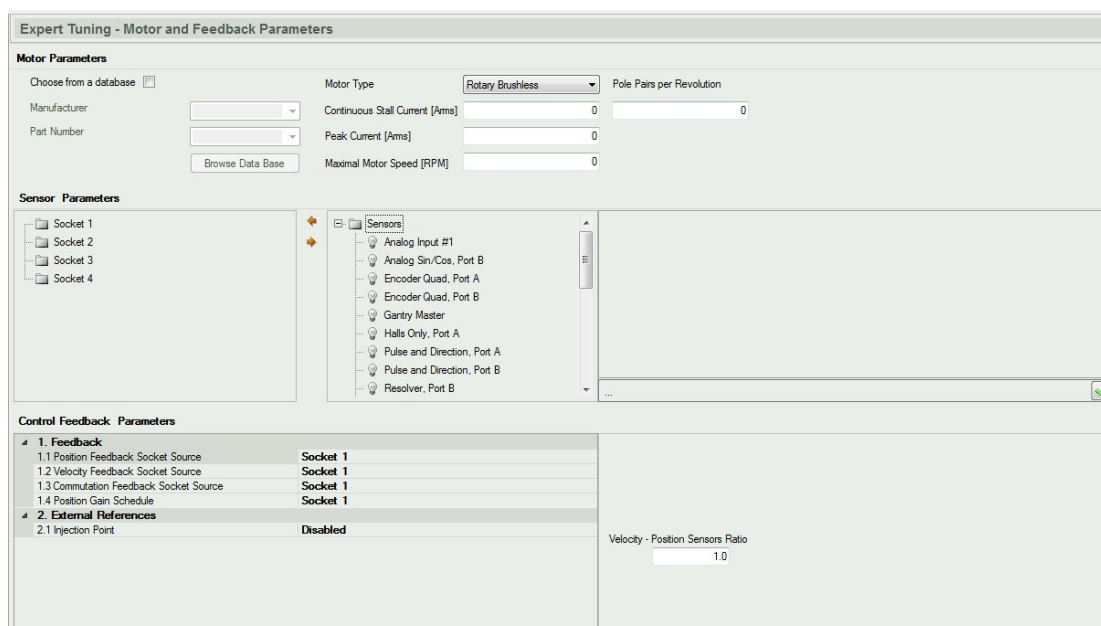
When you click the **Next** button all the parameters that you changed until now are sent to the drive's RAM memory. When you click **Apply** only the parameters that are relevant to the current task are sent to the drive's RAM memory.

To save parameters to the drive's Flash memory click **Finish**. The **Finish** button sends an "SV" command to the drive. This means that all the parameters currently stored in the RAM are saved to Flash. Clicking this button **does not send data to the drive**. This means that in order to save the work done on the current wizard page, you should first click **Next** to send the new parameters to the drive and then click **Finish** to save them.

It is good practice to upload and save your current drive parameters if you want to return to the original state of the drive after trying to make changes. To save the parameter file use the **System Tools** button refer to the section 3.3.1 The System Tools Button.

4.1.2 Motor and Feedback

In this window, the user enters the motor and feedback basic data.



Expert Tuning - Motor and Feedback Parameters

Motor Parameters

Choose from a database ☐ Motor Type: Rotary Brushless Pole Pairs per Revolution: 0

Manufacturer: [] Continuous Stall Current [Amps]: 0

Part Number: [] Peak Current [Amps]: 0

Browse Data Base Maximal Motor Speed [RPM]: 0

Sensor Parameters

Socket 1, Socket 2, Socket 3, Socket 4

Sensors: Analog Input #1, Analog Sin/Cos, Port B, Encoder Quad, Port A, Encoder Quad, Port B, Gantry Master, Halls Only, Port A, Pulse and Direction, Port A, Pulse and Direction, Port B, Resolver, Port B

Control Feedback Parameters

1. Feedback

1.1 Position Feedback Socket Source: Socket 1

1.2 Velocity Feedback Socket Source: Socket 1

1.3 Commutation Feedback Socket Source: Socket 1

1.4 Position Gain Schedule: Socket 1

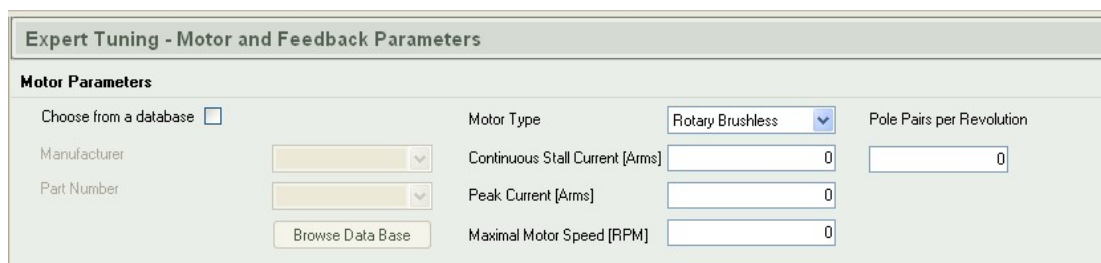
2. External References

2.1 Injection Point: Disabled

Velocity - Position Sensors Ratio: 1.0

4.1.2.1 Motor Parameters

For rotary brushless, brush, and stepper motors, this area is displayed accordingly:



Expert Tuning - Motor and Feedback Parameters

Motor Parameters

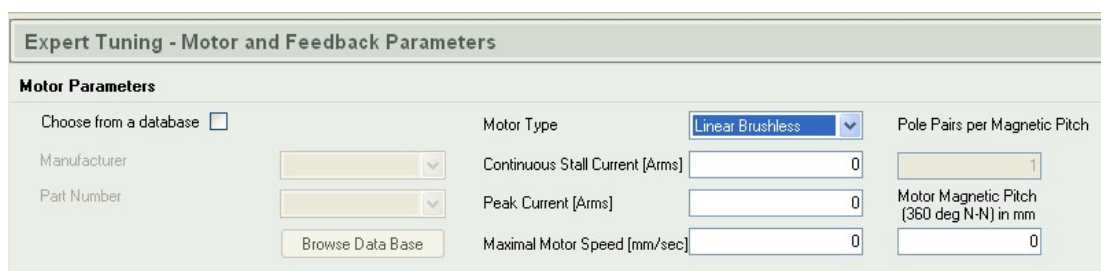
Choose from a database ☐ Motor Type: Rotary Brushless Pole Pairs per Revolution: 0

Manufacturer: [] Continuous Stall Current [Amps]: 0

Part Number: [] Peak Current [Amps]: 0

Browse Data Base Maximal Motor Speed [RPM]: 0

For a linear brushless, DC, and stepper motors, this area is displayed accordingly:



Expert Tuning - Motor and Feedback Parameters

Motor Parameters

Choose from a database ☐ Motor Type: Linear Brushless Pole Pairs per Magnetic Pitch: 1

Manufacturer: [] Continuous Stall Current [Amps]: 0

Part Number: [] Peak Current [Amps]: 0

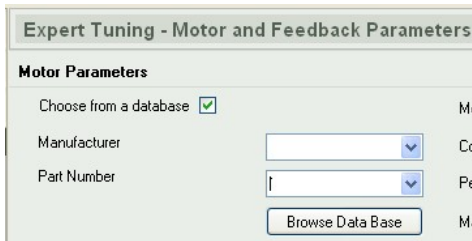
Browse Data Base Maximal Motor Speed [mm/sec]: 0

Motor Magnetic Pitch (360 deg N-N) in mm: 0

Within this area, you can manually enter the motor's basic information (or select your motor from an existing database – available in the future). The motor database includes motor parameters for motors from several manufacturers. This database is updated from time to time. If you cannot find the motor you are using, make sure you have the latest version of EAS, it may have been added lately.

The information includes the current and speed limits for the appropriate motor, which should be entered in the motor parameters area:

Choose from a data base Checkbox. Check to select a motor from the database (This option is not available yet. Check Elmo's website for the latest version)

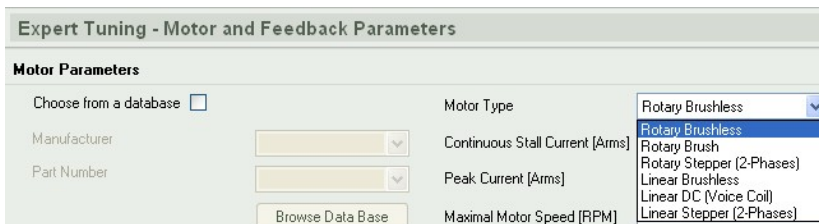


Manufacturer Select the manufacturer of the motor you are using from a list of manufacturers that are in the data base

Part Number Select the part number of your motor from a list of motors that are in the data base

Browse DataBase Future Option. Click this button to cause EAS to locate the motor parameters for your motor in the database. The parameters will appear in the appropriate fields.

Motor Type Select motor type from list:



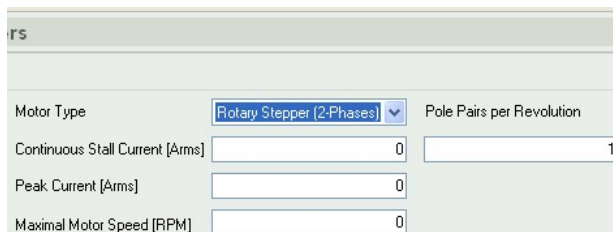
Continuous Stall Current, Amplitude RMS Current only for the Brushless, and Stepper (2-phased) of the motor's maximum allowed stall current.

Peak Current, Amplitude Peak RMS Current only for the Brushless, and Stepper (2-phased) of the maximum allowed current according to the motor's manufacturer data sheet. These two parameters use a restriction in the drive parameters **CL[1]** continuous and **PL[1]** peak current as explained below.

Maximal motor speed, RPM The maximum allowed motor speed in RPM (in the rotary motor) or in mm/sec (in linear motor) according to the motor manufacturer's data sheet. The command is limited to the value **VH[2]** equivalent in RPM units calculated by the commutation resolution.

Pole pairs per rev.

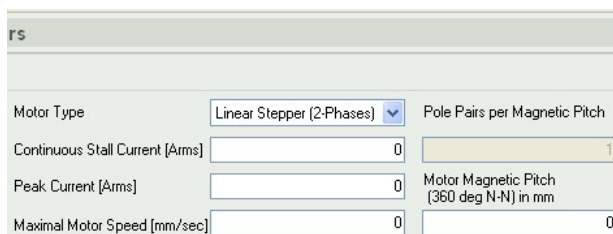
The number of motor pole pairs per revolution (for rotary brushless motors). If unknown, this field should be set to 0, otherwise set the value to a known number. During commutation tuning, the correct number of pole pairs will be detected. If the number entered here is different from the detected number (and not zero), the user will be prompted for the correct number.



Motor Type	Rotary Stepper (2-Phases)	Pole Pairs per Revolution
Continuous Stall Current [Amps]	0	1
Peak Current [Amps]	0	
Maximal Motor Speed [RPM]	0	

Pole per magnetic pitch

For linear motors, the magnetic pitch is required, where the resolution is calculated by one magnetic pitch.



Motor Type	Linear Stepper (2-Phases)	Pole Pairs per Magnetic Pitch
Continuous Stall Current [Amps]	0	1
Peak Current [Amps]	0	
Maximal Motor Speed [mm/sec]	0	

Motor Magnetic Pitch in mm

(Only for linear motors) The length of one electrical cycle in mm

The continuous stall current determines the maximum current that the drive is allowed to supply continuously without damaging the motor. This parameter is limited by (maximum phase current of the drive)/2 (for most drives), and continuous current in drive (**CL[1]**) is limited by this parameter.

The peak current command is additionally limited by the drive peak current (MC), together with its limited (by this parameter) peak current in drive (**PL[1]**). The peak current can only be supplied during a short period of time that is set by entering **Peak Current Duration** in the **Limits and Protections** tab (Refer to the section 4.1.3.1). For a full explanation of the current limiting mechanism in the drive, refer to the Language and User Program Guide, and Command Reference Guide.

4.1.2.2 Serial Absolute Encoders/Sensors

The SimplIQ Line servo-drives use the serial interface information in absolute serial interfaces encoders, only for startup position locking and then switch to the Sin/Cos mode (this is not relevant in the Gold Line). However, the Gold Line servo-drives support various types of true absolute serial interfaces encoders, and use the serial interfaces of the absolute sensors continuously during real time operation to determine the sensor position.

The position data is acquired by a communication transmission cycle, generated by the servo-drive once every 2nd TS (on the position and velocity loops routines), and is subsequently used for the servo current (commutation), velocity and position loops.

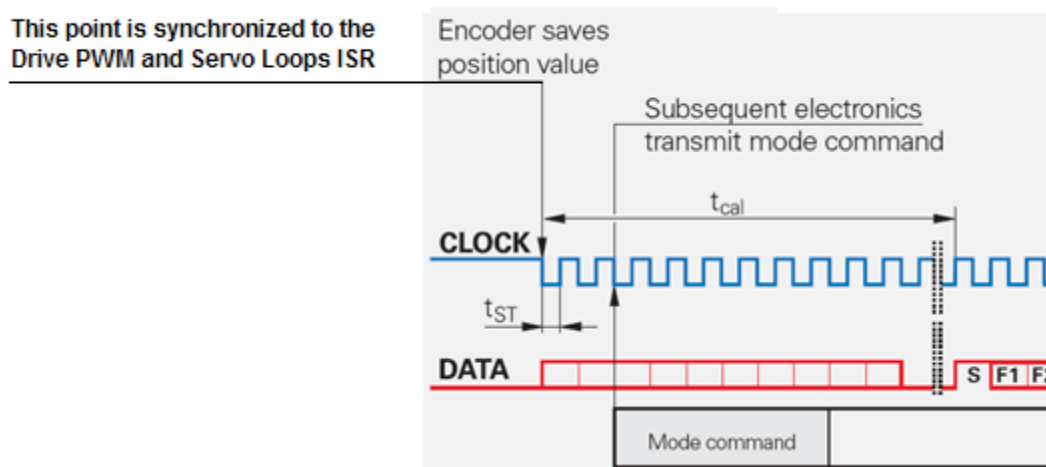
Some of the absolute sensor protocols have up to 96 bits of data (composed of commands / position information / status / errors / CRC codes / etc.), that is retrieved every transmission cycle.

Sensors also require different recovery times, this is the minimal time between each two consecutive transmission cycles, which in some situations, can be as high as 40 μ secs. As the sample rate of the gold servo-drives can be as low as 50 μ secs, the serial absolute position data should be read at rates of at least 10 kHz (each $2 \times T_S$ or 100 μ secs).

For this reason, the Gold servo-drive serial interfaces operate at fast clock rates, of either 2.5 MHz or 1.25 MHz. For some slow (low resolutions) SSI interface encoders, Elmo has also implemented serial interfaces at a frequency of 625 KHz.

It is important to note that using higher transmission rates (> 2.5 MHz) has no advantages whatsoever, as the data is read every velocity loop cycle. Using higher data rates will limit the signal glitch filtering ability, and eventually reduce the transmission immunity to noises.

The communication transmission cycle clock sequence is initiated by the Gold servo-drive CPLD and DSP, and is synchronized to the drive servo control loops ISR and PWM pulses within few nanoseconds (see figure below). This is important, since all absolute sensors also latch (locks) the encoder position value at that point (usually at the falling edge of the first clock of any new transmission cycle). Any jitter in this synchronization will result in significant velocity jitters and will impair the drive servo loop performances.



When working with absolute serial encoders, be aware that since the actual sensor position is sampled by the encoder internal electronics (the controller cannot sample every count like AqB signals), serial absolute encoder velocity readings are calculated by a derivative of the position. $1/T$ is not applicable for serial absolute sensors (similar to Analog Sin/Cos encoders). However, in serial absolute sensors, as they usually have very high inherent resolutions, this provides excellent velocity readings.

Typical serial sensors resolutions usually start from 13 bits per revolution (i.e. 8,192 counts per rev, on the low-end type sensors), and can reach 23, 25, 26 and even 32 bits per revolution. A 25 bits per revolution sensor (like the Heidenhain ECN 1325), is equivalent to 33,554,432 counts per revolution.



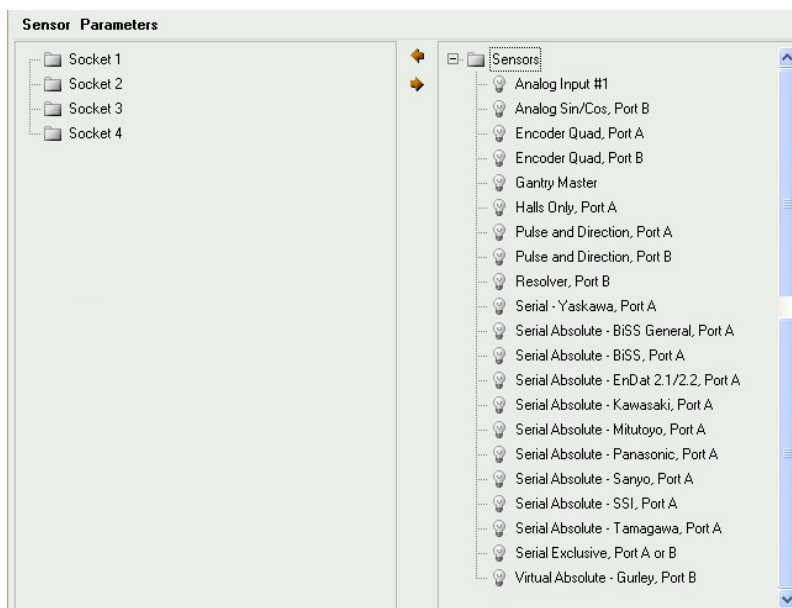
In linear scales, both Renishaw (Linear Resolute series) and Heidenhain (LIC4000 series) offer readily obtainable 1 nanometer resolution sensors.

Working with such high resolutions has certain limitations, mainly related to the position velocity and acceleration numbers dynamic range within the servo-drive.

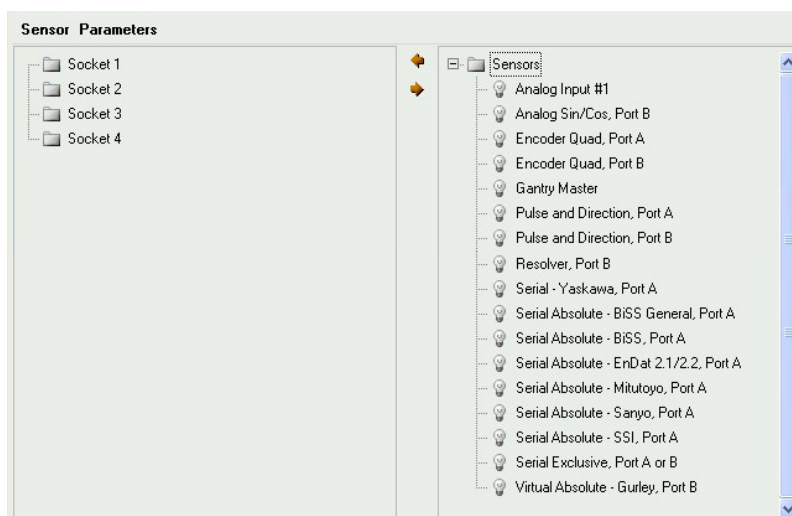
Gold line drives serial encoder interfaces support automatic propagation delay compensation, allowing automatic compensate for different cable length. Elmo has successfully tested sensors with cables length up to 100 Meters.

4.1.2.3 Sensor Parameters

For a Rotary Brushless and Brush motors, the following Encoder sensors are available:



For a Linear Brushless and DC motors, the Encoder sensors available are different:



Within the Sensor Parameters area, the motion sensors are assigned to a socket (explained later) and the main attributes of the sockets are set.

The initial list that appears in this window includes all the available sensors. Once a sensor is connected to a socket, it is removed from the list. Other sensors are also removed from the list if they occupy the same hardware resources as the selected sensor and cannot be connected at the same time.

4.1.2.3.1 What are Sockets?

Sockets are software objects that hold the information and settings of feedback sensors. The Gold Line drives support up to four sockets. Usually, each socket can be assigned to one of

the hardware feedback sensors that are connected to the drive. Virtual sensors are also supported but not discussed here.

Any socket can be used as the feedback source for position loop, velocity loop, commutation, position gain scheduling, or current/velocity/position reference. For example, in dual loop system incremental encoder connected to port B are assigned to Socket 1, the serial absolute sensor on port A is assigned to Socket 2. Socket 1 can be the commutation and velocity source, and socket 2 may be used for position. In another system, it is possible that only an analog encoder is connected, so the same socket is used for all the above purposes.

4.1.2.3.2 Assigning a Sensor to a Socket

To assign a sensor to a socket

1. Select a socket.
2. Select a feedback sensor.
3. Click the left arrow to add the sensor to the socket.
Alternatively, drag the sensor and drop it onto the required socket.

4.1.2.3.3 Socket Parameters

These parameters determine how the drive software treats the signals the socket receives. The available parameters depend on the type of feedback sensor that is assigned to the socket.

When you have completed entering the socket parameters, click **Apply** .

4.1.2.3.3.1 Encoder Quad, for Port A or B

1. General	
1.1 Sensor Name	Encoder Quad, Port A
2. Socket Parameters	
2.1 Direction	Non Invert
2.2 Glitch Filter (cnt/sec)	0
3. Socket Velocity Filter	
3.1 Filter Type	Disabled

Direction

Inverts the counting direction of the socket. It is recommended to leave it as “Non Invert” for the time being. You will be prompted to determine the positive direction of the motor movement later in the tuning wizard.

Glitch Filter(cnt/sec)

The Glitch filter option allows the user to filter noises in the encoder A/B/Index signal lines. It is set as a function of Frequency. The Glitch Filter Frequency settings, defines the Max allowable Encoder Count frequency in Counts/sec. It is usually recommended that this number will be set at least x10 of the max expected application encoder frequency, due to the get short delay and by that high resolution of 1/T speed calculation.

The Glitch filter range may be set between 120,000 to 75,000,000 counts/sec. and the Glitch Filter default is 10000000.

Note:

The filter frequency is entered in counts (after quadrature). However, the actual filters will filter the A signal separately and B signal separately (the frequency calculation is automatic assuming 90 degree between the two signals). This is important for encoders in which the inaccurate location of the optical sensors in the encoder may cause the shift between the A and B pulses to be different by 90°.

Socket Velocity Filter Filter Type

By default, this filter should be disabled. In some systems, usually with analog sensor or due to sensor problems (like burst in interpolators), the velocity reading may be very different from one reading to the next. In these cases, consider adding a FIR (Finite Impulse Response) filter to average the velocity reading.

With Quad encoder there is a way to cancel the 1/T speed calculation below a certain speed by setting this speed into

GS[3] parameter.

4.1.2.3.3.2 Analog Sin/Cos, Port B

1. General	
1.1 Sensor Name	Analog Sin/Cos, Port B
2. Socket Parameters	
2.1 Direction	Non Invert
2.2 Multiplication Factor	2
2.3 Glitch Filter (Cycles/sec)	0
3. Socket Velocity Filter	
3.1 Filter Type	Disabled

- Direction** Inverts the counting direction of the socket. It is recommended to leave it as “Non Invert” for the time being. You will be prompted to determine the positive direction of the motor movement later in the tuning wizard.
- Multiplication Factor** Determines the resolution of the reading. This number corresponds with the number of bits in an analog to digital converter interpreting the sine and cosine signals. If there are 10 bits, the resolution is $2^{10} = 1024$ counts per one cycle. This means that 1024 different levels are identified in the cycle of the sine (and cosine). There will be 1024 points of position reading within each feedback cycle. In general:
The sine and cosine signals are divided into $2^{\text{(Multiplication Factor)}}$ parts.
- Glitch Filter (Cycles/sec)** In Analog (Sin/Cos) encoders, the Glitch filter option allows the user to filter noises on the encoder Sine/Cos/Index signal lines. The Glitch Filter Frequency settings, defines the Max allowable Encoder Sine Periods (Before multiplication!) frequency in Cycles/sec. It is usually recommended that this number will be set at least x100 of the max expected Sine Period Frequency.
The Glitch filter range may be set between 30,000 to 18,750,000 cycles/sec .
- Socket Velocity Filter Filter Type** By default, this filter should be disabled. In some systems, usually with an analog sensor or due to sensor problems (like burst in interpolators), the velocity reading may be very different from one reading to the next. In these cases, consider adding a FIR (Finite Impulse Response) filter to average the velocity reading.

4.1.2.3.3.3 Halls Only, Port A

1. General	
1.1 Sensor Name	Halls Only, Port A
2. Socket Parameters	
2.1 Direction	Non Invert
3. Socket Velocity Filter	
3.1 Filter Type	Disabled

...



- Direction** Inverts the counting direction of the socket. It is recommended to leave it as “Non Invert” for the time being. You will be prompted to determine the positive direction of the motor movement later in the tuning wizard.
- Socket Velocity Filter Type** By default, this filter should be disabled. In some systems, usually with analog sensor or due to sensor problems (like burst in interpolators), the velocity reading may be very different from one reading to the next. In these cases, consider adding a FIR (Finite Impulse Response) filter to average the velocity reading.
- With high speed spindle with Hall sensor, it is recommended to turn off the 1/T speed calculation (by setting any value to GS[3]) and using 8 points of FIR filters.

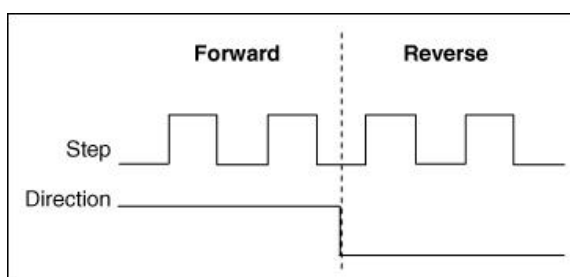
4.1.2.3.3.4 Pulse and Direction, for Port A and B

1. General	
1.1 Sensor Name	Pulse and Direction, Port A
2. Socket Parameters	
2.1 Direction	Non Invert
2.2 Glitch Filter (nanosecond)	0
3. Socket Velocity Filter	
3.1 Filter Type	Disabled

Direction

Inverts the counting direction of the socket. It is recommended to leave it as “Non Invert” for the time being. You will be prompted to determine the positive direction of the motor movement later in the tuning wizard. Usually Pulse and Direction sensor is used as a command reference, so it cannot be inverted in the commutation wizard.

The following example demonstrates the step signal referred to as pulses, and the direction defines the direction we are moving.



Glitch Filter (nanosecond)

The Glitch filter option allows the user to filter noises on the encoder A/B/Index signal lines. It is set as a function of time. The Glitch Filter time settings, defines the minimum allowable time of the pulse change (for example from 1 to zero) in nanosecond.

Socket Velocity Filter Filter Type

By default, this filter should be disabled. In some systems, usually with analog sensor or due to sensor problems (like burst in interpolators), the velocity reading may be very different from one reading to the next. In these cases, consider adding a FIR (Finite Impulse Response) filter to average the velocity reading. With Pulse and Direction sensor there is a way to cancel the 1/T speed calculation below a certain speed by setting this speed into GS[3] parameter.

4.1.2.3.3.5 Serial Absolute - BiSS, Port A

1. General	
1.1 Sensor Name	Serial Absolute - BiSS, Port A
2. Socket Parameters	
2.1 Direction	Non Invert
2.2 HW Sensor Resolution (Bits)	26
2.3 SW Sensor Resolution (Bits)	26
2.5 Temperature Support	False
2.6 Input Glitch Filter (nanosecond)	13
2.7 Clock Frequency (MHz)	2.50
3. Socket Velocity Filter	
3.1 Filter Type	Disabled

Direction

Inverts the counting direction of the socket. It is recommended to leave it as “Non Invert” always for an absolute sensor. You will be prompted to determine the positive direction of the motor movement later in the tuning wizard. Maintain the same direction for the sensor setting, set at a later stage.

Note: The absolute sensor can also be inverted and its absolute position will still be saved.

HW Sensor Resolution (Bits)

The number of bits that represent one mechanical cycle of the sensor (one revolution for a rotary motor or the protocol number of bits sent from the sensor in the linear sensors).

SW Sensor Resolution (Bits)

The number of bits to be used for control purposes. You can reduce the sensor’s resolution by using only part of the available bits. Select a software resolution bit number lower than the hardware resolution number of bits.

High Resolution Mask – the reduced bits can be from the low bits or from high bits. This parameter defines how many high bits we require to cancel, the remaining reduce bits are reduced from the low bits.

Temperature Support

Select “True” if your sensor transmits temperature information. The drive must ignore the temperature bits to get a correct position reading.

Input Glitch Filter (nanosecond)

The Input Glitch filter option allows the user to filter noises in the encoder Data signal lines. It is set as a function of time. The Input Glitch Filter time settings, defines the minimum allowable time for data change in data line (nanoseconds). This value should not exceed the encoder clock width.

Clock Frequency (MHz)

Communication frequency between the drive and the encoder. Range between 1.25 to 2.5 MHz.

Socket Velocity Filter

By default, this filter should be disabled. In some systems, usually

Filter Type

with analog sensor or due to sensor problems (like burst in interpolators), the velocity reading may be very different from one reading to the next. In these cases, consider adding a FIR (Finite Impulse Response) filter to average the velocity reading.

4.1.2.3.3.6 Serial Absolute - EnDat 2.1/2.2, Port A

1. General	
1.1 Sensor Name	Serial Absolute - EnDat 2.1/2.2, Port A
2. Socket Parameters	
2.1 Direction	Non Invert
2.2 HW Sensor Resolution (Bits)	8
2.3 SW Sensor Resolution (Bits)	8
2.5 Rotary Multiturn Resolution	0
2.6 Input Glitch Filter (nanosecond)	13
2.7 Clock Frequency (MHz)	2.50
3. Socket Velocity Filter	
3.1 Filter Type	Disabled
...	

Direction

Inverts the counting direction of the socket. It is recommended to leave it as “Non Invert” always for an absolute sensor. You will be prompted to determine the positive direction of the motor movement later in the tuning wizard. Maintain the same direction for the sensor setting, set at a later stage.

Note: Absolute sensor can also be inverted and absolute position will still be kept.

HW Sensor Resolution (Bits)

The number of bits that represent one mechanical cycle of the sensor (one revolution for a rotary motor or the protocol number of bits sent from the sensor in the linear sensors).

SW Sensor Resolution (Bits)

The number of bits to be used for control purposes. You can reduce the sensor’s resolution by using only part of the available bits by selecting software resolution bit number lower than the hardware resolution number of bits.

High Resolution Mask – the reduced bits can be from the low bits or from high bits. This parameter defines how many high bits we require to cancel, the remaining reduce bits are reduced from the low bits.

Rotary Multiturn Resolution

The number of bits in the multi-turn counter.

Input Glitch Filter (nanosecond)

The Input Glitch filter option allows the user to filter noises on the encoder Data signal lines. It is set as a function of Frequency. The Input Glitch Filter Frequency settings, defines the Max allowable Encoder Data Pulse Width in nanoseconds.

This value should not exceed the encoder clock width.

Clock Frequency (MHz)

Communication frequency between the drive and the encoder. Range between 1.25 to 2.5 MHz.

**Socket Velocity Filter
Filter Type**

By default, this filter should be disabled. In some systems, usually with an analog sensor or due to sensor problems (like burst in interpolators), the velocity reading may be very different from one reading to the next. In these cases, consider adding a FIR (Finite Impulse Response) filter to average the velocity reading.

Serial Absolute – Mitutoyo, Port A

1. General	
1.1 Sensor Name	Serial Absolute - Mitutoyo, Port A
2. Socket Parameters	
2.1 Direction	Non Invert
2.2 Sensor Resolution (Bits)	32
2.3 Software Resolution (Bits)	32
2.5 Input Glitch Filter (nanosecond)	13
2.6 Clock Frequency (MHz)	2.50
3. Socket Velocity Filter	
3.1 Filter Type	Disabled
...	

Direction

Inverts the counting direction of the socket. It is recommended to leave it as “Non Invert” always for an absolute sensor. You will be prompted to determine the positive direction of the motor movement later in the tuning wizard. Maintain the same direction for the sensor setting, set at a later stage.

Note: Absolute sensor can also be inverted and absolute position will still be kept.

**Sensor Resolution
(Bits)**

The number of bits that represent one turn in the sensor. This is always 32 bits, for this type of sensor.

**Software Resolution
(Bits)**

The number of bits to be used for control purposes. You can reduce the sensor’s resolution by using only part of the available bits by selecting software resolution bit number lower than the hardware resolution number of bits.

**Input Glitch Filter
(nanosecond)**

The Input Glitch filter option allows the user to filter noises on the encoder Data signal lines. It is set as a function of Frequency. The Input Glitch Filter Frequency settings, defines the Max allowable Encoder Data Pulse Width in nanoseconds. This value should not exceed the encoder clock width.

Clock Frequency (MHz)	Communication frequency between the drive and the encoder. Range between 1.25 to 2.5 MHz.
Socket Velocity Filter Filter Type	By default, this filter should be disabled. In some systems, usually with an analog sensor or due to sensor problems (like burst in interpolators), the velocity reading may be very different from one reading to the next. In these cases, consider adding a FIR (Finite Impulse Response) filter to average the velocity reading.

4.1.2.3.3.7 Serial Absolute – Panasonic, Port A

1. General	
1.1 Sensor Name	Serial Absolute - Panasonic, Port A
2. Socket Parameters	
2.1 Direction	Non Invert
2.2 Sensor Resolution (Bits)	17
2.3 Software Resolution (Bits)	17
2.5 Rotary Multiturn Resolution	0
2.6 Input Glitch Filter (nanosecond)	13
2.7 Clock Frequency (MHz)	2.50
3. Socket Velocity Filter	
3.1 Filter Type	Disabled
...	

Direction	Inverts the counting direction of the socket. It is recommended to leave it as “Non Invert” always for an absolute sensor. You will be prompted to determine the positive direction of the motor movement later in the tuning wizard. Maintain the same direction for the sensor setting, set at a later stage.
------------------	---

Note: Absolute sensor can also be inverted and absolute position will still be kept.

Sensor Resolution (Bits)	The number of bits that represent one turn in the sensor. Always 17 for this type of sensor
Software Resolution (Bits)	The number of bits to be used for control purposes. You can reduce the sensor’s resolution by using only part of the available bits by selecting software resolution bit number lower than the hardware resolution number of bits.
Rotary Multiturn Resolution	The number of bits in the multi-turn counter. The Panasonic sensor has 16 bits multi-turn counter, but a Gold Drive can read only 15 bits multi-turn.
Input Glitch Filter (nanosecond)	The Input Glitch filter option allows the user to filter noises on the encoder Data signal lines. It is set as a function of Frequency. The Input Glitch Filter Frequency settings,

defines the Max allowable Encoder Data Pulse Width in nanoseconds. This value should not exceed the encoder clock width.

Clock Frequency (MHz)

Communication frequency between the drive and the encoder. Range should be 2.5 MHz.

Socket Velocity Filter Filter Type

By default, this filter should be disabled. In some systems, usually with an analog sensor or due to sensor problems (like burst in interpolators), the velocity reading may be very different from one reading to the next. In these cases, consider adding a FIR (Finite Impulse Response) filter to average the velocity reading.

4.1.2.3.3.8 Virtual Absolute – Gurley, Port B

1. General	
1.1 Sensor Name	Virtual Absolute - Gurley, Port B
2. Socket Parameters	
2.1 Direction	Non Invert
2.2 Sensor Resolution (Bits)	12
2.3 Multiplication Factor	2
2.4 Input Glitch Filter (nanosecond)	1200
3. Socket Velocity Filter	
3.1 Filter Type	Disabled

...

Direction

Inverts the counting direction of the socket. It is recommended to leave it as “Non Invert” for the time being. You will be prompted to determine the positive direction of the motor movement later in the tuning wizard.

Note: Absolute sensor can also be inverted and absolute position will still be kept.

Sensor Resolution (Bits)

The number of bits that represent one turn in the sensor. Ranges between 10 – 12 bits.

Multiplication Factor

Determines the resolution of the reading. This number corresponds with the number of bits in an analog to digital converter interpreting the sine and cosine signals. If there are 10 bits, the resolution is $2^{10} = 1024$ (counts per cycle). This means that 1024 different levels are identified in the cycle of the sine (and cosine). There will be 1024 points of

position reading within each feedback cycle. In general:

The sine and cosine signals are divided into $2^{(\text{Multiplication Factor})}$ parts.

Input Glitch Filter (nanosecond)

The Input Glitch filter option allows the user to filter noises on the encoder Data signal lines. It is set as a function of Frequency. The Input Glitch Filter Frequency settings, defines the Max allowable Encoder Data Pulse Width in nanoseconds. This value should not exceed the encoder clock width.

Socket Velocity Filter Filter Type

By default, this filter should be disabled. In some systems, usually with analog sensor or due to sensor problems (like burst in interpolators), the velocity reading may be very different from one reading to the next. In these cases, consider adding a FIR (Finite Impulse Response) filter to average the velocity reading.

4.1.2.3.3.9 Analog Input #1

1. General	
1.1 Sensor Name	Analog Input #1
2. Socket Parameters	
2.1 Direction	Non Invert
2.2 Signal Type	Current
2.3 Analog Offset (+/-10 V)	0
2.4 Negative Dead-Band (+/-10 V)	0
2.4 Positive Dead-Band (+/-10 V)	0
2.5 Gain (A/V)	0
3. Low-Pass Input Filter	
3.1 Filter Type	Disabled
4. Socket Velocity Filter	
4.1 Filter Type	Disabled

Direction

Inverts the counting direction of the socket. It is recommended to leave it as “Non Invert” for the time being. You will be prompted to determine the positive direction of the motor movement later in the tuning wizard.

Signal Type

Describes how the voltage received is interpreted. Can be one of the following options:

- 1 –Current
- 2 – Velocity
- 3 – Position

Analog Offset (±10 V)

The analog voltage offset compensates for the offset of the analog signal. For details of the attributes of the Analog Input Offset, refer to the command AS[N] in the Command Reference Guide.

Negative Dead-Band (±10 V)	When reading the value into the dead band, the value is ignored. For details of the attributes of the Dead Band, refer to the command AD[] in the Command Reference Guide.
Positive Dead-Band (±10 V)	When reading in the value into the dead band, the value is ignored. For details of the attributes of the Dead Band, refer to the command AD[] in the Command Reference Guide.
Gain [(A cnt/sec cnt)/V]	This is the conversion factor of the analog reading and its units will depend on the signal type. For details of the attributes, refer to the commands AG[], AR[], in the Command Reference Guide.
Low-Pass Input Filter Filter Type	This low pass filter is filter the analog reading after considering the dead band and offset.
Socket Velocity Filter Filter Type	By default, this filter should be disabled. In some systems, usually with analog sensor or due to sensor problems (like burst in interpolators), the velocity reading may be very different from one reading to the next. In these cases, consider adding a FIR (Finite Impulse Response) filter to average the velocity reading.

4.1.2.3.3.10 Resolver, Port B

1. General	
1.1 Sensor Name	Resolver, Port B
2. Socket Parameters	
2.1 Direction	Non Invert
2.2 Resolver Pole Pairs	1
2.3 Multiplication Factor	2
2.4 Resolver Frequency [kHz]	20
3. Socket Velocity Filter	
3.1 Filter Type	Disabled
...	

Direction	Inverts the counting direction of the socket. It is recommended to leave it as “Non Invert” for the time being. You will be prompted to determine the positive direction of the motor movement later in the tuning wizard.
Resolver Pole Pairs	Analog Hall commutation support multi magnetic pole pairs for each Sin/Cos period.
Multiplication Factor	Determines the resolution of the reading. This number corresponds with the number of bits in an analog to digital converter interpreting the sine and cosine signals. If there are 10 bits, the resolution is $2^{10} = 1024$ (counts per cycle). This means that 1024 different levels are identified in the cycle of the sine (and cosine). There will be 1024 points of position reading within each feedback cycle. In general: The sine and cosine signals are divided into $2^{(\text{Multiplication Factor})}$ parts.
Resolver Frequency (kHz)	Excitation signal frequency with a default of 10KHz for TS=50 and 5KHz for TS=100. The frequency can be set to either 0.5/1/2/4 factor of the velocity sampling time frequency.
Socket Velocity Filter Filter Type	By default, this filter should be disabled. In some systems, usually with an analog sensor or due to sensor problems (like burst in interpolators), the velocity reading may be very different from one reading to the next. In these cases, consider adding a FIR (Finite Impulse Response) filter to average the velocity reading.

4.1.2.3.3.11 Serial Absolute – Kawasaki, Port A

1. General	
1.1 Sensor Name	Serial Absolute - Kawasaki, Port A
2. Socket Parameters	
2.1 Direction	Non Invert
2.2 Sensor Resolution (Bits)	13
2.3 Software Resolution (Bits)	13
2.5 Rotary Multiturn Resolution	0
2.6 Input Glitch Filter (nanosecond)	13
2.7 Clock Frequency (MHz)	1.00
3. Socket Velocity Filter	
3.1 Filter Type	Disabled
...	

Direction

Inverts the counting direction of the socket. It is recommended to leave it as “Non Invert” for the time being. You will be prompted to determine the positive direction of the motor movement later in the tuning wizard.

Note: Absolute sensor can also be inverted and absolute position will still be kept.

Sensor Resolution (Bits)

The number of bits that represent one turn in the sensor. Always 13 for this type of sensor.

Software Resolution (Bits)

The number of bits to be used for control purposes. You can reduce the sensor’s resolution by using only part of the available bits by selecting software resolution bit number lower than the hardware resolution number of bits.

Rotary Multiturn Resolution

The number of bits in the multi-turn counter.

Input Glitch Filter (nanosecond)

The Input Glitch filter option allows the user to filter noises on the encoder Data signal lines. It is set as a function of Frequency. The Input Glitch Filter Frequency settings, defines the Max allowable Encoder Data Pulse Width in nanoseconds. This value should not exceed the encoder clock width.

Clock Frequency (MHz)

Communication frequency between the drive and the encoder. Range should be 1 MHz.

Socket Velocity Filter Filter Type

By default, this filter should be disabled. In some systems, usually with an analog sensor or due to sensor problems (like burst in interpolators), the velocity reading may be very different from one reading to the next. In these cases, consider adding a FIR (Finite Impulse Response) filter to average the velocity reading.

4.1.2.3.3.12 Serial Absolute – SSI, Port A

1. General	
1.1 Sensor Name	Serial Absolute - SSI, Port A
2. Socket Parameters	
2.1 Direction	Non Invert
2.2 HW Sensor Resolution (Bits)	8
2.3 S'W Sensor Resolution (Bits)	8
2.5 Rotary Multiturn Resolution	0
2.6 Input Glitch Filter (nanosecond)	13
2.7 Clock Frequency (MHz)	2.500
2.8 Protocol Total Bits	8
2.9 Position LSB Number	0
3. Socket Velocity Filter	
3.1 Filter Type	Disabled
4. Socket Error	
4.1 Error Bit Number	0
4.2 Error Bit Logic	Active High

Example:

In the Example:

Sensor Resolution = 7

Multiturn Resolution = 4

Protocol Total Bits = 18

Position LSB number = 4

Error Bit number = 2

Direction

Inverts the counting direction of the socket. It is recommended to leave it as “Non Invert” for the time being. You will be prompted to determine the positive direction of the motor movement later in the tuning wizard.

Note: Absolute sensor can also be inverted and absolute position will still be kept.

HW Sensor Resolution (Bits)

The number of bits that represent one turn in the sensor. For a single turn sensor, this is the total number of bits. For a multi-turn sensor, enter the number of bits that represent one turn (do not include the multi-turn counter bits).

SW Sensor Resolution (Bits)

The number of bits to be used for control purposes. You can reduce the sensor’s resolution by using only part of the available bits by selecting software resolution bit number lower than the hardware resolution number of

	bits.
Rotary Multiturn Resolution	The number of bits in the multi-turn counter.
Input Glitch Filter (nanosecond)	The Input Glitch filter option allows the user to filter noises on the encoder Data signal lines. It is set as a function of Frequency. The Input Glitch Filter Frequency settings, defines the Max allowable Encoder Data Pulse Width in nanoseconds. This value should not exceed the encoder clock width. Since in the SSI protocol we cannot implement automatic propagation delay compensation, it is recommended to set the filter as low as possible.
Clock Frequency (MHz)	Communication frequency between the drive and the encoder. Range should be 1 MHz.
Protocol Total Bits	The total number of bits that the encoder transmits in the SSI protocol.
Position LSB number	The bit number of the position least significant bit, where bit 0 is the protocol LSB.
Socket Velocity Filter Filter Type	By default, this filter should be disabled. In some systems, usually with an analog sensor or due to sensor problems (like burst in interpolators), the velocity reading may be very different from one reading to the next. In these cases, consider adding a FIR (Finite Impulse Response) filter to average the velocity reading.
Socket error Error Bit Number	Number of the error bit in the SSI protocol bits, or None if no error bit exists.
Error Bit Logic	Active High means that if the error bit is high there is an error, and Active Low means that a low state signals an error.

4.1.2.3.3.13 Serial Absolute – Tamagawa, Port A

1. General	
1.1 Sensor Name	Serial Absolute - Tamagawa, Port A
2. Socket Parameters	
2.1 Direction	Non Invert
2.2 Sensor Resolution (Bits)	17
2.3 Software Resolution (Bits)	17
2.5 Rotary Multiturn Resolution	0
2.6 Input Glitch Filter (nanosecond)	13
2.7 Clock Frequency (MHz)	2.500
3. Socket Velocity Filter	
3.1 Filter Type	Disabled
...	

Direction

Inverts the counting direction of the socket. It is recommended to leave it as “Non Invert” for the time being. You will be prompted to determine the positive direction of the motor movement later in the tuning wizard.

Note: Absolute sensor can also be inverted and absolute position will still be kept.

Sensor Resolution (Bits)

The number of bits that represent one turn in the sensor. Always 17 for this type of sensor.

Software Resolution (Bits)

The number of bits to be used for control purposes. You can reduce the sensor’s resolution by using only part of the available bits by selecting software resolution bit number lower than the hardware resolution number of bits.

Rotary Multiturn Resolution

The number of bits in the multi-turn counter.

Input Glitch Filter (nanosecond)

The Input Glitch filter option allows the user to filter noises on the encoder Data signal lines. It is set as a function of Frequency. The Input Glitch Filter Frequency settings, defines the Max allowable Encoder Data Pulse Width in nanoseconds. This value should not exceed the encoder clock width.

Clock Frequency (MHz)

Communication frequency between the drive and the encoder. Range should be 2.5 MHz.

Socket Velocity Filter Filter Type

By default, this filter should be disabled. In some systems, usually with an analog sensor or due to sensor problems (like burst in interpolators), the velocity reading may be very different from one reading to the next. In these cases, consider adding a FIR (Finite Impulse

Response) filter to average the velocity reading.

4.1.2.3.4 Testing and Saving Socket Parameters

To test and save the socket parameters

1. Look at the line below the parameters table:

Socket Position: 0	
--------------------	---

2. Move the axis to see the position reading.

Make sure it makes sense: calculate the position change you expect to see for a revolution or a known distance for a linear motor. If the position reading is not what you expect, check the hardware connections and the settings.

For analog SIN/COS sensors the reading may not be correct, due to the calibration of these signals calculated at the commutation window.

3. Click **Accept** to save the changes you made.

4.1.2.4 Control Feedback Parameters

In this area, you determine the role of each socket (i.e., feedback sensor or an external reference sensor) used in controlling the feedback from the allocated sensors. There are two optional ways to produce feedback:

- From built-in sensors in the application
- From external reference sensor sources

4.1.2.4.1 Feedback

The application built-in feedback sensors are used to:

- Position feedback
- Velocity feedback
- Commutation feedback
- Position gain scheduling

The same socket can be used for more than one purpose. For example: a serial encoder can be used to perform all four feedback functions.

Note that after the first identification (described later in the commutation process) the drive does not have to use the Hall sensors as a commutation source.

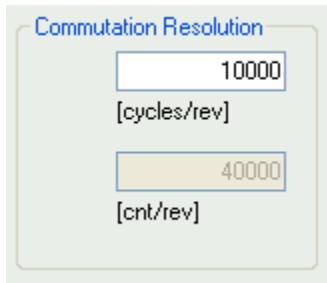
Here is the place to specify which sensor will be used as the commutation source during normal operation and not for the identification process. If you intend to use Hall sensors for commutation identification and for recovery from power down, but prefer a more accurate position sensor for normal operation; specify the position sensor as the commutation source.

4.1.2.4.2 Commutation Resolution

The feedback resolution setting differs according to sensor type and motor (rotary or linear).

Resolution for **Rotary motor** (Brush or Brushless):

Analog Sin/Cos



Commutation Resolution

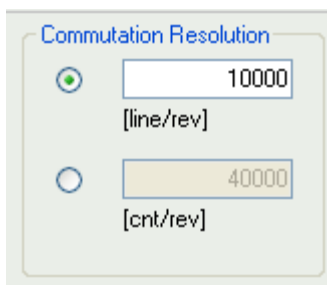
10000
[cycles/rev]

40000
[cnt/rev]

In **Cycles/rev** enter the number of sine cycles per mechanical revolution. EAS will calculate the number of counts per revolution using the following formula:

$$[\text{counts/rev}] = [\text{cycles/rev}] \times 2^{[\text{multiplication factor}]}$$

Encoder quad



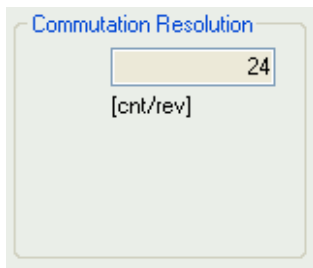
Commutation Resolution

☒ 10000
[line/rev]

☐ 40000
[cnt/rev]

In the resolution area you can select to enter either line/rev or cnt/rev. EAS will automatically calculate the other. $[\text{Cnt/rev}] = [\text{Line/rev}] \times 4$

Halls only

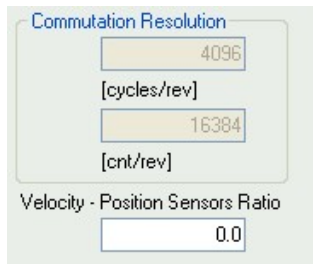


Commutation Resolution

24
[cnt/rev]

Resolution is automatically calculated as
 $(\text{Pole pair per rev}) \times 6$

Gurley

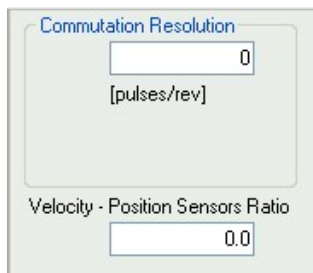


Automatically calculated using sensor resolution and multiplication factor:

$$[\text{cycles/rev}] = 2^{[\text{Sensor Resolution}]}$$

$$[\text{counts/rev}] = [\text{cycles/rev}] \times 2^{[\text{multiplication factor}]}$$

Pulse



[pulses/rev] is the number of pulses the encoder transmits per one revolution of the motor.

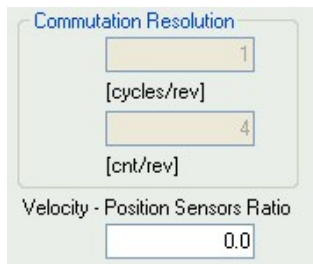
Serial absolute – BiSS
 Serial absolute Endat
 Serial absolute– Panasonic
 Serial absolute Mitutoyo
 Serial absolute Kawaski



Automatically calculated using software resolution:

$$[\text{cnt/rev}] = 2^{[\text{SW Sensor Resolution}]}$$

Resolver



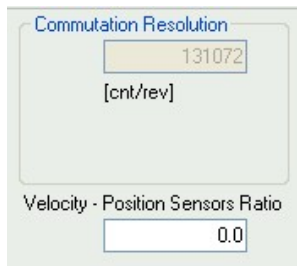
Automatically calculated using sensor resolution and multiplication factor:

$$[\text{cycles/rev}] = 2^{[\text{Sensor Resolution}]}$$

$$[\text{counts/rev}] = [\text{cycles/rev}] \times 2^{[\text{multiplication factor}]}$$

Serial absolute – SSI

Serial absolute -Makagawi



Automatically calculated using software resolution:

$$[\text{cnt/rev}] = 2^{[\text{SW Sensor Resolution}]}$$

For linear motors:

Analog Sin/Cos



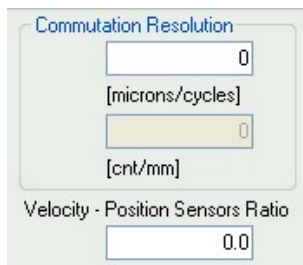
Enter the number of microns per sine cycle. The number of counts per mm is calculated automatically as:

$$[\text{cnt/mm}] = 1000 \times 2^{[\text{Multiplication Factor}]} / [\text{microns/cycle}]$$

Encoder quad

In the resolution area, you can select to enter either micron/count or cnt/mm. EAS will automatically calculate the other. $\text{Cnt/mm} = 1000 / (\text{micron/cnt})$

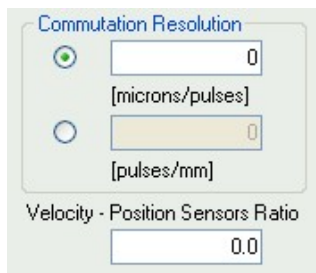
Gurley



Enter the number of microns per sine cycle. The number of counts per mm is calculated automatically as:

$$[\text{cnt/mm}] = 1000 \times 2^{[\text{Multiplication Factor}]} / [\text{microns/cycle}]$$

Pulse and Direction



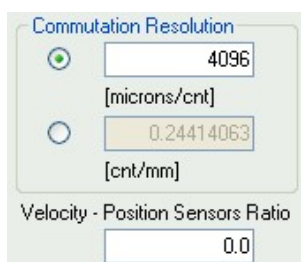
In the resolution area, you can select to enter either micron/pulse or pulse/mm. EAS will automatically calculate the other value.

Serial absolute – BiSS

Serial absolute Endat

Serial absolute– Panasonic

Serial absolute Mitutoyo



In the resolution area, you can select to enter either micron/count or cnt/mm. EAS will automatically calculate the other value. $\text{Cnt/mm} = 1000/(\text{micron/cnt})$

4.1.2.4.3 Velocity – Position Sensors Ratio

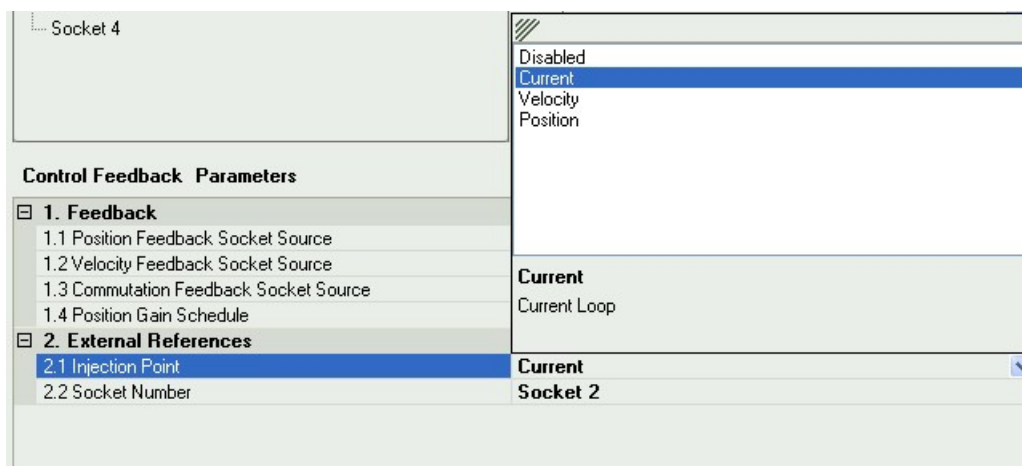
The ratio between velocity and position sensors can be entered in this window:



This factor is used if one sensor is used to close the position loop and a different sensor is used for the velocity loop. In most cases only one sensor is used and the ratio is 1. This is the default value. If the position resolution is higher than the velocity resolution this number should be less than one.

4.1.2.4.4 External References

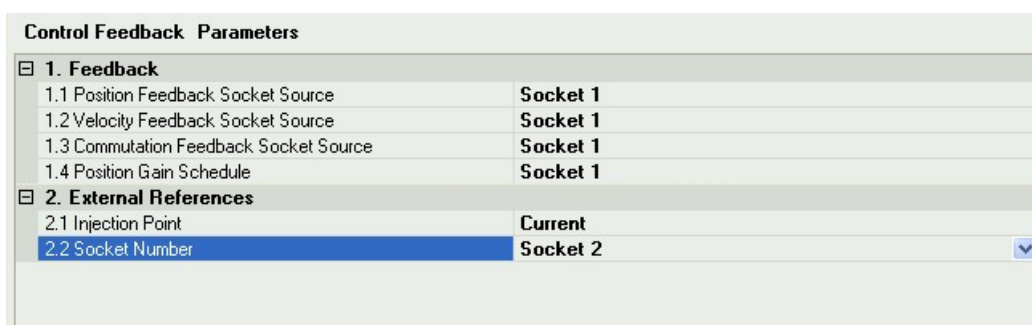
You can use any external reference sensor to obtain additional feedback, e.g. Pulse and Direction Ratio, but do not use the same Socket for the internal and external feedbacks as you may obtain command conflicts and are liable to confuse the operation of the servo-drive.



Control Feedback Parameters	
1. Feedback	
1.1 Position Feedback Socket Source	
1.2 Velocity Feedback Socket Source	
1.3 Commutation Feedback Socket Source	
1.4 Position Gain Schedule	
2. External References	
2.1 Injection Point	Current
2.2 Socket Number	Socket 2

The External References options offer the following:

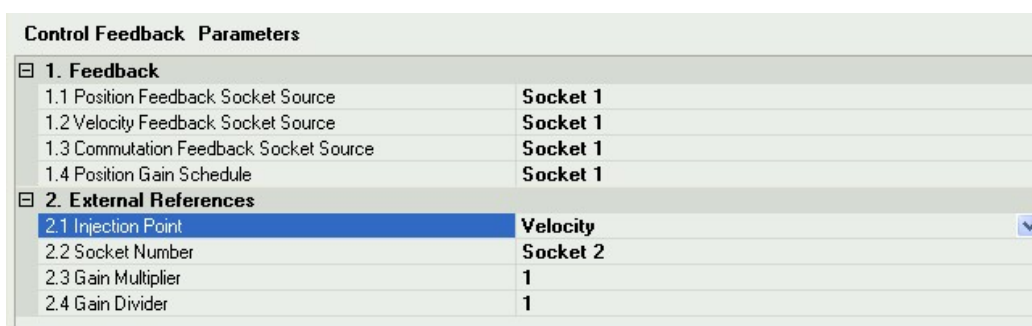
Injection Point Disabled External References are not allowed



Control Feedback Parameters	
1. Feedback	
1.1 Position Feedback Socket Source	Socket 1
1.2 Velocity Feedback Socket Source	Socket 1
1.3 Commutation Feedback Socket Source	Socket 1
1.4 Position Gain Schedule	Socket 1
2. External References	
2.1 Injection Point	Current
2.2 Socket Number	Socket 2

Current A sensor which tests current at the servo-drive is applied. The external sensor is by default allocated to the next available socket.

Socket Number The Socket selected for the external reference



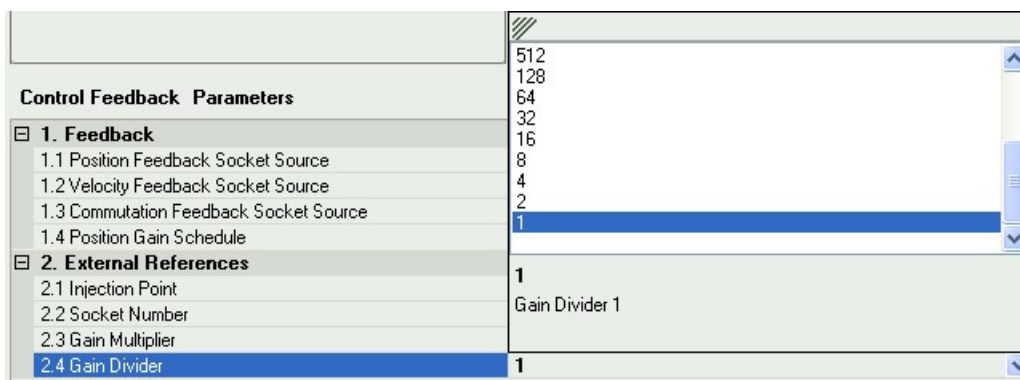
Control Feedback Parameters	
1. Feedback	
1.1 Position Feedback Socket Source	Socket 1
1.2 Velocity Feedback Socket Source	Socket 1
1.3 Commutation Feedback Socket Source	Socket 1
1.4 Position Gain Schedule	Socket 1
2. External References	
2.1 Injection Point	Velocity
2.2 Socket Number	Socket 2
2.3 Gain Multiplier	1
2.4 Gain Divider	1

Velocity A sensor which tests the velocity at the servo-drive is applied.

Position Similar options to Velocity

Gain Multiplier

Enter any integer value. Use the Gain Multiplier and Divider to gain an optimum value for comparison of the external sensor source with the internal sensor source for the servo drives under test.



Gain Divider

Select a Divider value from the pull-down integer list.

4.1.2.4.4.1 Pulse and Direction Ratio

The Pulse and Direction Ratio is defined as the ration of two 16bit numbers used as Gain Multiplier numerator and Gain Divider denominator in the factor $CA[14]/CA[15]$. This factor should optimally be less than 1, so that the Pulse frequency is not too large relative to the direction gain.

To set the External References in EAS:

1. Setup the drive Sensor Parameters as required.
2. At the External Reference options, select the reference Injection Point as Position or Velocity.

Control Feedback Parameters	
1. Feedback	
1.1 Position Feedback Socket Source	Socket 2
1.2 Velocity Feedback Socket Source	Socket 2
1.3 Commutation Feedback Socket Source	Socket 2
1.4 Position Gain Schedule	Socket 2
2. External References	
2.1 Injection Point	Position
2.2 Socket Number	Socket 1
2.3 Gain Multiplier	7
2.4 Gain Divider	8

3. Set the socket of reference. Any socket can be used for the command, but it is recommended to use a digital encoder (e.g. Pulse and Direction, Quad, or forward and reverse)
4. Set the Gain Multiplier and Gain Divider.

4.1.3 Limits and Protections

Expert Tuning - Limits and Protections

Limits Protections Input-Output

Drive and Application Limits

Current

Continuous current CL[1] [A]	1	Peak current PL[1] [A]	2	Peak current duration PL[2] [sec]	1
Motor continuous current [A]	0	Motor peak current [A]	0	Max drive current MC [A]	0

Acceleration and Velocity

Stop deceleration SD [cnt/sec^2]	0	Max velocity command VH[2] [cnt/sec]	0	Max feedback velocity HL[2] [cnt/sec]	0
-------------------------------------	--------------------------------	---	--------------------------------	--	--------------------------------

Position

Low command VL[3] [cnt]	0	Low feedback LL[3] [cnt]	0	Low modulo XM[1] [cnt]	0
High command VH[3] [cnt]	0	High feedback HL[3] [cnt]	0	High modulo XM[2] [cnt]	0

Application Test Limits

Profile acceleration AC [cnt/sec^2]	0	Profile deceleration DC [cnt/sec^2]	0	Profile velocity SP [cnt/sec]	0	Smoothing factor SF [msec]	0
--	--------------------------------	--	--------------------------------	----------------------------------	--------------------------------	-------------------------------	--------------------------------

In this window the limits that protect your application's safe performance are set. After you finish entering the data EAS makes sure that all the limits you entered do not contradict one another and are within the allowed values.

If an error occurs you will be prompted to correct it as shown below.

Limits Protections Input-Output

Drive and Application Limits

Current

Continuous current CL[1] [A]	0.5	Peak current PL[1] [A]	3	Peak current duration PL[2] [sec]	3
Motor continuous current [A]	0.707	Motor peak current [A]	2.83	Max drive current MC [A]	2

Acceleration and Velocity

Stop deceleration SD [cnt/sec^2]	1000000000	Max velocity command VH[2] [cnt/sec]	150000	Max feedback velocity HL[2] [cnt/sec]	2000000000
-------------------------------------	---	---	-------------------------------------	--	---

Position

Low command VL[3] [cnt]	-900000000	Low feedback LL[3] [cnt]	0	Low modulo XM[1] [cnt]	1000000000
High command VH[3] [cnt]	900000000	High feedback HL[3] [cnt]	0	High modulo XM[2] [cnt]	1000000000

Application Test Limits

Profile acceleration AC [cnt/sec^2]	1000000	Profile deceleration DC [cnt/sec^2]	0	Profile velocity SP [cnt/sec]	0	Smoothing factor SF [msec]	0
--	--------------------------------------	--	--------------------------------	----------------------------------	--------------------------------	-------------------------------	--------------------------------

Limits Error

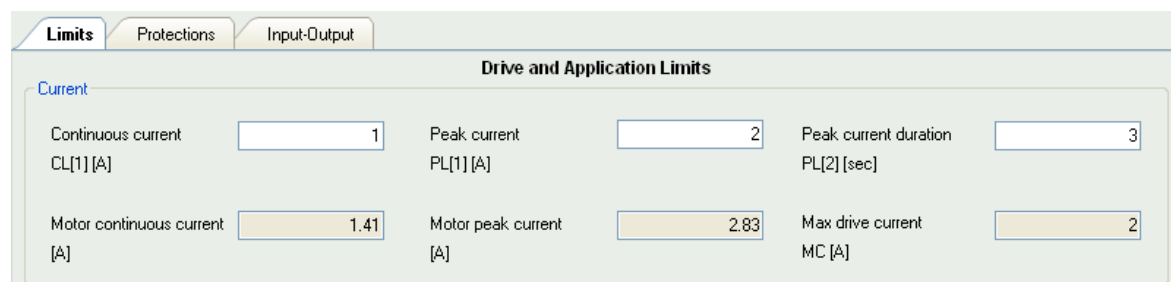
During operation there were following:
PL[1] can not be higher than Motor Peak Current
PL[1] can not be higher than MC
PL[1]=3.0E00 Drive Error 21: Operand Out of Range
Problems should be solved before leaving from the page!

4.1.3.1 Drive and Application Limits

The limits of the drive are combined with the limits of the motor to generate the application limits. If, for example, the motor can handle 5 Amps continuous current, but the drive can only supply 2 Amps, the drive's limit is used as the application limit.

The limits of the motor were already entered in the previous step of the Tuning Wizard (Motor and Feedback).

4.1.3.1.1 Current Limits



Drive and Application Limits					
Current					
Continuous current CL[1] [A]	1	Peak current PL[1] [A]	2	Peak current duration PL[2] [sec]	3
Motor continuous current [A]	1.41	Motor peak current [A]	2.83	Max drive current MC [A]	2

Continuous Current (Refer to CL[1] in the command reference) The maximum application continuous current (Sine amplitude). This number must not exceed MC/2 and the motor's max continuous current.

The application continuous current limit takes into consideration the current limitations of all the system components. This limit should be set so that the most sensitive component (the one with the lowest current limit) will not be damaged.

Peak Current (Refer to PL[1] in the command reference) The maximum application peak current (Sine amplitude). This number must not exceed MC or the motor's max peak current.

The peak current can be applied to the application for a short time period defined by Peak Current Duration. After applying, the peak current to the motor for the defined amount of time the current is lowered to the maximum continuous current even if it means that the performance is compromised.

Peak Current Duration (Refer to PL[2] in the command reference) The peak current is available for the peak duration time (see Peak Current above). For longer periods it is limited to PL[1]

Motor Continuous Current Motor Continuous RMS limit x $\sqrt{2}$. Motor Continuous Peak-to-Regen current. Automatically calculated from the motor's RMS continuous current.

Motor Peak Current Motor Peak RMS limit x $\sqrt{2}$. Motor Peak Peak-to-Regen current. Automatically calculated from the motor's RMS peak current. If the limitations set for the motor are stricter than the limitations

set for the application they become the effective limitations. By default, the motor peak current can be supplied for a maximum of three seconds.

Max Drive Current (See MC in the command reference) The drive's maximum peak current (Peak-to-Regen). Automatically read from the drive's information.

4.1.3.1.2 Acceleration and Velocity

Acceleration and Velocity		
Stop deceleration SD [cnt/sec ²]	1000000000	Max velocity command VH[2] [cnt/sec]
		666666
		Max feedback velocity HL[2] [cnt/sec]
		2000000000

Stop Deceleration (See SD in the command reference) Defines the deceleration used in case of stop emergencies. Also used as the acceleration limit for combined software and external reference commands.

Max Velocity Command (See VH[2] in the command reference) The maximum allowed speed command is the application speed limit.

Max Feedback Velocity (See HL[2] in the command reference) Maximum allowed speed-reading. If the speed-reading exceeds this limit, the drive is immediately disabled.

4.1.3.1.3 Position

Position		
Low command VL[3] [cnt]	-900000000	Low feedback LL[3] [cnt]
		-1000000000
		Low modulo XM[1] [cnt]
		-1000000000
High command VH[3] [cnt]	900000000	High feedback HL[3] [cnt]
		1000000000
		High modulo XM[2] [cnt]
		1000000000

Low Command (See VL[3] in the command reference) The low limit to the position controller command. Any command below this limit is truncated to VL[3]. Default value -999,999,990

Low Feedback (See LL[3] in the command reference) The low limit to the allowed motor position range. If the motor position is below this limit, the motor is automatically disabled. To enable the motor, set the position to a value within the permitted range.

Low Modulo (See XM[1] in the command reference) The counting range of the position feedback is XM[1]...XM[2]-1

High Command (See VH[3] in the command reference) The upper limit of the position controller command. Any command above this limit is truncated to VH[3]. Default value 999,999,990

- High Feedback** (See HL[3] in the command reference) The upper limit of the allowed motor position range. If the motor position is above this limit, the motor is automatically disabled. To enable the motor, set the position to a value within the permitted range.
- High Modulo** (See XM[2] in the command reference) The counting range of the position feedback is XM[1]...XM[2]-1

4.1.3.2 Application Test Limits

Application Test Limits			
Profile acceleration AC [cnt/sec ²]	1000000000	Profile deceleration DC [cnt/sec ²]	1000000000
		Profile velocity SP [cnt/sec]	300
			Smoothing factor SF [msec]
			0

In this area you can set acceleration, speed and smoothing limits to be used during the tuning to test the application's performance.

- Profile Acceleration** (See AC in the command reference) Maximum acceleration command used in velocity and position profiles.
- Profile Deceleration** (See DC in the command reference) Maximum deceleration command used in velocity and position profiles.
- Profile Velocity** (See SP in the command reference) Maximum velocity command to be used in position and velocity profiles
- Smoothing Factor** (See SF in the command reference) Minimum smoothing used in velocity and position profiles.

4.1.3.3 Protection

Expert Tuning - Limits and Protections

Limits **Protections** Input-Output

Position tracking error

Following error window ER[3] [cnt] Achieved position window TR[1] [cnt] Achieved position time TR[2] [msec]

Velocity tracking error

Following error window ER[2] [cnt/sec] Achieved velocity window TR[3] [cnt/sec] Achieved velocity time TR[4] [msec]

Overvoltage/Undervoltage

Overvoltage threshold XP[1] [V] Undervoltage threshold UV [V] Bus Voltage BV [V]

Brake

Brake stays released for [msec] after motor off - BP[1]

Brake stays engaged for [msec] after motor on - BP[2]

Motor Stuck

Current exceeded [%] of continuous current - CL[2]

and velocity was lower than [cnt/sec] - CL[3]

for a time period of [msec] - CL[4]

The Protection tab defines the error conditions that cause the drive to activate protections.

4.1.3.3.1 Position Tracking Error

Position tracking error

Following error window ER[3] [cnt] Achieved position window TR[1] [cnt] Achieved position time TR[2] [msec]

Following Error Window

(See ER[3] in the command reference) The maximum allowed position error in counts. If the error exceeds this value, the motor is automatically disabled.

Achieved Position Window

(See TR[1] in the command reference) Together with TR[2] defines the conditions in which a PTP motion is considered as completed. When the position is within TR[1] counts from the target for TR[2] milliseconds, the motion status is changed to 0.

Achieved Position Time

(See TR[2] in the command reference) Refer to the sub-section **Achieved Position Window** above.

4.1.3.3.2 Velocity Tracking Error

Velocity tracking error		
Following error window ER[2] [cnt/sec]	100000000	Achieved velocity window TR[3] [cnt/sec]
		Achieved velocity time TR[4] [msec]
		20

- Following Error Window** (See ER[2] in the command reference) The maximum allowed velocity error in counts. If the error exceeds this value, the motor is automatically disabled.
- Achieved Velocity Window** (See TR[3] in the command reference) Together with TR[4] defines the conditions in which a jog motion has reached the desired velocity. When the velocity is within TR[3] counts/sec from the target for TR[4] milliseconds, the motion status is changed to 0.
- Achieved Velocity Time** (See TR[4] in the command reference) Refer to the sub-section **Achieved Velocity Window** above.

4.1.3.3.3 Brake

Brake		
Brake stays released for	0	[msec] after motor off - BP[1]
Brake stays engaged for	0	[msec] after motor on - BP[2]

- Brake stays released for... after motor off** (See BP[1] in the command reference). If one of the digital outputs is defined as brake command, the drive allows the brake time to engage when turning the motor off. When the motor is turned off (MO = 0), the drive first commands the brake to engage. Then, for a time, it keeps the motor in place while the brake actually engages.
- Brake stays engaged for... after motor on** (See BP[2] in the command reference). If one of the digital outputs is defined as brake command, the drive allows the brake time to disengage when turning the motor on. The drive will hold the motor in its starting position for BP[2] msec after MO=1 command.

4.1.3.3.4 Motor Stuck

Motor Stuck

Current exceeded	0	[%] of continuous current - CL[2]
and velocity was lower than	0	[cnt/sec] - CL[3]
for a time period of	0	[msec] - CL[4]

A stuck motor is a motor that does not respond to the current command, due to failure of the motor, the drive system or the motion sensor.

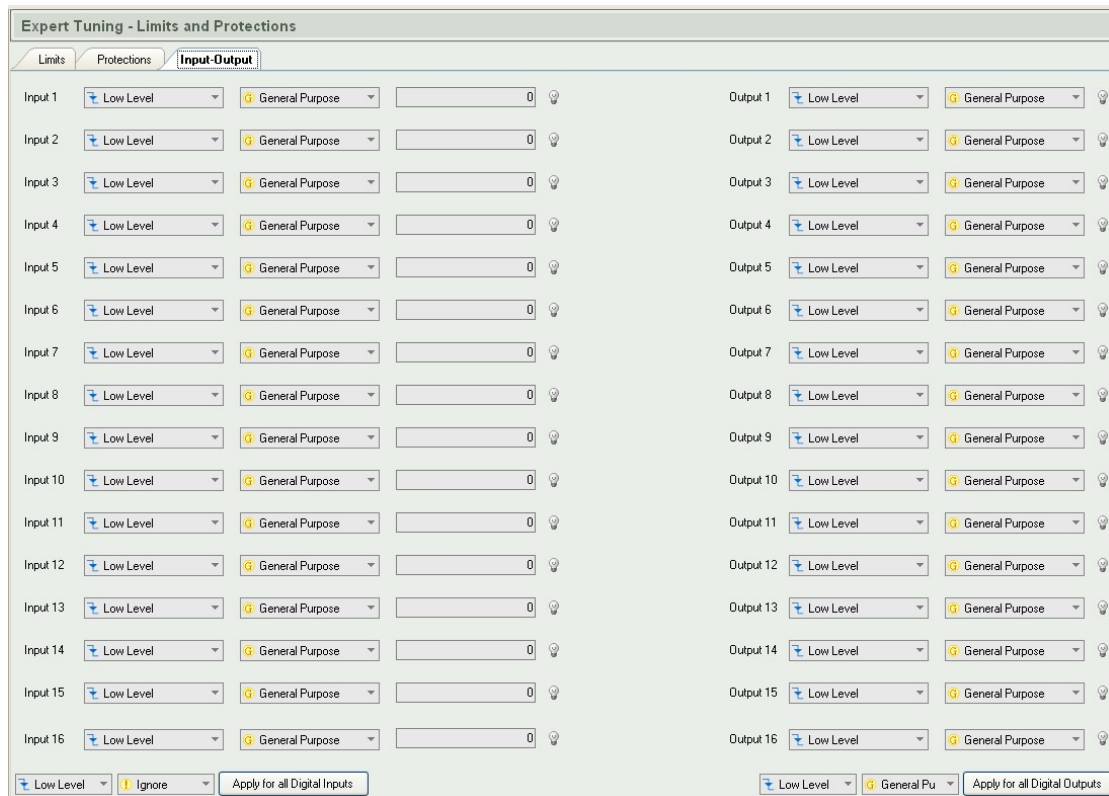
Current exceeded ..% of continuous current (See CL[2] in the command reference). If CL[2]<2 motor stuck protection is not applied. For other values of CL[2], if the motor current command level exceeds CL[2]% of the continuous current limit for more than 3 seconds and the velocity is still lower than CL[3], the motor is disabled.

And velocity was lower than... (See CL[3] in the command reference) The velocity threshold under which the motor is considered not moving.

For a time period of (See CL[4] in the command reference). The period in msec for which the motor is not yet considered stuck even if it does not respond.

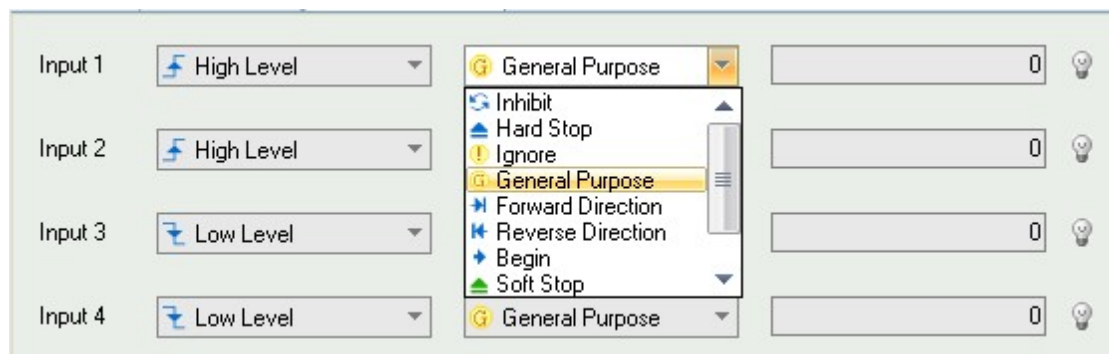
4.1.3.4 Input-Output

In the Input Output tab, you can define the functions of the inputs and outputs of the drive.



The window left hand side lists all the inputs available for the active drive with their properties and states. Below the input display there are buttons that affect all the inputs. On the right hand side the outputs are displayed with their properties and states. The buttons under this list affect all outputs.

4.1.3.4.1 Inputs

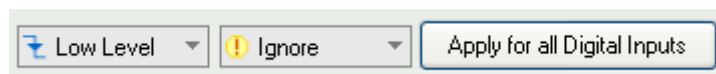


For each input, select whether it is active low or active high. Select the functionality assigned to each input from the list in the central column.

The right column is the input filter in milliseconds. Pulses shorter than the number of milliseconds entered are ignored. (See IF[N] in the Command Reference for more details). Leave this number 0 if you do not wish to apply a filter.

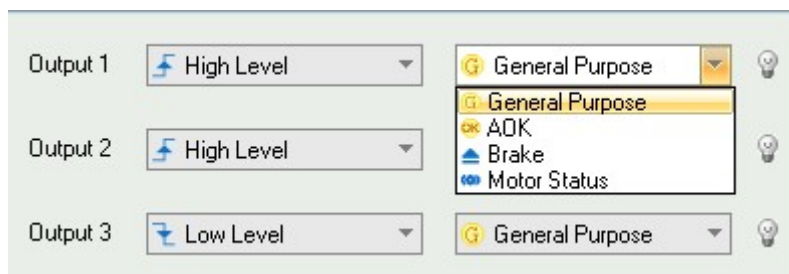
The light bulb is grey if the input is off, and green when it is on.

The buttons for the inputs are:



If you wish to make a change that will apply to all the inputs use the level and functionality buttons to select the desired setting and then click the **Apply for all Digital Inputs** button to apply the change.

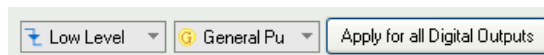
4.1.3.4.2 Outputs



Select for each output if it is active low or active high. Select the functionality assigned to each output from the list in the right column.

The light bulb is grey if the output is off, and blue when it is on.

The buttons at the bottom of the list apply the same change to all outputs are:



Select the active level and functionality you want to apply to all outputs using a list and then click **Apply for all Digital Outputs**.

4.1.4 Current Loop Tuning

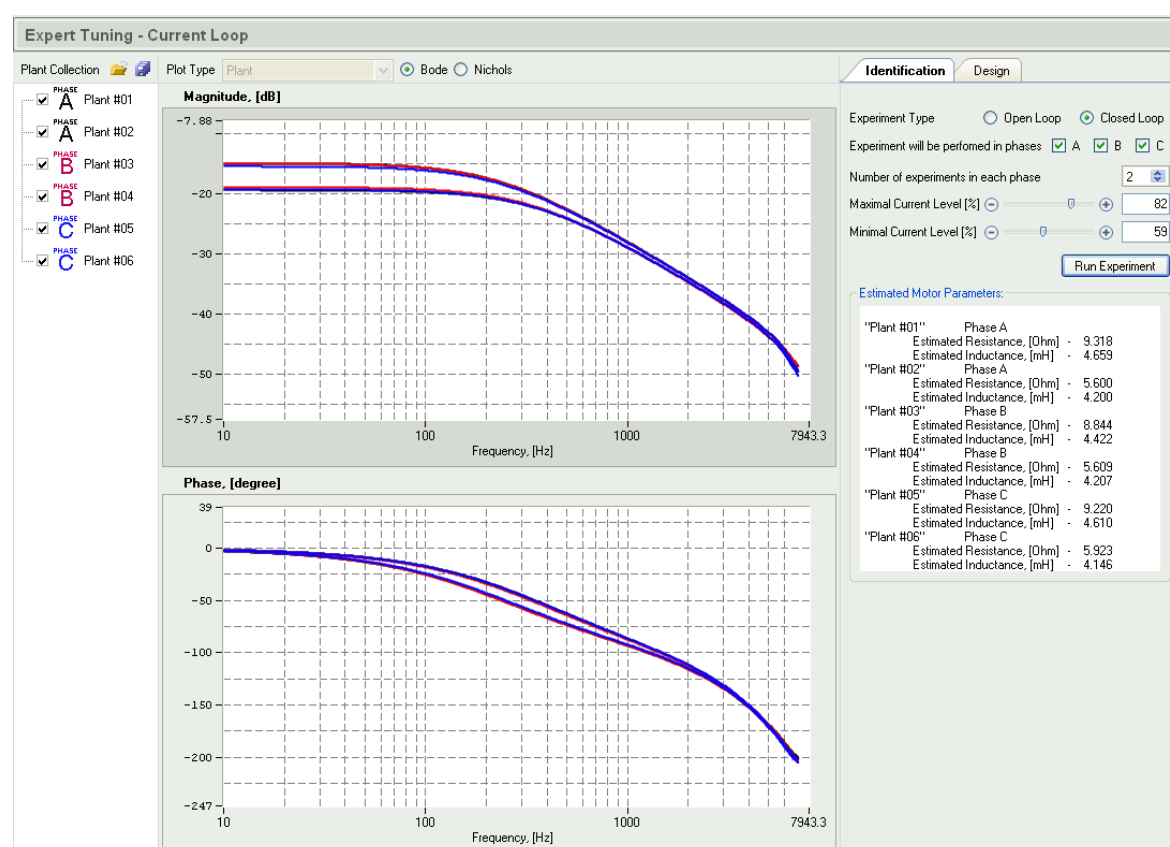
The current loop is the basis for all other control loops. No motion can be performed if the current loop is not working.

Automatic procedures in EAS can do most of the work in this process. As a user, you can select your level of involvement in the process: leave all the work to the automatic processes, enter your design requirements and then tweak the results or manually tune the drive.

The first step of the tuning process is to identify the plant: Signals are applied to the motor phases and EAS analyzes the response, generating a plant model (Frequency Response).

The information gathered in this stage is graphically displayed to the user for information. This data is also the basis for determining the current controller parameters.

4.1.4.1 The Current Tuning Window Structure



The tuning window has three main parts:

- The available plants list (collection) on the left side of window
- Graphic display
- Tuning and command area
- From the tuning window tool bar you can load a previously saved plant, save a plant, select a plot type (in design view) and select between Bode plot and Nichols.

It is recommended that you save your plant identification files and important design stages. The saved files may be useful later when you want to revise your work, alter it, or consult someone for support.

4.1.4.2 Current Loop Identification

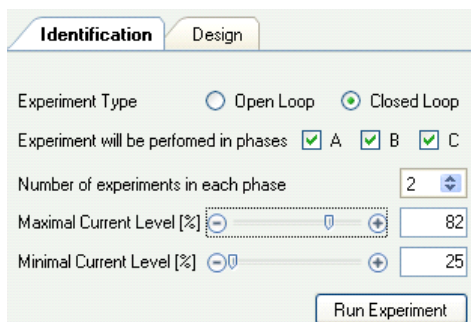
4.1.4.2.1 Experiment Type

The current loop identification can be performed in a closed loop or open loop. In the open loop experiment, there is no use of current feedback or control. The drive runs current through the motor and records the response.

In a closed loop, the drive uses a current controller to close the loop and then tests a step response of the motor. If you require hints about analyzing a step response, please refer to the section 4.1.12 Evaluation on page 208.

Note: The current loop sampling time cannot be changed during these tests. The default sampling time of the drive (which varies from model to model) is used.

4.1.4.2.2 Experiment Setting and Running



To run an experiment

1. Select one or more motor phases in which you want the identification experiment to be performed
2. Select how many experiments you want to run at each phase
3. Select the **Maximum Current Level** you want to use during the test. This value is a percentage of the application peak limit PL[1].
4. Select the **Minimum Current Level** you want to use during tests. This is useful if low current may not be enough to move the motor, for example, with high friction or high inertia.

Important: Presently, the **Minimum Current Level** cannot be changed for this experiment.

Note: In some situations, running repeated tests on the same motor phase results in different motor resistance estimations. If this happens, try to increase both maximum and minimum current levels. When the same experiment is performed with higher Current, the results are more accurate.

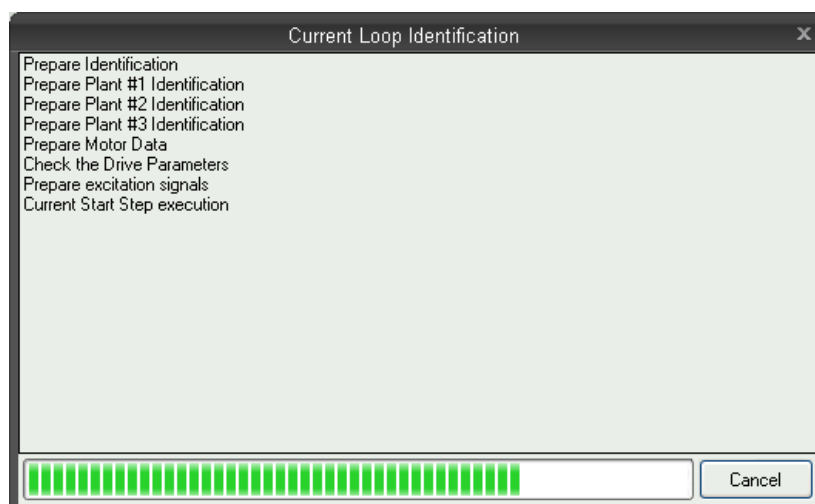
5. Click **Run Experiment**.

The following warning appears:



6. Click **OK** to continue.

7. The experiment begins. If you look at the motor you will see some movement, and you may hear some humming or clicking. The following screen appears:

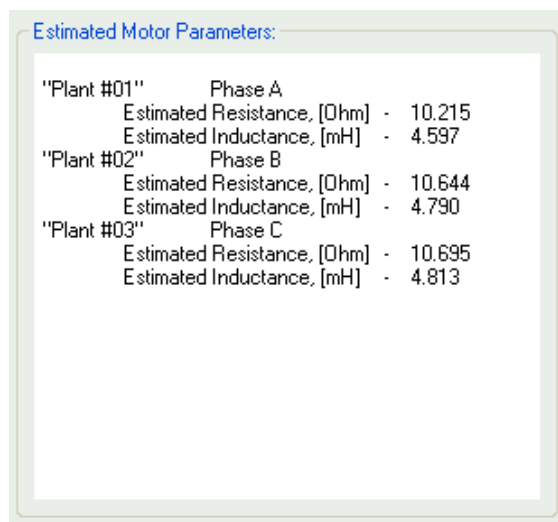


The progress of the various stages of the experiment can be monitored by reading the messages as they appear. If for some reason you need to abort the experiment, click **Cancel**.

4.1.4.2.3 Viewing the Experiment Results

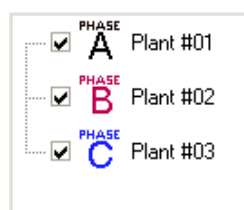
To view and analyze the experimental results

1. The **Estimated Motor Parameters** appear in the lower right hand side of the window.

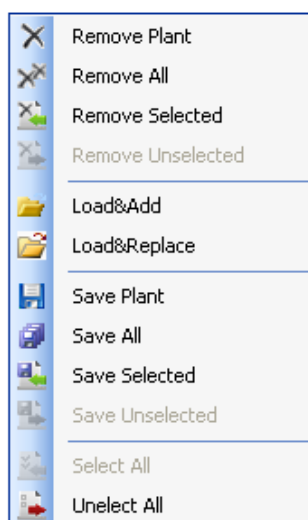


Each phase tested is considered a separate plant.

2. The **List of Plants** appears on the left hand part of the screen:



3. Deselecting a plant removes the graphic display of this plant to enable clearer viewing of individual phases. The deselected plant is still active for other purposes: it will be saved with the other plants and a design will be made for it together with the others.
4. Right clicking on a plant name opens the following menu:

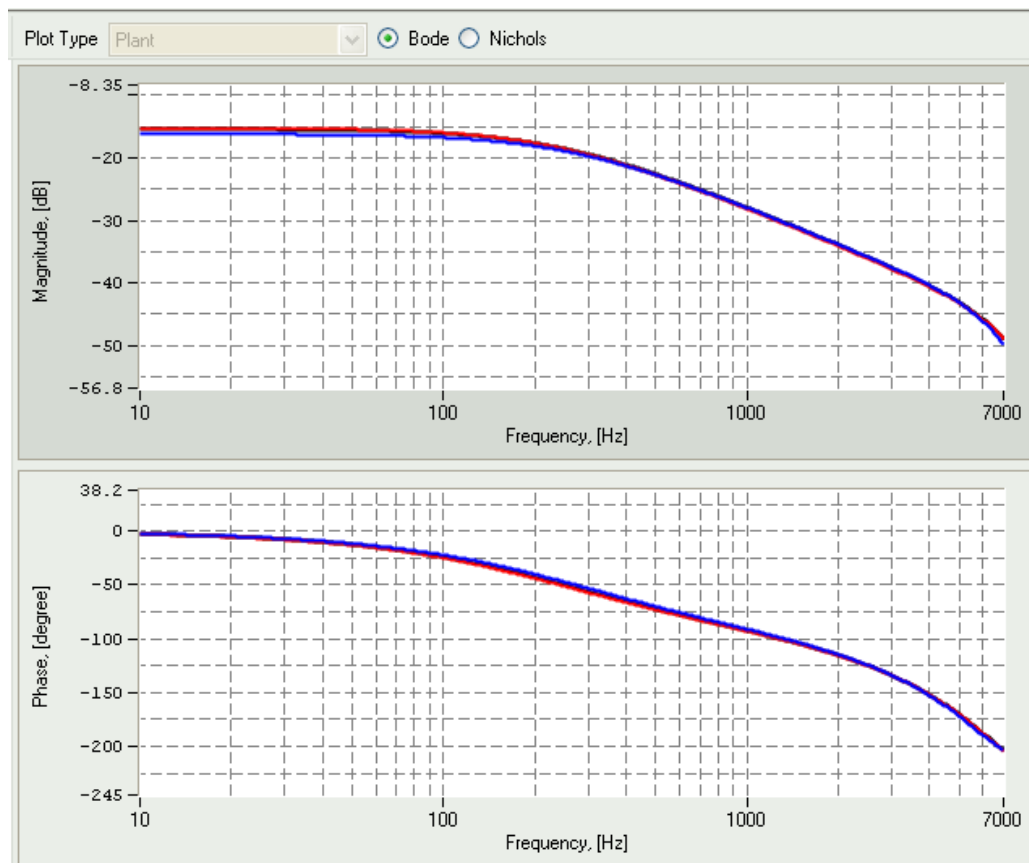




The Graphic Display shows the current frequency response in either Bode plot view or Nichols. The graphic display manipulation (zooming, riders etc.) for both displays is the same.

The Bode Plot:

The Bode plot combines two separate graphs: magnitude vs. frequency and phase vs. frequency.



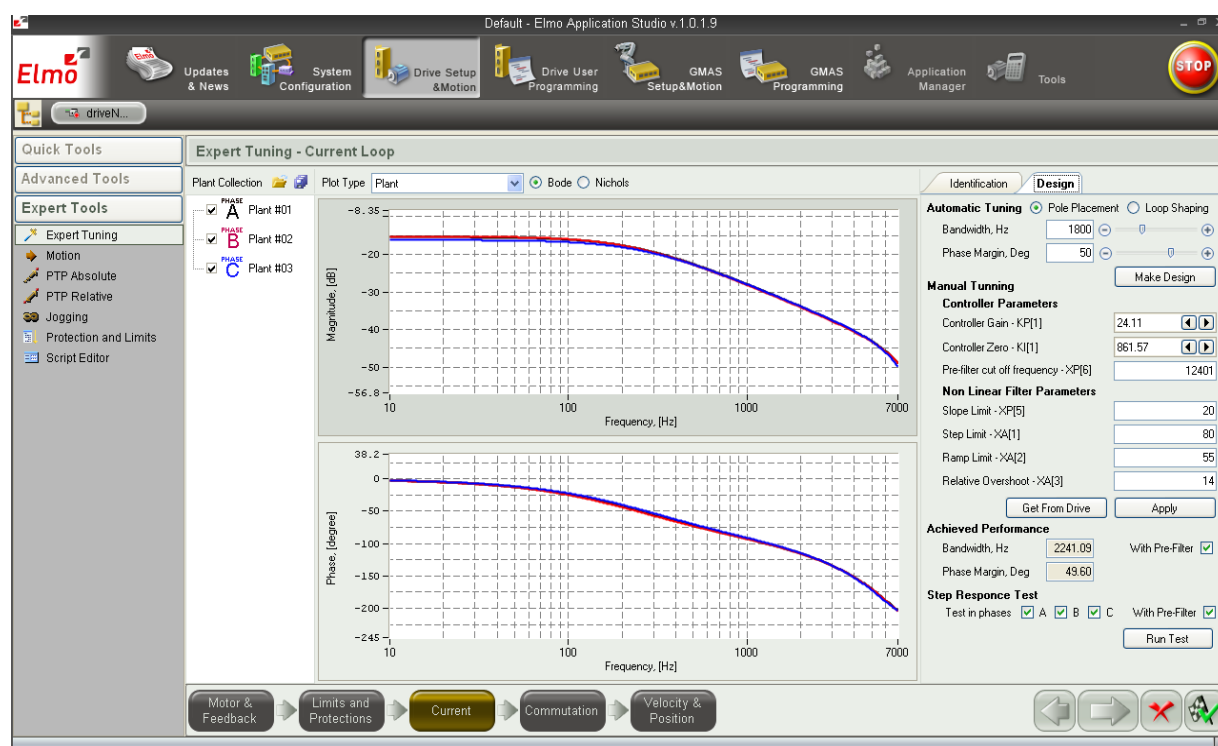
4.1.4.3 Current Loop Design

After obtaining a satisfactory result for the current plant identification process, it is necessary to design a current controller to close the current loop.

To design a current controller to close the current loop

1. Click to the **Design** tab:

The graphic display of the identified plant remains available.



4.1.4.3.1 Automatic Tuning

Use automatic tuning to allow the **EAS Expert Tuning Wizard** to calculate a controller that will meet your design demands for the given plant previously identified. During this phase, there is no motion in the motor. All the work performed is mathematical computation.

Depending on your system demands and expertise, you can use the automatic design results without altering anything, use the manual tuning option to change some of the results, or use manual tuning alone without the help of the automatic process.

Pole Placement

This is a fast calculation method taking a relatively crude approximation model of the plant and designing a simple controller to meet the user demands.

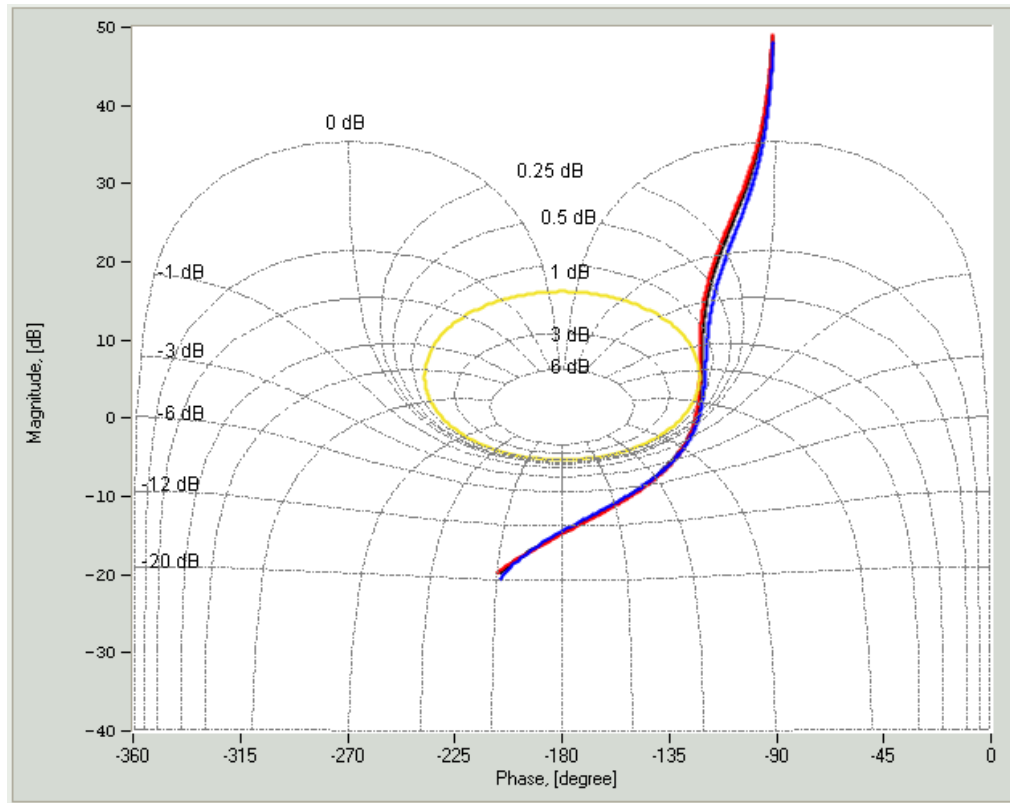
Loop Shaping

This design result usually produces better analysis. It is generally recommended. However, it is somewhat time consuming.

The Design

1. Select a design method using the radio buttons.
2. Use the scroll bars to determine the desired closed loop

- bandwidth in Hz and the phase margin in degrees, or enter the numbers in the text boxes.
3. Click the **Make Design** button to start the design process. The resulting closed loop (or loops if multiple plants were selected) Nichols diagram is displayed:



- The yellow ellipse defines the sensitivity circle (as shown in the Nyquist diagram) which is set according to the desired Phase Margin. The controller will be designed so that the entire graph is outside this area if possible.
4. If you prefer, you can select to view the same information in a Bode plot.
 5. Use the **Plot Type** drop down menu to view plots of: open loop, closed loop, closed loop with pre-filter, plant, controller or pre-filter.
 6. When the design is finished, the suggested controller parameters are displayed in the boxes under **Manual Tuning**. The actual bandwidth and phase margin of this design are shown under **Achieved Performance**.
 7. If you have not used the automatic procedure yet and want to see the design that is stored in the drive, click **Get**

From Drive. After using the automatic procedure the new parameters will be sent to the drive and the previous design is overwritten

8. If the resulting design is not satisfactory, try using a different design method, changing your demands if possible, or using the manual tuning.

4.1.4.3.2 Manual Tuning

The manual tuning can be used instead of the automatic design, or as a fine tuning tool.

Change the controller parameters and the non-linear parameters to receive the required design.

The result of any change in the parameters is immediately displayed in the graphs and in the Achieved Performance text boxes. For a more detailed explanation of the parameters, refer to the Gold Line Software Manual and the drive's command reference.

4.1.4.3.3 Testing the Design

When you reach a satisfactory design, click **Apply**. Until now, all the graphs displayed during the design process were only theoretical. You can perform a step response test to see the actual results of the design:

To perform a step response test

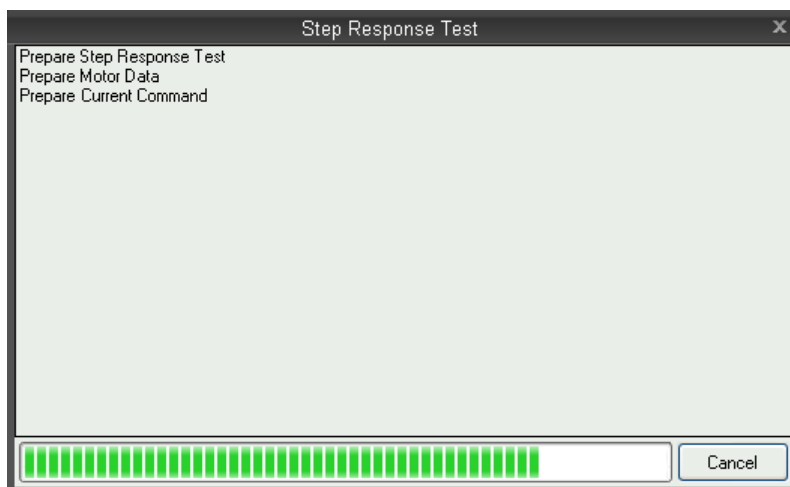
1. Select only the phases you want to test and deselect the other phases.

The following message is displayed:

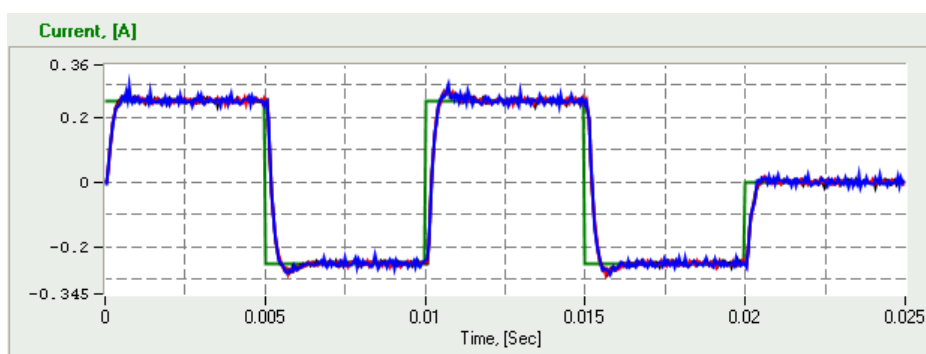


2. Click **OK** to start the test

You can follow the test in the monitor window:



3. When the test is completed, a graph of the test response appears at the lower part of the graphic display.



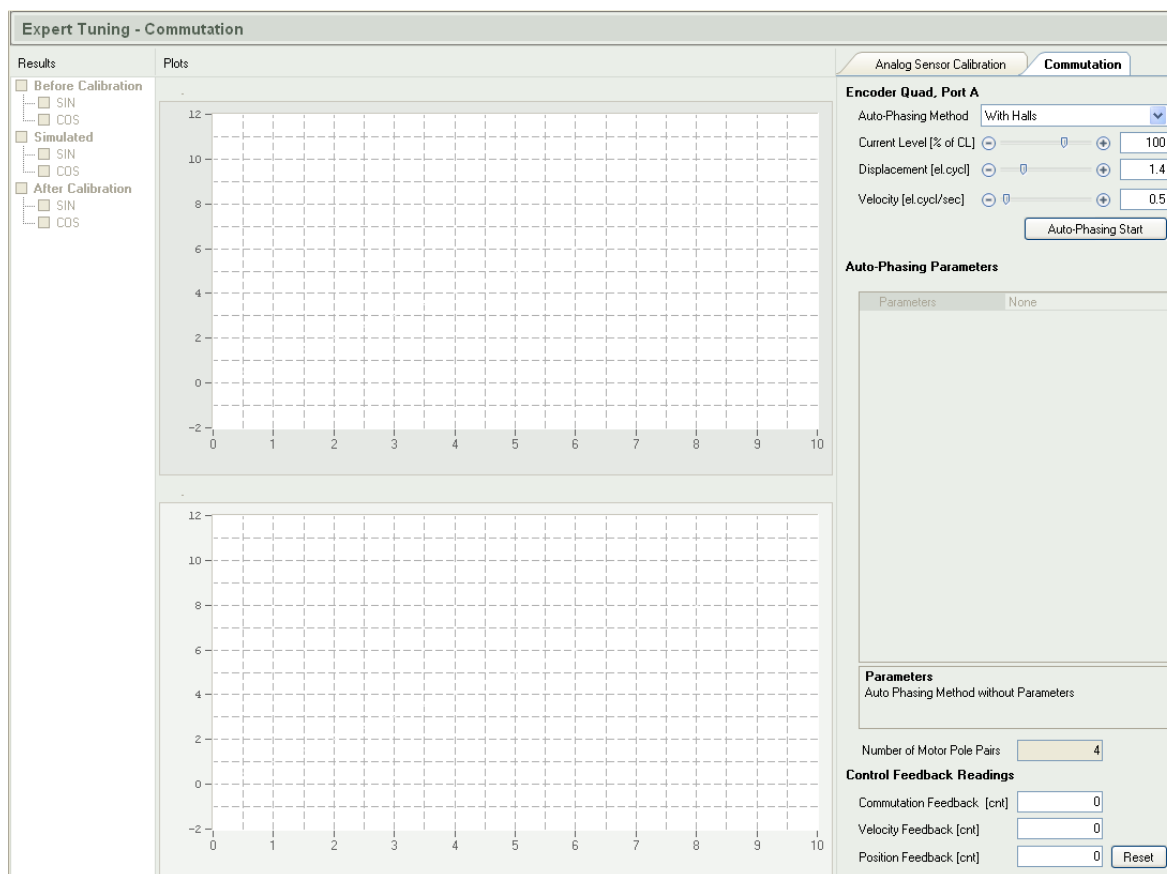
4. Double click the graph to view the test results in a full screen view. Double click again to return to normal view.

If you require more information about analyzing the step response refer to the section 4.1.12 Evaluation on page 208.

4.1.5 Commutation

To perform Commutation

1. Click the **commutation** button or **Next** arrow in the wizard to continue to the commutation window.



Within this window, the tuning wizard performs three tasks:

- a. Commutation – determining the relation between the commutation sensor reading and motor phases A, B and C, so that the drive runs the current through each phase at the correct electrical angle.
- b. Determines the direction that will be defined as positive motion for all the feedback sensors
- c. Analog sensor calibration – relevant only for systems with analog feedback sensors.

The window is divided into three areas:

- The results list area of the Analog Sensor Calibration
- The graphic display area that takes the main part of the screen is used for Analog sensor calibration
- The process control area – in this area the user can enter and view information pertaining to the process.

4.1.5.1 The Commutation Tab

This control performs the auto-phasing process. The auto-phasing process finds the initial phasing of the motor in relation to the reading of the commutation sensor. The process sets the parameters for absolute sensors.

For a brush or DC motor, this process is reduced to setting the sensor direction to the motor direction.

4.1.5.1.1 Commutation and Sensor Selection

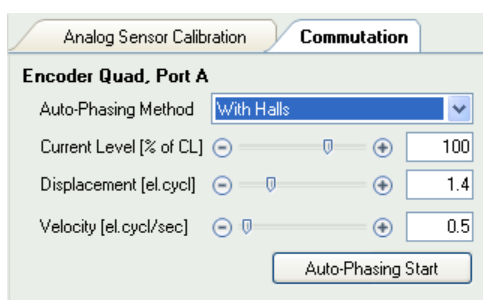
The commutation sensor provides the drive information about the motor's electrical angle. Accurate knowledge of this angle allows the drive to determine the correct current that needs to be applied to the motor.

The auto phasing process detects the relationship between the sensor reading and the motor's electrical angle. It also finds the correct order in which the motor phases should be powered regardless of the order in which they are wired.

The process varies according to the sensor that is connected. The paragraphs below describe the auto phasing process by sensor type.

Incremental Sensor and Halls

If both an incremental sensor and Hall sensors are present, it is recommended to use the incremental sensor as commutation sensor and select **With Halls** as auto-phasing method.



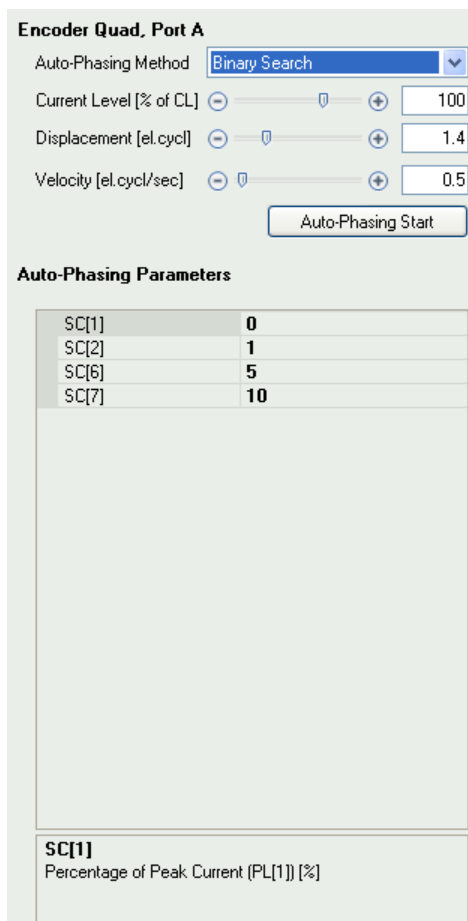
The commutation detection and operation involves:

1. Initial Auto-Phasing:
During the initial auto-phasing process, the motor will move. The parameters for the relationship between Hall reading and motor phases will be determined and set. The relationship between the incremental sensor reading and the electrical angle will also be determined and set.
2. During normal operation:
The commutation (determining the current to the motor) is based on the incremental sensor reading only. The Hall reading is ignored.
3. After power down or position loss:

Hall sensor reading is used for initial recovery without motor movement. During motion, some calculations are made until commutation can rely on the incremental sensor again.

Incremental Sensor without Hall Sensors

Use the incremental sensor as the commutation sensor, and select either **Stepper** or **Binary Search** as auto-phasing method.



Encoder Quad, Port A

Auto-Phasing Method: **Binary Search**

Current Level [% of CL]: 100

Displacement [el.cycl]: 1.4

Velocity [el.cycl/sec]: 0.5

Auto-Phasing Start

Auto-Phasing Parameters

SC[1]	0
SC[2]	1
SC[6]	5
SC[7]	10

SC[1]
Percentage of Peak Current (PL[1]) [%]

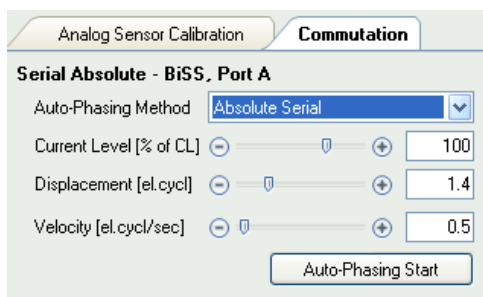
The commutation detection and operation will be as follows:

1. Initial Auto-Phasing:
During the initial auto-phasing process, the motor will move. The stepper method requires more movement than binary search. The relationship between the incremental sensor reading and the electrical angle of the motor will be determined and set.
2. During normal operation:
The commutation (determining the current to the motor) is based on the incremental sensor reading only.
3. After power down or position loss:

The auto-phasing method that was selected will be repeated.

Absolute Sensor with or without Halls

If both an absolute sensor and Hall sensors are present, it is recommended to select “Absolute Serial” as the auto-phasing method.



1. Initial Auto-Phasing:
During the initial auto-phasing process, the motor will move. The parameters for the relationship between the absolute sensor reading and the motor’s electrical angle will be determined and set.
2. During normal operation:
The commutation (determining the current to the motor) is based on the absolute sensor reading only. The Hall reading is ignored.
3. After power down or position loss:
The absolute position reading is used for commutation immediately without the need for any motor movement.

When to use a different method with absolute sensor?

In some cases, the absolute sensor reading does not have a one-to-one relationship to the motor’s electrical angle. In these cases, another auto-phasing method is required. See incremental sensors above to select a method.

4.1.5.1.2 Auto-Phasing Method Parameters

The different methods are briefly described below. For more details, refer to the Gold Line Language & User Program Manual and Gold Line Command Reference.

With Halls	Use this method when Hall sensors are connected to the drive. The auto-tuning algorithm detects the relationship between Hall A, Hall B and Hall C reading and the motor phases M1, M2, and M3. This relationship is saved in the drive, and can be used to rotate the motor after the drive was turned off. Parameters: None
Binary Search	The binary search method detects the relationship between sensor position reading and motor phases using minimal motor movement. Parameters: SC[1] – Maximum current. The maximum current in Amperes to be used for the identification. SC[2] – Time in seconds to reach maximum current. SC[6] – Leave the default value. SC[7] - Identify direction of movement: The minimum number of counts that is considered as a significant motor movement caused by the applied current.
Stepper	The stepper commutation detection method starts by activating the motor as a stepper motor. This detection method causes more motor movement than binary search. Parameters: SC[1] – Maximum current. The maximum current in Amperes to be used for the identification. SC[2] – Time in seconds to reach maximum current. SC[3] – Time to stabilize speed in seconds. How long to continue trying to stabilize speed. SC[4] – Time to decrease current to 0 after trying to stabilize speed (SC[2] + SC[3] + SC[4] = maximum experiment duration). SC[5] - Max. error at stable speed, cycle/sec: The maximum speed error allowed in electric cycles/sec for the speed to be defined as stable.
Analog Halls	An analog Sin/Cos sensor can be used as the commutation source. The Sin/Cos sensor should provide one to one information about the motor's electrical angle. This yields the requirement that one Sin/Cos sensor cycle equals one motor electric cycle.

Parameters: None

Absolute Serial

The relationship between the absolute encoder reading and the motor's electrical angle is detected during the initial phasing process.

Parameters: None

Gurley

The relationship between the absolute encoder reading and the motor's electrical angle is detected during the initial phasing process.

Parameters: None

**Activating Auto-
Phasing**

The Auto – Phasing control area for a quadrature encoder on port A is shown below. The main difference for other sensors is in the method selection, so the general steps are very similar.

When entering this tab default values for the maximum current, maximum displacement and maximum velocity are displayed. It is recommended not to change these values. Lower the values only if it is necessary for your system. Note that lowering these values may cause difficulty for the auto phasing process.

Encoder Quad, Port A
 Auto-Phasing Method With Halls
 Current Level [% of CL] 100
 Displacement [el.cycl] 1.4
 Velocity [el.cycl/sec] 0.5
 Auto-Phasing Start

Auto-Phasing Parameters
 Parameters None
 Parameters
 Auto Phasing Method without Parameters
 Number of Motor Pole Pairs 4

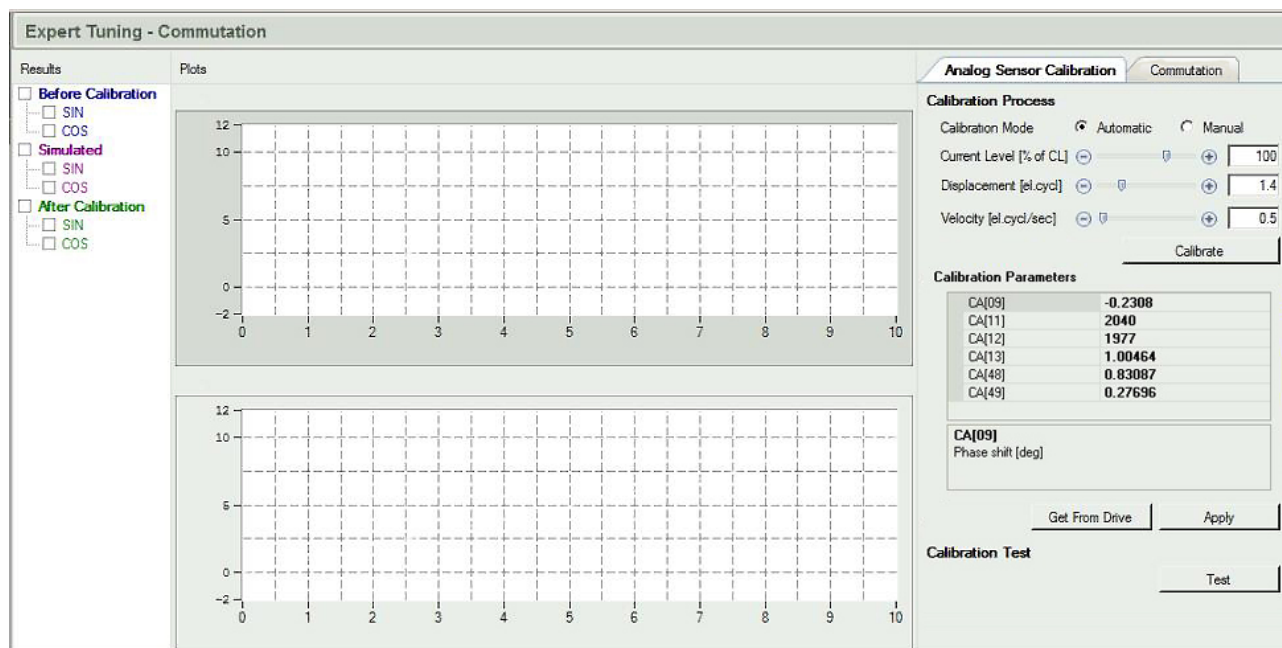
Control Feedback Readings
 Commutation Feedback [cnt] 0
 Velocity Feedback [cnt] 0
 Position Feedback [cnt] 0 Reset

1. The position reading of the various feedback sensors is displayed. If one sensor is used for more than one purpose (for example an absolute encoder is used for position, velocity and commutation reading), the readings will be identical.
2. Select the auto phasing method (see details above) and set the parameters.
3. Click **Auto-Phasing Start**.

4.1.6 Analog Sensor Calibration

To perform an analogue sensor calibration

1. If you are using an analog sensor such as Sin/Cos, select the **Analog Sensor Calibration** tab to calibrate the sensor for optimal performance.

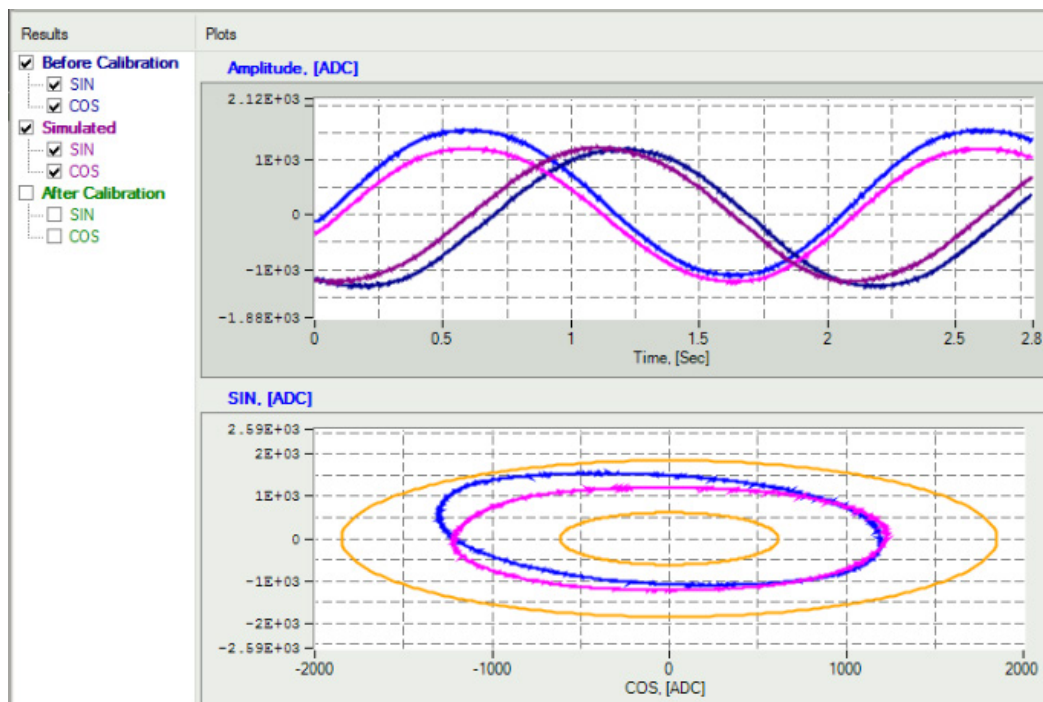


2. For all motors except DC brush select **Automatic**, set the calibration process limitations and click **Calibrate**.

CA[09]	-0.74658
CA[11]	2055
CA[12]	1979
CA[13]	1.05255
CA[48]	0.61376
CA[49]	0.20459

CA[09]	
Phase shift [deg]	

3. After a short calibration process graphs similar to the graphs below is displayed.



The top chart shows four graphs. If you deselect the simulated sine and cosine you can see only the measured sine and cosine in A/D converter units.

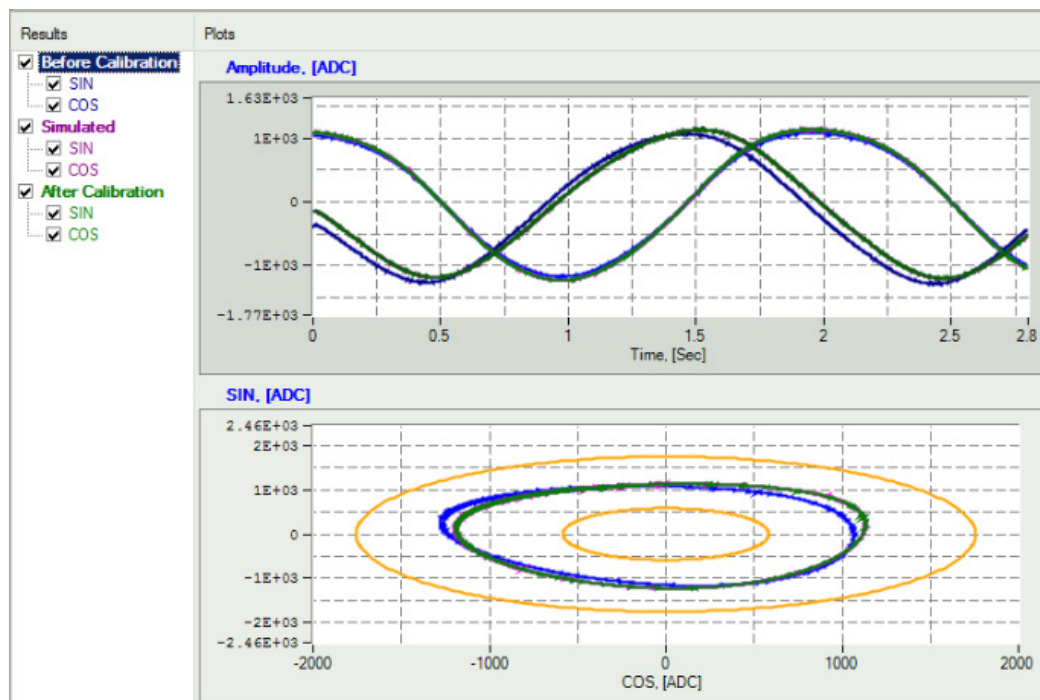
EAS generates simulated sine and cosine signals to improve the accuracy of the position measurement.

4. Look at the lower plot to see Lisajou plots of the measured and simulated signals. The yellow forms represent the boundaries for the calibrated signal. Note that the simulated signal is more symetrical and circular than the original measured signal. If the lower Lisajou plots move outside the yellow boundaries, the drive will produce errors. The drive should be reconfigured.

Note: The simualted signal appears elliptical due to the scaling of the axes (sin[ADC] & cos[ADC]).



5. To see the actual position reading performance after calibration click **Test**. Two more lines are added to the plots:



In this case you can see that the reading after the calibration is exactly the same as the simulated line.

Normally it is recommended to leave the calibration parameters untouched. If for some reason the calibration process does not produce the desired results in a special system, please refer to the Gold Line Command Reference to understand the parameters.

For DC brush motors select the **Manual** option and manually rotate the motor according to the instructions.

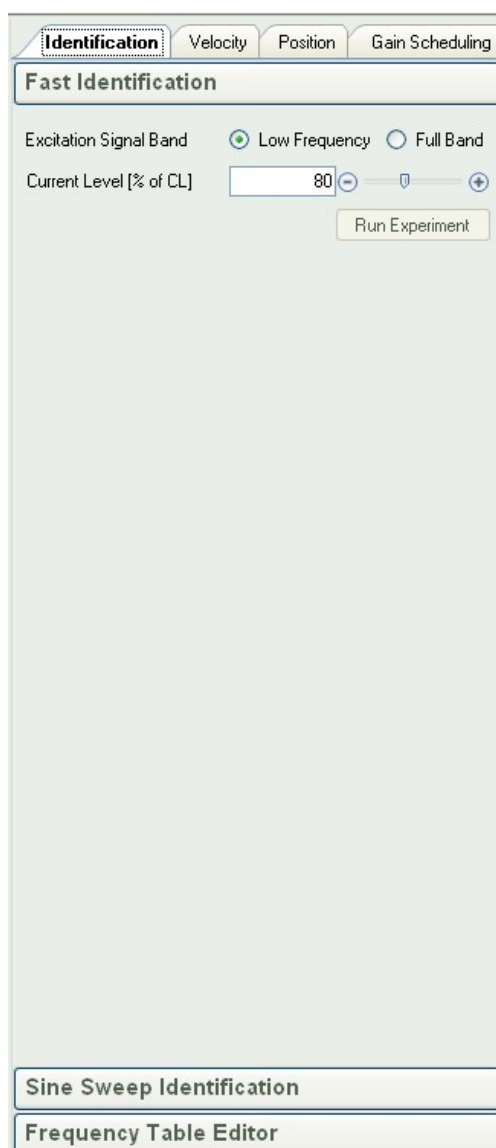
4.1.7 Velocity and Position Loops Tuning

The final stage of the tuning is tuning the velocity and position loop. The velocity loop must first be tuned and then the position loop.

In this window, you can perform four actions:

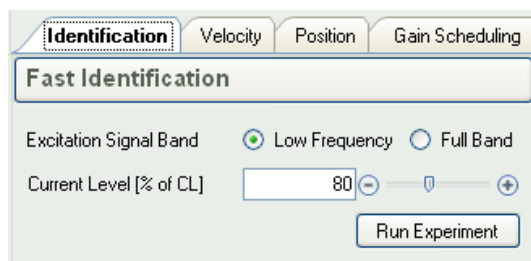
- Identification: The automatic identification process finds the system's frequency response
- Velocity loop design: Design and test a controller for the velocity loop
- Position loop design: Design and test a controller for the position loop
- Gain scheduling: Future option not supported yet.

4.1.7.1 Identification



The purpose of the identification process is to model the velocity plant and position plant. Use either **Fast Identification** or **Sine Sweep** to find the frequency response of your system.

4.1.7.1.1 Fast Identification

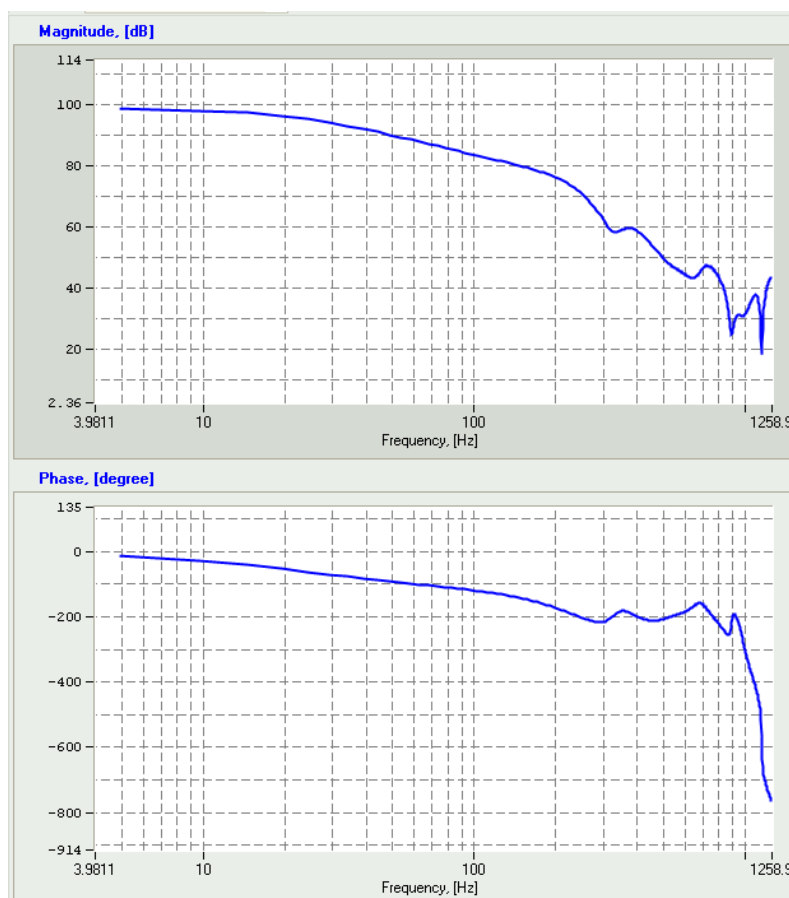


The low frequency identification performs a system identification for frequencies under 1250 Hz. This bandwidth is enough for most systems. If you have reason to suspect that, your system has resonances at higher frequencies, use the full band identification to scan frequencies up to 2500 Hz.

The identification test sends a fast multi sine signal and registers the response to the signal. The **Current Level** defines the percentage of the motor's current limit that will be applied to the motor during the test. Sometimes with a low current level, the test results may be problematic. Use high current levels where possible. If not possible, start at a low current level and increase the current until the results of consecutive tests taken with different current levels produce the same results.

4.1.7.1.2 An example of the process

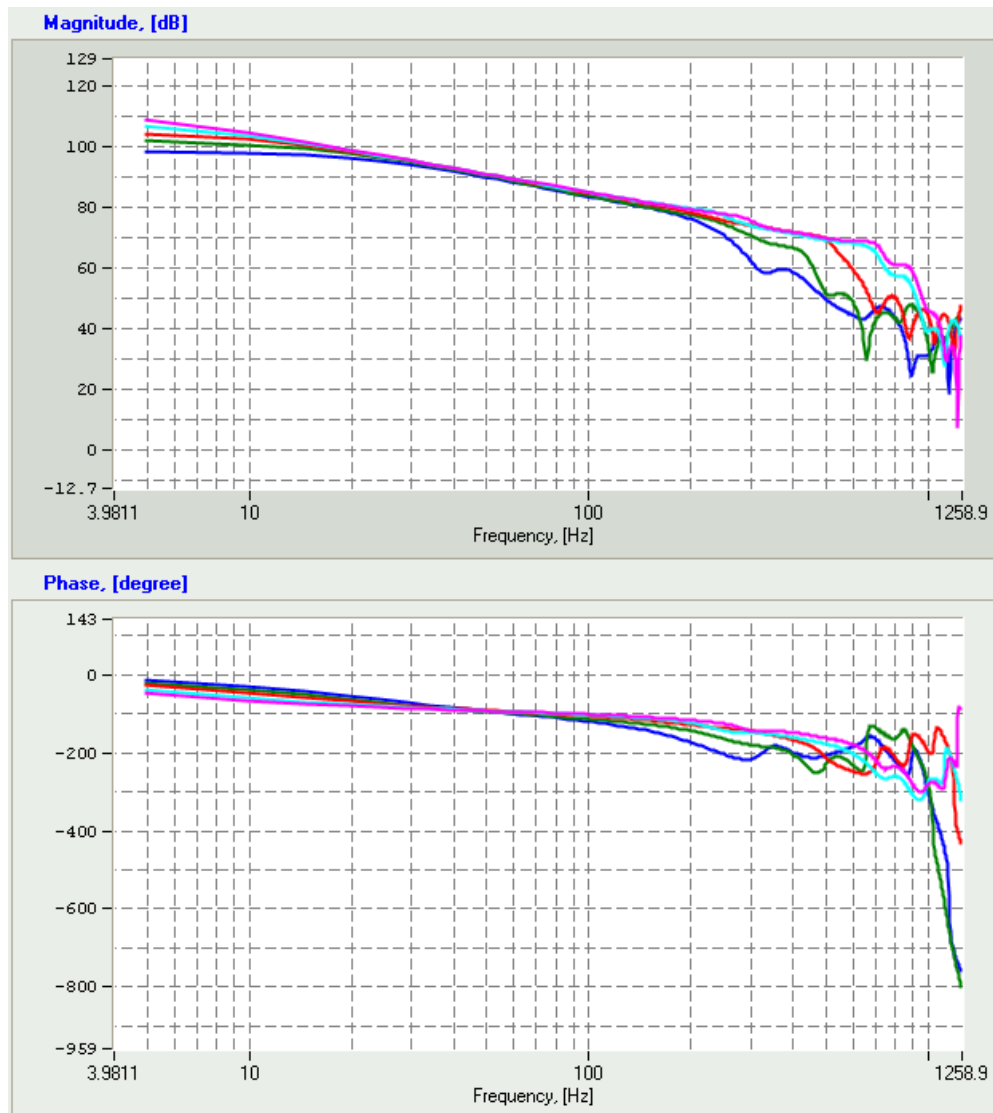
An experiment using 16% current produced the following result:





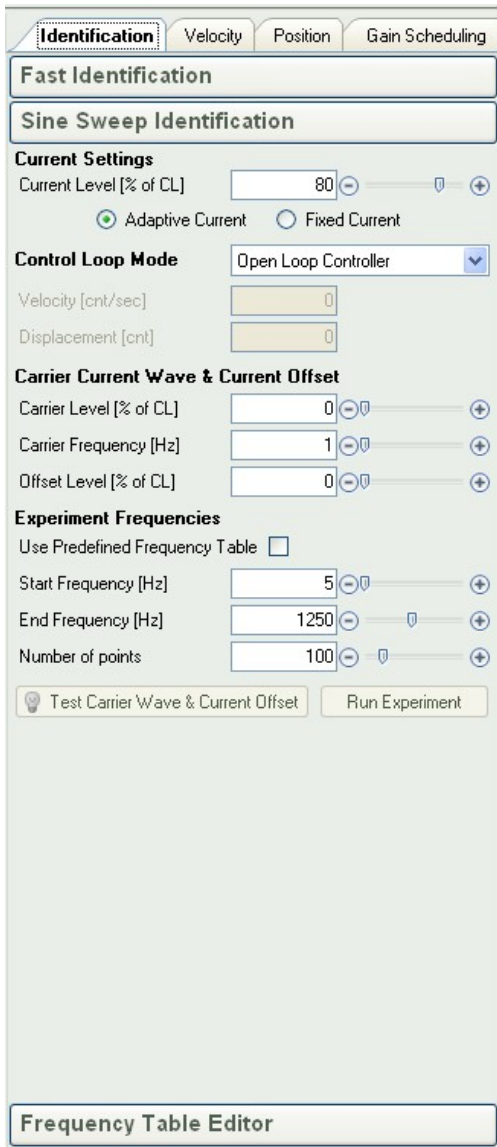
Another experiment at 30% produces slightly different results, and a 45% experiment produces different results.

After several more experiments, the results using 60% and 80% of the current repeat themselves closely enough to be considered correct plant identification. We can use any of these plants as a basis for design.



The graphic interface in this window is identical to the graphic interface used for current loop identification and design. For a detailed explanation about the graphic interface, refer to section 5.1.3.

4.1.7.1.3 Sine Sweep Identification



The screenshot shows the 'Identification' tab in the Elmo Application Studio software. The 'Sine Sweep Identification' sub-tab is active. The configuration is divided into several sections:

- Fast Identification**: A button at the top of the sub-tab.
- Current Settings**: Includes a 'Current Level [% of CL]' slider set to 80, and radio buttons for 'Adaptive Current' (selected) and 'Fixed Current'.
- Control Loop Mode**: A dropdown menu set to 'Open Loop Controller'.
- Velocity [cnt/sec]** and **Displacement [cnt]**: Input fields, both currently set to 0.
- Carrier Current Wave & Current Offset**: Includes sliders for 'Carrier Level [% of CL]' (0), 'Carrier Frequency [Hz]' (1), and 'Offset Level [% of CL]' (0).
- Experiment Frequencies**: Includes a checkbox for 'Use Predefined Frequency Table' (unchecked), and sliders for 'Start Frequency [Hz]' (5), 'End Frequency [Hz]' (1250), and 'Number of points' (100).
- Buttons**: 'Test Carrier Wave & Current Offset' and 'Run Experiment'.
- Frequency Table Editor**: A button at the bottom of the window.

The sine sweep method sends sine waves in a range of frequencies and records the system's response to each frequency.

The **Current Level** defines the percentage of the motor's current limit that will be applied to the motor during the test. Sometimes with a low current level, the test results may be problematic. Use high current levels where possible. You can set the offset current level, but not the time to reach offset. It is set to a constant (1 ms).

In general, it is recommended to use the **Adaptive Current** algorithm. This algorithm uses different current levels for different frequencies to optimize the identification process. If for some reason (for example high friction in the system), you wish to set a certain current to be used during the test select **Fixed Current**.

Control Loop Mode – The best system identification is achieved using the **open Loop Controller** option. This way the system is not affected by a controller.



Use the **Position Closed Loop Controller** if you want to perform sine sweep identification without moving the motor (if unexpected movement could damage your system).

Use the **Velocity Closed Loop Controller** if you want your motor to move at constant speed as a bias to the sine sweep. Such movement may be needed if your system is only allowed to move in one direction. In this situation, set the velocity to be in the desired direction.

There is another reason why you may want the motor moving while the identification process is continuing. When using a low-resolution encoder or halls-only, the small movement caused by the sine wave may be too small for the feedback to indicate it. If the motor is moving, a change in the movement will be seen. If this is your reason to rotate the motor you will receive better results using a **Carrier Current Wave & Current Offset**.

Carrier Current Wave

As explained above, when using a low-resolution encoder or Halls-only, it is recommended that the motor move while the identification is taking place. Use as much current as your system will allow for best results. It is recommended to select a carrier wave frequency below the range of frequencies that are tested. A carrier wave frequency within the test range will cause some distortion in the test results around this frequency.

Offset Level

Current Offset has been added. You can set the offset current level, but not the time to reach offset. It is set to a constant (1 ms).

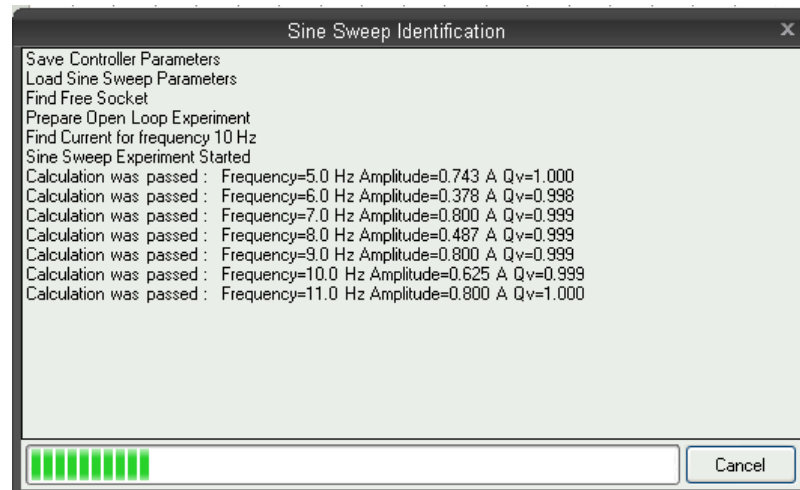
Experiment Frequencies

Select the range of frequencies you would like to test. Note that the tested frequencies are spaced according to a logarithmic scale and not evenly spaced along the frequency axis.

Select **Use Predefined Frequency Table** if you want to repeat a test using the last saved frequency table.

Click **Test Carrier Wave** to test the tether of the drive. Adjust the Current Level (CL) and Frequency, until the values are suitable and relevant for the servo drive under test.

Then click **Run Experiment**. After a warning the experiment begins.



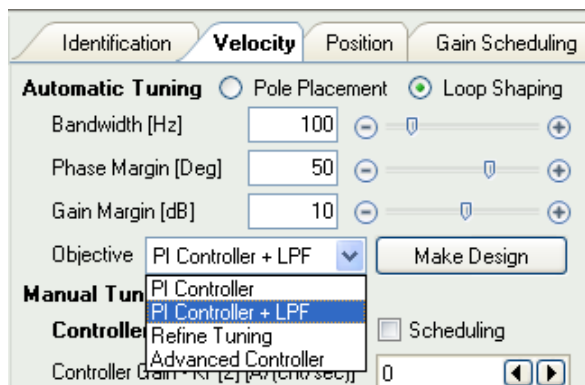
At the end of the test you will see a Bode plot of your plant.



4.1.8 Velocity Loop Design

The velocity controller is designed using the loop shaping method. The design is a mathematical process that determines parameters. The motor will not move during the design. After the design is finished, you can test the velocity-loop step response.

In the Automatic Tuning area shown below, enter the required bandwidth, phase margin and gain margin. Select the type of controller that is the design objective from the list and click Make Design.



Bandwidth Maximal recommended bandwidth. The automatic tuning process will calculate a controller for which the closed loop response bandwidth does not exceed this value

Phase Margin The required minimum phase margin of the closed loop

Gain Margin The required minimum gain margin of the closed loop

Objective Select a design objective from a list:

PI Controller

Design a PI controller with gain scheduling, and disable all low pass filters.

PI Controller + LPF

Design a PI controller with gain scheduling, and a second order low pass filter with Natural frequency of 800 Hz and damping factor 0.6.

Refine Tuning

Modifies KP[2] and KI[2] to achieve best performance. Should be used when the Automatic Tuning Requirements are changed, but you do not wish to perform the entire operation of finding a controller, or if you have added or subtracted advanced filters.

Advanced Controller

Adds a low pass filter and notch filter. Automatic controller always adds a low pass filter, but if a low pass filter is not necessary, its frequency will be 4000 Hz, which almost does not influence the system. The notch filter will be added only if the auto tuner finds it as the best possible solution. Only one notch filter will be added.

Click the **Make Design** button. A velocity controller that meets the design requirements as closely as possible is calculated. The graphic display will show the results of the design

process. The achieved performance values are displayed in the lower part of the design panel.

Achieved Performance		
Bandwidth [Hz]	202.0	Stable Loop 
Phase Margin [Deg]	52.2	
Gain Margin [dB]	9.8	
Step Response Test		<button>Run Test</button>

Note: Step response test currently does not operate in velocity loop shaping.

For more information about analyzing the Step Response, refer to the section Testing the Design on page 183.

If the results are not satisfactory, you can either try to change the original design requirements, manually change the controller parameters (refer to the Elmo Gold Line Software Manual) or change the filters:

Advanced Filters	
1. First Filter	
1.1. Filter Type	Low-Pass
1.2. Natural Frequency [Hz]	800
1.3. Damping Factor	0.6 
2. Second Filter	
2.1. Filter Type	Disabled
3. Third Filter	
3.1. Filter Type	Disabled
4. Fourth Filter	
4.1. Filter Type	Disabled
5. First Feedback Filter	
5.1. Filter Type	Disabled
6. Second Feedback Filter	
6.1. Filter Type	Disabled

When the design results meet your requirements, click **Apply** to send the controller parameters to the drive. For a step response test click **Run Test**.

For more information about analyzing the Step Response, refer to the section Testing the Design on page 183.

4.1.8.1 Saving and Loading a Design

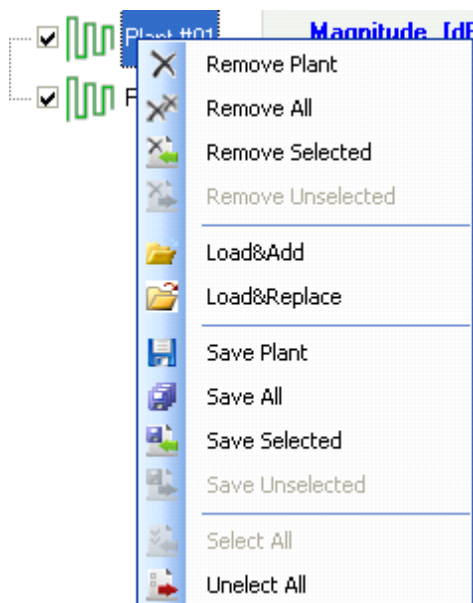
Use the save and load buttons on the toolbar to build and access a plant collection.



The files can be saved using the following formats:

*.MatWV (a proprietary format) or *.jpg to save a snapshot of the graph only, without data.

When a graph is already open, you can open another graph by right clicking the name of the open graph to invoke the following menu.



Select **Load & Add** to draw the lines included in the new file without removing the lines that are already displayed. This can be useful for comparison between the graphs. If you want to remove the currently displayed graph, select **Load & Replace**.

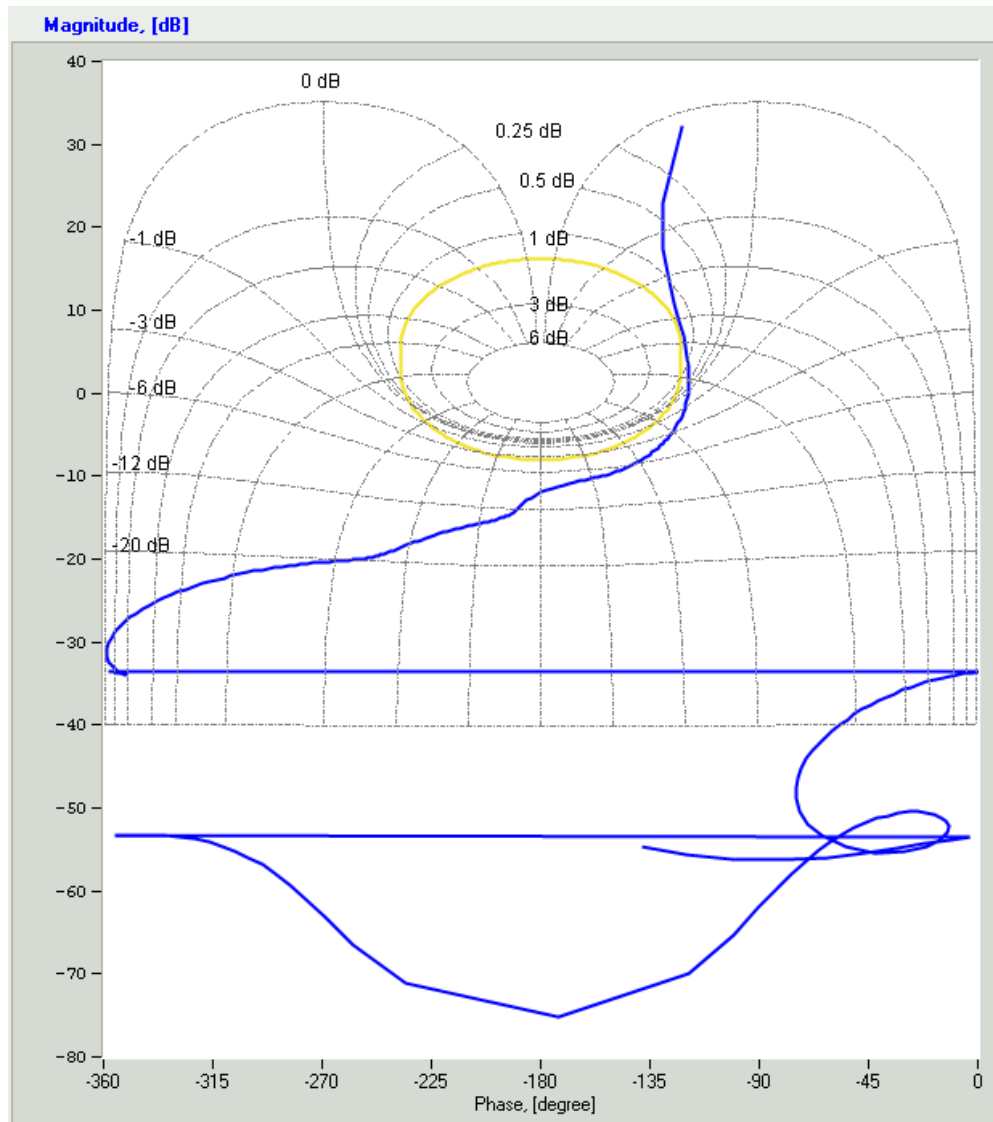
4.1.8.2 The Graphic Interface

Use the toolbar controls to select the graph to be presented and the presentation form.



Plot type Select from a list: Velocity plant, velocity open loop, velocity closed loop, velocity controller and filters, velocity controller, velocity filters, velocity feedback filters, velocity filter #1 - #4, Velocity feedback filter #1 - #2.

After designing a controller, the graphic display will show by default the Nichols plot of the open loop.



This graph shows both magnitude and phase on the same plot. The yellow ellipse is the sensitivity circle is set according to desired Phase Margin and Gain Margin. The plant including a controller will not enter this area.

Right click in the graph area to invoke the graphic interface options.

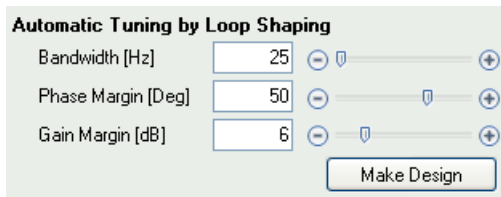
Use the radio push button if you prefer to view a Bode plot of the plant.

4.1.9 Position Loop Design

There is no need to perform another identification process before designing the position loop. The position loop is designed with the velocity loop as the plant to be controlled.

The position controller is designed using the loop shaping method. The design is a mathematical process that determines parameters. The motor will not rotate during the design. After the design is completed, you can test the position-loop step response.

In the Automatic Tuning area shown below, enter the required bandwidth, phase margin, gain margin, and click **Make Design**.



Automatic Tuning by Loop Shaping

Bandwidth [Hz] [-] [+]

Phase Margin [Deg] [-] [+]

Gain Margin [dB] [-] [+]

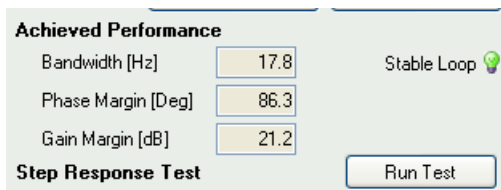
Make Design

Bandwidth Maximal recommended bandwidth. The automatic tuning process will calculate a controller for which the closed loop response bandwidth does not exceed this value

Phase Margin The required minimum phase margine of the closed loop

Gain Margin The required minimum gain margin of the closed loop

A position controller that meets the design requirements as closely as possible is calculated. The graphic display will show the results of the design process. The achieved performance values are displayed in the lower part of the design panel.



Achieved Performance

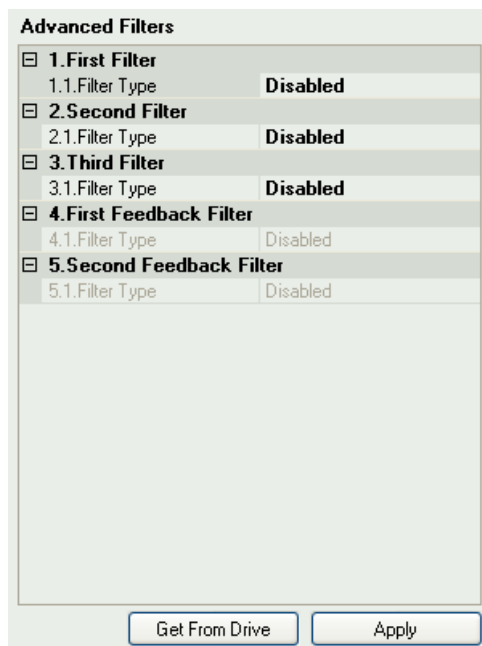
Bandwidth [Hz] Stable Loop 

Phase Margin [Deg]

Gain Margin [dB]

Step Response Test **Run Test**

If the results are not satisfactory, you can either try to change the original design requirements, manually change the controller gain (refer to the Elmo Gold Line Administrative Manual) or change the filters.



Advanced Filters

☒ 1.First Filter	1.1.Filter Type	Disabled
☒ 2.Second Filter	2.1.Filter Type	Disabled
☒ 3.Third Filter	3.1.Filter Type	Disabled
☒ 4.First Feedback Filter	4.1.Filter Type	Disabled
☒ 5.Second Feedback Filter	5.1.Filter Type	Disabled

Get From Drive **Apply**

When the design results meet your requirements, click **Apply** to send the controller parameters to the drive. For a step response test, click **Run Test**.

Important: Position step response test is not yet available.

If you want further information about analyzing the step response, refer to the section 4.1.12 below Evaluation on page 208.

4.1.9.1 Saving and Loading a Design

Use the save and load buttons on the toolbar to build and access a plant collection.

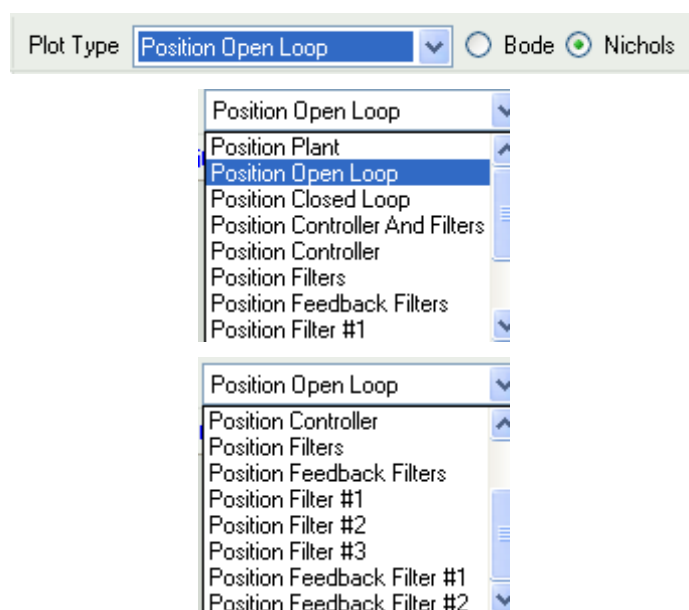


The files can be saved using the following formats:

*.MatWV (a proprietary format), *.mat for opening in Matlab or *.jpg.

4.1.9.2 The Graphic Interface

Use the toolbar controls to select the graph to be displayed, and the form of presentation:



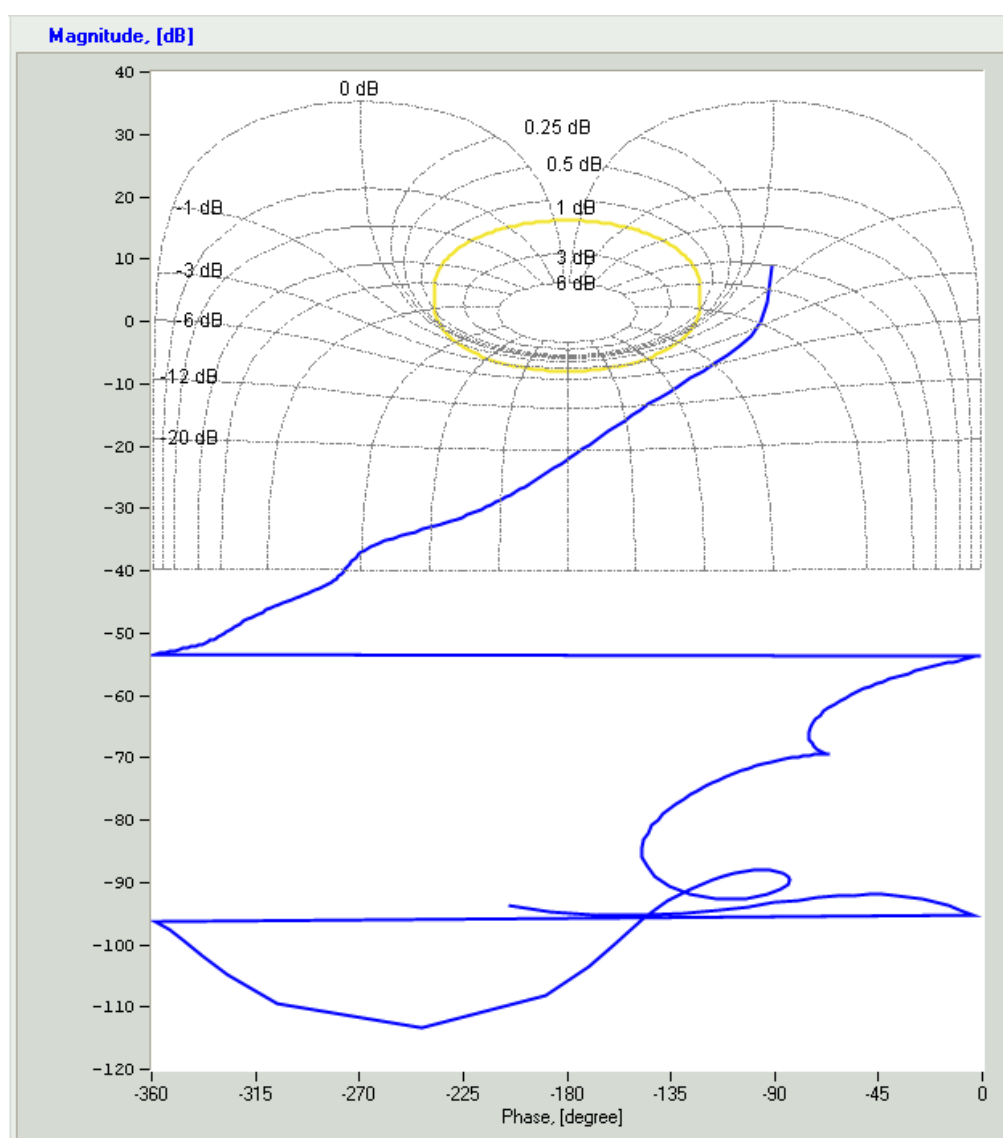
Plot type

Select from the following list:

Position plant	Displays the transfer function of the identified position plant
Position open loop	Displays the transfer function of the position loop including the controllers and filters selected as an open loop
Position closed loop	Displays the transfer function of the position loop including the controllers and filters selected as a closed loop

Position controller and filters	Displays the transfer function of the controller and filters only
Position controller	Displays the transfer function of the controller only
Position filters	Display the transfer function of the filters added to the position controlled
Position feedback filters	Display the transfer function of the filters applied to the position feedback
Position filter #1 - #3, position feedback filter #1 - #2	Display the transfer function of the selected filters

After designing a controller, the graphic display will by default, show the Nichols plot of the open loop:



This graph shows both magnitude and phase on the same plot. The yellow ellipse is the sensitivity circle is set according to desired Phase Margin and Gain Margin. The plant including a controller will not enter this area.

Right click in the graph area to invoke the graphic interface options. For a detailed explanation about the graphic interface, see section 5.1.3. Use the radio push button if you prefer to view a Bode plot of the plant.

4.1.10 Gain Scheduling

Under construction – To be developed

4.1.11 Exiting the Wizard

To finish the wizard and save all the parameters to the drive's flash memory, click the **Finish** button .

To exit the wizard without completing the entire process, click the **Cancel** button  or any other button that instructs Elmo Application Studio to revert to another window. A warning message will prompt you to restore the parameters that were stored in the drive before the Tuning Wizard was launched or save the parameters that were set so far by the wizard and then exit.

4.1.12 Evaluation

This chapter describes the evaluation of a Step Response, with Rise Time, Settling Time, and Overshoot. A step response is the waveform the motor exhibits when its reference command changes abruptly. Step responses are not very practical in real-life motoring applications, as the reference commands are nearly always acceleration limited and smoothed many times.

A step response is, however, good to reveal the detailed dynamic behavior of the controller. The most popular step-response figures of merit are:

Rise time	The time since the reference has been changed until the value (position or speed) covers 90% of the step.
Settling time	The time since the reference has been changed until the value (position or speed) remains permanently within 3% of the step.
Overshoot	The percentage of the deviation to the other side while stabilizing the step.

These figures of merit are shown in Figure 4.1. Note that the rise time is about 0.01, the settling time is 0.074, and the overshoot is about 30%.

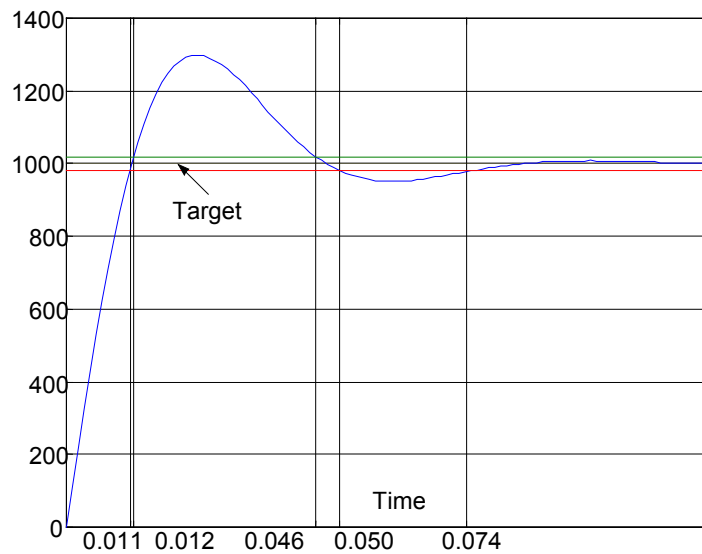


Figure 4.1: A step response

The overshoot level, as well as the ratio between the rise time and the settling time, reflects the gain and the phase margins. Gain or phase margin results that are too low may result in a high step response overshoot (more than 40%) followed by an undershoot, and a long settling time. If the phase margin is too high, the settling time is too long.

These properties are depicted in Figure 4.2 below, showing comparison between step responses of acceptable controllers and non-acceptable controllers. The plot is a simulation of three design examples: One with reasonable margins, one with margins that are too low and one with phase margins that are too high.

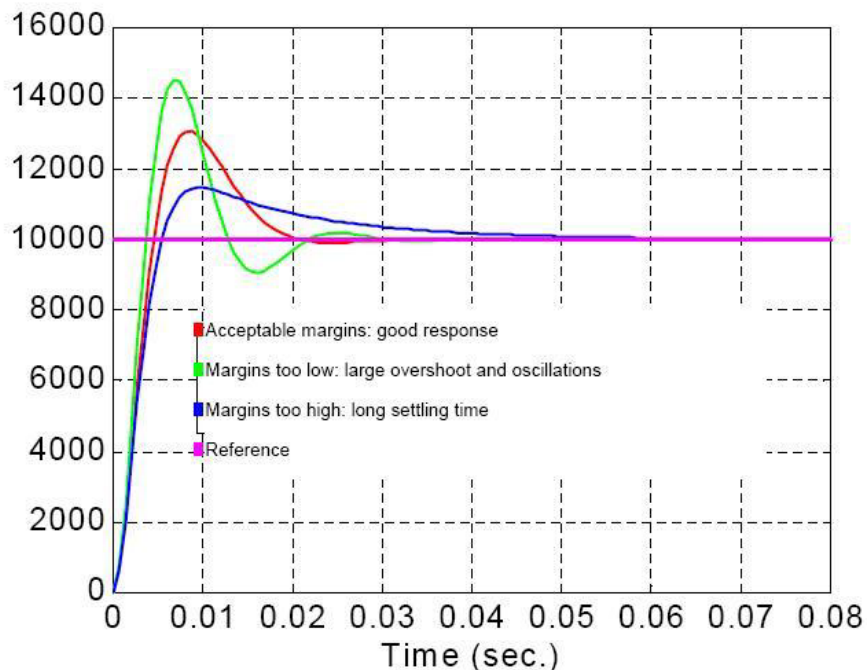


Figure 4.2: Comparison between step responses



The gain margin is the factor in which the controller gain can be increased until losing stability. The phase margin is the difference of the open-loop phase from -180 degrees at the point where the open-loop gain is 0 db. For further explanation, see the Auto-tuning manual or any basic textbook in control theory.

4.2 Special Tuning Application –Gantry System

4.2.1 Overview



Figure 4.3: Gantry system

The Gantry system (Figure 4.3) demonstrates control of two axes of which the Master performs two separate synchronized control operations; the Master axis locates and resolves the center point of the bridge and resolves the differential position between small anomalous movements of the bridge. To obtain optimum performance, all the PWMs must be synchronized.

The Gantry is configured such that the pivot controller is defined as the Master relative to the bridge end controller which is defined as the Slave. The movement of the Slave is therefore dependent on the Master. The X_1 Master therefore controls:

- $X_{\text{center}} = (X_1 + X_2) / 2$
- $\theta = (X_1 - X_2)$
- X_1 Master in Position mode send current command to Slave

Whereas the X_2 Slave controller implements the Forcer/Driver X_2 Current Loop, and sends the X_2 position information to X_1 Master.

In addition, this algorithm supports a planar motor where the differential adjustment is performed to the Y axis, together with the commutation angular correction.

X_1/X_2 have their own commutation feedbacks, and the Y_1/Y_2 commutation angle is set by the Y_1 sensor, and corrected by the θ phased shift.

Make sure that the hardware cabling is installed as per the Gantry Cabling Application Note.

4.2.2 Method Overview

After connecting the hardware according to the Gantry Cabling Application Note, perform the following steps to define and tune a gantry with Elmo Gold drives:

1. Setup the software.
2. Set up the communication between PC and the servo amplifiers.
3. Configure the **Slave** to include Commutation.
4. Copy the parameters from the slave to the master axis. This ensures that the basic operational parameters are identical.
5. The advanced configuration of the master and slave is continued with the position setting of the gantry controllers. These settings differ between the master and slave.
6. Tune the Yaw controller.
7. Perform error mapping and test the Gantry motion.
8. Raise the power limits to operational levels, tune for higher power levels and retest the Gantry motion.
9. The gantry is now tuned and ready for normal operation.

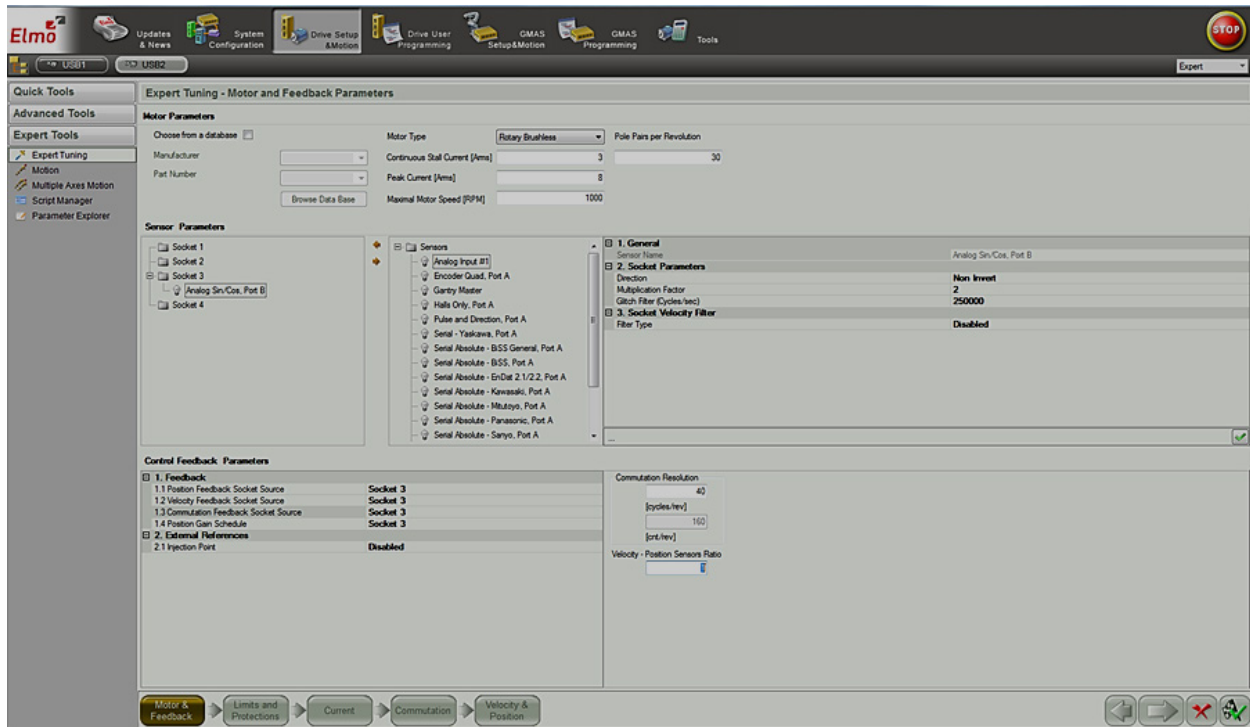
4.2.3 Setup and Slave Tuning

To setup and tune the Gantry Slave:

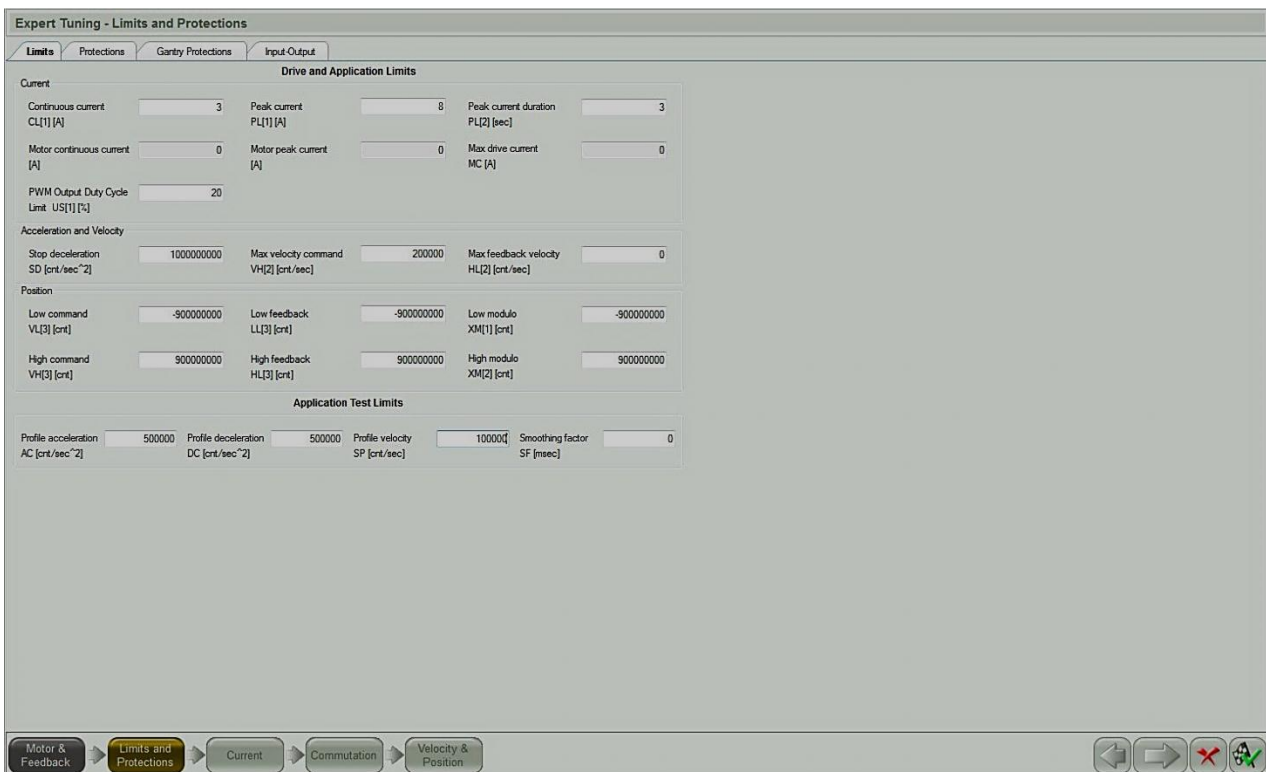
1. Verify that the EAS version is 1.2.0.2 or higher. Download the drive firmware version file NGDrive01.01.04.8317June2012B02G.gabs or higher (check for the latest released version), and upgrade the drives' firmware.
Verify that the drives are GCON Rev C. This is obligatory, and can be verified by typing the command WS[8], the value returned should be 2.
2. Connect the Gantry Master and Slave to the PC via USB, Ethernet or G-MAS connection. For the purpose of this procedure, the connection is assumed to be USB.
3. In the System Configuration window, **connect** the Master and Slave controllers.
4. From the top row menu, select the Tools icon, and open the terminal.
5. Verify that all drives in the gantry have similar values to the following:
 - a. Maximum current (MC)
 - b. Sampling time TS. Note that for GTRO/DRUM products $TS \geq 60$
 - c. **XP[1]**
 - d. **XP[2]**
6. Make sure the Slave **USB** (or Ethernet Slave) is selected.
7. From the **Drive Setup and Motion** window, run the Expert Tuning wizard starting at **Motor & Feedback**.

Note: All captures shown below are for illustration purposes only, unless specifically stated otherwise.

8. Setup the Expert Tuning – Motor Feedback Parameters, as shown in the screen below, with the following conditions:
 - Set the Motor Parameters with the Linear Brushless motor type, and settings as per motor specifications.
 - In the Sensor Parameters, use Socket 3 with the Analog Sin/Cos, Port B sensor. Where the sensor is a Digital Quad in port A or B, set accordingly.
 - Set the feedback parameters as per specifications.
 - Similarly, adjust the Control Feedback Parameters with the Position, Velocity, and Commutation sources set to Socket 3.
 - Set the Commutation Resolution according to the encoder specifications.



9. Click **Limits and Protection** in the Tuning wizard.
10. Set the Limits tab according to the application specifications. For the initial tuning, set the application current limits to 50% of the operating CL/PL.



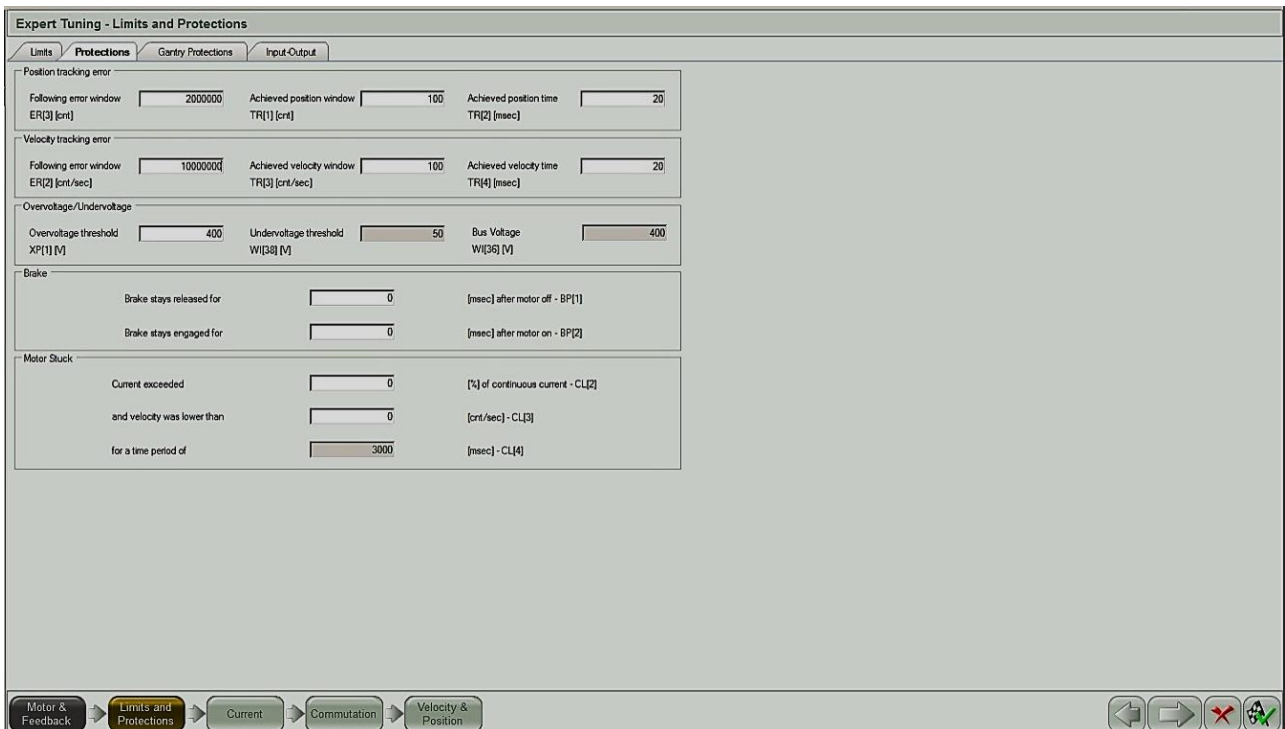
11. In the PWM duty cycle field box in the diagram above, enter the value of **US[1]** (PWM duty cycle) to 20%. Lowering the PWM duty cycle to a minimum for the tuning

procedure prevents uncontrolled motion at high power by limiting the motor speed & BEMF.

12. Set the Protections tab, as shown in the example below:

- a. Limit **ER[2]** to 20% of maximal velocity
- b. Limit **ER[3]** to several cm at most

13. Define the "motor stuck" event. This is an important step.



Expert Tuning - Limits and Protections

Limits | **Protections** | Gantry Protections | Input-Output

Position tracking error

Following error window ER[3] [cnt]	2000000	Achieved position window TR[1] [cnt]	100	Achieved position time TR[2] [msec]	20
---------------------------------------	---------	---	-----	--	----

Velocity tracking error

Following error window ER[2] [cnt/sec]	10000000	Achieved velocity window TR[3] [cnt/sec]	100	Achieved velocity time TR[4] [msec]	20
---	----------	---	-----	--	----

Overvoltage/Undervoltage

Overvoltage threshold XP[1] [V]	400	Undervoltage threshold WI[38] [V]	50	Bus Voltage WI[36] [V]	400
------------------------------------	-----	--------------------------------------	----	---------------------------	-----

Brake

Brake stays released for	0	[msec] after motor off - BP[1]
Brake stays engaged for	0	[msec] after motor on - BP[2]

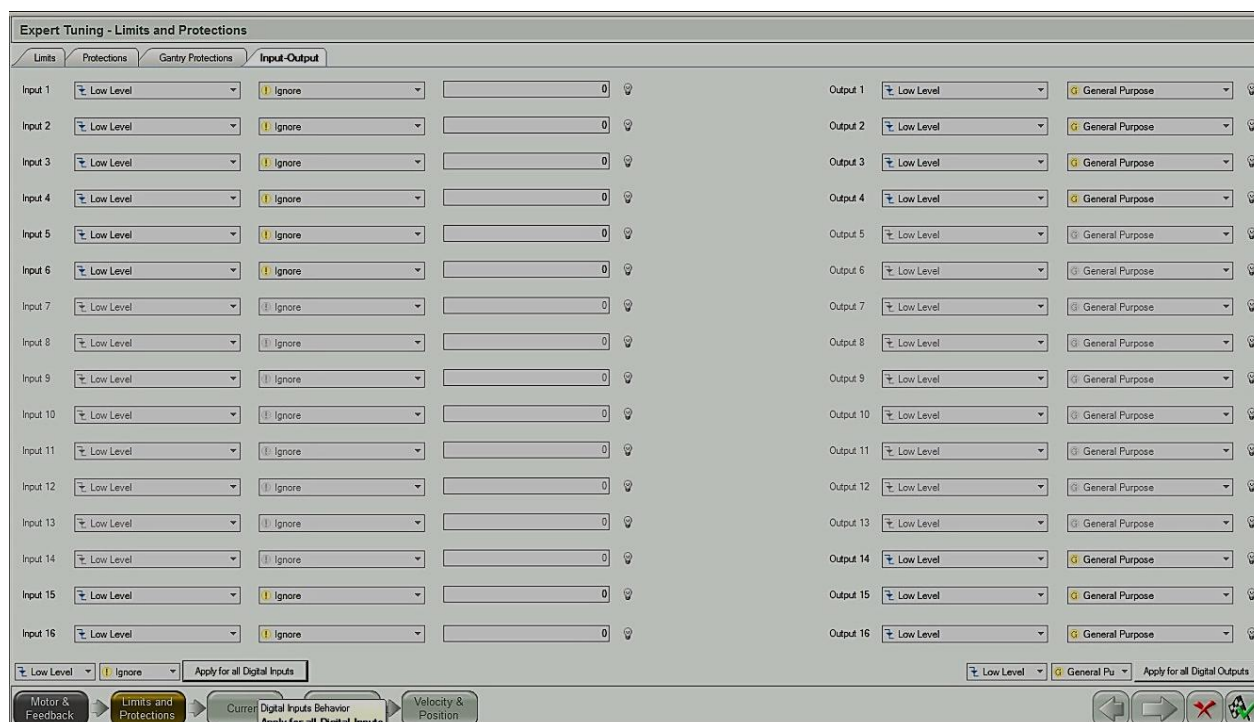
Motor Stuck

Current exceeded	0	[%] of continuous current - CL[2]
and velocity was lower than	0	[cnt/sec] - CL[3]
for a time period of	3000	[msec] - CL[4]

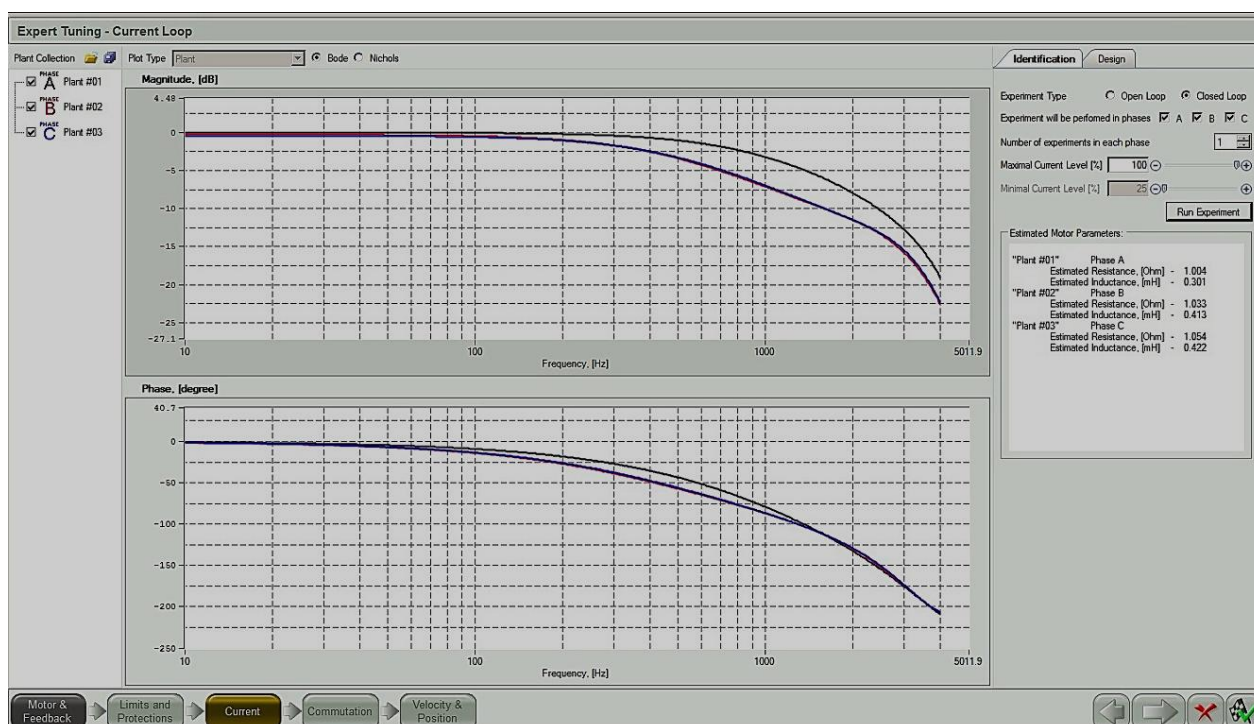
Motor & Feedback → **Limits and Protections** → Current → Commutation → Velocity & Position

Navigation icons: Previous, Next, Cancel, OK

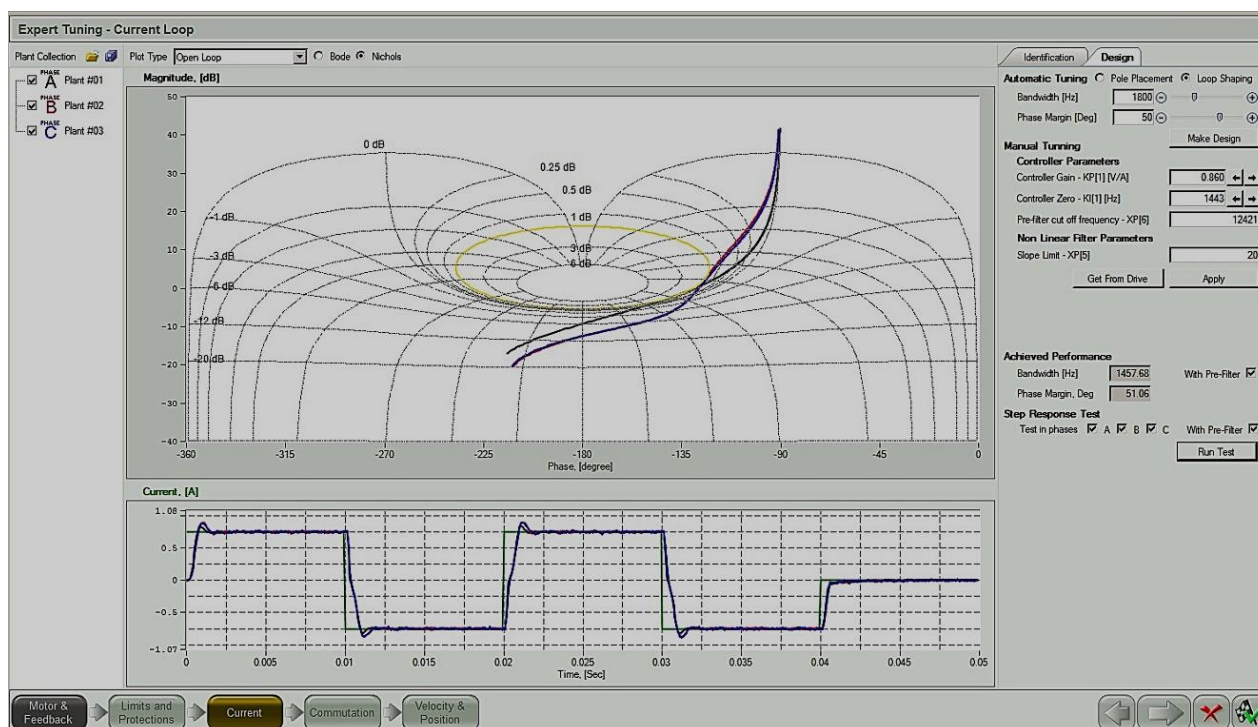
14. Set the Input Output according to the application. If there are none, set the Inputs to **Ignore** as shown in the example below.



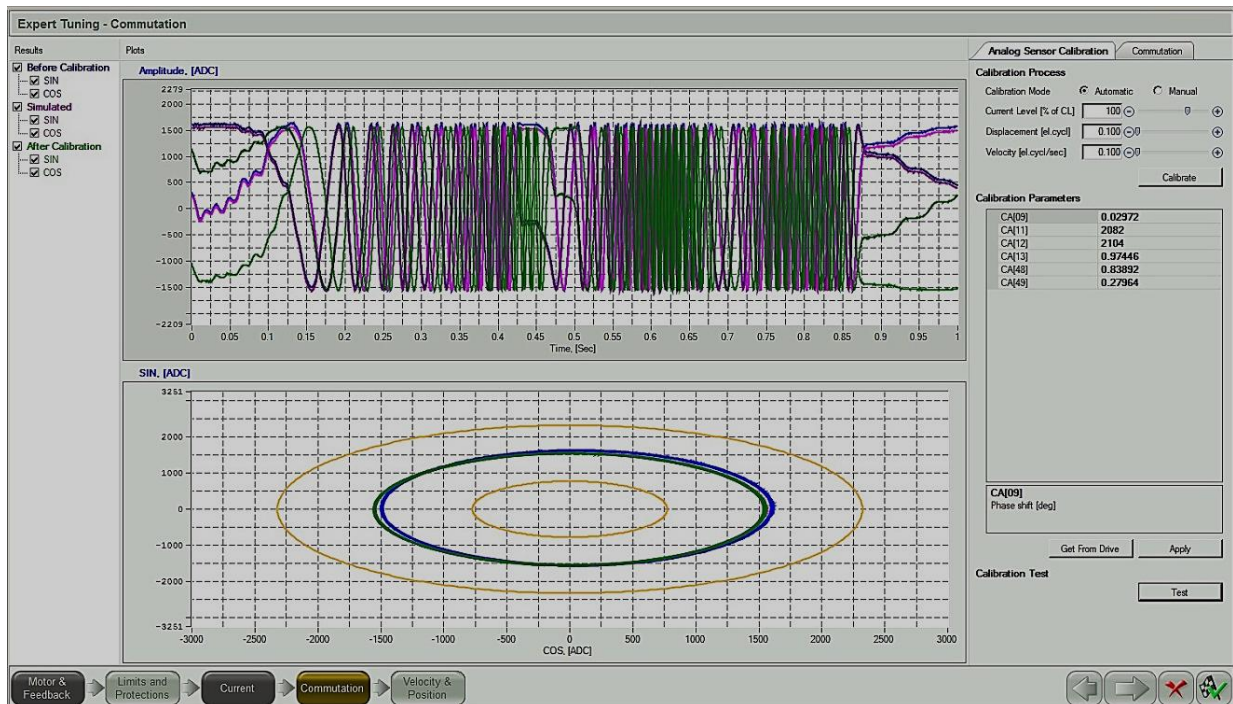
15. Click **Current** in the Tuning wizard.
16. In the Current window, Identification tab, click **Run Experiment**. The Bode graph is displayed. If necessary, adjust the Maximal or Minimal Current Level and repeat the experiment.



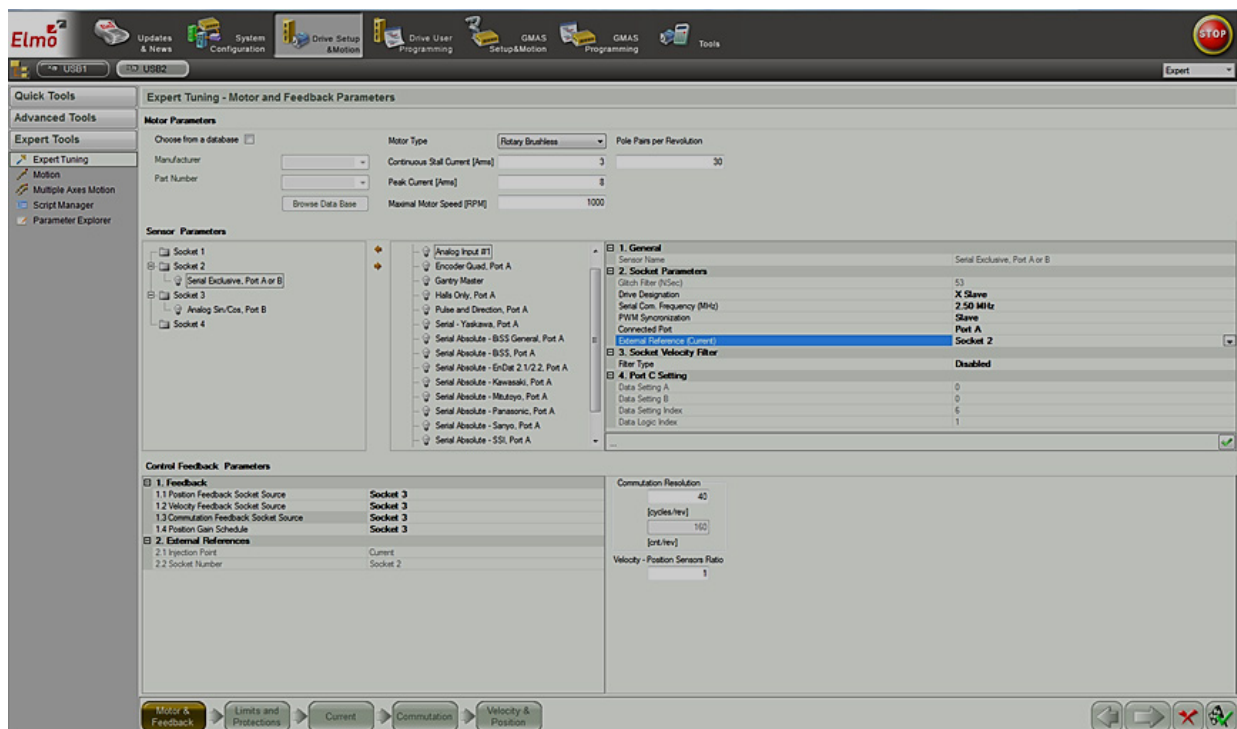
17. Click the design tab and click **Make Design**. The Nichols graph is drawn and the Plot Type appears as **Open Loop**.



18. When satisfied with the Nichols graphs, click **Run Test** to check the performance. The lower graphs shown above are displayed.
19. Click **Commutation** in the Tuning wizard.
20. For an **Analog Sensor**, perform **Calibration**.
Since the gantry feedback sensor are usually exceptionally sensitive, run the experiment with minimum displacement and velocity. The Calibration Mode is set to Automatic as default:
 - a. In the Analog Sensor Calibration tab, click **Calibrate**. Two graphs are produced, of which the lower SIN [ADC] graph should appear similar to the shape of a circle, or ellipse.
Both graphs display the sine/cosine before and after calibration. The post-calibration lower graph should appear as a circle or ellipse.
 - b. At Calibration Test, click **Test**. The following result is displayed which should follow the pattern of the original graphs as close as possible.



21. Click the Commutation tab. Select the Commutation method and click **Run Experiment**.
22. When the Gantry bridge moves, notice the direction of movement. Define this direction as positive or negative.
Pay attention to the direction of the master and slave in relation to the system as this must be uniformly and consistently defined.



23. Save the drive status by clicking  or at the terminal, use the SV command.
24. Return to System Configuration screen, download and save the parameters.
These parameters will be later uploaded to the master drive.
25. Click **Motor & Feedback** to set up the **Serial Exclusive** at **Socket 2** for the **Slave**:
 - c. Attach the Serial Exclusive sensor to **Socket 2**.
 - d. Setup the Serial Exclusive sensor as shown in the screen capture below. Make sure that the Drive Designation is set to **X Slave**, and the PWM Synchronization set to **Slave**.
 - e. Set the **External Reference Current** to **Socket 2**.
 - f. The **Control Feedback Parameters** should all be set to **Socket 3**.
The external references should remain grayed out.

1. General	
1.01 Sensor Name	Serial Exclusive, Port A or B
2. Socket Parameters	
2.01 Glitch Filter (NSec)	53
2.02 Drive Designation	X Slave
2.03 Serial Com. Frequency (MHz)	5.00 MHz
2.04 PWM Synchronization	Slave
2.05 Connected Port	Port A
2.06 External Reference (Current)	Socket 2
2.07 Index Data Settings A	0
2.08 Index Data Settings B	0
2.09 Index Data Function	6
2.10 Index Data Logic	1
Socket Position: 0	

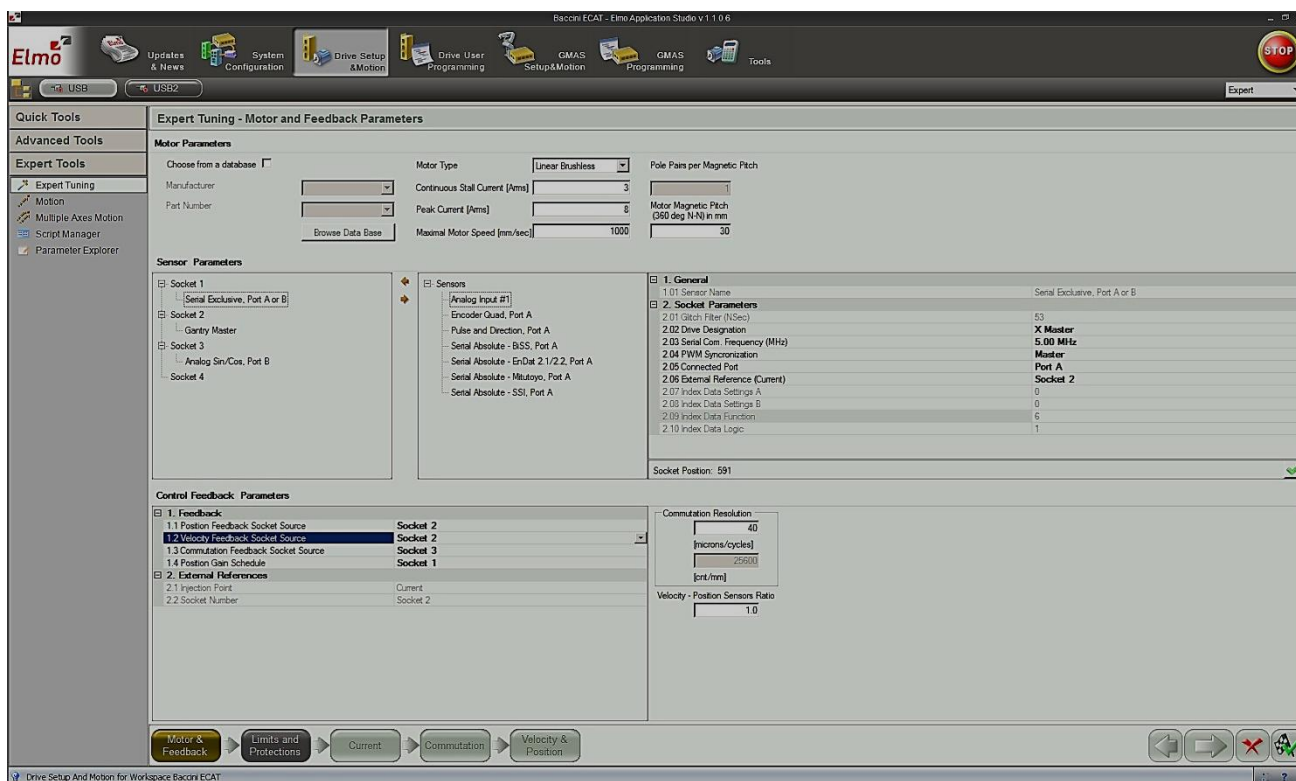
The Slave Socket parameters for the Serial Exclusive are defined according to the table:

Drive Designation	X Slave
Serial Communication Frequency	5.00 MHz (default value)
PWM Synchronization	Slave
Connected Port	Port A (Port B here is used for a feedback sensor)
External Reference (Current)	Socket 2. The current originates from the Master via this socket.

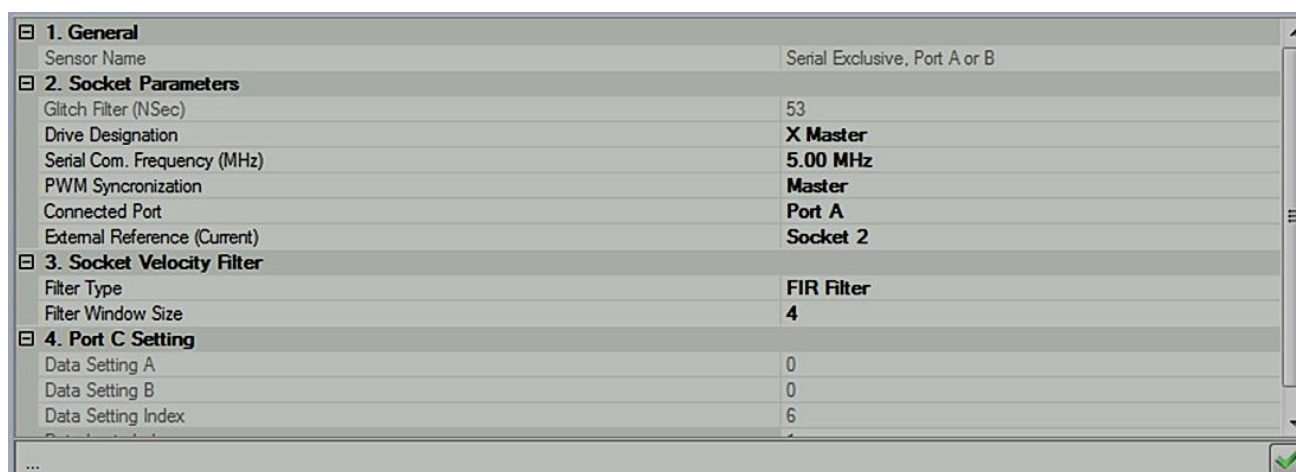
4.2.4 Master Setup and Tuning

To setup and tune the Gantry Master:

1. Click **System Configuration** to select the Master drive.
2. Upload the Slave's parameters saved previously, into the Master drive.
3. Select the Master **USB** (or Ethernet Master).
4. In the Tuning wizard, click **Motor & Feedback**.
5. Check the following:
 - a. General motor parameters
 - b. Limits & Protection
 - c. Input/Output
 - d. Verify that the settings for the Master are the same values as described in section 4.2.3 steps 5 - 10 above for the Slave.
 - e. If a **digital quad encoder** is used, type the command **GS[3]=[maximum speed]** in the Command Terminal.
Add a FIR filter to cancel the 1/T velocity calculation.
6. Click **Current** in the Tuning wizard.
7. In the **Identification** tab, click **Run Experiment** to test the motor current response.
8. Click the **Design** tab, and select **Run Test** to check step response. *However, do not redesign the current loop.* If in either tab a significant difference exists between the Master and the Slave, investigate. The Master and Slave should be identical.
9. Switch to **Commutation** in the Tuning wizard, and proceed with commutation for the Master drive as per section 4.2.3 steps 20 - 22 above using the same commutation method as for the Slave.



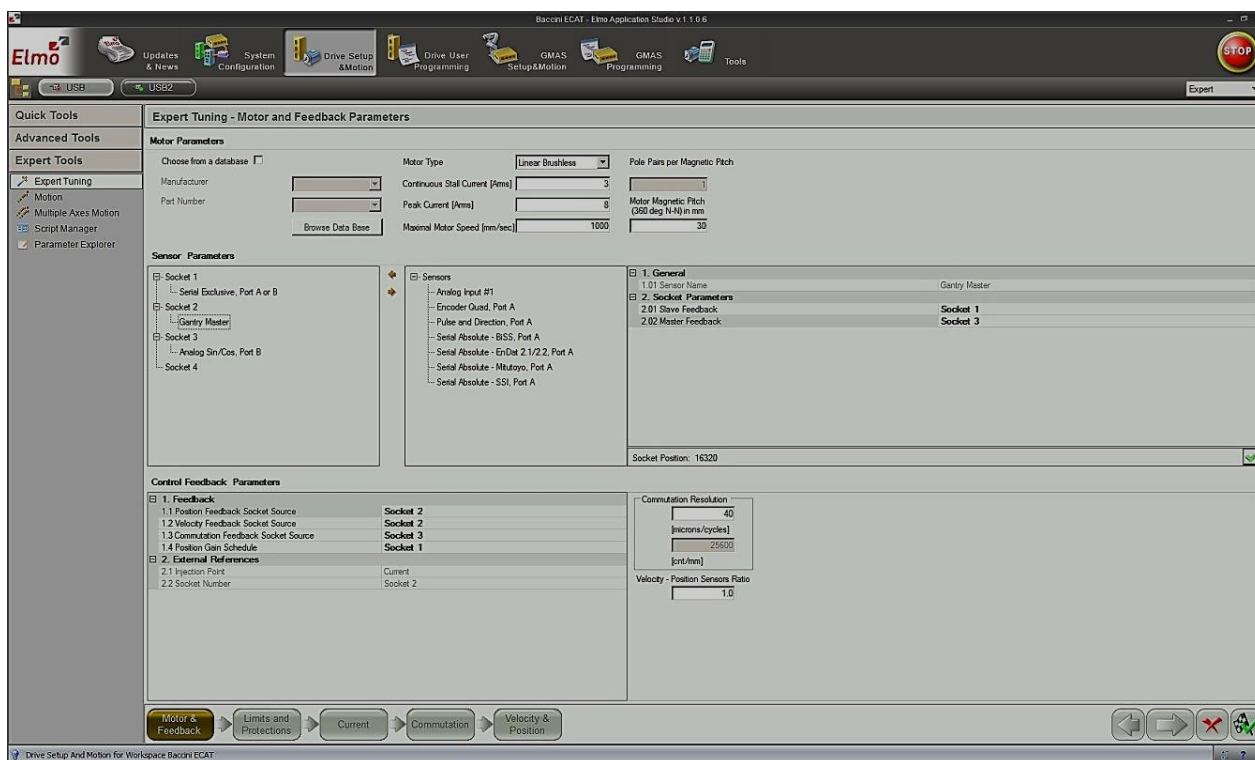
10. Click **Motor & Feedback** to set up the **Serial Exclusive** at **Socket 1**, and the **Gantry Master** at **Socket 2** for the **Master** at **USB (or Ethernet)**:
 - a. Make sure that the order of the sensors at the Sockets is exactly as shown in the screen capture below.
 - b. Setup the Serial Exclusive sensor as shown in the screen capture below. Make sure that the Drive Designation is set to **X Master**, and the PWM Synchronization set to **Master**.
 - c. Set the External Reference Current to **Socket 2**.
 - d. The Control Feedback Parameters should be set as shown in the screen capture below.



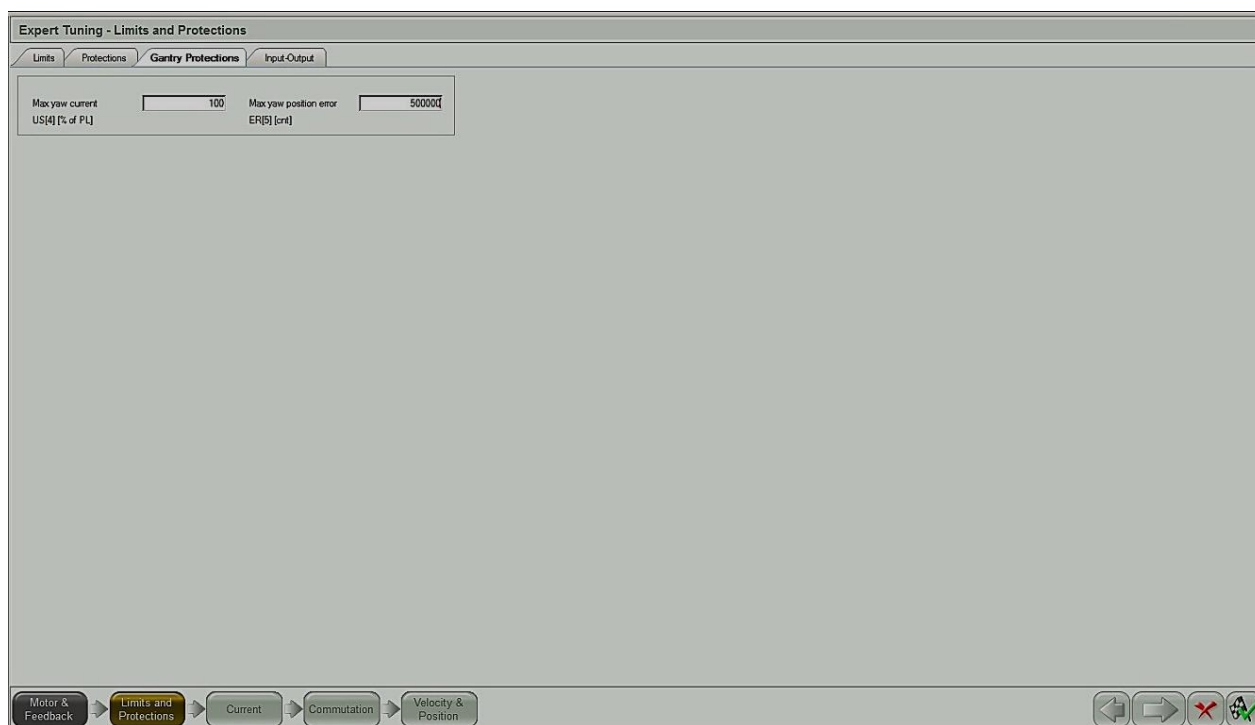
The Master Socket parameters for the Serial Exclusive are defined according to the table:

Drive Designation	X Master
Serial Communication Frequency	5.00 MHz (default value)
PWM Synchronization	Master
Connected Port	Port A (Port B here is used for a feedback sensor)
External Reference (Current)	Socket 2. The current is calculated from the Gantry socket.
Socket Velocity Filter	FIR filter

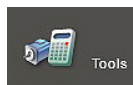
11. At the Sensor Parameters, highlight the **Gantry Master** connected to **Socket 2**.
12. Set the Socket Parameters as shown in the screen capture below. Make sure that:
 - a. The Slave Feedback is set to **Socket 1**.
 - b. The Master Feedback is set to **Socket 3**.
 - c. The Control Feedback Parameters are set as shown in the capture, with the external references preset to **Socket 2**.
 - d. Set the Position and Velocity Feedbacks to **Socket 2**.
 - e. Maintain the commutation feedback socket source selected to **Socket 3**.
13. Set a FIR filter at **Master Socket 1**. Make sure that the FIR filter window size is identical to that, at **Master Socket 3**.
14. Check that the motors are disabled.
15. Manually, move the gantry and check the encoder readings for all three sockets.
Check that the Slave and Master are defined in the same direction.

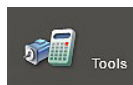


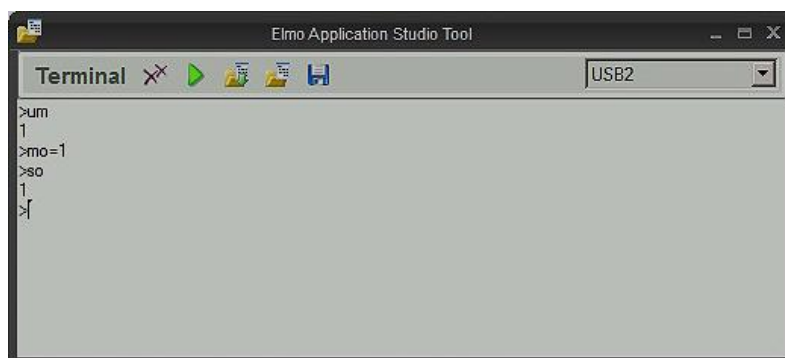
16. Click **Limits and Protections** in the wizard. The **Gantry Protections** tab should now be accessible.
17. Set the **Gantry Protections** according to the application requirements, similar to that shown in the screen capture below.



ER[5] – This Command parameter sets the maximum value for differential position. Limit the value of **ER[5]** to several mm. When the absolute value of the differential position is above this parameter, all the Gantry drives are disabled.



18. At the top of the EAS menu click . The EAS Tool Terminal opens.
19. Enter the commands shown in the screen capture to operate the **Slave** drive (**USB2**). Note that if the Slave drive is not enabled, the Master drive cannot be enabled. This is a safety feature, because once the gantry controls have been connected, the Master depends on inputs from the Slave, and without them, motion is not controlled.



20. Close the Terminal.
Once the appropriate software switches are enabled, there is a link between the drives. The yaw control loop is active and the velocity/position loops will be tuned for the plant.

4.2.5 Configuring the Gantry Controller

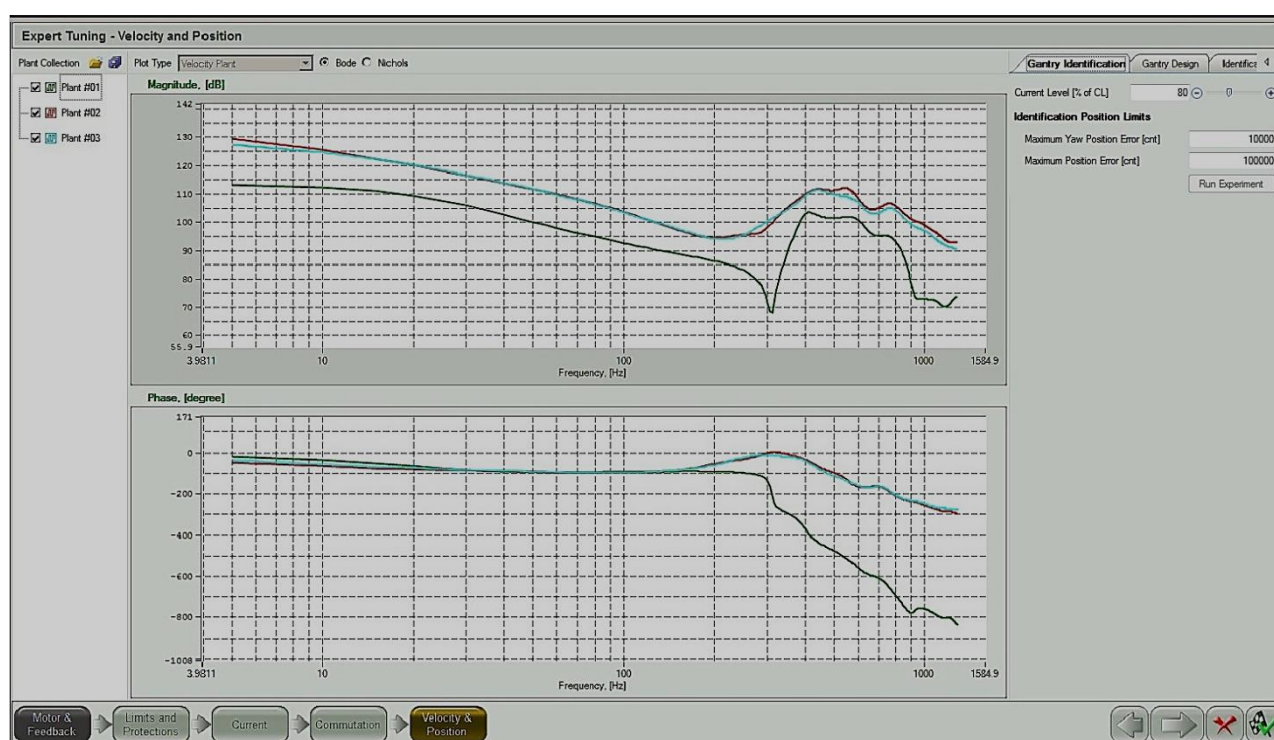
To configure the Gantry Controller:

1. In the Tuning wizard, click **Velocity & Position**.

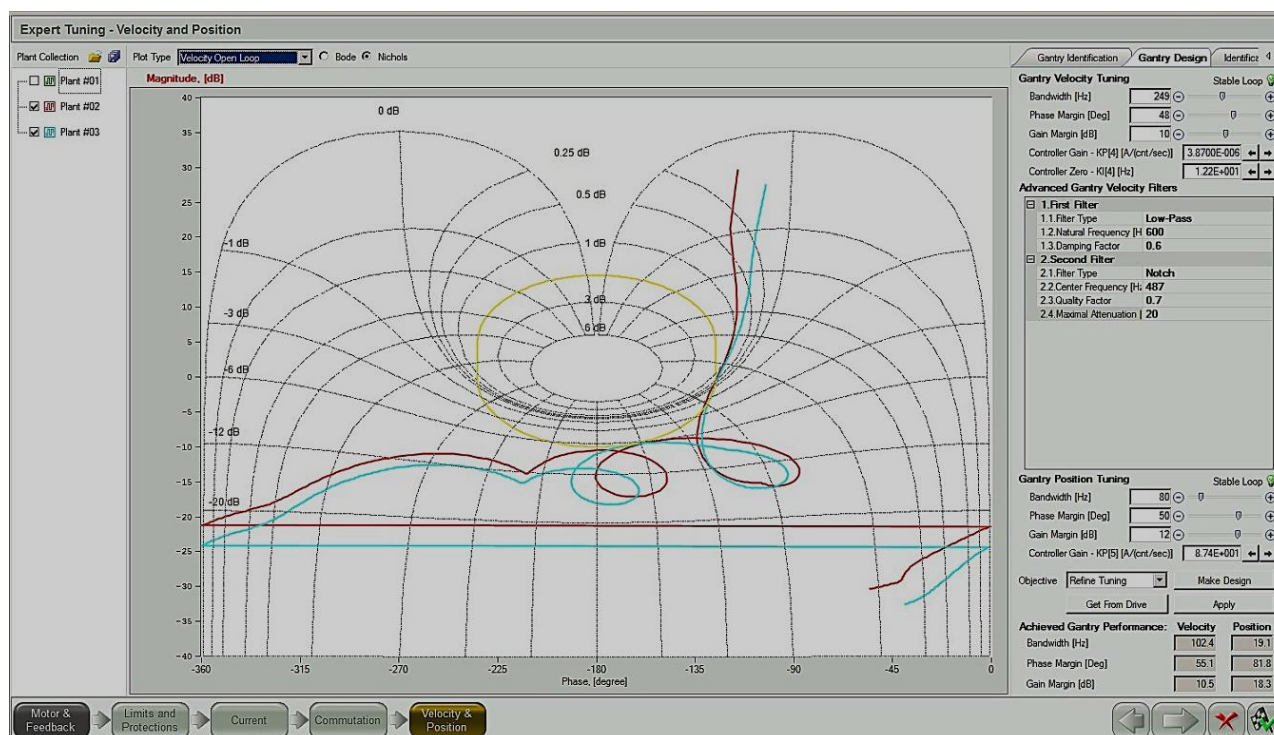
Note: EAS is automatically configured to set $FP[1]=0$, $FP[3]=0$, and $PX=0$ when starting the identification. This is necessary, because a result of a position difference will immediately cause the yaw control to try to correct it, which may produce uncontrolled motion.

While the Slave drive is enabled in Current mode, all Velocity & Position tests are performed from the Master viewpoint.

2. In the **Gantry Identification** tab, verify that the safety limits (maximum yaw position error and maximum position error) are acceptable. The appropriate proper values for both should be several cm. If uncontrolled motion occurs, the gantry drives will shut off when these limits are reached.
3. When the safety limits have been set, click **Run Experiment**. The Magnitude and Phase graphs are drawn. Select other values of the Current Level to produce converging graphs. When satisfied proceed to the next step.

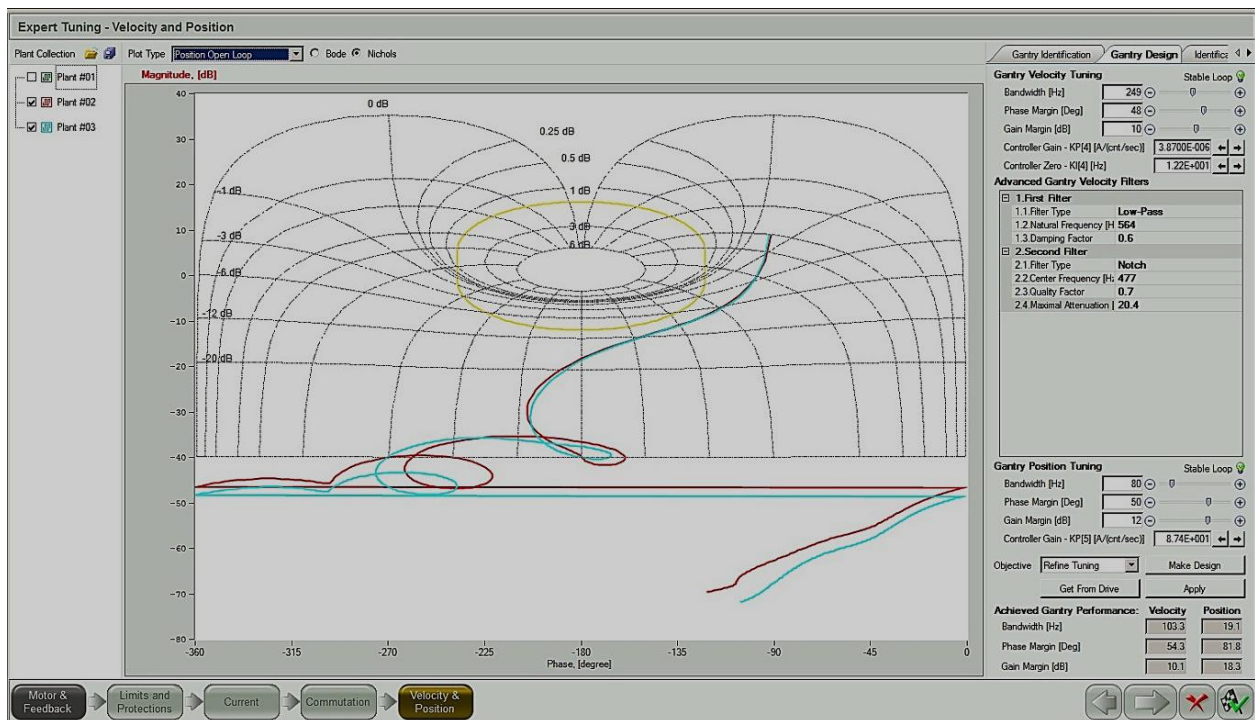


4. Click the **Gantry Design** tab. Select the following:
 - a. Plot type should be set to **Velocity Open Loop**.
 - b. Select which Plants are suitable for the design in the Gantry Design window.
 - c. Select from the Objective design options, and choose Advanced Gantry Velocity Filters, depending on the Objective design options selected. For further details, refer to the section 4.1.8 Velocity Loop Design on page 201.



5. Click **Make Design**. The above Nichols graph or similar is produced for the various Plants selected. In addition, the Achieved Gantry Performance statistics are shown in the lower right column of the window.

6. Select the following:
 - a. Plot type should be set to **Position Open Loop**.
 - b. Set the Gantry Velocity Tuning as shown in the screen capture below, the same settings as for the Velocity Open Loop.
 - c. Set the Gantry Position Tuning as shown in the screen capture below, the same settings as for the Velocity Open Loop.
 - d. Set the Advanced Gantry Velocity Filters as shown in the screen capture below.



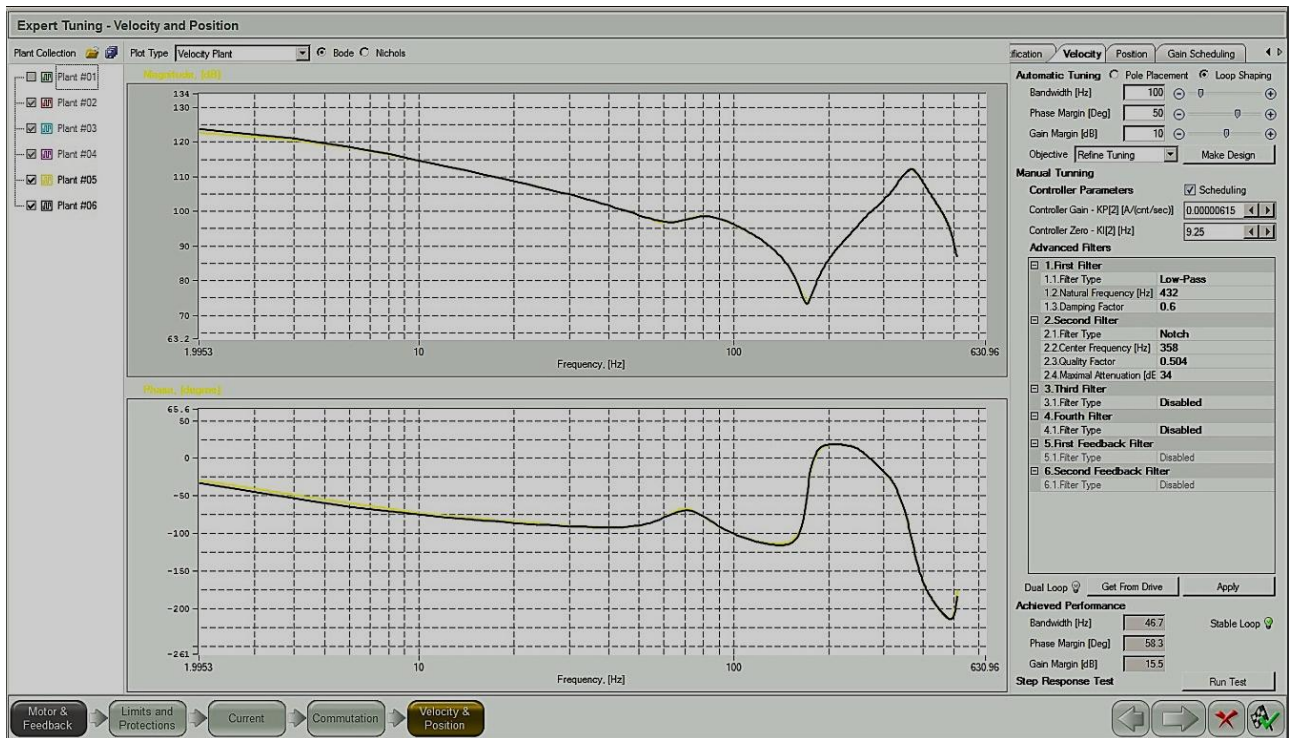
7. Click **Make Design**. The above Nichols graph or similar is produced for the various Plants selected. In addition, the Achieved Gantry Performance statistics are shown in the lower right column of the window.

Note: Make sure that the Slave is switched to ON.

8. In the **Identification** tab, check that the safety limit (maximum position error) is acceptable. The appropriate proper values are several cm. If uncontrolled motion occurs, the gantry drives will shut off if the gantry motor moves farther than this limit allows.
9. Click **Run Experiment**. *The Sine sweep cannot be used with the Gantry.*

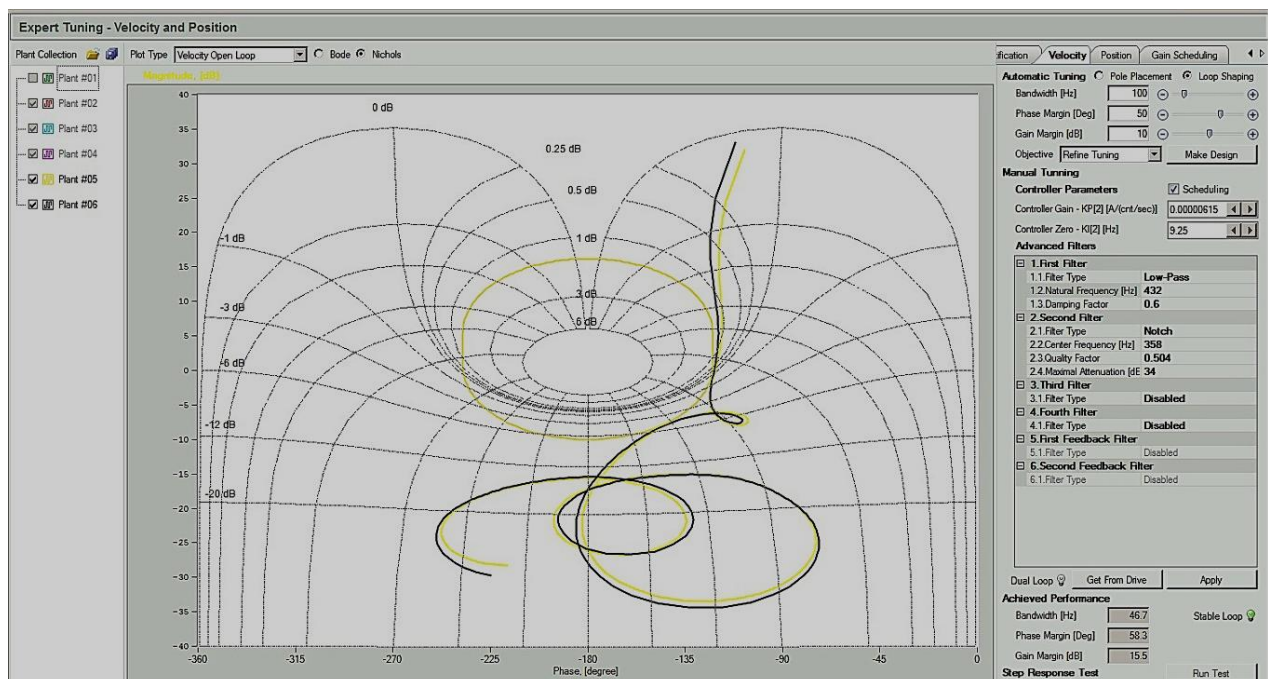


10. Click **Run Experiment**. *The Sine sweep cannot be used with the Gantry.*
11. Click the **Velocity** tab and set the following:
 - a. Automatic Tuning parameters required by the system.
 - b. Advanced Filter parameters as necessary depending on the Objective design options selected.

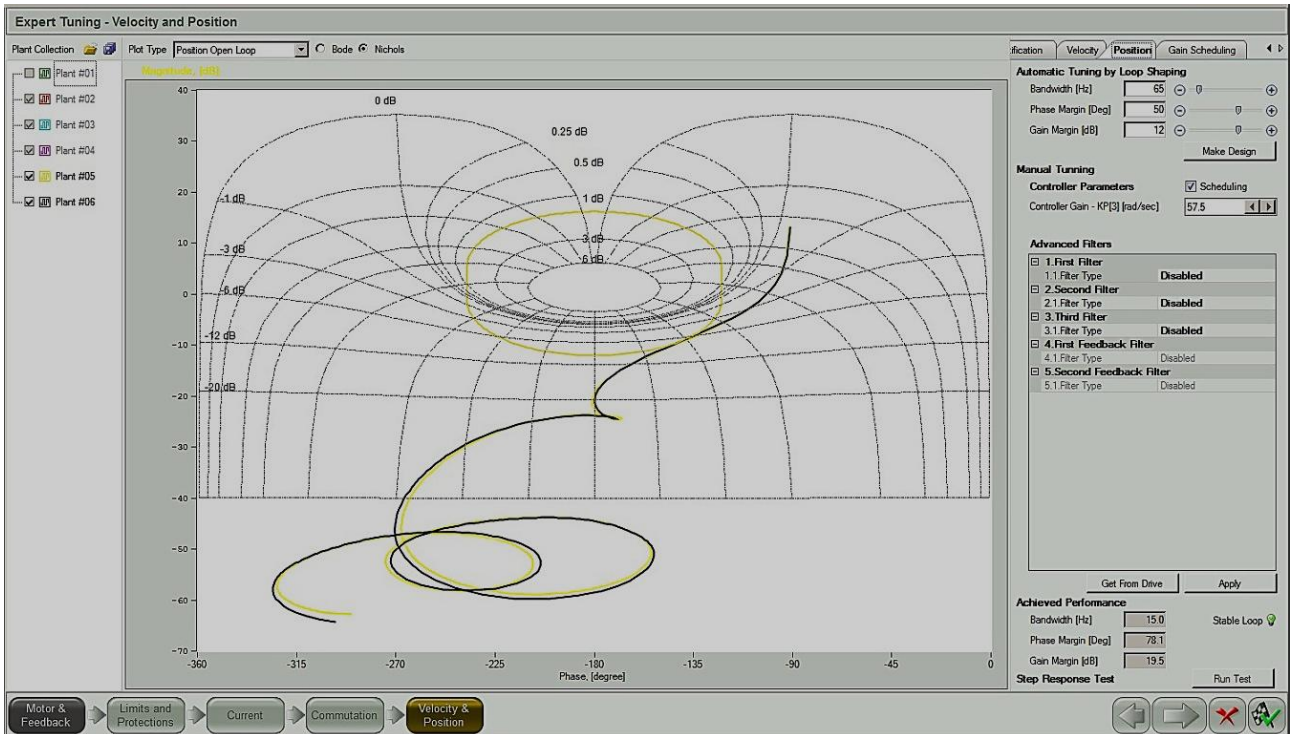


12. Click **Make Design**. The Bode graph is drawn and the Achieved Performance statistics are displayed as shown above.

Notice that a new set of Plant #0X graphs are displayed in the Plant Collection. The Gantry Plants are grayed and cannot be changed.



13. Select **Position Open Loop** for the Plot Type.
14. Click **Make Design** to produce the Nichols graph for the two Plants selected by the Position Open Loop.



15. The Nichols graph is draw as shown above. If satisfied with the results, save the configuration.

4.2.6 Error Mapping (Correction)

Most of Gantry systems are rigid, and if the sensor and mechanics are not perfectly aligned, the gantry (Yaw) control will continuously cause bridge misalignment, countered by excessive current in the system to force rearrangement of the bridge. To prevent this situation occurring, Elmo recommends using error mapping to correct the misalignment between the Master and the Slave. The following procedure explains how to perform the error correction in the gantry system.

To utilize Error Mapping on the Gantry it is necessary to perform the following:

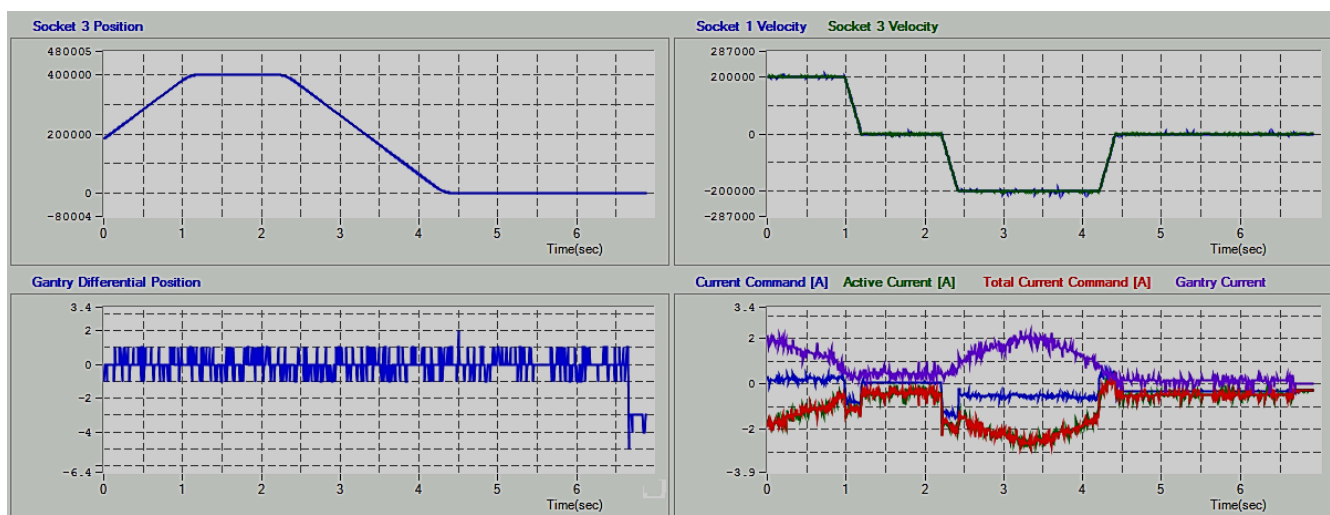
1. Cancel the operation of the Yaw Control using the command **US[4]=0**.
2. Set **FP[1] = 0; FP[3] = 0; PX = 0**
3. Set **UM=5** to enable master position mode.
4. Perform Homing:
 - a. Set command **OV[54]=3**. This will redirect the index signal so that all three sockets are homed with the Master's actual feedback.
 - b. Reset positions by entering the commands **FP[1]=0; FP[3]=0;** and **PX=0**.
 - c. Perform DS402 homing on the gantry Master using index or index+limits.

- d. If a G-MAS is connected to the drives, use the G-MAS to perform Homing.
5. Perform Error Mapping:
 - a. Run the error mapping procedure (refer to section 4.2.6.2 Code for Error Mapping Procedure). It may be adapted and used on any gantry. Please note that it is programmed for a gantry with an index signal **and** limit sensors.
 - b. The errors are mapped in relation to **Socket 3**. The value for each index should be the gantry error (stored in **WS[35]**)
6. Perform Motion testing:
 - a. Reestablish yaw control using the command **US[4]=100**.
 - b. To test and tune the yaw controller use the command **TW[14]=<step size>**.
This will provide the yaw controller with a step command, which can be monitored on the Recorder and corrected.
 - c. Set the step to zero again by issuing the command **TW[14]=0**.
7. After the above steps have been completed, the following steps can be performed to tune the gantry yaw control:
 - a. Home the system.
 - b. Enable error mapping by running the error mapping procedure.
 - c. Run the system at low speed over the entire span and:
 - i. Check the Currents.
If there are high currents in one direction and low currents in the other direction, or if currents are generally high, examine the error mapping procedure. The procedure is not functioning correctly.
 - ii. Make sure that the yaw control is small (~0) in both directions, forward and back.
 - d. When the system is running smoothly, the current limits and PWM may be returned to their operational values (but never exceed maximum).
 - e. When both homing **and** error mapping have been proofed, both loops can be tuned for optimal performance with the operational current levels, voltage and gains.

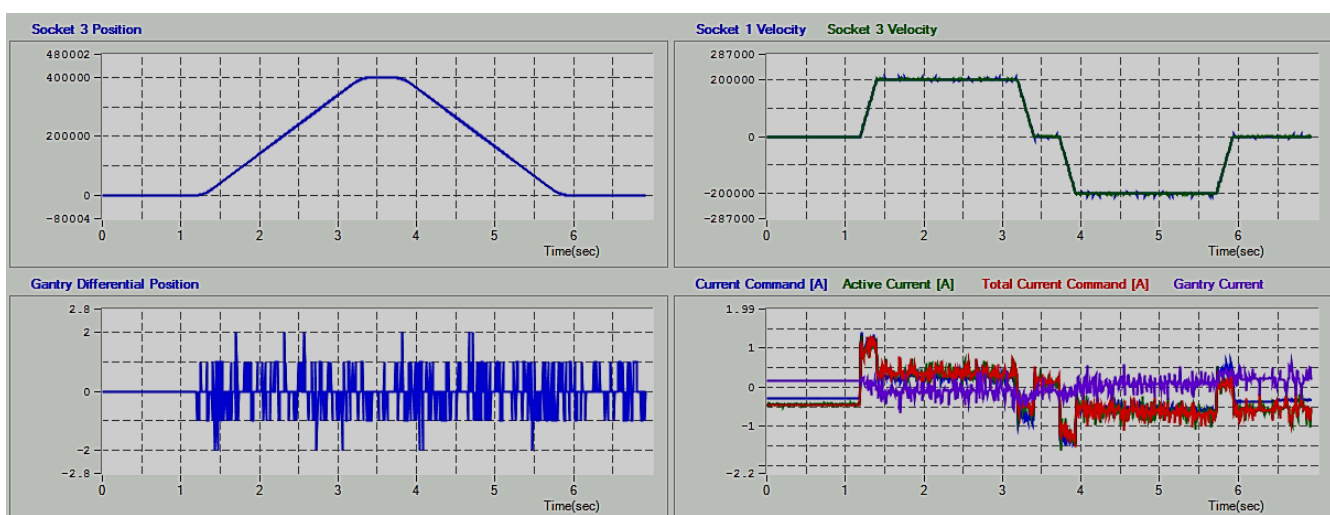
For further details refer to the Chapter Error Correction in the Gold Drive Administration Manual.

4.2.6.1 Error Mapping Results Example

1. To compare performance before and after error mapping, use the recorder to record the relevant parameters as seen in the figure below:



2. In the figure above it is evident, by the high currents during simple PTP motion, that the gantry yaw controller is (needlessly) applying great force to keep the gantry moving straight. Although the differential position error is small, the controller is over-straining to keep it in check.
3. Although in the example presented the differential errors are small before and after error mapping. After successfully applying the error correction procedure, the currents for correcting the differential errors are greatly diminished. The mechanical imperfections are corrected by the control with reduced effort.





4.2.6.2 Code for Error Mapping Procedure

```

##start
#define SPEED 100000
#define HOMING_SPEED 40000
#define GRID_FACTOR 14
#define GRID 16384

main()
function main()

    us[4]=0 // Disable yaw control before homing
    pc[1]=0 // Disable error mapping before starting procedure

    home() // Function for homing gantry
    map() // Function to map the gantry mechanical errors

    pc[1]=1 // Command to arm error mapping
    us[4]=100 // Start yaw control

    // Run test
    wait(1000)
    pa=vh[3] ; bg ;
    until(ms!=2)
    pa=0 ; bg ;

return

// -----
// Function map()
// - Map the gantry differential error on a defined grid.
// - For each grid point, the magnitude of the gantry differential
// error equals (X2 position) - (X1 position)
// - The function measures the differential error twice,
// first time while running in the positive direction, and
// second time in the negative direction.
// - The final error mapping value is the average value of the
// two measurements.
// -----
function map()
    int i

    // Power on (if not powered)
    // NOTE: Slave axis must be on to power the master axis.
    if (so!=1)
        mo=1
    end if
    until (so==1)

    // Set up PC[] array
    pc[3]=2 // Command for using ET[n] table
    pc[2]=3 //
    Command for error mapping on socket 3
    pc[6]=GRID_FACTOR // Sets the grid to 2^GRID_FACTOR
    pc[4]=1 // Low index of correction table
    pc[5]=(vh[3]/GRID)+1 // High index of correction table
    pc[7]=0 // Starting position on grid

    // Loop1: Go over each grid point, and measure the differential error
    sp=SPEED
    gp[1]=0 // The first error mapping point must be position 0
    for i=2:1:pc[5] // The loop begins from the second point
        pa=(i-1)*GRID // Command to go to grid point [i-1]
        bg
        until ((ms!=2) || (sr&0x10000000)) // Wait for end of motion (or limit)
        wait(700) // Wait 700mS to stabilize

```



```

        gp[i]=ws[35]          // Set error mapping value for point [i]
                                //      (ws[35] stores the (X2pos)-(X1pos) )
    end

// Go to software limit
pa=vh[3]
bg
until (ms!=2)

// Loop2: go over each grid point in the reverse direction, and measure
the
// differential error. For each point, calculate the average value between
// loop1 reading and this reading
for i=pc[5]:-1:2
    pa=(i-1)*GRID           // Go to grid point [i]
    bg
    until ((ms!=2) || (sr&0x10000000))// Wait for end of motion (or limit)
    wait(700)
    gp[i]=(gp[i]+ws[35])/2    // Error mapping value[i] = the average
between                                //      this and the previous reading
    end
    gp[(pc[5])]=0            // Set the last (virtual) point to 0

return

// -----
// Function home()
// - Open software limits
// - Home on RLS using HF[] commands
// - Home on Index using HF[] commands
// - Capture FLS and set software limits
// -----
function home()

    // Disable the drive
    mo=0

    // Open the software limits to max
    vh[3]=hl[3]
    vl[3]=ll[3]

    // Reset socket positions
    fp[1]=0;fp[3]=0

    // Configure HF[] array for RLS capturing
    hf[10]=3                // Set socket 3
    hf[2]=0                 // Absolute value setting
    hf[5]=3                 // When the event occurs, set PX=HM[2]
    hf[3]=7                 // Event on RLS
    hf[4]=0                 // Arm the homing function

    // Power on (if not powered).
    // NOTE: Slave axis must be on to power the master axis.
    if (so!=1)
        mo=1
    end if
    until (so==1)

    // Check if RLS reached. If so, move relative 10,000 counts (away from
RLS)
    while (ip&0x80)
        // Move towards RLS and reset position
        sp=HOMING_SPEED
        pa=vl[3]
        bg
        until (hf[1]==0)      // Wait until the limit has been captured

```




```
// Wait 200mS
wait(200)

// Configure HF[] array for index capturing
hf[3]=3           // Event on Index
hf[1]=1           // Arm the homing function
pa=vh[3]          // Move towards software limit
bg
until (hf[1]==0)   // Wait until Index has been captured

// Wait 200mS
wait(200)

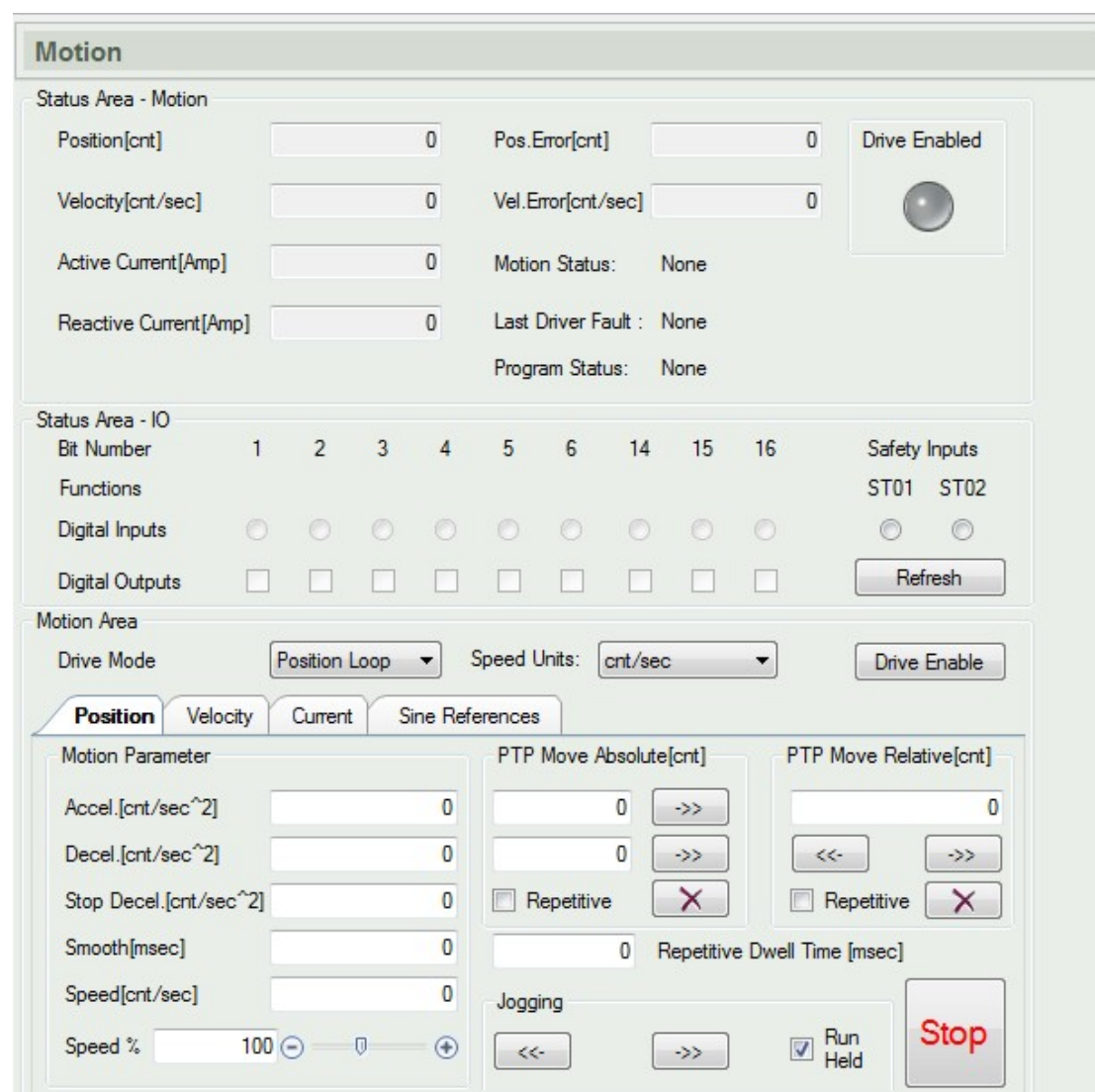
// Configure HF[] array for FLS capturing
hf[3]=5           // Event on FLS
hf[5]=2           // When the event occurs, do not change PX
hf[1]=1           // Arm the homing function
pa=vh[3]          // Move towards software limit
bg
until (hf[1]==0)   // Wait until index has been captured

// Disable servo
mo=0

// Set software limits relative to home position
vh[3]=hf[7]-1000
vl[3]=0

return
```

4.3 Single Axis Motion



This window allows you to perform all forms of single axis motions.

Select the desired control method, enter the required motion parameters and start motion.

A display of the inputs and outputs of the system allows the user to monitor other system status information that may influence the motion.

Note: Before you command motion using this window, you should complete any motion related configuration of the drive. Such configuration includes tuning the control parameters, setting limits and configuring inputs and outputs.

4.3.1 Screen Areas

The Motion screen is divided into two status, and a single motion, areas:

Status Area - Motion Displays the status of motion related parameters in numerical values, text and graphic display, as applicable for each monitored

parameter

Status Area - I/O

Graphic display of the status of the inputs and outputs of the drive

Motion Area

Set motion parameters and command motion.

4.3.2 The Motion Area

To explain the Motion Area and its parameters, it is necessary to explain the principle of the three cascading control loops; Position Loop, Velocity loop, and Current Loop, displayed in Figure 4.4.

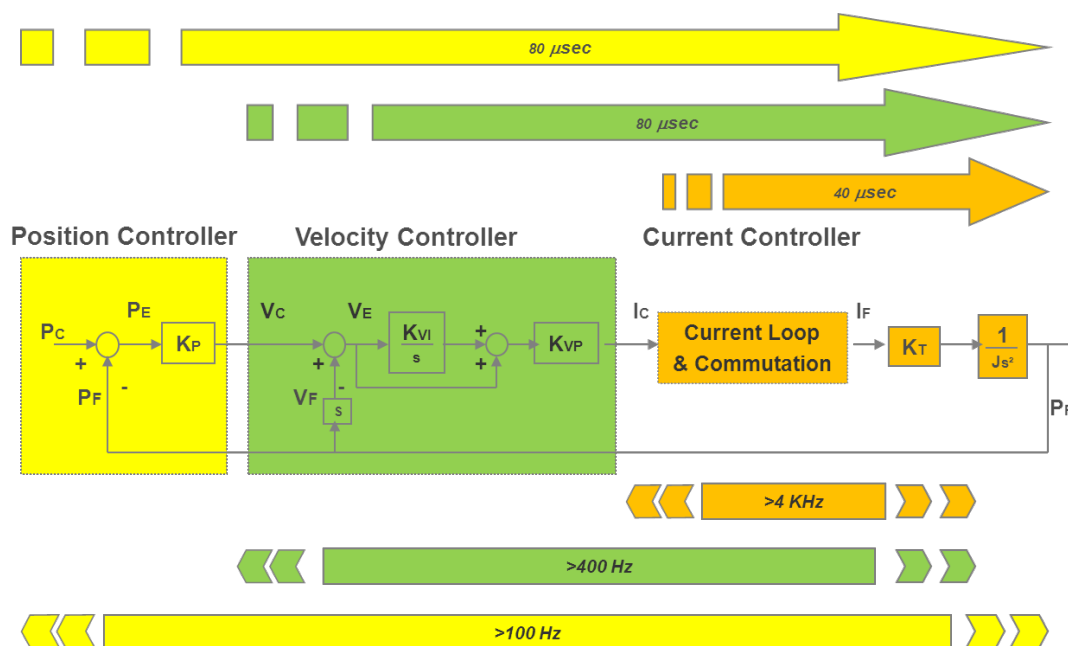
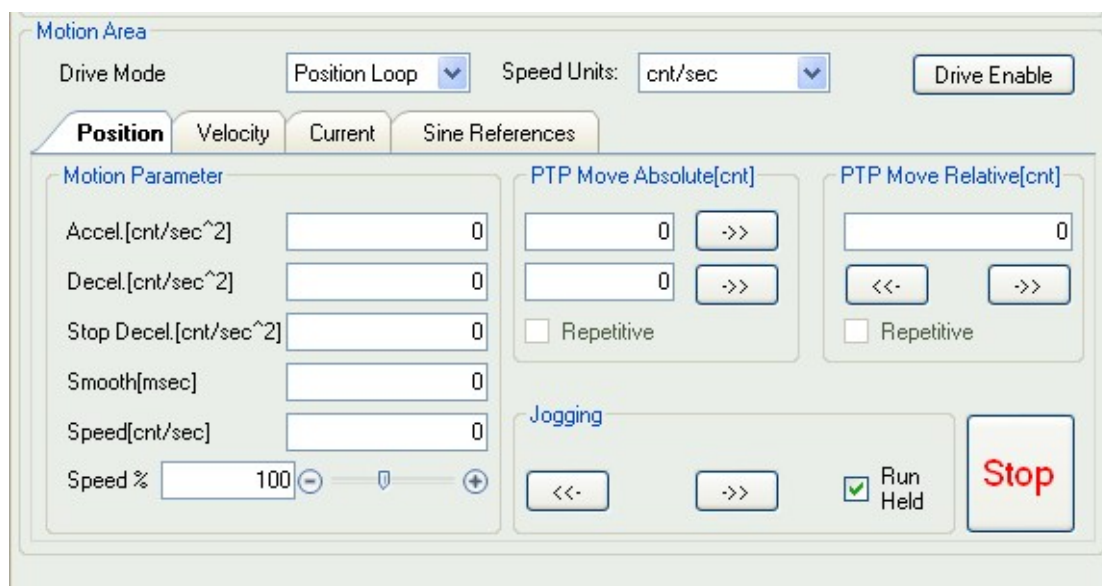


Figure 4.4 Three cascading control loops

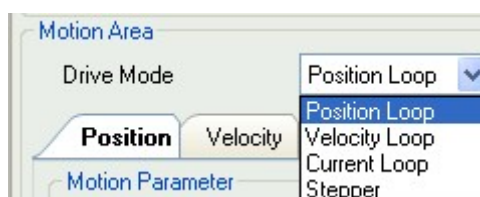
When tuning a motor the motor and feedback parameters are defined, dependent on the motor limits and protections, and the Current response characteristics required, to produce a customized Current Controller design. Similarly, the Velocity and Position response characteristics required are identified, to design the customized Velocity and Position Controllers Each of these Controllers consists of a loop.

The position controller comprises of a proportional gain, cascaded over the speed controller, and is implemented as a cascaded loop, where the inner loop is the Velocity Controller and the outer loop is a simple gain.

The defined motion activation in the EAS Motion Area, therefore depends on the loop selected to insert the motion, and the type of motion.



The **Motion Area** in the EAS application is where motion activation is performed. The Drive Mode selected in which the motion activation is to be performed, depends on the optional loops:



Before starting motion, select the following options (more details below):

- | | |
|--------------------|---|
| Drive Mode | The drive can control the motor using current loop, velocity loop, position loop, or stepper. Each control mode allows different types of motion and results in different motion characteristics. When a high order control loop is selected, all the loops of lower order are also active. For example, in position loop mode, the velocity loop and current loop are also active. |
| Speed Units | Select the units in which speed is entered and displayed by EAS |
| Motion tabs | Use Position, Velocity, Current, or Sine References commands. The available options change according to the selected drive mode. |

4.3.3 Selecting the Drive Mode

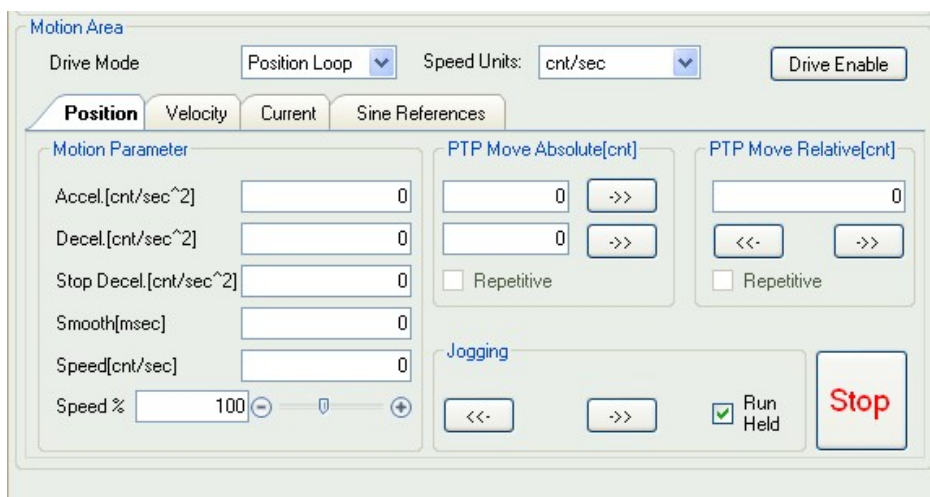
From the drop down menu **Drive Mode (UM)**, select the desired control mode for the motion:

- Position loop
- Velocity loop
- Current loop
- Stepper

The Drive Mode corresponds with the UM described in the Command Reference. Note that the drive must be disabled before changing the user mode.

4.3.3.1 Position Loop Mode

When Position Loop is selected from the **User Mode** list, the Motion Area appears.



To enter values to the Motion Area

1. Select the **Speed Units** you will use.
2. To enable the drive click **Drive Enable**. The button will become **Drive Disable**.
3. When the position loop is closed, the lower order control loops are also closed.
4. You can set a position command or profile, velocity and current commands.

4.3.3.1.1 The Position Tab

Motions commanded in the position tab are performed by calculating a position command and closing the position loop. A jogging command sent from the Position tab is not the same as jogging in the Velocity tab. When you start jogging from the position tab, a position profile is generated according to the acceleration and speed parameters and the position loop works to minimize the position error.

Motion Parameters

Acceleration, deceleration and stop deceleration are the same as AC, DC and SD (see command reference) in the units selected above. Smooth factor is SF and the speed is SP in the units

selected.

Speed %

Multiply the speed by the percent entered. Enter the desired number or use the bar to change the speed between 20% and 200% of the number entered above. The change will take effect

the next time you click on a **Start Motion**  button. You can change the speed on the fly during point-to-point or jogging motions.

PTP Move Absolute

Enter a single absolute target or two targets. Click the **Start Motion** button to start a point-to-point motion to the selected target. You can click on the other target's Start Motion Button to change the target on the fly. You can also enter a new target and click the button again to change target on the fly.

PTP Move Relative

Enter the absolute value of the distance you want the motor to move from its present location. Click the right pointing Start Motion button  to move in the positive direction. Click the left pointing Start Motion button  to start motion in the negative direction.

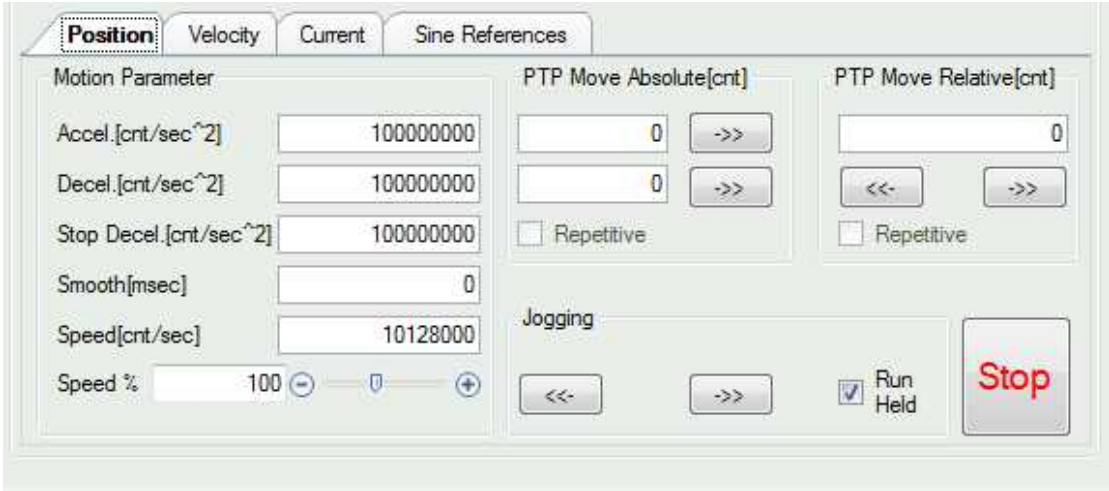
Jogging

Click one of the Start Motion buttons to start motion in the direction you want. Check the **Run Held** box if you want the motor to keep moving only as long as you keep the left mouse button pressed over the start motion button. If you check this box when motion is already in progress, the motion will continue until you either click the **Stop** button or click and release one of the Start Motion buttons.

Stop

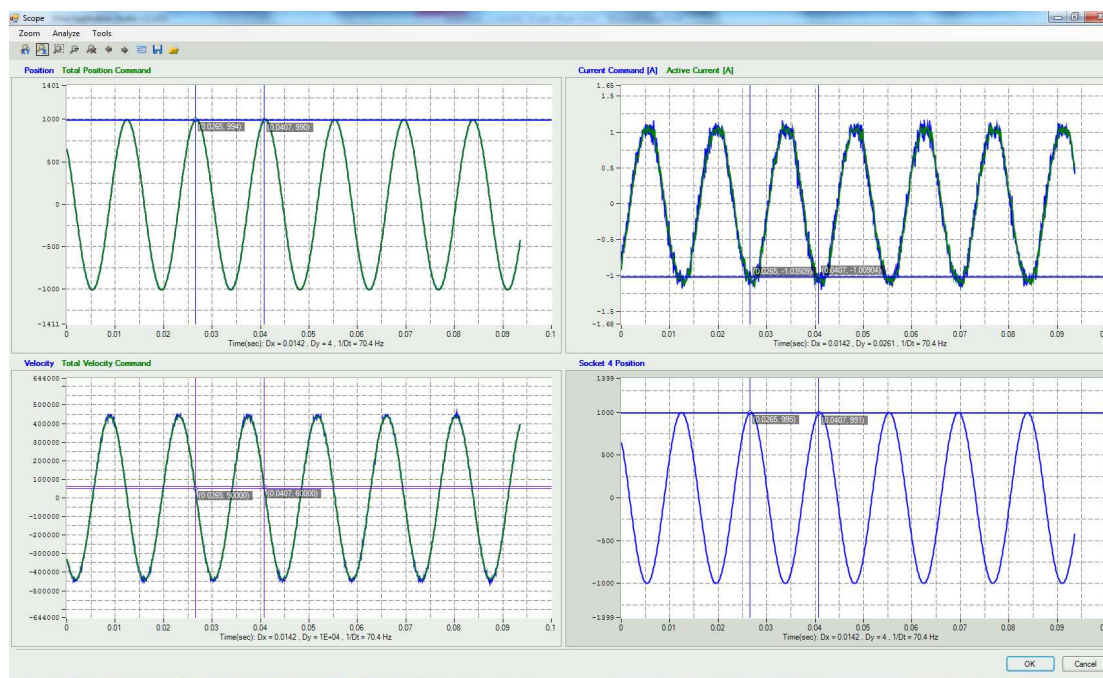
Clicking the Stop button will stop the motion in progress using the defined stop deceleration.

For example:



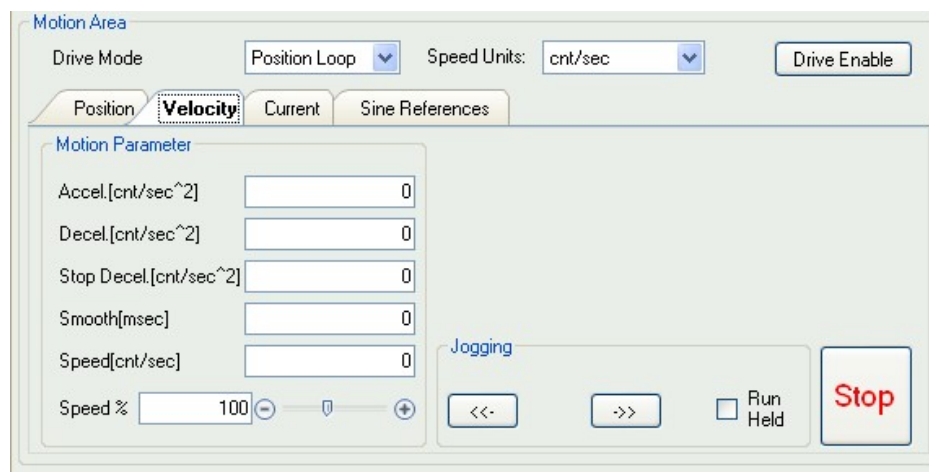
The screenshot displays the Elmo Application Studio interface with the 'Position' tab selected. The 'Motion Parameter' section on the left includes input fields for Accel. [cnt/sec²] (100000000), Decel. [cnt/sec²] (100000000), Stop Decel. [cnt/sec²] (100000000), Smooth [msec] (0), Speed [cnt/sec] (10128000), and Speed % (100). The 'PTP Move Absolute [cnt]' section has two input fields (both 0) and two right-pointing arrow buttons, with a 'Repetitive' checkbox. The 'PTP Move Relative [cnt]' section has one input field (0) and two arrow buttons (left and right), with a 'Repetitive' checkbox. The 'Jogging' section features left and right arrow buttons, a checked 'Run Held' checkbox, and a large red 'Stop' button.

The result produced can be seen from the wave form below:



4.3.3.1.2 The Velocity Tab for Drive Mode = Position Loop

The Velocity tab looks very similar to the Position tab without the point-to-point motions controls.



Though the functionality of the Jogging buttons is the same as described in the Position tab, the motion is generated in a different way, using the velocity command and velocity closed loop. The speed entered in this tab is JV and not SP.

For example:

Motion

Status Area - Motion

Position[cnt]

-493477

Pos.Error[cnt]

0

Drive Disabled



Velocity[cnt/sec]

0

Vel.Error[cnt/sec]

0

Active Current[Amp]

0.00

Motion Status:

Reactive Current[Amp]

0.00

Last Driver Fault : None

Program Status:

No user program is ready to run

Status Area - IO

Bit Number	1	2	3	4	5	6	14	15	16	Safety Inputs
Functions	GP	IGN	IGN	IGN	IGN	IGN		IGN	IGN	ST01 ST02
Digital Inputs	☒	☐	☐	☐	☐	☐	☐	☐	☐	☒ ☒
Digital Outputs	☐	☐	☐	☐	☐	☐	☐	☐	☐	Refresh

Motion Area

Drive Mode

Position Loop

Speed Units:

cnt/sec

Drive Enable

Position

Velocity

Current

Sine References

Motion Parameter

Accel.[cnt/sec^2]

100000000

Decel.[cnt/sec^2]

100000000

Stop Decel.[cnt/sec^2]

100000000

Smooth[msec]

0

Speed[cnt/sec]

0

Speed %

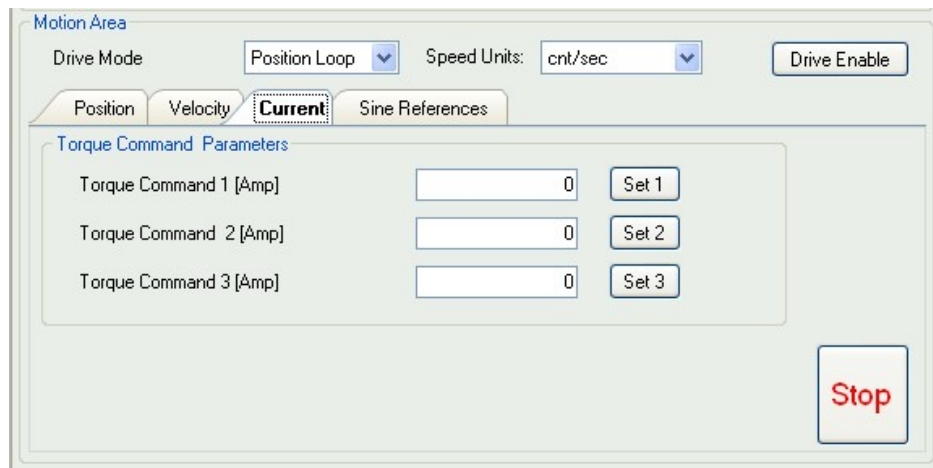
100

☐ Run Held

Stop

4.3.3.1.3 The Current Tab

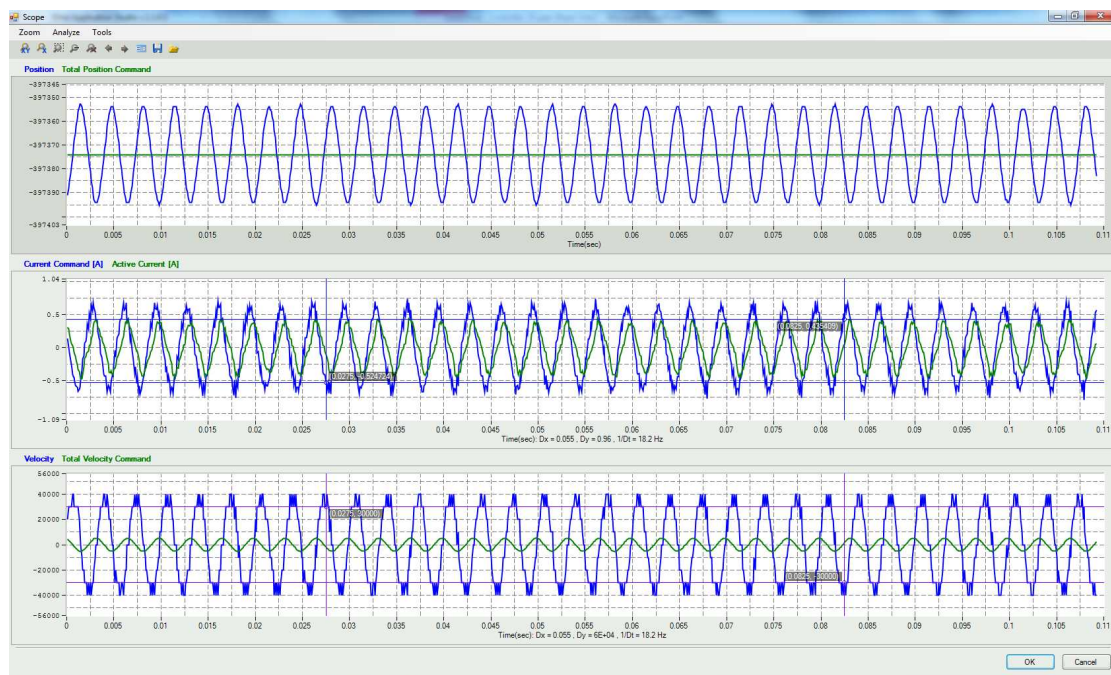
Use this tab for torque commands.



Enter the required torque command in Amperes and click **Set 1**, **Set 2**, or **Set 3**.

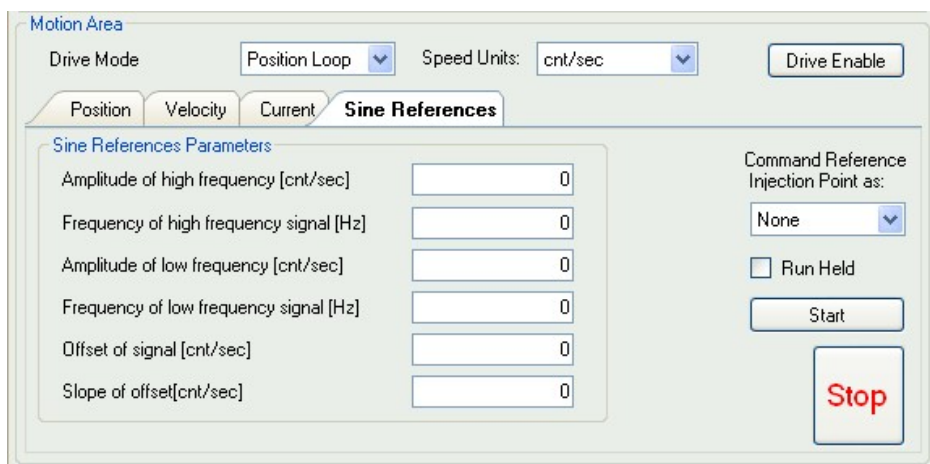
The **Stop** button stops the motor.

The results should be similar as shown the following recording:



4.3.3.1.4 The Sine References tab in Position Loop Mode

This tab tests the motor using sinusoidal motion, with the motor partially rotating in one direction and then reversing.



Enter the frequency and offset parameters to Record (using Recorder) the specifically sinusoidal form corresponding to the motor's tether movement. Enter the Sine Reference Parameters and then select from the options at the right side of the tab.

Amplitude of high frequency The input which produces a maximum graph slope at the high frequency. Refer to the examples in Figure 4.5 and Figure 4.6.

Frequency of high frequency signal (Hz) The highest frequency of the main Sine waves. Refer to the Active Current sine wave frequency examples in Figure 4.5 and Figure 4.6.

Amplitude of low frequency The amplitude of the sine wave at the lowest input frequency. Refer to the Velocity and Position graph examples in Figure 4.5 and Figure 4.6.

Frequency of low frequency signal The frequency of the lowest frequency waves.

Offset of signal The offset of the signal from 0, where the sine reference slope begins. Refer to the Velocity and Position graph examples in Figure 4.5 and Figure 4.6.

Slope of offset The slope of the offset, if not flat from 0. Refer to the Velocity and Position graph examples in Figure 4.5 and Figure 4.6.

Select whether the Command Reference Injection Point is by default from zero (None), Current or Velocity. This is usually set to Current or Velocity.

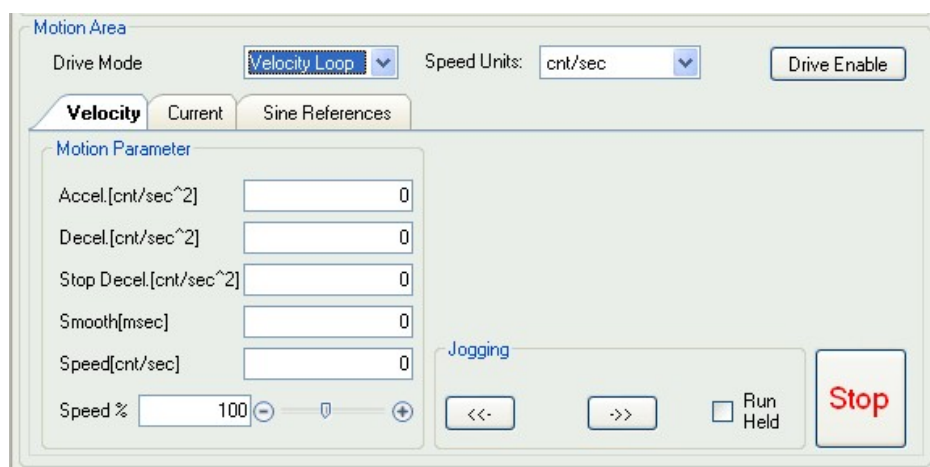


Click the checkbox next to **Run Held**, if the motion is to be continuous.

Click **Start** to start the sinusoidal motion and perform Record.

4.3.3.2 Velocity Loop Mode

When “Velocity Loop” is selected from the **User Mode** list, the Motion Area has the following appearance:



Select the **Speed Units** you will use. To activate the drive, click **Drive Enable**. The button changes to **Drive Disable**.

When the velocity loop is closed, the lower order current control loop is also closed. You can now set a velocity command or profile, and current commands.

4.3.3.2.1 The Velocity Tab

This tab is used for jogging motions using closed velocity control loop.

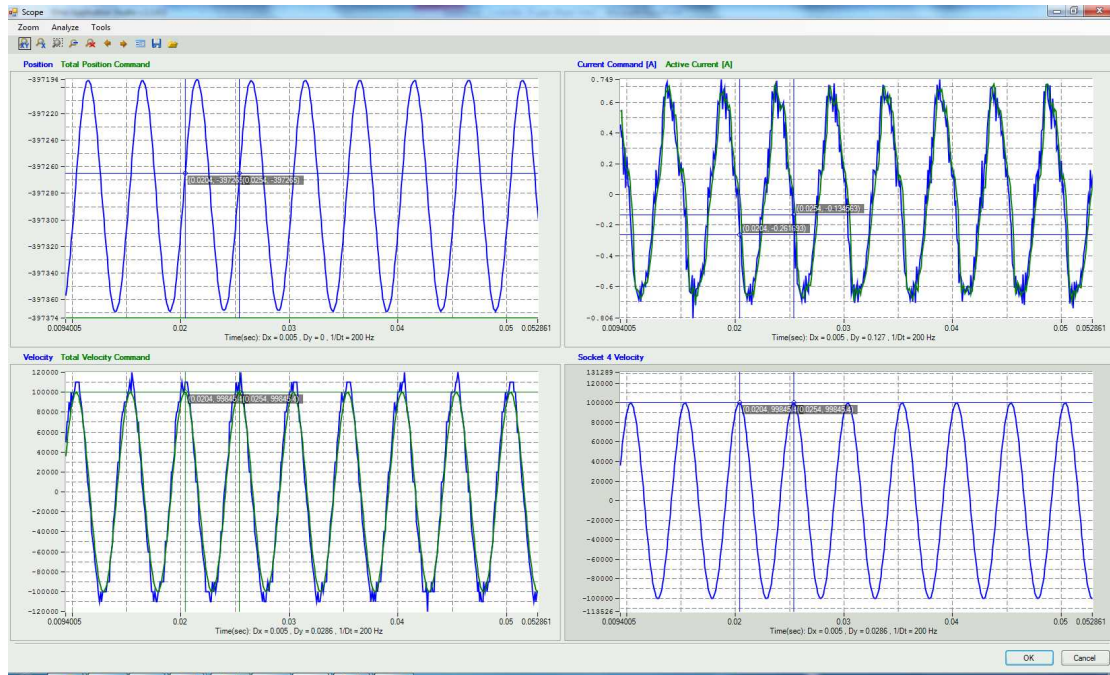
Motion Parameters Acceleration, deceleration and stop deceleration are the same as AC, DC and SD (see command reference) in the units selected above. Smooth factor is SF and the speed is JV in the units selected.

Speed % Multiply the speed by the percent entered. Enter the desired number or use the bar to change the speed between 20% and 200% of the number entered above. The change will take effect the next time you click on a **Start Motion**  button. You can change the speed on the fly during jogging motions.

Jogging Click one of the Start Motion buttons to start motion in the direction you want. Check the **Run Held** box if you want the motor to keep moving only as long as you keep the left mouse button pressed over the start motion button. If you check this box when motion is already in progress, the motion will continue until you either click the **Stop** button or click and release one of the Start Motion buttons.

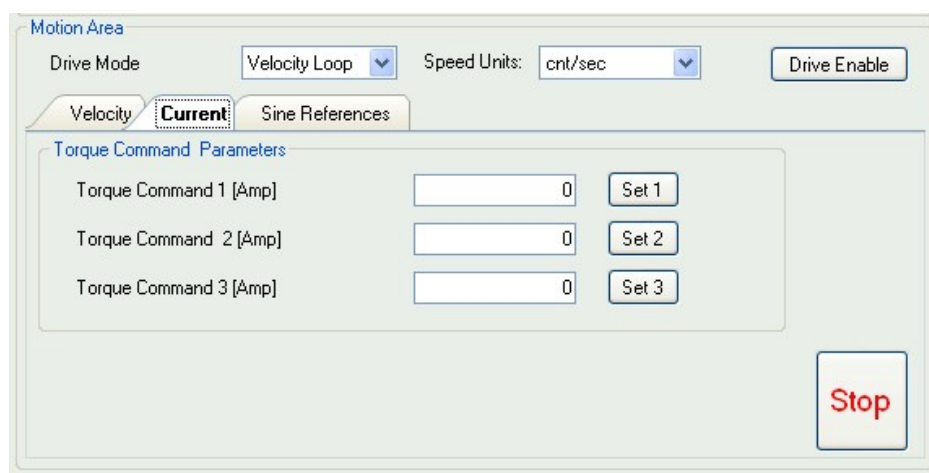
Stop Clicking the Stop button will stop the motion in progress using the defined stop deceleration.

The results should appears shown below:



4.3.3.2.2 The Current Tab

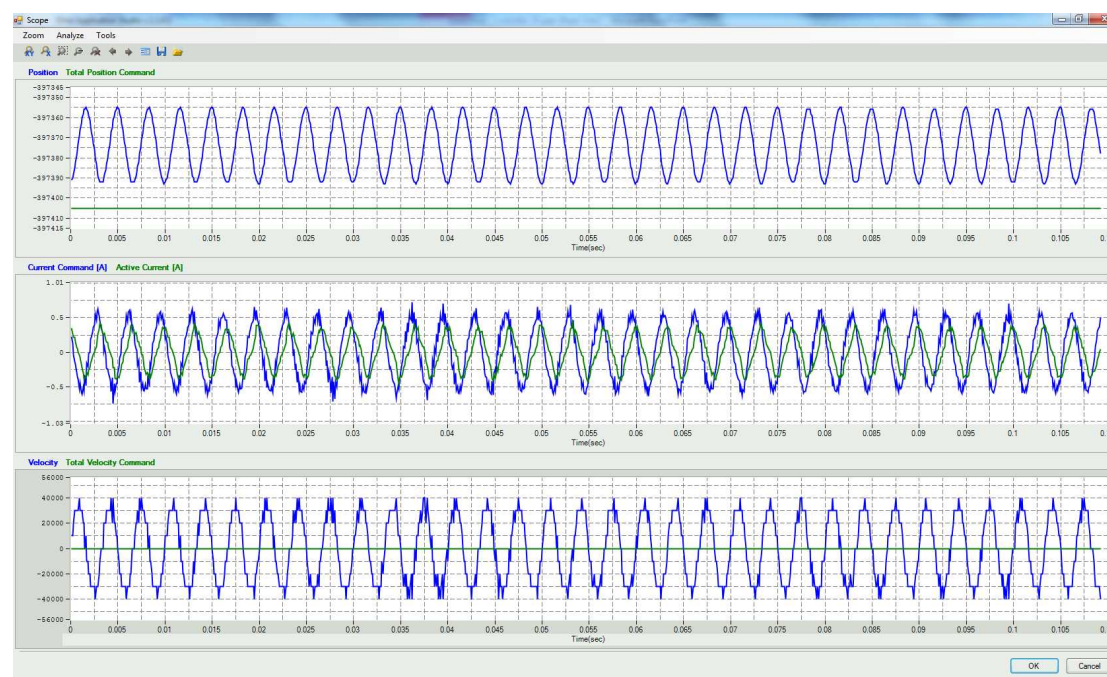
Use this tab for torque commands:



Enter the required torque command in Amperes and click **Set 1**, **Set 2**, or **Set 3**.

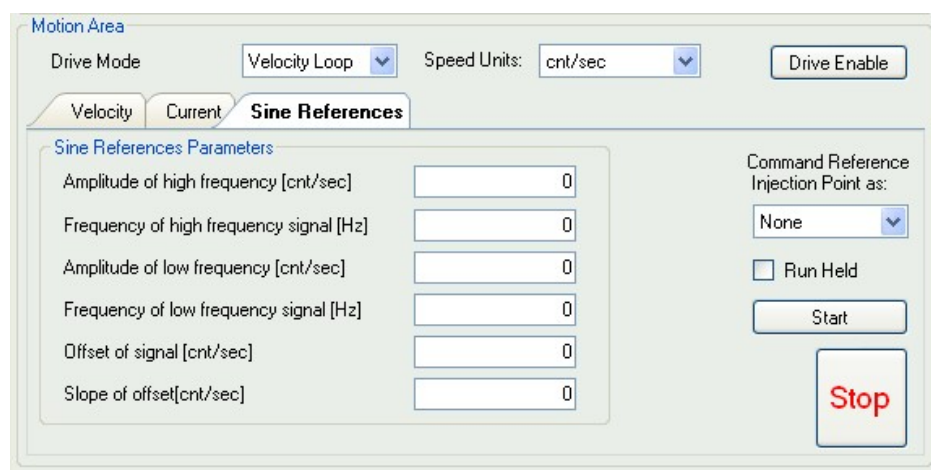
The **Stop** button stops the motor.

The results should appear as shown in the example below:



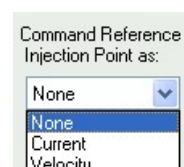
4.3.3.2.3 The Sine References tab in Velocity Loop Mode

This tab tests the motor using sinusoidal motion, with the motor partially rotating in one direction and then reversing.



Enter the frequency and offset parameters to Record (using Recorder) the specifically sinusoidal form corresponding to the motor's tether movement.

Amplitude of high frequency	The input which produces a maximum graph slope at the high frequency. Refer to the examples in Figure 4.5 and Figure 4.6.
Frequency of high frequency signal (Hz)	The highest frequency of the main Sine waves. Refer to the Active Current sine wave frequency examples in Figure 4.5 and Figure 4.6.
Amplitude of low frequency	The amplitude of the sine wave at the lowest input frequency. Refer to the Velocity and Position graph examples in Figure 4.5 and Figure 4.6.
Frequency of low frequency signal	The frequency of the lowest frequency waves.
Offset of signal	The offset of the signal from 0, where the sine reference slope begins. Refer to the Velocity and Position graph examples in Figure 4.5 and Figure 4.6.
Slope of offset	The slope of the offset, if not flat from 0. Refer to the Velocity and Position graph examples in Figure 4.5 and Figure 4.6.


☐ Run Held

Select whether the Command Reference Injection Point is by default from zero (None), Current or Velocity.

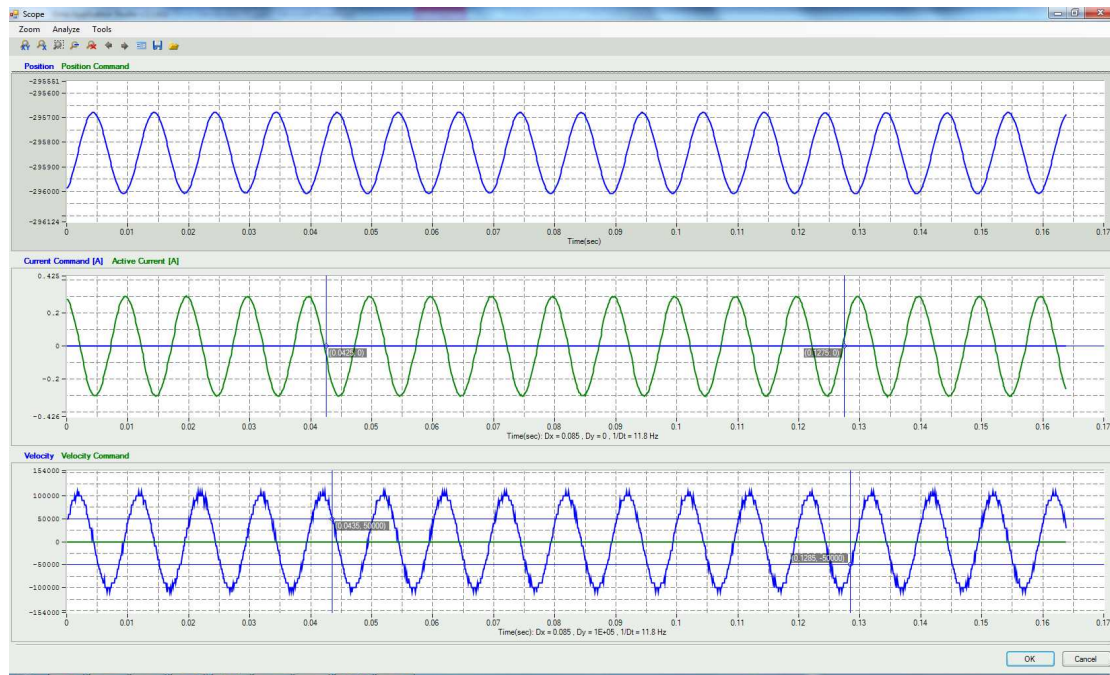
Click the checkbox next to **Run Held**, if the motion is to be continuous.

Click **Start** to start the sinusoidal motion and perform Record.

4.3.3.3 Current Loop

In this mode, only the Current tab is available. Refer to the above sections for instructions on how to use it.

The result displayed shows the Current injection on top of the Current mode as shown below.



4.3.3.3.1 The Sine References tab in Current Loop Mode

When the Current is injected to the Current Loop mode

Enter the frequency and offset parameters to Record (using Recorder) the specifically sinusoidal form corresponding to the motor's tether movement.

Main Sine Signal Amplitude (Amp)	The input which produces a maximum graph slope at the high frequency. Refer to the example in Figure 4.5 and Figure 4.6.
Main Sine Signal Frequency (Hz)	The highest frequency of the main Sine waves. Refer to the Active Current sine wave frequencies in Figure 4.5 and Figure 4.6.
Carrier Sine Signal Amplitude (Amp)	Changes the slope of the offset wave, introducing an extra signal amplitude which causes the main slope to appear wavy as shown in Figure 4.7 and Figure 4.8.
Carrier Sine Signal Frequency (Hz)	Changes the sine signal frequency of the slope by introducing an extra signal as shown in Figure 4.7 and Figure 4.8.
Signal Offset	The offset of the signal from 0. Where the sine reference slope begins. Refer to the Velocity and Position graphs in Figure 4.5 and Figure 4.6.
Signal Offset Slope	The slope of the offset, if not flat from 0. Refer to the Velocity and Position graphs in Figure 4.5 and Figure 4.6.

Command Reference Injection Point as:

None
None
Current
Velocity

Select whether the Command Reference Injection Point is by default from zero (None), Current or Velocity.

☐ Run Held

Click the checkbox next to **Run Held**, if the motion is to be continuous.

Start

Click **Start** to start the sinusoidal motion and perform Record.

The Sine References are adjusted to produce a slope as shown in Figure 4.5.

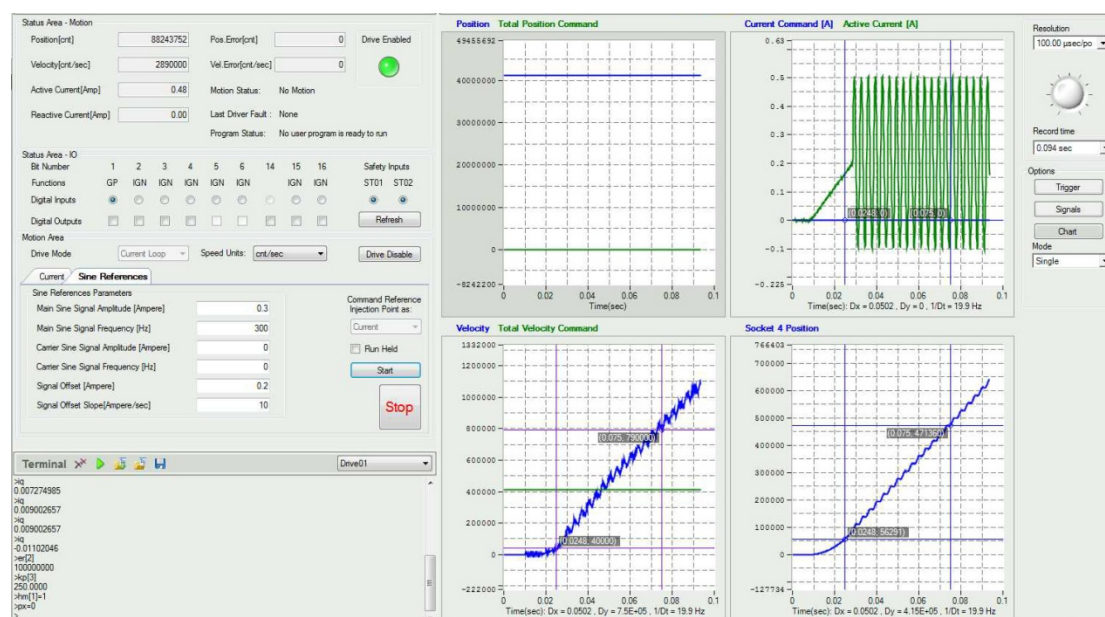


Figure 4.5: Current injection on Current mode with slope

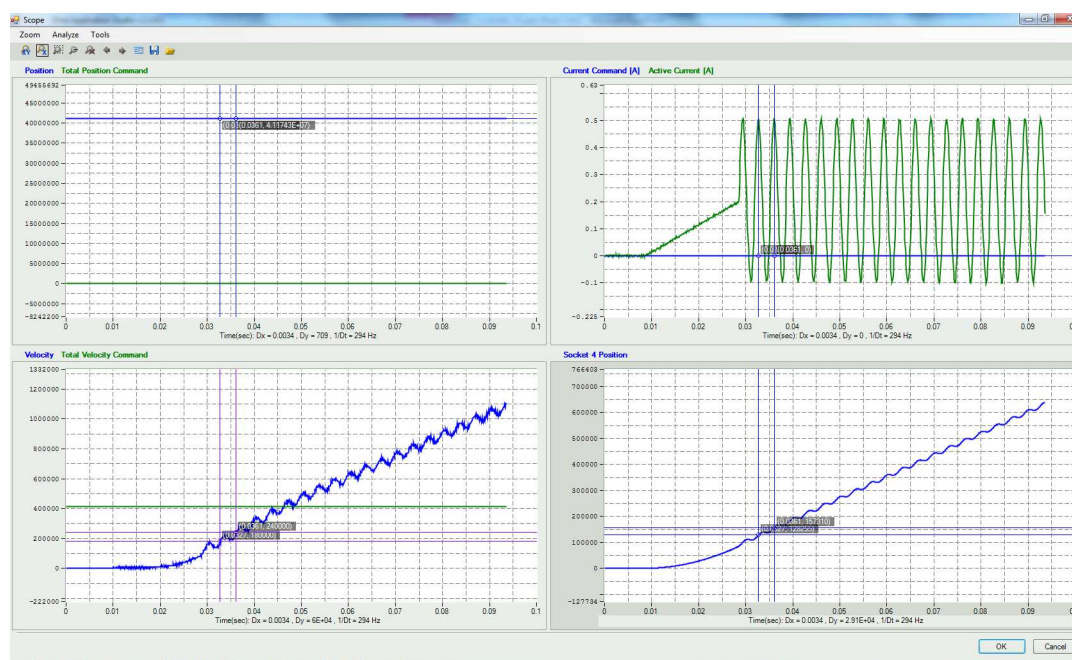


Figure 4.6: Current injection on Current mode with slope measured at 294 Hz

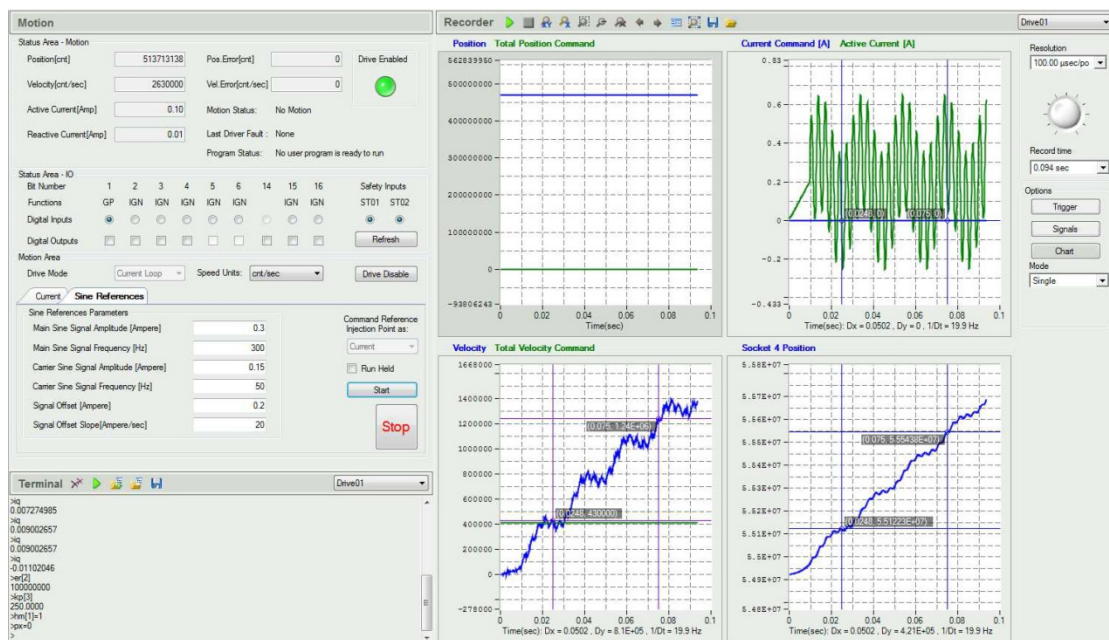


Figure 4.7: Current injection on Current mode with slope and carrier

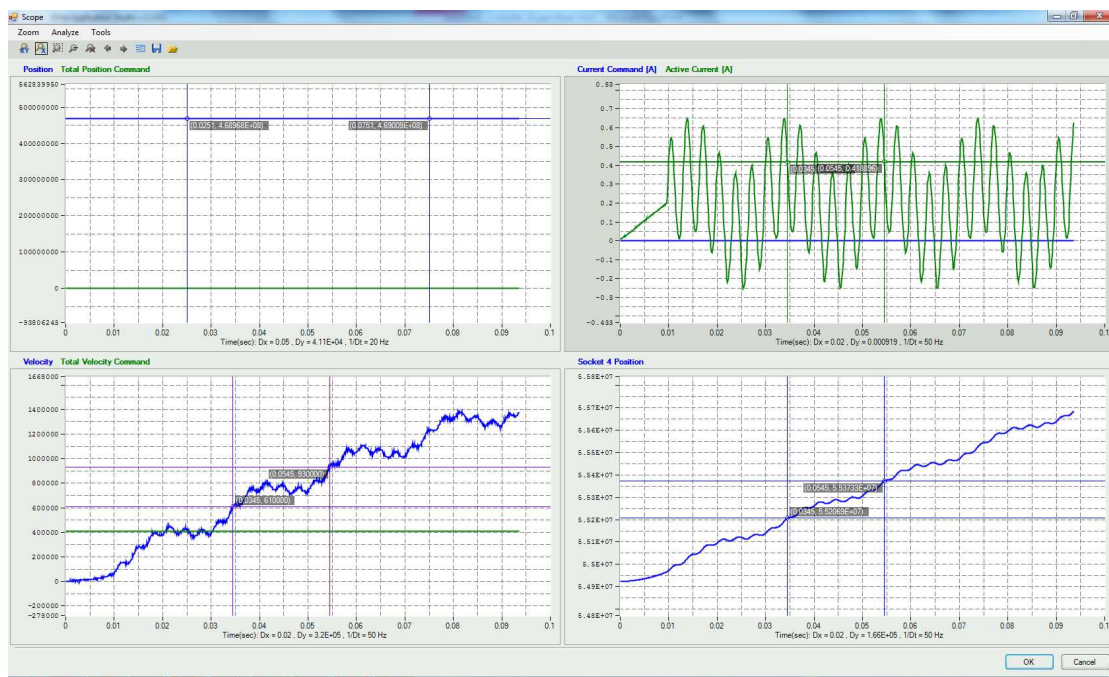
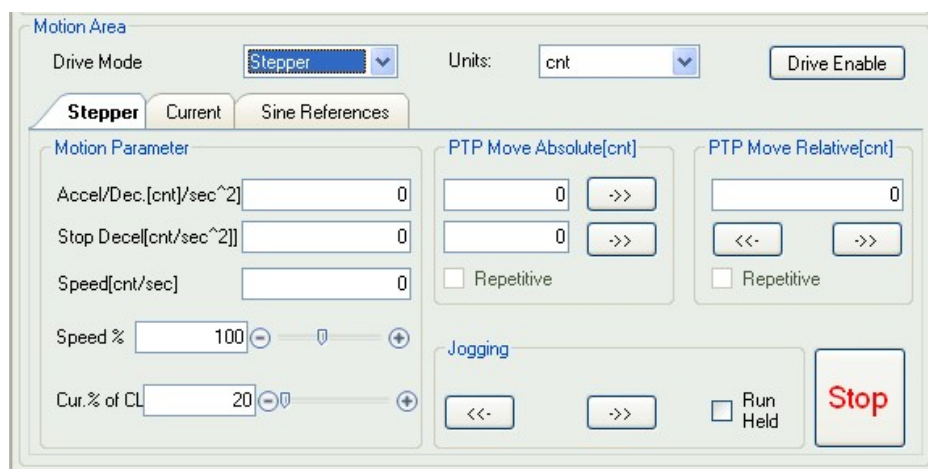


Figure 4.8: Current injection on Current mode with slope and carrier – graph details

4.3.3.4 Stepper Mode

In stepper mode, there are two tabs.



4.3.3.4.1 Stepper Tab

In the stepper tab, you can command point-to-point and jogging motions using the motor as a stepper motor. Select the position units from the **Units** list.

Motion Parameters Acceleration, deceleration and stop deceleration are the same as AC, DC and SD (see command reference) in the units selected above. The speed is SP in the units selected.

Speed % Multiply the speed by the percent entered. Enter the desired number or use the bar to change the speed between 20% and 200% of the number entered above. The change will take effect the next time you click on a **Start Motion**  button. You can change the speed on the fly during jogging or point-to-point motions.

Current % of CL Current percentage of the Current Level.

PTP Move Absolute Enter a single absolute target or two targets. Click the **Start Motion** button to start a point-to-point motion to the selected target. You can click on the other target's Start Motion Button to change the target on the fly. You can also enter a new target and click the button again to change target on the fly.

PTP Move Relative Enter the relative value of the distance you want the motor to move from its present location. Click the right pointing Start Motion button  to move in the positive direction. Click the left pointing Start Motion button  to start motion in the negative direction.

Jogging Click one of the Start Motion buttons to start motion in the direction you want. Check the **Run Held** box if you want the motor

to keep moving only as long as you keep the left mouse button pressed over the start motion button. If you check this box when motion is already in progress, the motion will continue until you either click the **Stop** button or click and release one of the Start Motion buttons.

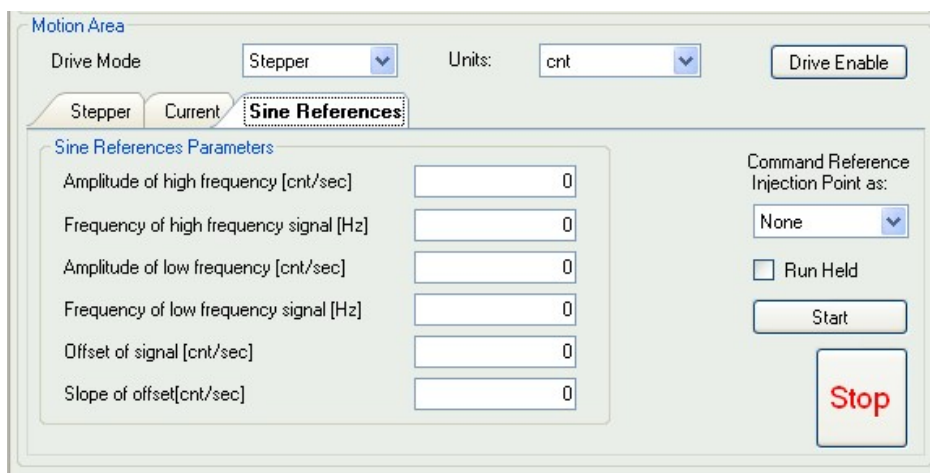
Stop Clicking the Stop button will stop the motion in progress using the defined stop deceleration.

4.3.3.4.2 The Current Tab in Stepper Mode

The current tab for stepper mode looks the same as the current tab in the other modes. The difference is that the current command in stepper mode will only excite a single motor phase and the motor will turn until it arrives at a stable position and stop there, held by the commanded torque.

4.3.3.4.3 The Sine References tab in Stepper Mode

This tab tests the motor using sinusoidal motion, with the motor partially rotating in one direction and then reversing.



Enter the frequency and offset parameters to Record (using Recorder) the specifically sinusoidal form corresponding to the motor's tether movement.

Amplitude of high frequency	The input which produces a maximum graph slope at the high frequency. Refer to the examples in Figure 4.5 and Figure 4.6.
Frequency of high frequency signal (Hz)	The highest frequency of the main Sine waves. Refer to the Active Current sine wave frequency examples in Figure 4.5 and Figure 4.6.
Amplitude of low frequency	The amplitude of the sine wave at the lowest input frequency. Refer to the Velocity and Position graph examples in Figure 4.5 and Figure 4.6.
Frequency of low frequency signal	The frequency of the lowest frequency waves.
Offset of signal	The offset of the signal from 0, where the sine reference slope begins. Refer to the Velocity and Position graph examples in Figure 4.5 and Figure 4.6.

Slope of offset

The slope of the offset, if not flat from 0. Refer to the Velocity and Position graph examples in Figure 4.5 and Figure 4.6.

Command Reference Injection Point as:

None
 Current
 Velocity

Select whether the Command Reference Injection Point is by default from zero (None), Current or Velocity.

☐ Run Held

Click the checkbox next to **Run Held**, if the motion is to be continuous.

Click **Start** to start the sinusoidal motion and perform Record.

4.3.4 The I/O Status Area

The I/O monitor shows the status of the digital inputs, outputs and Safety Inputs (STO) of the drive. Note that the inputs and outputs should be configured in the I/O control tool.

Status Area - IO

Bit Number	1	2	3	4	5	6	14	15	16	Safety Inputs	
Functions										ST01	ST02
Digital Inputs	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Digital Outputs	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Refresh

Click the digital output controls to turn the outputs on or off.

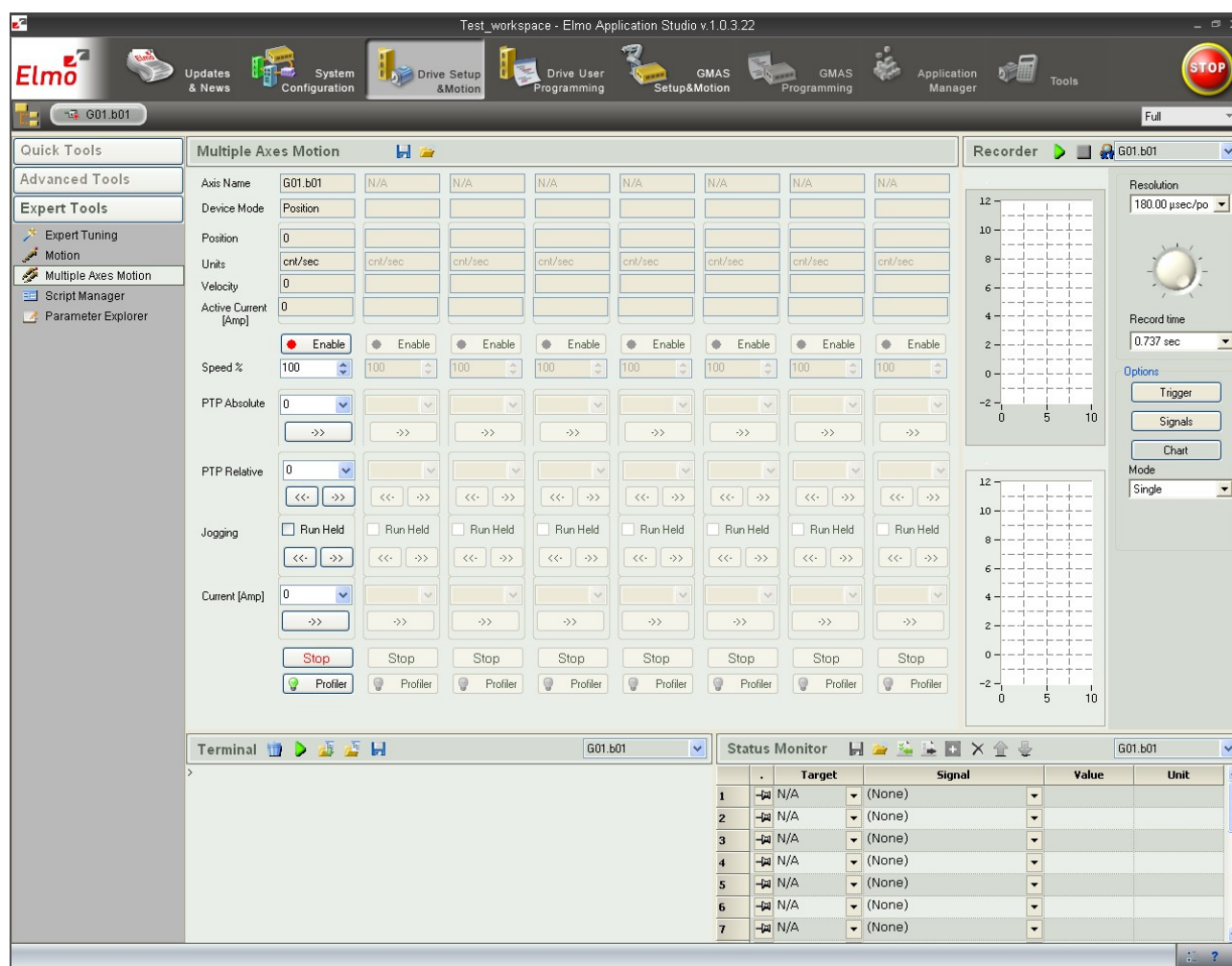
4.3.5 The Motion Status Area

Status Area - Motion

Position[cnt]	0	Pos.Error[cnt]	0	Drive Enabled ☐
Velocity[cnt/sec]	0	Vel.Error[cnt/sec]	0	
Active Current[Amp]	0	Motion Status:	None	
Reactive Current[Amp]	0	Last Driver Fault :	None	
		Program Status:	None	

The motion status area allows viewing the motion information at a glance.

4.4 Multiple Axis Motion

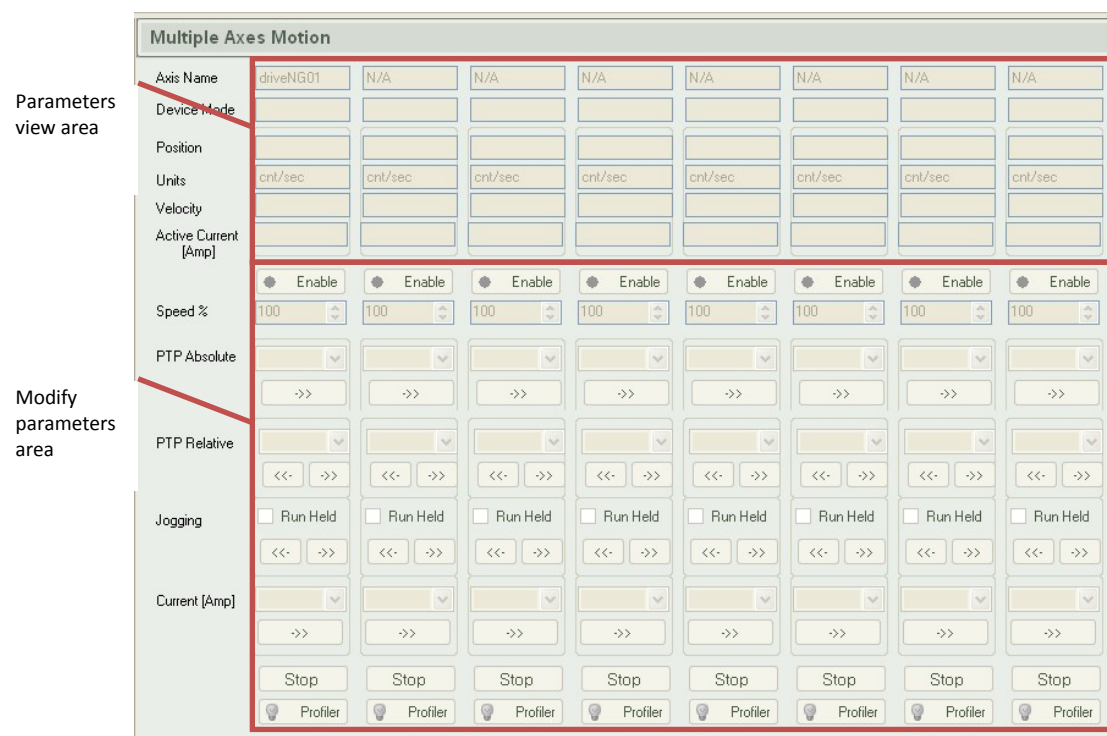


In the Multiple Axis Motion window, you can define the parameters for a group of axes. If you have defined a number of single axis drives, and on condition that, the drives are hardware linked, you may now link the motion of the drives within EAS, using the Multiple Axis Motion parameters.

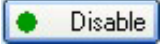
The Multiple Axis Motion window can control up to eight separate axes, and if less displayed, the remaining axes are disabled.

4.4.1 Parameters Table

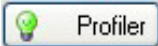
The Multiple Axis Area consists of the following parameters table.



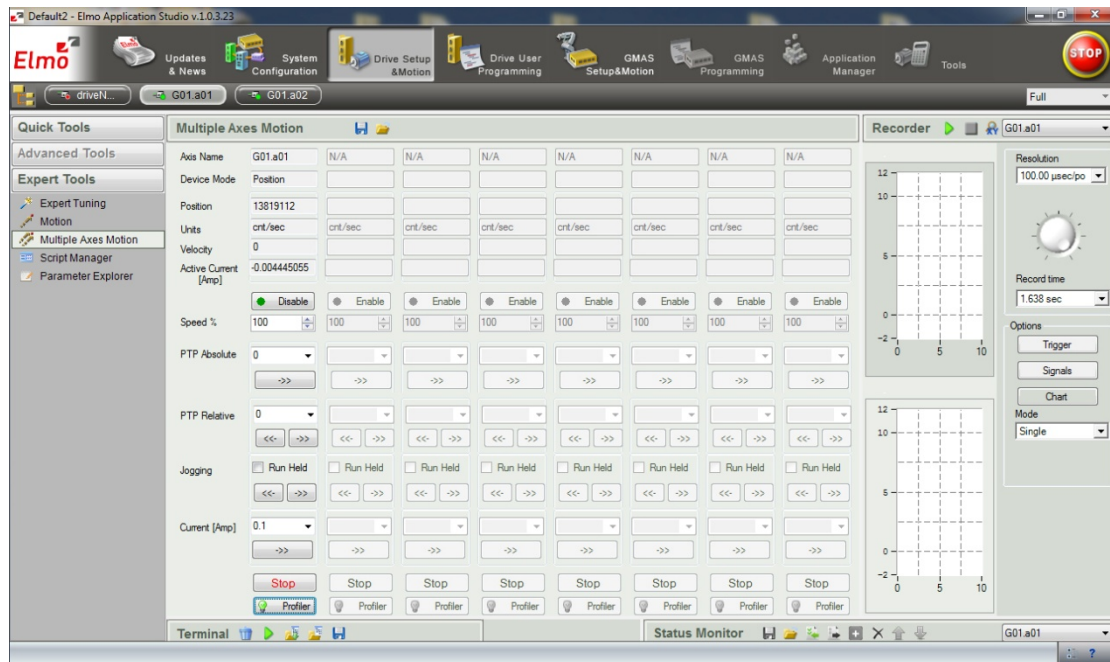
Multiple Axes Motion								
Axis Name	driveNG01	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Device Mode								
Position								
Units	cnt/sec	cnt/sec	cnt/sec	cnt/sec	cnt/sec	cnt/sec	cnt/sec	cnt/sec
Velocity								
Active Current [Amp]								
Speed %	100	100	100	100	100	100	100	100
PTP Absolute								
PTP Relative								
Jogging								
Current [Amp]								
	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop
	Profiler	Profiler	Profiler	Profiler	Profiler	Profiler	Profiler	Profiler

Parameter	Explanation
Axis Name	The name of the target defined by this application
Device Mode	Control Loop with the following options: - Position Loop - Velocity Loop - Current loop - Stepper With a default UM value of the servo drive
Position	Position status indicator. Position of the driven object, the servo drive position
Units	Cnt/sec, RPM, or Electrical Degrees
Velocity	For a group of axes, in MCS measurements this provides the velocity of the TCP.
Active Current (Amp)	The active current flowing per drive, controller, or I/O
	To enable the drive click Enable . The button displays Disable . The button color changes from red to green.
Speed %	The percentage Speed is the absolute percentage of the velocity without direction. Multiply the speed by the percent entered. Enter the desired number



Parameter	Explanation
	or use the bar to change the speed between 20% and 200% of the number entered above.
PTP Absolute	Enter a single absolute target. The change will take effect the when you click on the Start Motion  button. You can change the speed on the fly during point-to-point or jogging motions.
PTP Relative	Enter the relative value of the distance you want the motor to move from its present location. Click the right pointing Start Motion button  to move in the positive direction. Click the left pointing Start Motion button  to start motion in the negative direction.
Jogging	Click one of the Start Motion buttons to start motion in the direction you want. Check the Run Held box if you want the motor to keep moving only as long as you keep the left mouse button pressed over the start motion button. If you check this box when motion is already in progress, the motion will continue until you either click the Stop button or click and release one of the Start Motion buttons.
Current (Amp)	Enter the minimum to maximum value of the current relevant to the drive to allow smooth motion of the drive. This value should not be more than the Current Level (CL) of the drive. The change will take effect the when you click on the Start Motion  button. You can change the current on the fly during point-to-point or jogging motions.
Stop	Clicking the Stop button will stop the motion in progress using the defined stop deceleration.
Profile icon 	When the axis is selected as part of the multi-axes profile, the profile for axis is selectable and adjustable. A green bulb displays showing that the Profile is active.

Therefore, for example, during the motion of axis controlled by a G-MAS, the Multiple Axis Motion window appears as.



4.4.2 Units

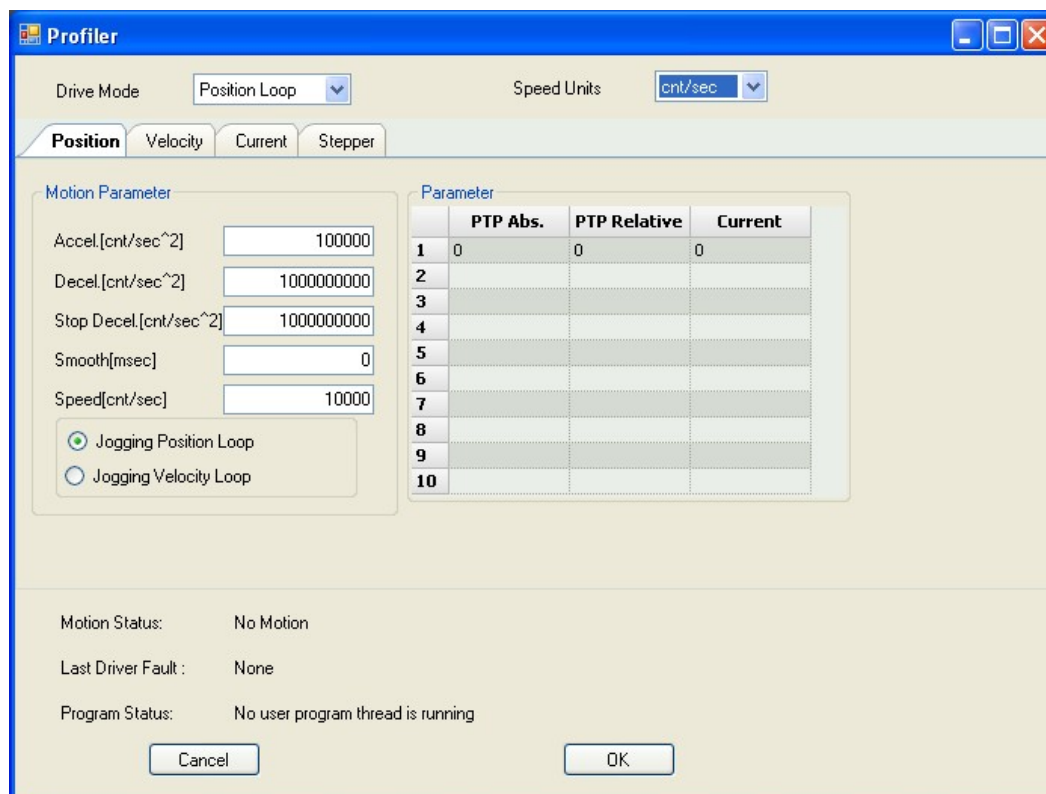
The following table describes the units relevant to the various motors and stepper motors available:

Mode	Position	Velocity
Position Mode	cnt	Cnt/sec RPM
Velocity Mode		Cnt/sec RPM
Stepper Mode	Cnt Electrical Degree	Cnt/sec Electrical Degree

4.4.3 Profiler

The motion profile of multiple axes grouped drives, controllers, and I/Os, may be defined as either NC or Distributed (Non-NC), with the appropriate operation mode applicable to each possible variation.

The Profiler window displays the following.



Profiler

Drive Mode: Position Loop Speed Units: cnt/sec

Position Velocity Current Stepper

Motion Parameter

Accel.[cnt/sec²] 100000

Decel.[cnt/sec²] 1000000000

Stop Decel.[cnt/sec²] 1000000000

Smooth[msec] 0

Speed[cnt/sec] 10000

☒ Jogging Position Loop
☐ Jogging Velocity Loop

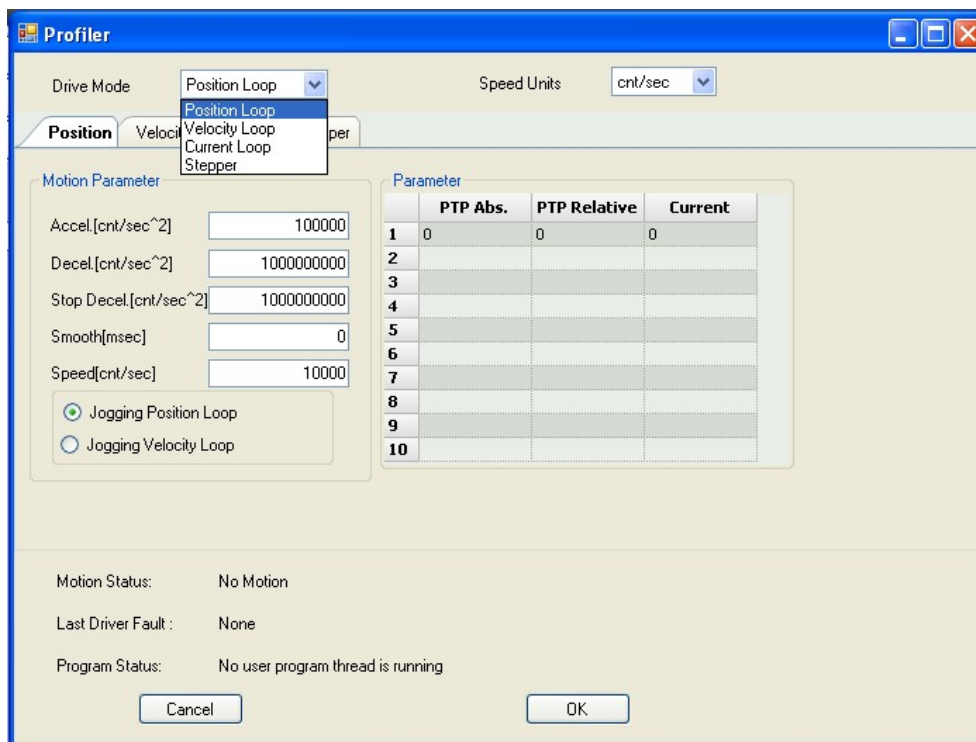
Parameter

	PTP Abs.	PTP Relative	Current
1	0	0	0
2			
3			
4			
5			
6			
7			
8			
9			
10			

Motion Status: No Motion
 Last Driver Fault: None
 Program Status: No user program thread is running

Cancel OK

The Drive mode has a number of control loop options, which depend on the enabled movement, and behavior of the drives as a group.



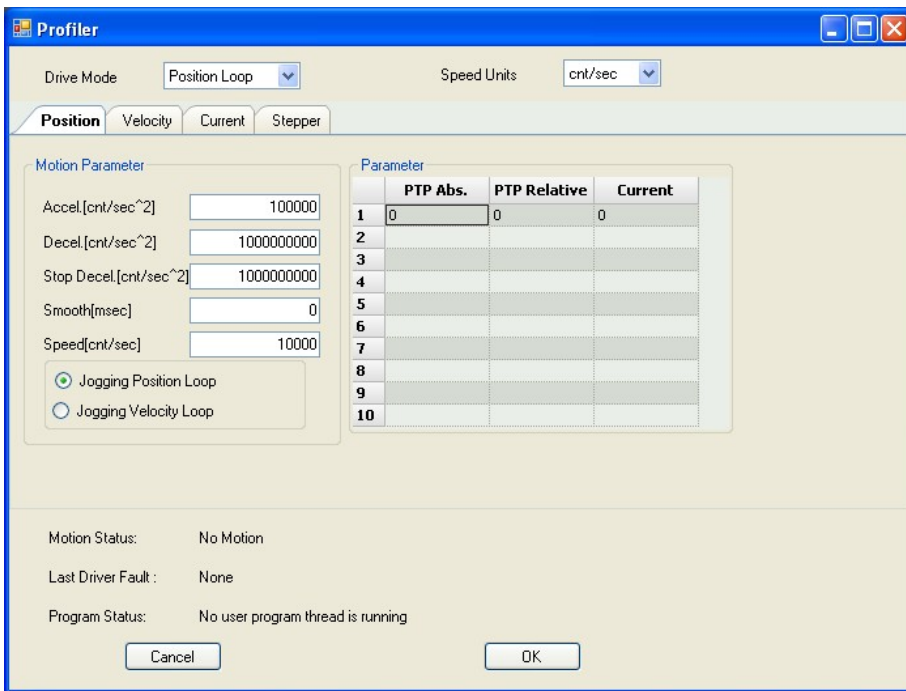
The following table details the dependence of these control loops and their movement.

Control Loop/ Movement	Position Loop	Velocity Loop	Current Loop	Stepper
PTP Absolute Movement	Enabled	Disabled	Disabled	Enabled
PTP Relative Movement	Enabled	Disabled	Disabled	Enabled
Jogging Movement	Enabled	Enabled	Disabled	Enabled
Current	Enabled	Enabled	Enabled	Enabled

To enter control loop parameters

1. Select from the Drive Mode pull-down options to choose a specific control loop, relevant to the operation of the drives as a group (refer to the sections 4.4.3.1 - 4.4.3.4 for further details).
- Alternatively, click the appropriate tab to open the selected control loop.
2. When you have completed entering the parameters, click **OK** to accept the changes, and return to the Multiple Axes Motion window.
 3. If you have entered values in the Parameter table, then you can view these listed values in the pull-down options next to PTP Absolute, PTP Relative, and/or Current.
 4. Operate the drive according to the settings created in the Profile window, and adjust as necessary.
 5. Select the next servo drive in the group of axes.
 6. Repeat steps 1 – 2 for the next drive, until all the drive parameters for the multi-axes group are entered.

4.4.3.1 Position Loop



The screenshot shows the 'Profiler' window with the 'Position' tab selected. The 'Drive Mode' is set to 'Position Loop' and 'Speed Units' is 'cnt/sec'. The 'Motion Parameter' section includes input fields for Accel, Decel, Stop Decel, Smooth, and Speed, with values 100000, 1000000000, 1000000000, 0, and 10000 respectively. Below these are radio buttons for 'Jogging Position Loop' (selected) and 'Jogging Velocity Loop'. The 'Parameter' table has 10 rows and 3 columns: PTP Abs., PTP Relative, and Current. The first row has values 0, 0, and 0. The status section at the bottom shows 'Motion Status: No Motion', 'Last Driver Fault: None', and 'Program Status: No user program thread is running'.

Within the Position Loop profiler tab, you can alter the following **Motion Parameters**.

Parameter	Definition
Accel	Defines the maximum allowed profiler acceleration. Uses the AC Command (from the Gold Line and SimplIQ Command Reference Guides)
Decel	Defines the maximum allowed profiler deceleration. Uses the DC Command (from the Gold Line and SimplIQ Command Reference Guides)
Stop Deceleration	Defines the deceleration in counts/second ² used to stop motions in case

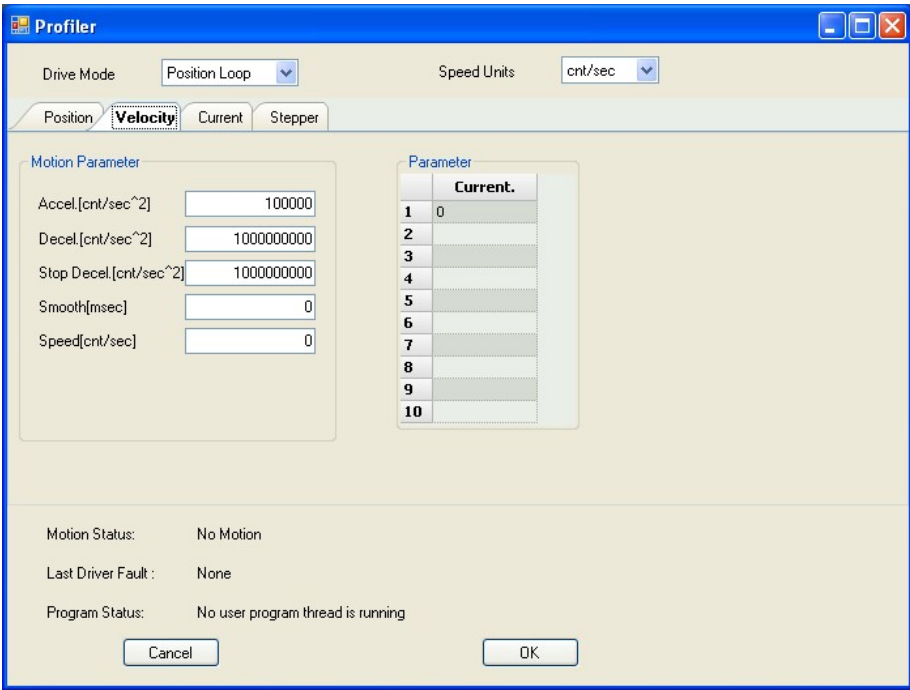
Parameter	Definition
	of emergency. In addition, SD defines the acceleration limit for the combination of software and external reference commands. Uses the SD Command (from the Gold Line and SimplIQ Command Reference Guides). When the Trapezium profile is not used, as in the Interpolation drive mode, this will be dependent on the drive.
Smooth	The motion smoothing factor, in milliseconds, for PTP and jogging. Uses the SF Command (from the Gold Line and SimplIQ Command Reference Guides). The smoothing of the motion prevents sharp and high dynamic speed changes. SF actually builds the acceleration for the defined period (msec), allowing acceleration to adjust the motion in moderate portions. When SF=0 all the requested acceleration is used by the profiler to build the speed command.
Speed	Absolute speed independent of direction. When the SP command is used (from the Gold Line and SimplIQ Command Reference Guides), this denotes the maximum speed in counts/sec which a point-to-point motion can reach.
Jogging Position Loop Jogging Velocity Loop	Jogging Velocity (JV command (from the Gold Line and SimplIQ Command Reference Guides)) sets the motor speed in counts/sec and switch to the velocity control loop. In speed control mode, the JV parameter specifies the software speed command. For un-profiled mode, the speed command is set to JV immediately. For profiled mode, the speed command is gradually changed to JV, according to the AC, DC and SF parameters. In the position control modes, the JV setting defines a constant speed software command, and is under position control. The value of JV defines the speed of the motion, i.e. it determines the rate at which the position command value changes. The parameters AC, DC and SF determine the acceleration limits to reach the final speed. In stepper mode, JV determines the rate at which the electric angle command value changes. The Jog Velocity (JV command (from the Gold Line and SimplIQ Command Reference Guides)) Decide whether the motion will be governed by the Position or velocity of the servo drive. Click the appropriate radio button.

In addition, instead of setting point-to-point values after each motion of the drive, a range of point-to-point and/or Current settings (up to ten) can be created in the Profile window to allow the drive to operate, from pull-down parameters listed in the value box next to PTP Absolute, PTP Relative , and Current, in the Multiple Axes Motion window.

These settings are entered under the **Parameter** heading.

PTP Abs.	PTP Relative	Current
Enter up to ten point-to-point absolute settings to generate the continuous motion.	Or, enter up to ten point-to-point relative settings.	Or, enter up to ten point-to-point current settings.

4.4.3.2 Velocity Loop



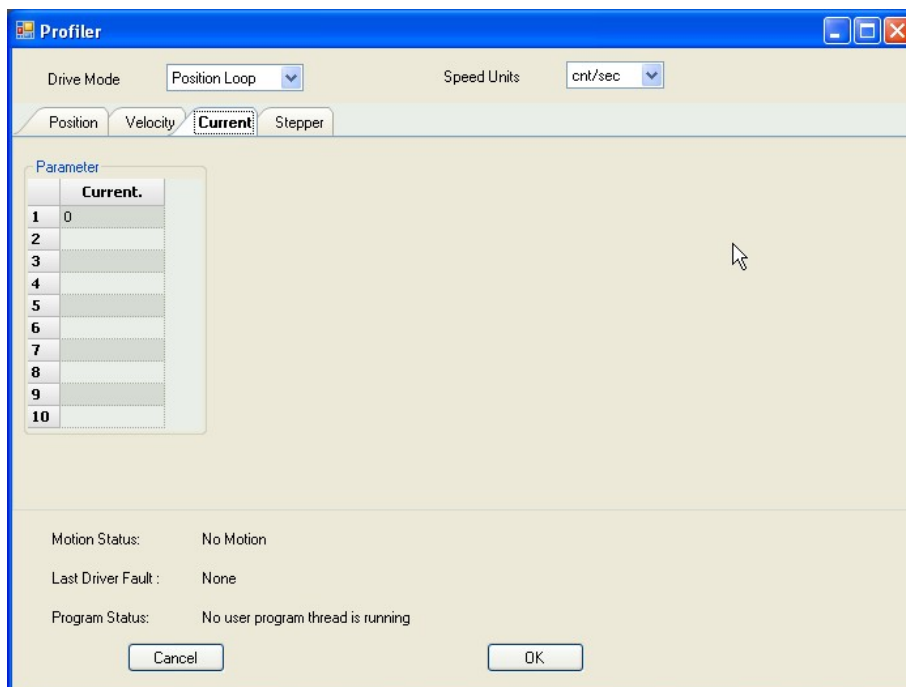
In the Velocity Loop profiler tab, you can alter the following **Motion Parameters**.

Parameter	Definition
Accel	Defines the maximum allowed profiler acceleration. Uses the AC Command (from the Gold Line and SimplIQ Command Reference Guides)
Decel	Defines the maximum allowed profiler deceleration. Uses the DC Command (from the Gold Line and SimplIQ Command Reference Guides)
Stop Deceleration	Defines the deceleration in counts/second ² used to stop motions in case of emergency. In addition, SD defines the acceleration limit for the combination of software and external reference commands. Uses the SD Command (from the Gold Line and SimplIQ Command Reference Guides). When the Trapezium profile is not used, as in the Interpolation drive mode, this will be dependent on the drive.
Smooth	The motion smoothing factor, in milliseconds, for PTP and jogging. Uses the SF Command (from the Gold Line and SimplIQ Command Reference Guides). The smoothing of the motion prevents sharp and high dynamic speed changes. SF actually builds the acceleration for the defined period (msec), allowing acceleration to adjust the motion in moderate portions.

Parameter	Definition
	When SF=0 all the requested acceleration is used by the profiler to build the speed command.
Speed	Absolute speed independent of direction. When the SP command is used (from the Gold Line and SimplIQ Command Reference Guides), this denotes the maximum speed in counts/sec which a point-to-point motion can reach.

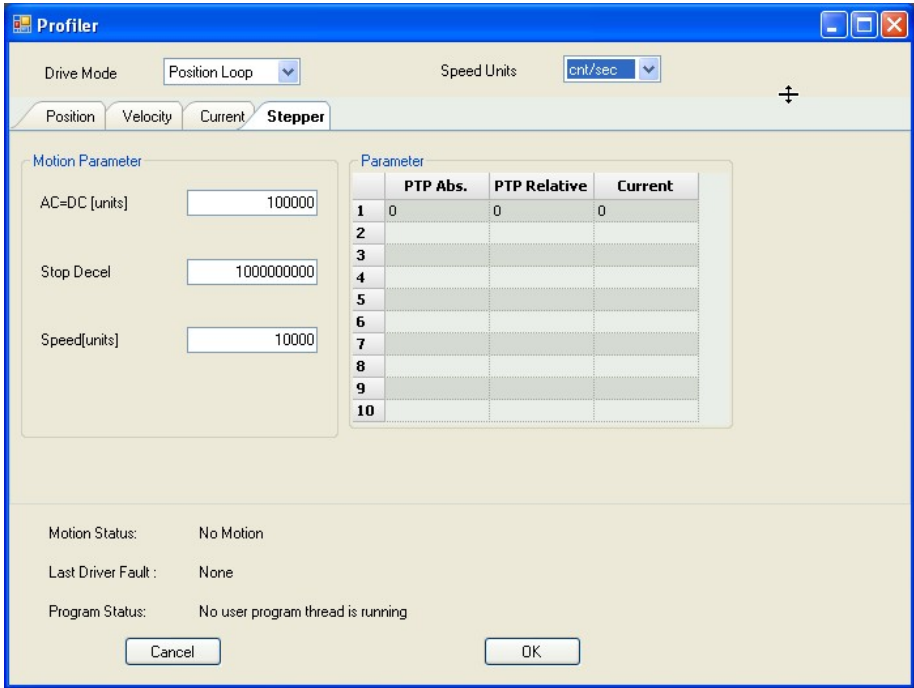
In addition, a range of Current settings (up to ten) can be created in the Profile window to allow the drive to operate, from pull-down parameters listed in the value box next to Current, in the Multiple Axes Motion window. These settings are entered under the **Parameter** heading.

4.4.3.3 Current Loop



In the Current Loop profiler tab, a range of Current settings (up to ten) can be created in the Profile window to allow the drive to operate, from pull-down parameters listed in the value box next to Current, in the Multiple Axes Motion window. These settings are entered under the **Parameter** heading.

4.4.3.4 Stepper



Profiler

Drive Mode: Position Loop Speed Units: cnt/sec

Position Velocity Current **Stepper**

Motion Parameter

AC=DC [units]: 100000

Stop Decel: 1000000000

Speed[units]: 10000

Parameter

	PTP Abs.	PTP Relative	Current
1	0	0	0
2			
3			
4			
5			
6			
7			
8			
9			
10			

Motion Status: No Motion

Last Driver Fault: None

Program Status: No user program thread is running

Cancel OK

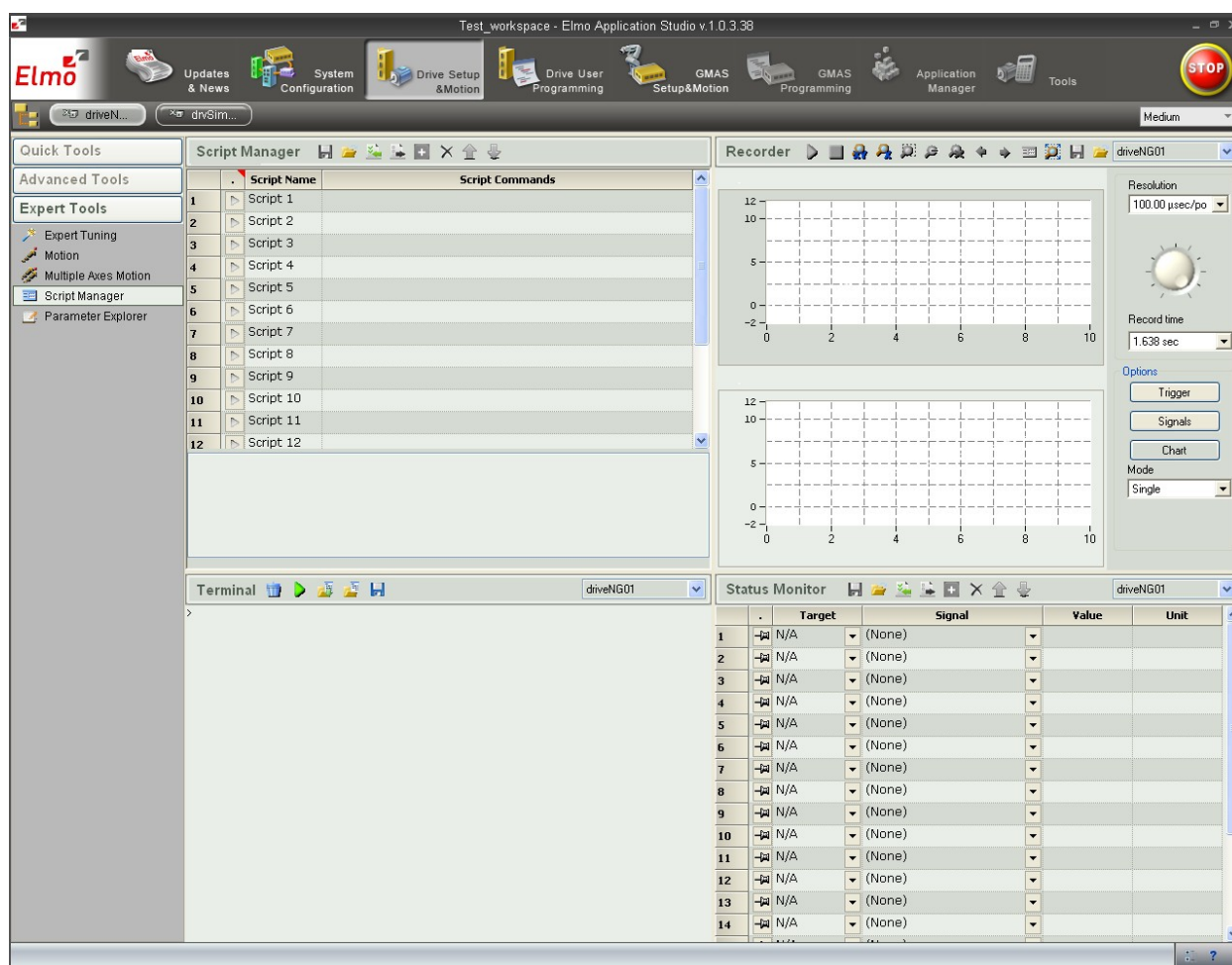
Within the Position Loop profiler tab, you can alter the following **Motion Parameters**.

Parameter	Definition
AC=DC	Defines the motion where the acceleration value, equals the value of the Deceleration
Stop Deceleration	Defines the deceleration in counts/second ² used to stop motions in case of emergency. In addition, SD defines the acceleration limit for the combination of software and external reference commands. Uses the SD Command (from the Gold Line and SimplIQ Command Reference Guides). When the Trapezium profile is not used, as in the Interpolation drive mode, this will be dependent on the drive.
Speed	Absolute speed independent of direction. When the SP command is used (from the Gold Line and SimplIQ Command Reference Guides), this denotes the maximum speed in counts/sec which a point-to-point motion can reach.

In addition, instead of setting point-to-point values after each motion of the drive, a range of point-to-point and/or Current settings (up to ten) can be created in the Profile window to allow the drive to operate, from pull-down parameters listed in the value box next to PTP Absolute, PTP Relative, and Current, in the Multiple Axes Motion window. These settings are entered under the **Parameter** heading.

PTP Abs.(integers)	PTP Relative (integers)	Current (A)
Enter up to ten point-to-point absolute settings to generate the continuous list of pull-down parameters in the Profile window.	And/or, enter up to ten point-to-point relative settings.	And/or, enter up to ten point-to-point current settings.

4.5 The Script Manager



The Script Manager allows you to create, save, load, organize and run scripts.

A script is a series of drive commands and/or inquiries, separated by a semicolon. Creating scripts allows the user to re-use command sequences.

Any command that is allowed in the terminal can be used in a script file. EAS does not verify the scripts' syntax.

The Script Table is saved by default, with the current workspace, when exiting EAS. When the EAS application is opened again, the Script Table is available.

Use the Script Manager to arrange the Script Table in the most convenient order for ease of use.

To open the Script Manager, choose the "Drive Setup & Motion" activity in the activity bar. In the Tool Selector, open the "Advanced Tools" and click the "Script Manager" main tool button.

4.5.1 Script Manager User Interface

4.5.1.1 Table Columns

	Script Name	Script Commands
1	▶ Script 1	
2	▶ Script 2	
3	▶ Script 3	
4	▶ Script 4	
5	▶ Script 5	
6	▶ Script 6	

The table columns consist of the following:

- Row Number** Allows selecting the row for action
- Run button** Click the run button to run the script
- Script Name** Click to edit the script name
- Script Commands** Click to edit the contents of the scripts

4.5.1.2 Toolbar Buttons



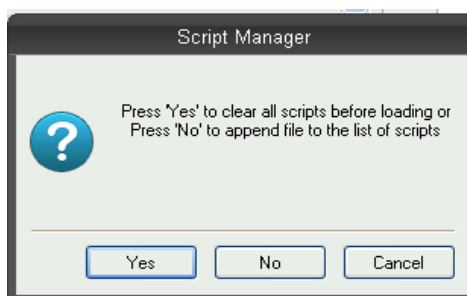
Save

Save the selected rows



Load

Load saved scripts. When you click this button the following dialog box appears:



Select all

Select all table rows



Deselect all

Deselects all rows



Insert row

Insert one row above the top row that is selected



Delete row

Deletes the selected rows and move rows up



Move rows up

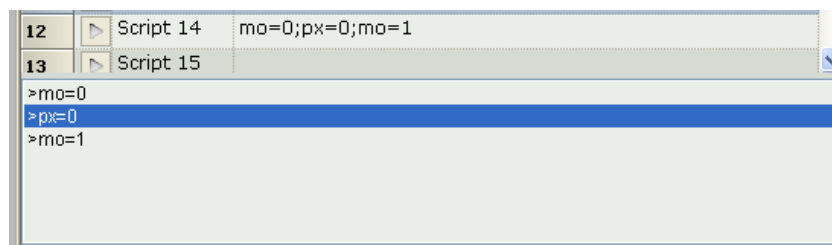
Move the selected rows towards the top of the table



Move rows down

Move the selected rows towards the end of the table

4.5.1.3 Output Area



The output area displays the communication between the PC and the drive when a script is run.

4.5.1.4 Table Functions

The Table has the following functions:

- Any Script Name or Script Commands cell can be selected for editing
- Any action out of the edited cell ends the editing mode
- Clicking the row number button selects the row
- Multiple rows can be selected using the Shift and CTRL buttons.

4.5.2 Creating a new script

To create a new script

1. Click inside the Script Commands cell in any empty Script Edit Line and type in the required commands.

If all the table lines are full, select the last line and click **Enter** to add an empty line at the end of the table or select a line and click **Insert Row**.

2. To change the name of the script, click inside the Script Name cell and edit it. It is recommended to use unique, meaningful names for the scripts.

It is also possible to create scripts in the Terminal window (See TBD). Creating a script from the Terminal will add it to the Script Table after the last non-empty line.



EAS allows more than one script by the same name to be displayed at the same time. This can be useful when a new script is based on an existing script with slight modifications. For obvious reasons, it is recommended to rename one of the scripts.

4.5.3 Saving Scripts

You can save a single script or a set of scripts in a file. Scripts are saved in a file with the extension “.bsc”.

To save a script

1. Select the lines to be saved by checking them. Click **Select All** to save all scripts.
2. Click **Save**.
3. A standard **save-as** dialog box appears. Name the file and save it. The default file name is the same as the name of the first script.

4.5.4 Loading Scripts

To load a script

1. Click **Load**
2. A standard **Open** dialog box appears. Select the desired file and click **Open**.
3. If the Script Table is not empty, another dialog offers two options:
 - Clear all scripts before loading, or
 - Append file to the list of scripts.
4. If **Append...** is selected, the loaded scripts will appear after the last non empty row available

4.5.5 Running Scripts

To run a script, click the Run button  next to its name. The commands are sent to the Active Drive, and the contents of the communication resulting from the script will appear in the output area in the lower part of the window.

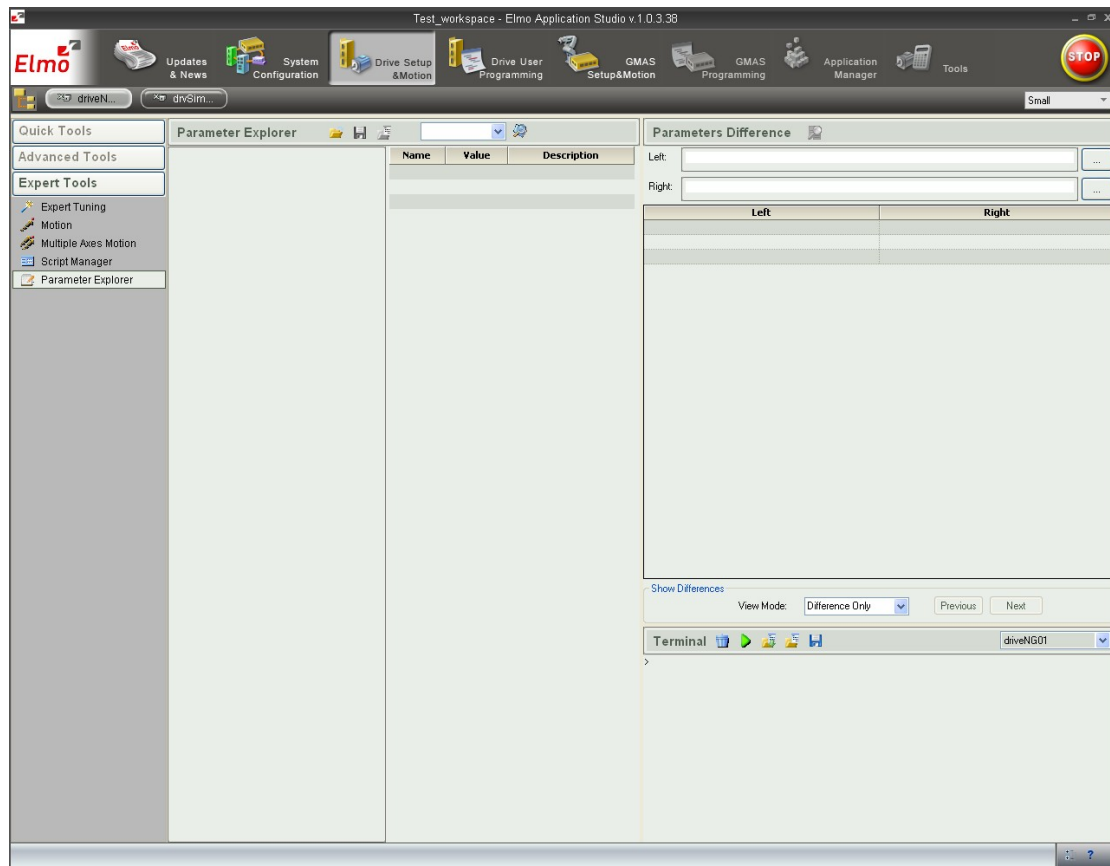
4.5.6 Organizing the Script Table

The Script Manager helps you create a personalized set of script buttons in the most useful order for your application. Move rows up and down to arrange your scripts in the right order. Use empty lines to create separating lines in your script list.

It is recommended to save separate script files for different activities. For example, one set of tools for system configuration, another for point-to-point motions, etc.



4.6 Drive Parameters



The Drive Parameters window can be used to:

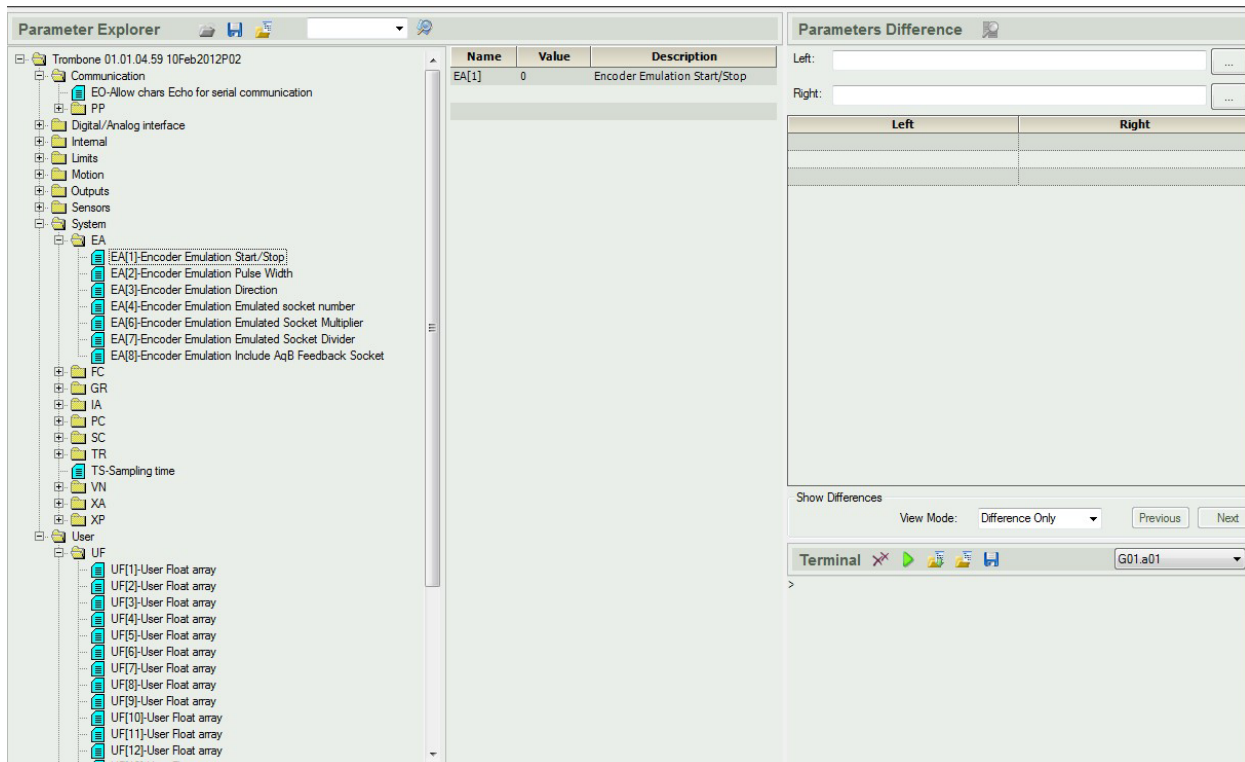
- View all the drive parameters
- Edit drive parameters
- Upload and save all the parameters
- Compare parameter files

The Device Parameters window includes three parameter related tools:

Parameter Explorer View, edit and save drive parameters

Parameters Difference Compare two saved parameter files

Terminal

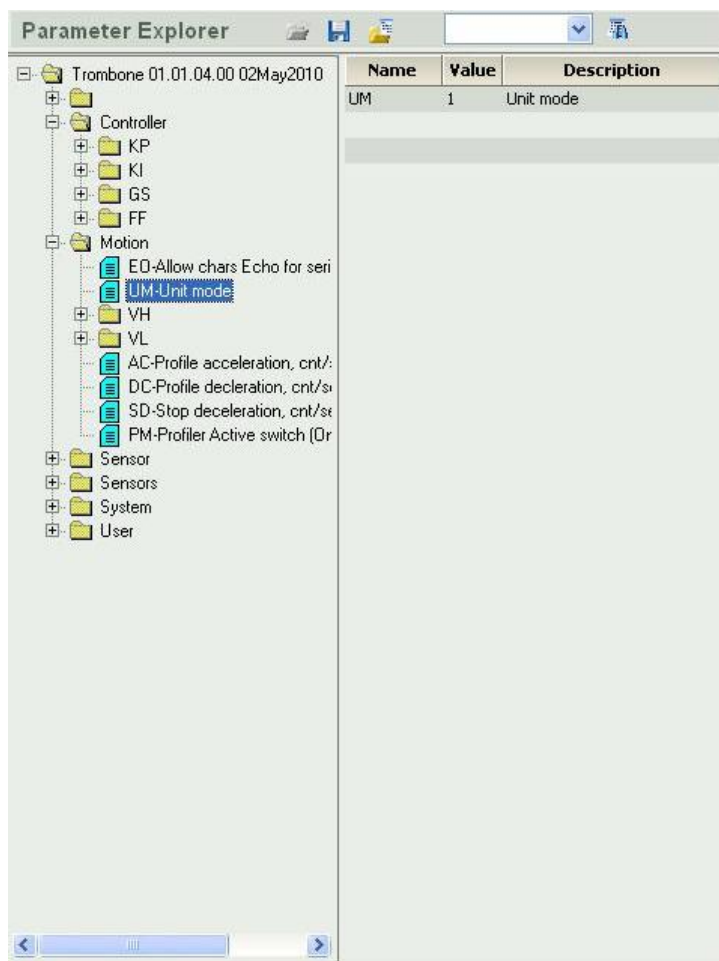


4.6.1 Parameter Explorer

The parameter explorer is a viewer and editor for drive parameters. It can be used to view or edit any drive parameter by name. The parameters are grouped by functionality and can be accessed via the tree hierarchical view or using the parameter search box.

In online mode, the parameters that are displayed are read from the active drive's personality file. Each parameter name is displayed in the tree with a short description. Clicking on the parameter name will display its name, value and description in the parameter table.

4.6.1.1 User Interface



4.6.1.1.1 The Parameter Tree

The parameter tree is read from the drive in online mode or from a saved file in offline mode. The folders in the tree correspond to parameter groups in the drive.

- Expand a folder to view parameters and arrays within the group.
- Click on a parameter name or icon  to show its value in the parameter table.
- Click on the + sign next to an array's name to expand the array and select individual parameters.
- Click on the array's name to load the entire array to the parameter table.
- Hold the Ctrl button down to select multiple parameters to display in the table.

4.6.1.1.2 The Parameters Table

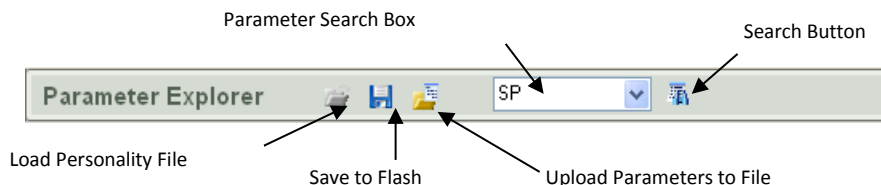
Name	Value	Description
SP	2000	Maximum speed indication

The parameters table is used to view and edit the value of any editable parameter.

The value of the selected parameters is read from the drive when they were selected. The value is not automatically refreshed. If the value is changed outside the table, for example in the terminal, the table will still show the previous value.

Exiting the value cell sends the new value to the drive.

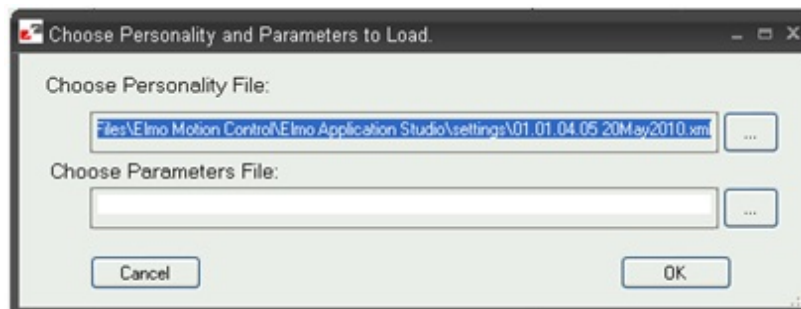
4.6.1.1.3 The Parameter Explorer Toolbar



The parameters Explorer toolbar shown above appears when a drive is connected in "Online" mode. In "Offline" mode, a saved personality file can be loaded.

Load Personality File

Active in Offline mode only. Click to open the following dialog:



The personality file of the latest drive you used is saved by default in the following location:

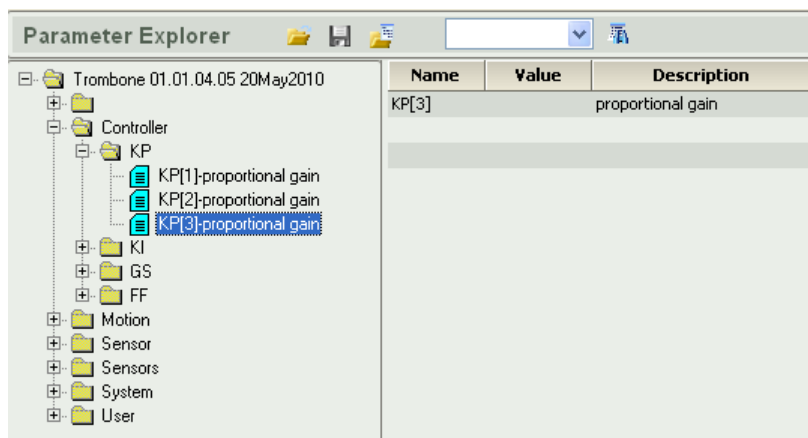
[EAS Installation directory, typically C:\Program Files]\Elmo Motion Control\Elmo Application Studio\settings\[version name].xml

The name of the xml file is the name of the firmware version of the drive.

Browse to the above-described location and click OK to view the personality file.

A parameters file can be loaded in the offline mode only.

Before selecting any personality in the offline mode, the last used personality (online or offline) is displayed.



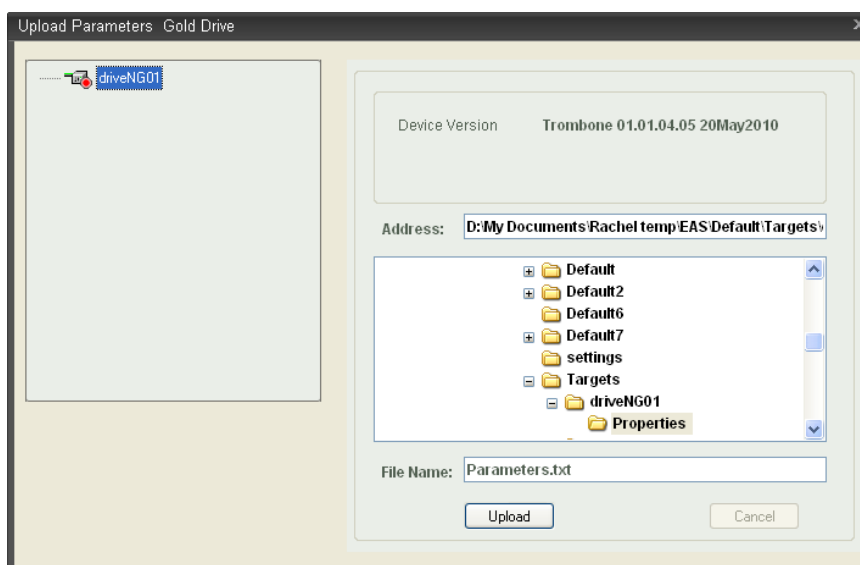
Opening the personality file allows you to browse the available parameters and their short description. Values are not displayed and cannot be edited if parameters file was not chosen.

Save to Flash

Active in Online mode only. Saves parameters to the drive's flash memory. When in Offline mode, and the parameters are loaded, they are saved to file.

Upload Parameters to File

Upload the current values of all the drive's parameters and save them in a text file. Click the button to open the following dialog:



Select a location and name your file. Click Upload and wait for the upload process to end.

An example of the contents of the generated file:

```
EO=1
UM=5
TS=50
KP[1]=25.74000
KP[2]=7.385000e-05
```

KP[3]=415.0000

KI[1]=750.8000

KI[2]=32.30000

XA[1]=80

...

This file can be used to download the same set of parameters to another drive or to restore the same configuration on the current drive.

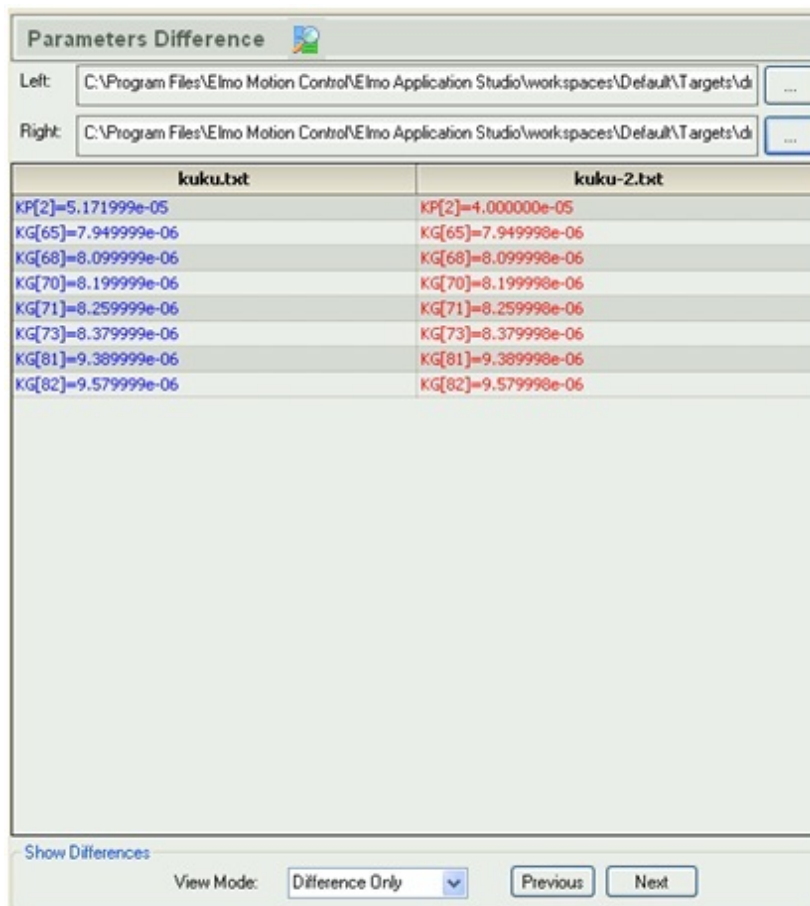
Parameters Search If you know the mnemonic for a parameter or array but not its location in the tree, enter the mnemonic in the search box and click Search or hit the Enter key. The requested parameter will be selected in the tree and displayed in the Parameters table.

Enter the name of an array to select the entire array or specify a single element of the array using its index.

The search is case insensitive.

4.6.1.2 Parameters Difference

This is a comparator for two text files containing lists of parameters with their values. This tool can be used in either online or offline mode.





The same parameters with the same values are shown in **black**. The same parameters with different values are displayed in **blue** and **red** as shown on the picture above. Different parameters are shown in **green**. Lines that are not parameters, or formatted as required, are shown in **magenta**.

Click the top **Browse** button to select the first file to compare and click the lower **Browse** button to select a second file. Click the **Compare** button to compare the files.

Use the **View Mode** selector to select how to present the comparison results:

- | | |
|------------------------|---|
| Difference only | Show only the different lines (default) |
| All | Show all the lines with the differences highlighted. Use the Next and Previous buttons to move between different lines. Loading this view may take some time. |
| Identical Only | Show only the identical lines. Loading this view may take some time. |

5 Supporting Tools

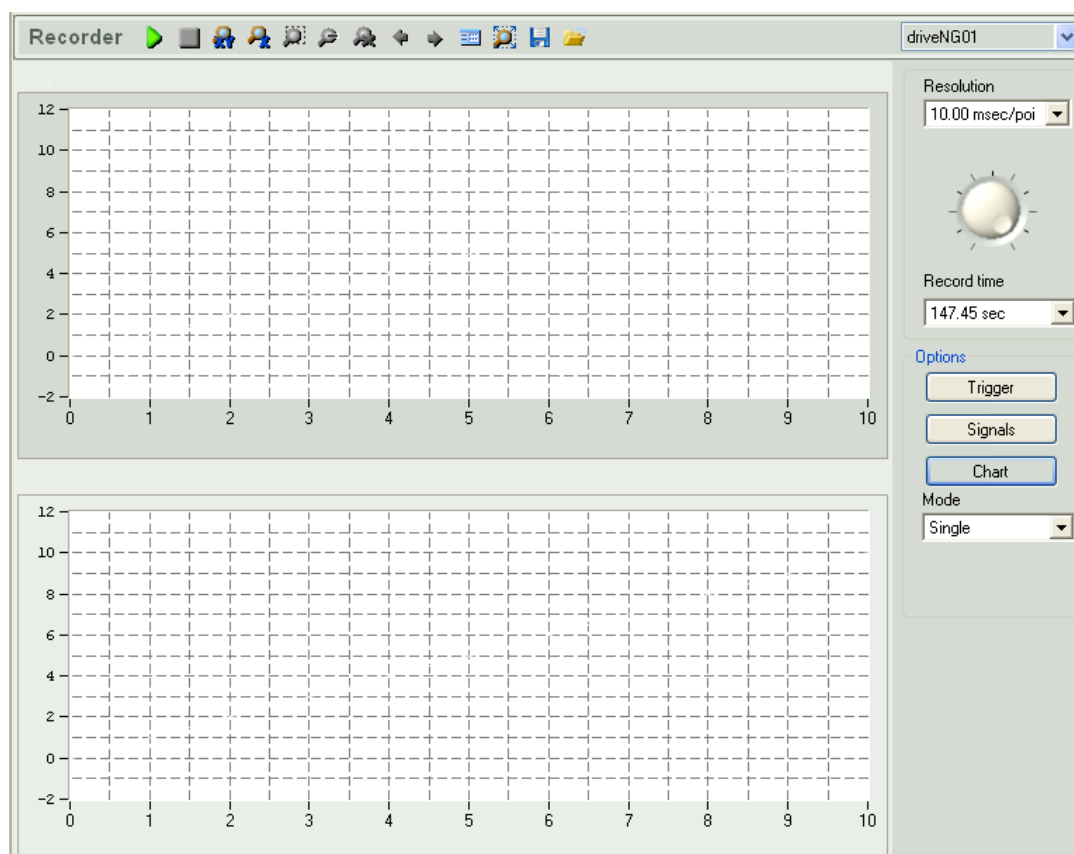
5.1 Recorder

The recorder is a very powerful tool for debugging and testing a system. Use the recorder to record one or more variables. The recorder allows the user to customize the contents of the recording and personalize the display. The recorded signals will originate from the built-in parameters of the personality of the device.

The main steps of a recording are:

1. Select the signals you want to record
2. Select and configure the trigger that starts the recording
3. Select the recording resolution and duration
4. Start/Stop recording

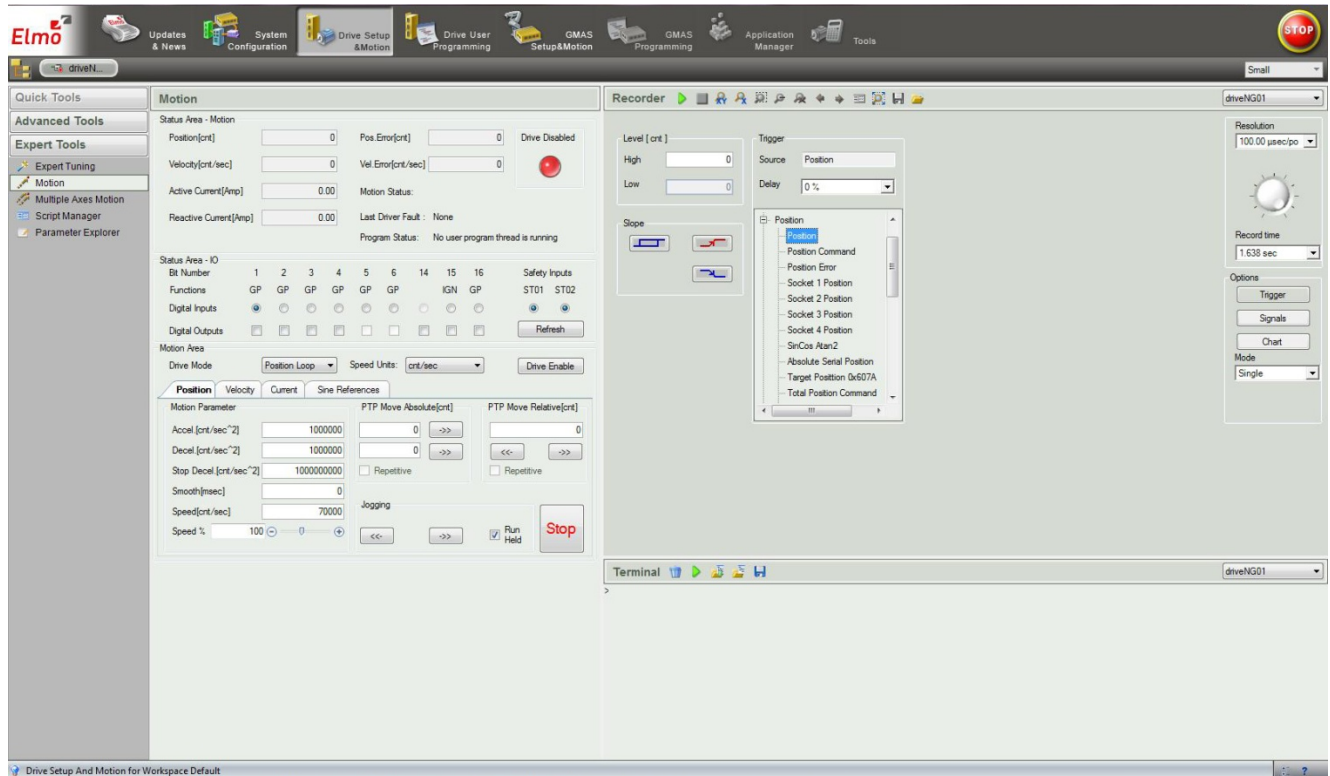
The default view of the recorder is the chart view:



The Recorder options are different for Drives and G-MAS with drives operating in coordinated/uncoordinated motion:

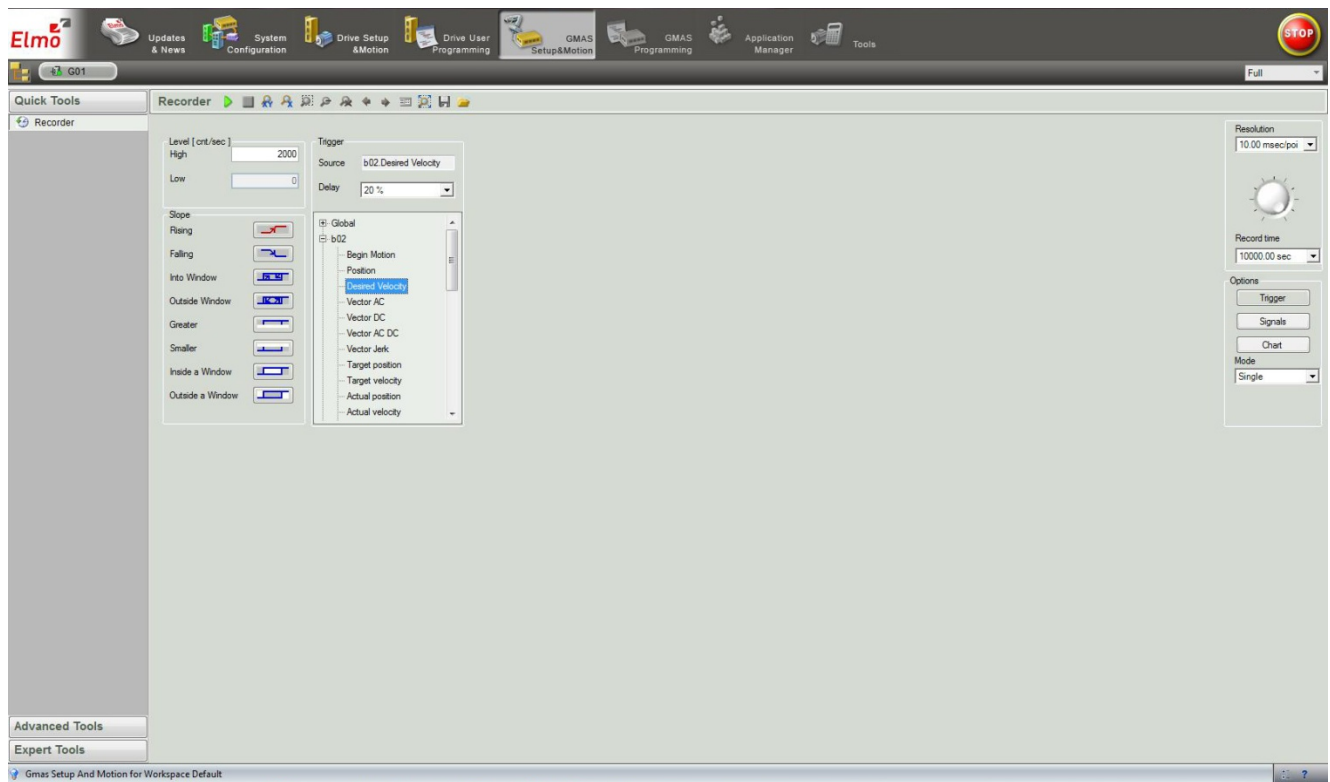
Drive option

The Trigger and Signal options are limited to the alternatives offered by the drive.



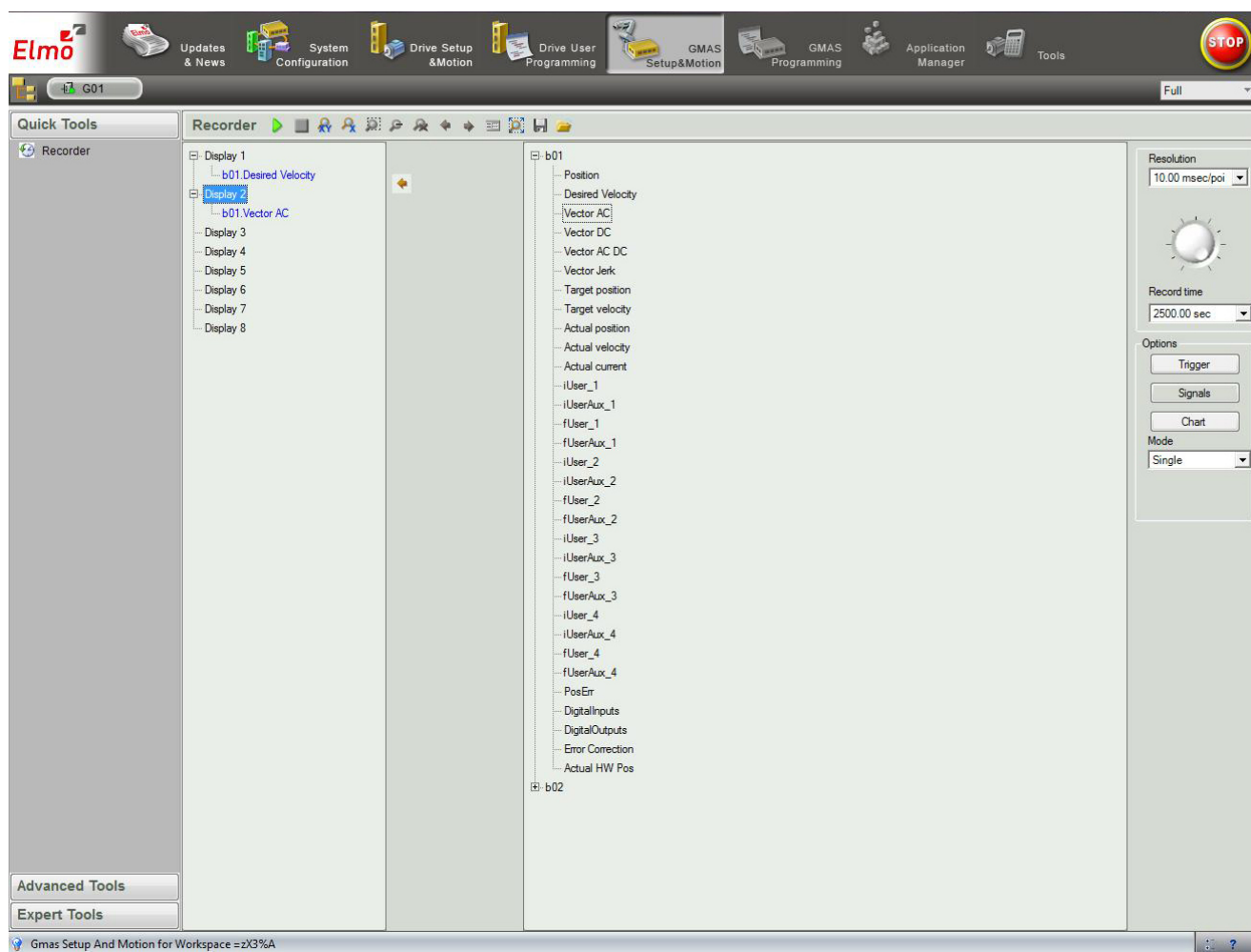
G-MAS option

The Trigger and Signal options are only restricted by the limitations of the G-MAS.



5.1.1 Selecting the Signals to Record

Click the **Signals** button in the Options display controls area to invoke the display of the signal selection view:



Expand the variable groups to see the variables that are available for recording. To select a variable to be recorded use one of two methods:

- Select the variable to be recorded. Drag and drop it onto the requested Display designator
- Or, select a display then select a variable and click the left arrow to add the selected variable to the selected display.

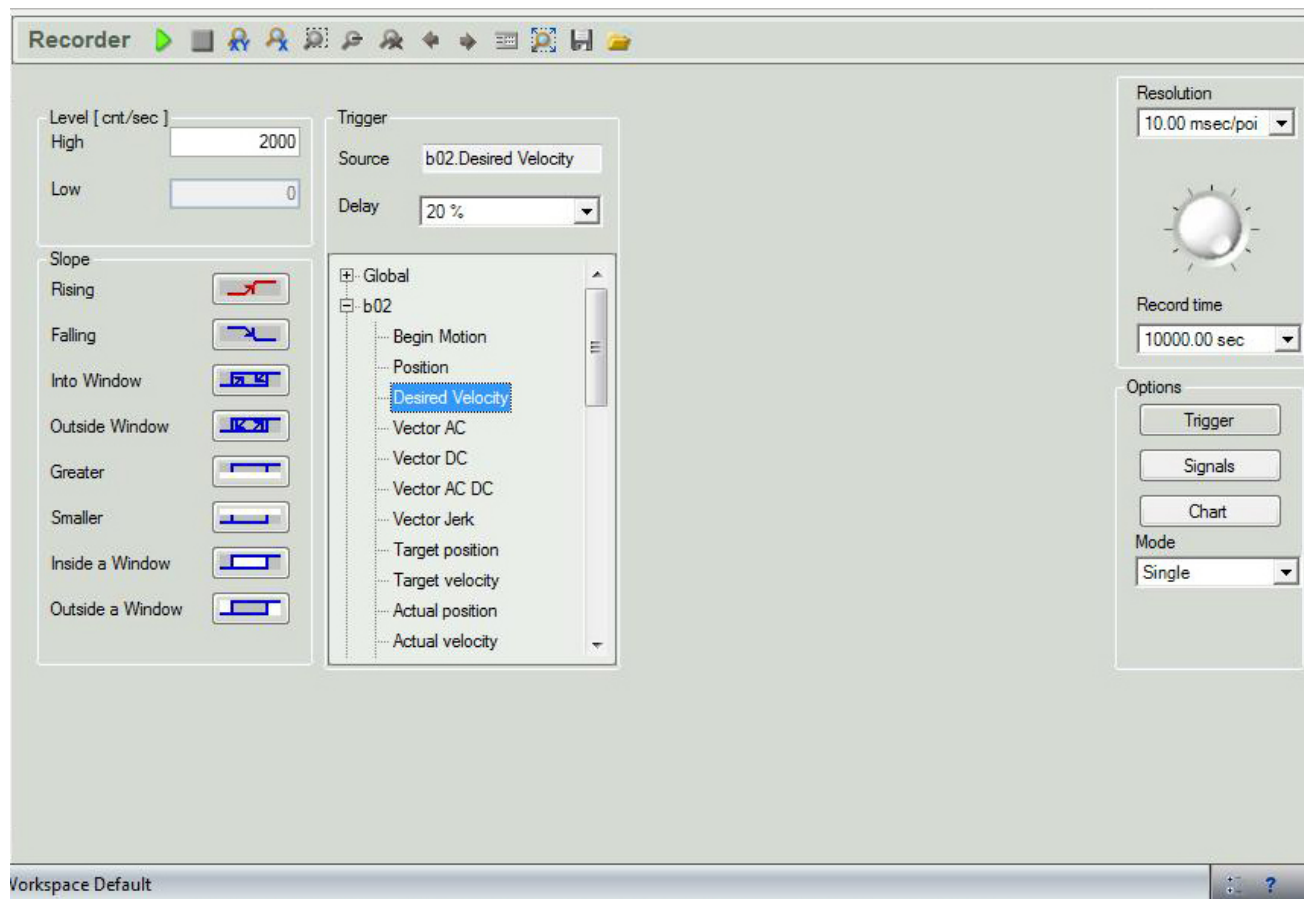
You can select up to 15 variables to record. You can select to display several variables on the same display or divide them between several displays. Note that adding signals to record reduces the record time displayed in the controls area.

To chart a specific parameter of the drive, highlight the parameter and the Display number.

Then click the  select button to select the parameter to a specific display. The parameter will then be charted.

5.1.2 The Trigger

Click the **Trigger** button in the display controls area to invoke the display of the trigger setting:



This window determines the conditions to begin recording.

Level

High and Low, trigger levels. Note that the units displayed change according to the selected trigger signal

Trigger

Source

Expand groups in the tree to find a signal that will be used as a trigger source

Delay

The delay between the trigger and the beginning of the recording
0% to 100% of the record time

Slope

The available options change according to the selected trigger signal and other choices.



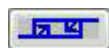
Rising edge

A trigger is captured when the trigger source signal crosses the “High” level in a low to high transition



Falling edge

A trigger is captured when the trigger source signal crosses the “Low” level in a high to low transition



Into window

A trigger is captured when the signal enters the window from outside it.



**Outside window
(Out of window)**

A trigger is captured if the signal started in the window, its level changes to be outside the window. This condition translates into any of the following sequences:

The signal crosses the low level twice

The signal crosses the high level twice

The signal crosses the high level and then the low level

The signal crosses the low level and then the high level



Greater

A trigger is captured when the transition remains higher than the signal.



Smaller

A trigger is captured when the transition remains smaller than the signal.



**Inside a window
(From inside window)**

A trigger is captured when the signal starts inside a window and exits the window.



**Outside a window
(From outside window)**

A trigger is captured when the signal starts outside a window and enters the window.

Resolution

Select the desired recording resolution from the list. The maximum recording time will change accordingly.

Recording Time

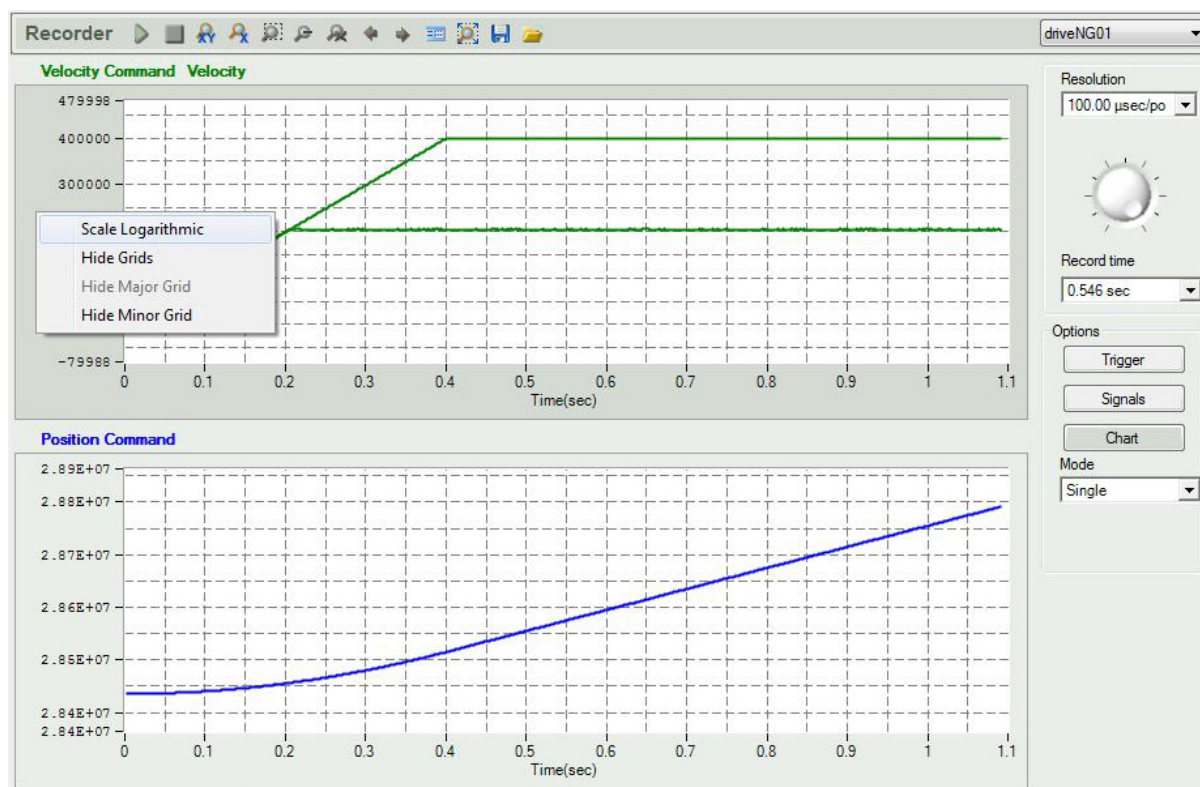
To maximize recording time, select the lowest resolution suitable for the recorded signals. Use the dial or drop down menu to select a shorter recording time.

Options

Trigger	When depressed activates the trigger pane options.
Signals	When depressed activates the signal pane options.
Chart	When depressed activates the charts display.
Mode	This is the mode in which the chart is displayed similar to the oscilloscope display.
Single	The chart is displayed without repetitive triggering
Auto	The chart is displayed with automatic continuous and repetitive triggering
Normal	The chart is displayed waiting for triggering. Note that Normal is only relevant and active for the G-MAS recorder.

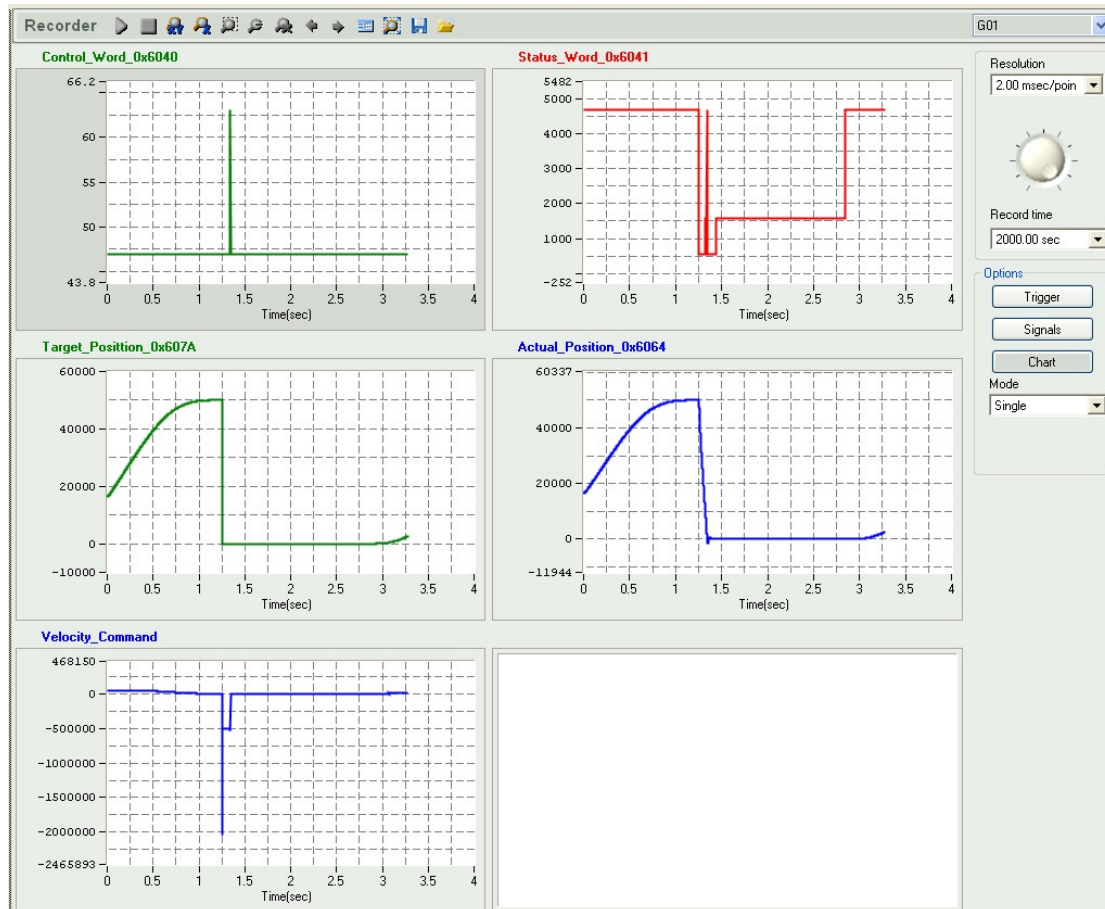
5.1.3 Graphic User Interface

The graphic user interface displays the movement output of a device in the Recorder Graphic User Interface pane. Selecting specific areas of the Recorder opens specialized menus appropriate to the section of the interface.

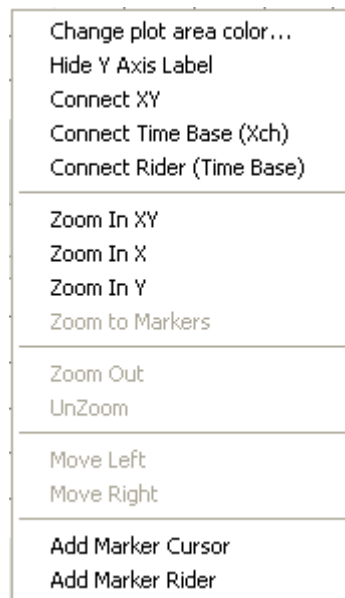


Right-click at the scalar area of the display invokes a menu, which allows the following:

Scale Logarithmic	Scales the graph to a higher scale for small values where a more detailed display is required.
Hide Grids	Hides the grids display in the graph
Hide Major Grid	Hides the major or minor grid lines depending on which option is accessible.
Hide Minor Grid	



Right-click in the display area to invoke the following menu:

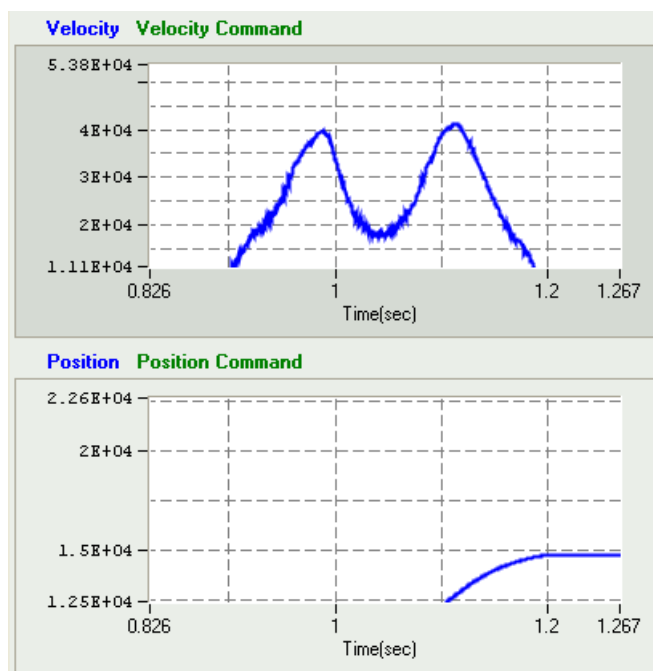


Change plot area color Select a new color for the background.

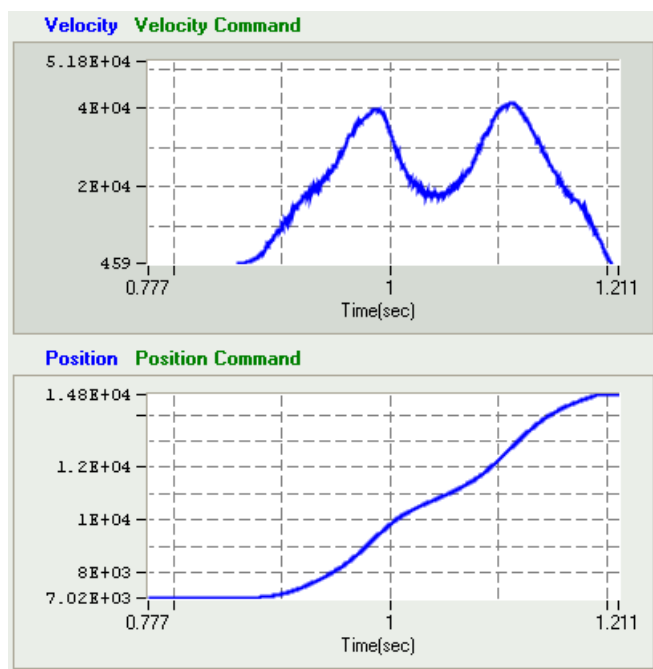
Hide All Y Axis Remove the Y Axis title and coordinates. Widen the graph area (the menu item reverts to **"Show All Y axis"**).

Connect XY If you start with the original plots and select **Connect XY**, and

then zoom in on an area in the upper plot, a zoom in action is performed on both plots. Both plots zoom in on the same area that was marked on the top plot.



Connect Time Base (Xch) If the time base of the plots is connected, zooming in on the top plot will have the following result.

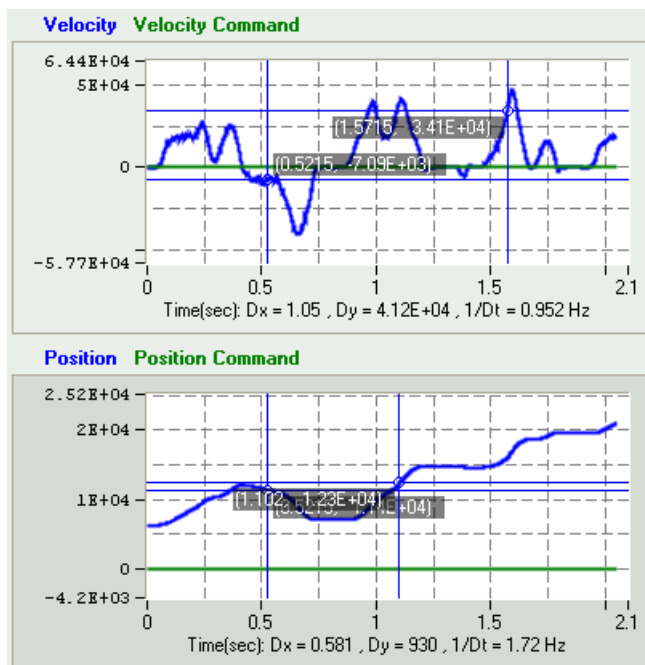


The lower plot shows the same time span as the upper plot. The Y axis of the lower plot is calculated to include maximum information about the recorded signal in the selected time.

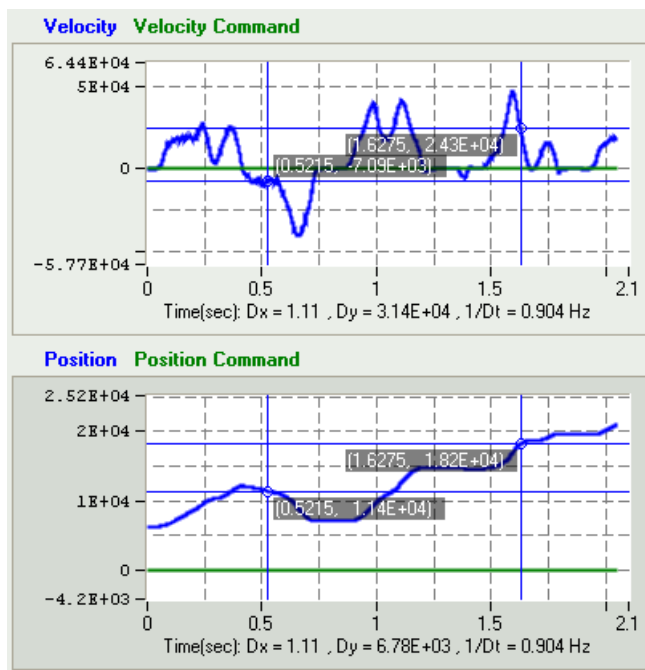
Connect Rider (Time Base)

If riders are shown (see “Add Marker Rider” below), this option causes the riders in both plots to move together.

The following plots display with the Riders not connected.



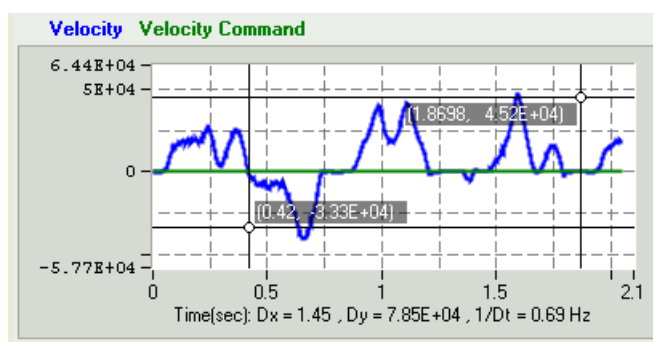
The following plots display with the Riders connected.



Zoom In XY

Click and drag the left mouse button to mark the area on which you want to zoom. You can continue to zoom in repeatedly as long as this option is selected.

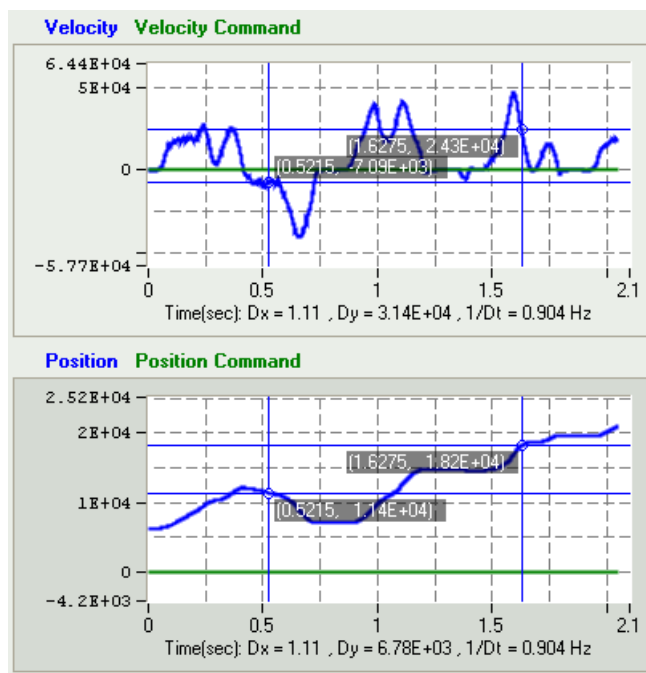
Zoom In X	Click and drag the left mouse button to mark the time interval on which you want to zoom. You can continue to zoom in repeatedly as long as this option is selected.
Zoom In Y	Click and drag the left mouse button to mark the signal values on which you want to zoom. You can continue to zoom in repeatedly as long as this option is selected.
Zoom to Markers	Zoom in to the area of the markers (active only when markers are displayed)
Zoom Out	Return to the previous zoom level
UnZoom	Return to the default view (no zoom)
Move Left/Right	Pan left or right in zoom in view
Add Marker Cursor	Add marker cursors to see exact X,Y values of two graph points:



Drag each marker point to the desired location.

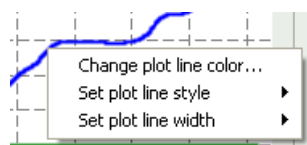
Add Marker Rider

Add a marker that rides the plot (follows the plot). The marker rides the first selected plant. The marker lines are the same color as the plot following.



To set the plot style, line color and width

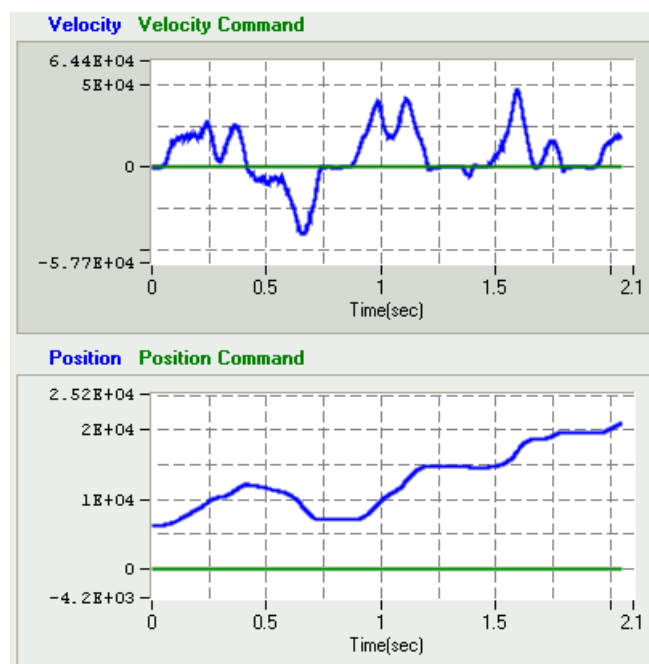
1. Right click the plot line to display the following menu:



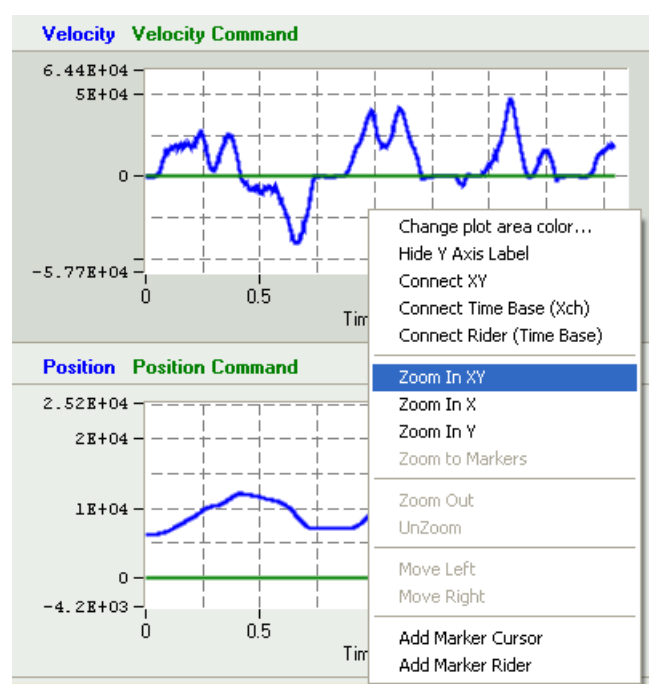
2. Change the plot line color, style and line width according to your requirements

5.1.3.1 Connecting Plots Example

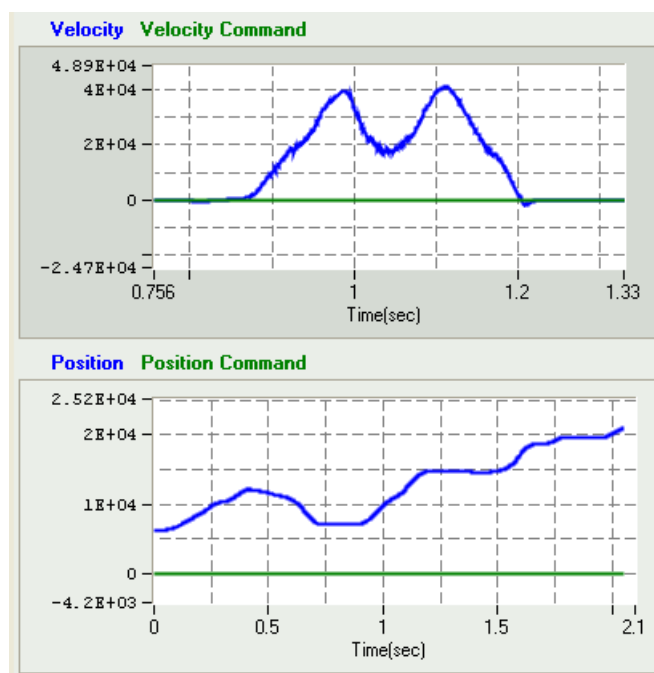
We will use the following plots to demonstrate connecting plots:



When the two plots are not connected, you can zoom in on an area of the upper plot. Right click inside the plot and select Zoom in XY.



After selecting an area to zoom in, the plots look like this:

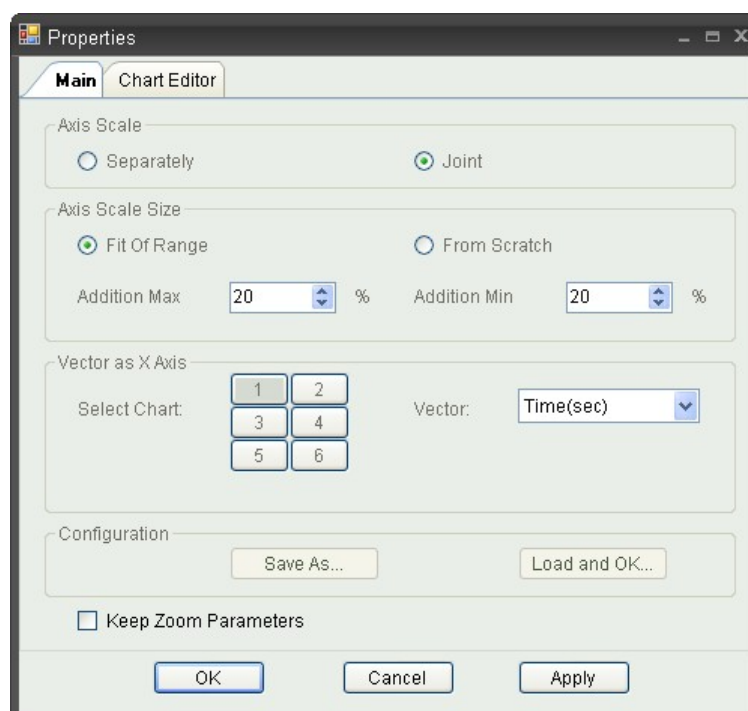


The zoom in action was performed only on the top plot. The lower plot was left unchanged.

5.1.4 Recorder Toolbar Buttons



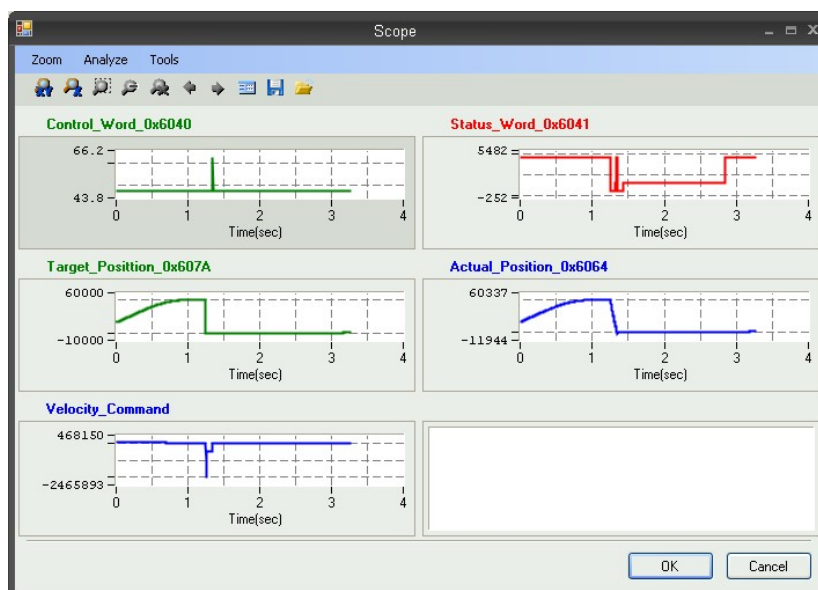
	Start Recording	The recording will start when the trigger condition is fulfilled
	Stop Recording	Cancel the recording process
	Zoom XY	Zoom to a defined area
	Zoom X	Zoom to a defined time interval
	Zoom to Marker	Zoom to the area defined by the markers
	Zoom Out	Return to the previous zoom level
	UnZoom	Return to the default display and cancel any previous zoom action
	Move right or left	To display the required part of the chart
	Window Properties	Opens the following dialog. Refer to the section 5.1.4.1 for further details.





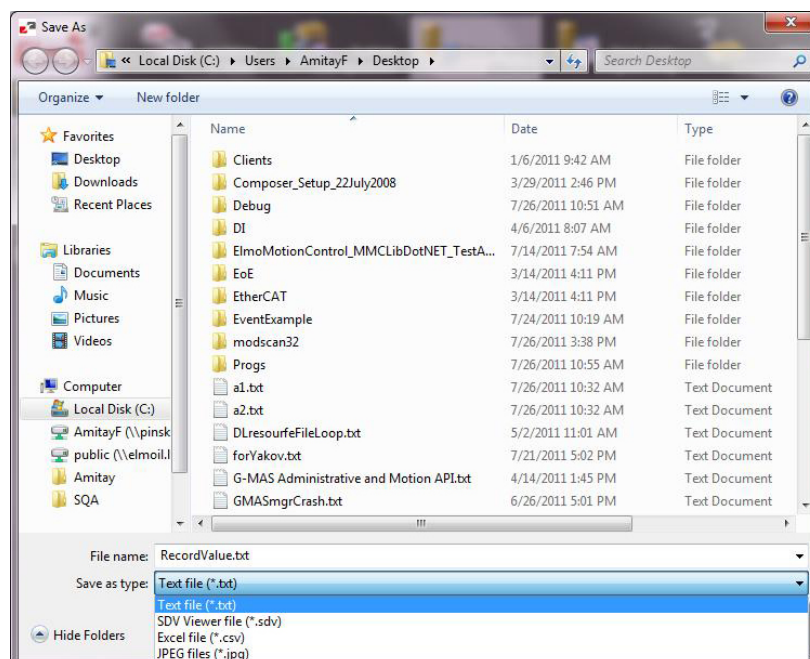
Show Maximized

Open the chart in a separate window. For further details refer to the section 5.1.4.2.



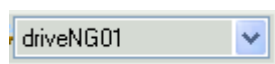
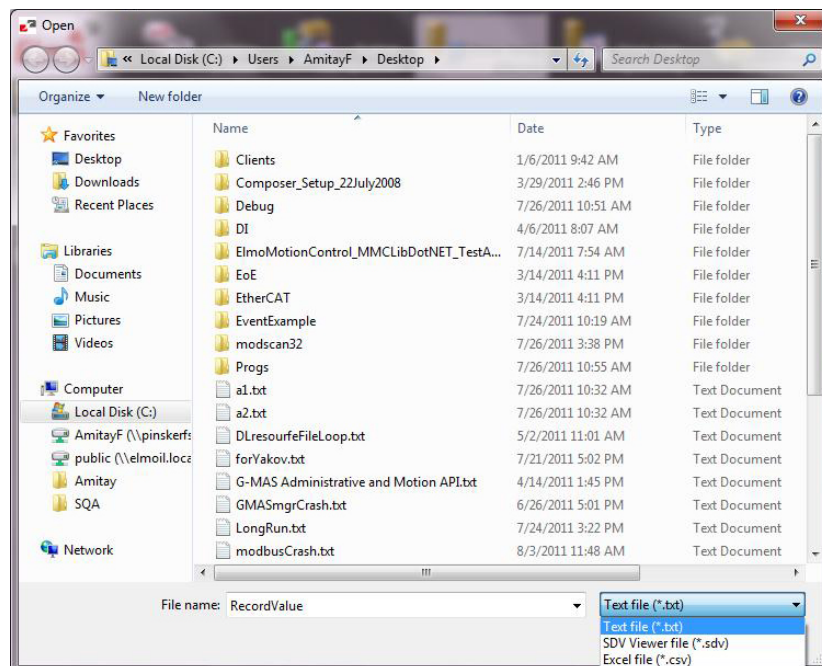
Save File

Save the results of the recording to a text, sdv viewer, Excel file, or JPG capture file.



Open File

Open a previously saved text, sdv viewer, or Excel file graphics file to display the appropriate graph.

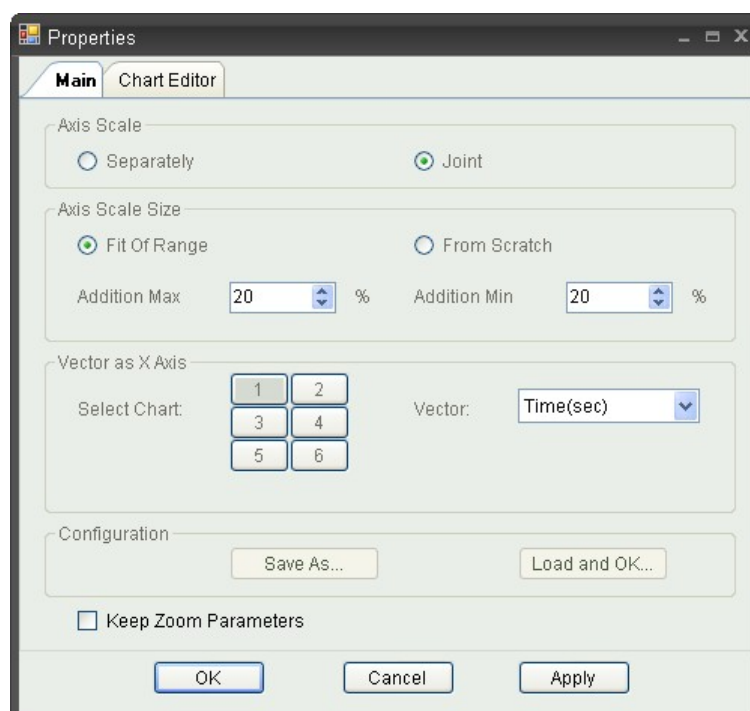


Target Selector

Select the target for recording. The default selection is the active target.

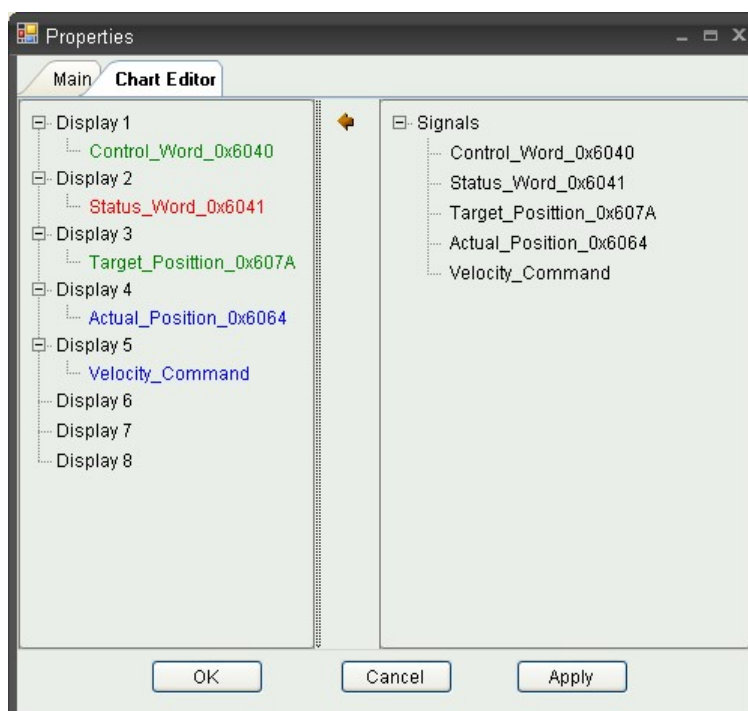
5.1.4.1 Windows Properties

Selecting the Windows Properties icon opens the Main properties window for the Recorder.



This window offers the following options. When any of the options are selected or changed, click **Apply** to apply the changes:

Axis Scale	The axis scale can either displayed as Separate charts or combined to a single Joint chart.
Axis Scale Size	Either Fit of Range where the application selects the range of axis automatically, or From Scratch where the axis scale is realigned to start from 0.
Vector as x Axis	Any chart can be selected where the vector is displayed as the X axis. The Vector parameter unit may be selected.
Configuration	The configuration set from this properties window may be saved as a file or loaded from a pre-saved file.
Keep Zoom Parameters	This radio button allows the Zoom parameters to be fixed for each set of charts per drive, or adapted per drive. Selecting Keep Zoom Parameters fixes the zoom parameters for all charts and drives.



Selecting the Chart Editor opens the option to select which signals are displayed on the charts either separately or as joint charts.

Signals

These are the signals being tested for the particular drive.

Display

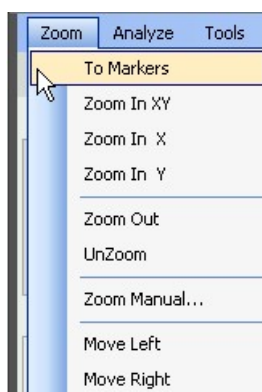
The display located for each of the signals. Use the  icon to select which display should show each signal. Optional, a display may show multiple signals, by selecting each signal and selecting the same display.

5.1.4.2 Scope window



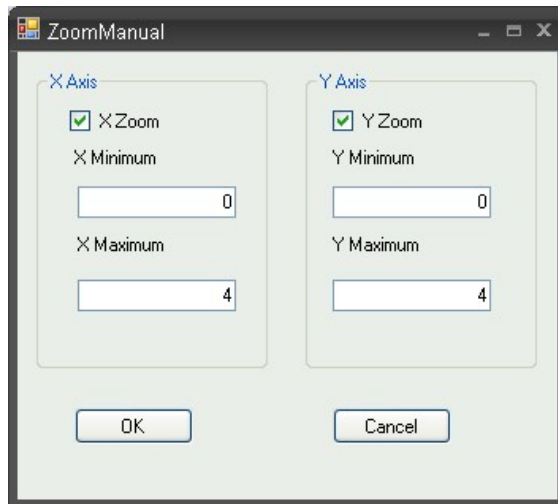
The Scope window displays the graphs in a separate window, and offers the following three menus:

Zoom

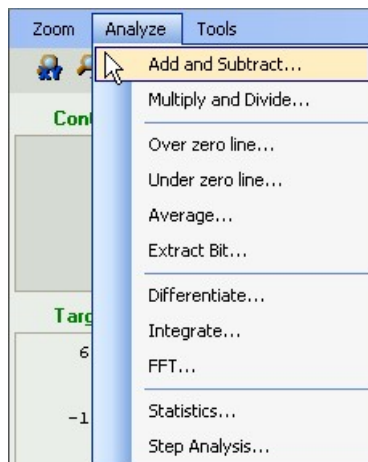


Refer to the section display area on page 286 for details of the Zoom properties.

The Zoom Manual facility allows manual changes to Zoom by adjusting the following window:



Analyze



Allows a specific type of analysis for multiple command parameters measured. A specific section of the graphs may be selected and analyzed to produce differential peaks and troughs where the variation is greatest. This type of analysis is widely used to troubleshoot faulty drives.

For each of the following windows opened when selecting a specific type of analysis:

1. Follow the instructions within this window to perform the analysis.
2. Change the name of the new vector analysis in the **New Vector Name** field.
3. Select the checkboxes as necessary to Add result to the current window, and/or Display result with a new window.
4. Click **OK** to start the analysis and produce a chart according to the selection made.

Add and Subtract

Analyze - Add and Subtract

Create a new vector using the following method:
 · Select as many vectors from the Add box as required (from none up to all).
 · Select as many vectors from the Subtract box as required (from none up to all).
 The new vector value will be the SUM of all the vectors selected from the Add box MINUS all the vectors selected from the Subtract box.

Add:	Subtract:
Time(sec)	Time(sec)
Control_Word_0x6040	Control_Word_0x6040
Status_Word_0x6041	Status_Word_0x6041
Target_Position_0x607A	Target_Position_0x607A
Actual_Position_0x6064	Actual_Position_0x6064
Velocity_Command	Velocity_Command

New Vector Name:

Constant to Add:

result

☐ Add result to the current window

☒ Display result at a new window

OK Cancel

Multiply and Divide

Analyze - Multiply And Divide

Create a new vector using the following method:
 · Select as many vectors from the <MULTIPLY> box as required (from one up to all).
 · Select as many vectors from the <DIVIDE> box as required (from none up to all).
 The new vector value will be the MULTIPLY of all the vectors selected from the <MULTIPLY> box and then DIVIDED by all the vectors selected from the <DIVIDE> box.

Multiply:	Divide:
Time(sec)	Time(sec)
Position	Position
Actual_Position_0x6064	Actual_Position_0x6064
Absolute_Serial_Position	Absolute_Serial_Position

New Vector Name:

Multiplication Factor:

result

☐ Add result to the current window

☒ Display result at a new window

OK Cancel

Over zero line

Analyze - Over zero line

Create a new vector using the following method:
This function eliminates all the data records that are under the zero line (negative values).
Select one or more vectors from the <Vectors> box, assign a name for the new vector and click <OK>.

Vectors:

Time(sec)
Position
Actual_Position_0x6064
Absolute_Serial_Position

New Vector Name

New

result

☐ Add result to the current window
☒ Display result at a new window

OK

Cancel

Under zero line

Analyze - Under zero line

This function creates a new vector by
Eliminating all the data records that are over the zero line (positive values).
Select one or more vectors from the <Vectors> box, assign a name for the new vector and click <OK>.

Vectors:

Time(sec)
Position
Actual_Position_0x6064
Absolute_Serial_Position

New Vector Name

New

result

☐ Add result to the current window
☒ Display result at a new window

OK

Cancel

Average

Analyze - Average

Create a new vector using the following method:
Calculates the average value of one or more of the selected vectors. Select one or more vectors from the <Vectors> box, assign a name for the new vector and click <OK>.

Vectors:

Time(sec)
Position
Actual_Position_0x6064
Absolute_Serial_Position

New Vector Name

New

result

☐ Add result to the current window

☒ Display result at a new window

OK Cancel

Extract Bit

Analyze - Extract Bit

Create a new vector using the following method:
Mask the bit selected by "Bit to Extract" from the selected vector yielding with a new vector of 0 and 1 values, whose name is defined by "New Vector Name".

Vectors:

Time(sec)
Position
Actual_Position_0x6064
Absolute_Serial_Position

New Vector Name

Bit to Extract:

New 0

result

☐ Add result to the current window

☒ Display result at a new window

OK Cancel

Differentiate

Analyze - Differentiate

Create a new vector by:
Differentiating the vector selected from the <Source> list by the vector selected from the <Differentiate by> list.
The new vector is multiplied by the <Multiplication Factor> and its name is defined by <New Vector Name>.

Source:

- Time(sec)
- Position
- Actual_Position_0x6064
- Absolute_Serial_Position

Differentiate by:

- Time(sec)
- Position
- Actual_Position_0x6064
- Absolute_Serial_Position

New Vector Name

New

Multiplication Factor

1

result

☐ Add result to the current window

☒ Display result at a new window

OK Cancel

Integrate

Analyze - Integrate

Create a new vector by:
Integrate the vector selected from the <Source> list by the vector selected at the <Integrate by> list.
The new vector is multiplied by the <Multiplication Factor> and its name is defined by <New Vector Name>.

Source:

- Time(sec)
- Position
- Actual_Position_0x6064
- Absolute_Serial_Position

Integrate by:

- Time(sec)
- Position
- Actual_Position_0x6064
- Absolute_Serial_Position

New Vector Name

New

Multiplication Factor

1

result

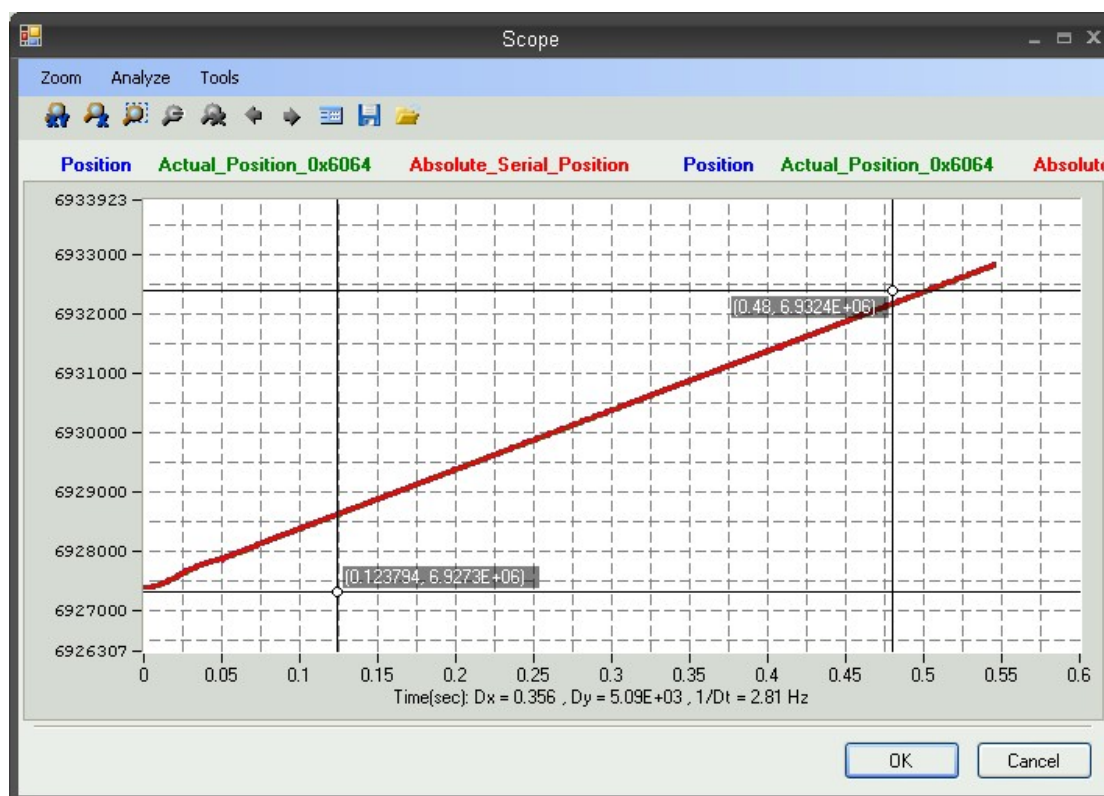
☐ Add result to the current window

☒ Display result at a new window

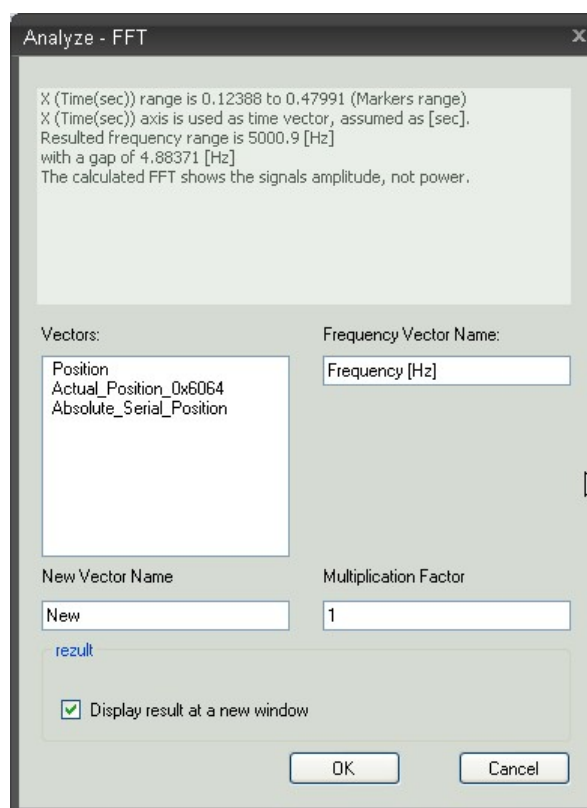
OK Cancel

FFT

1. Within the Scope window set the the Markers and range to be analyzed.



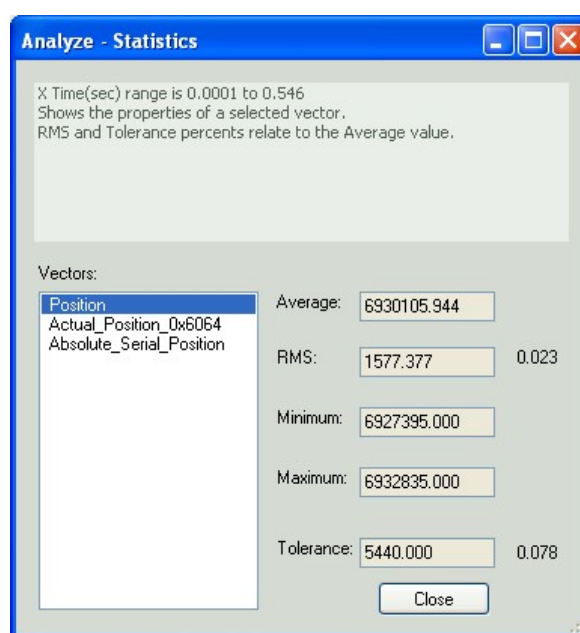
2. Select **FFT** from the **Analyze** menu.



3. Follow the instructions within this window to perform the analysis.
4. Select the **Frequency Vector Name** in Hz
5. Change the name of the new vector analysis in the **New Vector Name** field.
6. Select the checkboxes as necessary to Add result to the current window, and/or Display result with a new window.
7. Click **OK** to start the analysis and produce a chart according to the selection made.

Statistics

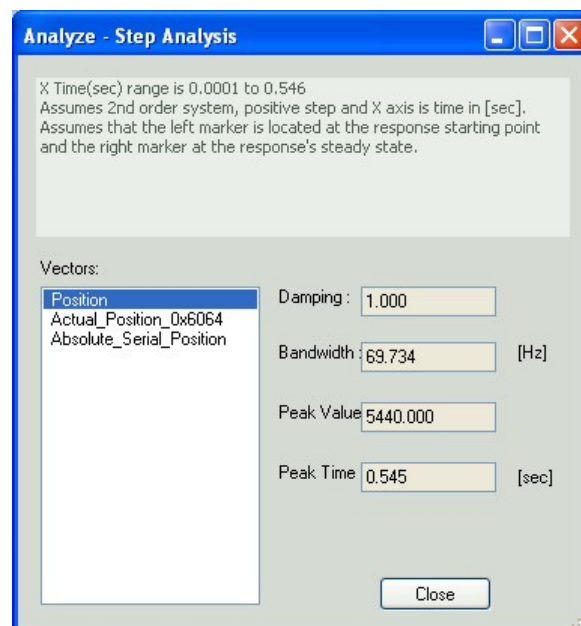
Displays statistical analysis according to the settings displayed in the instructions window pane.



Step Analysis

Allows step analysis between Markers set on the graph.

Select the **Vector** to be analyzed stepwise.



Tools



Offers a series of tools to change the default methods within the Scope window, using:

Windows properties

Refer to the explanation of the Windows property in section 5.1.4.1.

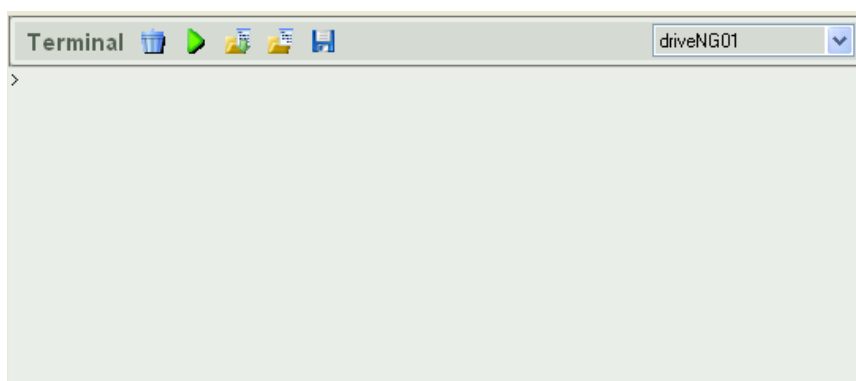
Save Values

Save the chart and its values as described in the section 5.1.4.

Load File

Loads the chart and its values as described in the section 5.1.4.

5.2 Terminal



The terminal window provides direct communication with the drive. Type any command or query to the drive at the prompt and hit enter to send the communication to the drive.

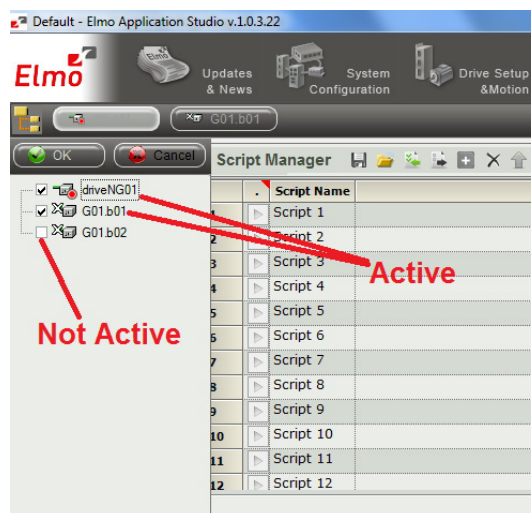
Use the toolbar buttons to save and load terminal sessions:

 Clear	Clear the terminal window
 Start Trace	Record all the commands that follow
 Stop Trace	Opens a “Save as” dialog box. The file can be saved as a record file (*.rcd) or a text file (.txt)
 Load Trace From File and Play	Select a recorded file to resend all the commands in it to the drive
 Load Trace From File	The session recorded in the text file is displayed in the terminal. No communication is sent to the drive
 Save Trace to File	Saves the trace to files. Similar to the Stop Trace button but without stopping the trace.

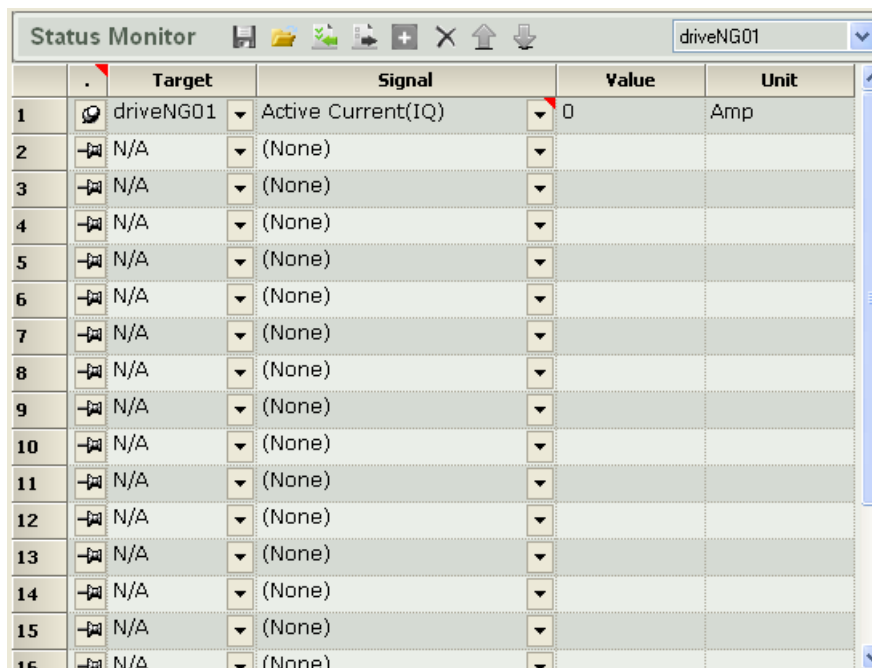
driveNG01

Target Selector

Use the list to communicate with any active drive. In the Tree targets shown in the diagram below, make sure to indicate the drive(s) as active, to allow communications with these drives.



5.3 Status Monitor



	Target	Signal	Value	Unit
1	driveNG01	Active Current(IQ)	0	Amp
2	N/A	(None)		
3	N/A	(None)		
4	N/A	(None)		
5	N/A	(None)		
6	N/A	(None)		
7	N/A	(None)		
8	N/A	(None)		
9	N/A	(None)		
10	N/A	(None)		
11	N/A	(None)		
12	N/A	(None)		
13	N/A	(None)		
14	N/A	(None)		
15	N/A	(None)		
16	N/A	(None)		

The Status Monitor displays the values of selected motion variables from one or more target drives.

The Status Monitor is a supporting auxiliary tool that is displayed in several tool layouts.

5.3.1 Status Monitor User Interface

5.3.1.1 Table Columns

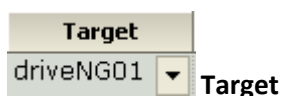


Update Selector

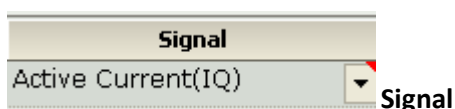
Row number

Only selected lines are updated from the drives. In non-selected lines, the value cell is empty.

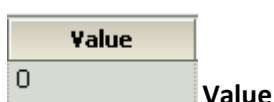
Allows selecting the row for action (not update: insert, delete, move...).



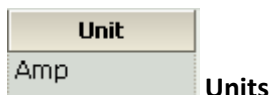
The name of the drive being monitored in this row. The cell is a drop down list of all the drives that are defined in the system.



The name of the signal monitored in this row. The cell is a combo. A drop down list that includes the parameters listed in paragraph 5.3.1.6. The user may enter a variable name to poll manually (For example, a value from an array).



The value of the monitored signal, sampled every 0.5 sec. If a value is different than it was in the previous reading, it is displayed in red. When two readings are identical, the value is black again.



A drop down with the units relevant to the selected signal

5.3.1.2 Toolbar Buttons

Target selector



Save

Saves selected monitor lines configuration to file



Load

Load a monitor configuration from file. Clicking this button invokes a dialog that offers you the option of either clearing the existing configuration before loading the configuration from file or appending the lines from the file after the last active row.



Select all

Select all rows



Deselect all

Deselect all rows



Insert row

Insert a new row before the selected row



Delete row

Delete the selected row and move rows up



Move rows up

Moves a row one level up



Move rows down

Moves a row one level down

5.3.1.3 Configuring a Line

Use the combi-box menu in the Target cell to select the drive you want to monitor in this line.



To monitor one of the signals available on the list

Use the drop down menu in the Signal cell to select the parameter.

The unit cell will display a drop down menu if a choice of units is available for this signal. Otherwise, the default units for the signal are displayed.

5.3.1.4 Saving Monitor Configuration to File

The file contains all the selected lines. The information saved for each line is:

- Target

- Parameter
- Units

To save monitor configuration

1. Select the lines to be saved
2. Click **Save**. A standard *save-as* dialog box appears.
3. Name the file and save it.

5.3.1.5 Loading Monitor Configuration from File

To load a monitor configuration

1. Click the “Load” button.
2. A standard “Open” dialog box appears. Select the desired file and click open.
3. If the Status Monitor Table is not empty, another dialog offers two options:
Clear all before loading, or
Append file to the table.
4. If “Append” is selected, the loaded rows will appear after the last non-empty row available.

Note: If the loaded file includes targets that are not currently in the system, the text **N/A** will appear in the target cell.

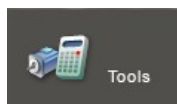
5.3.1.6 Organizing the Monitor Table

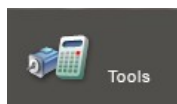
Organize the Status Monitor Table to view the information in the most convenient way

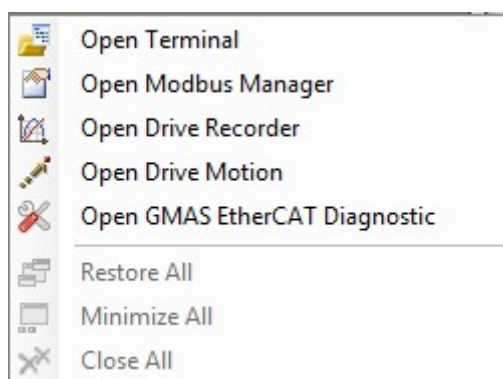
1. Group together signals you want to track at the same time
2. Bring signals that change often, such as position or velocity to the top, and scroll down occasionally to watch slower changing signals such as temperature or motion mode.
3. Insert or delete rows to add or remove monitored signals.

5.4 Floating Tools

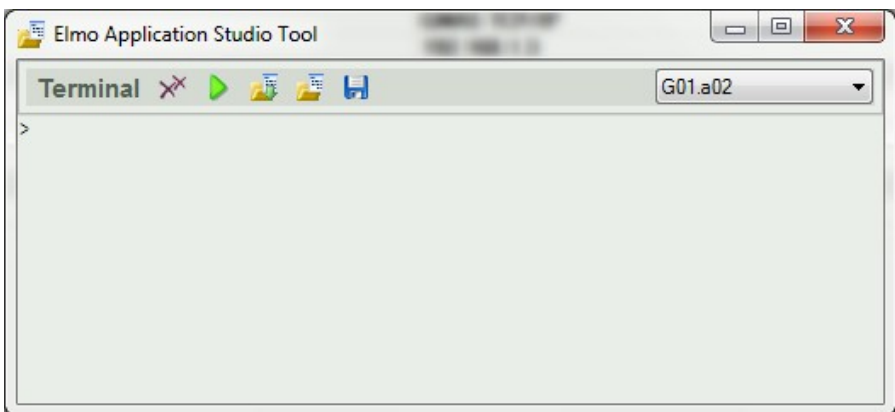
During the configuration and operation of an axis, multiple axes, or a group (vector) it may become necessary to open specific tools to implement calculations and commands directly to the drives. The following tools are therefore created as floating tools, which can be opened within any window.



To open the floating tool window, click . The floating tools menu window opens. This menu window remains open until either <Escape> or another option is clicked.



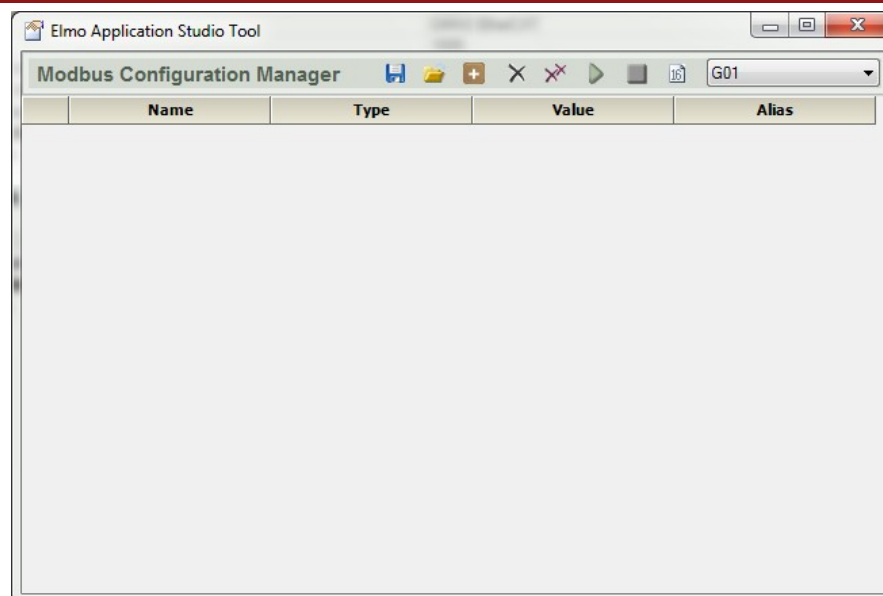
The following floating tools become available:

Tool	Window
Open Terminal	 For details of the Terminal's icons and window, refer to the section 5.2 Terminal.

Tool

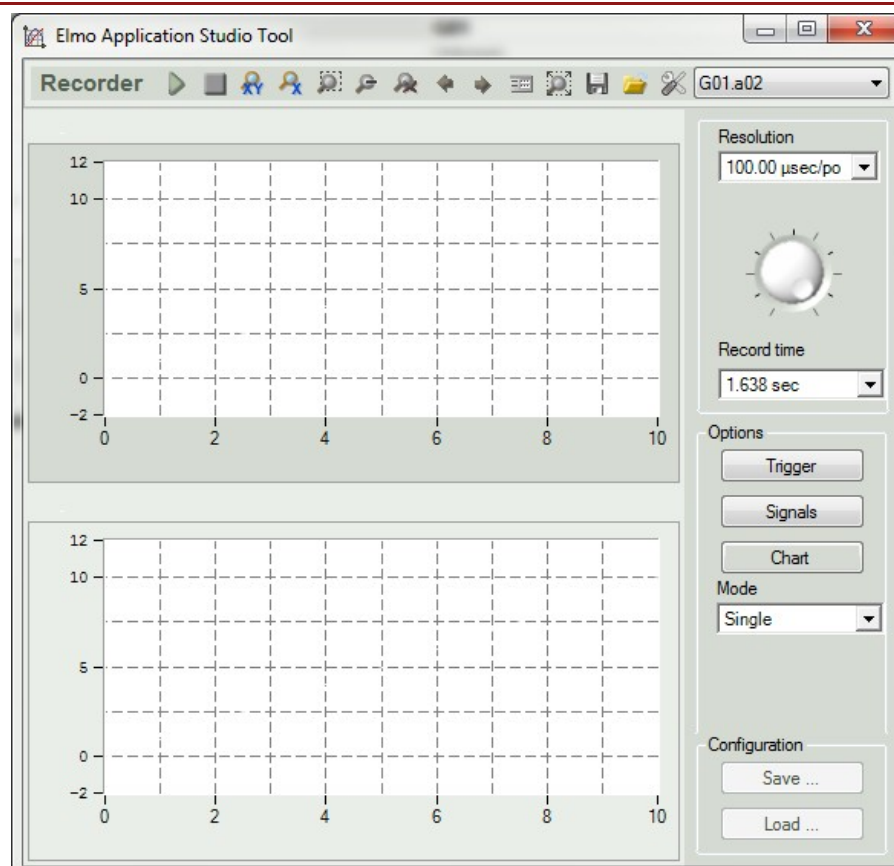
Window

Open Modbus Manager



For details of the Modbus Configuration Manager, refer to the section 7.3 Modbus Configuration Manager.

Open Drive Recorder

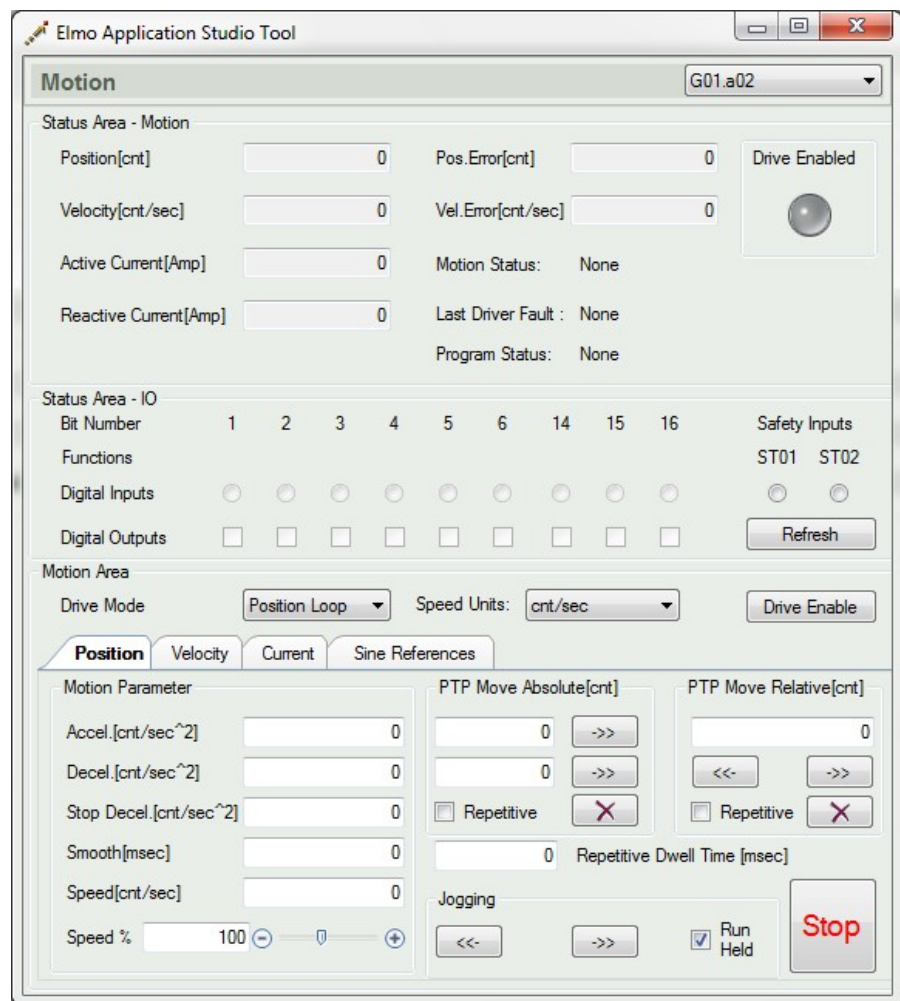


For details of the operation and configuration of the Driver Recorder, refer to the section 5.1 Recorder.

Tool

Window

Open Drive Motion



Elmo Application Studio Tool G01.a02

Motion

Status Area - Motion

Position[cnt]	0	Pos.Error[cnt]	0	Drive Enabled 
Velocity[cnt/sec]	0	Vel.Error[cnt/sec]	0	
Active Current[Amp]	0	Motion Status:	None	
Reactive Current[Amp]	0	Last Driver Fault :	None	
		Program Status:		None

Status Area - IO

Bit Number	1	2	3	4	5	6	14	15	16	Safety Inputs
Functions										ST01 ST02
Digital Inputs	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Digital Outputs	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Refresh

Motion Area

Drive Mode: Position Loop Speed Units: cnt/sec Drive Enable

Position Velocity Current Sine References

Motion Parameter

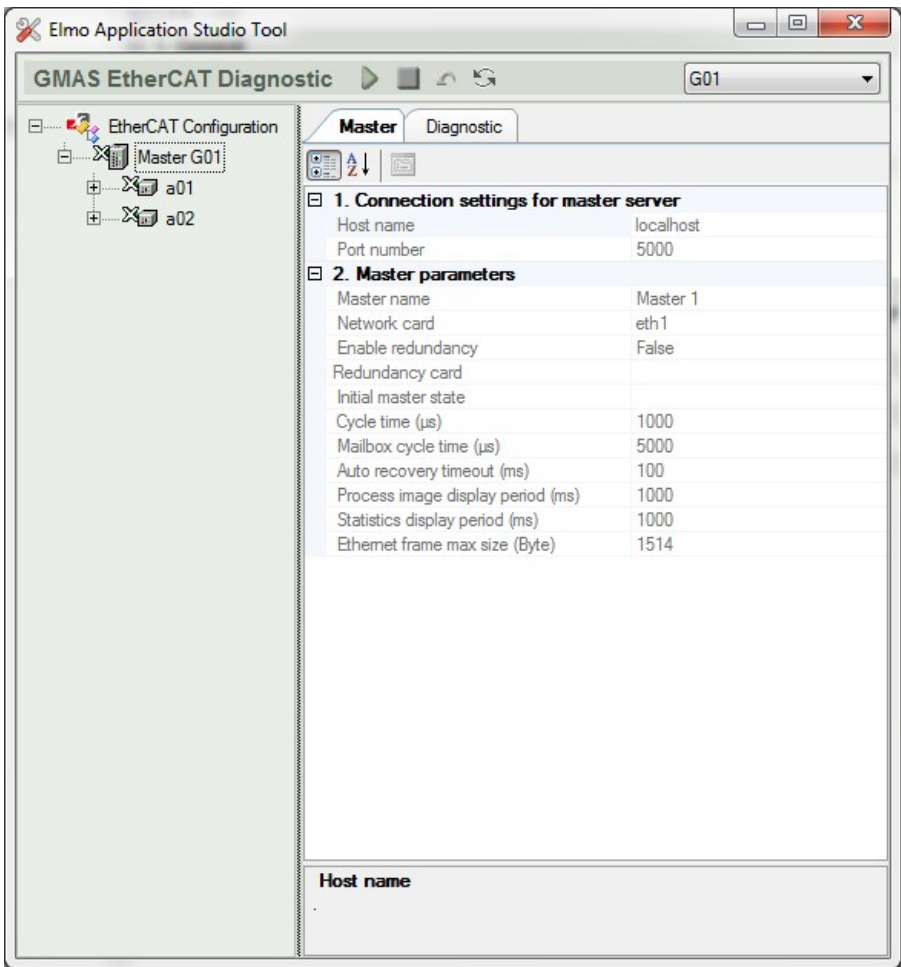
Accel.[cnt/sec ²]	0	PTP Move Absolute[cnt]	0	PTP Move Relative[cnt]	0
Decel.[cnt/sec ²]	0		0		
Stop Decel.[cnt/sec ²]	0	☐ Repetitive	X	☐ Repetitive	X
Smooth[msec]	0	Repetitive Dwell Time [msec]			
Speed[cnt/sec]	0				
Speed %	100				

Jogging

<< >> Run Held Stop

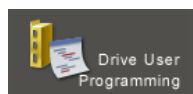
For details of the operation and configuration of the Motion window, refer to the section 4.3.2 The Motion Area.



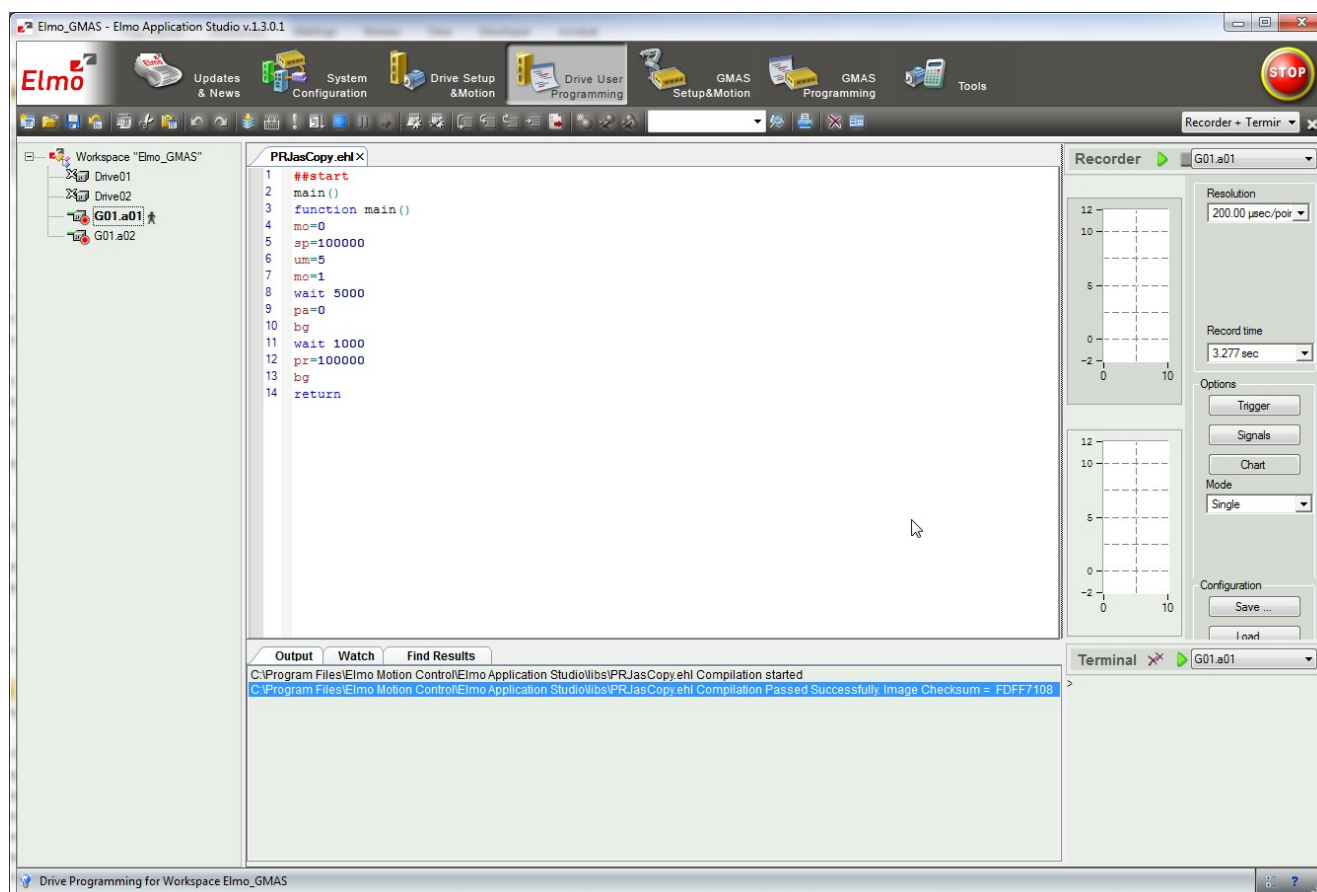
Tool	Window
Open GMAS EtherCAT Diagnostic	
Restore All	Restores all open floating windows
Minimize All	Minimizes all open floating windows
Close All	Closes all open floating windows

6 Drive User Programming

To enter the Drive User Programming window, click the Drive User Programming icon



This window allows you to edit, compile, download and debug programs that run on Elmo drives.



This chapter describes the Elmo Application Studio programming environment. To learn about the drive's programming language refer to the User Program Manual.

It is assumed that the reader is familiar with common editing, programming and debugging tools and concepts.

6.1 Programming Icon Options



The icon bar at the top of the programming window offers the following options:

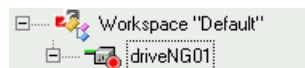
Icon	Explanation
	New program
	Open a present program from a directory
	Save the present program to a specific directory
	Upload program from another directory or another system
	Copy program from another application or directory
	Cut sections of the program for insertion in another place in the same or another program
	Paste sections of a program to insert them in another place in the same or another program
	Undo the previous action
	Redo the previous action, if undone
	Compile the program
	Build and download the program
	Start running the program from the beginning
	Start debugging the program
	Stop the program or debugging
	Break the debugging temporarily
	Move the action of the program to the next BreakLine
	Attach a section of parameters to the program
	Detach a section of linked parameters from the program
	During running, step over the program



Icon	Explanation
	During running, step into the program
	During running, step out of the program
	During running, run to the cursor
	Map the recordable variables
	Set a breakpoint
	Remove a breakpoint
	Remove all breakpoints
	Find a section in the program
	Print the program
	Clear the program from the drive
	Open the program's Properties window

6.2 Drive, Creating a Project and Program

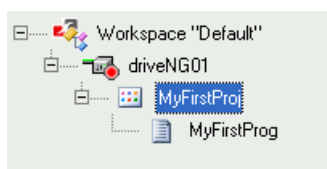
At the left hand side of the window, you will see your system tree. A simple tree includes a single Elmo Gold Line (NG) drive.



To write a program for this drive we need to create a project that includes the program. Single axis drives can only be linked to one project at a time and this project may include only a single program.

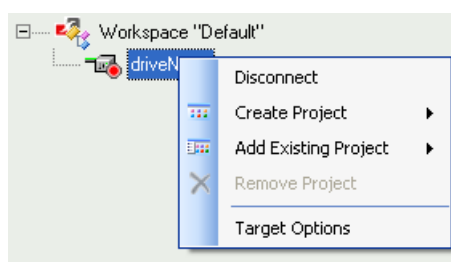
Of course, the project and program may be saved and set aside while a different program is linked to the drive.

Our simple tree for a first program will look like this.

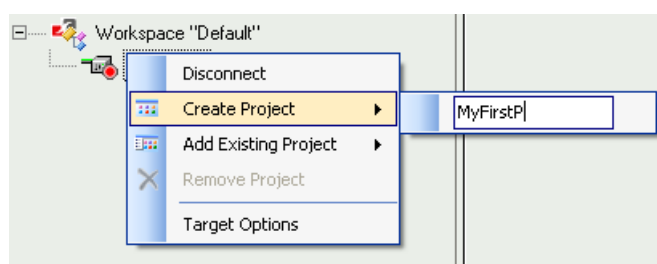


To Create a Project

1. Make sure your drive is connected.
2. Right click on the drive's name to invoke the following menu.



3. Click **Create Project**, type in your project name and click anywhere out of the text box to accept.

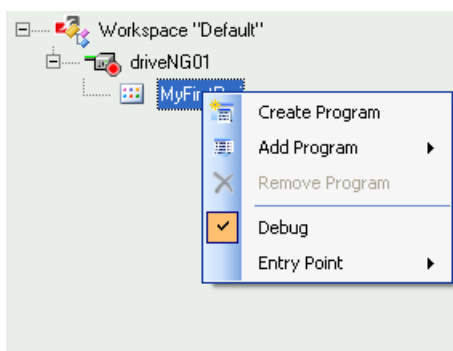


A project is created for your drive.

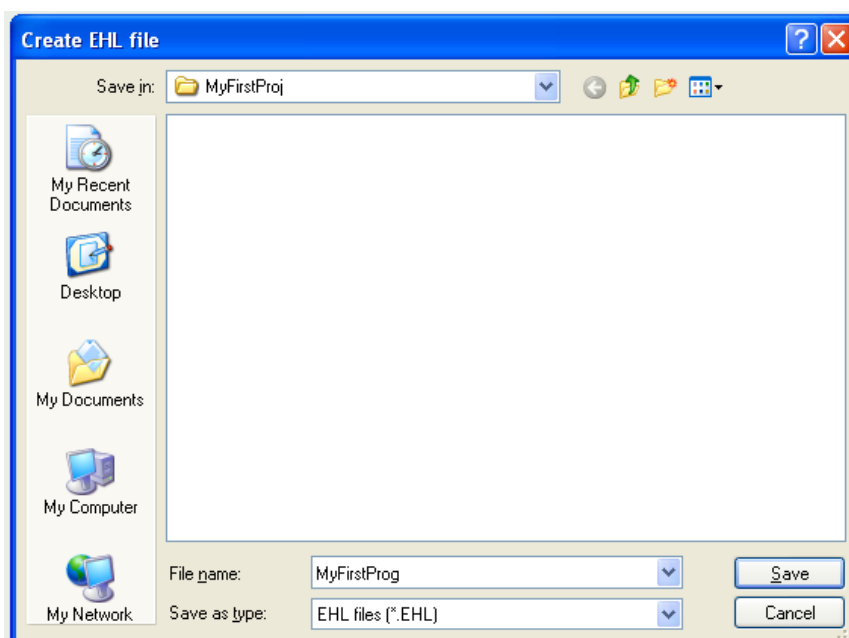


To Create a Program within a Project

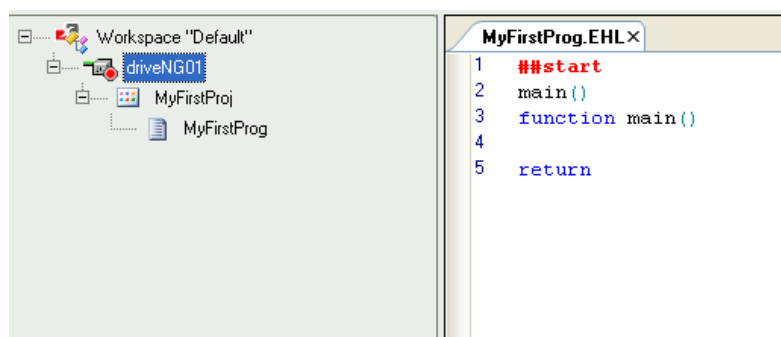
1. Right click the project name.



2. Click **Create Program**. In the dialog box that opens, name the program and click **Save**.



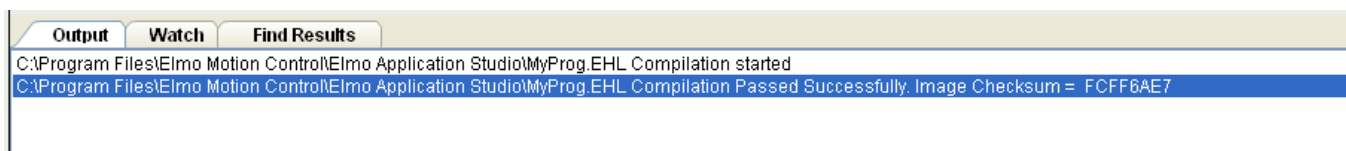
A new program file is saved. The file name is displayed in the tree and opened for editing. The new file already includes a very basic template of a program.



It includes a label: "##start" and an empty function "main". Though it is obviously an empty program, it is syntactically correct and complete and can be compiled and run without error.

To Compile a Program

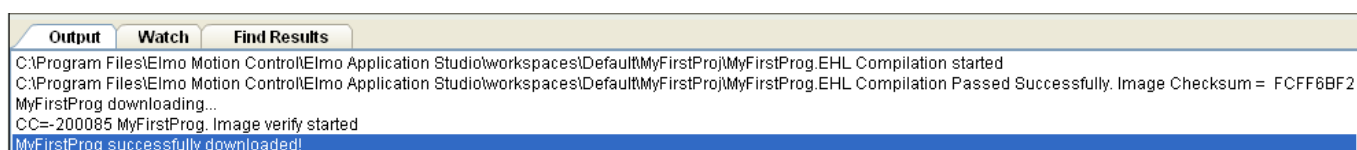
- To compile a program on the PC without downloading it to the drive click the  **Compile** button. The **Output** tab at the lower part of the screen shows the compilation results.



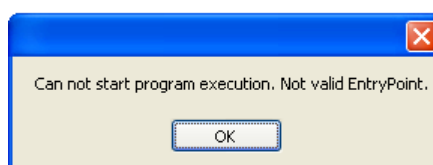
If there are errors in the program, you can double click the error message line in the output window to mark the location of the error in the program.

To Build and Download a Program

- To build and download a program, click the **Build** button . EAS will compile the program, and if no errors occur during compilation, it will download the program to the drive. This option is only available in the online mode. The **Output** displays the results of this action.



- To start running the program on the drive click the **Start** button . This button runs the program and ignores any selected debug options such as breakpoints. The following message may appear.



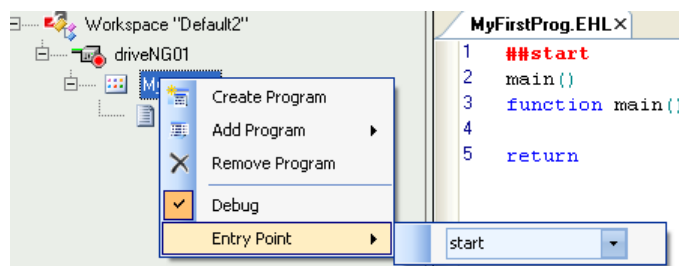
The reason for this message is that an Elmo drive program can start running at any label (line beginning with ##) or any void function. Unlike a C program, it does not always start at "main()".

The simple program template has two possible starting points:

The label ##start, and/or

The beginning of main function.

3. To select the starting point for the program execution, right click the name of the project and select **Entry Point**:



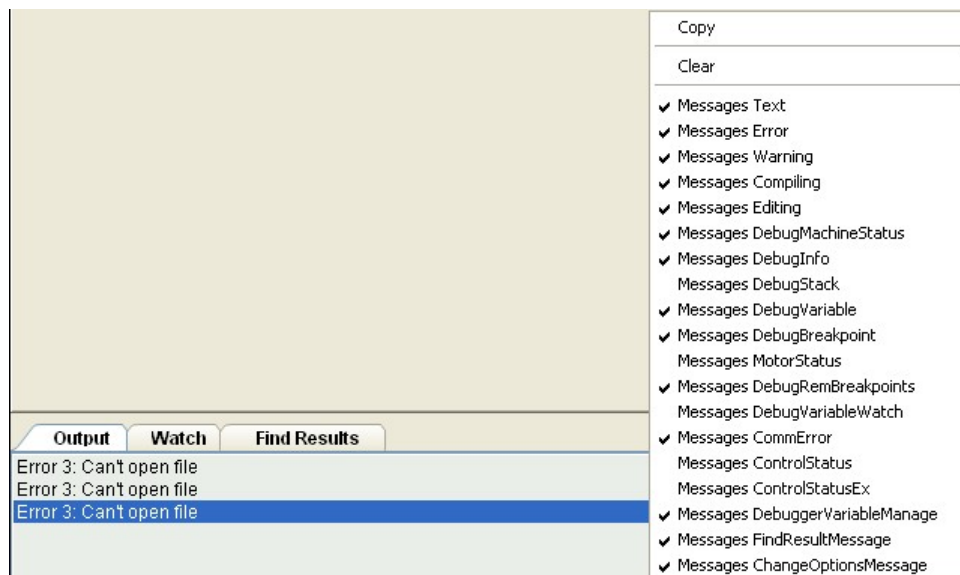
A list of the possible entry point becomes available.

4. Select the desired entry point.
5. Now you can click the **Start** button again and the program will run.

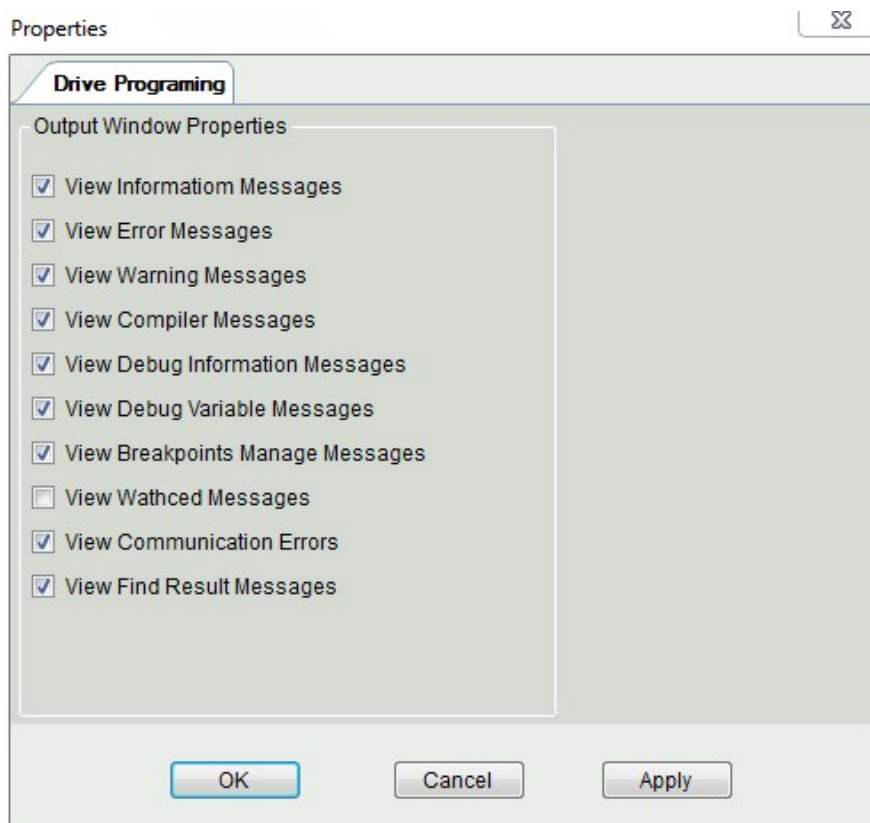
6.3 Configuration

To configure the properties of Drive User Programming

1. Right-click in the Output pane to open an options list.



2. Tick next to any or all of the options to view the respective message(s) during programming and operation.
3. Click the icon  to open the Drive Program window.





4. Select the options to be viewed by clicking the checkbox next to the option.
5. Click **Apply** to apply the changes and then **OK** to close the window.

6.4 Opening, Editing a Program File

A program file can be opened for editing as part of a project or on its own.

To open a program as part of a project, right click the project's name.

6.4.1 Opening a Program for Editing

To open a program without opening a project use the toolbar buttons:



New

Open a new program template



Open

Open an existing program file



Upload Program

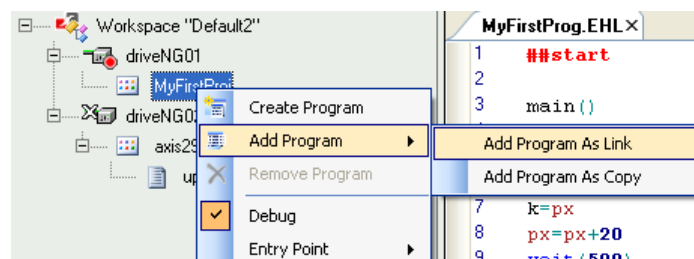
Upload a user program from a connected drive. In the dialog that opens, enter a name for the uploaded file and click Save. To open the new file use Open or the project related menu.

6.4.2 Opening a Program for Editing, Running and Debugging

To run a program on a drive, whether in debug mode or not, you need to assign a project to the drive and open a program as part of the project. Each drive supports a single program at a time.

To open a file as part of a project

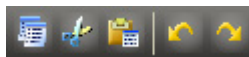
1. Right click the name of the project.



2. Click **Add Program**. There are two choices:
 - **Add Program As Link:** If you have multiple drives running the same program under different projects, select this option to apply the changes in the edited file to all the linked files. This way you edit only a single copy of the program and the changes take effect in all the projects.
 - **Add Program As Copy:** Open a previously saved program for editing. The changes made will apply only to the file in this project.

6.4.3 Editing a Program File

Use the following standard editing buttons located on the left of the toolbar to copy, cut, paste, undo or redo actions.

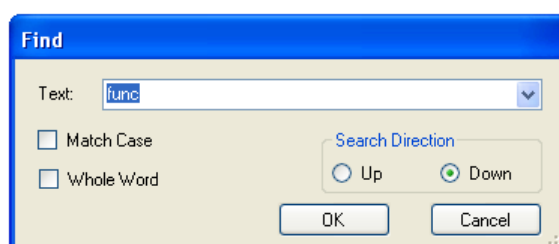


To search the program

1. Enter a search string in the search window and click **Search**

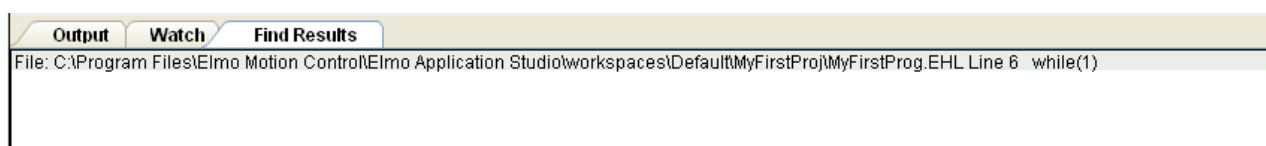


2. Select the search options in the following toolbox.



3. Click **OK** to search.

The search result will appear in the **Find Results** tab:



4. Double click the line in **Find Results** to highlight the line that includes your search string.

6.5 Debugging a Program

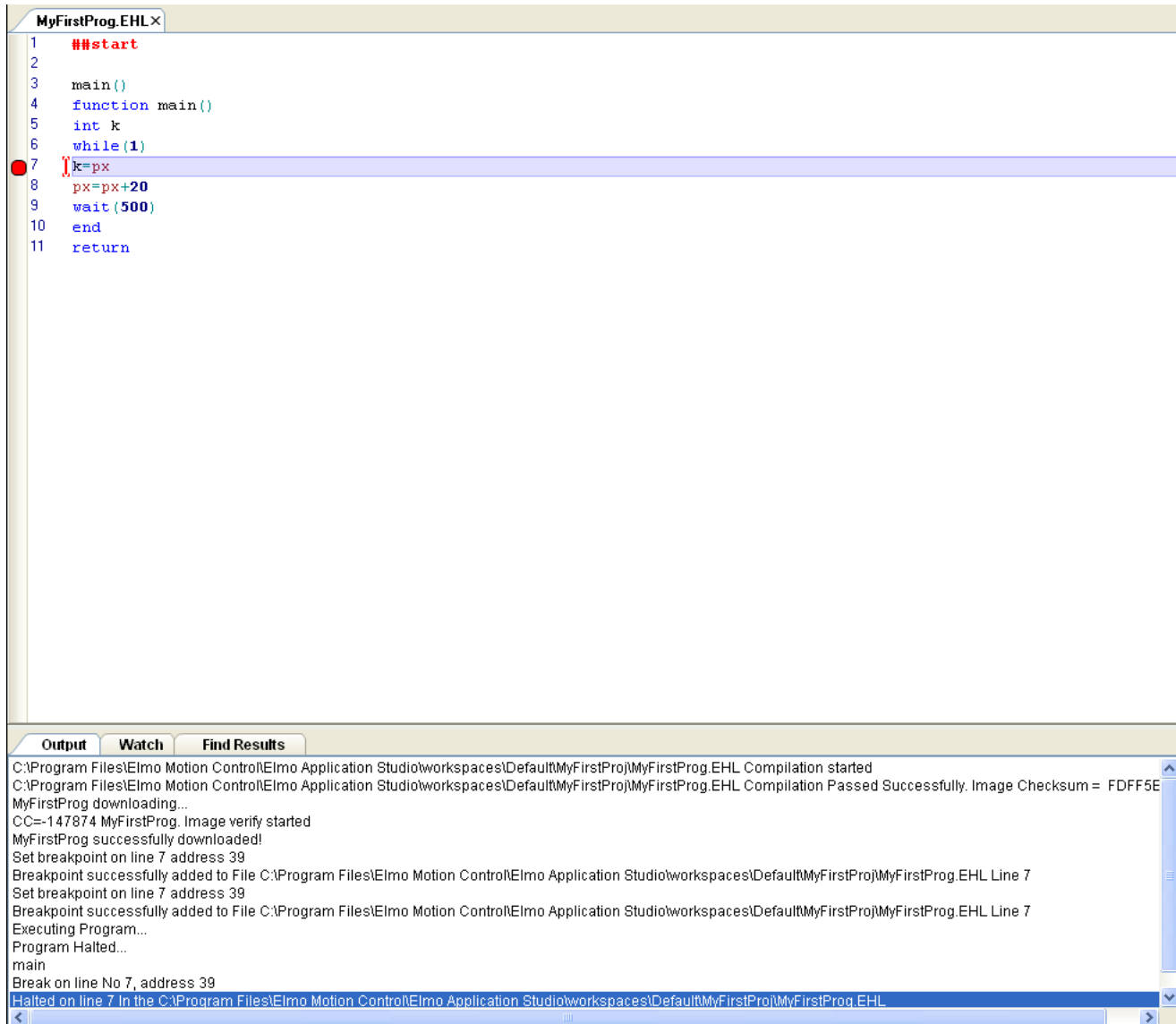
To debug a program

1. Use the following toolbar buttons:



Set Breakpoint 	Move the cursor to the line you want to put the breakpoint on and click the Set Breakpoint button
Remove Breakpoint 	Move the cursor to a line that has a breakpoint and click this button to remove it
Remove All Breakpoints 	Click to remove all the breakpoints
Step Over 	Click to continue executing the next line without stepping into a function or routine
Step Into 	Click to enter a function or routine and stop at the first command
Step Out 	Continue and then stop at the first instruction before the current function is called
Run to Cursor 	Halt execution at the line where the cursor is currently located (no breakpoint is needed)

2. Start running the program in the debug mode, using the **Start Debugging**  button. The program will run until the first breakpoint and halt program execution.
3. When the program halts, message is displayed in the output window. The line at which the program is halted is highlighted and the color of the breakpoint mark changes.



6.5.1 Watching Variables

Edited variable values defined as a Watch variable may be dragged and dropped from another window or Terminal.

To view the value of the program variable and drive parameters

1. Use the **Watch** tab to view the value of program variables and drive parameters.

Output	Watch	Find Results		
	Variable	Type	Value	View Hex
	k	Integer local variable	0X00000014	☒
	px	//----	40	☐
	sp	//----	80000	☐

2. Enter the names of the variables and parameters you want to watch in the **Variable** column. The **Value** column will display the values when the program halts at a breakpoint.
3. Check **View Hex** to view the hexadecimal representation of the value.

6.5.2 Debugging a Running Program

EAS allows you to connect to a drive that is already running an existing program and start debugging it.

To debug a program

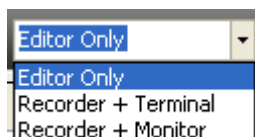
1. When a program is running on the drive, connect to the drive using EAS and open the same program running in the editor.
2. Set breakpoints and enter variables and parameters to watch if necessary.
3. Click the **Attach**  button to enter the debug mode. The program execution will halt when a breakpoint is reached.
4. To exit the debug mode and return to normal running mode click **Detach** .

6.6 The Layout Selector

To use the Layout Selector

1. On the right side of the toolbar, you will find the view selector.

Open the list to select one of three options:

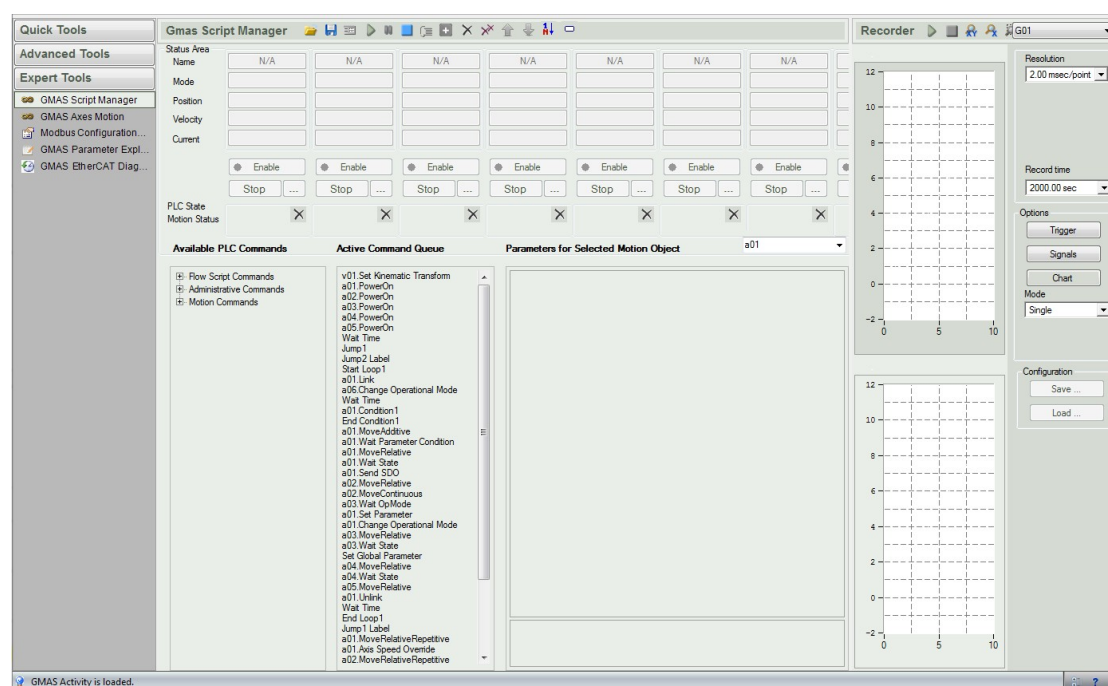


2. View the editor only or add supporting tools to your layout to help debugging.

7 G-MAS Setup and Motion



To open the G-MAS Setup and Motion activity window, click the  icon. This window allows you to perform servo drive operations directly and via scripts, and diagnose the G-MAS connects to the drives.



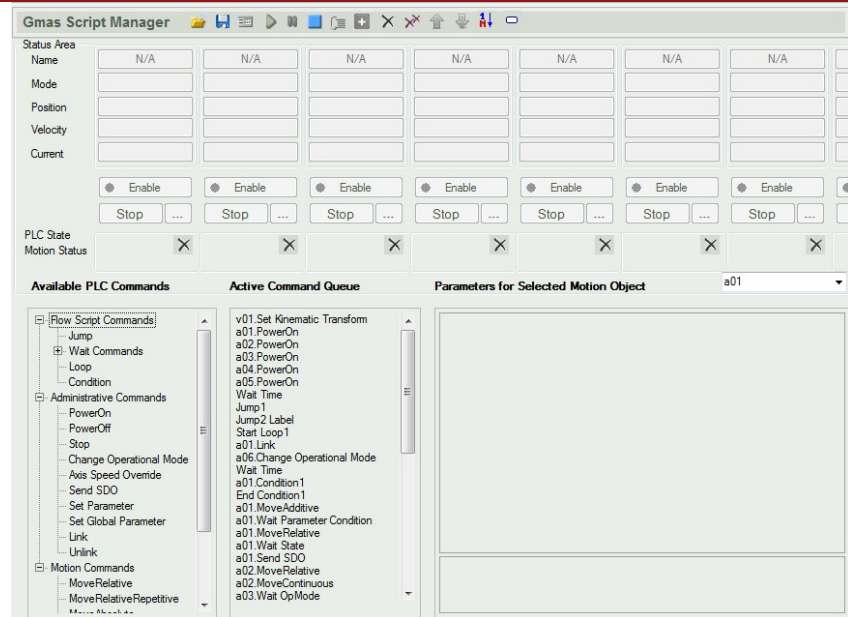
The following activities are available:

Activity	Explanation
G-MAS Script Manager	Details the loading and saving of specific and sophisticated G-MAS scripts to either test the G-MAS management and its drives during its design setup, or run the system as routines.



Activity

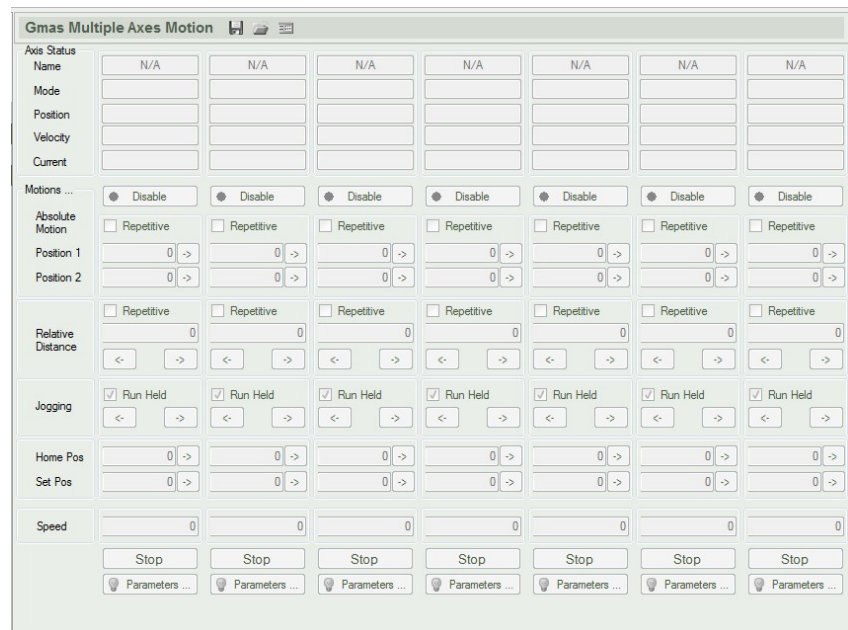
Explanation



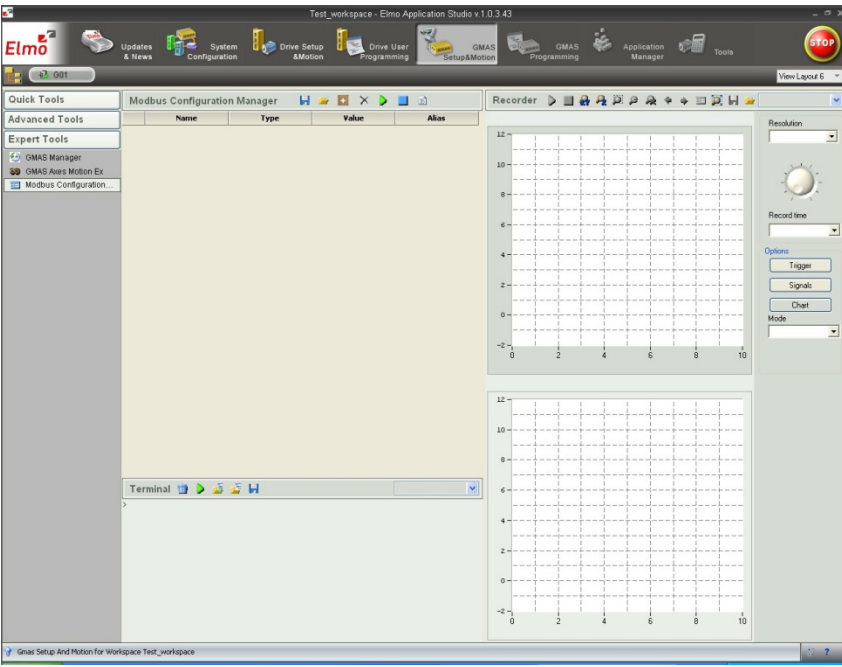
For further details, refer to the section 7.1 on page 336.

G-MAS Multiple Axes Motion

Details the multi-axes motion controlled by the G-MAS.

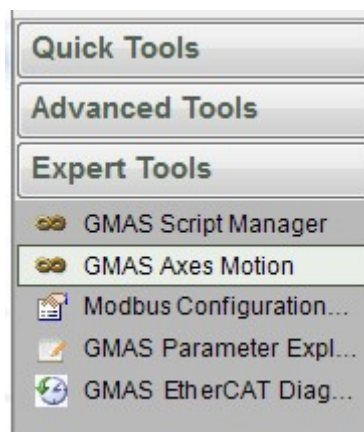


For further details, refer to the section 7.1 on page 336.

Activity	Explanation
Modbus Configuration	Details and allows editing of multiple Modbus configurations and their respective data, to operation a G-MAS controlling a series of of various drives.  For further details, refer to the section 7.3 on page 376.

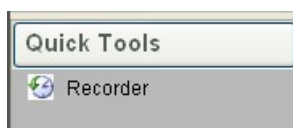
To select a G-MAS Setup & Motion activity

1. Select the G-MAS Setup & Motion option  to open the G-MAS management window.
2. At the Tools side bar, select from the menu of Tools.

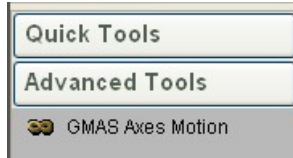


The following table displays the options available for each set of Tools.

Quick Tools



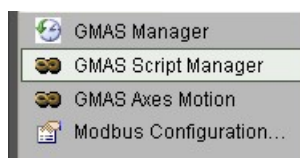
Advanced Tools



Expert Tools



3. Select any of the following options.



The relevant tool manager activity opens.

To activate the G-MAS from the Workspace Tree:



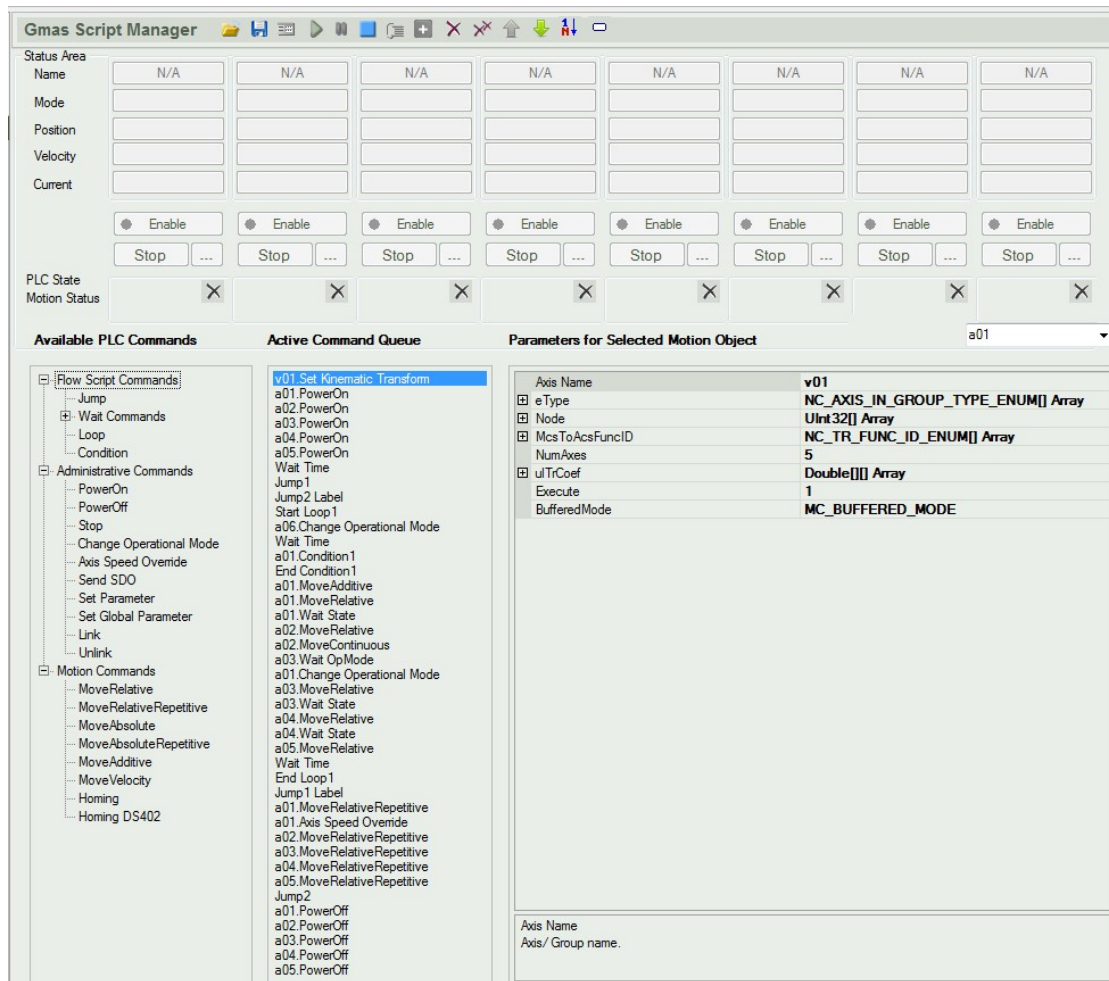
1. At the top left corner, click the Workspace tree icon 



2. Click the **OK** button.
The G-MAS icon changes from grey to a green highlighted icon.

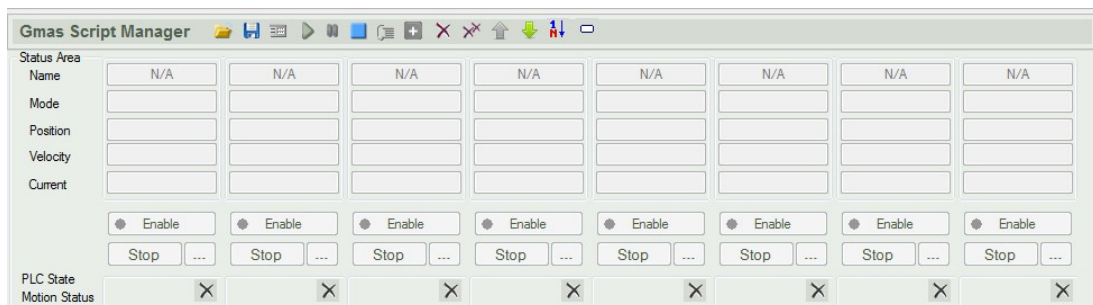
7.1 G-MAS Script Manager

The G-Mas Script Manager displays the following screen.



The modular display consists of the following:

The status area consists of the G-MAS Script Manager icons and displays the general status of each axis or vector, if defined as a combination of the axes.

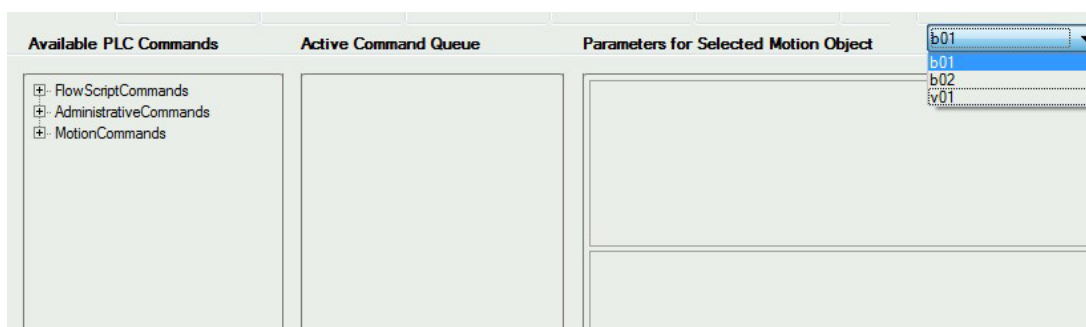


The Status Area fields consist of the following:

Name Name of the axis. By default b0X, or for group vector axes V0X

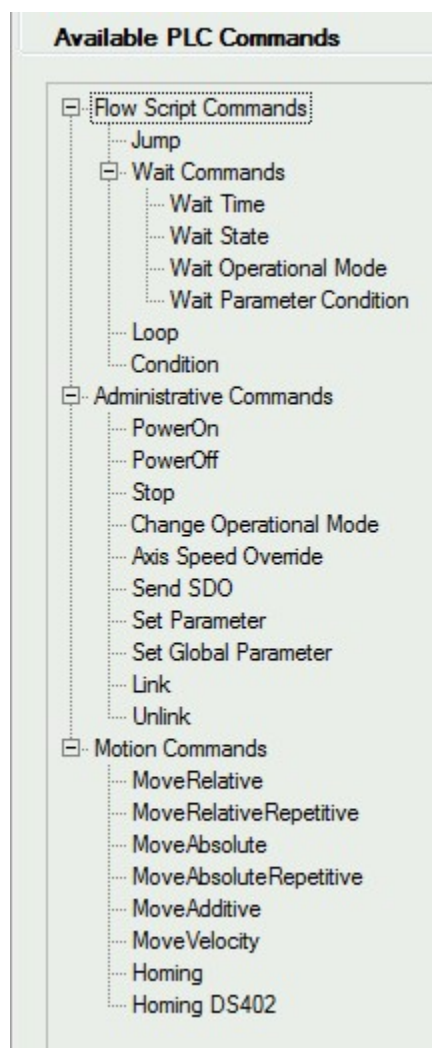
Mode	The DS402 mode motion of the axis
Position	Actual position
Velocity	Actual velocity
Current	The operative current of the drive
Enabled/Disabled	Whether the axis or group is powered on or not
Stop	Stop the motion of the axis. Does not operate per axis if grouped. Must press Stop under the vector name to Stop a group.
PLC State	The PLC state of the axis whether the axis is enabled or disabled, or otherwise
Motion Status	Motion status of the axis by default is Disabled or Standby. However, when the axis is enabled the motion status can be DC, cVel, etc.

The commands area allows a series of commands and functions to be queued and then activated, performing the motion function of the axis or group of axes.



The Available PLC Commands lists the available commands to use when operating a single or multiple drives, and consists of the following:

Flow Script Commands	Sets the flow for the queued command series
Administrative Commands	Sets the commands to administrate the motion of the axes
Motion Commands	Sets the command to perform the motion



The above commands may be dragged to the Active Command Queue area and their detailed parameters entered in the Parameters for Selected Motion Object area.

7.1.1 Toolbar Buttons

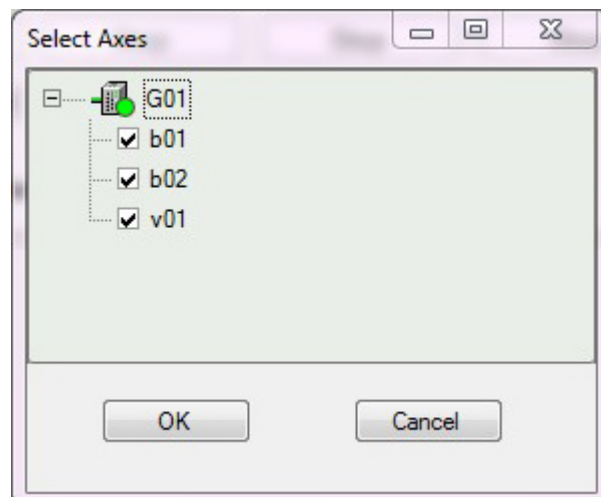
Gmas Script Manager		
	Save	Save the selected rows
	Load	Load a saved script. All present scripts are cleared and replaced with the loaded script.
	Select axis	Select an axis or axes on which to perform the commands
	Run the command sequence	Runs the command sequence in the Active Command Queue
	Halt the command sequence	Halts the operation of the command queue
	Stop the command sequence	Stop the sequence completely
	Step procedure	Performs the commands in the active queue stepwise. This is especially useful when checking commands and their parameters.
	Insert command	Insert one row above the top row that is selected
	Delete command	Deletes the selected command and move commands up
	Clear All	Clear all commands from the Active Commands Queue
	Move command up	Move the selected rows towards the top of the table
	Move command down	Move the selected rows towards the end of the table
	Renumber	Allows renumbering of a set of procedures to place in a specific order of operation.
	Add variables	Add variables to a function presently with active variables.

7.1.2 Manipulating the axes

The section describes the procedure to build a queue of Commands in the Commands Area and activate them to manipulate the axes or group of axes.

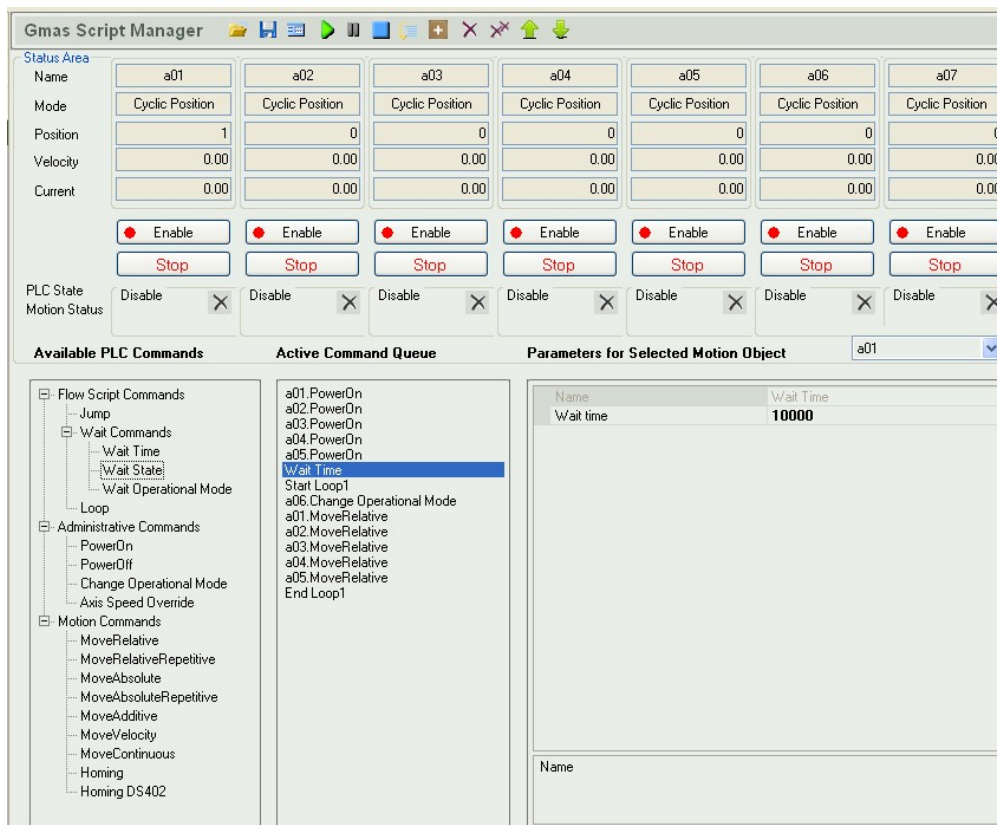
To manipulate the axes

1. Click  to select the axes. The Select Axes window opens

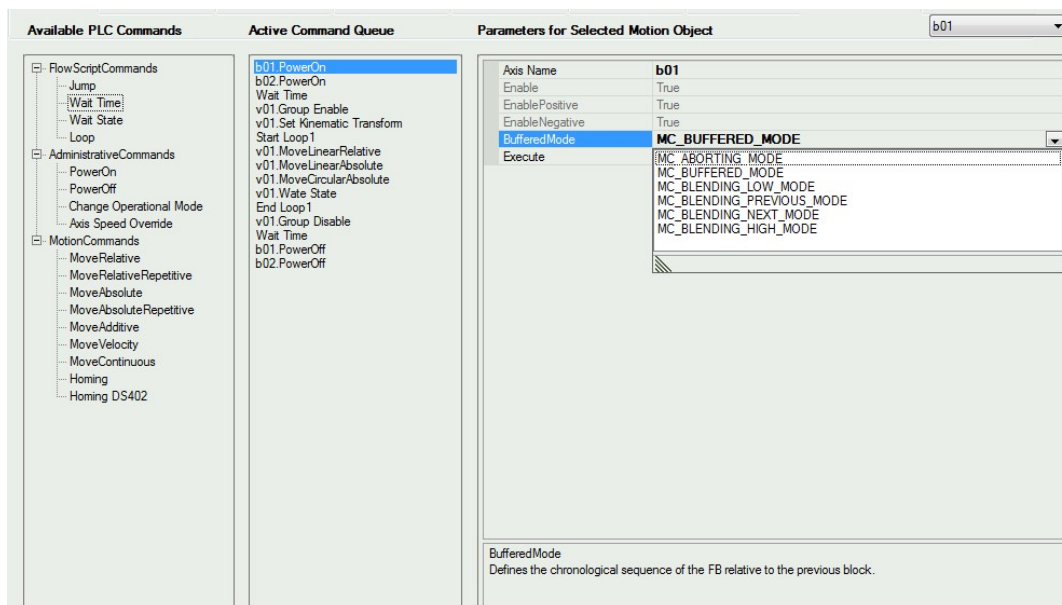


2. Select axis or axes to be included in the activity, and click the checkbox next to their name.
3. Within the Command Area, drag the relevant command to the Active Command Queue area and build a sequence of operations, as shown below.

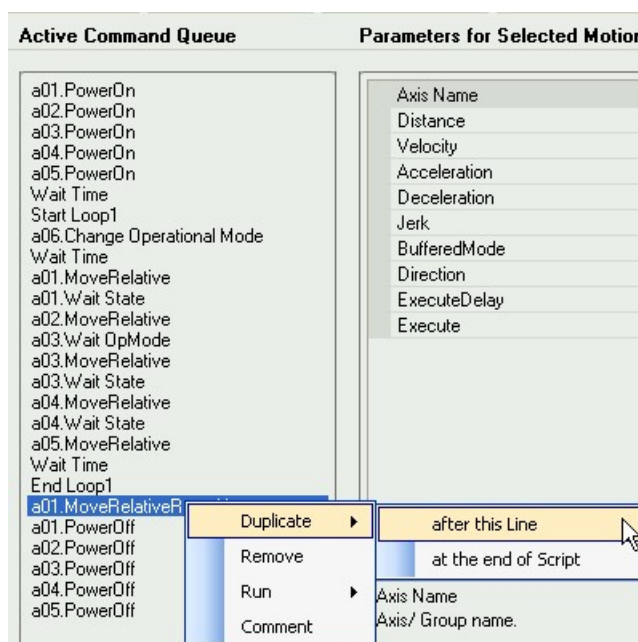
Note: Each axis or vector group of axes has its own set of commands delineated according to the name of the axis or group.



4. For each command entered, make sure to set the specific parameters applicable to that axis or group.

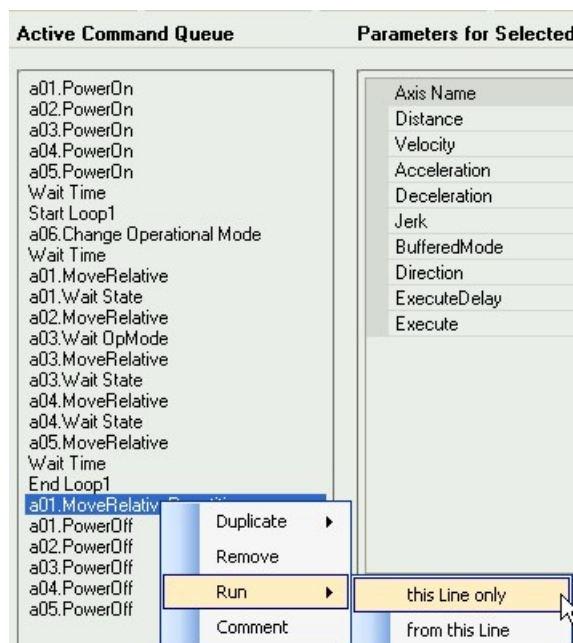


5. To duplicate a command for a set of axis:
 - a. Insert the command to the Active Command Queue.
 - b. Select the command to repeat and right-click on the command. A menu appears.

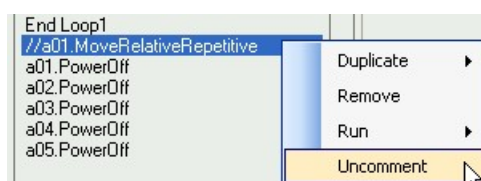


- c. Select **Duplicate**, and choose where to place the duplicate command:

After this Line	Immediately after this command line
At the end of Script	At the end of the script set of commands
6. To run a command for an axis:
 - d. Insert the command to the Active Command Queue.
 - e. Select the command to repeat and right-click on the command. A menu appears.



- f. Select **Run**, and choose when to run the command:
- | | |
|----------------|---|
| This Line only | Run this line command now |
| From this line | Run all commands starting from this command |
7. To remove a command, either click the icon , or alternatively, Select the command and right-click. Then select **Remove** from the menu that appears.
8. To change a command to a comment, select the command and right-click. From the menu that appears, select **Comment**. The command changes to a comment with two // appearing directly before it.



To remove the comment, select the commented command and right-click. Then select **Uncomment** from the menu. The command returns to its original form in the queue.

7.1.2.1 Flow Script Commands

All Flow command can be inserted to a command sequence on condition that the sequence is not active.

Active Command Queue	Parameters for Selected Motion Object				
a01.PowerOn a02.PowerOn a03.PowerOn a04.PowerOn a05.PowerOn Wait Time Start Loop1 a06.Change Operational Mode Wait Time a01.MoveRelative a01.Wait State a02.MoveRelative a03.Wait OpMode a03.MoveRelative a03.Wait State a04.MoveRelative a04.Wait State a05.MoveRelative Wait Time End Loop1 a01.MoveRelativeRepetitive a01.PowerOff a02.PowerOff a03.PowerOff a04.PowerOff a05.PowerOff	<table border="1"> <thead> <tr> <th>Name</th> <th>Wait Time</th> </tr> </thead> <tbody> <tr> <td>Wait time</td> <td>10000</td> </tr> </tbody> </table> Name	Name	Wait Time	Wait time	10000
Name	Wait Time				
Wait time	10000				

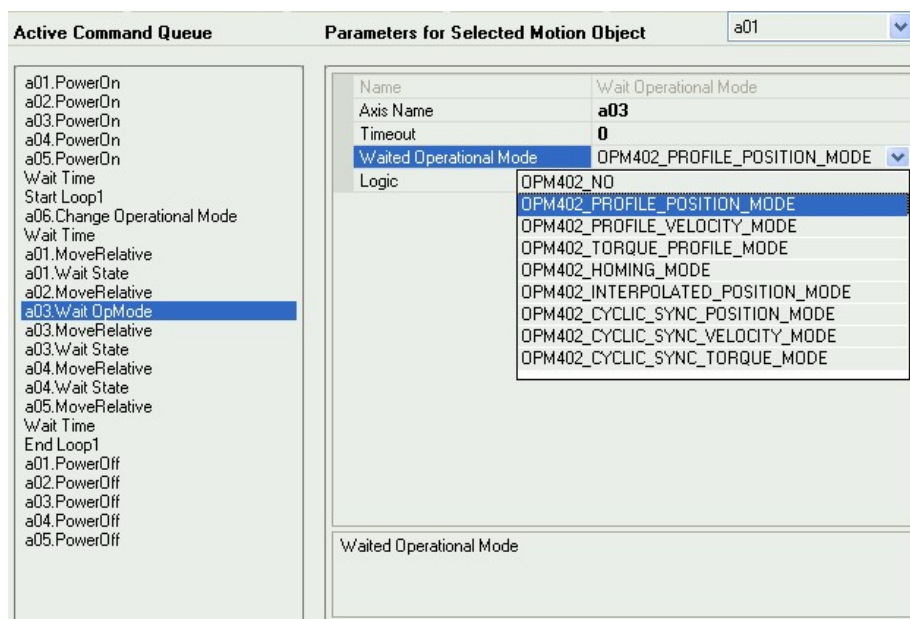
The delay time between moving from one command to another. Enter a realistic number to enable the axis to react between commands.

Wait Commands

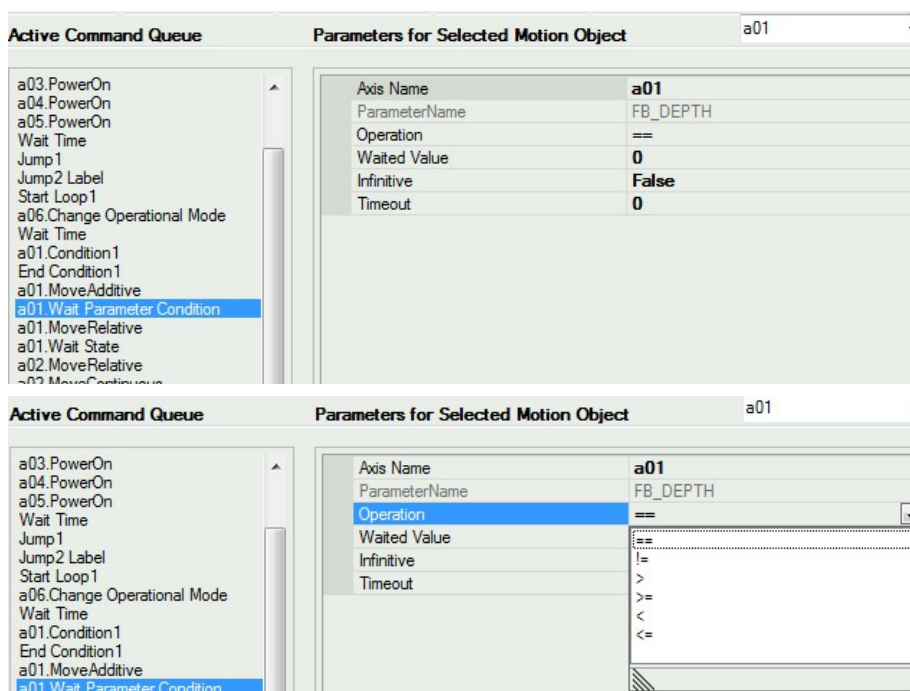
Active Command Queue	Parameters for Selected Motion Object										
a01.PowerOn a02.PowerOn a03.PowerOn a04.PowerOn a05.PowerOn Wait Time Start Loop1 a06.Change Operational Mode Wait Time a01.MoveRelative a01.Wait State a02.MoveRelative a03.Wait OpMode a03.MoveRelative a03.Wait State a04.MoveRelative a04.Wait State a05.MoveRelative Wait Time End Loop1 a01.MoveRelativeRepetitive a01.PowerOff a02.PowerOff a03.PowerOff a04.PowerOff a05.PowerOff	<table border="1"> <thead> <tr> <th>Name</th> <th>Wait State</th> </tr> </thead> <tbody> <tr> <td>Axis Name</td> <td>a01</td> </tr> <tr> <td>Timeout</td> <td>0</td> </tr> <tr> <td>Waited PLC State</td> <td>SYNCHRONIZED_MOTION</td> </tr> <tr> <td>Logic</td> <td> HOMING SYNCHRONIZED_MOTION CONTINUOUS_MOTION DISCRETE_MOTION STAND_STILL STOPPING DISABLED ERROR_STOP </td> </tr> </tbody> </table> Waited PLC State	Name	Wait State	Axis Name	a01	Timeout	0	Waited PLC State	SYNCHRONIZED_MOTION	Logic	HOMING SYNCHRONIZED_MOTION CONTINUOUS_MOTION DISCRETE_MOTION STAND_STILL STOPPING DISABLED ERROR_STOP
Name	Wait State										
Axis Name	a01										
Timeout	0										
Waited PLC State	SYNCHRONIZED_MOTION										
Logic	HOMING SYNCHRONIZED_MOTION CONTINUOUS_MOTION DISCRETE_MOTION STAND_STILL STOPPING DISABLED ERROR_STOP										

Select the appropriate logical wait state from the pull-down menu and enter a Timeout, after which the EAS continues the command queue.

Select whether the Logic should be True or False

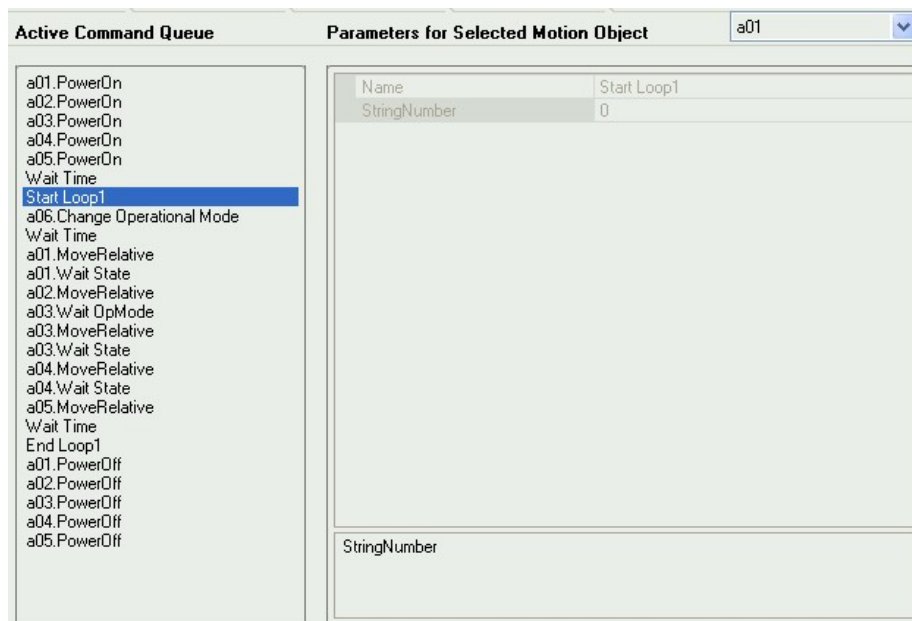


This Wait Operational Mode depends on the DS402 wait operational state allows the axis to change operational state before moving to the next command in the queue.



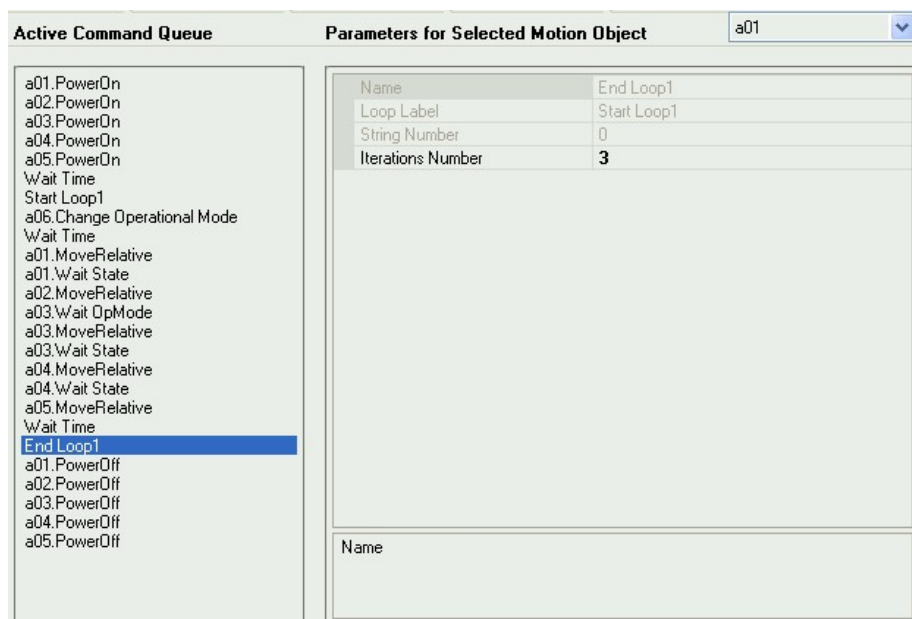
The Wait Parameter condition depends on the optional value of the condition, and can be changed for each axis.

Loop



A loop can be inserted at any time to a sequence of commands in the queue, and allows the user to setup a sequence of commands which repeat.

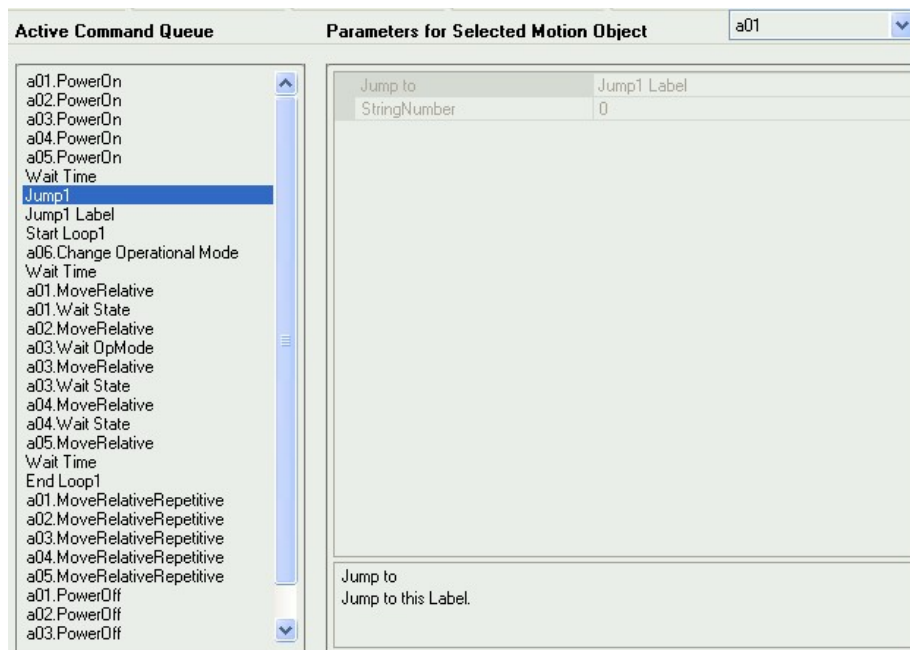
Selecting Loop, mounts two loop commands to the Active Command Queue; Start Loop, and End Loop.



To reiterate the command enter the StringNumber value at the End Loop command in the Parameter's detailed window.

Then use the   buttons to move the commands to their correct positions.

Jump

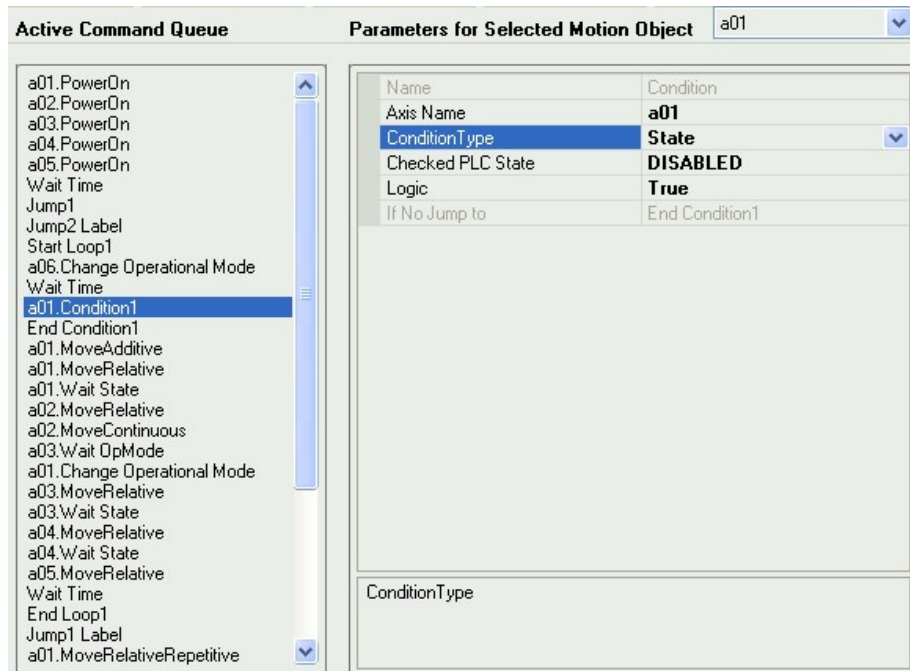


Jumps commands in a queue to the next JumpX Label and continues the procedure from that command.

Initially, selecting Jump, places two commands, for example, Jump1 and Jump1

Label, in the queue. Use the   buttons to move the Jump1 label command to its appropriate position.

Condition



Creates a conditional command situation where the command uses the standard If... then... application. Similar to the Jump command, the Active Command Queue uses the Condition label specific for an axis (for example, a01 Condition1 above) and creates the End Condition label (End Condition1), to discontinue the Conditional command.

Use the   buttons to move the End Condition label command to its appropriate position.

The Condition label has three parameters which allow selection of the following:

ConditionType

Select either State or OpMode (DS-402 operational mode)

Checked PLC State

If State mode then the following Checked PLC State options are available:

Name	Condition
Axis Name	a01
ConditionType	State
Checked PLC State	DISABLED
Logic	HOMING
If No Jump to	SYNCHRONIZED_MOTION
	CONTINUOUS_MOTION
	DISCRETE_MOTION
	STAND_STILL
	STOPPING
	DISABLED
	ERROR_STOP

If OpMode mode then the following Checked PLC State options are available:

Name	Condition
Axis Name	a01
ConditionType	OpMode
Checked Operational Mode	2_PROFILE_POSITION_MODE
Logic	OPM402_NO
If No Jump to	OPM402_PROFILE_POSITION_MODE
	OPM402_PROFILE_VELOCITY_MODE
	OPM402_TORQUE_PROFILE_MODE
	OPM402_HOMING_MODE
	OPM402_INTERPOLATED_POSITION_MODE
	OPM402_CYCLIC_SYNC_POSITION_MODE
	OPM402_CYCLIC_SYNC_VELOCITY_MODE
	OPM402_CYCLIC_SYNC_TORQUE_MODE

Logic

True or False.

If **True**, then the operation of the axis follows the Checked Operational Mode setting.

If **False**, then the operation of the axis **does not** follow the Checked Operational Mode setting and follows another mode

If NO Jump to

EndCondition1

(If No Condition then jump to)

7.1.2.2 Administrative Commands

Administrative commands do not perform any motion, but control the initiation of a motion.

PowerOn

Active Command Queue	Parameters for Selected Motion Object												
- a01.PowerOn - a02.PowerOn - a03.PowerOn - a04.PowerOn - a05.PowerOn - Wait Time - Jump1 - Jump2 Label - Start Loop1 - a06.Change Operational Mode - Wait Time - a01.MoveRelative - a01.Wait State - a02.MoveRelative - a03.Wait OpMode - a01.Change Operational Mode - a03.MoveRelative - a03.Wait State - a04.MoveRelative - a04.Wait State - a05.MoveRelative - Wait Time - End Loop1 - Jump1 Label - a01.MoveRelativeRepetitive - a02.MoveRelativeRepetitive - a03.MoveRelativeRepetitive - a04.MoveRelativeRepetitive - a05.MoveRelativeRepetitive - Jump2 - a01.PowerOff - a02.PowerOff - a03.PowerOff	<table border="1"> <tr> <td>Axis Name</td> <td>a01</td> </tr> <tr> <td>Enable</td> <td>True</td> </tr> <tr> <td>EnablePositive</td> <td>True</td> </tr> <tr> <td>EnableNegative</td> <td>True</td> </tr> <tr> <td>BufferedMode</td> <td>MC_BUFFERED_MODE</td> </tr> <tr> <td>Execute</td> <td></td> </tr> </table> MC_ABORTING_MODE MC_BUFFERED_MODE MC_BLENDING_LOW_MODE MC_BLENDING_PREVIOUS_MODE MC_BLENDING_NEXT_MODE MC_BLENDING_HIGH_MODE BufferedMode Defines the chronological sequence of the FB relative to the previous block.	Axis Name	a01	Enable	True	EnablePositive	True	EnableNegative	True	BufferedMode	MC_BUFFERED_MODE	Execute	
Axis Name	a01												
Enable	True												
EnablePositive	True												
EnableNegative	True												
BufferedMode	MC_BUFFERED_MODE												
Execute													

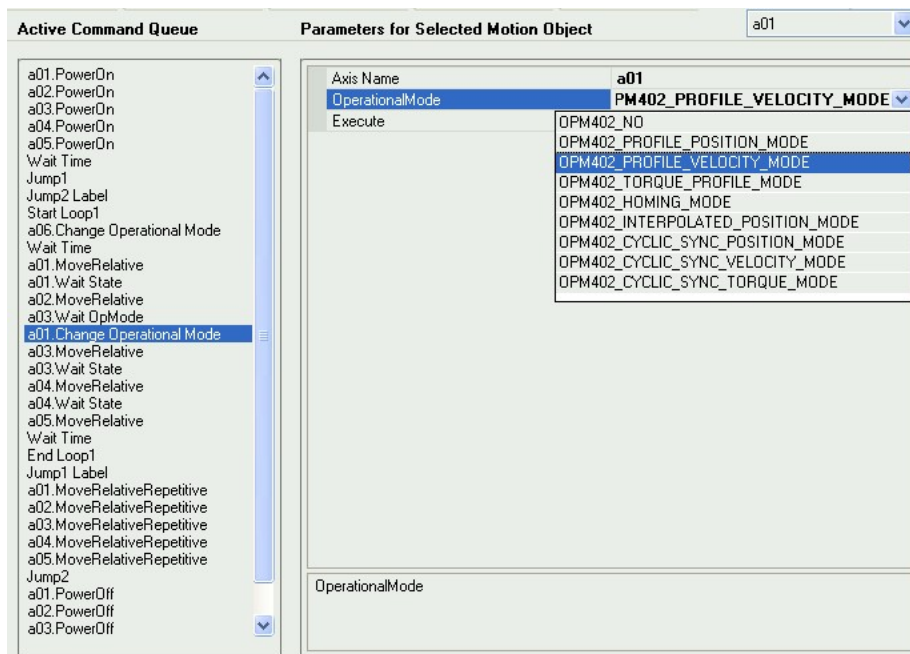
Initiates Power On when the axis is disabled and stopped using a selectable buffer mode. By default the buffer mode is MC_Buffered_Mode. If executed then Execute is set to 1, otherwise 0.

PowerOff

Active Command Queue	Parameters for Selected Motion Object												
- a01.PowerOn - a02.PowerOn - a03.PowerOn - a04.PowerOn - a05.PowerOn - Wait Time - Jump1 - Jump2 Label - Start Loop1 - a06.Change Operational Mode - Wait Time - a01.MoveRelative - a01.Wait State - a02.MoveRelative - a03.Wait OpMode - a01.Change Operational Mode - a03.MoveRelative - a03.Wait State - a04.MoveRelative - a04.Wait State - a05.MoveRelative - Wait Time - End Loop1 - Jump1 Label - a01.MoveRelativeRepetitive - a02.MoveRelativeRepetitive - a03.MoveRelativeRepetitive - a04.MoveRelativeRepetitive - a05.MoveRelativeRepetitive - Jump2 - a01.PowerOff - a02.PowerOff - a03.PowerOff	<table border="1"> <tr> <td>Axis Name</td> <td>a01</td> </tr> <tr> <td>Enable</td> <td>False</td> </tr> <tr> <td>EnablePositive</td> <td>True</td> </tr> <tr> <td>EnableNegative</td> <td>True</td> </tr> <tr> <td>BufferedMode</td> <td>MC_BUFFERED_MODE</td> </tr> <tr> <td>Execute</td> <td></td> </tr> </table> MC_ABORTING_MODE MC_BUFFERED_MODE MC_BLENDING_LOW_MODE MC_BLENDING_PREVIOUS_MODE MC_BLENDING_NEXT_MODE MC_BLENDING_HIGH_MODE BufferedMode Defines the chronological sequence of the FB relative to the previous block.	Axis Name	a01	Enable	False	EnablePositive	True	EnableNegative	True	BufferedMode	MC_BUFFERED_MODE	Execute	
Axis Name	a01												
Enable	False												
EnablePositive	True												
EnableNegative	True												
BufferedMode	MC_BUFFERED_MODE												
Execute													

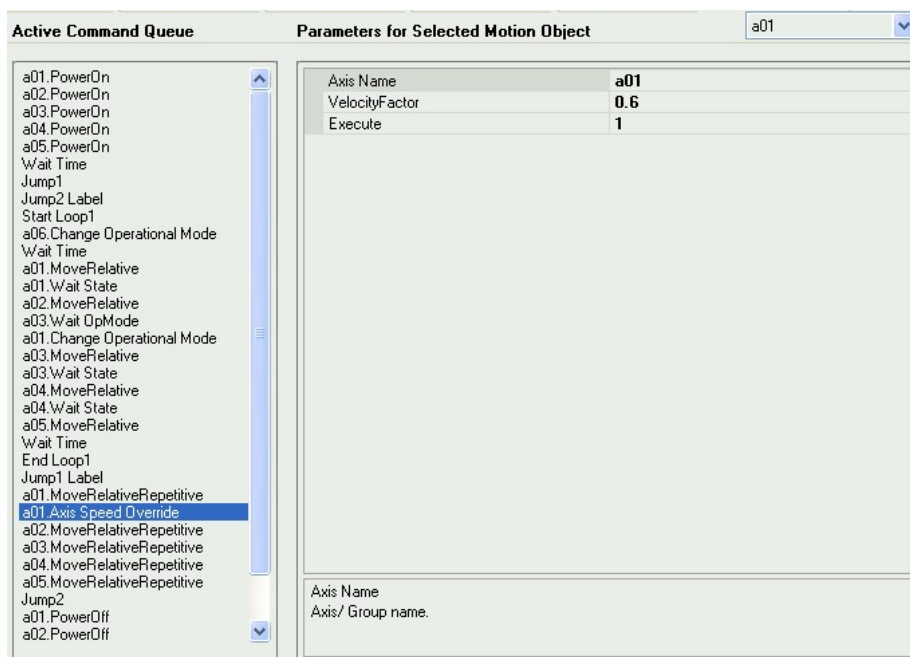
Initiates Power Off when the axis is enabled and at standstill using a selectable buffer mode. By default the buffer mode is MC_Buffered_Mode. If executed then Execute is set to 1, otherwise 0.

Change Operational Mode



Enables an axis to change its operation mode to another DS402 profile mode of operation or alternatively no DS402 profile mode. If executed then Execute is set to 1, otherwise 0.

Axis Speed Override



Enables an axis to lower its velocity by a Velocity Factor of the original speed. If executed then Execute is set to 1, otherwise 0.

Send SDO

Active Command Queue	Parameters for Selected Motion Object												
a03.PowerOn a04.PowerOn a05.PowerOn Wait Time Jump1 Jump2 Label Start Loop1 a06.Change Operational Mode Wait Time a01.Condition1 End Condition1 a01.MoveAdditive a01.Wait Parameter Condition a01.MoveRelative a01.Wait State a01.Send SDO	<table border="1"> <tr><td>Axis Name</td><td>a01</td></tr> <tr><td>Data</td><td>0</td></tr> <tr><td>Service</td><td>Download</td></tr> <tr><td>SubIndex</td><td>0</td></tr> <tr><td>DataLength</td><td>1</td></tr> <tr><td>Index</td><td>0x0</td></tr> </table>	Axis Name	a01	Data	0	Service	Download	SubIndex	0	DataLength	1	Index	0x0
Axis Name	a01												
Data	0												
Service	Download												
SubIndex	0												
DataLength	1												
Index	0x0												

Sends SDO message command, in units of 1, 2, or 4 bytes. This data length parameter receives in bytes. However, if a user sends a request to upload/download an SDO object that is not 1, 2 or 4 bytes, an error is returned.

The SubIndex defines which index value signifies the group of events to be transferred from the G-MAS. This parameter should mirror the enumerator value of the ucEventGroup variable, where applicable. Any +ve character values.

Set Parameter

Active Command Queue	Parameters for Selected Motion Object										
a03.PowerOn a04.PowerOn a05.PowerOn Wait Time Jump1 Jump2 Label Start Loop1 a06.Change Operational Mode Wait Time a01.Condition1 End Condition1 a01.MoveAdditive a01.Wait Parameter Condition a01.MoveRelative a01.Wait State a01.Send SDO a02.MoveRelative a02.MoveContinuous a03.Wait OpMode a01.Set Parameter	<table border="1"> <tr><td>Axis Name</td><td>a01</td></tr> <tr><td>ParameterName</td><td></td></tr> <tr><td>Value</td><td>0</td></tr> <tr><td>ParameterArrIndex</td><td>0</td></tr> <tr><td>ucEnable</td><td>1</td></tr> </table>	Axis Name	a01	ParameterName		Value	0	ParameterArrIndex	0	ucEnable	1
Axis Name	a01										
ParameterName											
Value	0										
ParameterArrIndex	0										
ucEnable	1										

Modifies the value of a vendor specific parameter. The ParameterArrIndex is the array index parameter, with any +ve integer values.

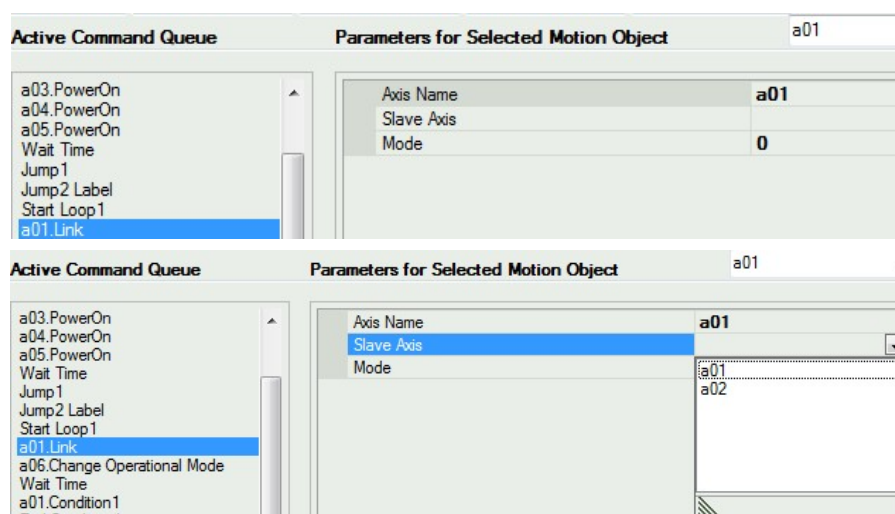
Set Global Parameter

Active Command Queue	Parameters for Selected Motion Object								
a03.PowerOn a04.PowerOn a05.PowerOn Wait Time Jump1 Jump2 Label Start Loop1 a06.Change Operational Mode Wait Time a01.Condition1 End Condition1 a01.MoveAdditive a01.Wait Parameter Condition a01.MoveRelative a01.Wait State a01.Send SDO a02.MoveRelative a02.MoveContinuous a03.Wait OpMode a01.Set Parameter a01.Change Operational Mode a03.MoveRelative a03.Wait State Set Global Parameter	<table border="1"> <tr><td>ParameterName</td><td></td></tr> <tr><td>Value</td><td>0</td></tr> <tr><td>ParameterArrIndex</td><td>0</td></tr> <tr><td>ucEnable</td><td>1</td></tr> </table>	ParameterName		Value	0	ParameterArrIndex	0	ucEnable	1
ParameterName									
Value	0								
ParameterArrIndex	0								
ucEnable	1								

Modifies the value of a vendor global parameter. The ParameterArrIndex is the

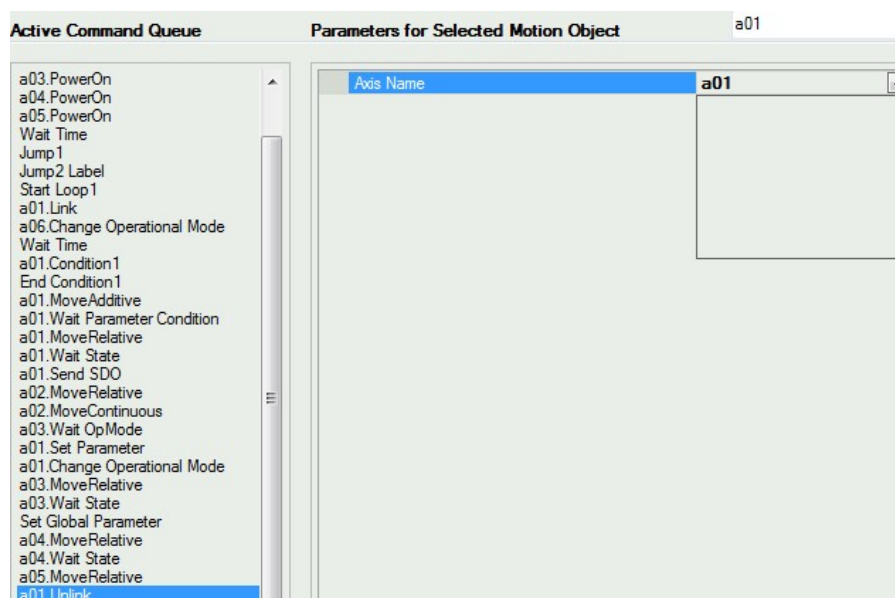
array index parameter, with any +ve integer values.

Link



Links a master axis with a slave axis.

Unlink



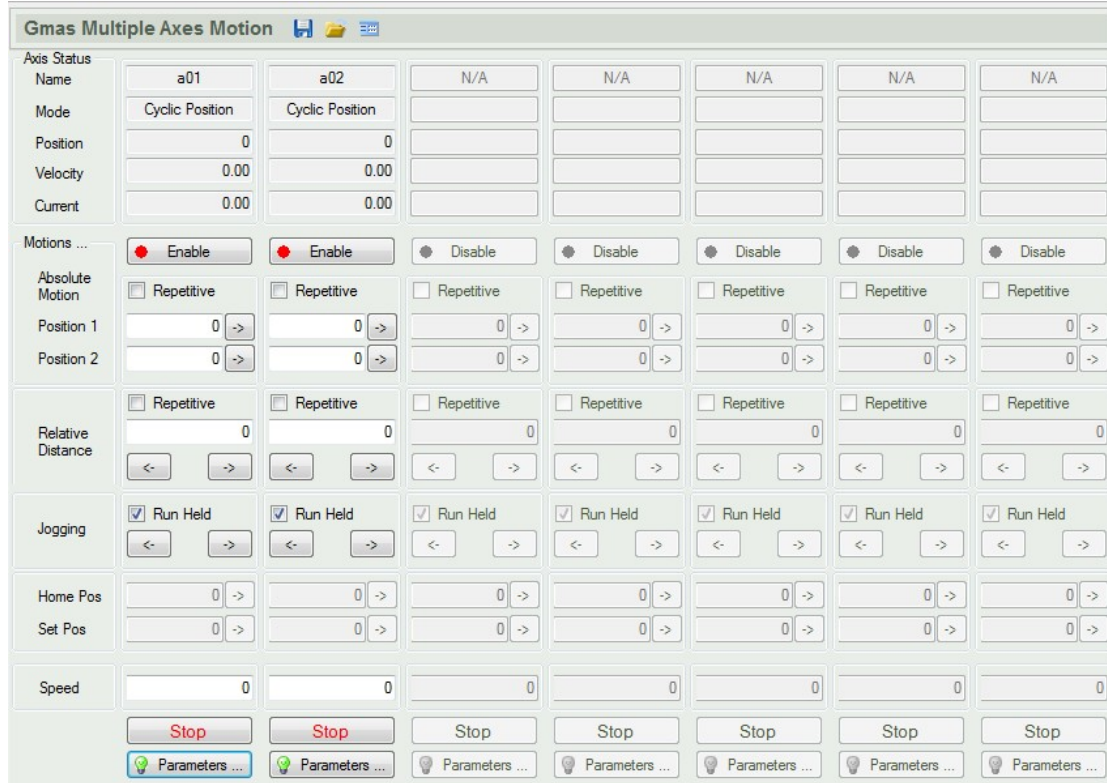
Unlinks the master axis with the slave axis.

7.1.2.3 Motion Commands

Motion commands perform motion. For a complete explanation of the motion commands refer to Chapter 5: Motion Function Blocks in the Administrative and Motion API documentation.

7.2 GMAS Uncoordinated Multiple Axes Motion

When the GMAS Multiple Axes Motion window is selected, a number of visual options are available.



Axis Status	a01	a02	N/A	N/A	N/A	N/A	N/A
Name	a01	a02	N/A	N/A	N/A	N/A	N/A
Mode	Cyclic Position	Cyclic Position					
Position	0	0					
Velocity	0.00	0.00					
Current	0.00	0.00					
Motions ...	Enable	Enable	Disable	Disable	Disable	Disable	Disable
Absolute Motion	☐ Repetitive	☐ Repetitive	☐ Repetitive	☐ Repetitive	☐ Repetitive	☐ Repetitive	☐ Repetitive
Position 1	0 ->	0 ->	0 ->	0 ->	0 ->	0 ->	0 ->
Position 2	0 ->	0 ->	0 ->	0 ->	0 ->	0 ->	0 ->
Relative Distance	☐ Repetitive 0 <- ->	☐ Repetitive 0 <- ->	☐ Repetitive 0 <- ->	☐ Repetitive 0 <- ->	☐ Repetitive 0 <- ->	☐ Repetitive 0 <- ->	☐ Repetitive 0 <- ->
Jogging	☒ Run Held <- ->	☒ Run Held <- ->	☒ Run Held <- ->	☒ Run Held <- ->	☒ Run Held <- ->	☒ Run Held <- ->	☒ Run Held <- ->
Home Pos	0 ->	0 ->	0 ->	0 ->	0 ->	0 ->	0 ->
Set Pos	0 ->	0 ->	0 ->	0 ->	0 ->	0 ->	0 ->
Speed	0	0	0	0	0	0	0
	Stop	Stop	Stop	Stop	Stop	Stop	Stop
	Parameters ...	Parameters ...	Parameters ...	Parameters ...	Parameters ...	Parameters ...	Parameters ...

It should be noted that all operations in this window are for uncoordinated multiple axes, i.e. the axes are not grouped.

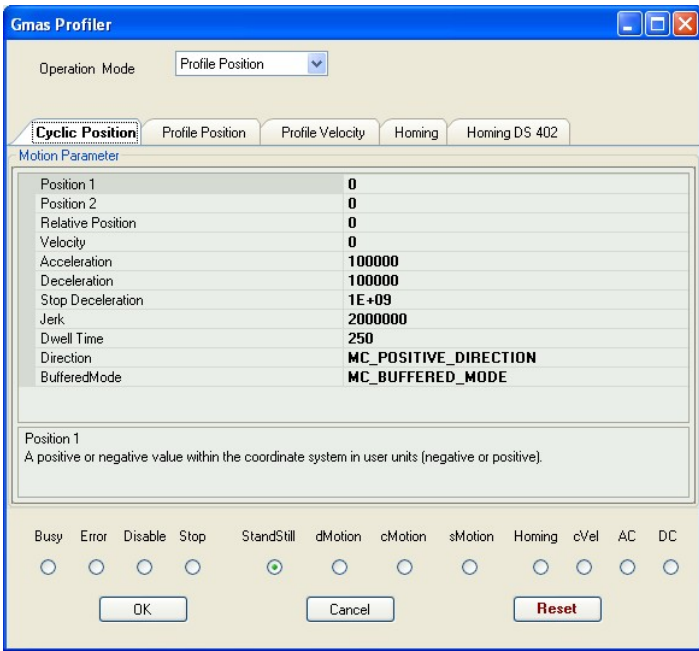
At the right top corner, the pull-down menu allows a number of visual options. Each option opens one or more panes, which include the Terminal (for further information on the Terminal refer to the section 5.2 on page 307) and Recorder (for further information on the Terminal refer to the section 5.1 on page 278) with the GMAS Multiple Axes Motion windowpane. Select the visual option as required.

7.2.1 Parameters Table

The GMAS Multiple Axes Motion area is similar visually to the Multiple Axes Motion area. However, the GMAS Multiple Axes Motion window, offers two possible options of motion controlled by the G-MAS depending on the G-MAS connection:

EtherCAT connection

The G-MAS Profiler window displays the Cyclic Position options with the other position options shown below.



Motion Parameter	
Position 1	0
Position 2	0
Relative Position	0
Velocity	0
Acceleration	100000
Deceleration	100000
Stop Deceleration	1E+09
Jerk	2000000
Dwell Time	250
Direction	MC_POSITIVE_DIRECTION
BufferedMode	MC_BUFFERED_MODE

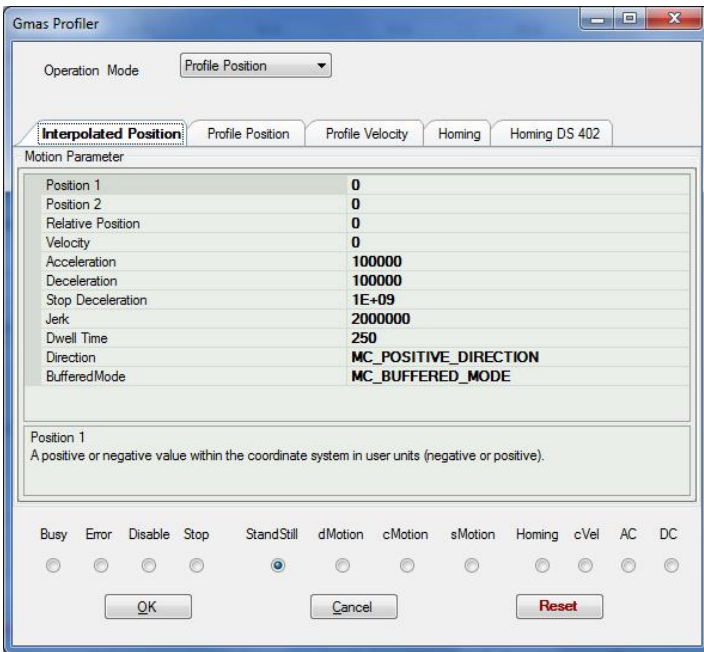
Position 1
A positive or negative value within the coordinate system in user units (negative or positive).

Busy Error Disable Stop StandStill dMotion cMotion sMotion Homing cVel AC DC
☐ ☐ ☐ ☐ ☒ ☐ ☐ ☐ ☐ ☐ ☐ ☐

OK Cancel Reset

CANbus connection

The G-MAS Profiler window displays the Interpolated Position options with the other position options shown below.



Motion Parameter	
Position 1	0
Position 2	0
Relative Position	0
Velocity	0
Acceleration	100000
Deceleration	100000
Stop Deceleration	1E+09
Jerk	2000000
Dwell Time	250
Direction	MC_POSITIVE_DIRECTION
BufferedMode	MC_BUFFERED_MODE

Position 1
A positive or negative value within the coordinate system in user units (negative or positive).

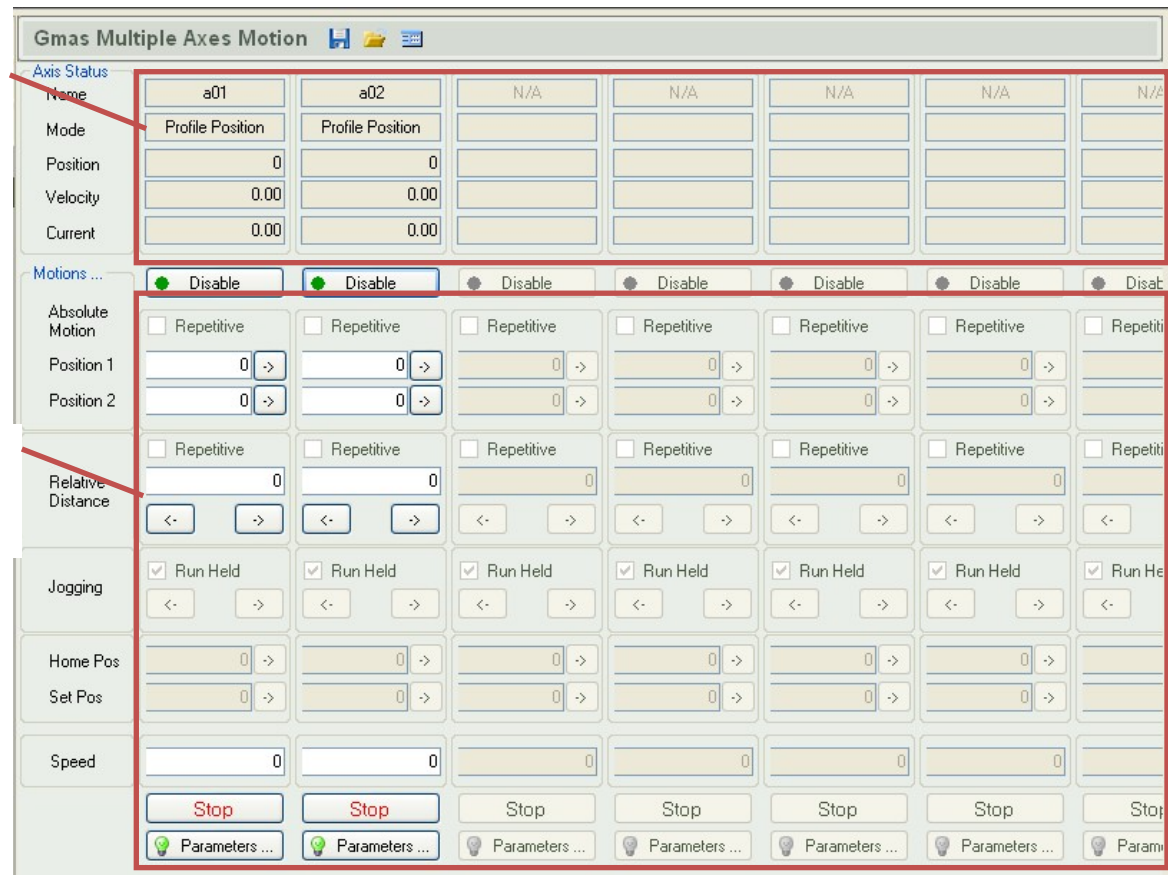
Busy Error Disable Stop StandStill dMotion cMotion sMotion Homing cVel AC DC
☐ ☐ ☐ ☐ ☐ ☒ ☐ ☐ ☐ ☐ ☐ ☐

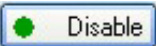
OK Cancel Reset

The GMAS Multiple Axes Motion area consists of the following parameters table.

Axis Status Parameters view area

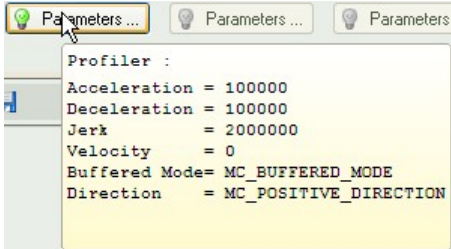
Motions... Modify parameters area

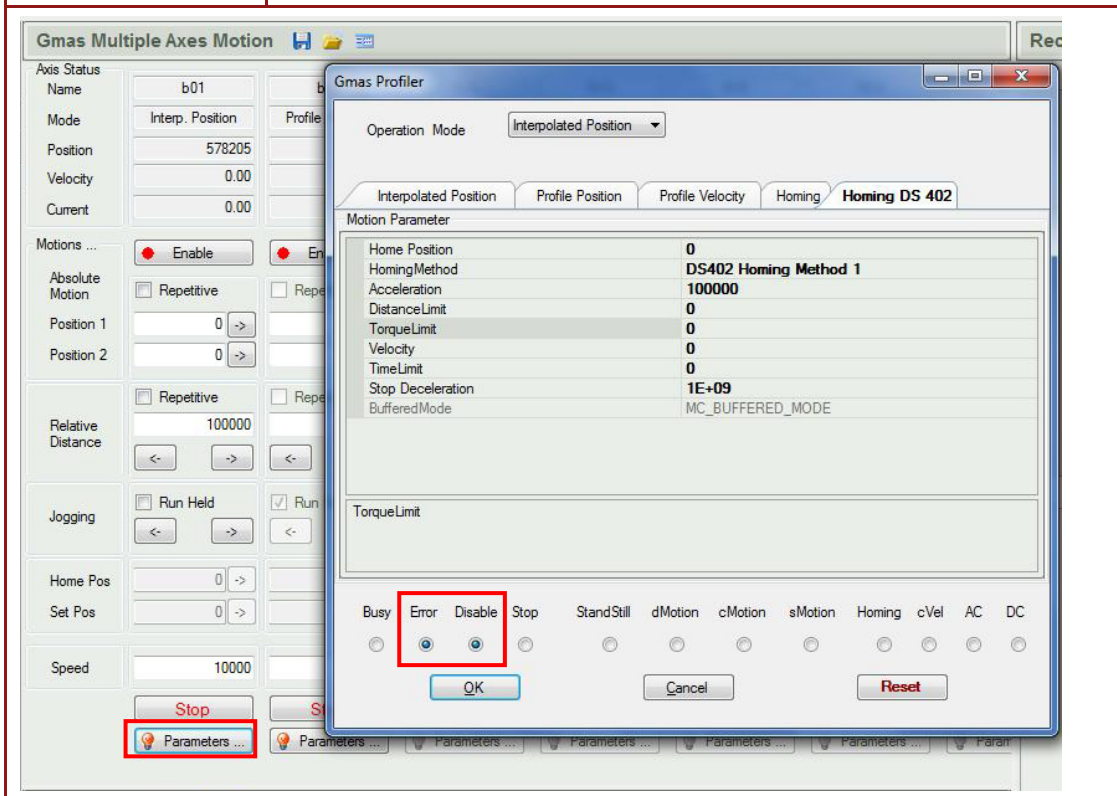


Parameter	Explanation
Axis Status	
Name	The name of the target axis, servo-drive, etc. defined by this application
Mode	Defaults to the Profile Position mode initially, and when no parameters are entered. The mode reflects the G-MAS profile window information and describes the present axis mode.
Position	Position status indicator. Position of the servo-drive at any single instant.
Velocity	For a group of axes, this provides the velocity of the TCP in MCS measurements.
Current	The active current flowing in the axis, drive, controller, or I/O
 Disable	To enable the drive click Enable . The button displays Disable . The button color changes from red to green.
Absolute Motion	Option to select Repetitive mode. Absolute motion defines the motion of the axis in a single movement, whereas Repetitive mode describes motion, which repeats.
Position 1	Position of the servo drive in the unit defined for the position.
Position 2	Two positions are selectable for both absolute and repetitive motion



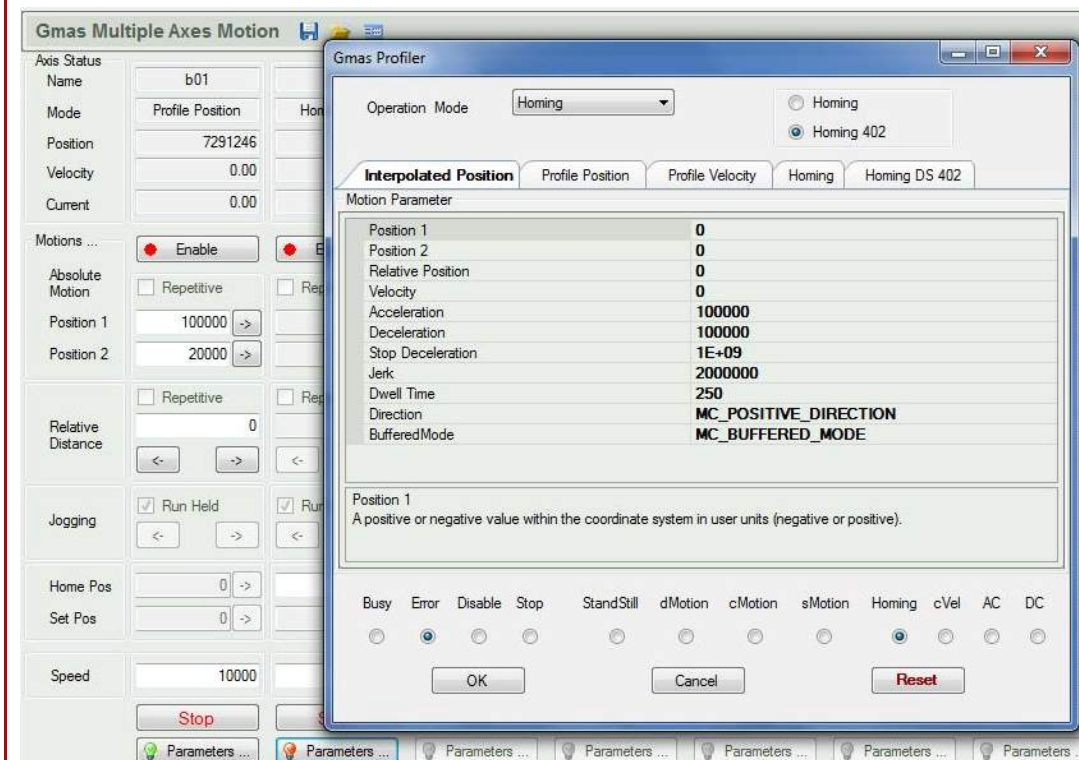
Parameter	Explanation
	The change will take effect the when you click on the Start Motion  button. You can change the speed on the fly during point-to-point or jogging motions.
Relative Distance	Relative distance of the servo-drive from the starting point in units defined for the distance. Click the right pointing Start Motion button  to move in the positive direction. Click the left pointing Start Motion button  to start motion in the negative direction.
Jogging	Motion can be jogging or if necessary Run Held and adjustable manually. The Run Held is set as default. If clicked the direction buttons become available. Then click the right pointing Start Motion button  to jog in the positive direction. Click the left pointing Start Motion button  to jog in the negative direction.
Home Pos (ition)	When causing the motion to be directed towards home, enter the Home position.
Set Pos (ition)	Allows setting a specific reference position for the G-MAS and motion of the axes.
Speed	This is the average velocity of the motion, which can be set in units of distance per time.
Stop	Clicking the Stop button will stop the motion in progress using the defined stop deceleration.

Parameter	Explanation
Parameters icon 	When the axis is selected as part of the multi-axes profile, the profile for axis is selectable and adjustable. A green bulb displays showing that the Profile is active. Click the button to open the GMAS Profiler. The Parameters button is context sensitive and when the mouse is moved over the button, the GMAS Profiler present settings for the axis, are displayed.  When a G-MAS error occurs for any reason, the Parameters button changes to a red light bulb, and the GMAS Profiler displays radio buttons next to both, Error and Disabled.



Parameter	Explanation
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	An example of a Homing is shown below. Notice the radio buttons next to both Error and Homing in the GMAS Profiler. The Parameters button also shows an error.
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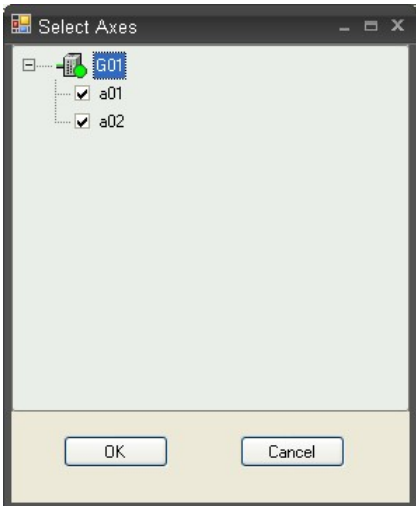


7.2.2 Icons

The following icons of the GMAS Multiple Axes Motion area allow operations in conjunction with the axes motion.



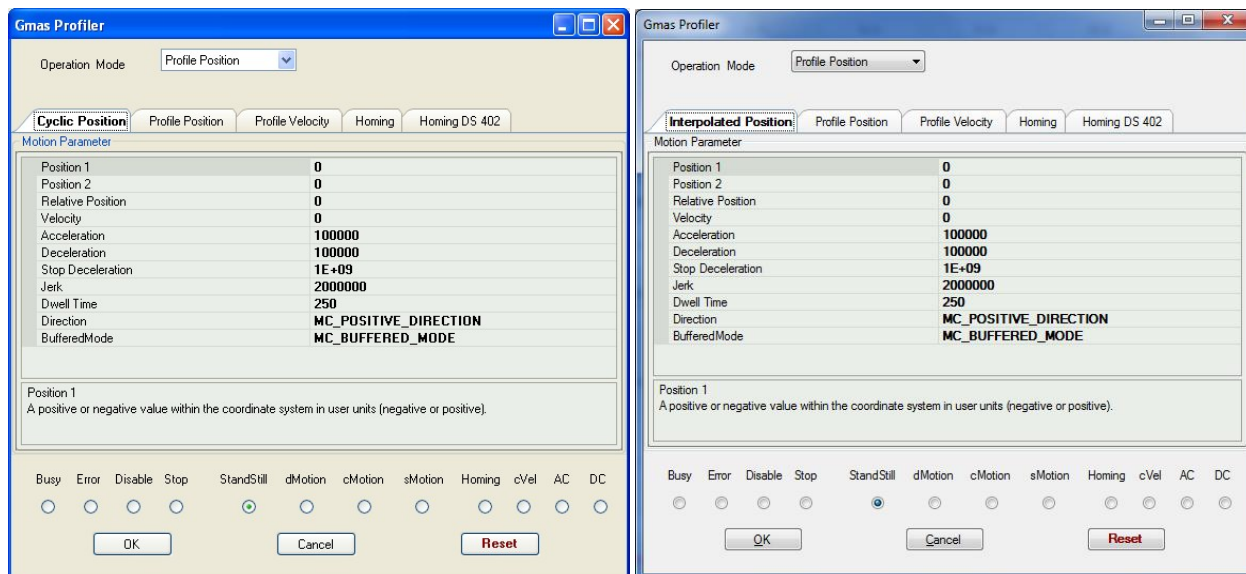
These icons perform the following:

Icon	Operation
	Saves the current queue to file. The axis/group name is also saved. Save only operates when the Commands Queue contains a function block.
	Loads the queue from a file, with the current command queue being cleared. The axis/group name is also loaded.
	Opens the following window to select an axis. Select or unselect an axis connected to the G-MAS. The selected axis (clicked checkbox) parameters will then be editable. 

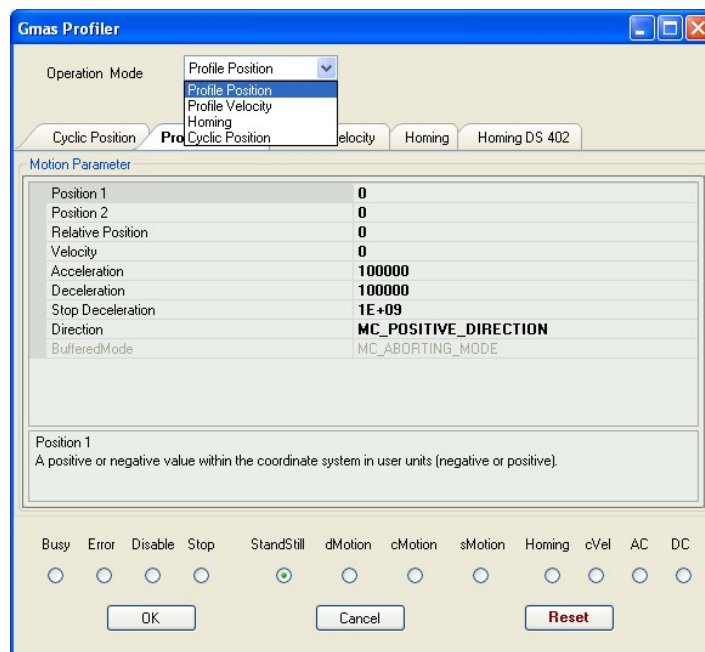
7.2.3 G-MAS Profiler

The motion profile of multiple axes grouped drives, controllers, and I/Os, may be defined according to the operation mode of the servo drive, with the appropriate operation mode applicable to each possible variation.

Open the G-MAS Profiler window by clicking the Parameters icon  Parameters ... in GMA5 Multiple Axes Motion window. The G-MAS Profiler window displays the following by default depending on whether the G-MAS connection is via EtherCAT or CANbus.



The Operation Mode may be selecting from the pull-down menu options.

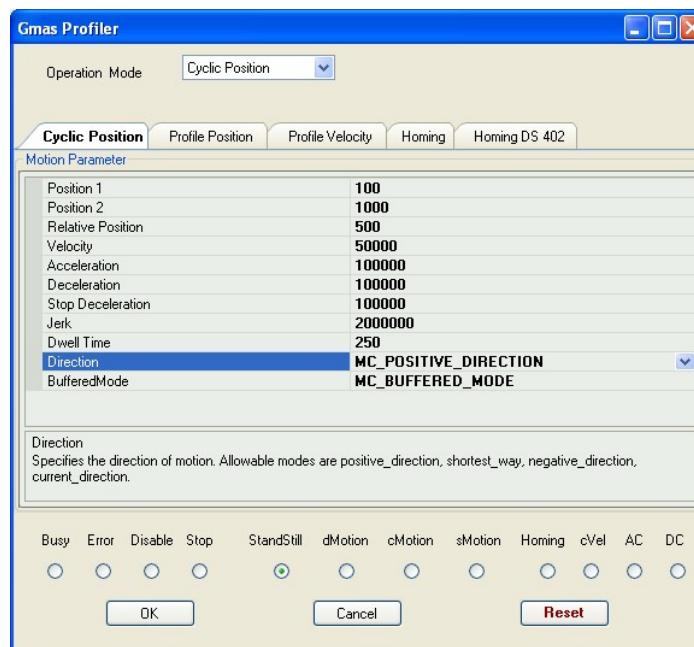


The Operation Mode offers a number of Profile tabs to vary the position of the axis.

Cyclic Position

For G-MAS connection via EtherCAT

Allows full editing of all parameters including Direction and the Buffered Mode.



The screenshot shows the 'Gmas Profiler' window with the 'Operation Mode' set to 'Cyclic Position'. The 'Cyclic Position' tab is selected, showing a list of motion parameters and their values:

Motion Parameter	Value
Position 1	100
Position 2	1000
Relative Position	500
Velocity	50000
Acceleration	100000
Deceleration	100000
Stop Deceleration	100000
Jerk	2000000
Dwell Time	250
Direction	MC_POSITIVE_DIRECTION
BufferedMode	MC_BUFFERED_MODE

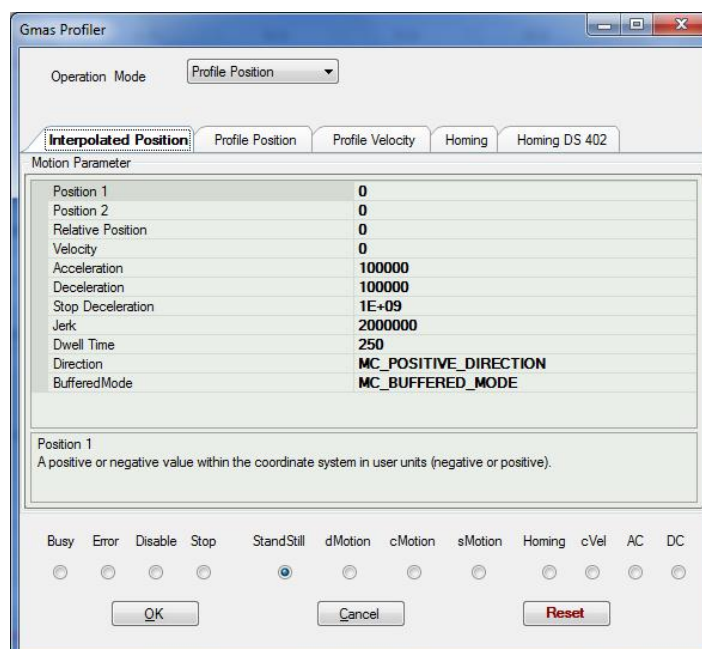
Below the table, there is a description for 'Direction':
Direction
Specifies the direction of motion. Allowable modes are positive_direction, shortest_way, negative_direction, current_direction.

At the bottom, there are status indicators for various states: Busy, Error, Disable, Stop, StandStill, dMotion, cMotion, sMotion, Homing, cVel, AC, DC. The 'StandStill' indicator is currently active (green dot). Buttons for 'OK', 'Cancel', and 'Reset' are at the bottom right.

Interpolated Position

For G-MAS connection via EtherCAT

Allows full editing of all parameters including Direction and the Buffered Mode.



The screenshot shows the 'Gmas Profiler' window with the 'Operation Mode' set to 'Profile Position'. The 'Interpolated Position' tab is selected, showing a list of motion parameters and their values:

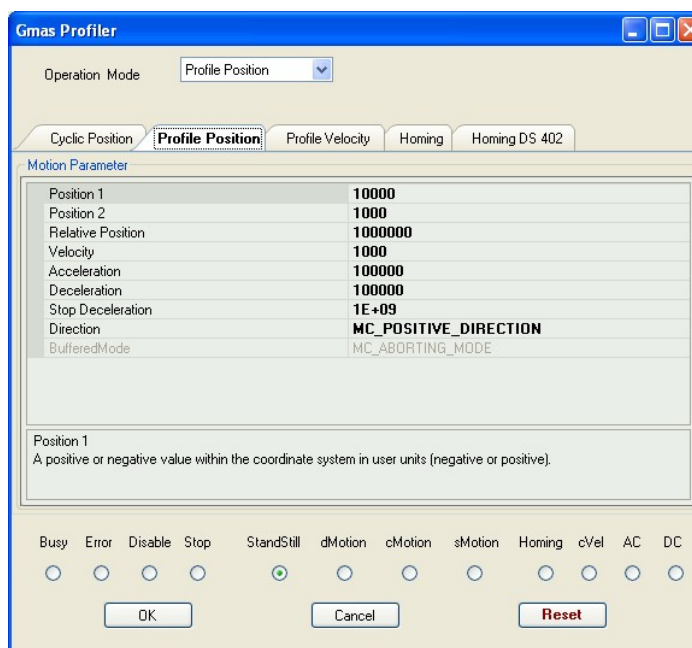
Motion Parameter	Value
Position 1	0
Position 2	0
Relative Position	0
Velocity	0
Acceleration	100000
Deceleration	100000
Stop Deceleration	1E+09
Jerk	2000000
Dwell Time	250
Direction	MC_POSITIVE_DIRECTION
BufferedMode	MC_BUFFERED_MODE

Below the table, there is a description for 'Position 1':
Position 1
A positive or negative value within the coordinate system in user units (negative or positive).

At the bottom, there are status indicators for various states: Busy, Error, Disable, Stop, StandStill, dMotion, cMotion, sMotion, Homing, cVel, AC, DC. The 'StandStill' indicator is currently active (green dot). Buttons for 'OK', 'Cancel', and 'Reset' are at the bottom right.

Profile Position

Describes the profile for the relative position movement of the axis.



The Gmas Profiler window is titled "Gmas Profiler". The "Operation Mode" dropdown is set to "Profile Position". The "Profile Position" tab is selected, showing the following parameters:

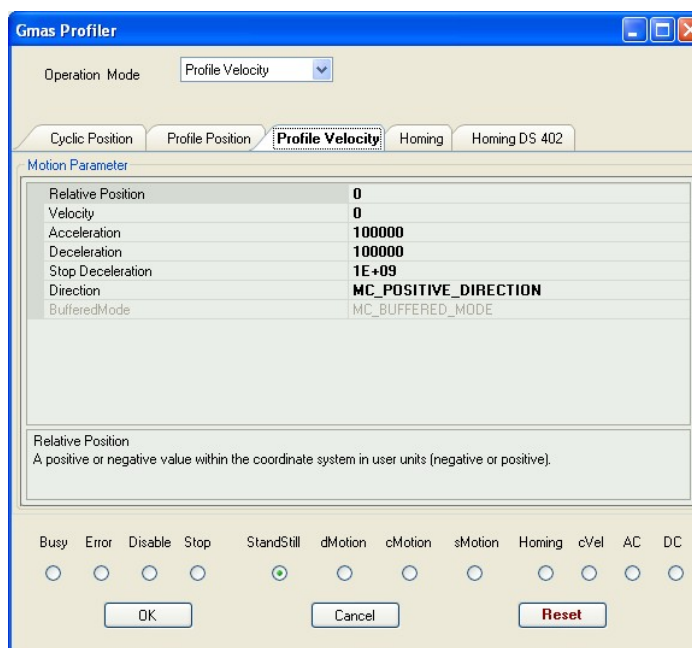
Parameter	Value
Position 1	10000
Position 2	1000
Relative Position	1000000
Velocity	1000
Acceleration	100000
Deceleration	100000
Stop Deceleration	1E+09
Direction	MC_POSITIVE_DIRECTION
BufferedMode	MC_ABORTING_MODE

Position 1
A positive or negative value within the coordinate system in user units (negative or positive).

Buttons: Busy, Error, Disable, Stop, StandStill, dMotion, cMotion, sMotion, Homing, cVel, AC, DC. Status: StandStill is active (green dot). Buttons: OK, Cancel, Reset.

Profile Velocity

Describes the profile for the relative velocity movement of the axis.



The Gmas Profiler window is titled "Gmas Profiler". The "Operation Mode" dropdown is set to "Profile Velocity". The "Profile Velocity" tab is selected, showing the following parameters:

Parameter	Value
Relative Position	0
Velocity	0
Acceleration	100000
Deceleration	100000
Stop Deceleration	1E+09
Direction	MC_POSITIVE_DIRECTION
BufferedMode	MC_BUFFERED_MODE

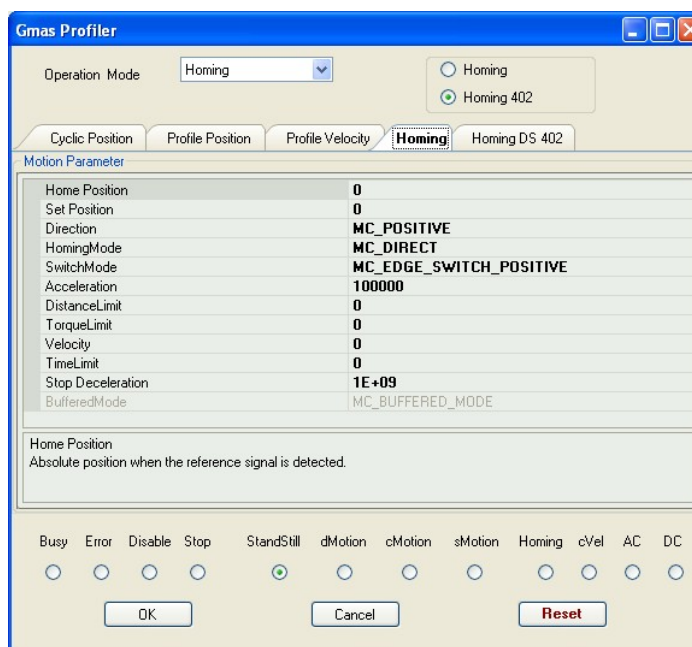
Relative Position
A positive or negative value within the coordinate system in user units (negative or positive).

Buttons: Busy, Error, Disable, Stop, StandStill, dMotion, cMotion, sMotion, Homing, cVel, AC, DC. Status: StandStill is active (green dot). Buttons: OK, Cancel, Reset.

Homing

If Homing is selected, another further option can be selected by clicking the radio button next to one of the following:

- Homing
- Homing 402 (Homing DS402)



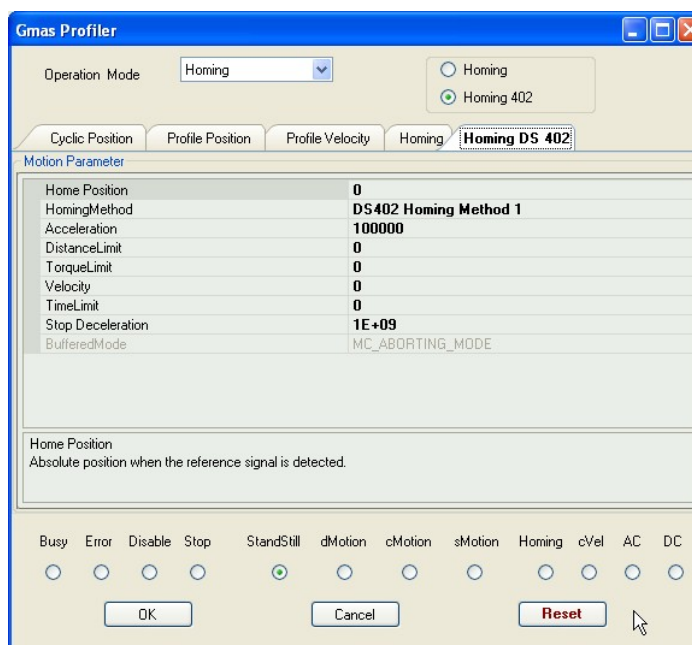
The screenshot shows the 'Gmas Profiler' window with the 'Operation Mode' set to 'Homing'. The 'Homing' radio button is selected, and the 'Homing DS 402' tab is active. The 'Motion Parameter' section displays the following values:

Home Position	0
Set Position	0
Direction	MC_POSITIVE
HomingMode	MC_DIRECT
SwitchMode	MC_EDGE_SWITCH_POSITIVE
Acceleration	100000
DistanceLimit	0
TorqueLimit	0
Velocity	0
TimeLimit	0
Stop Deceleration	1E+09
BufferedMode	MC_BUFFERED_MODE

Below the parameters, the 'Home Position' is described as 'Absolute position when the reference signal is detected.' At the bottom, there are status indicators for Busy, Error, Disable, Stop, StandStill, dMotion, cMotion, sMotion, Homing, cVel, AC, and DC. The 'StandStill' indicator is currently active. Buttons for OK, Cancel, and Reset are at the bottom right.

Homing DS402

Homing according to the DS402 PLCopen specification.

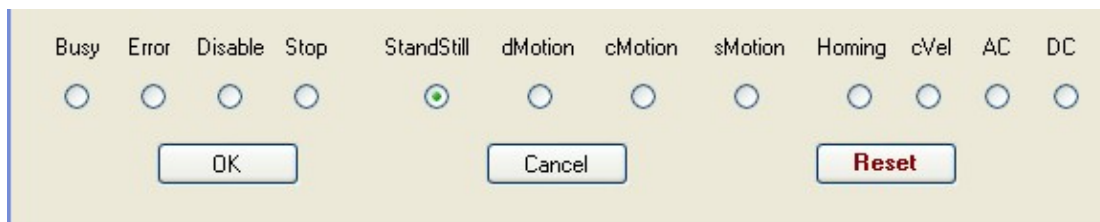


The screenshot shows the 'Gmas Profiler' window with the 'Operation Mode' set to 'Homing'. The 'Homing 402' radio button is selected, and the 'Homing DS 402' tab is active. The 'Motion Parameter' section displays the following values:

Home Position	0
HomingMethod	DS402 Homing Method 1
Acceleration	100000
DistanceLimit	0
TorqueLimit	0
Velocity	0
TimeLimit	0
Stop Deceleration	1E+09
BufferedMode	MC_ABORTING_MODE

Below the parameters, the 'Home Position' is described as 'Absolute position when the reference signal is detected.' At the bottom, there are status indicators for Busy, Error, Disable, Stop, StandStill, dMotion, cMotion, sMotion, Homing, cVel, AC, and DC. The 'StandStill' indicator is currently active. Buttons for OK, Cancel, and Reset are at the bottom right.

7.2.3.1.1 Activity and Main buttons

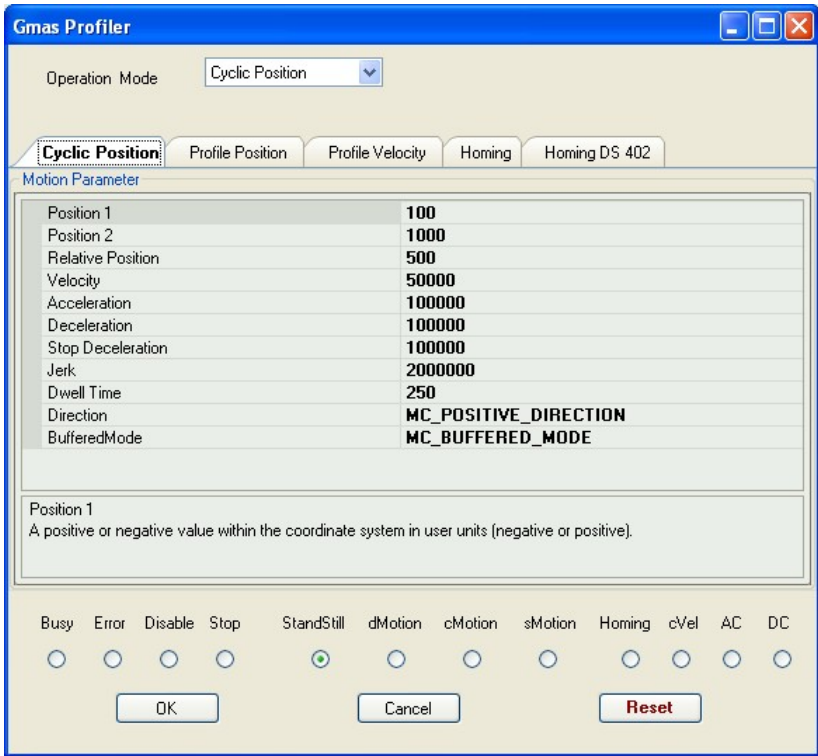


The radio buttons display the operation of the axis before, during, and after its motion, and in normal operation, more than one button is active. They describe the present status of the axis according to the PLC Open specification as follows:

Busy	Not in use at this moment
Error	During the operation of most modes (states) an error can occur, and both the operative mode and Error radio button will be active.
Disable	The axis is presently disabled.
Stop	The motion of the axis is at status Stop, but not Standstill and may be an interim state between other states.
StandStill	The axis is presently in standstill mode.
dMotion	The axis is operating in discrete motion, e.g. using the function block MoveAbsolute from Standstill
cMotion	The axis is operating in continuous motion
sMotion	The vector axis of a group is in synchronized motion with the group.
Homing	The axis is moving towards its natural home position and will complete when the axis is at Standstill.
cVel	The axis is operating with continuous velocity and continuous motion, therefore both cMotion and cVel radio buttons are active.
AC	Acceleration. The axis is accelerating.
DC	Deceleration. The axis is decelerating.

The lower three buttons describe the actions of the GMAS Profiler window for an axis. Therefore, use **OK** to accept changes to the window and close it, or **Cancel** to cancel the changes. If the status button indicators display an Error, then the axis should be reset, by pressing .

7.2.3.2 Cyclic Position



The screenshot shows the 'Gmas Profiler' window with the 'Cyclic Position' tab selected. The 'Operation Mode' is set to 'Cyclic Position'. The 'Motion Parameter' section contains the following values:

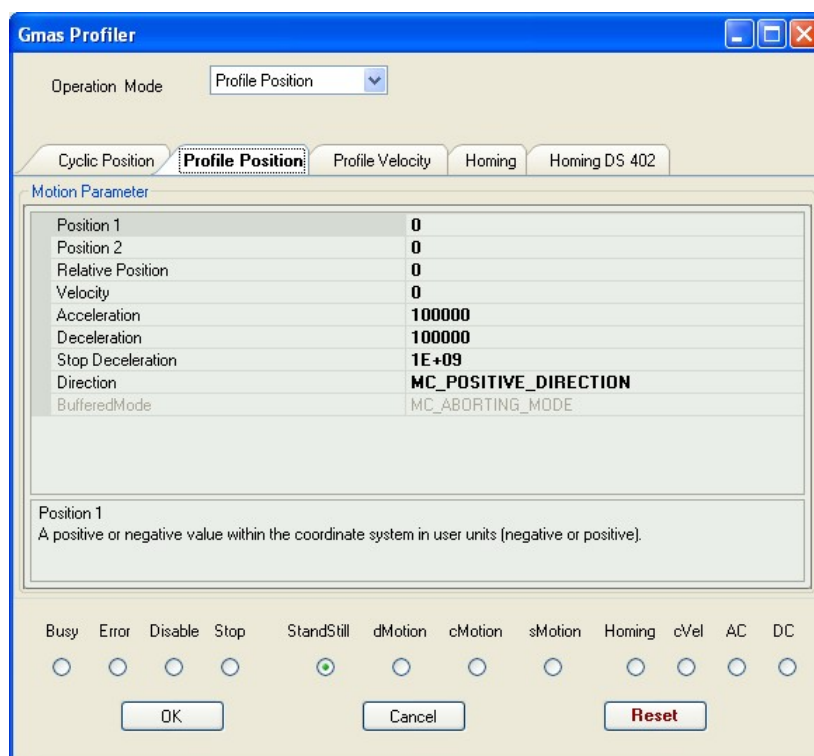
Position 1	100
Position 2	1000
Relative Position	500
Velocity	50000
Acceleration	100000
Deceleration	100000
Stop Deceleration	100000
Jerk	2000000
Dwell Time	250
Direction	MC_POSITIVE_DIRECTION
BufferedMode	MC_BUFFERED_MODE

Below the parameters, there is a status bar with indicators for Busy, Error, Disable, Stop, StandStill, dMotion, cMotion, sMotion, Homing, cVel, AC, and DC. The 'StandStill' indicator is currently active. At the bottom are 'OK', 'Cancel', and 'Reset' buttons.

Parameter	Definition
Position 1	Initial position of an object managed by an axis.
Position 2	Secondary position of an object managed by an axis.
Relative Position	Relative position between position 1 and 2
Velocity	Defines the maximum Velocity allowed in units/sec
Acceleration	Defines the maximum allowed profiler acceleration. Uses the AC Command (from the Gold Line and SimplIQ Command Reference Guides)
Deceleration	Defines the maximum allowed profiler deceleration. Uses the DC Command (from the Gold Line and SimplIQ Command Reference Guides)
Stop Deceleration	Deceleration during a Stop process. Defines the deceleration in counts/second ² used to stop motions in case of emergency or as a limit. In addition, SD defines the acceleration limit for the combination of software and external reference commands. Uses the SD Command (from the Gold Line and SimplIQ Command Reference Guides). When the Trapezium profile is not used, as in the Interpolation drive mode, this will be dependent on the drive. Only relevant for NC drives.
Jerk	Value of the Jerk. Any positive value in u/s ³

Parameter	Definition
Dwell Time	Delay time in secs, only relevant to Repetitive movements.
Direction	Specifies the direction of the motion, if any.
Buffered mode	Defines the behavior of an axis during motion, and whether buffering is used or not. Buffered mode only applies to Distributed and not NC axis.

7.2.3.3 Profile Position



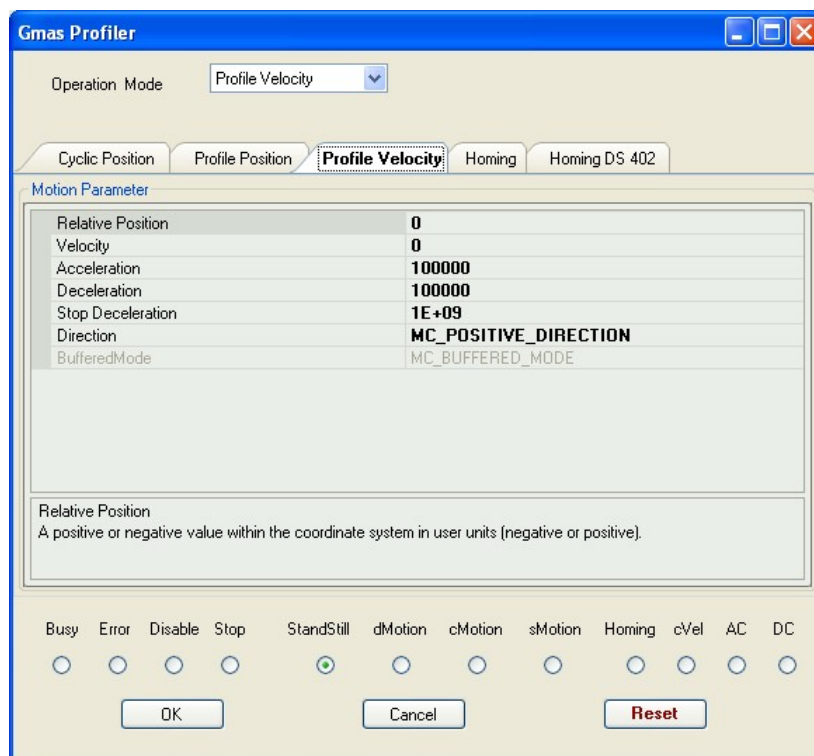
Within the Profile Position tab, you can alter the following **Motion Parameters**.

Parameter	Definition
Position 1	Initial position of an object managed by an axis.
Position 2	Secondary position of an object managed by an axis.
Relative Position	Relative position between position 1 and 2
Velocity	Defines the maximum Velocity allowed in units/sec
Acceleration	Defines the maximum allowed profiler acceleration. Uses the AC Command (from the Gold Line and SimplIQ Command Reference Guides)
Deceleration	Defines the maximum allowed profiler deceleration. Uses the DC Command (from the Gold Line and SimplIQ Command Reference Guides)



Parameter	Definition	
Stop Deceleration	Deceleration during a Stop process. Defines the deceleration in counts/second ² used to stop motions in case of emergency or as a limit. In addition, SD defines the acceleration limit for the combination of software and external reference commands. Uses the SD Command (from the Gold Line and SimplIQ Command Reference Guides). When the Trapezium profile is not used, as in the Interpolation drive mode, this will be dependent on the drive. Only relevant for NC drives.	
Direction	Specifies the direction of the motion, if any. This enumerator type can have 1-of-4 values depending on the MC_HomingMode parameter:	
	MC_POSITIVE	For MC_ABS_SWITCH, MC_BLOCK, and MC_REF_PULSE, starts in positive direction always. For MC_LIMIT_SWITCH starts in Positive direction searching positive LimitSwitch. The direction is automatically reversed from LimitSwitch initial state.
	MC_NEGATIVE	For MC_ABS_SWITCH, MC_BLOCK, and MC_REF_PULSE, starts in negative direction always. For MC_LIMIT_SWITCH starts in Negative direction searching negative LimitSwitch. The direction is automatically reversed from LimitSwitch initial state.
	MC_SWITCH_POSITIVE	For MC_ABS_SWITCH depends on Switch status at Execute edge. If Switch is Off, direction is positive, if On it is negative.
	MC_SWITCH_NEGATIVE	For MC_ABS_SWITCH depends on Switch status at Execute edge. If Switch is On, direction is positive, if Off it is negative.

7.2.3.4 Profile Velocity

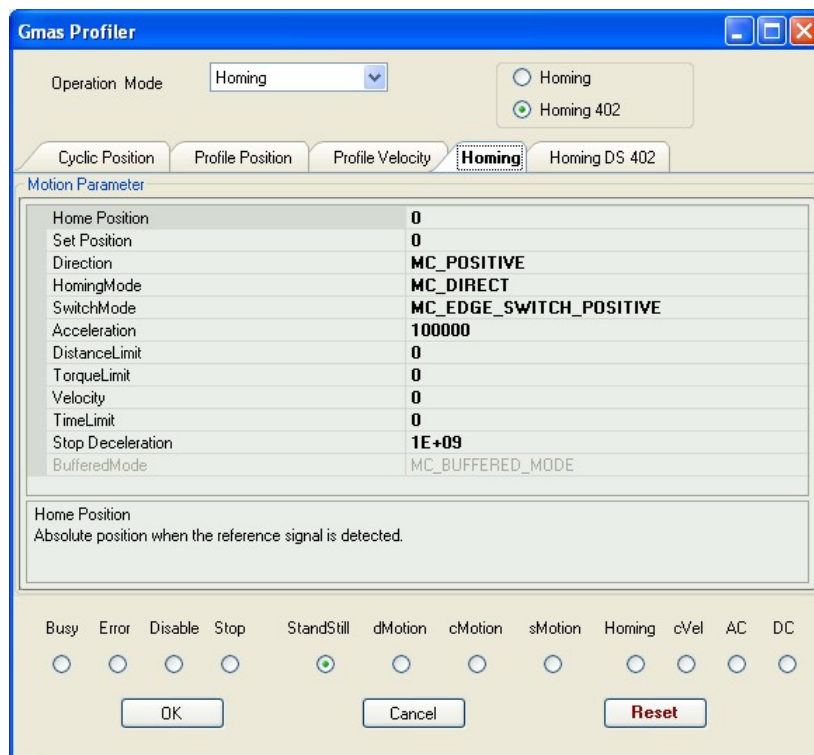


In the Profile Velocity tab, you can alter the following **Motion Parameters**.

Parameter	Definition	
Relative Position	Relative position between the initial position and the final position.	
Velocity	Defines the maximum Velocity allowed in units/sec	
Acceleration	Defines the maximum allowed profiler acceleration. Uses the AC Command (from the Gold Line and SimplIQ Command Reference Guides)	
Deceleration	Defines the maximum allowed profiler deceleration. Uses the DC Command (from the Gold Line and SimplIQ Command Reference Guides)	
Stop Deceleration	Deceleration during a Stop process. Defines the deceleration in counts/second ² used to stop motions in case of emergency or as a limit. In addition, SD defines the acceleration limit for the combination of software and external reference commands. Uses the SD Command (from the Gold Line and SimplIQ Command Reference Guides). When the Trapezium profile is not used, as in the Interpolation drive mode, this will be dependent on the drive. Only relevant for NC drives.	
Direction	Specifies the direction of the motion, if any. This enumerator type can have 1-of-4 values depending on the MC_HomingMode parameter:	
	MC_POSITIVE	For MC_ABS_SWITCH, MC_BLOCK, and MC_REF_PULSE, starts in positive direction

Parameter	Definition
	always. For MC_LIMIT_SWITCH starts in Positive direction searching positive LimitSwitch. The direction is automatically reversed from LimitSwitch initial state.
MC_NEGATIVE	For MC_ABS_SWITCH, MC_BLOCK, and MC_REF_PULSE, starts in negative direction always. For MC_LIMIT_SWITCH starts in Negative direction searching negative LimitSwitch. The direction is automatically reversed from LimitSwitch initial state.
MC_SWITCH_POSITIVE	For MC_ABS_SWITCH depends on Switch status at Execute edge. If Switch is Off, direction is positive, if On it is negative.
MC_SWITCH_NEGATIVE	For MC_ABS_SWITCH depends on Switch status at Execute edge. If Switch is On, direction is positive, if Off it is negative.

7.2.3.5 Homing



In the Homing tab, you can alter the following **Motion Parameters**.

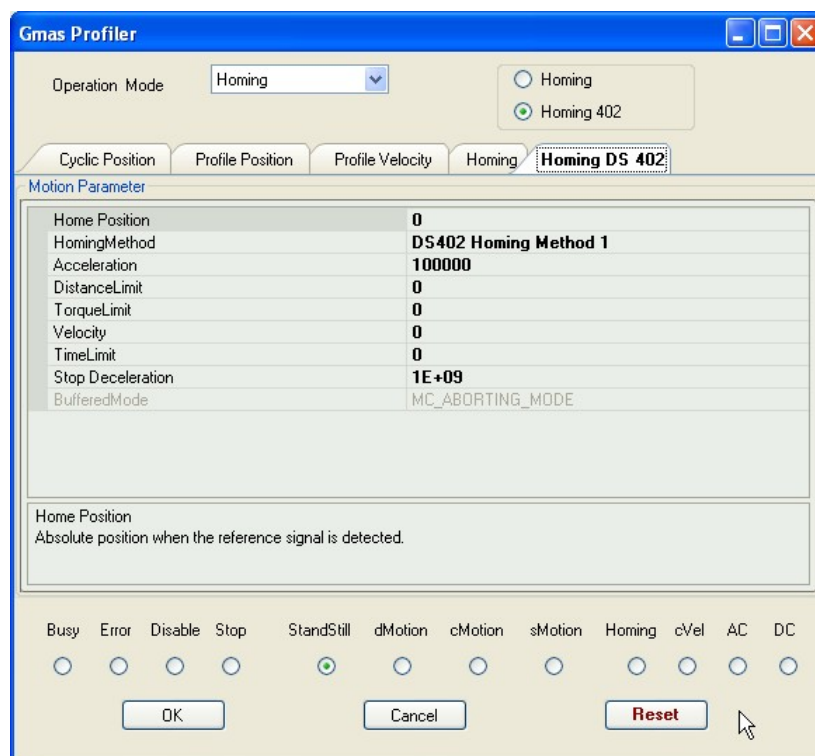


Parameter	Definition	
Home Position	Target position for the motion when conditions are met. Any -ve or +ve values in technical unit [u] are accepted.	
Set Position	If an input is inserted, Homing will modify the actual position to the Set Position value when the homing condition is met.	
Direction	Specifies the direction of the motion, if any. This enumerator type can have 1-of-4 values depending on the MC_HomingMode parameter:	
	MC_POSITIVE	For MC_ABS_SWITCH, MC_BLOCK, and MC_REF_PULSE, starts in positive direction always. For MC_LIMIT_SWITCH starts in Positive direction searching positive LimitSwitch. The direction is automatically reversed from LimitSwitch initial state.
	MC_NEGATIVE	For MC_ABS_SWITCH, MC_BLOCK, and MC_REF_PULSE, starts in negative direction always. For MC_LIMIT_SWITCH starts in Negative direction searching negative LimitSwitch. The direction is automatically reversed from LimitSwitch initial state.
	MC_SWITCH_POSITIVE	For MC_ABS_SWITCH depends on Switch status at Execute edge. If Switch is Off, direction is positive, if On it is negative.
	MC_SWITCH_NEGATIVE	For MC_ABS_SWITCH depends on Switch status at Execute edge. If Switch is On, direction is positive, if Off it is negative.
HomingMode	Homing supports the HomingMode as an ENUM datatype, which has the following modes:	
	HomeAbsSwitch	Absolute Switch homing plus limit switches
	HomeLimitSwitch	Homing against limit switches
	HomeBlock	Homing against hardware parts blocking movement
	HomeRefPulse	Homing using encoder reference pulse Zero Mark
	HomeDirect	Static Homing, forcing a position from a user reference
SwitchMode	Sensor condition to finalize StepAbsSwitch in any Switch mode. This is an enumerator type that can have 1-of-6 values:	
	MC_ON	When sensor is ON
	MC_OFF	When sensor is OFF



Parameter	Definition	
	MC_EDGE_ON	Rising Edge ON when Off to On transition in sensor
	MC_EDGE_OFF	Rising Edge OFF when On to Off transition in sensor
	MC_EDGE_SWITCH_POSITIVE	Edge depends on motion direction
	MC_EDGE_SWITCH_NEGATIVE	As previous parameter but opposite
	If the SwitchMode is either MC_Switch_Negative or MC_Switch_Positive, then the special process is also started in opposite direction depending from the switch state at Execute.	
Acceleration	Defines the maximum allowed profiler acceleration. Uses the AC Command (from the Gold Line and SimplIQ Command Reference Guides)	
DistanceLimit	Limit of the drive distance. If the StepAbsSwitch condition is not met within a DistanceLimit travel, an error is issued. 0 means no distance limit. Any +ve or -ve value in technical unit [u] is accepted.	
TorqueLimit	Limit of the torque force of the drive. 0 means no torque limit. Any positive float value in Torque units is accepted.	
Velocity	Value of the maximum velocity (not necessarily reached). Any positive float value in u/s.	
TimeLimit	Limit of the time for the drive to reach Home. If StepAbsSwitch condition is not met in the TimeLimit, an error is issued. 0 means no time limit. Any numerical value in seconds is accepted.	
Stop Deceleration	Deceleration during a Stop process. Defines the deceleration in counts/second ² used to stop motions in case of emergency or as a limit. In addition, SD defines the acceleration limit for the combination of software and external reference commands. Uses the SD Command (from the Gold Line and SimplIQ Command Reference Guides). When the Trapezium profile is not used, as in the Interpolation drive mode, this will be dependent on the drive. Only relevant for NC drives.	

7.2.3.6 Homing DS402 Position



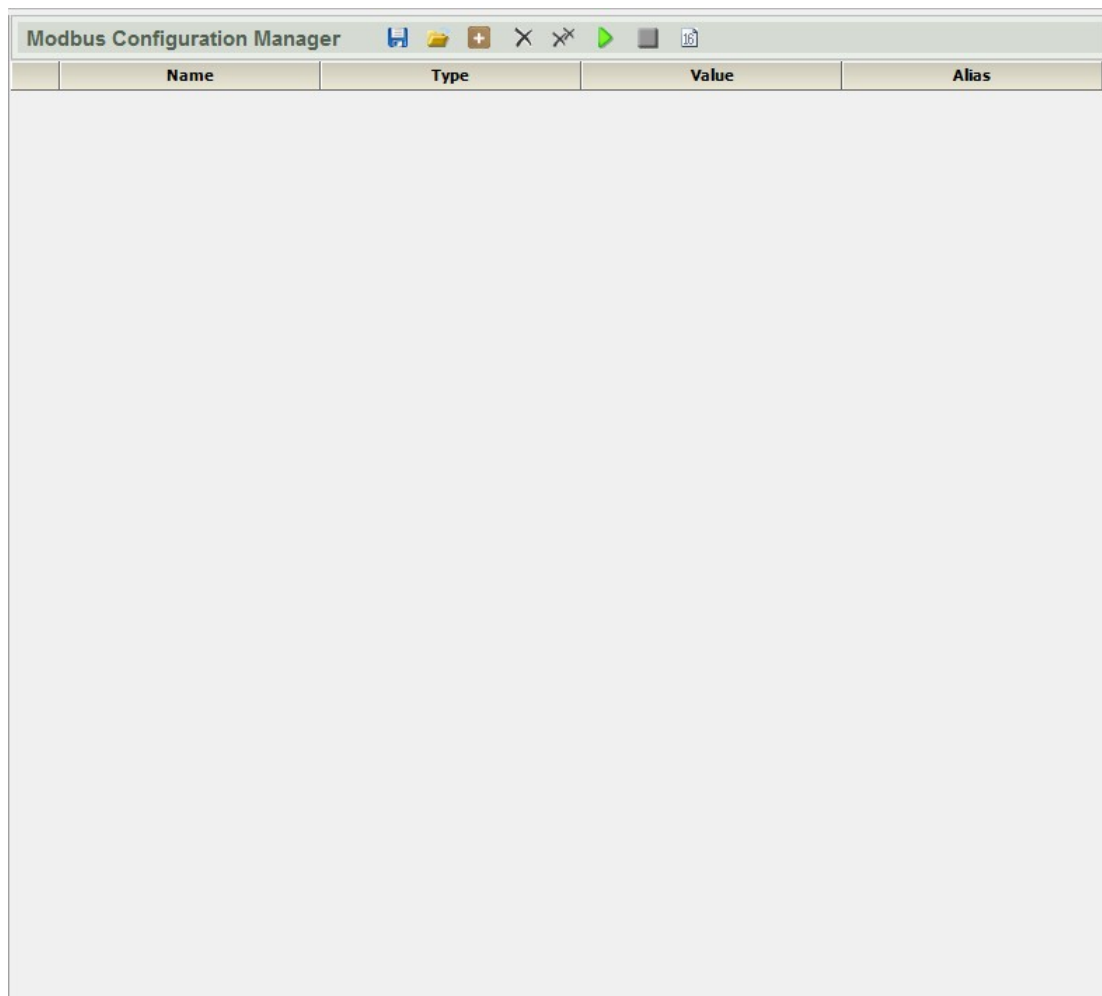
Within the Homing DS402 Position tab, you can alter the following **Motion Parameters**.

Parameter	Definition
Home Position	Target position for the motion when conditions are met. Any -ve or +ve values in technical unit [u] are accepted.
HomingMethod	DS-402 standard for homing of drive. Integer of value 1 – 36 with 4 values reserved.
Acceleration	Defines the maximum allowed profiler acceleration. Uses the AC Command (from the Gold Line and SimplIQ Command Reference Guides)
DistanceLimit	Limit of the drive distance. If the StepAbsSwitch condition is not met within a DistanceLimit travel, an error is issued. 0 means no distance limit. Any +ve or –ve value in technical unit [u] is accepted.
TorqueLimit	Limit of the torque force of the drive. 0 means no torque limit. Any positive float value in Torque units is accepted.
Velocity	Value of the maximum velocity (not necessarily reached). Any positive float value in u/s.
TimeLimit	Limit of the time for the drive to reach Home. If StepAbsSwitch condition is not met in the TimeLimit, an error is issued. 0 means no



Parameter	Definition
	time limit. Any numerical value in seconds is accepted.
Stop Deceleration	Deceleration during a Stop process. Defines the deceleration in counts/second ² used to stop motions in case of emergency or as a limit. In addition, SD defines the acceleration limit for the combination of software and external reference commands. Uses the SD Command (from the Gold Line and SimplIQ Command Reference Guides). When the Trapezium profile is not used, as in the Interpolation drive mode, this will be dependent on the drive. Only relevant for NC drives.

7.3 Modbus Configuration Manager



The Modbus Configuration Manager main display grid consists of four columns consisting of the following:

Name	Name of each data element and tree structure. The displayed name is formatted according to the memory zone it occupies according to the groups. The group heading and its sub-groups are only displayed if they have values: Coils (editable outputs acting as switches) 1 bit size (usual values of 0 or 1) Inputs (non-editable discrete values acting as indicators, c.f. LEDs) 1 bit size (usual values of 0 or 1) Can be data in the Holding or Input registers, which are 16 or 32 bit in size. A 32-bit data element can be separated into separate 16-bit registers. A 16-bit Holding or Input Register value or part of a 32-bit data element (excluding Float and Input Float) can be fragmented into separated bits.
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Holding Registers
(editable - adjusts
movement of drive)

16 or 32 bit size according to the attributes of the data
registry value:

Holding Register data - 16 bit size

Long data - 32 bit size

Float data - 32 bit size

**Input Registers (Non-
editable motion, position,
of drive)**

16 or 32 bit size according to the attributes of the data
registry value:

Input Register data - 16 bit size

Long data - 32 bit size

Float data - 32 bit size

Type Contains size of the data element as Bits number.

Value Receives data in hexagonal or decimal format. The value can easily be changed using
the hexagonal view , or edited by clicking within the field box.

Modbus Configuration Manager				
	Name	Type	Value	Alias
1	Coils			
2	Coil[1] 1:00001	1 bit	0	coil_1
3	Coil[2] 1:00002	1 bit	0	coil_2
4	Coil[3] 1:00003	1 bit	0	coil_3
5	Coil[4] 1:00004	1 bit	0	coil_4
6	Coil[5] 1:00005	1 bit	0	coil_5
7	Coil[6] 1:00006	1 bit	0	coil_6
8	Coil[7] 1:00007	1 bit	0	coil_7
9	Coil[8] 1:00008	1 bit	0	coil_8
10	Coil[9] 1:00009	1 bit	0	coil_9
11	Holding Registers			
12	Register[1] 4:0	16 bit	0x0000	holding_register__1
13	Register[2] 4:0	16 bit	0x0000	holding_register__2
14	Register[3] 4:0	16 bit	0x0000	holding_register__3
15	Register[4] 4:0	16 bit	0x0000	holding_register__4
16	Register[5] 4:0	16 bit	0x0000	holding_register__5
17	Register[6] 4:0	16 bit	0x0000	holding_register__6
18	Register[7] 4:0	16 bit	0x0000	holding_register__7
19	Register[8] 4:0	16 bit	0x0000	holding_register__8
20	Register[9] 4:0	16 bit	0x0000	holding_register__9
21	Register[10] 4:0	16 bit	0x0000	holding_register__10
22	Register[11] 4:0	16 bit	0x0000	holding_register__11
23	Register[12] 4:0	16 bit	0x0000	holding_register__12
24	Register[13] 4:0	16 bit	0x0000	holding_register__13
25	Register[14] 4:0	16 bit	0x0000	holding_register__14
26	Register[15] 4:0	16 bit	0x0000	holding_register__15
27	Register[16] 4:0	16 bit	0x0000	holding_register__16
28	Register[17] 4:0	16 bit	0x0000	holding_register__17
29	Register[18] 4:0	16 bit	0x0000	holding_register__18
30	Register[19] 4:0	16 bit	0x0000	holding_register__19
31	Register[20] 4:0	16 bit	0x0000	holding_register__20

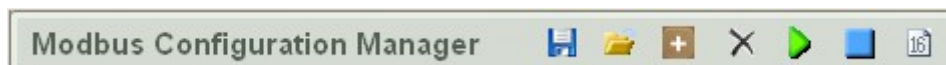
Alias The logical name of the data. This can be edited at any time by clicking within the
field box.



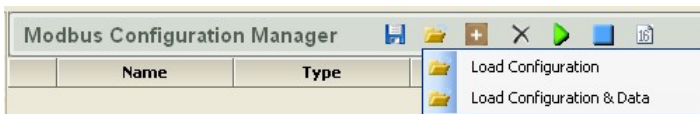
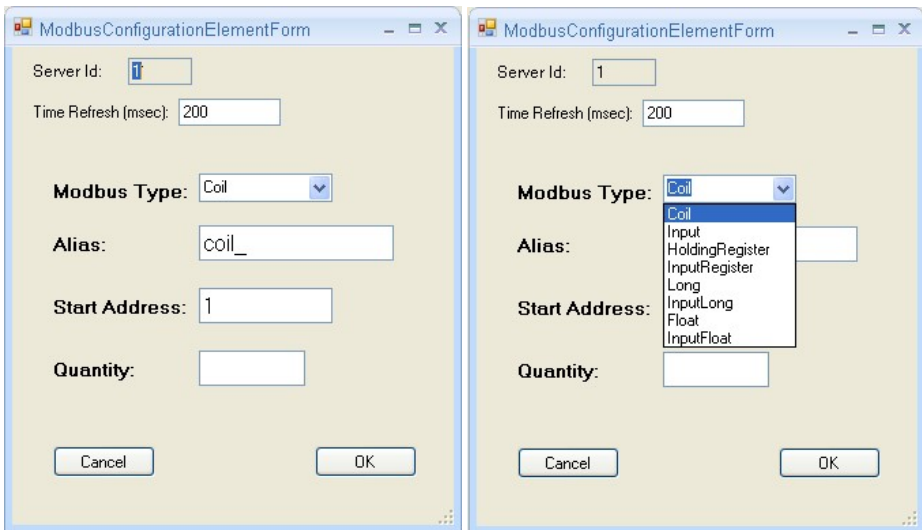
The following Modbus Configuration display shows a typical example of the various Coil, Input, etc. Modbus groups.

Name	Type	Value	Alias
Coils			
bit[1] 1:00000	1bit		coil_1
bit[2] 1:00001	1bit		coil_2
bit[3] 1:00002	1bit		coil_3
Inputs			
bit[1] 0:00000	1bit		input_1
bit[2] 0:00001	1bit		input_2
bit[3] 0:00002	1bit		input_3
bit[4] 0:00003	1bit		input_4
Holding Registers Zone			
Holding Registers			
Holding Register[1] 3:00000	16bit		holding_register_1
Holding Register[2] 3:00001	16bit		holding_register_2
Holding Register[3] 3:00002	16bit		holding_register_3
Holding Register[4] 3:00003	16bit		holding_register_4
Longs			
Long[1] 3:00004	32bit		long_1
Register[1] 3:00004	16bit		long_1_reg_1
bit[1] 3:00004.0	1bit		long_1_reg_1_bit_1
bit[2] 3:00004.1	1bit		long_1_reg_1_bit_2
bit[3] 3:00004.2	1bit		long_1_reg_1_bit_3
bit[4] 3:00004.3	1bit		long_1_reg_1_bit_4
bit[5] 3:00004.4	1bit		long_1_reg_1_bit_5
bit[6] 3:00004.5	1bit		long_1_reg_1_bit_6
bit[7] 3:00004.6	1bit		long_1_reg_1_bit_7
bit[8] 3:00004.7	1bit		long_1_reg_1_bit_8
bit[9] 3:00004.8	1bit		long_1_reg_1_bit_9
bit[10] 3:00004.9	1bit		long_1_reg_1_bit_10
bit[11] 3:00004.10	1bit		long_1_reg_1_bit_11
bit[12] 3:00004.11	1bit		long_1_reg_1_bit_12
bit[13] 3:00004.12	1bit		long_1_reg_1_bit_13
bit[14] 3:00004.13	1bit		long_1_reg_1_bit_14
bit[15] 3:00004.14	1bit		long_1_reg_1_bit_15
bit[16] 3:00004.15	1bit		long_1_reg_1_bit_16
Register[2] 3:00005	16bit		long_1_reg_2
Long[2] 3:00008	32bit		long_2
Register[1] 3:00008	16bit		long_2_reg_1
Register[2] 3:00009	16bit		long_2_reg_2
Floats			
Float[1] 3:00010	32bit		float_1
Float[2] 3:00012	32bit		float_2
Input Registers Zone			
Input Registers			
Input Register[1] 4:00000	16bit		input_register_1
Input Register[2] 4:00001	16bit		input_register_2

The Manager contains the following menu options to insert, and edit the Modbus configuration.



These icons perform the following:

Icon	Operation
	Saves the current Modbus grid to a file.
	Loads the Modbus configuration or configuration and data from a file, with the current Modbus grid being cleared. Two options are available:  You can save as many Configurations of the Modbus grid as you wish each under a different name. In this situation, you may select to only Load Configuration. However, you can also save a Configuration with its Modbus data of the movement of the multi-axes. In this situation, you may wish to Load Configuration & Data.
	Adds selected Modbus data. Select the Modbus type from the pull-down menu, and enter the Alias, Start Address, and Quantity. 
	Removes the selected Modbus data from the queue.
	Runs the Modbus server. The operation is only available when the Commands Queue contains a function block, and there is an online connection between the drive and the G-MAS.
	Stops the Modbus server. Send a command to stop Modbus data execution, when there is an online connection between the drive and the G-MAS.
	Set Decimal or Hexa format of the values. This toggle changes the view of the value.

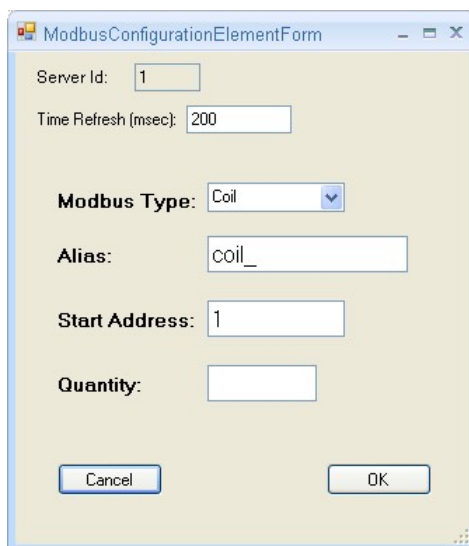
**Icon Operation**

Modbus Configuration Manager				
	Name	Type	Value	Alias
1	Coils			
2	Coil[1] 1:00001	1 bit	0	coil__1
3	Coil[2] 1:00002	1 bit	0	coil__2
4	Coil[3] 1:00003	1 bit	0	coil__3
5	Coil[4] 1:00004	1 bit	0	coil__4
6	Coil[5] 1:00005	1 bit	0	coil__5
7	Coil[6] 1:00006	1 bit	0	coil__6
8	Coil[7] 1:00007	1 bit	0	coil__7
9	Coil[8] 1:00008	1 bit	0	coil__8
10	Coil[9] 1:00009	1 bit	0	coil__9
11	Holding Registers			
12	Register[1] 4:0	16 bit	0x0000	holding_register__1
13	Register[2] 4:0	16 bit	0x0000	holding_register__2
14	Register[3] 4:0	16 bit	0x0000	holding_register__3
15	Register[4] 4:0	16 bit	0x0000	holding_register__4
16	Register[5] 4:0	16 bit	0x0000	holding_register__5
17	Register[6] 4:0	16 bit	0x0000	holding_register__6
18	Register[7] 4:0	16 bit	0x0000	holding_register__7
19	Register[8] 4:0	16 bit	0x0000	holding_register__8
20	Register[9] 4:0	16 bit	0x0000	holding_register__9
21	Register[10] 4:0	16 bit	0x0000	holding_register__10
22	Register[11] 4:0	16 bit	0x0000	holding_register__11
23	Register[12] 4:0	16 bit	0x0000	holding_register__12
24	Register[13] 4:0	16 bit	0x0000	holding_register__13
25	Register[14] 4:0	16 bit	0x0000	holding_register__14
26	Register[15] 4:0	16 bit	0x0000	holding_register__15
27	Register[16] 4:0	16 bit	0x0000	holding_register__16
28	Register[17] 4:0	16 bit	0x0000	holding_register__17
29	Register[18] 4:0	16 bit	0x0000	holding_register__18
30	Register[19] 4:0	16 bit	0x0000	holding_register__19
31	Register[20] 4:0	16 bit	0x0000	holding_register__20

7.3.1 Adding or Editing Modbus data

To add data to the Modbus grid

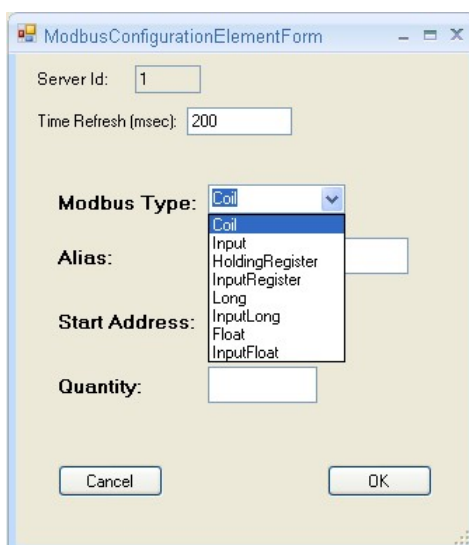
1. From the Manager menu options, select . The Modbus Configuration element form window opens.



The ModbusConfigurationElementForm window is shown. It contains the following fields:

- Server Id: 1
- Time Refresh (msec): 200
- Modbus Type: Coil (selected from a pull-down menu)
- Alias: coil_
- Start Address: 1
- Quantity: (empty)
- Buttons: Cancel, OK

2. Select the Modbus Type from the pull-down menu.



The ModbusConfigurationElementForm window is shown with the Modbus Type pull-down menu open. The menu options are:

- Coil (selected)
- Input
- HoldingRegister
- InputRegister
- Long
- InputLong
- Float
- InputFloat

3. Enter the Start Address in the memory zone, quantity of such objects and alias template.

Note: If overlapping memory regions of same type are entered, an error message is displayed.

4. Click **OK**. The configuration data is displayed in the Manager window grid.

	Name	Type	Value	Alias
1	Coils			
2	Coil[1] 1:00001	1 bit		coil_1



5. After entering a relevant number of data entries, make sure that the G-MAS is connected correctly and activated.
6. Click  to start the Modbus server. The Value should initiate a value of 0 for all parameters.

Modbus Configuration Manager				
	Name	Type	Value	Alias
1	[-] Coils			
2	Coil[1] 1:00001	1 bit	0	coil_1
3	Coil[2] 1:00002	1 bit	0	coil_2
4	Coil[3] 1:00003	1 bit	0	coil_3
5	Coil[4] 1:00004	1 bit	0	coil_4
6	Coil[5] 1:00005	1 bit	0	coil_5
7	Coil[6] 1:00006	1 bit	0	coil_6
8	Coil[7] 1:00007	1 bit	0	coil_7
9	Coil[8] 1:00008	1 bit	0	coil_8
10	Coil[9] 1:00009	1 bit	0	coil_9
11	[+] Holding Registers			
12	[-] Register[1] 4:0000	16 bit	0	holding_register_1
13	bit[1] 4:00001	1bit	0	reg_1_bit_1
14	bit[2] 4:00001	1bit	0	reg_1_bit_2
15	bit[3] 4:00001	1bit	0	reg_1_bit_3
16	bit[4] 4:00001	1bit	0	reg_1_bit_4
17	bit[5] 4:00001	1bit	0	reg_1_bit_5
18	bit[6] 4:00001	1bit	0	reg_1_bit_6
19	bit[7] 4:00001	1bit	0	reg_1_bit_7
20	bit[8] 4:00001	1bit	0	reg_1_bit_8
21	bit[9] 4:00001	1bit	0	reg_1_bit_9
22	bit[10] 4:0000	1bit	0	reg_1_bit_10
23	bit[11] 4:0000	1bit	0	reg_1_bit_11
24	bit[12] 4:0000	1bit	0	reg_1_bit_12
25	bit[13] 4:0000	1bit	0	reg_1_bit_13
26	bit[14] 4:0000	1bit	0	reg_1_bit_14
27	bit[15] 4:0000	1bit	0	reg_1_bit_15
28	bit[16] 4:0000	1bit	0	reg_1_bit_16
29	[+] Register[2] 4:0000	16 bit	0	holding_register_2
30	[+] Register[3] 4:0000	16 bit	0	holding_register_3
31	[+] Register[4] 4:0000	16 bit	0	holding_register_4

To edit a Value or Alias in the Modbus grid



1. Select a Coil, Holding Register etc. value field, and enter an appropriate value. Then press <Enter> for the new value to be accepted. Each bit of the registry adapts to the new value.

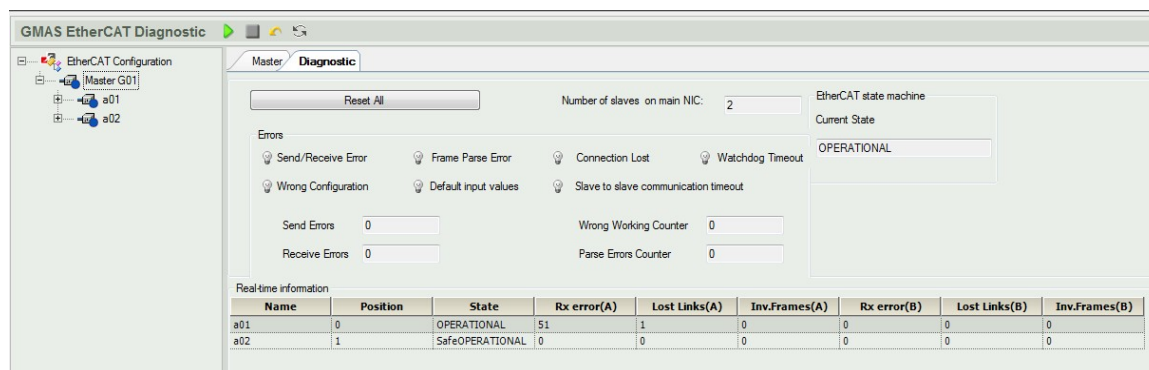
Modbus Configuration Manager				
	Name	Type	Value	Alias
1	Coils			
2	Coil[1] 1:00001	1 bit	0	coil__1
3	Coil[2] 1:00002	1 bit	0	coil__2
4	Coil[3] 1:00003	1 bit	0	coil__3
5	Coil[4] 1:00004	1 bit	0	coil__4
6	Coil[5] 1:00005	1 bit	0	coil__5
7	Coil[6] 1:00006	1 bit	0	coil__6
8	Coil[7] 1:00007	1 bit	0	coil__7
9	Coil[8] 1:00008	1 bit	0	coil__8
10	Coil[9] 1:00009	1 bit	0	coil__9
11	Holding Registers			
12	Register[1] 4:0000	16 bit	15644	holding_register__1
13	bit[1] 4:00001	1bit	0	reg_1_bit_1
14	bit[2] 4:00001	1bit	0	reg_1_bit_2
15	bit[3] 4:00001	1bit	1	reg_1_bit_3
16	bit[4] 4:00001	1bit	1	reg_1_bit_4
17	bit[5] 4:00001	1bit	1	reg_1_bit_5
18	bit[6] 4:00001	1bit	0	reg_1_bit_6
19	bit[7] 4:00001	1bit	0	reg_1_bit_7
20	bit[8] 4:00001	1bit	0	reg_1_bit_8
21	bit[9] 4:00001	1bit	1	reg_1_bit_9
22	bit[10] 4:0000	1bit	0	reg_1_bit_10
23	bit[11] 4:0000	1bit	1	reg_1_bit_11
24	bit[12] 4:0000	1bit	1	reg_1_bit_12
25	bit[13] 4:0000	1bit	1	reg_1_bit_13
26	bit[14] 4:0000	1bit	1	reg_1_bit_14
27	bit[15] 4:0000	1bit	0	reg_1_bit_15
28	bit[16] 4:0000	1bit	0	reg_1_bit_16
29	Register[2] 4:0000	16 bit	0	holding_register__2
30	Register[3] 4:0000	16 bit	0	holding_register__3
31	Register[4] 4:0000	16 bit	0	holding_register__4

To remove data from the Modbus grid

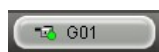
1. Select and highlight the Modbus data to be removed.
2. Select the  icon. The data is removed.

7.4 GMAS EtherCAT Diagnostics

The G-MAS EtherCAT Diagnostic windows should be used as diagnostics only. No operation can be performed from these windows that will affect the status of the EtherCAT configuration. The data areas are therefore grayed. The GMAS EtherCAT Diagnostics window consists of the following:



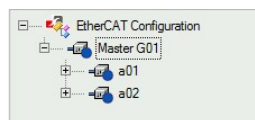
The GMAS Manager window contains the following options:



Displays the name of the G-MAS and verifies that it is active. (Not actual part of the GMAS Manager window).



Displays the active G-MAS and whether connected or not.



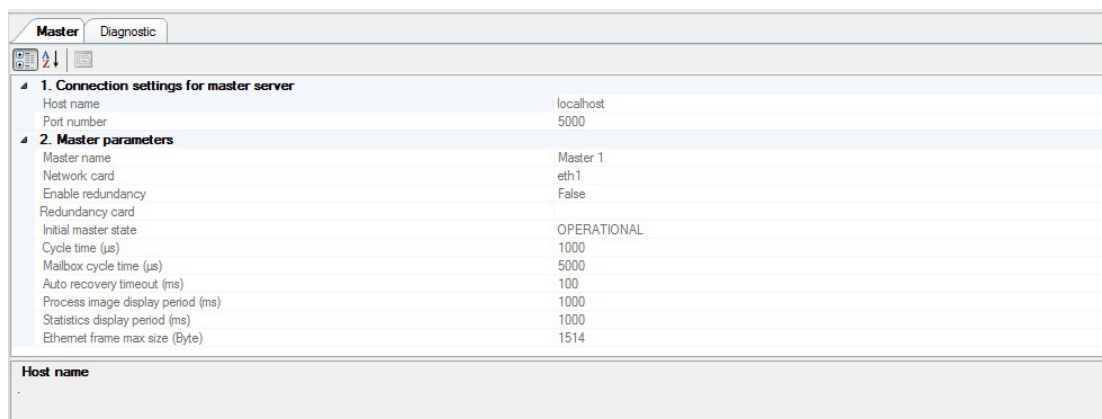
Master and slaves connected and active.

7.4.1 Master Diagnostics

The Master diagnostics consists of two tabs:

- Master
- Diagnostics

7.4.1.1 Master Tab



The EtherCAT Master settings consist of the following:

Connection settings for master server

Host name The Connection settings enable set up of the communication to a PC where the Master is running.

Port number

It is possible to attach to a remote or a local Master.

When trying to attach to localhost, if the Master is not running, it is started automatically with default settings (host name:localhost; port number: 5000).

In case of connecting to a remote Master, specify a host name and a port number. On further changing the host name or the port number, the connection is automatically performed.

Master parameters

Master Name Name of a selected Master

Network card Name of the network card, which provides an interface to connect slaves

Enable redundancy Enable/disable redundancy mode

Redundancy card Name of the network card, which is additionally used in redundancy mode

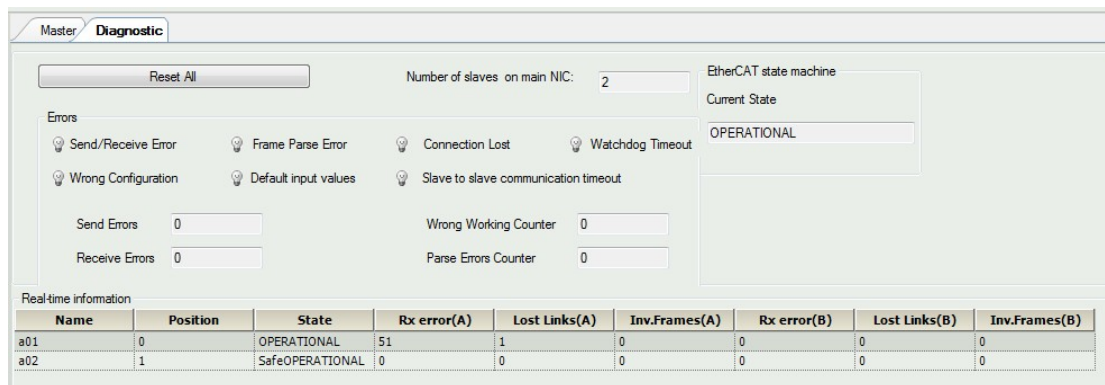
Initial master state

State to be used when starting up the Master:

Init	Defines the root of the communication relationship between the Master and the slave in an application layer. No direct communication between the Master and the slave on the application layer is possible. The Master has access to the Data Link (DL) Information registers.
Pre-Operational	The EtherCAT mailbox is active if the slave supports the optional mailbox. Both the Master and the slave can use the mailbox and the appropriate protocols to exchange application specific initializations and parameters. No process data communication is possible in this state.
Safe Operational	The application of the slave delivers actual input data without manipulating the output data. The outputs should be set to their "safe" state.
Operational	The application of the slave delivers actual input data and application of the Master should deliver actual output data.
Bootstrap	The application of the slave can accept a new firmware downloaded with the FoE protocol.

Cycle time	Cycle time setting in microseconds
Mailbox cycle time	Time to poll slaves mailboxes in microseconds
Auto recovery timeout	Time for Master device to recover slave device in milliseconds
Process image display period	Process Image refresh time in milliseconds
Statistics display period	Statistics information refresh time in milliseconds
Ethernet frame max size (Byte)	Maximum size of Ethernet frame in bytes

7.4.1.2 Diagnostic Tab



Name	Position	State	Rx error(A)	Lost Links(A)	Inv.Frames(A)	Rx error(B)	Lost Links(B)	Inv.Frames(B)
a01	0	OPERATIONAL	51	1	0	0	0	0
a02	1	SafeOPERATIONAL	0	0	0	0	0	0

The EtherCAT Diagnostic settings consist of the following:

Number of slaves on main NIC No. of slaves connected to the master via the Network Interface Card (NIC)

Errors

The following errors are only active when the Master is online. When an error is detected, the relevant error light bulb changes color to orange.

In addition, the Message tab displays the exact error with an Error No. For more details refer to 12 EtherCAT Error Messages on page 423.

- Send/receive error The Master can neither send nor receive a frame to/from a slave
- Frame parse error Error while frame parsing
- Connection lost The connection is lost to the Master/Slave
- Wrong configuration Current network configuration differs from the one downloaded to the Master
- Slave to slave communication timeout **For slaves only:**
The Slave to slave communication has exceeded its time to maintain communication
- Default input values Incorrect Working Counter(WKC), value exceeded limit. Default values were set for inputs
- Watchdog timeout Outputs of the Master Process Image were not set during timeout by the external communication

Real-time information								
Name	Position	State	Rx error(A)	Lost Links(A)	Inv.Frames(A)	Rx error(B)	Lost Links(B)	Inv.Frames(B)
a01	0	OPERATIONAL	51	1	0	0	0	0
a02	1	SafeOPERATIONAL	0	0	0	0	0	0

Real-time information

Name Name of the slave

Position Position order relative to the master

State	Present state of the slave
Rx error (A)	Read errors at the Port A
Lost Links (A)	Lost links at Port A
Inv. Frames(A)	Reads the invalid frames for port A
Rx error (B)	Read errors at the Port B
Lost Links (B)	Lost links at Port B
Inv. Frames(B)	Reads the invalid frames for port B
Reset All button	

All information within the Diagnostic window tab can be updated by pressing the Reset All button.

7.4.1.2.1 EtherCAT State Settings

The following tab parameters are available when the Master is online. This tab allows the user to view The Current State (the state of the EtherCAT State Machine (ESM)) is the present state of the system.

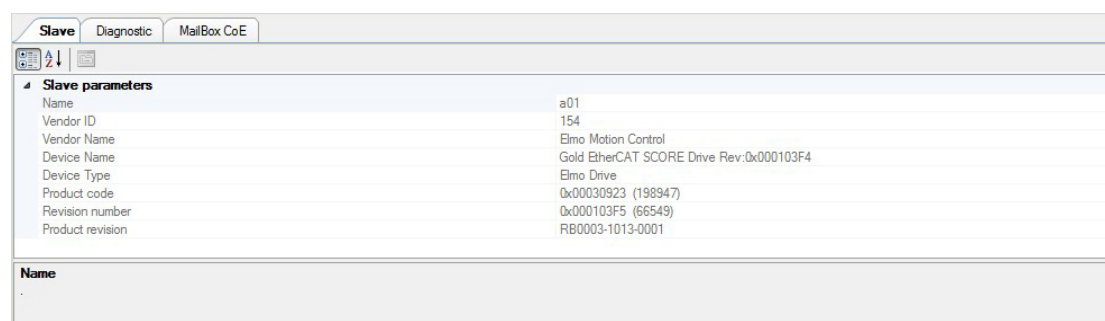
The state may be changed to only if the system allows the change. The default is INIT.

7.4.2 Slave Diagnostics

The Slave Diagnostics window consists of the following:

- Slave
- Diagnostics
- MailBox CoE

7.4.2.1 Slave Tab



Slave parameters	
Name	a01
Vendor ID	154
Vendor Name	Elmo Motion Control
Device Name	Gold EtherCAT SCORE Drive Rev:0x000103F4
Device Type	Elmo Drive
Product code	0x00030923 (198947)
Revision number	0x000103F5 (66549)
Product revision	RB0003-1013-0001
Name	

The EtherCAT Slave settings consist of the following:

Slave parameters

Name	Displays current slave name. Slave name can be changed
Vendor ID	Slave device vendor ID

Vendor Name	Slave device vendor
Device Name	Name of the device and whether CoE, EoE, or FoE
Device Type	Slave device type
Product code	Slave device product code (example: 72100946)
Revision number	Slave revision number (example: 65536)
Product revision	Slave product revision number (example: EK1100-0000-0001)

7.4.2.2 Diagnostics Tab

Slave		Diagnostic		MailBox CoE	
1. General Diagnostics		Port Diagnostic		Port Diagnostic	
Online Position	0	Port Name	Port A	Port Name	Port B
Offline	False	Rx Errors	0	Rx Errors	0
Wrong EtherCAT State	False	Lost Links	0	Lost Links	0
EtherCAT State Not Configured	False	Invalid Frames	0	Invalid Frames	0
Wrong Device Type	False				
Initialization Failed	False				
Mailbox Initialization Failed	False				

The EtherCAT Diagnostic tab consists of the following:

General Diagnostics

These are generally Boolean True/False diagnostic data to the EtherCAT status.

Online Position	0
Offline	False
Wrong EtherCAT State	False
EtherCAT state not configured	False
Wrong device type	False
Initialization Failure	False
Mailbox Initialization Failed	False

Port Diagnostic

Port A diagnostic

Port Name	Port A
Rx Errors	0
Lost Links	0
Invalid Frames	0

Port Diagnostic

Port B diagnostic

Port Name	Port B
Rx Errors	0
Lost Links	0
Invalid Frames	0

7.4.2.3 MailBox CoE Tab

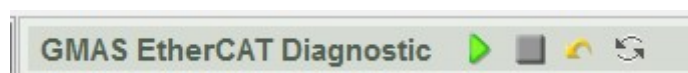
Slave	Diagnostic	MailBox CoE				
	Index	Name	Type	Flags	Value	Default value
1	0x0002	INTEGER8	SINT	R:P.S.O	0	00
2	0x1000	Device Type	UDINT	R:P.S.O	402	92010200
3	0x1001	Error Register	USINT	R:P.S.O	0	00
4	0x1002	Manufacturer Status Register	UDINT	R:P.S.O	59392	
5	0x1003	Pre-defined Error Field	ARRAY		16	
6	0x100B	Node-ID	UDINT	R:P.S.O W:P.S.O	-2136150913	
7	0x1016	Consumer heartbeat time	ARRAY		1	
8	0x1017	Producer heartbeat time	UDINT	R:P.S.O W:P.S.O	-2136211456	
9	0x1018	Identity Object	RECORD		4	
10	0x1023	Text Interpreter	UDINT	R:P.S.O	-2136151037	
11	0x1024	Text Interpreter	UDINT	R:P.S.O	-2136151040	

The EtherCAT MailBox CoE Tab is used to work with a slave's Object Dictionary (OD). The settings consist of the following:

Index	Number of OD object
Name	Object's name
Type	Object's data type
Flags	Object's access type (e.g., RO, read only, WO, write only)
Value	Actual value of OD object
Default value	Default value of OD object

7.4.3 GMAS EtherCAT Diagnostics Icons

To create these extended sets of commands, EAS offers quick tools:



These icons perform the following:

Icon	Operation
 Run	Runs the queue, and sends the function block to the G-MAS driver. The operation is only available when the Commands Queue contains a function block, and there is an online connection between the drive and the G-MAS.



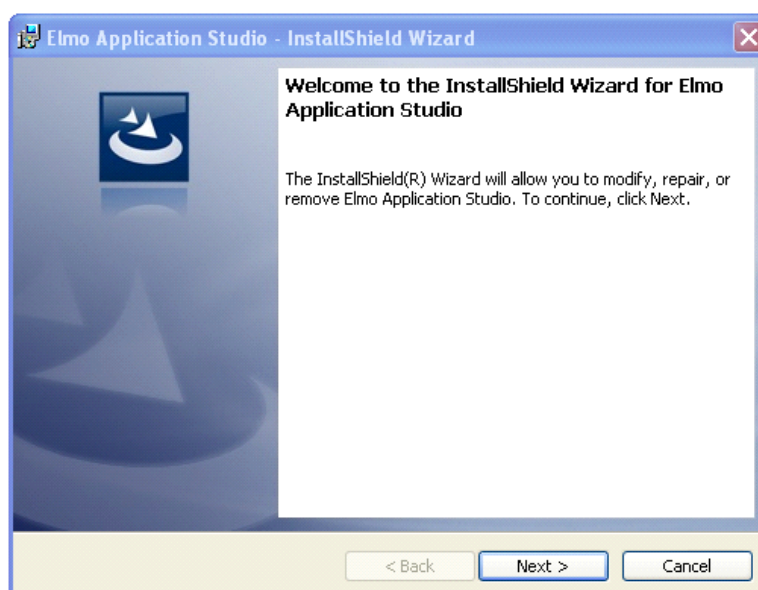
Icon	Operation
 Stop	Stops the queue executing. Send a command to stop the function block execution, when there is an online connection between the drive and the G-MAS.
 Refresh	Manually refreshes the data in the Network monitor window.
 Reset All	Resets the real-time information on the master and its slaves.

8 Upgrading and Uninstalling EAS

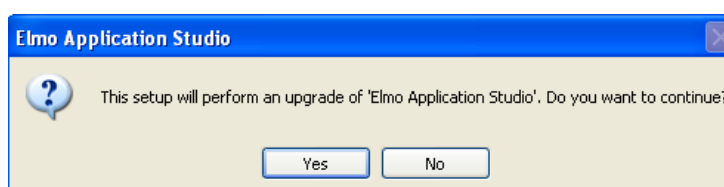
8.1 Upgrading EAS

To upgrade to a new version of EAS

1. Close EAS
2. Go to the location of the new version installation file (named “Elmo Application Studio Setup [version number].exe” and double click to open it
3. In the following window click **Next**:

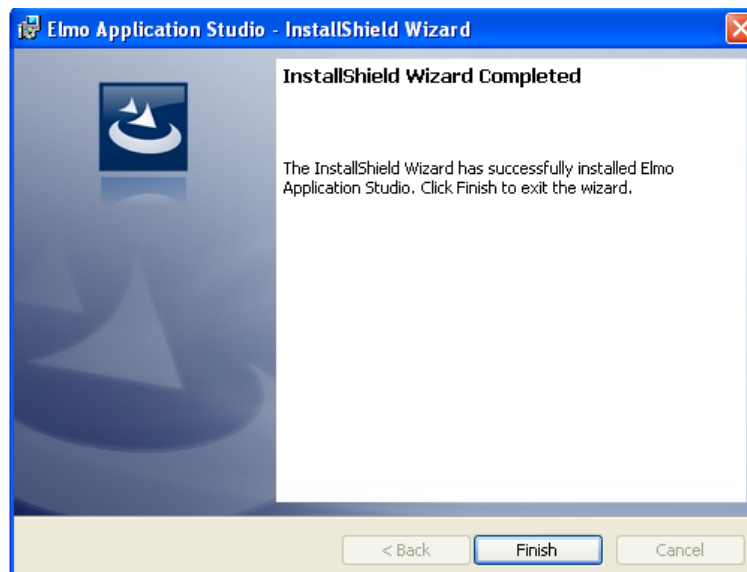


4. In the following window click **Yes**





5. Click **Next** when prompted by the install wizard
6. After the installation process is finished click **Finish** in the following window:



The upgrade process does not delete any of your saved files. All previously saved files can be found in their previous locations.

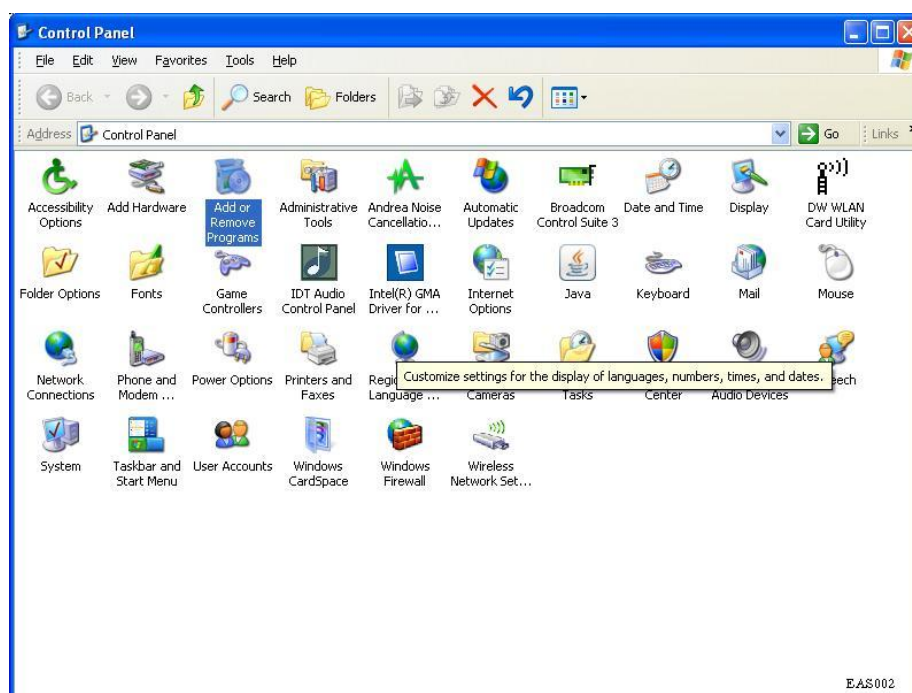
8.2 Uninstalling EAS

If you wish to uninstall EAS, you can use either Windows' Control Panel or the EAS installation program.

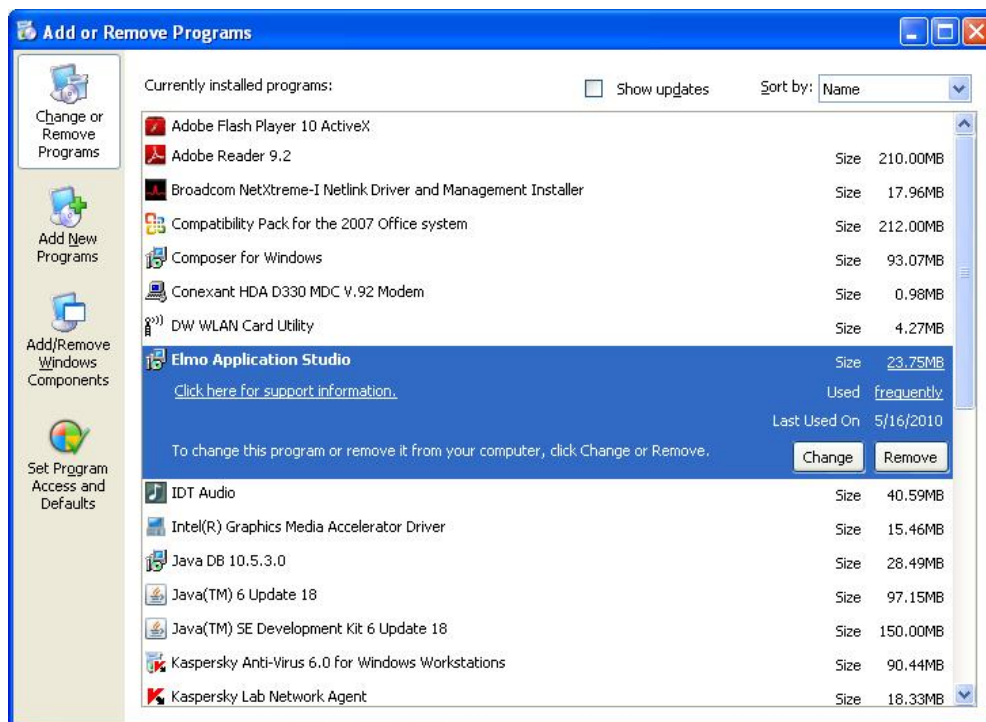
To uninstall using the control panel

Note: It is recommended that you close all running programs before starting this process.

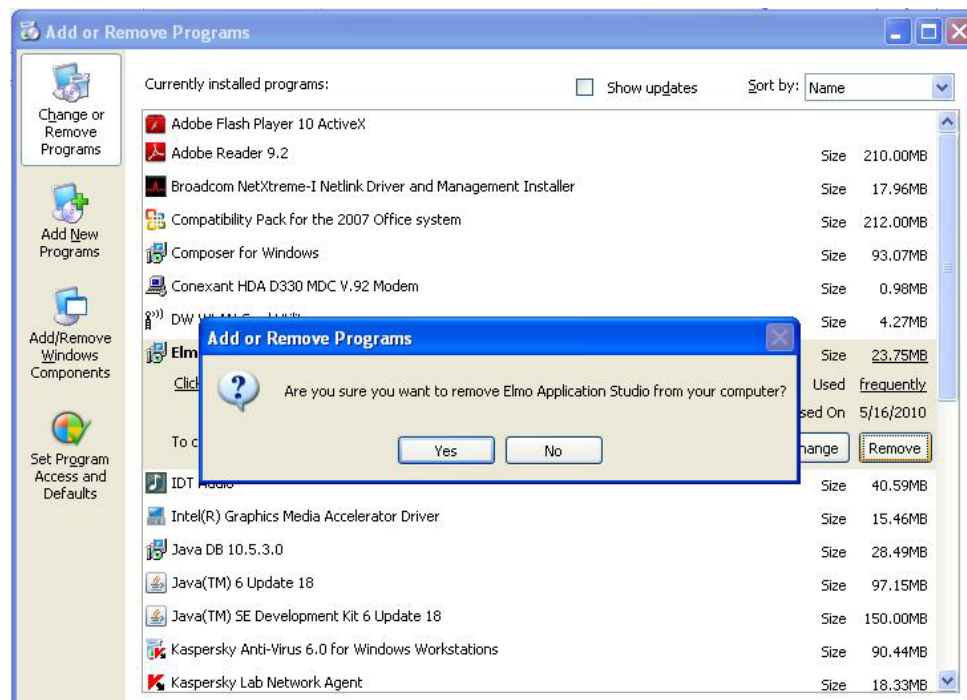
1. From the Windows **Start** menu select **Settings > Control Panel**



2. Double click *Add or Remove Programs*.
3. From the list of installed programs select *Elmo Application Studio*.



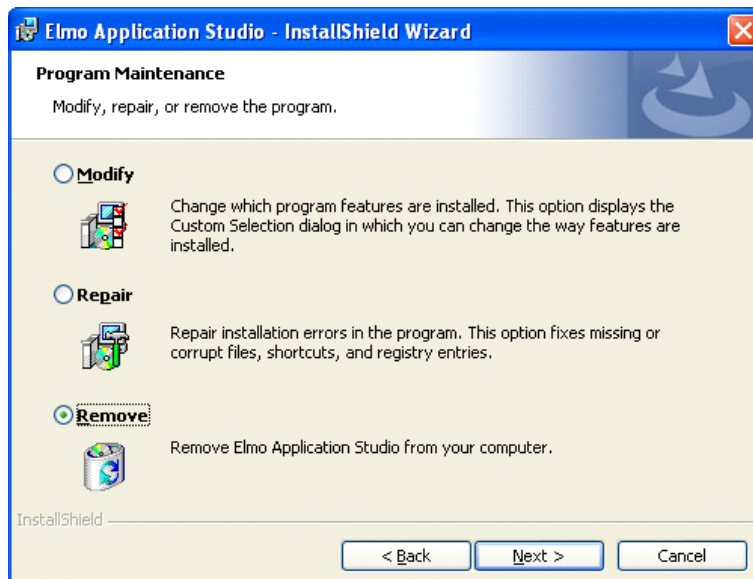
4. Click **Remove** and then **Yes**.



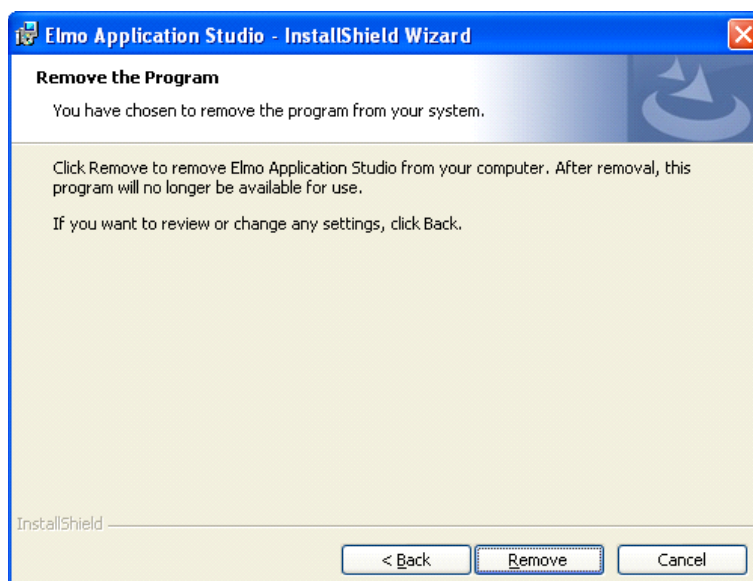
Elmo Application Studio will be uninstalled from your computer.

To uninstall EAS using EAS setup program

1. Start EAS setup.
2. Click **Next** to invoke the following screen.

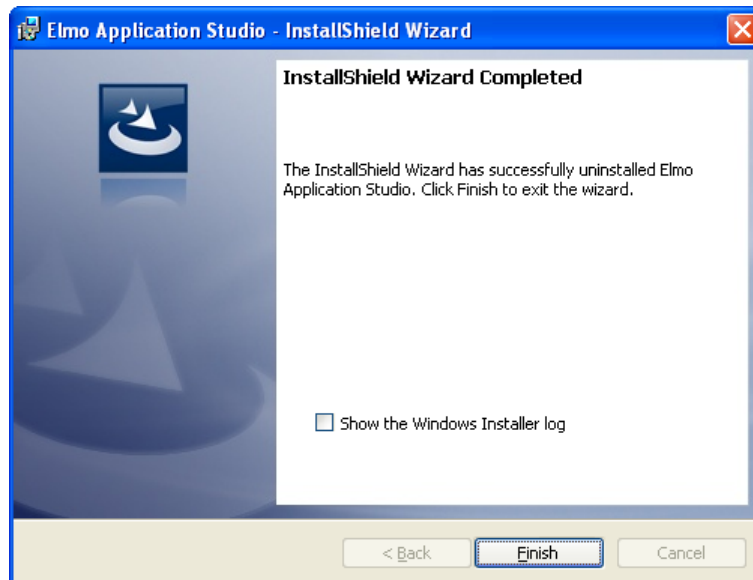


3. Select **Remove** and click **Next**.





4. Click **Remove**. Wait while EAS is being uninstalled.
5. When the process ends click **Finish**.



9 Drive Communication Setup

Important: Do not connect your drive to the PC before installing EAS. The required driver is installed as part of the installation.

9.1 Connect a Drive Using USB

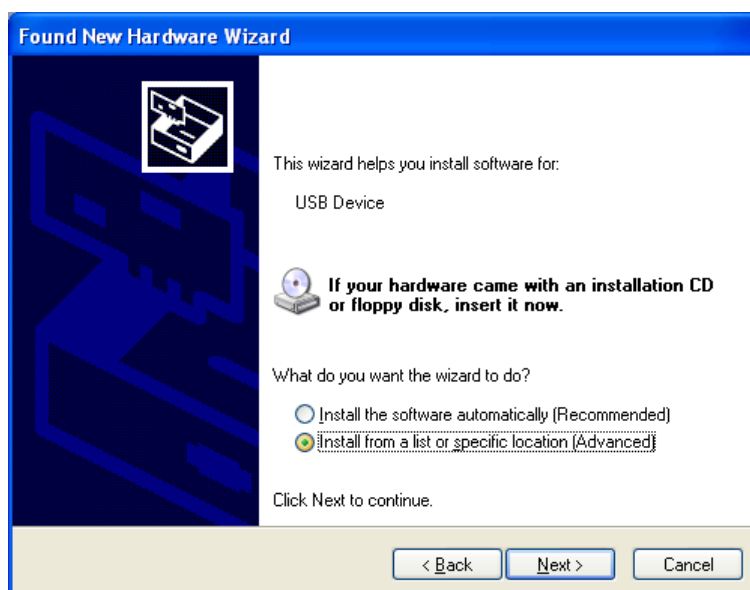
When installing and recognizing a drive

1. When you connect a new drive to the PC using a USB connection for the first time the following screen appears:



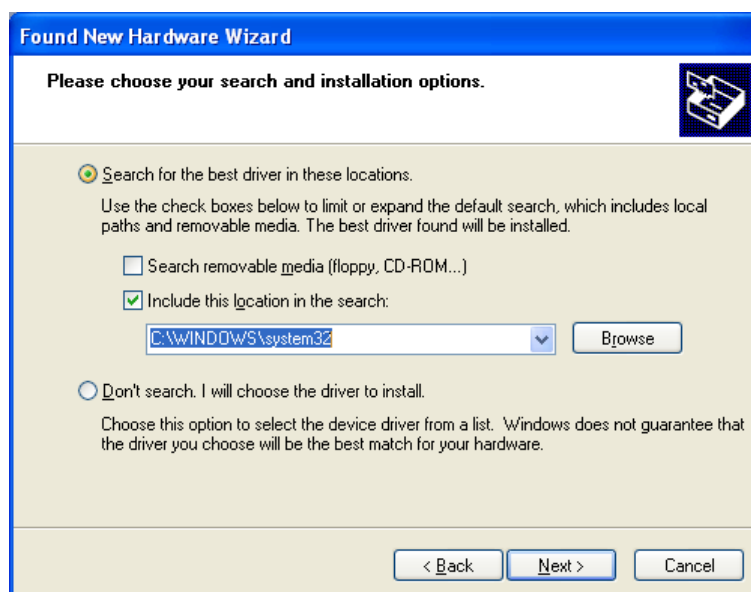
2. Select the third option: “No, not this time” and click **Next**.

The following screen appears:

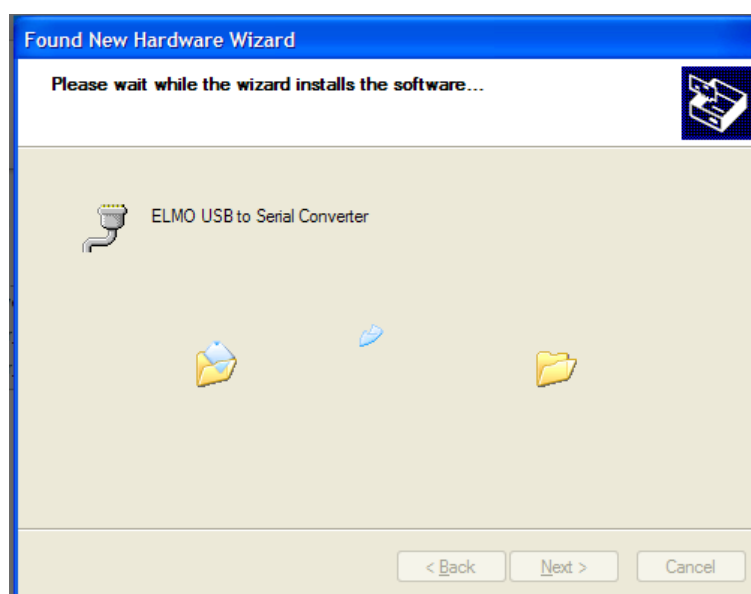


3. Select the second option: *Install from a list or specific location (Advanced)* and click **Next**.

In the following screen:

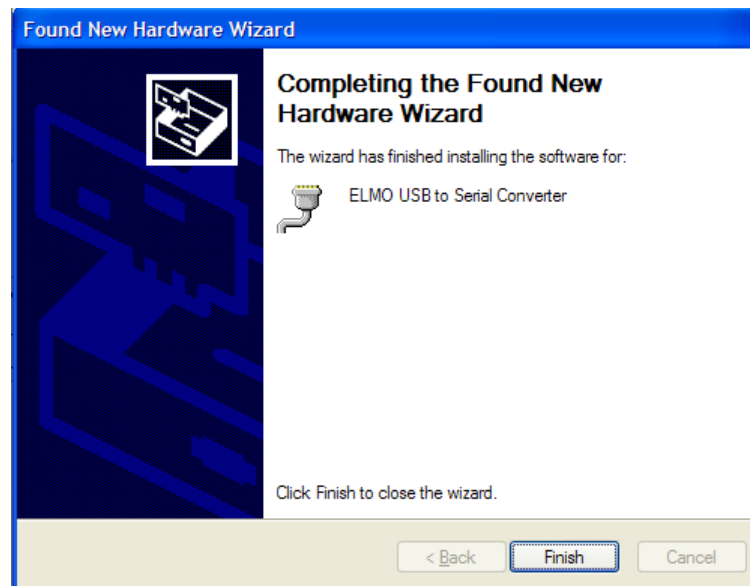


4. Select to search the driver and include the location "C:\WINDOWS\system32".
5. Click **Next** to start the installation process:



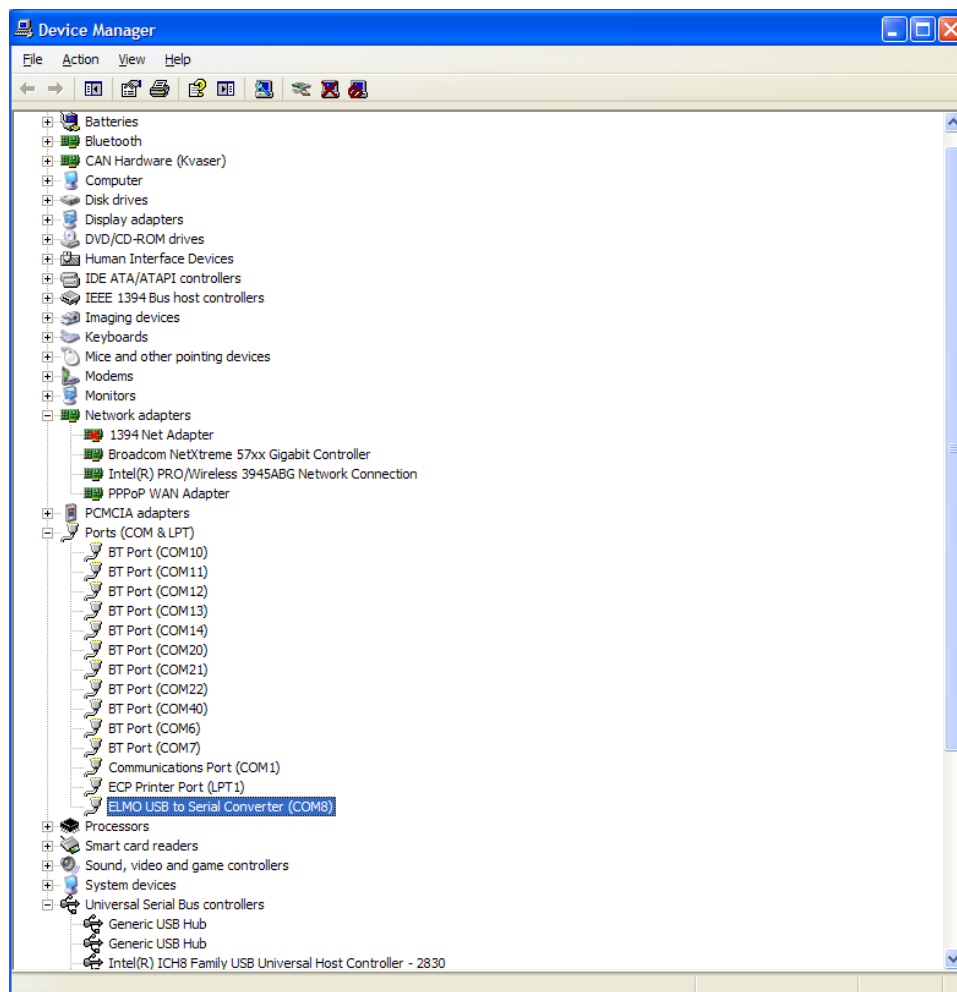
6. Click **Next**.

When the installation process is completed:



7. Click **Finish**.

The new port will now appear in the device manager:



9.2 Configure a Drive to use Ethernet with DHCP

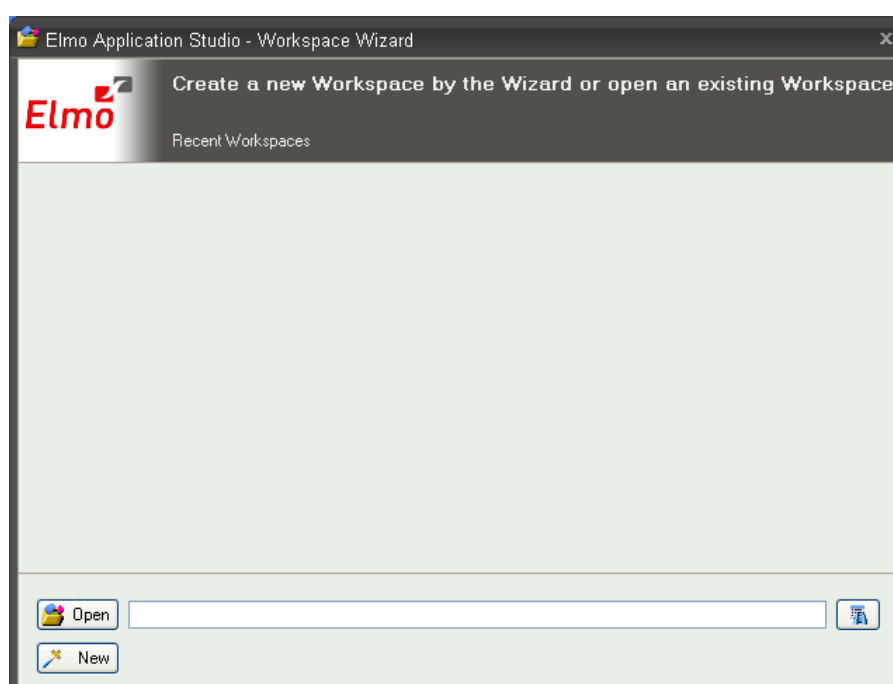
9.2.1 Configuring EAS and the servo drive

To configure the EAS and the servo drive

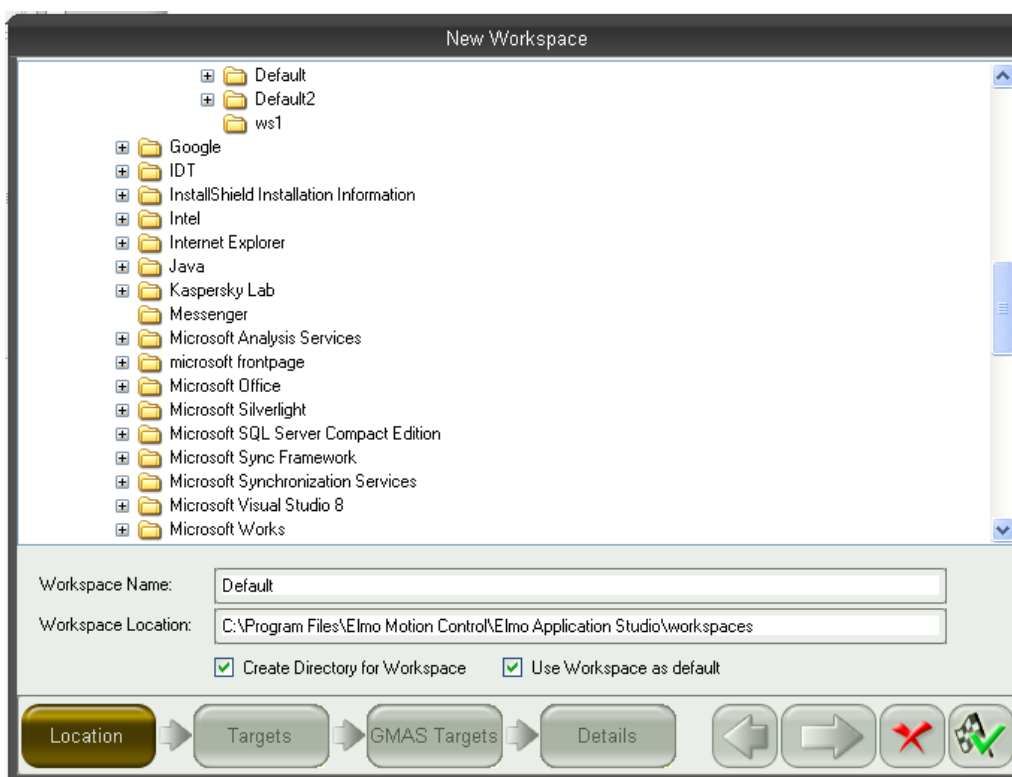
1. Follow the instructions in section 9.1 to connect your drive to the PC via USB.

Important: To maintain emphasis on this task, we will show only the steps relevant to configuring the communication to Ethernet with DHCP. After completing the configuration, please continue to the detailed systematic activation as described in section 1.4.

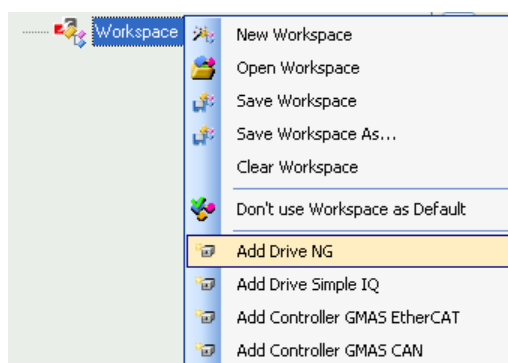
2. Open Elmo Application Studio. The following dialog appears.



3. Click **New**. In the following screen just click **Finish**  to open the main studio view.
Note that we are skipping important steps to focus on the process.



4. In the window that opens right click the workspace name and select **Add Drive NG** from the menu.

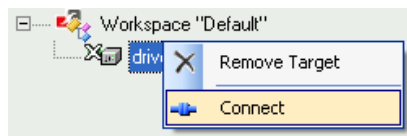


5. A new drive name appears under the workspace name and its default properties are displayed.

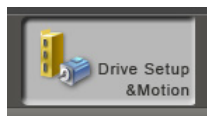
Click on the **Connection Type** to open a list and select **Direct Access USB**.



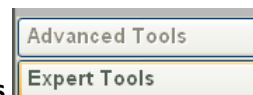
6. Click **Apply**  to save the drive's properties.
7. Right click the drive's name and click **Connect**



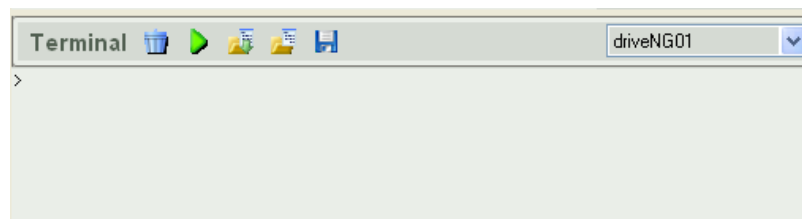
8. From the activity selector at the top part of the screen select **Drive Setup & Motion**



9. In the tools selector click **Expert Tools**



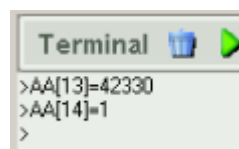
10. Select **Motion** to open a view that includes a terminal



11. In the terminal enter the following commands:

AA[13]=42330

AA[14]=1



These commands set the drive's communication options as Ethernet with DHCP enabled.

12. Click on the **Workspace**  button located at the top left of the screen to open a dialog.
13. Right click the drive's name and click **Disconnect**.

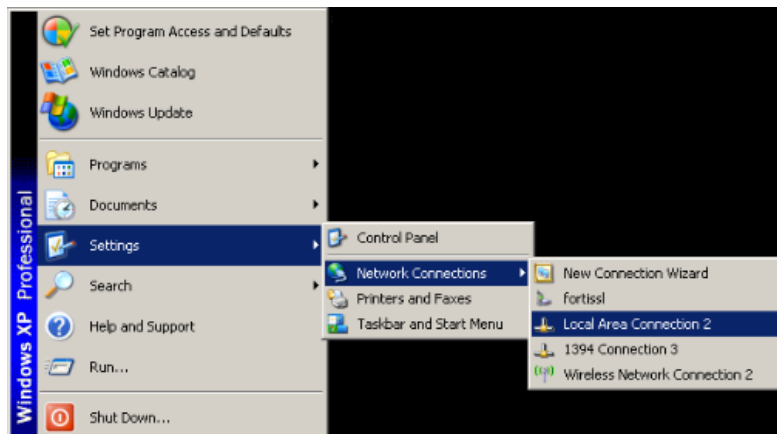


14. Restart the drive.

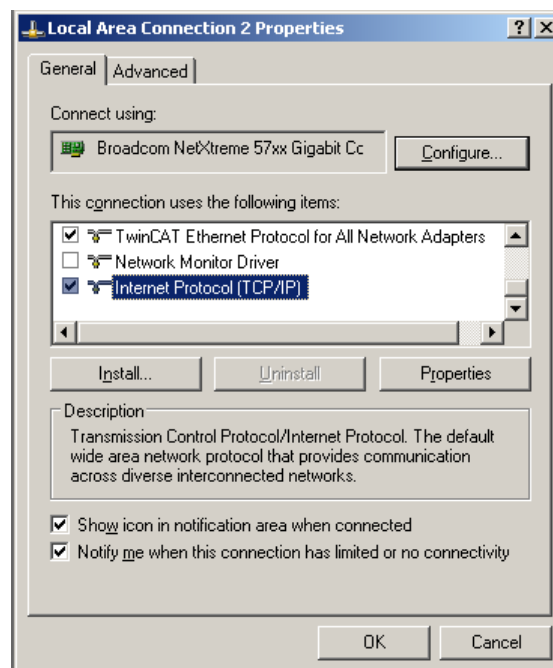
9.2.2 PC configuration

To set the PC configuration in XP Windows

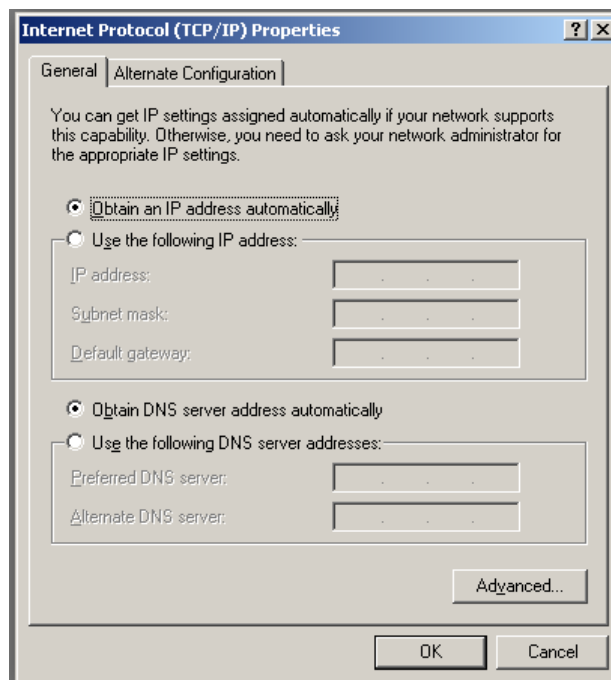
1. Select Start-> Settings->Network Connections->Local area connection->Properties



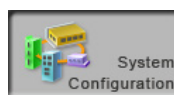
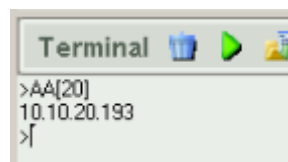
2. In the General tab select Internet Protocol(TCP/IP).



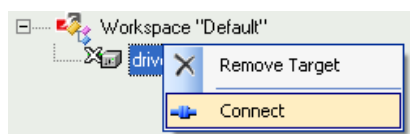
3. Click Properties and then select *Obtain an IP address automatically*.



4. Click **OK**.
5. Return to the EAS application.
6. In the terminal window type "AA[20]". The drive returns the IP address it uses.



7. Click System Configuration
8. In the Connection type select Direct access IP.
9. In **IP Address** select the address that was returned by the drive (If multiple devices are connected more than a single IP address is suggested).
10. Click **Apply**  to save the drive's properties.
11. Right click the drive's name and click **Connect**



The drive is now connected using Ethernet with DHCP.

9.2.3 Configure a Drive to use Ethernet with static IP

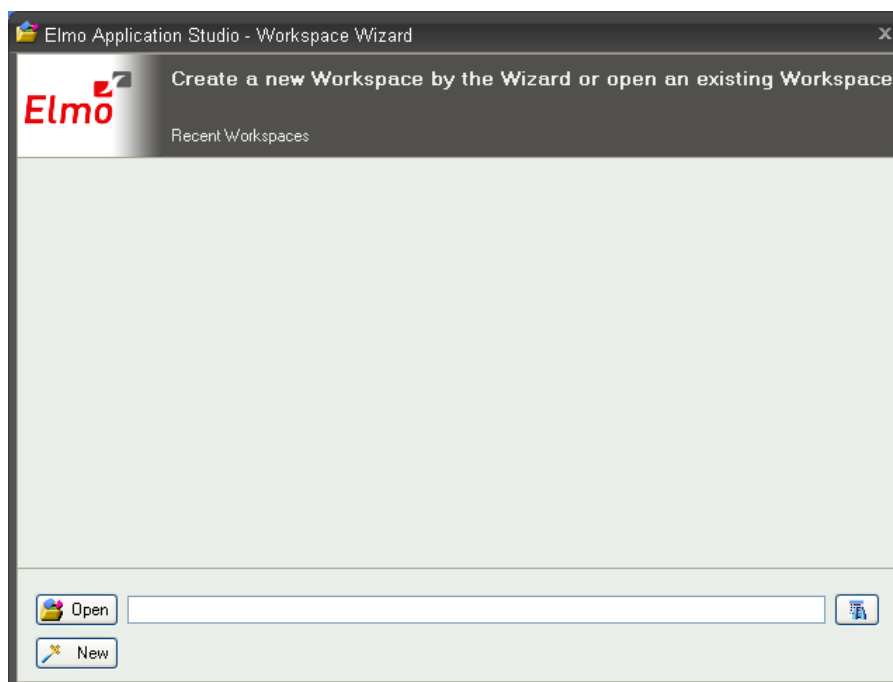
9.2.3.1 Configuring EAS and servo drive

To configure the EAS and servo drive

1. Follow the instructions in section 9.1 Connect a Drive Using USB to connect your drive to the PC via USB.

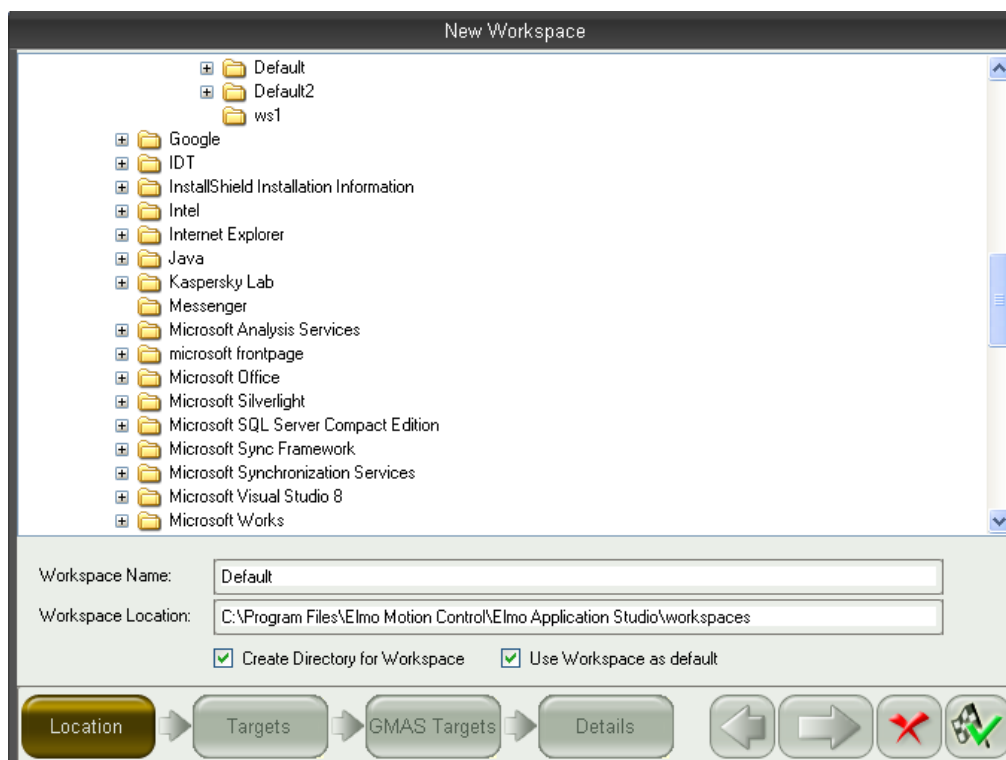
Important: To maintain emphasis on this task, only the steps that are relevant to configuring the communication to Ethernet with static IP are described here. After finishing the configuration, please continue to the detailed systematic activation as described in section 1.4 Getting Started with EAS – New Workspace Wizard.

2. Activate Elmo Application Studio. The following dialog appears.

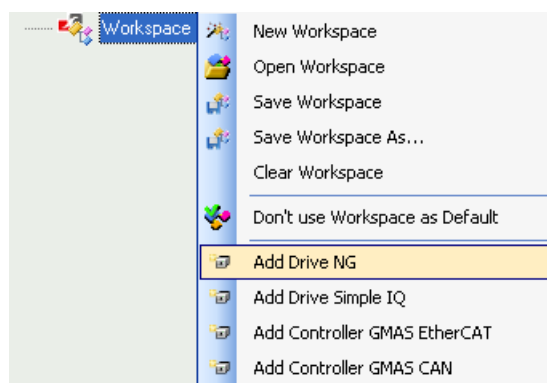


3. Click **New**.
4. In the following screen just click **Finish**  to open the main studio view.

Note: Important steps are omitted in order to focus on the process.

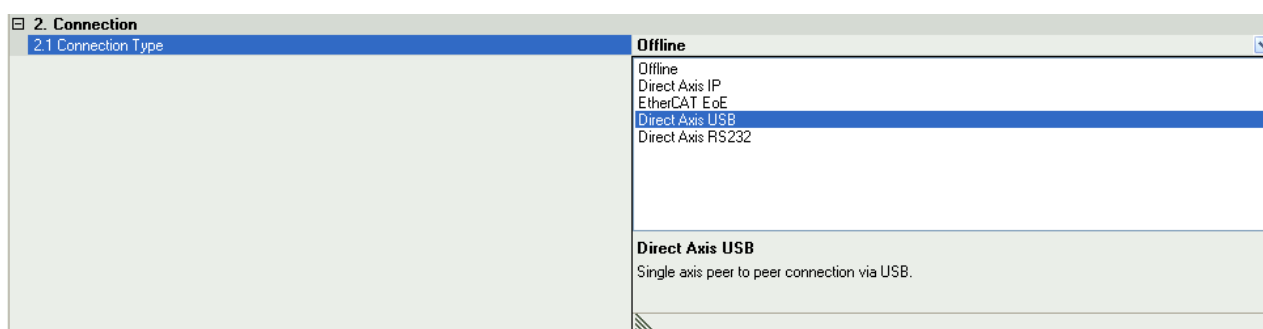


5. In the window that opens right click the workspace name and select **Add Drive NG** from the menu.

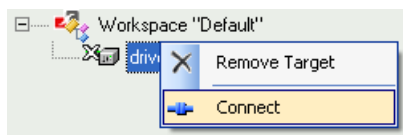


A new drive name appears under the workspace name and its default properties are displayed.

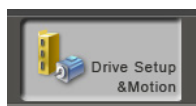
6. Click on the **Connection Type** to open a list and select **Direct Access USB**.



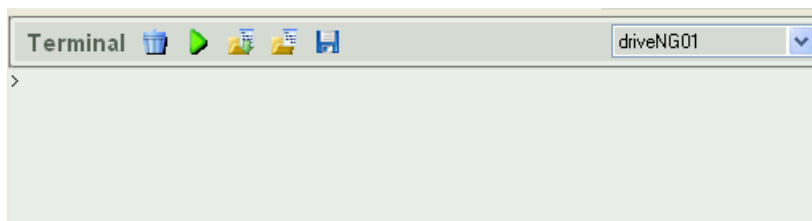
7. Click **Apply**  to save the drive's properties.
8. Right click the drive's name and click **Connect**.



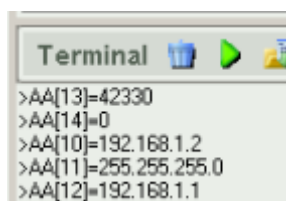
9. From the activity selector at the top part of the screen select **Drive Setup & Motion**



10. In the tools selector click **Expert Tools**
11. Select **Motion** to open a view that includes a terminal.



12. In the terminal enter the following commands:
 AA[13]=42330
 AA[14]=0
 AA[10]= [The IP address allocated to the drive. If in doubt ask your network system manager]
 AA[11]=255.255.255.0 (net mask)
 AA[12]=[gateway configuration]



The first two commands set the drive's communication options as Ethernet with DHCP disabled.

The IP address allocated to the drive should differ from the IP address later set in the PC configuration only by the last digit.

For example: AA[10] = 192.168.1.2, the IP address entered in the PC's LAN connection properties: 192.168.1.3

AA[11] is the net mask and should be the same for the drive and the PC.

AA[12] is the gateway. It should be the same as AA[10] only with "1" at the end. Note: If a wireless connection is configured on the same PC verify that the gateway number entered here is not the same as the wireless network's gateway number.

13. Click on the **Workspace**  button located at the top left of the screen to open a dialog.
14. Right click the drive's name and click **Disconnect**.

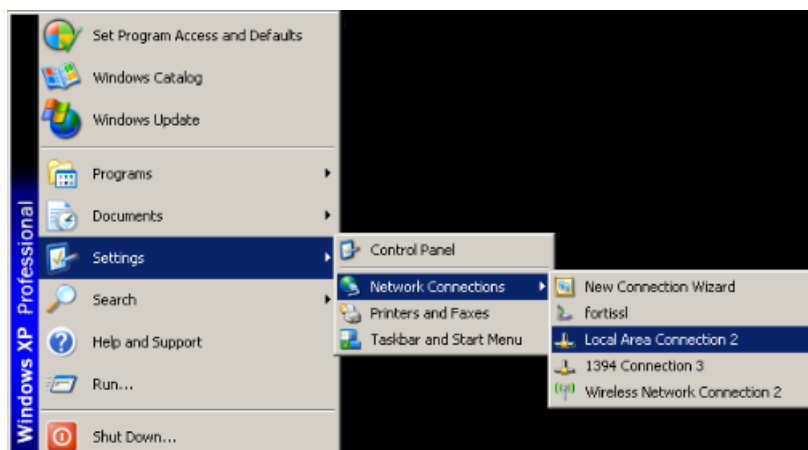


15. Restart the drive.

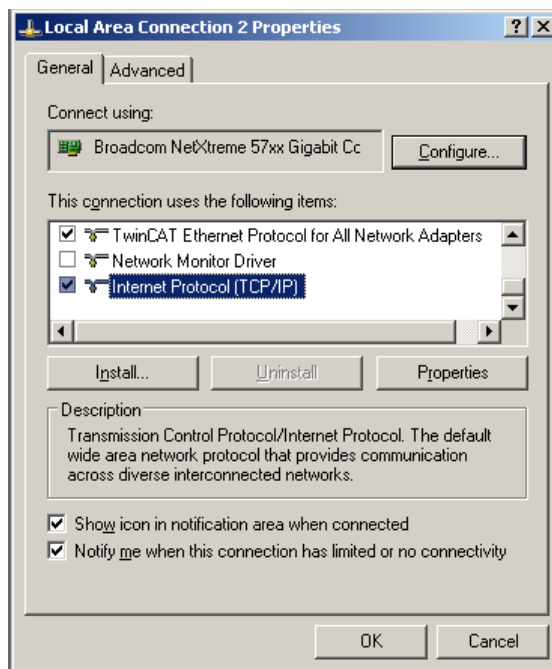
9.2.3.2 PC configurations

To configure the PC

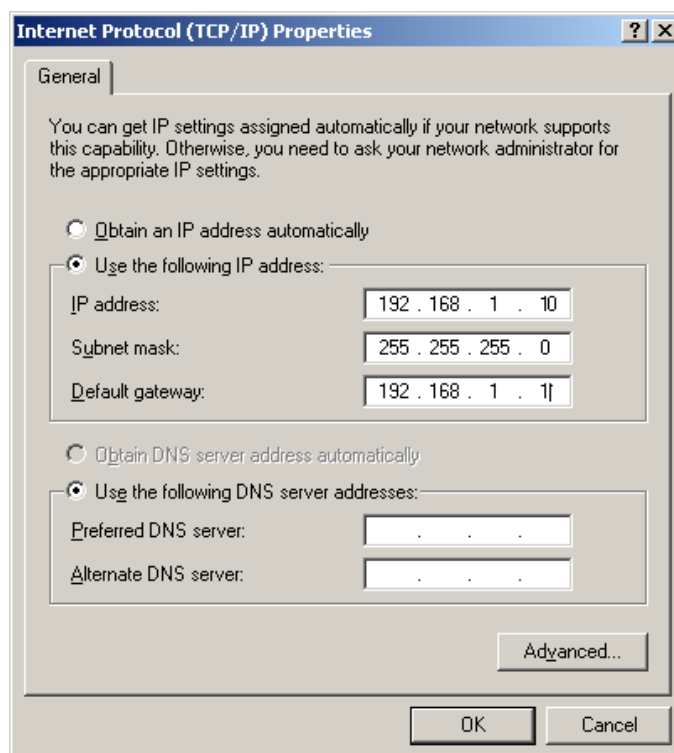
1. Select Start-> Settings->Network Connections->Local area connection->Properties



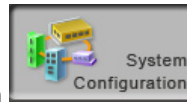
2. In the General tab select Internet Protocol (TCP/IP).



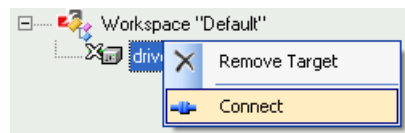
3. Click **Properties** and then select Use the following IP address.
4. Enter the IP address the PC will use, the subnet mask and the default gateway (see more details above)



5. Return to the EAS application.



6. Click the System Configuration
7. In the Connection type select *Direct access IP*.
8. At the IP Address select the address that was entered previously.
9. Click Apply  to save the drive's properties.
10. Right click the drive's name and click Connect

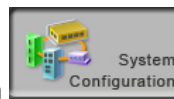


The drive is now connected using Ethernet with static IP.

9.2.4 Connecting a Different Drive

When you disconnect the current drive and replace it with a different type of drive Windows may sometimes recognize it as new hardware and require that you repeat the installation process. Repeat the same process described above. Windows may assign the new communication a different COM port number even if you are using the same physical port as before.

To use the new drive with the same workspace



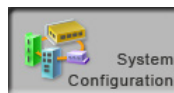
1. Click **System Configuration**

In the drive properties table open the Serial Port list

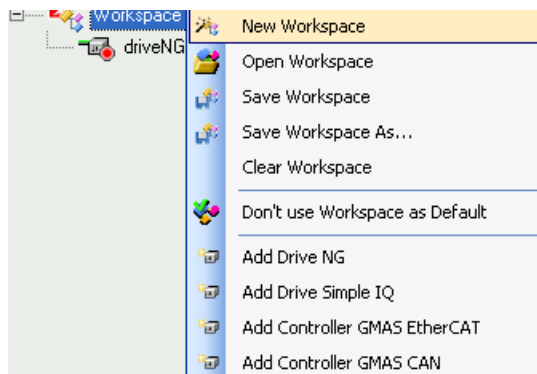
2. Connection	
2.1 Connection Type	Direct Axis USB
2.2 Serial Port	COM6

2. Select the new COM port.

To create a new workspace



1. Click System Configuration .
2. Right click the current workspace name



3. Select **New Workspace** and continue the procedure as described in section 1.4.

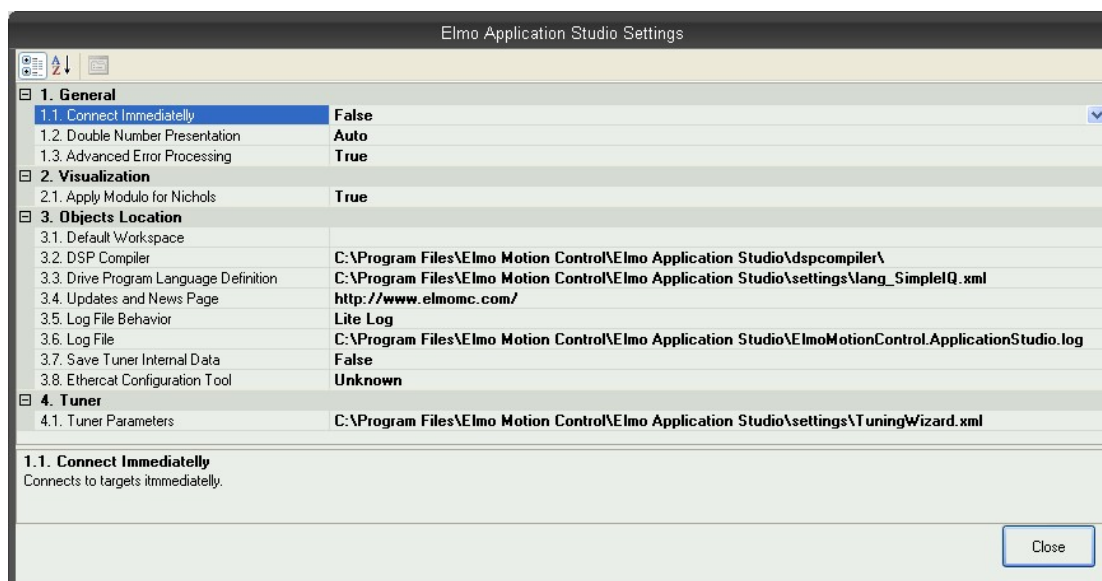
10 EAS Settings and Configuration

This chapter describes the EAS settings and configurations. It should be noted that changing a default configuration might cause the EAS to behave erratically.

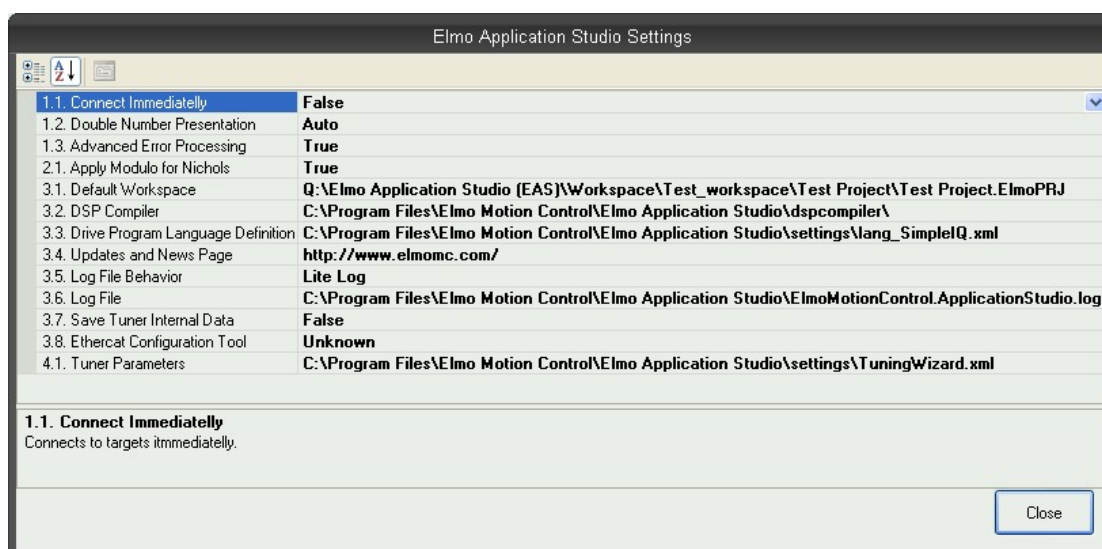
10.1 EAS Settings

To change the EAS settings

- From within any EAS window, click the **Settings** button  at the lower right corner of the screen to change the EAS settings. The EAS Settings window opens.

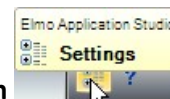


- By default, the list of Settings is arranged according to the main Headings. To change the order of the Settings list according to the numeric heading in the first column click the  button.





The button is context sensitive, and displays the title for the icon when the mouse surfaces over the icon.



The Settings window contains the following information and options:

General

Connection
Immediately

Offers the options to either connect immediately to the various controllers and drivers set in the Workspace, when the application starts, or manually connect them within the application. The Connection defaults to False, and manual connection.

Double Number
Presentation

1.2. Double Number Presentation	Auto
1.3. Advanced Error Processing	Fixed-point
2. Visualization	Scientific
2.1. Apply Modulo for Nichols	Auto

Allows numbers to be displayed in various formats depending whether either scientific or fixed-point notation is required. The application defaults to Auto, where the system defines the notational format.

Advanced Error
Processing

Set as True or False.

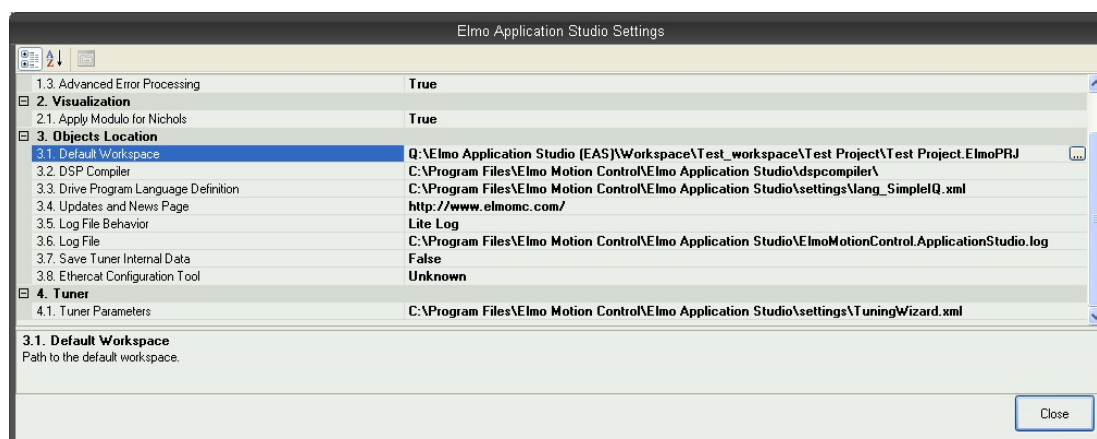
If **True**, displays both errors and warnings. When warned, the procedure continues.

If **False**, only displays Errors. Warnings are not displayed.

Visualization

Apply Modulo for
Nichols

Specific rendering of Nichols tuning chart allows the chart to be drawn outside of the range 0 - 360° if set to False. When set to True (default) the chart is drawn within the 0 -360° range.



To change any of the default locations click the in the field containing the present location and click the locate icon .

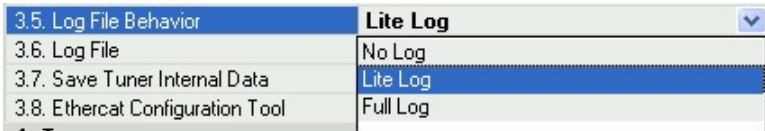
Default Workspace

The set default Workspace for all projects. Use the locate icon  to access

the required default file.

DSP Compiler	Default location for the compiler
Drive Program Language Definition	Default location for the language definition *.xml file of the drives.

Updates and News Page	Elmo's URL
-----------------------	------------

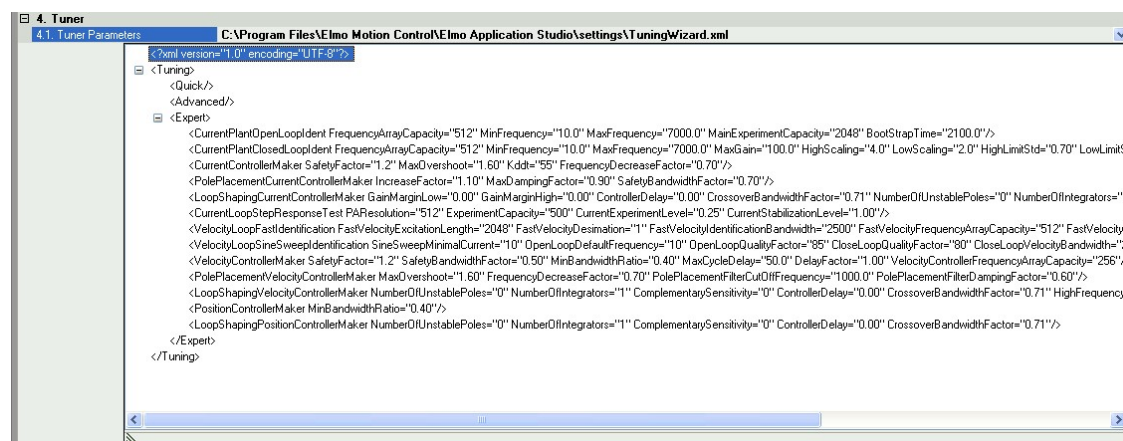
Log File Behavior	
-------------------	--

Offers a number of options for the Log file. The Full Log displays all changes, errors, etc. whereas the Lite will only display major changes, errors, etc.

Log File	Default location of the Log file.
----------	-----------------------------------

Save Tuner Internal Data	If set to True, will save the Tuner Internal Data in a specific file located by the application during Tuning.
--------------------------	--

EtherCAT Configuration Tool	Allow a specific EtherCAT configuration application to load to configure the EtherCAT connections from a specified location.
-----------------------------	--



Tuner Parameters	Allow the default tuning wizard parameters to be changed. The *.xml file can be edited and saved. Use caution when changing this file.
------------------	--

Warning: Changing this *.xml file with values incompatible with the drives, motion controllers, etc. can result in severe damage to the system.

10.2 Flash, RAM and Saving Data

The drive has a non-volatile Flash memory and a volatile RAM memory. Whenever you turn the drive on the parameters and other data that are stored in the flash memory are copied to the RAM memory.

When you communicate with the drive using a terminal, the data you enter is saved to the RAM. To save the data to flash you need to type an “SV” command in the terminal.

When using EAS, the data you enter in text boxes or using other selection controls is not immediately sent to the drive. In general, data is sent to the drive when you click a button that starts a process or motion, or when you leave a wizard page. In these situations, the data will be placed in the RAM, but not saved to flash.

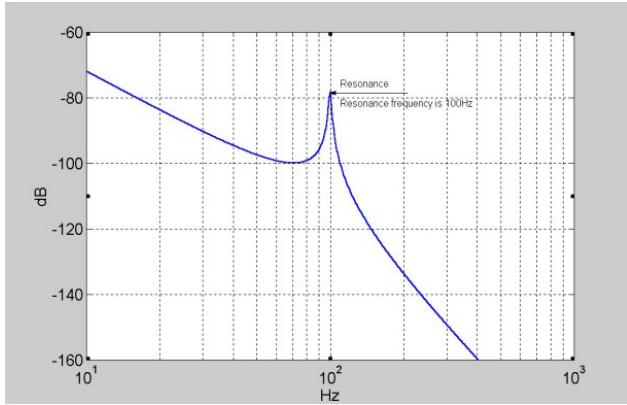
To save data to flash you have to click a **Finish**  button or an **Apply**  button where applicable. To save data that is entered in windows that do not include these buttons you can type “SV” in the terminal.

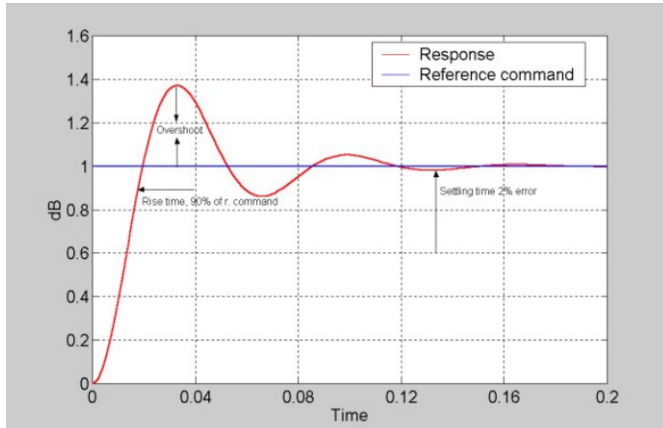
11 Glossary

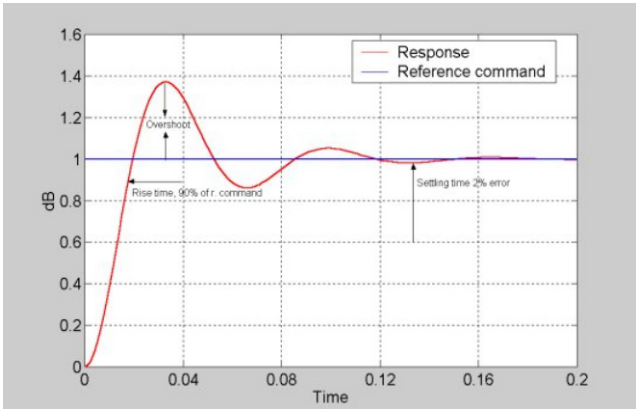
Term	Explanation
Acceleration	The rate at which speed increases. If speed is measured in counts/sec the acceleration is in counts/sec ² .
Advanced controller	A controller with a more complex structure than a simple PI or PID. It can include several notch filters, low pass filter, poles and zeros.
Analog Sin/Cos	
Application continuous current	The maximum current, in amperes, that can be used by the specific application. This value must be equal to or less than the continuous stall current defined by the manufacturer for the selected motor.
Application peak current	The maximum short-term current, in amperes, to be used with the specific application during the design phase of auto-tuning. This value must be equal to or less than the peak current defined by the driver manufacturer.
Application speed limit	The maximum motor speed, in RPM or meters per second, used for the application. This value must be equal to or less than the maximum mechanical speed defined by the motor manufacturer.
Bandwidth	The difference, in hertz, between the highest and lowest level of a frequency range. In a standard feedback system, responses to reference commands at low frequencies are probably large; however, at high frequencies, they decrease. It is customary to look at the frequency where the response command amplitude drops to 70% in amplitude, compared to a low frequency response as a split frequency between good response and bad response. This frequency is used as a figure of merit for the system and is called the system bandwidth.
Baud rate	The rate at which digital data is transmitted, in bits per second.
Continuous stall current	The maximum continuous current, in amperes, allowed for the motor. This value is defined by the motor manufacturer.
Counts	The position unit of measurement of the drive. Using rotary encoder feedback the number of counts per revolution is four times the number of lines in each encoder signal per revolution. The input from other sensors is converted so that position commands and readings can be given in counts.
Deceleration	The rate at which speed decreases. If speed is measured in counts/sec the deceleration is in counts/sec ² .
Displacement	The change in position of the system with respect to a specific reference point.
Drive continuous current	The maximum continuous current, in amperes, allowed for the

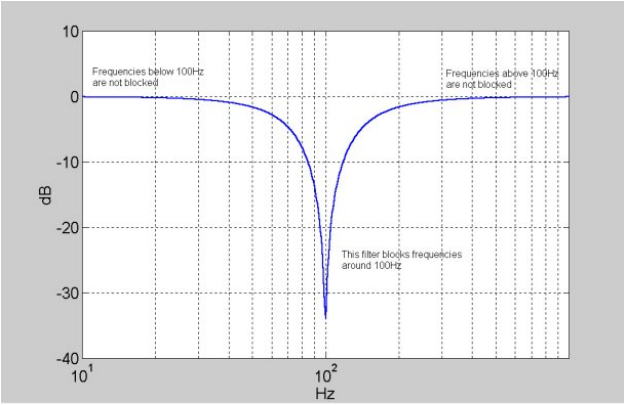


Term	Explanation
	drive. This value is defined by the drive manufacturer.
Encoder magnetic pitch	See Magnetic pitch.
Encoder resolution	The length of the position unit in linear motors. Four times the encoder grating pitch value, because it takes into account two encoder slot transitions (high-to-low and low-to-high) and two sets of slots (A and B).
Gain	The ratio of the output signal magnitude to the input signal magnitude.
Gain coefficients	Gain parameters used in the gain scheduling algorithm. See also KI and KP.
Gain scheduling	The means of accommodating for known variations in the dynamics of a system. Gain scheduling uses a customized algorithm that calculates adaptive gain modifications in order to improve system stability and accuracy.
KI	The integral gain parameter used to define a PID filter. It functions to reduce sharp peaks and to obtain a smoother step response.
KP	The proportional gain parameter used to define a PID filter. It functions as a means to obtain an optimal closed-loop transfer function.
Low pass	A filter whose transfer function transfers low frequencies and blocks high frequencies.
Magnetic pitch	The distance of one electrical cycle in a linear motor. See also Encoder resolution.
Maximum mechanical speed	The maximum motor speed defined by the manufacturer, specified in m/sec for linear motors and RPM for rotating motors.
MCS	Machine Coordinate System: The system of coordinates that is related to the machine. A Cartesian coordinate system with the origin in a fixed position relative to the machine (the origin is defined during the machine setup). Sometimes called World Coordinate System or Base Coordinate System. With Cartesian built machines, MCS is a Cartesian Coordinate system and may be identical to ACS, or mapped via a trivial transformation. The coordinate system from the physical multiple axes ACS is linked to the MCS via a kinematic transformation (forward and backward conversion). The MCS represents an imaginable space with up to six dimensions.

Term	Explanation
Notch filter	A filter that blocks a defined band of frequencies and transfers all frequencies above and below that band. For example, a filter has a transfer function of the form: $\frac{s^2 + 2 \cdot \xi_1 \cdot \omega \cdot s + \omega^2}{s^2 + 2 \cdot \xi_2 \cdot \omega \cdot s + \omega^2}$ where $\xi_1 < 0.5$ and $\xi_2 \approx 0.5$. Its Bode plot, depicted in Figure 11.1, with d1=0.01, d2=0.5 located at 100Hz, has a hole at frequency ω. The filter is therefore said to be a notch filter at frequency ω. The purpose of a notch filter is to block energy transfer to the motor around the notch frequency. This is one means of preventing a motor and load from accumulating energy at their resonance frequency, thereby avoiding shaking of the load.  The Bode plot shows the magnitude response in dB versus frequency in Hz on a logarithmic scale. The y-axis ranges from -160 dB to -60 dB, and the x-axis ranges from 10¹ Hz to 10³ Hz. A sharp dip (notch) is visible at 100 Hz, labeled 'Resonance' and 'Resonance frequency is 100Hz'. Figure 11.1: Bode Plot of a Notch Filter
Phase	The angular relationship between voltage and current waveforms.
PTP	Point-to-point motion, according to which the motor moves from its present position to a final point. The motor reaches the final point at zero speed and then remains at that point. The trajectory to the final point is calculated based on the speed, acceleration and deceleration limits.
PVT table	Position-, velocity- and time-tabulated motion defined in a table array.

Term	Explanation
Record resolution	The amount of time between consecutive sampling points. This value is calculated in conjunction with maximum recording time. The maximum number of recorded data points is 8000?. The record time length is calculated as: $8000/(\text{number of values}) * \text{record resolution}.$
Resonance	A condition whereby a large oscillatory amplitude occurs as a result of a small amplitude of periodic input, with a frequency close to one of the regular system frequencies. For example, a motor has a load whose transfer function has the Bode plot depicted in Figure 11.2. It has a local maximum at the frequency 100 Hz; therefore, it can be said that the motor and load have a resonance frequency of 100 Hz. The system absorbs energy at its resonance frequencies, thus tending to oscillate at those frequencies unless the controller is well designed to eliminate this phenomenon.  Figure 11.2: Example of a Bode Plot of a Transfer Function Including Resonance
RMS or Peak RMS	The Root Mean Square value
Smooth factor	The time, in milliseconds, that a motion speed profile is curved. The degree to which the “sharp corners” of a motion speed profile are curved. Smoothing a profile increases the time required to complete the motion.

Term	Explanation
Step response	The time required by a system for an output to pass through a specified percentage of a process. For example, a feedback system has a closed loop transfer function of: $\frac{\omega^2}{s^2 + 2 \cdot \xi \cdot \omega \cdot s + \omega^2}$ The system responds to a step command of 0 up to time 0, then 1 at any positive time. The following figure is an example in which $\omega = 100$ and $\xi = 0.3$.  Figure 11.3: Figures of Merit in a Step Response
TCP	Tool Centre point, the point in the machine that is commanded to move, typically to the center or the head of the tool. It can be described in different coordinate systems.

Term	Explanation
Transfer function	A mathematical expression or a graph that expresses the relationship between the outgoing and the incoming signals of a process or control element. An important property of motors is that their response to a pure sinusoidal current signal is also sinusoidal at the same frequency. Suppose a pure sinusoidal current signal at frequency ω and amplitude A is injected into a motor, and the motor speed is sinusoidal with an amplitude B and phase φ relative to the current signal. The transfer function of the motor at the frequency ω therefore has an amplitude B / A and phase φ (Figure 11.4, with 1.66 Amplitude and -90° phase).  Figure 11.4: A Transfer Function
Trigger logic	A pulse that activates a function (either <i>high</i> or <i>low</i>).

12 EtherCAT Error Messages

This help is provided to assist in operation of EtherCAT network. It consists of the following chapters:

- Diagnostic messages
- Studio messages
- Master messages

Each topic of the help describes the details of an error, and contains information on a possible causes and appropriate remedy.

12.1 Diagnostic messages

Error ID	Explanation and Cause	Possible Solution
D00012	Master diagnostics: Error occurred while sending or receiving frames	
	The frame was sent but wasn't received during timeout due to unstable connection or the frame wasn't transmitted by a slave.	Check the cables. Check whether the error still appears if some slaves are disconnected to find out the slave which causes the problem (detach, disconnect some slaves from the bus and rescan the bus)
D00013	Master diagnostics: Wrong or damaged frame was received	
	1. The frame was damaged due to a connection problem. 2. The frame was damaged while transmission by the EtherCAT device(s).	Check cables or disconnect some slaves.
D00014	Master diagnostics: No connection between Master and slaves	
	The cable connecting the network card and the slaves is damaged or unplugged.	Check the cable for normal operation and the connection.
D00015	Master diagnostics: Wrong Master configuration	
	The configuration received by the Master does not match the current network configuration.	
	A slave's type doesn't match the one on the network (accompanied with D00101 "SlaveName" has wrong device type.)	Change network configuration and restart the Master with the configuration that matches the network Reconfigure the bus.
	A slave is missed (accompanied with D00100 "SlaveName" is offline.)	Connect the missed slave to the bus.
	All slaves are missed:	
	Cable is connected to a proper card but	Connect the cable to the slaves.



Error ID	Explanation and Cause	Possible Solution
	not connected to the slaves	
	Cable is connected to the slaves but not to the proper card	Connect the cable to the proper card
	Cable is connected to the slaves and to the proper card but the slaves are powered off	Switch the power of the slaves on
D00016	Master diagnostics: Slave to slave communication timeout	
	Master cycle time was exceeded while reading/writing of outputs involved in S2S communication	Increase Cycle time.
D00023	Master diagnostics: Default values were set for inputs.	
	Master is not in the SO or OP state: these states were not requested to be reached by the Master	Switch the Master to SO or OP state to start process data update execution.
	Master is not in the SO or OP state: Some of these states were requested to be reached by the Master but failed because: Master license is invalid, has expired or Demo mode time limit has expired and it stays in Init; Master configuration is wrong There is no slave on the bus that has reached the requested SO or OP state (the Master reaches the requested state only after at least one slave connected to the Master has reached the same state).	Follow these steps: See D00003, D00004 or D00011 errors description for details See D00015 error description for details; check slaves errors and their description in the help to find out and fix the problem.
	Wrong WKC value exceeded limit because some slave isn't in SO or OP state.	Check slaves errors and their description in the help to find out and fix the problem.
	Wrong WKC value exceeded limit because some slave is configured wrongly	Follow these steps: Detach and set Generate separate CyclicCmd checkbox in Master's Cyclic tab (see Studio's help for details). Attach the Master, switch it to the OP state and find a slave whose variables values are not updated (set with default values - zero by default) or enable Master traces mode (see Studio's help for details) and find a slave using an address of the



Error ID	Explanation and Cause	Possible Solution
		failed cyclic command is shown in Master Output pane. You can also repeat the action after some of the slaves have been disconnected. The faulty slave will be found by exception. Change this slave's configuration to eliminate the fault or rescan the bus to get initial configuration read from ESI file in case of some changes were done. Acquire the latest ESI file from a vendor, update with it Studio's Slaves Library (see Studio's Help) and rescan the bus.
D00024	Master diagnostics: Master watchdog timeout. Default values were set for outputs.	
	Outputs of Master Process Image were not set during timeout by the external application (Studio doesn't write outputs cyclically.).	Check the external application.
D00100	"SlaveData: Name, Phys. addr. Pos." is offline.	
	The slave wasn't detected by the Master on the bus because of wrong bus or Master configuration	Change the bus configuration and restart the Master with the same configuration as in the bus.
D00101	"SlaveData: Name, Phys. addr. Pos." has wrong device type	
	The connected slave has the product code different from the configured one.	Change the bus configuration and restart the Master with the same configuration as in the bus.
D00102	"SlaveData: Name, Phys. addr. Pos." is in wrong state.	
	Slave's state differs from Master's state	Can happen while switching Master's state.
	Master doesn't switch slave from PO to the SO state because Mailbox initialization failed	See error D00107 description for details.
	The slave doesn't reach the requested state because of a wrong configuration (see slave's "State machine" tab) and/or can be sent as emergency message (see Studio's "Emergency" pane): wrong PDO assignment and/or PDO configuration wrong SM(s) configuration	See error D00106 description for details.
	The slave stays always in Init because	See error T03018 description for details



Error ID	Explanation and Cause	Possible Solution
	PDI not operational.	
D00103	"SlaveData: Name, Phys. addr. Pos." "Port Number": Rx errors counter value exceeded "RxErrorsCounterLimit"	
	Unstable communication on %Port №%	Check the cable. See error D00012 description for details
D00104	"SlaveData: Name, Phys. addr. Pos." "Port Number": Invalid frames counter value exceeded "InvalidFramesCounterLimit"	
	Received frames were damaged on previous slave(s) or the connection is poor.	Check the counters of the preceding slaves to localize the source. See error D00012 description for details.
D00105	"SlaveData: Name, Phys. addr. Pos." "Port Number": Lost links counter value exceeded "LostLinksCounterLimit"	
	Unstable communication on %Port №% or cable was plugged in/unplugged many times	Check the cables. See error D00012 description for details.
D00106	"SlaveData: Name, Phys. addr. Pos." initialization failed	
	Initialization command(-s) is(are) not executed by the slave due to the following reasons (an error can be displayed in AL status code (see slaves "State machine tab) and/or can be sent as emergency message): a wrong command is generated for slave (slave doesn't support the feature, e.g. DC clock); the command has wrong data (wrong data length, etc.); an error has occurred in the slave and it must be acknowledged before.	Detach the Master and change the slaves configuration to eliminate the fault or rescan the bus to get initial configuration read from ESI file in case of some changes were done. Acquire the latest ESI file (and/or EEPROM content as a *.bin file) from a vendor. Add/update Studios Slaves Library with new ESI (see Studio Help). Rewrite EEPROM content with a *.bin file (see Studio) and switch off/on the power of the slave. Rescan the bus. Ask Vendor if the slave was tested for conformance; Scan the bus using Diagnostic Scan Tool to find out more possible reasons. Additional check: Attach the Master, enable Master diagnostic traces (Ctrl+T), switch Master to OP state and find failed command in Master Output pane Find the command in Slave's "Init commands" tab and check the command data Reconfigure the slave to ensure the right



Error ID	Explanation and Cause	Possible Solution
		settings, acquire updated slave's ESI or disable Init command if it can be omitted.
D00107	"SlaveData: Name, Phys. addr. Pos." mailbox initialization failed	
	Communication error: frame lost or invalid frame/command receiving	Does not require fixing, if it happens once at transition and the slave reaches the requested state (Master repeats initialization process for the slave each "Auto recovery timeout" – see Master's settings in Master tab). Otherwise check bus connections.
	Mailbox initialization command(-s) is(are) not executed by the slave due to the following reasons (error can be shown in AL status code (see slave's "State machine" tab) and/or can be sent as emergency message (see Studio's "Emergency" pane)): a wrong command is generated for the slave (the slave doesn't support the feature) the command has wrong data (wrong data, data length, index, etc.)	Detach the Master and change the slave's configuration to eliminate the fault or rescan the bus to get initial configuration read from ESI file in case of some changes were done Acquire the latest ESI file (and/or EEPROM content as a *.bin file) from a vendor. Add/update Studio's Slaves Library with new ESI (see Studio Help). Rewrite EEPROM content with a *.bin file and switch off/on the power of the slave. Rescan the bus Ask Vendor if the slave was tested for conformance Scan the bus using Diagnostic Scan Tool to find out more possible reasons
D00108	AL status code and description: "ErrorCode" – "ErrorDescription". Slave "SlaveData: Name, Phys. addr. Pos."	
	Slave is misconfigured because of not up to date ESI file or wrong EEPROM content.	Acquire the latest ESI file (and/or EEPROM content as a *.bin file) from a vendor. Add/update Studio's Slaves Library with new ESI (see Studio Help). Rewrite EEPROM content with a *.bin file (see Studio) and switch off/on the power of the slave. Rescan the bus Ask Vendor if the slave was tested for conformance Scan the bus using Diagnostic Scan Tool to find out more possible reasons

Error ID	Explanation and Cause	Possible Solution
	SM watchdog timeout occurred because of a broken connection Master cycle time has exceeded SM Watchdog timeout value.	Possible remedies for this errors are the following: restore the connection and acknowledge the error in the Slave's Online->State machine tab. detach Master and change the slave's Watchdog setting in Slave tab: enable slave's Watchdog if it is disabled and increase SM Watchdog value (the SM Watchdog timeout is shown in milliseconds in the Watchdog field). Note! In case of non real-time Master (WinXP Master) the timeout should be at least ten time bigger then Master cycle time.
	Synchronization error.	Use a real-time Master: RTX, INtime... Check DC settings.

Error ID	Explanation and Cause	Possible Solution
	Other reason: see error description to locate the problem (possible error see in the table below).	

Code	Description	Current state (or state change)	Resulting state
0x0000	No error	Any	Current state
0x0001	Unspecified error	Any	Any + E
0x0011	Invalid requested state change	I -> S, I -> O, P -> O O -> B, S -> B, P -> B	Current state + E
0x0012	Unknown requested state		Current state + E
0x0013	Bootstrap not supported	I -> B	I + E
0x0014	No valid firmware	I -> P	I + E
0x0015	Invalid mailbox configuration	I -> B	I + E
0x0016	Invalid mailbox configuration	I -> P	I + E
0x0017	Invalid sync manager configuration	P -> S, S -> O	Current state + E
0x0018	No valid inputs available	O, S, P -> S	P + E
0x0019	No valid outputs	O, S -> O	S + E
0x001A	Synchronization error	O, S -> O	S + E
0x001B	Sync manager watchdog	O, S	S + E
0x001C	Invalid Sync Manager Types	O, S, P -> S	S + E
0x001D	Invalid Output Configuration	O, S, P -> S	S + E
0x001E	Invalid Input Configuration	O, S, P -> S	P + E
0x001F	Invalid Watchdog Configuration	O, S, P -> S	P + E
0x0020	Slave needs cold start	Any	Current state + E
0x0021	Slave needs INIT	B, P, S, O	Current state + E
0x0022	Slave needs PREOP	S, O	S + E, O + E
0x0023	Slave needs SAFEOP	O	O + E
0x002D	Invalid Output FMMU Configuration	O, S, P -> S	S + E
0x002E	Invalid Input FMMU Configuration	O, S, P -> S	P + E
0x0030	Invalid DC SYNCH Configuration	O, S	S + E
0x0031	Invalid DC Latch Configuration	O, S	S + E
0x0032	PLL Error	O, S	S + E
0x0033	Invalid DC IO Error	O, S	S + E
0x0034	Invalid DC Timeout Error	O, S	S + E
0x0042	MBX_EOE	B, P, S, O	Current state + E
0x0043	MBX_COE	B, P, S, O	Current state + E
0x0044	MBX_FOE	B, P, S, O	Current state + E
0x0045	MBX_SOE	B, P, S, O	Current state + E
0x004F	MBX_VOE	B, P, S, O	Current state + E
other codes < 0x8000	reserved		
0x8000 – 0xFFFF	Vendor specific		



Error ID	Explanation and Cause	Possible Solution
D00109	Unable to get AL status code (Invalid slave online index). Slave "SlaveData: Name, Phys. addr. Pos."	
	Slave with online index (auto-incremented address) is not detected on the bus to get AL status code.	
	The slave is disconnected	Connect the slave to the network.
	Wrong Master configuration	Restart Master with configuration that matches the network configuration.

12.2 Studio messages

Error ID	Explanation and Cause	Possible Solution

12.3 Master messages

Error ID	Explanation and Cause	Possible Solution
0x801A	Invalid working counter received Master sends a command to slave(s), but the slave or some slaves does not execute the command.	
	The command is wrong.	Enable Master diagnostic traces to see what command failed.
	The command has wrong or invalid data.	Check if command is correct and data are valid.
	Slave(s) do not support the feature.	Change slave's settings or configuration accordingly.
0x8201	No rights to unlock.	
	The Master was locked by a more privileged user (e.g., administrator) than that one who tries to unlock the Master.	To unlock the Master, the user should have same or more privileges than the user who locked the Master.
0x8008	Master not connected. Connect master before call.	
	Master stopped.	Start Master or detach Studio without stopping Master and attach again.
0x8003	General error.	
	Communication error.	Repeat the operation or restart Master, if the problem persists.
	System error.	
0x8019	Mailbox CANopen transition aborted. Master sends command to read/write OD object, but slave's response is "transition aborted". To see abort code value enable Master diagnostic traces mode and repeat the operation.	
	Wrong command	Change slave's configuration in case of CoE Init command, change command in case of manually created command.
	Wrong command data/value	Set correct data/value.
	Wrong slave's state	Switch slave to state that allow to perform the action.

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